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Title:	Report on Foreign Travel to Japan for participation in the 12th International Conference on Nuclear Criticality Safety and Follow-on Talks with JAEA and TEPCO on Fukushima Fuel Debris
Author(s):	Kostelac, Cole Michael
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Los Alamos NATIONAL LABORATORY

Memorandum

To: Dr. Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-ESH-21
Thru: Joetta Goda, LANL NCSP Task Manager, NEN-2, MS B228
From: Cole Kostelac, NEN-2, MS B228
Date: October 31, 2023

Subject: Report on Foreign Travel to Japan for participation in the 12th International Conference on Nuclear Criticality Safety and Follow-on Talks with JAEA and TEPCO on Fukushima Fuel Debris

Meeting Details

Attendees from LANL (primarily NCSP funded, except for NCS attendees)

Kelsey Amundson, Riley Bulso (NCS), Theresa Cutler, Cole Kostelac, David Hayes (NCS), Jesson Hutchinson, Garrett McMath, George McKenzie, Alex McSpaden, Mike Rising, Tara Robertson (NCS), Rene Sanchez, Andrew Smiley (NCS), Ionel Stetcu, Nicholas Thompson, Nicholas Whitman, Robert Weldon.

Meeting Title

The 12th International Conference on Nuclear Criticality Safety (ICNC 2023)

Meeting Locations

ICNC 2023 - Sendai International Center, Miyagi, Sendai, Japan
JAEA Meeting – JAEA Headquarters, Tokai-mura, Japan
TEPCO Meeting – Tokyo, Japan

Meeting Dates

ICNC 2023 - October 1st-6th, 2023
JAEA Meeting - October 10th, 2023
TEPCO Meeting - October 11th, 2023

Purpose of Travel

Attendees from Los Alamos National Laboratory traveled from the US to Japan to attend the 12th International Conference on Nuclear Criticality Safety.

Meeting Benefits to the NCSP

All NCSP-sponsored LANL attendees presented original, NCSP-funded research to the international criticality safety community. During this conference, LANL attendees identified multiple opportunities for collaboration to meet nuclear criticality safety needs with international and domestic organizations including IRSN, JAEA, AWE, and the NRC.

Meeting Summary

ICNC 2023 was the 12th International Conference on Nuclear Criticality Safety. It was primarily organized by the JAEA, and co-organized by the NEA and the Atomic Energy Society of Japan. There were 10 primary technical tracks:

1. Codes and Other Calculational Methods
2. Nuclear Data
3. Uncertainty and Sensitivity Analysis
4. Measurements, Experiments, and Benchmarks
5. Standards, Assessment Methodology, Regulations
6. Operational Practices and Safety Cases
7. Storage, Transport, and Disposal Issues
8. Criticality Accidents and Incidents
9. Professional Development Issues and Training
10. Future Challenges

And two special sessions:

A. Fukushima Dai-ichi Nuclear Power Plant
B. Machine Learning, Deep Learning

Monday, October 2, 2023 (ICNC 2023, Technical Meeting)

- A plenary session was given by JAEA representatives on the status of Fukushima Units 1-3 from a criticality safety perspective and the coming restart and renovations of the STACY critical assembly.
- Mike Rising attended the Nuclear Data Track 2. This session included 3 talks all related to thermal neutron scattering data and covariances. The talk by C. Chapman of ORNL on the thermal neutron scattering data covariance evaluation methodology was the most discussed topic of the session.
- Mike Rising co-chaired the Codes and Other Calculational Methods Track 1. Three of the four presentations focused on criticality calculations in random media. These methods to simulate criticality when the configuration of the fuel core is unknown has been inspired by the Fukushima nuclear power plant accident and has been a subject of inter-code and -method comparisons in a subgroup organized by the NEA at the WPNCS meetings. The final paper was more theoretical on the topic of multiplicity calculations.
- Jesson Hutchinson chaired the Fukushima Daiichi Nuclear Power Plant Special session.
- Andrew Smiley chaired the Operational Practices and Safety Cases session.
- Michael Rising chaired the Codes and Other Calculation Methods session.
- Ionel Stetcu had productive discussions with Dimitri Rochman (PSI, Switzerland), chair of the Nuclear Data session, about the philosophy of the nuclear data evaluations, finding common ground on the careful approach in the treatment of nuclear data evaluations as well as in the necessary critical view of model calculation results, especially when data are not available.

