How the new Clearance Levels of EU-BSS will change Clearance in Germany

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Overview

- System of clearance options in Germany
- Transposition of the EU-BSS of 2013
  - regulatory framework
  - time schedule
- System of unconditional clearance / specific clearance
- Imminent changes
  - clearance levels
  - reasons for changes
  - verification of compliance with CL by measurements

Objective

- Clearance is well established in Germany
  - history with clearance about 30 years
  - practices have been adopted over the years
  - in particular with unconditional clearance
- New CL of Annex VII Table A 1 of the EU BSS will govern unconditional clearance in the future
  - will jumble the ratios of CL between traditional key nuclides and hard-to-measure nuclides
- This will in turn affect the practice of clearance, in particular unconditional clearance

STRUCTURE OF REGULATORY FRAMEWORK

Regulatory Framework in Germany until 2017 (1)

- Atomic Energy Act (AtG)
  - highest legal level
  - requirements for licensing of nuclear installations, nuclear fuel, radioactive waste, liabilities etc.
  - contains definition of radioactive material
- Other laws on same level:
  - Precautionary Radiation Protection Act
  - Site Selection Act (site of DGR for SF)

Regulatory Framework in Germany until 2017 (2)

- Radiation Protection Ordinance (StrlSchV)
  - below Atomic Energy Act
  - contains regulations on dose limits/constraints, exemption, clearance (incl. EV/CL), discharges, incidents/accidents, radioactive waste etc.
- Other ordinances on same level:
  - X-Ray Ordinance
  - Nuclear Safety Officer and Reporting Ordinance
  - Nuclear Licencing Procedure Ordinance
  - Nuclear Reliability Assessment Ordinance

Future Regulatory Framework in Germany (1)

- The EU BSS are currently being transposed into national legislation in Germany

- There will be a new hierarchy:
  - Radiation Protection Act will regulate all aspects of radiation protection
    - definition of radioactive material
    - requirements, dose limits, precautionary radiation protection etc.
    - accompanied by some ordinances regulating details
  - Atomic Energy Act will only regulate remaining issues for phase-out of use of nuclear energy

Future Regulatory Framework in Germany (2)

- The new Radiation Protection Act (Strahlenschutzgesetz) will be supported by various ordinances
  - the ordinances are necessary for the Radiation Protection Act to become usable
  - planned to enter into force on 31 Dec. 2018
- The set of ordinances include:
  - Radiation Protection Ordinance (Strahlenschutzverordnung, StrlSchV),
  - Ordinance establishing dose values for early emergency response measures
  - Ordinance on the disposal of radioactive waste
  - Ordinance on protection against the harmful effects of non-ionising radiation when used on humans

CLEARANCE IN GERMANY

Clearance Levels in the German RPO

- Clearance in RPO
  - general requirements: § 29
  - clearance levels (values): Annex III
  - further requirements: Annex IV

- Clearance options in Germany:
  - unconditional clearance
  - clearance for a specific purpose

Clearance Options - Unconditional clearance

- Unconditional clearance:
  - no requirements for destination of material
- Options for unconditional clearance:
  - a. of all solid materials for reuse, recycling or disposal including building rubble < 1000 Mg/a
  - b. of liquids
  - c. of building rubble and soil > 1000 Mg/a [RP 113]
  - d. of buildings for reuse or demolition [RP 113]
  - e. of nuclear sites (after removal of the buildings)

- IAEA terminology:
  - clearance (similar to options a/c/d)

Clearance Options - clearance for specific purposes

- Clearance for specific purpose:
  - requirements on destination of material
- Options for clearance for specific purpose:
  - a. of solid materials for disposal on (conventional) landfills or for incineration
  - b. of liquids for incineration
  - c. of buildings for demolition only [RP 113]
  - d. of metal scrap for (conventional) smelting only [RP 89]

- IAEA terminology:
  - authorized release, authorized use (authorized disposal)

