

Koeberg Nuclear Power Station Environmental Monitoring Programme

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- Introduction
- Pre-operational phase
- Operational phase
- Retrospective dose assessments
- Quality control
- Conclusion

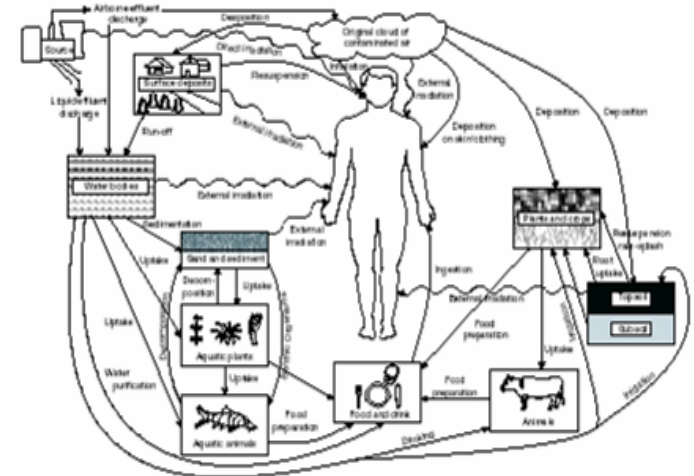
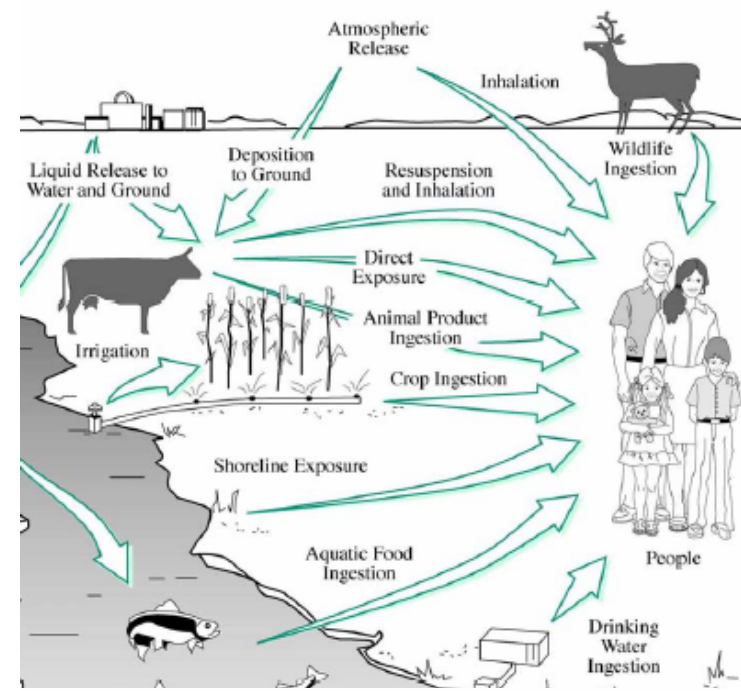


Introduction (1)

- Eskom Standard: GGS 1309, Environmental surveillance:

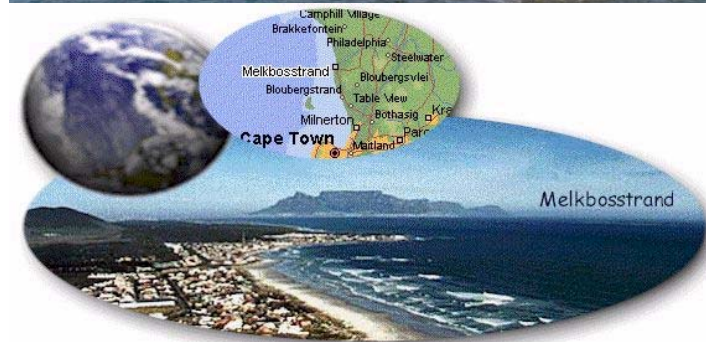
- *Eskom shall provide for the establishment, implementation and maintenance of an appropriate environmental monitoring and surveillance programme to ensure that the storage, disposal or effluent discharge of radioactive waste, does not result in unacceptable contamination of the environment and complies with the ALARA principle and public dose limits prescribed in Eskom standard, GGS 1303: Radiation protection dose limits.*

- Eskom Standard, GGS 1309 contains the environmental surveillance licensing requirements for Koeberg Nuclear Power Station.

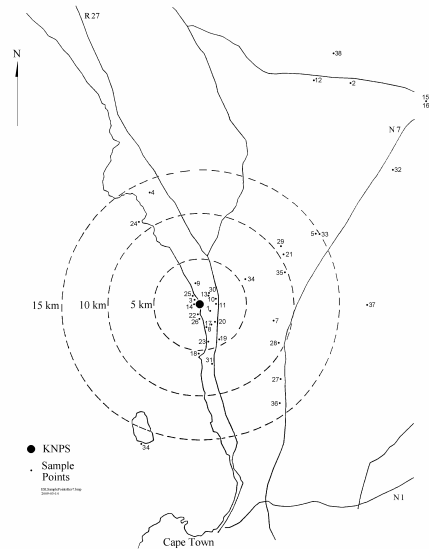


Introduction (2)

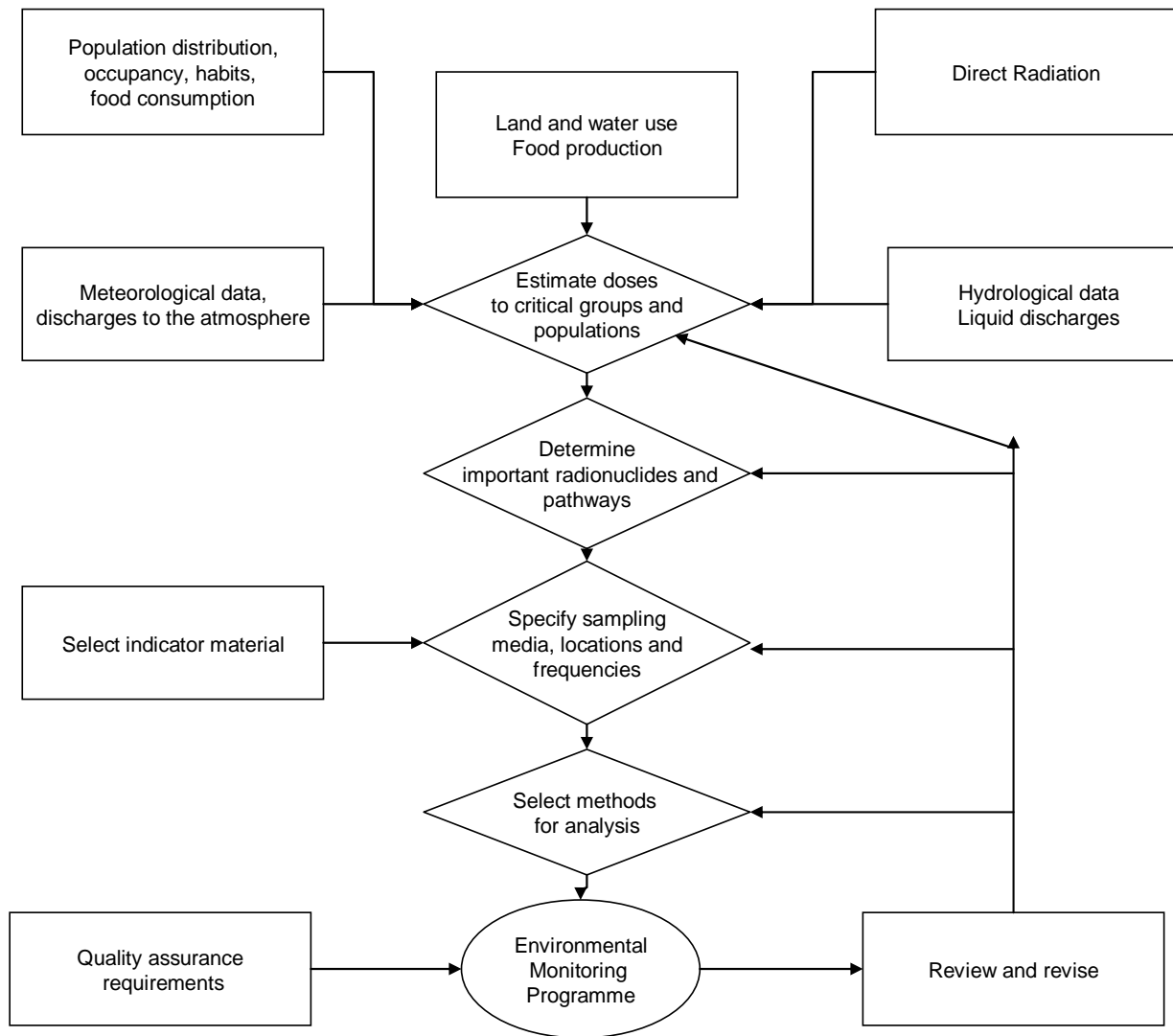
- Koeberg Nuclear Power Station is located approximately 30 km from Cape Town.
 - Construction started in 1976.
 - Unit 1 criticality: 4 July 1984
 - Unit 2 criticality: 25 July 1985
- The pre-operational phase of the environmental survey programme was conducted from 1979 to June 1981.
- The operational environmental survey programme immediately followed the pre-operational phase, even though Koeberg's Unit 1 and Unit 2 only achieved criticality in 1984 and 1985 respectively.



- Primary objectives are to:
 - Obtain base-line environmental monitoring data relating to activity in terrestrial, aquatic and airborne samples at indicator and environmental monitoring sites; and
 - Obtain base-line dose rate data relating to direct radiation in the vicinity of Koeberg Nuclear Power Station at various distances from the plant.
- The pre-operational phase planning requirements:
 - Spatial developments, population density, pathways of exposure, meteorology conditions, hydrology, sample media and preparation, sampling frequency, identification of indicator sites and control sites, measurement of direct radiation.



