

# Review of CRP and Meeting Objectives

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First Research Coordination Meeting of IAEA Coordinated Research Project on  
*Plasma-Wall Interaction for Irradiated Tungsten and Tungsten Alloys in Fusion Devices*  
IAEA, Vienna, 26-28 Nov 2013



# IAEA Coordinated Research Projects

See: <http://cra.iaea.org/>

## Nuclear Data Section CRPs

For example...

- CRP F44003 on **Primary Radiation Damage Cross Sections**. Determine ways to characterize radiation damage beyond the NRT dpa standard.
- CRP F43020 on **Data for Erosion and Tritium Retention in Beryllium Plasma-Facing Materials**. Experiments and modelling for the JET and ITER main wall material.
- CRP F44002 on **Nuclear Data Libraries for Advanced Systems: Fusion Devices (FENDL-3)**. Update the Fusion Evaluated Nuclear Data Library to support fusion reactor development and IFMIF.

In general:

- Usual aim is to produce data for some well-defined class of processes.
- Normally 8-14 participating projects.
- Normally 3 Research Coordination Meetings over the course of 3-4 years.
- An INDC (NDS) meeting report is produced for each RCM.
- Final report is often a data document, IAEA Tecdoc, but can be different.



## CRP on Irradiated Tungsten

**Full title:** Plasma-Wall Interaction for Irradiated Tungsten and Tungsten Alloys in Fusion Devices.

**But really...** Tritium Retention in Irradiated Tungsten.

**Main topics:**

- Characterization of microstructure of irradiated tungsten;
- Hydrogen trapping and migration in damaged tungsten.

**Main objective for the end of the CRP:** To provide best expert estimates and uncertainties for tritium retention in tungsten-based materials in a fusion reactor environment.

**Very much interest:** 19 participating projects, many of them multi-institute teams; all fusion parties well represented.

**Expected schedule:**

- First Research Coordination Meetings (RCM) **26-28 Nov 2013**.
- 2<sup>nd</sup> RCM in about **Jun-Aug 2015**, 3<sup>rd</sup> RCM in **Feb-Apr 2017**.
- **Final report** developed in 2017, **published in 2018**.

**Other activities** are possible, e.g. in connection with PSI or PFMC meeting.



## CRP Research Objectives

**Broad objective:** to understand how tritium retention, tritium migration and ways to extract trapped tritium are affected by radiation damage.

- Effects of neutron irradiation and charged particle surrogate irradiation on the microstructure of tungsten-based plasma-facing materials.
- Relation between tungsten microstructure after irradiation and properties of tritium retention and tritium migration.

**Goal for the end of the CRP:** Synthesize new information, extrapolate to relevant fusion neutron fluence, and provide best expert estimates and uncertainties for properties of tritium retention and tritium transport for tungsten-based materials in a fusion reactor environment.

**Central concept:** Irradiated tungsten microstructure.

- How to characterize microstructure (in experiment and in a database)?
- Study production and evolution of vacancies, interstitials, Frenkel pairs, line and plane dislocations, bubbles, grain boundaries, amorphization, ..., as a function of mode of irradiation.
- How does tritium trapping and tritium migration depend on microstructure?

**The CRP requires strong coupling between experiment and computation.**



## Database options and objectives

NDS and A+M Data Unit maintains databases on plasma-material interaction: see <https://www-amdis.iaea.org/ALADDIN>.

Some of the output of the CRP may be suitable for a database.

However, we have no data in ALADDIN at this time on microstructure or effects of irradiation or hydrogen transport in material, and we don't know a good structure for it either. This for discussion.



## Knowledge Base option

We maintain a Wiki-style knowledge base, <https://www-amdis.iaea.org/w/>, for information about atomic, molecular and plasma-material interaction data. It is a resource for locating such data and for supporting information.



## Objectives for the First RCM

**Exchange information about ongoing work.**

- 19 participants, 19 major active research projects.
- Experiments on damage production, hydrogen exposure.
- Applied and fundamental modelling.

**Review work that is most needed next 3-5 years.**

- Experiments and modelling to improve understanding of damage production; neutron and surrogate irradiation.
- Experiments and modelling to improve understanding of hydrogen in damaged tungsten, as it depends on the microstructure.
- Fundamental (QM) modelling to support applied (MD, KMC) work.

**Review and coordinate work plans.**

- Each participant to review work plan for next 1-3 years in light of all the work in the CRP.
- Make plans for cooperation; exchange of information between RCM.



## Meeting schedule

**Tuesday + Wednesday:** Presentations. 19 CRP participants and ITER.

**Thursday:** Review and discussion sessions towards work plan:

1. Production and characterization of damage; experiments and supporting modelling.
2. Hydrogen (tritium) retention and transport in damaged tungsten; experiments and supporting modelling.
3. Fundamental modelling and its connection to experiments and applied modelling.
4. Review of expected outputs of the CRP and of individual contributions; plans for coordinated work.

**Following the meeting:** Production of the meeting report, INDC(NDS) series. Presentation summaries are requested from all participants. I ask for volunteer help for the summaries of Items 1-3 in Thursday's discussion.

**Next likely interaction:** 21<sup>st</sup> PSI (Kanazawa, 26-30 May 2014) and 12<sup>th</sup> Hydrogen Workshop (Toyama, 2-4 June 2014). Consider some joint contributions.

... **Thank you and let the science begin** ...

