

GENERAL INSTRUCTION MANUAL**150.006**ISSUING ORG. **ENVIRONMENTAL PROTECTION DEPARTMENT**ISSUE DATE
01/22/2011REPLACES
06/12/2005SUBJECT **IONIZING RADIATION PROTECTION REQUIREMENTS FOR
ANALYTICAL X-RAY EQUIPMENT**APPROVAL
HALMPAGE NO.
1 OF 4**SCOPE**

This GI specifies the requirements additional to GI 150.003 "Ionizing Radiation Protection" for the use of analytical x-ray generating equipment. The requirements of this GI are not applicable to x-ray instruments used for medical or industrial radiography applications

CONTENT

- 1.0 DEFINITIONS**
- 2.0 RESPONSIBILITIES**
- 3.0 INSTALLATION OF NEW X-RAY GENERATING EQUIPMENT**
- 4.0 RADIOLOGICAL CONTROLS AND INSTRUMENT OPERATION**
- 5.0 PERSONAL EXPOSURE MONITORING**
- 6.0 SURVEY RECORDS**
- 7.0 TRAINING**
- 8.0 RECORDS**

1. *DEFINITIONS

- **Analytical x-ray equipment:** Equipment designed for irradiation of objects and materials for the purpose of inspection, testing, or analysis. It includes x-ray diffraction, x-ray tomography, and x-ray fluorescence equipment.
- **Sievert (Sv):** The SI unit of equivalent dose and effective dose: 1Sv=1J/kg.
- **Detection limit:** a measure of the lowest concentration that can be detected by survey meters.

2. RESPONSIBILITIES**2.1 Environmental Protection Department:**

- 2.1.1 Verify and approve of engineering and administrative controls associated with the installation and operation of Analytical x-ray equipment.
- 2.1.2 Assess the request of Radiation Protection Officers (RPO) for the inclusion of operators in the Saudi Aramco dosimetry program.

2.2 *Proponent Organization:

- 2.2.1 Ensure that the import, use, and installation of any type of analytical x-ray equipments are included in the proponent's practice license and done according to government regulation and Saudi Aramco standards.
- 2.2.2 Ensure security of analytical x-ray equipment when it is not in use.
- 2.2.3 Ensure that analytical x-ray equipment is operated by trained personnel who are aware of the hazards of the equipment and relevant engineering and administrative controls to mitigate the hazards of operation.
- 2.2.4 Ensure adequate warning signs are posted in and around facilities which contain analytical x-ray equipment.
- 2.2.5 Ensure all engineering controls designed to mitigate the hazards of analytical x-ray equipment are installed and functioning correctly.
- 2.2.6 Ensure all administrative controls established to mitigate the hazards of analytical x-ray equipment are adhered to.
- 2.2.7 Ensure that routine surveys required to verify the compliance of analytical x-ray equipment are carried out.
- 2.2.8 Ensure that any work or maintenance required to be carried out on analytical x-ray equipment is performed by an appropriately trained and qualified entity.

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HALMPAGE NO.
2 OF 4

2.2.9 Maintain records of all surveys carried out on analytical x-ray equipment.

2.2.10 Maintain records of all maintenance carried out on analytical x-ray equipment.

3. INSTALLATION OF NEW X-RAY GENERATING EQUIPMENT

- 3.1 No organization shall install x-ray analytical equipment without prior approval of Radiation Protection Unit of Environmental Protection Department (RPU/EPD). Details of proposed new x-ray generating equipment shall be provided to RPU/EPD by the user organization for approval.

