WPEC Expert Group on the High Priority Request List for Nuclear Data

Chair:	Dr. Arjan PLOMPEN
Members:	Representatives of the co-operating nuclear data evaluation projects (ENDF, JEFF, JENDL, ROSFOND/BROND) or NEA member countries
Observers:	International Atomic Energy Agency (IAEA), *By agreement* Chinese Evaluated Nuclear Data Library (CENDL) Project, *By invitation*
Date of creation:	May 1991
Duration:	June 2016

Mandate:

- Agreed at the 16th meeting of the Working Party on International Nuclear Data Evaluation Co-operation [NEA/SEN/NSC/WPEC(2004)2]
- Extended mandate as a part of WPEC activities at the 23rd meeting of the Nuclear Science Committee in June 2012 [NEA/SEN/NSC(2012)3]
- Revised and extended at the meeting of the NEA Nuclear Science Committee in June 2013 NEA/NSC/DOC(2013)2]
- Revised and extended at the 26th meeting of the Working Party on International Nuclear Data Evaluation Co-operation [NEA/SEN/NSC/WPEC(2014)2] and endorsed at the 25th meeting of the NEA Nuclear Science Committee in June 2014 [NEA/SEN/NSC(2014)2]

Purpose, scope and membership

The concept of a nuclear data request list has a long history in applied nuclear science. The concept is that if requests from applied users of data are collected in a convenient location it should provide a stimulus to measurers, modellers, and evaluators to undertake work that could lead to certain requests becoming satisfied.

A revised High Priority Request List (HPRL) for nuclear data needed for applications has been in existence under the auspices of the OECD Nuclear Energy Agency (NEA) for several years. This List provides a point of reference for nuclear data stakeholders and developers and has led to many new initiatives in nuclear data measurement, evaluation and validation. Its effectiveness in stimulating new measurements, evaluations and verification actions required to meet the expressed needs is well established.

A standing expert group is essential to maintain the HPRL as a point of reference in nuclear data research and development. The expert group will consist of at least three representatives from each data project: one from the data user, one from the evaluation and validation community and one from the experimental community. The expert group may have additional representatives from the IAEA Nuclear Data Section, as well as countries not represented in the above mentioned projects.

The HPRL will reflect the actions undertaken by WPEC and will help guide future activities. The expert group will report to WPEC.

Objectives

The expert group is responsible for managing the activities related to the HPRL, in particular for guaranteeing that the entries are up-to-date and well-motivated by current interests in the field of nuclear energy. The group is also responsible for stimulating follow-up to the entries and collecting the feedback provided by any of the related activities that may further the resolution of a request. The expert group will work mainly by electronic mail exchanges. Physical meetings will be held typically once a year.

The HPRL is organized as follows:

1. The List consists of one list with truly high priority requests, a list with general requests and a list with special purpose quantities divided in categories. This third list is an extension to the present List.
2. Stringent criteria are applied for entries on the lists. These will be evaluated by the Expert Group that will take the final decision for adopting a request.
3. A “high priority request” is justified by quantitative sensitivity studies (or the equivalent) and sufficiently documented.
4. A “general request” is well motivated for a specific quantity on a specific nucleus and is documented, but lacks a detailed backing by a sensitivity analysis or an impact study.
5. A “special purpose request” in a well-defined category is of interest to a recognized important subfield of applied nuclear science for which it is essential to stimulate new activity. Such a request may not satisfy the criteria as in the case of points 3. and 4.

The request lists will be subjected to periodic review to monitor progress and determine whether each individual request should continue to be included in these lists.

Deliverables

- A report on the status of all requests describing completed activities and outlook.
- An up-to-date online version of the “High Priority Request List for Nuclear Data”.

Request ID	H464 (NEA=464)		Status of the request	Request to be checked	
Target	Reaction and process	Incident Energy	Secondary energy or angle	Target uncertainty	Covariance
93-NP-237	(n,f) SIG,DE	200KeV-20MeV	0	0	Y
Field	Subfield	Date Request created	Date Request accepted	Ongoing action	
Fission	fast reactors	11-MAY-15			

Requester: Dr Fredrik TOVESSON at LANL, USA
Email: tovesson@lanl.gov

Project (context): Los Alamos National Laboratory

Impact:

- The Np-237 fission cross section has impact for certain fast nuclear reactor designs. A sensitivity study by Aliberti et al. [1] pointed to a target accuracy of 8% for this cross section for Sodium-cooled Fast Reactor of the Gen-IV type (high level waste recycling).
- WPEC Subgroup-26 [2]: Present uncertainty (BOLNA) 6-8% from 0.5-6 MeV. Required uncertainty for an Accelerator Driven Minor Actinide Burner (ADMAB): 1.5-4 %.
- For many measurements the ^{237}Np(n,f) is a reference cross section that is valuable on account of its low fission threshold and moderate activity.

