

Design of Transport Container

Reduction of Occupational Exposure executing
Transports of Radioactive Wastes

Transport Container Type A

Content

1. The Task
2. The Solution
3. Today Status

Transport Container Type A

The Task

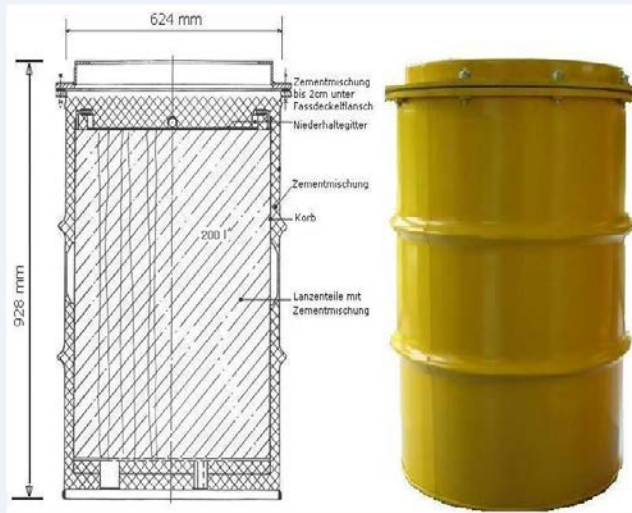
At present there are about 4'000 drums (200 l) in the KKM interim storage containing low level radioactive waste, awaiting transport to the interim storage in Zwiilag.

KKM is planned to be shut down in 2019, the decommissioning will last may be up to 2035. Even then there will be no deep geological final storage available, which may be in use 2050.

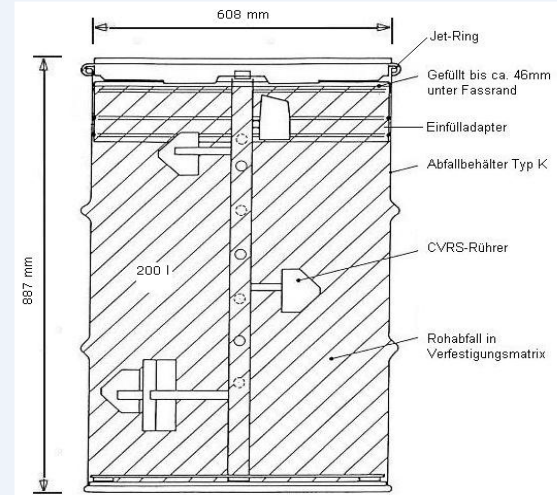
Radioactive waste transports have to be executed by lorries according to the regulations of the hazardous cargo ordinance (SDR / ADR).

Transport Container Type A

The Task



Cemented metals (core wastes)



Cemented spent resins

Transport Container Type A

The Task

Relevant data of the drums:

- Cemented resins and core wastes
- Dose rates up to about 100 mSv/h
- Activity content up to A_2 level (key nuclides Co-60, Cs-137)

Relevant boundary conditions for the transport on street:

- < 2 mSv/h at the outer surface of the lorry
- < 100 μ Sv/h in 2 m distance from these surfaces
- < 2 mSv/h on the surface of the transport package, 10 mSv/h as spot allowed

Transport Container Type A

The Task

Relevant data of the KKM interim storage:

- Maximum lifting mass for the crane 6.3 t
- Loading location at the storage difficult to access by lorries
- Loading equipment to be developed

