International Atomic Energy Agency

INDC(NDS)-57/U+F

INDC 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

by

J.R. Lemley
Nuclear Data Section

December 1973

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

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C O N T E N T S

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 for 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 Agency-developed 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.

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*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 $^{6}Li\ (n,\alpha)\ T$ and $^{7}Li\ (n,\ n'\alpha)\ T$. 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 Li_2BeF_4, are being considered as alternative coolant materials to metallic lithium. All contributing countries have included requests for data for various non-elastic 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,α) 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) Existing data 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 McNally[1].

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

1.) 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 shown[3] 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 + D-reaction 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) Target. 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) Reaction Type - Quantity. 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) Reaction Type - Variable. In this column are listed variables which are associated with the interaction listed under Quantity and for which data are required. Symbols used under the heading Variable are defined below:

X-Sect.	Total cross section for the interaction given under Quantity.
Part. X-Sect.	Partial cross section, e.g. for excitation of a particular level. Sufficient defining information should be given following the heading "Comments".
$P(E\gamma)$	Probability for production of gamma-rays as function of gamma energy. (This symbol has been used only with requests for capture gamma spectra).
$\sigma(\theta n)$	Angular distribution of elastically scattered neutrons; differential cross section.
$\sigma(\theta n')$	Angular distribution of non-elastic secondary neutrons; angular differential cross section.
$\sigma(E_{n'})$	Energy spectrum of secondary neutrons; energy differential cross section
$\sigma(E\gamma)$	Gamma-ray energy spectrum; energy differential cross section for production of gamma-rays from the reaction given under "Quantity"
$\sigma(\theta_{n'}, E_{n'})$	Angular distribution and energy spectrum of secondary neutrons; double-differential cross section.

$\sigma(\theta\gamma, E\gamma)$	Angular distribution and energy spectrum of gamma-rays; double-differential cross section for production of gamma-rays from the reaction given under "Quantity".

4) Priority: 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) Incident Energy (eV). For the incident particle defined under Quantity 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
Threshold	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) Country/Lab. and Requestor. 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) Year. 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 Comments, Status and Justification sublines which follow each request.

9) Comments: The Comments 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) Status: The Status 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) Justification: The Justification 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	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	Elastic	$\sigma(\theta n)$		1.4+7	15 %	USA AEC	Gough	71

Status: No data to required accuracy. 71

Justification: Need for shield, magnet cost estimates CTR 71

Target	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	Elastic	$\sigma(\theta n)$	2	4.0+6 – 1.5+7	10 %	USSR KUR	I.N. Golovin	

Comments: Refinement of data below 7 MeV and additional data above 7 MeV required;

Status: BNL-400, Third Ed., Vol. I, 1970; Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p.49.

Justification: Calculation of neutron transmission.

Target	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	Elastic	$\sigma(\theta n)$	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 Ed. lists 10 distributions between 2 and 14 MeV and none between 7.5 – 14 MeV.

Justification: Calculation of neutron transport.

	Reaction Type							
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	Elastic	$\sigma(\theta_n)$	2	1.0+3 – 1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For shielding calculations.						
^{6}Li	Elastic	$\sigma(\theta_n)$	1	1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Evaluation of neutron balance.						
^{6}Li	N,Triton	X-Sect.		3.0+6 – 1.4+7	10 %	USA AEC	Gough	71
		Status: No data to required accuracy.						71
		Justification: Needed to determine breeding ratio, CTR.						71
^{6}Li	N,Triton	X-Sect.	1	1.0+5 3.0+6	3 %	USSR KUR	I.N. Golovin	
		Status: C.A. Uttley et al., Proc. Third Conf. Neutron Cross Sections and Technology, Knoxville, 1971, Vol. II, p.551.						
		Justification: Tritium breeding and energy deposition						
^{6}Li	N,Triton	X-Sect.	1	3.0+5 1.5+7	5 %	GER KFK	H. Küsters D. Darvas	72

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year

Comments: Total T-production required, E-resolution should reproduce true shape.

Status: Sowerby et al. gave a review at Knoxville Conf. Present accuracy judged to be 10 % at 0.5 MeV, 15-20 % at 10 MeV.

Justification: Determination of more accurate T-breeding ratios.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	N,Triton	X-Sect.	2	Thermal-1.5+7	1-5 %	UK HAR	S. Blow	72

Comments: Recent evaluation may be good enough.

Status: C.A. Uttley, AERE-RR/NP 19 (72).

Justification: To evaluate neutron economy and tritium breeding.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	N,Triton	X-Sect.	1	3.0+6 – 1.4+7	5 %	FR FAR	D. Breton	73

Justification: Evaluation of neutron balance

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	N,N'D	X-Sect.		Threshold-1.4+7	10 %	USA AEC	Gough	72

Status: No data to required accuracy. 71

Justification: Needed for CTR applications. 71

Target	Reaction Type Quantity	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	

<u>Status:</u> Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p.49.

<u>Justification:</u> Neutron calculations and energy deposition in blanket materials;

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	N,N'D	X-Sect.	2	Threshold - 1.5+7	10 %	GER KFK	H. Küsters D. Darvas	72

<u>Comments:</u> E-resolution of 0.2 - 0.5 MeV would be sufficient.

<u>Status:</u> BNL 325, 2nd Ed. and Hopkins et al. in NP A 107 indicate present error to be around 15 - 20 %. No data thr. - 4 MeV.

<u>Justification:</u> Shielding estimates, Calculation of heat generation.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	N,N'D+N'γ	$\sigma(En')$ $\sigma(\theta n')$	2	Threshold - 1.5+7	20 %	GER KFK	H. Küsters D. Darvas	72

<u>Comments:</u> Neutron spectra up to maximum energies are required. Ang. distributions of neutrons at a few selected energies would be helpful.

<u>Status:</u> BNL 400, 3rd Ed. gives very few distributions only.

