

International Atomic Energy Agency

INDC(NDS)-57/U+F

INTERNATIONAL NUCLEAR DATA COMMITTEE

REQUEST LISTS OF NUCLEAR DATA FOR CONTROLLED FUSION RESEARCH

AS SUBMITTED TO THE INTERNATIONAL ATOMIC ENERGY AGENCY

BY MEMBER STATES

Compiled and Edited

Ъу

J.R. Lemley Nuclear Data Section

December 1973

IAEA NUCLEAR DATA SECTION, KÄRNTNER RING 11, A-1010 VIENNA

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1. BACKGROUND

In 1970 the International Nuclear Data Committee (INDC), which advises the Director General of the IAEA on all matters pertaining to nuclear data, recommended that the Agency's*Nuclear Data Section (NDS) assess the role of basic nuclear data in controlled fusion research (CFR) and in the prospective development of fusion reactors. In particular the INDC wanted to identify the needs and priorities fcr various types of nuclear data in fusion research and to explore the potential value of a nuclear data request list for fusion similar to the neutron data request lists which have proved useful in fission reactor development programs.

With the assistance of the International Fusion Research Council (IFRC), which is the Agency's advisory group for CFR, inquiries about nuclear data requirements in CFR were sent to scientists engaged in fusion research in several Member States. Additional information was also obtained from the literature and from participants in technical meetings sponsored by the Agency.

To provide a basis for comparison of data requests from various sources and to put requirements for specific nuclear data in context with all objectives of fusion research, the Agency developed a set of priority criteria for nuclear data requests for fusion. The Priority Criteria were reviewed by the IFRC, the INDC and by scientists associated with fusion research programs. The revised version of the Priority Criteria, which incorporates as far as possible the comments of all correspondents, appears in Section 3.

Of the data requests contained in this document only those from the UK and FRG and those in the Charged-particle Data Request List prepared by J.R. McNally (Section 5) have priorities assigned according to the Agencydeveloped Criteria. The priority assignments in the International Request List, which appears in Section 4.4 are therefore consistent generally only among requests from the same country and laboratory.

Implementation of the use of a unique set of priority criteria in the requests of all contributors to the International List has been only partially successful in spite of initial acceptance of the Agency-developed Criteria by representatives of all major fusion research programs. It is the view of some contributors to the international list that meaningful priority assignments are impossible at the present state of development of fusion research. After 1970 fusion data request lists appeared in several Member States. The INDC recommended that these national lists be collected by NDS and merged into an International Nuclear Data Request List for Fusion. Members of both INDC and IFRC assisted in establishing contacts with those responsible for the national lists and in forwarding nationally screened data requests to the Agency.

Data request lists have been received from five Member States: The Federal Republic of Germany (FRG), France, the UK, the USA and the USSR. The International Nuclear Data Request List for Controlled Fusion Research, which appears in Section 4.4, consists of these national lists merged and sorted by atomic number (Z) and mass number (A) of the target nucleus and by type of information requested (Quantity). The separate national lists are available on request from NDS. Currently under development at NDS is a general computerized system, WRENDA, for the maintenance of request lists for nuclear data for various applications. When the system becomes operational, the data requests for CFR will eventually be stored at NDS in WRENDA format for convenience in updating, selective retrieval and reproduction. At present it is not expected that data request lists for fusion will be retrieved or reproduced jointly with other request lists stored in the WRENDA system, such as those for development of fission reactors and nuclear safeguards techniques.

In response to inquiries from the Agency about the relative importance of charged-particle nuclear data and of fuel cycles other than D-T, J.R. McNally of Oak Ridge National Laboratory, USA, prepared the unofficial Charged Particle Nuclear Data Request List which appears as Section 5 of this report. Priority assignments are based on the Agency-developed Priority Criteria of Section 3. The List is included with permission of the author and the USAEC. The cooperation of Members of IFRC and INDC and of the individual contributors in establishing these request lists is gratefully acknowledged.

^{*}Throughout this document the International Atomic Energy Agency is referred to as "the Agency".

2. SUMMARY OF THE CONTENTS OF THE REQUEST LISTS

2.1 Contents of the International Request List

The International Request List (Section 4.4) contains 260 requests from five Member States: FRG, France, UK, USA and USSR. Since the requests have been reproduced essentially as received except for changes in format and, in some cases, translation into English, the subdivision of a request for the same information into denumerable list items is at present inconsistent so that comparison of the total or relative numbers of requests from various contributors is of little significance. For example a request for the cross section and angular distribution of neutrons from an (n,2n) reaction may appear as either one or two items in the List. In requests from the USA such subdivision has been maximized, and in requests from the FRG and the UK it has been minimized. For all requests in the List, the symbols in the "Reaction Type" columns and the supplementary comments should indicate exactly what information is required.

In the International Request List the deuterium-tritium (D-T) fuel cycle based on the reaction

$$D + T = {}^{4}He (3.5 MeV) + n (14.1 MeV)$$

is implicit. With one exception all requests are for data associated with neutron induced interactions. There are no requests for nuclear data associated with plasma interactions or charged-particle reactions. Except for a few requests for capture gamma-ray spectra all requests specify a maximum incident neutron energy of about 15 MeV.

Since the only economically feasible methods for generation of tritium are based on reactions of neutrons with lithium and since the D-T reaction produces 14-MeV neutrons, all countries contributing to the list have included requests for more accurate cross-section data for the tritium producing reactions ⁶Li (n, α) T and ⁷Li (n, n' ω) T. Other interactions of neutrons with lithium which affect tritium breeding, neutron transport and energy deposition also appear in the list.

Because of difficulties anticipated in pumping a liquid metal through strong magnetic fields, mixtures of fused fluoride salts, such as Li₂BeF₄, are being considered as elternative coolant materials to metallic lithium. All contributing countries have included requests for data for various nonelastic neutron reactions with fluorine in order to evaluate the effect of fluorine on the tritium breeding ratio and other neutronics calculations. For the structural materials to be used in the containment vessel, it will be necessary to calculate energy deposition (heat loading), radiation damage and angular and energy distributions of secondary neutron and gamma radiations. Many of the required data are unavailable especially in the MeV range except possibly near 14 MeV. The List contains data requests for cross sections for elastic and inelastic scattering, for (n,p) and (n, \mathcal{C}) reactions which cause void and gas-bubble formation, and for angular and energy distributions of secondary neutron and gamma radiations.

Nine elements - Ti, V, Cr, Fe, Ni, Zr, Nb, Mo, W - which are constituents of potentially useful structural materials, are referred to in the List. Only Mo is mentioned in requests from all five contributing countries. Since for most requests there has been no careful review of the status of existing data, it seems unlikely that any potentially useful material has been intentionally omitted from the list because the required nuclear data are sufficiently well known.

For the heavy elements - Pb, Bi, Th, ^{238}U - the USSR has submitted requests for cross section data for (n,2n) and (n,3n) reactions in order to evaluate possible use of these materials as neutron multipliers. For Pb and Bi the USSR has also requested gamma-production data and gamma-ray spectra for use in shielding calculations.

The List also contains data requests for C, which has potential application as a neutron moderator, and for Al and Cu, which have potential application in the blanket and superconducting magnet regions.

The International Request List seems to reflect three attitudes toward designation of priorities for nuclear data requests. One view is that priority assignments of any kind would be premature. For this reason the requests from the USA have no priority designations. From another viewpoint priorities are designated according to the relative importance which best current knowledge indicates the requested data may eventually be expected to assume in CFR and in design of a fusion reactor.

From a third point of view nuclear data requirements are put in perspective with all other requirements and objectives of CFR. It is this perspective from which the Agency attempted to develop the Priority Criteria of Section 3. At present demonstration of the scientific feasibility of controlled fusion as a practical energy source does not seem to depend critically on improved nuclear data. From the perspective of the entire CFR research program priority designations might therefore be expected to be generally low at the present time. Accuracy requirements might also be expected to remain rather liberal until more stringent requirements can be justified through meaningful sensitivity studies. Contributors to the present List have frequently assigned the same priority to all their requests which deal with the same element. This could possibly be attributed to a combination of the following circumstances:

1) Present design studies may indicate that certain materials will be useful, but it may not yet be possible to show through meaningful sensitivity studies how reactor design parameters depend on data for a specific nuclear interaction in a specific nuclide.

2) Fxisting duta may be inadequate to estimate the relative influence of various nuclear interactions so that all data requests specifying the same element rate the same priority.

3) Sufficiently thorough status reviews may have not yet been carried out to determine whether existing data totally or partially satisfy some of the requests.

Nuclear data requests for design of fission reactors can be based on detailed sensitivity studies which relate uncertainties in nuclear data to consequent uncertainties in reactor design parameters. For D-T burning experiments and proto-type fusion reactors detailed sensitivity studies are not yet possible because of uncertainties regarding the configuration of the ultimate plasma confinement system. The Nuclear Data Request List for CFR may therefore be expected to remain unstable for several years with regard to materials, priority assignments and requested accuracies.

As the scientific feasibility of controlled fusion becomes more certain, the data requirements for design of a fusion reactor may be expected to exceed even the data requirements for development of fission reactors. Although the present Data Request Lists may be somewhat premature, the channels of communication used in developing and maintaining this list and in satisfying the requests can help to insure that reliable nuclear data will be available whenever they are needed in fusion applications. 2.2 Contents of the Request List for Charged Particle Nuclear Data

In analogy with chemical chain reactions it may be possible to base the fuel cycle of a fusion reactor on a series of thermonuclear chain reactions. Once ignited, fuels such as ⁶Li or mixtures of ⁶Li and D might be burned to low-Z "ashes" as a result of interaction with energetic particles (p, d, t, ³He, α) produced in other reactions in the chain. With appropriate mixture and injection of fuel and removal of "cold ash" it might be possible to obtain net energy production under physically more easily attainable plasma conditions than those required for the direct reactions of ⁶Li and D. An introduction and bibliography on the application of thermonuclear chain reactions in controlled fusion research has been prepared by McNally¹.

The Request List for Charged Particle Nuclear Data (Section 5) was prepared by J.R. McNally, jr., of Oak Ridge National Laboratory, USA, in response to inquiries from the Agency about the relative priorities of charged-particle nuclear data in controlled fusion research. Accuracies of better than about 25 % in the absolute cross sections are required to evaluate various chain-reaction sequences. The Agency-developed Priority Criteria (Section 3) have been used as the basis of the priority assignments.

3. PRIORITY CRITERIA

The priority criteria which appear in this section were developed by the Agency with the assistance of the IFRC, INDC and many scientists engaged in controlled fusion research. Presently they are the basis of the priority assignments for the requests from the UK and FRG, which appear in the International Data Request List (Section 4.4), and for the charged-particle data requests of J.R. McNally (Section 5).

Priority Criteria for Nuclear Data Requests

in Controlled Fusion Research (CFR)

Priority 1

In general highest (first) priority shall be assigned to those nuclear data upon which some important aspect of CFR is immediately contingent. Specifically Priority 1 shall be assigned to requests for nuclear data which

- 1.) are required for evaluation of the feasibility of a proposed CF reactor concept or
- 2.) are required for immediate application of plasma phenomena in a fusion reactor context, or
- 3.) are essential for application of a material which is of conceptual importance in CFR, or
- 4.) are required for an important decision involving allocation of resources or redirection of research effort in CFR programmes, or
- 5.) are necessary to develop some important aspect of current CFR programmes to a level consistent with progress in other aspects of these programmes.

Priority 2

Priority 2 shall be assigned to nuclear data which

- 1.) are required for evaluation of materials of high potential utility in current CF reactor designs, or
- 2.) are expected to contribute to significant progress in CFR or reactor design studies in the near future.

Priority 3

Priority 3 shall be assigned to nuclear data which

- are of use in current design studies but are not of crucial importance, or
- 2.) are not of immediate importance for CFR but which have probability of becoming important as CFR programmes develop.

Priority 4

Priority 4 shall be assigned to nuclear data which

- 1.) fill out the body of information needed for fusion reactor technology, or
- 2.) are of potential interest for CFR but which cannot be assigned more definite priority at present.

4. THE INTERNATIONAL NUCLEAR DATA REQUEST LIST

4.1 Prefacing Remarks from the Contributors

1) France:

In the letter appended to the data requests of France, R. Joly cautions that the requests should be considered with prudence because without a model which permits determination of the consequences of uncertainties in nuclear data on the performance of a fusion reactor, data needs cannot be established by rigorous means.

