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Milestone Title	<i>Report on the Status of the SFWST Campaign International Activities in Disposal Research at SNL</i>

The following summaries are provided as fulfillment of milestone M4SF-17SN010307022 and represent international coordination activities in disposal research funded by the US DOE Spent Fuel and Waste Storage and Technologies (SFWST) Campaign during Fiscal Year 2017.

SFWST funded bi-lateral interactions with Taiwan

TECRO-AIT Joint Standing Committee Meeting on Civil Nuclear Cooperation, Sandia National Laboratories (SNL), Albuquerque, New Mexico. December 6-8, 2016

SNL researcher hosted and attended these meetings on behalf of DOE, SFWST. The SNL researcher participated in information exchanges within working group 2, “*Waste Management and Environmental Restoration*”, all having to do with the back end of the commercial nuclear fuel cycle. Specific areas of information exchange included:

- Public participation in siting of nuclear facilities,
- Geological repository sciences,
- Technology transfer for radioactive waste disposal,
- Nuclear fuel extended storage and transportation projects and
- The SFWST campaign progress in general.



SNL researcher provided DOE SFWST Milestone reports on the following topics:

- Public perceptions of nuclear facilities
 - *Insights from Public Surveys Related to Consent-Based Siting and Radioactive Waste Management in the United States*).
- Deep Geologic Disposal Research
 - *Evaluation of Used Fuel Disposition in Clay Bearing Rocks*
 - *Used Fuel Disposition in Crystalline Rocks*
 - *Proceedings of 6th US-German Workshop on Salt Repository*
- Deep Borehole Disposal
 - *Deep Borehole Field Test Conceptual Design*
 - *Deep Borehole Safety analysis*
- Spent Fuel Management
 - *Effects of Lower Drying-Storage Temperature on the Ductility of High-Burnup PWR Cladding*
 - *Documentation of All CIRFT Data Including Hydride Reorientation Tests*
 - *High-Burnup Spent Fuel Data Project Sister Rod Test Plan*
- Spent Fuel Canister
 - *Characterization of Canister Mockup Weld Residual Stresses*
 - *Thermal Modeling of a Loaded Magnastor Storage System at Catawba Nuclear Station*

The next annual meeting is scheduled for early December, 2017 and will be held in Taipei, Taiwan.

OECD-NEA Repository Metadata (RepMet) project

OECD Nuclear Energy Agency (NEA) launched the Radioactive Waste Repository Metadata Management initiative (RepMet) in 2014 under the auspices of the Integration Group for the Safety Case (IGSC) technical body. RepMet's goal is to recommend sets of metadata that can be used by national radioactive waste repository programmes to manage their data, information, and records thereof, in a way that is both harmonised internationally and suitable for long-term management and utilisation, e.g., in safety cases. Furthermore, the initiative that involves over ten different countries' programmes worked on the formulation of a consistent set of guiding principles for capturing and generating metadata, recommending a shortlist of selected relevant standards and guidelines on international good practises.

National radioactive waste repository programs require large amount of data across multiple disciplines (e.g. geoscience, radioactive waste management, engineering) that increase as these programmes proceed in number, type and quality for multiple reasons and goals (e.g.: site characterisation, licensing, safety case elaboration, etc.). Considering these boundary constraints, the core idea of long-term data management is that "data are being collected and managed for others to use them". Next generations of data-users have to be able to understand and access the information that the preserved data represent. Individual scientists and research teams, as well as managers and communications specialists, need to be aware of this and document their work accordingly.

RepMet is facilitating their task by bringing about a better understanding of a key aspect of the modern data management within the field of radioactive waste disposal, namely the identification and management of metadata. The initiative has analysed the metadata implementation both from

the high-level point of view (i.e. methodologies, approaches, organisation policies) and from a more technical one (i.e. recommendation and application of selected metadata standards, data modelling techniques and implementation of controlled dictionaries).

RepMet is developing libraries across three disciplines relevant to radioactive waste management. The libraries are shown in the table below, together with the corresponding disciplines and topics.

