BWR System Surface Contamination: Three Decades of Nuclide Specific Measurements

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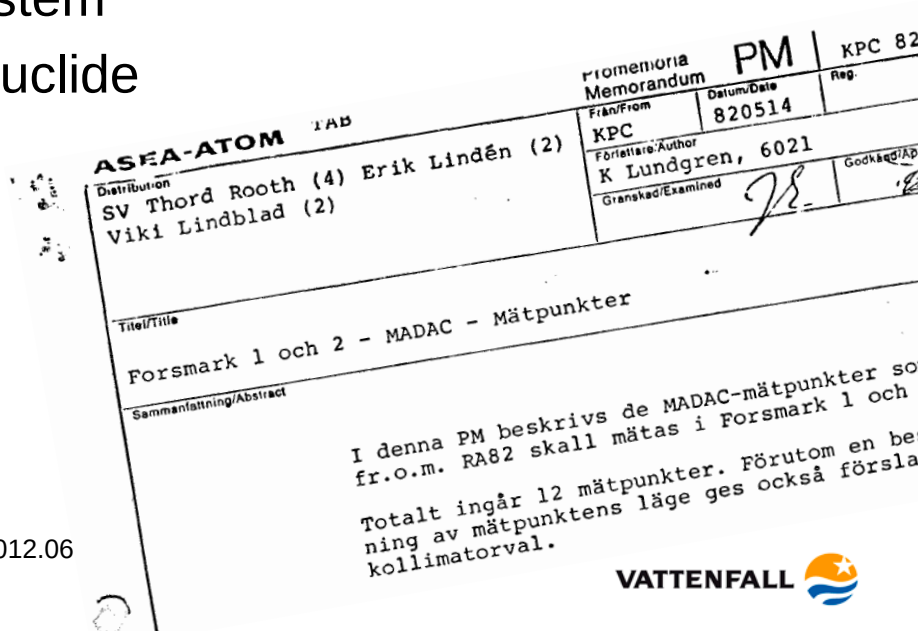
Background

- **Internal nuclide specific surface activity (Bq/m^2) is measured in pipes and heat exchangers.**
- A measurement program (MADAC) was included in the delivery of ASEA Atom BWRs.
- 12–15 measurement points are defined per unit and cover mainly:
  - Steam lines
  - Residual heat removal and reactor water clean-up systems
  - Fuel pool cooling and clean-up system
- A mobile HPGe detector is used for nuclide specific results, with a custom efficiency calibration for each point.



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Applications

- **For each measurement point, the internal system contamination is obtained in Bq/m^2.**
- The most commonly detected nuclides are the activated corrosion products Co-60, Co-58, Mn-54, Fe-59, Sb-124, Ag-110m.
- The results are put into long term trends which cover the entire history of Forsmark 1, 2 and 3. Ideally, the trends can be explained.
- The applications of the results include:
  - basis to confirm which nuclides that contribute to dose rates,
  - follow-up on the effects of changes in chemistry or other changes in the station,
  - basis for nuclide vectors to be used for waste handling.