2) The United Kingdom:

In the letter appended to the data requests of the UK, B. Rose states that the requests are for information and that in many cases it is not known whether existing data might satisfy certain requests. This implies that the requests may be either for measurement or for evaluation and that it has not yet proved possible to identify each request as being for one or the other. The priority designations are based on the Agency-developed Priority Criteria of Section 3.

3) The United States of America:

These requests were prepared by the Controlled Thermonuclear Research (CTR) Subcommittee of the United States Nuclear Data Committee (USNDC) under the auspices of the USAEC. The CTR Subcommittee felt that it was too early to set priorities for data requests for CTR, and therefore the requests from the USA appear without priority designations.²

4) Preface of the German Nuclear Data Request List for Fusion:

[Editor's Note: The following remarks and the data requests of the Federal Republic of Germany were communicated to the Agency by S. Cierjacks. The data requests have been included in the International Data Request List of Section 4.4]

It has been shown³ that in principle a large number of fusion reactions can be considered for energy production in a thermonuclear reactor. The three most important reactions are the following:

D + T	4 He (3.52 MeV) + n (14.06 MeV)
$D + {}^{3}He$	⁴ He (3.67 MeV) + p (14.67 MeV)
2D + 2D	T (1.01 MeV) + p (3.03 MeV)
	3 He (0.82 MeV) + n (2.45 MeV)

Among these the $D + {}^{3}$ He-reaction is - from a theoretical point of view - the most interesting process, since both reaction products are stable charged particles. Their energy should thus be easily utilized, and there might even be a possibility for direct conversion of the kinetic energy to electric power. However, 3 He is a very scarce component in the natural isotopic composition of helium, and consideration of net power yields attainable with the above reactions shows that this quantity for the D + T-process exceeds the yields for the $D + {}^{3}$ He- and the D + Dreaction by two and three orders of magnitude, respectively. Therefore, from the present stage of knowledge, the first prototype reactor will be most probably a DT-reactor.

Accepting this point of view, it is apparent that a large number of neutron data are necessary. In general various data for a large number of promising materials are required from thermal energies up to 15 MeV. A complete list of presently interesting materials and reactions has been given elsewhere.⁴ While for most of the elements under consideration sufficiently accurate data are available from thermal values up to ~1 MeV, there is a considerable lack of experimental information in the energy range from 1 - 15 MeV. An inspection of the lists of materials which might be used in thermonuclear reactors shows that the body of nuclear data needed for fusion purposes will presumable exceed even the data requirements for the development of fission reactors. Despite the tremendous extent of overall data needs, the present German request list contains only data requirements for five of the most important elements; Li, Be, F, Nb, Mo. The primary criteria leading to this selection arise from priority considerations elaborated in the national Memorandum on Fusion Reactor Technology. Major effort in the near future will be devoted to tests of computer codes and the reliability of microscopic neutron data. This can be achieved by comparison of experimentally determined and calculated results for the characteristic physical parameters (Tritium-breeding ratio, space-dependent neutron and power distribution etc.) of simple test blankets without any structural material. Our understanding of the present request list is, that only the needs for the next few years program are included. As thermonuclear research proceeds, new request will subsequently be added in the coming years.

The present compilation is a combined list of the three Research Centers, Kernforschungszentrum Karlsruhe, Kernforschungsanlage Juelich and Max-Planck Institut fuer Plasmaphysik, Garching, which are the main laboratories involved in the national fusion reactor technology program. Priority assignments are due to the criteria developed previously by the Agency and the International Fusion Research Council. Status information has been elaborated by S. Cierjacks and R. Meyer, Kernforschungszentrum Karlsruhe, as of June 1972.

4.2. Names and Addresses of the Requestors

Name (Country/Lab)	Address
S.J. Blow (UK HAR)	UK Atomic Energy Authority Atomic Energy Research Establishment Harwell, Didcot, Berkshire United Kingdom
D. Breton (FR FAR)	Centre d'Etudes Nucleaires B.P. No. 6 F-92 260 Fontenay-aux-Roses France
S. Cierjacks (GER KFK)	Institut fuer Angewandte Kernphysik Kernforschungszentrum Karlsruhe Postfach 3640 D-75 Karlsruhe Federal Republic of Germany
D. Darvas (GER IRE)	Kernforschungsanlage Juelich Institut fuer Reaktorentwicklung Postfach 356 D - 517 Juelich Federal Republic of Germany
I.N. Golovin (USSR KUR)	Institut Atomnoi Energii I.V. Kurchatova 46 Ulitsa Kurchatova Moscow D-182, Union of Soviet Socialist Republics
W.C. Gough (USA AEC)	Div. of Controlled Thermonuclear Research United States Atomic Energy Commission Washington D.C. 20545 United States of America
H. Kuesters (GER KFK)	Institut fuer Neutronenphysik und Reaktortechnik Kernforschungszentrum Karlsruhe Postfach 3640 D - 75 Karlsruhe Federal Republic of Germany

4.3 Description of Headings and Definition of Symbols

1) <u>Target.</u> The chemical symbol and mass number of the target nucleus are given. When the request refers to the multi-isotopic natural composition of an element, the mass number is omitted.

2) <u>Reaction Type - Quantity.</u> The nuclear interaction of interest is given in a conventional mnemonic notation which is intended to be self-explanatory, e.g. (elastic), (N,2N).

3) <u>Reaction Type - Variable.</u> In this column are listed variables which are associated with the interaction listed under <u>Quantity</u> and for which data are required. Symbols used under the heading <u>Variable</u> are defined below:

X-Sect.	Total cross section for the interaction given under <u>Quantity</u> .
Part. X-Sect.	Partial cross section, e.g. for excitation of a particular level. Sufficient defining information should be given following the heading <u>"Comments".</u>
Ρ(Εγ)	Probability for production of gamma-rays as function of gamma energy. (This symbol has been used only with requests for capture gamma spectra).
T (b n)	Angular distribution of elastically scattered neutrons; differential cross section.
ơ(0 n')	Angular distribution of non-elastic secondary neutrons; angular differential cross section.
σ(E _n ,)	Energy spectrum of secondary neutrons; energy differential cross section
σ(Εγ)	Gamma-ray energy spectrum; energy differential cross section for production of gamma-rays from the reaction given under " <u>Quantity</u> "
σ(θ _n , ε _n ,)	Angular distribution and energy spectrum of secondary neutrons; double-differential cross section.

O(BY, EY)

Angular distribution and energy spectrum of gamma-rays; double-differential cross section for production of gamma-rays from the reaction given under "<u>Quantity</u>".

4) <u>Priority</u>: The priority assigned by the requestor is indicated in this field. Different criteria have been used by the various contributors to the List so that the priority assignments (1, 2, 3 or 4) have consistent meaning only among the requests from a single Country and Laboratory. The Agency-developed criteria given in Section 3, have been used in the requests from the UK and FRG and by McNally in the Charged-Particle Data Request List (Section 5). When no priority has been assigned by the Requestor, this column is blank.

5) <u>Incident Energy</u> (eV). For the incident particle defined under <u>Quantity</u> are specified the lower and upper limits of the energy range for which data are required. Numerical specifications in eV are preferred. Alphabetic representations with the following definitions have also been used:

Thermal	neutron energies of about 0.025 eV
Thre shold	the threshold energy of the reaction specified under Quantity
Resonance	the resolved and unresolved resonance energy regions whose limits depend on the specific target nucleus

6) Accuracy. The required accuracy is specified in this field.

7) <u>Country/Lab.</u> and <u>Requestor</u>. The country and laboratory (or organization) and the name of the requestor(s) are given in these columns, respectively. Full expansions of the abbreviations of names of countries and laboratories may be found following the name of the requestor in Section 4.2.

8) <u>Year.</u> The year of origin is given under this heading on the first line of the request. It is also possible to specify a year-of-origin for each of the <u>Comments</u>, <u>Status</u> and <u>Justification</u> sublines which follow each request.

9) <u>Comments</u>: The <u>Comments</u> sublines, which may follow each request, may contain any additional relevant information, e.g. further specification of information given under other headings or special conditions under which the requested data should be obtained. 10) <u>Status</u>: The <u>Status</u> sublines may contain information about the status of existing or forthcoming measurement or evaluation work. Alternatively they may contain statements that no experimental measurements exist or that no status review has been made.

11) <u>Justification</u>: The <u>Justification</u> sublines should describe briefly, but precisely, the use which will be made of the data or the reasons for making the request. 4.4 International Nuclear Data Request List for Controlled Fusion Research

Target	Reactio Quantity	n Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year		
6 _{Li}	Elastic	♂(ð n)		1•4+7	15 9	USA AEC	Gough	71		
		Status:	No data to req	uired accuracy.				71		
		Justificat:	ion: Need for	shield, magnet cost	; estimates CT	R		71		
6 Li	Elastic	G(0 _n)	2	1.0+6 - 1.5+ 7	10 %	USSR KUR	I.N. Golovin	<u></u> ,		
		Comments:	Refinement of	f data below 7 MeV an	nd additional	data above 7 MeV	required;			
		<u>Status:</u>	•	rd Ed., Vol. I, 1970 or Reactors, Helsink	•	•	•			
		Justificat		tion of neutron trans						
6 Li	Elastic	5 (0 _n)	2	1.0+6 - 1.5+7	10 %	GER KFK	H. Küsters D. Darvas	72		
		Comments:	Additional angular distributions above 6 MeV, and an improvement of the accuracy below 6 MeV is required.							
		Status:	BNL 400, 3rd 7.5 - 14 MeV.	Ed. lists 10 distrib	butions betwee	n 2 and 14 MeV a	nd none between			
		Justificat	ion: Calculat	tion of neutron trans	sport.					

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Target	Reactio Quantity	n Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
6 _{Li}	Elastic	5 (0 _n)	2	1.0+3 - 1.5+7	20 %	UK HAR	S. Blow	72
		<u>Justificati</u>	<u>on:</u> For shie	lding calculations.				
6 Li	Elastic	5 (9 _n)	1	1.4+7	10 %	FR FAR	D. Breton	73
		<u>Justificati</u>	on: Evaluati	on of neutron balance	•			
6 _{Li}	N,Triton	X-Sect.		3.0+6 - 1.4+7	10 %	USA AEC	Gough	71
		Status:	No data to re	quired accuracy.				71
		Justificati	ons Needed t	o determine breeding	ratio, CTR.			71
6 Li	N,Triton	X-Sect.	1	1.0+5 3.0+6	3 %	USSR KUR	I.N. Golovin	
				al., Proc. Third Conf , Vol. II, p.551.	• Neutron Cr	oss Sections and	Technology,	
		Justificati	on: Tritium	breeding and energy d	leposition			
6 _{Li}	N,Triton	X-Sect.	1	3.0+5 1.5+7	<u>5</u> %	GER KFK	H. Küsters D. Darvas	72

Target	Reaction Quantity	n Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
		<u>Comments:</u> Status:	_	. gave a review at Ki		-	-	
			to be 10 % at	0.5 MeV, 15-20 % at mation of more accura	10 MeV.			
6 Li	N,Triton	X-Sect.	2	Thermal-1.5+7	1–5 %	UK HAR	S. Blow	72
		Comments:	Recent evalua	tion may be good enou	ıgh.			
		Status:	C.A. Uttley,	AERE-RR/NP 19 (72).				
		<u>Justificat</u>	<u>ion:</u> To evalu	ate neutron economy a	and tritium b	reeding.		
6 Li	N,Triton	X-Sect.	1	3.0+6 - 1.4+7	5 %	FR FAR	D. Breton	73
		Justificat:	<u>ion:</u> Evaluati	on of neutron balance	9			
6 Li	N,N'D	X-Sect.		Threshold-1.4+7	10 %	USA AEC	Gough	72
		Status:	No data to re	quired accuracy.				71
		Justificat	<u>ion:</u> Needed f	or CTR applications.				71

Target	Reaction Quantity	I Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
⁶ Li	N,N'D	X-Sect.	1	Threshold - 1.5+7	10 %	USSR KUR	I.N. Golovin	
				, G.B. Yankov, Proc. I IAEA, Vienna, 1970, V			actors,	
		Justificat	tion: Neutron	calculations and energ	y deposition	n in blanket mate	erials;	
6 _{Li}	И,И,И	X-Sect.	2	Threshold - 1.5+7	10 %	GER KFK	H. Küsters D. Darvas	72
2."		Comments:	E-resolution	of 0.2 - 0.5 MeV would	be sufficie	ent.		
		<u>Status:</u>	•	Ed. and Hopkins et al. 15 - 20 %. No data thr		7 indicate presen	at error	
		Justificat	<u>ion:</u> Shieldin	g estimates, Calculati	on of heat ${}_{i}$	generation.		
6 _{Li}	N,N'D+N' X	G (En') G (Ön')	2	Threshold - 1.5+7	20 %	GER KFK	H. Küsters D. Darvas	72
		Comments:	-	ra up to maxim um energ cted energies would be	-	uired. Ang. distr	vibutions of neutro	ns
		Status:	BNL 400, 3rd 3	Ed. gives very few dis	tributions d	only.		
		Justificat	ion: Calculat:	ion of neutron transpo	rt. Shieldir	ng estimates.		

