Progress report of WPEC Subgroup-C *"High priority request list"* (HPRL) for the period of June 2007 to May 2008

Arjan Plompen, coordinator of WPEC Subgroup-C (SG-C).

In the reporting period Don Smith retired as the US data provider representative of SG-C. Don has been instrumental in setting up the renewed HPRL and its policies. His place was taken by Yaron Danon of RPI, current chair of CSWEG.

The subgroup adopted three requests in the period prior to its meeting in Tokai on June 3, 2008. These requests are listed below.

Several members actively participated in the activities of WPEC Subgroup-26 *"Nuclear data needs for advanced reactor systems"* (SG-26) that in view of its methodology and focus was anticipated to be a major provider of new entries on the High Priority Request List for Nuclear Data (HPRL, http://www.nea.fr/html/dbdata/hprl). Following the conclusion of SG-26 in October 2007, its report was completed early 2008 and a first set of 19 entries of the HPRL were prepared for review (details in annex). SG-C took note of and encourages two WPEC Subgroup proposals that will provide follow-up to these requests.

SG-C further welcomes the first three Japanese entries that were reviewed and adopted on June 3, 2008. Follow-up is considered in the context of a more general initiative to investigate fission neutron spectra and Am-241 (details in annex).

The HPRL has been advertised by SG-C members among nuclear data producers and nuclear data users consistently throughout the reporting period. Examples of these are reports in the JEFF meetings, the JAEA Nuclear data symposium, the CSWEG meeting, the NEMEA-4 workshop, the AccApp'07 conference, several coordination meetings of EU projects (NUDAME, EFNUDAT, CANDIDE, PARTRA).

Annex A: List of new entries
Annex B: Agenda of the SG-C meeting, June 3, 2008, JAEA, Tokai, Japan
Annex C: Minutes of the SG-C meeting, June 3, 2008, JAEA, Tokai, Japan
Annex D: Letter to the SG-26 coordinator, concerning the new entries from SG-26.

Annex A   List of new entries

Adopted

ID	Target	Reaction	Quantity	Energy Range		Accuracy/Comment
12	92-U-235	(n,g)	SIG, RP	100 eV	1 MeV	3%, High Priority, Follow-up: SG-29
13	24-CR-52	(n,xd&xt)	SIG	Eth	65 MeV	20%, General request
14	94-PU-242	(n,g&tot)	SIG	0.5 eV	2 keV	8%, General request

Under revision

ID	Target	Reaction	Quantity	Energy Range		Accuracy/Comment
Japan						
432	95-AM-241	(n,g),	(n,tot), SIG	thermal	eV	5%, Nakagawa
433	95-AM-243	(n,f)	n, spectrum	Eth	10 MeV	10%, Toshinobu
434	96-CM-244	(n,f)	n, spectrum	Eth	10 MeV	10%, Toshinobu
SG-26						
435	92-U-238	(n,n')	SIG	67.4 keV	19.6 MeV	2%
436	94-PU-238	(n,f)	SIG	9.12 keV	6.07 MeV	3%
437	94-PU-238	(n,f)	nu	67.4 keV	1.35 MeV	2.50%
438	95-AM-241	(n,f)	SIG	183 keV	19.6 MeV	1.20%
439	95-AM-242	(n,f)	SIG	9.12 keV	1.35 MeV	4.70%
440	95-AM-243	(n,n')	SIG	24.8 keV	6.07 MeV	2.30%
441	96-CM-242	(n,f)	SIG	67.4 keV	6.07 MeV	32%
444	96-CM-244	(n,f)	SIG	67.4 keV	6.07 MeV	1.50%
445	83-BI-209	(n,n')	SIG	0.498 MeV	2.23 MeV	2.80%
446	96-CM-245	(n,f)	SIG	0.454 keV	6.07 MeV	2.90%
447	5-B-10	(n,a)	SIG	0.498 MeV	2.23 MeV	2.70%
448	11-NA-23	(n,n')	SIG	0.498 MeV	1.35 MeV	10.50%
449	6-C-12	(n,g)	SIG	0.54 eV	4 eV	5%
450	6-C-12	(n,g)	SIG	6.07 MeV	19.6 MeV	7.10%
451	94-PU-239	(n,g)	SIG	0.1 eV	0.54 eV	0.90%
452	94-PU-241	(n,g)	SIG	0.1 eV	0.54 eV	2.40%
453	8-O-16	(n,g)	SIG	2.23 MeV	19.6 MeV	9.90%
454	26-FE-56	(n,n')	SIG	0.498 MeV	19.6 MeV	1.50%
455	94-PU-241	(n,f)	SIG	Thermal	6.07 MeV	1.50%

Annex B Agenda SG-C meeting

Japan, JAEA Tokai-mura, Laboratory-2 bldg
14:00-17:00, June 03, 2008

14:00 Welcome by the chairman, A. Plompen
14:05 Adoption of the Agenda
14:10 Discussion about the new entries on the HPRL

- Input from Japan (3 entries)
- Input from Subgroup 26 (19 entries)
  - Introduction A. Plompen
  - List of response and observations
  - Entry-by-entry review
  - Discussion on follow-up (recommendations to WPEC)

15:30 coffee break
15:50 ....continued
16:30 Any other business
17:00 Closing

Annex C Minutes of the meeting

Present: Yaron Danon, Mike Dunn, Makoto Ishikawa, Robert Jacqmin, Yun-ichi Katakura, Dick McKnight, Luiz Leal, Tsuneo Nakagawa, Claes Nordborg, Arjan Plompen, Peter Rullhusen, Keiichi Shibata, Sasa Toshinobu