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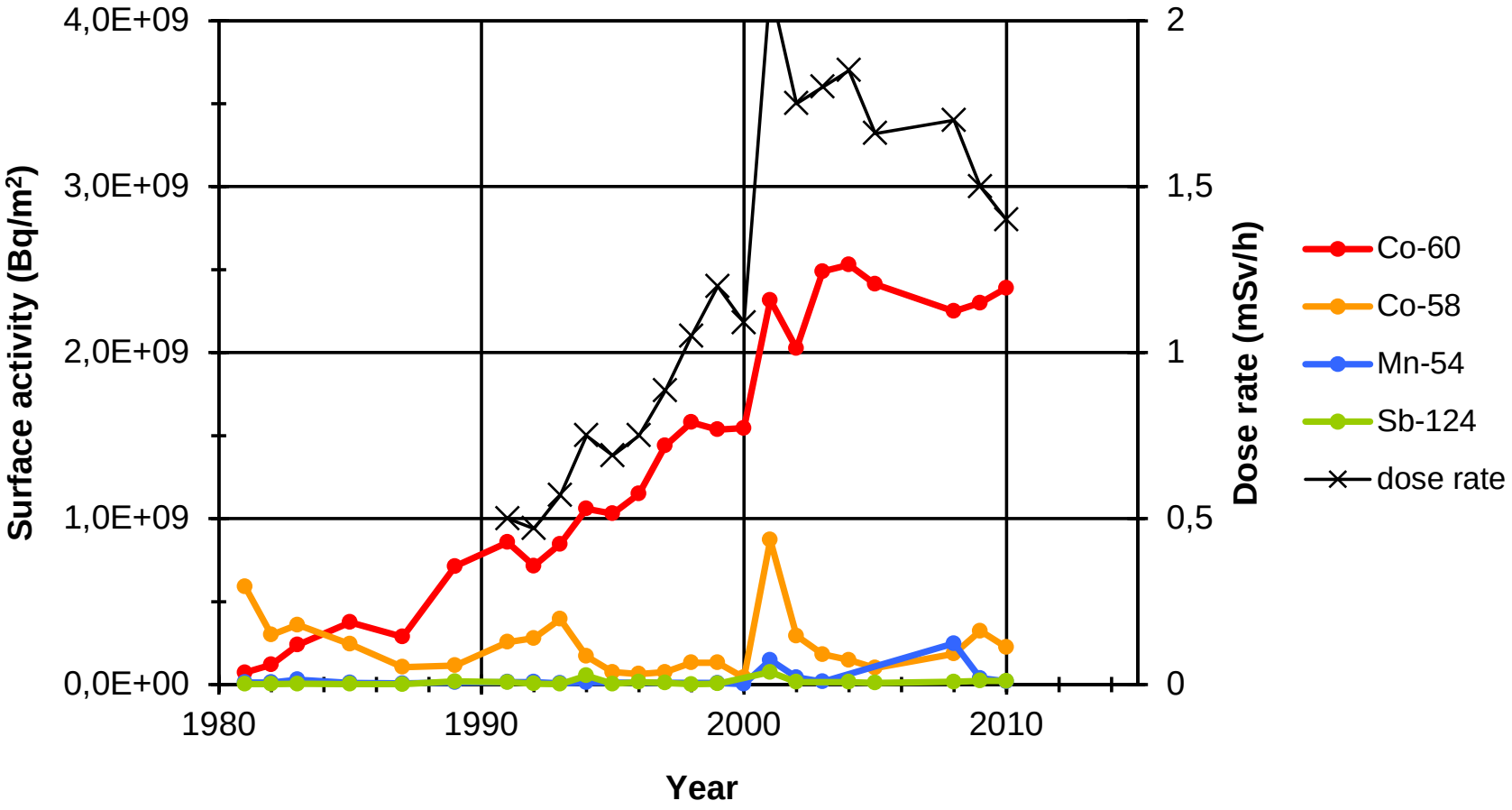
Forsmark 1 shutdown cooling system (SDC) trends