Clearance Option #1: unconditional clearance of all material types

- “unconditional clearance” =
  - all types of material
  - no requirement on destination (recycling, reuse, disposal)
  - building rubble > 1000 Mg/a (from specific site): separate values
- Radiological model:
  - enveloping scenarios
  - simple scenarios
  - cover external irradiation, inhalation, ingestion
  - realistic - conservative
  - parameter values and assumptions are based on results of many detailed calculations

Averaging Criteria

- Application of clearance levels requires
  - averaging mass
  - averaging area
  - details in Annex IV StrlSchV
- Averaging mass:
  - 300 kg general value (Annex IV part 1 no. 3)
  - up to 1 Mg for building rubble (Annex IV part 7 no. 2)
- Averaging area:
  - 1000 cm² general value (Annex IV part 1 no. 4)
  - 1 m² for surface areas in buildings (Annex IV part 5 no. 3) larger areas in special situations

LONG-TERM STABILITY OF CLEARANCE

Long-Term Stability of Clearance (1)

- IAEA Safety Report No. 89 on fundamental dose constraint (1988):
  - An individual radiation dose, regardless of its origin, is likely to be regarded as trivial if it is of the order of some tens of µSv/a

- 10 µSv/a approach of IAEA has been used in
  - ICRP 60 (1990)
  - IAEA and EU BSS (1996)
  - ICRP 103 (2007)
  - IAEA and EU BSS (2013)
- will remain valid for at least another 15 years (~ 2030)
  - fundamental value remains constant for 40 year (or more!)

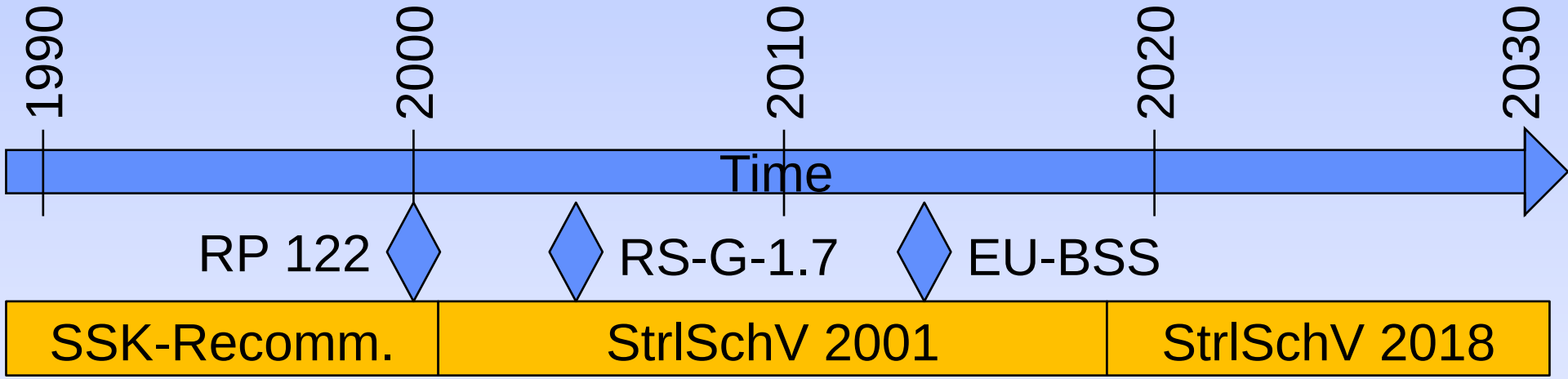
Long-Term Stability of Clearance (2)

- Clearance levels derived in regulatory framework in Germany:

Year	Document	Purpose	CL Co-60
1989	SSK Recomm. on clearance of metal scrap	uncond. cl., β/γ cl. for melting	0.1 Bq/g 1 Bq/g
1995	SSK Recomm. on uncond. cl.	uncond. cl.	0.1 Bq/g
1998	SSK Recomm. on metal scrap	cl. for melting	0.6 Bq/g
2000	Eur. Comm. RP 122	uncond. cl.	0.1 Bq/g
2001	Strahlenschutzverordnung (RPO)	uncond. cl., β/γ cl. for melting	0.1 Bq/g 0.6 Bq/g
2004	IAEA RS-G-1.7	Co-60	0.1 Bq/g
2013	Eur. Comm. BSS	uncond. cl.	0.1 Bq/g

Long-Term Stability of Clearance (2)

- Result:
  - CL of today will determine material management in current and future decommissioning projects



NPP large-scale decomm.

