



**Oak Ridge National Laboratory  
1 Bethel Valley Road  
Oak Ridge, TN 37831**

**SUBJECT:** Report on Foreign Travel to DOE/EURATOM JSC meeting in Luxembourg and JRC-Geel, Belgium  
**DATE:** 07/31/2023  
**TO:** Dr. Angela Chambers, Nuclear Criticality Safety Program Manager, National Nuclear Security Administration / NA-511  
**FROM:** Klaus Guber

**MEETING TITLE:** 2023 Joint Steering Committee Meeting between DOE and EURATOM

**MEETING LOCATION:** European Commission, Luxembourg and JRC-Geel, Belgium

**MEETING DATES:** 06/29/2023 – 06/30/2023 and 07/02/2023 07/12/2023

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

**MEETING PURPOSE:** The main purpose of the travel was to participate in the DOE/EURATOM Joint Steering Committee Meeting (JSC) in Luxembourg and to perform nuclear cross-section measurements at the Joint Research Center of the European Union in Geel (JRC-Geel), Belgium. The objective during this trip was twofold, firstly, to present the progress on Action Sheet 66 of the DOE/EURATOM agreement and secondly to continue neutron induced cross-section measurements at JRC-Geel for action sheet 66. These measurements for Zr isotopes are in accordance with Appendix B of the NCSP 5-year plan. Furthermore, additional work includes data reduction and sorting tasks for measurement campaigns for the <sup>91</sup>Zr sample transmission and capture data at JRC-Geel. All 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.

**MEETING BENEFITS TO THE NCSP:** Dr. Guber is a nuclear data specialist who has experience in nuclear data measurements, and 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 provide needed nuclear data for the NCSP. At the annual DOE/EURATOM Joint Steering Committee Meeting the progress on this work (Action Sheet 66) is reported.

**PURPOSE OF TRAVEL** The main purpose of the travel was twofold, firstly, to present the progress on Action Sheet 66 of the DOE/EURATOM agreement and secondly to continue neutron induced cross-section measurements and data reduction at JRC-Geel for action sheet 66. One of the goals of this trip was to finalize neutron capture cross-section measurements on a Zr-91 sample at JRC-Geel. Secondly, data reduction for the  $^{91}\text{Zr}$  sample capture and transmission data was performed. 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

Dr. Guber travel to Luxembourg to present the progress on Action Sheet 66 at the annual JSC meeting of the DOE/EURATOM agreement. The hybrid meeting was held at the European Commission building in Luxembourg and attended by 13 DOE personal and about 37 people from EU. On the agenda for the first morning was overview of the individual safeguards programs and activities. Followed by visits to the DG-ENER laboratories in the afternoon. On the second day the progress of the open of the action sheets were presented, followed by a discussion of future opportunities for collaborations.

After the meeting Klaus Guber traveled to JRC-Geel to continue 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  $\sim 20$  MeV that includes the resonance region for many isotopes/nuclides of interest to the NCSP. 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, neutron cross-section measurements activities for Zr isotopes were to be continued. The data sorting for the capture and transmission experiments for Zr-91 were finalized during this trip. These experiments also included data for the empty sample container, scattering sample and normalizations runs. After data sorting it was noted that the flux ion chamber during the capture experiments was intermittently malfunctioning and not observed during the experiments. Only after sorting the data, the problem with the flux measurement were revealed. After discussion with JRC personnel it was decided to see if flux measurements from previous experiments could be used. To determine if this is possible, the partial useful flux spectrum from the Zr-91 experiments was compared to previous flux recordings. The shapes of the two spectra are consistent and can be used as the final data is normalized to the B-10 ENDF library.

The data reduction for the sorted transmission data was performed. For this task, the GELINA specific software packages AGL and AGS were used. With AGS, the data can be converted to cross-section data or transmission data, respectively. The data for sample in and sample out were normalized to same neutron counts. In the next step the data were deadtime and background corrected. As a final step, sample in data were divided by sample out data and the transmission factors obtained. 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.



In addition, discussion about the existing GELINA inelastic cross section data for Fluorine were held. It was determined that the data could possibly be made available to the NCSP program. Further discussions are needed and it needs to be decided who is performing the data reduction, as this is a new procedure and expert advice is needed.