<u>Justification:</u> Calculation of neutron transport. Shielding estimates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	Non-elastic	X-Sect. σ(En')	2	2.0+6 - 1.5+7	20 %	UK HAR	S. Blow	72

<u>Comments:</u> To evaluate effect of neutron capture competition between ^{6}Li and structural materials in the calculation of tritium breeding.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	N,Xγ	X-Sect. $\sigma(E_\gamma)$	2	9.0+6 - 1.5+7	15 %	USSR KUR	I.N. Golovin	

<u>Comments:</u> Cross sections for gamma-ray production (15 % accuracy) and gamma-ray spectra are required.

<u>Status:</u> No experimental data known.

<u>Justification:</u> Gamma-ray heating and shielding calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{6}Li	^{6}Li+^{6}Li $\rightarrow$	^{7}Be+^{4}He+n		+3 — +6	—	USA AEC	Gough	71

<u>Comments:</u> Energy range keV to a few MeV

<u>Status:</u> None

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	Elastic	$\sigma(\theta_n)$		1.4+7	15 %	USA AEC	Gough	71

<u>Status:</u> None 71

<u>Justification:</u> Need for shield, magnet cost estimates, CTR. 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	Elastic	$\sigma(\theta_n)$	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.

Justification: Tritium breeding and energy deposition.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	Elastic	$\sigma(\theta_n)$	1	1.0+6 – 1.5+7	10%	GER KFK	H. Küsters D. Darvas	72

Comments: Additional distributions from 2 - 14 MeV (steps of 0.5 - 1 MeV) and improved accuracy required.

Status: BNL 400, 3rd Ed. contains 10 distributions between 2 and 14 MeV. Below 2 MeV most distributions are due to Lane, Langsdorf, Elwyn.

Justification: Calculation of neutron transport.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	Elastic	$\sigma(\theta_n)$	2	1.0+3 – 1.5+7	15 %	UK HAR	S. Blow	72

Justification: For shielding calculation

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	Elastic	$\sigma(\theta_n)$	1	1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Evaluation of the neutron balance.						
^{7}Li	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Energy spectra needed to evaluate effect of competition between neutron absorption by resonance absorbers and by ^{6}Li in calculation of tritium breeding ratio. Also needed to evaluate neutron transport in blanket and shield.						71
^{7}Li	Inelastic	Partial X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Inelastic cross section for 0.478 - MeV level required.						
		Status: Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970; IAEA, Vienna, 1970, Vol. I, P. 49.						
		Justification: Neutron calculations and energy deposition in coolant and blanket materials.						

Target	Reaction Type 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

<u>Comments:</u> Cross sections for the inelastic scattering to the 0.478-MeV level 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.

<u>Justification:</u> Shielding estimates, calculation of heat generation.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	N,N'T	X-Sect.		3.0+6 - 1.4+7	<10 %	USA AEC	Gough	71

<u>Comments:</u> Present accuracy leads to uncertainty of 0.1 in breeding ratio for CTR, Need <10 % at 14 MeV. 71

<u>Status:</u> Present accuracy is 25 % at 8 MeV, 15 % at 14 MeV.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	N,N'T	X-Sect.	1	Threshold-1.5+7	5 %	USSR KUR	I.N. Golovin	

<u>Status:</u> Yu.F. Chernilin, G.B. Yankov, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p. 49. V.S. Crocker et al., ibid., p. 67

<u>Justification:</u> Tritium breeding and energy deposition.

Target	Reaction Type Quantity	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
		Comments: A resolution and steps of 0.2 - 0.5 MeV would suffice.						
		Status: Hopkins et al. review data in LA-3765. Present accuracy around 15 %.						
		Justification: Determination of more accurate T-breeding rates.						
^{7}Li	N,N'T	X-Sect.	1	3.0+6 – 1.4+7	5 %	FR FAR	D. Breton	73
		Justification: Evaluation of neutron balance						
^{7}Li	N,N'T	X-Sect., $\sigma(E_{n'})$	2	2.5+6 – 1.5+7	5 %	UK HAR	S. Blow	72
		Status: T.W. Conlon AERE-R 7166						
		Justification: To evaluate tritium breeding.						
^{7}Li	N,N'T	$\sigma(E_{n'})$		~ 1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Need for shield, magnet cost estimates, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	N,N'T	$\sigma(E_{n'})$	1	1.0+7 — 1.5+7	15 %	USSR KUR	I.N. Golovin	

Comments: Angular distributions of secondary neutrons are required;

Status: No experimental data known.

Justification: Neutron transmission calculations;

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	N,2N	X-Sect., $\sigma(\theta_{n'})$, $\sigma(E_{n'})$	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Colovin	

Comments: Cross section (15 % accuracy) required and at energy 14-15 MeV the angular and energy distribution of secondary neutrons;

Status: D.S. Mather, L.J. Pain, AWRE 047/69, 1969

Justification: Blanket neutron calculations;

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	N,2N	X-Sect.	2	Threshold-1.5+7	20 %	GER KFK	H. Küsters D. Darvas	72

Comments: Three or four experimental points

Status: Very discrepant data at 14 MeV; only one data point below.

Justification: Estimates of neutron multiplication.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	Non-elastic	X-Sect. $\sigma(E_{n'})$	2	5.0+2 — 1.5+7	20 %	UK HAR	S. Blow	72

<u>Justification:</u> To evaluate effect of neutron capture competition between ^{6}Li and structural materials.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{7}Li	N, Xγ	X-Sect. $\sigma(E_{\gamma})$	1	9.0+6 — 1.5+7	15 %	USSR KUR	I.N. Golovin	

<u>Comments:</u> Gamma-ray production cross-sections (15 % accuracy) and gamma spectra are required;

<u>Status:</u> No experimental data known.

<u>Justification:</u> Gamma-ray heating and shielding calculations;

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{9}Be	Elastic	$\sigma(\theta_n)$	2	2.0+6 — 1.5+7	10 %	USSR KUR	I.N. Golovin	

<u>Status:</u> BNL-400, Third Ed., Vol. 1, 1970

<u>Justification:</u> Neutron transmission calculations

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{9}Be	Elastic	$\sigma(\theta_n)$	2	1.0+6 – 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72

<u>Status:</u> Confirmation of the ANL data at a few selected energies are thought to be useful. BNL 400, 3rd Ed. lists no distributions between 7 and 14 MeV.

