THE NEA HIGH PRIORITY NUCLEAR DATA REQUEST LIST

Status in March 2001

NEA Nuclear Science Committee
Working Party on International Evaluation Co-operation
Subgroup C

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Summary

The Nuclear Energy Agency's High Priority Nuclear Data Request List is a compilation of the highest priority nuclear data requirements. The purpose of the list is to provide a guide for those planning measurement, nuclear theory and evaluation programs. It is divided into the following sections:

Section 1. Standards, and requirements for the interpretation of measurements.

These have been adopted, primarily, from the USA request list (Compilation of Requests for Nuclear Data, ORNL/TM-12291; ENDF-354, January 1993).

Section 2. Dosimetry.

There are at present no requests in this section, pending a review.

Section 3. Fusion reactor technology.

Edward Cheng has co-ordinated the production of this list. A revised list was provided in May 1996. Additional requests from European countries and Japan are also included.

Section 4. Fission reactor technology.

There are contributions from France, Germany, Japan, Russia, UK and USA. The USA requirements are the Priority 1 requests in the USA 1993 Request List. The Russia list was revised in 1995. The French, German and UK requirements were revised in 1996 and the Japanese requirements revised in 2000.

Section 5. Requirements for medical and industrial applications.

Some of these are included in the Intermediate Energy List. The remaining requirements have been adopted from the USA 1993 list together with requirements received from Italy. In 2001 version, additional Japanese list was added.

Section 6. Intermediate energy requirements.

A.J. Koning (ECN Petten) has co-ordinated the production of this section. A revised list was produced in December 1996. Japanese requirements for waste transmutation and spallation neutron source were revised in 2001.

Historical background

The first High Priority Nuclear Data Request List was produced in the early 1980s by the NEA Committee on Reactor Physics, NEACRP, and the NEA Nuclear Data Committee, NEANDC. The aim was to provide targets for the improvement of nuclear data, primarily for application in the nuclear industry. The users were asked to define their most important requirements, taking into account the limited resources available for measurement and evaluation of data. It was the responsibility of the NEACRP to define the requirements. The NEANDC then reviewed progress in meeting the requirements and commented on the status of the available data and the feasibility of meeting the requirements.

The co-ordination of the production of the World Request List of Nuclear Data (WRENDA) has been the responsibility of the Nuclear Data Section of the IAEA since the 1970s. This contains a more extensive list of requirements. It was considered by the NEA Committees that a shorter, more focused list was needed which takes into account the practicality of meeting the requirements and the resources available. WRENDA had evolved from an earlier list (RENDA) which had been produced in the 1960s by the NEANDC. WRENDA is a collection of requests submitted by national nuclear data committees, international organisations and working groups, such as the international reactor dosimetry working groups. In the case of the High Priority List, the intention was to produce a list which had the consensus of the requesters, at least within Western Europe. In the first list such a consensus was achieved in Western Europe. However, different countries now have different priorities. Presently, only France and Japan are developing fast reactors and there is no international co-operation on fission reactor technology projects (only bilateral co-operative projects). For fusion reactor technology there is more international co-operation and it has been possible to produce a single list of requirements.

The High Priority Request List (HPRL) was reviewed each year by the OECD NEA Nuclear Science Committee's Working Parties on International Evaluation Co-operation (WPEC) and on Nuclear Data Measurement Activities (WPMA) in 1996-1998. Status reports were provided by the Chairman of the WPMA, in consultation with members. The comments of the WPMA and WPEC were considered by the requesters. However, the requester then decided what was to be included in the list. Some general comments concerning the requests made by the WPEC and WPMA The list was considered, by the WPEC and the WPMA at a joint meeting, the most recent one being held in May 1997. Consideration was given to the status of the data and the possibility of meeting the requirements. For a number of items measurements have been completed.

The following general comments were made about the requests:

1) In some cases the same accuracy is requested for the whole energy range, Thermal to 20 MeV, or Threshold to 20 MeV. One would expect the accuracy requirement to be higher in the peak of the reaction rate.
2) Consideration should be given to meeting some of the requirements using nuclear theory. This applies particularly to requests for radioactive nuclides. Those which could be met using theory should be indicated.
3) The existing measured data should be studied to see whether the measurement requirement has already been met, the need being for an improved evaluation.
4) Consideration should be given to the feasibility of meeting the requirement by measurement, the availability of samples and the possibility of meeting the requested accuracy using existing measurement techniques. It would be helpful if a view on where the measurement could be made were included in the list.
5) The WPEC and WPMA have asked that the name of the specific requester and the required application should be given for each item so that the requester can be contacted to discuss the requirements in more detail.
6) The WPEC/WPMA have asked that the requests be divided into Priority 1 and Priority 2 because there are at present too many requests for it to be practical to plan to work on many of them.

In the WPEC meeting in 2000, it was decided the HPRL should be maintained in Subgroup C (SG-C) in WPEC. This is the first version of HPRL after SG-C started the edition.

It should be said that in many cases the requesters are not able to judge the status of the available data nor the feasibility of meeting the requirement. The requesters would like the WPEC and the WPMA to review the requests and advise on how they might be met, whether they have already been met and whether they are feasible.

Specification of requirements

For interaction cross-sections the incident particle energy range is given. The accuracy requirements are to be interpreted as the 1 standard deviation requirement, unless otherwise stated. For fission and fusion reactor technology the interest is mainly in neutron interaction cross-sections, radioactive decay data and fission yields. Other comments and contact person for requests are summarized in Reference Section at the end of this document.

Definition of priorities

It is suggested that Priority 1 be interpreted as indicating data required in the next 5 years, and providing potential economic benefits. The priority 2 and 3 are also indicated as in the next 10 years and better than nothing, respectively.

SECTION 1: REQUIREMENTS FOR NUCLEAR DATA STANDARDS

These are the Priority 1 requirements from the USA 1993 Request List together with requests for Bi-209(n,f) and U-238(n,f) proposed by A. Carlson at the 1997 WPMA meeting. The WPMA co-ordinates with the INDC Standards Sub-Group to discuss these requirements.

1.A. Requirements for nuclear data standards

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
1.A.1	H(n,n) Cross Section	10-200 MeV	1%	*Measurements are in progress at Uppsala University* *100-160 MeV; 10% deviation from evaluations at 180 deg. Scattering angle (N. Olsson).* *The additional comments have been provided by Allan D. Carlson of NIST, USA.* [1]	USA-1
1.A.2	Li-7(a,n) Cross Section	4.4-6 MeV	1%	To Determine B-10(n,a_0).	USA-1
1.A.3	B-10(n,tot) Cross Section	1 keV-20 MeV	0.5-1%	*Recent measurements have been monitored by WPMA sub group on standard (A. Carlson).* *The additional comments have been provided by Allan D. Carlson of NIST, USA.* [2]	USA-1
1.A.4	B-10(n,a) Cross Section	1 keV-5 MeV	1%	*Recent measurements have been monitored by WPMA sub group on standard (A. Carlson).*	USA-1
1.A.5	B-10(n,a) Ratio a_0/a_1	10 keV-5 MeV	2-5%	*New measurements panned at Tohoku, Obninsk, Geel (A. Carlson).*	USA-1
1.A.6	O-16(n,a) Cross Section	1-14 MeV	5%	*There are Mn bath measurements on Be.*	USA-1
1.A.7	Au-197(n,g) Cross Section	0.2-2.5 MeV	2%		USA-1

1.A. Requirements for nuclear data standards (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
1.A.8	Bi-209(n,f) Cross Section	E_{th}-1 GeV	3-5%	Requested at the 1997 WPMA meeting by A. Carlson *The additional comments have been provided by Allan D. Carlson of NIST, USA.* [3]	USA-2
1.A.9	U-235(n,f) Cross Section	0.2- 20 MeV	0.5%	*The additional comments have been provided by Allan D. Carlson of NIST, USA.* [4]	USA-1
1.A.10	U-235(n,f) Cross Section	20-200 MeV	1-2%	*The additional comments have been provided by Allan D. Carlson of NIST, USA.* [4]	USA-1
1.A.11	U-238(n,f) Cross Section	E_{th}-20 MeV	0.5-1%	Requested at the 1997 WPMA meeting by A. Carlson. *The additional comments have been provided by Allan D. Carlson of NIST, USA.* [5]	WPMA-1
1.A.12	U-238(n,f) Cross Section	20-200 MeV	1-2%	Requested at the 1997 WPMA meeting by A. Carlson. New measurements: PTB/UCL at 34, 46, 61 MeV see Trieste Conf. (W. Newhauser). *Data are available, but only in part of the energy range requested.* *The additional comments have been provided by Allan D. Carlson of NIST, USA.* [5]	WPMA-1

SECTION 2: REQUIREMENTS FOR DOSIMETRY REACTIONS

The EURATOM Priority 1 requests in WRENDA 93/94 were included in the earlier version of the High Priority List. However, it is the opinion of the WPMA that these requirements should be reviewed. We can note that there is a new Russian library of dosimetry reaction cross-sections. The validation studies indicate the need for some integral measurements to be repeated. Note that a measurement of 237 Np(n,f) < 2 MeV has been made recently by NIST/LANL (A. Carlson).

SECTION 3: REQUIREMENTS FOR FUSION TECHNOLOGY

3.A. Double-differential cross-sections

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.A.1	O-16(n,xn) DDX	6-14 MeV	10%	DDX measured at 14 MeV at Osaka Univ. (A. Takahashi). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.2	Si-nat(n,xn) DDX	6-14 MeV	10%	DDX measured at 11.5, 18 MeV at Tohoku University (M. Baba). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.3	V-51(n,xn) DDX	6-14 MeV	10%	DDX measured at 14 MeV at Tohoku University (M. Baba). Elastic and inelastic x-section measured at 8-14 MeV at PTB (W. Mannhart). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]

3.A. Double-differential cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.A.4	Fe-nat(n,xn) DDX	6-14 MeV	10%	DDX measured at 11.5, 14, 18 MeV at Tohoku University (M. Baba). DDX measured at 14 MeV at Osaka University (A. Takahashi). Elastic and inelastic x-section measured at 8-14 MeV at PTB (W. Mannhart) *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.5	W-nat(n,xn) DDX	6-14 MeV	10%	DDX measured at 14, 18 MeV at Tohoku University (M. Baba). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.6	Pb-nat(n,xn) DDX	6-14 MeV	10%	DDX measured at 14 MeV at Osaka University (A. Takahashi). Elastic and inelastic x-section measured at 8-14 MeV at PTB (W. Mannhart). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]

3.A. Double-differential cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.A.7	Li-6(n,xn) DDX	6-14 MeV	10%	DDX measured at 11.5, 14 and 18 MeV by Tohoku University (M. Baba). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.8	Li-7(n,xn) DDX	6-14 MeV	10%	DDX measured at 11.5, 14 and 18 MeV by Tohoku University (M. Baba). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.9	Be-9(n,xn) DDX	6-14 MeV	10%	DDX measured at 11.5, 14 and 18 MeV by Tohoku University (M. Baba). DDX measured at 14 MeV at Osaka University (A. Takahashi). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.10	B-10(n,xn) DDX	6-14 MeV	10%	*An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.11	B-11(n,xn) DDX	6-14 MeV	10%	*An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.12	C-12(n,xn) DDX	6-14 MeV	10%	DDX measured for C at 14 MeV at Osaka University (A. Takahashi). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]