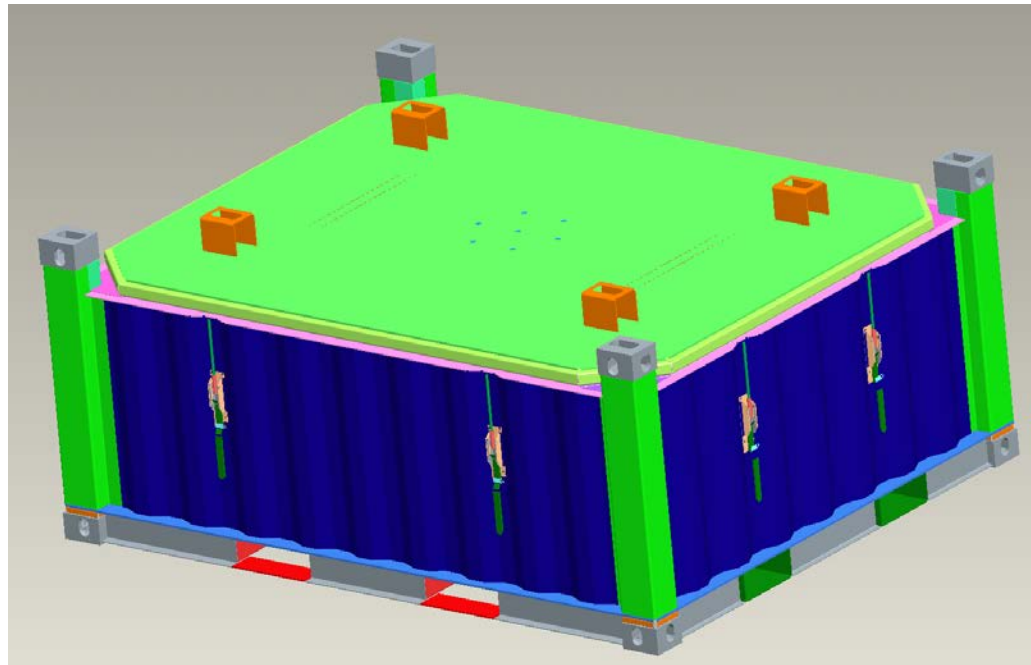
How to execute the transports with respect to:

- The limitation for lorries to 41 t
- Minimizing the amount of the transports
- Optimizing the time schedule of the transports
- Optimizing the staff dose

Transport Container Type A

The Solution

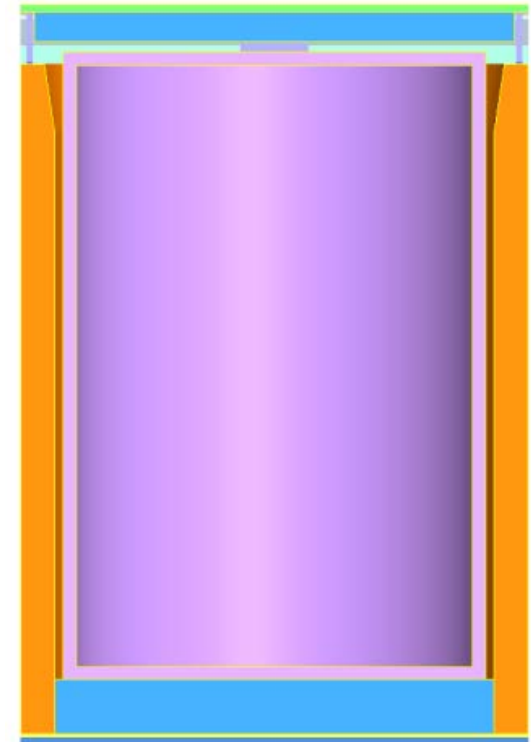
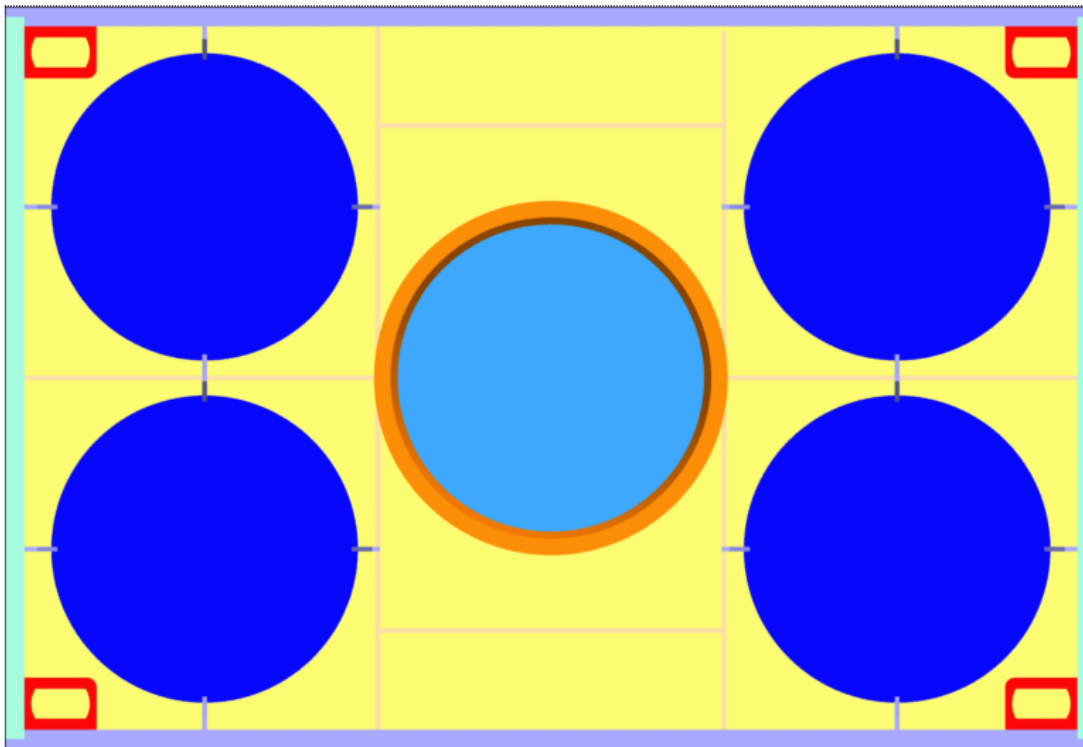
10' Container as Transport Package Type_(A) containing a shielding basket, no qualification for the drums as transport packages necessary



