

Updated Radiological Inventory of G1 Reactor Thanks to a Strengthened Data Processing

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The G1 reactor (46MWt) was built in 1955 and operated between 1956 and 1968 in Marcoule CEA Center. It has been designed and used for military purposes (plutonium production) as well as an industrial prototype for reactors then developed by CEA (G2 and G3) and EDF (6 units). It was the first French reactor based on the use of natural uranium as the fuel and graphite as moderator. It initially had 30, then 46 megawatts of thermal power. It was air-cooled at atmospheric pressure by a central slit, dividing the reactor into two half-piles (loading and unloading sides).

Cleanup and dismantling began in 1969. All external circuits including the cooling circuits were removed and in 1996, the International Atomic Energy Agency's dismantling level 2 classification was reached. The graphite stack is still inside the reactor. Nowadays the remaining structures/components are the concrete part of the reactor (31,000 t), several metallic pieces (thermal shield, ventilation...) and the graphite bloc (slightly more than 1,000 t).

Within the 2006 French regulation for the management of nuclear waste, the radiological inventory of long lived, intermediate and high activity have huge consequences on the technical choices for final disposal by Andra (sub-surface repository / underground repository). Within this framework, CEA, as well as other French waste producers, put strong efforts in improving its knowledge on irradiated graphite, with a particular emphasis on specific nuclides such as Cl-36, as well as H-3 and C-14.

This paper then presents the recent characterization works conducted on G1 reactor:

- Improvement of the physical description (3D model) and understanding of historical events (paper records, interviews...);
- Computation of activation levels thanks to a numerical model (MCNPX/CINDER-based);
- Laboratory analysis in 2008 on historical graphite samples, collected in 1969 after the reactor shut-down, only in the loading side of the reactor;
- Collection of new graphite samples in the unloading part of the reactor, undergoing laboratory analyses.

One challenge is to gather and compare these different kinds of information to consolidate the radiological inventory thanks to statistical and geostatistical data analysis. This strengthened data processing enables improving the understanding and the quantification of nuclide activity levels as

well as their spatial distribution. For instance, the spatial bias correction from graphite samples (due to their preferential localization in the expected highest activated part of the reactor) reduces the total amount estimates by around 30% for most of the nuclides. These updated results also play a crucial part for the preparation of future decommissioning works (planning, funding, waste package decision, waste volumes, waste categories...).

Another part of the work consists in identifying missing pieces of information and still uncertain parts of the reactor (sample analysis of activated concrete for instance) to reinforce the radiological inventory of G1 reactor.