EUROPEAN COMMISSION
Directorate-General for Research and Innovation

Energy
Fission Energy

HORIZON 2020

GRANT AGREEMENT

NUMBER 847552 — SANDA

This **Agreement** (‘the Agreement’) is **between** the following parties:

on the one part,

the **European Atomic Energy Community** (‘Euratom’), represented by the European Commission ('the Commission'),

represented for the purposes of signature of this Agreement by Head of Unit, Directorate-General for Research and Innovation, Administration and finance, Mila BAS SANCHEZ,

and

on the other part,

1. ‘the coordinator’:

CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT (CIEMAT), established in Avenida Complutense 40, MADRID 28040, Spain, VAT number: ESQ2820002J, represented for the purposes of signing the Agreement by Director General, Carlos Alejaldre

and the following other beneficiaries, if they sign their ‘Accession Form’ (see Annex 3 and Article 56):

2. **Magyar Tudomanyos Akademia Atommagkutato Intezete (ATOMKI)**, established in BEM TER 18/C, DEBRECEN H4026, Hungary, VAT number: HU15300344,

3. **COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA)**, established in RUE LEBLANC 25, PARIS 15 75015, France, VAT number: FR43775685019,

4. **EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN)**, established in ROUTE DE MEYRIN CERN, GENEVA 23 1211, Switzerland,

5. **CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)**, established in RUE MICHEL ANGE 3, PARIS 75794, France, VAT number: FR40180089013,

6. **AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS (CSIC)**, established in CALLE SERRANO 117, MADRID 28006, Spain, VAT number: ESQ2818002D,

7. **CENTRUM VYZKUMU REZ S.R.O. (CVREZ)**, established in HUSINEC-REZ 130, HUSINEC-REZ 250 68, Czech Republic, VAT number: CZ26722445,

8. **AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE (ENEA)**, established in LUNGOTEVERE GRANDE AMMIRAGLIO THAON DI REVEL 76, ROMA 000196, Italy, VAT number: IT00985801000,

9. **HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF EV (HZDR)**, established in BAUTZNER LANDSTRASSE 400, DRESDEN 01328, Germany,

10. **INSTITUTUL NATIONAL DE CERCETARE -DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI" (IFIN-HH) (IFIN-HH)**, established in Atomistilor Street 407, MAGURELE RO 077125, Romania, VAT number: RO3321234,

11. **INSTITUT DE RADIOPROTECTION ET DE SURETE NUCLEAIRE (IRSN)**, established in AV DE LA DIVISION LECLERC 31, FONTENAY AUX ROSES 92260, France, VAT number: FR68440546018,

12. **ASSOCIACAO DO INSTITUTO SUPERIOR TECNICO PARA A INVESTIGACAO E DESENVOLVIMENTO (IST-ID)**, established in AVENIDA ROVISCO PAIS 1, LISBOA 1049 001, Portugal, VAT number: PT509830072,

14. **INSTITUT JOZEF STEFAN (JSI)**, established in Jamova 39, LJUBLJANA 1000, Slovenia, VAT number: SI55560822,

15. **JYVASKYLAN YLIOPISTO (JYU)**, established in SEMINAARINKATU 15, JYVASKYLA 40100, Finland, VAT number: FI02458947,

16. **KARLSRUHER INSTITUT FUER TECHNOLOGIE (KIT)**, established in KAISERSTRASSE 12, KARLSRUHE 76131, Germany, VAT number: DE266749428,

17. **USTAV JADERNE FYZIKY AV CR (NPI)**, established in Husinec - Řež 130, REZ - PRAHA 25068, Czech Republic,

18. **NPL MANAGEMENT LIMITED (NPL)**, established in HAMPTON ROAD TEDDINGTON, MIDDLESEX TW11 0LW, United Kingdom, VAT number: GB200429166,

19. **NUCLEAR RESEARCH AND CONSULTANCY GROUP (NRG)**, established in WESTERDUINWEG 3, PETTEN 1755 LE, Netherlands, VAT number: NL807320316B01,

20. **NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA (NTUA)**, established in HEROON POLYTECHNIOU 9 ZOGRAPHOU CAMPUS, ATHINA 15780, Greece, VAT number: EL099793475,

21. **PAUL SCHERRER INSTITUT (PSI)**, established in FORSCHUNGSTRASSE 111, VILLIGEN PSI 5232, Switzerland, VAT number: CHE116133392MWST,

22. **PHYSIKALISCH-TECHNISCHE BUNDESANSTALT (PTB)**, established in Bundesallee 100, BRAUNSCHWEIG 38116, Germany, VAT number: DE811240952,

23. **STUDIECENTRUM VOOR KERNENERGIE / CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE (SCK-CEN)**, established in AVENUE HERRMANN DEBROUX 40, BRUXELLES 1160, Belgium, VAT number: BE0406568867,

24. **SOFIA UNIVERSITY ST KLIMENT OHRIDSKI (Sofia)**, established in BUL TZAR OSVOBODITEL 15, SOFIA 1504, Bulgaria,

25. **TECHNISCHE UNIVERSITAET WIEN (TUW)**, established in KARLSPLATZ 13, WIEN 1040, Austria, VAT number: ATU37675002,

26. **UNIVERSITATEA DIN BUCURESTI (UB)**, established in MIHAIL KOGALNICEANU STREET 36-46 SECTOR V, BUCURESTI 050107, Romania,

27. **UNIWERSYTET LODZKI (ULODZ)**, established in UL PREZYDENTA GABRIELA NARUTOWICZA 68, LODZ 90 136, Poland, VAT number: PL7240003243,

28. **JOHANNES GUTENBERG-UNIVERSITAT MAINZ (UMAINZ)**, established in SAARSTRASSE 21, MAINZ 55099, Germany, VAT number: DE149065685,

29. **THE UNIVERSITY OF MANCHESTER (UMANCH)**, established in OXFORD ROAD, MANCHESTER M13 9PL, United Kingdom, VAT number: GB849738956,

30. **PANEPISTIMIO IOANNINON (UOI)**, established in PANEPISTEMIOYPOLE PANEPISTEMIO IOANNINON, IOANNINA 45110, Greece, VAT number: EL090029284,

31. **UNIVERSITAT POLITECNICA DE CATALUNYA (UPC)**, established in CALLE JORDI GIRONA 31, BARCELONA 08034, Spain, VAT number: ESQ0818003F,

32. **UNIVERSIDAD POLITECNICA DE MADRID (UPM)**, established in CALLE RAMIRO DE MAEZTU 7 EDIFICIO RECTORADO, MADRID 28040, Spain, VAT number: ESQ2818015F,

33. **UNIVERSIDAD DE SANTIAGO DE COMPOSTELA (USC)**, established in COLEXIO DE SAN XEROME PRAZA DO OBRADOIRO S/N, SANTIAGO DE COMPOSTELA 15782, Spain, VAT number: ESQ1518001A,

34. **UNIVERSIDAD DE SEVILLA (USE)**, established in CALLE S. FERNANDO 4, SEVILLA 41004, Spain, VAT number: ESQ4118001I,

35. **UPPSALA UNIVERSITET (UU)**, established in VON KRAEMERS ALLE 4, UPPSALA 751 05, Sweden, VAT number: SE202100293201,

and 13. the **Joint Research Centre (JRC)** established in Rue de la Loi 200, BRUSSELS 1049, Belgium, if it signs the ‘Administrative Arrangement’ (see Annex 3b).

Unless otherwise specified, references to ‘beneficiary’ or ‘beneficiaries’ include the coordinator and the Joint Research Centre (JRC).

The parties referred to above have agreed to enter into the Agreement under the terms and conditions below.

By signing the Agreement or the Accession Form or the Administrative Arrangement, the beneficiaries accept the grant and agree to implement it under their own responsibility and in accordance with the Agreement, with all the obligations and conditions it sets out.

The Agreement is composed of:

Terms and Conditions

Annex 1 Description of the action

Annex 2 Estimated budget for the action

2a Additional information on the estimated budget

Annex 3 Accession Forms

3b Administrative Arrangement

Annex 4 Model for the financial statements

Annex 5 Model for the certificate on the financial statements

Annex 6 Model for the certificate on the methodology

TERMS AND CONDITIONS

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This Agreement sets out the rights and obligations and the terms and conditions applicable to the grant awarded to the beneficiaries for implementing the action set out in Chapter 2.

CHAPTER 2 ACTION

ARTICLE 2 — ACTION TO BE IMPLEMENTED

The grant is awarded for the action entitled '**Supplying Accurate Nuclear Data for energy and non-energy Applications**' — 'SANDA' (**'action'**), as described in Annex 1.

ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION

The duration of the action will be **48 months** as of 1 September 2019 ('**starting date of the action**').

ARTICLE 4 — ESTIMATED BUDGET AND BUDGET TRANSFERS

4.1 Estimated budget

The '**estimated budget**' for the action is set out in Annex 2.

It contains the estimated eligible costs and the forms of costs, broken down by beneficiary (and linked third party) and budget category (see Articles 5, 6, and 14).

4.2 Budget transfers

The estimated budget breakdown indicated in Annex 2 may be adjusted — without an amendment (see Article 55) — by transfers of amounts between beneficiaries, budget categories and/or forms of costs set out in Annex 2, if the action is implemented as described in Annex 1.

However, the beneficiaries may not add costs relating to subcontracts not provided for in Annex 1, unless such additional subcontracts are approved by an amendment or in accordance with Article 13.

CHAPTER 3 GRANT

ARTICLE 5 — GRANT AMOUNT, FORM OF GRANT, REIMBURSEMENT RATES AND FORMS OF COSTS

5.1 Maximum grant amount

The '**maximum grant amount**' is **EUR 3 499 948.00** (three million four hundred and ninety nine thousand nine hundred and forty eight EURO).

5.2 Form of grant, reimbursement rates and forms of costs

The grant reimburses **100% of the action's eligible costs** (see Article 6) (‘**reimbursement of eligible costs grant**’) (see Annex 2).

The estimated eligible costs of the action are EUR **4 666 600.00** (four million six hundred and sixty six thousand six hundred EURO).

Eligible costs (see Article 6) must be declared under the following forms ('**forms of costs**'):

(a) for **direct personnel costs**:

- as actually incurred costs (‘**actual costs**’) or
- on the basis of an amount per unit calculated by the beneficiary in accordance with its usual cost accounting practices (‘**unit costs**’).

Personnel **costs for SME owners** or **beneficiaries that are natural persons** not receiving a salary (see Article 6.2, Points A.4 and A.5) must be declared on the basis of the amount per unit set out in Annex 2a (**unit costs**);

(b) for **direct costs for subcontracting**: as actually incurred costs (**actual costs**);

(c) for **direct costs of providing financial support to third parties**: not applicable;

(d) for **other direct costs**:

- for costs of internally invoiced goods and services: on the basis of an amount per unit calculated by the beneficiary in accordance with its usual cost accounting practices (‘**unit costs**’);
- for all other costs: as actually incurred costs (**actual costs**);

(e) for **indirect costs**: on the basis of a flat-rate applied as set out in Article 6.2, Point E (‘**flat-rate costs**’);

(f) **specific cost category(ies):** not applicable.

5.3 Final grant amount — Calculation

The ‘**final grant amount**’ depends on the actual extent to which the action is implemented in accordance with the Agreement’s terms and conditions.

This amount is calculated by the Commission — when the payment of the balance is made (see Article 21.4) — in the following steps:

Step 1 — Application of the reimbursement rates to the eligible costs

Step 2 — Limit to the maximum grant amount

Step 3 — Reduction due to the no-profit rule

Step 4 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

5.3.1 Step 1 — Application of the reimbursement rates to the eligible costs

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) declared by the beneficiaries and linked third parties (see Article 20) and approved by the Commission (see Article 21).

5.3.2 Step 2 — Limit to the maximum grant amount

If the amount obtained following Step 1 is higher than the maximum grant amount set out in Article 5.1, it will be limited to the latter.

5.3.3 Step 3 — Reduction due to the no-profit rule

The grant must not produce a profit.

'**Profit**' means the surplus of the amount obtained following Steps 1 and 2 plus the action's total receipts, over the action's total eligible costs.

The '**action's total eligible costs**' are the consolidated total eligible costs approved by the Commission.

The '**action's total receipts**' are the consolidated total receipts generated during its duration (see Article 3).

The following are considered **receipts**:

(a) income generated by the action; if the income is generated from selling equipment or other assets purchased under the Agreement, the receipt is up to the amount declared as eligible under the Agreement;

(b) financial contributions given by third parties to the beneficiary or to a linked third party specifically to be used for the action, and

(c) in-kind contributions provided by third parties free of charge and specifically to be used for the action, if they have been declared as eligible costs.

The following are however not considered receipts:

(a) income generated by exploiting the action's results (see Article 28);

(b) financial contributions by third parties, if they may be used to cover costs other than the eligible costs (see Article 6);

(c) financial contributions by third parties with no obligation to repay any amount unused at the end of the period set out in Article 3.

If there is a profit, it will be deducted from the amount obtained following Steps 1 and 2.

5.3.4 Step 4 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations — Reduced grant amount — Calculation

If the grant is reduced (see Article 43), the Commission will calculate the reduced grant amount by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the maximum grant amount set out in Article 5.1.

The final grant amount will be the lower of the following two:

- the amount obtained following Steps 1 to 3 or
- the reduced grant amount following Step 4.

5.4 Revised final grant amount — Calculation

If — after the payment of the balance (in particular, after checks, reviews, audits or investigations; see Article 22) — the Commission rejects costs (see Article 42) or reduces the grant (see Article 43), it will calculate the '**revised final grant amount**' for the beneficiary concerned by the findings.

This amount is calculated by the Commission on the basis of the findings, as follows:

- in case of **rejection of costs**: by applying the reimbursement rate to the revised eligible costs approved by the Commission for the beneficiary concerned;
- in case of **reduction of the grant**: by calculating the concerned beneficiary's share in the grant amount reduced in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations (see Article 43.2).

In case of **rejection of costs and reduction of the grant**, the revised final grant amount for the beneficiary concerned will be the lower of the two amounts above.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS

6.1 General conditions for costs to be eligible

'**Eligible costs**' are costs that meet the following criteria:

(a) for **actual costs**:

(i) they must be actually incurred by the beneficiary;

(ii) they must be incurred in the period set out in Article 3, with the exception of costs relating to the submission of the periodic report for the last reporting period and the final report (see Article 20);

(iii) they must be indicated in the estimated budget set out in Annex 2;

(iv) they must be incurred in connection with the action as described in Annex 1 and necessary for its implementation;

(v) they must be identifiable and verifiable, in particular recorded in the beneficiary's accounts in accordance with the accounting standards applicable in the country where the beneficiary is established and with the beneficiary's usual cost accounting practices;

(vi) they must comply with the applicable national law on taxes, labour and social security, and

(vii) they must be reasonable, justified and must comply with the principle of sound financial management, in particular regarding economy and efficiency;

(b) for **unit costs**:

(i) they must be calculated as follows:

{amounts per unit set out in Annex 2a or calculated by the beneficiary in accordance with its usual cost accounting practices (see Article 6.2, Point A and Article 6.2.D.5)

multiplied by

the number of actual units};

(ii) the number of actual units must comply with the following conditions:

- the units must be actually used or produced in the period set out in Article 3;
- the units must be necessary for implementing the action or produced by it, and
- the number of units must be identifiable and verifiable, in particular supported by records and documentation (see Article 18);

(c) for **flat-rate costs**:

(i) they must be calculated by applying the flat-rate set out in Annex 2, and

(ii) the costs (actual costs or unit costs) to which the flat-rate is applied must comply with the conditions for eligibility set out in this Article.

6.2 Specific conditions for costs to be eligible

Costs are eligible if they comply with the general conditions (see above) and the specific conditions set out below for each of the following budget categories:

A. direct personnel costs;
B. direct costs of subcontracting;
C. not applicable;
D. other direct costs;
E. indirect costs;
F. not applicable.

