

Health & Safety Department (Safety Section)

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Document History Log

Any modification to the document must be reviewed and approved
as per the corporate policies and procedures of document control

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1 Purpose

Dubai Municipality developed this technical guideline to serve as a guide to employers to control, monitor and manage the radiation levels in their respective workplace(s) to as low as reasonably achievable (ALARA) to ensure the health and safety of their employees.

This technical guideline is issued in accordance with applicable International, UAE Federal and Local standards and regulations such as International Atomic Energy Agency (IAEA), Federal Authority on Nuclear Regulation, Local Order 61/1991, and Code of Practice for the Management of Dangerous Goods in the Emirate of Dubai, etc.

Radiation has many beneficial applications from power generation, medical field, radiography in non-destructive testing in industries, agriculture, veterinary, food preservation, laboratories, research, security and many more. Due to advancement of technology and growth of economies worldwide, the range and frequencies of applications grow each year, as more industries strive to seek greater efficiency and reliability in their operations. However, despite its many benefits, handling and use of radiation sources may and can cause harmful effects on the health and wellbeing of a person exposed to high doses of radiation.

Protecting employees from workplace hazards is of paramount importance wherein employers are mandated in Local Order 61/1991, Article 38.4 to “Take every precaution necessary for the protection of the worker and ensure his safety from occupational illness or potential work accident”.

2 Scope

This technical guideline covers ionizing radiation used in commercial and industrial activities, public or government institutions, including construction-related project sites in the emirate of Dubai.

This technical guideline does not cover ionizing radiation exposures in medical practice and nuclear power plant facilities. This document also does not cover non-ionizing radiation (e.g. UV, IR, microwave, EMF, etc.), background or naturally occurring radioactive material (NORM) and any other type of radiation except as mentioned above.

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3 Definitions

Unless the context otherwise requires, the following terms shall be deemed to mean the definitions hereby assigned to them.

Definition	Meaning
Accident	Any incident which occurred and has given rise to ill health, injury, or fatality.
Activity Concentration	The strength of a radioactive source per unit mass wherein the radionuclides are essentially distributed uniformly.
ALARA	As Low as Reasonably Achievable. Is a principle that aims to minimize the number of people exposed or maintain the level of ionizing radiation exposure as far below the specified regulatory requirements or limits as possible.
Controlled Area	Any work area where radiation exceeds 7.5 $\mu\text{Sv/hr}$ shall be designated as controlled area. Management shall ensure that only qualified workers or authorized individuals are allowed in controlled area.
DM	Dubai Municipality.
Effective Dose	The addition of equivalent doses to all human tissues and organs (whole body dose), each adjusted to account for the organs' sensitivity to radiation exposure expressed in millisieverts (mSv).
Emergency Preparedness and Response Plan	Document developed by the establishment to ensure the safety of people present on site and to minimize the effects of identified emergency events that could endanger an organization's ability to function.
Equivalent Dose	The absorbed dose (amount of radiation energy deposited in a mass, people, air, etc.) delivered to a tissue or organ, which

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Definition	Meaning
	considers the biological effectiveness of type and energy of radiation expressed in millisieverts (mSv).
FANR	Federal Authority for Nuclear Regulation.
Supervised Area	Areas with instantaneous dose rate of 2.5 μ Sv/hr to 7.5 μ Sv/hr shall be designated as supervised area. All supervised area must be regularly monitored.
Worker	Any person who works full time, part time or in a temporary basis to the company storing and using radioactive materials

4 Guidelines

4-1 Hazard Identification and Risk Assessment

The employer shall carry out comprehensive hazard identification and risk assessment for each type of radiation source and activities licensed by FANR and other UAE concerned government authorities. Risks which arise from routine use of radiation sources, likelihood and severity of potential exposure incidents that may arise, behavioral aspects of persons using radioactive materials, work procedures, adequacy of any existing controls, etc. must be considered.

Preliminary Hazard Assessment (PHA) shall also be carried out for new work activities, introduction or usage of new radiation sources, modification of radiation source storage area, or any major changes to ensure that new hazards have been identified and will be addressed to implementation of various health and safety controls.

