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ORNL
FOREIGN TRIP REPORT
TA 410169

DATE: July 31, 2017

SUBJECT: Report of Foreign Travel to Geel, Belgium – Klaus H. Guber, Reactor and Nuclear Systems Division

TO: Angela Chambers, 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** JRC-Geel, Geel, Belgium

**MEETING:
DATES** 6/27/2017 – 7/19/2017

**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 JRC-Geel. 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 Joint Research Center of the European Union (JRC-Geel) in Geel, Belgium. The primary objective during this trip was to continue neutron capture cross-section measurements on a thick Ce sample at JRC-Geel. Furthermore, additional work includes data reduction and sorting tasks for previous measurement campaigns for zirconium neutron capture cross-section at JRC-Geel. All of these work tasks have been performed for the NCSP, and the nuclear data measurement work is performed in collaboration with JRC-Geel of the European Community.

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

ABSTRACT: The traveler visited JRC-Geel in Geel, Belgium. At JRC-Geel, the objective of the visit is to continue additional neutron capture cross-section measurements for cerium using a thick sample at the GELINA facility. During the visit, Guber performed data reduction tasks for zirconium capture data obtained through measurements with the various sample thickness.

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REPORT OF FOREIGN TRAVEL

**Klaus Guber
Geel, Belgium
June 27 – July 19, 2017**

PURPOSE OF TRAVEL

The main purpose of the travel is to perform nuclear cross-section measurements at JRC-Geel in Geel, Belgium. The primary objective of this trip was to continue neutron capture cross-section measurements on a thick target cerium sample at JRC-Geel. Also, data sorting and reduction for the newly obtained data for zirconium was continued. These work tasks have been performed for the NCSP, and the nuclear data measurement work is performed in collaboration with JRC-Geel of the European Community.

Report

Klaus Guber traveled to JRC-Geel to perform nuclear data measurement and analysis work for the NCSP. At JRC-Geel, 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.

In the course of this trip, the cerium capture cross-section measurements for the thick sample which were started during the last visit have been continued. These measurements were necessary because of the poor statistics at higher neutron energies in previous runs. Due to a closed neutron shell the neutron capture cross section of ^{140}Ce is very small, and hence the data statistics obtained with the regular sample in previous runs turned out to be insufficient.

Additionally, data sorting tasks were continued at JRC-Geel for the previous neutron capture experiments measurement of the natural Zr samples of various thickness. 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.

Based on preliminary analysis of the zirconium data, the measured cross-section data are useful to support subsequent resonance evaluation work at ORNL as planned in the NCSP Five Year Plan. In the obtained

cerium data for the thick cerium sample not only resonance to higher neutron energies could be observed but also resonances of the minor isotopes (abundances less than 0.2%) could be seen. GELINA's high neutron flux in combination with a short pulse width and long flight path will enable ORNL to extend the resolved resonance region for zirconium beyond the existing resonance evaluation limit. In the high-energy neutron region, the dominating factor determining neutron energy resolution is the neutron pulse width.

Overall, Guber's foreign travel to JRC-Geel was very successful and essential to enable ORNL to complete the planned NCSP measurement and evaluation tasks as defined in the NCSP Five Year Plan.

Persons Contacted at JRC-Geel

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

Itinerary

06/27/17 – 06/28/17	Travel from Knoxville to Geel, Belgium
06/28/17 – 07/19/17	JRC-Geel -GELINA, Geel, Belgium
07/19/17	Travel from Geel, Belgium to Knoxville, USA

DISTRIBUTION

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