The planned Zr-92 transmission and capture data were as of now not performed. The reason for this delay is multifold. Firstly, the sample was delivered with a three-month delay, secondly the GELINA did not operate reliably and thirdly due to funding restriction the GELINA could not run all the time. Additionally, there is a shortage of GELINA personnel to run and control the experiments. The Zr-92 measurement campaign is scheduled to start mid-September after the scheduled maintenance during the summer break. A discussion was held on how NCSP could increase the support to perform the experiments.

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 on your trip:**

DOE/EURATOM meeting:

Ulla Engelmann, Director of Directorate G (Nuclear Safety and Security)  
Willem Janssens, Head of JRC Department JRC.G.II (Nuclear Science, Safeguards and Security)  
Richard Goorevich, ADA, NNSA  
Kevin Veal, NNSA/NPAC  
Brent McGinnis, PNNL  
Richard Pappas, NNSA/GMS  
Armando Crosland, DOE-NE

JRC-Geel:

Peter Schillebeeckx, Host, JRC-Geel  
Arjan Plompen, Section Head NP Unit, JRC-Geel  
Peter Siegler, JRC-Geel  
Stefan Kopecky, JRC-Geel  
Jan Heyse, JRC-Geel

**Presentations, Chair Responsibilities, etc.:**

- **Action Sheet 66: Neutron Induced Nuclear Data Cross Section Measurements at JRC-Geel,** presented at DOE/EURATOM meeting in Luxembourg.

**Distribution:**

Angela Chambers, [angela.chambers@nnsa.doe.gov](mailto:angela.chambers@nnsa.doe.gov)  
Doug Bowen, [bowendg@ornl.gov](mailto:bowendg@ornl.gov)  
Marsha Henley, [henleym@ornl.gov](mailto:henleym@ornl.gov)

**2023 Joint Steering Committee Meeting  
Between the United States Department of Energy (DOE) and the European Atomic Energy Community  
(Euratom) represented by the European Commission**

**29 - 30 June 2023, DG-ENER Luxembourg  
Luxembourg City, Luxembourg**

**Meeting Agenda**

**Day 1 – Thursday, 29 June 2023**

- 08:30 Le Royal Hotel Luxembourg - passport check and entry permits
- 08:50 U. S. Participants Departure from Hotel [Le Royal Hotel Luxembourg]
- 08:50 – 09:10 Arrival at DG-ENER Luxembourg (by individual means)
- 09:30 – 10:00 Registration of Participants (passport required)

**10:00 – 13:00 JSC Plenary Session (Meeting room: Euroforum 2, Room 02/395)**

- 10:00 – 10:30 Opening Remarks
  - Massimo Garribba, Deputy Director-General for Energy
  - Ulla Engelmann, Director Nuclear Safety and Security, Joint Research Centre
  - Richard Goorevich, Assistant Deputy Administrator for Nonproliferation and Arms Control, Defense Nuclear Nonproliferation, National Nuclear Security Administration
- 10:30 – 10:35 Review and Adoption of Agenda
  - Margarida Goulart, DG-JRC Brussels
  - Amber Footman, NNSA/INSEP
- 10:35 – 10:45 Overview of Euratom Safeguards Implementation
  - Stephan Lechner, Director Euratom Safeguards, DG ENER
- 10:45 – 10:55 Overview of JRC Safeguards and Security Activities
  - Willem Janssens, Head of Department Nuclear Science, Safeguards and Security, DG-JRC
- 10:55 – 11:10 Overview of DOE/NNSA Nuclear Safeguards Activities
  - Kevin Veal, NNSA/NPAC
- 11:10 – 11:25 *Coffee Break*
- 11:25 – 11:45 Overview of DOE/NNSA and JRC Export Control Activities
  - Richard Talley, NNSA/INECP [VIRTUAL]
  - Isabella Maschio, JRC [VIRTUAL]

- 11:45 – 12:05 Overview of DOE/NNSA – JRC collaborations in Nuclear Security Activities, including Border Monitoring Working Group and Nuclear Forensics Collaboration
- Dick Pappas, NNSA/GMS
  - Klaus Mayer, JRC [VIRTUAL]
- 12:05 – 12:15 Overview of DOE/NNSA's Safeguards Technology Development
- Arden Dougan, NNSA/Safeguards Technology [VIRTUAL]
- 12:15 – 12:30 Interventions from other EU services (EEAS, INTPA)
- 12:30 – 12:45 Discussion, priority setting and follow up actions
- 12:45 - 12:55 Formal signature/endorsement of previously agreed action sheets
- 12:55 – 13:00 Plenary Session Wrap Up / Group Photo
- 13:00 – 14:00 *Buffet Lunch, room EUFO 00/296*