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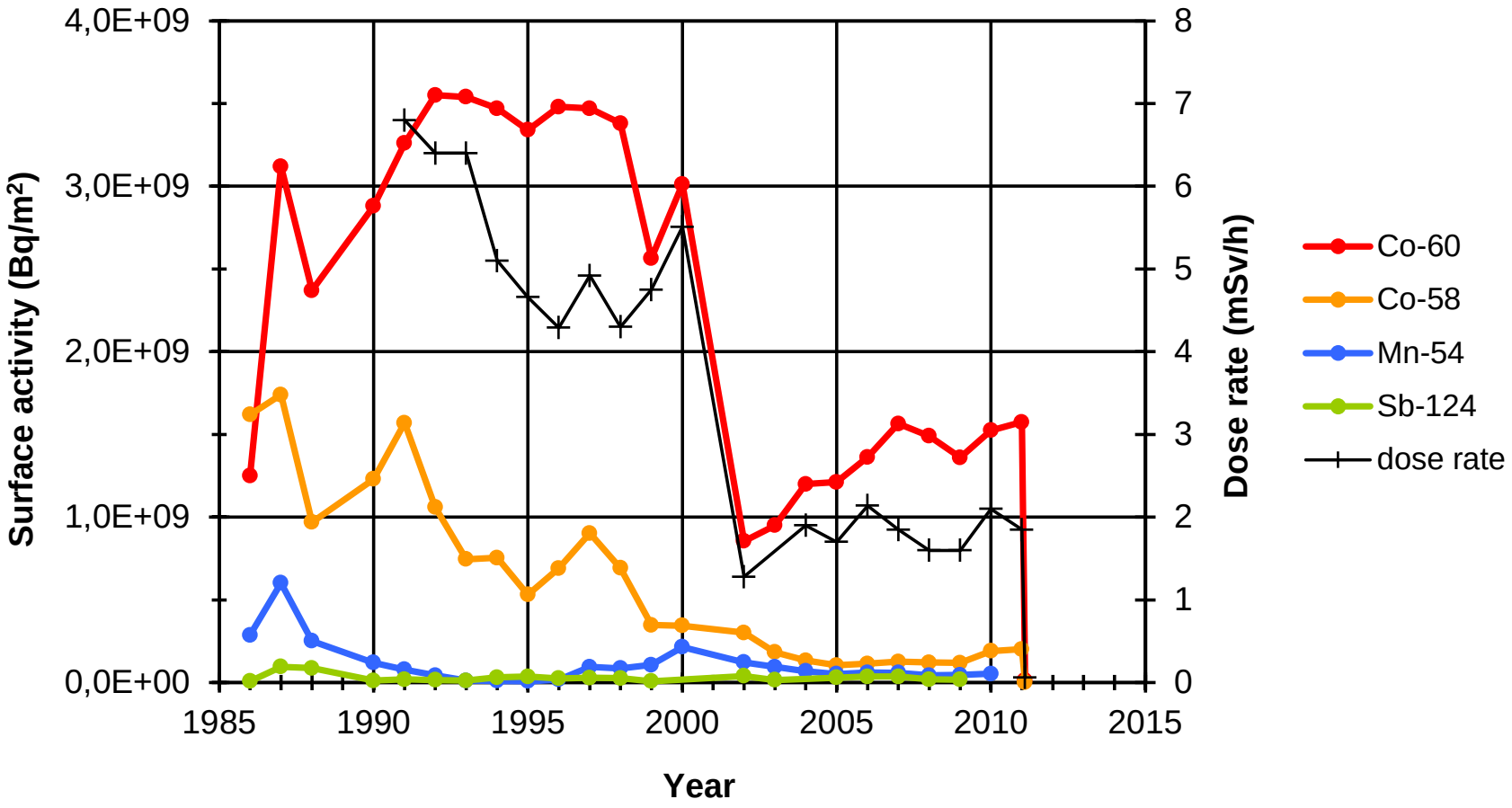
Forsmark 3 shutdown cooling system (SDC) trends