<u>Justification:</u> Calculation of neutron transport.

^{9}Be	Inelastic	X-Sect.	2	Threshold–1.5+7	15 %	USSR KUR	I.N. Golovin	

<u>Status:</u> BNL-325, 2nd Ed., Suppl. 2, Vol. 1 (1964).

<u>Justification:</u> Neutron calculations (blanket and shielding).

^{9}Be	Inelastic	$\sigma(\theta_{n'}, E_{n'})$, $\sigma(E_\gamma)$	2	8.0+6 – 1.5+7	10 %	GER KUR	S. Cierjacks D. Darvas	72

<u>Comments:</u> Spectra and angular distributions of secondary neutrons. and energy distribution of gammas required.

<u>Status:</u> No experimental data.

^{9}Be	N,2N	X-Sect.	2	Threshold–1.5+7	20 %	UK HAR	S. Blow	72

<u>Justification:</u> To evaluate neutron economy in breeding calculations.

Target	Reaction Type Quantity	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
		Justification: Improves the neutron balance						
^{9}Be	N,2N	X-Sect. $\sigma(\theta_{n'}, E_{n'})$ $\sigma(\theta_{\gamma}, E_{\gamma})$	2	Threshold-1.5+7	20 %	GER KFK	S. Cierjacks D. Darvas	72
		Comments: Cross section, spectrum and angular distributions of neutrons and gammas required. Status: Available data are incomplete. Justification: Radiation damage estimates.						
^{9}Be	N,2N	$\sigma(\theta_{n'})$, $\sigma(E_{n'})$	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Energy and angular distributions of neutrons required. Status: Experimental data are incomplete. Justification: Potential use for neutron multiplication and transmission calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{9}Be	N, ALPHA	X-Sect.	2	8.0+6 – 1.5+7	15 %	USSR KUR	I.N. Golovin	

<u>Status:</u> BNL-325, Second Ed., Suppl. 2, Vol. 1, (1964).

<u>Justification:</u> Helium accumulation calculations

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{9}Be	N, ALPHA	X-Sect.	2	8.0+6 – 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72

<u>Comments:</u> Total α-production required.

<u>Status:</u> Available data on total α-production insufficient.

<u>Justification:</u> Calculation of neutron transport.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{9}Be	N, Xγ	$\sigma(E_\gamma)$, X-Sect.	2	3.0+6 – 1.5+7	15 %	USSR KUR	I.N. Golovin	

<u>Comments:</u> Gamma-ray production cross-sections (accuracy 15 %) and gamma-ray spectra required;

<u>Status:</u> No experimental data known.

<u>Justification:</u> Gamma-ray heating and shielding calculations.

Target	Reaction Type Quantity	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
		Justification: Improves the neutron balance.						
^{10}B	N,3N	X-Sect.	2	1.0+7 — 1.4+7	15 %	FR FAR	D. Breton	73
		Justification: Improves the neutron balance.						
^{12}C	Elastic	$\sigma(\theta n)$	2	8.0+6 — 1.5+7	10 %	USSR KUR	I.N. Golovin	
		Comments: Neutron transmission calculations;						
		Status: BNL-400, Third Ed., Vol. 1, 1970.						
		Justification: Possible use as moderator.						
^{12}C	Inelastic	Partial X-Sect.		4.4+6 — 1.4+7	10 %	USA AEC	Gough	71
		Comments: Need 4.43-MeV γ-production.						72
		Status: LASL Drake, 6.5, 7.5, 14 MeV, NCSAC 31.						71
		GRT Orphan in progress, WASH 1124						68

Target	Quantity	Reaction Type 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 C5, 738 (1972)						
		Justification: Neutron absorption calculations						
^{12}C	N, N'3ALPHA	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: None						
^{12}C	N, N'3ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: Neutron economy and helium production.						
^{12}C	N, N'3ALPHA	$\sigma(E_{n'})$, X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Cross-section required to within 15 % and at 14 MeV the secondary neutron spectrum.						
		Status: Vasilyev, Zh. Eks. Teor. Fiz. 33 (1957) 1321.						
		Justification: Blanket neutron calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	Elastic	$\sigma(\theta n)$	2	2.0+6 - 1.5+7	10 %	USSR KUR	I.N. Golovin	

<u>Status:</u> BNL-400, Third Ed., Vol. 1, 1970.

<u>Justification:</u> Possible use of Li_2BeF_4 as coolant.

Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	Elastic	$\sigma(\theta n)$	2	1.0+6 - 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72

<u>Comments:</u> Distributions should be taken at steps of about (0.1-0.2) E_n.

<u>Status:</u> Available data have insufficient accuracy. ANL experiment underway will presumably improve situation below 1.5 MeV.

<u>Justification:</u> Calculation of neutron transport.

Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	Inelastic	X-Sect.		1.0+7 - 1.4+7	10 %	USA AEC	Gough	71

<u>Status:</u> None 71

<u>Justification:</u> Needed for CTR applications using LiF. 71

Target	Reaction Type Quantity	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

Justification: Neutron calculations for blanket and shielding.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	Inelastic	X-Sect.	1	1.0+6 - 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72

Comments: Inelastic excitation cross sections required.

Status: γ-line data up to 4 MeV can be found in BNL-325, 2nd Ed. + Broder et al., Helsinki Conf. p. 295. Present accuracy is ~15 - 20 %.

Justification: Calculation of heat generation, shielding estimates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	Inelastic	X-Sect.	1	1.0+7 — 1.5+7	20 %	UK HAR	S. Blow	72

Justification: Needed for applications using fused salt Li_2BeF_4

Target	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	Inelastic	$\sigma(\theta_{n'}, E_{n'})$, $\sigma(\theta_{\gamma}, E_{\gamma})$	1	1.0+6 — 1.5+7	20 %	GER KFK	S. Cierjacks, D. Darvas	72

Comments: Spectra and angular distribution of neutrons and γ-s required.

