Practical and Regulatory Aspects of Clearance and Exemption of Non-Nuclear Waste

Dr. J. Feinhals

DMT GmbH & Co. KG
Content

1  Dose Concept and Derived Values
2  Regulation in Germany
3  Some Good Experiences
4  The Important Role of Clearance
1 Dose Concept and Derived Values

IAEA standard 1988: some mrem are negligible (de minimis concept: dose is of no regulatory concern)

IAEA RS-G-1.7 2004 => IAEA BSS 2014

nuclide specific values for general clearance

EC BSS 2015 => nat. legislation 2018

Revision of RS-G-1.7 ???.

surface specific values, values for specific clearance

...
2 Regulation in Germany

unrestricted Clearance

- solid materials
  - with surface
- liquid material
- building rubble
  - excavated soil
  - in case of
  - > 1000 Mg/a
- nuclear sites
- buildings

unrestricted for reuse
2 Regulation in Germany

Specific Clearance

- solid materials with surface
  - landfill
- solid materials with surface
  - waste incineration
- buildings
  - demolition
- metal scrap with surface
  - melting

values for specific clearance > values for unrestricted clearance
## 2 Regulation in Germany

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Exemption limit</th>
<th>Surface contamination</th>
<th>General Clearance of</th>
<th>Specific Clearance of</th>
<th>Half-life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Activity [Bq]</td>
<td>Specific activity [Bq/g]</td>
<td>Solid substances, liquids, with the exception of column 6 [Bq/g]</td>
<td>Building rubble, excavated soil, in amounts over 1,000 Mg/a [Bq/g]</td>
<td>Buildings for reuse or continued use [Bq/cm²]</td>
</tr>
<tr>
<td>H-3</td>
<td>1 E+7</td>
<td>1 E+3</td>
<td>1 E+3</td>
<td>1 E+3</td>
<td>1 E+3</td>
</tr>
<tr>
<td>Be-7</td>
<td>1 E+7</td>
<td>1 E+3</td>
<td>100</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Mn-54</td>
<td>1 E+6</td>
<td>10</td>
<td>100</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Fe-55</td>
<td>1 E+6</td>
<td>1 E+4</td>
<td>100</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Zn-65</td>
<td>1 E+6</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Co-60</td>
<td>1 E+5</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Co-58</td>
<td>1 E+6</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Ag-110m+</td>
<td>1 E+6</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Sb-124</td>
<td>1 E+6</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cs-137+</td>
<td>1 E+4</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Cs-134</td>
<td>1 E+4</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Am-241</td>
<td>1 E+4</td>
<td>10</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

---

*Image of the table*
2 Regulation in Germany

Average Mass

unrestricted: 300 kg general
specific: 1 Mg for debris and excavated material
in single case higher values can be licensed

Average Area

unrestricted: 1000 cm² general
specific: 1 m² for buildings poss. more
100 m² for land areas
Recommendations given by the EC

RP 65: Principles and methods for establishing concentrations and quantities (Exemption Values) below which reporting is not required in the European Directive, 1993

RP 89: Recommended radiological protection criteria for the recycling of metals from the dismantling of nuclear installations, 1998

RP 101: Basis for the definition of surface contamination clearance levels for the recycling or reuse of metals arising from the dismantling of nuclear installations, 1999

RP 113: Recommended radiological protection criteria for the clearance of buildings and building rubble from the dismantling of nuclear installations, 2000

RP 117: Methodology and models used to calculate individual and collective doses from the recycling of metals from the dismantling of nuclear installations, 2000

RP 122: Practical use of the concepts of clearance and exemption – part I: Guidance on general clearance levels for practices, 2000

part II: Application of the concepts of exemption and clearance to natural radiation sources, 2001
### General Process for Clearance of Materials

1. **Assessment of History, Estimation of Activation**
2. **Pre-classification**
3. **Radioactive Waste**
   - **Clearable Waste**
4. **Determination of Nuclide Mixtures**
   - **Choice of Appropriate Measurements Techniques**
5. **Decay Storage**
6. **Pre-decision Measurement**
7. **Decision Measurement**
8. **Verification Measurement Necessary**
9. **Decision on Clearance**
10. **Transport Off Site**

