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

|  |  |
| --- | --- |
| **Abstract Number: 71** | **Poster P4.1** |
| **Author:**  **Tetsuhiro ICHIMURA, Satoru SUZUKI, Taichi ESAKI, Yoichi TAGAWA, Tadashi Maeda, Yoshito KITAGAWA**  **Nuclear Waste Management Organization of Japan (NUMO), Japan** [**tichimura@numo.or.jp**](mailto:tichimura@numo.or.jp) | |
| **Abstract Title:**  **A study of operational safety countermeasures and risk assessment for the waste transport systems using shaft and straight ramp** | |
| **Abstract (300-500 words):**  It is imperative to prevent the release of radionuclides caused by thermal and mechanical impacts on waste throughout the operational procedures of waste reception, waste encapsulation in containers, transportation to underground facilities, and waste emplacement. In the NUMO safety case [1], the reference design of the repository includes a waste transport system utilizing a spiral ramp for conveying waste from the surface to underground facilities. This design is applied across various generic Site-Descriptive Models (SDMs) representing potential host rocks and Engineered Barrier Systems (EBS), which encompass concepts such as the Prefabricated EBS Module ("PEM" hereafter). In this concept, an overpack containing a vitrified waste, along with bentonite buffer blocks, is assembled within a steel shell at the surface facility and transported using a conventional vehicle to the underground facilities. Several countermeasures have been implemented for this transport system to mitigate the risk of fire, particularly concerning combustibles such as diesel fuel and the rubber tires of the vehicle. Impact analysis has demonstrated that these countermeasures effectively reduce the risk to an acceptable level. To further mitigate the risk of fire, a conceptual design study has been conducted to explore alternative transportation systems include employing an elevator, a funicular system, and a pneumatic transportation system. These alternative designs not only aim to reduce the risk of fire but also offer increased design flexibility to accommodate various siting environments.  In the case of the shaft elevator transport system, the hoisting machine is located at the surface, eliminating potential sources of fire. Safety measures have been developed specifically for transporting a PEM, considering its weight (approximately 37,000 kg). The drop of a PEM poses a significant risk of mechanical impact on the waste. To mitigate this risk, the elevator is designed with multiple and multifarious brake systems, as well as several redundant wires. In the event of failure of these measures, where all elevator wires break and multiple brakes fail, a PEM contained within a cage could collide with the floor at the bottom of the shaft. To minimize the mechanical impact, structures as impact mitigation structures, consisting of piled-up steel boxes, have been designed at the bottom of the shaft. A numerical simulation using elasto-plastic analysis was conducted to assess the impact on a PEM in the event of a drop accident. The collision velocity was assumed to be equal to the terminal velocity of 350 km/h, corresponding to a freefall height of 500 meters.  When utilizing the impact mitigation structures, the estimated load on the PEM was 0.14 giganewtons (GN). Although the impact mitigation structures experienced significant deformation, the metal overpack containing a vitrified waste, bentonite buffer, and the steel shell of the PEM were only slightly deformed.  In contrast, without the impact mitigation structures, a load of 36 GN was applied to the PEM. In this scenario, both the bentonite buffer and the steel shell experienced significant deformation. The overpack was more deformed compared to the previous case, but it did not exceed the limit of breakage.  [1] NUMO-TR-21-01 | |