11th European ALARA Network Workshop
"ALARA in Radioactive Waste Management"
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New treatment concept for waste handling of replaced Ringhals Steam Generators.

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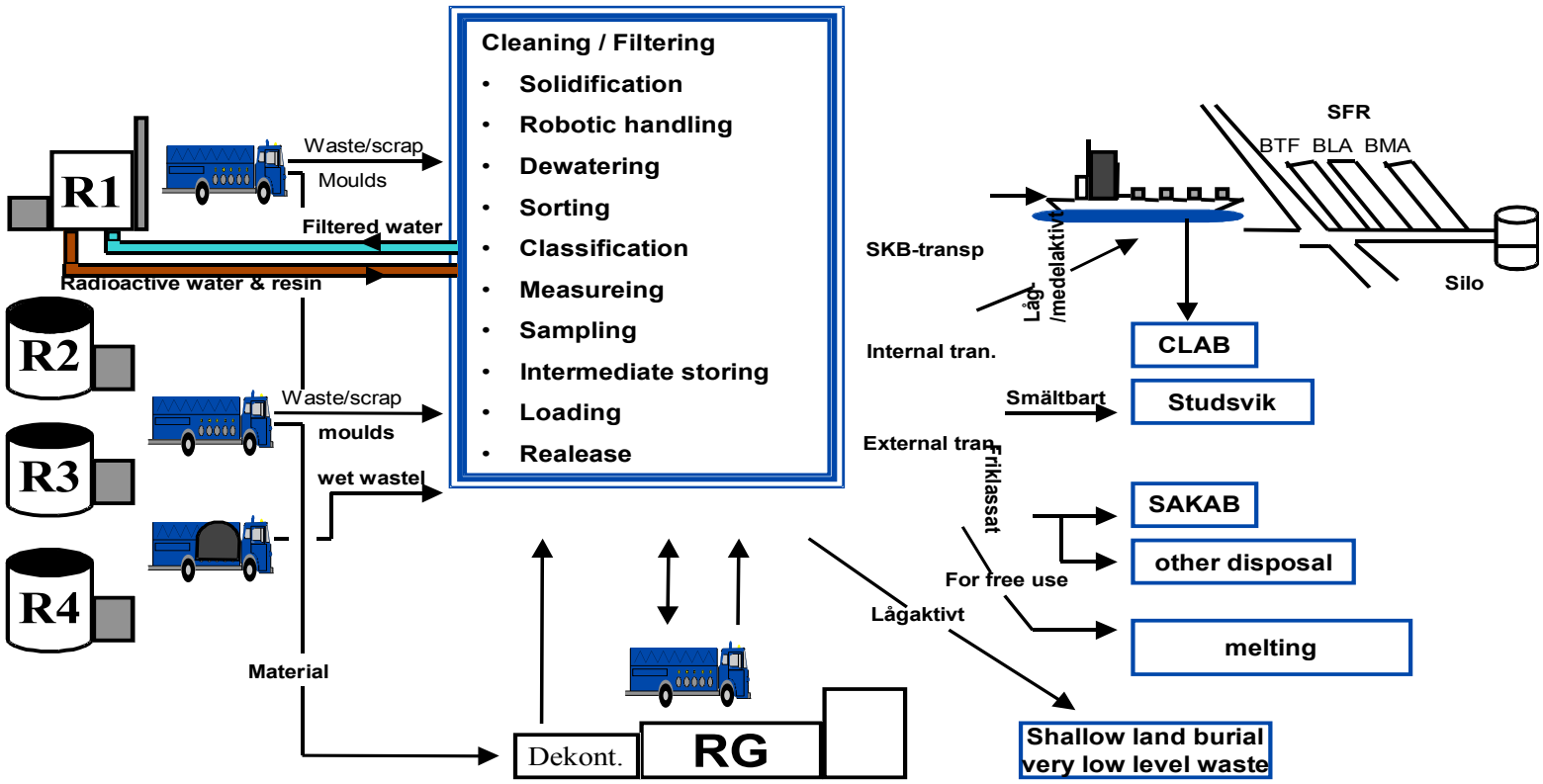
Agenda - scope

- Present waste handling process
- The case – “Steam Generator”
- Treatment concept for volume reduction
- Basic ALARA implementation (optimization towards minimization)
- Conclusion

Ringhals Waste Process



Avfallsutbildn w543 KAP 7 skillnad
BWR/PWR

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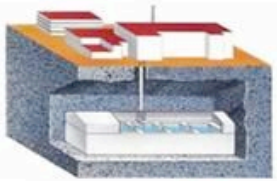
The Swedish system