CHANGES IN CL INCURRED BY EU-BSS

Relevant Changes to CL for Unconditional Clearance

- Changes in CL for selected radionuclides:

Nuclide	App. III Tab. 1 Col. 5 StrlSchV	Ann. VII Tab. A Part 1 BSS
H-3	1,000	100
C-14	80	1
Co-60	0,1	0,1
Sr-90+	0,6	1
Cs-137+	0,5	0,1
Am-241	0,05	0,1

- major reductions of CL for:
  - Cs-137+
  - H-3, C-14

Where do the Changes in CL come from?

- CL for unconditional clearance in EU-BSS are based on IAEA RS-G-1.7
  - RS-G-1.7 was adopted by IAEA and Eur. Commission as basis for internationally agreed set of CL and EV
    - technical basis: IAEA Safety Report 44
- Approach taken in RS-G-1.7 is different from previous recommendations on clearance:
  - value set valid both for exemption and clearance
  - with only one radiological model
  - underwent many changes during its development

History of RS-G-1.7
Overview

- 4 phases of development:
  - development of a concept for clearance levels for unconditional clearance: 1998-99
  - development of clearance levels and a document (DS 161) presenting these clearance levels and their background: 1999-2000
  - change of scope and development of a new set of levels for defining the scope (SDL) of the application of the IAEA BSS, finalisation of RS-G-1.7: 2001-2003
  - presentation of the new set of values as an internationally agreed set of clearance levels for unconditional clearance by the IAEA: since 2004

History of RS-G-1.7
What was in and what was out?

Initial aim:
development of CL

Next aim: great unification
one set of values for
practices, NORM, food,
commodities, discharges,
cleanup of contamin. land

Final aim: development of
- one set of EV/CL for practices
- one set of EV for NORM
- in SR 44 and RS-G-1.7

History of RS-G-1.7
The Radiological Model

- The radiological model developed accordingly
- 1st step:
  - scenarios only for calculation of clearance levels
  - basis 10 µSv/a
- 2nd step:
  - broadening of the scope
  - enlargement of scenarios to accommodate exemption, based on 10 µSv/a
  - second set of scenarios based on 1 mSv/a
- 3rd step:
  - addition of a groundwater pathway

CHALLENGES FROM CHANGES IN CL

CL no longer reflect Radiological Significance

- Relation of the clearance levels of key nuclides and correlated nuclides become imbalanced, e.g. by
  - strong reduction of CL of H-3 and C-14
  - strong reduction of CL of Cs-137+
- Examples:

Nuclide	Rad./DF_{ing} (Sv/Bq)	CL old (Bq/g)	CL new (Bq/g)
Co-60	γ: 1.17, 1.33 MeV	0.1	0.1
Cs-137+	γ: 0.66 MeV, β	0.5	0.1
H-3	weak β - 1.8E-11	1,000	100
C-14	weak β - 5.8E-10	80	1
Sr-90+	strong β - 2.8E-8	0.6	1

Concept of Key Nuclides becomes Distorted

- Concept of key nuclides
  - relevant in all clearance procedures in Germany
  - anchored in all parts of DIN 25457
  - measurement of key nuclides is enough to derive activities of all nuclides
- Concept applied usually for e.g.
  - Ni-63, Fe-55 correlated to Co-60
  - Sr-90+ correlated to Cs-137+
- H-3 and C-14
  - cannot be correlated
  - have to be measured separately
  - measurement can no longer rely solely on key nuclides