Status: No data of inelastic gammas available.

Justification: Calculation of heat generation, shielding estimates.

Target	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{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.

Target	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	N,ALPHA	X-Sect.	2	Threshold-1.5+7	10 %	GER KFK	S. Cierjacks, D. Darvas	72

Status: Present accuracy from BNL-325 and Csikai REA 7,4,83 estimated 15 - 20 %.

Justification: Calculation of neutron absorption and transmission rates.

Target	Reaction Type Quantity	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 experimental agreement.						71
		Justification: Needed for CTR applications using LiF.						71
^{19}F	Absorption	X-Sect.	2	Thermal-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: All neutron absorption processes should be included.						
		Status: Experimental data are contradictory.						
		Justification: 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 experimental agreement						
		Justification: Data needed for applications using Li_2BeF_4.						
^{19}F	Absorption	X-Sect.	2	Thermal-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Utilization in the coolant.						

Target	Reaction Type Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{19}F	N,X γ	$\sigma(E_{\gamma})$, X-Sect.	2	5.0+5 – 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Gamma-ray production cross-sections (accuracy 15 %) are required and gamma-ray spectra;						
		Status: BNL-325, Second Ed., Suppl. 2, Vol. I, 1964.						
		Justification: Gamma-ray heating and shielding calculations.						
^{27}Al	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No data to required accuracy						71
		Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR						71
^{27}Al	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		Comments: Energy and angular dependence of secondary neutrons needed.						71
		Justification: Calculation of neutron transport in blanket and shield.						
^{27}Al	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						
		Justification: Needed to calculate neutron transport in blanket and shield, CTR.						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{27}Al	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Comments: Gamma-ray spectra are required.						
		Justification: Calculation of heat generation in blanket and shield.						71
^{27}Al	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						
		Justification: Needed to calculate formation of higher mass isotopes						71
^{27}Al	N, GAMMA	$P(E_\gamma)$		Thermal Resonance	15 %	USA AEC	Gough	72
		Status: None						
		Justification: Capture needed to calculate heat generation in blanket and shield.						71
^{27}Al	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						
		Justification: Needed for radiation damage estimates.						

Target	Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{27}Al	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						
		Justification: Needed for radiation damage estimates						71
^{27}Al	Nonelastic	X-Sect., $\sigma(E_\gamma)$	3	Thermal-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: Needed for heating calculation in superconducting magnet regions.						
Ti	Inelastic	X-Sect.	3	3.0+6 —1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Ti	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Ti	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Ti	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	Elastic	$\sigma(\theta_n)$	1	2.0+6 – 1.5+7	10 %	USSR KUR	I.N. Golovin	

Status: J.H. Towle, NP, A117, (1968) 657; B. Holmqvist, T. Wiedling, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. II, p.327.

Justification: Potential use as structural material; determination of neutron transmission.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	Inelastic	X-Sect.	2	3.0+6 – 1.4+7	10 %	FR FAR	D. Breton	73

Justification: Potential constituent of containment vessel.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	Inelastic	$\sigma(E_{n'})$	1	2.0+6 – 1.5+7	15 %	USSR KUR	I.N. Golovin	

Status: J.H. Towle, NP, A117 (1968) 657; A.W. Barrows, et al., NP, A107 (1968) 153; B. Holmqvist, et al, NP, A146 (1970) 321.

Justification: Neutron calculations for blanket and shielding.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72

Justification: Needed to calculate neutron transport in blanket and shield, CTR. 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For blanket heating calculations.						
V	Inelastic	$\sigma(E\gamma)$		Threshold - 1.4+7	15 %	USA AEC	Gough	72
		Comments: Gamma ray spectra required						71
		Justification: To calculate heat generation in blanket and shield.						71
V	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No data to required accuracy.						
		Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR.						
V	N, 2N	X-Sect.	1	2.0+6 – 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Cross section required to within 15 %.						
		Status: V.J. Ashby et al., Phys. Rev. 3, 616 (1958); J.R. Williams et al., Trans. Am. Nucl. Soc. 9, 251 (1966)						
		Justification: Neutron blanket calculations						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	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
		__Justification:__ Potential constituent of containment vessel.						
V	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		__Comments:__ Energy and angular dependence of secondary neutron transport in blanket and shield, CTR.						71
V	N, 2N	$\sigma(\theta_{n'}, E_{n'})$	1	1.4+7		USSR KUR	I.N. Golovin	
		__Comments:__ Energy and angular distributions of secondary neutrons at 14 MeV						
		__Justification:__ Neutron blanket calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	N, GAMMA	X-Sect.	1	1.0+3 - 2.0+6 and 1.4+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966; G.G. Zaikin et al., AE, 23 (1967) 67; N.D. Dudey et al., JNE, 23 (1969) 443; R.G. Stieglitz et al., NP, A163 (1971) 592.						
		Justification: Neutron absorption, gamma-ray heating, production of heavy isotopes.						
V	N, GAMMA	X-Sect.	3	Thermal–1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy and heating calculations.						
V	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Justification: Needed to calculate formation of higher mass isotopes, CTR.						71
V	N, GAMMA	$\sigma(E_\gamma)$		Thermal Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR.						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	N, X γ	X-Sect. and $\sigma(E_\gamma)$	1	3.0+5-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Gamma-ray production cross section to 15 % and gamma-ray spectrum.						
		Status: No experimental data known.						
		Justification: Gamma-ray heating calculations.						
V	N, PROTON	X-Sect.	1	Threshold - 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325 Second Ed., Suppl. 2, Vol. IIA, 1966; D. Crumpton, Jour. no. Inorg. Nucl. Chem. 31 (1967) 3727; V.N. Levkovsky et al., Ya. Fiz. 10 (1969) 44.						
		Justification: Hydrogen accumulation calculations.						
V	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
V	N, PROTON	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
V	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						
		Justification: Needed for radiation damage estimates, CTR						71
V	N, ALPHA	X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966; D. Crumpton, Journ. Inorg. Nucl. Chem. 31 (1967) 3727; V.N. Levkovsky et al., Ya. Fiz. 10 (1969) 44.						
		Justification: Helium accumulation calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
V	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
V	N, ALPHA	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

