USE OF NATURAL AND ANTHROPOGENIC ANALOGUES OF CARBON TO SUPPORT DISPOSAL OF SPENT EXPERIMENTAL HTR FUEL

by

Fiona B. Neall[1], David Bennett[2] and Robert Winsley[3]

[1] Galson Sciences Ltd., Grosvenor House, Oakham, LE15 6AX, UK
Email: fbn@galson-sciences.co.uk
[2] Terrasalus Ltd., Oakham, LE15 9EL, UK
[3] RWM Ltd., Harwell, Didcot, OX11 0RH, UK

This paper sets out a model for the long-term evolution of carbon (in the form of pyrolytic carbon and graphite) associated with high temperature, gas-cooled reactor (HTR) spent fuel under conditions in a GDF near-field environment. Evidence from natural graphite occurrences and industrial processes has been used to support elements of the model and corroborate the expected stability of carbon over a one million-year timescale.

In HTRs, the carbon is an intimate part of the fuel elements in which (fissile) uranium and (fertile) thorium microspheres (‘fuel particles’) are embedded in a pyrolytic carbon and graphite matrix. A number of experimental and power-generation reactors have used this technology in the past (AVR, Germany; Dragon, UK; Peach Bottom, USA; THTR-300, Germany; Fort St Vrain, USA) and pebble-bed reactors currently under development use similar fuel technology.

For small-volume spent fuels from experimental reactors, complex processing required to separate the carbon from the spent fuel particles may be less attractive than direct disposal of the intact spent fuel. Post-closure criticality safety calculations indicate that the presence of the carbon around the highly enriched fuel particles acts as a diluent and allows a significantly greater amount of fissile material to be contained in each waste package than if the carbon is not present. However, to take benefit from the presence of the carbon, it must be shown to persist over the timescale of interest.