The pre-operational phase (2)



The KNPS Environmental Surveillance Laboratory

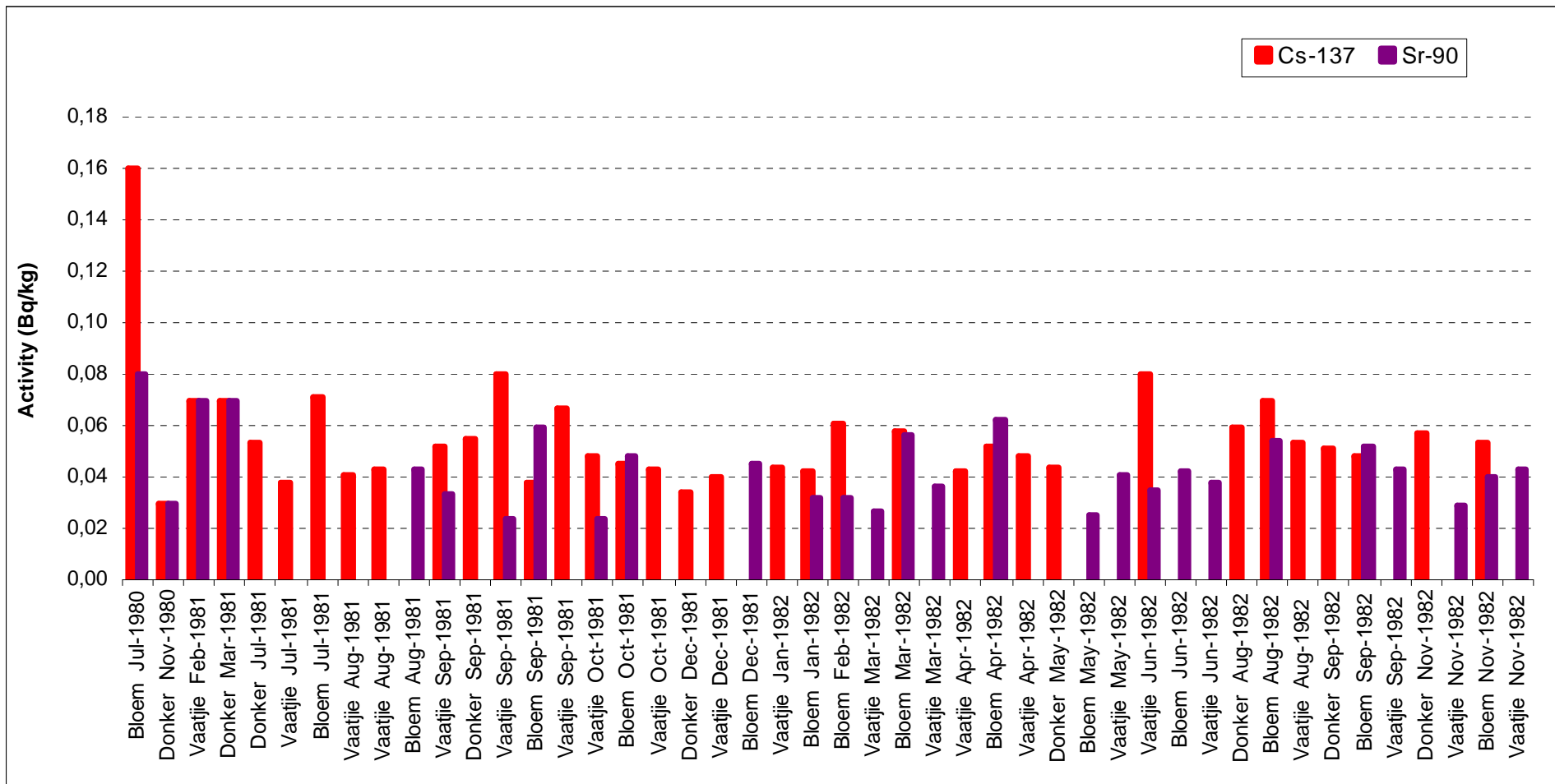


- Pre-operational phase results:
 - $\text{Ag}^{110\text{m}}$, Co^{60} , Cs^{134} , Cs^{137} , Mn^{54} were detected in airborne samples collected at both indicator and control sites.
 - Cs^{137} and Sr^{90} were detected in soil, oats, wheat and leafy vegetable samples. This has been attributed to weapon-testing fall-out.
 - Cs^{137} and Sr^{90} were detected in some milk samples. This has been attributed to weapon-testing fall-out.
 - The main sources of direct radiation in the vicinity of Koeberg Nuclear Power Station are due to NORM and TENORM



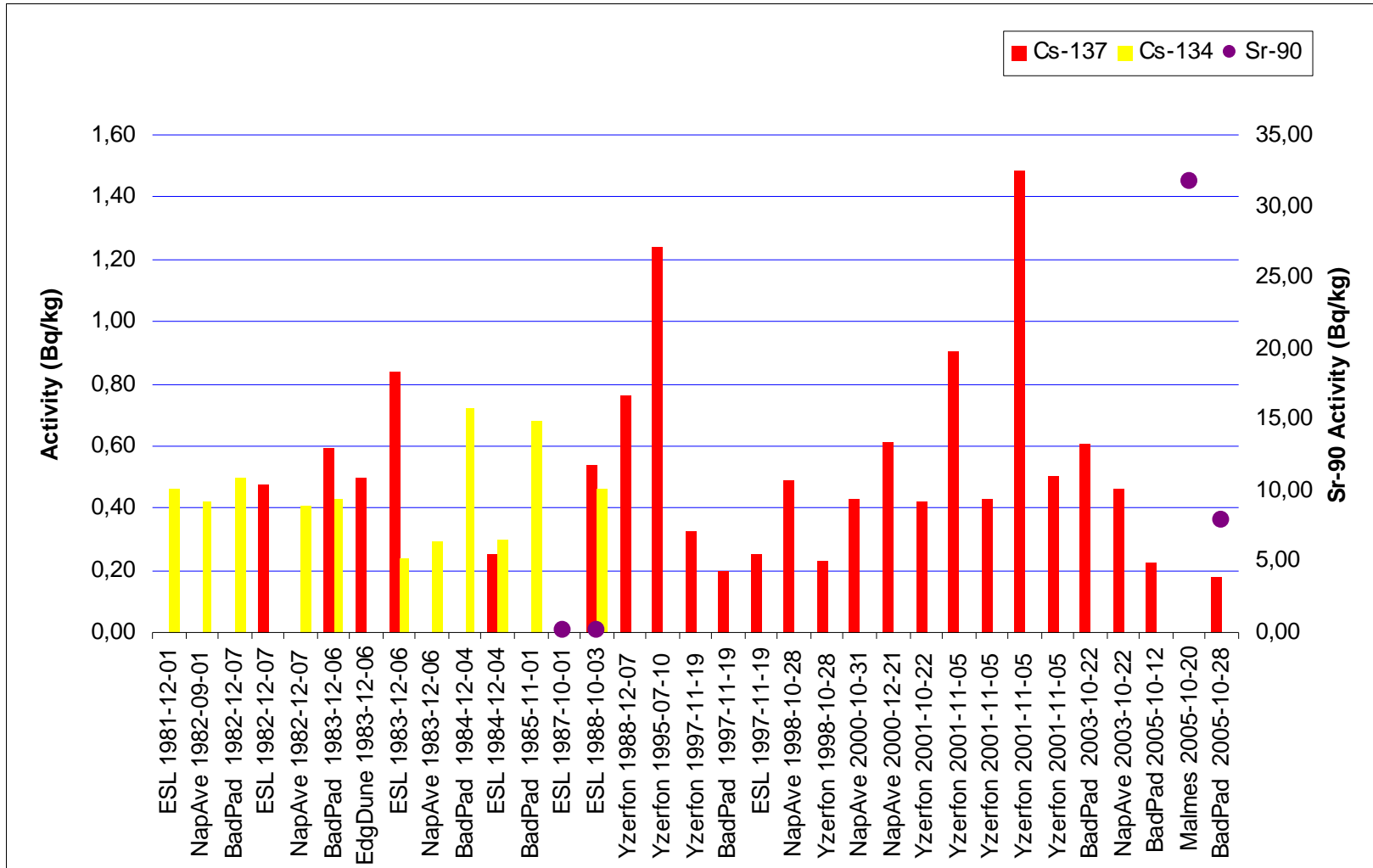
The pre-operational phase (5)

- Activity in milk samples (1980-1982)



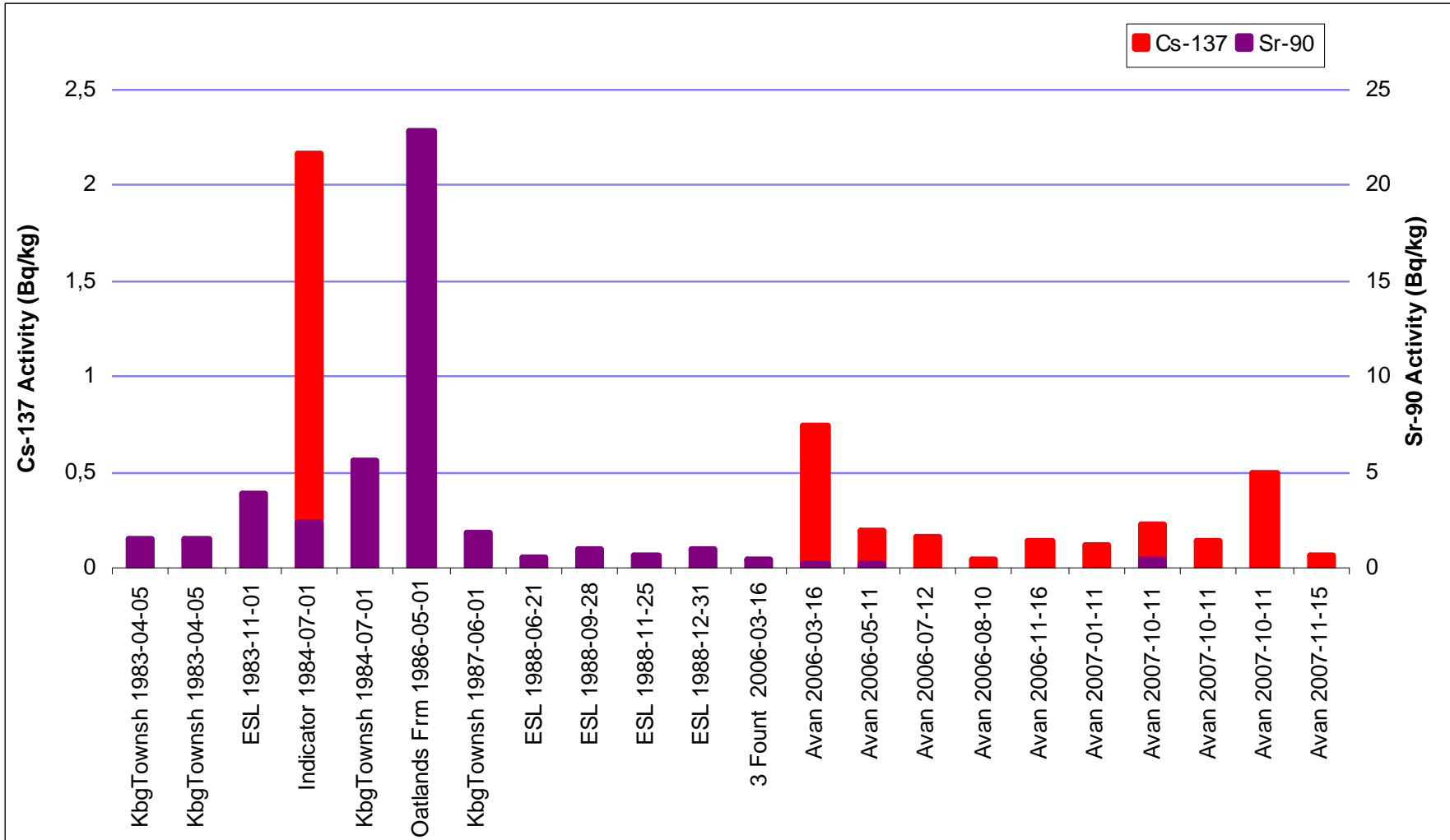
The pre-operational phase (6)