Tuesday, October 3, 2023 (ICNC 2023, Technical Meeting)

- HALEU integral experiments were discussed with NRC and DOE.

- Catherine Percher gave an ICSBEP update to the international community, which highlighted numerous recent NCERC experiments. There was some discussion of a shift within ICSBEP from primarily historical experiments in the early 2000s to primarily new experiments today.
- Mike Rising attended the Nuclear Data Track 2. These topics ranged from updates to various nuclear data evaluations for ENDF/B-VIII.1, for example, and to high-fidelity fission fragment simulation and evaluation methods and capabilities.
- Ionel Stetcu also attended Nuclear Data Track 2 and found a presentation particularly interesting: a Japanese group lead by S. Chiba presented a microscopic study of the total kinetic energy in fission, in which the main features of the experimental evidence are reproduced, even though quantitatively the agreement is not good enough for realistic criticality calculations.
- Jesson Hutchinson chaired the Measurements, Experiments, and Benchmarks session.

- **LANL Presentations**
  - Andrew Smiley presented on “Lessons Learned from Ventilation and Glovebox Flooding Via Overfilling of the Wet Vacuum System in a Plutonium Facility” in the Operational Practices and Safety Cases session.
  - Cole Kostelac presented on “Optimization Algorithm for Criticality Experiment Design using Whisper” in the Measurements, Experiments, and Benchmarks session.
  - Jesson Hutchinson presented on “Criticality Experiments to Reduce Compensating Errors in Plutonium Nuclear Data” in the Measurements, Experiments, and Benchmarks session.
  - Nicholas Thompson presented on “The EUCLID Experiment and Nuclear Data Library Comparison” in the Measurements, Experiments, and Benchmarks session.
  - Theresa Cutler presented on “Reactivity Coefficient Measurements to Aid in Reducing Compensating Errors in Plutonium Nuclear Data” in the Measurements, Experiments, and Benchmarks session.
  - Mike Rising presented on “Verification and Validation of the New MCNP6.3 Criticality Features” in the Codes and Other Calculational Methods session.
  - Alex McSpaden presented a poster on “Analysis of the MUSiC He-3 Multiplicity Data” in the Measurements, Experiments, and Benchmarks poster session.
  - Kelsey Amundson presented a poster on “An Alternative to Solution Experiments for Nuclear Data Validation & Training: Reflection and Interaction of Juxtaposed Uranium (RAIJU) Experiment Design” in the Measurements, Experiments, and Benchmarks poster session.
  - Ionel Stetcu presented on “Consistent Nuclear Data Evaluations for Criticality Safety” in the Nuclear Data session.

Wednesday, October 4, 2023 (ICNC 2023, Technical Meeting)

- In the Operational Practices and Safety Class session interest in international criticality safety training was expressed by attendees
- Mike Rising co-chaired the Codes and Other Calculational Methods Track 1.

- Mike Rising attended the Uncertainty and Sensitivity Analysis Track 3. By far, the most interesting talk was provided by T. Endo related to efficient uncertainty quantification methods that rely on deterministic "sampling" of a given distribution of unknown parameters. This technique has real merit in the world of uncertainty quantification where large multi-variate distributions are difficult to propagate uncertainties through complex multi-physics simulations, for example.
- Rene Sanchez chaired the Measurements, Experiments, and Benchmarks session.