Target	Reactior Quantity	n Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
6 _{Li}	Non-elastic	X-Sect. T (En')	2	2.0+6 - 1.5+7	20 %	UK HAR	S. Blow	72
		<u>Comments:</u>		ffect of neutron cap ation of tritium brea	•	ion between ⁶ Li a	and structural mate	rials
6 _{Li}	N,X X	X-Sect. C(Ey)	2	9.0+6 - 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments:		s for gamma-ray produ	uction (15 % a	accuracy) and gai	mma-ray spectra are	
		<u>Comments:</u> <u>Status:</u>	required.	s for gamma-ray produ al data known.	action (15 % a	accuracy) and ga	mma-ray spectra are	
		Status:	required. No experiment				mma-ray spectra are	
 6_Li	⁶ Li+ ⁶ Li →	Status:	required. No experiment	al data known.			mma-ray spectra are Gough	71
	⁶ Li+ ⁶ Li →	<u>Status:</u> Justificat	required. No experiment <u>ion:</u> Gamma-ra	al data known. y heating and shield		ons.		
⁶ Li		<u>Status:</u> Justificat ⁷ Be+ ⁴ He+n	required. No experiment <u>ion:</u> Gamma-ra	al data known. y heating and shield +3 - +6		ons.		
⁶ Li 7 _{Li}		<u>Status:</u> <u>Justificat</u> ⁷ Be+ ⁴ He+n <u>Comments:</u>	required. No experiment <u>ion:</u> Gamma-ra Energy range	al data known. y heating and shield +3 - +6		ons.		
	<u>ي</u>	<u>Status:</u> <u>Justificat</u> ⁷ Be+ ⁴ He+n <u>Comments:</u> <u>Status:</u>	required. No experiment <u>ion:</u> Gamma-ra Energy range	al data known. y heating and shield +3 - +6 keV to a few MeV	ing calculatio	ons. USA AEC	Gough	71

Target	Reaction Quantity	Type Variable	Priority	Incident	Energy	Accuracy	Country/Lab	Requestor	Year	
7 _{Li}	Elastic	• (0 _n)	1	2 . 0+6 -	1.5+7	10 %	USSR KUR	I.N. Golovin		
		Comments: Refinement of data below 7 MeV and additional data above 7 MeV are required.								
		Status: BNL-400, Third Ed., Vol. 1, 1970; Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p.49.								
		Justificat	<u>ion:</u> Tritium b	reeding an	nd energy dep	osition.				
7 _{Li}	Elastic	5 (9 _n)	1	1.0+6 -	1.5+7	1.0%	GER KFK	H. Küsters D. Darvas	72	
•		<u>Comments:</u> Additional distributions from 2 - 14 MeV (steps of 0.5 - 1 MeV) and improved accuracy required.								
		Status:	BNL 400, 3rd E distributions				een 2 and 14 MeV.	Below 2 MeV most		
		<u>Justificat</u>	<u>ion:</u> Calculati	on of neut	ron transpor	t.				
7 _{Li}	Elastic	• (0 _n)	2	1.0+3 -	1.5+7	15 %	UK HAR	S. Blow	72	
		<u>Justificat</u>	<u>ion:</u> For shiel	ding calcu	lation					

Target	Reaction Quantity	Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
7 _{Li}	Elastic	G (θ _n)	1	1.4+7	10 %	FR FAR	D. Breton	73
		Justificat	<u>ion:</u> Evaluati	on of the neutron ba	lance.			
7 _{Li}	Inelastic	G (E _n :)		Threshold-1.4+7	15 %	USA AEC	Gough	72
		<u>Status:</u>	None					71
		Justificat	between by ⁶ Li i	pectra needed to eva neutron absorption b n calculation of tri o evaluate neutron t	y resonance a tium breeding	bsorbers and ratio. Also	l.	71
7 _{Li}	Inelastic	Partial X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments:	Inelastic cro	ss section for 0.478	- MeV level	required.		
		Status:		in, G.B. Yankov, Pro O; IAEA, Vienna, 197			eactors,	
		Helsinki, 1970; IAEA, Vienna, 1970, Vol. I, P. 49. Justification: Neutron calculations and energy deposition in coolant and blanket materials.						

	Reaction	п Туре								
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year		
7 _{Li}	Inelastic	Partial X-Sect.	2	5.0+5 — 1.5+7	10 %	GER KFK	H. Küsters D. Darvas	72		
		Comments:	Cross section	ns for the inelastic s	cattering to	the 0.478-MeV le	evel required.			
		<u>Status:</u> See BNL 325, 2nd Ed. plus Hopkins et al. NP 107 A and Knitter et al. Wash. Conf. 1968 for existing data. Data need confirmation or improved accuracy data insufficient to determine shape.								
		Justification: Shielding estimates, calculation of heat generation.								
7 _{Li}	N,N'T	X-Sect.		3.0+6 - 1.4+7	<10 %	USA AEC	Gough	71		
		<u>Comments:</u>		acy leads to uncertai 4 <10 % at 14 MeV.	nty of 0.1 in	n breeding ratio		71		
		Status:	Present accur	acy is 25 % at 8 MeV,	15 % at 14 1	Me V .				
7 _{Li}	N,N'T	X-Sect.	1	Threshold-1.5+7	5 %	USSR KUR	I.N. Golovin			
		<u>Status</u> :	Reactors, Hel	in, G.B. Yankov, Proc sinki, 1970, IAEA, Vi et al., ibid., p. 67						
		Justificat	<u>ion:</u> Tritium	breeding and energy d	eposition.					

Target	Reaction Quantity	Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
7 _{Li}	N,N'T	X-Sect.	1	Threshold-1.5+7	5 %	GER KFK	H. Küsters D. Darvas	72
		<u>Comments:</u> <u>Status:</u> Justificat	Hopkins et al	and steps of 0.2 - 0. • review data in LA-3 ation of more accurat	765. Present	accuracy around	15 %.	
7 _{Li}	N,N'T	X-Sect. Justificat	l <u>ion:</u> Evaluati	3.0+6 — 1.4+7 on of neutron balance	5 % :	FR FAR	D. Breton	73
7 _{Lī}	N,N'T	X-Sect., $\mathbf{G}(\mathbf{E}_{n}, \mathbf{I})$ <u>Status:</u> <u>Justificat</u>	2 T.W. Conlon A ion: To evalu	2.5+6 - 1.5+7 ERE-R 7166 ate tritium breeding.	5 %	UK HAR	S. Blow	72
7 _{L1}	N,N'T	σ (E _n ;) <u>Status:</u> <u>Justificat</u> :	None ion: Need for	~ 1.4+7 shield, magnet cost	15 % estimates, C	USA AEC TR	Gough	71 71 71

Target	Reaction Quantity	Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Y
7 _{L1}	N.N'T	G (E _n ;)	1	1.0+7 - 1.5+7	15 %	USSR KUR	I.N. Golovin	
		<u>Comments:</u> <u>Status:</u> Justificat	No experiment	ibutions of secondar, al data known. transmission calcula		e required;		
7 _{Li}	N, 2N	X-Sect., $\sigma(\Theta_n)$, $\sigma(E_n)$	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Colovin	
		Comments:		n (15 % accuracy) req nd energy distributi				
		Status:	D.S. Mather,	L.J. Pain, AWRE 047/	69, 1969			
		Justificat	ion: Blanket	neutron calculations	;			
7 _{Li}	N,2N	X-Sect.	2	Threshold-1.5+7	20 %	GER KFK	H. Küsters D. Darvas	7
		Comments:	Three or four	experimental points				
		<u>Status:</u>	Very discrepa	nt data at 11 MeV; or	nly one data	point below.		
				s of neutron multipl:				

Reaction Quantity	ı Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Non-elastic	X-Sect. G (E _n ,)	2	5.0+2 - 1.5+7	20 %	UK HAR	S. Blow	72
	Justificati			on capture com	petition between	⁶ Li	
N, X Y	X-Sect. C(Eg)	1	9.0+6 - 1.5+7	15 %	USSR KUR	I.N. Golovin	
		spectra					
	Status:	N o experiment	al data known.				
	Justificati	<u>on:</u> Gamma-ra	y heating and shiel	ding calculati	ons;		
Elastic	σ (θ _n)	2	2.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin	
	Status:	BNL-400, Thir	d Ed., Vol. 1, 1970				
	Justificati	on: Neutron	transmission calcul	ations			
	Quantity Non-elastic N, X¥	Non-elastic X-Sect. $\mathbf{C}(\mathbf{E}_{n},)$ Justificati N, X X X-Sect. $\mathbf{C}(\mathbf{E}_{X})$ Comments: Status: Justificati Elastic $\mathbf{C}(\mathbf{O}_{n})$ Status:	QuantityVariablePriorityNon-elasticX-Sect.2 $\mathbf{T}(\mathbf{E_n})$ Justification:To evaluand strueN, XX-Sect.1 $\mathbf{T}(\mathbf{E_x})$ $\mathbf{Comments:}$ Gamma-ray produceStatus:No experimentJustification:Gamma-rayElastic $\mathbf{T}(\mathbf{O_n})$ 2Status:ENL-400, Thir	QuantityVariablePriorityIncident EnergyNon-elasticX-Sect.2 $5.0+2 - 1.5+7$ $\mathbf{T}(\mathbf{E}_n,)$ Justification:To evaluate effect of neutr and structural materials.N, XXX-Sect.1 $9.0+6 - 1.5+7$ $\mathbf{T}(\mathbf{E}_X)$ Comments:Gamma-ray production cross-secti are required;Status:No experimental data known.Justification:Gamma-ray heating and shielElastic $\mathbf{T}(\mathbf{O}n)$ 2 $2.0+6 - 1.5+7$ Status:ENL-400, Third Ed., Vol. 1, 1970	QuantityVariablePriorityIncident EnergyAccuracyNon-elasticX-Sect.2 $5.0+2 - 1.5+7$ 20 % $\mathbf{\sigma}(\mathbf{E}_n,)$ Justification:To evaluate effect of neutron capture com and structural materials.20 %N, X¥X-Sect.1 $9.0+6 - 1.5+7$ 15 % $\mathbf{\sigma}(\mathbf{E}_{\mathbf{X}})$ Comments:Gamma-ray production cross-sections (15 % accurate required; Status:No experimental data known. Justification:Gamma-ray heating and shielding calculatiElastic $\mathbf{\sigma}(\mathbf{C}_n)$ 2 $2.0+6 - 1.5+7$ 10 %	QuantityVariablePriorityIncident EnergyAccuracyCountry/LabNon-elasticX-Sect.2 $5.0+2 - 1.5+7$ 20 %UK HAR $\mathbf{T}(\mathbf{E_n})$ Justification:To evaluate effect of neutron capture competition between and structural materials.N, X %X-Sect.1 $9.0+6 - 1.5+7$ 15 %USSR KUR $\mathbf{T}(\mathbf{E_g})$ Comments:Gamma-ray production cross-sections (15 % accuracy) and gamma are required;Status:No experimental data known.Justification:Gamma-ray heating and shielding calculations;Elastic $\mathbf{T}(\mathbf{C}n)$ 2 $2.0+6 - 1.5+7$ 10 %USSR KURElastic $\mathbf{T}(\mathbf{C}n)$ 2 $2.0+6 - 1.5+7$ 10 %USSR KUR	Quantity Variable Priority Incident Energy Accuracy Country/Lab Requestor Non-elastic X-Sect. 2 5.0+2 - 1.5+7 20 % UK HAR S. Blow G (E _n ,) <u>Justification:</u> To evaluate effect of neutron capture competition between ⁶ Li and structural materials. N , X * X-Sect. 1 9.0+6 - 1.5+7 15 % USSR KUR I.N. Golovin N, X * X-Sect. 1 9.0+6 - 1.5+7 15 % USSR KUR I.N. Golovin G (E _{x}) Comments: Gamma-ray production cross-sections (15 % accuracy) and gamma spectra

Target	Reactior Quantity	n Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
9 _{Be}	Elastic	G (9 n)	2	1.0+6 - 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72
		<u>Status:</u>		of the ANL data at a useful. BNL 400, 3rd 14 MeV.		-		
		Justificat	: <u>ion:</u> Calculat	ion of neutron transp	port.			
9 _{Be}	Inelastic	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		<u>Status:</u> Justificat		Ed., Suppl. 2, Vol. 1 calculations (blanket		ng).		
Be	Inelastic	G (On', E _n G (Ey)), 2	8.0+6 - 1.5+7	10 %	GER KUR	S. Cierjacks D. Darvas	72
		<u>Comments:</u>	-	ngular distributions stribution of gammas		neutrons.		
		Status:	No experiment	al data.				
9 Be	N,2N	X-Sect.	2	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificat	ion: To evalu	ate neutron economy i	n breeding ca	alculations.		