- Activity in soil samples (1981-2005)

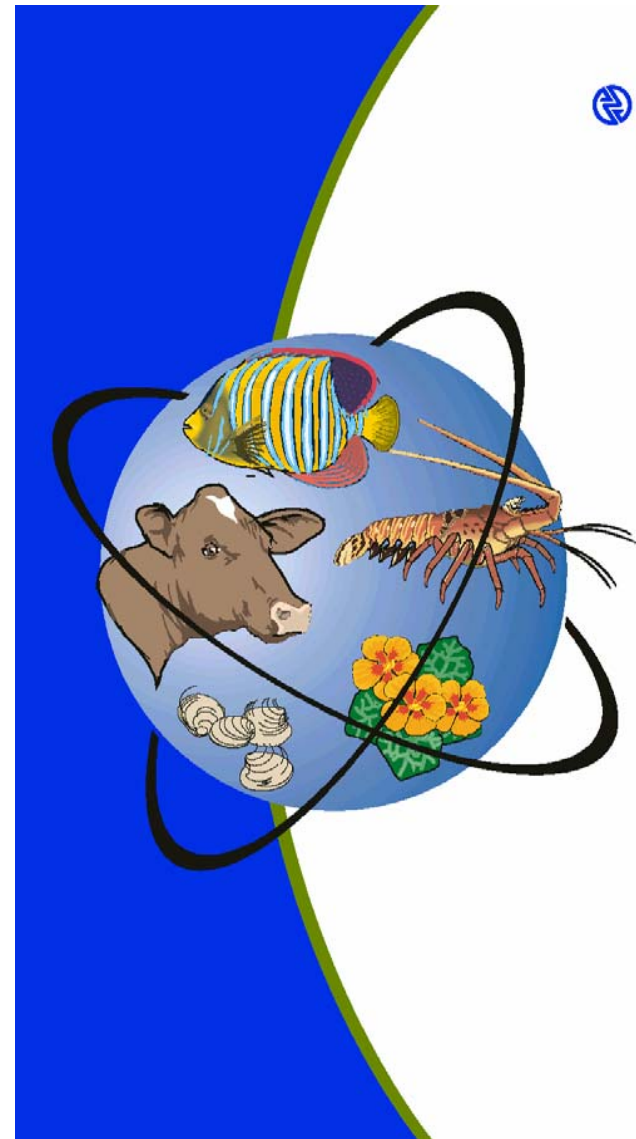


The pre-operational phase (7)

- Activity in leafy vegetables (1983-2007)



- The Koeberg Nuclear Power Station 2009 Radiological Environmental Survey Annual Report:
 - This report details the results of the environmental surveillance programme at the Koeberg Nuclear Power Station Environmental Survey Laboratory (ESL), for the period 1 January 2009 to 31 December 2009, according to the Eskom Generation Standard: GGS-1309, Radiation Protection - Environmental Surveillance”.



- Aquatic pathway sampling programme
 - Abalone samples collected (19)
Indicator sites (15) and control sites (4).
 - Black mussel samples collected (34)
Indicator sites (13) and control sites (21).
 - Crayfish collected (19) Indicator sites (14) and control sites (5).
 - Kelp collected (18) Indicator sites (14) and control sites (4).



- Aquatic pathway sampling programme
 - Sea sediment samples collected (24) Indicator sites (18) and control sites (6).
 - Seawater samples collected (134) outfall (104), intake basin (12) and control sites (18).
 - White mussels collected (27) Indicator sites (23) and control sites (4).
 - Black mussels collected from the inlet during outages.



- Aquatic pathway sampling programme
 - Abalone activity $\text{Ag}^{110\text{m}}$ (0.41 Bq/kg) Co^{60} (0.09 Bq/kg), Cs^{137} (0.07 Bq/kg)
 - Black mussels activity $\text{Ag}^{110\text{m}}$ (0.28 Bq/kg), Co^{60} (0.05 Bq/kg)
 - Crayfish activity $\text{Ag}^{110\text{m}}$ (0.19 Bq/kg)
 - Fish (*Pachymetopon blochii*) activity Cs^{137} (0.15 Bq/kg)
 - Kelp activity $\text{Ag}^{110\text{m}}$ (0.26 Bq/kg), I^{131} (0.68 Bq/kg), Cs^{137} (0.15 Bq/kg)

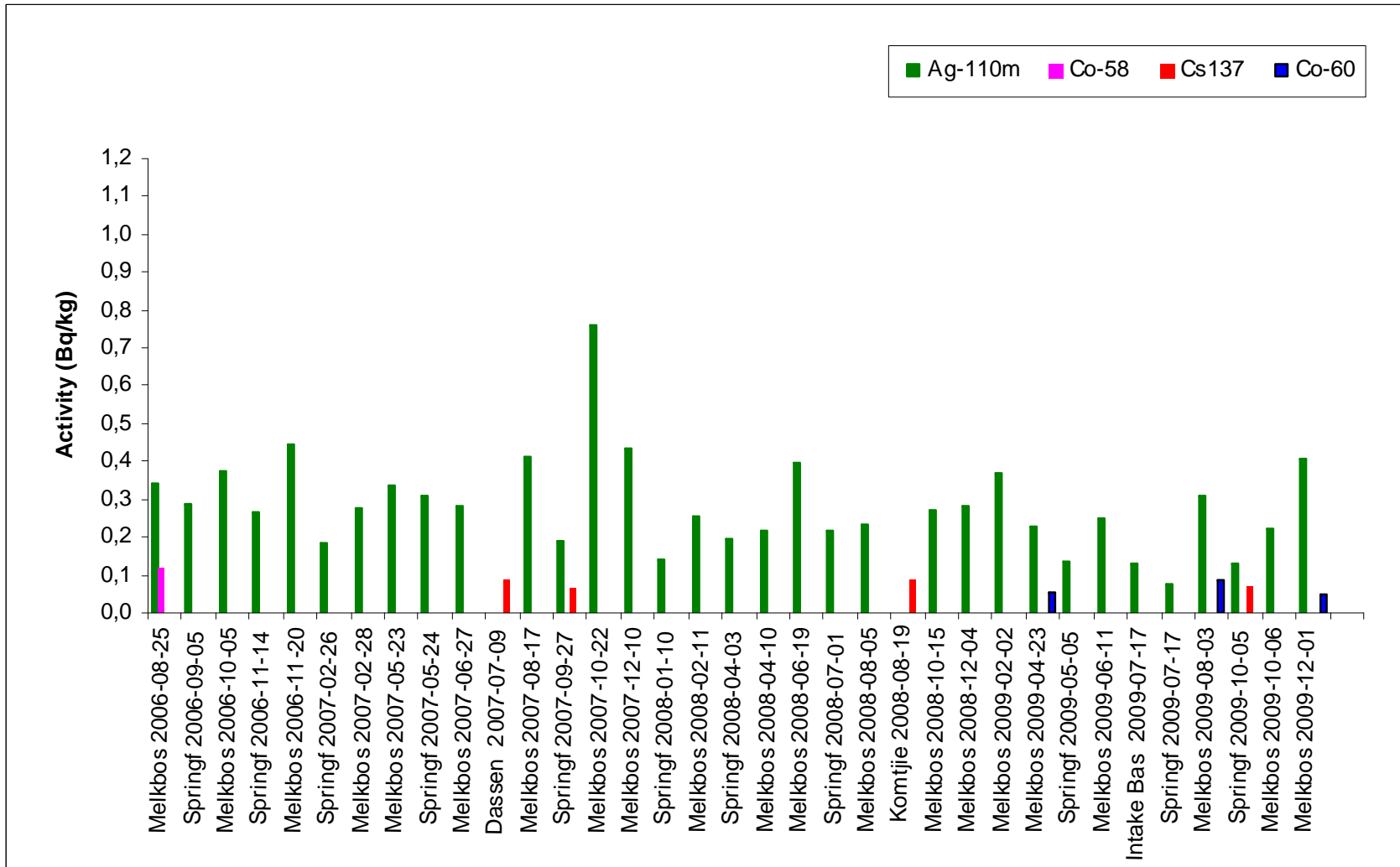


- Aquatic pathway sampling programme
 - White mussel activity (*Donax serra*) activity 300m south of the Koeberg Outfall $\text{Ag}^{110\text{m}}$ (6.38 Bq/kg) Co^{58} (0.16 Bq/kg), Co^{60} (0.15 Bq/kg), Cs^{137} (0.07 Bq/kg)