'Direct costs' are costs that are directly linked to the action implementation and can therefore be attributed to it directly. They must not include any indirect costs (see Point E below).

'Indirect costs' are costs that are not directly linked to the action implementation and therefore cannot be attributed directly to it.

A. Direct personnel costs

Types of eligible personnel costs

A.1 Personnel costs are eligible, if they are related to personnel working for the beneficiary under an employment contract (or equivalent appointing act) and assigned to the action ('**costs for employees (or equivalent)**'). They must be limited to salaries (including during parental leave), social security contributions, taxes and other costs included in the **remuneration**, if they arise from national law or the employment contract (or equivalent appointing act).

Beneficiaries that are non-profit legal entities[1] may also declare as personnel costs **additional remuneration** for personnel assigned to the action (including payments on the basis of supplementary contracts regardless of their nature), if:

(a) it is part of the beneficiary's usual remuneration practices and is paid in a consistent manner whenever the same kind of work or expertise is required;

(b) the criteria used to calculate the supplementary payments are objective and generally applied by the beneficiary, regardless of the source of funding used.

'Additional remuneration' means any part of the remuneration which exceeds what the person would be paid for time worked in projects funded by national schemes.

Additional remuneration for personnel assigned to the action is eligible up to the following amount:

(a) if the person works full time and exclusively on the action during the full year: up to EUR 8 000;

(b) if the person works exclusively on the action but not full-time or not for the full year: up to the corresponding pro-rata amount of EUR 8 000, or

(c) if the person does not work exclusively on the action: up to a pro-rata amount calculated as follows:

{{EUR 8 000

divided by

the number of annual productive hours (see below)},

multiplied by

the number of hours that the person has worked on the action during the year}.

A.2 The **costs for natural persons working under a direct contract** with the beneficiary other than an employment contract are eligible personnel costs, if:

(a) the person works under conditions similar to those of an employee (in particular regarding the way the work is organised, the tasks that are performed and the premises where they are performed);

(b) the result of the work carried out belongs to the beneficiary (unless exceptionally agreed otherwise), and

[1] For the definition, see Article 2.1(14) of the Rules for Participation Regulation No 1290/2013: '**non-profit legal entity**' means a legal entity which by its legal form is non-profit-making or which has a legal or statutory obligation not to distribute profits to its shareholders or individual members.

(c) the costs are not significantly different from those for personnel performing similar tasks under an employment contract with the beneficiary.

A.3 The **costs of personnel seconded by a third party against payment** are eligible personnel costs, if the conditions in Article 11.1 are met.

A.4 **Costs of owners** of beneficiaries that are small and medium-sized enterprises ('**SME owners**') who are working on the action and who do not receive a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2a multiplied by the number of actual hours worked on the action.

A.5 **Costs of 'beneficiaries that are natural persons'** not receiving a salary are eligible personnel costs, if they correspond to the amount per unit set out in Annex 2a multiplied by the number of actual hours worked on the action.

<u>Calculation</u>

Personnel costs must be calculated by the beneficiaries as follows:

{{hourly rate

multiplied by

the number of actual hours worked on the action},

plus

for non-profit legal entities: additional remuneration to personnel assigned to the action under the conditions set out above (Point A.1)}.

The number of actual hours declared for a person must be identifiable and verifiable (see Article 18).

The total number of hours declared in EU or Euratom grants, for a person for a year, cannot be higher than the annual productive hours used for the calculations of the hourly rate. Therefore, the maximum number of hours that can be declared for the grant are:

{number of annual productive hours for the year (see below)

minus

total number of hours declared by the beneficiary, for that person in that year, for other EU or Euratom grants}.

The '**hourly rate**' is one of the following:

(a) for personnel costs declared as **actual costs** (i.e. budget categories A.1, A.2, A.3): the hourly rate is calculated *per full financial year*, as follows:

{actual annual personnel costs (excluding additional remuneration) for the person

divided by

number of annual productive hours}.

using the personnel costs and the number of productive hours for each full financial year covered by the reporting period concerned. If a financial year is not closed at the end of the reporting period, the beneficiaries must use the hourly rate of the last closed financial year available.

For the 'number of annual productive hours', the beneficiaries may choose one of the following:

(i) 'fixed number of hours': 1 720 hours for persons working full time (or corresponding pro-rata for persons not working full time);

(ii) 'individual annual productive hours': the total number of hours worked by the person in the year for the beneficiary, calculated as follows:

{annual workable hours of the person (according to the employment contract, applicable collective labour agreement or national law)

plus

overtime worked

minus

absences (such as sick leave and special leave)}.

'Annual workable hours' means the period during which the personnel must be working, at the employer's disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.

If the contract (or applicable collective labour agreement or national working time legislation) does not allow to determine the annual workable hours, this option cannot be used;

(iii) 'standard annual productive hours': the 'standard number of annual hours' generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the 'standard annual workable hours'.

If there is no applicable reference for the standard annual workable hours, this option cannot be used.

For all options, the actual time spent on **parental leave** by a person assigned to the action may be deducted from the number of annual productive hours.

As an alternative, beneficiaries may calculate the hourly rate *per month*, as follows:

{actual monthly personnel cost (excluding additional remuneration) for the person

divided by

{number of annual productive hours / 12}}

using the personnel costs for each month and (one twelfth of) the annual productive hours calculated according to either option (i) or (iii) above, i.e.:

- fixed number of hours or
- standard annual productive hours.

Time spent on **parental leave** may not be deducted when calculating the hourly rate per month. However, beneficiaries may declare personnel costs incurred in periods of parental leave in proportion to the time the person worked on the action in that financial year.

If parts of a basic remuneration are generated over a period longer than a month, the beneficiaries may include only the share which is generated in the month (irrespective of the amount actually paid for that month).

Each beneficiary must use only one option (per full financial year or per month) for each full financial year;

(b) for personnel costs declared on the basis of **unit costs** (i.e. budget categories A.1, A.2, A.4, A.5): the hourly rate is one of the following:

(i) for SME owners or beneficiaries that are natural persons: the hourly rate set out in Annex 2a (see Points A.4 and A.5 above), or

(ii) for personnel costs declared on the basis of the beneficiary's usual cost accounting practices: the hourly rate calculated by the beneficiary in accordance with its usual cost accounting practices, if:

- the cost accounting practices used are applied in a consistent manner, based on objective criteria, regardless of the source of funding;

- the hourly rate is calculated using the actual personnel costs recorded in the beneficiary's accounts, excluding any ineligible cost or costs included in other budget categories.

  The actual personnel costs may be adjusted by the beneficiary on the basis of budgeted or estimated elements. Those elements must be relevant for calculating the personnel costs, reasonable and correspond to objective and verifiable information;

and

- the hourly rate is calculated using the number of annual productive hours (see above).

B. Direct costs of subcontracting (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if the conditions in Article 13.1.1 are met.

C. Direct costs of providing financial support to third parties

Not applicable

D. Other direct costs

D.1 **Travel costs and related subsistence allowances** (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible if they are in line with the beneficiary's usual practices on travel.

D.2 The **depreciation costs of equipment, infrastructure or other assets** (new or second-hand) as recorded in the beneficiary's accounts are eligible, if they were purchased in accordance with

Article 10.1.1 and written off in accordance with international accounting standards and the beneficiary's usual accounting practices.

The **costs of renting or leasing** equipment, infrastructure or other assets (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are also eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets and do not include any financing fees.

The costs of equipment, infrastructure or other assets **contributed in-kind against payment** are eligible, if they do not exceed the depreciation costs of similar equipment, infrastructure or assets, do not include any financing fees and if the conditions in Article 11.1 are met.

The only portion of the costs that will be taken into account is that which corresponds to the duration of the action and rate of actual use for the purposes of the action.

D.3 **Costs of other goods and services** (including related duties, taxes and charges such as non-deductible value added tax (VAT) paid by the beneficiary) are eligible, if they are:

(a) purchased specifically for the action and in accordance with Article 10.1.1 or

(b) contributed in kind against payment and in accordance with Article 11.1.

Such goods and services include, for instance, consumables and supplies, dissemination (including open access), protection of results, certificates on the financial statements (if they are required by the Agreement), certificates on the methodology, translations and publications.

D.4 **Capitalised and operating costs of 'large research infrastructure'**[2] directly used for the action are eligible, if:

(a) the value of the large research infrastructure represents at least 75% of the total fixed assets (at historical value in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure[3]);

(b) the beneficiary's methodology for declaring the costs for large research infrastructure has been positively assessed by the Commission ('**ex-ante assessment**');

(c) the beneficiary declares as direct eligible costs only the portion which corresponds to the duration of the action and the rate of actual use for the purposes of the action, and

(d) they comply with the conditions as further detailed in the annotations to the H2020 grant agreements.

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[2] '**Large research infrastructure**' means research infrastructure of a total value of at least EUR 20 million, for a beneficiary, calculated as the sum of historical asset values of each individual research infrastructure of that beneficiary, as they appear in its last closed balance sheet before the date of the signature of the Agreement or as determined on the basis of the rental and leasing costs of the research infrastructure.

[3] For the definition, see Article 2(6) of the H2020 Framework Programme Regulation No 1291/2013: '**Research infrastructure**' are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. Where relevant, they may be used beyond research, e.g. for education or public services. They include: major scientific equipment (or sets of instruments); knowledge-based resources such as collections, archives or scientific data; e-infrastructures such as data and computing systems and communication networks; and any other infrastructure of a unique nature essential to achieve excellence in research and innovation. Such infrastructures may be 'single-sited', 'virtual' or 'distributed'.

D.5 **Costs of internally invoiced goods and services** directly used for the action are eligible, if:

(a) they are declared on the basis of a unit cost calculated in accordance with the beneficiary's usual cost accounting practices;

(b) the cost accounting practices used are applied in a consistent manner, based on objective criteria, regardless of the source of funding;

(c) the unit cost is calculated using the actual costs for the good or service recorded in the beneficiary's accounts, excluding any ineligible cost or costs included in other budget categories.

The actual costs may be adjusted by the beneficiary on the basis of budgeted or estimated elements. Those elements must be relevant for calculating the costs, reasonable and correspond to objective and verifiable information;

(d) the unit cost excludes any costs of items which are not directly linked to the production of the invoiced goods or service.

'Internally invoiced goods and services' means goods or services which are provided by the beneficiary directly for the action and which the beneficiary values on the basis of its usual cost accounting practices.

E. Indirect costs

Indirect costs are eligible if they are declared on the basis of the flat-rate of 25% of the eligible direct costs (see Article 5.2 and Points A to D above), from which are excluded:

(a) costs of subcontracting and

(b) costs of in-kind contributions provided by third parties which are not used on the beneficiary's premises;

(c) not applicable;

(d) not applicable.

Beneficiaries receiving an operating grant[4] financed by the EU or Euratom budget cannot declare indirect costs for the period covered by the operating grant, unless they can demonstrate that the operating grant does not cover any costs of the action.

F. Specific cost category(ies)

Not applicable

6.3 Conditions for costs of linked third parties to be eligible

[4] For the definition, see Article 121(1)(b) of Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 ('**Financial Regulation No 966/2012**')(OJ L 218, 26.10.2012, p.1): '**operating grant**' means direct financial contribution, by way of donation, from the budget in order to finance the functioning of a body which pursues an aim of general EU interest or has an objective forming part of and supporting an EU policy.

Costs incurred by linked third parties are eligible if they fulfil — *mutatis mutandis* — the general and specific conditions for eligibility set out in this Article (Article 6.1 and 6.2) and Article 14.1.1.

6.4 Conditions for in-kind contributions provided by third parties free of charge to be eligible

In-kind contributions provided free of charge are eligible direct costs (for the beneficiary or linked third party), if the costs incurred by the third party fulfil — *mutatis mutandis* — the general and specific conditions for eligibility set out in this Article (Article 6.1 and 6.2) and Article 12.1.

6.5 Ineligible costs

'**Ineligible costs**' are:

(a) costs that do not comply with the conditions set out above (Article 6.1 to 6.4), in particular:

- (i) costs related to return on capital;
- (ii) debt and debt service charges;
- (iii) provisions for future losses or debts;
- (iv) interest owed;
- (v) doubtful debts;
- (vi) currency exchange losses;
- (vii) bank costs charged by the beneficiary's bank for transfers from the Commission;
- (viii) excessive or reckless expenditure;
- (ix) deductible VAT;
- (x) costs incurred during suspension of the implementation of the action (see Article 49);

(b) costs declared under another EU or Euratom grant (including grants awarded by a Member State and financed by the EU or Euratom budget and grants awarded by bodies other than the Commission for the purpose of implementing the EU or Euratom budget); in particular, indirect costs if the beneficiary is already receiving an operating grant financed by the EU or Euratom budget in the same period, unless it can demonstrate that the operating grant does not cover any costs of the action.

6.6 Consequences of declaration of ineligible costs

Declared costs that are ineligible will be rejected (see Article 42).

This may also lead to any of the other measures described in Chapter 6.

CHAPTER 4 RIGHTS AND OBLIGATIONS OF THE PARTIES

SECTION 1 RIGHTS AND OBLIGATIONS RELATED TO IMPLEMENTING THE ACTION

ARTICLE 7 — GENERAL OBLIGATION TO PROPERLY IMPLEMENT THE ACTION

7.1 General obligation to properly implement the action

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement and all legal obligations under applicable EU, international and national law.

7.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 8 — RESOURCES TO IMPLEMENT THE ACTION — THIRD PARTIES INVOLVED IN THE ACTION

The beneficiaries must have the appropriate resources to implement the action.

If it is necessary to implement the action, the beneficiaries may:

- purchase goods, works and services (see Article 10);
- use in-kind contributions provided by third parties against payment (see Article 11);
- use in-kind contributions provided by third parties free of charge (see Article 12);
- call upon subcontractors to implement action tasks described in Annex 1 (see Article 13);
- call upon linked third parties to implement action tasks described in Annex 1 (see Article 14);
- call upon international partners to implement action tasks described in Annex 1 (see Article 14a).

In these cases, the beneficiaries retain sole responsibility towards the Commission and the other beneficiaries for implementing the action.

ARTICLE 9 — IMPLEMENTATION OF ACTION TASKS BY BENEFICIARIES NOT RECEIVING EU FUNDING

Not applicable

ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES

10.1 Rules for purchasing goods, works or services

10.1.1 If necessary to implement the action, the beneficiaries may purchase goods, works or services.

The beneficiaries must make such purchases ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their contractors.

10.1.2 Beneficiaries that are 'contracting authorities' within the meaning of Directive 2004/18/EC[5] (or 2014/24/EU[6]) or 'contracting entities' within the meaning of Directive 2004/17/EC[7] (or 2014/25/EU[8]) must comply with the applicable national law on public procurement.

10.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 10.1.1, the costs related to the contract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 10.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 11 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES AGAINST PAYMENT

11.1 Rules for the use of in-kind contributions against payment

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties against payment.

The beneficiaries may declare costs related to the payment of in-kind contributions as eligible (see Article 6.1 and 6.2), up to the third parties' costs for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services.

The third parties and their contributions must be set out in Annex 1. The Commission may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the

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5 Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public work contracts, public supply contracts and public service contracts (OJ L 134, 30.04.2004, p. 114).

6 Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC. (OJ L 94, 28.03.2014, p. 65).

7 Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors (OJ L 134, 30.04.2004, p. 1)

8 Directive 2014/25/EU of the European Parliament and of the Council of 26 February 2014 on procurement by entities operating in the water, energy, transport and postal services sectors and repealing Directive 2004/17/EC (OJ L 94, 28.03.2014, p. 243).