1. The agenda was adopted
2. Discussion about the new entries
   a. The request 432 was presented by Tsuneo Nakagawa. The request is for 5% accuracy for ^{241}Am(n,tot) and (n,g) from thermal to eV. The upper energy limit should be changed to 10 eV. Tsuneo mentions discrepancies in thermal cross section measurements and evaluations. It was not clear that the most recent measurements for thermal capture probably agree (Maidana 2001, Fioni 2001, Bringer 2006, Nakamura 2007, LANL 2007-unpublished) as a result of stating in one table total and ground state capture results. Earlier results are clearly discrepant. This includes the relatively recent result of Shinohara 1997. According to the new findings capture to the ground state is 609-628 b, while total capture is about 700 b. Shinohara 1997 and Kalebin 1976 are really off. Mughabghab is unusually low : 587(12) for total capture, 533(13) for ground state capture! Current files: 619 (ENDF/B-VII) to 647 b (JEFF-3.1) are all low! Later in the WPEC meeting Yun-ichi Katakura showed that the new JENDL actinides file adopted a value of almost 700 b together with an isomer ratio consistent with the new measurements. For benchmarks this led to an improvement. Tsuneo further noted that no time-of-flight measurement covers the lowest two resonances for capture. The measured total cross sections (two at thermal) show a total cross section of 610-650 b which is below the total capture cross section! It was further argued in detail that accurate data are needed for MOX fueled reactors, see paper Toru Yamamoto JAEA-Conf 2006-009, see HPRL entry. McKnight: this is not a real sensitivity study. Libraries are swapped to show impact on calculations, but the tests are not specific to Am-241. Conclusion: this is a valid issue which lacks a full sensitivity analysis, so this should be a general request. Olivier Bouland, may be able to elaborate further
   b. The requests H433 and H434 were presented by Sasa Toshinobu. These ask for the fission neutron spectrum for ^{243}Am (H433) and ^{244}Cm (H434) at 10% accuracy from thermal to 10 MeV incident neutron energy. Evidence is shown for the importance of this quantity on the basis of the analysis of an OECD benchmark for an accelerator driven transmutor with a minor actinide loading of 90% (11% Am-243, 4.6% Cm-244). The evidence for the importance of these fission neutron spectra is indirect, which indicates this should be a general request. The problem of fission neutron spectra is an important general issue that is not even properly solved for the major actinides. Accurate measurements already are scarce for ^{235}U and ^{239}Pu so that progress for this request will critically depend on improved physics modeling. In this respect it will be important to check the performance of ENDF/B-VII which has recently adapted fission neutron spectra. Furthermore, follow-up may result through a planned CRP starting around 2010 by the IAEA-NDS for the major actinides.
   c. Subgroup-C requests
      i. Arjan Plompen presents a general introduction to the next 19 new entries which result from the efforts of SG26. A main point is that sensitivity studies prioritized the requests on the basis of back-propagation of target uncertainties on key reactor integral parameters

and a comparison with new covariance matrices (BOLNA). The study concerns advanced systems that are the focus of much current day research. The list of 19 was noted to contain few major actinide requests and comparatively little emphasis on Pu isotopes. The representativeness and completeness of these 19 was discussed. Part of the elimination of major actinides data issues result from rather tight uncertainties that resulted from the BOLNA covariances. Part of the emphasis on certain minor and non actinides is believed by some to be the result of overly pessimistic BOLNA uncertainties. This points to one major concern: how reliable are the BOLNA covariances? A short discussion showed that there is a clear need to have a follow-up project to assess these in relation to the requests that were entered.

It was observed that the SG26 report has three summary tables (31, 32 and 33) for fast systems, the VHTR and PWR . A significant number of these entries do not appear in the list of 19. Some of the uncertainties mentioned in table 31 do not correspond to the lowest of the fast systems. Dick used the appendices with detailed tables for each system for the uncertainties in the requests.

Following this discussion and meeting Arjan Plompen made a more complete survey of the issues emerging from the system target accuracy studies detailed in the appendix of the SG-26 report. This resulted in the letter presented in Annex D with ensuing proposals for further entries on behalf of SG-26 and suggestions for modification to the final report.

ii. Discussion about selection process of SG26 requests. Robert and Arjan pose the question. Dick indicates this is a somewhat subjective choice. Robert: is impact not dependent on the system or number of systems. This is of course conditioned by which system you prefer, an essentially political choice that WPEC as part of NSC should stay clear of. Dick: we should be aware of the BOLNA work being a quick and dirty way to crank out covariances in a short time span. Arjan: should we ask Massimo to issue the remaining points of the main tables as requests? (see above and Annex D). What about high and general priority (response of Don Smith)? At the WPEC meeting it was settled that all issues arising from this subgroup qualify as a high priority request since the verdict is based on I) is it emerging from a current study of common interest, II) is it backed by a sensitivity analysis.

iii. Discussion about individual entries.

   I. “U(n,inl)” took particularly long but served to set the general principles for the remaining requests. First we should not mention the requested uncertainty but call it target uncertainty. This should not be mentioned in the summary line since too tight requirements might scare off people. The document should specify the targets for each system to allow a judgment on relevance by the user. In general, NEA should ask the requester about a confirmation that the published request is acceptable to him. A general recommendation should be added that any effort to bridge the gap between present and target uncertainty is encouraged. We should verify the impact statements and precise them (indicate the need for consistent update of all SG26 requests)

II. Specific comments other requests

a. ^{243}Am inelastic; verify why it is singled out
b. ^{242}Cm is it met with surrogate reactions?
c. Cm-244 only ADMAB, surrogate reactions?
d. ^{209}Bi better known than 30-40%.
e. Should accuracy be stated per reactor parameter? This is too complicated! Comments are sufficient.
f. ^{245}Cm. Yaron Danon worked on this 10 years ago. Can he comment on the experimental status?
g. ^{10}B: does this concern k_{eff} or rod-worth? JENDL-3.3 and standards state a much better accuracy up to 1 MeV. Are there remaining issues with experiments?
h. ^{23}Na inelastic: 4-7.9 % according to appendices (so why 10%?)
i. ^{12}C capture. Rowlands: 1/v should give same accuracy as thermal up to 1 MeV, so met?
j. ^{12}C total/elastic Rowlands: Mughaghab Says much better present accuracy: verify!
k. ^{239}Pu(n,γ), ^{241}Pu (n,γ) uncertainties?
l. ^{16}O unc? High E: (n,γ)->(n,α)
m. ^{56}Fe inel: present uncertainty is better than stated

d. Any other business

No actual discussion took place on June 3. Here, I summarize the discussion about the SG-C presentation in the WPEC meeting concerning follow-up (actions). The main points of actions are: verify with Massimo Salvatores what are all the conclusions of the SG-26 (Annex D), complete the list of entries 19->60(!), modify the formulation of each request according to the above discussion, interact with the new subgroup on microscopic data improvements for advanced reactors to make sure that the list of 60 is reduced to the main core of issues that require longer term attention.

Annex D, Letter to the coordinator of SG-26

Dear Massimo,
At the SG-C and WPEC meetings in Tokai, 3-6 June, the new HPRL entries arising from SG-26 were discussed. Dick McKnight had provided 19 new requests on the basis of the SG-26 report and these were reviewed by SG-C. Individually these are all justified.
However,

1) These are not all that come out from the report: See tables 1, 2 and 3 below.
2) I, and others with me, do not understand why the present list of 19 are singled out and why they are emphasized in the report.
3) From the arguments in the report it is clear that all problems identified in tables 1, 2 and 3 below need to be addressed in order for the final data base to meet the target uncertainties on integral parameters. The list should therefore be expanded to include all these items.
4) Since this confusion arose, it may be needed to modify the SG-26 report to better clarify what is really needed. See the suggestions later on.
5) I need not emphasize that a proper understanding of what needs doing is important for guidance of the new subgroups of WPEC proposed in follow-up to SG26, for the definition of HPRL entries and for other parties initiatives (JEFF, JENDL, ENDF, CANDIDE,…)

I was triggered to reread the report with emphasis on the proposed nuclear data target uncertainties, when I made the following summary of the 19 new entries on the HPRL that result from SG26:

SFR, LFR, GCFR, ABMTR, ADMAB, EFR

- ✓ Fission: ^{238}Pu, ^{241,242}Am, ^{242,244,245}Cm
- ✓ Inelastic: ^{238}U, ^{243}Am, ^{209}Bi, ^{23}Na, ^{56}Fe
- ✓ Neutron removal (capture): ^{10}B, ^{12}C, ^{16}O
- ✓ Thermal spectrum

VHTR, EPR

- ✓ Capture (neutron removal): ^{12}C, ^{239}Pu, ^{241}Pu
- ✓ Fission: ^{241}Pu

What struck me from the above list concerning fast systems was the virtual absence of Pu isotopes, the remarkable singling out of ^{243}Am inelastic, the specific mentioning of ^{209}Bi inelastic, while omitting other similar cases. Also I remembered that Table 31 of the report summarizes the fast reactor needs and eight of its entries were not represented (below more about Table 31).