Transport Container Type A

The Solution

Shielding basket with additional shielding in the center position

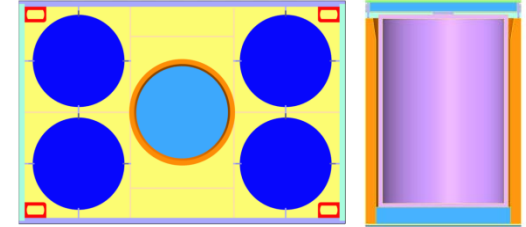


Transport Container Type A

The Solution

Data of the shielding basket:

- Maximum shielding basket weight is limited by the crane's lifting capacity, taking the loading equipment and drum masses into account
 - o Transport of five drums, average weight 360 kg / drum
 - o Loading equipment calculated with 500 kg
- Thickness of the shielding basket 40 mm steel, additional shielding of the inner drum by a pipe of 40 mm steel and a disc of 80 mm steel in the bottom
- Additional shielding by steel discs of 20 mm in the bottom of the basket at the outer drum positions
- Calculations: center position dose rates of about 60 mSv/h, outer position dose rates about 7 mSv/h possible

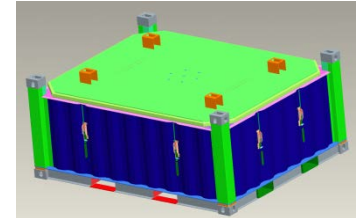


Transport Container Type A

The Solution

Data of the Transport Container:

- 10' Container, but height only 1.30 m
- Maximum total weight including basket 12 t
- Weight of empty Container about 2 t, that means transport of three containers at the same time possible with one lorry due to the conventional transport regulations
- Container independent from baskets, only limited by the maximum mass of 12 t, so different baskets possible (shielding, positions and number of drums)

