

System decontamination of two BWR units performed during 2011 and 2012

ISOE 2012

Prague

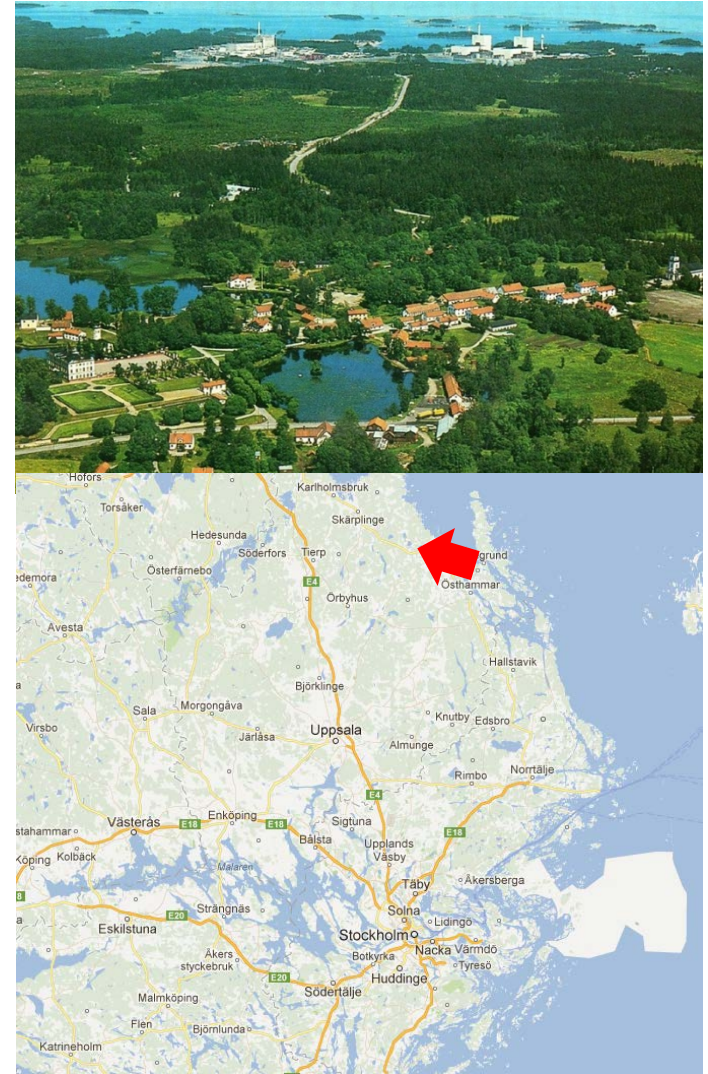
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Forsmark Kraftgrupp AB

- 160 km north of Stockholm, capital of Sweden
- Three BWR units
- Constructed in 1971-1985
- Site of final disposal
- First to detect the Chernobyl accident



F2

1981
Asea-Atom
1000 MW Output



F3

1985
Asea-Atom
1200 MW Output

- Decontaminated 2012

- Shut down cooling system, SCS
- Reactor water clean up system, RWCU

- Decontaminated 2011

- Shut down cooling system
- Reactor water clean up system

- Decontaminated 2001

- Shut down cooling system

Decontamination Technique

- HP CORD/UV - Oxalic and Permanganic acid
- AREVA
- Small amount of secondary waste (only water and carbon dioxide)
- AMDA (Automated Mobile Decontamination Appliance) supplied by OKG



Reasons for Decontamination

F2

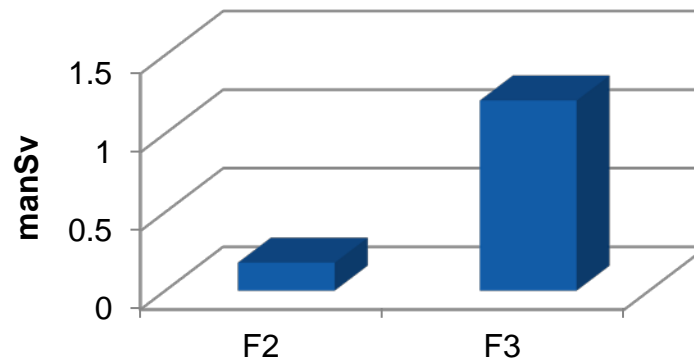
- Inspection and maintenance of heat exchangers in the reactor water clean up system.

Dose savings

F3

- Work to secure the piping of shut down cooling system.
- Increase of temperature of the control rod drive water.