European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

11.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the costs related to the payment of the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 12 — USE OF IN-KIND CONTRIBUTIONS PROVIDED BY THIRD PARTIES FREE OF CHARGE

12.1 Rules for the use of in-kind contributions free of charge

If necessary to implement the action, the beneficiaries may use in-kind contributions provided by third parties free of charge.

The beneficiaries may declare costs incurred by the third parties for the seconded persons, contributed equipment, infrastructure or other assets or other contributed goods and services as eligible in accordance with Article 6.4.

The third parties and their contributions must be set out in Annex 1. The Commission may however approve in-kind contributions not set out in Annex 1 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- their use does not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards the third parties.

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the costs incurred by the third parties related to the in-kind contribution will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 13 — IMPLEMENTATION OF ACTION TASKS BY SUBCONTRACTORS

13.1 Rules for subcontracting action tasks

13.1.1 If necessary to implement the action, the beneficiaries may award subcontracts covering the implementation of certain action tasks described in Annex 1.

Subcontracting may cover only a limited part of the action.

The beneficiaries must award the subcontracts ensuring the best value for money or, if appropriate, the lowest price. In doing so, they must avoid any conflict of interests (see Article 35).

The tasks to be implemented and the estimated cost for each subcontract must be set out in Annex 1 and the total estimated costs of subcontracting per beneficiary must be set out in Annex 2. The Commission may however approve subcontracts not set out in Annex 1 and 2 without amendment (see Article 55), if:

- they are specifically justified in the periodic technical report and
- they do not entail changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their subcontractors.

13.1.2 The beneficiaries must ensure that their obligations under Articles 35, 36, 38 and 46 also apply to the subcontractors.

Beneficiaries that are 'contracting authorities' within the meaning of Directive 2004/18/EC (or 2014/24/EU) or 'contracting entities' within the meaning of Directive 2004/17/EC (or 2014/25/EU) must comply with the applicable national law on public procurement.

13.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 13.1.1, the costs related to the subcontract concerned will be ineligible (see Article 6) and will be rejected (see Article 42).

If a beneficiary breaches any of its obligations under Article 13.1.2, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 14 — IMPLEMENTATION OF ACTION TASKS BY LINKED THIRD PARTIES

14.1 Rules for calling upon linked third parties to implement part of the action

14.1.1 The following **affiliated entities**[10] and **third parties with a legal link to a beneficiary**[11] ('**linked third parties**') may implement the action tasks attributed to them in Annex 1:

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[10] For the definition see Article 2.1(2) Rules for Participation Regulation No 1290/2013: '**affiliated entity**' means any legal entity that is:
- under the direct or indirect control of a participant, or
- under the same direct or indirect control as the participant, or
- directly or indirectly controlling a participant.

'Control' may take any of the following forms:
(a) the direct or indirect holding of more than 50% of the nominal value of the issued share capital in the legal entity concerned, or of a majority of the voting rights of the shareholders or associates of that entity;
(b) the direct or indirect holding, in fact or in law, of decision-making powers in the legal entity concerned.

However the following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:
(a) the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50% of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;
(b) the legal entities concerned are owned or supervised by the same public body.

- UNIVERSITE DE CAEN NORMANDIE (UNICAEN), affiliated or linked to CNRS
- INSTITUT POLYTECHNIQUE DE GRENOBLE (G-INP), affiliated or linked to CNRS
- UNIVERSITE DE BORDEAUX (UBx), affiliated or linked to CNRS
- INSTITUT MINES-TELECOM (IMT Atlantique), affiliated or linked to CNRS
- UNIVERSITE DE NANTES (Univ Nantes), affiliated or linked to CNRS

The linked third parties may declare as eligible the costs they incur for implementing the action tasks in accordance with Article 6.3.

The beneficiaries must ensure that the Commission, the European Court of Auditors (ECA) and the European Anti-Fraud Office (OLAF) can exercise their rights under Articles 22 and 23 also towards their linked third parties.

14.1.2 The beneficiaries must ensure that their obligations under Articles 18, 20, 35, 36 and 38 also apply to their linked third parties.

14.2 Consequences of non-compliance

If any obligation under Article 14.1.1 is breached, the costs of the linked third party will be ineligible (see Article 6) and will be rejected (see Article 42).

If any obligation under Article 14.1.2 is breached, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 14a — IMPLEMENTATION OF ACTION TASKS BY INTERNATIONAL PARTNERS

Not applicable

ARTICLE 15 — FINANCIAL SUPPORT TO THIRD PARTIES

15.1 Rules for providing financial support to third parties

Not applicable

15.2 Financial support in the form of prizes

Not applicable

15.3 Consequences of non-compliance

Not applicable

[11] **'Third party with a legal link to a beneficiary'** is any legal entity which has a legal link to the beneficiary implying collaboration that is not limited to the action.

ARTICLE 16 — PROVISION OF TRANS-NATIONAL OR VIRTUAL ACCESS TO RESEARCH INFRASTRUCTURE

16.1 Rules for providing trans-national access to research infrastructure

Not applicable

16.2 Rules for providing virtual access to research infrastructure

Not applicable

16.3 Consequences of non-compliance

Not applicable

SECTION 2 RIGHTS AND OBLIGATIONS RELATED TO THE GRANT ADMINISTRATION

ARTICLE 17 — GENERAL OBLIGATION TO INFORM

17.1 General obligation to provide information upon request

The beneficiaries must provide — during implementation of the action or afterwards and in accordance with Article 41.2 — any information requested in order to verify eligibility of the costs, proper implementation of the action and compliance with any other obligation under the Agreement.

17.2 Obligation to keep information up to date and to inform about events and circumstances likely to affect the Agreement

Each beneficiary must keep information stored in the Participant Portal Beneficiary Register (via the electronic exchange system; see Article 52) up to date, in particular, its name, address, legal representatives, legal form and organisation type.

Each beneficiary must immediately inform the coordinator — which must immediately inform the Commission and the other beneficiaries — of any of the following:

(a) **events** which are likely to affect significantly or delay the implementation of the action or the EU's financial interests, in particular:

- (i) changes in its legal, financial, technical, organisational or ownership situation or those of its linked third parties and
- (ii) changes in the name, address, legal form, organisation type of its linked third parties;

(b) **circumstances** affecting:

- (i) the decision to award the grant or
- (ii) compliance with requirements under the Agreement.

17.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 18 — KEEPING RECORDS — SUPPORTING DOCUMENTATION

18.1 Obligation to keep records and other supporting documentation

The beneficiaries must — for a period of five years after the payment of the balance — keep records and other supporting documentation in order to prove the proper implementation of the action and the costs they declare as eligible.

They must make them available upon request (see Article 17) or in the context of checks, reviews, audits or investigations (see Article 22).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Article 22), the beneficiaries must keep the records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The Commission may accept non-original documents if it considers that they offer a comparable level of assurance.

18.1.1 Records and other supporting documentation on the scientific and technical implementation

The beneficiaries must keep records and other supporting documentation on scientific and technical implementation of the action in line with the accepted standards in the respective field.

18.1.2 Records and other documentation to support the costs declared

The beneficiaries must keep the records and documentation supporting the costs declared, in particular the following:

(a) for **actual costs**: adequate records and other supporting documentation to prove the costs declared, such as contracts, subcontracts, invoices and accounting records. In addition, the beneficiaries' usual cost accounting practices and internal control procedures must enable direct reconciliation between the amounts declared, the amounts recorded in their accounts and the amounts stated in the supporting documentation;

(b) for **unit costs**: adequate records and other supporting documentation to prove the number of units declared. Beneficiaries do not need to identify the actual eligible costs covered or to keep or provide supporting documentation (such as accounting statements) to prove the amount per unit.

In addition, **for unit costs calculated in accordance with the beneficiary's usual cost accounting practices**, the beneficiaries must keep adequate records and documentation to prove that the cost accounting practices used comply with the conditions set out in Article 6.2.

The beneficiaries and linked third parties may submit to the Commission, for approval, a certificate (drawn up in accordance with Annex 6) stating that their usual cost accounting practices comply with these conditions ('**certificate on the methodology**'). If the certificate is approved, costs declared in line with this methodology will not be challenged subsequently, unless the beneficiaries have concealed information for the purpose of the approval.

(c) for **flat-rate costs**: adequate records and other supporting documentation to prove the eligibility of the costs to which the flat-rate is applied. The beneficiaries do not need to identify the costs covered or provide supporting documentation (such as accounting statements) to prove the amount declared at a flat-rate.

In addition, for **personnel costs** (declared as actual costs or on the basis of unit costs), the beneficiaries must keep **time records** for the number of hours declared. The time records must be in writing and approved by the persons working on the action and their supervisors, at least monthly. In the absence of reliable time records of the hours worked on the action, the Commission may accept alternative evidence supporting the number of hours declared, if it considers that it offers an adequate level of assurance.

As an exception, for **persons working exclusively on the action**, there is no need to keep time records, if the beneficiary signs a **declaration** confirming that the persons concerned have worked exclusively on the action.

For costs declared by linked third parties (see Article 14), it is the beneficiary that must keep the originals of the financial statements and the certificates on the financial statements of the linked third parties.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, costs insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 42), and the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 19 — SUBMISSION OF DELIVERABLES

19.1 Obligation to submit deliverables

The coordinator must submit the '**deliverables**' identified in Annex 1, in accordance with the timing and conditions set out in it.

19.2 Consequences of non-compliance

If the coordinator breaches any of its obligations under this Article, the Commission may apply any of the measures described in Chapter 6.

ARTICLE 20 — REPORTING — PAYMENT REQUESTS

20.1 Obligation to submit reports

The coordinator must submit to the Commission (see Article 52) the technical and financial reports set out in this Article. These reports include requests for payment and must be drawn up using the forms and templates provided in the electronic exchange system (see Article 52).

20.2 Reporting periods

The action is divided into the following ‘**reporting periods**’:

- RP1: from month 1 to month 18
- RP2: from month 19 to month 36
- RP3: from month 37 to month 48

20.3 Periodic reports — Requests for interim payments

The coordinator must submit a periodic report within 60 days following the end of each reporting period.

The **periodic report** must include the following:

(a) a ‘**periodic technical report**’ containing:

(i) an **explanation of the work carried out** by the beneficiaries;

(ii) an **overview of the progress** towards the objectives of the action, including milestones and deliverables identified in Annex 1.

This report must include explanations justifying the differences between work expected to be carried out in accordance with Annex 1 and that actually carried out.

The report must detail the exploitation and dissemination of the results and — if required in Annex 1 — an updated ‘**plan for the exploitation and dissemination of the results**’.

The report must indicate the communication activities;

(iii) a **summary** for publication by the Commission;

(iv) the answers to the ‘**questionnaire**’, covering issues related to the action implementation and the economic and societal impact, notably in the context of the Horizon 2020 key performance indicators and the Horizon 2020 monitoring requirements;

(b) a ‘**periodic financial report**’ containing:

(i) an ‘**individual financial statement**’ (see Annex 4) from each beneficiary and from each linked third party, for the reporting period concerned.

The individual financial statement must detail the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) for each budget category (see Annex 2).

The beneficiaries and linked third parties must declare all eligible costs, even if — for actual costs, unit costs and flat-rate costs — they exceed the amounts indicated in the estimated budget (see Annex 2). Amounts which are not declared in the individual financial statement will not be taken into account by the Commission.

If an individual financial statement is not submitted for a reporting period, it may be included in the periodic financial report for the next reporting period.

The individual financial statements of the last reporting period must also detail the **receipts of the action** (see Article 5.3.3).

Each beneficiary and each linked third party must **certify** that:

- the information provided is full, reliable and true;
- the costs declared are eligible (see Article 6);
- the costs can be substantiated by adequate records and supporting documentation (see Article 18) that will be produced upon request (see Article 17) or in the context of checks, reviews, audits and investigations (see Article 22), and
- for the last reporting period: that all the receipts have been declared (see Article 5.3.3);

(ii) an **explanation of the use of resources** and the information on subcontracting (see Article 13) and in-kind contributions provided by third parties (see Articles 11 and 12) from each beneficiary and from each linked third party, for the reporting period concerned;

(iii) information on the amount of each interim payment and payment of the balance to be paid by the Commission to the Joint Research Centre (JRC);

(iv) a '**periodic summary financial statement**', created automatically by the electronic exchange system, consolidating the individual financial statements for the reporting period concerned and including — except for the last reporting period — the **request for interim payment**.

20.4 Final report — Request for payment of the balance

In addition to the periodic report for the last reporting period, the coordinator must submit the final report within 60 days following the end of the last reporting period.

The **final report** must include the following:

(a) a '**final technical report**' with a **summary** for publication containing:

(i) an overview of the results and their exploitation and dissemination;

(ii) the conclusions on the action, and

(iii) the socio-economic impact of the action;

(b) a '**final financial report**' containing:

(i) a '**final summary financial statement**', created automatically by the electronic exchange system, consolidating the individual financial statements for all reporting periods and including the **request for payment of the balance** and

(ii) a '**certificate on the financial statements**' (drawn up in accordance with Annex 5) for each beneficiary and for each linked third party, if it requests a total contribution of

EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 5.2 and Article 6.2).

20.5 Information on cumulative expenditure incurred

Not applicable

20.6 Currency for financial statements and conversion into euro

Financial statements must be drafted in euro.

Beneficiaries and linked third parties with accounting established in a currency other than the euro must convert the costs recorded in their accounts into euro, at the average of the daily exchange rates published in the C series of the *Official Journal of the European Union*, calculated over the corresponding reporting period.

If no daily euro exchange rate is published in the *Official Journal of the European Union* for the currency in question, they must be converted at the average of the monthly accounting rates published on the Commission's website, calculated over the corresponding reporting period.

Beneficiaries and linked third parties with accounting established in euro must convert costs incurred in another currency into euro according to their usual accounting practices.

20.7 Language of reports

All reports (technical and financial reports, including financial statements) must be submitted in the language of the Agreement.

20.8 Consequences of non-compliance

If the reports submitted do not comply with this Article, the Commission may suspend the payment deadline (see Article 47) and apply any of the other measures described in Chapter 6.

If the coordinator breaches its obligation to submit the reports and if it fails to comply with this obligation within 30 days following a written reminder, the Commission may terminate the Agreement (see Article 50) or apply any of the other measures described in Chapter 6.

ARTICLE 21 — PAYMENTS AND PAYMENT ARRANGEMENTS

21.1 Payments to be made

The following payments will be made to the coordinator:

- one **pre-financing payment**;
- one or more **interim payments**, on the basis of the request(s) for interim payment (see Article 20), and
- one **payment of the balance**, on the basis of the request for payment of the balance (see Article 20).

21.2 Pre-financing payment — Amount — Amount retained for the Guarantee Fund

The aim of the pre-financing is to provide the beneficiaries with a float.

It remains the property of the EU until the payment of the balance.

The amount of the pre-financing payment will be EUR **1 866 638.93** (one million eight hundred and sixty six thousand six hundred and thirty eight EURO and ninety three eurocents).

The Commission will — except if Article 48 applies — make the pre-financing payment to the coordinator within 30 days, either from the entry into force of the Agreement (see Article 58) or from 10 days before the starting date of the action (see Article 3), whichever is the latest.

An amount of EUR **174 997.40** (one hundred and seventy four thousand nine hundred and ninety seven EURO and forty eurocents), corresponding to 5% of the maximum grant amount (see Article 5.1), is retained by the Commission from the pre-financing payment and transferred into the '**Guarantee Fund**'.

Moreover, the part of the pre-financing payment related to the Joint Research Centre (JRC) (**165 332.80** (one hundred and sixty five thousand three hundred and thirty two EURO and eighty eurocents)) is not paid to the coordinator, but kept by the Commission for the JRC.

21.3 Interim payments — Amount — Calculation

Interim payments reimburse the eligible costs incurred for the implementation of the action during the corresponding reporting periods.

