INDC '170

International Atomic Energy Agency

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INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

REQUESTS FOR TARGETS AND SAMPLES FOR NUCLEAR DATA MEASUREMENTS

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May 1972

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

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Summary

This report contains the official requests for targets and samples for nuclear data measurements received from laboratories in IAEA Member States, within the modest 1972 programme for this purpose in the Nuclear Data Section (NDS). For most samples requested the material is expensive, and most requestors have fund or currency problems. Proposals are given for alternative ways in which some requests can be fulfilled. It is also proposed that the programme, under certain conditions, should be continued in 1974.

I. Background

During the late sixties the IAEA received several requests for assistance with the acquisition of accelerator targets and samples. The International Nuclear Data Committee (INDC) recommended in 1969 that needs of this kind within IAEA Member States be explored in a survey which was made by the Nuclear Data Section (NDS) of the Agency and presented in 1970 to the Committee. Upon the subsequent recommendation of the committee some modest funds were made available for 1972 in order to try, as an experiment, to fulfill some of the needs which were found during the survey. On 14 May 1971 a circular letter (see Annex I) was sent out to a large number of institutes, inviting requests for samples. In this report we shall summarize the requests that have been received in response to that letter.

II. The Requests

The number of requested samples is much smaller than the number of samples in the 1970 survey. This is only to be expected because of the restrictive conditions recommended by the INDC for financial support by the Agency. Even more predominant than in the survey is the proportion of samples of expensive material, and an emphasis persists also on "unattainable" material, such as fissile isotopes.

Solange de Barros, Brazil requests ^{233}U and W for neutron resonance capture and spectroscopic studies with a 22 MeV Linac with up to 25 m flight paths (in Rio de Janeiro).

S. Dritsa, Greece requests Zr, ^{97}Mo, Hf and Nb samples for capture gamma measurements with 25 keV neutrons from an Iron filter at the Greek Research Reactor in Athens.

J. Csikai, Hungary requests ^{231}Pa, ^{233}U, ^{235}U, ^{237}Np and ^{239}Pu samples for fission product yields at 14 MeV with an Activatron 111 type TMC neutron generator in Debrecen.

Pakistan requests (a) a ^{240}Pu sample for fission studies; mass and energy distribution of fragments; (b) separated isotopes for capture gamma studies of ^{86}Sr, ^{170}Er, ^{172}Yb and ^{176}Yb at a swimming pool reactor at Rawalpindi.

S. Rapeanu, Romania requests thin foils of ^{235}U, ^{238}U, ^{239}Pu, ^{241}Pu, ^{241}Am, ^{243}Am for isomer fission studies and Na and NaK samples for thermal scattering law studies with a cyclotron in Bucarest.

T. Enginol, Turkey requests ^{184}W and ^{235}U samples for coherent scattering measurements with slow neutrons from the Triga reactor at the Çekmece centre in Istambul.

F. Cvelbar, Yugoslavia requests materials for capture gamma studies with 14 MeV neutrons from the Cockroft-Walton in Ljubljana.

For each individual request we have searched RENDA for matching entries; references here have been made to entries in EANDC 85 'U' (April 1970). *

For the purpose of determining which requests should be financially supported by the Agency, we propose here the following "order of consideration" of the requests:

1. S. Dritsa, Greece
2. Solange de Barros, Brazil
3. J. Csikai, Hungary
4. F. Cvelbar, Yugoslavia
5. Other requestors on equal level.

The first four entries in that list can - with some stretching of the criteria - be considered to include requests of categories A and B as defined in the pertinent INDC recommendation (Annex II): The fifth entry contains, in our view, requests of category C. Clearly it is impossible to exercise complete objectivity, and the proposed order is based on the comparison with entries in RENDA as well as on our impression of the feasibility, that is on the probability that the required accuracies will actually be accomplished.

