# Looking back at developing WAC:

## Some personal remarks based on my experience starting about 30 years ago

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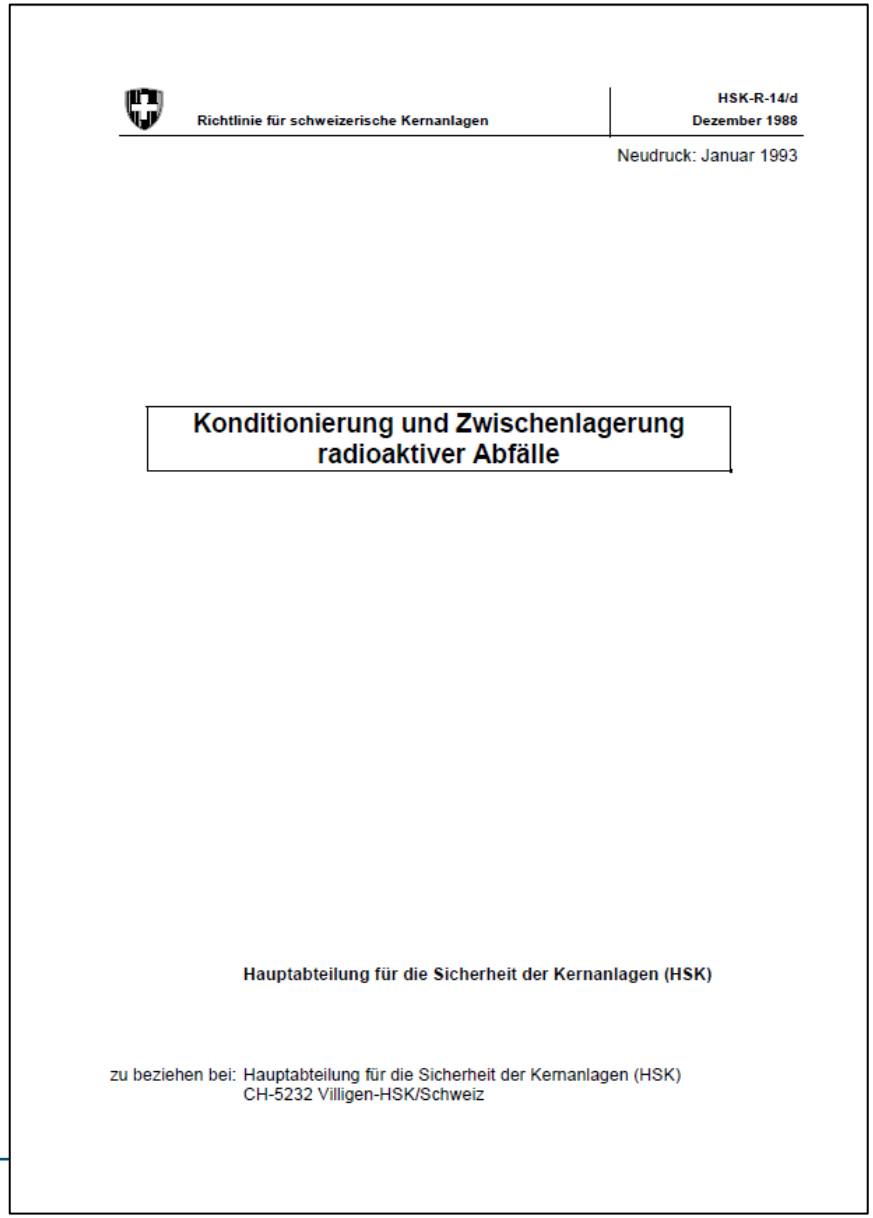
# **Waste acceptance criteria:** the beginning

- Waste management was considered already in the very early days of NPP operation but was initially seen as just a 'engineering task'
- Waste considered …
  - nuclear power plants (1st plant in operation in 1969)
  - medicine, industry and research (mainly 'small producers'), incl. legacies
- However, finding 'solutions' (centralized interim storage, disposal sites) more time-consuming than originally expected
- And: experience collected – reflected in first regulatory guideline on waste & interim storage in place in 1980; revised in 1988
- Some *'lessons learned'* already at that time
  - minimum quality of waste package beneficial for handling, incl. incidents → early treatment/packaging provides 'immediate' protection
  - differences between wastes → need to develop specific waste treatment procedures (pre-treatment, solidification, packaging)
  - importance of documentation (retirement of those having done the work)
  - … and: experience with specifications of residues from reprocessing

# Revision of regulatory guideline (1988): key aspects

- Conditioning needs regulatory permit (clearance)
- Requirement: provide certificate of suitability for resulting waste product for …
  - transportation
  - interim storage
  - disposal
- Assessment of suitability for disposal
  - case-by-case assessment and
  - use of preliminary waste acceptance criteria
- … covering a broad range of requirements



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zu beziehen bei: Hauptabteilung für die Sicherheit der Kernanlagen (HSK)
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# *'Get waste treatment going'*: key elements

- Assessment of suitability of product, to be done before start of 'routine' production → assessment of disposal suitability based on …
  - documentation sufficiently extensive to perform assessment
  - some testing, prototypes, etc. (if needed – mainly in initial phase)
- Collection of data and documentation – time consuming; therefore …
  - unify and define limited number procedures by grouping similar waste packages → waste types
    - waste type specification with most of the information
    - waste package data sheet for each package (package-specific data & QM)
  - full documentation of individual waste packages only as exception
- Work process for clearance of waste treatment involving all parties
  - regulator with waste producers
  - waste producers with operators (treatment, storage) & disposal organisation → giving feedback to the regulator ('waste acceptance')
  - … for disposal solutions (repositories): use of waste acceptance procedures (incl. tool box) & preliminary waste acceptance criteria

