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**ORNL
FOREIGN TRIP REPORT
TA 351868**

DATE: January 31, 2014

SUBJECT: Report of Foreign Travel to Moscow, Russia and Paris, France – Bradley T. Rearden, Reactor and Nuclear Systems Division

TO: Jerry N. McKamy, Director, Office of Environment, Safety, and Health, National Nuclear Security Administration / NA-00-10/GTN, 1000 Independence Ave., SW, Washington, DC 20585-1290

FROM: Bradley T. Rearden

PURPOSE: The primary purpose of the travel to Moscow was to participate in the Organization for Economic Cooperation and Development (OECD) Working Party on Nuclear Criticality Safety (WPNCS) Expert groups and Advanced Monte Carlo Techniques (AMCT) and Uncertainty Analysis for Criticality Safety Assessment (UACSA). The primary purpose of the travel to Paris was to participate in the international conference on Supercomputing for Nuclear Applications and Monte Carlo (SNA-MC) 2013.

SITES VISITED: Kurchatov Institute, Moscow; Cité des sciences et de l'industrie, Paris

ABSTRACT: The OECD/WPNCS UACSA expert group is working to apply advanced uncertainty analysis tools to improve confidence in criticality safety validation, and the AMCT expert group is working to establish best practices for the application of advanced Monte Carlo simulations for criticality safety analysis. Both of these expert groups align well the NCSP Analytical Methods tasks, and Brad Rearden is leading activities and contributing key results in both of these expert groups. The SCALE tools developed under Rearden's leadership with NCSP Analytical Methods support provide enabling capabilities that advance the state-of-the-art within the OECD expert groups where new approaches are presented and reviewed in collaboration with the international community.

SNA-MC 2013 continues a series of international conferences with a dedicated focus on Monte Carlo analysis. NCSP Analytical Methods supports the three SCALE Monte Carlo codes for criticality safety and criticality accident alarm system analysis, and this conference provided a venue to present the latest methods developed with NCSP support and to review new techniques presented by other teams. Additionally, the SCALE Monte Carlo capabilities were part of a unique invited session on international Monte Carlo codes, where 22 code teams were represented for direct collaboration.

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REPORT OF FOREIGN TRAVEL

**Bradley T. Rearden
Moscow, Russia and Paris, France
October 21–November 2, 2013**

PURPOSE OF TRAVEL

The primary purpose of the travel to Moscow was to participate in the Organization for Economic Cooperation and Development (OECD) Working Party on Nuclear Criticality Safety (WPNCS) Expert groups and Advanced Monte Carlo Techniques (AMCT) and Uncertainty Analysis for Criticality Safety Assessment (UACSA). The primary purpose of the travel to Paris was to participate in the international conference on Supercomputing for Nuclear Applications and Monte Carlo (SNA-MC) 2013.

Report

UACSA expert group is working to apply advanced uncertainty analysis tools to improve confidence in criticality safety validation. In this meeting, a review of the current benchmark exercises that focus on the determination of correlations in uncertainties between criticality safety benchmark experiments was conducted. The group agreed in principle on the benchmark activity, but there was some debate about the terminology used in the benchmark description. Rearden volunteered to edit the benchmark description in the hope of finding terminology acceptable to all members. Several teams presented preliminary results from the original draft of the benchmark, with several participants using SCALE in their work. Rearden provided three presentations. Rearden's first presentation provided updated results of an earlier exercise to determine the impact of manufacturing tolerances on criticality safety assessment. In this presentation, the new Sampler tool of SCALE was applied to quantify the uncertainty in k_{eff} due to approximately 30 manufacturing uncertainties, including fuel enrichment, fuel-rod dimensions, and fuel-rod pitch. Rearden's second presentation provided an overview of the SCALE/Sampler approach to quantify correlations in uncertainties in benchmark experiments and preliminary results for all experiments in an evaluation from the International Criticality Safety Benchmark Experiment Program (ICSBEP). Here it was found that the primary source of experimental uncertainty for low-enriched uranium fuel-rod lattice experiments is derived from uncertainty in the fuel rod pitch, especially where all pitch uncertainties within a single experiment are treated as fully correlated. Further investigation is required to determine the true level of correlation within each experiment to better assess correlation between experiments. Rearden's third presentation described the initial ORNL investigation into the ENDF/B-VII.1 neutron cross-section covariance data. These initial investigations have seemingly revealed several errors in the ENDF/B-VII.1 data qualified and distributed by the National Nuclear Data Center at Brookhaven National Laboratory that will require further investigation.

The OECD/WPNCS AMCT expert group is working to establish best practices for the application of advanced Monte Carlo simulations for criticality safety analysis. Rearden is leading an exercise to examine errors in Monte Carlo flux tallies, which are needed for reaction rate analysis as well as sensitivity analysis. Preliminary results reveal that errors in the values of the tallies that exceed their reported uncertainties by an order of magnitude are possible in some regions of large fissile systems. The expert group will conduct further investigations and eventually issue best-practices guidance. Additionally, Rearden presented an extended overview of enhanced capabilities that will be available in SCALE 6.2, including significant improvements in continuous-energy Monte Carlo, continuous-energy sensitivity analysis, continuous-energy depletion, as well as the uncertainty quantification capabilities of Sampler. Several expert group members expressed an interest in participating in the SCALE 6.2 beta testing program.

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Overall, Rearden's participation in these meetings provided the opportunity to ensure that NCSP Analytical Methods interests are represented in the international community.

Itinerary

10/21/2013 - 10/22/2013	Travel from Knoxville, TN, USA to Moscow, Russia
10/24/2013 – 10/25/2013	Attend OECD/WPNCS AMCT and UACSA Meetings
10/26/2013	Travel from Moscow, Russia to Paris, France
10/28/2013 – 11/01/2013	Attend SNA-MC 2013
11/02/2013	Travel from Paris, France to Knoxville, TN, USA

DISTRIBUTION

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