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* For RENDA72 entries see Annex IV

A prerequisite for the success of the programme is that the expensive materials are made available to the Agency for this purpose. Only if all elements and isotopes were available would the "order of consideration" also be an "order of priority". If this is not the case, the order, in which the requests can be fulfilled, will be determined by the supply of material at hand. In the extreme case of no outside supply of material, only parts of the requests can be fulfilled, and we would then propose the following distribution:

Dritsa: Zr, Mo (natural) and Nb or Hf
Cvelbar: Y, Pr, Ho
Solange de Barros: (perhaps) W

III. Requests in detail (ordered by country, alphabetic)

BRAZIL

Requestor:	Solange de Barros
Institute:	Centro Braziliero de Pesquisas Fisicas, Rio de Janeiro.
Purpose:	Neutron resonance capture, as well as spectroscopic studies, such as decay schemes, etc. on ^{233}U and W.
Facility:	22 MeV Linac (electron); time-of-flight spectrometer, Ge-Li detectors. Flight paths ranging from 5 to 25 metres.
Sample specifications; general:	For resonance capture: About 100 grams of metallic material (or perhaps oxide) of high purity. For spectroscopic studies: Samples of 10 cm x 10 cm, total $\sim$ 500 mg.
Requested samples:	^{233}U, W
RENDA 70:	^{233}U: Corresponds to RENDA 70 ref. no 948; request by J.C. Vidal. Requested accuracy 20%, neutron energy 1 keV - 2 MeV, priority 2. W: Only requests for separated W isotopes, with priority 1.
Projected accuracy:	-
Costs and availability:	No cost estimates received from Geel. For ^{233}U there is in the USAEC research pool a sample with the specified material characteristics, batch number RS-74.
Category:	Partly A

GREECE

Requestor:	S. Dritsa (Some correspondance also with L. Lois)
Institute:	Nuclear Research Centre "Democritos", Athens
Purpose:	(n, γ) measurements, neutron energy 25 keV (and thermal).
Facility:	GRR (Greek Research Reactor; Open pool type reactor). Iron filter to extract 25 keV neutrons, FWHM 4.3 keV. The flux expected to exceed 4 x 10^5 n/sec. For gamma detection: Ge(Li) spectrometer.
Sample specifications; general:	Area ? cm^2. Thickness: "thick samples" due to small cross section at this energy.
Requested samples:	Zr, ^{97}Mo, Hf, Nb
RENDA70:	Zr: Corresponds to RENDA70 ref. no. 445; request by R. Erlich. Requested accuracy 15 %, neutron energy 3 keV - 10 MeV, priority 2.
	^{97}Mo: Corresponds to RENDA70 ref. no. 529; request by J.J. Schmidt. Requested accuracy 10%, energy range 10 keV - 2 MeV, priority 2. Cf also RENDA70 ref.no.528.
	Hf: Corresponds to RENDA70 ref. no. 791; request by R.T. Bayard. Requested accuracy 20%, energy range 0.2 - 50 keV, priority 2.
	Nb: Corresponds to RENDA70 ref. no. 498; request by H. Alter, R. Avery, R.T. Bayard. Requested accuracy 10%, energy range 1 - 100 keV, priority 2.
Projected accuracy:	-
Costs and availability:	Cost estimates not received from Geel. Zr and ^{97}Mo would be available from, for example, Harwell, and the cost would be of the order £ 25,/ each plus material (in the case of ^{97}Mo it is £ 0.40 per mg). Perhaps sample no. 159701 in USAEC research pool could be suitable for ^{97}Mo.
Suggested category:	A
Further comments:	Dr. Dritsa and Dr. Lois have indicated that they would probably also be in a position to make other similar 25 keV measurements. For example:
	^{93}Zr (RENDA 472; 10%, priority 2)
	Mo (RENDA 516; 20%, priority 1)
	^{95}Mo (RENDA 524 and 525; 10% priority 2)
	Also work with thermal neutrons would be possible, and RENDA ref.no. 721 (^{156}Eu) was mentioned as an example.
	Some expert help from Dr.Greenwood (Idaho) is being given to the group. The group seems willing to take on other measurements which might be suggested, and which would be feasible with their facility.

HUNGARY

Requestor: J.Csikai

Institute: Institute for Theoretical Physics, University of Debrecen.

Purpose: Systematic investigations of fission product yields as function of mass number of nuclei at 14 MeV neutron energy.

Facility: Activatron 111 type TMC neutron generator. Gamma spectra of fission products will be measured by a 30 cm^3 NEA Ge (Li) spectrometer in conjunction with a DIDAC-4000 Intertechnique analyser. Unfolding of gamma spectra by computer.

