Presentation Part II
BRACHYTHERAPY
METHODOLOGY FOR DOSE ESTIMATES IN NORMAL OPERATION.

Internacional Atomic Energy Agency
OBJECTIVE

- Methodology for dose estimation in normal operating brachytherapy conditions.
- Example of dose estimation in normal operating brachytherapy conditions.
To estimate doses during normal operating conditions it is necessary to identify the people potentially exposed and the exposure conditions during the daily routines.

It is required to do estimations for:

1. Exposed workers.
2. Members of the public.
## Exposed Workers in the Practice of Brachithrapy

<table>
<thead>
<tr>
<th>Exposed Worker</th>
<th>Assigned tasks</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brachytherapy Unit operator technician</td>
<td>Operating the unit from the control panel</td>
<td>Y/N</td>
</tr>
<tr>
<td></td>
<td>Positioning the patient at the equipment for treatment.</td>
<td>Y/N</td>
</tr>
<tr>
<td>Medical Physicist</td>
<td>Quality control</td>
<td>Y/N</td>
</tr>
<tr>
<td>Medical radiotherapist</td>
<td>Place the implant in the brachytherapy room</td>
<td>Y/N</td>
</tr>
</tbody>
</table>
The instantaneous dose rate (IDR) at the primary barrier can be estimated by the equation:

$$ IDR = \frac{DR_0 \cdot B}{d^2} $$

$DR_0$: Kerma rate at 1 m from the source.
$B$: barrier transmission factor. (*)
$d$: distance at the calculus point.

$B = 10 \left\{ 1 + \left[ \frac{S - TVL_1}{TVL_{e}} \right] \right\}$

(*) $B = 10$

$S$: thickness of the barrier.
$TVL_1 = TVL_{e}$: Tenth Value Layers (15.2 cm, for Ir-192)
1. Control panel located on a Primary barrier

The average dose rate that the operator receives in a week can be estimated from the instantaneous doses rate (IDR):

\[ R_w = IDR \times \frac{W U T}{DR_0} \]

- \( DR_0 \): Dose rate at the isocenter of the equipment.
- \( W \): Weekly work load,
- \( U \): Use factor
- \( T \): Occupation factor.

The annual dose received by a control panel operator is:

\[ D_1 = R_w \times N_w \]

- \( N_w \): Number of working weeks in a year.

Considerations for dose estimation

1. According to the standard IEC 60601-2-17 it is assumed that the dose rate at 1 m from the head of the unit is 0.01 mGy/h.
2. \( N_0 \) patients a day are treated, assuming that each work shift has 2 technicians and each technician positions half of the patients.
3. In each patient positioning field and placement of guide tubes the technician should take approximately 5 minutes.
4. Technicians work 5 days a week, 50 weeks a year.

\[ D_2: \text{Annual dose due to the positioning of the patients} \]

\[ D_2 = \frac{N_o}{2} \text{pat/days} \times 0.0833\text{h/pat} \times 0.01\text{mSv/h} \times 50\text{ weeks/year} \times 5\text{ days/week} \ (\text{mSv/year}) \]
Annual total dose ($D_{ta}$) that the operator receives in normal operating conditions

$D_{ta} = D_1 + D_2$

**Conclusion:** $D_{ta}$ must be less than the dose constrain ($P$)
MEMBERS OF THE PUBLIC EXPOSED IN THE PRACTICE OF HDR BRACHYTHERAPY

<table>
<thead>
<tr>
<th>Members of the Public</th>
<th>Activity</th>
<th>Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient’s escort</td>
<td>Waiting during treatment</td>
<td>Y/N</td>
</tr>
<tr>
<td></td>
<td>Assistance of the elderly people and children.</td>
<td>Y/N</td>
</tr>
<tr>
<td>Hospital workers and other patients</td>
<td>Offices, bathrooms, halls where the hospital workers are present.</td>
<td>Y/N</td>
</tr>
</tbody>
</table>
To estimate the doses received by the members of the public we use the same equations that are used to estimate the control panel operator doses. Distances, use and occupation factors should be realistic.

Primary barrier: \[ IDR = \frac{DR_0 \cdot B}{d^2} \]