**14:00 – 16:00 DG-ENER Laboratory Tour**

- 14:00 – 14:10 Assignment of Group in Preparation of DG-ENER Lab Tours
- 14:10 – 15:00 DG-ENER Containment and Surveillance Lab Tour: Group One  
DG-ENER Nondestructive Assay Lab Tour: Group Two
- 15:00 – 15:50 DG-ENER Nondestructive Assay Lab Tour: Group One  
DG-ENER Containment and Surveillance Lab Tour: Group Two
- 15:50 – 16:00 Final Remarks / Adjourn Day One
- 16:00 Depart for Hotel

**19:00 – 21:00 Dinner**

- 19:00 – 19:30 U. S. Participants Meet in Lobby
- 19:30 – 21:00 **Dinner at Foyer Européen** (address: 10-12, Rue Heinrich Heine, L-1720 Luxembourg)

**Day 2 – Friday, 30 June 2023**

08:30      Departure from Hotel

**09:00 – 12:00 Action Sheet Briefings**

09:00 - 09:05	Opening Remarks	Margarida Goulart, DG-JRC Brussels Amber Footman, NNSA/INSEP
09:05 - 09:35	Discussion of Nuclear Forensics Action Sheets <ul style="list-style-type: none"> <li>- Action Sheet 56: Cooperation on <math>^{231}\text{Pa}</math>-<math>^{235}\text{U}</math> Age Dating Measurements of Uranium for Nuclear Forensics [VIRTUAL]</li> <li>- Action Sheet 61: Cooperation on Plutonium Age Dating for Nuclear Forensics [VIRTUAL]</li> </ul>	Ruth Kips, LLNL
09:35 - 09:55	Discussion of Export Control Action Sheets <ul style="list-style-type: none"> <li>- Action Sheet 53: Technical Collaboration on Strategic Export Controls [VIRTUAL]</li> <li>- Action Sheet 57: Collaboration on Trade Analysis and Visualization [VIRTUAL]</li> </ul>	Richard Talley, INECP Cristina Versino, JRC
09:55 – 10:10	Discussion of Safety Action Sheet <ul style="list-style-type: none"> <li>- Action Sheet 66: Neutron Induced Nuclear Data Cross Section Measurements at JRC-Geel</li> </ul>	Klaus Guber, ORNL
10:10 – 10:25	<i>Coffee break</i>	
10:25 - 11:40	Discussion of Safeguards Action Sheets <ul style="list-style-type: none"> <li>- Action Sheet 48: Cooperation in Joint Outreach and Training on Nuclear Safeguards</li> <li>- Action Sheet 62: Cooperation on Safeguards Measurement Quality Assurance [VIRTUAL]</li> <li>- Action Sheet 63: Enhancement of Measurement Quality for Nuclear Safeguards Accountancy [VIRTUAL]</li> <li>- Action Sheet 67: Improving Digital Cherenkov Viewing Device Image Analysis to Gain Effectiveness and Efficiency in Spent Fuel Verification [VIRTUAL]</li> <li>- Action Sheet 68: Joint Testing and Evaluation of the Fixed Energy Response Function Analysis with</li> </ul>	Brent McGinnis, PNNL Pete Mason, NBL PO Pete Mason, NBL PO T. Jay Harrison, PNNL Duc Vo, LANL

	Multiple Efficiencies (FRAM) Version 6.1 Code [VIRTUAL]	
11:40 – 12:00	Summary Discussion of Open Action Sheets	Margarida Goulart, DG- JRC Brussels Amber Footman, NNSA/INSEP
12:00 – 13:30	<i>Buffet Lunch, room EUFO 00/296</i>	
<b>13 :30 – 15:30 Discussion on Opportunities for Future Collaboration</b>		
13:30 – 15:00	<ul style="list-style-type: none"> <li>- Nuclear Forensics Proposals</li> <li>- Export Control Collaboration</li> <li>- Nuclear Safety</li> <li>- International Safeguards</li> <li>- International Nuclear Security</li> </ul>	DG-JRC / NNSA DG-JRC / NNSA DG-JRC / NNSA Goulart / Footman DG-JRC / NNSA
15:00 – 15:30	Closing Remarks and Adjourn	Janssens / Erdmann / Veal