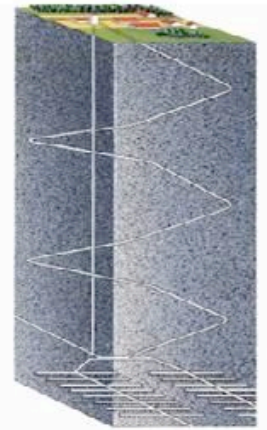
Power plants

Fuel Interim Storage

CLAB



Power plants



Repository

Spent fuel

Operational waste

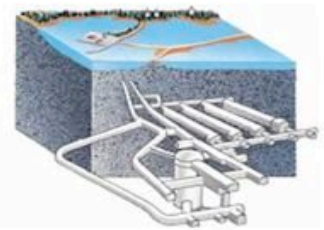
Long lived nuclides

Not built

Studsvik

< 5 %

> 95 %



Repository

Operational waste

Short lived nuclides

In operation

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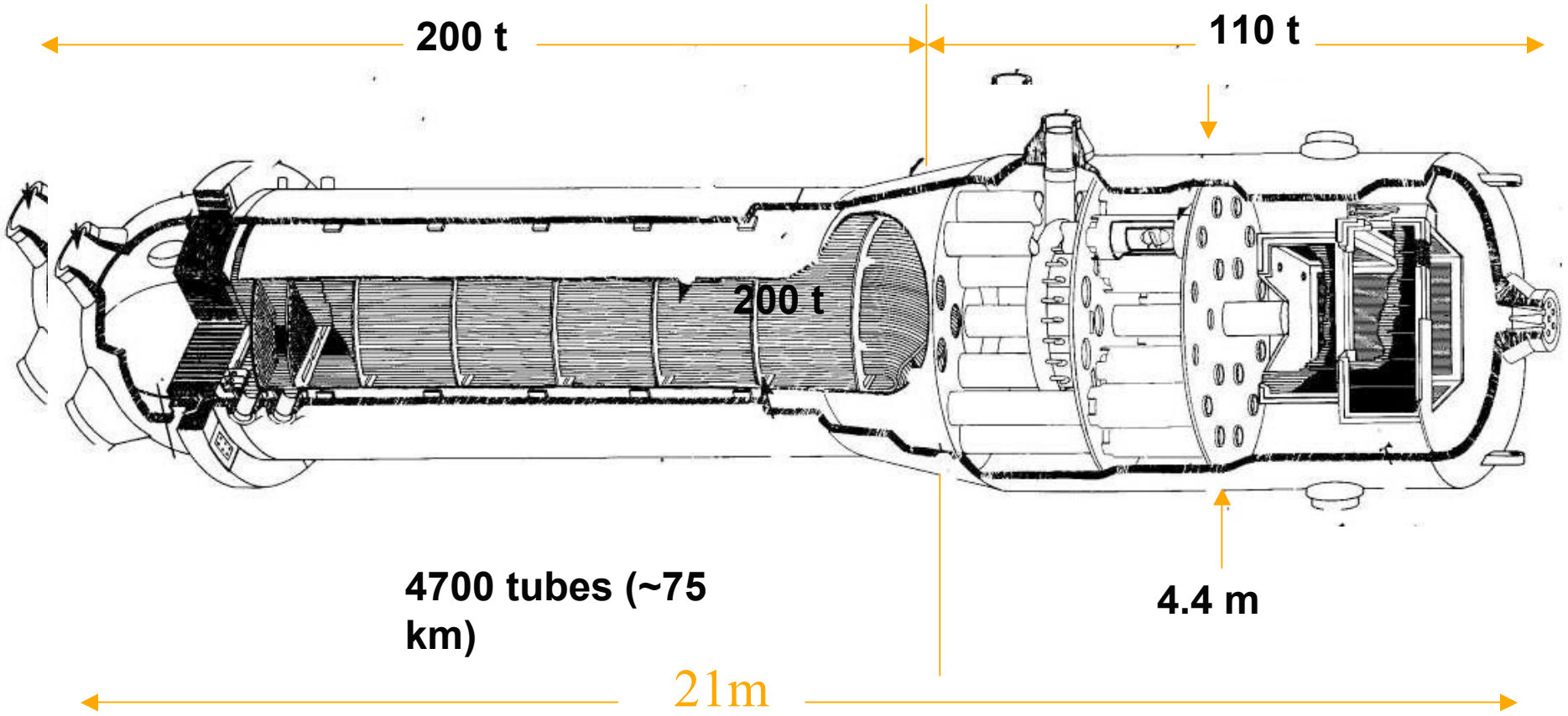
The regulators demands

- An inventory shall be made of the Nuclear waste within the site area of a facility. An identity-marked waste package or other unit that allows for unique identification shall correspond to each registered waste item. The list should be kept up to date.