Accuracy:
Uncertainties of 2-3%

Justification document:
There is a discrepancy of about 6-9% between a recent measurement performed by the n_TOF collaboration and ENDF/B-VII (C. Paradela et al. [3]).
The higher n_TOF values are supported by a validation exercise by Leong et al. [4].
A recent independent result in the energy range from 4.8 to 5.6 MeV yields cross sections that in function of energy first agree with ENDF/B-VII and then with the n_TOF result (M. Diakaki et al. [5]).
Independently an issue was recently found when cross sections for Pu-isotopes referred to the ^{238}U(n,f) cross section were compared to the same cross sections referred to the ^{237}Np(n,f) cross section in the same measurement arrangement (P. Salvador et al. [6]).
Comment from requester:
Comments from evaluator/experimentalist:
Comments for achieved accuracy:

Review comment:
The request is well motivated and of some concern also to reactor dosimetry when using spectral indices and/or reaction rates of 237Np fission chambers (IRDFF [7]).

Additional file attached:

References:
[1] G. Aliberti et al., Annals of Nuclear Energy 33 (2006) 700–733.
[2] M. Salvatores et al., Nuclear Science NEA/WPEC-26, www.oecd.org.
[3] C. Paradela et al., Phys. Rev. C 82 (2010) 034601; Korean Physical Society 59 (2011) 1519.
[4] L.S. Leong et al., Annals of Nuclear Energy 54 (2013) 36.

[5] M. Diakaki et al, Nuclear Data Sheets 119 (2014) 52.
[6] P. Salvador et al., Nuclear Data Sheets 119 (2014) 55.
[7] International Reactor Dosimetry and Fusion File, https://www-nds.iaea.org/IRDFF/ (2014).

Proposed Changes in the HPRL Website

1. Background

The High Priority Request List (HPRL) web pages and database are maintained by the Data Bank on behalf of WPEC Subgroup C. The request list is currently divided in two categories of requests: High Priority (HP) and General (G).

This document describes the changes requested by Subgroup C in order:

- To add a third category of requests for Special Purpose Quantities (SPQ),
- To generally improve the appearance and usage of the HPRL web pages.

The request to add a third category affects both the database and the web interface. In this document, the Subgroup C request is translated into changes to the web interface and further discussion may be necessary if the related changes to the database are not straightforward.

The following HPRL webpages are directly affected by the Subgroup C request:

- Main page (www.oecd-nea.org/dbdata/hprl)
- New request form (www.oecd-nea.org/dbdata/hprl/requestform.html)

A few additional web pages may be affected indirectly via e.g., drop-down lists:

- Request editor (www.oecd-nea.org/dbdata/hprl/editdb.pl?submit=Edit+this+record&id=432)
- …

2. Proposed changes to the HPRL Main Page

Replace the menu bar by six tiles (as indicated in the image below together with additional changes):