The Commission will pay to the coordinator the amount due as interim payment within 90 days from receiving the periodic report (see Article 20.3), except if Articles 47 or 48 apply.

Payment is subject to the approval of the periodic report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as interim payment** is calculated by the Commission in the following steps:

Step 1 — Application of the reimbursement rates

Step 2 — Limit to 90% of the maximum grant amount

21.3.1 Step 1 — Application of the reimbursement rates

The reimbursement rate(s) (see Article 5.2) are applied to the eligible costs (actual costs, unit costs and flat-rate costs; see Article 6) declared by the beneficiaries and the linked third parties (see Article 20) and approved by the Commission (see above) for the concerned reporting period.

21.3.2 Step 2 — Limit to 90% of the maximum grant amount

The total amount of pre-financing and interim payments must not exceed 90% of the maximum grant amount set out in Article 5.1. The maximum amount for the interim payment will be calculated as follows:

{90% of the maximum grant amount (see Article 5.1)

minus

{pre-financing and previous interim payments}}.

21.4 Payment of the balance — Amount — Calculation — Release of the amount retained for the Guarantee Fund

The payment of the balance reimburses the remaining part of the eligible costs incurred by the beneficiaries for the implementation of the action.

If the total amount of earlier payments is greater than the final grant amount (see Article 5.3), the payment of the balance takes the form of a recovery (see Article 44).

If the total amount of earlier payments is lower than the final grant amount, the Commission will pay the balance within 90 days from receiving the final report (see Article 20.4), except if Articles 47 or 48 apply.

Payment is subject to the approval of the final report. Its approval does not imply recognition of the compliance, authenticity, completeness or correctness of its content.

The **amount due as the balance** is calculated by the Commission by deducting the total amount of pre-financing and interim payments (if any) already made, from the final grant amount determined in accordance with Article 5.3:

{final grant amount (see Article 5.3)

minus

{pre-financing and interim payments (if any) made}}.

At the payment of the balance, the amount retained for the Guarantee Fund (see above) will be released and:

- if the balance is positive: the amount released will be paid in full to the coordinator together with the amount due as the balance;
- if the balance is negative (payment of the balance taking the form of recovery): it will be deducted from the amount released (see Article 44.1.2). If the resulting amount:
    - is positive, it will be paid to the coordinator
    - is negative, it will be recovered.

The amount to be paid may however be offset — without the beneficiaries' consent — against any other amount owed by a beneficiary to the Commission or an executive agency (under the EU or Euratom budget), up to the maximum EU contribution indicated, for that beneficiary, in the estimated budget (see Annex 2).

21.5 Notification of amounts due

When making payments, the Commission will formally notify to the coordinator the amount due, specifying whether it concerns an interim payment or the payment of the balance.

For the payment of the balance, the notification will also specify the final grant amount.

In the case of reduction of the grant or recovery of undue amounts, the notification will be preceded by the contradictory procedure set out in Articles 43 and 44.

21.6 Currency for payments

The Commission will make all payments in euro.

21.7 Payments to the coordinator — Distribution to the beneficiaries

Payments will be made to the coordinator.

Payments to the coordinator will discharge the Commission from its payment obligation.

The coordinator must distribute the payments between the beneficiaries without unjustified delay.

Pre-financing may however be distributed only:

(a) if the minimum number of beneficiaries set out in the call for proposals has acceded to the Agreement (see Article 56) and

(b) to beneficiaries that have acceded to the Agreement (see Article 56).

21.8 Bank account for payments

All payments will be made to the following bank account:

Name of bank: BANCO BILBAO VIZCAYA ARGENTARIA S.A.
Full name of the account holder: CENTRO INVESTIGACIONES ENERGETICASMEDIOAMBIENTALES TECNOLOGICA CIEMAT
IBAN code: ES8901822370450200019431

21.9 Costs of payment transfers

The cost of the payment transfers is borne as follows:

- the Commission bears the cost of transfers charged by its bank;
- the beneficiary bears the cost of transfers charged by its bank;
- the party causing a repetition of a transfer bears all costs of the repeated transfer.

21.10 Date of payment

Payments by the Commission are considered to have been carried out on the date when they are debited to its account.

21.11 Consequences of non-compliance

21.11.1 If the Commission does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros ('reference rate'), plus three and a half points. The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only upon request submitted within two months of receiving the late payment.

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

Suspension of the payment deadline or payments (see Articles 47 and 48) will not be considered as late payment.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

21.11.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or the participation of the coordinator may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 22 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

22.1 Checks, reviews and audits by the Commission

22.1.1 Right to carry out checks

The Commission will — during the implementation of the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing deliverables and reports.

For this purpose the Commission may be assisted by external persons or bodies.

The Commission may also request additional information in accordance with Article 17. The Commission may request beneficiaries to provide such information to it directly.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

22.1.2 Right to carry out reviews

The Commission may — during the implementation of the action or afterwards — carry out reviews on the proper implementation of the action (including assessment of deliverables and reports), compliance with the obligations under the Agreement and continued scientific or technological relevance of the action.

Reviews may be started up to two years after the payment of the balance. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the review is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The Commission may carry out reviews directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted (including information on the use of resources). The Commission may request beneficiaries to provide such information to it directly.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with external experts.

For **on-the-spot** reviews, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a '**review report**' will be drawn up.

The Commission will formally notify the review report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations ('**contradictory review procedure**').

Reviews (including review reports) are in the language of the Agreement.

22.1.3 Right to carry out audits

The Commission may — during the implementation of the action or afterwards — carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Audits may be started up to two years after the payment of the balance. They will be formally notified to the coordinator or beneficiary concerned and will be considered to have started on the date of the formal notification.

If the audit is carried out on a third party (see Articles 10 to 16), the beneficiary concerned must inform the third party.

The Commission may carry out audits directly (using its own staff) or indirectly (using external persons or bodies appointed to do so). It will inform the coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

The coordinator or beneficiary concerned must provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. The Commission may request beneficiaries to provide such information to it directly.

For **on-the-spot** audits, the beneficiaries must allow access to their sites and premises, including to external persons or bodies, and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a '**draft audit report**' will be drawn up.

The Commission will formally notify the draft audit report to the coordinator or beneficiary concerned, which has 30 days to formally notify observations ('**contradictory audit procedure**'). This period may be extended by the Commission in justified cases.

The '**final audit report**' will take into account observations by the coordinator or beneficiary concerned. The report will be formally notified to it.

Audits (including audit reports) are in the language of the Agreement.

The Commission may also access the beneficiaries' statutory records for the periodical assessment of unit costs or flat-rate amounts.

22.2 Investigations by the European Anti-Fraud Office (OLAF)

Under Regulations No 883/2013[16] and No 2185/96[17] (and in accordance with their provisions and procedures), the European Anti-Fraud Office (OLAF) may — at any moment during implementation of the action or afterwards — carry out investigations, including on-the-spot checks and inspections, to establish whether there has been fraud, corruption or any other illegal activity affecting the financial interests of the EU.

22.3 Checks and audits by the European Court of Auditors (ECA)

Under Article 287 of the Treaty on the Functioning of the European Union (TFEU) and Article 161 of the Financial Regulation No 966/2012[18], the European Court of Auditors (ECA) may — at any moment during implementation of the action or afterwards — carry out audits.

The ECA has the right of access for the purpose of checks and audits.

22.4 Checks, reviews, audits and investigations for international organisations

In conformity with its financial regulations, the European Union, including the European Anti-Fraud Office (OLAF) and the European Court of Auditors (ECA), may undertake, including on the spot, checks, reviews, audits and investigations.

This Article will be applied in accordance with any specific agreement concluded in this respect by the international organisation and the European Union.

22.5 Consequences of findings in checks, reviews, audits and investigations — Extension of findings

[16] Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18.09.2013, p. 1).

[17] Council Regulation (Euratom, EC) No 2185/1996 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities' financial interests against fraud and other irregularities (OJ L 292, 15.11.1996, p. 2).

[18] Regulation (EU, Euratom) No 966/2012 of the European Parliament and of the Council of 25 October 2012 on the financial rules applicable to the general budget of the Union and repealing Council Regulation (EC, Euratom) No 1605/2002 (OJ L 298, 26.10.2012, p. 1).

22.5.1 Findings in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to the rejection of ineligible costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44) or to any of the other measures described in Chapter 6.

Rejection of costs or reduction of the grant after the payment of the balance will lead to a revised final grant amount (see Article 5.4).

Findings in checks, reviews, audits or investigations may lead to a request for amendment for the modification of Annex 1 (see Article 55).

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations may also lead to consequences in other EU or Euratom grants awarded under similar conditions ('**extension of findings from this grant to other grants**').

Moreover, findings arising from an OLAF investigation may lead to criminal prosecution under national law.

22.5.2 Findings in other grants

The Commission may extend findings from other grants to this grant ('**extension of findings from other grants to this grant**'), if:

(a) the beneficiary concerned is found, in other EU or Euratom grants awarded under similar conditions, to have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and

(b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — no later than two years after the payment of the balance of this grant.

The extension of findings may lead to the rejection of costs (see Article 42), reduction of the grant (see Article 43), recovery of undue amounts (see Article 44), suspension of payments (see Article 48), suspension of the action implementation (see Article 49) or termination (see Article 50).

22.5.3 Procedure

The Commission will formally notify the beneficiary concerned the systemic or recurrent errors and its intention to extend these audit findings, together with the list of grants affected.

22.5.3.1 If the findings concern **eligibility of costs**: the formal notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings;

(b) the request to submit **revised financial statements** for all grants affected;

(c) the **correction rate for extrapolation** established by the Commission on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected if the beneficiary concerned:

(i) considers that the submission of revised financial statements is not possible or practicable or

(ii) does not submit revised financial statements.

The beneficiary concerned has 90 days from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method**. This period may be extended by the Commission in justified cases.

The Commission may then start a rejection procedure in accordance with Article 42, on the basis of:

- the revised financial statements, if approved;
- the proposed alternative correction method, if accepted

or

- the initially notified correction rate for extrapolation, if it does not receive any observations or revised financial statements, does not accept the observations or the proposed alternative correction method or does not approve the revised financial statements.

22.5.3.2 If the findings concern **substantial errors**, **irregularities or fraud** or **serious breach of obligations**: the formal notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings and

(b) the flat-rate the Commission intends to apply according to the principle of proportionality.

The beneficiary concerned has 90 days from receiving notification to submit observations or to propose a duly substantiated alternative flat-rate.

The Commission may then start a reduction procedure in accordance with Article 43, on the basis of:

- the proposed alternative flat-rate, if accepted

or

- the initially notified flat-rate, if it does not receive any observations or does not accept the observations or the proposed alternative flat-rate.

22.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, any insufficiently substantiated costs will be ineligible (see Article 6) and will be rejected (see Article 42).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 23 — EVALUATION OF THE IMPACT OF THE ACTION

23.1 Right to evaluate the impact of the action

The Commission may carry out interim and final evaluations of the impact of the action measured against the objective of the Euratom programme.

Evaluations may be started during implementation of the action and up to five years after the payment of the balance. The evaluation is considered to start on the date of the formal notification to the coordinator or beneficiaries.

The Commission may make these evaluations directly (using its own staff) or indirectly (using external bodies or persons it has authorised to do so).

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

23.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the Commission may apply the measures described in Chapter 6.

SECTION 3 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND AND RESULTS

SUBSECTION 1 GENERAL

ARTICLE 23a — MANAGEMENT OF INTELLECTUAL PROPERTY

23a.1 Obligation to take measures to implement the Commission Recommendation on the management of intellectual property in knowledge transfer activities

Beneficiaries that are universities or other public research organisations must take measures to implement the principles set out in Points 1 and 2 of the Code of Practice annexed to the Commission Recommendation on the management of intellectual property in knowledge transfer activities[19].

This does not change the obligations set out in Subsections 2 and 3 of this Section.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

23a.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the Commission may apply any of the measures described in Chapter 6.

SUBSECTION 2 RIGHTS AND OBLIGATIONS RELATED TO BACKGROUND

ARTICLE 24 — AGREEMENT ON BACKGROUND

24.1 Agreement on background

The beneficiaries must identify and agree (in writing) on the background for the action ('**agreement on background**').

[19] Commission Recommendation C(2008) 1329 of 10.4.2008 on the management of intellectual property in knowledge transfer activities and the Code of Practice for universities and other public research institutions attached to this recommendation.

'**Background**' means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that:

(a) is held by the beneficiaries before they acceded to the Agreement, and

(b) is needed to implement the action or exploit the results.

24.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 25 — ACCESS RIGHTS TO BACKGROUND

25.1 Exercise of access rights — Waiving of access rights — No sub-licensing

To exercise access rights, this must first be requested in writing ('**request for access**').

'**Access rights**' means rights to use results or background under the terms and conditions laid down in this Agreement.

Waivers of access rights are not valid unless in writing.

Unless agreed otherwise, access rights do not include the right to sub-license.

25.2 Access rights for other beneficiaries, for implementing their own tasks under the action

The beneficiaries must give each other access — on a royalty-free basis — to background needed to implement their own tasks under the action, unless the beneficiary that holds the background has — before acceding to the Agreement —:

(a) informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel), or

(b) agreed with the other beneficiaries that access would not be on a royalty-free basis.

25.3 Access rights for other beneficiaries, for exploiting their own results

The beneficiaries must give each other access — under fair and reasonable conditions — to background needed for exploiting their own results, unless the beneficiary that holds the background has — before acceding to the Agreement — informed the other beneficiaries that access to its background is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel).

'**Fair and reasonable conditions**' means appropriate conditions, including possible financial terms or royalty-free conditions, taking into account the specific circumstances of the request for access, for example the actual or potential value of the results or background to which access is requested and/or the scope, duration or other characteristics of the exploitation envisaged.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

25.4 Access rights for affiliated entities

Unless otherwise agreed in the consortium agreement, access to background must also be given — under fair and reasonable conditions (see above; Article 25.3) and unless it is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel) — to affiliated entities[20] established in an EU Member State or '**associated country**'[21], if this is needed to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 25.1), the affiliated entity concerned must make the request directly to the beneficiary that holds the background.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

25.5 Access rights for third parties

Not applicable

25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

SUBSECTION 3 RIGHTS AND OBLIGATIONS RELATED TO RESULTS

ARTICLE 26 — OWNERSHIP OF RESULTS

26.1 Ownership by the beneficiary that generates the results

Results are owned by the beneficiary that generates them.

'**Results**' means any (tangible or intangible) output of the action such as data, knowledge or information — whatever its form or nature, whether it can be protected or not — that is generated in the action, as well as any rights attached to it, including intellectual property rights.

26.2 Joint ownership by several beneficiaries

Two or more beneficiaries own results jointly if:

[20] For the definition, see 'affiliated entity' footnote (Article 14.1).

[21] For the definition, see Article 2.1(3) of the Rules for Participation Regulation No 1290/2013: '**associated country**' means a third country which is party to an international agreement with the Union, as identified in Article 5 of Council Regulation (Euratom) No 1314/2013 of 16 December 2013 on the Research and Training Programme of the European Atomic Energy Community (2014-2018) complementing the Horizon 2020 – The Framework Programme for Research and Innovation ('**H2020 Euratom Research and Training Programme Regulation No 1314/2013**') (OJ L 347, 20.12.2013, p. 948) . Article 5 sets out the conditions for association of non-EU countries to Horizon 2020.

(a) they have jointly generated them and

(b) it is not possible to:

(i) establish the respective contribution of each beneficiary, or

(ii) separate them for the purpose of applying for, obtaining or maintaining their protection (see Article 27).

The joint owners must agree (in writing) on the allocation and terms of exercise of their joint ownership ('**joint ownership agreement**'), to ensure compliance with their obligations under this Agreement.