To understand what really comes out from the report, I went back to the tables with the target accuracies for the systems (tables 256-263 from the appendix) and deleted all entries for which no substantial uncertainty improvements were required. These reduced tables are shown as tables 5-12 below. I then constructed tables 1-3 which summarize the isotopes and quantities for which at least one energy group has uncertainties that need to be substantially reduced. These tables show all eight systems. Table 1 is for U, Np, Pu, table 2 is for Am and Cm and table 3 is for non-actinides.

Together tables 1-3 show 60 cases of isotopes and quantities that require improvement of data accuracies for at least one of the 8 systems. I realize that some of these entries may be contested (probably about 7-8, the uncertainty due to counting statistics ☺), but to clear these issues is really the job of the follow-up subgroup on microscopic data for advanced reactor systems.
In conclusion, we argued at the SG-C and WPEC meetings that all these 60 entries should logically appear on the HPRL. I imagine that you agree?

It is instructive to condense tables 1-3 to a table that has at least two fast systems that require tighter accuracies. This is of interest to identify both the main cross-cutting issues and the system-specific points. The result of this exercise is shown in table 4, below.
Table 4 has 30 entries for a total of 17 isotopes. This may first of all be contrasted with table 31 of the SG26 report which has 18 entries for 15 isotopes, or with the 19 SG26-entries currently on the HPRL.

Aside from the mere statistics, the following points appear of interest:

1) As in table 31 of the SG-26 report, there is a lot more concern for the Pu isotopes than is evident from the present entries on the HPRL.
2) The following cross-cutting issues appear in table 4 of this letter and are not in table 31 of the SG26-report:
   a. Nu-bar: Pu-238, Cm-244
   b. Fission σ: Am-243, Cm-242
   c. Capture σ: Pu-240, Pu-241, Pu-242, Am-241, Na-23, Fe-56, Pb
   d. Inelastic σ: Pu-239, Zr-90
   e. Elastic σ: Cr-52, Fe-56
3) System-specific issues (so, in tables 1-3, but not in 4)
   a. Many requests for minor actinides are due to ADMAB (mostly not repeated in this list)
   b. Inelastic σ: Pu-240 for LFR, Bi-209, Am-241, Am-243 and Np-237 for ADMAB, Pu-242 for SFR, C, Si for GFR, O for EFR
   c. Elastic σ: U-238 for ABTR, C for GFR, O for EFR, Pb for LFR
   d. Fission σ: U-234 for EFR, Cm-246 for SFR
   e. Capture σ: Pu-238 for SFR, Am-242m for SFR, Si for GFR, Ni-58 for EFR

Comments about the SG26 report

The above summary is of relevance for the HPRL and other follow-up activities, but I also believe that the SG-26 report could reflect it better. In particular, I would propose to extend Table 31 of the SG26 report and for consistency also tables 25-30 (system specific lists). These tables should reflect the findings of tables 5-12 given below. To make those tables manageable in print, I propose to show only one line per item (no detailed splitting in energy groups) with the main energy range of interest and the tightest accuracy required for that range.
The text would then have to modified to reflect the above summary in a few sentences. The various summaries would also have to be adapted.
Going more deeply in the report, I further found that the issue of the weighting factors λ should be further clarified and interpreted. In particular, one should also show λ≠1 (case B) for the SFR in table 26 (it is available from the appendix). From this and the corresponding ABTR results a discussion may be elaborated that shows the merit of partial data improvements. With this I mean improvements that do not quite make it to the target accuracy specified but do significantly close the gap.
My reasoning is that the main points of attention are the inequalities of Eq. 27 (SG26-report) that reflect that the target uncertainties on integral parameters must be met. Each of these inequalities defines a domain in a very high dimensionality cross-section uncertainty space that is connected to the target uncertainties of the integral parameters by the sensitivity coefficients. If the data uncertainties lie in the intersection of the domains defined by each individual integral parameter for a given system, then all integral uncertainty targets are met for that system. It should be clear that the minimization of Eq. 26 was employed to find a solution of preference in this domain and that there are (infinitely) many alternative solutions. The procedure is aimed at finding the practically attainable solution and is conditioned by the choice of the λ. That there are several solutions is shown by a comparison of the reference choice (λ=1) and the cases a and b for the weights λ. That it is relevant to take alternative choices of λ in consideration is also evident. In particular, when λ=10 is taken for inelastic scattering cross sections, some of the deficiencies disappear: i.e. some energy groups for U-238 are no longer there, Zr-90 is eliminated and the remaining U-238 groups show a factor two less target accuracy. Of course this goes at the expense of tighter accuracy requirements for other important cross sections. The main example is Pu-239 capture. I believe that elaborating on this point in the SG26 report provides a better understanding to the reactor and nuclear data communities about the role of improvements of nuclear data. In particular, it is important to avoid initiatives from being stopped when the actors realize that the final most stringent target accuracy is out of reach and that therefore the work is useless.

I apologize to make these remarks so late. However, I think that they are of interest and hope that you are willing to take these onboard as far as the SG-26 report is concerned. It is still not sent to the printer, so if we act quickly this can still be done. I can help if needed.

In terms of follow-up: it was proposed to have a short term subgroup of WPEC on microscopic data for advanced reactors with the aim to clear up as many entries as possible from my list of 60 (tables 1-3, below) and to identify the real priorities for further work. The idea is that we have had feedback that some of the statements about present day uncertainties are too pessimistic, and that perhaps new measurement and evaluation capabilities might shed a light on which λ values to use. E.g. from the above it is quite imaginable that all actinide (except for the U-238) inelastic issues may disappear if only we can do well enough for capture on Pu-239. And, if we can do well enough for inelastic on structural materials it is just possible that a bit worse accuracy for Pu-239 capture will suffice.
Regards,

Arjan Plompen

Table 1: U, Np and Pu isotopes and quantities for which significant uncertainty reductions are required