Disciplines	RepMet Libraries	Topics
Geoscience	<i>Site Characterisation Library</i>	Geological and geophysical characterisation of the repository site.
Radioactive Waste Management	<i>Waste Package Library</i>	Packaged waste and spent nuclear fuel ready for final disposal at the repository.
Engineering	<i>Repository Library</i>	Repository requirements and structure at closure.

The SNL researcher has been participating in RepMet since its inception when he was elected Vice Chair of the project (the chair is from the Nuclear Decontamination Authority in the UK). RepMet working group meetings are held twice in a calendar year. In November, 2016, working group meetings were held in Madrid, followed by a tour of ENRESA RWM facilities in El Cabril near Cordoba, Spain. In April, 2017, working group meetings were held at the NEA Headquarters in Paris, France.

Working group meetings are held to enable participants in the RepMet project to work face-to-face while developing the libraries, and ensure the final product is acceptable to the multiple RWM programs.

The next RepMet meeting is scheduled for October, 2017 in Paris at the NEA Headquarters.

SFWST funded bi-lateral interactions with the Republic of Korea

The U.S. DOE and the Republic of Korea (ROK) Ministry of Science, ICT and Future Planning (MISP) both have active research programs in the utilization of civilian nuclear energy and the nuclear fuel cycle.

Spent fuel storage, transportation and disposal are an inherent part of the nuclear fuel cycle. Research is being performed in both the US and ROK to evaluate storage, transportation and disposal of spent nuclear fuel. SNL researchers are US Laboratory points of contact for both disposal research as well as storage and transportation research in the Spent Fuel Management Working Group (SFMWG). During June of 2017, SNL researchers attended planning sessions for the development of specific areas of collaboration that benefit the US government by supporting the High Level Bilateral Commission (HLBC) sponsored SFMWG in Seoul, ROK.

The scope of the SFMWG is:

- (a) Research, development, demonstration and technical cooperation on storage, transportation, and disposal of spent fuel;
- (b) Joint efforts to diversify options on spent fuel management in each country;
- (c) Development of advanced technology to minimize the impact of spent fuel management on the

environment, public health and safety;

(d) Cooperation on the effective implementation of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, and other relevant international cooperation mechanism

(e) Exchange of technical expertise and cooperation in the decommissioning of nuclear power plants; and

(f) Other areas of cooperation as determined by the Commission.

The 2nd Meeting of the HLBC Spent Fuel Management Working Group (SFMWG) was held in Seoul, Korea on June 28-29, 2017. In the opening remarks, the U.S. head of delegation noted that it is fortunate for both sides to have an opportunity to exchange opinions on spent fuel issues despite the ongoing transition to new administrations in both U.S. and ROK while decisions are pending. The Head of the ROK Delegation agreed that both governments are in a phase of transition and mentioned that the safe management of spent fuel will continue to be a major challenge for both countries and asked to maintain strong ties. He expressed the hope that this meeting will produce fruitful discussions.

Both sides also discussed an annual report and future activities as well as joint projects and information exchange projects. The results are as follows:

No.	Contents	Discussion	Results
Session I: Joint Projects			
1	Development of technology to evaluate the integrity of spent fuel materials	<ul style="list-style-type: none">- (U.S.) The U.S. side introduced the status of the U.S. research program and acknowledged the ROK's contributions. The U.S. side suggested active cooperation.- (ROK) Recognizing the importance of technical cooperation, the ROK side suggested to discuss specific cooperation items at the meeting with KAERI on June 29.	Both sides agreed to continue information exchange and deferred the execution of this project until the budget from the U.S. side is secured.
2	Development of standardized canisters for transportation, storage and disposal	<ul style="list-style-type: none">- (U.S.) The U.S. side mentioned the status of its technological progress and suggested to share the lessons and information. The U.S side underlined that the development of canister is a key component of the Yucca Mt. license application, and expressed interest in the application of canister standardization concept.	Both sides agreed to share the lessons and analysis results of the research for further cooperation.