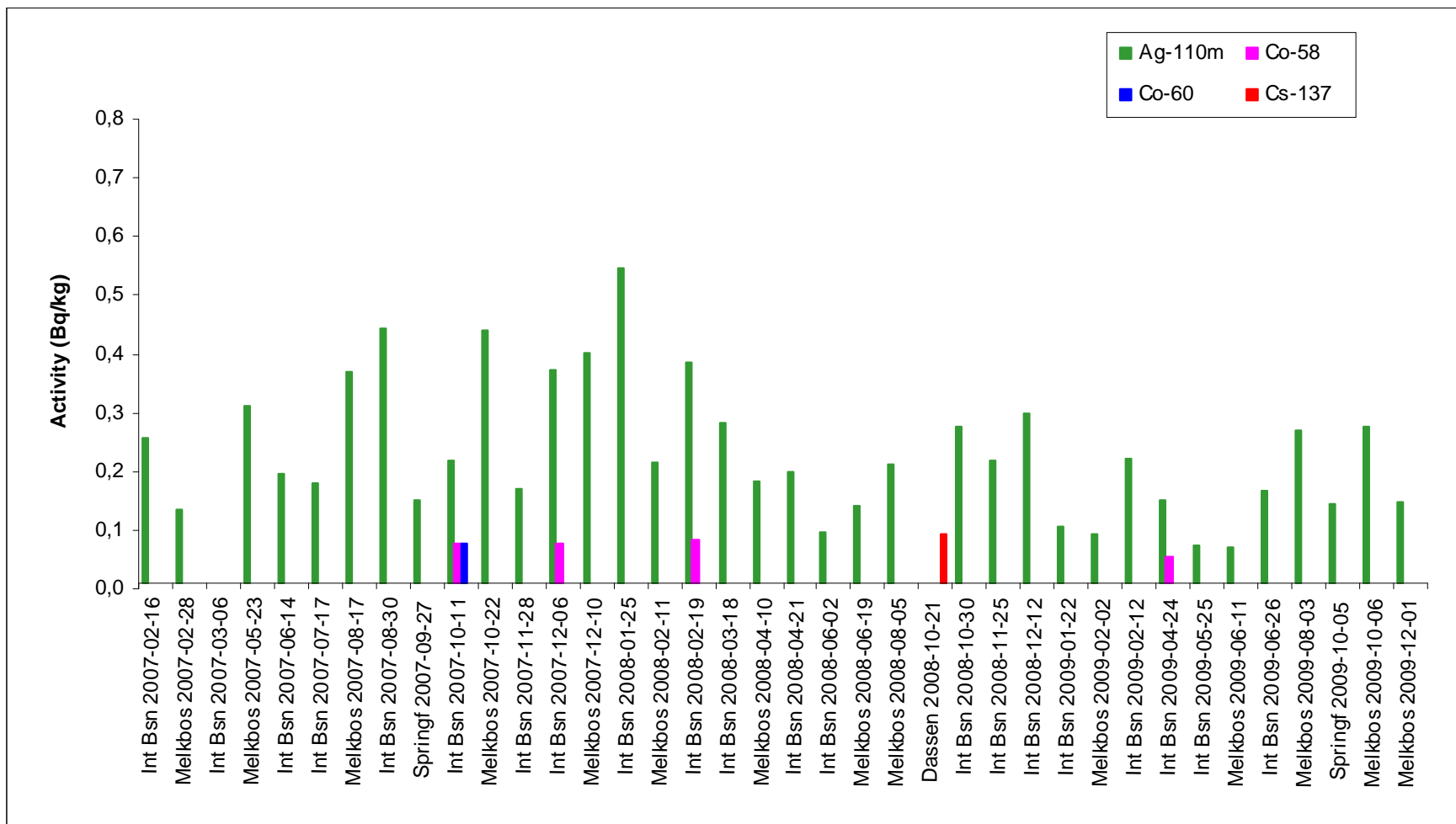
The operational phase (6)

- Activity in abalone (2006-2009)



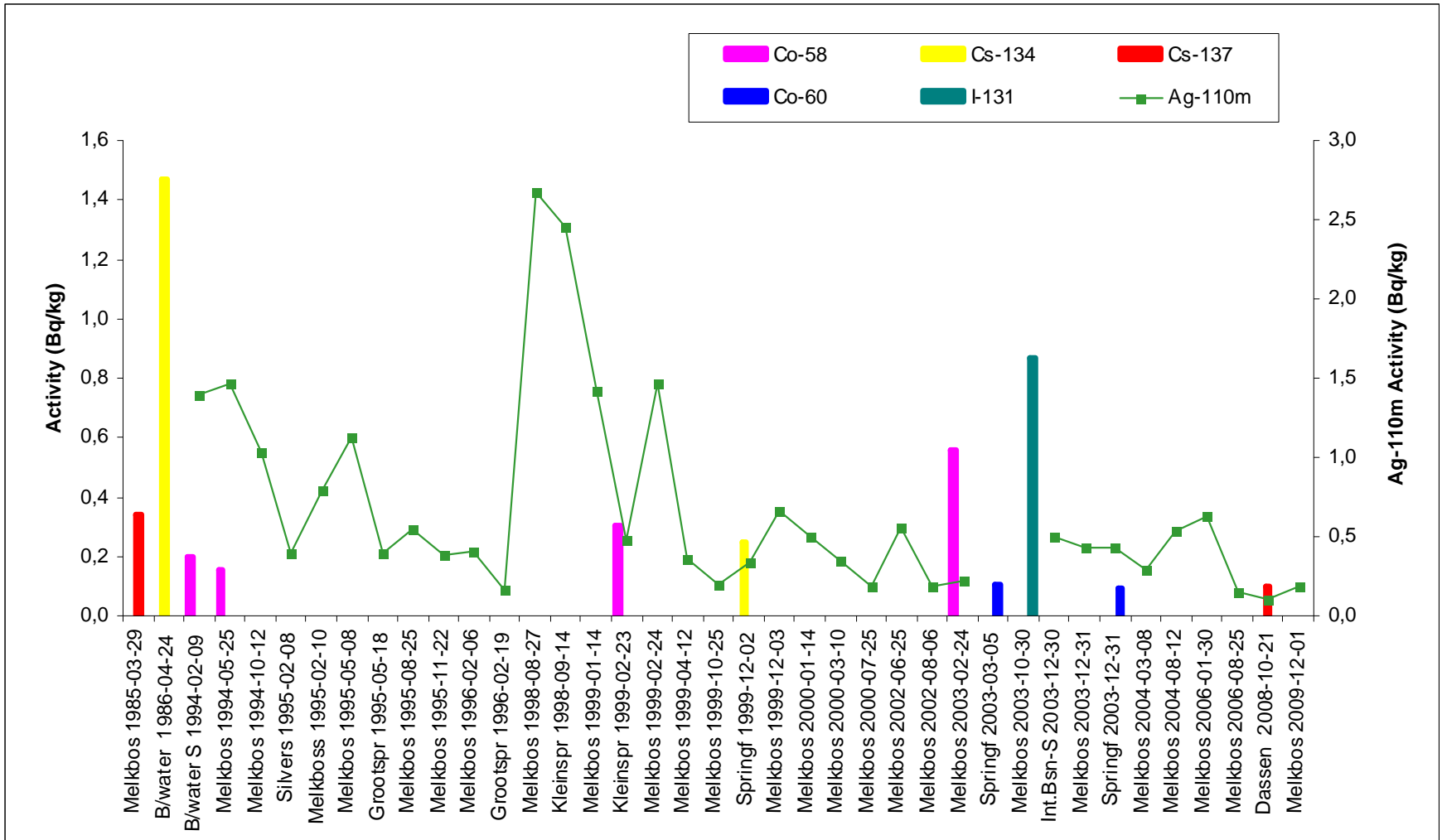
The operational phase (7)

- Activity in black mussels (2007-2009)



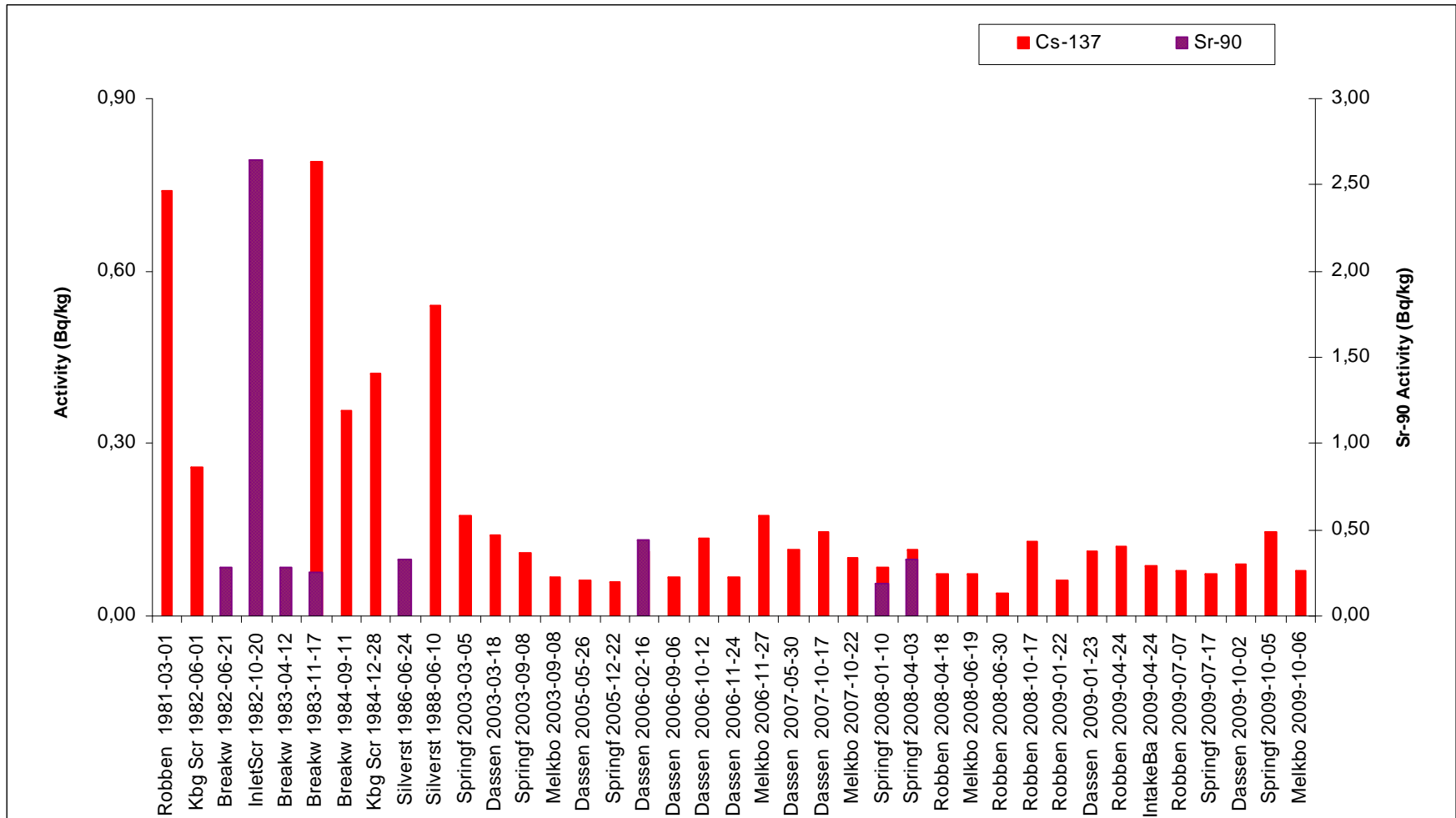
The operational phase (8)