Risk assessment conducted shall consider the following aspects for inclusion:

- Dose rate consideration from all x-ray generators and radioactive sources;
- Potential exposure of stakeholders such as workers (any person who works full time, part time or in a temporary basis to the company storing and using radioactive materials), visitors, and the public for the different normal use scenario and emergency incidents;
- Current radiation source operational limitations and technical conditions;

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- Different scenarios or events that may lead to failure of structures, systems, components and procedures relating to health and safety or might lead to potential radiation exposures and the consequences of such failures;
- External factors which could affect health and safety;
- Operating errors due to human factors, etc.

Upon completion of risk assessment by considering the existing controls in place, the establishment should be able to ascertain the adequacy of existing controls.

In cases wherein new or improved controls are necessary, selection should be based on the principle of the hierarchy of hazard controls which consist of elimination or minimization through engineering, administrative and personal protective equipment controls.

Risk assessment and control measures being implemented within the organization must be reviewed and revised as necessary such as:

- If the risks are not adequately controlled by the current control measures in place;
- Prior alteration or modification of work processes, facility, new radiation sources, or any activity that may result changes to the risks associated with the use and storage of radioactive sources;
- After incidents in the workplace;
- Changes to relevant UAE regulatory guidelines, international and local standards and industry best practices.

Hazard identification and risk assessment shall only be conducted by person(s) which are competent to use the appropriate methodologies and techniques in hazard identification and have sufficient knowledge of the work activity.

4-2 Radiation Protection and Safety Program

The employer is mandated to comply with Local Order 61/1991 and other applicable UAE Federal and local regulations to ensure the health and safety of workers and the public thru establishment and implementation of a documented and appropriate Radiation Protection and Safety Program which covers the following:

- Radiation Health and Safety Policies;
- Management structure;
- Delegation of resources, roles, responsibilities, accountability and authority;
- Role of Radiation Protection Officer;

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- Competence, Training and Awareness;
- Legal and other requirements;
- Health, safety and protection procedures;
- Health surveillance program;
- Inventory and information on all radioactive sources and x-ray generators;
- Emergency preparedness and response plan;
- Operational control arrangements such as:
 - Designation of controlled and supervised areas;
 - Workplace, worker and public compliance monitoring (includes system of recording and reporting exposures and other relevant information for health, safety and protection measures);
 - Acquisition and maintenance of radiation protection instruments and personal protective equipment;
- Reporting requirements within the establishment and to concerned external authorities such as DM, FANR for incidents, overexposures, etc.;
- Managements' periodic review and audit of the performance of radiation protection and safety program;
- Quality assurance and process improvement.

The Radiation Health and Safety Policy shall be properly posted on a conspicuous place and the Radiation Protection and Safety Program shall be based on the establishment's risk assessment, must be commensurate to meet the needs of the operating organization's radiation risk and adequate to ensure compliance with applicable regulations of UAE Federal, FANR, DM and other concerned authorities.

4-3 Personnel Responsibilities and Qualification Requirements

The employer shall ensure that his/her senior management is committed and responsible for overseeing radiation safety in accordance with all regulations and that all personnel engaged in their establishments' licensed activities are all competent and qualified to undertake their respective duties and responsibilities and be trained to follow safety procedures.

The employer shall ensure to employ adequate, suitably qualified and competent personnel (e.g. Qualified Experts, Radiation Protection Officers, Radiographers, etc.) in accordance with FANR requirements to ensure the health and safety of workers and public thru proper implementation of radiation protection and safety program and compliance with applicable UAE federal and local regulations.

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4-4 Radiation Dose Limits

The employer shall take every precaution necessary for the protection of the worker and members of the public by minimizing number of individuals exposed and ensuring their safety from related illnesses or potential accident thru proper management and minimization of radiation doses as low as reasonably achievable (ALARA).

The employer shall ensure that the normal permissible effective dose exposures shall not be exceeded as below:

Type of Person	Annual Effective Dose
Workers	20 mSv
Public	1 mSv
Other Workers	1 mSv

Note: mSv means milliSievert

The effective dose limit for workers (radiographers and persons directly involved in radiography) is averaging 20 mSv annually for a period of five years (100 mSv in five-year period) and shall not exceed 50 mSv occupational exposure on any given year. Doses wherein the workers are exposed includes doses, which were received while working with other establishment or entities.

The lens of the eye of the worker shall not be exposed to equivalent doses of 20 mSv annually averaged over a five-year period and 50 mSv on any given year.

The other parts of the body of worker which includes the hands, feet or skin shall not be exposed to annual equivalent dose of 500 mSv. The equivalent dose limits to the skin apply to the average dose over 1 cm² of the most highly irradiated area of the skin.