Target	Reaction Quantity	Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
9 _{Be}	N,2N	X-Sect.	2	2.0+6 — 1.4+7	15 %	FR FAR	D. Breton	73
		<u>Justificat</u>	<u>ion:</u> Improves	the neutron balance				
9 _{Be}	N,2N	X-Sect. $ \mathbf{\nabla}(\mathbf{\theta}\mathbf{n}'_{\mathbf{j}}\mathbf{E}_{\mathbf{n}'}) $ $ \mathbf{\nabla}(\mathbf{\theta}_{\mathbf{j}'},\mathbf{E}_{\mathbf{j}'}) $	2	Threshold-1.5+7	20 %	ger kfk	S. Cierjacks D. Darvas	72
		Comments:	ons of neutrons					
		Status:	Available dat	a are incomplete.				
		<u>Justificat</u>	<u>ion:</u> Radiatio	n damage estimates.				
9 _{Be}	N ; 2N	σ (θ _{n'}), σ (E _{n'})	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
	•.	Comments:	Energy and an	gular distributions o	of neutrons r	equired;		
		Status:	Experimental	data are incomplete.				
		<u>Justificat</u>		l use for neutron mul ssion calculations.	ltiplication	and		

Target	Reaction Quantity	n Type Variable	Priority	Incident	Energy	Accuracy	Country/Lab	Remestor	Year	
9 _{Be}	N, ALPHA	X-Sect.	2	8.0+6 -	1.5+7	15 %	USSR KUR	I.N. Golovin		
		<u>Status:</u> Justificat	BNL-325, Seco ion: Helium a							
9 _{Be}	N, ALPHA	X-Sect.	2	8 . 0+6 —	1.5+7	10 %	ger kfk	S. Cierjacks D. Darvas	72	
		Comments:	Total 🕵-prod	uction req	uired.					
		Status:	Available dat	a on total	K -produc	tion insuffic:	ient.			
		<u>Justificat</u>	ion: Calculat	ion of neut	tron trans	port.				
9 _{Be}	N, X X	G (E g), X-Sect.	2	3.0+6 -	1.5+7	15 %	USSR KUR	I.N. Golovin	· <u> </u>	
		Comments:	Comments: Gamma-ray production cross-sections (accuracy 15%) and gamma-ray spectra required;							
		Status:	No experiment	al data kno	0WD •					
		Justificat	<u>ion:</u> Gamma-ra	y heating a	and shield	ing calculatio	ons.			

Target	Reaction Quantity	Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
10 _B	N,2N	X-Sect.	2	8.0+6 - 1.4+7	15 %	FR FAR	D. Breton	73
		<u>Justificat</u>	ion: Improves	the neutron balance.				
10 _B	N, 3N	X-Sect.	2	1.0+7 — 1.4+7	15 %	FR FAR	D. Breton	73
		Justificat	<u>ion:</u> Improves	the neutron balance.				
12 _C	Elastic	σ (θ _n)	2	8.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin	
		<u>Comments:</u>	Neutron transm	nission calculations;				
		Status:	BNL-400, Third	1 Ed., Vol. 1, 1970.				
		Justificat	ion: Possible	use as moderator.				
12 _C	Inelastic	Partial X-Sect.	- <u></u>	4•4+6 — 1•4+7	10 %	USA AEC	Gough	71
		<u>Comments:</u>	Need 4.43-MeV	X -production.				72
		<u>Status:</u>		5.5, 7.5, 14 MeV, NCS progress, WASH 1124	AC 31.			71 68

	Reacti	on Type						
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
12 _C	N,ALPHA	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status:	A.W. Obst et	al., PR <u>C5</u> , 738 (197	2)			
		Justificat	tion: Neutron	absorption calculation	ons			
¹² c	N, N'3ALPHA	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status:	None					
		000000	Home					
12 _C	N, N' 3ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificat	ion: Neutron	economy and helium p	roduction.			
¹² C	N, N' 3ALPHA	G (E _{n'}), X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments:	Cross-section neutron spect	required to within 3	15 % and at 14	MeV the seconda	iry	
		Status:	Vasilyev, Zh.	Eks. Teor. Fiz. 33	(1957) 1321.			
		Justificat	ion: Blanket	neutron calculations				

	React,	ion Type										
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year				
19 _F	Elastic	g (ð n)	2	2.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin					
		Status: BNL-400, Third Ed., Vol. 1, 1970.										
		Justificat	tion: Possible	use of Li2BeF4 as c	oolant.							
												
19 _F	Elastic	T (0 n)	2	1.0+6 - 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72				
		Comments:	Distributions	should be taken at a	steps of abou	at (0.1-0.2) En.						
	+ <u>1</u>	<u>Status:</u>		a have insufficient a ly improve situation		-	way					
•		Justificat	<u>ion:</u> Calculat	ion of neutron trans	port.							
19 _F	Inelastic	X-Sect.		1.0+7 - 1.4+7	10 %	USA AEC	Gou <i>r</i> h	71				
		Status:	None					71				
		Justificat	ion: Needed f	or CTR applications 1	ising LiF.			71				
		~										

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year				
19 _F	Inelastic	X-Sect.	2	1.0+6 - 1.5+7	15 %	ussr kur	I.N. Golovin					
		Status: BNL-325, Second Ed., Suppl. 2, Vol. I, 1964; BNL-400, Third Ed., Vol. I. 1970										
	1	Justificat	Justification: Neutron calculations for blanket and shielding.									
19 _F	Inelastic	X-Sect.	1	1.0+6 - 1.5+7	10 %	GER KFK	S. Cierjacks D. Dervas	72				
		Comments:	Comments: Inelastic excitation cross sections required.									
		<u>Status:</u>	-	up to 4 MeV can be fo der et al., Helsinki 15 - 20 %.								
		Justificat	ion: Calculat	ion of heat generatio	on, shielding	estimates.						
19 _F	Inelastic	X-Sect.	1	1.0+7 - 1.5+7	20 %	UK HAR	S. Blow	72				
		Justificat	ion: Needed f	or applications using	; fused salt]	^{Li} 2 ^{BeF} 4						

	React	ion Type									
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year			
19 _F	Inelastic	σ(θ _n , E _n ,), σ(θ _γ , E _γ)	1	1.0+6 — 1.5+7	20 %	GER KFK	S. Cierjacks D. Darvas	72			
			Spectra and a	ngular distribution c •	of neutrons a	nd					
		Status:	No data of in	elastic gammas availa	ble.						
	·	Justification: Calculation of heat generation, shielding estimates.									
19 _F	N , 2N	X-Sect.	2	Threshold-1.5+7	20 %	UK HAR	S. Blow	72			
		Justification: To evaluate neutron economy in breeding calculations.									
19 _F	N , AL PHA	X-Sect.	2	Threshold-1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72			
			Present accur estimated 15	acy from BNL-325 and - 20 %.	Csikai REA 7	,4,83					
		Justification: Calculation of neutron absorption and transmission rates.									

Target	Reacti Quantity	on Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year					
19 _F	Absorption	X-Sect.	2	Thermal-1.4+7	10 %	USA AEC	Gough	71					
		Status:	Poor experime	ntal agreement.				71					
		Justificati	lon: Needed f		71								
19 _F	Absorption	X-Sect.	2	Thermal-1.5+7	15 %	USSR KUR	I.N. Golovin						
		Comments:	All neutron a	bsorption processes a	should be inc	luded.							
		Status:											
		Justificati	ustification: Neutron calculations and energy deposition in coolant.										
 19 _F	Absorption	X-Sect.	1	Thermal-1.5+7	10 %	UK HAR	S. Blow	72					
		Status:	Poor experime:	ntal agreement									
		Justificati	ion: Data nee	ded for applications	using Li ₂ BeF	4 •							
19 _F	Absorption	X-Sect.	2	Thermal-1.4+7	10 %	FR FAR	D. Breton	73					
r.	YOBOT P (TOU				10 /0	IN FAIL	De Dietom	د ۱					
		Justificati	on: Utilizat	ion in the coolant.									
								·					

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year		
19 _F	N , X X	G (E y), X-Sect.	2	5.0+5 - 1.5+7	15 <i>%</i>	USSR KUR	I.N. Golovin	<u>,</u>		
		<u>Comments:</u>		duction cross-sectio gamma-ray spectra;	ns (accuracy	15 %) are				
		Status:	BNL-325, Seco	nd Ed., Suppl. 2, Vo	1. I, 1964.					
		Justification: Gamma-ray heating and shielding calculations.								
27 _{A1}	N, 2N	X-Sect.	<u></u>	1.4+7	10 %	USA AEC	Gough	71		
		Status:	No data to re	quired accuracy				71		
		<u>Justification</u> : Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR								
27 _{A1}	N, 2N	G (9 _n , E _n ,)	1.4+7	15 %	USA AEC	Gough	71		
		Comments:	Energy and an	gular dependence of a	secondary neu	trons needed.		71		
		Justification: Calculation of neutron transport in blanket and shield.								
27 _{A1}	Inelastic	G (E _n ,)		Threshold-1.4+7	15 %	USA AEC	Gough	72		
. *		<u>Status:</u> Justificat	None ion: Needed to	o calculate neutron	transport in 1	blanket and shiel	d, CTR.	71		

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Coun	try/Lab	Requestor	Year
27 _{A1}	Inelastic	а (Е ^р)		Threshold-1.4+7	15 9	USA	AEC	Gough	72
				tra are required. ion of heat generati		and s	shield.		71
27 _{A1}	N, GAMMA	X-Sect.		1.4+7	20 %	USA	AEC	Gough	71
			None on: Needed t	o calculate formatio	n of higher m	ass is	otopes		71
27 _{A1}	N, GAMMA	Р(Е ў)		Thermal Resonance	15 %	USA	AEC	Gough	72
	•	<u></u>	one on: Capture :	needed to calculate	heat generati	on in	blanket and	shield.	71
27 _{A1}	N, PROTON	X-Sect.		1.4+7	20 %	USA	AEC	Gough	71
		<u>Status:</u> Justificatio	None on: Needed f	or radiation damage	estimat es.				

	React	ion Type			-			
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
27 _{A1}	N, ALPHA	X-Sect.	**************************************	1.4+7	20 %	USA AEC	Gough	71
		Status:	None					
		Justificati	on: Needed f	or radiation damage e	estimates			71
							+-F-,	
27 _{Al}	Nonelastic	X-Sect., C (E _X)	3	Thermal-1.5+7	20 %	UK HAR	S. Blow	72
		<u>Justificati</u>	on: Needed f	or heating calculation	on in supercon	nducting magnet n	regions.	
Ti.	Inelastic	X-Sect.	3	3.0+6 -1.4+7	10 %	FR FAR	D. Breton	73
		Justificati	<u>on:</u> Potentia	l constituent of cont	tainment vess	el.		
Ti	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

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Target		lon Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Ti	n, proton	X-Sect. Justificatio	3 2011 Potentia	Threshold-1.4+7 L constituent of cont	10 % ainment vess	FR FAR	D. Breton	73
 Ti	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
	Justification: Potential constituent of containment vessel.							