Isotope	Quantity	ABTR	SFR	EFR	GFR	LFR	ADMAB	VHTR	PWR
U234	σ_{fiss}			■					
U235	σ_{capt}			■	■			■	■
U238	σ_{capt}	■	■	■	■	■		■	■
U238	σ_{el}	■							■
U238	σ_{inel}	■	■	■	■	■			■
Np237	σ_{capt}						■		
Np237	σ_{fiss}						■		
Np237	σ_{inel}						■		
Pu238	ν		■		■	■	■		
Pu238	σ_{capt}		■						
Pu238	σ_{fiss}		■	■	■	■	■		
Pu239	σ_{capt}	■	■	■	■	■	■		
Pu239	σ_{inel}	■	■	■	■	■	■		
Pu240	ν		■	■	■	■	■		
Pu240	σ_{capt}		■	■	■	■	■		■
Pu240	σ_{fiss}		■	■	■	■	■		
Pu240	σ_{inel}					■			
Pu241	σ_{capt}		■				■	■	■
Pu241	σ_{fiss}	■	■	■	■	■	■	■	
Pu242	σ_{capt}		■	■			■		
Pu242	σ_{fiss}		■	■	■	■	■		
Pu242	σ_{inel}		■						

Table 2; Am and Cm isotopes and quantities for which significant uncertainty reductions are required

Isotope	Quantity	ABTR	SFR	EFR	GFR	LFR	ADMAB	VHTR	PWR
Am241	ν						■		
Am241	σ_{capt}				■		■		
Am241	σ_{fiss}		■		■	■	■		
Am241	σ_{inel}						■		
Am242m	σ_{capt}		■						
Am242m	σ_{fiss}		■			■	■		
Am243	σ_{capt}						■		
Am243	σ_{fiss}		■				■		
Am243	σ_{inel}						■		
Cm242	σ_{fiss}			■			■		
Cm243	σ_{fiss}						■		
Cm244	ν		■				■		
Cm244	σ_{capt}						■		
Cm244	σ_{fiss}		■	■	■	■	■		
Cm245	σ_{fiss}		■	■	■	■	■		
Cm246	σ_{fiss}		■						

Table 3: Non-actinides isotopes and quantities for which significant uncertainty reductions are required

Isotope	Quantity	ABTR	SFR	EFR	GFR	LFR	ADMAB	VHTR	PWR
B10	σ_{capt}	■	■			■			
C	σ_{capt}							■	
C	σ_{el}				■				
C	σ_{inel}				■			■	
N15	σ_{el}						■		
O	σ_{capt}			■					■
O	σ_{el}			■					■
O	σ_{inel}			■					■
Na23	σ_{capt}	■	■						
Na23	σ_{inel}	■	■	■					
Si28	σ_{capt}				■				
Si28	σ_{inel}				■				
Cr52	σ_{el}	■	■						
Fe56	σ_{capt}	■	■	■		■	■		
Fe56	σ_{el}	■	■						
Fe56	σ_{inel}	■	■	■		■	■		
Ni58	σ_{capt}			■					
Pb	σ_{capt}					■	■		
Pb	σ_{inel}					■	■		
Pb	σ_{el}					■			
Bi209	σ_{inel}						■		
Zr90	σ_{inel}	■	■			■	■		

Table 4: The case of data requirements for more than one fast system. Isotopes and quantities for which significant uncertainty reductions are required.

Isotope	Quantity	ABTR	SFR	EFR	GFR	LFR	ADMAB
U238	σ_{capt}	■	■	■	■	■	
U238	σ_{inel}	■	■	■	■	■	
Pu238	ν		■		■	■	■
Pu238	σ_{fiss}		■	■	■	■	■
Pu239	σ_{capt}	■	■	■	■	■	■
Pu239	σ_{inel}	■	■	■	■	■	■
Pu240	ν		■	■	■	■	■
Pu240	σ_{capt}		■	■	■	■	■
Pu240	σ_{fiss}		■	■	■	■	■
Pu241	σ_{capt}		■				■
Pu241	σ_{fiss}	■	■	■	■	■	■
Pu242	σ_{capt}		■	■			■
Pu242	σ_{fiss}		■	■	■	■	■
Am241	σ_{capt}				■		■
Am241	σ_{fiss}		■		■	■	■
Am242m	σ_{fiss}		■			■	■
Am243	σ_{fiss}		■				■
Cm242	σ_{fiss}			■			■
Cm244	ν		■				■
Cm244	σ_{fiss}		■	■	■	■	■
Cm245	σ_{fiss}		■	■	■	■	■
Na23	σ_{capt}	■	■				
Na23	σ_{inel}	■	■	■			
Cr52	σ_{el}	■	■				
Fe56	σ_{capt}	■	■	■		■	■
Fe56	σ_{el}	■	■				
Fe56	σ_{inel}	■	■	■		■	■
Pb	σ_{capt}					■	■
Pb	σ_{inel}					■	■
Zr90	σ_{inel}	■	■			■	■

Tabel 5: ABTR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%)			
				Required		
			Initial	λ=1	λ≠1 [(a)]	λ≠1 [(b)]
U238	σ_{capt}	24.8 - 9.12 keV	9	3	2	2
	σ_{el}	6.07 - 2.23 MeV	15	15	12	8
		2.23 - 1.35 MeV	19	15	11	8
		1.35 - 0.498 MeV	5	5	4	3
	σ_{inel}	19.6 - 6.07 MeV	29	12	15	21
		6.07 - 2.23 MeV	20	3	4	6
		2.23 - 1.35 MeV	21	4	5	6
		1.35 - 0.498 MeV	12	7	8	11
		183 - 67.4 keV	11	7	9	11
Pu239	σ_{capt}	1.35 - 0.498 MeV	18	10	7	5
		498 - 183 keV	12	6	4	3
		183 - 67.4 keV	9	5	4	3
		67.4 - 24.8 keV	10	6	4	3
		24.8 - 9.12 keV	7	6	4	3
		9.12 - 2.03 keV	16	7	5	4
	σ_{inel}	6.07 - 2.23 MeV	22	12	15	21
		2.23 - 1.35 MeV	19	15	19	19
		1.35 - 0.498 MeV	29	19	24	29
Pu241	σ_{fiss}	1.35 - 0.498 MeV	17	12	12	9
		498 - 183 keV	14	9	9	7
		183 - 67.4 keV	20	9	9	7
Fe56	σ_{capt}	19.6 - 6.07 MeV	46	24	15	12
		183 - 67.4 keV	11	8	6	5
		67.4 - 24.8 keV	13	10	7	6
		2.03 - 0.454 keV	11	8	6	5
	σ_{el}	6.07 - 2.23 MeV	8	7	5	4
	σ_{inel}	2.23 - 1.35 MeV	25	6	7	10
		1.35 - 0.498 MeV	16	8	9	13
Cr52	σ_{el}	183 - 67.4 keV	11	8	6	4
Zr90	σ_{inel}	6.07 - 2.23 MeV	18	11	13	18
Na23	σ_{capt}	19.6 - 6.07 MeV	46	27	27	18
	σ_{inel}	1.35 - 0.498 MeV	28	10	12	18
B10	σ_{capt}	498 - 183 keV	15	14	11	9

