



HTR-N

HTR-N & N1
High-Temperature Reactor Physics and Fuel Cycle Studies
(EC-funded Projects: FIKI-CT-2000-00020 & FIKI-CT-2001-00169)

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Document Title

HTR-N PROJECT PEER REVIEW

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Chronology and history of revisions

Rev.	Date	Description
1 st Working draft	11/12/2002	Initial draft with first review plan for HTR-N Partners comments - Review activity keeps following
2 nd Working draft	9/7/2003	First formal issue – definition of the review plan, WP3 documents review
3 rd Working draft	19/12/2003	latest updated version – revision of the review plan, added reviews
4th Working draft	26/10/2004	latest updated version – revision of the review plan, added reviews
0	30/11/2004	final draft - first formal issue

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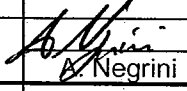
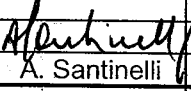
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0	30/11/2004	first issue				
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Cronologia e storia delle revisioni

Chronology and history of revisions

Rev. / rev.	Data / date	Descrizione /description
0	30/11/2004	First formal issue: for issued draft versions chronology see HTR-N document HTR-N-03/07-D-3.5.1-2_0 (review plan and WP3 documents review updating)

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1. SCOPE

The document provides the general requirements and objectives for performing the HTR-N project [1] peer review activity under Task 3.5 of Work Package 3. It also identifies a reference list, updated as necessary, for the most relevant HTR-N documents designated for reviewing and, possibly, for further investigations through computer program calculations and selected analyses.

The review activity is being applied according to the HTR-N project Quality Assurance guidelines and procedures described in references [2, 3] with the principal objective of verifying reliable and consistent generation and exchange of data/information originated inside the HTR-N Project.

This document is mainly intended for outlining and planning the review task, with a general, mainly formal, summary of the of the review activity, while details on review results and comments are being addressed by suitable review reports.

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2. INTRODUCTION

A Q.A. basic framework for the HTR-N project has been proposed by Ansaldo and discussed between the HTR-N partners, leading to the Q.A. reference documents reported in [2, 3]. Further to the definition of general guidelines for harmonising the HTR-N Q.A. procedures between the HTR-N project and the Partners', some general criteria and rules are also addressed for ensuring a reliable and consistent generation, verification and exchange of information and data originated inside the HTR-N Project.

These rules and criteria have to be considered in the main guidelines for performing the peer review activity which, besides checking and validating the formal consistency of documents, may also propose and/or go through alternative, as far as simplified to the extent possible, evaluations by computer program calculations and focused analyses.

The main criteria for assessing the HTR-N documents by peer review, in order to certify the basic correctness of final deliverables, can be summarised in the following:

- a) consistency among the different parts relevant to the HTR-N Project (input data, information, methods, processes);
- b) reliability and traceability of contents and applications.

The specific objectives of the HTR-N Q.A., as also applicable to the review activity, may be summarised in the following:

1. validation of referential correctness and consistency of data sources;
2. check/verification of the inherent correctness in the design-analysis process;
3. verification of the traceability of data and methodologies used;
4. support of the reproducibility of the obtained results (as also by alternative methods);
5. qualification of the document contents as valuable knowledge and reference for future works and transfer to possible applications as well.

The purpose of the peer review is to go through the above objectives and to identify comments and/or recommendations useful for improving the document contents, be these editorial or simply formal Q.A. aspects, as well as specific technical aspects and issues, whose eventual solution may not be addressed on general grounds but has more likely to be dealt with on a case by case basis.

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3. PEER REVIEW CHECK-LIST

As also recalled in reference [3] the document drafting/issuing responsibility stays with the drafting/issuing Partner, which goes through the processing steps, assigning the applicable Q.A. grade A or B, as per the “Partner Organisation” column in the above scheme.

It is assumed that, when the document is formally sent to the HTR-N Partners for comments and review (required for Level 1 Q.A., not needed for Level 2 Q.A., i.e. for support documents/others), the document is in the final form and approved for emission according to the Q.A. system of the drafting/issuing Partner. The comments and concurrence of the non-drafting/issuing Partners is more likely a general review for assessing the basic technical acceptance of the document contents, as well as their consistency with the HTR-N project.

The purpose of the peer review is rather carrying out a more thoughtful assessment for checking both the formal consistency and substantial correctness of data input and assumption, use of methods and of the evaluation performed. An independent evaluation may be also required for assessing the results by alternative analyses.

In order to accomplish the aforementioned objectives, the basic peer review criteria can be translated into a number of practical check-points, to which possible review issues and/or question marks may be referred.

The following check-items will be then considered by the peer review of the HTR-N document reports:

1. Completeness and correctness of document:
 - 1.1 scope of the study
 - 1.2 background knowledge
 - 1.3 problem/purpose
2. Compliance with HTR-N Project requirements:
 - 2.1 applicable codes/standards
 - 2.2 referenced input data sets
 - 2.3 rationales and justifications for input data not supported by adequate references
 - 2.4 analyses tools and methods: computer programs, DB's, calculation assumptions
 - 2.5 results and discussion
3. List of reference sources:
 - 3.1 where applicable, reference to the Sinter DB should be addressed.

More specifically, the document review shall be able to check if the following question items may be fulfilled:

1. Are document title, number, revision, Q.A. level and any other applicable HTR-N form field filled in complete and correct?

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2. Is report document based on the design and service loading conditions specified in the HTR-N Project contract (i.e. deliverable list as per Annex I [1]) and/or in the applicable design specifications and have all these requirements been considered?
3. Are applicable codes edition and classification clearly referenced?
4. Are used computer programs and nuclear libraries properly identified and described?
5. Is a general description of the method used for analysis included or referenced?
6. Are reference sources listed?
7. Do analytical results clearly confirm adequate design?
8. Are used drawings, calculations, computer printouts, and sketches included?
9. Are boundary and interface conditions adequately and appropriately considered?
10. Are used analytical and/or experimental methods and assumptions appropriate and correctly applied?
11. Are areas, having the most severe loading condition for design conditions or for any specified condition, listed along with the loading values?
12. Is a short discussion of the results (useful for benchmarking the activity status and for supplying inputs to drafting progress reports) with possible follow-up and further actions included?

The above check and question item lists may be seen as directly extracted, and here collected for mentioning and synthesis convenience, from the Q.A. principles which have been based and inspired in the reference HTR-N Q.A. documents [1, 2].

So that these item lists indeed represent a very general and broad set from which the current criteria for carrying out the review on a given document can be based according to their actual relevance and applicability to the document to be reviewed.

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4. PEER REVIEW DOCUMENT LIST

Depending on the document, the peer review may be performed according to different levels of relevance. In case of project reports which the WPM and/or the PM consider appropriate for peer review is this may also eventually require a specific type and scope of re-calculations by alternative methodologies (computer programs and/or nuclear libraries).

In this context, further to the above check items of section 3, the peer review should also consider:

1. reasonability of assumptions, methodology and approximations in a domain which may be fitting with the peer review re-evaluations;
2. the document consistency, besides to the internal cross-check, to the peer review and possible other external references as well;
3. the different calculation consistency (to an extent to be defined on a case by case basis).

Just in case of comments involving major check-items or issues on the report under review, the WPM and/or PM may re-address the report to the issuing Partner for requiring its eventual revision the issuing Partner then shall provide for additional information/corrections as needed and/or the document technical revision according to the internal Q.A. procedures of his own Organisation.

A reference list of HTR-N documents is provided in Table 1 for peer review planning.

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Table 1 – HTR-N documents Peer Review reference list.

