Introducing the concept of the isodose for optimization of decontamination activities based on typical Northern European houses

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Outline

• Introduction to the concept of the isodose

• Influences of
  - building materials
  - resident behaviour
  - vertical migration
  - variability in contamination

• Comparison to normal decontamination
Definition of the isodose

The isodose $ID_{i,k}$ is defined by the outer boundary of one or more zones in space that contribute for the most part to a given fraction $k$ to the dose at the observation point $i$. For $\rho_{D,i}(\vec{r})$ being a continuous function with the maximum $\rho_{D,i,max} < \infty$ the isodose $ID_{i,k}$ can be chosen from the range $0 < ID_{i,k} < \rho_{D,i,max}$ and the fraction of dose contribution $ki$ caused by the zones that were determined by the isodose is described by

$$k_i = \int f(\rho_{D,i}(\vec{r}))dV/D_{i,\infty} \text{ FOR } f(\rho_{D,i}(\vec{r})) = \begin{cases} \rho_{D,i}(\vec{r}), & \rho_{D,i}(\vec{r}) \geq ID_{i,k} \\ 0, & \rho_{D,i}(\vec{r}) < ID_{i,k} \end{cases}$$
Authentic Swedish house models

• Wooden house and brick house
• Eleven observation points:
  - #1 bedroom
  - #2 bathroom
  - #3 second bedroom (e.g. child, guest)
  - #4 dressing room
  - #5 corridor
  - #6 restroom
  - #7 hall
  - #8 workroom
  - #9 kitchen
  - #10 living room
  - #11 dining room
• Contamination on the ground as well as 2.5 cm and 5cm beneath it
• Positions of doors and windows are reflected in the shape of the isodose lines
Brick house – residential behaviour

- Zones decrease with entering the soil
- Zones slightly increase for deeper soil depth
Wooden house – residential behaviour

- Zones are smaller compared to the brick house
- Isodose lines are gentler compared to the brick house
Brick house – vertical migration

- Dominance of the top soil layer
- Zones slightly become smaller as the contaminants migrate into deeper soil levels
Contamination variability

- Comparison of the homogeneous contamination scenario with three different contamination variability scenarios
Brick house – contamination variability
Wooden house – contamination variability
Comparison of decontaminating 116 m²

<table>
<thead>
<tr>
<th>Ground contamination of 500 kBq/m² $^{137}$Cs</th>
<th>Primary dose (mGy/a)</th>
<th>After normal decontamination</th>
<th>After optimized decontamination</th>
<th>Comparison of relative dose reductions</th>
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<tbody>
<tr>
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<td>Dose (mGy/a)</td>
<td>Relative dose reduction</td>
<td>Dose (mGy/a)</td>
<td>Relative dose reduction</td>
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<td>Brick house:</td>
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<tr>
<td>Homogeneous scenario</td>
<td>1.37</td>
<td>1.21</td>
<td>12.3%</td>
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<tr>
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</tbody>
</table>
Conclusions

• Introduction to the concept of the isodose

• Influences of
  - building materials
  - resident behaviour
  - vertical migration
  - variability in contamination

• Comparison to normal decontamination
Further details