#### Application
- **Application to Authority**
  - Includes Clearance Plan for Campaign

#### Execution
- **Execution of Campaign According to Clearance Plan**
  - Approved by Authority
  - Inspections by Experts

#### Permit
- **Permit for Clearance**
  - By Authority on Basis of Data for Each Batch or Entire Campaign
Annex 1: Main steps for a clearance plan

<table>
<thead>
<tr>
<th>No</th>
<th>Step</th>
<th>Instruction</th>
<th>Responsible</th>
<th>Signature</th>
<th>Check</th>
<th>Signature</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Provisional acceptance by operator of facility for reutilization of cables on basis of this plan</td>
<td>Responsible</td>
<td>Responsible</td>
<td>Responsible</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Analyzing of samples placed in different zones during operation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Determination of nuclide vectors for different materials by using the results of sampling and activation calculations</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Definition of different zones according to advanced zoning concept (s. table 1 in this report), definition of criteria for gamma dose rate and beta counting rate for these zones</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Cutting of cables for storage in grid boxes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Zone I: Go directly to step 10 for documentation Zone II/IIIa: Go directly to step 8 Zone IIIb: Transport to ISR Go on with step 7 Zone IV: Materials are out of the scope of this plan and have to be treated as radioactive waste</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Calibration of Total Gamma counter RTM 644 by use of already existing results of measurements with grid boxes filled with cables, threshold value 80% of equivalent</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Checks performed by independent experts or by operator
clearance value
Decision measurement: Measurement of grid boxes by Total GammaCounter RTM 644. Cables with more than 80% of the equivalent clearance value are allocated to zone IV

8  In situ gamma measurement are executed at grid boxes
Zone II: at 10% of boxes
Zone III a: at each box

9  Dose rate measurement at the allocated container for transport. If net dose rate > 0.095 μSv/h, content of container has to be rechecked.

10 Preparation of report with documentation of all data necessary to show compliance with Swiss clearance regulations. Measurements of zone I are only included as background measurements

11 Notification to competent authority with report and announcement of date for transport off site to facility for reutilization

12 After min. 14 days transport off site, if no other remark by authority was given

13 Declaration of acceptance by facility for reutilization as well as results of control measurements by the authority have to be included in the documentation

Clearance Plan: prepared by
Signature

Clearance plan checked by experts, approved by authority

released by
Signature
3 Some Good Experiences
Application of Removal

Plant Greifswald site
1,800,000 Mg

Category I
Not contaminated
Ca. 1,235,000 Mg

Category II and III
Potentially contaminated
Ca. 565,000 Mg

Plant components
TH 1 – 6, IH 6
Ca. 50,000 Mg

Concrete
Ca. 26,000 Mg

Building structures
Ca. 1,185,000 Mg

Plant components
Ca. 68,000 Mg

Remaining building structures
Ca. 471,000 Mg

Removal 2/3
Clearance 1/3

Some Good Experiences
• In Germany, there has always been a lack of disposal facilities.
• To keep the amount of waste as low as reasonably possible Germany developed many regulations for clearance of materials.
• These regulations are based on IAEA’s de minimis concept of a trivial dose of some 10 µSv/y.
4 The Important Role of Clearance

Clearance (several pathways are possible)
- Unrestricted clearance
- Recycling
- Landfilling

Radioactive waste
Reuse (under defined circumstances)
4 The Important Role of Clearance

What happens, if clearance levels will be reduced (e.g. by EU-BSS)?

97.2% => 90%  
2.4% => 9.6%  
more waste by factor of 4!

Clearance / Exemption (several paths are possible)
- Unrestricted release
- Recycling
- Landfilling

Radioactive waste
Reuse (under defined circumstances)
4 The Important Role of Clearance

Reducing the activity

- **very short lived** 
  \( T1/2 < 5 \text{y} \)
- **short lived** 
  \( T1/2 < 30.5 \text{y} \)
- **long lived nuclides**

\[ \text{Activity [%]} \]

\[ \text{Years} \]

- Exemption
- Specific Clearance
- RS-G-1.7
Generation of radioactive waste shall be kept to the minimum practicable. 
Principle 7 of IAEA Safety Fundamentals
Questions?

TUV NORD Akademie

10th International Symposium
Release of Radioactive Materials
Provisions for Clearance and Exemption

Call for Papers
07th – 09th November 2017
Hotel
Melia, Berlin