- **LANL Presentations**
  - Riley Bulso presented "Application of an Empirical Density Law via Python for Aqueous Plutonium Chloride Systems in MCNP6" in the Codes and Other Calculation Methods session.
  - Tara Robertson presented "Application of a Density Law via Python for Aqueous Plutonium Nitrate Systems in MCNP6" in the Codes and Other Calculation Methods session.
  - David Hayes presented "In Silico Versus in Situ the Challenging Landscape of Nuclear Criticality Safety Training" in the Professional Development Issues and Training session.
  - Nicholas Whitman presented "High Multiplication Neutron Noise Measurements Using the Seven Percent Critical Experiment 7uPCX" in the Measurements, Experiments, and Benchmarks session.
  - Robert Weldon presented on "Methods to Determine Burst Repeatability for Godiva IV" and "Quantifying Burst Repeatability for Godiva IV" in the Measurements, Experiments, and Benchmarks session.
  - Garrett McMath presented on "Experiment Design and Preparation for a Shielding Benchmark Utilizing Godiva IV" in the Measurements, Experiments, and Benchmarks session.
  - Rene Sanchez presented on "MUSiC: Critical Experiment with Bare Highly Enriched Uranium Shells Benchmark in the Measurements, Experiments, and Benchmarks session.
  - Geordie McKenzie presented on "Future of the MUSiC Experiment Data" in the Measurements, Experiments, and Benchmarks session.
  - M. Rising presented on "Verification and Performance Impact of the New Parallel MCNP6.3 Particle Track Output Capability for Subcritical Multiplication Simulations" and co-chaired in the Codes and Other Calculational Methods

Thursday, October 5, 2023 (ICNC 2023, Technical Meeting)

- Lengthy discussions regarding the LANL Chlorine Worth Study (CWS) performed at NCERC took place at the Uncertainty and Sensitivity session.
- Closing session, mainly highlighting the importance of criticality safety in the fuel debris removal in the Fukushima Daiichi Nuclear Power Station.

Friday, October 6, 2023 (ICNC 2023, Tours)

- **Tour of Fukushima Daiichi Nuclear Power Station (Kelsey Amundson, Geordie McKenzie, Garrett McMath, Jesson Hutchinson)**
  - First was JESCO tour, which is running environmental management.
  - Got to see an overview of the efforts related to contaminated soil and water.

  - In the afternoon there was a TEPCO tour which got within about 100 feet of all 6 units.
  - This tour helped provide context for potential fuel debris support.
  - In addition, lots of good interaction with IRSN.
- **Tour of JAEA (Theresa Cutler)**
  - Visit included the nuclear museum which has the mock-up of the Tokai-mura accident.
  - Followed by tour of FCA and STACY. People at both facilities are eager for our expertise. FCA mentioned lots of plans for benchmarks, focused on IRPhEP since they care mostly about the supplemental measurements.
  - STACY continued discussion of their fuel supply issues which greatly limits the types of experiments they can perform upon startup next year.
  - Side discussions with ORANO during the bus ride on our capabilities.
- **Tour of NanoTerasu Cyclotron and Onagawa Nuclear Power Station (Cole Kostelac)**
  - NanoTerasu is a new cyclotron being built on the campus of Tohoku University in Sendai. We got some presentations about it in a conference room and got to look down onto the beam floor.
  - Onagawa is a three-unit BWR power station that was closer to the epicenter of the earthquake than Fukushima. Despite this none of the reactors suffered core damage in large part due to the fact the emergency generators did not fail, and cooling was uninterrupted. They showed us the new sea wall they have built which is now 29m tall instead of 13m. We got to look into the reactor building and turbine hall. They are decommissioning Unit 1 and restarting 2 and 3 within the next couple years; there is a lot of construction going on.

Tuesday, October 10, 2023 (JAEA Meeting)

- LANL had two separate meetings with JAEA. The JAEA is interested in writing a paper on the void reactivity coefficient measurements performed as part of the high Pu240 Jupiter experiment. Preliminary results were shown and a joint paper was discussed. In addition, they are interested in potentially evaluating the void reactivity coefficient measurements for both Jupiter and high Pu240 Jupiter in IRPhEP. The second topic was related to a staff exchange in which a researcher from JAEA would come to Los Alamos for 1 year.
- The second meeting involved the Criticality Safety Research Group at JAEA as well as colleagues from IRSN. This included discussions and a tour of STACY and FCA. The discussions mainly focused on new STACY, which is currently scheduled to achieve criticality in early/mid 2024. Most of the discussions were related to the possibility of performing neutron noise measurements at new STACY. Additional discussions will take place in the future on other topics (such as training of operators).