Unless otherwise agreed in the joint ownership agreement, each joint owner may grant non-exclusive licences to third parties to exploit jointly-owned results (without any right to sub-license), if the other joint owners are given:

(a) at least 45 days advance notice and

(b) fair and reasonable compensation.

Once the results have been generated, joint owners may agree (in writing) to apply another regime than joint ownership (such as, for instance, transfer to a single owner (see Article 30) with access rights for the others).

26.3 Rights of third parties (including personnel)

If third parties (including personnel) may claim rights to the results, the beneficiary concerned must ensure that it complies with its obligations under the Agreement.

If a third party generates results, the beneficiary concerned must obtain all necessary rights (transfer, licences or other) from the third party, in order to be able to respect its obligations as if those results were generated by the beneficiary itself.

If obtaining the rights is impossible, the beneficiary must refrain from using the third party to generate the results.

26.4 Euratom ownership, to protect results

26.4.1 Euratom may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to disseminate its results without protecting them, except in any of the following cases:

(a) the lack of protection is because protecting the results is not possible, reasonable or justified (given the circumstances);

(b) the lack of protection is because there is a lack of potential for commercial or industrial exploitation, or

(c) the beneficiary intends to transfer the results to another beneficiary or third party established in an EU Member State or associated country, which will protect them.

Before the results are disseminated and unless any of the cases above under Points (a), (b) or (c) applies, the beneficiary must formally notify the Commission and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the Commission decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

No dissemination relating to these results may take place before the end of this period or, if the Commission takes a positive decision, until it has taken the necessary steps to protect the results.

26.4.2 Euratom may — with the consent of the beneficiary concerned — assume ownership of results to protect them, if a beneficiary intends — up to four years after the period set out in Article 3 — to stop protecting them or not to seek an extension of protection, except in any of the following cases:

(a) the protection is stopped because of a lack of potential for commercial or industrial exploitation;

(b) an extension would not be justified given the circumstances.

A beneficiary that intends to stop protecting results or not seek an extension must — unless any of the cases above under Points (a) or (b) applies — formally notify the Commission at least 60 days before the protection lapses or its extension is no longer possible and at the same time inform it of any reasons for refusing consent. The beneficiary may refuse consent only if it can show that its legitimate interests would suffer significant harm.

If the Commission decides to assume ownership, it will formally notify the beneficiary concerned within 45 days of receiving notification.

26.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to the any of the other measures described in Chapter 6.

ARTICLE 27 — PROTECTION OF RESULTS — VISIBILITY OF EU FUNDING

27.1 Obligation to protect the results

Each beneficiary must examine the possibility of protecting its results and must adequately protect them — for an appropriate period and with appropriate territorial coverage — if:

(a) the results can reasonably be expected to be commercially or industrially exploited and

(b) protecting them is possible, reasonable and justified (given the circumstances).

When deciding on protection, the beneficiary must consider its own legitimate interests and the legitimate interests (especially commercial) of the other beneficiaries.

27.2 Euratom ownership, to protect the results

If a beneficiary intends not to protect its results, to stop protecting them or not seek an extension of protection, Euratom may — under certain conditions (see Article 26.4) — assume ownership to ensure their (continued) protection.

27.3 Information on EU funding

Applications for protection of results (including patent applications) filed by or on behalf of a beneficiary must — unless the Commission requests or agrees otherwise or unless it is impossible — include the following:

> "The project leading to this application has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847552".

27.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 28 — EXPLOITATION OF RESULTS

28.1 Obligation to exploit the results

Each beneficiary must — up to four years after the period set out in Article 3 — take measures aiming to ensure '**exploitation**' of its results (either directly or indirectly, in particular through transfer or licensing; see Article 30) by:

(a) using them in further research activities (outside the action);

(b) developing, creating or marketing a product or process;

(c) creating and providing a service, or

(d) using them in standardisation activities.

This does not change the security obligations in Article 37, which still apply.

28.2 Results that could contribute to European or international standards — Information on EU funding

If results are incorporated in a standard, the beneficiary concerned must — unless the Commission requests or agrees otherwise or unless it is impossible — ask the standardisation body to include the following statement in (information related to) the standard:

> "Results incorporated in this standard received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847552".

28.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced in accordance with Article 43.

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 29 — DISSEMINATION OF RESULTS — OPEN ACCESS — VISIBILITY OF EU FUNDING

29.1 Obligation to disseminate results

Unless it goes against their legitimate interests, each beneficiary must — as soon as possible — '**disseminate**' its results by disclosing them to the public by appropriate means (other than those resulting from protecting or exploiting the results), including in scientific publications (in any medium).

This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

A beneficiary that intends to disseminate its results must give advance notice to the other beneficiaries of — unless agreed otherwise — at least 45 days, together with sufficient information on the results it will disseminate.

Any other beneficiary may object within — unless agreed otherwise — 30 days of receiving notification, if it can show that its legitimate interests in relation to the results or background would be significantly harmed. In such cases, the dissemination may not take place unless appropriate steps are taken to safeguard these legitimate interests.

If a beneficiary intends not to protect its results, it may — under certain conditions (see Article 26.4.1) — need to formally notify the Commission before dissemination takes place.

29.2 Open access to scientific publications

Each beneficiary must ensure open access (free of charge online access for any user) to all peer-reviewed scientific publications relating to its results.

In particular, it must:

(a) as soon as possible and at the latest on publication, deposit a machine-readable electronic copy of the published version or final peer-reviewed manuscript accepted for publication in a repository for scientific publications;

Moreover, the beneficiary must aim to deposit at the same time the research data needed to validate the results presented in the deposited scientific publications.

(b) ensure open access to the deposited publication — via the repository — at the latest:

(i) on publication, if an electronic version is available for free via the publisher, or

(ii) within six months of publication (twelve months for publications in the social sciences and humanities) in any other case.

(c) ensure open access — via the repository — to the bibliographic metadata that identify the deposited publication.

The bibliographic metadata must be in a standard format and must include all of the following:

- the terms "Euratom" and "Euratom research and training programme 2014-2018";
- the name of the action, acronym and grant number;

- the publication date, and length of embargo period if applicable, and
- a persistent identifier.

29.3 Open access to research data

Regarding the digital research data generated in the action ('**data**'), the beneficiaries must:

(a) deposit in a research data repository and take measures to make it possible for third parties to access, mine, exploit, reproduce and disseminate — free of charge for any user — the following:

  (i) the data, including associated metadata, needed to validate the results presented in scientific publications, as soon as possible;

  (ii) not applicable;

  (iii) other data, including associated metadata, as specified and within the deadlines laid down in the 'data management plan' (see Annex 1);

(b) provide information — via the repository — about tools and instruments at the disposal of the beneficiaries and necessary for validating the results (and — where possible — provide the tools and instruments themselves).

This does not change the obligation to protect results in Article 27, the confidentiality obligations in Article 36, the security obligations in Article 37 or the obligations to protect personal data in Article 39, all of which still apply.

As an exception, the beneficiaries do not have to ensure open access to specific parts of their research data under Point (a)(i) and (iii), if the achievement of the action's main objective (as described in Annex 1) would be jeopardised by making those specific parts of the research data openly accessible. In this case, the data management plan must contain the reasons for not giving access.

29.4 Information on EU funding — Obligation and right to use the EU emblem

Unless the Commission requests or agrees otherwise or unless it is impossible, any dissemination of results (in any form, including electronic) must:

(a) display the EU emblem and

(b) include the following text:

"This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847552".

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the Commission.

This does not however give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

29.5 Disclaimer excluding Commission responsibility

Any dissemination of results must indicate that it reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

29.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 30 — TRANSFER AND LICENSING OF RESULTS

30.1 Transfer of ownership

Each beneficiary may transfer ownership of its results.

It must however ensure that its obligations under Articles 26.2, 26.4, 27, 28, 29, 30 and 31 also apply to the new owner and that this owner has the obligation to pass them on in any subsequent transfer.

This does not change the security obligations in Article 37, which still apply.

Unless agreed otherwise (in writing) for specifically-identified third parties or unless impossible under applicable EU and national laws on mergers and acquisitions, a beneficiary that intends to transfer ownership of results must give at least 45 days advance notice (or less if agreed in writing) to the other beneficiaries that still have (or still may request) access rights to the results. This notification must include sufficient information on the new owner to enable any beneficiary concerned to assess the effects on its access rights.

Unless agreed otherwise (in writing) for specifically-identified third parties, any other beneficiary may object within 30 days of receiving notification (or less if agreed in writing), if it can show that the transfer would adversely affect its access rights. In this case, the transfer may not take place until agreement has been reached between the beneficiaries concerned.

30.2 Granting licenses

Each beneficiary may grant licences to its results (or otherwise give the right to exploit them), if:

(a) this does not impede the access rights under Article 31 and

(b) not applicable.

In addition to Points (a) and (b), exclusive licences for results may be granted only if all the other beneficiaries concerned have waived their access rights (see Article 31.1).

This does not change the dissemination obligations in Article 29 or security obligations in Article 37, which still apply.

30.3 Commission right to object to transfers or licensing

Not applicable

30.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such a breach may also lead to any of the other measures described in Chapter 6.

ARTICLE 31 — ACCESS RIGHTS TO RESULTS

31.1 Exercise of access rights — Waiving of access rights — No sub-licensing

The conditions set out in Article 25.1 apply.

The obligations set out in this Article do not change the security obligations in Article 37, which still apply.

31.2 Access rights for other beneficiaries, for implementing their own tasks under the action

The beneficiaries must give each other access — on a royalty-free basis — to results needed for implementing their own tasks under the action.

31.3 Access rights for other beneficiaries, for exploiting their own results

The beneficiaries must give each other — under fair and reasonable conditions (see Article 25.3) — access to results needed for exploiting their own results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

31.4 Access rights of affiliated entities

Unless agreed otherwise in the consortium agreement, access to results must also be given — under fair and reasonable conditions (Article 25.3) — to affiliated entities established in an EU Member State or associated country, if this is needed for those entities to exploit the results generated by the beneficiaries to which they are affiliated.

Unless agreed otherwise (see above; Article 31.1), the affiliated entity concerned must make any such request directly to the beneficiary that owns the results.

Requests for access may be made — unless agreed otherwise — up to one year after the period set out in Article 3.

31.5 Access rights for the EU institutions, bodies, offices or agencies and EU Member States

The beneficiaries must give access to their results — on a royalty-free basis — to the European Atomic Energy Community (Euratom) and its joint undertakings, for developing, implementing and monitoring Euratom policies and programmes or for compliance with obligations assumed through international cooperation with third countries and international organisations.

As an exception to Article 31.1, such access rights include the right to authorise third parties to use the results in public procurement and the right to sublicense and are limited to non-commercial and non-competitive use.

31.6 Access rights for third parties

Not applicable

31.7 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

SECTION 4 OTHER RIGHTS AND OBLIGATIONS

ARTICLE 32 — RECRUITMENT AND WORKING CONDITIONS FOR RESEARCHERS

32.1 Obligation to take measures to implement the European Charter for Researchers and Code of Conduct for the Recruitment of Researchers

The beneficiaries must take all measures to implement the principles set out in the Commission Recommendation on the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers[23], in particular regarding:

- working conditions;
- transparent recruitment processes based on merit, and
- career development.

The beneficiaries must ensure that researchers and third parties involved in the action are aware of them.

32.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the Commission may apply any of the measures described in Chapter 6.

ARTICLE 33 — GENDER EQUALITY

33.1 Obligation to aim for gender equality

The beneficiaries must take all measures to promote equal opportunities between men and women in the implementation of the action. They must aim, to the extent possible, for a gender balance at all levels of personnel assigned to the action, including at supervisory and managerial level.

[23] Commission Recommendation 2005/251/EC of 11 March 2005 on the European Charter for Researchers and on a Code of Conduct for the Recruitment of Researchers (OJ L 75, 22.3.2005, p. 67).

33.2 Consequences of non-compliance

If a beneficiary breaches its obligations under this Article, the Commission may apply any of the measures described in Chapter 6.

ARTICLE 34 — ETHICS AND RESEARCH INTEGRITY

34.1 Obligation to comply with ethical and research integrity principles

The beneficiaries must carry out the action in compliance with:

(a) ethical principles (including the highest standards of research integrity)

and

(b) applicable international, EU and national law.

Funding will not be granted for activities carried out outside the EU if they are prohibited in all Member States or for activities which destroy human embryos (for example, for obtaining stem cells).

The beneficiaries must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiaries must ensure that the activities under the action do not:

(a) aim at human cloning for reproductive purposes;

(b) intend to modify the genetic heritage of human beings which could make such changes heritable (with the exception of research relating to cancer treatment of the gonads, which may be financed), or

(c) intend to create human embryos solely for the purpose of research or for the purpose of stem cell procurement, including by means of somatic cell nuclear transfer.

In addition, the beneficiaries must respect the fundamental principle of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity[24].

This implies compliance with the following fundamental principles:

- **reliability** in ensuring the quality of research reflected in the design, the methodology, the analysis and the use of resources;
- **honesty** in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair and unbiased way;
- **respect** for colleagues, research participants, society, ecosystems, cultural heritage and the environment;
- **accountability** for the research from idea to publication, for its management and organisation, for training, supervision and mentoring, and for its wider impacts

[24] European Code of Conduct for Research Integrity of ALLEA (All European Academies) http://ec.europa.eu/research/participants/data/ref/h2020/other/hi/h2020-ethics_code-of-conduct_en.pdf

and means that beneficiaries must ensure that persons carrying out research tasks follow the good research practices and refrain from the research integrity violations described in this Code.

This does not change the other obligations under this Agreement or obligations under applicable international, EU or national law, all of which still apply.

34.2 Activities raising ethical issues

Activities raising ethical issues must comply with the '**ethics requirements**' set out as deliverables in Annex 1.

Before the beginning of an activity raising an ethical issue, each beneficiary must have obtained:

(a) any ethics committee opinion required under national law and

(b) any notification or authorisation for activities raising ethical issues required under national and/or European law

needed for implementing the action tasks in question.

The documents must be kept on file and be submitted upon request by the coordinator to the Commission (see Article 52). If they are not in English, they must be submitted together with an English summary, which shows that the action tasks in question are covered and includes the conclusions of the committee or authority concerned (if available).

34.3 Activities involving human embryos or human embryonic stem cells

Activities involving research on human embryos or human embryonic stem cells may be carried out, in addition to Article 34.1, only if:

- they are set out in Annex 1 or
- the coordinator has obtained explicit approval (in writing) from the Commission (see Article 52).

34.4 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 35 — CONFLICT OF INTERESTS

35.1 Obligation to avoid a conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the action is compromised for reasons involving economic interest, political or national affinity, family or emotional ties or any other shared interest ('**conflict of interests**').

They must formally notify to the Commission without delay any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The Commission may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

35.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement or participation of the beneficiary may be terminated (see Article 50).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 36 — CONFIDENTIALITY

36.1 General obligation to maintain confidentiality

During implementation of the action and for four years after the period set out in Article 3, the parties must keep confidential any data, documents or other material (in any form) that is identified as confidential at the time it is disclosed ('**confidential information**').

If a beneficiary requests, the Commission may agree to keep such information confidential for an additional period beyond the initial four years.

If information has been identified as confidential only orally, it will be considered to be confidential only if this is confirmed in writing within 15 days of the oral disclosure.

Unless otherwise agreed between the parties, they may use confidential information only to implement the Agreement.

The beneficiaries may disclose confidential information to their personnel or third parties involved in the action only if they:

(a) need to know to implement the Agreement and

(b) are bound by an obligation of confidentiality.

This does not change the security obligations in Article 37, which still apply.

The Commission may disclose confidential information to its staff, other EU institutions and bodies. It may disclose confidential information to third parties, if:

(a) this is necessary to implement the Agreement or safeguard the EU's financial interests and

(b) the recipients of the information are bound by an obligation of confidentiality.