	React	ion Type									
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year			
V	Elastic	σ(θ _n)	1	2.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin				
		<u>Status :</u>	Proc. Int. Co	P, <u>All7</u> , (1968) 657; nf. Nucl. Data for Re Vol. II, p.327.							
		<u>Justifications</u> Potential use as structural material; determination of neutron transmission.									
7	Inelastic	X-Sect.	2	3.0+6 - 1.4+7	10 %	FR FAR	D. Breton	73			
		Justificat	<u>ion:</u> Potentia	l constituent of cont	ainment vess	el.					
V	Inelastic	G (E _n ;)	1	2.0+6 - 1.5+7	15 %	USSR KUR	I.N. Golovin				
		Status:		P, <u>All7</u> (1968) 657; A 53; B. Holmqvist, et							
		Justificat	ion: Neutron	calculations for bla	nket and shi	elding.					
۷	Inelastic	G (E ₁ ,)		Threshold-1.4+7	15 %	USA AEC	Gough	72			
		Justificat:	CTR.	71							

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Tear		
▼	Inelastic	X-Sect. and	3	Threshold-1.5+7	20 %	UK HAR	S. Blow			
		e (e 🔋)								
		Justificatio	n: For blan	ket heating calculat:	Long.					
۷	Inelastic	σ (Εγ)		Threshold - 1.4+7	15 🌾	USA AEC	Gough	72		
		Comments: C	amma ray spe	ectra required				71		
		Justificatio	m: To calcu	late heat generation	in blanket a	and shield.		71		
v	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71		
		<u>Status:</u> N	o data to re	quired accuracy.						
		Justificatio		needed to reduce und cation estimates for		neutron				
	N, 2N	X-Sect.	1	2.0+6 - 1.5+7	15 %	USSR KUR	I.N. Golovin			
		<u>Commentas</u> C	ross section	required to within]	.5 %.					
			.J. Ashby et oc. 9, 251 (al., Phys. Rev. 3, 6 1966)	516 (1958); J	.R. Williams et a	il., Trans. Am. Nuc	cl.		
		Justification: Neutron blanket calculations								

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Acouracy	Country/Lab	Requestor	Year		
			•							
v	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72		
		Justification: For neutron economy calculations								
V	N, 2N	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73		
		<u>Justificati</u>	<u>on:</u> Potentia	l constituent of cont	tainment vess	el.				
V	N, 2N	б (0 _n , , Е _n)		1.4+7	15 %	USA AEC	Gough	71		
			Energy and an and shield, C	gular dependence of a TR.	secondary neu	tron transport in	n blanket	71		
v	N, 2N	6'(0 , E _{n'})	1	1.4+7	. <u></u>	USSR KUR	I.N. Golovin	<u></u>		
		Comments:	Energy and an	gular distributions (of secondary	neutrons at 14 M	sV			
		<u>Justificati</u>	ons Neutron	blanket calculations.	•					

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year	
v	n, ganna	X-Sect.	1	1.0+3 - 2.0+6 and 1.4+7	15 %	USSR KUR	I.N. Golovin		
	<u>Status:</u> BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966; G.G. Zaikin et al., AE, <u>23</u> (1967) 67; N.D. Dudey et al., JNE, <u>23</u> (1969) 443; R.G. Stieglitz et al., NP, <u>A163</u> (1971) 592.								
		<u>Justificati</u>	on: Neutron	absorption, gamma-raj	r heating, pr	oduction of heavy	isotopes.		
Δ	N, GAMMA	X-Sect.	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72	
		Justificati	ons For neut	ron economy and heati	ng calculati	ons.			
v	N, GAMMA	X-Sect.		1.4+7	20 %	usa aec	Gough	71	
		<u>Justificati</u>	on: Needed t	o calculate formation	n of higher m	ass isotopes, CTR	•	71	
v	N, GAMMA	Q. (E ^{\$})		Thermal Resonance	15 %	USA AEC	Gough	71	
		<u>Status</u>	None					71	
		Justificatio	on: Needed t	o calculate heat gene	ration in bl	anket and shield,	CTR.	71	

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year			
v	n, x 7	I-Sect. and C(Ey)	1	3.0+5-1.5+7	15 %	USSR KUR	I.N. Golovin				
		<u>Comments:</u> Gamma-ray production cross section to 15 $\%$ and gamma-ray spectrum.									
		Status: No experimental data known.									
		Justification	: Gamma-ray	heating calculations.							
۷	N, PROTON	X-Sect.	1	Threshold - 1.5+7	15 %	USSR KUR	I.N. Golovin				
		D.	Crumpton, J	Ed., Suppl. 2, Vol. I our. no. Inorg. Nucl. et al., Ya. Fiz. <u>10</u> (Chem. <u>31</u> (1	967) 3727;					
		Justification	<u>i</u> Hydrogen a	ccumulation calculation	ns.						
<u></u>	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71			
•							40 4 5 1	-			
		Status: No	ne					71			
		Justification	: Needed for	r radiation damage est:	imates, CTR			71			

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
v	n, proton	X-Sect. Justificatio	3 ns For gas	Threshold-1.5+7 production rates.	20 %	UK HAR	S. Blow	72
V	N, PROTON	X-Sect. Justificatio	2 <u>n:</u> Potentia	Threshold-1.4+7 1 constituent of con-	10 % tainment vess	FR FAR el.	D. Breton	73
v	N, ALPHA		one n: Needed fo	1.4+7 or radiation damage of	20 %	USA AEC R	Gough	71 71
v	N, ALPHA	D V	. Crumpton, .N. Levkovsk	Threshold-1.5+7 nd Ed., Suppl. 2, Vol Journ. Inorg. Nucl. (y et al., Ya. Fiz. <u>1(</u> ccumulation calculati	Chem. <u>31</u> (196 <u>0</u> (1969) 44.		I.N. Golovin	

N, A		-Sect.		Incident Energy	Accuracy	Country/Lab	Requestor	
'N, A	LPHA X.	-Sect.	2					
			3	Threshold-1.5+7	20 %	UK HAR	S. Blow	
	<u>J</u> 1	ustifications	For gas pro	oduction rates.				
							<u> </u>	
N, A		-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	

Target	Reacti Quantity	ion Type Variable	Priority	Incident Energy	Acouracy	Country/Lab	Requestor	Year
Cr	Inelastic	X-Sect. Justification	3 <u>:</u> Potential	3.0+6 - 1.4+7 constituent of conta	10 % ainment vesse	FR FAR	D. Breton	73
Cr	Inelastic	C (E J)	3 <u>:</u> For blank	Threshold-1.5+7	20 % ons.	UK HAR	S. Blow	72
Gr	Inelastic	S(Eg) <u>Status:</u> No <u>Justification</u>	: Needed ar	1.4+7 e gamma ray spectra - t and shield, CTR	20 % to calculate	USA AEC heat generation	Gough	71 71 71
Cr	Inelastic	G (F _n ,) <u>Status:</u> No. <u>Justification</u>		Threshold-1.4+7 calculate neutron to	15 % ransport in t	USA AEC Dlanket and shield	Gough , CTR	72 71

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cr	N, GAMNA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status:</u> 1	None					71
		Justificatio	on: Needed to	o calculate formation	of higher ma	ass isotopes, CTR		71
Cr	N, GAMMA	X-Sect. and G (Eg)	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		Justificatio	on: For neutr	con economy and heatir	ng calculati	ons.		
Cr	N, GAMMA	P(E g)		Thermal - Resonance	15 %	USA AEC	Gough	71
		<u>Status</u>	Vone					71
		Justificatio	on: Needed to	o calculate heat gener	ation in blo	anket and shield		
Cr	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justificatio	on: Potential	constituent of conta	inment vess	el.		

Target	React Quantity	ion Typ e Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cr	n, 2n	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		Justificati	on: For neut	ron economy calculat	ions.			
Cr	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status:	None	· · · · ·				71
		Justificati		needed to reduce un cation estimates for	. –	neutron		71
Cr	N, 2N	() , En'	, ,	1.4+7		USA AEC	Gough	71
		<u>Status:</u>	None		-		*	71
		Justificati		nd angular dependence e neutron transport			ā to	71
		Na an Maria an Island a sta an an an Angela.						
Cr	n, proton	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		<u>Justificati</u>	<u>on:</u> Potentia	l constituent of cont	ainment vess	91.	;	
			a n, par a f. p. 11 p. 11 p. 1 . p.				and the second	

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cr	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	
7		Justificati	on: For gas	production rates.				
Cr	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
			None on: Needed f	or radiation damage	estimates, C	1R		
Cr	N. ALPHA	X-Sect. Justification	3 <u>on:</u> Potentia	Threshold-1.4+7	10 % tainment ves	FR FAR sel.	D. Breton	73
Cr	N, ALPHA	X-Sect. Justificatio	3 on: For gas	Threshold-1.5+7 production rates.	20 %	UK HAR	S. Blow	72

Target	Quantity	ion Type Variable	Priority	Incident	Energy	Accuracy	Country/Lab	Requestor	Year
Cr	N, ALPHA	X-Sect.		1.4+7		20 %	USA AEC	Gough	71
			None ons. Needed for	r radiatic	on damage es	timates, CTR	• 25		71
Fe	Inelastic	X-Sect.	2	3.0+6	1.4+7	10 %	FR FAR	D. Breton	73
	١	Justificati	on: Potential	constitue	ont of conta	inzent vesse	1.		
Fe	Inelastic	X-Sect.		Threshold	1-1•4+7	15 %	USA AEC	Gough	72
		Status:	None						71
			ons Needed to	calculate	e neutron tra	ansport in b	lanket and shield,	CTR.	71
Fe	Inelastic	X-Sect. and C(Eg)	3	Threshold	1–1•5+7	20 %	UK HAR	S. Blow	~~
*		Justificatio	on: For blank	et heating	g càlculation	ns.			

Target	React: Quantity	ion Typ e Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Fe	Inelastic	G-(E })		Threshold-1.4+7	15 %	USA AEC	Gough	71
		<u>Status</u> N	one					71
		Justification	n : Needed to) calculate heat gener	ation in bla	anket and shield,	CTR	71
Fe	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: No	one					71
		Justification	n: Needed to	calculate formation	of higher m	ass isotope, CTR.		71
Fe	N, GAMMA	X-Sect. and T(Eg)	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		Justification	n: For neutr	on economy and heatin	g calculatio	ons.		
Fe	N, GAMMA	P(E)	- <u></u>	Thermal- Resonance	15 %	USA AEC	Gough	71
		<u>Status:</u> No	one					71
		Justification	n: Needed to	o calculate heat gener	ation in bla	anket and shield,	CTR.	71

Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
N, 2N	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
	Justificatio	<u>n:</u> Potentia	l constituent of con-	tainment vess	el.		
N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HẠR	S. Blow	72
	<u>Justificatic</u>	<u>n:</u> For neut	ron economy calculat:	ions.			
N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
	Status: N	one					71
	<u>Justificatio</u>			ertainty in r	neutron multiplic	cation	71
•					N		
N, 2N	$\boldsymbol{\sigma}(\boldsymbol{\theta}_{n^*}, E_{n^*})$		1.4+7	15 %	USA AEC	Gough	71
	<u>Status:</u> N	one					71
	Justificatio					d to	71
	N, 2N N, 2N	Justification N, 2N X-Sect. Justification N, 2N X-Sect. Status: N Justification N, 2N C(On, En) Status: N Status: N	Justification: Potential N, 2N X-Sect. 3 Justification: For neut N, 2N X-Sect. Status: None Justification: Accuracy estimate: N, 2N $\mathcal{G}(\Theta_n, E_n)$ Status: None Justification: Energy a	Justification: Potential constituent of cont N, 2N X-Sect. 3 Threshold-1.5+7 Justification: For neutron economy calculat: N, 2N X-Sect. 1.4+7 Status: None Justification: Accuracy needed to reduce und estimates for CTR. N, 2N G (O _n , E _n) 1.4+7 Status: None Justification: Energy and angular dependence	Justification: Potential constituent of containment vess N, 2N X-Sect. 3 Threshold-1.5+7 10 \$ Justification: For neutron economy calculations. N, 2N X-Sect. 1.4+7 10 \$ Status: None Justification: Accuracy needed to reduce uncertainty in restimates for CTR. N, 2N $\mathbf{J}(\mathbf{G}_{11}, \mathbf{E}_{12})$ 1.4+7 15 \$ N, 2N $\mathbf{J}(\mathbf{G}_{11}, \mathbf{E}_{12})$ 1.4+7 15 \$	Justification: Potential constituent of containment vessel. N, 2N I-Sect. 3 Threshold-1.5+7 10 \$ UK HAR Justification: For neutron economy calculations. N, 2N I-Sect. 1.4+7 10 \$ USA AEC Status: None Justification: Accuracy needed to reduce uncertainty in neutron multiplice stimates for CTR. N, 2N G (0 _n ', E _n ') 1.4+7 15 \$ USA AEC Status: None	Justification: Potential constituent of containment vessel. N, 2N X-Sect. 3 Threshold-1.5+7 10 % UK HAR S. Blow Justification: For neutron economy calculations. Interfection: S. Blow S. Blow N, 2N I-Sect. 1.4+7 10 % USA AEC Gough Status: None Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR. N, 2N C(G ₁₁ , E ₁₂) 1.4+7 15 % USA AEC Gough Status: None Justification: Energy and angular dependence of secondary neutrons needed to

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Fe	N, PROTON	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justificati	on: Potentia	L constituent of con-	taimment vess	el.		
Fe .	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
	·	Justificati	on: For gas	production rates.			•	
Fa	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
. •		Status:	None					71
		<u>Justificati</u>	on: Needed fa	or radiation damage e	stimates.			71
Fe	N, ALPHA	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justificati	ons Potentia	l constituent of cont	tainment vess	91.		