3.A. Double-differential cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.A.13	Cr-nat(n,xn) DDX	6-14 MeV	10%	DDX measured at 14 MeV at Tohoku (M. Baba) and Osaka University (A. Takahashi). Elastic and inelastic x-section measured at 8-14 MeV at PTB (W. Mannhart). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.14	Mn-55(n,xn) DDX	6-14 MeV	10%	DDX measured at 14 MeV at Tohoku University (M. Baba). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]
3.A.15	Ni-nat(n,xn) DDX	6-14 MeV	10%	DDX measured at 14, 18 MeV at Tohoku University (M. Baba) and at 14 MeV at Osaka University (A. Takahashi). *An accuracy of 10% has already been achieved for many of these at 14 MeV.*	[6-10]

3.B. Neutron multiplication reactions

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.B.1	Li-7(n,n'p) Cross Section	E_{th}-15 MeV	3%	*Satisfied with the present ENDF/B-VI evaluation at 14 MeV.*	USA [10]
3.B.2	Pb(n,2n) Cross Section	E_{th}-15 MeV	3%		USA [10]
3.B.3	Be(n,2n) Cross Section	E_{th}-15 MeV	3%	*Discrepancies occur in several evaluations and measurements. Integral test at ANL shows good agreement with ENDF/B-VI. There is a new evaluation by Targesen+.* *This should be compared with the integral experiments and the measurement requirements reviewed.*	USA [10]

3.C. Activation cross-sections

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.C.1	N-14(n,p)C-14 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. Measured data above 10 MeV very sparse. *Satisfied below 7 MeV? Morgan, NSE 70 (1979) 163.*	USA [10]
3.C.2	Ti-48(n,a)Ca-45 Cross Section	E_{th}-15 MeV	20%		USA [10]
3.C.3	Ca-45(n,a)Ar-42 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern for V-Cr-Ti alloy: Ti-48(n,a)Ca-45(n,a). A radionuclide of waste disposal concern. *Impossible to measure. Theory?* *Many of these cannot be measured because of their radioactivity. Consideration should be given to meeting them using theory.*	USA [10]
3.C.4	V-50(n,2n)V-49 Cross Section	E_{th}-15 MeV	20%	Materials recycling concern. *Use theory?* *Many of these cannot be measured because of their radioactivity. Consideration should be given to meeting them using theory.*	USA [10]

3.C. Activation cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.C.5	Fe-58(n,g)Fe-59 Cross Section	Therm.-1 MeV	20%	Fe-59 decays into Co-59 which produces Co-60 via neutron capture reactions. Co-60 is of waste management concern. *Impossible to measure. Theory?* *Many of these cannot be measured because of their radioactivity. Consideration should be given to meeting them using theory.*	USA [10]
3.C.6	Ni-63(n,a)Fe-60 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. *Many of these cannot be measured because of their radioactivity. Consideration should be given to meeting them using theory.*	USA [10]
3.C.7	Ni-64(n,2n)Ni-63 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. *Use theory?* *Many of these cannot be measured because of their radioactivity. Consideration should be given to meeting them using theory.*	USA [10]
3.C.8	Cu-65(n,t)Ni-63 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. *Met? (A. Ignatyuk).*	USA [10]

3.C. Activation cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.C.9	Zn-64(n,p)Cu-64 Cross Section	5-15 MeV	5%	Dosimetry cross-section. *Many data available, but two discrepant data sets 7-10 MeV. Re-evaluation required taking into account new decay data?* *See comments of D. Smith, ANL.* [11]	USA [10]
3.C.10	Mo-94(n,p)Nb-94 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. Probably satisfied -- IAEA CRP Reports. *Almost met?*	USA [10]
3.C.11	W-182(n,n'a)Hf-178m Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. *Measurements performed. Preliminary results reported (IAEA-CRP).* *See comments of D. Smith, ANL.* [12]	[10]
3.C.12	W-186(n,n'a)Hf-182 Cross Section	E_{th}-15 MeV	20%	Waste disposal concern. *Measurements performed. Preliminary results reported (IAEA-CRP).* *See comments of D. Smith, ANL.* [12]	USA [10]
3.C.13	Pb-204(n,p)Tl-204 Cross Section	E_{th}-15 MeV	20%	Decay heat and radiological hazard concerns.	USA [10]
3.C.14	Pb-204(n,t)Tl-202 Cross Section	E_{th}-15 MeV	20%	Decay heat and radiological hazard concerns. *Met? (A. Ignatyuk).*	USA [10]

3.C. Activation cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.C.15	Al-27(n,n'a)Na-23 Cross Section	E_{th}-15 MeV	20%	Safety and maintenance concerns. *Difficult. Vonach 20-30%?*	USA [10]
3.C.16	Si-29(n,t)Al-27 Cross Section	E_{th}-15 MeV	20%	Tritium production in SiC.	USA [10]
3.C.17	Ca-45(n,a)Ar-42 Cross Section	E_{th}-15 MeV	20%	*Merged into 3.C.3.*	USA [10]
3.C.18	Sn-120(n,g)Sn-121 Cross Section	Therm.-1 MeV	20%	Waste disposal concern. *Recent measurement at ORELA (D. Larson).*	USA [10]
3.C.19	Sn-125(n,g)Sn-126 Cross Section	Therm.-1 MeV	20%	Waste disposal concern. *Met? -- Karlsruhe.*	USA [10]
3.C.20	V-51(n,n'a)Sc-47 Cross Section	E_{th}-15 MeV	20%	Expt. needed. There is a discrepancy between evaluation and experiment. (Ikeda, JAERI). *See comments of D. Smith, ANL.* [13]	USA [10]
3.C.21	V-50(n,n'a)Sc-46 Cross Section	E_{th}-15 MeV	20%	Fusion reactor spectrum (5-10%).	USA [10]
3.C.22	Sn-124(n,g)Sn-125 Cross Section	Therm.-15 MeV	20%	Fusion reactor spectrum (5-10%).	USA [10]

3.C. Activation cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.C.23	Si-nat(n,p)(n,a) Cross Section	9-13 MeV	10%	*LANL: (n,xp) and (n,xa) measured from threshold to 30 MeV (R. Haight).* *The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.* *Many of these cannot be measured because of their radioactivity. Consideration should be given to meeting them using theory.* *Many data available, but gap between 9-13 MeV* [14].	USA[10] Japan-2 [15]

3.D. Near-term and very low activation power reactors

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.D.1	Cu(n,xn) DDX	6-14 MeV		Nuclear heating in the super-conducting TF magnet. *DDX measured at 14, 18 MeV at Tohoku University (M. Baba) and at 14 MeV also at Osaka University (A. Takahashi).*	USA[10]
3.D.2	Cu-63,65(n,g) Cross Section	Therm.-1 MeV	10%	Nuclear heating in the super-conducting TF magnet. *Data available from ORELA for E < 50 keV; is the requirement for data at higher En?*	USA[10]
3.D.3	Ta-181(n,g) Cross Section	Therm.-1 MeV	10%	Nuclear heating in the super-conducting TF magnet. *Resonance region is important to determine the self-shielding effect. Data available from Karlsruhe for 3 keV < E < 200 keV.*	USA[10]
3.D.4	Mn-55(n,g) Cross Section	Therm.-1 MeV	10%	Decay heat in 316SS and Inconel alloy. *Data available from ORELA for E < 700 keV Gamma-g for E < 110 keV suspicious large Gn-Gg correlation.*	USA[10]
3.D.5	Ta-181(n,g) Cross Section	Therm.-1 keV	10%	Decay heat in 316SS and Inconel alloy.	USA[10]
3.D.6	Ni(n,x)Co-60 Cross Section	E_{th}-15 MeV	20%	Waste management for reactor components (316SS and Iconel). *Principal reactions needed: Ni-60(n,p) and Ni-61(n,n'p). Met? 14 MeV + theory; Vonach.*	USA[10]

3.D. Near-term and very low activation power reactors (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.D.7	Si(n,x)Al-27 Cross Section	E_{th}-15 MeV	20%	Waste disposal issue for SiC. *Primarily Si-28(n,n'p). Recommended measurements: Si-28(n,xp) at 14 MeV. Measurements at LANL on total Al-27 production.*	USA[10]
3.D.8	V-51(n,n'p)Ti-50 Cross Section			Unsatisfied n,n'p cross-sections. *Evaluated cross-section at 14 MeV might be too large (D. Smith, ANL).* [16] *Recommended measurements: V-51(n,xp) at 14 MeV. Theory + existing measurements?*	USA[10]

3.E. Alpha slowing-down dosimetry reactions (plasma diagnostics)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
3.E.1	O-16(n,2n)O-15 Cross Section	E_{th}-20 MeV	20%		USA[10]
3.E.2	O-16(g,n)O-15 Cross Section	17-20 MeV	20%		USA[10]
3.E.3	Be-9(n,d)Li-8 Cross Section	E_{th}-20 MeV	20%	ENDF/B-VI is in agreement with experiment (Scobel, Hamburg). *The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.*	USA[10]
3.E.4	Be-9(n,p)Li-9 Cross Section	E_{th}-16 MeV	20%		USA[10]
3.E.5	Ne-20(n,2n)Ne-19 Cross Section	E_{th}-20 MeV	20%		USA[10]
3.E.6	Ne-20(g,n)Ne-19 Cross Section	> 17 MeV	20%		USA[10]
3.E.7	Ne-22(n,a)O-19 Cross Section	E_{th}-16 MeV	20%		USA[10]
3.E.8	Ne-20(n,t)F-18 Cross Section	E_{th}-20 MeV	20%		USA[10]
3.E.9	Mg-24(n,t)Na-22 Cross Section	E_{th}-20 MeV	20%		USA[10]
3.E.10	Si-30(n,He3)Mg-28 Cross Section	E_{th}-20 MeV	20%		USA[10]
3.E.11	Si-28(n,t)Al-26 Cross Section	E_{th}-20 MeV	20%		USA[10]
3.E.12	T-He-4 scattering Cross Section		20%	20% He-4 energy is from 1 to 3.5 MeV. High priority is given at 3.5 MeV. More precise energy transfer data is needed.	USA[10]

SECTION 4: REQUIREMENTS FOR FISSION REACTOR TECHNOLOGY

Requirements are included for France, Germany, Japan, Russia, UK and USA. In the French list of requirements there is a particular emphasis on data for structural materials and the higher plutonium isotopes for both thermal and fast reactor applications. The German list contains requests for V, Cr (and isotopes Cr-50 and 52), Ni, Zr and Pu-242. The Japanese list was revised in May 1997, with the addition of requests relating to decay heat predictions added in May 1998. It includes requests for structural materials, fission product capture, minor actinide isotopes and fission product decay data. The Russian list was revised in 1995. It includes requests for structural materials, fission product capture and minor actinide isotopes. The UK list (AEAT-0427) has been revised and reviewed at the UK Nuclear Science Forum meeting held in May 1996. Requirements relating to fast reactors have been removed from the earlier list. The requirements in the UK list are classified in three categories, according to their relative importance. The requester is also named. The USA requirements are the set of Priority 1 requests given in the 1993 USA Request List. Requirements are given for structural materials, oxygen, and primary and secondary actinide isotopes.

