Requalification of Legacy Radioactive Waste in Germany

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Introduction

- Currently: no operating repository for radioactive waste in Germany
  - the (legacy) waste is kept in interim storage facilities
- The operation of the Konrad repository for radioactive waste with negligible heat generation is expected in 2022
- Large stocks of German low-level and intermediate-level waste products were generated since the middle of the last century
  - waste products with a fragmentary data situation from today's perspective
  - waste products with different stages of qualification
  - most waste products possibly do not comply with the requirements of the intended Konrad repository
- Generation of fully qualified waste packages is one of the main tasks in Germany until the expected opening of the Konrad repository

Situation Today

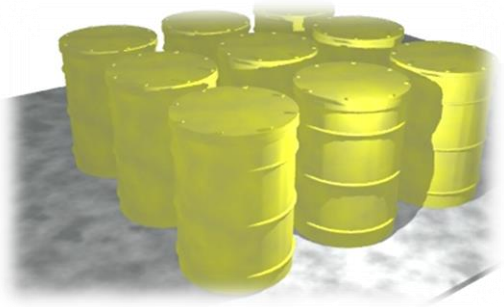
- The Konrad repository has detailed requirements for
  - waste products,
  - the quality characteristics of the waste products in dependence of the activity inventory,
  - the containers to be used,
  - waste packages,
  - the declaration of the activity inventory and
  - the declaration of non-radioactive toxic components

- In the 1990´s quality assurance plans (QAPs) have been established
  - documented conditioning and qualification of waste and
  - reliable waste flow tracking are ensured

- QAPs contain each step from the application, review and approval of the intended conditioning or (re-) qualification campaign and the description of the individual working steps

Requalification Strategies for Disposal (1)

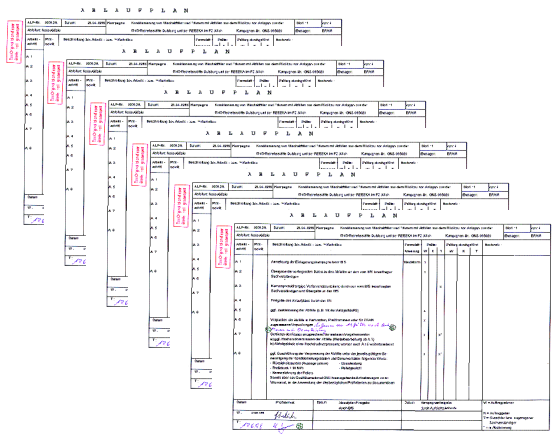
- Basic principles for the requalification of legacy waste:
  1. collection of existing data
  2. further procedure, e.g. measurement of missing data or waste conditioning
- Main legacy waste products: different residues from e. g.
  - decontamination,
  - compaction,
  - incineration,
  - evaporation and
  - cementation processes



- The >10.000 legacy waste products in Germany are mainly stored in 200-l-drums and were generated in the last four decades
- Radionuclide inventory: low to intermediate level waste
- Documentation: from very poor to nearly complete

Requalification Strategies for Disposal (2)

- The requalification is carried out stepwise for several lots of similar waste products and similar detection requirements
  - evaluation of existing and collected data depicts which data are still missing
  - poorly documented waste products: non destructive measurements before the approval of the qualification process by the competent authority (BfS)
  - determination of the procedures for the final treatment of the waste
- BfS endorses the complete process covering examinations and the procedures for final waste treatment
  - necessary steps are specified in quality assurance plans (QAP)
  - QAP are regulating all waste product specific conditioning steps, e. g. packaging, in order to fulfill the acceptance requirements for the Konrad repository



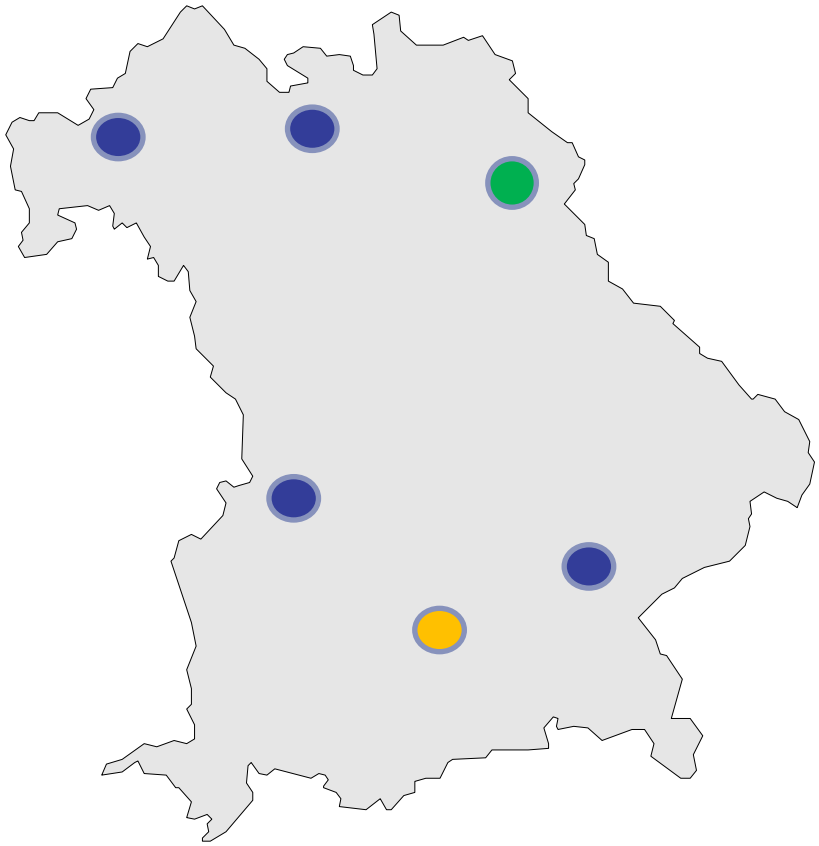
Requalification Strategies for Disposal (3)