Sample specifications, general: Diameter 19 mm, on 10 - 15 micron Al foil, 20 mm diam. Homogeneity within 10% except edge effects. All as oxides.

Requested samples:

Number of samples	Isotope	Enrichment	Thickness mg/cm^2	Est.cost for fabrication, US$	
5	^{231}Pa		0.100	100	
2	^{233}U	95%	5	450	comment see below
4	^{235}U	≥95%	10	900	
2	^{237}Np		10	450	
2	^{239}Pu	(other Pu isotopes < 3%	1	270	
2	^{239}Pu	"	2	270	

RENDA70: No entries in RENDA70 would directly support these measurements, with the possible exceptions of ref.nos. 1018 and 1191 (G.R. Keepin, requesting 15% accuracy, priority 2) for ^{235}U and ^{239}Pu. Also the yields of certain products have been requested, e.g. 1014-1017 and 1187 - 1190, (by R.T. Bayard and others, requesting accuracies of 1-3%, priority 2) with better accuracies.

Projected accuracy: Efforts will be made to achieve an accuracy of 10% or better for the chain yields.

Costs and availability: The fabrication costs as estimated by Geel are given for each set of samples above. For ^{235}U and ^{237}Np Geel finds it rather difficult to make samples of the given thickness with the required homogeneity. They therefore suggest to use thinner samples (maximum 5 mg/cm^2) unless the homogeneity requirement can be relaxed. These isotopes available only as loans. For ^{233}U the batch no PAD-SIC in the USAEC research pool would meet the requirements. For ^{235}U and ^{239}Pu there are several batches in the pool with the required characteristics.

Suggested category: B

Further comment: The samples will be needed, not all at once but over a period of three years.

PAKISTAN

Requestor: S.K.A. Jafri, PAEC, Karachi

Institute: Pinstech, Rawalpindi

Purpose: (a) Fission studies (^{240}Pu). Particularly a two-parameter measurement of mass- and energy distribution of fragments.

(b) Capture gamma measurements, particularly level energies and spins, etc.

Facility: Swimming Pool Reactor (5 MW), used also for production of radio-isotopes.

Sample specifications; general: (a) 100 g/cm^2 on Ni backing of 80 - 120 $\mu g/cm^2$; 2 cm diameter.

(b) No requirements on samples given.

Requested samples: (a) ^{240}Pu, see above
(b) The following separated isotopes:

Isotope	Enrichment	Form	Weight	Material cost US $
^{170}Er	90-97	Oxide	2	1000
^{86}Sr	90-98	$SrCO_3$	4	2000
^{172}Yb	85-98	Oxide	3	1350
^{176}Yb	85-99	Oxide	2	800

RENDA70: No corresponding entries.

Projected accuracy: -

Costs and availability: (a) Preparation costs $ 135. Material available only as loans.

(b) Materials, see above. Fabrication costs including handling charges roughly estimated to about $ 375 per sample.

Suggested category: C

ROMANIA

Requestor: S. Rapeanu

Institute: Cyclotron Department, Institute for Atomic Physics, Bucarest.

Purpose: (a) Study of double-humped potential barrier parameters; Isomeric fission through intermediate states by (n,2nf) and (n, γf) reactions . Neutron energies 0.3 - 15 MeV.

(b) Study of the thermal neutron scattering law for Na and NaK at various temperatures.

Facility: Cyclotron, 12.5 MeV (for deuterons; source D(d,n)) or 6.25 MeV (for protons; source ^{7}Li(p,n)). Detection of fission fragments with nitrogen-filled spark counter (time resolution about 3 x 10^{-8} sec) and gas scintillator (time resolution about 5 x 10^{-9} sec).

Sample specifications; general:

(a) All 10 mm diameter. Backing of 1 mg/cm^2 on Al ring.

(b) Purity (Na): 99.9%, thickness 8-10 mm; area 3cm x 6cm; stainless steel or Inconel canning to allow up to 700°C.

Requested samples:

(a)

Isotope	purity %	thickness µg/cm^2	uniformity %	backing
^{235}U	99	200	2	Ni
^{238}U	99	200	10	Ni
^{239}Pu	99	200	2	Ni
^{241}Pu	95	1000	10	Ni
^{241}Am;	95	50	10	Al
^{243}Am;	95	50	10	Al

(b) Na and NaK

RENDA70 No entries

Projected accuracy: (a) About 5%

(b) Resolution 3%, 2% at the quasi-elastic peak

Costs and availability: (a) US $ 135 per sample for fabrication, plus another $ 200 for Americium separation in the case of ^{241}Pu. Material as loans only, except perhaps the Au isotopes which can be bought for about U.S.$ 100 each.