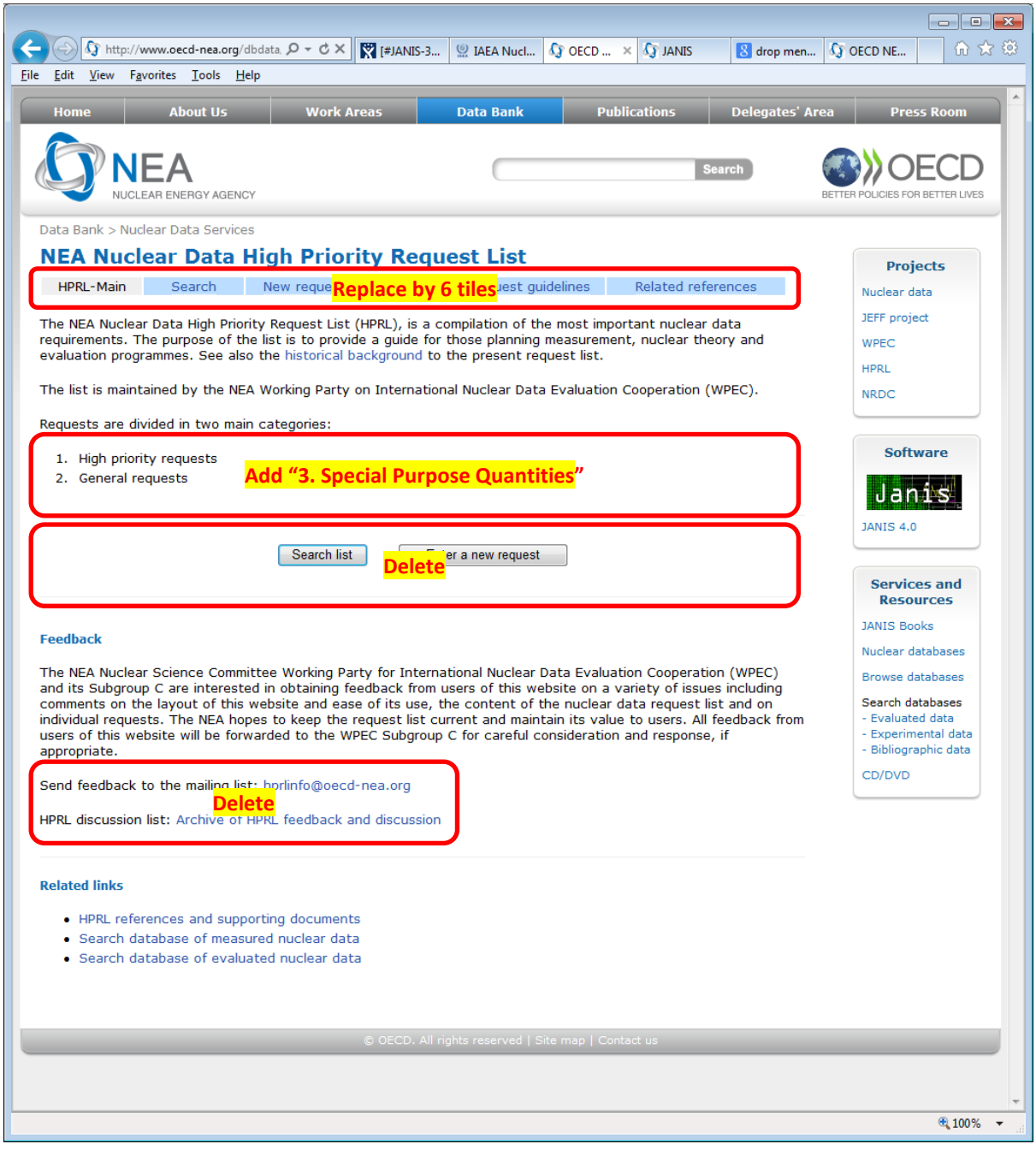
1) HPRL Main
2) High Priority Requests (HPR)
3) General Requests (GR)
4) Special Purpose Quantities (SPQ)
5) New Requests
6) Discussion and Feedback

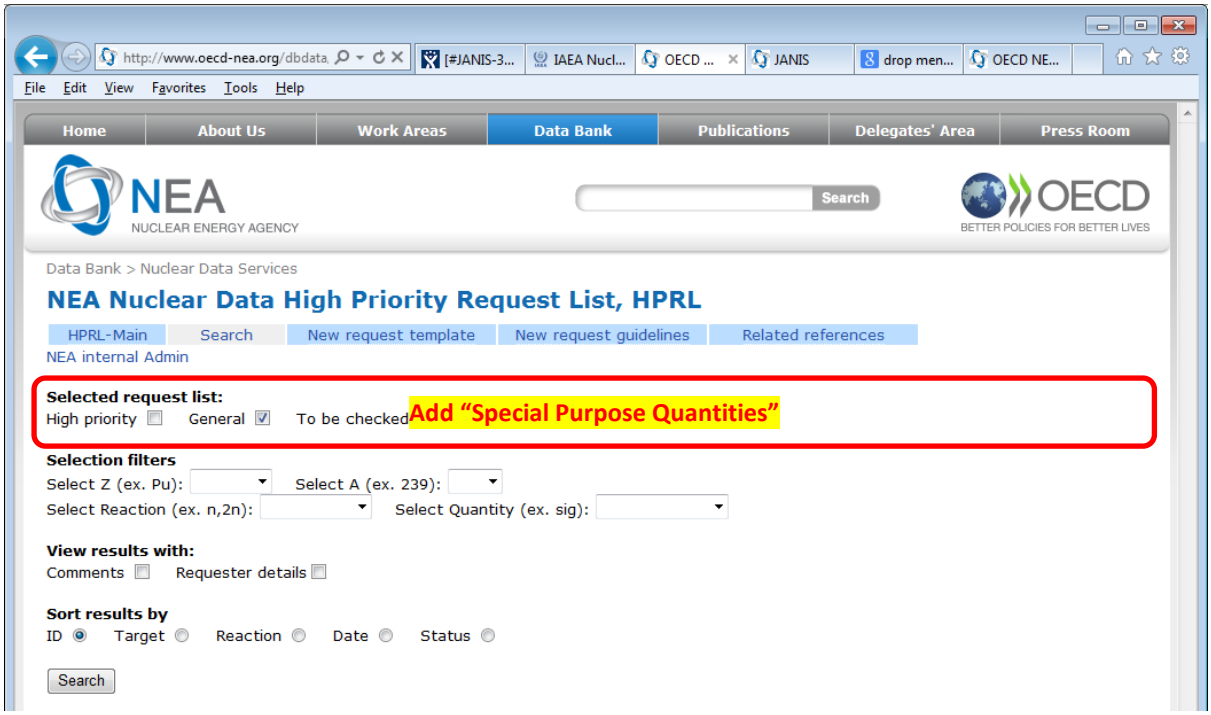
Clicking on “New Requests” should direct to the “New Request Form” (as today) and clicking on “Discussion and Feedback” should direct to the HPRL Mailing List web page, a list of the available feedback documents, and a form allowing new feedback to be entered.