Item No.	Deliv. No. (Annex I)	Deliverable title (HTR-N contract Annex I)	Activity Task (RWP ¹)	Doc. Type ²	Document Title	Document No. - Revision	Date	Review status ³	Main Review Result: Comments / Actions
1	3.0.0	Summary Report on Work Package 3	3.0.0	D (vs. S)	Revised Work Program for WP3: Physics Analysis of Different Fuel Cycles	HTR-N-01/6-D-3.0.1 Rev.5	20/6/2002	C	Review completed on 4/6/2003.
2	3.1.1	Report on selected input and output parameters and results for reference designs	3.1.4	D (vs. S)	Definition of common output parameters	HTR-N-01/02-D-3.1.5 Rev.1	20/6/2002	C	Review completed on 4/6/2003
3			3.1.6	D	Definition of common parameters	HTR-N-02/09-D-3.1.1 Rev.1	10/10/2002	C	Review completed on 26/6/2003
4			3.1.3 & 3.1.5	D (vs. S)	Definition of reference coated particles and plutonium compositions (1 st and 2 nd generation Pu)	HTR-N-02/06-D-3.1.4 Rev.0	25/06/2002	C	Review completed on 1/7/2003
5			3.1.1	D (or S ?)	Specification of HTR-MEDUL Core for different fuel cycles	HTR-N-00/10-D-3.1.2 Rev.? (old form used)	17/10/2000	C	Review completed on 4/7/2003
6			3.1.2	D (or S ?)	Fuel element physical parameters for Pu fuel cycles in a prismatic block type core	HTR-N-00/12-D-3.1.3 Rev.? (old form used)	26/04/2002	C	Review completed on 7/7/2003
7			N1/3.1	S	Plutonium (1 st and 2 nd generation) cell burnup benchmark specification	HTR-N1-02/06-S-3.1.1 Rev.1	7/10/2002	C	Review completed on 7/7/2003
8	3.0.0	Summary Report on Work Package 3	N/3.5.4		Summary Report on Work Package 3 of HTR-N	HTR-N-04/10-D-3.0.0	15/11/2004	C	Review completed on 30/11/2004

¹ RWP = WP3 Revised Work Program, i.e. WP3 activity Tasks and Deliverable as planned in document “Revised Work Program for WP3”

² deliverable documents: D = deliverable, M = meeting minutes, P = progress report; S = support document

³ C = Completed, P = Planned, S = in Progress

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Item No.	Deliv. No. (Annex I)	Deliverable title (HTR-N contract Annex I)	Activity Task (RWP ⁴)	Doc. Type ⁵	Document Title	Document No. - Revision	Date	Review status ⁶	Main Review Result: Comments / Actions
9	3.5.2	Summary report and inter-comparison of results	N/3.5.4	D	Physics Analyses of HTR Concepts with Different Fuel Cycles - Summary Report and Inter-comparison of Results	HTR-N-04/10-D-3.5.2 Rev.1	25/11/2004	C	Review completed on 26/11/2004
10	3.2.0	Summary report on core physics calculations on selected variations on the continuous reload design	N/3.2b.3	D	Studies on the Continuous Reload Pebble Bed HTRs - Summary Report	HTR-N-04/10-D-3.2.0	4/10/2004	C	Review completed on 30/11/2004
11	3.3.0	Summary report on core physics calculations on selected variations on the batch-wise reload design	N/3.3b.2	D		merged with HTR-N-04/10-D-3.0.0		C	see document #8
12	N1/3.1.1	Report on Pu cell burnup benchmark	N1/3.1	S	CEA's contribution to plutonium cell burnup benchmark problem	HTR-N1-03/04-S-3.1.1 -2, Rev.0	16/04/2003	C	Review completed on 9/3/2004
13	N1/3.3.1	Report on strategy study on LWR/HTR symbiosis	N1/	D					Out of scope of this review
14	3.3.3	Fuel cycles with burnable poison	N/3.3a.2	D	Design of burnable poison particles to reduce the reactivity swing in batch-wise fuelled High Temperature Reactors	HTR-N-03/05-D-3.3.3 Rev.0	28/05/2003	C	Review completed on 17/6/2003
15	N1/3.0.0	Summary report on Work Package 3	N1/	D		--			Out of scope of this review

⁴ RWP = WP3 Revised Work Program, i.e. WP3 activity Tasks and Deliverable as planned in document "Revised Work Program for WP3"

⁵ deliverable documents: D = deliverable, M = meeting minutes, P = progress report; S = support document

⁶ C = Completed, P = Planned, S = in Progress

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(Table 1 – cont.)

Item No.	Deliv. No. (Annex I)	Deliverable title (HTR-N contract Annex I)	Activity Task (RWP ⁷)	Doc. Type ⁸	Document Title	Document No. - Revision	Date	Review status ⁹	Main Review Result: Comments / Actions
16	3.2.1	Assessment of Pu based fuel cycles	N/3.2a. 2/b.2	D	Feasibility of burning first and second generation Pu by Pebble Bed HTRs	HTR-N-03/11-D-3.2.1 Rev.0	17/11/2003	C	Review completed on 10/12/2003
17	3.2.2	Assessment of Pu/Th based fuel cycles	N/3.2a. 1/b.1	D	Incineration of LWR-Plutonium (1. Generation and 2. Generation) in a Modular HTR using Thorium-based Fuel	HTR-N-02/05-D-3.2.2 Rev.1	22/6/2004	C	Review completed on 26/10/2004

⁷ RWP = WP3 Revised Work Program, i.e. WP3 activity Tasks and Deliverable as planned in document “Revised Work Program for WP3”

⁸ deliverable documents: D = deliverable, M = meeting minutes, P = progress report; S = support document

⁹ C = Completed, P = Planned, S = in Progress

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5. PEER REVIEW RESULT SUMMARY

The document sequence number just follows the time order by which they have been marked/received for enlisting in the review table.

Document #1¹⁰: “Revised Work Program for WP3: Physics Analysis of Different Fuel Cycles”, HTR-N-01/6-D-3.0.1, Rev.5 [4]

Q.A. remarks:

1. appropriate letter code is “S” (rather than “D”), as no specific Deliverable or Task is foreseen in Annex I to the EC contract [1] under the relevant deliverable list of WP 3 for the activity addressed by this document: Task 3.0, with only one deliverable (D-3.0.0), is actually addressing the summary report of WP 3;
2. the document should be more correctly numbered [3] as *HTR-N-01/06-S-3.0.0-1_5* (where the revision number _5, identifier for archiving purposes [3], attached to the document number may be optional): the extension 3.0.1 may be acceptable, in any case, if no mix-up risk exists with any activity task 3.0.1 (this could have been eventually introduced in the RWP itself);
3. the revision chronology should be completely indicated on the appropriate chronology table (to this end the updated HTR-N first and second page forms, HTR-N 01/1 and HTR-N 02/1, should be used);
4. the electronic filing indications should complete the logical address for retrieving the document, i.e. “SINTER/Protected Area/Documents/Search/HTR-N”, instead of “SINTER” only; the actual file format of the document is “PDF”, instead of MS Word doc.

document consistency (updating):

1. the document should be periodically updated for the latest completion dates of the enlisted activities (e.g. activity RWP N/3.5.3 for deliverable D-3.5.1).

done by AN on 4/6/2003

¹⁰ this document, which defines the HTR-N & N1 nuclear physics activities in WP 3, is assumed as activity reference and quoted as “RWP” by this PR.

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Document # 2: "Definition of common output parameters", HTR-N-01/02-D-3.1.5, Rev.1 [5]Q.A. remarks:(cover page)

1. appropriate letter code is "S" (rather than "D") as this document is a support document (coded as N/3.1.4 in the activities defined by the RWP) of Deliverable-3.1.1 foreseen in Annex I to the EC contract [1];
2. appropriate numbering should be *HTR-N-01/02-S-3.1.1-(4)_1* for identification as one of the supporting documents of the contractual deliverable D-3.1.1: number (4) may be used if correspondence with activity N/3.1.4 of the RWP is sought (but this close matching with the RWP activities is neither strictly necessary, nor practical), in any case it shall comply with a progressive numbering criterion (chosen by the WPM) for the "S" documents of D - 3.1.1;
3. the "Document type" field should report a shorter a standardised diction (a generic "report" or a specific denomination like "data set" could be used [3]);
4. the month number "02" does not match that of the first issue date (31/05/2001);
5. the electronic filing indications should complete the logical address for retrieving the document, i.e. "SINTER/Protected Area/Documents/Search/HTR-N", instead of "SINTER" only; the actual file format of the document is "PDF", instead of MS Word doc.;
6. the acronym "N/A" (not/applicable) cannot be used in the "Issue/approval" field: conversely the document is not actually a formal issue but just a working draft. Moreover, if a higher Q.A. level of the HTR-N document is sought (i.e. Q.A. level 1) the "N/A" cannot be addressed in the "Review" field: a review must be requested for Level 1 Q.A.;
7. the updated HTR-N forms for the first and second page, HTR-N 01/1 and HTR-N 02/1, should be used);

(second page)

8. on the top header the Task number should be 3.1 (as also reported on the first page) instead of 3.1.1 (which is actually the deliverable number);
9. same comment as item #3 above; moreover, supporting of deliverable 3.1.1 should be apparent from the document number itself (if correctly assigned), which is displayed on the near field, i.e. useless to repeat it in the "Document type" field;
10. the document index/table of contents is missed at the beginning of the document.

comments/observations:

1. pg.2 – even if the cycle concept may be meaningless for a MODUL pebble bed reactor with continuous reload, its capacity factor can be expected quite high, but hardly matching one. So that a full 365 days cycle length could perhaps result in a biased comparison with other systems;
2. pg.2 – ID #0.5 (Applied code system): used libraries, version and processing method should be mentioned as well;
3. pg.3 and following – the diction "...max. value occurring anywhere in the core..." should also presume the description of location where the actual core peaking occurs;
4. pg.7 – the cited comparison needs notwithstanding, it is noted how sometimes the Cm-246, "cut-off" nuclide, is reported by very high burn-up fuel cycle calculations;
5. pg.7 – the numbering of the document mentioned as reference [3] should comply with general HTR-N Q.A. rules, as per item #2 of the above-listed Q.A. remarks: close matching with the RWP activities may be convenient but not strictly necessary, so that a simple order numbering can be followed for this document which is not enlisted in the RWP.