# *'Get waste treatment going'*: key elements

- Assessment of suitability of product to be done before start of 'routine' production → assessment of disposal suitability based on
  - documentation sufficiently extensive to perform the assessment

Observations from the early days

- 'cultural' differences between waste disposal organisation (research oriented) and waste producers (production oriented) → disappeared over time (mutual understanding)
- heterogeneous waste from multiple small producers are more challenging for 'waste acceptance' than NPP waste and fuel → initial learning of all parties mitigated challenge

  - regulator with waste producers
  - waste producers with operators (treatment, storage) & disposal organisation → giving feedback to the regulator ('waste acceptance')
  - … for disposal solutions (repositories): use of waste acceptance procedures (incl. tool box) & preliminary waste acceptance criteria

# **Waste acceptance:** key principles

- As long as waste treatment procedures & disposal solutions are not yet fully specified – be sufficiently flexible & assess options for both
- Thus, define already in early phases of waste management waste acceptance procedures (and WAC) that maintain flexibility for both waste treatment and disposal solutions that allow optimisation
- Graded approach: concentrate on large waste streams – but: be careful with small waste volumes that can become a 'show stopper' (P.S.: for all wastes a disposal path must be available)
- … this requires to screen all waste streams but concentrate on those of highest importance → this needs a good tool-box for analyses
- Complexity and cost: standardize waste packages wherever possible early enough (advantage of industry vs. 'small producers')
- Try to segregate wastes – do not 'perturb' large waste streams with small amount of waste having negative effect on many/all wastes

# **Waste acceptance criteria & process:** elements

**1** Properties of final waste package – *'what is needed to assess suitability of waste package for disposal (incl. allocation to repository)'*

- Quantitative information to check compliance with requirements
  - size, weight, handling devices, stackability, surface dose rate, …
  - nuclide inventory: guaranteed limits for key nuclides, 'correlations' for other
  - other (gas-/heat production, materials → chemistry, ….)
- Additional information as input for case-by-case assessment

**2** Characterisation – *'what needs to be measured for each package, what for samples and what can be inferred by other means?'*

- Geometry, structure
- Physical & chemical properties → materials
- Radiological properties (nuclides, dose rates, …)

**3** Other information needed – *'what needs to be known to have confidence in final product?'*

**4** Documentation – *'is everything needed adequately described?'*

**5** Measures taken in parallel to production (e.g. as part of QA)

# Waste acceptance criteria & process: elements

1 Properties of final waste package – *'what is needed to assess suitability of waste package for disposal (incl. allocation to repository)'*

2 Characterisation – *'what needs to be known of final waste package?'*

3 Other information needed – *'what needs to be known to have confidence in final product?'*

- Process description & control of process (measurements)
- QA-measures taken (measurements)
- Testing to qualify process (or: use tests done for same/similar process)

4 Documentation – *'is everything needed adequately described?'*

- Description of waste treatment process (incl. characterisation)
- Waste type specification (all relevant information)
- Example of waste package data sheet

5 Measures taken in parallel to and after production (e.g. as part of QA: measurements related to product, 'history' of package, …)

# Waste acceptance criteria & process: elements

1 Properties of final waste package – *'what is needed to assess*

**Summary:** what has to be fulfilled …

- Requirements on properties of final waste package

  A few requirements to be fulfilled by all wastes (e.g. size, weight)

  Other requirements are derived on case-by-case assessment (nuclide inventory, material limits (complexants, gas production, toxicity, …))

- Requirements on Quality Assurance

  Information that demonstrates that waste package fulfills specification (guaranteed parameters, other parameters)

- Requirements on specification (documentation)

  All characteristics to assess safety & feasibility of disposal must be included or can be derived with available information

# **Simplified assessment:** cases analysed with tool-box

| Parameter | Scenario | | | |
|---|---|---|---|---|
| | Operational phase Post-closure phase | | | Post-closure phase |
| | Release of volatile nuclides during normal operation | Mechanical impact | Thermal impact | Release (groundwater pathway) |
| **Waste volume** | **X** | | | **X** |
| **Nuclide inventory** | | | | |
| Average | **X** | | | **X** |
| Maximum | | **X** | **X** | |
| Speciation | **X** | | | |
| **Leakage rate of package** | **(X) b)** | | | |
| **Waste matrix class** [1)] | **X** | **X** | **X** | |
| **Package class** [1)] | | **X** | **X** | |
| **Waste group** [1)] | | | | **X** |
| **Handling route** [1)] | | **X** | **X** | |

simplified, in reality with more details

# Summary & conclusions

- Waste acceptance criteria & corresponding process are highly relevant for overall waste management programme and affect:
  - Waste treatment and packaging (and 'managing' the origin of wastes)
  - Transportation (and handling) with corresponding infrastructure
  - Interim storage
  - Disposal
- Waste acceptance process should be developed very early in the waste management programme because …
  - it is an essential element of the optimization of the overall waste management process (affecting all the issues mentioned above)
  - it defines the boundary conditions for developing waste conditioning
  - it defines the boundary conditions for the development of transportation, interim storage and disposal as these elements have to accept all waste that comply with the WAC (process & criteria)
- For all working on waste acceptance: a lot of experience is available – take advantage of what has been learned elsewhere

**thank you**
**for your attention**

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