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Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	y Country/Lab	Requestor	Year
Fe	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificati	.on: For gas	production rates.				
Fe	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status:	None					71
		Justificati	on: Needed f	or radiation damage (estimates, C	TR		71
Ni	Inelastic	X-Sect.	3	3.0+6 - 1.4+7	10 %	FR FAR	D. Breton	73
		Justificati	<u>on:</u> Potentia	al constituent of con-	tainment ves	ssel.		
Ni	Inelastic	X-Sect. and of (Eg)	. 3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
	· .	Justificati	on: For blar	nket heating calculat:	ions.			

		ion Type				,		
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Tear
Ni	Inelastic	G (E ^g)		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status:	None					71
		<u>Justificat</u> :		re gamma ray spectra t et and shield, CTR	co calculate	heat generation		71
Ni	Inelastic	G (E _n ,)	<u>, , , , , , , , , , , , , , , , , , , </u>	Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status:	None					71
		<u>Justificat</u> :	Lons Needed to	o calculate neutron tr	ansport in 1	blanket and shield	, CTR	71
Ni	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status:	None					71
		Justificati	ions Needed to	o calculate formation	of higher ma	ass isotopes, CTR.		71
 Ni	N, GAMMA	X-Sect. and G (Eg)	1 3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
¹ A <u>n</u>		Justificati	on: For neut	ron economy and heatin	g calculatio	ons.		

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Aocuracy	Country/Lab	Requestor	Tear
Ni	N, GAMMA	P(E y)		Thermal-Resonance	15 %	USA AEC	Gough	71
		Status: No	ne					71
		Justification	s Needed to	calculate heat genera	tion in bla	nket and shield, C	TR	71
••••••••••••••••••••••••••••••••••••••					7 b			
Ni	N, 2N	X-Seot.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		<u>Justification</u>	<u>s</u> Potential	. constituent of contai	nment vesse	1.		
	·····							
Ni	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No	data to req	uired accuracy				71
		Justification	-	needed to reduce uncer ation estimates for CT	-	eutron	: .	71
		<u></u>						
Ni	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		Justification	<u>s</u> For neutr	on economy calculation	8.			

Target	React: Quantity	ion Type . Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Tear
Ni	N, 2N	6 (0 _{n'} , E _{n'})		1.4+7	15 %	USA AEC	Gough	71
•		Status: No	me					. 71
		Justification		nd angular dependence e neutron transport i	-		to	71
ni.	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification	18 Potential	constituent of cont	ainment vesse	1.		
Ni	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification	II For gas p	production rates.				
Ni	n, proton	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status:</u> No	ne					71
		Justification	s Needed fo	or radiation damage e	stimates, CTF	t		71
			<u></u>					

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Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
N1	n, Alpha	X-Sect. Justificatio	3 <u>m:</u> Potential	Threshold-1.4+7	10 % tainment vess	FR FAR el.	D. Breton	73
Ni.	N, ALPHA	X-Sect. Justificatio	3 n: For gas p	Threshold-1.5+7 production rates.	20 %	UK HAR	S. Blow	72
Ni	N, ALPHA		one n: Needed fo	1.4+7 or radiation damage e	20 %. stimates, CT	USA AEC R	Gough	71 71 71 71
Gu	Elastic	B D	• Holmqvist, ata for React	8.0+6 — 1.5+7 Ed., Vol. II, 1970; T. Wiedling, Proc. I Fors, Helsinki, 1970; ransmission calculat	nt. Conf. Nuc IAEA, Vienna		I.N. Golovin p.327	

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cu	Inelastic	Q (E X)		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status:	lone					71
		Justificatio		re gamma ray spectra et and shield, CTR	to calculate	heat generation		71
Cu	Inelastic	G (E _{n'})		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status:	lone					71
		<u>Justificatic</u>	n: Needed to	o calculate neutron t	ransport in 1	blanket and shield	1.	71
Cu	Inelastic	Comments: C	2 amma spectra	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: I	NL-325, Secor	nd Ed., Suppl. 2, Vol. et al., Ya. Fiz. <u>12</u>				
		Justificatio	n: Neutron o	calculations for blan	ket and shie	lding.		
Cu	Non-elastic	X-Sect. and C (Eg)	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificatio	n: Needed fo	or heating calculation	ns in superco	onducting magnet r	region.	

React	ion Type						
Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
n,x d	$\mathbf{G}(\mathbf{E}_{\mathbf{\xi}})$ and X-Sect.	2	5.0+5 — 1.5+7	15 <i>¶</i> .	USSR KUR	I.N. Golovin	
				required to	15 %		
	<u>Status:</u> E	NL-325, Seco	nd Ed., Suppl. 2, Vol.	IIA, 1966.			
	Justificatio	ons Gamma-ra	y heating and shielding	ng calculatio	ons.		
N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
	<u>Status:</u> N	lone					71
	Justificatio	n: Needed to	o calculate formation	of higher ma	ass isotopes, CT	R.	71
•	·						
N, GAMMA	P(E y)		Thermal-Resonance	15 %	USA AEC	Cough	71
	Status: N	lone					71
		n: Needed to	o calculate heat gener	ation in bla	unket and shiel	1. CTR	71
							-
	Quantity N,X ð	N, X X N, X X T(Ey) and X-Sect. Comments: O a Status: F Justificatio N, GAMMA X-Sect. Status: N Justificatio N, GAMMA P(Ey) Status: N	Quantity Variable Priority N,X N,X T(Ey) and 2 X-Sect. <u>Comments:</u> Gamma-ray pro and gamma-ray <u>Status:</u> BNL-325, Seco <u>Justification:</u> Gamma-ray N, GAMMA X-Sect. <u>Status:</u> None <u>Justification:</u> Needed to N, GAMMA P(Ey) <u>Status:</u> None	Quantity Variable Priority Incident Energy N,X (Mathematical Comments) Gamma-ray 5.0+5 - 1.5+7 X-Sect. Comments: Gamma-ray production cross-section and gamma-ray spectra. Status: ENL-325, Second Ed., Suppl. 2, Vol. Justification: Gamma-ray heating and shieldiz N, GAMMA X-Sect. 1.4+7 Status: None Justification: N, GAMMA P(Eg) Thermal-Resonance Status: None	Quantity Variable Priority Incident Energy Accuracy N,X % $\P(E_g)$ and 2 5.0+5 - 1.5+7 15 % X-Sect. Comments: Gamma-ray production cross-section required to and gamma-ray spectra. Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966. Justification: Gamma-ray heating and shielding calculation Gamma-ray heating and shielding calculation N, GAMMA X-Sect. 1.4+7 20 % Status: None Justification: Needed to calculate formation of higher me N, GAMMA P(E_g) Thermal-Resonance 15 %	Quantity Variable Priority Incident Energy Accuracy Country/Lab N,X (M) C(Ey) and 2 5.0+5 - 1.5+7 15 % USSR KUR X-Sect. Comments: Gamma-ray production cross-section required to 15 % and gamma-ray spectra. Status: ENL-325, Second Ed., Suppl. 2, Vol. IIA, 1966. Justification: Gamma-ray heating and shielding calculations. N, GAMMA X-Sect. 1.4+7 20 % USA AEC Status: None Justification: Needed to calculate formation of higher mass isotopes, CT N, GAMMA P(Ey) Thermal-Resonance 15 % USA AEC Status: None	Quantity Variable Priority Inoident Energy Accuracy Country/Lab Requestor N,X (Maxwell Comments: Gamma-ray 5.0+5 - 1.5+7 15 % USSR KUR I.N. Golovin X-Sect. Comments: Gamma-ray production cross-section required to 15 % USSR KUR I.N. Golovin Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966. Justification: Gamma-ray heating and shielding calculations. N, CAMMA X-Sect. 1.4+7 20 % USA AEC Gough Status: None Justification: Needed to calculate formation of higher mass isotopes, CTR. Thermal-Resonance 15 % USA AEC Ccugh

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cu	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		<u>Statuss</u> No	data to re	mired accuracy.				71
		Justification	-	needed to reduce un cation estimates for	-	leutron		71
Cu	N, 2N	σ (θ _n , E _n)		1.4+7	15 ¢	USA AEC	Gough	71
		Statuss No	ne					71
		Justification		nd angular dependence calculate neutron	-		, CTR.	71
Cu	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status:</u> No	ne					71
		Justification	: Needed fo	or radiation damage e	estimates, CTR	2		71
Cu	N. PROTON	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
				nd Ed., Suppl. 2, Vol accumulation calcula	• -			

.		ion Type			•			
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	· Year
Cu	N, ALPEA	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
Į.		<u>Status</u>	BNL-325, Seco	nd Ed., Suppl. 2, Vo	1. IIA, 1966			
		Justificati	ion: Helium a	ccumulation calculat:	ions.			
Cu	N, ALPHA	X-Sect.	<u></u>	1.4+7	20 %	USA AEC	Gough	71
		Status:	None					71
		Justificati	on: Needed f	or radiation damage (estimates, CT	R		71
Zr	Elastic	(6 n)	2	5.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin	<u></u>
		Status:	BNL-400, Third	d Ed., Vol. II, 1970				
			on: Neutron	transmission calculat	tions.			
Zr	Inelastic	X-Sect. and G (Eg)	L 3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		·	on: For blan	ket heating calculati	ions-			

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	Inelastic	G (E ₃)		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status:	None					71
		Justificati	on: Needed a and shie	re gamma-ray spectra [.] ld, CTR.	to calculate	heat generation i	n blanket	71
Zr	Inelastic	G (E ¹ ,)		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status:	None					71
		<u>Justificati</u>	ons Needed t	o calculate neutron t	ransport in i	blanket and shield	, CTR	71
Zr	Inelastic	G (E _n)	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		:	ENL-400, Thir Proc. Int. Co	nd Ed., Vol. IIA, 1960 d Ed., Vol. II, 1970; nf. Nucl. Data for Rea 1970, Vol. II, p. 359	0.A. Salnik			
		Justificatio	ons Neutron	calculations for blank	ket and shie	lding.		

	React	ion Type						
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Tear
Zr	n, x v	G (Ey) and X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
			lemma-ray grod and gamma-ray	uction cross-section spectra.	required to	within 15 %.		
		<u>Status</u>	NL-325, Secon	d Ed., Vol. IIA, 196	56.			
		Justificatio	n: Gama-ray	heating and shield	ng calculatio	008.	•	
·								
Zr	n, Gamma	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status</u> N	lone					71
		Justificatio	n: Needed to	calculate formation	of higher m	ass isotopes, CTR	l.	71
· · · ·								<u></u>
Zr	N, GAMMA	р(е у)		Thermal-Resonance	15 %	USA AEC	Gough	71
		<u>Stàtus</u> N	lone					71
		Justificatio	n: Needed to	calculate heat gene	ration in bla	anket and shield,	CTR.	71
		·						

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, GAMMA	X-Sect. and G(Ey)	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		<u>Justification</u>	For neut	ron economy and heati	ng calculatio	ons •		
Zr	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		Justification	E For neutr	con economy calculati	.ons.			
Zr	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Da		et al., Proc. Int. C tors, Helsinki 1970, 59		1970,		
		Justification	L Neutron n	mltiplication calcul	ations.			
Zr	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No	data to rec	puired accuracy.		·		71
		Justification	-	needed to reduce und ation estimates for	-	neutron		71

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, 2N	σ(θ _n ', E _{n'})		1.4+7	15 4	USA AEC	Gough	בי ביי
		<u>Status</u> N	one					71
		Justificatio		nd angular dependence o e neutron transport in			. to	71
Zr	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificatio	ns For gas	production rates.				
Zr	N, PROTON	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
				nd Ed., Vol. IIA, 1966 y, et al., Ya. Fiz. (19	•			
		<u>Justificatio</u>	n: Hydrogen	accumulation calculat:	ions.			
Zr	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status</u> N	one					71
		Justificatio	n: Needed f	or radiation damage est	timates, CTF	2		71