(b) Fabrication US $ 800 each . Material US $ 25 for Na and US $ 110 for NaK.

Suggested category: C

TURKEY

Requestor:	T. Enginol
Institute:	Çekmece Nuclear Research and Training Centre, Istambul.
Purpose:	Measurements of coherent scattering of slow neutrons in ^{184}W and ^{235}U of various enrichments.
Facility:	TR-I (Triga type). Two axes M.A.N. neutron spectrometer (diffractometer).
Sample specifications, general:	Pressed metallic powder rods or powder crystals, 75 g, 270 - 325 mesh. Length 5/4", diameter $\frac{1}{2}$".
Requested samples:	^{184}W, 85% enriched ^{235}U, natural ^{235}U, enrichments 10, 40 and 80%.
RENDA70	No entries.
Projected accuracy:	-
Costs and availability:	For fabrication about US $ 340 each sample plus $ 160 for canning (Aluminium container) and $ 25 for handling. In other words a total of about $ 2600. For metal cylinders the cost would be somewhat lower and, in fact, the homogeneity better. For material the ^{184}W alone would exceed US $ 20 000 and only a loan would be feasible. The cost for such a loan is high. For a three-month period, Harwell (AERE) offers to lend a sample of about 90% enrichment at a cost of 25 £/g which would give a total of about $ 4 700. This does not include insurance. If other suppliers would be willing to offer similar loan conditions, i.e. 10% of value, the requested 85% enrichment not in the AERE catalogue would cost about $ 2 300. For the U samples the material cost is quite modest but it would require the clearance of appropriate authorities in the supplier country.
Suggested category:	C
Further comments:	Experiment planned similar as described in Yu.A. Aleksandrov et al: "Determination of Nuclear Amplitudes of W Isotope Scattering Using a Neutronographic Method", Yad.Fiz. 10, 328, 1969. (Transl.: Sov.J. Nucl. Phys., 10, 189, 1970).

YUGOSLAVIA

Requestor: F. Cvelbar

Institute: Institut "Jožef Stefan", Ljubljana

Purpose: Neutron capture gamma ray studies with 14MeV neutrons.

Facility: Cockroft-Walton, 100 keV deuterons, tritium target. Telescope scintillation pair spectrometer.

Sample specification, general: The samples should be in the form of spheres, 110 cm^3 volume, and half-spheres 55 cm^3. In order to make sure that contaminating the sample material is avoided if it is supplied on a loan basis, the group proposes to supply glass spheres and half-spheres which could be filled with the sample material in powder form. Purity should be 99% or better.

Requested samples:

Samples	form	approx. weight, g
Sc	sphere	170
V	"	250
Rh	"	700
Pr	"	400
Ho	half-sphere	250
Lu	"	230

RENDA70: No directly corresponding entries except ref.no.225, C. Philis for data on ^{45}Sc (n,) ^{46}Sc(85d). For the requestor's comment to this please see Annex III. See also below under further comments.

Projected accuracy: -

Costs and availability: The preparation of each sample will be about $ 200 plus 25 $ for packaging and handling, if the suggested procedure of powder filled spheres is chosen. Aluminium canning would be preferred by BCMN. For solid metal spheres a cost of about $ 160 is estimated. To this should be added another $ 160 for canning for Pr and Rh. Canning is not needed at room temperature for Lu, Ho, Y and Sc.

Approximate value of material in US $:

Sc 25 500(metal powder)/5100 (Solid metal)
Y 70 (oxide)/750(metal powder)/300 (solid metal)
Rh 24 500
Pr 100 (oxide)/1560(metal powder)/560(solid metal)
Ho 175 (oxide)/875 (metal powder)/600 (solid metal)
Lu 3.450(oxide)/11 500 (metal powder)/17 100(solid metal)

The estimated cost for solid-metal includes the considerable excess material needed for fabrication in that alternative.