Under the conditions set out in Article 4 of the Rules for Participation Regulation No 1290/2013[25], the Commission must moreover make available information on the results to other EU institutions, bodies, offices or agencies as well as Member States or associated countries.

The confidentiality obligations no longer apply if:

[25] Regulation (EU) No 1290/2013 of the European Parliament and of the Council of 11 December 2013 laying down the rules for participation and dissemination in "Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020)" (OJ L 347, 20.12.2013 p.81).

(a) the disclosing party agrees to release the other party;

(b) the information was already known by the recipient or is given to him without obligation of confidentiality by a third party that was not bound by any obligation of confidentiality;

(c) the recipient proves that the information was developed without the use of confidential information;

(d) the information becomes generally and publicly available, without breaching any confidentiality obligation, or

(e) the disclosure of the information is required by EU or national law.

36.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 37 — SECURITY-RELATED OBLIGATIONS

37.1 Results with a security recommendation

Not applicable

37.2 Classified information

Not applicable

37.3 Activities involving dual-use goods or dangerous materials and substances

Not applicable

37.4 Consequences of non-compliance

Not applicable

ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING

38.1 Communication activities by beneficiaries

38.1.1 Obligation to promote the action and its results

The beneficiaries must promote the action and its results, by providing targeted information to multiple audiences (including the media and the public) in a strategic and effective manner.

This does not change the dissemination obligations in Article 29, the confidentiality obligations in Article 36 or the security obligations in Article 37, all of which still apply.

Before engaging in a communication activity expected to have a major media impact, the beneficiaries must inform the Commission (see Article 52).

38.1.2 Information on EU funding — Obligation and right to use the EU emblem

Unless the Commission requests or agrees otherwise or unless it is impossible, any communication activity related to the action (including in electronic form, via social media, etc.) and any infrastructure, equipment and major results funded by the grant must:

(a) display the EU emblem and

(b) include the following text:

For communication activities:

"This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847552".

For infrastructure, equipment and major results:

"This *[infrastructure][equipment][insert type of result]* is part of a project that has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 847552".

When displayed together with another logo, the EU emblem must have appropriate prominence.

For the purposes of their obligations under this Article, the beneficiaries may use the EU emblem without first obtaining approval from the Commission.

This does not, however, give them the right to exclusive use.

Moreover, they may not appropriate the EU emblem or any similar trademark or logo, either by registration or by any other means.

38.1.3 Disclaimer excluding Commission responsibility

Any communication activity related to the action must indicate that it reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

38.2 Communication activities by the Commission

38.2.1 Right to use beneficiaries' materials, documents or information

The Commission may use, for its communication and publicising activities, information relating to the action, documents notably summaries for publication and public deliverables as well as any other material, such as pictures or audio-visual material received from any beneficiary (including in electronic form).

This does not change the confidentiality obligations in Article 36 and the security obligations in Article 37, all of which still apply.

If the Commission's use of these materials, documents or information would risk compromising legitimate interests, the beneficiary concerned may request the Commission not to use it (see Article 52).

The right to use a beneficiary's materials, documents and information includes:

(a) **use for its own purposes** (in particular, making them available to persons working for the

Commission or any other EU institution, body, office or agency or body or institutions in EU Member States; and copying or reproducing them in whole or in part, in unlimited numbers);

(b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes);

(c) **editing or redrafting** for communication and publicising activities (including shortening, summarising, inserting other elements (such as meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation);

(d) translation;

(e) giving **access in response to individual requests** under Regulation No 1049/2001[27], without the right to reproduce or exploit;

(f) **storage** in paper, electronic or other form;

(g) **archiving**, in line with applicable document-management rules, and

(h) the right to authorise **third parties** to act on its behalf or sub-license the modes of use set out in Points (b), (c), (d) and (f) to third parties if needed for the communication and publicising activities of the Commission.

If the right of use is subject to rights of a third party (including personnel of the beneficiary), the beneficiary must ensure that it complies with its obligations under this Agreement (in particular, by obtaining the necessary approval from the third parties concerned).

Where applicable (and if provided by the beneficiaries), the Commission will insert the following information:

"© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the Euratom under conditions."

38.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

Such breaches may also lead to any of the other measures described in Chapter 6.

ARTICLE 39 — PROCESSING OF PERSONAL DATA

39.1 Processing of personal data by the Commission

Any personal data under the Agreement will be processed by the Commission under Regulation No

[27] Regulation (EC) No 1049/2001 of the European Parliament and of the Council of 30 May 2001 regarding public access to European Parliament, Council and Commission documents, OJ L 145, 31.5.2001, p. 43.

45/2001[28] and according to the 'notifications of the processing operations' to the Data Protection Officer (DPO) of the Commission (publicly accessible in the DPO register).

Such data will be processed by the '**data controller**' of the Commission for the purposes of implementing, managing and monitoring the Agreement or protecting the financial interests of the EU or Euratom (including checks, reviews, audits and investigations; see Article 22).

The persons whose personal data are processed have the right to access and correct their own personal data. For this purpose, they must send any queries about the processing of their personal data to the data controller, via the contact point indicated in the privacy statement(s) that are published on the Commission websites.

They also have the right to have recourse at any time to the European Data Protection Supervisor (EDPS).

39.2 Processing of personal data by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with applicable EU and national law on data protection (including authorisations or notification requirements).

The beneficiaries may grant their personnel access only to data that is strictly necessary for implementing, managing and monitoring the Agreement.

The beneficiaries must inform the personnel whose personal data are collected and processed by the Commission. For this purpose, they must provide them with the privacy statement(s) (see above), before transmitting their data to the Commission.

39.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under Article 39.2, the Commission may apply any of the measures described in Chapter 6.

ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE COMMISSION

The beneficiaries may not assign any of their claims for payment against the Commission to any third party, except if approved by the Commission on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the Commission has not accepted the assignment or the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the Commission.

[28] Regulation (EC) No 45/2001 of the European Parliament and of the Council of 18 December 2000 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data (OJ L 8, 12.01.2001, p. 1).

CHAPTER 5 DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES — RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES — RELATIONSHIP WITH PARTNERS OF A JOINT ACTION

ARTICLE 41 — DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES — RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES — RELATIONSHIP WITH PARTNERS OF A JOINT ACTION

41.1 Roles and responsibility towards the Commission

The beneficiaries have full responsibility for implementing the action and complying with the Agreement.

The beneficiaries are jointly and severally liable for the **technical implementation** of the action as described in Annex 1. If a beneficiary fails to implement its part of the action, the other beneficiaries become responsible for implementing this part (without being entitled to any additional EU funding for doing so), unless the Commission expressly relieves them of this obligation.

The **financial responsibility** of each beneficiary is governed by Article 44.

41.2 Internal division of roles and responsibilities

The internal roles and responsibilities of the beneficiaries are divided as follows:

(a) Each **beneficiary** must:

- (i) keep information stored in the Participant Portal Beneficiary Register (via the electronic exchange system) up to date (see Article 17);
- (ii) inform the coordinator immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 17);
- (iii) submit to the coordinator in good time:
  - individual financial statements for itself and its linked third parties and, if required, certificates on the financial statements (see Article 20);
  - the data needed to draw up the technical reports (see Article 20);
  - ethics committee opinions and notifications or authorisations for activities raising ethical issues (see Article 34);
  - any other documents or information required by the Commission under the Agreement, unless the Agreement requires the beneficiary to submit this information directly to the Commission.

(b) The **coordinator** must:

- (i) monitor that the action is implemented properly (see Article 7);
- (ii) act as the intermediary for all communications between the beneficiaries and the

Commission (in particular, providing the Commission with the information described in Article 17), unless the Agreement specifies otherwise;

(iii) request and review any documents or information required by the Commission and verify their completeness and correctness before passing them on to the Commission;

(iv) submit the deliverables and reports to the Commission (see Articles 19 and 20);

(v) ensure that all payments are made to the other beneficiaries without unjustified delay (see Article 21);

(vi) inform the Commission of the amounts paid to each beneficiary, when required under the Agreement (see Articles 44 and 50) or requested by the Commission.

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including linked third parties).

41.3 Internal arrangements between beneficiaries — Consortium agreement

The beneficiaries must have internal arrangements regarding their operation and co-ordination to ensure that the action is implemented properly. These internal arrangements must be set out in a written '**consortium agreement**' between the beneficiaries, which may cover:

- internal organisation of the consortium;
- management of access to the electronic exchange system;
- distribution of EU funding;
- additional rules on rights and obligations related to background and results (including whether access rights remain or not, if a beneficiary is in breach of its obligations) (see Section 3 of Chapter 4);
- settlement of internal disputes;
- liability, indemnification and confidentiality arrangements between the beneficiaries.

The consortium agreement must not contain any provision contrary to the Agreement.

41.4 Relationship with complementary beneficiaries — Collaboration agreement

Not applicable

41.5 Relationship with partners of a joint action — Coordination agreement

Not applicable

CHAPTER 6 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — SANCTIONS — DAMAGES — SUSPENSION — TERMINATION — FORCE MAJEURE

SECTION 1 REJECTION OF COSTS — REDUCTION OF THE GRANT — RECOVERY — SANCTIONS

ARTICLE 42 — REJECTION OF INELIGIBLE COSTS

42.1 Conditions

The Commission will — after **termination of the participation of a beneficiary**, at the time of an **interim payment**, **at the payment of the balance** or **afterwards** — reject any costs which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 22).

The rejection may also be based on the **extension of findings from other grants to this grant** (see Article 22.5.2).

42.2 Ineligible costs to be rejected — Calculation — Procedure

Ineligible costs will be rejected in full.

If the rejection of costs does not lead to a recovery (see Article 44), the Commission will formally notify the coordinator or beneficiary concerned of the rejection of costs, the amounts and the reasons why (if applicable, together with the notification of amounts due; see Article 21.5). The coordinator or beneficiary concerned may — within 30 days of receiving notification — formally notify the Commission of its disagreement and the reasons why.

If the rejection of costs leads to a recovery, the Commission will follow the contradictory procedure with pre-information letter set out in Article 44.

42.3 Effects

If the Commission rejects costs at the time of an **interim payment** or **the payment of the balance**, it will deduct them from the total eligible costs declared, for the action, in the periodic or final summary financial statement (see Articles 20.3 and 20.4). It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the Commission rejects costs **after termination of the participation of a beneficiary**, it will deduct them from the costs declared by the beneficiary in the termination report and include the rejection in the calculation after termination (see Article 50.2 and 50.3).

If the Commission — **after an interim payment but before the payment of the balance** — rejects costs declared in a periodic summary financial statement, it will deduct them from the total eligible costs declared, for the action, in the next periodic summary financial statement or in the final summary financial statement. It will then calculate the interim payment or payment of the balance as set out in Articles 21.3 or 21.4.

If the Commission rejects costs **after the payment of the balance**, it will deduct the amount rejected from the total eligible costs declared, by the beneficiary, in the final summary financial statement. It will then calculate the revised final grant amount as set out in Article 5.4.

ARTICLE 43 — REDUCTION OF THE GRANT

43.1 Conditions

The Commission may — **after termination of the participation of a beneficiary**, **at the payment of the balance** or **afterwards** — reduce the grant amount (see Article 5.1), if :

(a) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or

(b) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).

43.2 Amount to be reduced — Calculation — Procedure

The amount of the reduction will be proportionate to the seriousness of the errors, irregularities or fraud or breach of obligations.

Before reduction of the grant, the Commission will formally notify a '**pre-information letter**' to the coordinator or beneficiary concerned:

- informing it of its intention to reduce the grant, the amount it intends to reduce and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the Commission does not receive any observations or decides to pursue reduction despite the observations it has received, it will formally notify **confirmation** of the reduction (if applicable, together with the notification of amounts due; see Article 21).

43.3 Effects

If the Commission reduces the grant **after termination of the participation of a beneficiary**, it will calculate the reduced grant amount for that beneficiary and then determine the amount due to that beneficiary (see Article 50.2 and 50.3).

If the Commission reduces the grant **at the payment of the balance**, it will calculate the reduced grant amount for the action and then determine the amount due as payment of the balance (see Articles 5.3.4 and 21.4).

If the Commission reduces the grant **after the payment of the balance**, it will calculate the revised final grant amount for the beneficiary concerned (see Article 5.4). If the revised final grant amount for the beneficiary concerned is lower than its share of the final grant amount, the Commission will recover the difference (see Article 44).

ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS

44.1 Amount to be recovered — Calculation — Procedure

The Commission will — after **termination of the participation of a beneficiary, at the payment of the balance** or **afterwards** — claim back any amount that was paid, but is not due under the Agreement.

Each beneficiary's financial responsibility in case of recovery is limited to its own debt (including undue amounts paid by the Commission for costs declared by its linked third parties), except for the amount retained for the Guarantee Fund (see Article 21.4).

44.1.1 Recovery after termination of a beneficiary's participation

If recovery takes place after termination of a beneficiary's participation (including the coordinator), the Commission will claim back the undue amount from the beneficiary concerned, by formally notifying it a debit note (see Article 50.2 and 50.3). This note will specify the amount to be recovered, the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Commission will **recover** the amount:

(a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the Commission may offset before the payment date specified in the debit note;

(b) not applicable;

(c) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) , Article 106a of the Euratom Treaty and Article 79(2) of the Financial regulation No 966/2012.

If payment is not made by the date specified in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC[29] applies.

44.1.2 Recovery at payment of the balance

[29] Directive 2007/64/EC of the European Parliament and of the Council of 13 November 2007 on payment services in the internal market amending Directives 97/7/EC, 2002/65/EC, 2005/60/EC and 2006/48/EC and repealing Directive 97/5/EC (OJ L 319, 05.12.2007, p. 1).

If the payment of the balance takes the form of a recovery (see Article 21.4), the Commission will formally notify a '**pre-information letter**' to the coordinator:

- informing it of its intention to recover, the amount due as the balance and the reasons why;
- specifying that it intends to deduct the amount to be recovered from the amount retained for the Guarantee Fund;
- requesting the coordinator to submit a report on the distribution of payments to the beneficiaries within 30 days of receiving notification, and
- inviting the coordinator to submit observations within 30 days of receiving notification.

If no observations are submitted or the Commission decides to pursue recovery despite the observations it has received, it will **confirm recovery** (together with the notification of amounts due; see Article 21.5) and:

- pay the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is positive** or
- formally notify to the coordinator a **debit note** for the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is negative**. This note will also specify the terms and the date for payment.

If the coordinator does not repay the Commission by the date in the debit note and has not submitted the report on the distribution of payments: the Commission will **recover** the amount set out in the debit note from the coordinator (see below).

If the coordinator does not repay the Commission by the date in the debit note, but has submitted the report on the distribution of payments: the Commission will:

(a) identify the beneficiaries for which the amount calculated as follows is negative:

{{{beneficiary's costs declared in the final summary financial statement and approved by the Commission multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned

plus

its linked third parties' costs declared in the final summary financial statement and approved by the Commission multiplied by the reimbursement rate set out in Article 5.2 for each linked third party concerned}

divided by

the EU contribution for the action calculated according to Article 5.3.1}

multiplied by

the final grant amount (see Article 5.3)},

minus

{pre-financing and interim payments received by the beneficiary}}.

(b) formally notify to each beneficiary identified according to point (a) a **debit note** specifying the terms and date for payment. The amount of the debit note is calculated as follows:

{{amount calculated according to point (a) for the beneficiary concerned

divided by

the sum of the amounts calculated according to point (a) for all the beneficiaries identified according to point (a)}

multiplied by

the amount set out in the debit note formally notified to the coordinator}.

If payment is not made by the date specified in the debit note, the Commission will **recover** the amount:

(a) by **offsetting** it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the Commission may offset before the payment date specified in the debit note;

(b) by **drawing on the Guarantee Fund**. The Commission will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) not applicable;

(ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) , Article 106a of the Euratom Treaty and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

44.1.3 Recovery of amounts after payment of the balance

If, for a beneficiary, the revised final grant amount (see Article 5.4) is lower than its share of the final grant amount, it must repay the difference to the Commission.