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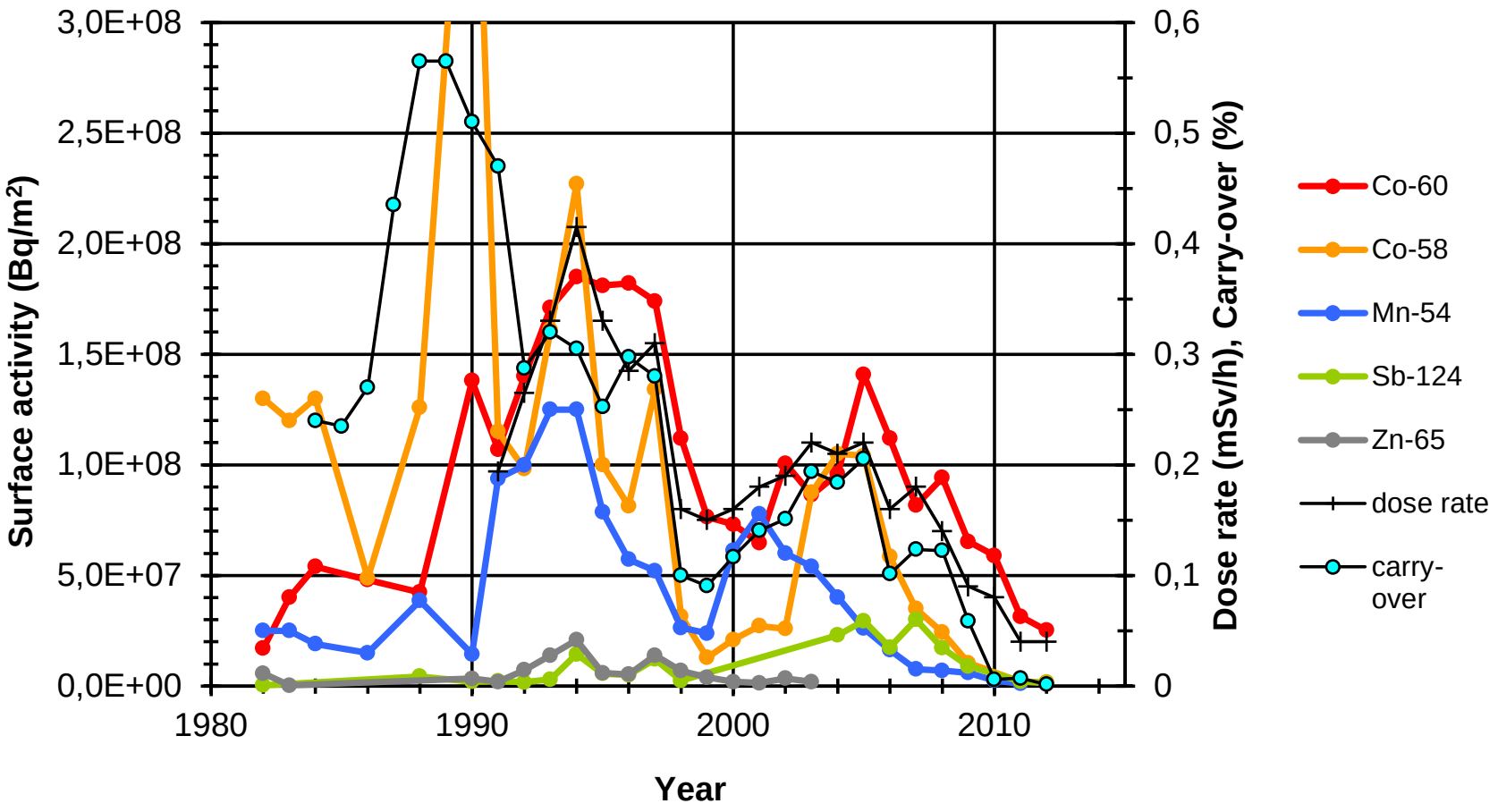
Forsmark 2 steam line trends