The effective dose limit to the public and other workers of the establishment not directly involved in radiography activities (e.g. office staff, drivers, etc.) shall not receive an annual exposure of 1 mSv. The annual equivalent dose exposure for these individuals shall not exceed 15 mSv for the lens of the eye and 50 mSv at any point of the skin.

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The employer shall ensure appropriate work task provision for female employees which are pregnant, or breastfeeding and the equivalent dose is as low as reasonably achievable (ALARA) and shall not exceed 1 mSv during the pregnancy period.

4-5 Controlled and Supervised Area Management

Employers shall ensure that any work in controlled areas wherein workers can be subjected to occupational radiation exposure is adequately supervised by designated radiation safety personnel of the establishment. *No radiography work shall commence without the presence and approval of the radiation safety personnel to ensure that the rules, procedures, protective measures and safety arrangements are properly implemented.*

Employers shall designate appropriate controlled and supervised areas wherein specific control and safety arrangements can be implemented and provided for controlling radiation exposures, preventing entry of unauthorized people in worksite, preventing spread of contamination during normal work settings and preventing or limiting the extent of unnecessary exposures.

In the determination of controlled area boundaries, the following shall be considered:

- Magnitude of expected normal exposures;
- Likelihood and magnitude of potential exposures; and
- Nature and the extent of the required safety and protection measures.

The employer shall conduct the following:

- Suitable controlled areas shall be defined by physical means and if not reasonably practicable by some other appropriate means to address prevailing circumstances and specified exposure times;
- Ionizing radiation symbol in accordance with ISO and other appropriate safety instructions shall be provided at access points and other conspicuous locations with the controlled area;
- Implement established radiation protection and safety program in accordance with applicable rules, regulations and procedures;
- Restrict access to controlled areas thru use of physical barriers which include locks and imposition of administrative control such as work permits wherein the degree of limitation is proportionate with the likelihood and magnitude of expected exposures;
- Entrance of controlled areas, as appropriate shall be provided with the necessary personal protective equipment, personal and workplace monitoring equipment and suitable storage of personal clothing;

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- Exits for controlled areas, as appropriate shall be provided with equipment to monitor skin, clothing and any objects/articles removed for contamination, washing or shower facilities and suitable storage for equipment and protective clothing which is contaminated;
- Periodically review existing work conditions to determine the possibility to revise protective and safety measures in place or the controlled/supervised area boundaries.

4-6 Personal Protective Equipment

The employer shall ensure to provide suitable personal protective equipment which in accordance with Emirates Authority for Standardization and Metrology (ESMA) and/or conforms to international standards such as BS, EN, ISO, ANSI, ASTM, etc. Personal protective clothing may include the following as appropriate:

- Protective clothing;
- Respiratory Equipment;
- Protective aprons, gloves and organ shields.

Employers must note that use of personal protective equipment does not provide unlimited protection and provides insignificant protection from more penetrating radiation used in industrial radiography. *PPE shall not be used solely as a substitute for engineering controls such as shielding and distance but may be used in conjunction with other risk control measures and sound safe systems of work.*

Workers shall be provided by employers with adequate training and instruction in the proper use, testing and fitting of respiratory protective equipment and other personal protective equipment.

Activities which require usage of specific PPE's are provided only to workers who on the basis of medical advice are capable of safely sustaining the extra effort necessary.

All PPE's including emergency response equipment should be properly stored, checked, maintained and tested at regular intervals.

Additional exposures or non-radiological risks that might be related to performing tasks while using personal protective equipment shall be considered.

4-7 Workers Responsibility

All workers shall ensure to fulfill their duties and responsibilities for their personal, workplace and general public health and safety during the conduct of activities related to the use and storage of radioactive materials.

The following are:

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- Abide with all health, safety and protection procedures including all applicable safety rules and regulations of the establishment at all times while at work;
- Equipment such as radiation monitors and survey meters shall be used properly;
- Personal protective equipment as required shall be properly and diligently used;
- Wear issued dosimeters with personal alarm monitors properly while conducting work or near radioactive sources at all times. *Workers are not allowed to use dosimeters not issued to them;*
- Ensure cooperation with the employer with regards to health, safety and protection programs, health surveillance and dose assessment programs;
- Provide employers with previous and up to date employment records (covering the past 5 years) relevant to radiation use and storage activities. This shall include previous dose records, medical reports, etc.;
- Refrain from willful unsafe actions or disregard of health and safety rules of the establishment which could create unsafe conditions and situations;
- Willing to accept information, training, instruction and supervision from the establishment;
- Report to the establishment any unsafe acts, hazards, situations and conditions that may arise or are present in the workplace.

