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Corrosion of Copper-Coated Used Fuel Canisters – Regulatory Research on the Canadian Design

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Deep geological repositories (DGRs) for the disposal of used nuclear fuel are the internationally agreed upon solution to achieve containment and isolation through a series of natural and engineered barrier systems. Used fuel containers (UFCs) are an important aspect of these systems; the current Canadian design [1], while similar to those of Finland and Sweden (steel with a corrosion-resistant copper layer), is unique due to the thinner, integrally bonded copper (3 mm versus 50 mm). While research into copper corrosion relevant to DGRs has been ongoing for decades, our recent systematic literature review [2] highlighted several knowledge gaps centred around the impact of changing environmental conditions, unsaturated corrosion, and compounding corrosion influences. Our on-going experimental program addresses these knowledge gaps through experiments on 1) corrosion in unsaturated bentonite 2) corrosion in bentonite when heated, 3) the impact of groundwater composition on corrosion behaviour, 4) the impact of deliquescent and non-deliquescent salts on corrosion, and 5) long-term corrosion in sulfide-containing saturated environments when previous corrosion has occurred. Though work is ongoing, this research has confirmed that the presence of moist, compacted bentonite provides a controlling influence on the physical characteristics of moisture layers on the surface of the copper, resulting in increased corrosion [3], but heating results in a reduction in moisture presence on the surface and a near complete cessation of corrosion when heating leads to bentonite desiccation [4]. These results will support upcoming regulatory assessments of how both operational and post-closure conditions will impact long-term safety.

[1] NWMO. *Postclosure Safety Assessment of a Used Fuel Repository in Crystalline Rock*. Technical Report NWMO-TR-2017-02, Toronto, Canada.

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[3] Harper CO, Brown JL, Amos RT. The impact of bentonite on copper corrosion early in deep geological repository lifecycles. *Journal of Nuclear Materials - Under Review*.

[4] Harper CO, Brown JL, Amos RT. The impact of elevated temperatures and decreasing moisture on corrosion of copper in contact with bentonite. *In Prep*.