- All relevant steps are accompanied by independent experts
  - ➢ accuracy and usability of the collected data and work performed can be ensured
- After the completion of the requalification campaign: generation of a comprehensive documentation
  - ➢ documentation is verified and testified by the independent expert on behalf of the BfS

- Waste products which do not fulfill the acceptance requirements because of the radioactive inventory
  - ➢ compiled data are obtained in a qualified process and therefore can be used for the documentation of the waste product properties for any other disposal facility

Requalification Experiences with Bavarian Legacy Waste (1)

- A special strategy for legacy waste was applied
  - ➢ when little or no reliable information was known in advance and / or
  - ➢ when sophisticated external measurement campaigns had to be carried out.
- Qualification campaign
  - ➢ about **1150** packages (mostly 200-l-drums)
  - ➢ origin in the 1980ies and older
  - ➢ partially external treatment



Requalification Experiences with Bavarian Legacy Waste (2)

- Objectives
  - exclusion of nuclear fuel
  - identification of possible (hidden) shielding
  - information about the physical condition of the waste product (e. g. water)
  - reliable determination of all radiological data for the later declaration for the final repository (Konrad repository)
  - consideration of a complex logistic situation (e. g. many drums were stored in stacked order)
  - limitation of transports and measurements to the necessary amount

Image:
Radiochemie, TU München

Requalification Experiences with Bavarian Legacy Waste (3)

- Strategy
  - research about all available documentation and information
  - identification of lots of several waste drums with expected similar inventory
  - definition of representative drums for a lot
  - agreement about the necessary measurements and tests
  - transport to the measurement institute and first non-destructive testing
  - discussion of the results and determination of further measures

Requalification Experiences with Bavarian Legacy Waste (4)

possible measurements

individual measurement plan

contamination, dose rate

non destructive measurements

segment. γ-scanning SGS

digital radiography DR

tomography TCT

nuclear fuel

destructive measurements

sampling

radiochemical analysis

iterative evaluation

At different milestones a preliminary evaluation of the measurements was carried out and further steps were defined.

final evaluation

further treatment, documentation

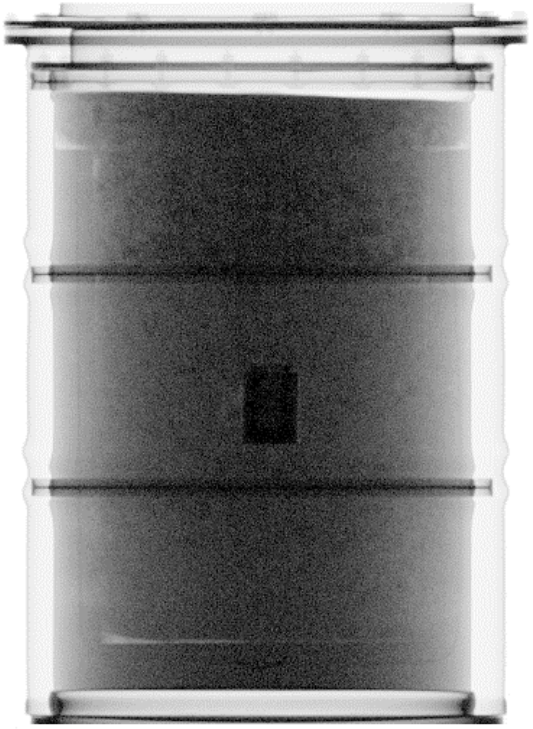


Image:
Radiochemie , TU München

Requalification Experiences with Bavarian Legacy Waste (5)

nuclear power plant	total number	examined drums	segm. gamma scanning	digital radio-graphy	computer tomo-graphy	inner inspec-tions	sampling and analysis
NPP 1	403	64	14	14	14	49	2
NPP 2	397	188	96	96	46	29	18
NPP 3	232	71	61	61	13	23	2
NPP 4	118	80	76	76	76	80	9
sum	1150	403	247	247	149	181	31
Percen-tage	100 %	35 %	21 %	21 %	13 %	16 %	3 %

Number of requalified drums and applied measurements

Conclusion

- Large stocks of legacy radioactive waste exist, which do not comply with the requirements of the Konrad repository.
- Requalification campaigns with thousands of waste packages have successfully been carried out.
- Quality assurance plans contain all necessary steps of specific (re-qualification) campaigns and optimize the procedures for each campaign in advance.
- When sophisticated measurement equipment was needed an iterative procedure was adopted. Repeated evaluations of the non-destructive res. destructive measurements limited the measures to the necessary limit.