- Activity in crayfish (1985-2009)

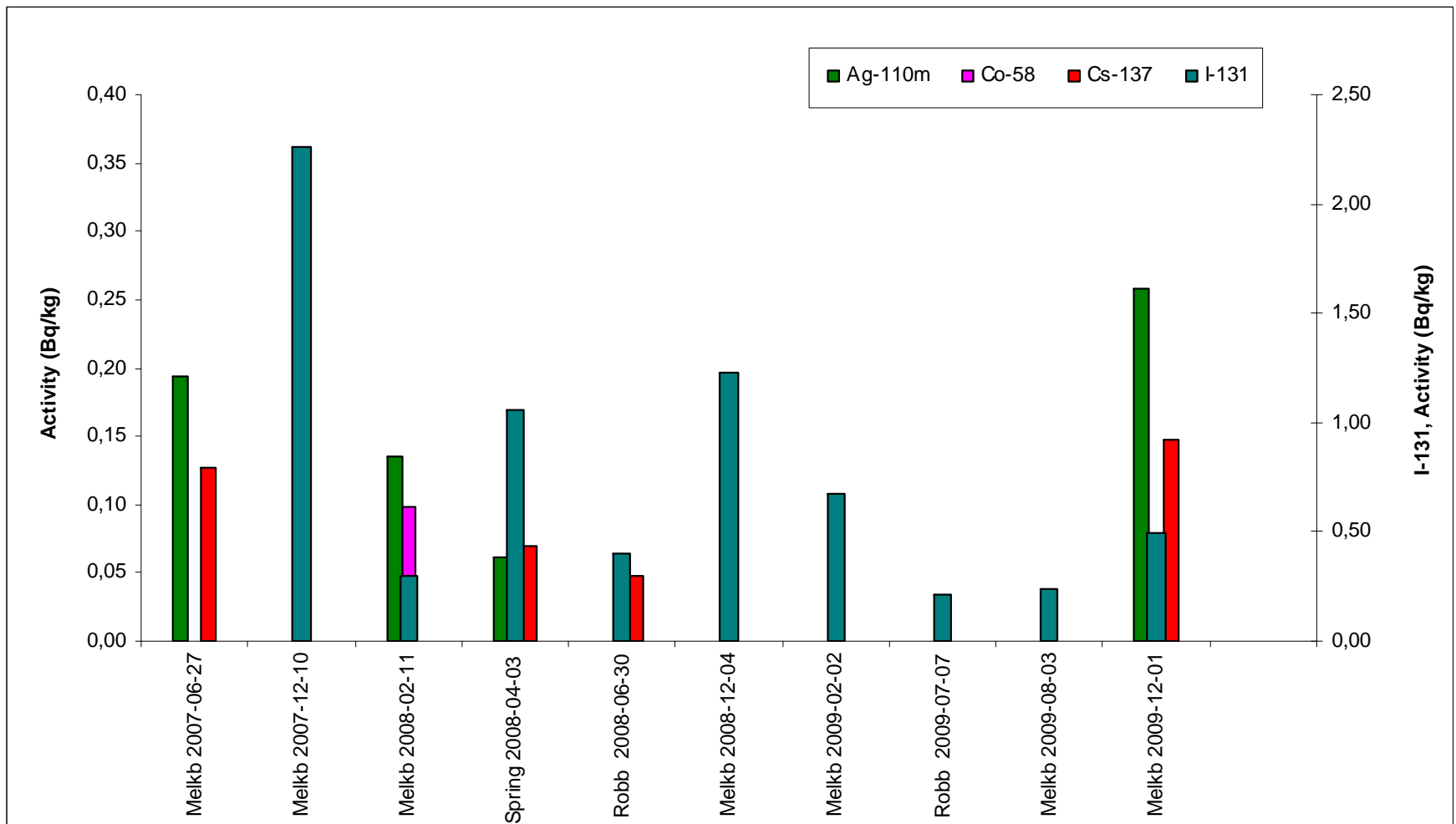


The operational phase (9)

- Activity in fish (1985-2009)

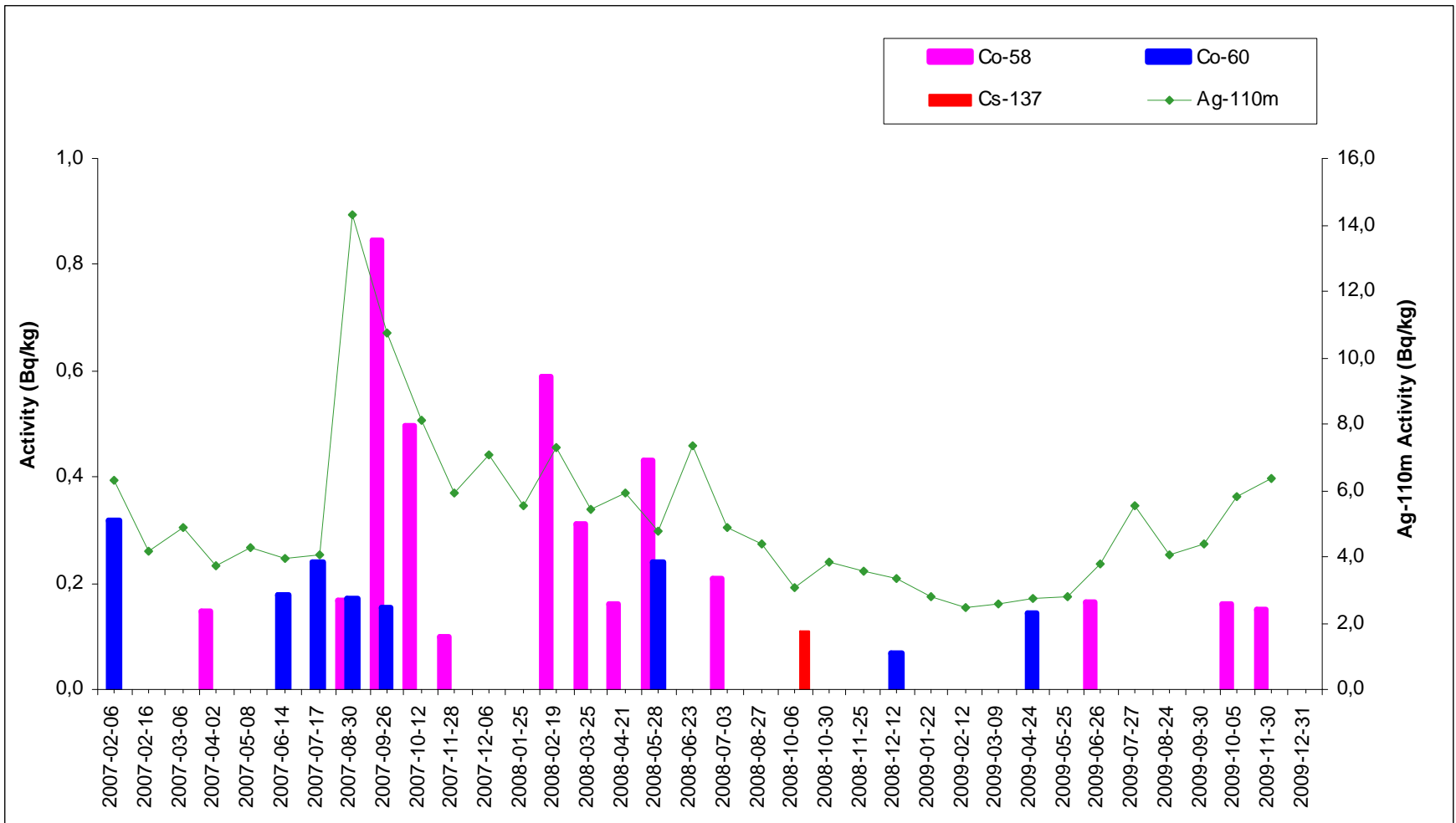


- Activity in kelp (2007-2009)



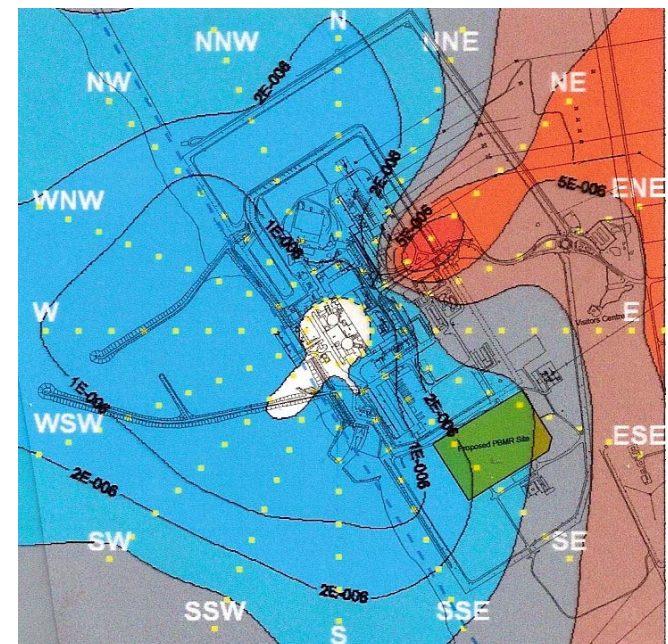
The operational phase (11)

- Activity in white mussels (2007-2009)



The operational phase (12)