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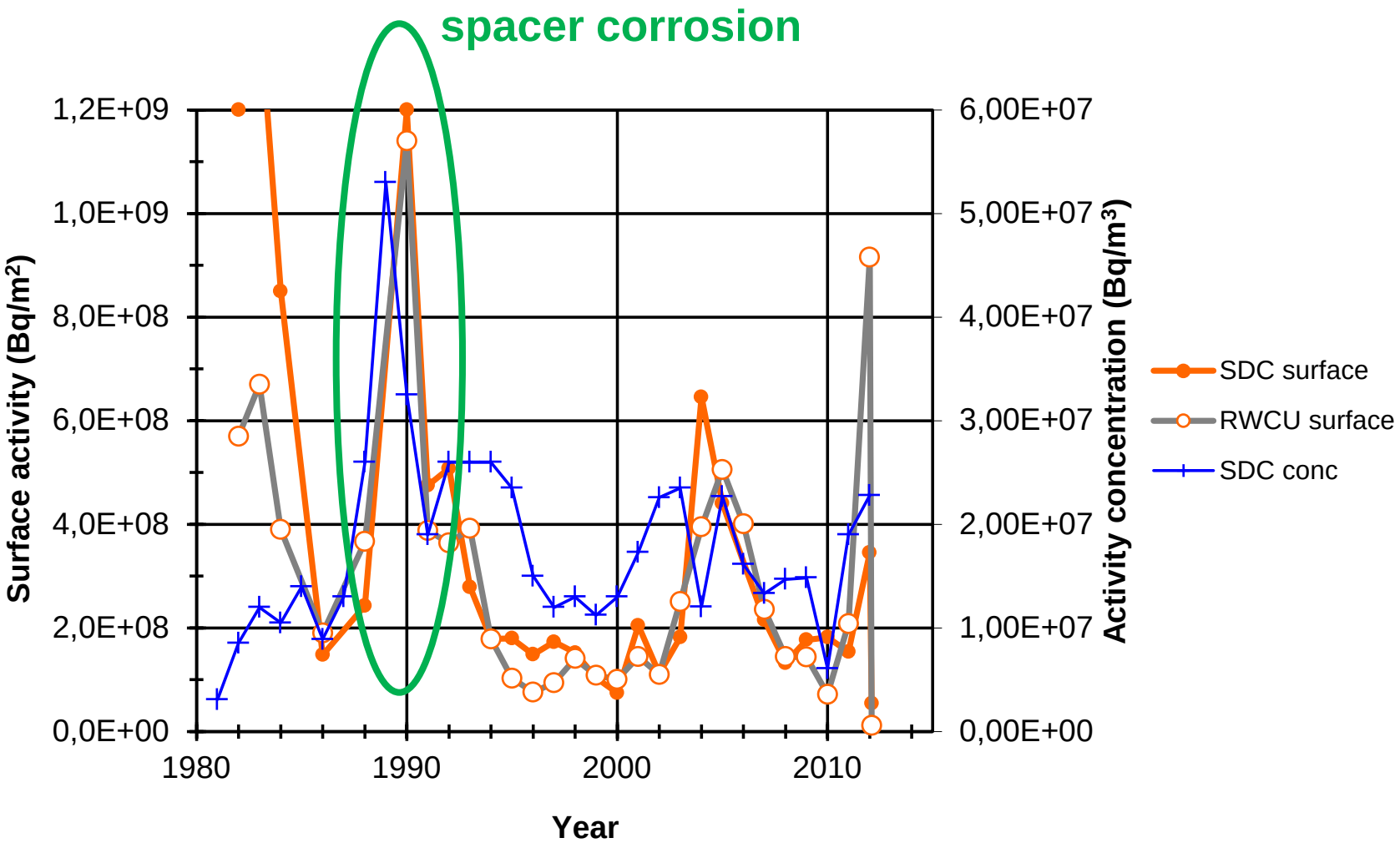
Forsmark 2 SDC and RWCU trends for Co-58



