

# System decontamination of two BWR units performed during 2011 and 2012

ISOE 2012

Prague

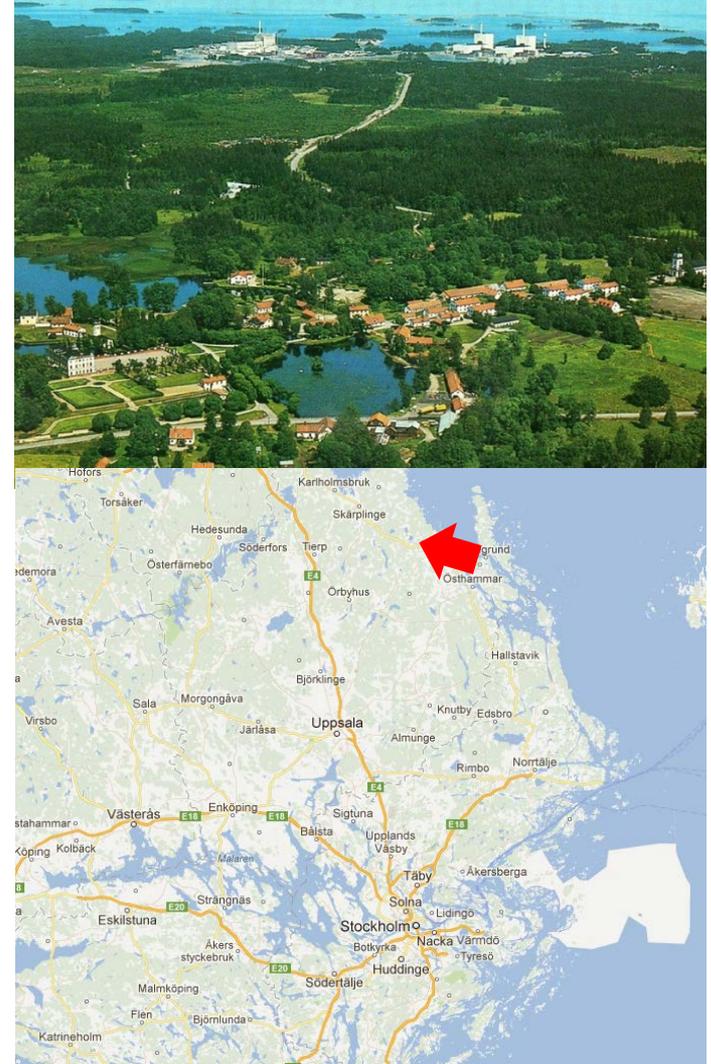
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# Forsmark Kraftgrupp AB

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

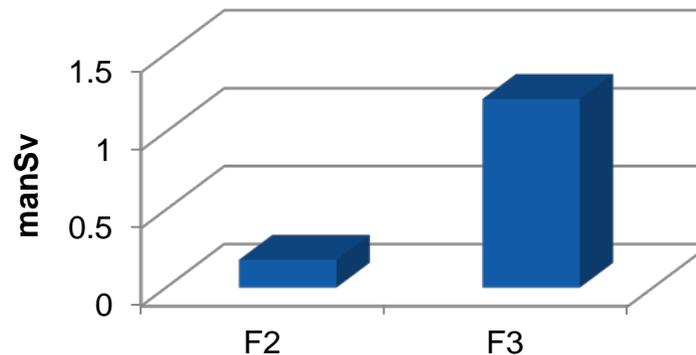
- Inspection and maintenance of heat exchangers in the reactor water clean up system.

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

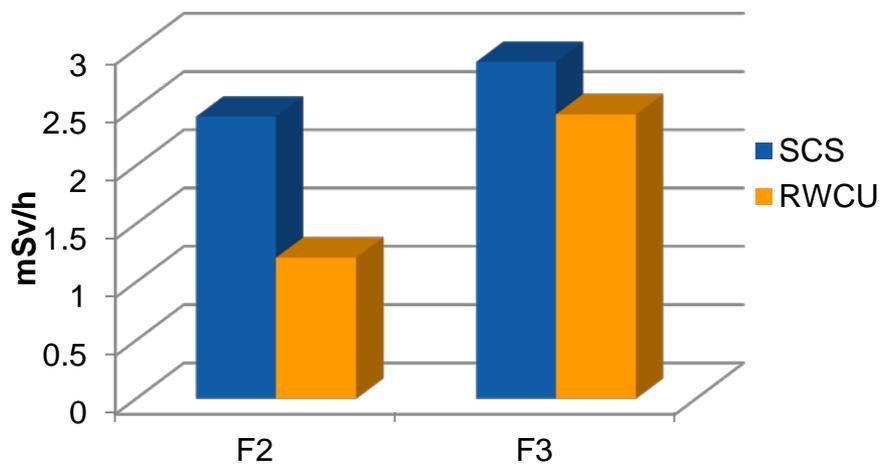
3 cycles  
130 hours  
32 measuring points