- Nuclear waste that is handled, processed, stored or disposed of at the facility shall be confined in a safe manner. The necessary preparatory measures shall be taken at the facility for a safe confinement of nuclear waste in connection with transport to and storage or disposal in another another facility. Measures required in accordance with the the first and second paragraph shall be specified in the safety report.

- If nuclear waste arises which, in terms of quantity and type, deviates from that specified in the safety report, the necessary measures for safe confinement of the non –conforming waste shall be documented in a plan. Before the measures may be initiated, a safety review of the plan shall be performed and the regulator should be notified of the plan.

Steam Generator - Technical data



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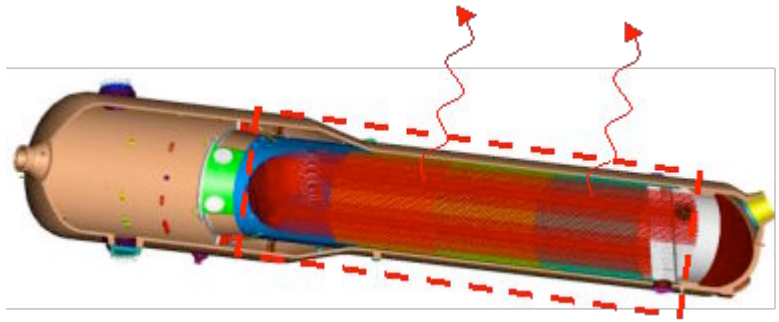
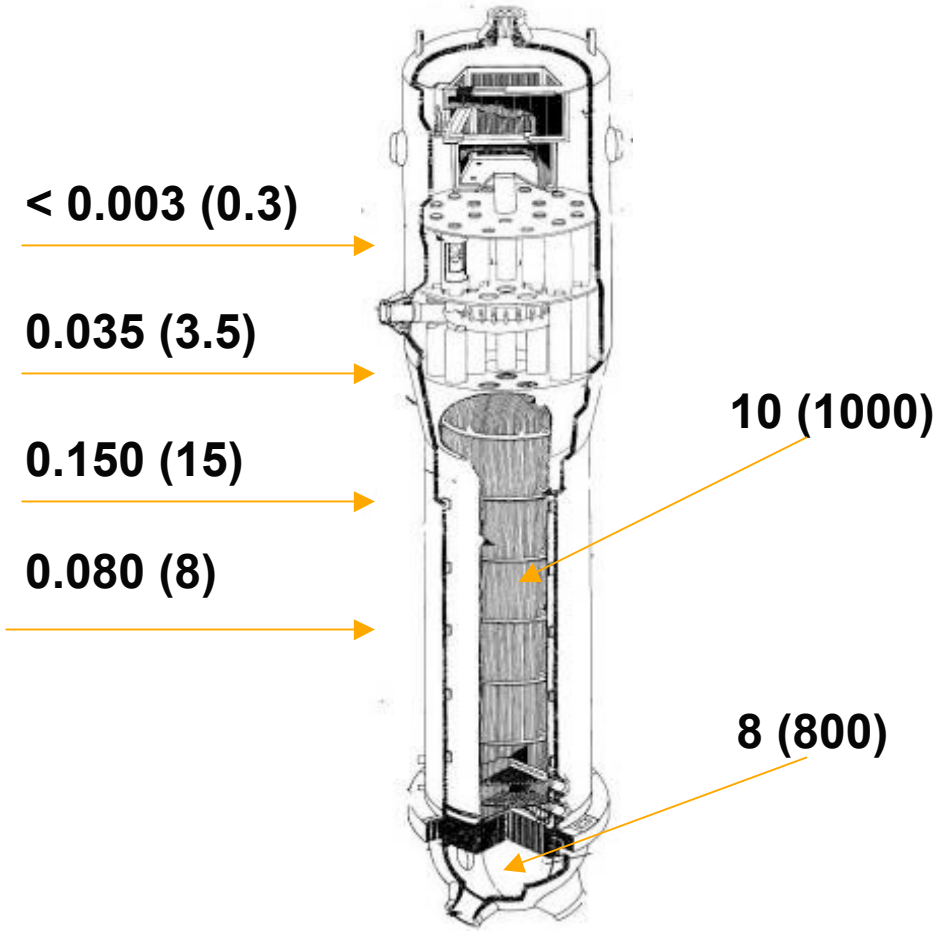
Radiological data

- Radioactivity inventory TBq Ci
  - Total: ~1,3 35
  - Co-60: ~ 0.65 17,5
  - Ni-63: ~ 0,6 17

- Activity distribution
  - 95 % in the tube bundle
  - 5 % in the primary chambers



October 2005, mSv/h (mrem)



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Transportation

Departure Ringhals

Arrival Studsvik

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Waste treatment site

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Metallic waste processing incl. Melting–main targets

Technical

- Achieve maximum volume reduction > 95 %
- Homogenize the metal for robust characterization for nuclide specific free release by weight.
- Provide an opportunity for reuse and unrestricted recycling of material of valuable material.