“10 % Rule” loses Applicability
Nuclide Vectors become more Complex

- German StrlSchV contains “10 % Rule”
  - allowing to exclude a set of radionuclides from a nuclide mixture if they together contribute less than 10 % to the result of the sum of fractions
  - e.g. Fe-55, Ni-63, H-3, C-14 etc. up to now
- Low CL for H-3 and C-14 will no longer allow to do so
  - nuclide vectors become more complex
  - more radionuclides to be measured

Measurement Procedures need to be Altered

- Specifications for measurement procedures
  - have been based on current StrlSchV and DIN 25457
- Significant changes envisaged
  - especially if hard-to-measure nuclides like C-14 need to be included
  - inclusion of further nuclides
  - calibration procedures
  - software updates
    - automatic nuclide vector derivation
    - automatic evaluation of measurement results
  - new discussions and coordination with authorities/experts

EV are no longer Upper Limit for CL

- No interrelation between clearance levels and exemption values any more
  - previous concept: always CL ≤ EV for systematic reasons
  - this concept is now completely obsolete
- Germany will abolish mass-related EV for “moderate amounts” (< 3 Mg)
  - there are no longer any numerical limits for (mass-related) clearance levels
  - gives new room for case-by-case approaches
    - higher CL in special cases

OTHER CHALLENGES TO CLEARANCE

Use of Specific Clearance Options
Clearance of Metal Scrap for Melting

- Use of the specific clearance options: clearance of
  - metal scrap for melting in conventional smelter (RP 89)
- Specific clearance of metals
  - important option in material management
  - close the gap between uncond. cl. and radioactive waste
- Problem:
  - smelters: metal industry – fear or radioactivity
  - standard contracts prohibit activity concentration “above background”
  - based on measurements in entrance monitors
  - if CL in RP 89 are fully utilised, dose rate triggers entrance monitors
- A few smelters still accept cleared material

Use of Specific Clearance Options Clearance of Waste for Disposal

- Use of the specific clearance options: clearance of
  - waste for disposal (conventional landfill or incineration plant)
- Specific clearance of (all types of) waste
  - important option in material management
  - close the gap between uncond. cl. and radioactive waste
- Problem:
  - in many federal states of Germany, this clearance option is severely impeded or made impossible to use
  - heads of atomic authorities of Federal States and district administrators often try to win the public opinion by prohibiting acceptance of cleared material on landfill sites
- A few landfill sites/incinerators still accept cleared waste

Questioning of Parameter Values used in Derivation of CL (1)

- In many licensing procedures for clearance, it has become customary to question compliance with relevant parameter values used in in derivation of CL
  - although standard clearance procedures are applied
- Examples:
  - Clearance of building - RP 113
    assumption that CL are utilised on average by 33%
    authorities demand that operator determines utilisation factor *a posteriori*
  - Clearance of waste for disposal (landfill)
    assumption of working hours for transport driver,
    landfill capacity, surface water quantities etc.

Questioning of Parameter Values used in Derivation of CL (2)

- Discussions are triggered although
  - there is no concrete cause in a licensing procedure
  - the model as a whole is robust against any single parameter excursion
- Example: Inhalation doses (RP 114)
  - $$H_{inh} = D_{inh} \cdot t_e \cdot f_d \cdot f_k \cdot C_{dust} \cdot B_r / \delta / \rho$$
    - assumptions on single parameters on conservative side
    - product of these parameters will be conservative even if single values fall below the assumptions
- These unnecessary discussions lead to significant impediment and deferral in licensing procedures

CONCLUSIONS

Conclusions

- Clearance is and must remain an indispensable part of management of radioactive waste and residual materials
- Severe impediments have emerged over the last years
- Introduction of new CL for uncond. clearance by EU-BSS
  - based on IAEA RS-G-1.7/SR 44
  - entail changes in CL of several radionuclides (H-3, C-14, Cs-137)
  - will lead to changes in clearance procedures
  - take time to implement in practice
- Clearance must always be understood
  - on the basis of the radiation protection goal 10 µSv/a
  - not only based on the words of the law