4. RADIOLOGICAL CONTROLS AND INSTRUMENT OPERATION

- 4.1 Laboratories containing analytical x-ray equipment must be kept locked when not in use.
- 4.2 Only competent, authorized personnel are permitted to operate the x-ray equipment.
- 4.3 Persons operating the x-ray equipment shall test the safety features of the equipment regularly. These features include, but not limited to the warning light, interlocks and electrical switches.
- 4.4 The entrance to laboratories containing x-ray equipment shall be posted with a radiation warning sign that bear the radiation symbol as well as following statement "CAUTION X-RAY, THE EQUIPMENT IN THIS ROOM PRODUCES X-RAY WHEN ENERGIZED".
- 4.5 Analytical x-ray generators or tubes must be labeled with signs bearing the radiation caution symbol and the words "Caution - High Intensity X-ray Beam" in Arabic and English.
- 4.6 At the switch that energizes the tube a label "Caution Radiation - This Equipment Produces Radiation When Energized" shall be present.
- 4.7 A red warning light shall be activated when the electrical circuit is switched on to indicate that that X-rays are being produced. The warning light shall be wired so that the high voltage circuit cannot be energized if the light is burned out.
- 4.8 In cases where the primary x-ray beam is not intercepted by the apparatus under all conditions of operation, protective auxiliary shielding shall be provided to avoid exposure to the primary beam. In all new equipment shielding devices shall be included in an interlock system so that the high voltage circuit cannot be energized if the shielding is missing or incorrectly positioned.
- 4.9 *Each x-ray generator must be shielded so that radiation leakage, measured at a distance of 5 centimeters from its external surface, cannot produce a dose rate in excess of 2.5 micro Sv per hour.
- 4.10 No operator shall bypass a safety device without prior approval of the proponent/organization Radiation Protection Officer (RPO).
- 4.11 No repair or maintenance work shall be performed on analytical x-ray equipment that could expose personnel to the primary beam. Work may be performed only when the power supply is completely de-energized.
- 4.12 The x-ray equipment shall not be left unattended during operation unless the room is locked or the equipment is secured to prevent unauthorized access.

5. PERSONNEL EXPOSURE MONITORING

- 5.1 Personnel monitoring devices, including whole body and finger-ring monitors (e.g., TLD badges and rings) shall be provided by the Company and worn by all persons engaged in analytical x-ray operations as deemed necessary by RPU/EPD.

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3 OF 4**6. RADIATION SURVEYS**

- 6.1 A radiation survey shall be performed upon installation of new x-ray generating equipment and annually thereafter.
- 6.2 Radiation surveys shall also be required in the following circumstances:
- 6.2.1 where changes in procedures or alteration of equipment may change the radiation characteristics
- 6.2.2 where personnel monitoring devices show a significant increase over previous readings
- 6.3 The radiation survey meter used must be sufficiently sensitive (detection limit ≤ 0.5 MSV/hr) for the detection and quantification of x-ray exposures.
- 6.4 In the event that survey readings are found to exceed maximum recommended exposure levels quoted in GI 150.003, the equipment will be taken out of service and an investigation conducted to determine the cause. Equipment shall not be returned to service until satisfactory resolution of the problem is presented to and approved by the responsible Radiation Protection Officer (RPO) or equivalent and when survey readings indicate that radiation levels are within recommended limits.

7. TRAINING

- 7.1 A list of qualified operators and operating instructions should be posted on or near the x-ray generating equipment.
- 7.2 Persons who will be operating x-ray equipment shall receive a course of instruction on the safe operation of the equipment from either the instrument manufacturer or from a previously trained worker.
- 7.3 All operators must attend a minimum of one course in radiological protection with specific focus for the application.

8. RECORDS

- 8.1 The responsible RPO shall maintain records of the following information specific to his organization:
- 8.1.1 Description of the x-ray generating equipment, manufacturer, model number, serial number, operating parameters (maximum operating voltage and current) and location
- 8.1.2 Site plan showing the location of the x-ray equipment in the facility
- 8.1.3 Personnel exposures
- 8.1.4 Details of workers experience, training and qualifications relating to x-ray generating equipment usage and radiation protection
- 8.1.5 Site inspection reports
- 8.1.6 Maintenance reports
- 8.1.7 Personnel overexposures
- 8.1.8 Investigations into radiation leakage above recommended exposure levels
- 8.1.9 Records of radiation surveys and work location monitoring. A copy of each survey record shall be maintained by the responsible RPO and a copy of the record shall be posted on or next to the x-ray equipment. Each survey record shall include the following information:
- Date of the survey
 - Name, type, serial number and manufacturer of the x-ray generating equipment
 - The operating conditions of the x-ray generating equipment at the time of the survey
 - Description, serial number, and the calibration expiry date of the radiation survey meter(s) used
 - Exposure rate values
 - Name and signature of the person conducting the survey
 - Details of maintenance, and investigations of high readings

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4 OF 4

RECOMMENDED:

MANAGER,
ENVIRONMENTAL PROTECTION DEPARTMENT

DATE: _____

CONCURRED:

MANAGER,
RESEARCH & DEVELOPMENT CENTER

DATE: _____

CONCURRED:

MANAGER,
EXPEC ADVANCED RESEARCH CENTER

DATE: _____

*CONCURRED:

EXECUTIVE DIRECTOR,
PETROLEUM ENGINEERING & DEVELOPMENT

DATE: _____