4-8 Workplace Monitoring

The employer shall ensure that all workplaces, including storage facilities involving radiation sources, are having an established, maintained and updated monitoring program under the supervision of Radiation Protection Officers (RPO) or Qualified Experts.

Monitoring of workplaces shall be done sufficiently to:

- Properly evaluate the radiological conditions;
- Assess exposures in controlled and supervised areas; and
- Conduct classification review of areas identified as controlled and supervised.

Workplace monitoring will depend on different factors such as:

- Ambient dose rate levels;
- Activity concentration in air;
- Expected fluctuations; and
- Likelihood and magnitude of potential exposures.

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When radiation work is conducted in an operating area wherein other individuals could be exposed to ionizing radiation, the RPO shall establish a work permit system to prevent exposure to persons not involved in radiography activity.

Workplace monitoring measurements of radiation levels shall include the following positions:

- Industrial radiography in shielded enclosures:
 - Around the perimeter walls and doors (and other openings) of the radiation source storage area or enclosure under different working conditions to ensure that shielding is adequately maintained;
 - At the entrance to the enclosure after completion of each industrial radiography activity to check if the radiation source has been properly returned to the exposure device or that X ray emission has stopped.
- Site radiography activities:
 - Around the perimeter barriers during the test or first exposure, depending on the circumstances to ensure proper positioning of the barriers;
 - At the position of the operator during wind-out of the radiation source or when the X ray generator is energized, to ensure that the radiation levels are acceptable;
 - Around the perimeter barriers during routine exposures, to ensure that dose rates are below the specified regulatory values;
 - At the position of the operator during wind-in of the radiation source or when the exposure of X-ray generator has been terminated;
 - Around the exposure device after each exposure, to confirm if the radiation source is fully returned to its shielded position;
 - Around on-site radiation source storage to ensure if shielding is provided adequately;
 - Around work site upon completion of radiography activities, to ensure that all radiation sources are not left on-site;
 - Around vehicles that are used for transporting radiation sources. Monitoring conducted prior departure to and from the work site;

The workplace monitoring program shall include locations which are monitored and its frequency. Records and findings of the workplace monitoring program shall be properly kept and updated by the organization and shall be made available to workers, Dubai Municipality and concerned UAE authorities upon request.

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4-9 Personnel and Health Surveillance Monitoring

The employer shall be responsible for the necessary arrangements of occupational exposure assessment and health surveillance of workers.

All workers who are directly or indirectly involved in radiography activities shall be provided with Occupational Health Cards issued by Dubai Healthcare Authority, Dubai Municipality or other concerned government authority may recommend including other persons for health surveillance monitoring based on workplace OHS assessment.

The employer shall ensure that the individual monitoring of workers shall be conducted by FANR or UAE government approved/recognized dosimetry services company.

The employer shall provide individual monitoring to any worker within their establishment who works regularly or occasionally in controlled areas, or who may be exposed to radioactive contamination, or who may receive significant occupational exposure. In cases wherein individual monitoring of workers is inappropriate, inadequate or not possible, the employer shall make sure that the occupational exposure is assessed based on the result of workplace monitoring and on information on the locations and durations of exposure of the worker.

Dose records of each worker identified for individual and health surveillance monitoring shall be properly kept. Occupational dose records shall be made available to Dubai Municipality and other concerned authority during inspection and upon request.

The employer shall ensure that all dose records of each worker shall be properly kept during the whole duration of employment under the organization and afterwards until the worker attains 75 years of age and for not less than 30 years after the last occupational exposure during his tenure of work within the establishment.

The employer shall provide copies of dose records to worker(s) when they decide to leave the establishments' employment.

The employer shall provide Health and Safety Department of Dubai Municipality the following documents at least twice a year:

- List of all workers identified for individual and health surveillance monitoring.
- Dose record for each worker.

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4-10 Personnel Information, Instruction and Training

All workers including other personnel of the establishment not directly involved in radiography activities (e.g. office staff, drivers, etc.) shall receive commensurate information, instruction and training from the establishment.