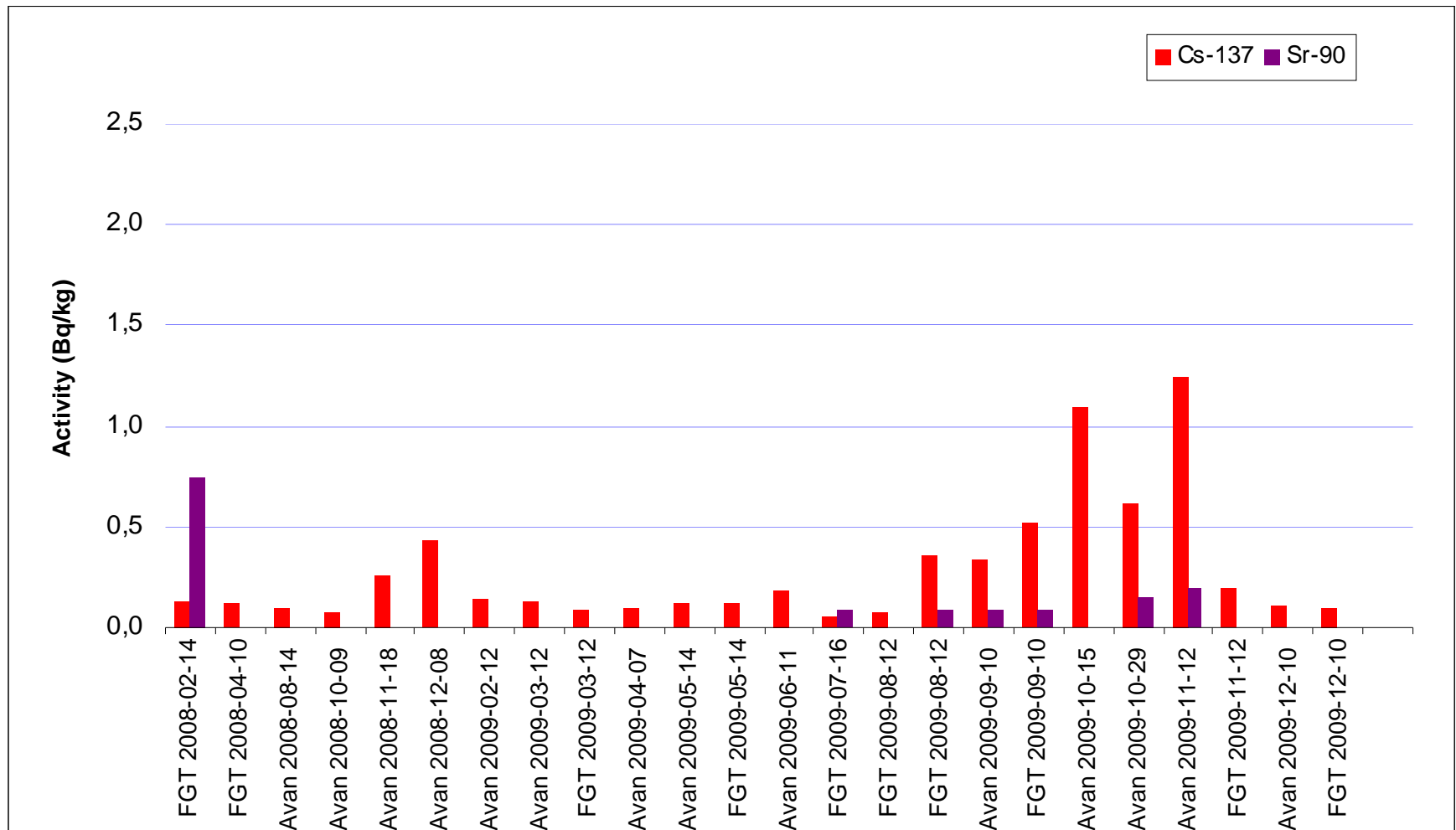
- Terrestrial pathway sampling programme
 - Air particulate and air iodine samples collected (257) Indicator sites (205) and control sites (52).
 - Broad leaf vegetable samples collected (57) Indicator sites (36) and control sites (21).
 - Wheat and oats collected (4) Indicator sites (14) and control sites (5).
 - Leafy vegetables collected (26) Indicator sites (13) and control sites (13).



- Terrestrial pathway sampling programme
 - Sewage sludge: Melkbosstrand Waste Water Treatment Works
 - Forty-six (46) sewage sludge samples were collected from MSW.
 - Trace quantities of $\text{Ag}^{110\text{m}}$, Co^{58} , and Co^{60} were detected in 26 samples
 - I^{131} continues to be detected regularly and was found in 38 of the 46 sludge samples collected

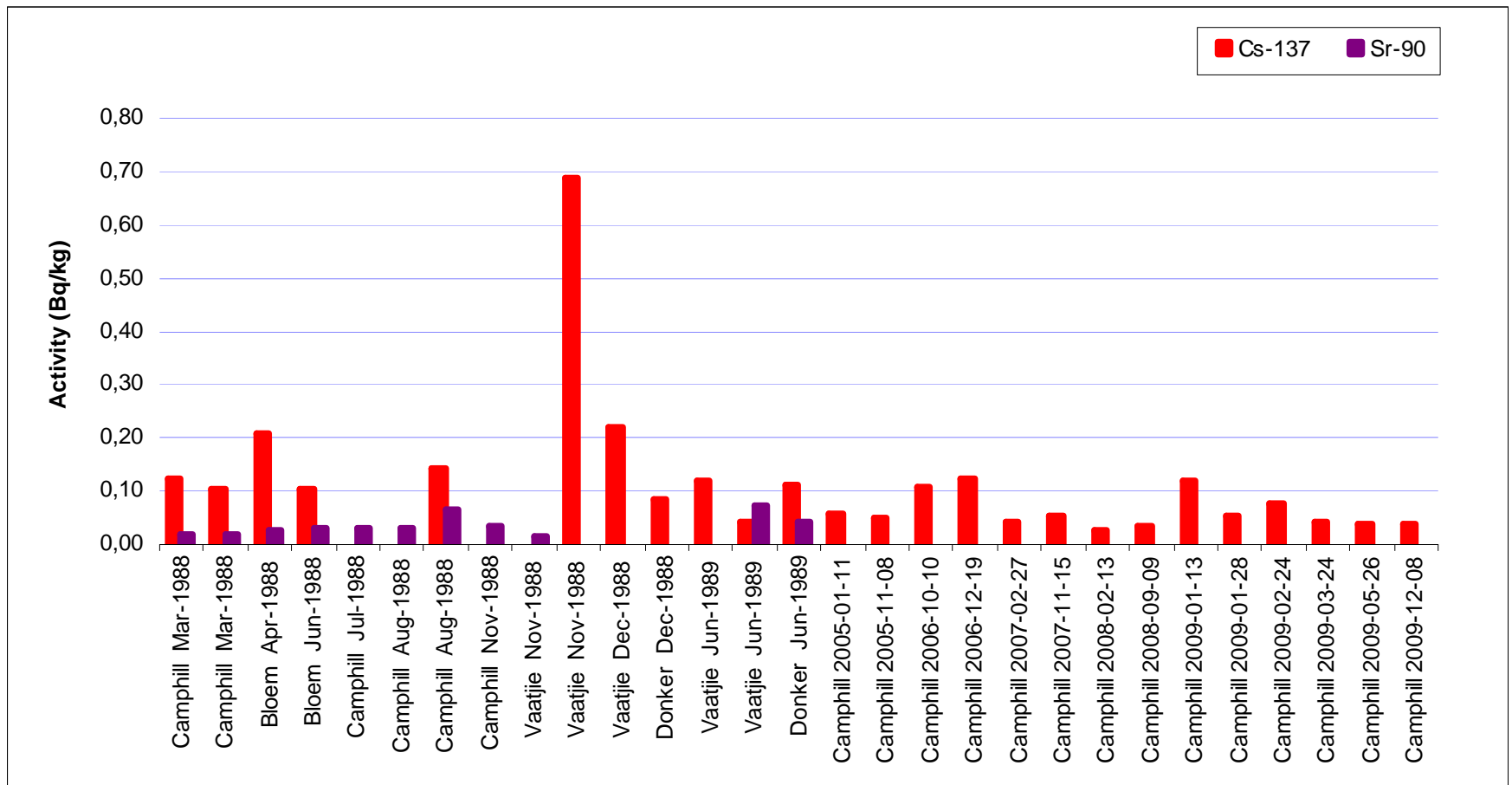


- Activity in leafy vegetables (2008-2009)

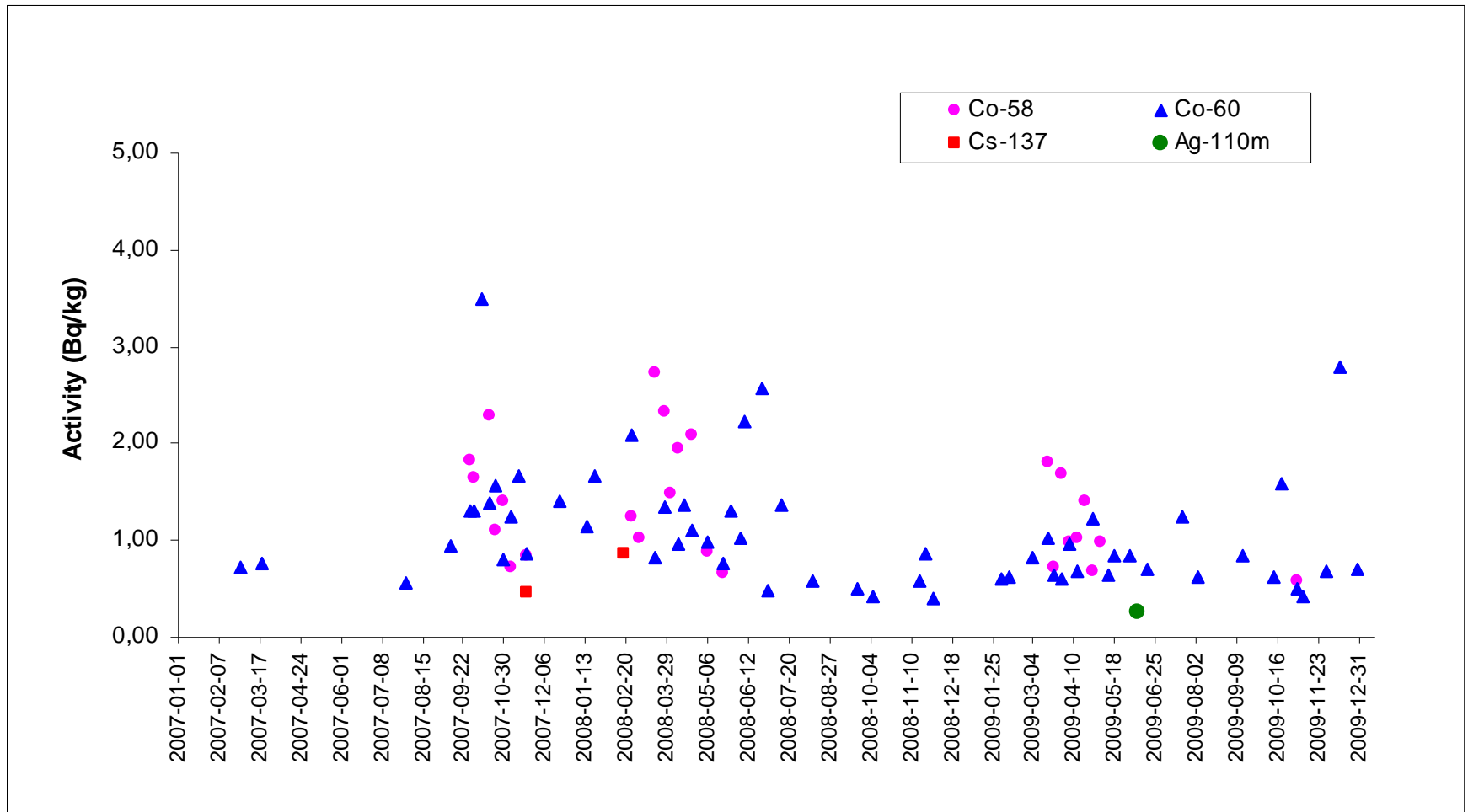


The operational phase (15)