3	Development of technology for Zr recovery	<ul style="list-style-type: none"> - (U.S.) The U.S. side suggested to delay execution of the project to 2019 due to budget constraints and both sides agreed to continue dialogue for cooperation. - (ROK) The ROK side agreed to the U.S. proposal. 	<ul style="list-style-type: none"> - Both sides agreed to launch the joint project in 2019. - Both sides agreed to continue active collaboration
4	Deep Borehole R&D	<ul style="list-style-type: none"> - (U.S.) The U.S. side mentioned the government decision to discontinue deep borehole disposal technology and proposed to drop this item due to the Yucca mountain licensing process priority. The U.S. side will issue year-end reports which can be shared with the ROK side and added that lab base interactions could be continued. - (ROK) The ROK side agreed to the U.S. proposal. 	<p>Both sides agreed to remove this item from the agenda list, while lab based interaction could be continued (outside of the HLBC SFMWG).</p>

Session II: Information Exchange Projects

1	Development of technology for off-gas capture	<ul style="list-style-type: none"> - (U.S.) Considering the overlapping scope of this item between the WG and JFCS, the U.S. side proposed to undertake this item under the JFCS program and report the results to the working group - (ROK) The ROK side agreed. 	<p>Both sides agreed to discuss this item under the JFCS program.</p>
2	Conceptual design for disposal facility	<ul style="list-style-type: none"> - (U.S.) The U.S. side suggested that conceptual design and thermal design be combined. The U.S. side mentioned that there are many opportunities in long term cooperation. - (ROK) The ROK side agreed. 	<p>Both sides agreed to continue cooperation as a combined activity under the total system performance assessment code activity.</p>
3	A total system performance assessment code	<ul style="list-style-type: none"> - (U.S.) The U.S. side welcomed cooperation proposal in this 	<p>Both sides agreed to continue with more</p>

	for disposal facility	area, especially related to the GDSA conducted in the U.S. - (ROK) The ROK side suggested increasing the level of cooperation from the current information exchange.	active forms of cooperation.
4	Transportation risk assessment program	- (U.S.) The U.S. side proposed to provide consultancy review for the model being developed by the ROK side. - (ROK) The ROK side agreed.	Both sides agreed to exchange experience and information.
5	Transmission of experiences from decommissioning entities	- (U.S.) The U.S. side recommended the KHNP to take part in the workshop on Nov.2017 to leverage resources for further bilateral cooperation. The U.S. side will provide the U.S. DOE point of contact to ROK. - (ROK) The ROK side agreed to participate in the workshop and inform the U.S side of POC.	Both sides agreed to continue this information exchange.
6	Re-evaluation of the thermal design criterion of the repository	- (U.S.) The U.S. side mentioned that research in this area will be combined into the total system performance assessment activity. - (ROK) The ROK side presented the status of its activities.	Both sides agreed to continue cooperation as a combined activity under the total system performance assessment code activity.
7	Waste-forms for immobilization of long-lived fission products for final disposal	- (U.S.) Considering the overlapping scope of this item between the WG and JFCS, the U.S. side proposed to undertake this item under the JFCS program and report the results to the SFMWG. - (ROK) The ROK side agreed to the U.S side proposal.	Both sides agreed to discuss this item under the JFCS program and report status to the SFMWG.
8	Nuclear fuel cycle option studies	- (U.S.) The U.S side agreed to establish the economic analysis subgroup under the JFCS and suggested active cooperation.	Both sides agreed to conduct this item under the JFCS program and report

		- (ROK) The ROK side agreed.	status in coordination with the SFMWG.
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Session III: Annual Report and Future Plan

1	Annual Report	-	Both side agreed that the ROK side will draft the annual report and the U.S side will give feedbacks.
2	Future plans, etc.	-	Both side agreed to hold the 3 rd Meeting of the SFMWG in the occasion of the 2 nd HLBC plenary. * In case of significant delay in holding the next meeting, teleconference is to be held to monitor progress at a mutually acceptable time.