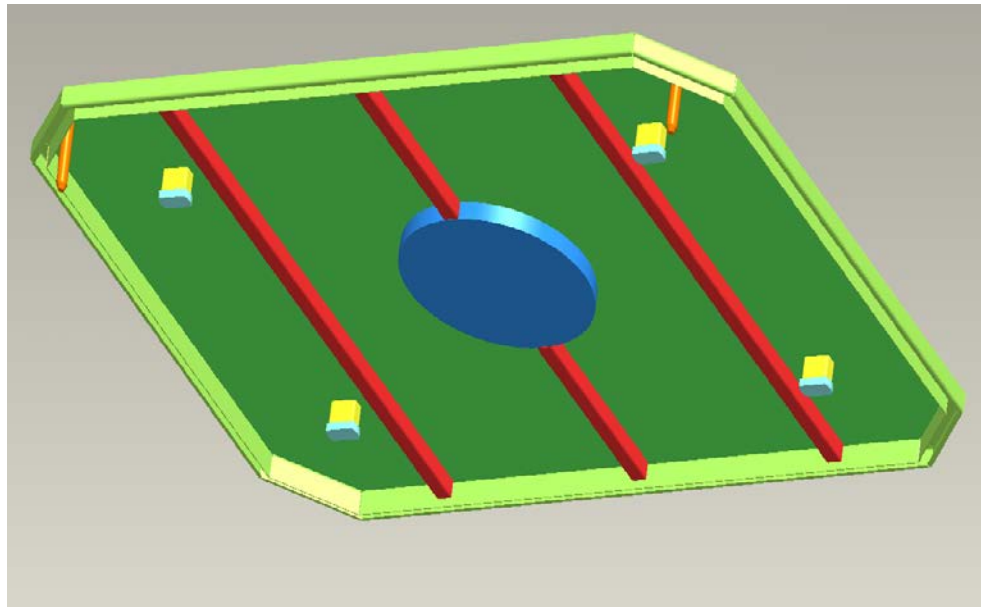
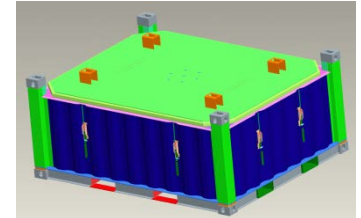


Transport Container Type A

The Solution

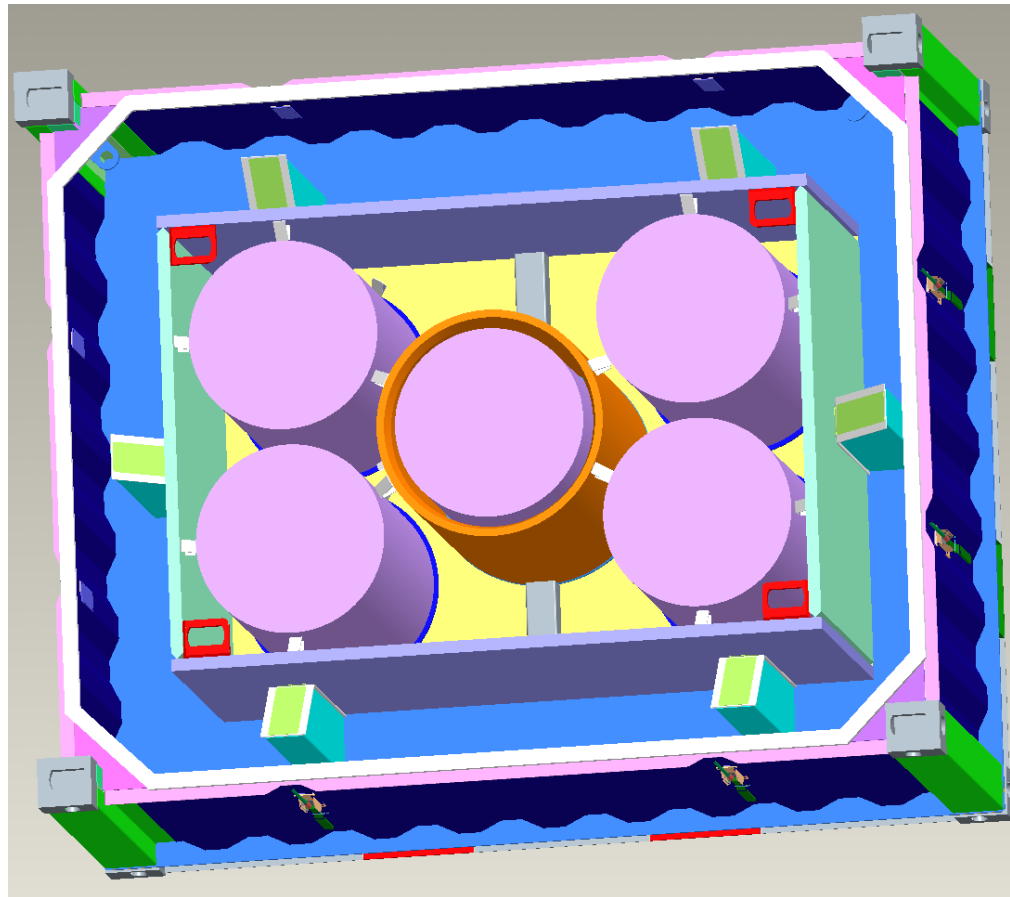
Data of the Transport Container:

- Only minor shielding in the roof of the container, iron disc with 20 mm thickness for the drum in the center position



Transport Container Type A

The Solution

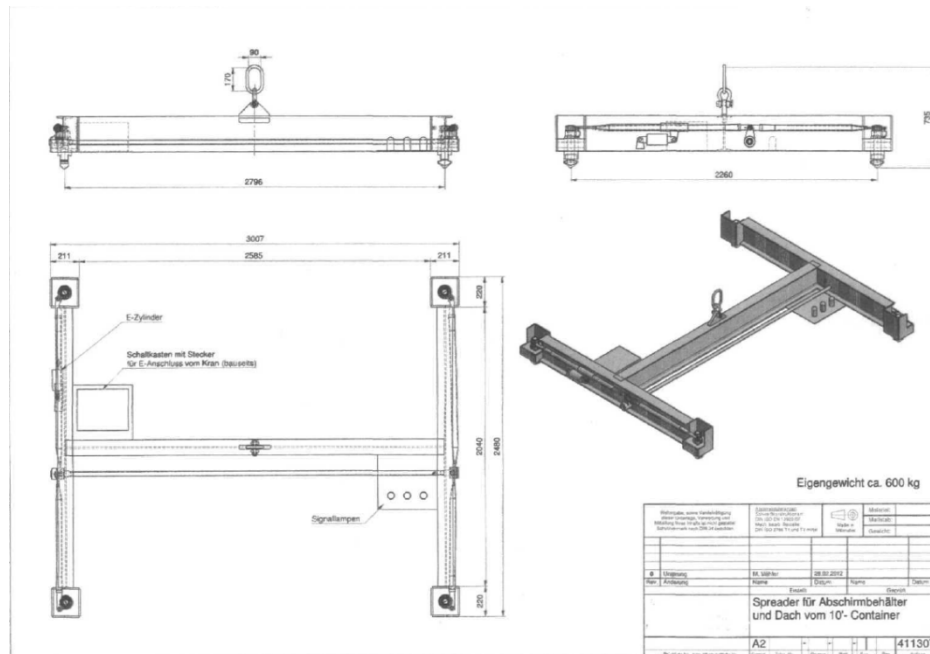


Transport Container Type A

The Solution

Data of the lifting equipment (spreader):