	React	ion Type						
farget	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status</u> :	None					71
		<u>Justifica</u>	tion: Needed f	or radiation damage e	estimates, CT	R		71
Zr	N, ALPHA	X-Sect.	2	Threshold-1.5+7	15 9	USSR KUR	I.N. Golovin	
		Status:		nd Ed., Vol. IIA, 196 y et al., Ya. Fiz. <u>10</u>				
		Justificat	tion: Helium a	ccumulation calculati	lons.			
Zr	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
ðr	N, ALPHA			Threshold-1.5+7 production rates.	20 %	UK HAR	S. Blow	72
Zr 23 _{ND}	N, ALPHA Elastic			-	-	UK HAR USSR KUR	S. Blow I.N. Golovin	72
		Justifica	tion: For gas l ENL-400, Thir Proc. Int. Co IAEA, Vienna,	production rates.	10 % Yu.F. Chern: actors, Hels:	USSR KUR ilin, G.B. Yankov inki 1970,	I.N. Golovin	72

Requestor	Year
H. Küsters D. Darvas	72
H. Küsters D. Darvas	72
S. Blow	72
•	S. Blow

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Coun	try/Lab	Requestor	Year
93 _{ND}	Inelastic	€ (E ₈)	· <u>· · · · · · · · · · · · · · · · · · </u>	Threshold-1.4+7	15 🧖	USA	AEC	Gough	71
		Status: No	one						71
		Justification		re gamma ray spectra to on in blanket and shiel		heat			71
93 _№	Inelastic	σ(θ _y , ε _y) σ(θ _n , ε _n)	2	1.0+6 — 1.5+7	20 %	ŒR	KFK	H. Küsters D. Darvar	72
		<u>Comments:</u> Sp	pectra and an	ngular distributions of	neutrons a	nd y'	s are require	d.	
		Status: N	SE 40, 294 (1	.970) gives J-y ield					
		Justification	n: Radiation	a damage estimates.					
93 _{ND}	Inelastic	G (E ⁿ ,)		Threshold-1.4+7	15 9	USA	AEC	Gough	72
		<u>Status</u> No	one						7 1
		Justification	ns Needed to	calculate neutron tra	nsport in t	lanke	t and shield,	CTR	71

_ .		ion Type	- · · ·	* • • • •			D	
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
93 _{ND}	Inelastic	G (E _n)	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		<u>Status:</u>	Reactors, Hel E. Almen et a	in, G.B. Yankov, Pros sinki, 1970, IAEA, V l., bid., Vol. II, p et al., Ya. Fiz. (19	ienna, 1970, ⁻ •349;			
		Justifica	tions Neutron	calculations for blau	nket and shie	lding.		
⁹³ ND	N, GAMMA	X-Sect.	1	1.0+7 — 1.5+7	15 9	USSR KUR	I.N. Golovin	
		Statuss	BNL-325, Seco	nd Ed., Suppl. 2, Vol	L. IIB, 1966.		•	
		Justifica	tion: Heavy is	otope accumulation ca	alculations.			
93 _{ND}	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status:	Rone					71
		<u>Justifica</u>	tion: Needed t	o calculate formation	n of higher m	ass isotopes, CTR		71
⁹³ лъ	N, GAMMA	X-Sect. an	nd 3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		Justifica	tion: For neut	ron economy and heat:	ing calculati	one.		

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
⁹³ №	N, GAMMA	P(E%)		Thermal-Resonance	15 9	USA AEC	Gough	71
		Status:	None					71
		Justificat	<u>ions</u> Needed t	o calculate heat gener	ation in bl	anket and shield	, CTR	71
93 _{ND}	N,X¥	T (E y)		Thermal-1.4+7	15 %	USA AFC	Gough	71
	s.*	Comments:	Total gamma p	roduction required.		÷		
		Status:	None					
		<u>Justificat</u> :	ion: CTR appl	ications.				
93 _{Nb}	N, X¥	X-Seot. and C(Ex)	d 1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		<u>Comments</u>	Gamma-ray pro	duction cross-section	to within l	5 % and gamma-ray	y spectra.	
		Status:	No experiment	al data of the require	d accuracy	are known.		
		Justificat:	ion: Gamma-ra	y heating and shieldin	g calculati	ons.		
 93 _№		Y (1)			10 A		(
	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
NO								
MO		Justificat:	ion: For neut	ron economy calculati	ons.			

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
93 _{Nb}	N, 2N		2	Threshold-1.5+7	10 %	ger kfk	H. Küsters D. Darvas	72
		<u>Comments:</u>	would be pref	counting the outcom erred to clarify the served decay modes.	-			
		<u>Status:</u>	rays from ⁹² Z 92 ^{Nb} isomer i theory indica	ts obtained by count: following decay of s also reported. Sys- te too low (n,2n) - y (see Drake et al.	10.2 d ⁹² Nb. tematics and perhaps due	A 3.2 h statistical		
		Justificat	<u>ion:</u> Radiatio	n damage estimates.				
93 _№	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Statuss	No data to re	quired accuracy.				71
		Justificat		needed to reduce und multiplication estima	••			71
93 _{ND}	N, 2N	σ(θ ₁ , Επ')	1.4+7	15 %	USA AEC	Gough	71
		Status:	None					71
		<u>Justificat</u> :		nd angular dependence e neutron transport i			l to	71

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
93 _{ND}	N, 2N	σ (θ _n , E _n)	1	Threshold-1.5+7	10 %	USSR KUR	I.N. Golovin	
		Comments	Secondary neu	tron measurements req	uired;			
		· · · · · · · · · ·	Reactors, Hel	et al., Proc. Int. Co sinki, 1970, IAEA, Vi al., ZP <u>244</u> (1971) 35	enna, 1970, 1			
		Justificati	on: Neutron	multiplication and re	diation dama,	ge calculations.		
93 _{Nb}	n, proton	X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
			Reactors, Hel	in, G.B. Yankov, Proc sinki, 1970, IAEA, Vi y et al., Ya. Fiz. <u>10</u>	enna, 1970, 1		;	
		Justificatio	on: Kydrogen	accumulation calcula	tions.			
93 _№	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificatio	ons For gas	production rates.				

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Target	React: Quantity	ion Type Variable	Priority	Incident	Fnergy	Accuracy	Cour	try/Lab	Requestor	Year
141 80 1									neque a tor	1691
⁹³ лъ	N, PROTON	X-Sect.	2	3.0+6 —	1.5+7	20 %	GER	KFK	H. Küsters D. Darvas	72
		Status: Only a few experimental data points with insufficient accuracy (BNL-325, GA-8133)								
		<u>Justificati</u>		n damage es d radioacti	•	calculation of rheat.	f tran	smutation		
93 _{Nb}	N, PROTON	X-Sect.		1.4+7		20 %	USA	AEC	Gough	71
	~	Status:	None							
		Justificati	on: Needed f	or radiatio	on damage	estimates, CT	R			
93 _№	N, ALPHA	X-Sect.		1•4+7		20 %	USA	AEC	Gough	71
		Status:	None							71
		<u>Justificati</u>	<u>on:</u> Needed f	or radiatio	on damage	estimates, CT	R			71

React	ion Type						
Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
N, ALPHA	X-Sect.	2	4.5+6 - 1.5+7	20 %	CER KFK	H. Küsters D. Darvas	72
	<u>Status:</u>			en 7-20 MeV w	ith		
	Justificat						
N, ALPHA	X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
	<u>Status</u>	Reactors, Hel	sinki, 1970, IAEA, Vi	enna, 1970, '	Vol. I, p.49;		
	Justificat	<u>ion:</u> Helium a	ccumulation calculati	ons.			
N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
	Justificat:	ion: For gas	production rates.				
	Quantity N, ALPHA N, ALPHA	N, ALPHA X-Sect. Status: Justificat: N, ALPHA X-Sect. Status: Justificat: N, ALPHA X-Sect.	QuantityVariablePriorityN, ALPHAX-Sect.2Status:Experimental 15% accuracy Justification:Radiatic transmisN, ALPHAX-Sect.1Status:Yu.F. Chernil Reactors, Hel V.N. Levkovsk Justification:Helium aN, ALPHAX-Sect.3	QuantityVariablePriorityIncident EnergyN, ALPHAX-Sect.24.5+6 - 1.5+7Status:Experimental data available between 15 % accuracy (GA-8133).Justification:Radiation damage estimates, can transmission rates and radioanN, ALPHAX-Sect.1N, ALPHAX-Sect.1Threshold-1.5+7Status:Yu.F. Chernilin, G.B. Yankov, Proc Reactors, Helsinki, 1970, IAEA, Vi V.N. Levkovsky et al., Ya. Fiz.Justification:Helium accumulation calculati	Quantity Variable Priority Incident Energy Accuracy N, ALPHA X-Sect. 2 4.5+6 - 1.5+7 20 % Status: Experimental data available between 7-20 MeV w 15 % accuracy (GA-8133). Justification: Radiation damage estimates, calculation of transmission rates and radioactive afterh N, ALPHA X-Sect. 1 Threshold-1.5+7 15 % Status: Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Reactors, Helsinki, 1970, IAEA, Vienna, 1970, V.N. Levkovsky et al., Ya. Fiz. 10, (1969) 44. Justification: Helium accumulation calculations. N, ALPHA X-Sect. 3 Threshold-1.5+7 20 %	Quantity Variable Priority Incident Energy Accuracy Country/Lab N, ALPHA X-Sect. 2 4.5+6 - 1.5+7 20 % GER KFK Status: Experimental data available between 7-20 MeV with 15 % accuracy (GA-8133). Justification: Radiation damage estimates, calculation of transmission rates and radioactive afterheat. N, ALPHA X-Sect. 1 Threshold-1.5+7 15 % USSR KUR Status: Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p.49; V.N. Levkovsky et al., Ya. Fiz. 10, (1969) 44. Justification: Helium accumulation calculations. N, ALPHA X-Sect. 3 Threshold-1.5+7 20 % UK HAR	Quantity Variable Priority Incident Energy Accuracy Country/Lab Requestor N, ALPHA X-Sect. 2 4.5+6 - 1.5+7 20 % GER KFK H. Küsters D. Darvas Status: Experimental data available between 7-20 MeV with 15 % accuracy (GA-8133). Justification: Radiation damage estimates, calculation of transmission rates and radioactive afterheat. I.N. Golovin N, ALPHA X-Sect. 1 Threshold-1.5+7 15 % USSR KUR I.N. Golovin Status: Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p.49; V.N. Levkovsky et al., Ya. Fiz. 10, (1969) 44. Justification: Helium accumulation calculations. N, ALPHA X-Sect. 3 Threshold-1.5+7 20 % UK HAR S. Blow

	React	ion Type						
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Үөг
94 _{Nb}	N, GAMMA	X-Sect.	3	Thermal-1.0+5	10 %	UK HAR	S. Blow	72
		Justificati	on: For indu 95Nb and	aced activity calcula A 95mnb.	ations. Rates	of creation of		

Targe t	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Yea
No	Elastic	σ (θ _n)	1	3.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin	
		<u>Status:</u>	B. Holmqvist	ed Ed., Vol. II, 1970 , T. Wiedling, Proc. Isinki, 1970, IAEA, V	Int. Conf. Nuc			
		Justificat	<u>ion:</u> Neutron	transmission calcula	tions.			
10	Elastic	G(9 n)	2	1.0+6 - 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72
		<u>Comments</u>		s at steps of (0.1-0. of ANL data at selec				
		Status:		from 6-14 MeV, Presence BNL-400, 3rd ed.	nt accuracy e	stimated		
*.**		Justificat	ion: Radiatio	on damage estimates.				
Mo	Inelastic	X-Sect.	3	3.0+6 - 1.4+7	10 %	FR FAR	D. Breton	73
		Justificat	ion: Potentia	l constituent of con	tainment vesse	el.		

Target	React: Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Мо	Inelastic	X-Sect. and T (Ey)	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		<u>Justificatic</u>	n: For blan	ket heating calculati	.ons.			
Mo	Inelastic	Ω (E ^{β})		Threshold-1.4+7	15 %	USA AEC	Gough	71
		<u>Status</u> : N	lone					71
		Justificatio		re gamma ray spectra on in blanket and shi		heat		71
 Mo	Inelastic	G (E _n)		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: No	ne					71
		Justificatio	n: Needed t	o calculate neutron t	ransport in	blanket and shiel	d, CTR	71
Мо	Inelastic	T (E _n ')	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	_
			•	d Ed., Vol. II, 1970; nd Ed., Suppl. 2, Vol				
	·	Justificatio	n: Neutron	calculations for blar	ket and shie	lding.		