	Reaction Type							
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cr	Inelastic	X-Sect.	3	3.0+6 — 1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Cr	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For blanket heating calculations.						
Cr	Inelastic	$\sigma(E_\gamma)$		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed are gamma ray spectra to calculate heat generation in blanket and shield, CTR						71
Cr	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						
		Justification: Needed to calculate neutron transport in blanket and shield, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cr	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate formation of higher mass isotopes, CTR						71
Cr	N, GAMMA	X-Sect. and $\sigma(E_\gamma)$	3	Thermal–1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy and heating calculations.						
Cr	N, GAMMA	$P(E_\gamma)$		Thermal—Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield						
Cr	N, 2N	X-Sect.	3	Threshold–1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Reaction Type Quantity	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
		Justification: For neutron economy calculations.						
Cr	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: None						71
		Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR						71
Cr	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Energy and angular dependence of secondary neutrons needed to calculate neutron transport in blanket and shield, CTR.						71
Cr	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Quantity	Reaction 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	
		Justification: For gas production rates.						
Cr	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						
		Justification: Needed for radiation damage estimates, CTR						
Cr	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Cr	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cr	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						
		Justification: Needed for radiation damage estimates, CTR.						71
Fe	Inelastic	X-Sect.	2	3.0+6 – 1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Fe	Inelastic	X-Sect.		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed to calculate neutron transport in blanket and shield, CTR.						71
Fe	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	–
		Justification: For blanket heating calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Fe	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR						71
Fe	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate formation of higher mass isotope, CTR.						71
Fe	N, GAMMA	X-Sect. and $\sigma(E_\gamma)$	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy and heating calculations.						
Fe	N, GAMMA	$P(E_\gamma)$		Thermal— Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR.						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Fe	N, 2N	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		<u>Justification:</u> Potential constituent of containment vessel.						
Fe	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		<u>Justification:</u> For neutron economy calculations.						
Fe	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		<u>Status:</u> None						71
		<u>Justification:</u> Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR.						71
Fe	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		<u>Status:</u> None						71
		<u>Justification:</u> Energy and angular dependence of secondary neutrons needed to calculate neutron transport in blanket and shield, CTR						71

Target	Reaction Type Quantity	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
		Justification: Potential constituent of containment vessel.						
Fe	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
Fe	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates.						71
Fe	N, ALPHA	X-Sect.	2	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Fe	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
Fe	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71
Ni	Inelastic	X-Sect.	3	3.0+6 – 1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Ni	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For blanket heating calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Ni	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed are gamma ray spectra to calculate heat generation in blanket and shield, CTR						71
Ni	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed to calculate neutron transport in blanket and shield, CTR						71
Ni	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate formation of higher mass isotopes, CTR.						71
Ni	N, GAMMA	X-Sect. and $\sigma(E_\gamma)$	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy and heating calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Ni	N, GAMMA	P(E$_\gamma$)		Thermal-Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR						71
Ni	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Ni	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No data to required accuracy						71
		Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR.						71
Ni	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Ni	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Energy and angular dependence of secondary neutrons needed to calculate neutron transport in blanket and shield, CTR						71
Ni	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Ni	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
Ni	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Ni	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Ni	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
Ni	N, ALPHA	X-Sect.		1.4+7	20 %.	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71
Cu	Elastic	$\sigma(\theta_n)$	2	8.0+6 – 1.5+7	10 %	USSR KUR	I.N. Golovin	
		Status: BNL-400, Third Ed., Vol. II, 1970; B. Holmqvist, T. Wiedling, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna 1970. Vol. II, p.327						
		Justification: Neutron transmission calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cu	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed are gamma ray spectra to calculate heat generation in blanket and shield, CTR						71
Cu	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed to calculate neutron transport in blanket and shield.						71
Cu	Inelastic	$\sigma(E_\gamma)$	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Gamma spectra						
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966; O.A. Salnikov et al., Ya. Fiz. 12 (1970) 1132.						
		Justification: Neutron calculations for blanket and shielding.						
Cu	Non-elastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: Needed for heating calculations in superconducting magnet region.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cu	$N,X\gamma$	$\sigma(E_\gamma)$ and X-Sect.	2	5.0+5 — 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Gamma-ray production cross-section required to 15 % and gamma-ray spectra.						
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966.						
		Justification: Gamma-ray heating and shielding calculations.						
Cu	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate formation of higher mass isotopes, CTR.						71
Cu	N, GAMMA	$P(E_\gamma)$		Thermal-Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cu	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No data to required accuracy.						71
		Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR.						71
Cu	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Energy and angular dependence of secondary neutrons needed to calculate neutron transport in blanket and shield, CTR.						71
Cu	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71
Cu	N. PROTON	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966						
		Justification: Hydrogen accumulation calculations.						

