

**OAK RIDGE NATIONAL LABORATORY  
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**ORNL  
FOREIGN TRIP REPORT  
TA 366024**

**DATE:** March 26, 2015

**SUBJECT:** Report of Foreign Travel Paris, France – Luiz C. Leal, Reactor and Nuclear Systems Division

**TO:** Jerry N. McKamy, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511/GTN, 1000 Independence Ave., SW, Washington, DC 20585-1290

**FROM:** Luiz C. Leal

**MEETING:  
TITLE** Collaboration meeting with the Institut de Radioprotection et de Sûreté (IRSN)

**MEETING:  
LOCATION** IRSN Headquarters Paris, France

**MEETING:  
DATES** IRSN: September 21 to November 1, 2014

**ATTENDEES:  
ON BEHALF  
OF NCSP** Luiz Leal

**MEETING:  
BENEFIT TO  
NCSP** As part of the activities listed in the Nuclear Criticality Safety Program (NCSP) Five-year plan Luiz Leal worked at IRSN to test and improve new nuclear data evaluations that ORNL is developing for the NCSP. The visit to IRSN provided the opportunity to interact with IRSN criticality safety experts to help expedite the progress on completing new nuclear data evaluations for the NCSP. Another important point is the work with IRSN provided the opportunity to improve the accuracy of the NCSP nuclear data evaluations through extensive testing with IRSN proprietary experimental benchmark data. There is an ongoing effort to generate an evaluated cross-section data for  $^{16}\text{O}$  and  $^{235}\text{U}$ . The IRSN work focused on the evaluation of  $^{16}\text{O}$  and  $^{235}\text{U}$ . During the visit, Luiz Leal also had the opportunity to meet with researchers from the Bruyères-le-Châtel (BRC) laboratory that is part of the French Energy Commission (CEA). The meeting with BRC provided the opportunity to obtain additional differential and integral data that will improve the NCSP nuclear data evaluations.

**PURPOSE:** The purpose of the travel to France is to perform nuclear cross-section evaluation work in accordance with the NCSP Five Year Plan. The travel provided the opportunity for Leal to work with IRSN staff to test and improve the  $^{16}\text{O}$  and  $^{235}\text{U}$  nuclear data evaluations, respectively.

**SITES:  
VISITED** IRSN Headquarters and OECD/NEA Headquarters

**ABSTRACT:** Leal worked at IRSN on the resonance evaluations of  $^{16}\text{O}$  and  $^{235}\text{U}$  and generated MCNP cross-section libraries with the new resonance evaluations in order to test the evaluations with benchmark experiments. In addition, Leal also generated MCNP cross-section libraries using the new ORNL evaluations, and the cross-section libraries were used to model proprietary IRSN benchmark experiments. Based on feedback from the benchmark testing, Leal was able to improve the  $^{16}\text{O}$  and  $^{235}\text{U}$  evaluations. In addition to the work with IRSN, a researcher from BRC traveled to IRSN for a day meeting to discuss a path forward to make further improvements to the new  $^{235}\text{U}$  evaluation. ORNL has developed a new  $^{235}\text{U}$  resonance evaluation that improves benchmark results in the intermediate energy region using new differential experiments carried out at LANL and RPI. The IRSN-BRC meeting served to determine a strategy for improving the high-energy  $^{235}\text{U}$  evaluation with assistance from BRC. A new cross section library has been assembled including ORNL and the BRC evaluation. Leal generated MCNP libraries for testing at ORNL and IRSN. The ORNL, IRSN, and BRC team established plans to meet again in the March-April 2015 timeframe to discuss the benchmark results and finalize the new  $^{235}\text{U}$  evaluation.

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on the distribution list and to U.S. Government Agencies and their Contractors.**

## **REPORT OF FOREIGN TRAVEL**

**Luiz C. Leal**

**Paris, France**

**September 21 to November 1, 2014**

### **PURPOSE OF TRAVEL**

The purpose of the travel to France is to perform nuclear cross-section evaluation work in accordance with the NCSP Five Year Plan. The travel provided the opportunity for Leal to work with IRSN and BRC staff to test and improve the  $^{16}\text{O}$  and  $^{235}\text{U}$  evaluations. These work tasks have been performed in accordance with the NCSP Five Year Plan.

### **Report**

Selected critical benchmark experiments for  $^{16}\text{O}$  and  $^{235}\text{U}$  were used to test the performance of new nuclear data evaluations that have been developed under the NCSP Nuclear Data element. IRSN staff members selected a series of benchmark problems sensitive to  $^{16}\text{O}$  and  $^{235}\text{U}$ . In addition, the performance of the covariance data in the description of the benchmark uncertainties was also investigated for  $^{16}\text{O}$  and  $^{235}\text{U}$ . For  $^{235}\text{U}$ , a cross-section library was obtained combining the new ORNL resolved resonance evaluation combined with a high-energy evaluation performed at BRC. Selected sets of benchmark sensitive to the resonance region and high-energy region were calculated. A list of tasks, shown in APPENDIX A, was laid out at a meeting including participants from IRSN, ORNL and BRC. The meeting focused on issues pertinent to the  $^{235}\text{U}$  evaluation and benchmark experiments in the intermediate and high-energy regions. BRC researchers provided a new high-energy evaluation that appears to improve benchmark results. The ORNL, IRSN, and BRC meeting participants agreed that further benchmark tests are needed and therefore the evaluation may be proposed to the WPEC/CIELO project.

Overall, Leal's foreign travel to IRSN has been important to completing nuclear data evaluation work tasks as defined in the NCSP Five Year Plan. Furthermore, the travel has accelerated the cross-section evaluation and testing effort thereby enabling ORNL to perform work toward completing the NCSP Five Year Plan tasks for these key evaluations.

### **Itinerary**

9/21/14 - 9/22/14	Travel from Knoxville, TN, USA to Paris, France
9/23/14 - 10/30/14	Work at IRSN
11/01/14	Travel from Paris, France to Knoxville, TN, USA

## APPENDIX A

### Action plan

Action	Description	Purpose	Entity in charge	Comment
1	Extend high energy evaluation to 1 keV	Test consistency of average cross section from resonance range and high energy	CEA/DAM	
2	Calculation of Average cross section with NJOY	Compare average cross sections	ORNL/IRSN	
3	Replace unresolved cross section with cross section calculated by Bruyères-Le-Châtel	Perform Benchmark calculations	CEA/DAM ORNL/IRSN	
4	Gather of a selected set of benchmark covering the energy range from thermal to fast	Use integral benchmark to improve differential data evaluation	IRSN	
5	Select reactor benchmark	Test evaluation for reactor applications	IRSN	

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