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Мо	N, GAMMA	X-Sect.	1	1.0+7 - 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL	-325, Seco	nd Ed., Suppl. 2, Vol	. IIB, 1966.			
	-	Justification:	Heavy is	otope accumulation ca	lculations.			
Mo	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		<u>Status:</u> None	e					71
		Justification:	Needed 🐟	c calculate formation	of higher m	ass isotopes, CTF	ł	71
		·····						
Мо	N, GAMMA	X-Sect. and C(Ex)	3	Thermal - 1.5+7	10 %	UK HAR	S. Blow	72
		Justification:	For neut	ron economy and heati	ng calculati	ons.		
Мо	N, GAMMA	P(E 5)		Thermal-Resonance	15 %	USA AEC	Gough	71
	•	Status: None	9					71
	•	Justification:	Needed to	o calculate heat gene	ration in bl	anket and shield,	, CTR	71

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Мо	Ň , XX	G (E g)	,	Thermal-1.4+7	15 <i>¶</i> .	USA AEC	Gough	71
		<u>Comments:</u>	Spectra from	total gamma productio	n			. 71
		Status:	None					71
		Justificati	<u>on</u> : CTR appl	ications				71
Мо	N, X T	. σ (ε γ)	1 21	Thermal-1.5+7	15 9%	USSR KUR	I.N. Golovin	
		Comments:	Gamma-ray spe	ctra required				
		Status:	No experiment	al data, known				
		Justificati	on: Gamma-ra	y heating calculation	s and shiel	ding calculations		
						a. E.	···	
Мо	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justificati	on: Potentia	l constituent of cont	ainment ves	sel.		
Мо	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		<u>Justificati</u>	on: For neut	ron economy calculati	ons.			

							• •		
	React	ion Type							
arget	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Yea	
io	N, 2N	X-Sect.	2	Threshold-1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72	
		Comments:	multiplicatio	outgoing neutrons to on by transmission is produced for ⁹² Mo and	required, sin				
		<u>Status:</u> Present evaluations rely on nuclear systematics and 14 MeV data for Mo, Mo ⁹² and Mo ¹⁰⁰ , present accuracy 20-30 %.							
		Justificati	ion: Calculat	tion of neutron multi	plication; ra	diation damage e	stimates.		
0	N, 2N	Justificati	ion: Calculat	tion of neutron multi	plication; ra 10 %	diation damage e USA AEC	stimates. Gough		
0	n, 2n	X-Sect.				-		71 71	
o	N, 2N	X-Sect.	No data to re .on: Accuracy	1.4+7	10 % certainty in 1	USA AEC		-	
fo Io	N, 2N N, 2N	X-Sect.	No data to re <u>.on:</u> Accuracy multipli	l.4+7 equired accuracy y needed to reduce un	10 % certainty in 1	USA AEC		71	
		X-Sect. <u>Status:</u> <u>Justificati</u> X-Sect. and $\mathbf{T}(\mathbf{E}_{n})$	No data to re <u>on:</u> Accuracy multipli 1 1 Cross section	1.4+7 equired accuracy y needed to reduce un ication estimates for	10 % certainty in r CTR 15 % e energy range	USA AEC neutron USSR KUR	Gough	71	
		X-Sect. <u>Status:</u> <u>Justificati</u> X-Sect. and $\mathbf{T}(\mathbf{E}_n)$ <u>Comments:</u>	No data to re <u>on:</u> Accuracy multipli 1 1 Cross section secondary neu	1.4+7 equired accuracy y needed to reduce un ication estimates for Threshold-1.5+7 n required over entire	10 % certainty in r CTR 15 % e energy range	USA AEC neutron USSR KUR	Gough	71	

	React	ion Type						
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Мо	N, 2N	σ(0 _n , E _n)		1.4+7	15 %	USA AEC	Gough	71
		Comments:	mergy and an	gular dependence of a	secondary neut	rons are needed.		71
	· ·	Status:	None .					71
		Justificatio	on: To calcu	late neutron transpo	rt in blanket	and shield, CTR		71
		: 						
Мо	N, PROTON	X-Sact.		1•4+7	20 %	USA AEC	Gough	71
		Status:	None					71
		Justificati	on: Needed f	or radiation damage (estimates			71
Mo	n, proton	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
1 1	•	Justificatio	on: Potentia	l constituent of con	tainment vesse	21.		
Mo	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificatio	on: For gas	production rates.			1. 	-

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	React:	ion Type						
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, PROTON	X-Sect.	2	1.5+6 — 1.5+7	20 %	GER KFK	S. Cierjacks D. Darvas	72
		Status:		oints for Mo ^{92,94,96} rum averages only. E O %.				
		<u>Justifica</u>		n damage estimates, o mutation rates and ra t.				
Mo	N ₉ PROTON	X-Sect.	1 BNI-325 Seco	Threahold-1.5+7 nd Ed., Suppl. 2, Vol	15 %	USSR KUR	I.N. Golovin	
- - - -				accumulation calcula	·			
Mo	N, ALPHA	X-Sect.	1	Threshold-1.5+7	15 <i>¶</i>	USSR KUR	I.N. Golovin	
		Status:	-	al data of required a ccumulation calculati	-			

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Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Мо	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status:	None					71
· 		<u>Justificati</u>	i <u>on:</u> Needed f	or radiation damage o	estimates, CT	R		71
Mo	N, ALPHA	X-Sect.	2.	5.0+6 — 1.5+7	20 %	GER KFK	S. Cierjacks D. Darvas	72
•			average for M on: Radiatio of tran	for Mo ^{92,98,100} and f No. Accuracy estimated on damage estimates; o asmutation rates and	l is 30-50 %. Calculation	um		
			afterhea		••••••••••••••••••••••••••••••••••••••			
Mo	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justificati	on: For gas	production rates.				
Mo	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justificati	on: Potentia	l constituent of cont	aimmant raga	.1		

Target	Reacti Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
W	Inelastic	X-Sect.	3	3.0+6 - 1.4+7	10 %	FR FAR	D. Breton	73
		Justification	<u>s</u> Potential	constituent of conta	inment vess	el.		
W	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification	<u>:</u> Potential	constituent of conta	inment vess	el.		
W	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification	: Potential	constituent of conta	inment vess	əl.		
W	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		<u>Justification</u>	<u>:</u> Potential	constituent of conta	inment vesse	91.		

Target	React Quantity	ion Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year		
°⊨ Pb	N , X ð	Q (E ^{X)}	2	Thermal-1.5+7	15 %	USSR = KUR	I.N. Golovin			
		Comments:	Gamma-ray spe	ctra required						
		Status: No experimental data known								
		<u>Justificati</u>	<u>on:</u> Camma-ra	y heating and shield	ing calculati	ons				
Pb	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %		I.N. Golovin			
				Ed., Suppl. 2, Vol. F. Pain, AWRE-047/69						
	91) - 11	Justificati	on: Possible	use as neutron mult:	iplier.					
209 _{Bi}	n, x T	д (Е ^{\$})	2	Thermal-1.5+7	15 9.	USSR KUR	I.N. Golovin			
		Comments:	Gamma-ray spe	ctra required.						
		Status:	No experiment	al data known						
		Justificati	<u>on:</u> Camma-ra	y heating calculation	ns and shield:	ing calculations				

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Target	React Quantity	tion Type Variable	Priority	Incident Energy	Accuracy	Countr	y/Lab	Requestor	Year
209 Bi	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR	KUR	I.N. Golovin	
		Status:	BNL-325, Sec	ond Ed., Suppl. 2, Vo	1. IIC, 1966.				
		<u>Justifica</u>	tion: Possible	e use as neutron mult	iplier.				
232 _{Th}	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR	KUR	I.N. Golovin	
		<u>Status:</u> Justifica		ond Ed., Suppl. 2 Vol e use as neutron mult	•				
232 _{Th}	N, 3N	X-Sect.	2	Threshold-1.5+7	15 9/	USSR	KUR	I.N. Golovin	
		Status:	BNL-325, Seco	ond Ed., Suppl. 2, Vo	1. III, 1966				
		Justifica	tion: Neutron	multiplication					
238. U	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR	KUR	I.N. Golovin	
		<u>Status:</u>		ond Ed., Suppl. 2, Vo L.F. Pain, AWRE-047/					
		Justificat	tion: Possible	e use as neutron mult:	iplier.				

	Reaction Type							
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
238 ₀	N, 3N	X-Sect.	2	Threshold-1.5+7	15 <i>%</i>	USSR KUR	I.N. Golovin	
		Status:		nd Ed., Suppl. 2, Vo L.F. Pain, AWRE-047/				
		Justificat	tions Neutron	multiplication.				

5. REQUEST LIST FOR CHARGED-PARTICLE NUCLEAR DATA FOR CONTROLLED THERMONUCLEAR RESEARCH

by J. Rand MCNALLY, Jr. Oak Ridge National Laboratory Oak Ridge, Tennessee, USA

[Editor's Note: The Charged-Particle Data Request List was prepared by J.R. McNally, Jr., in response to inquiries by the Agency about the. relative priorities of charged-particle nuclear data in controlled fusion research. It is used with permission of the author and the USAEC.

The Agency-developed Priority Criteria of Section 3 have been used as the basis of the priority assignments. Accuracies of better than about 25 % in the absolute cross sections are required.]

PRIORITY	REACTION	ENERGY RANGE
l	6 Li(d, α) α + 22.4 MeV	100 keV - 5 MeV
1	6Li(d,p) ⁷ Li + 5.0 MeV	100 keV - 5 MeV
l	6 Li(d,p)t + α + 2.6 MeV	100 keV - 5 MeV
l	$6_{Li(d,n)}^{7}Be + 3.4 MeV$	100 keV - 5 MeV
l	6 Li(d,n) ³ He + α + 1.8 MeV	100 keV - 5 MeV
l	6 Li(d,d') 6 Li* \rightarrow d + α - 1.5 MeV	3 MeV - 6 MeV
l	6 Li(α, α') 6 Li* \rightarrow d + α - 1.5 MeV	3 MeV - 12 MeV
l	6 Li(p,p') 6 Li* \rightarrow d + α - 1.5 MeV	3 MeV - 15 MeV
l	6 Li(p, 3 He) α + 4.0 MeV	100 keV - 15 MeV
l	$9_{\mathrm{Be}(\mathrm{p},\alpha)}^{6}$ Li + 2.1 MeV	10 keV - 15 MeV
1	$9_{Be(p,d)2\alpha + 0.7 MeV}$	10 keV - 15 MeV
1	11 B(p, sk)2sk + 8.7 MeV	10 keV - 5 MeV
. 3	⁶ Li(⁶ Li,x)v (8 reactions)	100 keV - 5 MeV
3	${}^{6}_{\text{Li(t,p)}}{}^{8}_{\text{Li}} \stackrel{0.95}{\rightarrow} \beta^{-} + 2\alpha + 14 \text{ MeV}$	10 keV - 2 MeV
3	⁶ Li(t,n)2α + 16.1 MeV	10 keV - 2 MeV
3	$6_{Li(t,d)}$ ⁷ Li + 1.0 MeV	10 keV - 2 MeV
3	${}^{6}_{\text{Li}}({}^{3}_{\text{He},n}){}^{8}_{\text{B}} {}^{0.6\text{S}}_{\text{+}} e^{+} + 2\alpha + 12 \text{ MeV}$	2 MeV - 8 MeV
3	6 Li(3 He,d) 7 Be + 0.1 MeV	100 keV - 8 MeV
3	⁶ Li(³ He,p)2α + 16.9 MeV	100 keV - 8 MeV
3	$6_{\text{Li}(\alpha,p)}9_{\text{Be}}$ - 2.1 MeV	3 MeV - 12 MeV
3	$t(t,n)n + \alpha + 11.3 MeV$	lo keV - lo MeV
3	$t(p,n)^{3}$ He - 0.8 MeV	1.5 MeV - 15 MeV
3	d(x,x')p + n - 2.2 MeV	$\begin{cases} x = p, \alpha \\ 3 \text{ MeV} - 15 \text{ MeV} \end{cases}$
3	3 He(t,d) α + 14.3 MeV	100 keV - 10 MeV
4	All other light particle reactions	100 keV - 15 MeV
	$(p,d,t,^{3}He,\alpha)$ with elements throug	h ¹⁸ 0 for

CTR with special search for resonances

6. REFERENCES

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C-060 86.06.04