*Tabel 6: **SFR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.***

Isotope	Cross-Section	Energy range	Uncertainty (%)			
			Initial	Required		
				λ=1	λ≠1 [a]	λ≠1 [b]
U238	σ_{capt}	24.8 - 9.12 keV	9	4	3	3
	σ_{inel}	6.07 - 2.23 MeV	20	5	7	11
		2.23 - 1.35 MeV	21	5	6	10
		1.35 - 0.498 MeV	12	6	7	11
Pu238	σ_{capt}	183 - 67.4 keV	17	12	12	10
		67.4 - 24.8 keV	22	13	13	12
	σ_{fiss}	6.07 - 2.23 MeV	21	6	6	5
		2.23 - 1.35 MeV	34	6	6	5
		1.35 - 0.498 MeV	17	3	3	3
		498 - 183 keV	17	4	4	3
		183 - 67.4 keV	9	5	5	4
		67.4 - 24.8 keV	12	6	7	6
		24.8 - 9.12 keV	11	7	7	6
	ν	1.35 - 0.498 MeV	7	3	3	2
		498 - 183 keV	7	3	3	3
		183 - 67.4 keV	7	4	4	4
Pu239	σ_{capt}	1.35 - 0.498 MeV	18	11	8	7
		498 - 183 keV	12	7	5	4
		183 - 67.4 keV	9	6	4	4
		67.4 - 24.8 keV	10	7	5	4
		24.8 - 9.12 keV	7	6	4	4
		9.12 - 2.03 keV	16	7	5	4
	σ_{inel}	6.07 - 2.23 MeV	22	13	16	22
		1.35 - 0.498 MeV	29	12	15	25
Pu240	σ_{capt}	1.35 - 0.498 MeV	16	7	7	7
		498 - 183 keV	14	5	5	5
		183 - 67.4 keV	14	5	5	4
		67.4 - 24.8 keV	11	5	5	4
		24.8 - 9.12 keV	10	5	5	4
	σ_{fiss}	6.07 - 2.23 MeV	5	3	3	3
		2.23 - 1.35 MeV	6	3	3	2
		1.35 - 0.498 MeV	6	2	2	2
		2.03 - 0.454 keV	22	13	13	11
	ν	2.23 - 1.35 MeV	3	2	2	2
		1.35 - 0.498 MeV	4	2	2	1
		498 - 183 keV	5	3	3	3
Pu241	σ_{capt}	1.35 - 0.498 MeV	32	14	15	13
		498 - 183 keV	21	11	11	10
	σ_{fiss}	6.07 - 2.23 MeV	14	7	7	6
		2.23 - 1.35 MeV	21	6	6	5
		1.35 - 0.498 MeV	17	3	3	3
		498 - 183 keV	14	3	3	2
		183 - 67.4 keV	20	3	3	2
		67.4 - 24.8 keV	9	3	3	3
		24.8 - 9.12 keV	11	4	4	3
		9.12 - 2.03 keV	10	5	5	5
		2.03 - 0.454 keV	13	4	4	4
		454 eV-22.6 eV	19	9	9	8
Pu242	σ_{capt}	498 - 183 keV	24	11	11	10

		183 - 67.4 keV	32	10	10	9
		67.4 - 24.8 keV	37	9	10	8
		24.8 - 9.12 keV	39	8	8	8
		9.12 - 2.03 keV	39	12	13	11
	σ_{fiss}	19.6 - 6.07 MeV	37	15	16	14
		6.07 - 2.23 MeV	15	5	5	5
		2.23 - 1.35 MeV	21	5	5	4
		1.35 - 0.498 MeV	19	4	4	3
		498 - 183 keV	19	9	9	8
	σ_{inel}	1.35 - 0.498 MeV	60	26	27	38
Am241	σ_{fiss}	6.07 - 2.23 MeV	12	7	7	6
		2.23 - 1.35 MeV	10	6	7	6
		1.35 - 0.498 MeV	8	6	6	5
Am242m	σ_{capt}	498 - 183 keV	29	15	15	13
		183 - 67.4 keV	19	12	12	11
	σ_{fiss}	6.07 - 2.23 MeV	23	8	8	7
		2.23 - 1.35 MeV	20	8	8	7
		1.35 - 0.498 MeV	17	4	4	4
		498 - 183 keV	17	3	3	3
		183 - 67.4 keV	17	3	3	3
		67.4 - 24.8 keV	14	4	4	4
		24.8 - 9.12 keV	12	4	4	4
		9.12 - 2.03 keV	12	7	7	6
		2.03 - 0.454 keV	12	5	5	5
Am243	σ_{fiss}	6.07 - 2.23 MeV	11	8	8	7
		1.35 - 0.498 MeV	9	7	7	6
Cm244	σ_{fiss}	6.07 - 2.23 MeV	31	8	8	7
		2.23 - 1.35 MeV	44	8	8	7
		1.35 - 0.498 MeV	50	5	5	5
		498 - 183 keV	37	12	13	11
	ν	6.07 - 2.23 MeV	11	7	7	6
		2.23 - 1.35 MeV	11	7	7	6
		1.35 - 0.498 MeV	6	4	4	4
Cm245	σ_{fiss}	2.23 - 1.35 MeV	44	14	15	14
		1.35 - 0.498 MeV	49	9	9	8
		498 - 183 keV	37	7	7	6
		183 - 67.4 keV	48	7	7	6
		67.4 - 24.8 keV	27	9	9	8
		24.8 - 9.12 keV	14	9	9	8
Cm246	σ_{fiss}	1.35 - 0.498 MeV	40	16	17	15
Fe56	σ_{capt}	19.6 - 6.07 MeV	46	14	11	11
		183 - 67.4 keV	11	6	4	4
		67.4 - 24.8 keV	13	7	5	4
		2.03 - 0.454 keV	11	5	4	3
	σ_{el}	6.07 - 2.23 MeV	8	5	4	3
		2.23 - 1.35 MeV	6	5	4	3
	σ_{inel}	19.6 - 6.07 MeV	13	9	11	13
		6.07 - 2.23 MeV	7	4	5	7
		2.23 - 1.35 MeV	25	3	4	7
		1.35 - 0.498 MeV	16	3	4	6
Cr52	σ_{el}	183 - 67.4 keV	11	6	5	4
Zr90	σ_{inel}	6.07 - 2.23 MeV	18	9	11	18
Na23	σ_{capt}	19.6 - 6.07 MeV	46	18	16	14
	σ_{inel}	2.23 - 1.35 MeV	13	9	12	13
		1.35 - 0.498 MeV	28	4	5	8
B10	σ_{capt}	1.35 - 0.498 MeV	15	9	7	6

	Cont.	498 - 183 keV	15	5	4	3
		183 - 67.4 keV	10	4	3	3
		67.4 - 24.8 keV	10	5	4	3
		24.8 - 9.12 keV	8	6	4	4