- **Radiation Protection - ALARA**
  - Accurate mapping of the radioactive sources – for dose control
  - Mapping of materials radioactivity content – for free release
  - Initial dose budget set to 40 mmanSv
  - Optimized radiation shields
  - Rigorous control (online) of activity transport and deposit
  - Minimal dispersion of contamination in the facility
  - No (minimal) internal intakes of radio nuclides
  - No (minimal) radiological impact on other activities
  - Continuous ALARA optimization
  - Why invent? – Use existing knowledge!
  - Use of the Alpha-value (450 €/ mmanSv)
  - Management and workers involvement
  - Use differences in company cultures and join forces

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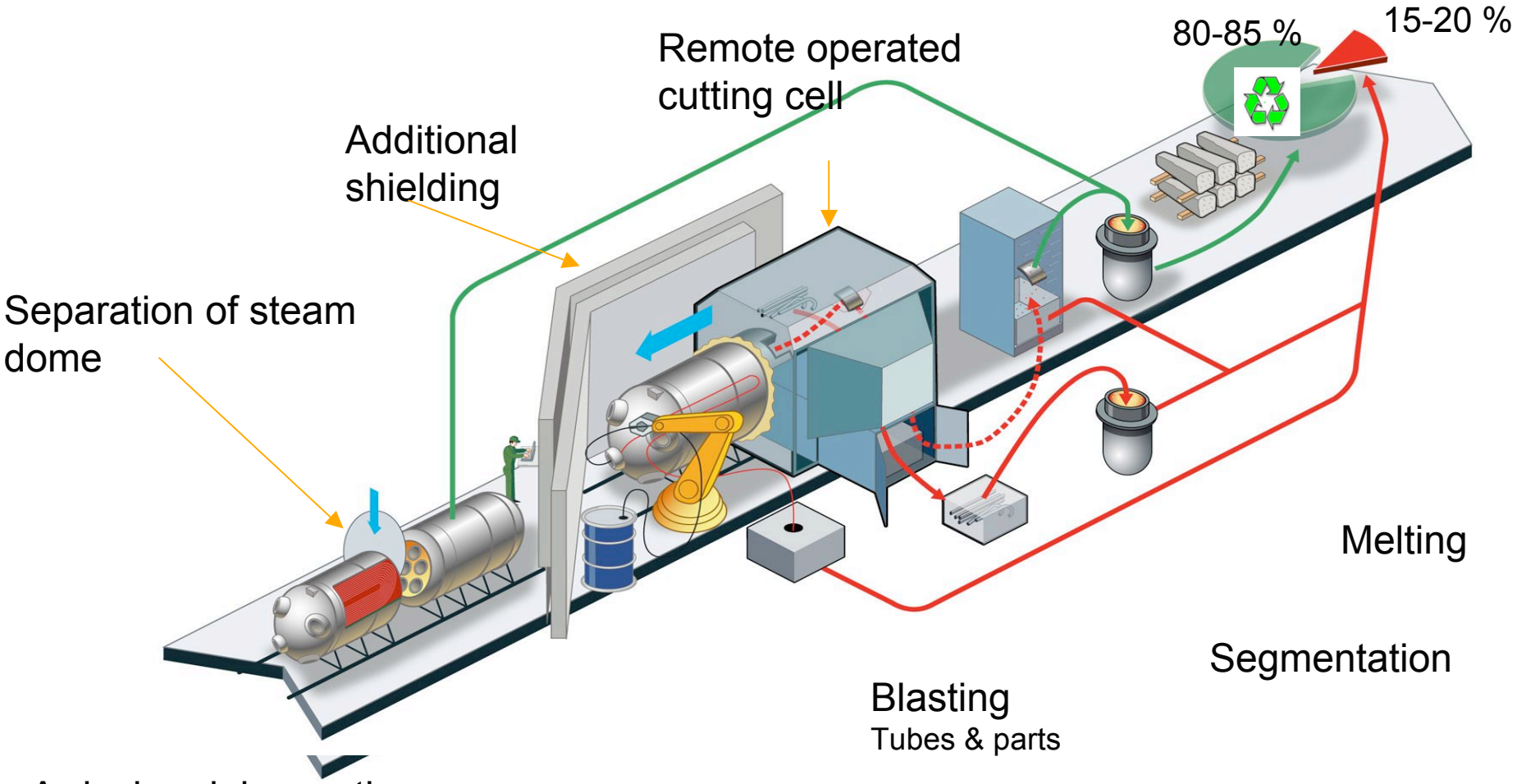
Technical concept



