



HTR-N & N1
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Document Title

**Revised work program for WP3:
Physics Analysis of Different Fuel Cycles**

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1. Introduction

Work Package 3 of the «HTR-N» contract is concerned with the assessment of the performance of fuel types in different (high temperature) reactor systems to be investigated with respect to Pu-incineration capabilities, economics and safety, with emphasis on Pu-incineration. According to the original contract FIKI-CT-2000-00020 «HTR-N» [1] and confirmed at the kick-off meeting [2], WP3 was supposed to deal only with *1st generation civil plutonium*. However, in view of the reductions in Work Package 3 of the follow-up contract «HTR-N1» compared to the proposal FIS5-2001-00074 «HTR-N1» [3], the work program of «HTR-N» WP3 has to be modified in order to cover *2nd generation civil plutonium* (recycled MOX, «Pu-II») as well. This will support strategy studies on LWR/HTR symbiosis by the new partners COGEMA and BNFL in «HTR-N1». Generally speaking, the revision means that a second Pu-vector, viz. from reprocessed LWR MOX fuel, will have to be taken into account.

From the «Description of Work» (Technical Annex) in the «HTR-N1» contract [4] the following tasks have been defined for «HTR-N1» Work Package 3 «Strategies and Benchmark for Plutonium Burning». The activities under the new «HTR-N1» contract started 1. September 2001. The schedule for the proposed tasks is then as follows (see [4]):

- N1/3.1 Plutonium cell burn-up benchmark (**FZJ (1.5 Man-Months), CEA (1.5 MM), NRG (1 MM), IRI (1 MM), IKE (1 MM), UNIPI (1 MM); September 2001 - August 2002**)
- N1/3.2 Identification of reference (Pu-II) cycle (**NRG (2 MM); February 2002 - April 2003**)
- N1/3.3 Strategy study on LWR/HTR symbiosis (**COGEMA (1 MM), BNFL (1 MM); September 2002 - October 2003**)

Task 3.1 does not require any interaction with «HTR-N». Task 3.2 involves the definition of the Pu-II vector and reference fuel cycle, after which core physics analyses will be performed within «HTR-N» WP3, tasks 3.2b (pebble bed HTR with continuous recycling) and 3.3b (block type HTR) to optimise for Pu-incineration and minimum generation of minor actinides. Task 3.3 will be based on these results. *In «HTR-N» WP3 3 MM will be transferred from Siemens/KWU (now FRAMATOME-ANP GmbH) to FRAMATOME for LWR/HTR Pu-II strategy studies.*

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2. Revised work program

In this revision of the WP3 work program the original tasks have been retained but the original tasks 3.2 «Fuel cycles with continuous reload (pebble bed HTR)» and 3.3 «Fuel cycles with batch-wise reload (block type HTR)» each have been split in one part dealing with *1st generation Pu* and one part dealing with *2nd generation Pu* from recycled LWR MOX fuel. The number and identification of deliverables remains unchanged. The activities within the tasks are as follows:

Task 3.1 - Definition of common parameters

This task is mainly unchanged. A reference composition of *2nd generation Pu* will be added to the set of common parameters. The following subtasks have been defined:

- N/3.1.1 Definition of reference pebble bed HTR (HTR-Modul) (FZJ/January 2001/COMPLETED)
- N/3.1.2 Definition of reference block type HTR (CEA/January 2001/COMPLETED)
- N/3.1.3 Selection of reference *1st generation Pu* composition (CEA,FZJ/January 2001/COMPLETED)
- N/3.1.4 Definition of common output parameters to be calculated for each design (NRG/July 2002)
- N/3.1.5 Selection of reference *2nd generation Pu* composition (BNFL, COGEMA, FRAMATOME/February 2002/COMPLETED)
- N/3.1.6 Production of deliverable 3.1.1 (NRG, FZJ, CEA/July 2002)

Task 3.2a - Fuel cycles with continuous reload (pebble bed HTR): *1st generation Pu*

This task contains the activities of the original task 3.2. However, the number of cases studied should be reduced in order to preserve resources for the study of Pu-II cases in Task 3.2b. The following subtasks have been defined:

- N/3.2a.1 Investigation of Th/Pu fuel cycle (FZJ/July 2002)
- N/3.2a.2 Investigation of pure Pu fuel cycle (NRG/July 2002)
- N/3.2a.3 Optimisation of power size of U-fuelled annular cores (IKE/September 2002)

For each of the cases studied in tasks 3.2a, 3.2b, 3.3a, 3.3b and 3.4 the common output parameters agreed upon will be calculated to facilitate intercomparison of the different concepts with respect to Pu-incineration capabilities, economics and safety.

Task 3.2b - Fuel cycles with continuous reload (pebble bed HTR): *2nd generation Pu*

This task contains the new activities related to and required for the «Strategy study on LWR/HTR symbiosis» in «HTR-N1». The following subtasks have been defined:

- N/3.2b.1 Investigation of Th/Pu fuel cycle (FZJ/February 2003)
- N/3.2b.2 Investigation of pure Pu fuel cycle (NRG/February 2003)
- N/3.2b.3 Intercomparison of results and production of deliverable 3.2.0 (NRG, FZJ, IKE/May 2003)

Task 3.3a - Fuel cycles with batch-wise reload (block type HTR): *1st generation Pu*

This task contains the activities of the original task 3.3. However, the number of cases studied should be reduced in order to preserve resources for the study of Pu-II cases in Task 3.3b. The following subtasks have been defined:

- N/3.3a.1 Investigation of MOX and Pu/MA based fuel cycles (CEA/July 2002)
- N/3.3a.2 Investigation on the optimal use of burnable particles (IRI/December 2002)

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Task 3.3b - Fuel cycles with batch-wise reload (block type HTR): 2nd generation Pu

This task contains the new activities related to and required for the «Strategy study on LWR/HTR symbiosis» in «HTR-N1». The following subtasks have been defined:

- N/3.3b.1 Investigation of MOX and Pu/MA based fuel cycles (**CEA/February 2003**)
- N/3.3b.2 Production of deliverable 3.3.0 (**CEA, IRI/May 2003**)

Task 3.4 - Spectrum transmitter

This task is mainly unchanged. The following subtasks have been defined:

- N/3.4.1 Investigation on the use of fast islands in HTRs for incineration of (minor) actinides (**ITU/September 2001/COMPLETED**)
- N/3.4.2 Production of deliverable 3.4.1 (**ITU/September 2001**)
- N/3.4.3 Definition of follow-up activities (**ITU/June 2002**)

Task 3.5 - Peer review and synthesis of the results

This task is -in a formal sense- mainly unchanged as well. The following subtask have been defined:

- N/3.5.1 Provide comment on proposals for QA guidelines (**ALL/August 2001/COMPLETED**)
- N/3.5.2 Additional QA guidelines and definition of procedures for document preparation, review and approval (**ANSALDO, UNIPI/June 2002**)
- N/3.5.3 Peer review (**ANSALDO, UNIPI/March 2003**)
- N/3.5.4 Intercomparison of results and production of deliverables 3.5.2 and 3.0.0 (**NRG/September 2003**)

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References

- [1] European Fifth Framework Program Contract no. FIKI-CT-2000-00020 «HTR-N», signed 4. September 2000.
- [2] Minutes of kick-off meeting «HTR-N», document no. HTR-N-00/10-M-0.1.1, 9. October 2000.
- [3] European Fifth Framework Program Proposal no. 2000-014 «HTR-N1», January 2001
- [4] European Fifth Framework Program Contract no. FIKI-CT-2001-00169 «HTR-N1», signed 20. September 2001.