The employer shall establish a training program to be delivered annually to the workers and shall include refresher training commensurate with their respective duties and responsibilities, radiation awareness and other health and safety training. Emergency response training shall also be given to each member of staff at least twice a year.

Whenever visitors are present, ensure that they are given induction training and as much as possible monitored to ensure that they are not exposed to unnecessary exposure from radiation and other work and site related hazards.

All information, instruction and training shall be easily understood by all workers by using language that they can understand. These programs shall also include methods to measure the understanding of workers through asking questions or completing short written exam after delivery of every discussion and training.

Records of any training including induction and toolbox talks shall be properly kept for at least five (5) years and be made readily available to Dubai Municipality Health and Safety inspectors and other regulatory agencies for review and demonstrate compliance with pertinent UAE and DM regulations.

4-11 Radiation Monitoring Equipment

The employer shall consult the Qualified Expert on the selection of radiation monitoring equipment appropriate for the specific type of radiation hazard.

All radiation monitoring equipment shall be properly maintained, tested and calibrated at appropriate intervals as recommended by the manufacturer in accordance with international and UAE standards.

Maintenance shall only be conducted by the manufacturer or by competent individuals in accordance with the manufacturer's instructions.

Copies of valid test/calibration certificates usually done annually or as per manufacturers' recommendation including calibration/maintenance logbook shall be properly kept for at least five (5) years and be made readily

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available to Dubai Municipality Health and Safety inspectors and other regulatory agencies for review and demonstrate compliance with pertinent UAE and DM regulations.

4-12 Emergency Preparedness and Response

The employer shall ensure that Emergency Preparedness and Response Plan (EPRP) shall be properly developed, maintained and implemented in cases of emergency situations. The EPRP shall cover all reasonably foreseeable emergencies and shall be commensurate with the nature and magnitude of the risks.

Arrangements for developing EPRP shall involve the following steps:

- Identification of potential incidents and evaluation of its related risks;
- Development of necessary emergency plans and procedures to address identified incidents and risks;
- Acquisition of appropriate emergency response equipment;
- Conducting training to the staff to properly implement response plans and procedures including proper use of emergency equipment;
- Conduct emergency response drills at least twice a year to evaluate EPRP;
- Review and update plan as necessary.

See Annex A as guide for the development of Emergency Preparedness and Response Plan (EPRP).

EPRP shall include reporting procedure of emergency incidents to Dubai Municipality and other competent government authorities.

EPRP may involve response by external organizations and specialist consultants. The plan should clearly give details of any external response, and the employer must ensure that the responders are fully aware and accept their responsibilities. Proper communication arrangements shall also be in place to ensure immediate and efficient communication with all the involved parties.

Names of emergency persons and other contact information stated in the EPRP shall be reviewed and updated at least once a year.

Emergency equipment shall be properly maintained and inspected at least annually and be readily available as needed.

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4-13 Reporting Requirements

The employer shall notify and submit the necessary reports to Health and Safety Department of Dubai Municipality and other concerned government authorities during the following incidents:

- Any over exposure shall be reported within 24 hours of the time the incident was discovered. An investigation report must be submitted explaining the root cause of the incident and the preventive measures taken.
- Uncontrolled, lost or missing radioactive sources or radiation generator shall be reported as soon as possible but not later than four hours through DM hotline 800900.
- Release of radioactive material that could cause exceedance of dose regulatory limits from events such as fires, explosions, theft, road accidents, and other accidents shall be reported as soon as possible but not later than four hours thru DM hotline 800900.
- Any event that requires immediate protective action to avoid overexposure to ionizing radiation to the public, serious injuries, fatality, etc. shall be reported as soon as possible but not later than four hours through DM hotline 800900.

4-14 Storage of Radiation Sources

All radiation sources and assemblies shall only be kept in storage areas approved by FANR and other concerned agencies.

All storage facilities shall have the following minimum requirements:

- Storage should be kept locked and keys held only by authorized personnel;
- Radiation symbol (trefoil) displayed on the entrance door of storage room;
- Resistant to fire;
- Located away from sources of corrosion, fire and explosion hazards;
- Made of materials which provide adequate shielding to reduce dose rates outside the storage room(s);
- Provided with adequate safety signs and symbols;
- Emergency contact numbers (e.g. DM, FANR, Civil Defense, RPO, etc.) posted at the entrance and other conspicuous locations in the storage room;
- Properly maintained and calibrated fixed radiation monitors;
- Inventory and information of radiation sources stored;
- Entry alarms, etc.