Collective dose savings



Decontamination Factors

F2

3 cycles

130 hours

32 measuring points

F3

2 cycles

96 hours

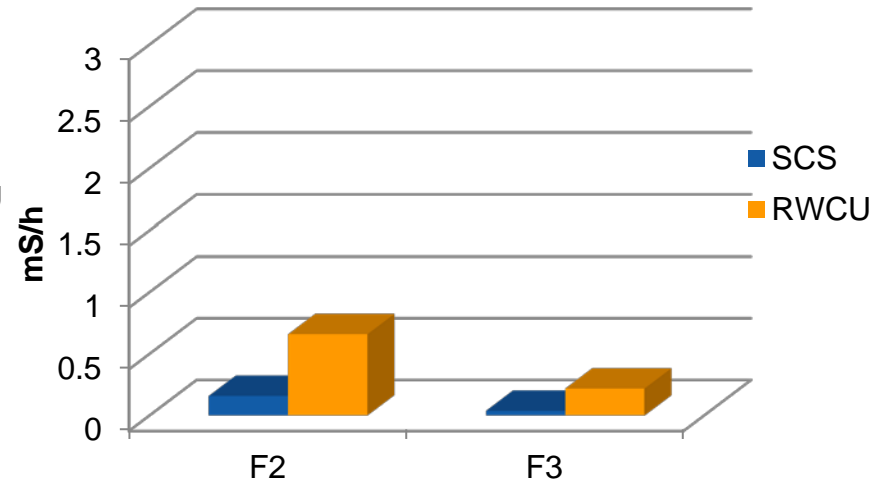
22 measuring points

**Higher initial dose rates at F3
but lower after
decontamination**

**Average dose rate before
decontamination**

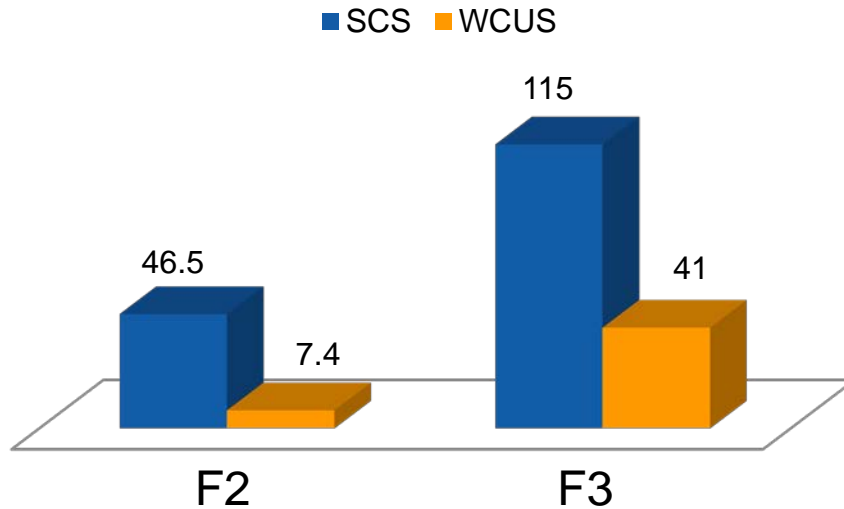


**Average activity after
decontamination**



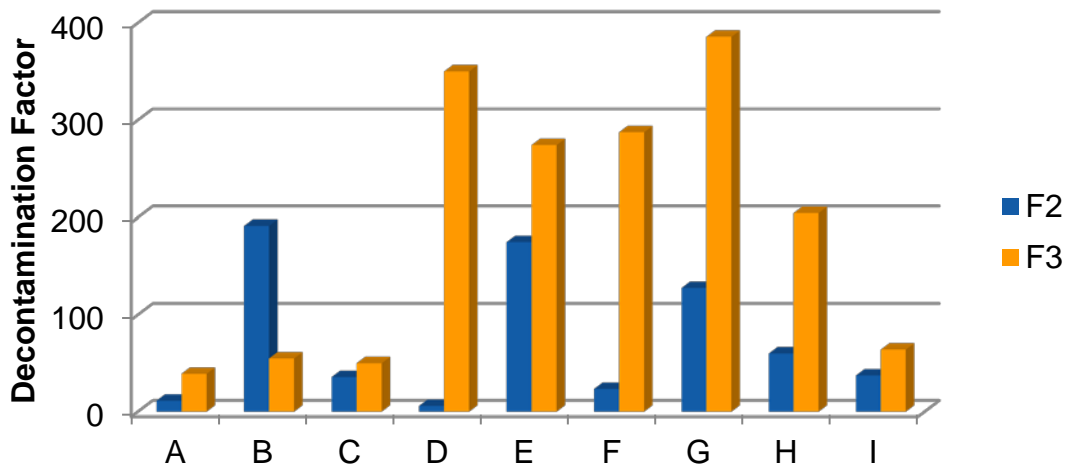
Results

Decontamination factors for F2 and F3



Decontamination factor higher at F3 for almost all comparable locations

Decontamination factors at comparable locations



Reasons for the Difference in Decontamination Factors

- Different design

- F2 5 year older than F3.
- Piping thickness, flow velocity, material selection

- History

- F3 decontaminated 2001. F2 never been decontaminated. Older oxide.