Target	Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Cu	N, ALPHA	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIA, 1966						
		Justification: Helium accumulation calculations.						
Cu	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71
Zr	Elastic	$\sigma(\theta_n)$	2	5.0+6 — 1.5+7	10 %	USSR KUR	I.N. Golovin	
		Status: BNL-400, Third Ed., Vol. II, 1970						
		Justification: Neutron transmission calculations.						
Zr	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For blanket heating calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed are gamma-ray spectra to calculate heat generation in blanket and shield, CTR.						71
Zr	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed to calculate neutron transport in blanket and shield, CTR						71
Zr	Inelastic	$\sigma(E_{n'})$	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Vol. IIA, 1966; BNL-400, Third Ed., Vol. II, 1970; O.A. Salnikov et al., Proc. Int. Conf. Nucl. Data for Reactors, Helsinki 1970, IAEA, Vienna 1970, Vol. II, p. 359						
		Justification: Neutron calculations for blanket and shielding.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, Xγ	$\sigma(E_\gamma)$ and X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Gamma-ray production cross-section required to within 15 %. and gamma-ray spectra.						
		Status: BNL-325, Second Ed., Vol. IIA, 1966.						
		Justification: Gamma-ray heating and shielding calculations.						
Zr	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate formation of higher mass isotopes, CTR.						71
Zr	N, GAMMA	$P(E_\gamma)$		Thermal-Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR.						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, GAMMA	X-Sect. and $\sigma(E_\gamma)$	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy and heating calculations.						
Zr	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy calculations.						
Zr	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: O.A. Salnikov et al., Proc. Int. Conf. Nucl. Data for Reactors, Helsinki 1970, IAEA, Vienna 1970, Vol. II, p. 359						
		Justification: Neutron multiplication calculations.						
Zr	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71
		Status: No data to required accuracy.						71
		Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR						71

	Reaction Type							
Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Energy and angular dependence of secondary neutrons needed to calculate neutron transport in blanket and shield, CTR.						71
Zr	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
Zr	N, PROTON	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Vol. IIA, 1966; V.N. Levkovsky, et al., Ya. Fiz. (1969) 44.						
		Justification: Hydrogen accumulation calculations.						
Zr	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71

Status: None 71

Justification: Needed for radiation damage estimates, CTR 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, ALPHA	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	

Status: BNL-325, Second Ed., Vol. IIA, 1966;
V.N. Levkovsky et al., Ya. Fiz. 10 (1969) 44.

Justification: Helium accumulation calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Zr	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72

Justification: For gas production rates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	Elastic	$\sigma(\theta_n)$	1	3.0+6 — 1.5+7	10 %	USSR KUR	I.N. Golovin	

Status: BNL-400, Third Ed., Vol. II, 1970; Yu.F. Chernilin, G.B. Yankov,
Proc. Int. Conf. Nucl. Data for Reactors, Helsinki 1970,
IAEA, Vienna, 1970, Vol. I, p.49;
B. Holmqvist, T. Wiedling, Ibid., Vol. II, p.341

Justification: Neutron transmission calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	Elastic	$\sigma(\theta_n)$	2	1.0+6 – 1.5+7	10 %	GER KFK	H. Küsters D. Darvas	72

Comments: Angular distributions at a few selected energies would be sufficient.

Status: No experimental data between 8–15 MeV.

Justification: Radiation damage estimates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	Inelastic	Partial X-Sect.	2	Threshold-1.5+7	10 %	GER KFK	H. Küsters D. Darvas	72

Comments: Formation of the 13.6-y isomer in ^{93}Nb.

Status: No experimental data available.

Justification: Calculation of heat generation and radioactive afterheat.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72

Justification: For blanket heating calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed are gamma ray spectra to calculate heat generation in blanket and shield, CTR						71
^{93}Nb	Inelastic	$\sigma(\theta_\gamma, E_\gamma)$ $\sigma(\theta_{n'}, E_{n'})$	2	1.0+6 – 1.5+7	20 %	GER KFK	H. Küsters D. Darvas	72
		Comments: Spectra and angular distributions of neutrons and γ's are required.						
		Status: NSE 40, 294 (1970) gives γ-yield						
		Justification: Radiation damage estimates.						
^{93}Nb	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed to calculate neutron transport in blanket and shield, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	Inelastic	$\sigma(E_n)$	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; E. Almen et al., bid., Vol. II, p.349; O.A. Salnikov et al., Ya. Fiz. (1970) 1132.

Justification: Neutron calculations for blanket and shielding.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, GAMMA	X-Sect.	1	1.0+7 — 1.5+7	15 %	USSR KUR	I.N. Golovin	

Status: BNL-325, Second Ed., Suppl. 2, Vol. IIB, 1966.

Justification: Heavy isotope accumulation calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71

Status: None 71

Justification: Needed to calculate formation of higher mass isotopes, CTR 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, GAMMA	X-Sect. and $\sigma(E_\gamma)$	3	Thermal-1.5+7	10 %	UK HAR	S. Blow	72

Justification: For neutron economy and heating calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, GAMMA	P(E_γ)		Thermal-Resonance	15 %	USA AEC	Gough	71

Status: None — 71

Justification: Needed to calculate heat generation in blanket and shield, CTR — 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N,Xγ	$\sigma(E_\gamma)$		Thermal-1.4+7	15 %	USA AEC	Gough	71

Comments: Total gamma production required.

Status: None

Justification: CTR applications.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, Xγ	X-Sect. and $\sigma(E_\gamma)$	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	

Comments: Gamma-ray production cross-section to within 15 % and gamma-ray spectra.

Status: No experimental data of the required accuracy are known.

Justification: Gamma-ray heating and shielding calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72

Justification: For neutron economy calculations.

Target	Reaction Type Quantity	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

Comments: A measurement counting the outcoming neutrons would be preferred to clarify the situation of hitherto unobserved decay modes.

Status: Present results obtained by counting 0.93 MeV gamma rays from ^{92}Zr following decay of 10.2 d ^{92}Nb. A 3.2 h ^{92}Nb isomer is also reported. Systematics and statistical theory indicate too low (n,2n) - perhaps due to unobserved decay (see Drake et al. in GA-8133)

Justification: Radiation damage estimates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71

Status: No data to required accuracy. 71

Justification: Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, 2N	$\sigma(\theta_{n'}, E_{n'})$		1.4+7	15 %	USA AEC	Gough	71

Status: None 71

Justification: Energy and angular dependence of secondary neutrons needed to calculate neutron transport in blanket and shield, CTR 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, 2N	$\sigma(\theta_{n'}, E_{n'})$	1	Threshold-1.5+7	10 %	USSR KUR	I.N. Golovin	

Comments: Secondary neutron measurements required;

Status: V.S. Crocker et al., Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. I, p.67; M. Häring et al., ZP 244 (1971) 352.

