

## **Behaviour of Carbon-14 Released from Activated Steel in Repository Conditions – a Key Issue in the Long-term Safety of Decommissioning Waste**

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The major part of the activity inventory in the decommissioning waste of a typical NPP is to be found in the activated steel components, i.e. in the reactor pressure vessel and its internals. In the long-term performance assessments, Carbon-14, which mainly originates in the activation reaction of Nitrogen-14, is found to dominate the radiation exposure in the environment, especially if all the uncertainties relating to its behaviour are addressed. Hence special attention in the long-term safety case is to be given for the behaviour and speciation of C-14 released from activated metals in the repository conditions

In the decommissioning plan for Loviisa NPP, C-14 has been assessed in a conservative way in order not to underestimate the radiological consequences, but at the same time the need for a better knowledge on the related phenomenology was identified. In activated components C-14 is released from the metal as it corrodes. There is no unambiguous conception on the speciation of carbon released in such conditions. Three different variants are possible, and there are some indications to be found in literature for each of them: carbonate, organic gaseous substance, and organic soluble substance. In general, the most common carbon species in the repository conditions is carbonate, which precipitates in the cementitious repository conditions and is released only to a small extent. Yet the reaction mechanism and kinetics from carbide, the most probable species in metal, to carbonate is not sufficiently known, and the relating available thermodynamic data is very limited. On the other hand, there are experimental indications of both gaseous and soluble organic substances, but the applicability of those experiments to the repository conditions may be questionable. Furthermore the species may change due to some reactions either in the near- or the far-field.

The presentation summarizes the open questions identified in the long-term safety case for the decommissioning waste from Loviisa NPP as well as discusses the possibility to enhance the knowledge on this issue by experimental work.