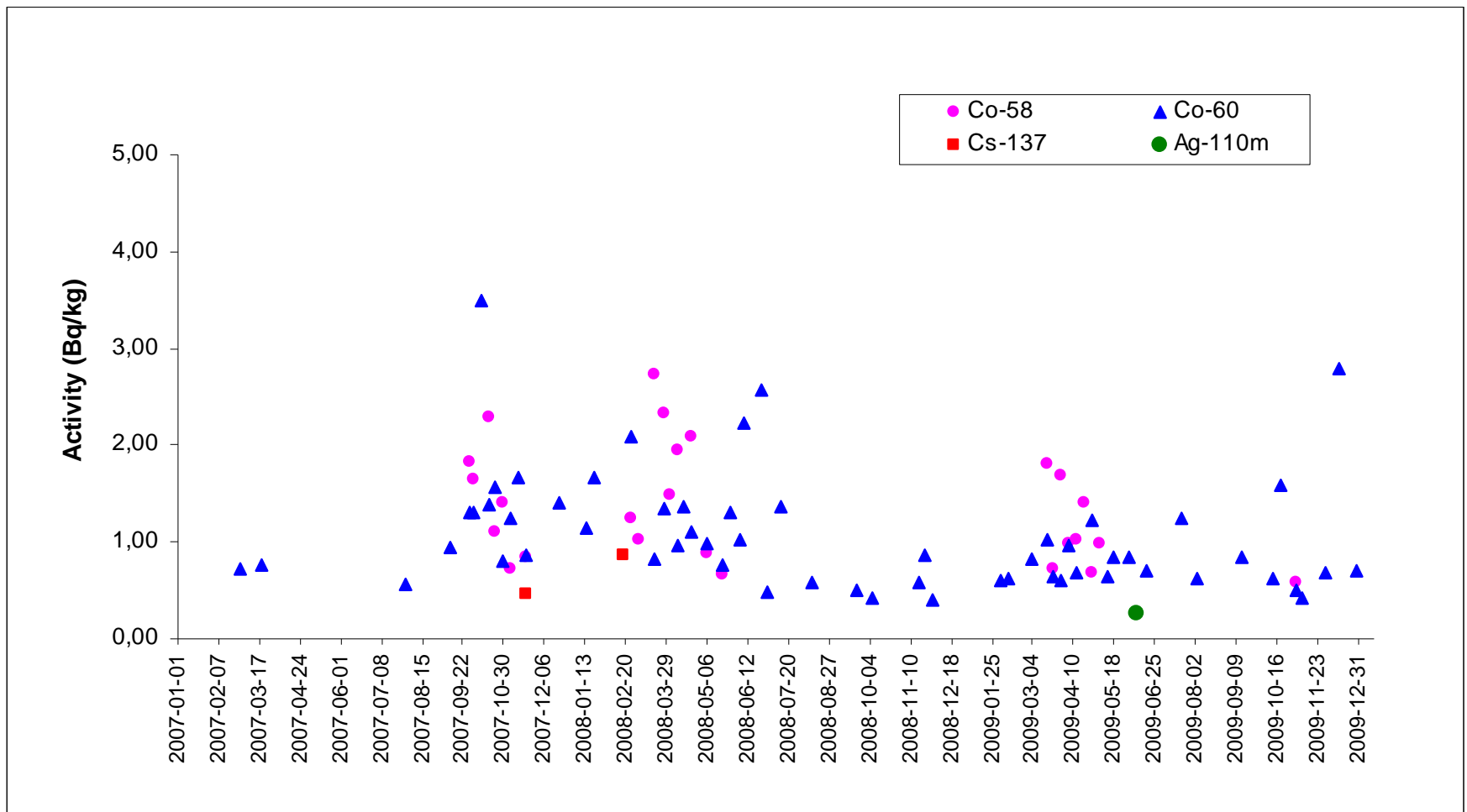
- Activity in milk (1988-2009)



- Activity in sewage sludge (2007-2009)

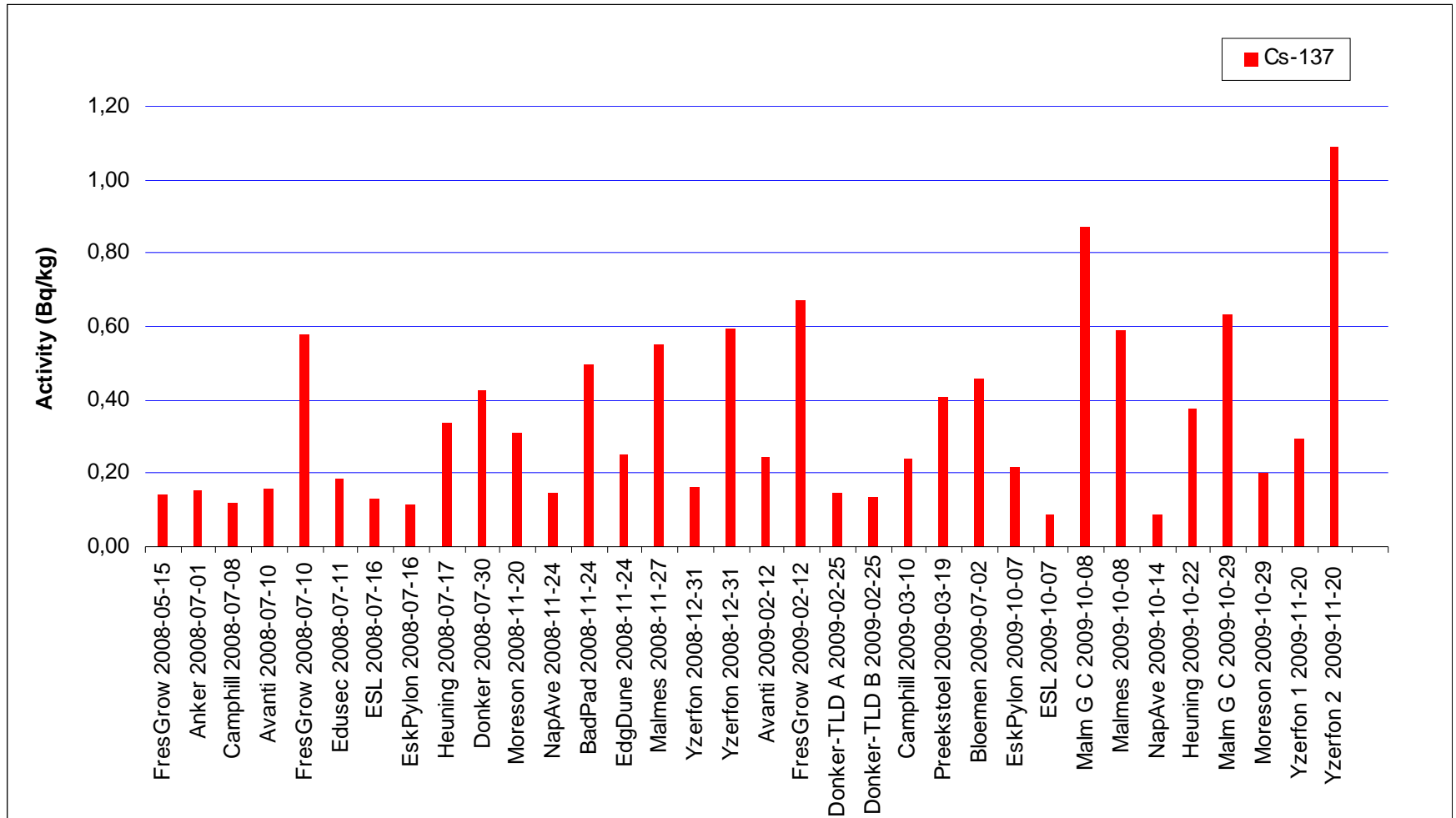


- Iodine activity in sewage sludge (2007-2009)