## F3

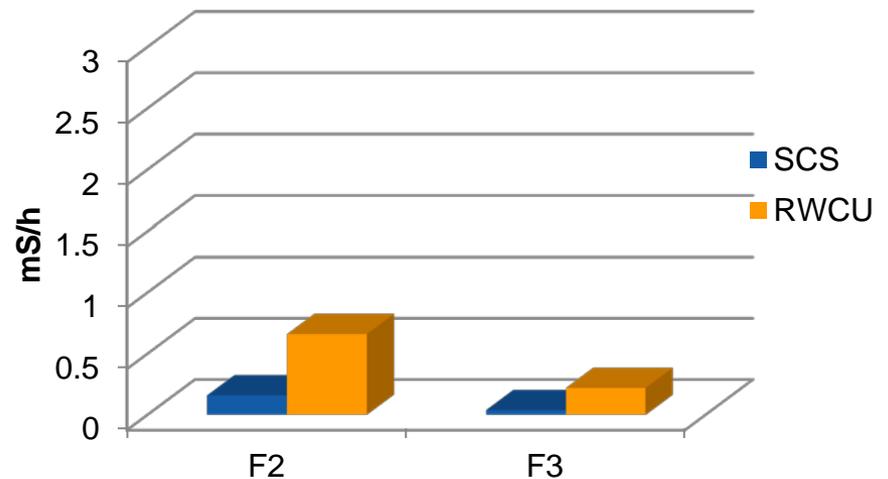
2 cycles  
96 hours  
22 measuring points