4.A. Structural materials

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.1	V-nat(n,tot) Cross Section Res. P.	0.5-20 MeV	3%	Also required for fusion technology. High resolution measurements required. *Very high resolution (2.5 ps/m) measurement done at Geel: E < 10 MeV: uncertainty 3% E > 10 MeV: system. uncert. 5%. The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.*	Germany-2[17]
4.A.2	Cr-nat(n,tot) Cross Section Res. P.	0.1 keV-5 MeV	3%	Also required for fusion technology. UK Cat. 2 evaluation requirement for shielding calculations (C.J. Dean). *High resolution (typically 20 ps/m) measurements available from: KFK, ORELA and Geel (0.24-1.0 MeV).*	France-1 [18] UK-2[19]
4.A.3	Cr-52(n,tot) Cross Section Res. P.	10 eV-20 MeV	3%	Also required for fusion technology. *Analysis of ORELA and Geel data (see 4.A.2) in progress at Cadarache.*	France-1[18] USA[20]

4.A. Structural materials (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.4	Fe-58(n,tot) Cross Section Res. P.	1-400 keV	5-10%	Also required for fusion technology.	USA[20]
4.A.5	Ni-nat(n,tot) Cross Section Res. P.	0.5-5 MeV	3%	Also required for fusion technology. UK Cat. 2 evaluation requirement for shielding calculations (C.J. Dean). *Evaluation of Geel data is in progress (Froehner, Karlsruhe). Measurement done at Geel: original resolution 2.5 ps/m, but large statist. uncertainties if collapsed to 10 ps/m, statist. uncertainty is about 3% system. uncert.: see 4.A.1 (V) earlier measurements at ORELA.*	France-2 [18] Germany [17] UK-2 [19]
4.A.6	Ni-nat(n,tot) Cross Section Res. P.	5-20 MeV	3%	Also required for fusion technology. *Measurement done at Geel: original resolution 2.5 ps/m, but large statist. uncertainties if collapsed to 10 ps/m, statist. uncertainty is about 3% system. uncert.: see 4.A.1 (V) earlier measurements at ORELA.*	Germany-2[17]
4.A.7	Zr-nat(n,tot) Cross Section Res. P.		5%	Also required for fusion technology. UK Cat. 2 evaluation requirement for reactor core calculations (C.J. Dean).	UK-2 [19]
4.A.8	Cr-nat(n,g) Cross Section	0.1 keV-1 MeV	10%	Integral data are available to 10 % (Dresden SEG/RRR small sample reactivities). *Gamma-g from Geel up to 300 keV (Cr-50), 500 keV (Cr-52) (F. Corvi) (See 4.A.9 and 4.A.10)*	France-1 [18]

4.A. Structural materials (cont.)

Request ID	Reaction/ Quantity	E nergy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.9	Cr-50(n,g) Cross Section		5%	Analysis of resonance data required. *Gamma-g from Geel up to 300 keV; existing measured data might be affected by errors in detector calibration. Weighting function re-analysis cannot now be made, but gamma-spectrum is not as hard as for Fe. Accuracy of 10% perhaps achieved. Also, normalization was done to Cr-52 (similar hardness) (F. Corvi)*	Germany-1[17]
4.A.10	Cr-52(n,g) Cross Section		5%	Analysis of resonance data required. In progresss at Cadarache. *Gamma-g from Geel up to 300 keV; existing measured data might be affected by errors in detector calibration. Weighting function re-analysis cannot now be made, but gamma-spectrum is not as hard as for Fe. Accuracy of 10% perhaps achieved. Also, normalization was done for 1.63 keV resonance internally to transition measurement) (F. Corvi)*	Germany-1[17]
4.A.11	Fe-56(n,g) Cross Section	Res. Region	5%	*Gamma-g from Geel up to 300 keV, accuracy 7-10% (F. Corvi); See also recent re-evaluation by F. Frohner.*	USA[20]
4.A.12	Ni-nat(n,g) Cross Section	0.1 keV-1 MeV	5%	Evaluation required to include the results of the Geel measurement. Independent measurements are desirable to confirm the Geel data. *Gamma-g from Geel up to 450 keV (F. Corvi).*	France-1[18]
4.A.13	Ni-nat(n,g) Cross Section	0.6-1 MeV	10%	*See also recent re-evaluation by F. Frohner.*	Japan (Withdrawn)

4.A. Structural materials (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.14	Ni-nat(n,g) Cross Section	1-10 MeV	50%	*See also recent re-evaluation by F. Frohner.*	Japan (Withdrawn)
4.A.15	Ni-58(n,g) Cross Section	res. region	5%	*Gamma-g from Geel up to 450 keV, accuracy 5-10% (F. Corvi)*	USA[20]
4.A.16	Ni-60(n,g) Cross Section	res. region	5%	*Gamma-g from Geel up to 450 keV, accuracy 5-10% (F. Corvi)*	USA[20]
4.A.17	Zr-93(n,g) Cross Section		20%	Long-lived fission product	Germany[17]
4.A.18	Si-nat(n,p)(n,a) Cross Section	9-13 MeV	10%	Moved to 3.C.23	Japan-2 [15]
4.A.19	Cr-nat(n,p) Cross Section	E_{th}-5 MeV	20%	*Recent activation measurements by collaboration ANL-Geel-Julich (D.L. Smith).* [22] [23]	France-2[18]
4.A.20	Cr-nat(n,a) Cross Section	E_{th}-8 MeV	20%	*(n,xa) DDX measurements 4.5-14 MeV at Tohoku Univ. (M. Baba).* [23]	France-2[18]
4.A.21	Fe-nat(n,p) Cross Section	E_{th}-5 MeV	10%	*% Fe-54, -56: many data available (activation) (D.L. Smith).* [24] *The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.* [23]	France-2[18]

4.A. Structural materials (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.22	Fe-nat(n,a) Cross Section	E_{th}-8 MeV	10%	*Fe-56(n,xa) DDX measurements done up to 50 MeV at LANL (R. Haight).* *Fe(n,xa) measured at 4.5-14 MeV at Tohoku University (M. Baba).* [23]	France-2[18]
4.A.23	Ni-nat(n,p) Cross Section	E_{th}-5 MeV	10%	*Ni-58: many data available (activation) (D.L. Smith)* [25]. [23]	France-2[18]
4.A.24	Ni-nat(n,a) Cross Section	E_{th}-8 MeV	10%	*Ni-58, -60(n,xa) DDX measurements done up to 50 MeV at LANL (R. Haight) and at 4.5-11.5 MeV, Tohoku University (M. Baba).* *The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.* [23]	France-2[18]
4.A.25	Ni-58(n,a) Cross Section	6-10 MeV	10%	Inconsistencies in existing data. *See EFF evaluation by Vonach for status of the data.* [23]	USA[20]
4.A.26	Ni-58 (n,n'a) Cross Section	E_{th}-20 MeV	5%	*This requirement is considered to be beyond the scope of current techniques.* [23]	USA[20]

4.A. Structural materials (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.27	Cr-nat(n,n’) Cross Section	E_{th}-5 MeV	10%	*(n,n'g) measurements planned at Geel following Fe, Pb*	France-1[18]
4.A.28	Fe-nat(n,n’) Cross Section	E_{th}-5 MeV	5%	*(n,n'g) measurements in progress at Geel to 2-3 MeV, 8 angles, high resolution at 1 angle (E. Dupont).*	France-1[18]
4.A.29	Fe-56(n,n’) Cross Section	2-5 MeV	10%		Japan (Withdrawn)
4.A.30	Fe-56(n,n’) Cross Section	E_{th}-4 MeV	2-5%		USA[20]
4.A.31	Ni-nat(n,n’) Cross Section	E_{th}-5 MeV	5%	*(n,n'g) measurements planned at Geel following Fe, Pb, Cr.*	France-1[18]
4.A.32	Ni-nat(n,xn) DDX	5-20 MeV	5%	To check nuclear model calcs. *In principle these measurements could also be made at LAMPF/WNR. Many measurements have already been made, for example, at Lowell, Oak Ridge and Argonne, and some of these have not been published or taken into account in current evaluations. See, for example, the Proc. of the Julich Conference.*	USA[20]
4.A.33	Zr-nat(n,xn) DDX	E_{th}-1 MeV	1-5%		USA[20]
4.A.34	W-182(n,n')(n,2n) DDX	50 keV-2 MeV	10%		Japan (Withdrawn)
4.A.35	W-182(n,n')(n,2n) DDX	2-20 MeV	50%	*The WPEC/WPMA considered that the requirements 2-20 MeV, 50% had been met. The need for data on the separate isotopes was questioned.*	Japan (Withdrawn)
4.A.36	W-183(n,n')(n,2n) DDX	50 keV-2 MeV	10%		Japan (Withdrawn)

4.A. Structural materials (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.A.37	W-183(n,n')(n,2n) DDX	2-20 MeV	50%	*The WPEC/WPMA considered that the requirements 2-20 MeV, 50% had been met. The need for data on the separate isotopes was questioned.*	Japan (Withdrawn)
4.A.38	W-184(n,n')(n,2n) DDX	50 keV-2 MeV	10%		Japan (Withdrawn)
4.A.39	W-184(n,n')(n,2n) DDX	2-20 MeV	50%	*The WPEC/WPMA considered that the requirements 2-20 MeV, 50% had been met. The need for data on the separate isotopes was questioned.*	Japan (Withdrawn)
4.A.40	W-186(n,n')(n,2n) DDX	50 keV-2 MeV	10%		Japan (Withdrawn)
4.A.41	W-186(n,n')(n,2n) DDX	2-20 MeV	50%	*The WPEC/WPMA considered that the requirements 2-20 MeV, 50% had been met. The need for data on the separate isotopes was questioned.*	Japan (Withdrawn)

4.B. Coolants, moderator materials and fuel diluents

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.B.1	N-nat(all) Cross Section	1 eV-10 MeV	5%	Required for nitride fuel studies. There are discrepancies, particularly in the 432 keV resonance. *Question about 432 keV resonance should be solved (J. Harvey). The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.* *Higher En: broad resol. (n,n') measurements 2.6-3.6 MeV, Lowell (G. Kegel).*	France-2[18]
4.B.2	N-15(all) Cross Section	1 eV-10 MeV	10%	For studies of fuels using N-15	France-2[18]
4.B.3	O-nat (n,ela) Cross Section	0.4-3 MeV	1-5%	Discrepant data.	USA[20]
4.B.4	O-nat (n,a) Cross Section	E_{th}-8 MeV	5%	There is a 30% difference between B-VI and JENDL-3 and this has a significant effect on calculated values of k_{eff} . *DDX measurements at Tohoku University (M. Baba).* *Planned up to 30 MeV at LANL (R. Haight).*	France-1[18]
4.B.5	Na-23(n,n') Cross Section	E_{th}-4 MeV	5%	Discrepancies between evaluations. *High resol. (n,n'g) measurements done at Geel to 2.2 MeV; combined SAMMY anal. with sig-t.*	France-1[18]

4.B. Coolants, moderator materials and fuel diluents (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.B.6	Pb-nat			Coolant. Assessments are required of the status of the data for alternative coolant materials and fuel diluent materials for plutonium incinerating reactors. *Data available: sig-t: Pb-208: ORELA; Pb-207: Geel; sig(n,g): Pb-207, -208 Geel.*	France-2[18]
4.B.7	Ce			Fuel diluent. Assessments are required of the status of the data for alternative coolant materials and fuel diluent materials for plutonium incinerating reactors. *Measurement done at TIT.*	France-2[18]
4.B.8	Mg			Fuel diluent. Assessments are required of the status of the data for alternative coolant materials and fuel diluent materials for plutonium incinerating reactors. *Data available: sig-t and sig(n,g) ORELA; PR C14 (76) 1328; NSE 78 (81) 110.*	France-2[18]
4.B.9	Bi-209(all) Cross Section	Therm.-20MeV	20%	Pb-Bi coolant. *(n,g) Po-210 production; measurement is in progress at TIT.*	Japan-1 [26]