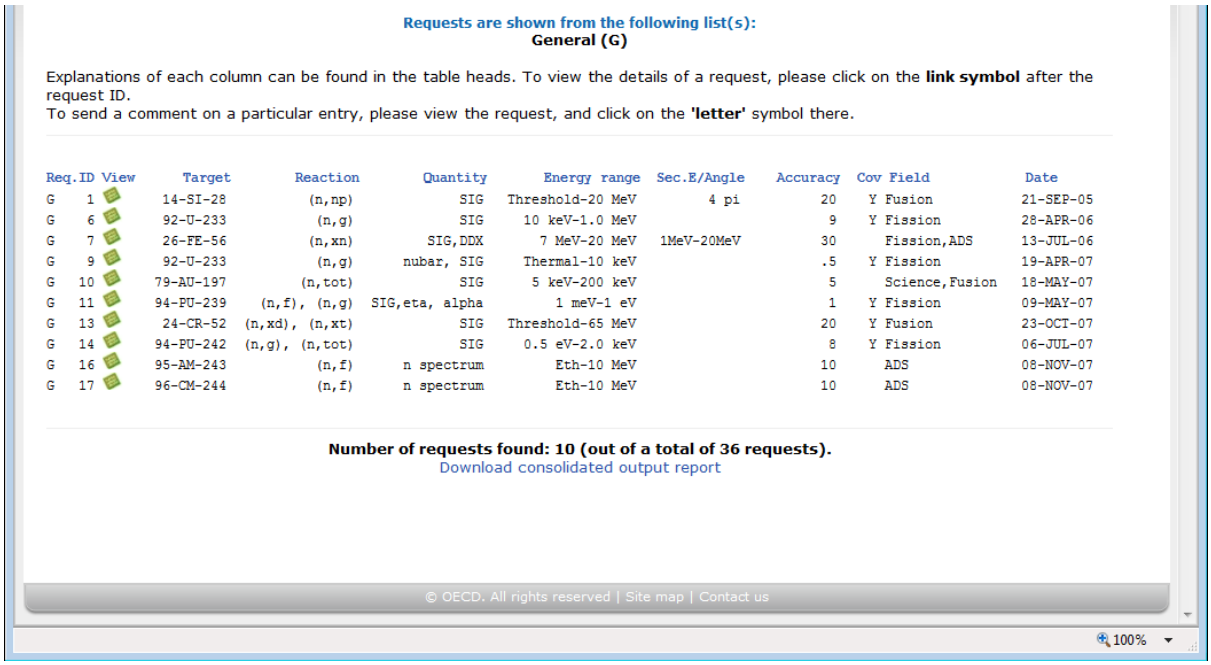
Clicking on the tile of HPR or GR should direct to the corresponding list (as it would come out of the search form without selecting anything, except HPR or GR). Clicking on the tile of SPQ should direct to another page with tiles for the various SPQ (e.g. Spectrum averaged dosimetry cross-sections or

Decay data, to the extent they are established) and after that to the list of requests as for HPR and GR, but then only for one of the SPQ category. On each of these pages the search facility could appear on top of it (ideally in a compact mode, so just a button, that expands the search form only when it is needed and leaving the list visible). See the example below for GR (assembled from two screenshots).

The search function to simultaneously query all lists should remain available (e.g. to find anything Pu-239, or everything fission).