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reported mistyping: pg.3/6 for “particle”/“every”.

general comment: the document provide quite a comprehensive and exhaustive list for the “common output parameters”. Nevertheless, for a number of utilisation and needs, a convenient subset of the most relevant and key parameters should be identified for an immediate referencing outline of an indispensable minimum necessary and useful for characterising the considered system and the main results of the performed analyses.

done by AN on 9/6/2003

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Document #14: “Design of burnable poison particles to reduce the reactivity swing in batch-wise fueled High Temperature Reactors”, HTR-N-03/05-D-3.3.3, Rev.0 [6]

Q.A. remarks:

(cover page)

1. the document number is correct only if this report is the actual document for addressing Deliverable No. 3.3.3 of Annex I to the HTR-N contract (see ref.[1]);
2. if this is the case, the actual deliverable description: “Fuel cycles with burnable poison”, could be added to the document title (this should especially applied when document and deliverable denominations may substantially differ);
3. WP and Task number 3 and 3.3, respectively, instead of N/3 and N/3.3a.2: these should stick with the contractual document (HTR-N contract, Annex I [1]), moreover, the numbering method must also be kept coherent with other HTR-N documents. The RWP numbering is rather useful for addressing activity contents and, possibly, an aid for addressing the HTR-N1 documents which have been merged with the HTR-N project;
4. HTR-N instead of HTR-N1 in the *document No.* field;
5. the Q.A. level must be 1 for a deliverable document [3];
6. current document status is “review”;
7. the date actually seems not consistent, it also does not match that of the chronology on the second page (as a general rule, the cover page shall report the latest version, while the document history, if any, can be detailed on the chronology table);
8. the acronyms of the partners addressing the review (ANS + others?), the document control and approval (with the names of the responsible persons for the latter two) have to be indicated;
9. the form number (bottom left of the 1st and 2nd page, HTR-N 01/1 and HTR-N 02/1) is not to be edited (01 and 02 refer to the form page, /1 to the form revision, see ref.[3]);

(second page)

10. same remark as per item #2 above;
11. the Index/Table of contents is missed;
12. the references must be sequentially numbered as they appear per citation order in the document;
13. references must be cited by the reference number, rather than author(s)-year (author can be expressly mentioned, if liked/necessary, the year may be confusing, should be avoided unless be necessary to underline it in a specific context – the number of a numbered reference list must be given in any case);

comments/observations:

(mark-up reported in italic by the reviewer(s) on the draft document (Word format) are intended as possible hint/complement for enhanced elucidation and/or readability, if any)

1. pg.4 – formula (1) should be explained as limited to bracket values ≥ 0 (i.e. to times t of the order of (one?) year, or so, with the applicable values of N, R and Φ ;
2. pg.5 – formula (2): the bracket expression could have missed the square (the second term in the bracket should be limited to ≤ 1 , in any case);

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3. pg.5 – reference to Fig.1 should be added for BPP model;
4. pg.8 – (Figure 2) no apparent effect of Pu build-up from fertile U-238 (92%) may be observed on the k_{inf} reference curve: is there any interpretation for that?
5. pg.8 – (Figure 3) $k_{inf} - 1.1$ are correctly addressed as absolute quantities: for clearness this should be also done on the Figure itself ($|k_{inf} - 1.1|$ and/or $|\Delta k|$);
6. pg.9 – besides their greater size, use of Gd BPP's would not require, differently to ^{10}B , any isotopic enrichment, with additional manufacturing and economic advantages;
7. pg.9 – the different k_{inf} trend between U and Pu fuels is more likely due to the lack of a fertile component in the latter, which does not allow compensating for the consumption of the Pu initially loaded (conversely, the higher actinides – MA's – bred from Pu are mostly non-fissile isotopes with poor reactivity, i.e. wastes¹¹); the breeding of the U-238 in the U fuel seems instead allowing a smooth and constant drop of the k_{inf} through a more extended irradiation period, even if an apparent effect is not observed on the k_{inf} curve itself (e.g. something like a small increase at low BU's, more typical, perhaps, of the true thermal spectra rather than less breeding epithermal ones – this could possibly explain item #4 above)
8. a possible mis-typing occurred in the description of Fig.7 (pg.22) for the 620MWd/tPu burn-up;
9. pg.10, ref. to Fig.9 – the overall areas of the U-Pu spectra seems different (the U area appears substantially larger than Pu's one especially in the thermal region): it should be confirmed that they are both normalised (if so) in order the reader may assess apparent differences due to just log-scale visual effects;
10. pg.10 – a possible mistyping: Pu240, rather than Pu241, should be actually characterised by a strong (100.000 barns or so), almost purely capturing, resonance in the 1 eV region; Pu241 (and Pu239 as well) fission & capture resonances should be likely located a little earlier, in the $0,2 \div 0,3$ EV region (where incidentally, Fig.9, the Pu spectrum maximum actually occurs);
11. pg.10 – 1st observation: U235 has generally higher fission probabilities ($1 / (1 + \alpha)$) than fissile Pu's in the thermal region (from 15% to 40% depending on Pu241-239, energy level and nuclear data considered): this, despite the lower ν , may results in higher η values for U235, and then k_{inf} for a multiplying medium with negligible parasitic absorption;
12. pg.10 – 2nd observation: the small U238 neutron absorption (of the order of 1 barn at 0,2 eV) can nevertheless weight for about a 5% in a 8%-92% U235-U238 fuel mixture, such to give an appreciable contribution in controlling the U235 high reactivity (fertile materials are in fact sometimes addressed as “natural poisoning” of the fissile nuclides). The same function couldn't be likely exploited in Pu-mixtures by Pu240, despite its strong, but somewhat localised, resonance and its substantially lower concentration in Pu-mixtures (not much regrettable, of course) in comparison with U238 in U ones;
13. pg.10 – reactivity coefficients: a summarising table could be perhaps useful;
14. pg.12 – conclusions: a summarising table could perhaps enlighten fast comparison between the different cases.

¹¹ which would eventually require sub-critical core management to get rid of

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general comment:

the document reports interesting results, very good data presentation with deep examinations and well explained interpretations corroborating the analysis of the results; these indeed provide an effective added value for complementing the numeric calculations themselves. Just a little fuzziness perhaps remains for the “needles”. In this regard, a question on an alternate solution (whether meaningful/practicable) could rise concerning the use of spherical BPP’s admixed in cylindrical fuel compacts.

Calculations for single specific cases, carried out by other reviewers with alternate methods/libraries, could eventually give a possible measure on the uncertainty of the reactivity swing (for a selected composition/case) as this could be attributable to the tools being employed when performing assessment on burnable poisoning.

completed by AN on 17/6/2003

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Document # 3 : “Definition of common parameters”, HTR-N-02/09-D-3.1.1, Rev.1 [7]

Note: this document wraps up different supporting documents to address Deliverable 3.1.1 (“Report on selected input and output parameters and results for reference designs”). The single documents which are included in this deliverable are being addressed individually by this review, while the general part of D-3.1.1 is addressed hereby.

Q.A. remarks:(cover page)

1. the letter code “D” is appropriate as this document is intended as the final Deliverable-3.1.1 foreseen in Annex I to the EC contract [1];
2. the document status is “review” if the drafting phase has been completed and no other major modification of the document is underway; it has to be switched to “final” after this review stage has been accomplished and remarked changes implemented
3. last applicable revision seems to be “1,” therefore the number “2” on the revision column and the “dd mm yyyy” on the date column must be deleted;
4. the acronym “N/A” (not/applicable) cannot be used in the “Control/WP Manager” and “Approval/Project Manager” fields: the acronyms of the responsible organisations and the names of the WPM and PM must appear on these fields;
5. as the document Q.A. level is “1”, a review is required [3] and the acronym of the reviewer(s) (ANS + others?) must appear in the “Partner’s review” field;
6. the actual file format of the document is “PDF”, instead of MS Word doc.;
7. the form number (bottom left of the 1st and 2nd page, HTR-N 01/1 and HTR-N 02/1) must not be edited: “01” and “02” in the original form templates (“.dot” for MS Word) refer to the form page (i.e. cover page and second page), “./1” (both for cover and second page) to the form revision number (see ref.[3]);

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8. definition of document type must be the same both on cover and second page form: “deliverable” is then appropriate also for the second page form;
9. the chronology table (updated HTR-N forms) is missed;
10. the Index/Table of contents is missed: besides being generally required, this would be particularly necessary here for improving the readability of the document, which is structured on others reported as appended attachments;

reported mistyping: pg.3 for “originally” and “civil plutonium composition”); pg.5 for “PARTICLES”

comments/observations:

1. pg.3 – the letters A - B - C - D - E would better designate “ATTACHMENT - A / B / C / D / E”, or similar diction (eventually by capitol letters and centred text for better distinguishing the separation/attachment status), where the collected documents are included, rather than naming the documents themselves;

completed by AN on 26/6/2003

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Document #4: “Definition of reference coated particles and plutonium compositions (1st and 2nd generation Pu)”, HTR-N-02/06-D-3.1.4, Rev.0 [8]

Note: this document is attached to HTR-N-02/09-D-3.1.1 as an integral part for constituting Deliverable - 3.1.1

Q.A. remarks:

(cover page)

1. appropriate letter code is “S” (rather than “D”) as this is a support document of Deliverable-3.1.1 (foreseen in Annex I to the EC contract [1]), which covers the activities N/3.1.3 and N/3.1.5 of the RWP;
2. appropriate numbering should be *HTR-N-02/06-S-3.1.1-(x)_0*, i.e. as deliverable D-3.1.1 support document: (x) should be a progressive number, controlled by the WPM, for the “S” documents of D-3.1.1;
3. the “Document type” field should report a shorter a standardised diction (a generic “report” or a specific denomination like “data set” could be used [3]); supporting of deliverable 3.1.1 should be apparent from the document number itself (if correctly assigned);
4. document status should be “review” (in case no major change is expected) prior to final issue;
5. the electronic filing field is missed: filing indications should complete the logical address for retrieving the document, i.e. “SINTER/Protected Area/Documents/Search/HTR-N”, instead of “SINTER” only;
6. the actual file format of the document is “PDF”, instead of MS Word doc.;
7. the acronym “N/A” (not/applicable) cannot be used in the “Issue/approval” field; moreover, the review is always requested for a Level 1 Q.A. document, so that the acronym(s) of the reviewing partner(s) must also appear in the review field;
8. the updated HTR-N forms for the first and second page, HTR-N 01/1 and HTR-N 02/1, should be used): these allow to specify and distinguish the names and acronyms of the WPM and PM, besides the reviewer’s;

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9. the date coding (-yy/mm-) in document number does not match that of the cover page and the issuing date (i.e. HTR-N-01/02-D-3.1.4 instead of HTR-N-02/06-D-3.1.4;
10. same comment as item #3 above; moreover, supporting of deliverable 3.1.1 should be apparent from the document number itself (if correctly assigned), which is displayed on the near field, i.e. useless to repeat it in the “Document type” field;
11. the chronology table (updated HTR-N forms) and the Index/Table of contents are missed: besides being generally required, this would be particularly necessary here for improving the readability of the document, which is structured on others reported as appended attachments;
12. the Index/Table of contents is missed at the beginning of the document;

reported mistyping: pg.3 (both!) – reasons for exclamation point could be barely straightforward or misunderstanding: it should be better to enlighten them.

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comments/observations:

1. pg.2 – reference fuel kernels: the differences between maximum allowed burnups are indeed apparent for the different fuels (800 MWd/kg vs. 120 MWd/kg for U and Pu vs. Th based compositions). A rationale (which cannot be even found in the referenced reference [1] of the document) would be expected for justifying the grounds on which such a large discrepancy is based on;
2. pg.2 – coating material list C C SiC C: a few words and a scheme describing what these actually are and how they are distributed/arranged each other would be extremely helpful for the reader (as well as for future reference and comprehension); reference to documents capable of describing the basic HTR fuel particle design could be also helpful;
3. pg.2 – compact/pebble: should be defined and/or sketched what they are;
4. pg.2 – packing fraction: the applicability of an upper limit, i.e. a measure of the average minimum technologically allowable distance between fuel particles which may be permitted by design and/or controlled by the manufacturing process, should be mentioned;
5. pg.3 – larger differences are, on the average, remarked for the composition “B” vs. “A” of 1st generation Pu in respect of the “Thorium” and “OTTO” values (i.e. the mean of the two), so that the composition “A” would seem, in principle, more adherent to real ones than “B”; conversely, the “experimental” compositions, i.e. those used in some specific experiments could deviate somewhat, for any reason, from typical LWR’s discharge – this could be worth for further investigation;
6. pg.3 – it is remarked in the text that composition “B” and “C” are consistent each other, nonetheless, composition “A” has been recommended/adopted for “1st generation PU” calculations and composition “C” for the “2nd generation PU”: while this may be reasonable for addressing most of work already carried out with composition “A” at the time this document was issued , it could be convenient to have run some selected benchmarking cases with “B” vs. “A” in order to get a measure of the main differences (in terms of k_{inf} , BU’s, etc) that may be expected in the results (this seems to be, anyway, the intention as foreseen by the last paragraph sentence of pg.3);
7. pg.4 – reference [2]: a private communications is generally not acceptable, if enlisted as a reference, under current Q.A. criteria for the reason that they are difficultly traceable (unless registered and maintained in a general archiving system of the organisation): a solution could be either to report copy of the original communication inside an appendix attached to the document or to specify its relevant content directly in the text of the document;
8. pg.5 – Appendix A, WP3 meeting minutes: suitable forms should be used for reporting the HTR-N WP MM’s; these could be either arranged as based on the document forms HTR-N 01/1 and HTR-N 02/1 (in order to have a consistent appearance between deliverables and MM’s) or by adopting the actual forms/templates currently used by the organisation that is issuing the MM’s. It is remarked that the list of Participants and an Action/Partner list are not reported in the MM attached as Appendix A;
9. pg.5-6 – Appendix A and B: the document pages should be subsequently numbered, there are actually 2 pages (the WP3 MM reported as Appendix A attachment) in between page 5 and 6 of the document; Appendix B is not numbered as well;
10. Appendix B, 1st page (not numbered) – cooling time: 3 years of cooling time are understood as the LWR UO_x spent fuel idle time before processing takes place; spent fuel reprocessing (with some losses), Pu fuel re-fabrication and storage time before loading in the HTR core should be also considered;
11. Appendix B, 2nd page – ref.2: it is remarked in the text that ref.2 does not specify the grounds on which the reported composition has been assumed: since ref.2 (i.e. the HTR-N Annual Technical Progress Report, September 2001) is a derived report (as far as the fuel data in

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subject are concerned), the original reference of that document should be used instead; it may be in fact quite legitimate reporting data from a referenced document without the need of justifying them (as this is rather the task of the reference from which the data are derived);

12. Appendix B, 2nd page – Pu compositions: differences between the two isotopic vectors are explained in terms of different BU levels reached by the LWR UO_x (25 GWd/t vs. 41.2 GWd/t): while this may be apparently reasonable, it is then remarked that the currently adopted definition “1st generation Pu” is little meaningful if not agreed and stated between the Partners the grounds on which the Pu source, i.e. the type of LWR fuel cycle (reactors, enrichments, irradiation/dwelling-storage time), are based on;
13. Appendix B, 3rd page – 2 additional years for MOX fuel fabrication: time delays should be more clearly indicated on the scheme (i.e. 3+2 years before “2nd Pu” fabrication, 3 y cooling before HTR irradiation); just for comparison, reference [9] assumes 4 y cooling time for LWR UO_x fuel + 2 y storage prior 1st-g.MOX irradiation and 7 y cooling time for MOX fuel + 2 y storage prior 2nd-g.MOX irradiation.

general comment/discussion:

The Pu compositions may be not, presumably, univocally determined as these are quite dependent on overall fuel compound history (irradiation, dwelling time, reprocessing, storage, etc); also, possibly different fuel streams, from different power reactors fuel batches, could be mixed-up during reprocessing and re-fabrication.

So that a Plutonium composition, which could be expressed through evaluation on large accumulated stocks from LWR's spent fuels (for a given Country, or even on a EU scenario) rather than assessed on a specific LWR cycle, could eventually represent the most realistic Pu feedstock for supplying MOX fuels.

completed by AN on 1/7/2003

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Document # 5: “Specification of HTR-MEDUL Core for different fuel cycles”, HTR-N-00/10-D-3.1.2, Rev.-- [10]

Note: this document is attached to HTR-N-02/09-D-3.1.1 as an integral part for constituting Deliverable - 3.1.1

Q.A. remarks:

(cover page)

1. appropriate letter code is “S” (rather than “D”) as this is a support document of Deliverable-3.1.1 (foreseen in Annex I to the EC contract [1]), which covers the activity N/3.1.1 of the RWP;
2. appropriate numbering should be *HTR-N-00/10-S-3.1.1-(x)_0*, i.e. as deliverable D-3.1.1 support document: (x) should be a progressive number, controlled by the WPM, for the “S” documents of D-3.1.1;
3. the updated HTR-N forms for the first and second page, HTR-N 01/1 and HTR-N 02/1, are not used by the document, which was issued before the final issuing of the forms (this may require to single out specific Q.A. contents);
4. indication of the document status and revision number are missed;
5. the Q.A. level of the document is not apparent (technical check/control, Q.A. attribution and approval by the issuing organisation);
6. number of pages and page numbering are missed;