4.C. Absorber materials

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.C.1	Ag(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc). *sig(n,g) measurement in progress at Geel; new Gamma-n data from TRIPLE collaboration (F. Corvi).*	France-1 [18] UK-2[19]
4.C.2	Cd(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc).	France-1 [18] UK-2[19]
4.C.3	In(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc). *Rather good information on resonance parameters available.*	France-2 [18] UK-2[19]
4.C.4	Eu(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc). *Rather good information on resonance parameters available.*	France-2 [18] UK-2[19]
4.C.5	Gd(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc).	France-2 [18] UK-2[19]
4.C.6	Dy(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc).	France-2 [18] UK-2[19]

4.C. Absorber materials

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.C.7	Er(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc). An assessment of the status of current evaluations is required. RPI measurements, to 100 eV (Gatlinburg, 1994) should be studied when the analysis of the measurements is complete. *Some information on resonance parameters available from Columbia! Correct evaluations for missing resonance!* *JENDL-3.3 includes evaluation for almost all important isotopes. (JNDC)*	France-2 [18] UK-2[19]
4.C.8	Hf(n,g) Cross Section	Therm., res. region	5%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc). An assessment of the status of current evaluations is required.	France [18] UK-2[19]

4.D. Fission product cross-sections

The inelastic scattering measurements requested for the validation of theoretical methods are being carried out at Geel. The measurements on Pd and Mo have been completed; the data are at the NEA Data Bank; two papers have been presented at the Trieste Conference. There is now a requirement for the improvement of those evaluations for which the theoretical methods used were not suitable (refer to WPEC Sub-Group 17). Requirements for many isotopes might be met in the first instance by the analysis of integral measurements using existing evaluations (JEF, JENDL and ENDF/B-VI). (Fr., UK N.T. Gulliford, AEA Technology, C.H. Zimmerman BNF plc; for burn-up credit based on fission product absorption.) Analyses of the CERES thermal reactor spectrum measurements are in progress. Further analyses are also required of the fast integral measurements.

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.D.1	Tc-99(n,g) Cross Section	1 eV-100 keV	10%	For studies of incineration and burn-up effects. *Measurements in progress by Saclay/Geel collaboration; preliminary results Trieste Conf. (A. Lepretre).* *Measurements done at KUR and TIT (JNDC).*	France-1[18] Russia[21]
4.D.2	Rh-103(n,3n) Cross Section		20%	UK Cat. 2 measurement request (C.H. Zimmerman, BNF plc). Averages in U-235 and Pu-239 fission spectra might meet the requirements.	UK-2[19]
4.D.3	Xe-131(n,g) Cross Section	4-500 keV	20%	burn-up	Japan-2 [27]
4.D.4	Cs-133(n,tot)(n,g) Cross Section	1 eV-10 keV	3%	UK Cat. 1 measurement request (M.C. Moxon, C.J. Dean, AEA Technology, R.W. Mills BNF plc). Discrepancies between differential and integral data. Long term planning at Geel.	UK-1[19] Russia[21]
4.D.5	Cs-135(n,g) Res. P.	0.1-500 keV	10%	Merged in to 4.D.6	Japan-1[27]
4.D.6	Cs-135(n,g) Res. P.	10meV-500keV	10%	burn-up	Japan-1 [27] Russia[21]

4.D. Fission product cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.D.7	Cs-137(n,g) Res. P	10 meV-100 keV	10%		Russia[21]
4.D.8	Nd-143(n,g) Cross Section	0.1-500 keV	10%	*10-550 keV; measurement done at TIT (JNDC).*	Russia[21]
4.D.9	Nd-145(n,g) Cross Section	0.1-500 keV	10%	*10-550 keV; measurement done at TIT (JNDC).*	Russia[21]
4.D.10	Sm-149(n,g) Cross Section	25 keV	5%	burn-up. *Measurement done at Karlsruhe (K. Wisshak).*	Japan (Withdrawn)
4.D.11	Sm-151(n,g) Cross Section	0.1-500 keV	10%	burn-up. *For theoretical estimate see Rauscher et al., Trieste Conf.*	Japan-2 [27]
4.D.12	Se-79(n,g) Cross Section	Therm.-20MeV	5%		France-2[18]
4.D.13	Zr-93(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18]
4.D.14	Mo-95(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.15	Tc-99(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.16	Rh-103(n,g)	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18] UK-1 [19]
4.D.17	Pd-107(n,g) Cross Section	Therm.-20MeV	5%		France-1[18]

4.D. Fission product cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.D.18	Ag-109(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18] UK-1 [19]
4.D.19	Sn-126(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18]
4.D.20	I-129(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18]
4.D.21	Cs-133(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.22	Cs-135(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18]
4.D.23	Nd-143(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.24	Nd-145(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18] UK-1 [19]
4.D.25	Sm-147(n,g) Cross Section	Therm.-20MeV	5%	*Of interest in astrophysics; could perhaps be measured at ORNL or Karlsruhe. Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18] UK-1 [19]

4.D. Fission product cross-sections (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.D.26	Sm-149(n,g) Cross Section	Therm.-20MeV	5%	*Of interest in astrophysics; could perhaps be measured at ORNL or Karlsruhe. Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.27	Sm-150(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18]
4.D.28	Sm-151(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.29	Sm-152(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.30	Eu-153(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-1[18] UK-1 [19]
4.D.31	Gd-155(n,g) Cross Section	Therm.-20MeV	5%	*Requirements might be met by integral experiments. There are thermal values and resonance parameters for most of these materials.*	France-2[18] UK-1 [19]

4.E. Primary actinides

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.1	U-235(n,f) Cross Section, Eta, Alpha	1 meV-10 eV	0.2-0.5%	*ORNL and Geel eta data agree (see Gatlinburg p. 642), but uncertainties remain above 0.3 eV.*	USA[20]
4.E.2	Pu-239(n,f) Cross Section, Eta, Alpha	1 meV-10 eV	0.2-0.5%	*Measurements could possibly be made at Dubna for Pu-239 and Pu-241 if supported by the ISTC (V. Popov).*	USA[20]
4.E.3	Pu-239(n,f) Cross Section, Eta, Alpha	10 meV-1 eV	0.5%	*Measurements could possibly be made at Dubna*	France-2[18] UK-2[19] (measr.req. 5%)
4.E.4	Pu-241(n,f) Cross Section, Eta, Alpha	10 meV-1 eV	1%	UK Cat. 2 measurement request (C.J. Dean). *Measurements could possibly be made at Dubna.*	France-2[18] UK-2[19] (measr.req. 5%)
4.E.5	U-235 Res. P.			Requirements for recently completed resonance parameter analyses to be incorporated in JEF and ENDF/B, especially for U-233, U-235 and Pu-241. (Note: These have already been included in JENDL.) UK Cat. 1 evaluation request (C.J. Dean). *A re-analysis of the resonance capture data is required and this is being carried out by an international team at ORNL (completion due in 1997).* *A WPEC sub-group is monitoring and validating the evaluation work.*	USA[20] France-1[18] UK-1 [19]

4.E. Primary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.6	Pu-242 Res. P.	1 eV-1 keV	3%	Requirements for recently completed resonance parameter analyses to be incorporated in JEF and ENDF/B, especially for U-233, U-235 and Pu-241. (Note: These have already been included in JENDL.) For MOX recycling in thermal reactors. *available to appr. 10% (Poortmans+), NP A207 (1973) 342.*	USA[20] Germany-1[17]
4.E.7	Pu-239(n,f) Cross Section	10 eV-1.5 MeV	0.5%	High resolution in the resonance range. *The possibility of achieving this accuracy, and the real need, was questioned by the WPEC and the WPMA.*	USA[20]
4.E.8	Pa-231(n,g) Cross Sections Alpha	1 eV -500 keV	5-10%		Russia[21]
4.E.9	Pa-233(n,g) Cross Sections Alpha	1 eV-500 keV	5-10%		Russia[21]
4.E.10	Th-232(n,g) Cross Sections Alpha	1 eV-500 keV	5%	*For most of stronger resonance up to 800 eV Gamma-g known to 7%, but large uncertainty at higher En. Measurements planned at Geel (F. Corvi)* *possibly at Dubna (ISTC) (Y. Popov).*	France-1[18]
4.E.11	U-233(n,g) Cross Sections Alpha	1 eV-500 keV	5%		France-1[18]

4.E. Primary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.12	U-235(n,g) Cross Sections Alpha	1 eV-1 keV	3%	UK Cat. 1 evaluation request (C.J. Dean, AEA Technology). *Analysis of alpha-measurements at Dubna being continued (Y. Popov).*	France-1[18] UK-1[19]
4.E.13	Pu-240(n,g) Cross Sections Alpha	1 eV-1 keV	5%	UK Cat. 1 measurement request (C.J. Dean). *The recent analysis by Bouland and Derrien might meet this requirement.*	France-1[18] UK-1[19] Russia[21]
4.E.14	Pu-240(n,g) Cross Sections Alpha	1-500 keV	5%	*Measurements might be possible at Dubna for Pu-240 and Pu-242.* *Pu-241 might be too radioactive. Data of Weston and Todd to about 10% (NSE 63 (1977) 143).*	France-1[18] Russia[21]
4.E.15	Pu-241(n,g) Cross Sections Alpha	1 eV-500 keV	5%	*Pu-241 might be too radioactive for accurate measurements.*	France-1[18] Russia[21]
4.E.16	Pu-242(n,g) Cross Sections Alpha	1 eV-500 keV	5%	*<1 keV Gamma-g known to approximately 10%. Poortmans +, NP A207 (1973) 342.* *Measurements might be possible at Dubna.*	France-1[18]
4.E.17	Pu-242(n,g) Cross Sections Alpha	0.025 eV-1 keV	3%	*<1 keV Gamma-g known to approximately 10%. Poortmans +, NP A207 (1973) 342.* *Measurements might be possible at Dubna.*	Germany-1[17]
4.E.18	Th-232(n,n') Cross Sections	E_{th}-5 MeV	5% 15%	*Planned 0.2-0.6 MeV Obninsk (N. Kornilov).*	France-1[18] Russia[21]

4.E. Primary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.19	U-238(n,n') Cross Sections	E_{th}-5 MeV	5% 10%	UK Cat. 1 measurement request (C.J. Dean and M. Halsall). There are gaps in the measured data. U-238 inelastic scattering is a topic studied by a sub-group of the Working Party on Evaluation Co-operation. *A re-evaluation of available data, including recent data from ANL (A.B. Smith) + Tohoku (M. Baba) should be made.*	France-1[18] UK-1[19] Russia[21]
4.E.20	Pu-239(n,n') Cross Sections	E_{th}-5 MeV	10% 15%	*Some recent data from Lowell (G. Kegel, NSE 122 (1996) 366).*	France-2[18] Russia[21]
4.E.21	Pu-240(n,n') Cross Sections	E_{th}-5 MeV	20% 15%		France-2[18] Russia[21]
4.E.22	Th-232 Delayed n. yield	Fast	5%	*Measurements planned at Obninsk (N. Kornilov) (ISTC project).*	Russia[21]
4.E.23	U-233 Delayed n. yield	Thermal + Fast	5%	*Measurements planned at Obninsk (N. Kornilov) and Dubna (for thermal n) (Y. Popov) (ISTC projects).*	Russia[21]
4.E.24	U-235 Delayed n. yield			UK Cat. 2 evaluation request (C.J. Dean). *Measurements of the time dependent spectra for U-235 and U-238 have recently been completed at Lowell. Measurements for t < 200 ms (thermal n) at Dubna (Y. Popov), further measurements planned (ISTC).*	UK-2[19]