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The radiation level around the perimeter wall and at the entrance of the storage room shall be kept ALARA and the radiation level at one (1) meter distance from the surface of the container or pit shall not exceed 5.0 $\mu\text{Sv/hr}$.

5 References

- Federal Authority for Nuclear Regulation (FANR) – Basic Safety Standards for Facilities and Activities involving Ionizing Radiation other than in Nuclear Facilities (FANR-Reg-24)
- Federal Authority for Nuclear Regulation (FANR) – Radiation Safety in Industrial Radiography (FANR-RG-19)
- International Atomic Energy Agency (IAEA) – Practical Radiation Technical Manual – Personal Protective Equipment
- International Atomic Energy Agency (IAEA) – Radiation Protection and Safety in Industrial Radiography Safety Reports Series No. 13
- International Atomic Energy Agency (IAEA) – Radiation Safety in Industrial Radiography Specific Safety Guide (SSG-11)
- International Atomic Energy Agency (IAEA) – Training in Radiation Protection and the Safe Use of Radiation Sources Safety Reports Series No. 20
- International Commission on Radiological Protection (ICRP) – ICRPaedia, The System of Radiological Protection

	Organization Unit:	Health & Safety Department	الوحدة التنظيمية:	
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ANNEX A: EMERGENCY PREPAREDNESS AND RESPONSE PLAN DEVELOPMENT GUIDE

The information provided below is intended to guide the employer in the development of Emergency Preparedness and Response Plan (EPRP) for his/her radioactive material storage and use activities in industries. The employer should consider the following to be included in their EPRP as appropriate.

1. Types of Emergency

Below are the incidents that have historically occurred in companies involved in industrial radiography that should be addressed in EPRP. Other types of emergencies shall be included in the EPRP as appropriate.

a. For gamma radiography:

- Radiation source was stuck in the collimator, near the entrance of exposure device or guide tube.
- Shielding of the exposure device has been physically compromised due to damage.
- Disconnected radiation source from the drive cable which remained in the guide tube.
- Radiation source projected out from the end of guide tube.
- The pipeline crawler was stuck in a pipe with the source exposed.
- Lost radiation source.
- Fire incidents.
- Presence of unauthorized individuals in the controlled area during exposure.
- Transportation or movement source incidents.

b. For x-ray generators:

- Failure to terminate generation of radiation after intended time period.
- Unintentionally energized x-ray generator.
- Failure of the radiographer to terminate a manually controlled generation of radiation.
- Malfunction incidents involving safety and warning systems including deliberate or willful acts to override the system.
- Uncontrolled x-ray generation due to other malfunctions.
- Shielding or filtration was affected due to physical damage.
- Presence of unauthorized individuals in the controlled area during exposure.

2. Scope

The Emergency Preparedness and Response Plan (EPRP) shall include at least the following:

- EPRP implementation scenarios (advise on when to implement)
- Duties and responsibilities of identified personnel who will be implementing the plan
- Emergency Response Equipment description, information and location
- Training requirements for personnel which will be involved in the plan
- Radiological protection technical and other related data for each identified incident
- Procedures to be conducted at various phases, specific for each identified incident scenario.

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- i. Initial Stage: To control or contain the emergency situation
- ii. Planning Stage: Plan and recovery rehearsal
- iii. Recovery Stage: To regain control of the emergency situation
- iv. Post Emergency Stage: Return to normal operational or current situation
- v. Reporting Stage: Report preparation which include assessment of doses incurred
- vi. Referral arrangements to medical experts if there are indicated overexposure incidents
- vii. Identification of personnel to be contacted and government authorities such as Dubai Municipality, etc. during various stages of emergency incidents. Information shall include telephone numbers, fax numbers, email addresses or hotline numbers (DM: 800900).

