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Nuclear Energy in Canada

(2) Technology for Radioactive Waste Disposal: Slurry Fracture Injection (SFI) Zero Discharge Deep Well Disposal - Considerations for the Fukushima Daiichi Nuclear Power Plant Site Clean-up -

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1. Introduction

Slurry Fracture Injection (SFI) is an environmentally sustainable and advanced deep well disposal technology. SFI is used to dispose of large volumes of various waste streams including: contaminated soil, sludge, slurry, tank bottoms, and contaminated water. Such waste streams may also be low-level radioactive wastes or Naturally Occurring Radioactive Material (NORM). SFI disposal has been used extensively as a secure and permanent solution to achieve a Zero-Discharge Waste Management Strategy.

2. Advanced Deep Well Disposal

The SFI technology is an advanced deep well disposal process with Process Control. Deep geological sequestration has been proven as a viable solution for the permanent disposal of waste streams such as contaminated soil, sludge, and slurry. Large volumes of these waste streams, including NORM, (10,000+ m^3/month) have been successfully disposed by using the SFI process. The same approach has potential viability for large volumes of such waste streams that are contaminated with low-level radioactivity. However, additional HSE controls need to be implemented to ensure safe handling and slurry preparation of these radioactive waste streams. Implementation of the SFI process results in significant environmental advantages including elimination of run-off & contamination risks to surface and groundwater; elimination of surface land use impairment; elimination of landfills and surface storage; and elimination of long-distance transport risks & costs.

3. SFI Process

To describe the SFI process in its basic terms, waste material is screened to specified injection criteria (if required), then slurried in a stream of waste-water. Slurry is made with as high a waste concentration as possible and pumped down a waste disposal well at in situ fracturing pressures into a suitable deep geologic formation. SFI disposal occurs into thick, porous, permeable geologic formations of intermediate depth (350 to 2000+ m). Special emphasis is placed on the use of industry Best Practices and Process Control features to mitigate risks and achieve Zero-Discharge waste disposal.

SFI is an innovative, sustainable, cyclic hydraulic fracturing process using lower injection rates and pressures (versus conventional hydraulic fracturing methods). The SFI process has been applied to unconsolidated sand formations. The formation geomechanics induced by the SFI process cause the development of a uniform, expansive stimulated rock volume around the disposal well, with significant formation storage capacity. SFI mechanics mitigate development of induced seismicity or fault reactivation.

Extensive process monitoring must be utilized during SFI operations in order to ensure effective Process Control (i.e. ensure in situ containment, optimization of disposal formation response, maximize formation storage capacity, and mitigate wellbore integrity risks). Monitoring techniques include: well logging, formation testing, bottomhole pressure monitoring and engineering analyses (indicator pressure analyses, pressure fall-off analyses,

injection pressure analyses, etc.). This data is continuously used to modify and optimize the slurry design and injection strategies to ensure Process Control during active SFI disposal operations.

Figure 1: Schematic of SFI Facility

4. Conclusion

The SFI technology is being used as an advanced deep well disposal process for many waste streams in different countries, including NORM.

This workshop will review:

- Best Practices (geological, technical, regulatory, and environmental aspects) for the use of SFI technology.
- Geology and technical considerations for assessing the SFI process for the Zero Discharge Deep Well Disposal of certain waste streams generated from the decommissioning of the Fukushima Daiichi Nuclear Power Plant.
- SFI field cases, comprehensive risk assessments, and regulatory issues for deep well disposal.