4.E. Primary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.25	U-238 Delayed n. yield	Fast	3%	*Measurements in progress at Birmingham University (D. Weaver).* *Integral measurements at Cadarache, Obninsk and JAERI. Measurements of the time dependent spectra for U-235 and U-238 have recently been completed at Lowell. Measurements planned at Obninsk (N. Kornilov).*	France-1[18]
4.E.26	Pu-239 Delayed n. yield	Thermal + Fast	3%	Measurements in thermal and fast spectra. Because of the interest in plutonium recycling in thermal reactors and plutonium incineration in fast reactors there is a requirement for improvements in the data for plutonium isotopes. *Measurements are planned at Dubna.* *These delayed neutron data requirements were proposed by A. Filip, the previous chairman of the WPEC Sub-Group on Delayed Neutron Data Benchmarking. The requirements are being reviewed by the new chairman, A. D'Angelo.*	France-2[18]

4.E. Primary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.27	Pu-241 Delayed n. yield		5%	Because of the interest in plutonium recycling in thermal reactors and plutonium incineration in fast reactors there is a requirement for improvements in the data for plutonium isotopes. *Measurements for t < 200 ms (thermal n) at Dubna (Y. Popov) further measurements planned at Dubna (ISTC) and Obninsk (N. Kornilov).* *These delayed neutron data requirements were proposed by A. Filip, the previous chairman of the WPEC Sub-Group on Delayed Neutron Data Benchmarking. The requirements are being reviewed by the new chairman, A. D'Angelo.*	France-2[18]
4.E.28	Pu-242 Delayed n. yield		7%	Because of the interest in plutonium recycling in thermal reactors and plutonium incineration in fast reactors there is a requirement for improvements in the data for plutonium isotopes. *Measurements are planned at Dubna.* *These delayed neutron data requirements were proposed by A. Filip, the previous chairman of the WPEC Sub-Group on Delayed Neutron Data Benchmarking. The requirements are being reviewed by the new chairman, A. D'Angelo.*	France-2[18]
4.E.29	Th-232(n,f) Cross Section			For evaluation improvement	Russia[21]

4.E. Primary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.E.30	U-233(n,f) Cross Section			For evaluation improvement	Russia[21]
4.E.31	Pu-240(n,f) Cross Section			For JEF evaluation improvement	France-1[18]
4.E.32	Pu-241(n,f) Cross Section			For JEF evaluation improvement	France-1[18]
4.E.33	Pu-242(n,f) Cross Section			For JEF evaluation improvement	France-1[18]
4.E.34	Th-232(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.E.35	U-233(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.E.36	U-235(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.E.37	U-238(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.E.38	Pu-239(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.E.39	Pu-241(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]

4.F. Secondary actinides

The analysis of integral measurements can help to meet these requirements. Capture reaction rates have been measured in irradiation experiments (e.g. the French Sherwood thermal reactor and PROFIL and TRAPU fast reactor irradiations). At JAERI/FCI measurements of r and fission rate ratios are planned.

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.1	Np-237(n,f) Cross Section	3-15 MeV	2-3%	*This requirement is considered to be essentially met. A new evaluation has been made at Obninsk.*	USA[20] Russia[21]
4.F.2	Am-243(n,f) Cross Section	10-20 MeV	20% 5%	*The measurements made at Geel and Obninsk could meet the requirements.*	Japan-1 [29,30] Russia[21]
4.F.3	Np-237(n,f) n spectrum	-10 MeV 10-20 MeV	10% 30%	Transmutation. *Obninsk scientists report important difference of fission neutron spectra from the ENDF/B-VI evaluation at MeV energies. Planing to measure in JAERI(FCA)/ORNL joint program and at IPPE in ISTC program*	Japan-1 [29,30] Russia[21]
4.F.4	Pu-238(n,f) n spectrum	-10 MeV 10-20 MeV	10% 30%	Transmutation. *Obninsk scientists report important difference of fission neutron spectra from the ENDF/B-VI evaluation at MeV energies.*	Japan-1 [29,30] Russia[21]
4.F.5	Am-241(n,f) n spectrum	-10 MeV 10-20 MeV	10% 30%	Transmutation. *Obninsk scientists report important difference of fission neutron spectra from the ENDF/B-VI evaluation at MeV energies. Planing to measure in JAERI(FCA)/ORNL joint program.*	Japan-1 [29,30] Russia[21]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.6	Am-243(n,f) n spectrum	-10 MeV 10-20 MeV	10% 30%	Transmutation. *Obninsk scientists report important difference of fission neutron spectra from the ENDF/B-VI evaluation at MeV energies. Planing to measure in JAERI(FCA)/ORNL joint program.*	Japan-1 [29,30]
4.F.7	Cm-244(n,f) n spectrum	-10 MeV 10-20 MeV	10% 30%	Transmutation. *Obninsk scientists report important difference of fission neutron spectra from the ENDF/B-VI evaluation at MeV energies.*	Japan-1 [29,30]
4.F.8	Np-237(n,g) Cross Section	0.1 eV-1 keV	5%	UK Cat. 2 measurement request. *Measurement in progress by Saclay-Geel collaboration (A. Lepretre).* *Measurement has been done at Kyoto Univ. in 50 eV-1 keV and at TIT in 10-300 keV. (JNDC)*	France-1[18] UK-2[19] Russia[21]
4.F.9	Np-237(n,g) Cross Section	1 keV-5 MeV	5-10%	*Measurements planned at Dubna.* *Measurement has been done at Kyoto Univ. 50 eV-1 keV and at TIT in 10-300 keV. (JNDC)*	France-1[18] Russia[21]
4.F.10	Pu-238(n,g) Cross Section	10-20 MeV	20% 5-10%	Transmutation.	Japan-1 [29,30] Russia[21]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.11	Am-241(n,g) Cross Section	0.1 eV-1 keV	5-10%	UK Cat. 2 measurement request (C.H. Zimmerman, BLF plc) for assessment of actinide waste production (D.J. Edens, Magnox Electric) for calculation of neutron emission rates. *Measurements are possible at Geel if a suitable sample can be obtained. Note: Froehner has reviewed the resonance region data and considers that they are adequate.*	France-2[18] UK-2[19] Russia[21]
4.F.12	Am-241(n,g) Cross Section	1 keV-5 MeV	5-10%		France-2[18]
4.F.13	Am-243(n,g) Cross Section	0.1-1 eV	5-10%	UK Cat. 2 measurement request (D.J. Edens, Magnox Electric) for calculation of neutron emission rates. *No suitable sample available.*	France-2[18] UK-2[19] Russia[21]
4.F.14	Am-243(n,g) Cross Section	1 eV-5 MeV	5-10%	*No suitable sample available.*	France-2[18]
4.F.15	U-236(n,g) Res. P.	1 eV-10 keV	5%	*Planned at Dubna (ISTC) (Y. Popov). Earlier data (E < 1 keV), 75Wash, p. 728.*	USA[20]
4.F.16	Np-237(n,f) Prompt n yield			Resolution of nu p discrepancy. *It was considered by the WPMA that the Frehaut data are too low and a further measurement is not required. See Kokhlov measurement reported at Gatlinburg.*	France-2[18] Russia[21]
4.F.17	Am-241(n,f) Prompt n yield				Russia[21]
4.F.18	Am-243(n,f) Prompt n yield				Russia[21]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.19	Np-237(n,n') Cross Section	E_{th}-5 MeV	10-15%	*Measurements in progress at Obninsk, completion mid-97. In progress at Obninsk; see Trieste Conference (N. Kornilov).*	France-1[18] Russia[21]
4.F.20	Np-237(n,n') Cross Section	E_{th}-10 MeV 10-20 MeV	20% 30%	Transmutation. *In progress at Obninsk; see Trieste Conference (N. Kornilov).*	Japan-1 [29,30]
4.F.21	Pu-238(n,n') Cross Section	E_{th}-10 MeV 10-20 MeV	20% 30%	Transmutation.	Japan-1 [29,30] Russia[21]
4.F.22	Am-241(n,n') Cross Section	E_{th}-5 MeV	20%		France-2[18] Russia[21]
4.F.23	Am-241(n,n') Cross Section	E_{th}-10 MeV 10-20 MeV	20% 30%	Transmutation. *Could be measured at Lowell, < 1 MeV (if supported by NRC).*	Japan-1 [29,30]
4.F.24	Am-243(n,n') Cross Section	E_{th}-5 MeV	20%	*No suitable sample.*	France-2[18] Russia[21]
4.F.25	U-234(n,3n) Cross Section	Ave. in fission spectrum	10%	UK Cat. 1 measurement request (C.H. Zimmerman, BNF plc). Discrepancies with integral measurements.	UK-1[19]
4.F.26	Np-237(n,2n) Cross Section	Ave. in fission spectrum	10%	UK Cat. 1 measurement request (C.H. Zimmerman, BNF plc). Discrepancies with integral measurements.	UK-1[19]
4.F.27	Pu-238(n,2n) Cross Section	E_{th}-20 MeV	20%	Transmutation. *Combine recent measurement from St. Petersburg with model calcul. Maslov/Konshin (see comment below by D. Smith).*	Japan-1 [29,30]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.28	Am-241(n,2n) Cross Section	E_{th}-20 MeV	20%	Transmutation. *The measurement requirement is probably fulfilled and the WPMA asks if this could be checked.* [32]	Japan-1 [29,30]
4.F.29	Am-243 (n,2n) Cross Section	E_{th}-20 MeV	20%	Transmutation.	Japan-1 [29,30]
4.F.31	Np-237(n,f) Delayed n yield	Fast	5%	*Recent measurements at Obninsk (N. Kornilov).* *Delayed neutron data requirements proposed by A. Filip, the previous chairman of the WPEC Sub-Group on Delayed Neutron Data Benchmarking.*	Russia[21]
4.F.32	Np-237(n,f) Delayed n yield	Fast	10%	Transmutation. *Planned at Dubna (for thermal n) (Y. Popov) (ISTC project).*	Japan-1 [29-31]
4.F.33	Pu-238(n,f) Delayed n yield	Fast	10%	Transmutation.	Japan-1 [29-31]
4.F.34	Am-241(n,f) Delayed n yield	Fast	10%	*Recent measurement by Parish + (see T. Parish, Trieste Conf.).* *Delayed neutron data requirements proposed by A. Filip, the previous chairman of the WPEC Sub-Group on Delayed Neutron Data Benchmarking.*	Russia[21]
4.F.35	Cm-244(n,f) Delayed n yield	Fast	20%	Transmutation.	Japan-1 [29-31]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.36	Am-241(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.F.37	Cm-242(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.F.38	Cm-245(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.F.39	Cm-249(n,f) Tritium Yield	Therm.-20MeV	10%	BURN-UP (Tritium Production)	Japan-1 [28]
4.F.40	Th-229 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.41	U-235 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.42	U-238 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.43	Np-237 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.44	Np-239 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.45	Pu-238 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.46	Pu-239 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.47	Pu-240 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.48	Pu-241 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.49	Pu-242 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.50	Am-241 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.51	Am-242m Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.52	Am-243 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.53	Cm-242 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]
4.F.54	Cm-244 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]

4.F. Secondary actinides (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.F.55	Cm-246 Spontaneous Fission Spectra		25%	Neutron Source Evaluation and Dose Estimation Also neutron yield is required.	Japan-2 [34]

4.G. Fission product yield data

There is a requirement for the development of models to represent the energy dependence of yields and these could require more measurements. There is an IAEA CRP on Fission Yield Data and energy dependence is one of the topics being considered.