Tabel 7: EFR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%)		
			Initial	Required	
				λ=1	λ≠1 [(a)]
U234	σ_{fiss}	1.35 - 0.498 MeV	38	30	32
U235	σ_{capt}	183 - 67.4 keV	31	23	19
		67.4 - 24.8 keV	33	23	19
		24.8 - 9.12 keV	34	23	19
		9.12 - 2.03 keV	34	25	21
U238	σ_{capt}	24.8 - 9.12 keV	9	3	2
	σ_{inel}	6.07 - 2.23 MeV	20	4	4
		2.23 - 1.35 MeV	21	4	4
		1.35 - 0.498 MeV	12	5	5
		183 - 67.4 keV	11	9	9
Pu238	σ_{fiss}	2.23 - 1.35 MeV	34	24	30
		1.35 - 0.498 MeV	17	10	9
		498 - 183 keV	17	12	10
Pu239	σ_{capt}	498 - 183 keV	12	9	5
		183 - 67.4 keV	9	7	4
		67.4 - 24.8 keV	10	7	4
		24.8 - 9.12 keV	7	6	4
		9.12 - 2.03 keV	16	6	3
	σ_{inel}	6.07 - 2.23 MeV	22	14	14
Pu240	σ_{capt}	498 - 183 keV	14	9	9
		183 - 67.4 keV	14	7	6
		67.4 - 24.8 keV	11	6	6
		24.8 - 9.12 keV	10	7	7
	σ_{fiss}	1.35 - 0.498 MeV	6	4	3
	ν	1.35 - 0.498 MeV	4	3	2
Pu241	σ_{fiss}	1.35 - 0.498 MeV	17	8	7
		498 - 183 keV	14	7	6
		183 - 67.4 keV	20	6	5
		67.4 - 24.8 keV	9	6	6
		24.8 - 9.12 keV	11	7	6
		9.12 - 2.03 keV	10	8	7
		2.03 - 0.454 keV	13	7	6
Pu242	σ_{capt}	67.4 - 24.8 keV	37	26	27
		24.8 - 9.12 keV	39	25	26
		9.12 - 2.03 keV	39	28	29
	σ_{fiss}	1.35 - 0.498 MeV	19	11	9

Cm242	σ_{fiss}	6.07 - 2.23 MeV	53	44	42
		498 - 183 keV	66	51	50
		183 - 67.4 keV	63	49	48
Cm244	σ_{fiss}	1.35 - 0.498 MeV	50	20	17
Cm245	σ_{fiss}	1.35 - 0.498 MeV	49	43	41
		183 - 67.4 keV	48	42	40
Fe56	σ_{capt}	2.03 - 0.454 keV	11	8	5
	σ_{inel}	2.23 - 1.35 MeV	25	7	7
		1.35 - 0.498 MeV	16	8	9
Ni58	σ_{capt}	19.6 - 6.07 MeV	48	20	12
		6.07 - 2.23 MeV	15	9	5
Na23	σ_{inel}	1.35 - 0.498 MeV	28	8	8
O16	σ_{capt}	19.6 - 6.07 MeV	100	14	8
		6.07 - 2.23 MeV	100	11	6
	σ_{el}	6.07 - 2.23 MeV	55	16	17
		2.23 - 1.35 MeV	12	9	9
	σ_{inel}	19.6 - 6.07 MeV	100	28	29

Tabel 8: GFR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%)		
			Initial	Required	
				λ=1	λ≠1 [(a)]
U235	σ_{capt}	9.12 - 2.03 keV	34	13	11
U238	σ_{capt}	24.8 - 9.12 keV	9	2	1
		9.12 - 2.03 keV	3	1	1
	σ_{inel}	19.6 - 6.07 MeV	29	7	10
		6.07 - 2.23 MeV	20	2	2
		2.23 - 1.35 MeV	21	2	2
		1.35 - 0.498 MeV	12	2	3
		183 - 67.4 keV	11	7	9
Pu238	σ_{fiss}	6.07 - 2.23 MeV	21	7	8
		2.23 - 1.35 MeV	34	8	8
		1.35 - 0.498 MeV	17	5	5
		498 - 183 keV	17	6	7
		67.4 - 24.8 keV	12	7	8
		24.8 - 9.12 keV	11	7	8
	ν	1.35 - 0.498 MeV	7	4	4
		498 - 183 keV	7	5	6
Pu239	σ_{capt}	183 - 67.4 keV	9	6	4
		67.4 - 24.8 keV	10	5	4
		24.8 - 9.12 keV	7	4	3
		9.12 - 2.03 keV	16	3	2
	σ_{inel}	6.07 - 2.23 MeV	22	8	10
		1.35 - 0.498 MeV	29	12	15
Pu240	σ_{capt}	183 - 67.4 keV	14	6	7
		67.4 - 24.8 keV	11	5	6
		24.8 - 9.12 keV	10	5	6
	σ_{fiss}	6.07 - 2.23 MeV	5	3	3
		2.23 - 1.35 MeV	6	3	3
		1.35 - 0.498 MeV	6	2	3
		2.03 - 0.454 keV	22	9	10
	ν	1.35 - 0.498 MeV	4	2	2
Pu241	σ_{fiss}	6.07 - 2.23 MeV	14	6	6
		2.23 - 1.35 MeV	21	6	6
		1.35 - 0.498 MeV	17	4	4
		498 - 183 keV	14	3	3
		183 - 67.4 keV	20	3	3
		67.4 - 24.8 keV	9	3	3
		24.8 - 9.12 keV	11	3	3
		9.12 - 2.03 keV	10	2	2
		2.03 - 0.454 keV	13	3	3
		454 - 22.6 eV	19	5	5
Pu242	σ_{capt}	183 - 67.4 keV	32	13	14
		67.4 - 24.8 keV	37	9	10
		24.8 - 9.12 keV	39	8	9
		9.12 - 2.03 keV	39	7	8
	σ_{fiss}	6.07 - 2.23 MeV	15	6	6
		2.23 - 1.35 MeV	21	5	6
		1.35 - 0.498 MeV	19	4	4
Am241	σ_{capt}	183 - 67.4 keV	7	4	4
		67.4 - 24.8 keV	8	3	4

		24.8 - 9.12 keV	7	3	4
		9.12 - 2.03 keV	7	3	3
		2.03 - 0.454 keV	7	3	4
	σ_{fiss}	6.07 - 2.23 MeV	12	3	4
		2.23 - 1.35 MeV	10	3	4
		1.35 - 0.498 MeV	8	3	3
Cm244	σ_{fiss}	6.07 - 2.23 MeV	31	12	12
		2.23 - 1.35 MeV	44	13	13
		1.35 - 0.498 MeV	50	8	9
Cm245	σ_{fiss}	1.35 - 0.498 MeV	49	16	17
		498 - 183 keV	37	13	14
		183 - 67.4 keV	48	11	11
		67.4 - 24.8 keV	27	11	12
C	σ_{el}	6.07 - 2.23 MeV	5	4	3
		2.23 - 1.35 MeV	5	2	2
		1.35 - 0.498 MeV	5	2	1
		498 - 183 keV	5	2	2
		183 - 67.4 keV	3	2	2
	σ_{inel}	19.6 - 6.07 MeV	30	9	13
		6.07 - 2.23 MeV	35	11	14
Si28	σ_{capt}	19.6 - 6.07 MeV	53	6	4
	σ_{inel}	6.07 - 2.23 MeV	14	3	4
		2.23 - 1.35 MeV	50	6	8