Obviously it is a prerequisite in this context, that the expensive material can be supplied as loans. The time needed during which the sample should be available to the group is of the order of a couple of months. INDC members could be of immense help in this case if the respective countries could make some needed material available as loans.

The difficulties in chemical separation of rare earths might make it necessary for the group to consider slightly higher impurity, namely 1 - 2 % other rare earths. The price of sample material would otherwise double in some cases.

Suggested category: B

Further comments: The measurements are made in the following way: In the centre of a spherical (for heavier elements a half-sphere) sample the T target is located as a neutron source. A number of isotopes have already been studied; see for example:

1. Nucl. Instr. 44, 292 (1966)
2. Nucl. Phys. A 130, 401 (1969)
3. Nucl. Phys. A 138, 412 (1969)
4. Nucl. Phys. A 158, 251 (1970)

The mass dependence of the obtained integrated cross sections shows significant departures from that obtained by activation techniques. For such a comparison in some detail see ref. 4 above. Ref. 1 and 2 contain detailed descriptions of the experimental techniques used.

All requested samples here are monoisotopic elements (except Lu, 98% + 2%). The group might be prepared to make measurements also on other isotopes of light and medium-weight nuclei, if samples can be made available. Therefore we might point out the following entries for (n, γ)data in RENDA going up to at least 14 MeV (priority given first, in parentheses):

R.J. Howerton; thermal to 15 MeV. 30% acc.

(1) 205	^{34}S	(2) 339	^{58}Fe
(2) 210	^{41}K	(1) 344	Co
(1) 221	^{44}Ca	(3) 406	^{63}Cu
(1) 222	^{46}Ca	(1) 421	^{64}Zn
(2) 327	^{54}Fe	(1) (1088	^{238}U)

W.N. McElroy; 1 keV - 18 MeV. 10% acc.

(2) 223 Sc (2) 346 Co
(2) 340 ^{58}Fe (2) 407 ^{63}Cu

C. Philis
(1) 225 ^{45}Sc/^{46}Sc (85d)/ (1) 766 ^{169}Tm/^{170}Tm(130d)/

Other entries exist in RENDA for neutron energies up to 10 MeV, and also for them this series of measurements could be of some value. See also the requestor's own comments in Annex III.

IV. "Non-requests"

A few responses have been received expressing an interest in the programme, but without specific requests at the present time. The countries concerned are Australia, Bulgaria, South Africa and New Zealand. In addition, it is quite probable that other countries are equally interested. It was, for example, surprising that this time no request was received from India, although during the survey four different laboratories gave rather detailed information on their needs.

In the case of all the countries mentioned above the primary interest in the supply of separated isotopes on loan was mentioned specifically.

V. Observations and conclusions

The 1970 survey and this programme together form a basis for some general observations which can be made regarding future targets and samples programmes.

V.1. Continuation?

A predominant need, as shown already in the first survey and even more obvious from the requests reported on here, is for loans of expensive material, that is separated isotopes and in some cases for rare natural elements. Another need which is equally prevalent is for fissile isotopes, many of which are available only as loans. It is logical to expect, therefore, that loans of sample materials will be of major importance if the programme will be continued in some future. A prerequisite for the feasibility of the targets and samples programme in a long term is that materials be made available to the Agency - as loans - by those of its Member States which have sufficient supply of the needed isotopes and elements. If, for example, IAEA Member States would make their research pools available, a great deal of requests could be fulfilled by the Agency taking upon itself to bear the cost of fabrication or refabrication of the samples. Loans can certainly be handled on a commercial basis. This has already been tried by the AERE, Harwell for U.K. institutes. Undoubtedly also for a loan, there is a capital cost involved but 10% of full value per three months seems a rather high price. The present programme might be taken as a "test case" in order to explore the willingness to put materials at the disposal of the Agency.

Suggested recommendations (a): The programme should be continued if sufficient cooperation in the supply of materials by IAEA Member States will be demonstrated in the 1972 programme.
(b): The funds available in future programmes should be used primarily to cover costs of preparation of samples rather than the material involved, which should - wherever possible - be supplied as loan from IAEA Member States.