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7. the Index/Table of contents is missed at the beginning of the document;
8. the document identifications (project, WP, Task, document number, document type, page numbers) are not reported on the second page (this is just a clean page format);
9. the references list is missed; no indication to references is made in the document.

reported mistyping: pg.2 for “Kernel”.

comments/observations:

1. scope, use, applicability and extent for the data reported on this specification are not indicated;
2. pg.2 – Table I: it is not clear what is the “MEDUL-HTR” (geometry and material zones are, as apparent from Fig.1 on 3rd page, modelling scheme for computer program calculations, no reference to a real and/or conceptual system is available); all the data reported in Table I are neither referenced nor justified;
3. pg.2 – Table I: core power and power density are not indicated: even if these were not relevant for the original purpose of these data, nevertheless they would be useful to give an idea of the type/size of reactor considered;
4. pg.2 – Table II: it would be useful and enlightening to be able to put in correspondence the indicated Zones with an actual physical system;
5. pg.2 – Table III: the applicable fuel pebble and particle scheme/picture would be useful here (see also comments/observations N.2÷3 for document #4 above);

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6. pg.2 – burn-up: see comments/observations N.1 for document #4 above;
7. pg.2 – Isotopic composition: same comments as per above apply; no reference is reported, data are neither explained, nor justified.

general comment/discussion:

The document would seem more likely a short data sheet rather than an actual formal document and, actually it would seem appearing as the source of the “HTR benchmark” in Appendices A and B of the above reviewed Document #4. In particular, Appendix A (i.e. the WP3 MM’s of 14/6/2002) seem making mention to these data as defined for the “Pu cell burnup benchmark”, which is an activity of the HTR-N1 project (N1/3.1 of the RWP, project in which, incidentally, the originator of this review is not participating).

Now, should the purpose of a benchmark finalised to pure computational aspects (comparison of different computer programs and/or calculation methodologies), the actual consistency, correctness, reliability and traceability of the proposed data would have, inside a reasonable extent, a relative relevance.

Conversely, if such a benchmark is aiming at comparisons between physical parameters intended for performance assessments (as evaluated by means of different codes/methods), which could also be referenced as actual HTR reactor physics duty characterisations afterwards, the correctness and traceability of the data (as related to the current state of the art and for what can be presently known) become relevant.

Moreover, since the above-mentioned WP3 MM’s actually define the Pu compositions reported as benchmark data (i.e. “the original 1/62/24/8/5 Pu-I composition”) “remaining as the reference Pu-I composition for the “Pu-I based calculations in HTR-N for Task 3.2a and 3.3a”, it becomes evident that, their original purpose and scope of application notwithstanding, the basic fuel data reported in this “benchmark” document are quite relevant instead, and must be duly certified.

Therefore, it would seem that this somewhat informal document, issued for application scope and purpose different from those for which it has been subsequently used, needs to be more consistently redrafted in order to become adequate for constituting the relevant fuel data source reference (as it is actually applied) that supports a number of key Tasks under the HTR-N WP3 activity. So that, adequate grounds and justifications, as well as formal appearance, should be accomplished through a document revision as per the above-reported review items: this is of utmost importance both for consolidating the WP3 data input on which the HTR fuel technology is based on and assuring the necessary traceability for any future understanding and need.

completed by AN on 4/7/2003

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Document #6: “Fuel element physical parameters for Pu fuel cycles in a prismatic block type core”, HTR-N-00/12-D-3.1.3, Rev.-- [11]

Note: *this document is attached to HTR-N-02/09-D-3.1.1 as an integral part for constituting Deliverable - 3.1.1*

Q.A. remarks:

(cover page)

1. appropriate letter code is “S” (rather than “D”) as this is a support document of Deliverable-3.1.1 (foreseen in Annex I to the EC contract [1]), which covers the activity N/3.1.2 of the RWP;
2. the date is not consistent with the document code (-yy/mm-), moreover, as a deliverable D - 3.1.1 support document, appropriate numbering should be *HTR-N-02/04-S-3.1.1-(x)_0*, where (x) should be a progressive number, controlled by the WPM, for the “S” documents of D - 3.1.1;
3. the updated HTR-N forms for the first and second page, HTR-N 01/1 and HTR-N 02/1, are not used (this may require to single out specific Q.A. contents);
4. indication of the document status and revision number are missed;
5. the Q.A. level of the document is not apparent (technical check/control, Q.A. attribution and approval by the issuing organisation);
6. number of pages and page numbering are missed;

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7. the Index/Table of contents is missed at the beginning of the document;
8. the document identifications (project, WP, Task, document number, document type, page numbers) are not reported on the second page (this is just a clean page format);
9. the references list is missed; most of data are not referenced/justified in the document.

comments/observations:

1. scope, use, applicability and extent for the data reported on this specification are not indicated;
2. pg.2 – the fuel/core parameters list does not address, where available, the figures reported on the following pages of the document (i.e. the reported data do not make specific reference to the shown drawings); most of reported data is neither referenced nor justified;
3. pg.2 – no fuel compact and particle drawing/scheme has been reported;
4. pg.2 – reference to document HTR-N-00/10-D-3.1.2: document information should be given in a Reference list, reference documents should be identified and referenced by an order number;
5. the type of fuel(s) being considered is not explicitly defined;
6. pg.2 – fuel kernel (diameter).....200 μm : the referenced document HTR-N-00/10-D-3.1.2 (reviewed as Doc.#5 above) reports 240 μm for PuO_2 fuel (if this is the actual fuel choice, as it may be inferred from the density attribution on the following (4th) line, i.e. “ PuO_2 density”);
7. a kernel diameter of 240 μm for PuO_2 fuel is also reported in document HTR-N-02/06-D-3.1.4, “Definition of reference coated particles and plutonium compositions (1st and 2nd generation Pu)”, (reviewed as Doc.#4 above);

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8. pg.2 – Plutonium isotopic composition: reference is made to document HTR-N-00/10-D-3.1.2 but, as per review of Doc.#5 above, the source/justification of these data has not been provided there;
9. pg.2 – coatings C/C/SiC/C(thickness).....100/35/35/40 μm : reference is made to document HTR-N-00/10-D-3.1.2 (review Doc.#5) but, actually, these data are not reported there; instead, they may be found in (successive) document HTR-N-02/06-D-3.1.4 (review Doc.#4), but with somewhat different values (95/40/35/40 μm), which lack reference, in any case;
10. pg.2 – PuO_2 density 10.0 g/cm^3 : PuO_2 density is not referenced in doc. HTR-N-00/10-D-3.1.2, but in (successive) doc. HTR-N-02/06-D-3.1.4, which reports a slightly different density value (10.4 g/cm^3);
11. pg.2 – graphite density1.74 g/cm^3 : graphite density is slightly different in doc. HTR-N-00/10-D-3.1.2 (1.75 g/cm^3);
12. commenting of the above two remarks (the relevance apart that such slight differences could have on actual calculations) is for addressing possible different data sources and/or considerations which could have been applied when selecting those values;
13. pg.3, 4, 5 – the figures reported in these pages are neither numbered nor title-described, so that linking with the parameters enlisted on pg.2 is not apparent; as also previously recalled, fuel compact and particle pictures would be also needed;
14. pg.3, 4, 5 – the figures reported do not make any reference to a specific reactor model/type (even if conceptual/generic this should be enlightened).

general comment/discussion:

Many of the remarks on this document are similar to Doc.#5 review ("Specification of HTR-MEDUL Core for different fuel cycles", HTR-N-00/10-D-3.1.2), so that same recommendations concerning consistency, correctness, reliability and traceability also apply to this document.