- Mass about 500 kg
- Qualification according to KTA 3902, chapter 4.2



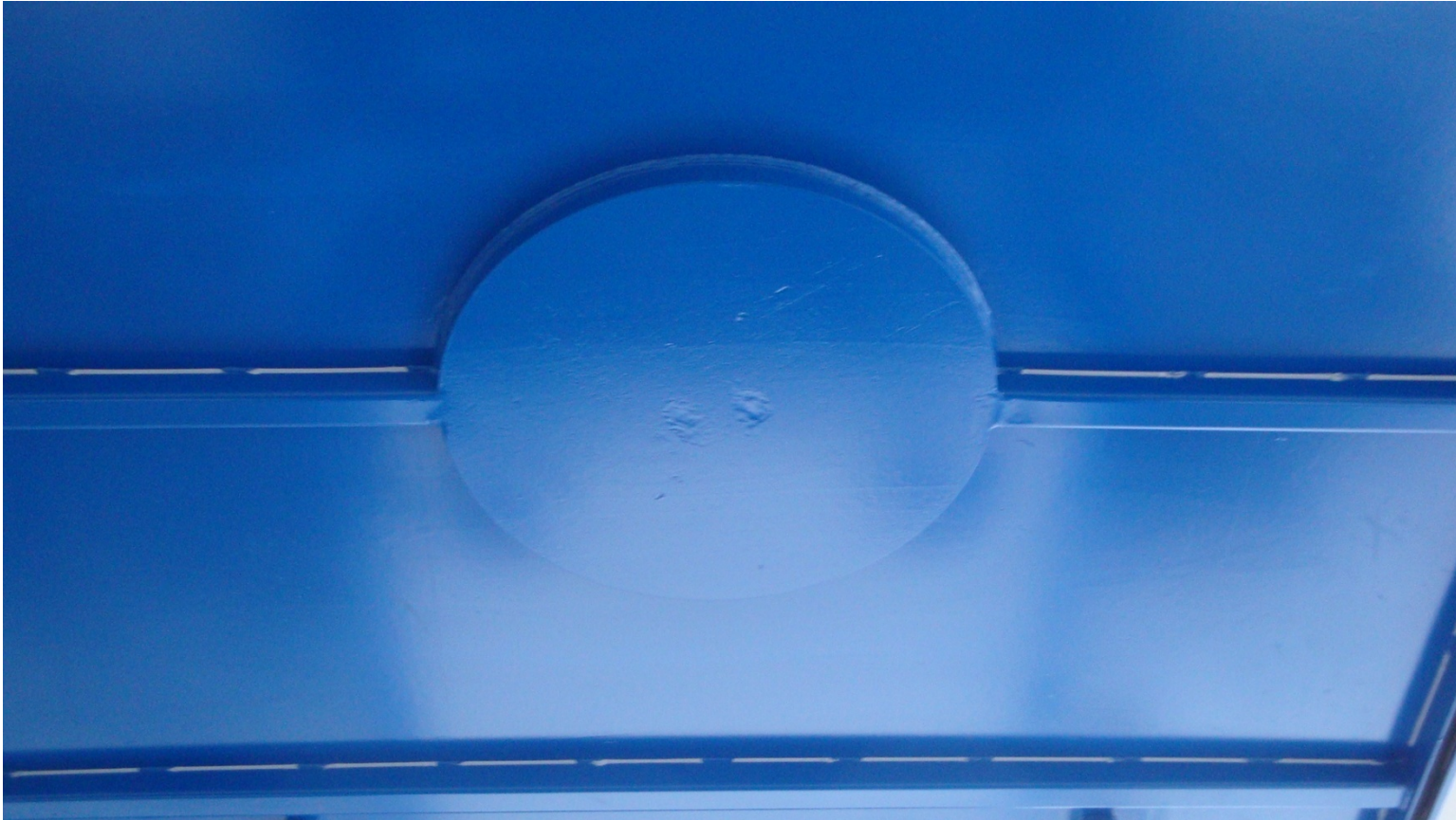
Transport Container Type A

The Solution



Transport Container Type A

The Solution



Transport Container Type A

The Solution



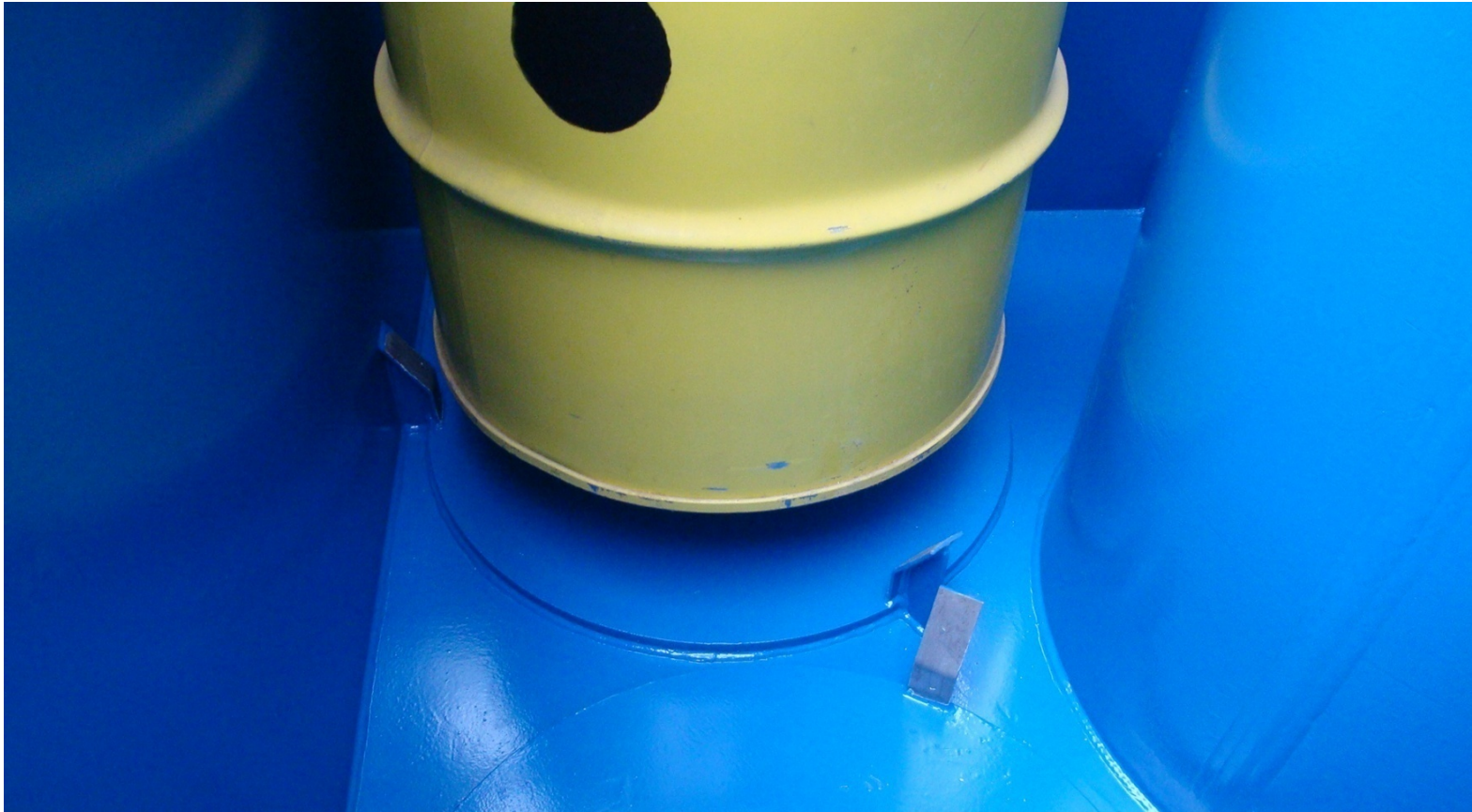
Transport Container Type A

The Solution



Transport Container Type A

The Solution



Transport Container Type A

The Solution



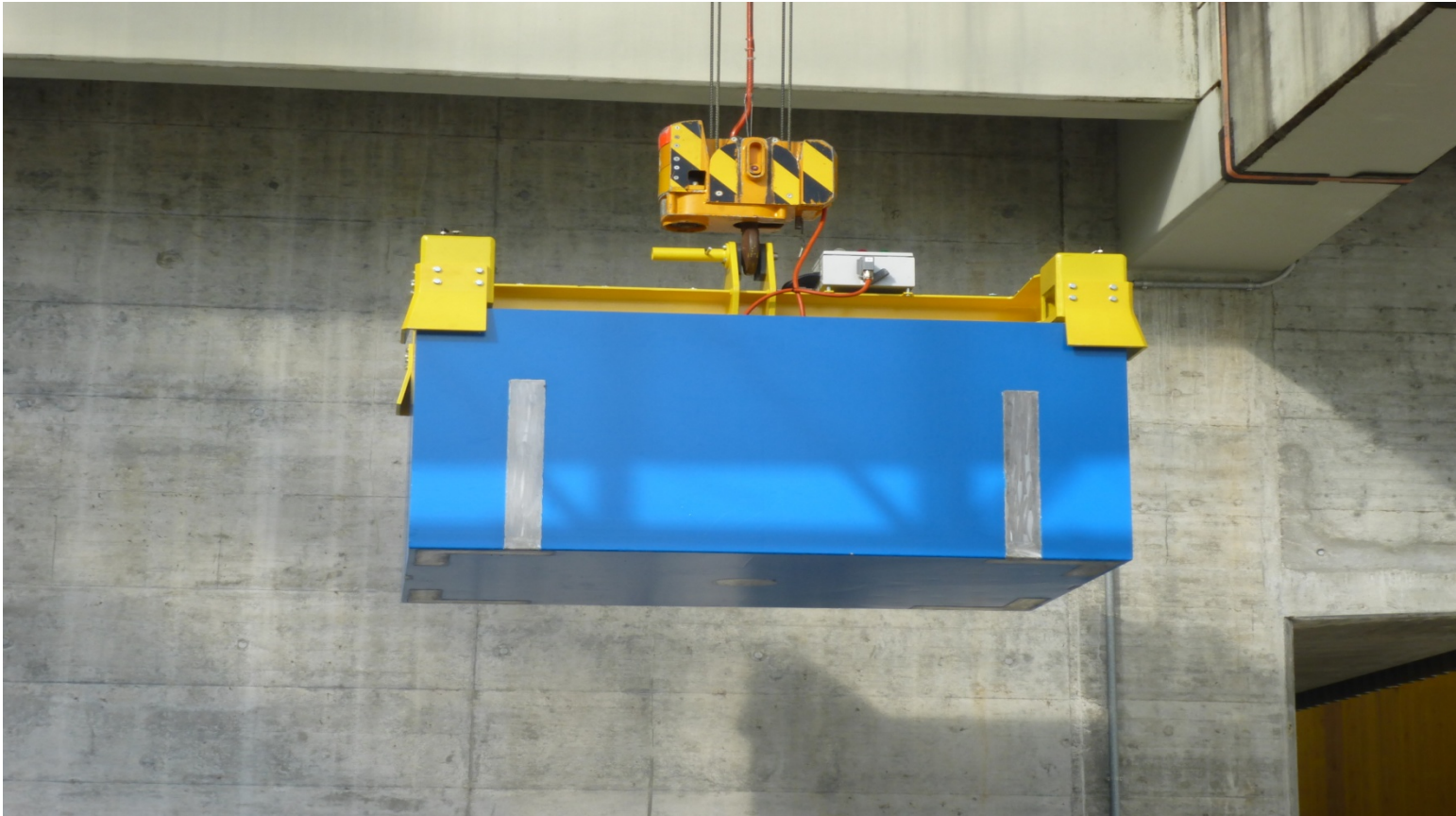
Transport Container Type A

The Solution



Transport Container Type A

The Solution



Transport Container Type A

The Solution



Transport Container Typ A

The Solution

Average data of the drums:

- Gamma activity about 50 GBq, mainly Co-60, (A_2 value $4E+11Bq$), in older drums due to fuel defects Cs-137 (A_2 value $7E+11Bq$)
- Ø Doserate in 10 cm distance 6 mSv/h
- Ø Doserate in 1 m distance 350 μ Sv/h

Calculations for the dose reduction:

- Ø Doserate in 40 cm distance (working area) 1.5 mSv/h
- Working directly at the drums for preparing as package Type_(A) about 2.5 minutes (replacing lock in the drum lid)