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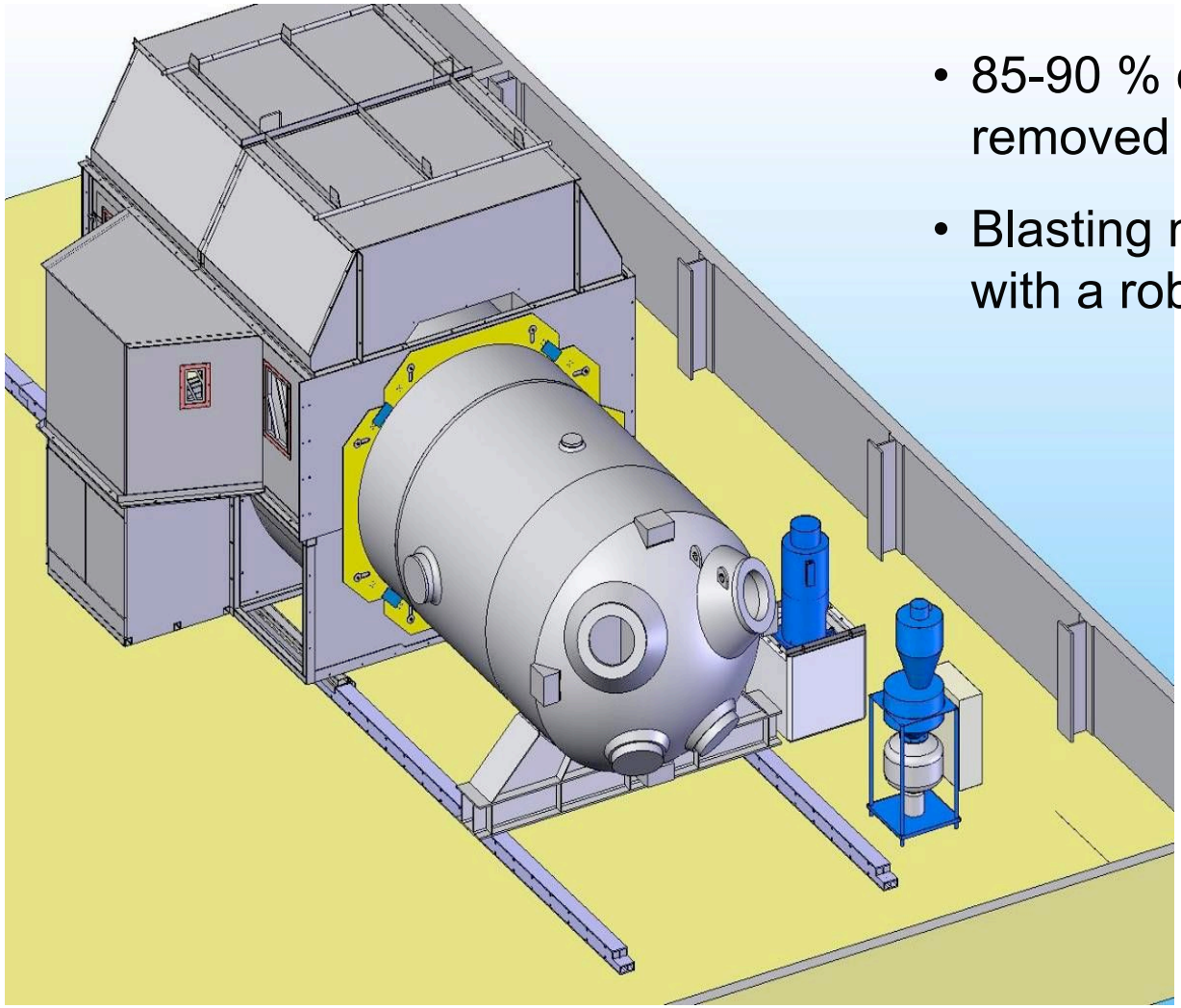
Tube blasting

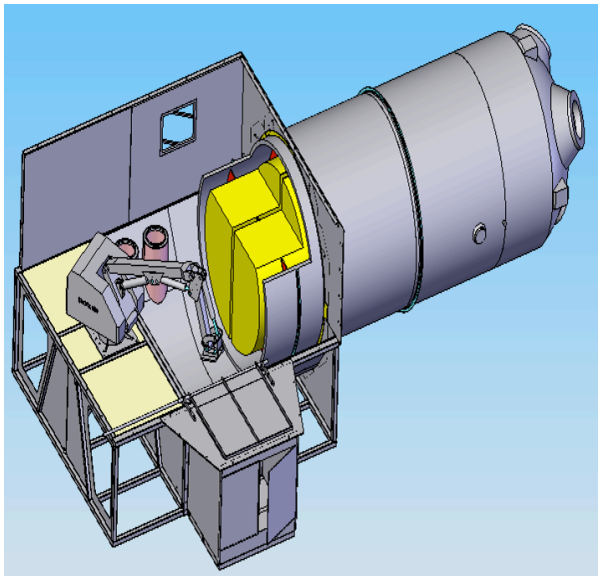


- 85-90 % of the radioactivity removed
- Blasting nozzles positioned with a robot