V.2. Quality of work

The "quality" of requests, both with respect to the information supplied with the request and with respect to the projects themselves displays great variation from case to case. It is striking that three of the four individual requestors on the list of "order of consideration" in paragraph II have received assistance from the IAEA in the form of research contracts. The research contracts are often combined with expert advice both for the planning of the research programmes and for the technical performance of scientific work. Although it is very valuable if a requestor is given assistance by expert help there are many reasons for not including samples into other assistance programmes:
(a) Assistance to scientific research in developing countries is already extremely limited. UNDP criteria, which are also applied by the Agency, limit the use of technical assistance funds to projects which contribute to the economical development of the country. Only the mechanism of a research contract can be used to encourage research in developing countries.
(b) New equipment which is supplied by some assistance programme often does not include samples; in any case there is hardly ever any long-term funding in foreign currencies provided for and the continuation of some research may consequently very often depend entirely upon the access to targets and samples. (c) Loans of material are probably handled more easily outside a programme of assistance or of research contracts. Furthermore, loans of expensive materials on a commercial basis are at present rather limited and rather expensive. (d) Countries outside the OECD area other than developing countries could also be served by this programme, even though the question of Agency financing the acquisition of samples might be subject to limitations in these cases.

Suggested recommendations: The information between the Committee and experts to developing countries might be improved: The Agency should inform the INDC of the appropriate parts of experts reports in the case of Agency programmes and INDC members should distribute to the Committee similar

reports in the case of experts in bilateral assistance programmes. The experts, on the other hand, should be informed of the activities of the INDC, including the targets and samples programme.

V.3. The information supplied by the requestor

As already mentioned in the previous paragraph, the quality of the requests appears to vary considerably. The information which was supplied fell in most cases far short of what had been asked for in our letter. This may partly be caused by our inexperience when formulating the letter, but there is also, no doubt, considerable uncertainty on the part of the requestors regarding the actual details that they are supposed to specify: this is particularly the case for acceptable impurities and for backing material.
The estimated accuracies which the experiment is expected to achieve are given only in two cases, and then without any supporting evidence. The correspondence between the requestor and the potential suppliers of samples and/or fabrication services can and should be streamlined. We are not suggesting a recommendation to alleviate this problem here, but we only suggest one possible way: A possible approach could be that requestors address themselves directly with their request to an INDC member located at a laboratory which actually routinely carries out sample preparation. The dialogue necessary for arriving at realistic sample specifications before INDC consideration of the requests could then be manageable, and this could give a better basis for cost estimates.

VI. Acknowledgement

The considerable help that has been given by the sample fabrication group at the EURATOM laboratories in Geel, particularly Dr. K.Lauer, is gratefully acknowledged.

ANNEX I

INTERNATIONAL ATOMIC ENERGY AGENCY
AGENCE INTERNATIONALE DE L'ENERGIE ATOMIQUE
МЕЖДУНАРОДНОЕ АГЕНТСТВО ПО АТОМНОЙ ЭНЕРГИИ
ORGANISMO INTERNACIONAL DE ENERGIA ATOMICA
KÄRNTNER RING 11, P.O. BOX 590, A-1011 VIENNA, AUSTRIA

TELEPHONE: 52 45 11
52 45 25
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CABLE: INATOM VIENNA

IN REPLY PLEASE REFER TO.
PRIERE DE RAPPELER LA RÉFÉRENCE:

DAT/343

14 May 1971

Dear Colleague,

During the first half of 1970, a survey was made of the needs for accelerator targets and samples for nuclear data experiments (our first letter was sent out on 10 December 1969). The results of this survey, as presented to the International Nuclear Data Committee (INDC), showed clearly that some remedial action is called for. As a consequence the Nuclear Data Section of the IAEA is trying to find ways and means to support the acquisition of such targets and samples, whenever applicable on a loan basis.

We now have reason to believe that some limited means will be made available already 1972 to start a small programme for this purpose. In accordance with their recommendation adopted in 1970, the INDC will review all requests in this programme. The adopted policy and procedure are given in the enclosed document. If you (or anyone else at your Institute) find it impossible to acquire samples or targets in other ways you are invited to submit a request listing your needs. Such a list should be given with as much pertinent information as possible, and should particularly contain in detail:

1. The purpose for which the targets are needed. This should include a short description of the experiment, as planned, its time-scale and perhaps a reference to any related published work. Projected accuracies of results may be important in the review of the requests.