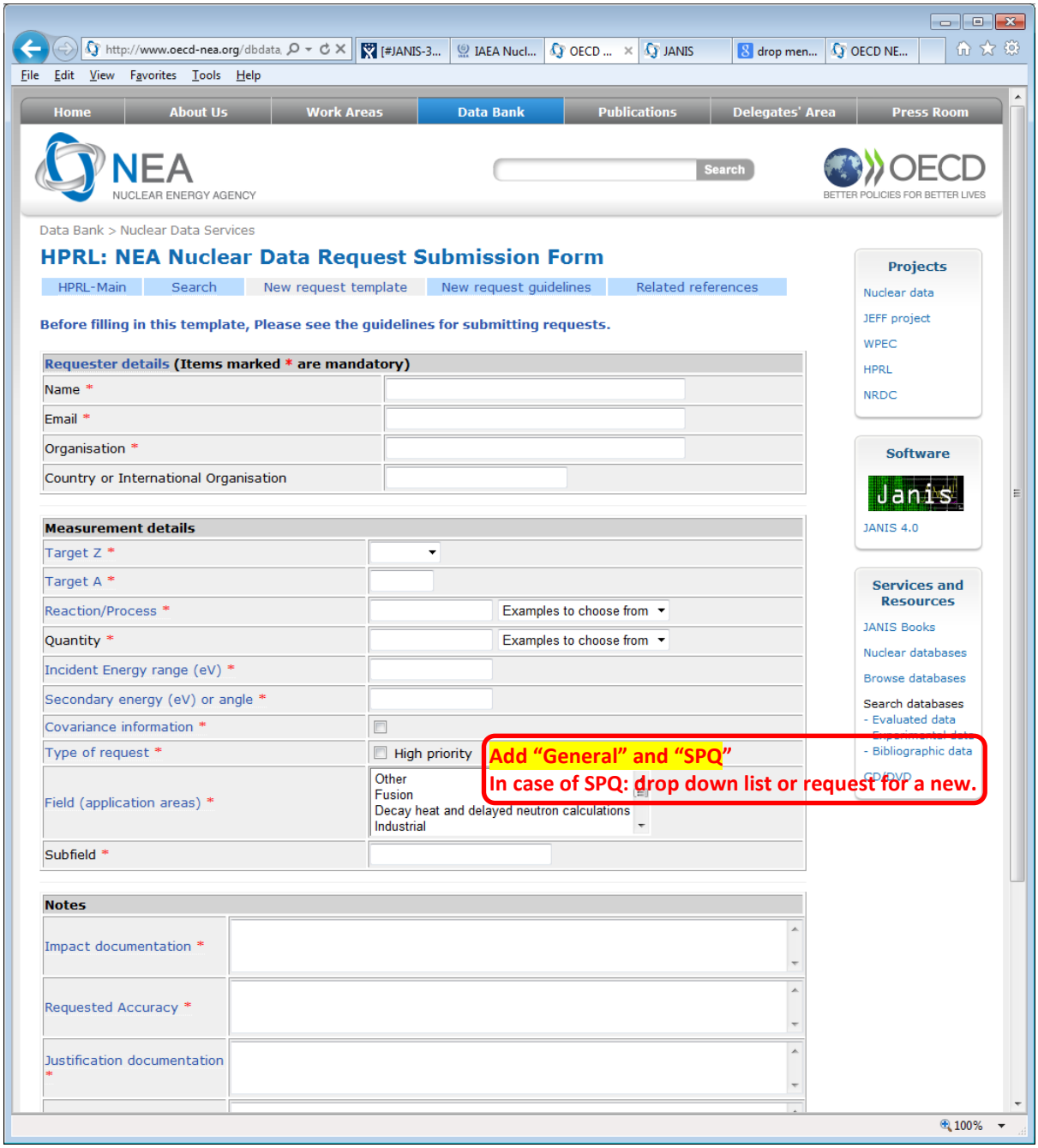




Req.ID	View	Target	Reaction	Quantity	Energy range	Sec.E/Angle	Accuracy	Cov	Field	Date
G 1		14-SI-28	(n,np)	SIG	Threshold-20 MeV	4 pi	20	Y	Fusion	21-SEP-05
G 6		92-U-233	(n,g)	SIG	10 keV-1.0 MeV		9	Y	Fission	28-APR-06
G 7		26-FE-56	(n,xn)	SIG,DDX	7 MeV-20 MeV	1MeV-20MeV	30		Fission,ADS	13-JUL-06
G 9		92-U-233	(n,g)	nubar, SIG	Thermal-10 keV		.5	Y	Fission	19-APR-07
G 10		79-AU-197	(n,tot)	SIG	5 keV-200 keV		5		Science,Fusion	18-MAY-07
G 11		94-PU-239	(n,f), (n,g)	SIG,eta, alpha	1 meV-1 eV		1	Y	Fission	09-MAY-07
G 13		24-CR-52	(n,xd), (n,xt)	SIG	Threshold-65 MeV		20	Y	Fusion	23-OCT-07
G 14		94-PU-242	(n,g), (n,tot)	SIG	0.5 eV-2.0 keV		8	Y	Fission	06-JUL-07
G 16		95-AM-243	(n,f)	n spectrum	Eth-10 MeV		10		ADS	08-NOV-07
G 17		96-CM-244	(n,f)	n spectrum	Eth-10 MeV		10		ADS	08-NOV-07