Justification: Neutron multiplication and radiation damage calculations.

Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, PROTON	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: Hydrogen accumulation calculations.

Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72

Justification: For gas production rates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	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)

Justification: Radiation damage estimates, calculation of transmutation rates and radioactive afterheat.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71

Status: None

Justification: Needed for radiation damage estimates, CTR

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71

Status: None 71

Justification: Needed for radiation damage estimates, CTR 71

Target	Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, ALPHA	X-Sect.	2	4.5+6 — 1.5+7	20 %	GER KFK	H. Küsters D. Darvas	72

Status: Experimental data available between 7-20 MeV with 15 % accuracy (GA-8133).

Justification: Radiation damage estimates, calculation of transmission rates and radioactive afterheat.

Target	Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	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.

Target	Quantity	Reaction Type Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{93}Nb	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72

Justification: For gas production rates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{94}Nb	N, GAMMA	X-Sect.	3	Thermal-1.0+5	10 %	UK HAR	S. Blow	72

Justification: For induced activity calculations. Rates of creation of ^{95}Nb and ^{95m}Nb.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	Elastic	$\sigma(\theta_n)$	1	3.0+6 — 1.5+7	10 %	USSR KUR	I.N. Golovin	

Status: BNL-400, Third Ed., Vol. II, 1970; B. Holmqvist, T. Wiedling, Proc. Int. Conf. Nucl. Data for Reactors, Helsinki, 1970, IAEA, Vienna, 1970, Vol. II, p.341

Justification: Neutron transmission calculations.

Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	Elastic	$\sigma(\theta_n)$	2	1.0+6 – 1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72

Comments: Distributions at steps of (0.1–0.2) E_n would suffice. Confirmation of ANL data at selected energies would be useful.

Status: Lacking data from 6–14 MeV. Present accuracy estimated 20 %. Reference BNL-400, 3rd ed.

Justification: Radiation damage estimates.

Target	Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	Inelastic	X-Sect.	3	3.0+6 — 1.4+7	10 %	FR FAR	D. Breton	73

Justification: Potential constituent of containment vessel.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	Inelastic	X-Sect. and $\sigma(E_\gamma)$	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For blanket heating calculations.						
Mo	Inelastic	$\sigma(E_\gamma)$		Threshold-1.4+7	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed are gamma ray spectra to calculate heat generation in blanket and shield, CTR						71
Mo	Inelastic	$\sigma(E_{n'})$		Threshold-1.4+7	15 %	USA AEC	Gough	72
		Status: None						71
		Justification: Needed to calculate neutron transport in blanket and shield, CTR						71
Mo	Inelastic	$\sigma(E_{n'})$	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-400, Third Ed., Vol. II, 1970; BNL-325, Second Ed., Suppl. 2, Vol. IIB, 1966.						
		Justification: Neutron calculations for blanket and shielding.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, GAMMA	X-Sect.	1	1.0+7 — 1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIB, 1966.						
		Justification: Heavy isotope accumulation calculations.						
Mo	N, GAMMA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate formation of higher mass isotopes, CTR						71
Mo	N, GAMMA	X-Sect. and $\sigma(E_\gamma)$	3	Thermal — 1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy and heating calculations.						
Mo	N, GAMMA	$P(E_\gamma)$		Thermal-Resonance	15 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed to calculate heat generation in blanket and shield, CTR						71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, Xγ	$\sigma(E_\gamma)$		Thermal-1.4+7	15 %	USA AEC	Gough	71
		Comments: Spectra from total gamma production						71
		Status: None						71
		Justification: CTR applications						71
Mo	N, Xγ	$\sigma(E_\gamma)$	1	Thermal-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Comments: Gamma-ray spectra required						
		Status: No experimental data, known						
		Justification: Gamma-ray heating calculations and shielding calculations						
Mo	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Mo	N, 2N	X-Sect.	3	Threshold-1.5+7	10 %	UK HAR	S. Blow	72
		Justification: For neutron economy calculations.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, 2N	X-Sect.	2	Threshold-1.5+7	10 %	GER KFK	S. Cierjacks D. Darvas	72

<u>Comments:</u> Counting of outgoing neutrons to determine neutron multiplication by transmission is required, since activity is produced for ^{92}Mo and ^{100}Mo only.

<u>Status:</u> Present evaluations rely on nuclear systematics and 14 MeV data for Mo, Mo^{92} and Mo^{100}, present accuracy 20-30 %.

<u>Justification:</u> Calculation of neutron multiplication; radiation damage estimates.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, 2N	X-Sect.		1.4+7	10 %	USA AEC	Gough	71

<u>Status:</u> No data to required accuracy 71

<u>Justification:</u> Accuracy needed to reduce uncertainty in neutron multiplication estimates for CTR 71

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, 2N	X-Sect. and $\sigma(E_{n'})$	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	

<u>Comments:</u> Cross section required over entire energy range; secondary neutron spectrum at 14 MeV.

<u>Status:</u> No experimental data known

<u>Justification:</u> Neutron multiplication calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, 2N	$\sigma(\theta_n', E_n')$		1.4+7	15 %	USA AEC	Gough	71
		Comments: Energy and angular dependence of secondary neutrons are needed.						71
		Status: None.						71
		Justification: To calculate neutron transport in blanket and shield, CTR						71
Mo	N, PROTON	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates						71
Mo	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
Mo	N, PROTON	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						

Target	Reaction Type 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: 14 MeV data points for $Mo^{92,94,96,97}$ and fission spectrum averages only. Estimated accuracy 30-50 %.

Justification: Radiation damage estimates, calculation of transmutation rates and radioactive afterheat.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, PROTON	X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	

Status: BNL-325, Second Ed., Suppl. 2, Vol. IIB, 1966.

Justification: Hydrogen accumulation calculations.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, ALPHA	X-Sect.	1	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	

Status: No experimental data of required accuracy.