2. The type of facility at which the experiment will be performed.

3. The <u>desired</u> specifications and/or range of <u>tolerable</u> specifications of the required targets. Note particularly for sample and for backing:

a) geometrical specifications
b) chemical specifications

whenever possible.

4. The financial arrangements made (funds granted or applied for) in support of the experiment. Indicate also specifically whether or not the funding of the samples is expected to present a problem; often the currency appears to be a greater problem than the funds.

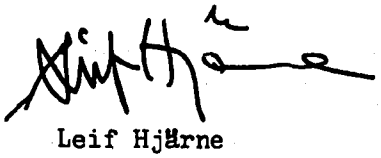
In view of the very limited means available, the requests will be carefully screened, and some criteria which will be used by INDC have been indicated in their policy recommendation. Briefly, this means that preference will be given to measurements related to urgent needs in applied nuclear science and technology. For neutron data it is suggested that experimentalists consult the following two documents which are implicitly referred to in the enclosed document:

- RENDA: EANDC 85 "U" (April 1970)
- Non-EANDC request list for neutron nuclear data measurements (to be published during the second half of 1971).

It should be pointed out that INDC will only consider requests submitted through the competent Government authority to the IAEA. In the interest of a rapid handling of the requests, the requestor should simultaneously send an information copy directly to the Nuclear Data Section of the IAEA.

The next meeting of the INDC will take place in Bombay, 12 - 16 July 1971, and it would be advantageous, if we could have at least preliminary information as soon as possible.

Yours sincerely,



Leif Hjärne
Nuclear Data Section
Div. of Research and
Laboratories

Enclosure

ANNEX II

FINAL RECOMMENDATION FROM THE INDC

February 1971

Recommended Policy and Procedures for the Handling of Requests for Targets and Samples for Nuclear Data Measurements

A. Policy for Evaluation of Requests

The requests may be classified into three categories as follows:

Category A: Requests for targets and samples needed for nuclear data measurements corresponding to priorities 1 and 2 in the current carefully examined and approved neutron data measurement request lists (e.g. RENDA) and to first priority data requests (as defined below) for the scientific and technical development in areas such as safeguards and nuclear fusion.

Category B: Requests for targets and samples needed for nuclear data measurements corresponding to lower priority requests in the request lists and subject areas mentioned in Category A, and to less urgent data needs for applied nuclear purposes.

Category C: Requests for targets and samples needed for nuclear data measurements not covered by Categories A and B.

Requests in Category A, and in exceptional cases also in Category B, should be considered for direct funding or other applicable support by the IAEA. Requests in Category C, and normally also in Category B, should not be considered for direct funding.

For inclusion in Category A there can also be considered other subject areas in the general field of peaceful uses of nuclear energy of vital interest to the program of the IAEA. The inclusion of high priority requests for data for such a subject field in Category A can be made by the IAEA contingent upon the recommendation of an advisory body. Appropriate priorities explicitly defined and vouched for by such an advisory body as well as the careful examination and approval of the data requests by the same or other advisory bodies will be a prerequisite for the inclusion.

All requests will be considered and carefully evaluated by the INDC. Regarding those requests which cannot be funded or otherwise supported directly by the IAEA, suggestions may be given by INDC members to the requestors as to other possible methods for the procurement of targets and samples. The IAEA should assist the requestors in this procurement by correspondence, if necessary.

B. Procedure for Evaluation of Requests

In order to be considered by the INDC, requests for targets and samples should be submitted formally through the cognizant Government authority to the IAEA. The Nuclear Data Section of the IAEA is asked to take the appropriate steps to ensure this and to keep the INDC members informed.

The requests should be categorized and compiled by the Nuclear Data Section and sent to the members of the INDC by the Scientific Secretary. This should be done on a quarterly or half-yearly basis, depending on the number of requests.

The members of the INDC should convey their comments to the Chairman of INDC within a period of two months and send copies to the Executive and Scientific Secretaries of the INDC.

The Scientific Secretary should prepare a summary report, including draft recommendations, and circulate it to the INDC members, after consultation with outside experts, if necessary.

The Chairman of the INDC will submit those recommendations, on which, in his opinion, a consensus has been reached, to the Director General of the IAEA. Other cases should be taken up at the following INDC meeting.