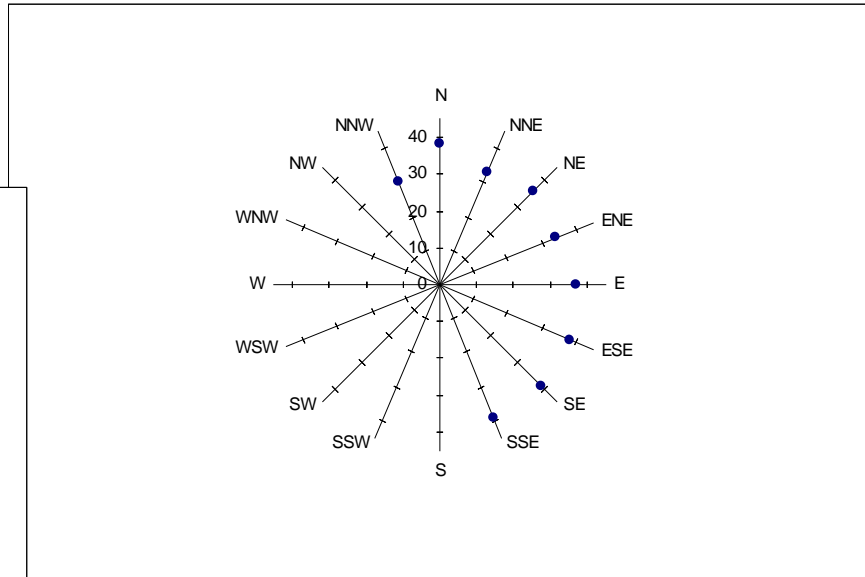
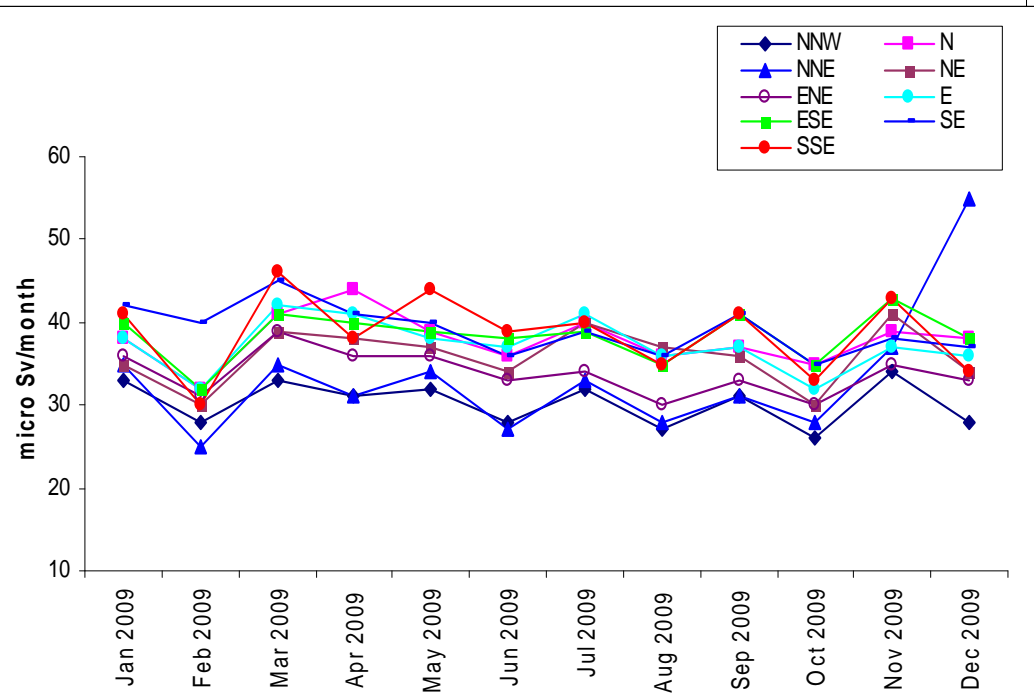
The operational phase (18)

- activity in soil samples (2008-2009)

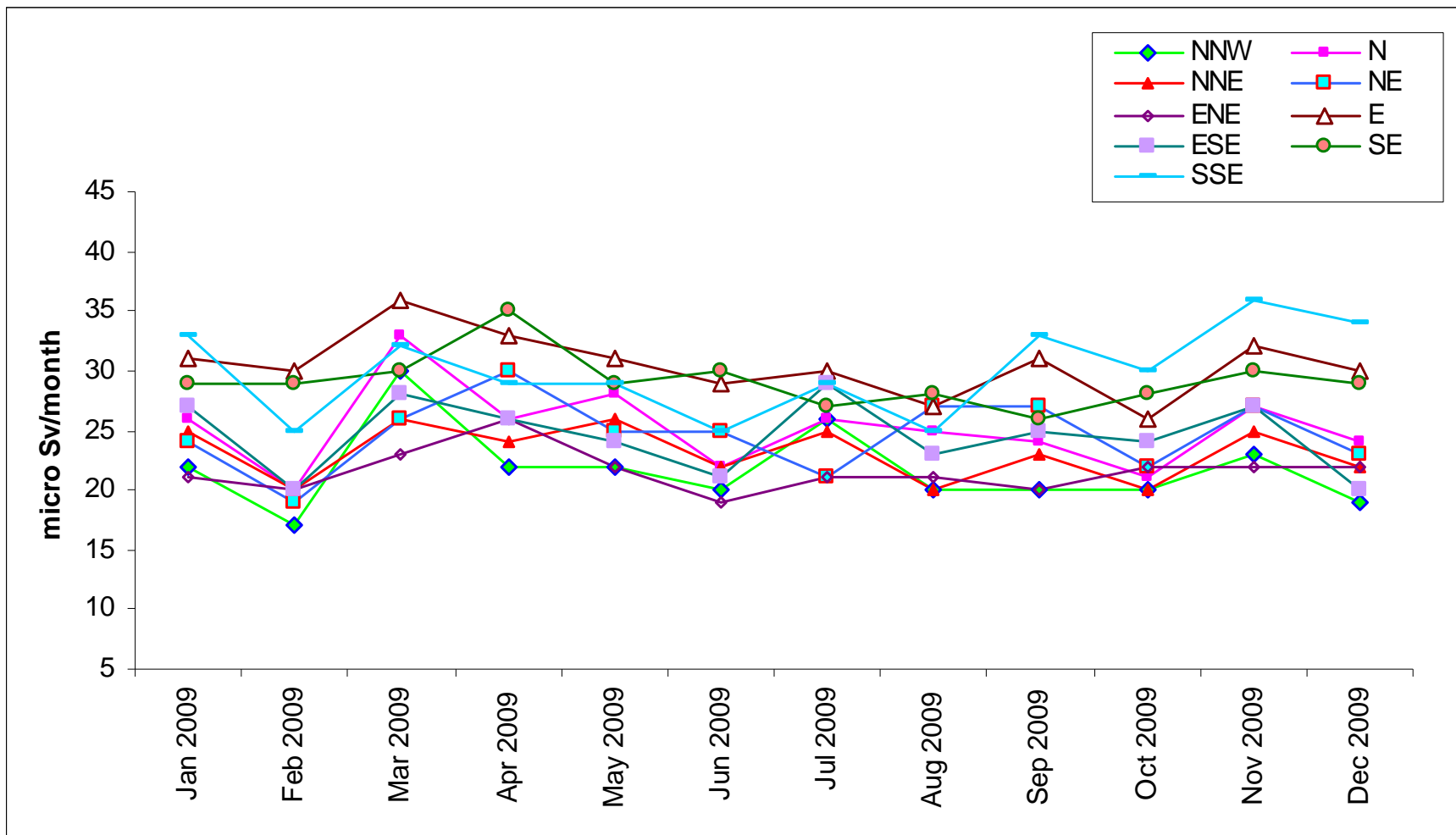


The operational phase (19)

- Direct pathway monitoring programme: inner perimeter 2009

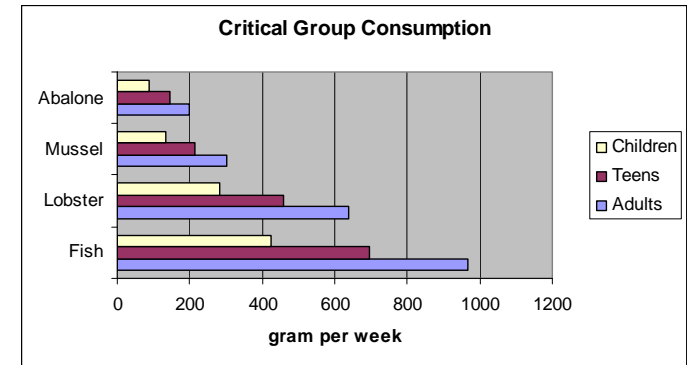


- Direct pathway monitoring programme: PEB 2009



- Marine activity: dose assessment:

- Activity (Bq/kg) x Consumption rate (kg) x ICRP-68 DCF (Sv/Bq) for different age groups

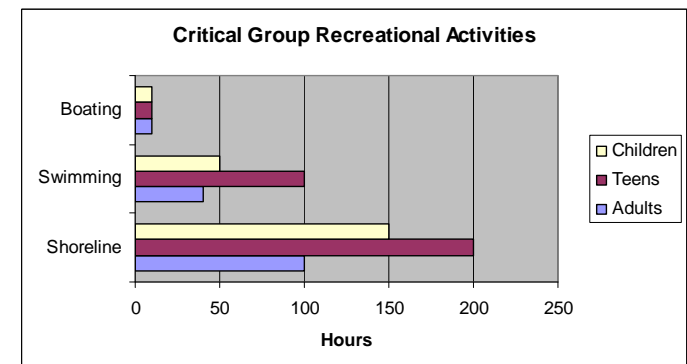


- Sewage activity: dose assessment:

- Sewage sludge mixed with 1cm soil layer with density of 1600 kg/m³ x 12 hours exposure time. The DCF is taken from Regulatory Guide 1.109

- Committed dose to the public:

- 4 to 6 microsievert per annum



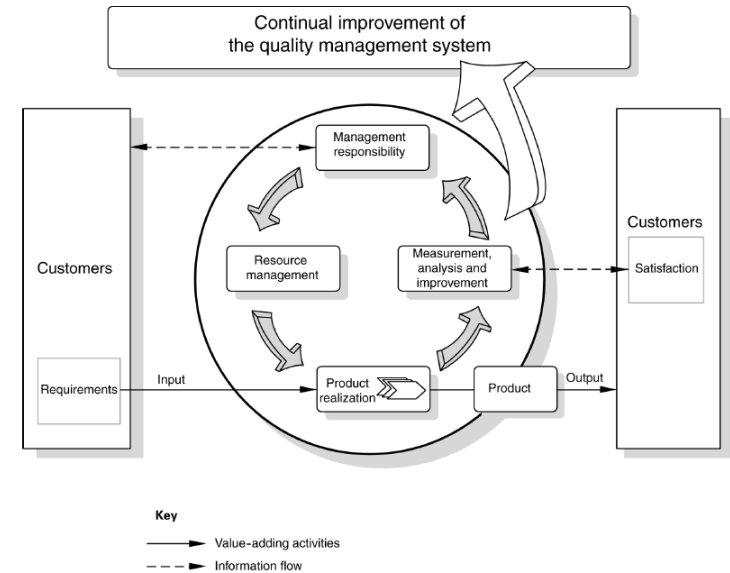
- IAEA Inter-comparison survey:

- 2009** - An inter-comparison study was initiated by the IAEA in June 2009, in which the ESL is participating. Samples were delivered in December 2009, and the deadline for result reporting is 15 April 2010. The date of the final report is, as yet, unknown.

- 2007** - The final report of the inter-comparison study performed in 2007 was received in May 2009.

- In-House Inter-Comparison Study

- An inter-comparison study was performed between the ESL and Radiochemistry (Site). The results of this study proved satisfactory.



- The results of the 2009 environmental surveillance programme do not indicate any significant adverse effect on the public and the environment.
- The results do not show any significant increase in the levels of radioactivity in environmental samples over pre-operational levels, with the exception of the marine and sewage sludge samples, which contain traces of radionuclides derived from Koeberg Nuclear Power Station.

Thank you
Questions