Segmentation in the cell

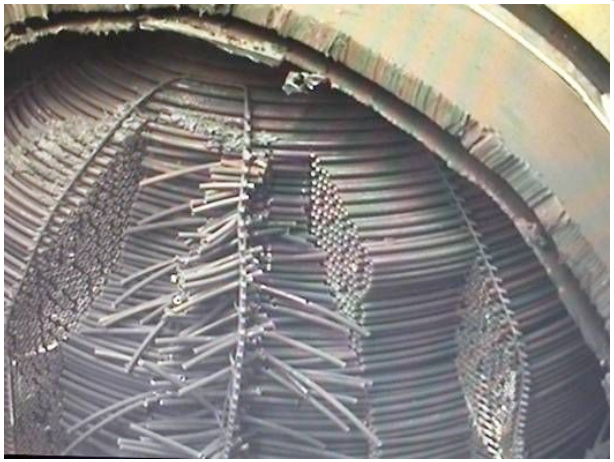
Remote functions

- grinding machine
- torch
- shovel
- magnetic lift



Support systems

- hydraulics
- bag house filter
- hepa filters

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Conclusion

- It is a big challenge to treat a steam generator
- We have
  - worked in accordance to the specified safety reviewed plan for the project (except the exceeded dose goal 30 mmanSv, but we still do believe that this is possible)
- What to do
  - we must put more focus on dose optimization to achieve minimization (shielding, remote control, discover new tools and develop methods etc.)
- We are proud but never satisfied

Future

Ringhals have signed an letter of intent with Studsvik for treatment of 8 steam generators

Thank you for your attention !

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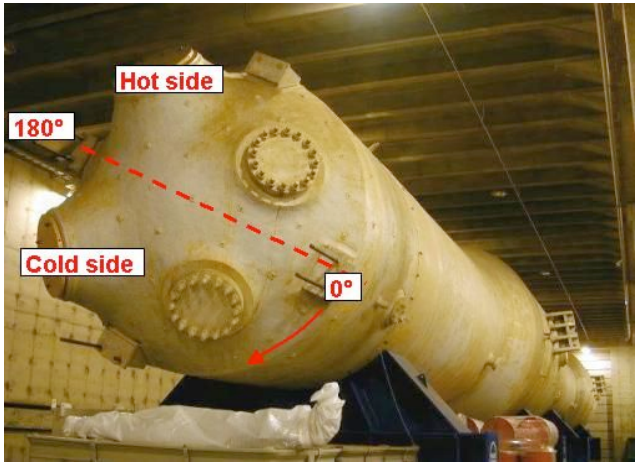
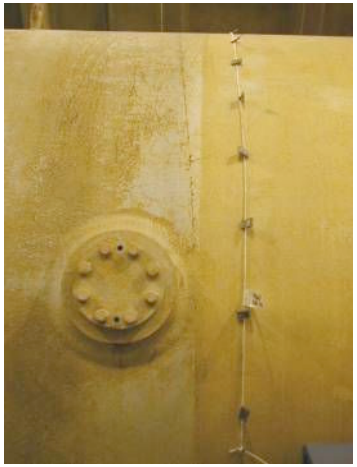
Mapping of the sources

- Dose rate
  - GM- detector
  - TLD (axial & vertical)
- NS
  - Volume activity
  - Surface activity
  - (Induced activity)





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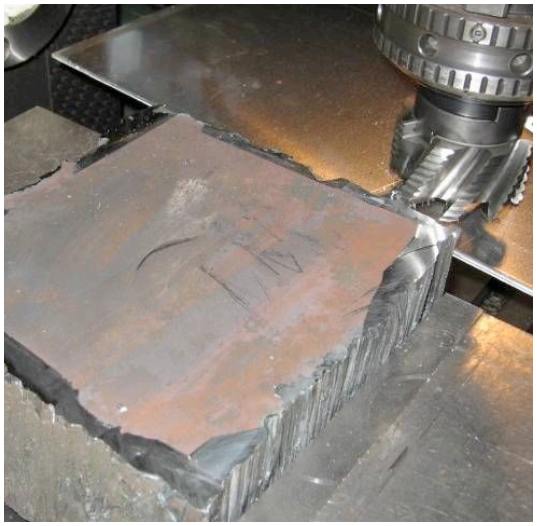
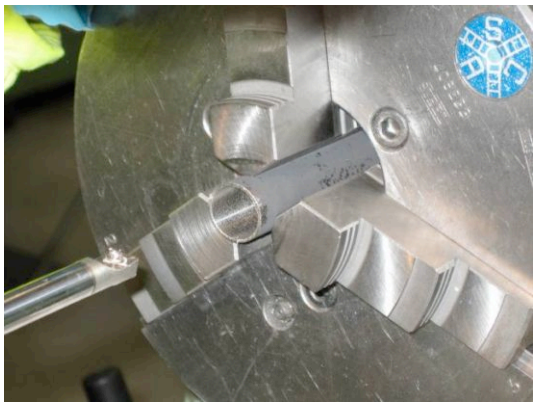
Mapping of materials radioactivity content