** The WPMA referred to studies by Siegler and Hambsch, relevant to the development of models. Reference should be made to the measurements carried out at ILL (Lohengrin).*

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.G.1	U-235 Mass chains 92 and 140	Thermal fission		Important in gamma scanning to determine fission rates.	France-1[18]
4.G.2	Pu-239 Mass chains 92 and 140	Thermal fission		Important in gamma scanning to determine fission rates.	France-1[18]
4.G.3	U-235, Pu-239 Nd isotope yields			For burn-up monitoring	France-1[18]
4.G.4	Pu-239 Chains 125 and 153	Thermal fission	10%	Cat. 2, for fuel reprocessing (C.H. Zimmerman, BNF plc).	UK-2[19]
4.G.5	Pu-241 Tritium yield and Chain 125	Thermal fission	10%	Cat. 2, for fuel reprocessing (C.H. Zimmerman, BNF plc; also requested by R.W. Mills, BNF plc).	UK-2[19]
4.G.6	Pu-241 Chain 129	Thermal fission	5%	Cat. 2, for fuel reprocessing (C.H. Zimmerman, BNF plc).	UK-2[19]
4.G.7	U-238 Chains 85 and 125 Nd-148 yield		10% 1%	For burn-up monitoring	UK-2[19]

4.G. Fission product yield data (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.G.8	Pu-241 Chains 106 and 129		10%	Chain 129 is in Category 1.	UK-1,2[19]
4.G.9	U-233 Mass/charge yield to A=102-108		5%	FP decay heat g -ray discrepancy at moderate cooling	Japan-2 [33]
4.G.10	Cm-244 (chain yields)	Therm.-20MeV	20%	Transmutation.	Japan-2 [29,30]

4.H. Radioactive decay data

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.H.1	Mo-101		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations. *The WPMA considered that much of the data are already known to 5%. The WPMA also made reference to Studsvik measurements at ILL Grenoble, unpublished.*	UK-2[19]
4.H.2	Tc-102		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations. *The WPMA considered that much of the data are already known to 5%. The WPMA also made reference to Studsvik measurements at ILL Grenoble, unpublished.*	UK-2[19]
4.H.3	Tc-104		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations. *The WPMA considered that much of the data are already known to 5%. The WPMA also made reference to Studsvik measurements at ILL Grenoble, unpublished.*	UK-2[19]
4.H.4	Tc-105		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations.	UK-2[19]
4.H.5	Sb-131		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations. *The WPMA considered that much of the data are already known to 5%. The WPMA also made reference to Studsvik measurements at ILL Grenoble, unpublished.*	UK-2[19]

4.H. Radioactive decay data (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.H.6	Te-131m		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations. *The WPMA considered that much of the data are already known to 5%. The WPMA also made reference to Studsvik measurements at ILL Grenoble, unpublished.*	UK-2[19]
4.H.7	Te-134		5-10%	Half-lives, mean beta and gamma energies, branching ratios and decay data. For decay heat calculations. *The WPMA considered that much of the data are already known to 5%. The WPMA also made reference to Studsvik measurements at ILL Grenoble, unpublished.*	UK-2[19]
4.H.8	U-232 Half-life		1%	Discrepant data. Measurement of actinide isotopes (requested by C.H. Zimmerman, BNF plc)	UK-1[19]
4.H.9	Np-236m Branching ratio		5%	Measurement of actinide isotopes (requested by C.H. Zimmerman, BNF plc)	UK-2[19]
4.H.10	Cm-244 Pa, Pg, Px, Pce		1-10%	For fuel and mass assay. Measurement of actinide isotopes (requested by C.H. Zimmerman, BNF plc)	UK-3[19]
4.H.11	Cm-245 Pa, Pg, Px		1-10%	For fuel and mass assay. Measurement of actinide isotopes (requested by C.H. Zimmerman, BNF plc)	UK-3[19]
4.H.12	Decay scheme data			List of about 30 isotopes (for decay heat and delayed neutron calculations) (R.W. Mills, BNF plc). See JEF/DOC-671.	
4.H.13	Sb-131		5%	For decay heat predictions (D.J. Edens, Magnox Electric).	UK-2[19]
4.H.14	Sb-131m		5%	For decay heat predictions (D.J. Edens, Magnox Electric).	UK-2[19]
4.H.15	Te-134		5%	For decay heat predictions (D.J. Edens, Magnox Electric).	UK-2[19]
4.H.16	Np-237 Pa, Pg, Pce		3%	For waste management studies (A.L. Nichols, AEA Technology).	UK[19]

4.H. Radioactive decay data (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.H.17	Pu-241 Half-life		0.5%	For materials accountancy (C.H. Zimmerman, BNF plc). Improved evaluation required. *A new measurement of half-life has been made at Geel to 0.2 % (see Trieste Conf., A. Verbruggen).*	UK[19]
4.H.18	Se-79 Half-life		20%	Request made by F. Mann, Hanford.	USA[20]
4.H.19	Sn-126 Half-life		20%	Request made by F. Mann, Hanford.	USA[20]
4.H.20	Rb-89 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-3 [33]
4.H.21	Y-94 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]
4.H.22	Y-95 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]
4.H.23	Mo-101 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-3 [33]
4.H.24	Mo-102 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]

4.H. Radioactive decay data (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.H.25	Tc-101 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-3 [33]
4.H.26	Tc-102 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-1 [33]
4.H.27	Tc-104 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-1 [33]
4.H.28	Tc-105 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-1 [33]
4.H.29	Xe-137 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]
4.H.30	Xe-138 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]
4.H.31	Cs-138 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]

4.H. Radioactive decay data (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
4.H.32	Cs-139 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]
4.H.33	Ba-141 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-2 [33]
4.H.34	La-143 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-3 [33]
4.H.35	Rh-108 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-1 [33]
4.H.36	Te-133 Level scheme + b-feeding rate, or g -energy			FP decay heat g -ray discrepancy at moderate cooling.	Japan-3 [33]
4.H.37	Np-237 Spontaneous fission half-life		5%		Japan (Withdrawn)
4.H.38	Pu-238 Spontaneous fission half-life		5%		Japan (Withdrawn)

SECTION 5: REQUIREMENTS FOR MEDICAL AND INDUSTRIAL APPLICATIONS

5.A. Requirements for medical and industrial applications

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
5.A.1	Si-28(n,p) Cross Section	E_{th}-15 MeV	10%	Diagnosis of ICF implosions. *Many data available, but gap between 9-13 MeV* [14].	USA
5.A.2	Zn-64(n,p) Cross Section	E_{th}-20 MeV		Radioisotope production. Requested by E. Menapace, ENEA, Bologna. *See the comment by D. Smith.* [11]	Italy
5.A.3	Ga-nat(n,z) Cross Section	0.1-1 MeV	10%	Semiconductor damage.	USA
5.A.4	As-nat(n,z) Cross Section	0.1-1 MeV	10%	Semiconductor damage.	USA
5.A.5	Kr-80(n,2n) Cross Section	E_{th}-15 MeV	10%	Diagnosis of ICF implosions.	USA
5.A.6	Cd-108(n,g) Cross Section	1 meV-0.1MeV	10-20%	Medical isotope production.	USA
5.A.7	W-187(n,g) Cross Section	1 meV-0.1MeV	10-20%	Medical isotope production.	USA
5.A.8	B-10(a,n) Cross Section	E_{th}-4 MeV	10%	Diagnosis of ICF implosions.	USA
5.A.9	Os-nat(a,n) Cross Section	E_{th}-38 MeV		Radioisotope production. Requested by E. Menapace, ENEA, Bologna.	Italy
5.A.10	Ir-nat(p,xn) Cross Section	E_{th}-45 MeV		Radioisotope production. Requested by E. Menapace, ENEA, Bologna.	Italy

5.A. Requirements for medical and industrial applications

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
5.A.11	Li-7(p,n) Cross Section & Spectrum	E_{th}-3 MeV	10%	Low Energy Neutron Source (for BNCT)	Japan-2 [34]
5.A.12	Be-9(p,n) Cross Section & Spectrum	E_{th}-3 MeV	10%	Low Energy Neutron Source (for BNCT)	Japan-2 [34]

SECTION 6: HIGH-PRIORITY NUCLEAR DATA REQUEST LIST FOR INTERMEDIATE ENERGIES

6.A. Requirements for intermediate nuclear data evaluation

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.A.1	O-16 (p,non)	10-200 MeV			Netherlands
6.A.2	O-16(n,xn)	27-70 MeV			Netherlands
6.A.3	Al-27(p,ela)	20-200 MeV			Netherlands
6.A.4	Al-27(p,p')	20-200 MeV			Netherlands
6.A.5	Al-27(p,non)	20-200 MeV			Netherlands
6.A.6	Al-27(n,ela)	40-100 MeV			Netherlands
6.A.7	Al-27(n,n’)	40-100 MeV			Netherlands
6.A.8	Al-27(n,non)	40-100 MeV			Netherlands
6.A.9	Al-27(n,xn)	25-80 MeV			Netherlands
6.A.10	Fe-56(p,non)	10-200 MeV			Netherlands
6.A.11	Fe-56(n,xn)	45-80 MeV			Netherlands
6.A.12	Fe-56(n,xp)	20-80 MeV			Netherlands
6.A.13	Ni-58(p,xn)	80-160 MeV			Netherlands
6.A.14	Ni-58(p,xp)	25-45 MeV			Netherlands
6.A.15	Ni-58(n,xn)	25-80 MeV			Netherlands
6.A.16	Ni-58(n,xp)	25-80 MeV			Netherlands
6.A.17	Zr-90(n,xn)	25-80 MeV			Netherlands
6.A.18	Zr-90(n,xp)	25-80 MeV			Netherlands
6.A.19	Zr-90(p,xp)	25-45 MeV			Netherlands
6.A.20	Mo-100(p,ela)	20-200 MeV			Netherlands
6.A.21	Mo-100(p,p’)	20-200 MeV			Netherlands
6.A.22	Mo-100(p,non)	20-200 MeV			Netherlands
6.A.23	Mo-100(n,ela)	20-100 MeV			Netherlands
6.A.24	Mo-100(n,n’)	20-100 MeV			Netherlands