Tabel 9: LFR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%) Initial	Required λ=1	Required $\lambda \neq 1$ [a]
U238	σ_{capt}	24.8 - 9.12 keV	9	2	2
	σ_{inel}	6.07 - 2.23 MeV	20	3	4
		2.23 - 1.35 MeV	21	2	3
		1.35 - 0.498 MeV	12	2	3
		183 - 67.4 keV	11	4	5
Pu238	σ_{fiss}	6.07 - 2.23 MeV	21	8	8
		2.23 - 1.35 MeV	34	7	7
		1.35 - 0.498 MeV	17	3	4
		498 - 183 keV	17	3	4
		183 - 67.4 keV	9	5	5
		67.4 - 24.8 keV	12	6	6
		24.8 - 9.12 keV	11	7	7
	ν	1.35 - 0.498 MeV	7	3	3
		498 - 183 keV	7	3	3
		183 - 67.4 keV	7	4	4
Pu239	σ_{capt}	1.35 - 0.498 MeV	18	7	5
		498 - 183 keV	12	4	3
		183 - 67.4 keV	9	4	3
		67.4 - 24.8 keV	10	5	3
		24.8 - 9.12 keV	7	5	3
		9.12 - 2.03 keV	16	6	4
	σ_{inel}	1.35 - 0.498 MeV	29	7	10
		498 - 183 keV	34	12	15
Pu240	σ_{capt}	1.35 - 0.498 MeV	16	6	7
		498 - 183 keV	14	4	5
		183 - 67.4 keV	14	4	4
		67.4 - 24.8 keV	11	4	5
		24.8 - 9.12 keV	10	5	6
	σ_{fiss}	6.07 - 2.23 MeV	5	3	3
		2.23 - 1.35 MeV	6	3	3
		1.35 - 0.498 MeV	6	2	2
	ν	1.35 - 0.498 MeV	4	1	1
		498 - 183 keV	5	3	3
	σ_{inel}	183 - 67.4 keV	43	13	16
Pu241	σ_{fiss}	2.23 - 1.35 MeV	21	8	8
		1.35 - 0.498 MeV	17	4	4
		498 - 183 keV	14	3	3
		183 - 67.4 keV	20	3	3
		67.4 - 24.8 keV	9	3	3
		24.8 - 9.12 keV	11	4	4
		9.12 - 2.03 keV	10	5	6
Pu242	σ_{capt}	183 - 67.4 keV	32	11	12
		67.4 - 24.8 keV	37	11	12
		24.8 - 9.12 keV	39	12	13
	σ_{fiss}	6.07 - 2.23 MeV	15	7	8
		2.23 - 1.35 MeV	21	7	7
		1.35 - 0.498 MeV	19	4	4
Am241	σ_{fiss}	1.35 - 0.498 MeV	8	5	6
Am242m	σ_{fiss}	498 - 183 keV	17	8	8

Cm244	σ_{fiss}	2.23 - 1.35 MeV	44	14	14
		1.35 - 0.498 MeV	50	6	7
Cm245	σ_{fiss}	1.35 - 0.498 MeV	49	11	12
		498 - 183 keV	37	7	8
		183 - 67.4 keV	48	7	8
		67.4 - 24.8 keV	27	9	9
Fe56	σ_{capt}	183 - 67.4 keV	11	6	4
		67.4 - 24.8 keV	13	7	5
	σ_{inel}	2.23 - 1.35 MeV	25	4	6
		1.35 - 0.498 MeV	16	4	5
Zr90	σ_{inel}	6.07 - 2.23 MeV	18	6	9
Pb206	σ_{capt}	183 - 67.4 keV	15	7	5
		6.07 - 2.23 MeV	6	3	5
		2.23 - 1.35 MeV	14	3	4
		1.35 - 0.498 MeV	9	4	5
Pb207	σ_{inel}	2.23 - 1.35 MeV	14	5	7
		1.35 - 0.498 MeV	11	3	4
Pb208	σ_{el}	1.35 - 0.498 MeV	7	3	2
		498 - 183 keV	5	3	3
	σ_{inel}	19.6 - 6.07 MeV	18	7	9
B10	σ_{capt}	1.35 - 0.498 MeV	15	5	3
		498 - 183 keV	15	2	2
		183 - 67.4 keV	10	2	2
		67.4 - 24.8 keV	10	3	2
		24.8 - 9.12 keV	8	3	2
		9.12 - 2.03 keV	8	5	4

Tabel 10: ADMAB-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%)		
			Initial	Required	
				λ=1	λ≠1 [(a)]
Pu238	σ_{fiss}	6.07 - 2.23 MeV	21	7	7
		2.23 - 1.35 MeV	34	6	6
		1.35 - 0.498 MeV	17	3	3
		498 - 183 keV	17	4	4
	ν	1.35 - 0.498 MeV	7	3	3
		498 - 183 keV	7	3	3
Pu239	σ_{capt}	1.35 - 0.498 MeV	18	7	5
		498 - 183 keV	12	5	4
		183 - 67.4 keV	9	5	3
		67.4 - 24.8 keV	10	5	4
		24.8 - 9.12 keV	7	5	3
		9.12 - 2.03 keV	16	4	3
	σ_{inel}	6.07 - 2.23 MeV	22	8	10
		2.23 - 1.35 MeV	19	6	8
		1.35 - 0.498 MeV	29	5	6
Pu240	σ_{capt}	183 - 67.4 keV	14	6	6
	σ_{fiss}	2.23 - 1.35 MeV	6	3	3
		1.35 - 0.498 MeV	6	2	2
	ν	1.35 - 0.498 MeV	4	2	2
Pu241	σ_{capt}	1.35 - 0.498 MeV	32	8	8
		498 - 183 keV	21	7	7
	σ_{fiss}	6.07 - 2.23 MeV	14	5	5
		2.23 - 1.35 MeV	21	4	4
		1.35 - 0.498 MeV	17	2	2
		498 - 183 keV	14	2	2
		183 - 67.4 keV	20	2	2
		67.4 - 24.8 keV	9	2	2
		24.8 - 9.12 keV	11	2	2
		9.12 - 2.03 keV	10	2	2
		2.03 - 0.454 keV	13	3	3
		454 - 22.6 eV	19	7	7
Pu242	σ_{capt}	24.8 - 9.12 keV	39	10	10
	σ_{fiss}	6.07 - 2.23 MeV	15	7	7
		2.23 - 1.35 MeV	21	5	5
		1.35 - 0.498 MeV	19	4	4
Np237	σ_{capt}	1.35 - 0.498 MeV	10	5	5
		498 - 183 keV	6	3	3
		67.4 - 24.8 keV	7	3	3
		24.8 - 9.12 keV	5	3	3
		9.12 - 2.03 keV	5	3	3
		2.03 - 0.454 keV	6	4	4
Np237	σ_{fiss}	6.07 - 2.23 MeV	8	3	3
		2.23 - 1.35 MeV	8	2	2
		1.35 - 0.498 MeV	6	2	2
		498 - 183 keV	6	4	4
	σ_{inel}	2.23 - 1.35 MeV	22	6	7
		1.35 - 0.498 MeV	29	5	6
		498 - 183 keV	45	10	12
Am241	σ_{capt}	1.35 - 0.498 MeV	7	2	2

