



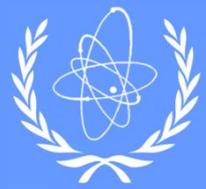
Presentation

INDUSTRIAL RADIOGRAPHY

METHODOLOGY FOR DOSE ESTIMATES IN

ACCIDENT CONDITIONS.

International Atomic Energy Agency.



OBJECTIVE

- **Example of dose estimates in industrial practice installations during accident conditions.**





INTRODUCTION

The estimations of doses in conditions of accident start from identifying the main scenarios, that because of their probability and the consequences, could happen in extreme conditions. It is recommended to analyze accident scenarios previously occurred.

Dose estimates are required for people who may be affected:

- 1. Occupationally Exposed Personnel.**
- 2. Members of the Public.**

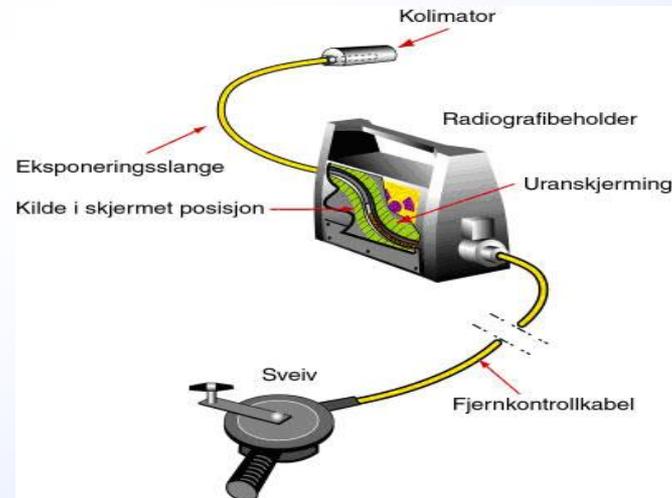




SCENARIOS

Most important scenarios in the practice of Gammagraphy

1. Blockage of the source of the gammagraphy equipment when the source is exposed.
2. Loss of a source of Gammagraphy during storage or transportation.
3. Inadvertent entry of a worker or a member of the public to the controlled area while the source is exposed.
4. Inadvertent permanence of an operator or a member of the public within the controlled area, while the source is exposed.



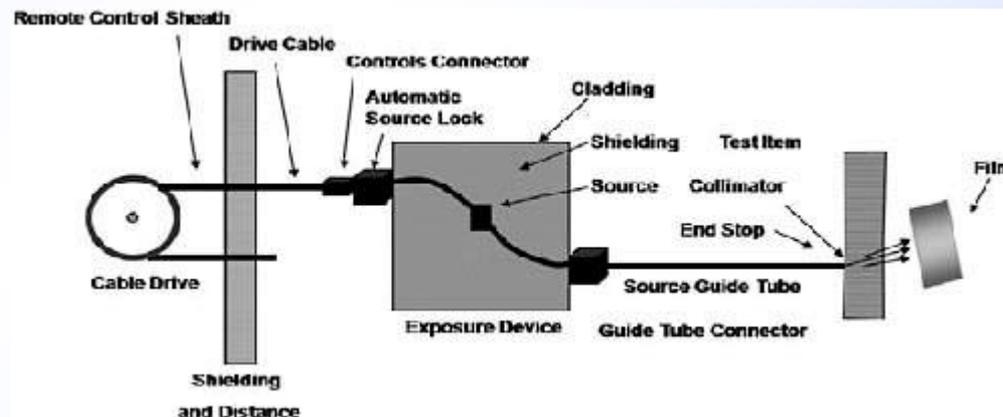


SCENARIOS

Loss of a source of Gammagraphy during storage or transportation.

Generally, there are two different conditions of exposure of the person in this scenario:

1. The source is in contact with the body (in the hand or in a pocket) during a certain time.
2. The source is at a distance "d" of the person for a certain time.





DOSE ESTIMATION

Dose received by the person due to the possession of the source, in contact with the body, during a certain time.

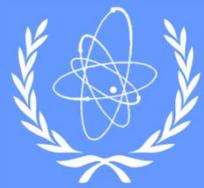
$$D_c = F_c * T_c * A$$



F_c , Is the conversion factor of the absorbed dose rate, applied to the soft tissue absorbed dose. (Table 14 y 15 EPR-D-VALUES 2006) (For I-192 $F_c = 8.5 \cdot 10^{-15}$ Gy/Bq*s), (For Cs-137 $F_c = 5.9 \cdot 10^{-15}$ Gy/Bq*s), (For Am-Be ($\gamma+n$) sources , $F_c = 8.9 \cdot 10^{-17}$ Gy/Bq*s)

T_c , Is the period of time the person keeps the source in contact.

A , Is the initial Activity of the source (assuming conservative considerations)



DOSE ESTIMATION FOR GAMMA SOURCES

Dose received by people due to placement of the source at a distance "d" from these people, for a certain time.

The dose rate by Irradiation can be determined by equation:

$$\dot{H}_{ir} = \frac{\Gamma \cdot A}{d^2}$$

- Γ , is the gamma constant for the radioisotope used (Γ for I-192 is 0.135 mSv m²/ GBq h).
- A, is the activity of the source.
- d, is the distance between the source and the person irradiated.



The dose received by the person by irradiation "D" is calculated by the equation:

$$D = H * T$$

T, it is the time of permanence of the person under conditions of irradiation.



DOSE ESTIMATION FOR NEUTRON SOURCES

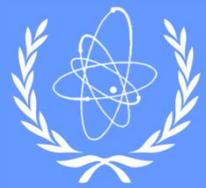
Dose received by people due to placement of the neutron source at a distance "d", for a certain period of time.

The total dose received by a person exposed to a source of neutrons includes two fundamental components:

- The dose received by the GAMMA radiation, associated with the ALPHA and GAMMA emitting isotopes, containing the neutron sources.
- The dose due to neutron radiation emitted by these sources.

The dose due to GAMMA radiation is estimated in a manner similar to that described above.





DOSE ESTIMATION FOR NEUTRON SOURCES

Dose received by people due to placement of the neutron source at a distance "d", for a certain period of time.

The dose rate per neutron can be determined by the following equations:

$$\phi_n = A * E_f$$

$$H = (C_{dn} * \phi_n) / 4\pi(d_h)^2$$

E_f , is the efficiency of the ALFA-NEUTRON reaction

C_{dn} , is the neutron dose coefficient, for neutrons of 5.45 MeV

H , is the dose rate per neutron

d_h , is the distance between the neutron source and the exposed person.

$$D = H * T$$

T , is the time used in the manipulation of the source