- Labeling of the drum about 0.5 minutes

Transport Container Typ A

The Solution

Estimated dose reduction:

- 4'000 drums, 3 minutes with a dose rate of about 1.5 mSv/h
- Estimated dose reduction in KKM **300 mSv**
- Additional dose reduction in Zwilag of about **200 mSv** for the replacement of the lock in the lid of the drum
- In total dose reduction of about **500 mSv**
- In principle no dose for the loading of the drums due to remote controlled handling of the crane

Transport Container Typ A

The Solution

Financials:

Investment in equipment up to now, three container including shielding baskets and two spreader about 250'000 CHF

Additional container and shielding baskets for an optimized transport logistics additional 250'000 CHF

α -value about 1'000 CHF per mSv

Remark: Dose and money savings due to the optimization of transports compared to transports in usual 10' or 20'containers are not taken into account.

Transport Container Typ A

Today Status

Pilot transport campaign with six transports under execution, five transports with in total 70 drums done without any problems

Average collective staff dose of about 30 μSv per transport due to the manual handling and measurements necessary

Control of the transport regulations by regulatory body, result: normality, all requirements met

Drums can be transported with dose rates nearly as calculated:

- About 5 to 6 mSv/h at the outer positions
- About 60 mSv/h at the center position
- Total activity in the container about 25% of the A_2 value
- Maximum transport index TI about 190 (package 100)
- Maximum transport activity $6.9 \text{ E}+11 \text{ Bq}$

Transport Container Typ A

Today Status

Optimization:

- The dose rate at the container lid is in the range of 1.5 mSv/h and therefore limiting the drums for transport.
The dose rate in 2 m distance above the lorry, created by three containers, is in the range of about 100 μ Sv/h.
- The lid of the container will be changed by implementing additional shielding due to the maximum gross mass allowed for the lorry.
- By that the aimed and estimated values of the drum dose rates will be met for the transports.