6.A. Requirements for intermediate nuclear data evaluation (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.A.25	Mo-100(n,non)	20-100 MeV			Netherlands
6.A.26	Mo-100(n,xn)	25-80 MeV			Netherlands
6.A.27	Mo-100(n,xp)	25-80 MeV			Netherlands
6.A.28	Mo-100(p,xn)	25-160 MeV			Netherlands
6.A.29	W-184(p,ela)	20-200 MeV			Netherlands
6.A.30	W-184(p,p’)	20-200 MeV			Netherlands
6.A.31	W-184(p,non)	20-200 MeV			Netherlands
6.A.32	W-184(n,ela)	15-100 MeV			Netherlands
6.A.33	W-184(n,n’)	15-100 MeV			Netherlands
6.A.34	W-184(n,non)	15-100 MeV			Netherlands
6.A.35	W-184(n,xn)	25-80 MeV			Netherlands
6.A.36	W-184(n,xp)	25-80 MeV			Netherlands
6.A.37	W-184(p,xn)	25-160 MeV			Netherlands
6.A.38	W-184(p,xp)	25-160 MeV			Netherlands
6.A.39	W-184(n,f)	50-200 MeV			Netherlands
6.A.40	W-184(p,f)	50-200 MeV			Netherlands
6.A.41	Pb-208(p,non)	40-200 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands
6.A.42	Pb-208(n,ela)	60-100 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands
6.A.43	Pb-208(n,xn)	25-80 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands
6.A.44	Pb-208(n,xp)	25-80 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands

6.A. Requirements for intermediate nuclear data evaluation (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.A.45	Pb-208(p,xp)	25-160 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands
6.A.46	Pb-208(p,f)	50-200 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands
6.A.47	Pb-208(n,f)	50-200 MeV		A ”Concerted Action" is under way to measure various intermediate energy reactions on Pb-208 (Meulders, UCL Louvain-la-Neuve).	Netherlands
6.A.48	Th-232(p,ela)	20-200 MeV			Netherlands
6.A.49	Th-232(p,p’)	20-200 MeV			Netherlands
6.A.50	Th-232(p,non)	20-200 MeV			Netherlands
6.A.51	Th-232(n,ela)	6-100 MeV			Netherlands
6.A.52	Th-232(n,n’)	6-100 MeV			Netherlands
6.A.53	Th-232(n,non)	6-100 MeV			Netherlands
6.A.54	Th-232(n,xn)	25-80 MeV			Netherlands
6.A.55	Th-232(n,xp)	25-80 MeV			Netherlands
6.A.56	Th-232(p,f)	50-200 MeV			Netherlands
6.A.57	Th-232(n,f)	50-200 MeV			Netherlands
6.A.58	U-238 (p,ela)	20-200 MeV			Netherlands
6.A.59	U-238 (p,p’)	20-200 MeV			Netherlands
6.A.60	U-238 (p,non)	20-200 MeV			Netherlands
6.A.61	U-238 (n,ela)	6-100 MeV			Netherlands
6.A.62	U-238 (n,n’)	6-100 MeV			Netherlands
6.A.63	U-238 (n,non)	6-100 MeV			Netherlands
6.A.64	U-238 (n,xn)	25-80 MeV			Netherlands
6.A.65	U-238 (n,xp)	25-80 MeV			Netherlands
6.A.66	U-238 (p,f)	50-200 MeV			Netherlands
6.A.67	U-238 (n,f)	50-200 MeV			Netherlands

6.B. Requirements for ATW

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.B.1	Cu(p,xnyp),(n,xnyp) DDX	20-3000 MeV	50%	Accelerator Structural Material. SPALLATION N-SOURCE (Beam Dump)	Japan-1 [29,30,35]
6.B.2	Nb(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Accelerator Structural Material.	Japan-2 [29,30]
6.B.3	N(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Fuel Material.	Japan-1 [29,30]
6.B.4	Na(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Coolant Material.	Japan-1 [29,30]
6.B.5	Cl(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Fuel Material.	Japan-2 [29,30]
6.B.6	Zr(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-2 [29,30]
6.B.7	Mo(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Structural Material.	Japan-1 [29,30]
6.B.8	Tc(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Long-lived FP.	Japan-2 [29,30]
6.B.9	I(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Long-lived FP.	Japan-2 [29,30]
6.B.10	W(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-1 [29,30]
6.B.11	Pb(p,nyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-1 [29,30]
6.B.13	Bi(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-1 [29,30]
6.B.14	Np(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-1 [29,30]
6.B.15	Pu(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-1 [29,30]

6.B. Requirements for ATW (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.B.16	Am(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-1 [29,30]
6.B.17	Cm(p,xnyp)(n,xnyp) DDX	20-1500 MeV	50%	Target Material.	Japan-2 [29,30]
6.B.18	Fe(p,xnyp) DDX	20-3000 MeV	50%	Beam Window Material: HT-9. SPALLATION N-SOURCE (Beam Dump)	Japan-1 [29,30,35]
6.B.19	Ni(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: HT-9.	Japan-1 [29,30]
6.B.20	Mn(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: HT-9.	Japan-1 [29,30]
6.B.21	Cr(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: HT-9.	Japan-1 [29,30]
6.B.22	Mo(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: HT-9.	Japan-1 [29,30]
6.B.23	Si(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30]
6.B.24	O(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30]
6.B.25	Ti(p,xnyp) DDX	0.8-3.0 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30,36]
6.B.26	Al(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30]
6.B.27	Ba(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30]
6.B.28	Zn(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30]
6.B.29	C(p,xnyp) DDX	0.8-1.5 GeV	50%	Beam Window Material: ceramics.	Japan-2 [29,30]

6.B. Requirements for ATW (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.B.30	Bi-209(n,γ0)Po-210 Cross Section	Therm.-1MeV 1-20 MeV	15% 20%	Coolant Material.	Japan-1 [26]

6.C. Requirements for Spallation Neutron Source

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.C.1	Ta(p,xnyp)(n,xnyp) DDX	20-3000 MeV	50%	Target Material.	Japan-1 [36]
6.C.2	Hg(p,xnyp)(n,xnyp) DDX	20-3000 MeV	50%	Target Material.	Japan-1 [36]
6.C.3	D(p,xnyp),(n,xnyp) DDX	20-3000 MeV	50%	Moderator Material.	Japan-1 [36]
6.C.4	D(p,n) Cross Section & DDX	20-3000 MeV	50%	Moderator Material.	Japan-2 [35]
6.C.5	D(n,ela) Cross Section & Angular Dist.	20-3000 MeV	20%	Moderator Material.	Japan-1 [35]
6.C.6	Be(p,xnyp)(n,xnyp) DDX	20-3000 MeV	50%	Target and Reflector Material.	Japan-1 [35,36]
6.C.7	Be(p,x) Activation Cross Section	20-3000 MeV	30%	Reflector Material.	Japan-1 [35]
6.C.8	C(p,x)(n,x) Activation Cross Section	20-3000 MeV	30%	Beam Dump, Soil.	Japan-1 [35]
6.C.9	C(p,xn) DDX	20-3000 MeV	50%	Beam Dump	Japan-1 [35]
6.C.10	C(n,xn) DDX	20-150 MeV	50%	Beam Dump	Japan-2 [35]
6.C.11	N(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Air	Japan-1 [35]

6.C. Requirements for Spallation Neutron Source (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.C.12	O(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Air & Cooling Water	Japan-1 [35]
6.C.13	Na(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Magnet & Beam Tube	Japan-2 [35]
6.C.14	Al(p,x) Activation Cross Section	20-3000 MeV	30%	Beam Tube	Japan-1 [35]
6.C.15	Si(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Soil	Japan-1 [35]
6.C.16	Ca(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Magnet & Beam Tube	Japan-2 [35]
6.C.17	V(p,x) Activation Cross Section	0.8-3 GeV	30%	Beam Window	Japan-1 [35]
6.C.18	V(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]
6.C.19	Cr(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Magnet & Beam Tube	Japan-1 [35]
6.C.20	Cr(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]

6.C. Requirements for Spallation Neutron Source (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.C.21	Fe(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Magnet, Beam Tube, Beam Dump	Japan-1 [35]
6.C.22	Fe(n,xn) DDX	20-150 MeV	50%	Beam Dump	Japan-1 [35]
6.C.23	Fe(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]
6.C.24	Ni(p,x) ,(n,x) Activation Cross Section	20-3000 MeV	30%	Magnet, Beam Tube, Reflector	Japan-1 [35]
6.C.25	Ni(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]
6.C.26	Ni(n,xn) DDX	20-150 MeV	50%	Reflector	Japan-1 [35]
6.C.27	Cu(p,x) Activation Cross Section	20-3000 MeV	30%	Super Conduction Magnet, Beam Dump	Japan-1 [35]
6.C.28	Cu(n,x) Activation Cross Section	20-150 MeV	30%	Beam Dump	Japan-1 [35]
6.C.29	Cu(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]
6.C.30	Nb(p,x) Activation Cross Section	20-3000 MeV	30%	Super Conduction Magnet	Japan-1 [35]
6.C.31	Mo(p,x) Activation Cross Section	0.8-3 GeV	30%	Beam Window	Japan-1 [35]
6.C.32	Mo(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]

6.C. Requirements for Spallation Neutron Source (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.C.33	Ga(p,x) Activation Cross Section	20-3000 MeV	30%	Coolant	Japan-1 [35]
6.C.34	Ta(p,x) Activation Cross Section	20-3000 MeV	30%	Target Material	Japan-1 [35]
6.C.35	Ta(n,x) Activation Cross Section	20-150 MeV	30%	Target Material	Japan-1 [35]
6.C.36	Ta(p,xn) DDX	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.37	Ta(n,xn) DDX	20-150 MeV	50%	Target Material	Japan-1 [35]
6.C.38	Ta(p,xg) Spectrum	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.39	Ta(n,xg) Spectrum	20-150 MeV	50%	Target Material	Japan-1 [35]
6.C.40	W(p,x) Activation Cross Section	20-3000 MeV	30%	Target Material, Reflector	Japan-1 [35]
6.C.41	W(n,x) Activation Cross Section	20-150 MeV	30%	Target Material, Reflector	Japan-1 [35]
6.C.42	W(p,xn) DDX	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.43	W(n,xn) DDX	20-150 MeV	50%	Target Material	Japan-1 [35]
6.C.44	W(p,z) DDX	0.8-3 GeV	50%	Beam Window	Japan-1 [35]
6.C.45	W(p,xg) Spectrum	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.46	W(n,xg) Spectrum	20-150 MeV	50%	Target Material	Japan-1 [35]

6.C. Requirements for Spallation Neutron Source (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.C.47	Hg(p,non),(p,ela) Cross section	0.1-3000MeV	30%	Target Material	Japan-1 [35]
6.C.48	Hg(n,tot),(n,ela) Cross Section	0.1-3000MeV	30%	Target Material	Japan-1 [35]
6.C.49	Hg(p,x) Activation Cross Section	20-3000 MeV	30%	Target Material	Japan-1 [35]
6.C.50	Hg(n,x) Activation Cross Section	0.1-150 MeV	30%	Target Material	Japan-1 [35]
6.C.51	Hg(p,xn) DDX	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.52	Hg(n,xn) DDX	1-150 MeV	50%	Target Material	Japan-1 [35]
6.C.53	Hg(p,xg) Spectrum	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.54	Hg(n,xg) Spectrum	1-150 MeV	50%	Target Material	Japan-1 [35]
6.C.55	Pb(p,x) Activation Cross Section	20-3000 MeV	30%	Target Material	Japan-1 [35]
6.C.56	Pb(n,x) Activation Cross Section	20-150 MeV	30%	Target Material	Japan-1 [35]
6.C.57	Pb(p,xn) DDX	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.58	Pb(n,xn) DDX	20-150 MeV	50%	Target Material, Reflector	Japan-1 [35]
6.C.59	Pb(p,xg) Spectrum	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.60	Pb(n,xg) Spectrum	20-150 MeV	50%	Target Material	Japan-1 [35]

6.C. Requirements for Spallation Neutron Source (cont.)