Justification: Helium accumulation calculations

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Mo	N, ALPHA	X-Sect.		1.4+7	20 %	USA AEC	Gough	71
		Status: None						71
		Justification: Needed for radiation damage estimates, CTR						71
Mo	N, ALPHA	X-Sect.	2	5.0+6 — 1.5+7	20 %	GER KFK	S. Cierjacks D. Darvas	72
		Status: 14 MeV data for $Mo^{92,98,100}$ and fission spectrum average for Mo. Accuracy estimated is 30-50 %.						
		Justification: Radiation damage estimates; calculation of transmutation rates and radioactive afterheat.						
Mo	N, ALPHA	X-Sect.	3	Threshold-1.5+7	20 %	UK HAR	S. Blow	72
		Justification: For gas production rates.						
Mo	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Reaction Type Quantity	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: Potential constituent of containment vessel.						
W	N, 2N	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
W	N, PROTON	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						
W	N, ALPHA	X-Sect.	3	Threshold-1.4+7	10 %	FR FAR	D. Breton	73
		Justification: Potential constituent of containment vessel.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Pb	N, Xγ	$\sigma(E_\gamma)$	2	Thermal-1.5+7	15 %	USSR KUR	I.N. Golovin	

Comments: Gamma-ray spectra required

Status: No experimental data known

Justification: Gamma-ray heating and shielding calculations

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
Pb	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %		I.N. Golovin	

Status: BNL-325, Second Ed., Suppl. 2, Vol. IIC, 1966;
D.S. Mather, L.F. Pain, AWRE-047/69, 1969

Justification: Possible use as neutron multiplier.

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{209}Bi	N, Xγ	$\sigma(E_\gamma)$	2	Thermal-1.5+7	15 %	USSR KUR	I.N. Golovin	

Comments: Gamma-ray spectra required.

Status: No experimental data known

Justification: Gamma-ray heating calculations and shielding calculations

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{209}Bi	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. IIC, 1966.						
		Justification: Possible use as neutron multiplier.						
^{232}Th	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2 Vol. III, 1966						
		Justification: Possible use as neutron multiplier						
^{232}Th	N, 3N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. III, 1966						
		Justification: Neutron multiplication						
^{238}U	N, 2N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	
		Status: BNL-325, Second Ed., Suppl. 2, Vol. III, 1966; D.S. Mather, L.F. Pain, AWRE-047/69, 1969						
		Justification: Possible use as neutron multiplier.						

Target	Reaction Type Quantity	Variable	Priority	Incident Energy	Accuracy	Country/Lab	Requestor	Year
^{238}U	N, 3N	X-Sect.	2	Threshold-1.5+7	15 %	USSR KUR	I.N. Golovin	

Status: BNL-325, Second Ed., Suppl. 2, Vol. III, 1966;
D.S. Mather, L.F. Pain, AWRE-047/69, 1969.

Justification: Neutron multiplication.

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

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[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
1	$^{6}Li(d,\alpha)\alpha + 22.4$ MeV	100 keV - 5 MeV
1	$^{6}Li(d,p)^{7}Li + 5.0$ MeV	100 keV - 5 MeV
1	$^{6}Li(d,p)t + \alpha + 2.6$ MeV	100 keV - 5 MeV
1	$^{6}Li(d,n)^{7}Be + 3.4$ MeV	100 keV - 5 MeV
1	$^{6}Li(d,n)^{3}He + \alpha + 1.8$ MeV	100 keV - 5 MeV
1	$^{6}Li(d,d')^{6}Li^{*} \rightarrow d + \alpha - 1.5$ MeV	3 MeV - 6 MeV
1	$^{6}Li(\alpha,\alpha')^{6}Li^{*} \rightarrow d + \alpha - 1.5$ MeV	3 MeV - 12 MeV
1	$^{6}Li(p,p')^{6}Li^{*} \rightarrow d + \alpha - 1.5$ MeV	3 MeV - 15 MeV
1	$^{6}Li(p,^{3}He)\alpha + 4.0$ MeV	100 keV - 15 MeV
1	$^{9}Be(p,\alpha)^{6}Li + 2.1$ MeV	10 keV - 15 MeV
1	$^{9}Be(p,d)2\alpha + 0.7$ MeV	10 keV - 15 MeV
1	$^{11}B(p,\alpha)2\alpha + 8.7$ MeV	10 keV - 5 MeV
3	$^{6}Li(^{6}Li,x)y$ (8 reactions)	100 keV - 5 MeV
3	$^{6}Li(t,p)^{8}Li \xrightarrow{0.9s} \beta^{-} + 2\alpha + 14$ MeV	10 keV - 2 MeV
3	$^{6}Li(t,n)2\alpha + 16.1$ MeV	10 keV - 2 MeV
3	$^{6}Li(t,d)^{7}Li + 1.0$ MeV	10 keV - 2 MeV
3	$^{6}Li(^{3}He,n)^{8}B \xrightarrow{0.6S} e^{+} + 2\alpha + 12$ MeV	2 MeV - 8 MeV
3	$^{6}Li(^{3}He,d)^{7}Be + 0.1$ MeV	100 keV - 8 MeV
3	$^{6}Li(^{3}He,p)2\alpha + 16.9$ MeV	100 keV - 8 MeV
3	$^{6}Li(\alpha,p)^{9}Be - 2.1$ MeV	3 MeV - 12 MeV
3	$t(t,n)n + \alpha + 11.3$ MeV	10 keV - 10 MeV
3	$t(p,n)^{3}He - 0.8$ MeV	1.5 MeV - 15 MeV
3	$d(x,x')p + n - 2.2$ MeV	$x = p,\alpha$; 3 MeV - 15 MeV
3	$^{3}He(t,d)\alpha + 14.3$ MeV	100 keV - 10 MeV
4	All other light particle reactions $(p,d,t,^{3}He,\alpha)$ with elements through ^{18}O for CTR with special search for resonances	100 keV - 15 MeV

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