- SG jacket
  - NS oxide analyses (Sec. side)
  - NS material analyses
- SG tubes
  - NS oxide analyses (primary side)
  - NS material analyses
- Analyse of difficultly measurable nuclides, initial water chemistry data – verified to be much lower when measured on removed activity with blast-decon





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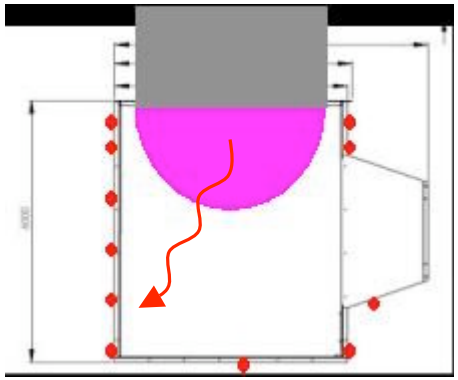
How to set this Dose Goal?

- Complicated component to dismantle
- New designed equipment and industrial standard equip. in radiation environment
- What is an acceptable dose for SG waste process? A reflexion, this component has been a part of producing 115 TWh!
- Attempt to calculated goal from average dose coefficient for produced standard waste packages in Ringhals 1997-2007 - 1,1E-11 mSv/ Bq (7 mmanSv)
- Initial dose budget was set, with the “dream scenario” in mind, but more realistic according to time schedule and calculated (determined) radiation levels, to 40 mmanSv

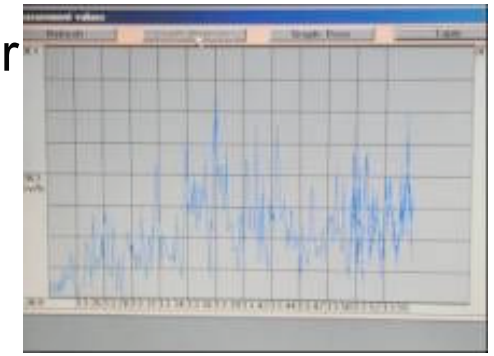
Optimized radiation shields

- Take advantage of shields in-built
- Use mapping data and source data to calculate for each realistic situation
- Calculate for sufficient shields
  - We used MicroShield and Mercurad
- Options to increase effectiveness of a shield when sources can vary and fluctuate
- A shield should serve it's purpose, it don't have to be luxurious



Rigorous control (online) of activity transport and deposit

- To have control over radioactivity movements is a necessity
  - Online measurement to determine D_f
  - Extremely important during decontamination for verify deposition
  - Important during machining
- Manual routine measurements and having a nose for deviations is crucial

