[Form 2 (to be reported to Committee on Countermeasures for Contaminated Water Treatment and to be disclosed to public)

| Technology Information | |
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| Area | 2 (Select the number from “Areas of Technologies Requested”) |
| Title | Long-term geological sequestration of tritium using deep-well injections |
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1. Overview of Technologies (features, specification, functions, owners, etc.)

The release of tritium and other radionuclides into the ocean has become one of the biggest public concerns at the Fukushima Daiichi NPP site. While pump-and treat options are planned for decontamination of local groundwater (e.g., ALPS technology), there are currently no viable and affordable technologies to separate tritium chemically and physically from the contaminated water. Thus, the treated water would still contain tritium and would have to be kept away from the accessible environment for decades. This can be done in storage tanks but the total waste volumes are large and cost could become an issue.

This proposal suggests exploring the possibility of injecting tritiated water into deep geological formations for long-term disposal. In North America, as regulated under the Underground Injection Control (UIC) program, toxic wastewater has been commonly disposed off in the deep subsurface, including contaminated water from municipalities and water produced from hydrocarbon exploration. Given that tritium has a relatively short half-life and it eventually decays into harmless hydrogen, the deep-well injection of tritium-contaminated water may be a promising option at this site. In general, with favorable geologic conditions, it is possible to design deep underground injection of wastewater such that there is no endangerment of shallow aquifers and other environmental receptors. There are, however, many potential concerns associated with deep-well injection of wastewater, such as the upward migration along preferential flow paths (such as faults) and the potential for pressure-induced reactivation of faults. In addition, there is currently no regulatory framework in place that would allow injection of tritium-contaminated water.

An investigation into the feasibility and performance of deep underground injection of tritiated water would involve (1) evaluation of regulatory framework, (2) site characterization, (3) design of deep-well injection and disposal system, (4) simulation of injection reservoir flow and transport processes, (5) risk assessment, and (6) design of sophisticated monitoring system. In this context, LBNL has developed various analytical and simulation tools for designing and managing deep-well injections:

- TOUGH family of codes for comprehensive and rigorous numerical modeling of tritium plume migration, pressure propagation, and hydro-geomechanical-coupled processes [Pruess et al., 2012; Rutqvist et al., 2010]
- Statistical tools to evaluate the risk of fault activation and induced seismicity [Bachmann et al. 2011, 2012]
- Optimization methods for designing pressure management strategies [Cihan et al., 2011]
- System-level risk assessment tools for quantitative evaluation of disposal risk

In additions, LBNL has available various site characterization and monitoring technologies including the hydrologic characterization of faults.

2. Notes (Please provide following information if possible.)

- Technology readiness level (including cases of application, not limited to nuclear industry, time line for application)

Most of the analytical and site characterization technologies mentioned above have been applied to actual deep-well injections and are ready to use.

- Challenges

Although the public acceptance might be an issue, it would be resolved by setting a proper regulation and providing proper information to the public.

- Others (referential information on patent if any). NO RELATED PATENTS

Bachmann, CE, S Wiemer, J Woessner, S Hainzl, Statistical analysis of the induced Basel 2006 earthquake sequence: introducing a probability-based monitoring approach for Enhanced Geothermal Systems, Geophysical Journal International, Volume 186, Issue 2, pages 793–807, August 2011, DOI: 10.1111/j.1365-246X.2011.05068.x

Cihan, A., Zhou, Q. and Birkholzer, J.T., 2011. Analytical solutions for pressure perturbation and fluid leakage through aquitards and wells in multilayered aquifer systems. Water Resour. Res., W10504.

Pruess, K., C. Oldenburg, and G. Moridis, TOUGH2 User's Guide, Version 2.1, Report LBNL-43134, Lawrence Berkeley National Laboratory, Berkeley, Calif., 2012.

Rutqvist J., Vasco D., and Myer L. Coupled reservoir-geomechanical analysis of $CO_2$ injection and ground deformations at In Salah, Algeria. Int. J. Greenhouse Gas Control, 4, 225–230 (2010)