Wednesday, October 11, 2023 (TEPCO Meeting)

- IRSN and LANL met with TEPCO and Sojitz in Tokyo. Presentations were given by all parties. TEPCO is very concerned about potential re-criticality during fuel debris removal. IRSN and LANL discussed how we could help with monitoring and data analysis. The fuel debris removal work is very timely and is planning to start this FY potentially.

Attachment(s): Meeting agenda

Copy: Doug Bowen, ORNL, bowendg@ornl.gov
John Miller, SNL, millerj@sandia.gov
Marsha Henley, ORNL, henleym@ornl.gov
Johnna Marlow, LANL, jmarlow@lanl.gov

Monday, October 2	Tuesday, October 3	Wednesday, October 4	Thursday, October 5
	8:00–8:30, Coffee *Exhibition Hall 1*		
8:30–11:00, Plenary Session *Exhibition Hall 2*	***8:30–10:35, Session 4*** *Room 1: Track 1, Codes and Other Calculation Methods* *Room 2: Track 8, Criticality Accidents and Incidents* *Room 3: Track 6, Operational Practices and Safety Cases* *Room 4: Track 5, Standards, Assessment Methodology, Regulations*	***8:30–10:35, Session 7*** *Room 1: Track 1, Codes and Other Calculation Methods* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Track 9, Professional Development Issues and Training* *Room 4: Track 4, Measurements, Experiments, and Benchmarks*	***8:30–10:35, Session 11*** *Room 1: Track 3, Uncertainty and Sensitivity Analysis* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Special Session 2, Machine Learning, Deep Learning*
		10:35–11:05, Coffee *Exhibition Hall 1*	
11:00–11:30, Coffee *Exhibition Hall 1*	***11:05–12:45, Session 5*** *Room 1: Track 1, Codes and Other Calculation Methods* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Track 4, Measurements, Experiments, and Benchmarks* *Room 4: Track 5, Standards, Assessment Methodology, Regulations*	***11:05–12:45, Session 8*** *Room 1: Track 1, Codes and Other Calculation Methods* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Track 9, Professional Development Issues and Training* *Room 4: Track 4, Measurements, Experiments, and Benchmarks*	***11:05–12:45, Closing Session*** *Exhibition Hall 2*
11:30–12:45, Session 1 *Room 1: Track 2, Nuclear Data* *Room 2: Track 8, Criticality Accidents and Incidents* *Room 3: Track 6, Operational Practices and Safety Cases* *Room 4: Special Session 1, Fukushima Dai-Ichi Nuclear Power Plant*			
	12:45–14:00, Lunch *Exhibition Hall 1*		
14:00–15:40, Session 2 *Room 1: Track 2, Nuclear Data* *Room 2: Track 8, Criticality Accidents and Incidents* *Room 3: Track 6, Operational Practices and Safety Cases* *Room 4: Special Session 1, Fukushima Dai-Ichi Nuclear Power Plant*	***14:00–16:05, Session 6*** *Room 1: Track 2, Nuclear Data* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Track 6, Operational Practices and Safety Cases* *Room 4: Track 4, Measurements, Experiments, and Benchmarks*	***14:00–15:40, Session 9*** *Room 1: Track 3, Uncertainty and Sensitivity Analysis* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Track 10, Future Challenges* *Room 4: Track 4, Measurements, Experiments, and Benchmarks*	
15:40–16:10, Coffee *Exhibition Hall 1*	***16:05–16:10, Coffee*** *Exhibition Hall 1*	***15:40–16:10, Coffee*** *Exhibition Hall 1*	
16:10–17:50, Session 3 *Room 1: Track 1, Codes and Other Calculation Methods* *Room 2: Track 8, Criticality Accidents and Incidents* *Room 3: Track 6, Operational Practices and Safety Cases* *Room 4: Special Session 1, Fukushima Dai-Ichi Nuclear Power Plant*	***16:10–17:50, Poster Session*** *Exhibition Hall 1*	***16:10–17:50, Session 10*** *Room 1: Track 3, Uncertainty and Sensitivity Analysis* *Room 2: Track 7, Storage, Transport, and Disposal Issues* *Room 3: Track 10, Future Challenges* *Room 4: Track 4, Measurements, Experiments, and Benchmarks*	