The beneficiary's share of the final grant amount is calculated as follows:

{{{beneficiary's costs declared in the final summary financial statement and approved by the Commission multiplied by the reimbursement rate set out in Article 5.2 for the beneficiary concerned

plus

its linked third parties' costs declared in the final summary financial statement and approved by the Commission multiplied by the reimbursement rate set out in Article 5.2 for each linked third party concerned} divided by

the EU contribution for the action calculated according to Article 5.3.1}

multiplied by

the final grant amount (see Article 5.3)}.

If the coordinator has not distributed amounts received (see Article 21.7), the Commission will also recover these amounts.

The Commission will formally notify a **pre-information letter** to the beneficiary concerned:

- informing it of its intention to recover, the due amount and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If no observations are submitted or the Commission decides to pursue recovery despite the observations it has received, it will **confirm** the amount to be recovered and formally notify to the beneficiary concerned a **debit note**. This note will also specify the terms and the date for payment.

If payment is not made by the date specified in the debit note, the Commission will **recover** the amount:

(a) by **offsetting** it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the Commission or an executive agency (from the EU or Euratom budget).

In exceptional circumstances, to safeguard the EU's financial interests, the Commission may offset before the payment date specified in the debit note;

(b) by **drawing on the Guarantee Fund**. The Commission will formally notify the beneficiary concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) not applicable;

(ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) , Article 106a of the Euratom Treaty and Article 79(2) of the Financial Regulation No 966/2012.

If payment is not made by the date in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the date for payment in the debit note, up to and including the date the Commission receives full payment of the amount.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2007/64/EC applies.

ARTICLE 45 — ADMINISTRATIVE SANCTIONS

In addition to contractual measures, the Commission may also adopt administrative sanctions under Articles 106 and 131(4) of the Financial Regulation No 966/2012 (i.e. exclusion from future procurement contracts, grants, prizes and expert contracts and/or financial penalties).

SECTION 2 LIABILITY FOR DAMAGES

ARTICLE 46 — LIABILITY FOR DAMAGES

46.1 Liability of the Commission

The Commission cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of implementing the Agreement, including for gross negligence.

The Commission cannot be held liable for any damage caused by any of the beneficiaries or third parties involved in the action, as a consequence of implementing the Agreement.

46.2 Liability of the beneficiaries

Except in case of force majeure (see Article 51), the beneficiaries must compensate the Commission for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement.

SECTION 3 SUSPENSION AND TERMINATION

ARTICLE 47 — SUSPENSION OF PAYMENT DEADLINE

47.1 Conditions

The Commission may — at any moment — suspend the payment deadline (see Article 21.2 to 21.4) if a request for payment (see Article 20) cannot be approved because:

(a) it does not comply with the provisions of the Agreement (see Article 20);

(b) the technical or financial reports have not been submitted or are not complete or additional information is needed, or

(c) there is doubt about the eligibility of the costs declared in the financial statements and additional checks, reviews, audits or investigations are necessary.

47.2 Procedure

The Commission will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day notification is sent by the Commission (see Article 52).

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining period will resume.

If the suspension exceeds two months, the coordinator may request the Commission if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the technical or financial reports (see Article 20) and the revised report or statement is not submitted or was submitted but is also rejected, the Commission may also terminate the Agreement or the participation of the beneficiary (see Article 50.3.1(l)).

ARTICLE 48 — SUSPENSION OF PAYMENTS

48.1 Conditions

The Commission may — at any moment — suspend payments, in whole or in part and interim payments or the payment of the balance for one or more beneficiaries, if:

(a) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed or is suspected of having committed:

 (i) substantial errors, irregularities or fraud or

 (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or

(b) a beneficiary (or a natural person who has the power to represent or take decision on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2).

If payments are suspended for one or more beneficiaries, the Commission will make partial payment(s) for the part(s) not suspended. If suspension concerns the payment of the balance, — once suspension is lifted — the payment or the recovery of the amount(s) concerned will be considered the payment of the balance that closes the action.

48.2 Procedure

Before suspending payments, the Commission will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to suspend payments and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the Commission does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the suspension procedure is not continued.

The suspension will **take effect** the day the confirmation notification is sent by the Commission.

If the conditions for resuming payments are met, the suspension will be **lifted**. The Commission will formally notify the coordinator or beneficiary concerned.

During the suspension, the periodic report(s) for all reporting periods except the last one (see Article 20.3), must not contain any individual financial statements from the beneficiary concerned and its linked third parties. The coordinator must include them in the next periodic report after the suspension is lifted or — if suspension is not lifted before the end of the action — in the last periodic report.

The beneficiaries may suspend implementation of the action (see Article 49.1) or terminate the Agreement or the participation of the beneficiary concerned (see Article 50.1 and 50.2).

ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION

49.1 Suspension of the action implementation, by the beneficiaries

49.1.1 Conditions

The beneficiaries may suspend implementation of the action or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 51) — make implementation impossible or excessively difficult.

49.1.2 Procedure

The coordinator must immediately formally notify to the Commission the suspension (see Article 52), stating:

- the reasons why and
- the expected date of resumption.

The suspension will **take effect** the day this notification is received by the Commission.

Once circumstances allow for implementation to resume, the coordinator must immediately formally notify the Commission and request an **amendment** of the Agreement to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement or the participation of a beneficiary has been terminated (see Article 50).

The suspension will be **lifted** with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension of the action implementation are not eligible (see Article 6).

49.2 Suspension of the action implementation, by the Commission

49.2.1 Conditions

The Commission may suspend implementation of the action or any part of it, if:

(a) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed or is suspected of having committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles);

(b) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2), or

(c) the action is suspected of having lost its scientific or technological relevance.

49.2.2 Procedure

Before suspending implementation of the action, the Commission will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to suspend the implementation and the reasons why and
- inviting it to submit observations within 30 days of receiving notification.

If the Commission does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify **confirmation** of the suspension. Otherwise, it will formally notify that the procedure is not continued.

The suspension will **take effect** five days after confirmation notification is received (or on a later date specified in the notification).

It will be **lifted** if the conditions for resuming implementation of the action are met.

The coordinator or beneficiary concerned will be formally notified of the lifting and the Agreement will be **amended** to set the date on which the action will be resumed, extend the duration of the action and make other changes necessary to adapt the action to the new situation (see Article 55) — unless the Agreement has already been terminated (see Article 50).

The suspension will be lifted with effect from the resumption date set out in the amendment. This date may be before the date on which the amendment enters into force.

Costs incurred during suspension are not eligible (see Article 6).

The beneficiaries may not claim damages due to suspension by the Commission (see Article 46).

Suspension of the action implementation does not affect the Commission's right to terminate the Agreement or participation of a beneficiary (see Article 50), reduce the grant or recover amounts unduly paid (see Articles 43 and 44).

ARTICLE 50 — TERMINATION OF THE AGREEMENT OR OF THE PARTICIPATION OF ONE OR MORE BENEFICIARIES

50.1 Termination of the Agreement, by the beneficiaries

50.1.1 Conditions and procedure

The beneficiaries may terminate the Agreement.

The coordinator must formally notify termination to the Commission (see Article 52), stating:

- the reasons why and
- the date the termination will take effect. This date must be after the notification.

If no reasons are given or if the Commission considers the reasons do not justify termination, the Agreement will be considered to have been '**terminated improperly**'.

The termination will **take effect** on the day specified in the notification.

50.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a periodic report (for the open reporting period until termination; see Article 20.3) and

(ii) the final report (see Article 20.4).

If the Commission does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The Commission will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Improper termination may lead to a reduction of the grant (see Article 43).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

50.2 Termination of the participation of one or more beneficiaries, by the beneficiaries

50.2.1 Conditions and procedure

The participation of one or more beneficiaries may be terminated by the coordinator, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must formally notify termination to the Commission (see Article 52) and inform the beneficiary concerned.

If the coordinator's participation is terminated without its agreement, the formal notification must be done by another beneficiary (acting on behalf of the other beneficiaries).

The notification must include:

- the reasons why;
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing);
- the date the termination takes effect. This date must be after the notification, and

- a request for amendment (see Article 55), with a proposal for reallocation of the tasks and the estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination takes effect after the period set out in Article 3, no request for amendment must be included unless the beneficiary concerned is the coordinator. In this case, the request for amendment must propose a new coordinator.

If this information is not given or if the Commission considers that the reasons do not justify termination, the participation will be considered to have been **terminated improperly**.

The termination will **take effect** on the day specified in the notification.

50.2.2 Effects

The coordinator must — within 30 days from when termination takes effect — submit:

(i) a report on the distribution of payments to the beneficiary concerned and

(ii) if termination takes effect during the period set out in Article 3, a '**termination report**' from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Articles 20.3 and 20.4).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the Commission (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the Commission, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Commission will — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

Step 1 — Application of the reimbursement rate to the eligible costs

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary and its linked third parties in the termination report and approved by the Commission.

Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Commission will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

If the payments received **exceed the amounts due**:

- if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The Commission will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the Commission will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- in all other cases, in particular if termination takes effect after the period set out in Article 3, the Commission will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Commission the amount due and the Commission will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:

    - termination takes effect after an interim payment and

    - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

  In this case, the Commission will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Commission the amount due. The Commission will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the Commission does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the Commission does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that

- the beneficiary concerned must not repay any amount to the coordinator.

Improper termination may lead to a reduction of the grant (see Article 43) or termination of the Agreement (see Article 50).

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the Commission

50.3.1 Conditions

The Commission may terminate the Agreement or the participation of one or more beneficiaries, if:

(a) one or more beneficiaries do not accede to the Agreement (see Article 56);

(b) a change to their legal, financial, technical, organisational or ownership situation (or those of its linked third parties) is likely to substantially affect or delay the implementation of the action or calls into question the decision to award the grant;

(c) following termination of participation for one or more beneficiaries (see above), the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants (see Article 55);

(d) implementation of the action is prevented by force majeure (see Article 51) or suspended by the coordinator (see Article 49.1) and either:

 (i) resumption is impossible, or

 (ii) the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants;

(e) a beneficiary is declared bankrupt, being wound up, having its affairs administered by the courts, has entered into an arrangement with creditors, has suspended business activities, or is subject to any other similar proceedings or procedures under national law;

(f) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has been found guilty of professional misconduct, proven by any means;

(g) a beneficiary does not comply with the applicable national law on taxes and social security;

(h) the action has lost scientific or technological relevance;

(i) not applicable;

(j) not applicable;

(k) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed fraud, corruption, or is involved in a criminal organisation, money laundering or any other illegal activity;

(l) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:

 (i) substantial errors, irregularities or fraud or

 (ii) serious breach of obligations under the Agreement or during the award procedure (including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles);

(m) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed — in other EU or Euratom grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (**extension of findings from other grants to this grant**; see Article 22.5.2);

(n) despite a specific request by the Commission, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its linked third parties or international partners that is in one of the situations under points (e), (f), (g), (k), (l) or (m) and to reallocate its tasks.

50.3.2 Procedure

Before terminating the Agreement or participation of one or more beneficiaries, the Commission will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to terminate and the reasons why and

- inviting it, within 30 days of receiving notification, to submit observations and — in case of Point (l.ii) above — to inform the Commission of the measures to ensure compliance with the obligations under the Agreement.

If the Commission does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify to the coordinator or beneficiary concerned **confirmation** of the termination and the date it will take effect. Otherwise, it will formally notify that the procedure is not continued.

The termination will **take effect**:

- for terminations under Points (b), (c), (e), (g), (h), (j), (l.ii) and (n) above: on the day specified in the notification of the confirmation (see above);

- for terminations under Points (a), (d), (f), (i), (k), (l.i) and (m) above: on the day after the notification of the confirmation is received.

50.3.3 Effects

(a) for **termination of the Agreement**:

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a periodic report (for the last open reporting period until termination; see Article 20.3) and

(ii) a final report (see Article 20.4).

If the Agreement is terminated for breach of the obligation to submit reports (see Articles 20.8 and 50.3.1(l)), the coordinator may not submit any reports after termination.

If the Commission does not receive the reports within the deadline (see above), only costs which are included in an approved periodic report will be taken into account.

The Commission will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

This does not affect the Commission's right to reduce the grant (see Article 43) or to impose administrative sanctions (Article 45).

The beneficiaries may not claim damages due to termination by the Commission (see Article 46).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

(b) for **termination of the participation of one or more beneficiaries**:

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a report on the distribution of payments to the beneficiary concerned;

(ii) a request for amendment (see Article 55), with a proposal for reallocation of the tasks and estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination is notified after the period set out in Article 3, no request for amendment must be submitted unless the beneficiary concerned is the coordinator. In this case the request for amendment must propose a new coordinator, and

(iii) if termination takes effect during the period set out in Article 3, a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Article 20).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the Commission (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the Commission, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Commission will — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

Step 1 — Application of the reimbursement rate to the eligible costs

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary and its linked third parties in the termination report and approved by the Commission.

Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Commission will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

If the payments received **exceed the amounts due**:

- if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The Commission will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the Commission will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- in all other cases, in particular if termination takes effect after the period set out in Article 3, the Commission will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Commission the amount due and the Commission will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:

  - termination takes effect after an interim payment and

  - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

  In this case, the Commission will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Commission the amount due. The Commission will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the Commission does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the Commission does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that
- the beneficiary concerned must not repay any amount to the coordinator.

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

SECTION 4 FORCE MAJEURE

ARTICLE 51 — FORCE MAJEURE

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,
- was unforeseeable, exceptional situation and beyond the parties' control,
- was not due to error or negligence on their part (or on the part of third parties involved in the action), and
- proves to be inevitable in spite of exercising all due diligence.

The following cannot be invoked as force majeure:

- any default of a service, defect in equipment or material or delays in making them available, unless they stem directly from a relevant case of force majeure,
- labour disputes or strikes, or
- financial difficulties.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

The party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

CHAPTER 7 FINAL PROVISIONS

ARTICLE 52 — COMMUNICATION BETWEEN THE PARTIES

52.1 Form and means of communication

Communication under the Agreement (information, requests, submissions, 'formal notifications', etc.) must:

- be made in writing and
- bear the number of the Agreement.

All communication must be made through the Participant Portal **electronic** exchange system and using the forms and templates provided there.

If — after the payment of the balance — the Commission finds that a formal notification was not accessed, a second formal notification will be made by registered post with proof of delivery ('formal notification on **paper**'). Deadlines will be calculated from the moment of the second notification.

Communications in the electronic exchange system must be made by persons authorised according to the Participant Portal Terms & Conditions. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a 'legal entity appointed representative (LEAR)'. The role and tasks of the LEAR are stipulated in his/her appointment letter (see Participant Portal Terms & Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Commission website.

52.2 Date of communication

Communications are considered to have been made when they are sent by the sending party (i.e. on the date and time they are sent through the electronic exchange system).

Formal notifications through the **electronic** exchange system are considered to have been made when they are received by the receiving party (i.e. on the date and time of acceptance by the receiving party, as indicated by the time stamp). A formal notification that has not been accepted within 10 days after sending is considered to have been accepted.

Formal notifications **on paper** sent by **registered post** with proof of delivery (only after the payment of the balance) are considered to have been made on either:

- the delivery date registered by the postal service or
- the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

52.3 Addresses for communication

The **electronic** exchange system must be accessed via the following URL:

https://ec.europa.eu/research/participants/portal/desktop/en/projects/

The Commission will formally notify the coordinator and beneficiaries in advance any changes to this URL.

Formal notifications on paper (only after the payment of the balance) addressed **to the Commission** must be sent to the official mailing address indicated on the Commission's website.