3. Emergency Response Equipment

For emergency situations involving gamma sources the following equipment must be made available:

- a. Appropriate, functional and calibrated radiation survey meters capable of measuring both high and low dose rates;
- b. Dosimeters - personal alarm and direct reading (electronic personal dosimeters is preferred over quartz fiber electroscope);
- c. Thermo luminescent dosimeters (TLD) and/or film badges for extra personal dosimeters;
- d. Lead shot bags and extra lead sheet;
- e. Appropriate and adequate tool kit and source recovery equipment which includes pliers, long handling tongs, bolt cutters, screwdrivers, flashlight, hacksaw, adjustable wrench;
- f. Additional container with shielding for emergency scenario;
- g. Communication equipment such as mobile phones, radio transmitters and receivers, etc.;
- h. Adequate spare batteries to be used for equipment such as electronic personal dosimeters, radiation survey meters, mobile phones and flashlights;
- i. Equipment Manual;
- j. Incident logbook with calculator, pens and paper materials.

4. Specific Emergency Procedures

Practical guidance for emergencies involving gamma sources is recommended:

- a. Radiographers (the response initiator) should:
 - i. Recognize abnormal situations that may develop into an emergency;
 - ii. Do not touch the source if or maybe exposed;
 - iii. Remain calm and move away safely from the exposed radiation source. Ensure to inform other radiographers/individuals nearby the vicinity that there may be a problem;
 - iv. Conduct radiation dose rate measurements and record any dose measurements by direct reading dosimeters;

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- v. Establish or re-establish controlled area barriers in accordance with dose rate reference levels;
 - vi. Prevent or prohibit access to the newly established controlled area;
 - vii. Do not leave controlled area unattended;
 - viii. Inform RPO, client and other concerned personnel as per company escalation protocols and seek assistance.
- b. Radiation Protection Officer (RPO) should:
- i. Implement properly the established Emergency Procedures taking care to minimize doses that may be received as a result of the course of action;
 - ii. If recovery of radiation source is needed:
 - Rehearse or practice planned recovery actions outside the controlled area;
 - Implement planned recovery action. Never allow the radiation source to come in contact with the hands or other parts of the body;
 - In cases of unsuccessful recovery actions, leave the controlled area and consider the next course of action to be done while maintaining surveillance of the controlled area.
 - iii. Notify Dubai Municipality and other concerned government authorities as required;
 - iv. Call for technical assistance as necessary from qualified expert or manufacturer;
 - v. When the emergency situation is over and the radiation source has been secured safely, conduct recording of names of individuals and their relative locations in the area of incident to assess the estimated doses received;
 - vi. Return personal dosimeters to the dosimetry service to determine accurate assessment of dose received;
 - vii. Prepare a report based on the doses received;
 - viii. Send damaged or malfunctioning equipment to the manufacturer or qualified expert for detailed examination and repair prior reuse;
 - ix. Prepare incident or accident report and submit it to Dubai Municipality and other concerned authorities.
- c. If it is suspected that the radiation source capsule might have been damaged, radiographers should be extra careful in taking the necessary actions because the radioactive material could leak out and there could be a risk of contamination. Specialized monitoring equipment and expertise are needed to detect and measure radioactive contamination which most companies conducting radiography activities may not have. If it is determined or suspected that the source capsule may be damaged or ruptured, the company should seek advice from a qualified expert. Contact information of this qualified expert should be included in the Emergency Preparedness and Response Plan.

Practical guidance for emergencies involving x-ray radiation generators is recommended:

- a. Radiographers (the response initiator) should:

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- i. Recognize abnormal situations that may develop into an emergency;
 - ii. Electrical power to the radiography equipment shall be turned off;
 - iii. Conduct radiation survey to check if the tube is de-energized;
 - iv. Radiography equipment shall not be moved until information of its current position, beam direction and exposure settings (tube voltage, current and time) have been recorded;
 - v. Inform the RPO of the situation that happened.
- b. Radiation Protection Officer (RPO) should:
- i. Notify Dubai Municipality and other concerned government authorities as required;
 - ii. Conduct recording of names of individuals and their relative locations in the area of incident to assess the estimated doses received;
 - iii. Return personal dosimeters to the dosimetry service to determine accurate assessment of dose received;
 - iv. Prepare a report based on the doses received;
 - v. Prepare incident or accident report and submit it to Dubai Municipality and other concerned authorities as appropriate.

6 Suggestions, Comments & Complaints

For (suggestions, comments, and complaints)	For further information
- Unified interactive platform that connects Dubai Government and its customers: The 04 Platform https://04.gov.ae/ - Dubai Municipality - Call Center (24/7): 800900	Safety@dm.gov.ae - Dubai Municipality - Call Center (24/7): 800900