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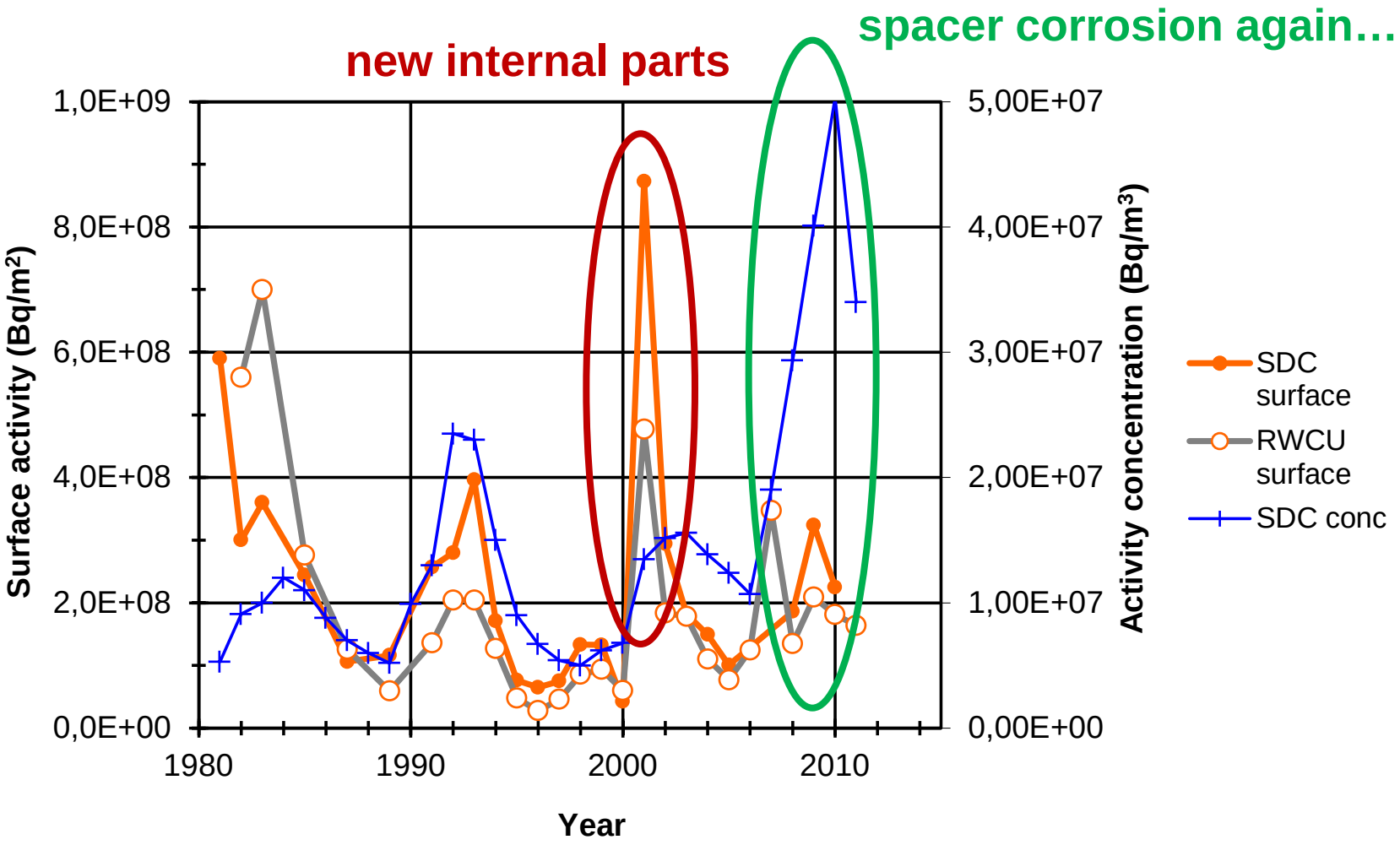
Forsmark 1 SDC and RWCU trends for Co-58



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Surface acticity measurements – method

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Surface acticity measurements – method

- Gamma spectra are analyzed in ORTEC's Gammavision:
  - background spectrum is subtracted from main spectrum,
  - efficiency is calculated from a measurement on a planar reference source (Eu-152) and a model that takes into account the geometry and shielding for each measurement point,
  - the results are corrected, evaluated and put into the trend curves.

Mätpunkt 12, 31-421

Nuklid	A (Bq/m^2)	1 s (%)
Mn-54	2,09E+07	2,2
Co-58	1,63E+07	2,6
Co-60	4,41E+07	0,6
Zn-65	7,58E+05	30,6
Sb-124	3,72E+06	3,1
Sb-125	4,46E+06	15,7

Mätpunkt 13, 31-421

Nuklid	A (Bq/m^2)	1 s (%)
Mn-54	2,07E+07	1,3
Co-58	1,22E+07	3,0
Co-60	2,45E+07	0,9
Sb-124	4,06E+06	4,6
Sb-125	5,72E+06	21,4

Mätpunkt 1, 30-321 vertikalt rör

Nuklid	A (Bq/m^2)	1 s (%)
Mn-54	4,58E+07	7,5
Fe-59	1,30E+07	22,7
Co-58	1,19E+08	4,3
Co-60	1,36E+09	0,4
Sb-124	1,86E+07	4,6

Mätpunkt 2, 30-321 verti

Nuklid	A (Bq/m^2)
Mn-54	5,65E+07
Fe-59	2,30E+07
Co-58	1,61E+08
Co-60	1,39E+09
Zn-65	3,25E+07
Sb-124	2,62E+07

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Thank you for your attention!

Questions?

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