Therefore, an updated revision is also recommended for Doc.#6, as per the above-listed review comments, in order to make it more consistent and formal for constituting the relevant fuel data source reference that supports the block type HTR-N WP3 Tasks. As previously mentioned, this would be of greatest importance both for consolidating the WP3 data input on which the HTR fuel technology is based on and assuring the necessary traceability for any future understanding and need.

completed by AN on 7/7/2003

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**Document #7: “Plutonium (1st and 2nd generation) cell burnup benchmark specification”,
HTR-N1-02/06-S-3.1.1, Rev.1 [12]**

Note: this document is attached to HTR-N-02/09-D-3.1.1 as an integral part for constituting Deliverable - 3.1.1

Q.A. remarks:

(cover page)

1. differently from remark n.3 of review Doc.#14, WP and Task number indicated as N1/3 and N1/3.1 may be convenient here for the HTR-N1 project in order to avoid possible mix-up with similarly numbered HTR-N activities [1];
2. document status should be updated to “final”, if all pending reviews have been completed;
3. the Q.A. level can be changed to 1;
4. the acronym “N/A” (not/applicable, typed for Rev.0) cannot be used in the “Control/WP Manager” and “Approval/Project Manager” fields, so that the acronyms of the responsible organisations and the names of the WPM and PM must appear on these fields; even if, in fact, the document is lower Q.A. level (2), it is supposed having received the endorsement for issuing under the HTR-N (N1) project;
5. it is remarked that preliminary draft submitted by authors are not Rev.0: they become so after the HTR-N document process (either under level 1 or 2 Q.A.) has been accomplished [3];
6. the electronic filing indications should complete the logical address for retrieving the document, i.e. “SINTER/Protected Area/Documents/Search/HTR-N”, instead of “SINTER” only;

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7. Chronology and history of revisions: apparently, what has been addressed as “first proposal” probably was a first document draft, rather than a document version issued as Rev.0, while what has been addressed as Rev.1 is the document final version, approved and reviewed by all the Partners, so that it should be actually Rev.0;
8. the Index/Table of contents is missed at the beginning of the document;

reported mistyping: pg.6 for “Document HTR-N-02/06-D-3.1.4” (at ref.[4], vs. Document HTR-N-02/06-D-3.4.1).

comments/observations:

1. pg.3 – ref.[2]: as remarked by comment n.7 of review Doc.#4, private communications are not generally acceptable reference if not traceable; more specifically, this reference should be reported in the form of a self-consistent rationale/justification summarising both the original proposal and the discussion which followed at the WP3 meeting;
2. pg.4 – no drawing/scheme for fuel pebble and particle has been referenced and/or reported;
3. pg.4 – Fuel element parameters: reported data are not directly referenced: while the first three numbers seems taken from HTR-N-00/10-D-3.1.2, see review Doc.#5 above, where they are not referenced/justified in turn, no source/ground for the Pu content ($1 \div 3$ g/FE) is shown;

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4. pg.4 – Coated particle parameter: reported data have not direct reference (this should be actually [4], where, in turn, missed or weak data justification is available, see review Doc.#4);
5. pg.4 – Plutonium isotopic composition: it is remarked that composition “A”, which is reported in this Doc.#7 as referenced from HTR-N-02/06-D-3.1.4 (ref.[4]), is actually missing any source/ground as it has been originally referenced from HTR-N-00/10-D-3.1.2, where no specific reference/justification has been provided (see review Doc.#5 above, comment n.7);
6. pg.4 – 2^{nd} generation Pu from ref.[2] : same comment as per n.1 above;
7. pg.4 – Pu isotopic composition: as for Pu composition dependence on actual BU levels, see also comment n.12 of review Doc.#4;
8. pg.5 – General parameters: no direct reference and/or justification grounds for the shown values is reported.

completed by AN on 7/7/2003

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Document #16: “Feasibility of Burning First and Second Generation Plutonium by Pebble Bed HTRs”, HTR-N-03/11-D-3.2.1, Rev.0 [13]

Q.A. remarks:

(cover page)

1. the first page of this document (as it has been sent .PDF version) is a non-standard page (just a plain page with title, authors and date/codes typed on it): its function is neither clear, customary, nor adhering to current HTR-N Q.A. rules, so it should be dropped;
2. the second page of the PDF version, which is actually the first of the .doc version, appears to be a merger (as apparent from the header/footer mix-up and the deletion of the EC and HTR-N&N1 contractual references) of the standard HTR-N first and second page forms (i.e. HTR-N 01/1 and HTR-N 02/1), most probably due to the attachment of the non-standard clean page above: it is therefore recommended that the true HTR-N form pages are restored for this document;
3. task number N/3.2a/b.2: the RWP actually reports three different activity subjects under the header “a”, so it must be more precisely indicated which one is referenced (most probably a.2, so that Task number should be changed to N/3.2a.2/b.2 accordingly through the document);

(second page)

4. a number of blank pages (i.e. pages formatted as per the second page HTR-N 02/1 form, but containing any text) are left in the document (actually, they appear being generated by couples of MS Word “Page Break” without anything in between): these should be definitely dropped. However, should these be needed for any purpose, then quotations such as “*page intentionally left blank*” should appear on them;
5. the “Table of Contents” is missed
6. pg.5/6 – a formatted page (pg.5 on .doc, pg.6 on .PDF versions), more likely the cover page of the original NRG document from which this deliverable has been derived, is incorporated inside the HTR-N form page: this seems quite inappropriate and rather confusing. As per current HTR-N Q.A. rules [3] in fact (which, incidentally, have been subsequently applied also by other EC project), either the whole original Partner document (written on its own original forms) is attached to the HTR-N forms (cover plus, eventually, one second page with revision chronology only) or the document is entirely reported on the HTR-N forms themselves (i.e. by utilising as many as needed second page HTR-N 02/1 forms), tracking its actual origin just on the cover page HTR-n 01/1 form (i.e. the “Original document No.” field). This latter has been actually the most widely applied procedure between Partners, because of its simplicity of application, while the former, even if the most correct from the Q.A. standpoint, requires handling and converting files under the PDF environment in order to perform attachments without mixing up style formatting (as customary in Word);
7. pg.7/8 – “Abstract”, “Keywords” are section headings more appropriate for a paper than a report;
8. pg.8/9 – is there any reference for “The capability of reaching ...in the early seventies,” ?
9. pg.9/10 – references and/or rationales for data assumption and inputs summarised in Tables 1-2 and Fig.1 are missed;
10. pg.9/10 – does “Reloading rate = 3000kg Pu/day” mean that 3tons (which seem quite excessive in any case) of new fresh Pu are reloaded in the core or this is just the quantity of Pu fuel currently reshuffled from the bottom to the top of the core each day? (And, in case, which is the share between reloaded/reshuffled?)
11. pg.9/10 – “Fuel element packing density”: number of pebbles per m³?

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12. pg.9/10 – “He mass flow rate” should be expressed in kg/s;
13. pg.12/13 – third paragraph: are the mentioned computer codes library adaptations tested/certified, documented and traceable somewhere?
14. pg.13/14 – first paragraph: “...presented in this paper ...”, change with document/report;
15. pg.13/14 – the PDF version has lost β in “...data (yields β_i)..”;
16. pg.14/15 – second and third paragraph: “...presented in this paper ...”, change with document/report;
17. pg.15/16 – the reference for the Pu compositions is missed (report HTR-N1-02/06-S-3.1.1);
18. pg.15/16-16/17 – it is not clear if Fig.2 refers to 1st or 2nd generation Pu: in any case, $k_{eff}(BU,T)$ plots for the other cases (i.e. the two 1st generation compositions, if this is actually for the 2nd) should also have been reported for comparison;
19. pg.15/16 – “...pebbles were fed into the reactor at a rate of 3000 gram Pu per day.” 3000 kg Pu per day are shown on Table 1 pg.9/10 instead;
20. while it may be, in principle, acceptable attaching a paper presentation to an Appendix of a formal document, the document (which is, incidentally, an EC deliverable report) must be self-standing, i.e. inherently comprehensive and complete. Therefore, the paper should eventually reference the document and not vice versa (to this end any reference/mention to the paper, if not indirectly stated) should be dropped from the document itself; generally, papers are not in fact formal Q.A. documents (and even less conference presentations).

reported mistyping:

1. pg.9/10 – “.... design. E.g. the conical ...”;
2. pg.16/17 – “and fuelled with 2 grams second generation Pu...” should be read “..and fuelled with 2 grams/pebble second generation Pu..”;

comments/observations:

1. pg.12/13 – “...flows necessary to simulate natural convection in a situation without mass flow.”: should perhaps better intended as “ ...under loss of flow conditions (i.e. He coolant active pumping)”;
2. pg.12/13 – “....a cylindrical cell with an equivalent radius.” Is this merely geometrically equivalent or neutronics behaviour/effects are weighted as well (self-shielding, spectrum/groups, etc.), eventually, through the heterogeneity factor? (ok, dealt with in section 3.3);
3. pg.13/14 – is the fast/thermal energy cut-off at 2.1eV resulting from the discussed procedure to collapse neutronics to 2-groups?
4. pg.13/14 – should the uniform vertical flow have an impact on the BU radial distribution (less BU for pebbles flowing at the core centre, higher at the edge) and then on the radial core power/BU profiles? Being the pebbles re-mixed when discharged at bottom and reloaded at top, the uniform vertical flow approximation could just affect the core thermal and safety performances, i.e. lower fuel temperature at the core centre vs. the true case;
5. pg.17/18 – Fig.3 and Fig.4: the power density appears much higher at the outer core radius than at the centre: reasons for this should be explained, by mentioning also if this is customary for the HTR (MEDUL) design or due to the specific Pu fuel loading. Explanations should be given as well for the thermal distribution slumping to the reactor bottom (e.g. for the assumed uniform top-to-bottom radial pebble flow, for instance);

completed by AN on 10/12/2003

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Document #12: “CEA’s contribution to plutonium cell burnup benchmark problem”, HTR-N1-03/04-S-3.1.1-2, Rev.0 [14]