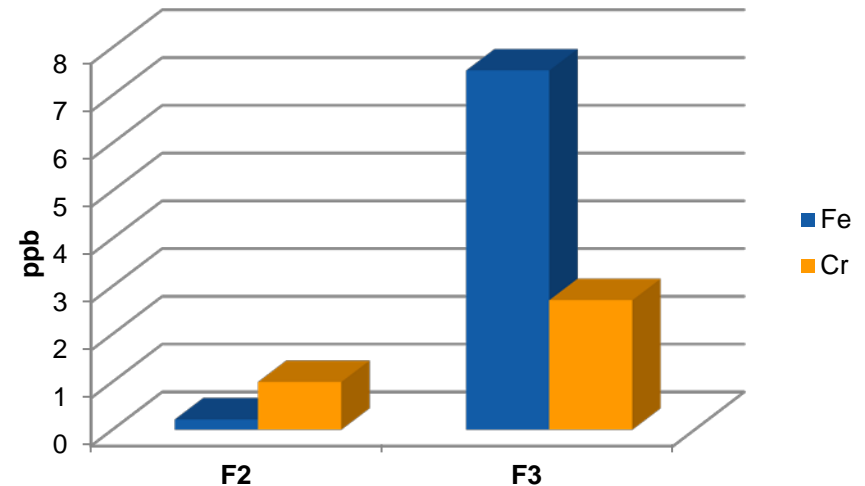
- Differences in water chemistry

- Higher Fe and Cr content in F3 system water.
- Due to bypass of condensate cleaning system.
- Results in a thicker, more readily dissolved oxide?

- Differences in dose rate measurements

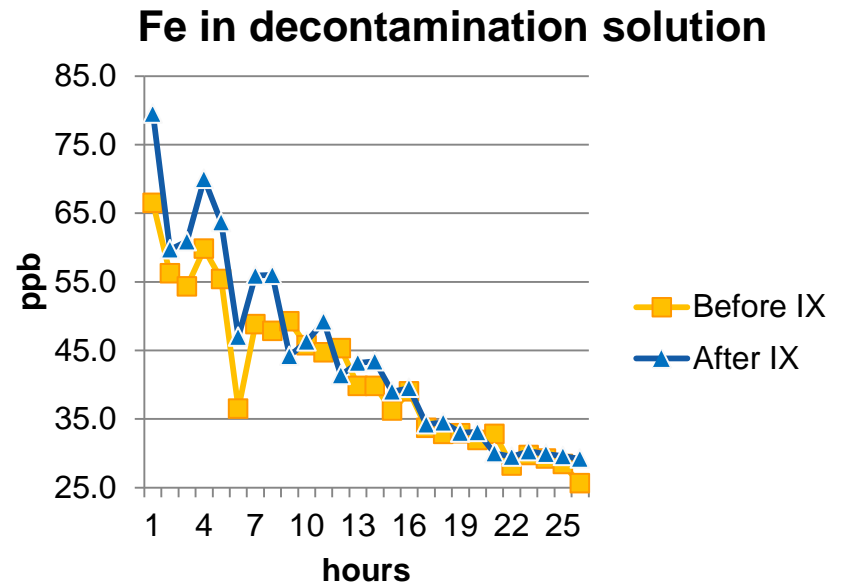
- Effect only on low dose rate areas

Fe and Cr in reactor water



Problems and Lessons Learned

- Sampling lines
 - F3 – Titanium, F2 – Stainless steel
 - Different operating conditions for sample line before and after IX
- Drainage of vents
 - High dose rates after contamination.
 - Some vents were drained in the hope to remove loose contamination.
 - Did not work at all.
- Removal of sensitive equipment
 - Pumping wheels
- Oxygen injection
 - Lower recontamination.



Future Work

- Recontamination measurements
 - During F3 outage 2012 the recontamination of the systems will be measured.
 - For F2, this will be performed during the 2013 outage.
- F1 Decontamination
 - Forsmark unit 1 will probably be decontaminated soon.
 - Evaluation of the F2 decontamination will tell us when and how.
- Measuring actinides
 - All chemistry samples have been stored.
 - Will be used to determine the amount of actinides in system and decontamination waste.



Thank you for listening