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ORNL
FOREIGN TRIP REPORT
TA 447668

DATE: January 06, 2020

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, Pantex Plant, PO Box 30020, Amarillo, TX 79120-0020

FROM: Klaus H. Guber

**MEETING:
TITLE** N/A

**MEETING:
LOCATION** JRC-Geel, Geel, Belgium

**MEETING:
DATES** 11/26/2019 – 12/18/2019

**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 main 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 induced cross-section measurements on for a ^{142}Ce sample at JRC-Geel. Furthermore, additional work includes data reduction and sorting tasks for measurement campaigns for the ^{142}Ce sample transmission and capture data 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 neutron capture cross-section measurements for a ^{142}Ce using sample at the GELINA facility. During the visit, Guber finalized data sorting tasks for ^{142}Ce transmission and capture experiments.

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REPORT OF FOREIGN TRAVEL

**Klaus Guber
Geel, Belgium**

November 27 – December 18, 2019

PURPOSE OF TRAVEL

The main purpose of the travel is to perform nuclear cross-section measurements at JRC-Geel in Geel, Belgium. The first objective of this trip was to continue data sorting and reduction of neutron induced cross-section measurements using a Ce-142 sample at JRC-Geel. Secondly, it was attempted to install the new version of the data sorting software AGS was on 64-bit operating systems, such as MAC OS. 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, neutron cross-section measurements activities for Ce-142 were to be continued. The newly obtain transmission data using a Ce-142 sample with better statistics were sorted into TOF spectra for sample in and sample out. The capture data sorting for Ce-142 were finalized during this trip and cross section produced. These experiments include runs for the empty sample container, scattering sample and normalizations runs.

For these tasks, the GELINA specific software packages AGL and AGS were used. In the first step, all runs were checked for consistency using the recorded scalers. In a second step the accepted list mode data runs were sorted into TOF spectra. For the transmission experiments this data conversion was completed for the sample in and sample out as well as various runs with black resonance filters for background determination. The sorted TOF spectra for the capture experiment were reduced to cross section using the AGS software package. With AGS, the data from the TOF spectra can be converted to cross-section data or transmission data, respectively. This 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 results the Ce-142 transmission and capture data will be useful to support subsequent resonance evaluation work at ORNL as planned in the NCSP Five Year Plan. GELINA's high neutron flux in combination with a short pulse width and long flight path might enable ORNL to resolve more resonances compared to previous experiments. 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 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
Arjan Plompen, Section Head NP Unit
Peter Siegler
Stefan Kopecky
Jan Heyse

Itinerary and Schedule

11/26/19 – 11/27/19	Travel from Knoxville to Geel, Belgium
11/27/19 – 11/29/19	JRC-Geel -GELINA, Geel, Belgium. Discussion about how to install new AGS software on 64-bit computers. Attempt to install the software on MAC 64-bit operating system.
11/20/19 – 12/01/19	Weekend
12/02/19 – 12/06/19	JRC-Geel -GELINA, Geel, Belgium. Continue data sorting for capture experiments of Ce-142. Data reduction for Ce-142 capture experiments. Data are processed with AGS software to produce cross section form the TOF-spectra.
12/07/19 – 12/08/19	Weekend
12/09/19 – 12/13/19	JRC-Geel -GELINA, Geel, Belgium. Data reduction for Ce-142 capture experiments. Data are processed with AGS software to produce cross section form the TOF-spectra. Data sorting for transmission experiments.
12/14/19 – 12/15/19	Weekend
12/16/19 – 12/17/19	JRC-Geel -GELINA, Geel, Belgium. Data reduction for Ce-142 capture experiments. Data are processed with AGS software to produce cross section form the TOF-spectra. Data sorting for transmission experiments.
12/18/19	Travel from Brussels, Belgium to Knoxville, USA

DISTRIBUTION

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