3. Proposed changes to the New Request Form

The “Type of request” field should be updated with additional categories (“General” and “Special Purpose Quantities”)



3. Proposed changes to drop-down lists

The following drop-down lists are available in various forms:

- Z of the target from www.oecd-nea.org/dbdata/hprl/zsym.htm (and hardcoded in `hprl.pl')
- A of the target from the database table `hprlzaq'
- Reaction (including entrance channel) from www.oecd-nea.org/dbdata/hprl/rlist.htm
- Quantity (cross-section, etc.) from www.oecd-nea.org/dbdata/hprl/qlist.htm
- Field (application areas) from the database table `hprlpurpose'
- Priority (H, G, SP) is hardcoded in the "Request Editor". There are to be several lists of SPQ. NEA should provide a coding system to distinguish.

These lists should be reviewed, made consistent and complemented in order to allow Special Purpose requests, e.g. Thermal Scattering Law data on a compound. One may use EXFOR dictionary for that purpose.

4. Example of Special Purpose Quantities

(For implementation refer to the note of SG-C for this example,).

It is proposed to create a specific request list in the category of Special Purpose Quantities for spectrum averaged dosimetry cross-sections. The new measurements should make effort to reach uncertainty 2-5% (E50% < 15 MeV) or 5-10% (E50% > 15 MeV), as in the best previous experiments.

Cf-252(SF) spectra

Not measured yet (26 reactions):
Sc-45(n,g), Nb-93(n,g), Li-6(n,t)He-4, Fe-58(n,g), Ag-109(n,g), U-235(n,g), B-10(n,a), U-238(n,g), W-186(n,g), Am-241(n,f), P-31(n,p), Zn-67(n,p), Fe-54(n,a), In-115(n,2n), Pr-141(n,2n), As-75(n,2n), Y-89(n,2n) , Ti-47(n,np), Na-23(n,2n), Ti-49(n,np), Ti-48(n,np), Fe-54(n,2n), Bi-209(n,3n) ,Tm-169(n,3n), Co-59(n,3n)

Outliers (4 reactions): Co-59(n,γ), Mo-92(n,p), Ni-60(n,p), Ti-46(n,2n)
Large discrepancies or uncertainties: Th-232(n,f)

U-235(n_{th},f) spectra

Not measured yet (25 reactions):
Sc-45(n,g), Nb-93(n,g), Fe-58(n,g), Ag-109(n,g), U-235(n,g), Ta-181(n,g), Th-232(n,g), U-238(n,g), Cu-63(n,g), In-115(n,g), W-186(n,g), Am-241(n,f), In-115(n,2n), Pr-141(n,2n), Cu-65(n,2n), Cr-52(n,2n), Ti-47(n,np), Na-23(n,2n), Ti-49(n,np), Ti-48(n,np), Ti-46(n,2n), Fe-54(n,2n), Bi-209(n,3n), Tm-169(n,3n), Co-59(n,3n)

Outliers (4 reactions):
Li-6(n,t)He-4, B-10(n,a)Li-7 – outlier (due to 12% contribution of (n,a)ta ?), La-139(n,g), P-31(n,p)

Large discrepancies or uncertainties: Rh-103(n,n'), Tm-169(n2n), Mn-55(n,2n)

Date: Dec 2013 - Mar 2015 *back to CRP-web*

Proposals for new measurements for IRDFF community and HPRL.

I. Spectrum Averaged (SPA) cross sections

Following the action of 1st RCM (see Report INDC(NDS)-0639, page 15) and analysing the available SPA data measured in fields:

Cf-252(s.f.) - available measured data and C/E plots
U-235(n_{th},f) - available measured data and C/E plots
MACS(30 keV) - available measured data and C/E plots

we formulate a list of Not-Measured, Outliers or "Discrepant" data for IRDFF community and for submission to HPRL:

NB.1. Since it is difficult to measure the (n,γ) cross sections due to impact of room and set-up returned neutrons, only the threshold reactions from Not-Measured (marked as **bold)**, Outliers and Discrepant reactions we primarily recommend to measure and to include in HPRL.