Higher initial dose rates at F3  
but lower after  
decontamination

Average dose rate before  
decontamination

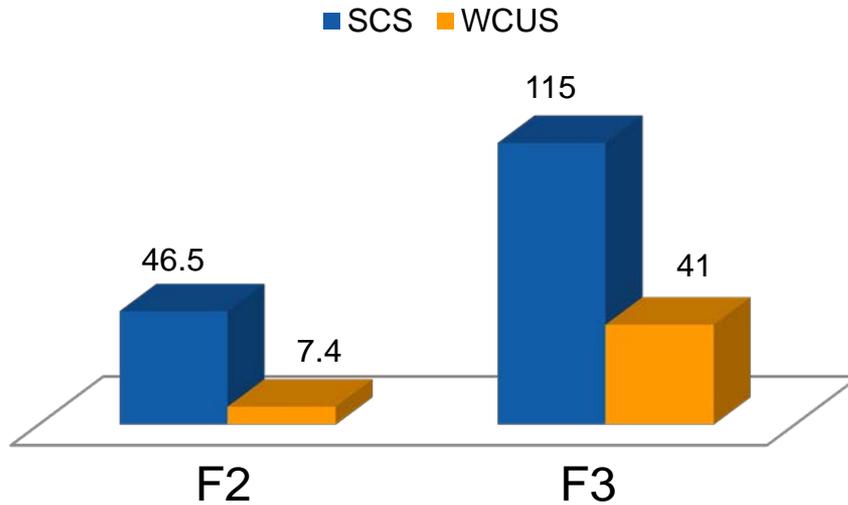


Average activity after  
decontamination



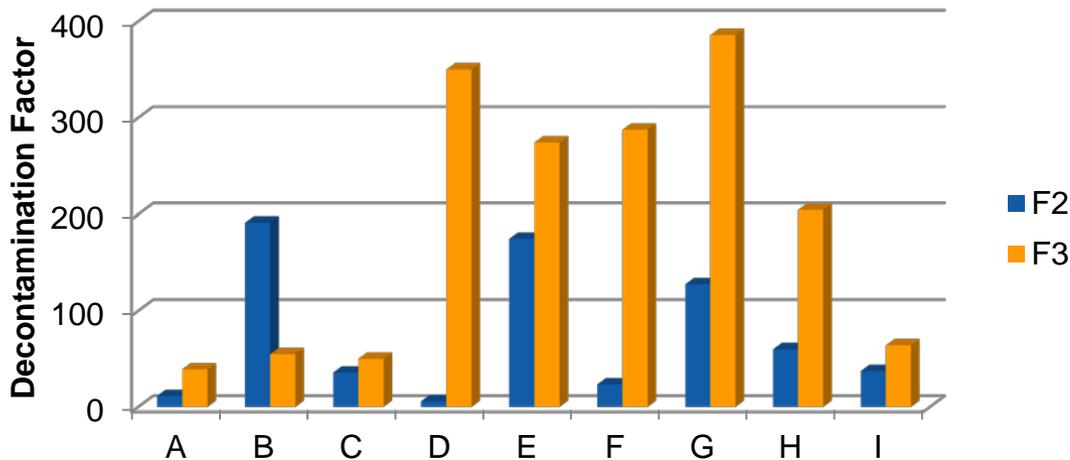
# Results

## Decontamination factors for F2 and F3



Decontamination factor higher at F3 for almost all comparable locations

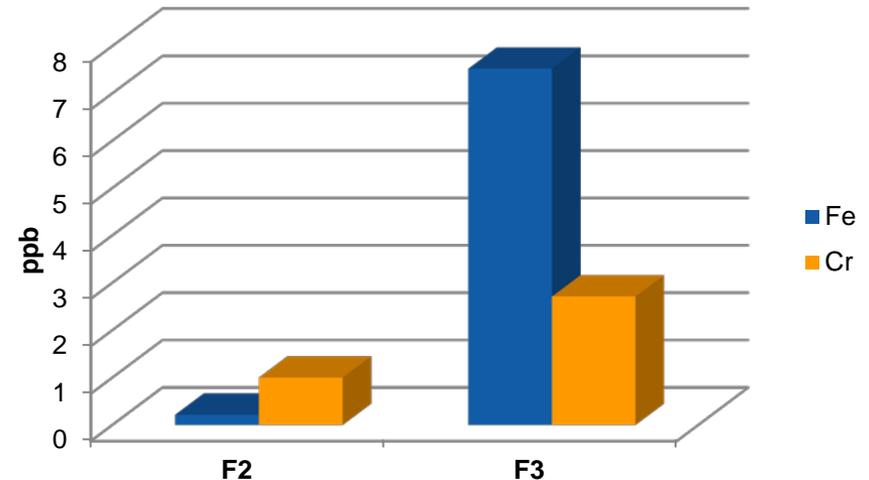
## Decontamination factors at comparable locations



# Reasons for the Difference in Decontamination Factors

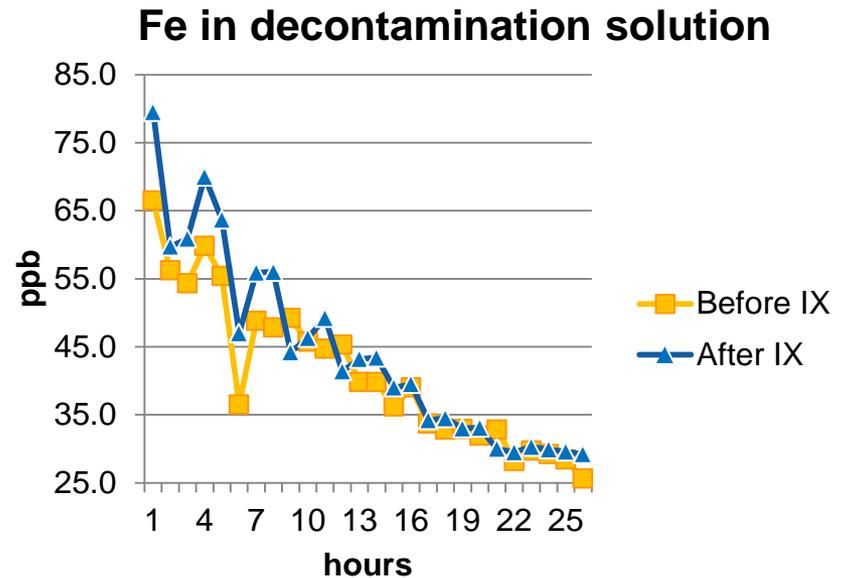
- Different design
  - F2 5 year older than F3.
  - Piping thickness, flow velocity, material selection
- History
  - F3 decontaminated 2001. F2 never been decontaminated. Older oxide.
- Differences in water chemistry
  - Higher Fe and Cr content in F3 system water.
  - Due to bypass of condensate cleaning 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