

Interoffice Memorandum

To: D. Hahn,
DIR-NENP

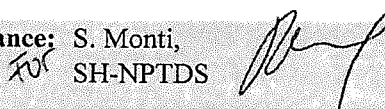


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Through:

Clearance: S. Monti,
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Reference: I3-CS-54421

Date: 2016-08-01

Subject: Report on the Consultants Meeting on Reviewing the Outcome of the CRP, Updating HEEP and Integration of Magnesium Chlorine Cycle for Hydrogen Production in HEEP Library

Place of Meeting: VIC, Vienna, Austria
Date of Meeting: 19-21 July 2016
PTAEO code: 1000155.2016.06.RBF-MP1-2016.613222-NHR-TRV-Non Staff
Cons.NENP-Nuclear Power Technology Development Section
Chairperson: Mr Yan Xinglong
Scientific Secretary: Mr Ibrahim Khamis

ATTENDING EXPERTS

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1. Background

The Hydrogen Economic Evaluation Programme (HEEP), developed by the Agency is still under continuous update. HEEP is being used for the economic assessment of nuclear hydrogen production. To reach a confident level by users, HEEP has undergone a benchmarking within the recently completed the CRP entitled "Examining the Techno-Economics of Nuclear Hydrogen Production and Benchmark Analysis of the IAEA HEEP Software". Participants to the CRP provided an ample of important recommendations for the update of HEEP. Furthermore, since its last release, feedback from other users of HEEP has provided valuable input for the update of HEEP. Recent research publications

showed that the magnesium chlorine is eyed as another promising hydrogen production technology which can be integrated with different nuclear power plants and analysed using HEEP. HEEP already has several processes for nuclear hydrogen production including conventional and high temperature electrolysis, and thermochemical and hybrid thermochemical cycles such as Sulphur-Iodine (S-I), Hybrid-Sulphur (HyS) and others.

The aim of this consultants meeting was to assess the above mentioned feedback and suggestions, and to draft a roadmap for the HEEP update based on all recommendations received by the Agency.

2. Objectives of the meeting

The purpose of the consultancy meeting is to:

- Review various input and feedback provided by HEEP users.
- Discuss ways to include recommendations in future update of HEEP.
- Discuss the potential update of HEEP based on available details and information of the magnesium chlorine thermochemical hydrogen production cycle.
- Discuss update of HEEP based on modelling of cost estimation credit for by-products such as: oxygen, electricity, and/or heat.
- Assess improvement of the calculations in HEEP by applying capacity specific cost correlation separately for the different processes.
- Expand the user's manual of HEEP with details on all major updates.
- Update HEEP to become compatible with different operating system.

3. Agenda

The complete agenda of the meeting is included as ANNEX I of this report.

4. Summary of the work done and results achieved

The meeting discussed three main items: the update of HEEP, launching a new CRP, and status of the TECDOC based on the recently completed CRP. Based on the recommendations of the CRP and the feedback of several experts and users of HEEP, a roadmap on HEEP updates was discussed and drafted for a potential update and release of a new version of HEEP. The roadmap was structured for implementation through two phases as follows:

1. Updates to be incorporated in 1st phase by December 2016

- Expanding manuals to add explanations on economic models, equations used, description/definitions of input parameters and clarifications, benchmarking case studies and generic case studies.
- Perform efficiency calculations for nuclear energy, hydrogen generation along with overall efficiency and display as one the result.
- Minor modifications in database library (rename APWR to SMR) and add SCWR library-based on Generic Case.
- Mention contact details and associated information for downloading source files in Splash Screen of HEEP.
- Include cost estimation credit for oxygen as a by-product.
- Provide feature to process results excel sheet format.
- Make HEEP compatible with different operating system.

2. Updates to be incorporated in 2nd phase after December 2016

- Features to perform optimization studies and sensitivity analysis.
- Provide options to consider renewable/other energy sources for comparative assessment.
- Include cost estimation credit for other by-products.
- Improve the calculations by applying capacity specific cost correlation separately for the different processes.
- Display input parameters in graphical form.

In concurrent with the completed CRP's recommendations, the CM discussed the initiation of a new CRP with focus on the assessment of nuclear hydrogen production technologies where main objectives for this new CRP could be assessing technical and economic aspects of nuclear hydrogen production for near-term deployment with the main aim of providing milestone recommendations to the MSs considering nuclear hydrogen production. The overall objectives of this CRP are proposed as: to review and assess previous experience gained from R&D on nuclear hydrogen production in MSs; to assess the techno-economics of near-term deployment of nuclear hydrogen production; to assess the roadmap for commercialization of nuclear hydrogen production; to establish milestone recommendations to MSs on nuclear hydrogen production; and to improve understanding of the feasibility of nuclear hydrogen as part of the future hydrogen economy.

Finally, the status of the TECDOC resulted from the already completed CRP on Examining the Techno-Economics of Nuclear Hydrogen Production and Benchmark Analysis of the IAEA HEEP Software was also discussed and the principle CSIs were requested to update their contributions within 1 month in order to complete the first draft of the TECDOC and get it ready for final submission.

3. **Conclusions**

The CM was timely needed to:

- Draft a roadmap for future updates of HEEP based on various recommendations,
- Formulate a draft of a new CRP on Assessing technical and economic aspects of nuclear hydrogen production for near-term deployment to provide a roadmap including milestone recommendations for nuclear hydrogen production commercial deployment and conduct feasibility case studies for nuclear hydrogen production deployment,
- Review status of the foreseen TECDOC for the completed CRP.

ANNEX I



IAEA Consultants Meeting on

Reviewing the Outcome of the CRP, Updating HEEP and Integration of Magnesium Chlorine Cycle for Hydrogen Production in HEEP Library

VIC, Vienna, Austria

Room C0737

19 to 21 July 2016

Meeting Agenda

Tuesday, 19 July 2016		
09:30	Welcoming remarks	Mr Khamis, IAEA
09:35	Introduction of participants	All participants
09:40	Overview and objectives of the meeting	Mr Khamis, IAEA
	Introduce the main Recommendations and Feedback on HEEP	
10:00	Discussion on the inputs and Feedback on HEEP	All participants
10:30	<i>Coffee Break</i>	
11:00	Discussion on the CRP's Recommendations	All participants
12:30	<i>Lunch Break</i>	
14:00	Discussion on update of HEEP (including cost estimation of cogeneration and by-products in HEEP)	All participants
15:00	<i>Coffee Break</i>	
15:15	Discussion on update to HEEP Library & HEEP User's Manual	All participants
17:30	<i>Wrap up of Day 1</i>	

Wednesday, 20 July 2016		
09:00	Discussion on extending HEEP's Library (new technologies like Mg-Cl thermochemical cycle)	All participants
10:30	<i>Coffee Break</i>	
11:00	Discussion on Updating HEEP to become compatible with different operating system	All participants
12:30	<i>Lunch Break</i>	
14:00	Discussion on Overall economic and technical models in HEEP	All participants
15:30	<i>Coffee Break</i>	
15:45	Discussion on future activities on HEEP & Nuclear hydrogen production (e.g. new CRP)	All participants
17:30	<i>Wrap up of Day 2</i>	

Thursday, 21 July 2016		
09:00	Finalizing a roadmap for the update of HEEP	All participants
11:00	<i>Coffee Break</i>	
11:15	Conclusions and Recommendations	All participants
12:15	Closing Remarks	Mr Khamis, IAEA
12:30	<i>Adjourn the Meeting</i>	