Q.A. remarks:

(cover page)

1. document number 'HTR-N1-03/04-S-3.1.1-2' may be apparently correct where this actually applies to the second support document for the HTR-N1 deliverable 3.1.1. ;
2. name and organisation of the WP manager and Project coordinator should appear at the right bottom of the cover page (rather than N/A – check mark-up on the MS-Word file copy);

(second page)

3. “Table of Contents” is missing on the third page;
4. table numbering seems not consistent on the MS-Word file on pages 6-12 (it should be following as Table IV from page 6, instead of V, after Table I-II-III on page 4, i.e. all Table numbers should be scaled down by one from page 6);
5. reference number of Apollo should be [3] instead of 2 on page 5;
6. “C1” instead of “C” on table caption at the end of section 5.2 (page 9);
7. “C2” instead of “C” on table captions of section 5.3 (pages 10-11);
8. the actual number of pages is not matching the indicated number at the footer (14 vs. 15).

comments/observations:

diagrams showing evolution of the nuclide concentrations could have been helpful for visualising general composition trend vs. burn-up.

completed by AN on 9/3/2004

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Document #17: "Incineration of LWR-Plutonium (1. Generation and 2. Generation) in a Modular HTR using Thorium-based Fuel", HTR-N-02/05-D-3.2.2, Rev.1 [15,16]

Q.A. remarks:

(cover page)

1. the first page of this document is not fully complying with the HTR-N 01/1 form: the form type indication is missed at the bottom left and number of pages/Annex pages indications are missed at the bottom right;
2. Task indication in the Task field should be N/3.2a.1/b.1 according to the RWP;
3. the issuing Partner (FZJ) original document reference number is either missed or N/A;
4. the number of Annex pages is either missed or N/A;
5. Q.A. level (indicated as 'B') referring to the original document is not applicable if this is not indicated (Q.A. 'B' status would imply that the original Partner document has been issued but without full compliance to the Partner organisation Q.A. procedures);
6. document status cannot be 'final' as it is apparently under review while not complying yet to the HTR-N Q.A. requirements [3];
7. HTR-N Q.A. level 1 is "de facto" pending on the fulfilment of the HTR-N Q.A. requirements (see above);
8. a blank page is left in place of the second one (which should actually be the chronology, appearing as 3rd instead);
9. chronology: it is understood that the 'first issue' should actually represent an original draft version of the document for Partners' review, rather than a Rev.0 issue, which should actually be the present one;
10. the chronology page is not reported on the standard 2nd page HTR-N form (HTR-N 02/1 template) but on simple non-headed plain page;
11. another blank page is inserted after the chronology page (it is remarked that no blank page should occur in a document: conversely, if so for any reason, it should eventually be stated as such);

(second page)

12. the whole document (cover page apart, see above) has been reported on non-headed, simple plain pages; this is not acceptable in general, even more for a HTR-N deliverable: either Partner organisation or the HTR-N Project (HTR-N 02/1 template) forms are to be used;
13. any given page (cover page apart, see above) of this document is not traceable to any Program, project, WP, Task, document No., Rev. No, Type of document, indication of total No. of pages forming the document is also missed: all these elements were recognised and accepted (through the HTR-N Q.A. requirements, ref.[3]) by the HTR-N Partners as a minimum, together with the HTR-N logo, to substantiate a Q.A. environment in the HTR-N Project;
14. page 6 is blank (see above).

comments/observations:

1. pg.7 – "...Until the year 2000 they will amount to about ...": since this document has been apparently written after the year 2000, the period should be past;
2. pg.7 – 1st-2nd generation Pu compositions reported in Table 1 should be indicated;

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3. pg.9 – Table 1 data (HTR-MODUL data) should be related to references /1-4/;
4. pg.11 – “....minimisation of residual Pu in the discharged fuel element...” should be read as minimisation of the residual *fissile* Pu in the fuel element;
5. pg.12 – “...in view of the proliferation aspect, ... accept the production of U233, but ... the handling of HEU in order to incinerate...”: Table IV displays need of management of quite high concentration levels of fissile U in connection with a 27% fissile Pu decrease (from 70% to 51%); it is actually assumed that the process there considered might be particular for very specific scenarios, possibly worth to be worked out, such to complement the whole extent of possible options which could be eventually outlined for Pu incineration through peculiar HTR processing cycles;
6. pg.14 – T-coefficients would be more enlightening if parameterised vs. specific D-T's or reported for given Delta-T distributions/transient type;
7. pg.16 – it should be clearly indicated which case (a or b) are the fuelling strategies reported in Table VII referred to: high Pu burning ratio or low residual Pu discharge. More specifically, it should be indicated how to compare the 66% burned/charged Pu ratio in Table VII first row to 1st generation Pu Table III 4th, i.e. to case a) or case b);
8. pg.16 – Table VII: the average BU of the 2nd row (200500MWd/t) is higher than that of the 1st row (174000MWd/t) the lower BU's of fuel types notwithstanding: any mistyping or specific reason should be addressed;
9. pg.17 – first paragraph is rather unclear, hidden rationale not well justified: tables as those used for illustrating the 1st generation Pu cases should be included, as a minimum;
10. pg.17 – possible mistyping: “..inherently save..” instead of “safe”.

As a general remark, it is noted that both 1st and 2nd generation Pu incineration estimates reported in the document are not directly addressing any assessment concerning the eventual build-up of MA's (Minor Actinides) which, expected to be not negligible (especially for a thermal spectrum system), could represent, inter alia, relevant figures for both decay heat and radiotoxicity considerations in connection with procedures for interim storage, handling, packaging, geological disposal, as well as long-term scenarios.

completed by AN on 26/10/2004

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Document #9: “Physics Analyses of HTR Concepts with Different Fuel Cycles - Summary Report and Inter-comparison of Results”, HTR-N-04/10-D-3.5.2, Rev.1 [17]

Q.A. remarks:

(cover page)

1. Task indication: better to make it explicit (like Task: 3.2-3.3-3.4);
2. The lower-left mark of the cover page is intended to indicate the form number/revision status and must not be edited (until a revision of the form is not accomplished): the current cover page form number is HTR-N 01/1 (which stays for HTR-N form number 01/revision 1, while the second page is HTR-N-02/1): form number HTR-N 02/09 does not exist and must be replaced with HTR-N 01/1 instead;
3. A blank page (with NRG disclosing conditions) is left following the cover: this should be deleted;

(second page)

4. Same wrong form number indication (HTR-N 02/09) is also at the lower-left of the second and following pages: as per above, this should be replaced with HTR-N-02/1);
5. The header of the cover page is also left on the chronology page and three more following pages: the standard 2nd page form should be used instead (i.e. that one appearing from page 7 on);
6. Page 5 seems containing same kind of information relevant to the cover page, its use is not well clear (eventually, copy of the original NRG document cover page could be attached as an Appendix, if needed for any purpose);
7. Pages 6 and 10 are blank and should be either deleted or addressed with indications of the kind: “**(page intentionally left blank)**”, or similar, eventually put as a transverse watermark;
8. Same comment for Task indication on the second page header as per above #1;

comments/observations:

1. pg.8: “Abstract” is more commonly used for papers, while documents prefer forewords like Summary/Scope/Purpose/etc.;
2. pg.9: “...core follow...”, more exact with “...core load follow...”;
3. pg.9: “...operation;. the ...” check punctuation marks;
4. pg.9: “...the two HTR systems currently in operation...”: the sentence is a bit misleading when addressing the MEDUL and GT-MHR designs together with the actual operating HTR’s, i.e. the HTR-10 and the HTR;
5. pg.9: “...reports 3-9 from the references...”: references [3-9] are mentioned before Ref.[2], if any;
6. pg.9: “...found..”: check punctuation;
7. pg.12: “design [2]. ...”, reference [2] comes after [3-9];
8. pg.12: “...design [2]. E.g. the conically ...”, sentence should not start with e.g.;
9. pg.14: sentence is spread in between table/figure, which make it a little confusing;
10. pg.14: Table and Figures do not follow sections numbering (if that was intended by adopting three-digit numbers): the middle digit is either useless or misused;

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11. pg.17: "... the elements, to 10^{-4} ": it could be useful to make clear whether the 1/10.000 of defected c.p. fraction is a figure applicable to the single FE (i.e. sort of 95/95 CFL statistical limit) or to a given fabrication batch constituted of a number of FE (i.e. 95 CFL batch average);
12. pg.18: columns in table 3.1.3 appear rather mixed-up;
13. pg.22: change Fig.3 to Fig.3.2.3;
14. pg.28: the fast islands basic idea would be worth for some more detail especially in quantitative terms relating to improved HTR overall performances for TRU's (Pu's+MA's) incineration;
15. pg.29: "slght" for "slight".

completed by AN on 26/11/2004

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**Document #10: "Studies on the Continuous Reload Pebble Bed HTRs - Summary Report",
HTR-N-04/10-D-3.2.0, Rev.0 [18]**