NB.2. SPA for **high threshold (above ≈ 10 MeV) dosimetry reactions**, which may serve to "measure" the unknown high energy part of ^{252}Cf(s.f.) and ^{235}U(n_{th},f) spectra, will require intensive source and probably new detection techniques (e.g. AMS) alternative to the conventional activation one. For more details see proper information .

1. SPA in Cf-252(s.f.) field

Not Measured yet (26 reactions):

Sc-45(n,γ), Li-6(n,t)He-4, Nb-93(n,γ), Fe-58(n, γ), Ag-109(n, γ), U-235(n, γ), B-10(n,a), U-238(n, γ), W-186(n, γ), **Am-241(n,f), P-31(n,p), Zn-67(n,p), Fe-54(n,α), In-115(n,2n), Pr-141(n,2n), As-75(n,2n), Y-89(n,2n), Cr-52(n,2n), Ti-47(n,np), Na-23(n,2n), Ti-49(n,np), Ti-48(n,np), Fe-54(n,2n), Bi-209(n,3n), Tm-169(n,3n), Co-59(n,3n), ^{117}Sn(n,n')^{117m}Sn**

Outliers (4 reactions):

Co-59(n,γ), Mo-92(n,p), Ni-60(n,p), Ti-46(n,2n)

Large Discrepancies or Uncertainties (2 reactions):

Th-232(n,f), U-238(n,2n)

2. SPA in U-235(n_{th},f) field

Not Measured yet (22 reactions):

Sc-45(n,γ), Nb-93(n,γ), Fe-58(n, γ), Ag-109(n,γ), U-235(n,γ), Ta-181(n,γ), Th-232(n,γ), W-186(n,γ), **Am-241(n,f), In-115(n,2n), Pr-141(n,2n), Cu-65(n,2n), Cr-52(n,2n), Ti-47(n,np), Na-23(n,2n), Ti-49(n,np), Ti-48(n,np), Ti-46(n,2n), Fe-54(n,2n), Bi-209(n,3n), Tm-169(n,3n), Co-59(n,3n), ^{117}Sn(n,n')^{117m}Sn**

Outliers (5 reactions):

Mn-55(n,γ), U-238(n, γ), La-139(n, γ), P-31(n,p), U-238(n,2n)

P.S.: Li-6(n,t)He-4, B-10(n,α)Li-7 are not outliers due to ≈30-20% contribution from (n,n'α) and (n,t2α)

Large Discrepancies or Uncertainties (6 reactions):

Rh-103(n,n'), U-238(n,γ), Cu-63(n,γ), Tm-169(n,2n), Mn-55(n,2n), Ni-58(n,2n)

3. MACS (30 keV) field

Not Measured yet (4 reactions):

Ag-109(n,γ)Ag-110m, Th-232(n,γ)Th-233, U-235(n,γ)U-236, U-238(n,γ)U-239

II. Mono-energy cross sections

1. Low threshold reactions

The new reaction ^{117}Sn(n,n')^{117m}Sn was proposed for inclusion IRDFF by RCM-2 (no one measurement on plateau !)

^{117}Sn(n,n')^{117m}Sn https://www-nds.iaea.org/IRDFFtest/Sn117(n,n)Sn117m.pdf

This dosimeter has been already experimentally tested (irradiated) employing the inreached Tin foil (93% at. ^{117}Sn) in different reactor spectra at CEA. However, the microscopic nuclear data for this reaction suffer of lack measurements on plateau (5 - 10 MeV), discrepancies between library evaluations, lack of uncertainties … prevent this reaction to be used.

2. High threshold (n,xn) reactions (point and energy-integrated cross sections)

CRP strives to evaluate and eventually add to the IRDFF library the high threshold reactions with cross section plateaus located between 20 and 100-200 MeV to meet the requirements of the high neutron energy accelerator driven sources such as ADS.
Often it happens to be a set of several reactions of (n,xn) type on one of isotope: ^{89}Y, ^{59}Co, ^{169}Tm, ^{197}Au, ^{209}Bi, ^{175}Lu, ^{169}Tm, ^{139}La, ^{139}Rh, ^{63}Cu, ^{93}Nb .... Due to this, already one foil can serve for neutron fluence monitoring and spectrum unfolding.

