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**ORNL  
FOREIGN TRIP REPORT  
TA 366866**

**DATE:** March 26, 2015

**SUBJECT:** Report of Foreign Travel to Geel, Belgium – Klaus H. Guber, 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:** Klaus H. Guber

**MEETING:  
TITLE** N/A

**MEETING:  
LOCATION** Institute for Reference Materials and Measurements (IRMM), Geel, Belgium

**MEETING:  
DATES** 10/10/2014 – 10/31/2014 and 11/9/2017 – 11/21/2014

**ATTENDEES:  
ON BEHALF  
OF NCSP** Klaus H. Guber

**MEETING:  
BENEFIT TO  
NCSP** Dr. Guber is a nuclear data specialist who has experience in nuclear data measurements, and he traveled to Geel, Belgium to perform neutron cross-section measurements using the Geel Electron Linear Accelerator (GELINA) at IRMM. The measurements have been performed in accordance with the Nuclear Criticality Safety Program (NCSP) Five Year Plan, and the measurements provide needed nuclear data for the NCSP.

**PURPOSE:** The primary purpose of the travel is to perform nuclear cross-section measurements at the Institute for Reference Materials and Measurements (IRMM) in Geel, Belgium. The primary objective is to perform neutron cross-section measurements on vanadium (V) at IRMM. Furthermore, additional work includes data reduction tasks for measurements that were performed during two previous measurement campaigns in March—July 2014. The previous campaign includes calcium (Ca) and cerium (Ce) neutron capture cross-section measurements at IRMM. All of these work tasks have been performed for the NCSP, and the nuclear data measurement work is performed in collaboration with IRMM of the Joint Research Institute of the European Community.

**SITES:  
VISITED** IRMM at the Joint Research Institute of the European Community, Geel, Belgium

**ABSTRACT:** The traveler visited IRMM in Geel, Belgium. At IRMM, the objective of the visit is to initiate neutron transmission and capture cross-section measurements for V using the GELINA facility. During the visit, the traveler also continued data reduction tasks for Ce and Ca neutron capture data obtained through measurements with “thick” samples.

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## **REPORT OF FOREIGN TRAVEL**

**Klaus Guber  
Geel, Belgium**

**October 10–November 23, 2014**

### **PURPOSE OF TRAVEL**

The primary purpose of the travel is to perform nuclear cross-section measurements at the Institute for Reference Materials and Measurements (IRMM) in Geel, Belgium. The primary objective is to perform neutron cross-section measurements on V at IRMM. Furthermore, additional work includes data reduction tasks for measurements that were performed during two previous measurement campaigns in March–July 2014. The previous campaign includes Ca and Ce neutron capture cross-section measurements at IRMM. All of these work tasks have been performed for the NCSP, and the nuclear data measurement work is performed in collaboration with IRMM of the Joint Research Institute of the European Community.

### **Report**

Klaus Guber traveled to IRMM to perform nuclear data measurement and analysis work for the NCSP. At IRMM, the GELINA (Geel Electron Linear Accelerator) neutron facility can be used to perform neutron-induced cross-section measurements in the neutron energy range from thermal up to ~20 MeV that includes the resonance region for many isotopes/nuclides of interest to the NCSP. GELINA is similar in capability to the Oak Ridge Electron Linear Accelerator (ORELA) in the U.S.; however, ORELA is no longer available for performing neutron cross-section measurements. GELINA is a neutron source driven by a pulsed electron beam, which produces neutrons via Bremsstrahlung from a uranium target. Due to a special compression system, the accelerated electron pulse of GELINA can be compressed to one nsec pulse width at full power. In combination with a long flight path, the GELINA facility provides excellent time-of-flight (TOF) resolution, which determines the neutron energy. Therefore individual resonances of the cross section can be resolved at much higher neutron energies, and this neutron energy-resolution capability is essential for determining the detailed neutron cross-section structure for nuclides of importance to criticality safety applications.

During this trip, two types of experiments were performed at GELINA: transmission experiments to determine the transmission for the thick and thin V samples as well as neutron capture at 60 meters on Flight Path (FP) 14 with different filter combinations using a thick V sample with 80 mm diameter and 14 mm thickness. The data were obtained during the course of a 5-week measurement campaign.

Additionally, data reduction tasks continued at IRMM for the previous neutron capture and transmission measurements of the thick natural Ce and Ca samples. For this task, the GELINA specific software packages AGL and AGS were used. In the first step, all list mode data were converted into TOF spectra. This data conversion was completed for the sample, sample holder, open beam and different background filter configurations. With AGS, the data can be converted to cross-section data or transmission data. The GELINA data-reduction software enables the experimentalist to process all experimental uncertainties in a consistent way to produce a covariance matrix describing all experimental effects, and the experimental covariance data are essential for supporting the cross-section covariance evaluation effort. At this stage, the data are ready for reduction to transmission or cross section, respectively.

Based on preliminary analysis of the Ce and Ca data, the measured cross-section data are useful to support subsequent resonance evaluation work at ORNL. With the high neutron flux from GELINA using a short pulse width in combination with a long flight path, it will be possible to extend the resolved resonance region for Ce beyond the existing resonance evaluation limit of 230 keV. In this energy region, the dominating part for neutron energy resolution is the neutron pulse width. It is expected that the measured Ce and Ca data will be provided to the ORNL evaluators who will prepare new resonance evaluations per the schedule in the NCSP Five-Year Plan.

Overall, Guber's foreign travel to IRMM was very important to completing NCSP measurement and evaluation tasks as defined in the NCSP Five Year Plan.

### **Persons Contacted at IRMM**

Peter Schillebeeckx, Host  
Willy Mondelaers, Section Head NP Unit  
Peter Siegler  
Stefan Kopecky  
Jan Heyse  
Arjan Plompen

### **Itinerary**

10/10/14 - 10/11/14	Travel from Knoxville to Frankfurt, Germany
10/11/14 - 10/11/14	Personal day in Germany
10/12/14 - 10/12/14	Travel to Geel, Belgium
10/12/14 - 10/31/14	IRMM-GELINA, Geel, Belgium
11/01/14 - 11/08/14	Personal time, vacation
11/09/14 - 11/09/14	Travel to Geel, Belgium
11/09/14 - 11/21/14	IRMM-GELINA, Geel, Belgium
11/22/14 - 11/22/14	Personal day in Germany
11/23/14	Travel from Frankfurt, Germany to Knoxville, USA

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