Q.A. remarks:

(cover page)

1. The cover page header is that of the second page instead of the first (with the EC and the HTR-N project logo);
2. Is Rev.B correct concerning original Partner document?
3. The lower-left mark of the cover page is intended to indicate the form number/revision status and must not be edited (until a revision of the form is not accomplished): the current cover page form number is HTR-N 01/1 (which stays for HTR-N form number 01/revision 1, while the second page is HTR-N-02/1): form number HTR-N 03/11 does not exist and must be replaced with HTR-N 01/1 instead;

(second page)

4. Same wrong form number indication (HTR-N 03/11) is also at the lower-left of the second and following pages: as per above, this should be replaced with HTR-N-02/1);
5. Pages 2, 6, 8, 10, 12 and 20 are blank pages and should be either deleted or addressed with indications of the kind: **"(page intentionally left blank)"** , or similar, eventually put as a transverse watermark;
6. Page 5 seems containing same kind of information relevant to the cover page, its use is not well understood (eventually, copy of the original NRG document cover page could be attached as an Appendix, if needed for any purpose);

comments/observations:

1. pg.9: "....Loss of Coolant Accidents (P/DLOCA" appear as truncated sentence;
2. pg.21-22: same comments as per 11-12 of document #9 above;
3. same comments as per above document #9 as these may apply for identical parts.

completed by AN on 30/11/2004

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Document #8: “Summary Report on Work Package 3 of HTR-N”, HTR-N-04/10-D-3.0.0, Rev.0 [19]

Q.A. remarks:

(cover page)

1. Task: 3.1-3.5;
2. The lower-left mark of the cover page is intended to indicate the form number/revision status and must not be edited (until a revision of the form is not accomplished): the current cover page form number is HTR-N 01/1 (which stays for HTR-N form number 01/revision 1, while the second page is HTR-N-02/1): the indicated form number (*HTR-N 02/09*) does not exist and must be replaced with HTR-N 01/1 instead;

(second page)

3. A blank page (with NRG disclosing conditions) is left following the cover: this should be deleted;
4. The header of the cover page is also left on the chronology page and two more following pages: the standard 2nd page form should be used instead (i.e. that one appearing from page 7 on);
5. Page 5 seems containing same kind of information relevant to the cover page, its use is neither well understood nor needed: it seems actually duplicating, with another form, the cover page inside the document; moreover, copy of the original NRG document cover page cannot be applied to non-NRG authors)
6. Page 6: blank page to be dropped;
7. Same wrong form number indication (HTR-N 02/09) is also at the lower-left of the second page form: this should be replaced with HTR-N-02/1);
8. pg.8: “*Abstract*” is more commonly used for papers, while documents prefer forewords like *Summary/Scope/Purpose/etc.*;

comments/observations:

1. pg.9: “...operation;, the ...” check punctuation marks;
2. pg.9: “...the two HTR systems currently in operation...”: the sentence appears somewhat confusing when addressing the MEDUL and GT-MHR, i.e. HTR designs, together with actually existing and operating HTR’s, i.e. the HTR-10 and the HTTR;
3. pg.9: “....to the HTR-N QA guidelines ...”: Q.A.;
4. pg.9: “...reports 3-10 from the references...”: references [3-10] are mentioned before Ref.[2], if any;
5. pg.9: “....found..”: check punctuation;
6. Page 10: blank page to be dropped;
7. pg.11: “HTR-N project [2]. ...”, reference [2] comes after [3-10];
8. pg.12: “...design [2]. E.g. the conically ...”, sentence should not start with e.g.;
9. pg.14: sentence is spread in between table/figure, which make it a little confusing;

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10. pg.14: Table and Figures three-digit numbering do not follow sections’;
11. pg.16: “...can be found in [3]” check punctuation;
12. pg.21: change “.... given in Fig.3 which ...” to Fig.3.2.3;
13. pg.28: “The peer review of documents” change with “This task has been dealing with the peer review of documents”;
14. pg.28: “...under Task 3.5 as well as....” change with “...under Task 3.5, as well as....”;
15. pg.28 “Nine reports (table 6.1) have been reviewed....” change with “Fourteen reports, constituting a total of nine deliverables (Table 6.1), have been reviewed...”;
16. pg.28: update Table 6.1 according to Table 1 (pages 9-11) of this document (ANSALDO STU-HTRN - 0003 00, Annex to HTR-N-03/07-D-3.5.1-2_0);
17. pg30: update reference [10] as “...Final - Version November 2004”.

completed by AN on 30/11/2004

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6. ACRONYMS AND DEFINITIONS

DB	Data Base
Q.A.	Quality Assurance
WPM	Work Package Manager
PM	Project Manager
PR	Peer Review
RWP	Revised Work Plan
WPM	Work Package Manager
PM	Project Manager

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7. REFERENCES

- [1] "High-Temperature Reactor Physics and Fuel Cycle Studies", Annex I to Contract FIKI-CT-2000-00020, Rev.6, 20/06/2000, FZJ-TTB No.E0125.01.99.
- [2] HTR-N-02/06-D-2.2.1_0, "Additional Q.A. Guidelines for the HTR-N Project - (Quality Assurance Requirements on Nuclear Data)", Ansaldo Nucleare, STU-HTRN – 0001 00, Rev.0, 10 June 2002.
- [3] HTR-N-02/06-D-3.5.1-1_0, "HTR-N Project Q.A. Requirements", Ansaldo Nucleare, STU-HTRN – 0002 00, Rev.0, 20 June 2002.
- [4] J.C. Kuijper, W. von Lensa, "Revised Work Program for WP3: Physics Analysis of Different Fuel Cycles", HTR-N-01/6-D-3.0.1, Rev.5, 20 June 2002.
- [5] J.C. Kuijper and J.B.M. de Haas, "Definition of common output parameters", HTR-N-01/02-D-3.1.5, Rev.1, 20 June 2002.
- [6] J.L. Kloosterman, "Design of burnable poison particles to reduce the reactivity swing in batch-wise fueled High Temperature Reactors", HTR-N-03/05-D-3.3.3, Rev.0, 28 May 2003
- [7] J.C. Kuijper et al., "Definition of common parameters", HTR-N-02/09-D-3.1.1, Rev.1, 10 October 2002.
- [8] J.C. Kuijper et al., "Definition of reference coated particles and plutonium compositions (1st and 2nd generation Pu)", HTR-N-02/06-D-3.1.4, Rev.0, 25 June 2002.
- [9] OECD-NEA, "Accelerator-driven Systems (ADS) and Fast Reactors (FR) in Advanced Nuclear Fuel Cycles- A Comparative Study", 2002.
- [10] H.J. Rütten, "Specification of HTR-MEDUL Core for different fuel cycles", HTR-N-00/10-D-3.1.2, Rev.-, 17 October 2000.
- [11] X. Raepsaet, "Fuel element physical parameters for Pu fuel cycles in a prismatic block type core", HTR-N-00/12-D-3.1.3, Rev.-, 26 April 2002.
- [12] H.J. Rütten et al., "Plutonium (1st and 2nd generation) cell burnup benchmark specification", HTR-N1-02/06-S-3.1.1, Rev.1, 7 October 2002.
- [13] J.B.M. de Haas, J.C. Kuijper, "Feasibility of Burning First and Second Generation Plutonium by Pebble Bed HTRs", HTR-N-03/11-D-3.2.1, Rev.0, 17 November 2003.
- [14] F. DAMIAN and X. RAEPSAET, "CEA's contribution to plutonium cell burnup benchmark problem", HTR-N1-03/04-S-3.1.1-2, Rev.0, 16 April 2003.
- [15] e-mail transmittal to the HTR-N Partners from "Kuijper, J.C." kuijper@nrg-nl.com; subject: "RE: HTR-N Report Pu-Incineration"; date: gio ott 14, 2004 11:01; attachment: 20041013_Burning_Pu_12_JCK.doc. (see *ref.[16]*).

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- [16] H. J. Rütten K.A. Haas, "Incineration of LWR-Plutonium (1. Generation and 2. Generation) in a Modular HTR using Thorium-based Fuel", HTR-N-02/05-D-3.2.2, Rev.1, 22/6/2004.
- [17] J.B.M de Haas, J.C. Kuijper et al., "Physics Analyses of HTR Concepts with Different Fuel Cycles - Summary Report and Inter-comparison of Results", HTR-N-04/10-D-3.5.2, Rev.1, 25/11/2004.
- [18] J.B.M de Haas, J.C. Kuijper et al., "Studies on the Continuous Reload Pebble Bed HTRs - Summary Report", HTR-N-04/10-D-3.2.0, Rev.0, 4/10/2004.
- [19] J.B.M de Haas, J.C. Kuijper et al., "Summary Report on Work Package 3 of HTR-N", HTR-N-04/10-D-3.0.0, Rev.0, 15/11/2004.