		498 - 183 keV	5	2	2
		183 - 67.4 keV	7	2	2
		67.4 - 24.8 keV	8	2	2
		24.8 - 9.12 keV	7	2	2
		9.12 - 2.03 keV	7	2	2
		2.03 - 0.454 keV	7	3	3
	σ_{fiss}	19.6 - 6.07 MeV	13	6	6
		6.07 - 2.23 MeV	12	2	2
		2.23 - 1.35 MeV	10	1	1
		1.35 - 0.498 MeV	8	1	1
		498 - 183 keV	8	4	4
	ν	6.07 - 2.23 MeV	2	1	1
		2.23 - 1.35 MeV	2	1	1
	σ_{inel}	6.07 - 2.23 MeV	15	6	8
		2.23 - 1.35 MeV	30	5	6
		1.35 - 0.498 MeV	25	4	5
		498 - 183 keV	23	8	9
Am242m	σ_{fiss}	1.35 - 0.498 MeV	17	6	6
		498 - 183 keV	17	5	5
		183 - 67.4 keV	17	5	5
		67.4 - 24.8 keV	14	6	6
		24.8 - 9.12 keV	12	6	6
Am243	σ_{capt}	1.35 - 0.498 MeV	14	3	3
		498 - 183 keV	9	2	2
		183 - 67.4 keV	7	2	2
		67.4 - 24.8 keV	5	2	2
		24.8 - 9.12 keV	7	2	2
		9.12 - 2.03 keV	7	3	3
		2.03 - 0.454 keV	7	3	3
	σ_{fiss}	6.07 - 2.23 MeV	11	2	2
		2.23 - 1.35 MeV	6	2	2
		1.35 - 0.498 MeV	9	2	2
	σ_{inel}	6.07 - 2.23 MeV	18	5	6
		2.23 - 1.35 MeV	35	4	5
		1.35 - 0.498 MeV	42	2	3
		498 - 183 keV	41	4	4
		183 - 67.4 keV	80	4	5
		67.4 - 24.8 keV	81	12	15
Cm242	σ_{fiss}	6.07 - 2.23 MeV	53	26	26
		498 - 183 keV	66	28	28
		183 - 67.4 keV	63	28	28
Cm243	σ_{fiss}	1.35 - 0.498 MeV	50	10	10
		498 - 183 keV	37	8	8
		183 - 67.4 keV	47	8	8
Cm244	σ_{capt}	498 - 183 keV	23	6	6
		183 - 67.4 keV	18	6	6
		67.4 - 24.8 keV	17	6	6
		24.8 - 9.12 keV	19	6	6
	σ_{fiss}	6.07 - 2.23 MeV	31	3	3
		2.23 - 1.35 MeV	44	3	3
		1.35 - 0.498 MeV	50	2	2
		498 - 183 keV	37	4	4
		183 - 67.4 keV	48	7	7
	ν	6.07 - 2.23 MeV	11	3	3
		2.23 - 1.35 MeV	11	2	2
		1.35 - 0.498 MeV	6	1	1

		498 - 183 keV	6	4	4
Cm245	σ_{fiss}	6.07 - 2.23 MeV	31	7	7
		2.23 - 1.35 MeV	44	6	6
		1.35 - 0.498 MeV	49	3	3
		498 - 183 keV	37	3	3
		183 - 67.4 keV	48	3	3
		67.4 - 24.8 keV	27	3	3
		24.8 - 9.12 keV	14	3	3
		9.12 - 2.03 keV	13	4	4
		2.03 - 0.454 keV	13	5	5
Fe56	σ_{capt}	183 - 67.4 keV	11	5	3
		67.4 - 24.8 keV	13	6	4
		2.03 - 0.454 keV	11	5	4
	σ_{inel}	6.07 - 2.23 MeV	7	3	3
		2.23 - 1.35 MeV	25	2	2
		1.35 - 0.498 MeV	16	2	2
Zr90	σ_{inel}	6.07 - 2.23 MeV	18	3	4
N15	σ_{el}	2.23 - 1.35 MeV	5	3	2
		1.35 - 0.498 MeV	5	1	1
		498 - 183 keV	5	2	1
		183 - 67.4 keV	5	2	2
Pb	σ_{capt}	9.12 - 2.03 keV	182	20	14
	σ_{inel}	6.07 - 2.23 MeV	5	3	4
Bi209	σ_{inel}	2.23 - 1.35 MeV	34	3	3
		1.35 - 0.498 MeV	42	4	5

Tabel 11: VHTR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%)		
			Initial	Required	
				λ=1	$\lambda \neq 1$ [(a)]
U235	σ_{capt}	24.8 - 9.12 keV	34	15	18
		9.12 - 2.03 keV	34	14	17
U238	σ_{capt}	454 - 22.6 eV	2	1	1
Pu241	σ_{capt}	0.54 - 0.10 eV	7	2	3
	σ_{fiss}	454 - 22.6 eV	19	6	8
		4.00 - 0.54 eV	27	9	12
C	σ_{capt}	19.6 - 6.07 MeV	20	7	7
		4.00 - 0.54 eV	20	5	5
	σ_{inel}	19.6 - 6.07 MeV	30	7	12
		6.07 - 2.23 MeV	35	14	25

Tabel 12: PWR-overview of nuclear data target uncertainties that are not met according to the BOLNA uncertainties. Results include different assumptions for the weight factors λ.

Isotope	Cross-Section	Energy range	Uncertainty (%)		
			Initial	Required	
				λ=1	$\lambda \neq 1$ [(a)]
U235	σ_{capt}	67.4 - 24.8 keV	33	20	19
		24.8 - 9.12 keV	34	18	16
		9.12 - 2.03 keV	34	12	10
U238	σ_{capt}	24.8 - 9.12 keV	9	5	4
		454 - 22.6 eV	2	1	1
	σ_{scatt}	6.07 - 2.23 MeV	15	5	5
		2.23 - 1.35 MeV	19	8	7
Pu240	σ_{capt}	0.10 eV-thermal	5	3	4
Pu241	σ_{capt}	0.54 - 0.10 eV	7	3	4
	σ_{fiss}	454 - 22.6 eV	19	5	6
		4.00 - 0.54 eV	27	8	10
O	σ_{capt}	19.6 - 6.07 MeV	100	12	11
		6.07 - 2.23 MeV	100	10	9
	σ_{scatt}	19.6 - 6.07 MeV	85	16	14
		6.07 - 2.23 MeV	55	13	11
		2.23 - 1.35 MeV	12	8	8