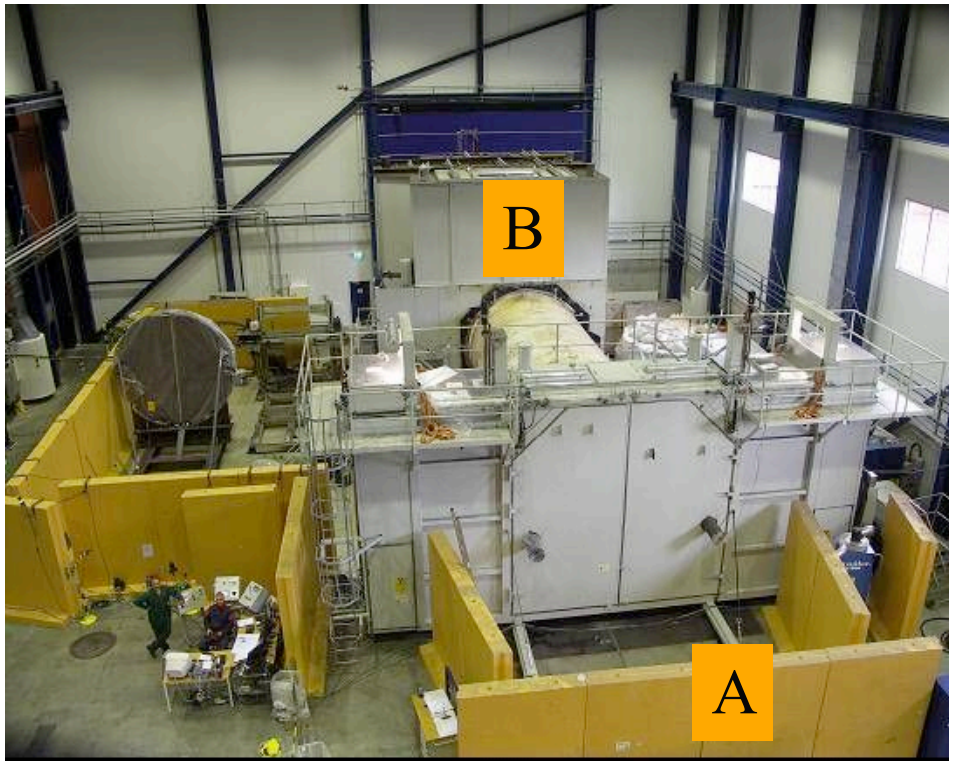


Minimal dispersion of contamination in the plant

- Starting point is to minimize influence on personnel, plant and surroundings
  - Find out what´s the potential risk situations
  - Establish underpressure in cells, tents
  - Filtrate auxiliary ventilation and keep your eye on activity build up
  - Use local exhaust ventilation
  - Establish online measurement for airborne activity
  - Fence in areas with potential risks for spreading of activity and use encapsulation.
  - Look for indications!

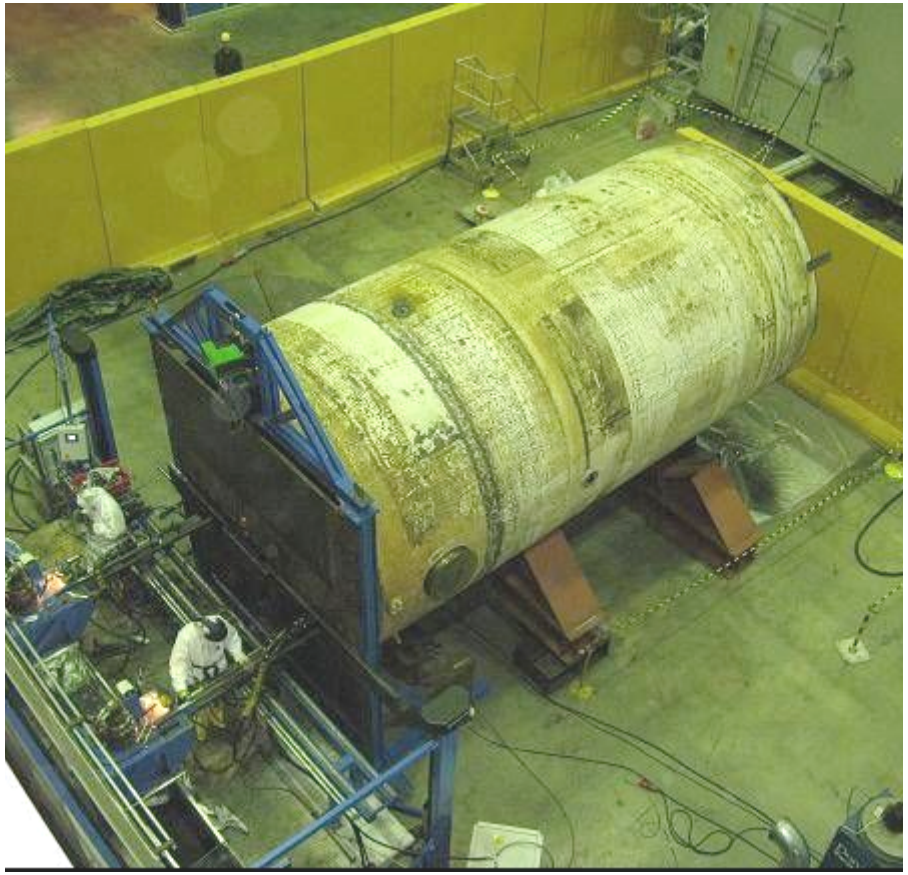
No (minimal) radiological impact on other activities

- Use mobile shields
- Design shields to protect surroundings
- Designate area solely for SG treatment
- Avoid exposure from passive sources



Continuous ALARA optimization

- This is not an isolated case, ALARA can be improved as the project proceeds.
- It´s easy to have high expectation but harder to have a sense of what´s good enough, dare to try and to achieve the experience for optimisation!
- Tube pulling is a new concept for the second SG and stands for a large share of the total dose, this will have focus for ALARA-optimisation.



Why invent? – Use existing knowledge!

- ALARA is very often to gain from experience
- Just adapt and try to improve for SG waste processing