ANNEX III

Excerpts from request of F. Cvelbar, Yugoslavia

The experimental technique used in the measurements can be seen from reprints of our papers which are enclosed to the letter. Let us recall here that the spectra are measured by a special telescopic scintillation pair spectrometer. Samples (spheres for light nuclei and half spheres for heavier ones) are placed around the neutron source. Spectra cover the deexcitation of intermediate states to the bound states of final nuclei. For cases studied till now integrals of the spectra

$$\sigma_{int} = \frac{1}{4\pi}\int\int_{En}^{En+Q} \frac{\partial^2\sigma}{\partial\Omega\,\partial E}\, d\Omega\, dE_\gamma$$

were compared with the results of the activation analysis. It was observed that the activation cross section data as a function of mass number are scattered between 1mb and 10mb while the integrated cross section values show a smooth mass dependence, having a value of about 1mb in the region of medium weight nuclei. The difference is in contradiction to our present knowledge about the radiative capture of fast nucleons. The two cross sections should agree within say 50% or less.

In order to verify that large differences really exist and to get them accurate enough to be used as a good basis for the theoretical study, both cross sections have to be further measured. Concerning the integrated cross section measurements the data for heavy and some medium weight nuclei still have to be collected. From this programme the most expensive (but interesting) targets are presented in the table.

It is clear that collecting the radiative neutron capture data for technological purposes one normally asks for the activation analysis cross section values, which cover all possible capture events (while the integrated cross section includes only transitions to the bound states of final nuclei). However, the activation data obtained so far are not very reliable. In some cases the values reported by different authors differ for a factor of 10. To clear the situation up, there

is not enough to repeat the activation measurements but one has to measure also the integrated values and try to find the theoretical explanation for the difference between the corresponding values. Without doing so, it will be very difficult to avoid the systematic errors in the activation analysis cross section data.

Measurements of the integrated cross sections are therefore indirectly important also for the technological purposes and according to the criteria of Requests for the Neutron Data Measurements (EANDC 85'U') should have high priority. The mass dependence of σ_{int} being smooth, it is not important to measure it just for the isotopes required by the data users. It is important to have enough points in the cross section versus mass diagram. From this point of view materials, presented in the table of our requests, were selected. Of these materials only the Sc coincides directly with the requests of the EANDC 85 'U'.

After the completion of this report RENDA72 was issued as INDC(SEC)-25/6 (Draft). The comparison between the sample requests and the entries in that report has given the following additional comment. It should be pointed out, here, that RENDA72 was not available to the requestors.

Solange de Barros, Brazil

^{233}U (n, γ): Ref no 933: H. Gerwin, J.J.Went, V. Ben i, Thermal - 1MeV, accuracy 20%, priority 1

Ref. no 934: M. Cardot. 1 keV - 2 MeV, priority 2

W(n, γ): Only for separated W isotopes, e.g. ref. nos. 829 (^{182}W), 831 (^{183}W) and 833 (^{184}W): H. Alter. 1 keV - 1 MeV, priority 1.

Dritsa, Greece

Zr(n, γ): Ref. no. 428, same as RENDA70, ref. no. 445

^{97}Mo (n, γ): Ref. no. 530: R. Håkansson. 1 eV - 10 MeV, accuracy 10%, priority2

Ref. no. 531: same as RENDA70 ref. no. 529

Hf (n, γ): Ref. no. 795: same as RENDA70 ref. no. 791

Nb(n, γ): Ref. no. 487: C.G. Campbell. 0.1 - 100 keV, accuracy 20%, priority 1

Ref. no. 488: J.Y. Barre. 0.1 keV - 1 MeV, accuracy 20%, priority 3

Ref. no. 489: same as RENDA70, 498

Nb(n, γ): spectrum Ref. no. 490: M.de Mevergnies, A.Paulsen. 1keV-15 MeV, accuracy 15% (20% for spectrum), priority 3.

Csikai, Hungary

^{235}U Fission yields: Ref. no. 1013: J.-Y. Barre. 0.5 keV - 1 MeV (note that this is lower than the planned experiment at 14 MeV), accuracy 10%, priority 2.

^{239}Pu Fission yields: Ref. no. 1210: J.-Y. Barre same as for ^{235}U.

Cvelbar, Yugoslavia

The requests by Howerton quoted in the comment have been withdrawn, except for those for ^{58}Fe, Co and ^{63}Cu (new ref. nos 324, 333 and 396).