Symposium on Recycling of metals arising from operation and decommissioning of nuclear facilities, April 8-10, 2014 at Studsvik

Utilization of External Capacities as an Integral Component of Concepts for Residues and Dismantling Using the Example of the CARLA Plant

National and International Experiences in Recycling

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ABSTRACT

In Germany, nuclear industry has impressively demonstrated that decommissioning and dismantling of nuclear installations are technologically feasible tasks. From numerous projects, already concluded as well as still in process, substantial experiences could be gained which shall find their way into future strategies for decommissioning and dismantling. The overhasty and uncoordinated change in national energy policy, willingly called "energy turnaround", will inevitably lead to a real wave of decommissioning projects. Mastering these will only be possible by consistently implementing the available pool of experiences.

Future dismantling strategies will have to design the interaction between dismantling and treatment of residues in a much more flexible way in order to perform the whole dismantling process more efficiently. The more intensive utilization of external capacities for the treatment of residues can make a relevant essential contribution.

By the CARLA plant Siempelkamp offers such a safe and reliable component for every dismantling project, based on a proven and tested past while continuously developing for the future. Until today, more than 28,000 tons of radioactive metals could be processed in the CARLA plant and subsequently could be harmlessly recycled to a large extent. Over the time, the offered scope of service has constantly been expanded. In the separation and cutting area components with dimensions of up to the size of a 40’ container can be treated by thermal as well as mechanical separation methods.

The outside storage area for containers with a capacity of approx. 150 pieces of 20’ containers along with the authorized storage period for delivered material of 3 years enables us to react very flexibly to all project situations and by buffer storage customer specific campaigns of sufficient size can be arranged. In April 2012, the decontamination capacity could be clearly extended by commissioning of a new decont-room. Here, a suspension track blasting equipment was installed along with an inside tube blasting equipment. With this equipment, all tubes starting from a diameter of 20 mm can be decontaminated. Further steps of upgrading are in planning stage. For metals having been processed by melting and for nearly all process wastes licensed release procedures according to § 29 StrlSchV (radiation protection ordinance) are available including established disposal paths. Taking into account several marginal conditions, a decay storage of up to 20 years can be effected for metal ingots at our premises at Krefeld. This, too, is an important contribution to more flexibility and higher efficiency.
The CARLA plant fulfills all requirements which are indispensable for a good concept to treat residues. It avoids waste, reduces the waste volume and provides for subsequent recycling of the residues. The licensed capacity of the plant is sufficient to make up for any peak of demand resulting from the present situation. Thus the operators are able to design their dismantling strategies in the plants much more freely.

Disassembly works, for example, can be predated into the post-closure phase. Different project steps can be processed parallely and the whole material logistics in the plant can be optimized.

By increased involvement of external capacities like CARLA the challenges of the national dismantling activities over the coming years can be mastered successfully to a large extent.

The same applies to the international sector where, however, the sometimes strongly differing framework requirements regarding the situation of the final repository or release options may lead to different key aspects for involving CARLA into the individual projects.

In international technological comparison, German dismantling projects doubtlessly take a leading position, however, regarding efficiency there is still room for optimization. An early involvement of qualified service suppliers can help to push this optimization.

Fig.1: Layout of the CARLA Plant
Utilization of External Capacities as an Integral Component of Concepts for Residues and Dismantling Using the Example of the CARLA-Plant

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National energy politics will generate a veritable wave of decommissioning projects in near future.

This can only be managed by consequently implementing the pool of experiences having been established up to now.

Modern dismantling strategies must facilitate a flexible interaction of dismantling and processing of residues.

The whole process of dismantling must become more efficient.

Increasingly involving external capacities like the CARLA plant, can contribute essentially to tackling this task.
Plant

- Licensed capacity: 4,000 t/a
- Free capacity: 2,000 t/a
- 24 years of failure-free operation
- More than 29,000 t of metal have been safely processed
- At present transition from two to three shift operation
- Plant is operated customer specifically
- Accredited measurement laboratory

Layout CARLA Plant
License

- Licence acc. to § 7 of the German Radiation Protection Ordinance for the treatment of radioactive materials
- Licence acc. to Federal Immission Control Law for a melting facility
- Acceptance Limits:
  - 1,000 Bq/g in total
  - add. 10,000 Bq/g for H-3, C-14, Fe-55 and Ni-63
  - < 15 g/100 kg portion of fissionable nuclides
- Origin of material:
  - from the whole nuclear cycle worldwide
Sorting and Cutting

- Sorting area for scrap and mixed waste.
- Cutting of components up to dimensions of 2,5 m x 2,5 m x 12 m.
- Broad range of mechanical and thermal cutting equipment available:
  - 450 t hydraulic shears
  - Mobile hydraulic shears
  - Wire saws / cold cutting machine
  - Plasma burner and gas burner
  - Manual tools
The CARLA was equipped with a new decont room:

- Operation of two suspension track blasting equipments for material up to:
  - Ø 900 mm, length 1,100 mm, unit weight approx. 400 kg

- Equipment with an inside pipe blasting device for:
  - Tubes with inside diameter 20 - 200 mm, unit length < 1 m
Melting

Treatment of

- **Ferrous metals**
  - carbon steel / iron
  - stainless steel
  - galvanized steel
  - coated steel

- **Non-ferrous metals**
  - aluminium
  - copper
  - brass
  - lead

- **Compound material**
  - two-component-material e.g. stainless steel / lead
Melting

- Melting in a 3.2 tons MF-induction furnace
- Homogenisation by electromagnetically induced circulation
- Casting to 1 ton ingots
Granulating

- Producing of granules
- Pooring of the liquid iron through a high pressure water jet
- Generating of granules with diameters between 1 - 8 mm for the manufacturing of heavy concrete containers
Melting

**Max.gross weight of containers:** 24 t

**Preferred materials:**

- generally: surface contaminated metals
- for recycling: carbon steel
- for sale after release: stainless steel, copper, brass, aluminium, lead

**Preferred nuclides in fingerprint:**

- U, Pu, Am, Th, Pa, Sr, Cs, Ag, Eu, C, H (high decontamination effect by melting)
- Fe, Ni (high release limits)
- Co (short half life time)
Sampling & Analysis

- In-process sampling of all resulted materials (here as an example for dust, slag and metals)
- Sample geometry corresponding to the calibration standards
- Analysis in the SNT laboratory, accredited according to DIN EN ISO/IEC 17025 by gamma-spectrometry
- Provide a comprehensively radiological documentation
- Retain samples of all fractions have to be stored
References

Material:

- **Ferrous metals** 27,250 t
  - carbon steel / iron
  - stainless steel
  - galvanized steel
  - coated steel

- **Non-ferrous metals** 725 t
  - aluminium
  - copper and brass
  - lead

- **Compound material** 125 t
  - two-component-material
e.g. stainless steel / lead

Projects with customers from:

- Germany, UK, Netherlands, Italy, Belgium, Austria, Switzerland and France
Buffer and Decay Storage

- Container storage yard for up to 130 pcs. of 20′- containers
- Licensed storage period for delivered material of 3 years.
- Buffer storage for resulting ingots over 5 years.
- Decay storage for 500 t of ingots with max. 8,3 Bq/g of Co-60 over 20 years.
- Storage of process waste for max. 0,5 / 1,0 years.

Storage capacity creates flexibility!
Recycling

Metal Flow Chart

NPP

Material, Activity, Size

Cutting, Sorting, Melting - SNT

Activity, chemical Analysis

Release

Decay Storage

Recycling

< 0.1 Bq/g

< 0.6 Bq/g

< 4 Bq/g

> 4 Bq/g

< 8 Bq/g

Decay Storage

GERITA (max. 200 t/a)

Disposal (max. 100 t/a)

Release

Decay Storage

GERTA (max. 200 t/a)

Disposal (max. 100 t/a)

Conventional Recycling / Disposal

Recycling for Nuclear Technology

Cast iron containers

Granulated Concrete

Other Components

* All values exemplary for Co-60
### Recycling Products

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<tr>
<td>MOSAIK® casks</td>
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<tr>
<td>Cast iron containers</td>
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<td>Granulate concrete casks</td>
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<tr>
<td>Taylor made containers</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>8,096</strong></td>
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Radioactive metals of nearly all kinds from operation and decommissioning of nuclear plants throughout the world are delivered to CARLA for processing.

95% of the metals can be re-used after processing by SNT. Approx. 40% of them can be released and approx. 60% will be re-used for new products in nuclear industry. Up to now, more than 27,000 t could be recycled by CARLA.

By processing in CARLA metals are decontaminated and qualified. Only approx. 5% of radioactive waste is resulting for disposal.

Of a given quantity of 29,000 t of melted metals in CARLA:

- 15,000 t have been re-used within nuclear industry
- 10,500 t have been re-used outside nuclear technology after release
- 1,500 t have been returned to the customers
Advantages

The concept for residues of the CARLA plant

- Avoiding waste, reducing the waste volume and facilitating a later re-use of the residues;

- Offering sufficient capacity, even for future peaks of demand;

- Increasing the flexibility of the operators regarding dismantling strategies like moving forward disassembly works to the post-closure phase or parallelly processing different project sections;

- Optimizing the whole material logistics in your plants;

- Boosting efficiency of your dismantling projects!
Thank you very much!

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