**Integration Group for the Safety Case (IGSC) Symposium 2024***MOVING TOWARDS THE CONSTRUCTION OF A SAFE DGR – GETTING REAL*

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| **Abstract Title:** Human intrusion scenarios in the safety case: comparing and contrasting repositories in crystalline rock versus sedimentary basins | |
| **Abstract (300-500 words):**  Human intrusion scenarios are an important part of safety case (SC) assessments, requiring deliberate thought and implementation based on the underlying geology. Yet human intrusion may be one of the most difficult future uncertainties for the SC. Crystalline rocks such as granite are intended for the siting of deep geologic repositories (DGR) by several countries. Other countries have planned or operate DGRs in salt or clay formations located in sedimentary basins. The international standard for SC is to consider a stylized intrusion, which seems acceptable for crystalline rocks but less so for sedimentary basins with resources. Yucca Mountain (YM) in Nevada and the Waste Isolation Pilot Plant (WIPP) in New Mexico are two examples from the US developed by the Department of Energy (DOE) with contrasting approaches to human intrusion. YM used a stylized intrusion scenario, but WIPP explicitly contemplates inadvertent drilling intrusion scenarios based on current practices and is regularly updated for each 5-year compliance recertification Performance Assessment (PA). WIPP is located in thick bedded salts of the Delaware Basin, part of the greater Permian Basin, one of the most prolific oil and gas producing regions in the world. In addition, most US production of potash is from the area surrounding WIPP. In contrast, YM is in fractured tuff within a region largely barren of natural resources.  The US Environmental Protection Agency’s (EPA) generic environmental standards for radioactive waste disposal in 40 CFR Part 191 require inadvertent drilling to be included in PA. Guidance on drilling rates suggested < 3 boreholes/km2 per 10,000 years for non-sedimentary rocks, and an order of magnitude higher for sedimentary rock. YM was to consider one deterministic, stylized intrusion. EPA’s specific regulations for WIPP intrusions require probabilistic evaluation and modelling of potential impacts of resource exploration and exploitation. Given the robustness of the salt repository, no releases of radionuclides are anticipated in an undisturbed scenario, and the only pathway leading to releases is a disturbed scenario involving drilling. EPA has closely reviewed and evaluated DOE’s approach, data, calculations, and parameters for modelling these scenarios. One key parameter, the deep drilling rate, which is based on a moving 100-year average and projected for 9,900 years, has more than tripled since the first compliance application in 1996 due to the “shale revolution” enabled by hydraulic fracturing, horizontal drilling, and related techniques and technologies. This resurgence was unanticipated--oil and gas production had been declining for more than 2 decades before WIPP opened.  History has many examples where natural resources identified as unattractive may become economic, resource estimates may change considerably, material that may have been considered waste may become a resource, and they all can be rapidly abandoned due to depletion, geopolitics, and other factors. Regulations should have provisions and mechanisms, such as FEP analyses, to periodically test assumptions and modify approaches taken in the SC throughout the planning, development, and operation of DGRs. | |