Figures/materials illustrating the status of such reactions:

^{209}Bi(n,3-8n)	https://www-nds.iaea.org/IRDFFtest/Bi(n,xn).pdf
^{89}Y(n,2-4n) & (n,p)	https://www-nds.iaea.org/IRDFFtest/Y89(n,xn).pdf
^{59}Co(n,3-5n)	https://www-nds.iaea.org/IRDFFtest/Co(n,xn).pdf
^{197}Au(n,3-5n)	https://www-nds.iaea.org/IRDFFtest/Au(n,xn).pdf
^{175}Lu(n,2-4n)	https://www-nds.iaea.org/IRDFFtest/Lu(n,xn).pdf
^{169}Tm(n,2-3n)	https://www-nds.iaea.org/IRDFFtest/Tm(n,xn).pdf
^{54}Fe(n,2n)	https://www-nds.iaea.org/IRDFFtest/Fe54n2n.pdf
^{139}La(n,4-10n)	…...
^{103}Rh(n,4-8n)	……
^{nat}Fe(n,x)^{54}Mn	……
^{nat}Ti(n,x)^{46}Sc, ^{47}Sc, ^{48}Sc	……..

see also on of the overview https://www-nds.iaea.org/IRDFFtest/RCM1/Pronyaev-nxn-high-en-dos.pdf

III. Common Request on experimental UNCERTAINTIES for reactions listed above

The new measurements should make effort **to reach uncertainty 2-5% ($E_{50\%}$ < 15 MeV) or 5-10% ($E_{50\%}$ > 15 MeV)**, as in the best previous experiments.

Simakov requests translated to request form

Example: 45Sc(n,g) in the 252Cf(SF) SPA.

- In reality this example needs to be repeated 32 times for Cf252 SPA, 32 times for 235U(n,f) SPA, 4 times for 30 keV MACS.
- For 117Sn(n,n')117mSn the request is for the first measurements at the cross section plateau, i.e. from 5 to 10 MeV (*de facto - requested by C. Destouches, CEA)* .
- For 20-100 MeV the request is for any good data on (n,3-6n) reactions on 197Au, 169Tm, 209Bi, 59Co, 63Cu, 89Y, 93Nb, 139La, 103Rh, 175Lu, natFe(n,x)54Mn, natTi(n,x)46,47,48Sc.

Main messages:

1. we need IT support to start with SPQ,
2. we need secretarial support with the Simakov requests, once (After 1 is completed).

Example request form

(form field names left, form entries right, additions SG-C in purple, to do in red)**:**

Requester details	
Name	Simakov
Email	s.simakov@iaea.org
Organisation	IAEA
Country or international organization	IAEA
Measurement details (this field should be **Request details, action NEA**)	
Target Z	Sc
Target A	45
Reaction/process	(n,g)
Quantity	SPA
Incident energy range	FNS 252Cf(SF)
Secondary energy (eV) or angle	NA
Covariance information	Y
Type of request	SPQ
Field (application areas)	Reactor Dosimetry (to be defined)
Subfield	Validation
Notes	
Impact documentation	IRDFF webpage https://www-nds.iaea.org/IRDFF/ IRDFF test CRP page https://www-nds.iaea.org/IRDFFtest/ <link to pdf proposal of Simakov, action NEA> <link to pdfs refs in the proposal of Simakov, action NEA>
Requested Accuracy	New measurements must make an effort to reach 2-5% uncertainty for E50%<15 MeV or 5-10% for E50%>15 MeV).
Justification documentation	As impact documentation.
General comments	The International Reactor Dosimetry and Fusion File aims at providing validated evaluated neutron dosimetry reactions for all applications in reactors and fusion technology development. Spectrum averaged cross sections in well characterized fields such as the 252Cf(SF), 235U(n-th,f) fission neutron spectra and the quasi-maxwellian 30 keV spectrum are essential to validation of the proposed cross sections in fields that are close to the interest in applications.
Attached files:	Proposal Simakov and the documents referred in his text.

Reviewer comment:

Reactions without threshold measured in fast spectra such as the ^{252}Cf(SF) and ^{235}U(n-th,f) spectrum tend to have their spectrum averaged cross section dominated by scattering contributions and 'room-return' neutrons.
In all cases experiments should be careful to minimize these contributions and maximize the reaction rate of the target spectrum. For new experiments best estimates must be provided by detailed Monte Carlo calculation of the spectrum realized in the experiment and the Monte Carlo model must be made available to IRDFF to facilitate validation of new proposals for the cross section. In all cases it is advised to publish both the fully corrected SPA and the measured reaction rates of the primary reaction and the monitor reactions used for normalization and validation of the model. The measured reaction rates must be provided with a full covariance matrix.