Request ID	Reaction/ Quantity	Energy Range	Accuracy	Comments *WPEC comments in italic*	Originator Country-Priority
6.C.61	Bi(p,g)Po-210 Cross Section	6-20 MeV	20%	Target Material	Japan-1 [35]
6.C.62	Bi(p,x) Activation Cross Section	20-3000 MeV	30%	Target Material	Japan-1 [35]
6.C.63	Bi(n,x) Activation Cross Section	20-150 MeV	30%	Target Material	Japan-1 [35]
6.C.64	Bi(p,xn) DDX	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.65	Bi(n,xn) DDX	20-150 MeV	50%	Target Material	Japan-1 [35]
6.C.66	Bi(p,x g) Spectrum	20-3000 MeV	50%	Target Material	Japan-1 [35]
6.C.67	Bi(n,xg) Spectrum	20-150 MeV	50%	Target Material	Japan-1 [35]

References

[1] HYDROGEN for Standard

Several experiments by the Uppsala group, a good reference may be the paper given at the Trieste NDST Conference: Neutron-Proton Scattering at 96 and 162 MeV, N. Olson et al. Neutron-Proton Differential Cross-Section Measurements for En from 28 to 75 MeV, by S. Benck et al., Trieste NDST Conference. Measurement of the Neutron-Proton Differential Cross-Section at 14.1 MeV, W. Buerkle and G. Mertens, to be published in Few-Body Systems. Measurement of the Angular Distribution of Neutron-Proton Scattering at 10 MeV, R.C. Haight et al., to be published in Fusion Engineering and Design. Additional work is planned on this experiment during the fall of 1997. Measurements have been made of the 170 degree to 140 degree cross-section ratio at LANL by J. Ullmann for a number of energies above 20 MeV. These data are now being analysed. An absolute measurement of the back-angle cross-section is being planned by S. Vigdor et al. at the Indiana University Cyclotron Facility at 190 MeV using a tagged neutron beam.

[2] BORON for Standard

A short summary report was presented to the WPMA Meeting in May 1997.

[3] Bi-209 FISSION for Standard

A.N. Smirnov et al., Phys. Rev. C53 (1996) 2911. Fission Cross-Section Ratios of nat Pb and 209 Bi Relative to 235 U for Neutron Energies from Threshold to 400 MeV, P. Staples et al., Bull. Am. Phys. Soc. 40 (1995) 962 and P. Staples, Private communication. G.A. Tutin et al., Proc Second International Conference on ADTT, Kalmar, Sweden.

[4] U-235 FISSION for standard

The tabulated P. Lisowski et al. LANL data which extend to 200 MeV are now available. PTB measurements by W. Newhauser et al. in the 30 to 60 MeV are now being analysed.

[5] U-238 FISSION for Standard

The tabulated P. Lisowski et al. LANL 238 U(n,f) cross-section ratio to 235 U(n,f) which extends to 200 MeV are now available Measurement of the 238 U Fission Cross-Section at 34 MeV, 46 MeV and 61 MeV Neutron Energy, W.D. Newhauser et al., Trieste NDST Conference. A.N. Smirnov et al., Phys. Rev. C53 (1996) 2911. Neutron Induced Fission Cross-Section Measurements for 232 Th, 235 U, 238 U at 75 MeV, A.N. Smirnov, Trieste NDST Conference. Fission Cross-Section Ratios for 232 Th, 238 U, and 237 Np Relative to 235 U from 1 MeV to 200 MeV, A.V. Fomichev et al., Trieste NDST Conference.

[6] The most recent US data requests list compiled by ORNL.

[7] ECN report, EAF-Doc-004, March 1994.

[8] Cheng, Urgent Nuclear Data Needs for Tokamak Reactor Diagnostics, a memo dated 15 June 1994.

[9] Private communications with Don Smith and Yujiro Ikeda, March 1996.

[10] Contact regarding the requests in Section 3 should be addressed to: Edward Cheng, TSI Research, Inc., Solona Beach CA USA 92075.

E-mail: etcheng@cts.com

[11] Zn-64(n,p)Cu-64 (Comment by D. Smith of Argonne National Laboratory)

There are a lot of data available covering the energy range from threshold to 20 MeV. It could be that the goal is satisfied but perhaps not because of the noticeable discrepancy between two data sets in the range 7-10 MeV. If this discrepancy could be resolved and a new evaluation performed I think the requirement might be satisfied. However, if the discrepancy cannot be resolved, perhaps a new measurement is required in this energy range. This could be done at PTB quite readily since they have been doing some careful measurements on other similar reactions. In the past there were problems associated with uncertainty over the decay branching properties of Cu-64. As a result of careful radioactivity studies several years ago, I think this problem has been resolved and the new decay information needs to be considered in any new evaluation. In any event, we can say with some certainty that the requirement is met at least partially.

[12] W-182(n,n'alpha)Hf-178m and W-186(n,n'alpha)Hf-182 (Comment by D. Smith of Argonne National Laboratory)

These reactions were both included in the IAEA CRP on long-lived radioactivities. A final report on this work has been prepared by Anatoly Pashchenko with the help of Herbert Vonach. I would suggest contacting Anatoly and Herbert for a status report on these two reactions. I think that the need may be at least partially met by this work.

[13] V-51(n,n'alpha)Sc-47 (Comment by D. Smith of Argonne National Laboratory)

Some data are given around 14 MeV indicating a few-millibarn cross-section. It is surprising that Ikeda et al. do not see it given the intensity of the neutron source they used. The measurement ought not to be very hard because V is essentially monoisotopic and Sc-47 is easy to detect and measure. More experimental work is required since theory would not be very reliable for this process. The need is not met, even partially, at this stage.

[14] Si-28(n,p) (Comment by D. Smith of Argonne National Laboratory)

There are a lot of data available on this reaction from threshold to 9 MeV and 13-20 MeV. The ”gap" from 9-13 MeV has not been addressed. There is some structure in the cross-section (light target) and some of the data are discrepant. The requirement is probably satisfied partially but not completely. In particular, a careful measurement from 9-15 MeV would be very useful here and this could be done at PTB.

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[16] V-51(n,n'p)Ti-50 (Comment made by D. Smith, Argonne National Laboratory)

The question I have is: Why is this information needed? Ti-50 is stable. If the concern is for the sequential production of Ti-51 via Ti-50(n,gamma)Ti-51, I don't understand the significance since Ti-51 is short-lived. Also, I have doubts about the importance of sequential reactions in most radiation environments. In any event, more calculations of sequential reaction yields are needed, even using very crude cross-sections, to see if there is any significance. It is true that there are problems with the evaluated cross-section for V-51(n,n'p)Ti-50. It seems that the ENDF/B-VI evaluation for this reaction (which came from Argonne) is about a factor of 3 too large at 14 MeV, based on a comparison with the single data point from Livermore. The Argonne evaluation was based entirely on nuclear models and, unfortunately, no comparison was made then to the available data. I tend to trust the Livermore result, at least to within 20-30%, so a revision is definitely needed in the ENDF evaluation. There is no indication as to either the energy range or accuracy that needs to be considered for satisfying this request. Perhaps a new measurement of proton production by Haight at Los Alamos would be useful since the V-51(n,p)Ti-51 component, which is rather well known, could be easily subtracted from the total proton production cross-section measured directly. This would yield the (n,n'p) contribution indirectly. A direct measurement of the (n,d) contribution by Haight would also be helpful, if it is really the production of Ti-50 which is of concern for fusion applications.

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[22] Cr(n,p) (Comments by D. Smith of Argonne National Laboratory)

There are four stable isotopes of Cr [Cr-50 (4.4%), Cr-52 (84.8%), Cr-53(9.5%) and Cr -54 (2.4%)]. The request is for data from threshold to 5 MeV. Actually this is the deep threshold region for all these reactions, where the cross-sections are quite small. Data are available for both Cr -52 and Cr-53 at energies above 5 MeV, but the cross-section was too small to measure accurately at lower energies. However, nuclear models, guided by the data at higher energies, could probably provide the needed answers to the 20% accuracy level desired. Cr-50 and Cr-54 are quite minor isotopes. The question I have is: Why are these cross-sections needed at such a low energy? Perhaps an integral measurement in an actual reactor spectrum is what is really needed here.

[23] Measured data are available for (n,p) and (n,a) cross-sections in Cr, Fe and Ni which are considered to meet the requirements of ±10% (at least for the principal isotopes). An assessment of the data is required (note: there are some very large differences between the data in different evaluations). There is an IAEA CRP which considers many of these reactions. The accuracy requirement refers to the average in reactor spectrum.

[24] Fe(n,p) (Comments by D. Smith of Argonne National Laboratory)

There are four stable isotopes of Fe [Fe-54 (5.8%), Fe-56 (91.72%), Fe-57(2.2%) and Fe-58 (0.28%)]. The (n,p) cross-sections for Fe-54 and Fe-56 are reasonably well known in the range threshold to 5 MeV, perhaps not to 10% at the very lowest energies, but certainly that well wherever the cross-section is not too small. There are some data for Fe-57 but because it is a very minor isotope, the cross-section is not known with 10% accuracy. Fe-58 is not relevant because the isotopic abundance is too small. In total, this requirement has probably been met. The question I have is: Why are these cross-sections needed at such a low energy? Perhaps an integral measurement in an actual reactor spectrum is what is really needed here.

[25] Ni(n,p) (Comments by D. Smith of Argonne National Laboratory)

There are five stable isotopes of Ni [Ni-58 (68.27%), Ni-60 (26.10%), Ni-61 (1.13%), Ni-62 (3.59%) and Ni-64 (0.91%)]. In my opinion, the requirement for Ni-58(n,p) has been satisfied. There are cross-section data to very low energy (several microbarn region). In some respects this

reaction is nearly a standard. The cross-section for Ni-60(n,p) is very small below 5 MeV. There are some data at higher energy. Nuclear models, guided by higher-energy data, could be used to estimate the cross-section in this region, but probably not to the requisite 10% accuracy. There are some (n,p) data for Ni-61 that yield an estimate of the cross-section near threshold. For Ni-62, the threshold is higher so the region below 5 MeV is probably irrelevant. There appear to be no data for Ni-64(n,p). The half life of Co-64 is very short. However, this is a minor isotope. So, in total, the (n,p) process is probably adequately known for practical purposes, and if not then the requirement is nearly satisfied. The question I have is: Why are these cross-sections needed at such a low energy? Perhaps an integral measurement in an actual reactor spectrum is what is really needed here.

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[32] Am-241(n,2n) (Comment by D. Smith of Argonne National Laboratory)

Recent measurements by Filatenkov and co-workers at Khlopin Radium Institute in St. Petersburg, Russia, provide unique data from 13-15 MeV. These data, guided by nuclear modelling by Maslov (at Minsk) and Konshin during his stay at JAERI, should be sufficient to meet this requirement. Probably all that is needed at this stage is an evaluation of this information.

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