

Characterisation of the natural radioactivity of the first geothermal installation in Flanders, Belgium

Friday, 30 September 2016 15:08 (0:02)

Content

Geothermal energy is a local source that is based on the heat generated by the earth. As the heat is continuously regenerated, geothermal exploitation can be considered as a renewable and, depending on the techniques used, a sustainable energy production system. With this respect, the Flemish Campine region has taken a pioneering role in the research on the use of deep geothermal energy. On September 2015, VITO, Vlaamse Instelling Voor Technologisch Onderzoek, decided to drill an exploration well with a planned depth of 3.5 km on the Balmatt site near Mol. The purpose was to demonstrate that it is possible in the Campine area to pump up hot water from a reservoir located in the Carboniferous Limestone Group for thermal use and electricity production. If tests meet expectations, it opens possibilities for the construction of dozens of geothermal power plants and for the creation of several heating networks in the provinces Antwerp and Limburg. The exploitation of geothermal energy is believed to cause little or no harm to the environment. Geothermal steam and hot water however do contain naturally occurring traces of gases, chemicals and radionuclides that could be harmful in high concentrations. Determining the radioactivity content of the formation water is important, since being in contact with the installation it may accumulate radioactivity in scales (NORM), e.g. by precipitation or radon decay. In geothermal installations with a high activity concentration of radium isotopes and their daughter products in the formation water (and the installation), monitoring and analysis of radiation is therefore required to ensure radiation protection of workers and the environment. During production tests on the first well at the Balmatt site, several formation water samples were collected in order to analyze their natural radioactivity content and chemical composition. From the chemical point of view it was revealed that the water has a high salt content with a chlorine concentration of 87 g/L. The activity concentration of ^{226}Ra and ^{228}Ra , was determined to be 108.85 ± 6.61 Bq/L and 24.54 ± 2.66 Bq/L, respectively. The decay products of ^{226}Ra , such as ^{210}Pb and ^{210}Po were found to have a much lower concentration with values of 0.687 ± 0.037 and 0.036 ± 0.007 Bq/L, respectively. The activity concentration of U and Th isotopes was found to be low as well. The highest activity concentration of the thorium isotopes was found to be for ^{228}Th (0.360 ± 0.070 Bq/L), which is normal since it is a decay product of ^{228}Ra present in the water. In European regulations, geothermal installations have been included in the so-called Basic Safety Standards for Radiation Protection (EU Directive 2013/59/Euratom) as a NORM practice of concern to the Member States. At a Belgian level “geothermal energy production, including exploration and pumping activities in the development thereof” has recently been added as a NORM practice to national radiation protection legislation by the FANC-Decree of March 3, 2016, ensuring control of radiation protection by the national regulatory body (FANC) in the installations and in the safe disposal or discharge of solid and liquid residues which exceed the exemption criteria. The radiological characterisation of several geological samples obtained from different depths during the drilling, the formation water and suspended particles will be addressed in view of their impact on future exploitation of installations. Detailed description of the sampling, radiochemical and measurement methods applied and the associated challenges with the analysis of these samples will be discussed in the paper.

About the Presenter

M. Bruggeman

Primary author(s) : Dr. VASILE, Mirela (SCK-CEN, Belgium)

Co-author(s) : Dr. BRUGGEMAN, Michel (SCK-CEN, Belgium); Mr. VAN MEENSEL, Steven (VITO, Belgium); Dr. LAENEN, Ben (VITO, Belgium); Dr. BIERMANS, Geert (FANC, Belgium)

Presenter(s) : Dr. BRUGGEMAN, Michel (SCK-CEN, Belgium)

Session Classification : Special Session: Metrology of NORM

Track Classification : Special Topic: Metrology of NORM