Formal notifications on paper (only after the payment of the balance) addressed **to the beneficiaries** must be sent to their legal address as specified in the Participant Portal Beneficiary Register.

ARTICLE 53 — INTERPRETATION OF THE AGREEMENT

53.1 Precedence of the Terms and Conditions over the Annexes

The provisions in the Terms and Conditions of the Agreement take precedence over its Annexes.

Annex 2 takes precedence over Annex 1.

53.2 Privileges and immunities

Nothing in the Agreement may be interpreted as a waiver of any privileges or immunities accorded to the *EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH* by its constituent documents or international law.

ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES

In accordance with Regulation No 1182/71[30], periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

ARTICLE 55 — AMENDMENTS TO THE AGREEMENT

55.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

55.2 Procedure

The party requesting an amendment must submit a request for amendment signed in the electronic exchange system (see Article 52).

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3).

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[30] Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8.6.1971, p. 1).

If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why;
- the appropriate supporting documents, and
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The Commission may request additional information.

If the party receiving the request agrees, it must sign the amendment in the electronic exchange system within 45 days of receiving notification (or any additional information the Commission has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date agreed by the parties or, in the absence of such an agreement, on the date on which the amendment enters into force.

ARTICLE 56 — ACCESSION TO THE AGREEMENT

56.1 Accession of the beneficiaries mentioned in the Preamble

The other beneficiaries must accede to the Agreement by signing the Accession Form (see Annex 3) in the electronic exchange system (see Article 52) within 30 days after its entry into force (see Article 58).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 58).

If a beneficiary does not accede to the Agreement within the above deadline, the coordinator must — within 30 days — request an amendment to make any changes necessary to ensure proper implementation of the action. This does not affect the Commission's right to terminate the Agreement (see Article 50).

56.2 Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 55. It must include an Accession Form (see Annex 3) signed by the new beneficiary in the electronic exchange system (see Article 52).

New beneficiaries must assume the rights and obligations under the Agreement with effect from the date of their accession specified in the Accession Form (see Annex 3).

ARTICLE 57 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

57.1 Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

As an exception, the Agreement is governed by a different applicable law for the following beneficiaries:

- EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH: by the applicable EU law, supplemented if necessary by the law of France and, where appropriate, by the general principles governing the law of international organisations and the rules of general international law

57.2 Dispute settlement

If a dispute concerning the interpretation, application or validity of the Agreement cannot be settled amicably, the General Court — or, on appeal, the Court of Justice of the European Union — has sole jurisdiction. Such actions must be brought under Article 272 of the Treaty on the Functioning of the EU (TFEU).

As an exception, if such a dispute is between the Commission and PAUL SCHERRER INSTITUT, the competent Belgian courts have sole jurisdiction.

As an exception, for the following beneficiaries:

- EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

such disputes must — if they cannot be settled amicably — be referred to arbitration. Each party must formally notify to the other party its intention of resorting to arbitration and the identity of the arbitrator. The Permanent Court of Arbitration Optional Rules for Arbitration Involving International Organisations and States in force at the date of entry into force of the Agreement will apply. The appointing authority will be the Secretary-General of the Permanent Court of Arbitration following a written request submitted by either party. The arbitration proceedings must take place in Brussels and the language used in the arbitral proceedings will be English. The arbitral award will be binding on all parties and will not be subject to appeal.

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 44, 45 and 46), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice of the European Union — under Article 263 TFEU.

ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT

The Agreement will enter into force on the day of signature by the Commission or the coordinator, depending on which is later.

SIGNATURES

For the coordinator

Carlos Alejaldre with ECAS id nlopcaye signed in the Participant Portal on 16/05/2019 at 11:35:30 (transaction id SigId-36874-5TQQNnV9KNlOpfEn51gO6IVT7ouq05yREa7H7xuzssrbdhQjUZReeKhWzHkQELFztS31IN55tQXIIELzlrktfG0-rS0vSrmBGYCSC78KhOuOnG-sjZxmieQeIh4kzfCmHSnjghqmkUkZRURePnqsi6RXVc). Timestamp by third party at
Thu May 16 12:35:35 CEST 2019

For the Commission

Signed by Milagros BAS SANCHEZ with ECAS id bassami as an authorised representative on 23-05-2019 21:07:07 (transaction id SigId-29847-0f4CT7Jdm5exGyozew5YS8pB8SGMmzKm4yvcycrw9zrUcoqLFzJCWfYh6e7SOBVP509Th8EpJ0Mf71nAbioMgke-jpJZscgsw0Kv1vxGC5zvJV-1x2aMOmN8otAPBU6NhzhCEQubztOrWzQcTipWKVJhLoa)
Thu May 23 21:07:12 CEST 2019

EUROPEAN COMMISSION
Directorate-General for Research and Innovation
Fission Energy

ANNEX 1 (part A)

Research and Innovation action

NUMBER — 847552 — SANDA

Table of Contents

1.1. The project summary

Project Number [1]	847552	Project Acronym [2]	SANDA

One form per project

General information	
Project title [3]	Supplying Accurate Nuclear Data for energy and non-energy Applications
Starting date [4]	01/09/2019
Duration in months [5]	48
Call (part) identifier [6]	NFRP-2018
Topic	NFRP-2018-4 Improved nuclear data for energy and non-energy modelling applications.
Fixed EC Keywords	Nuclear physics, Nuclear related engineering, Very large data bases
Free keywords	Nuclear Data - Experiments – Evaluation – Uncertainties- Cross section and nuclear structure libraries for Safety, Simulation, Performance, Medical and other applications

Abstract [7]

Supplying Accurate Nuclear Data for energy and non-energy Applications.
The project will include experimental measurements of new or improved quality data, evaluation, validation and dissemination of the data to produce libraries that can be used by safety authorities, research institutions, the nuclear energy industry, health organizations, other non-energy applications and the EU society at large. The project will also include in smaller fraction support to detector development, facility setups and samples fabrication to prepare important measurements and validations that are not possible in the time framework of the present proposal but that will be required in near future for the safe and efficient use of nuclear technologies.
The selection of topics, isotopes, reactions, measurements, experiments and evaluation has been made taking into account the relevance, expected impact and priorities of the resulting data according to the NEA/OECD and IAEA high priority lists and committees as well as the experience of the participants and of previous EU proposals with large participation of the partners for the present proposal (CHANDA, ANDES,…). The impact has been evaluated from the perspective of a safe, efficient and competitive use of nuclear technologies.
In comparison with previous projects, the present proposal proposes to concentrate more efforts on delivering actual results than in the preparation for the future, by enhancing the support to evaluations, validations and actual measurements. Also special attention has been paid to make sure that the topics included cover the non-energy application requiring nuclear data as well as it will cover the needs of the nuclear energy sector.
Respecting those principles, the proposal has also tried to be as inclusive to the different EU research groups and countries as possible maintaining the manageability of the project, its efficiency and the maximum quality and relevance of the action and involved partners.

1.2. List of Beneficiaries

Project Number [1]	847552	Project Acronym [2]	SANDA

List of Beneficiaries

No	Name	Short name	Country	Project entry month[8]	Project exit month
1	CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT	CIEMAT	Spain	1	48
2	Magyar Tudomanyos Akademia Atommagkutato Intezete	ATOMKI	Hungary	1	48
3	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES	CEA	France	1	48
4	EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH	CERN	Switzerland	1	48
5	CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	CNRS	France	1	48
6	AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS	CSIC	Spain	1	48
7	CENTRUM VYZKUMU REZ S.R.O.	CVREZ	Czech Republic	1	48
8	AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE	ENEA	Italy	1	48
9	HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF EV	HZDR	Germany	1	48
10	INSTITUTUL NATIONAL DE CERCETARE -DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI" (IFIN-HH)	IFIN-HH	Romania	1	48
11	INSTITUT DE RADIOPROTECTION ET DE SURETE NUCLEAIRE	IRSN	France	1	48
12	ASSOCIACAO DO INSTITUTO SUPERIOR TECNICO PARA A INVESTIGACAO E DESENVOLVIMENTO	IST-ID	Portugal	1	48
13	JRC -JOINT RESEARCH CENTRE-EUROPEAN COMMISSION	JRC	Belgium	1	48
14	INSTITUT JOZEF STEFAN	JSI	Slovenia	1	48
15	JYVASKYLAN YLIOPISTO	JYU	Finland	1	48
16	KARLSRUHER INSTITUT FUER TECHNOLOGIE	KIT	Germany	1	48
17	USTAV JADERNE FYZIKY AV CR	NPI	Czech Republic	1	48
18	NPL MANAGEMENT LIMITED	NPL	United Kingdom	1	48
19	NUCLEAR RESEARCH AND CONSULTANCY GROUP	NRG	Netherlands	1	48

1.2. List of Beneficiaries

No	Name	Short name	Country	Project entry month[8]	Project exit month
20	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	NTUA	Greece	1	48
21	PAUL SCHERRER INSTITUT	PSI	Switzerland	1	48
22	PHYSIKALISCH-TECHNISCHE BUNDESANSTALT	PTB	Germany	1	48
23	STUDIECENTRUM VOOR KERNENERGIE / CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE	SCK-CEN	Belgium	1	48
24	SOFIA UNIVERSITY ST KLIMENT OHRIDSKI	Sofia	Bulgaria	1	48
25	TECHNISCHE UNIVERSITAET WIEN	TUW	Austria	1	48
26	UNIVERSITATEA DIN BUCURESTI	UB	Romania	1	48
27	UNIWERSYTET LODZKI	ULODZ	Poland	1	48
28	JOHANNES GUTENBERG-UNIVERSITAT MAINZ	UMAINZ	Germany	1	48
29	THE UNIVERSITY OF MANCHESTER	UMANCH	United Kingdom	1	48
30	PANEPISTIMIO IOANNINON	UOI	Greece	1	48
31	UNIVERSITAT POLITECNICA DE CATALUNYA	UPC	Spain	1	48
32	UNIVERSIDAD POLITECNICA DE MADRID	UPM	Spain	1	48
33	UNIVERSIDAD DE SANTIAGO DE COMPOSTELA	USC	Spain	1	48
34	UNIVERSIDAD DE SEVILLA	USE	Spain	1	48
35	UPPSALA UNIVERSITET	UU	Sweden	1	48

1.3. Workplan Tables - Detailed implementation

1.3.1. WT1 List of work packages

WP Number[9]	WP Title	Lead beneficiary[10]	Person-months[11]	Start month[12]	End month[13]
WP1	Developments of new innovative detector devices	5 - CNRS	80.80	1	48
WP2	New nuclear data measurements for energy and non-energy applications	1 - CIEMAT	213.00	1	48
WP3	Target Preparation for Improvement of Nuclear Data Measurements	21 - PSI	66.20	1	48
WP4	Nuclear data evaluation and uncertainties	21 - PSI	173.20	1	48
WP5	Nuclear data validation and integral experiments	3 - CEA	69.20	1	48
WP6	Management, ND research coordination at EU level and Education and Training	1 - CIEMAT	27.40	1	48
		Total	629.80		

1.3.2. WT2 list of deliverables

Deliverable Number[14]	**Deliverable Title**	**WP number**[9]	**Lead beneficiary**	**Type**[15]	**Dissemination level**[16]	**Due Date (in months)**[17]
D1.1	Report on the study and construction of new devices for precise fission cross section measurements	WP1	5 - CNRS	Report	Public	48
D1.2	Report on the design of the large gas cell for IGISOL	WP1	15 - JYU	Report	Public	24
D1.3	Report on the performances of new devices for precise study of fission products and their decay in view of measurements	WP1	3 - CEA	Report	Public	24
D1.4	Report on the commissioning of a compact broad-band fast neutron spectrometer	WP1	3 - CEA	Report	Public	36
D1.5	Report on the performance of the SCONE setup at NFS	WP1	3 - CEA	Report	Public	48
D1.6	Report on the performance of the HPGe equipped with newly developed electronics	WP1	4 - CERN	Report	Public	48
D1.7	Report on the development and performances of the new detectors for capture cross section measurements at n-TOF	WP1	1 - CIEMAT	Report	Public	48
D1.8	Report on the development and performances of the new detectors for non-energy applications	WP1	22 - PTB	Report	Public	24
D2.1	Report on the (n,f) cross section measurements	WP2	29 - UMANCH	Report	Public	48
D2.2	Report on the (n,chp) cross section measurements	WP2	5 - CNRS	Report	Public	48
D2.3	Report on the 239Pu(n,g),	WP2	8 - ENEA	Report	Public	40

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	92,94,95Mo(n,g) cross measurements at n_TOF and GELINA					
D2.4	Report on the 239Pu, 233U, 14N and 35,37Cl inelastic cross section measurements at GELINA	WP2	10 - IFIN-HH	Report	Public	48
D2.5	Report on the measurements of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross sections at GELINA.	WP2	13 - JRC	Report	Public	48
D2.6	Report of the decay data measurements performed with DTAS and BELEN	WP2	6 - CSIC	Report	Public	42
D2.7	Report on the development of a new technique for obtaining low resolution information on the beta delayed neutron energies with BELEN-like detectors.	WP2	31 - UPC	Report	Public	30
D2.8	Report on the method based on the PI-ICR technique for general fission product yield studies at JYFL	WP2	15 - JYU	Report	Public	36
D2.9	Spectrum averaged cross sections for dosimetry	WP2	18 - NPL	Report	Public	44
D2.10	Report on the measurement of double-differential charged-particle emission cross sections at the CERN n_TOF facility in the neutron energy range from 20 MeV to 200 MeV	WP2	22 - PTB	Report	Public	48
D2.11	Report on the production cross sections of beta+ emitters used for range verification in proton therapy.	WP2	34 - USE	Report	Public	30

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D2.12	Report on the fission yield studies with the LOHENGRIN spectrometer at ILL	WP2	5 - CNRS	Report	Public	36
D2.13	Report on fission yield studies with FALSTAFF at ILL	WP2	3 - CEA	Report	Public	48
D2.14	Report on fission yield studies in inverse kinematics at FAIR	WP2	33 - USC	Report	Public	34
D2.15	Report on the of half-live and gamma-ray emission probabilities of beta emitters measurement	WP2	3 - CEA	Report	Public	40
D3.1	Report on the meetings performed in the frame of (“Producer – user – interaction”)	WP3	21 - PSI	Report	Public	36
D3.2	Report on the meetings performed in the frame of “Network of target producers”	WP3	13 - JRC	Report	Public	42
D3.3	Report on produced targets	WP3	13 - JRC	Report	Public	30
D3.4	Documentation of the design of a mass separation tool for target preparation	WP3	28 - UMAINZ	Report	Public	48
D3.5	Documentation of the site specification for installation of a mass separator in the Hotlab of PSI	WP3	21 - PSI	Report	Public	36
D4.1	Report on code development, methods	WP4	21 - PSI	Report	Public	40
D4.2	Report on new nuclear reaction data evaluation	WP4	3 - CEA	Report	Public	48
D4.3	Report on the evaluation for fission yields	WP4	3 - CEA	Report	Public	36
D4.4	Report on the evaluation for nuclear structure and decay data	WP4	10 - IFIN-HH	Report	Public	36
D4.5	Report on the processing and sensitivity analysis	WP4	32 - UPM	Report	Public	36

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D4.6	Report on the applications: recommendation	WP4	1 - CIEMAT	Report	Public	36
D4.7	Report on the possibility to generalize the high-energy model uncertainties methodology	WP4	3 - CEA	Report	Public	48
D5.1	Report on sensitivity analysis methods	WP5	1 - CIEMAT	Report	Public	24
D5.2	Report on ESFR, MYRRHA, and ALFRED sensitivity and impact studies	WP5	23 - SCK-CEN	Report	Public	24
D5.3	Report on JHR sensitivity and impact study	WP5	3 - CEA	Report	Public	24
D5.4	Report on HLW sensitivity and impact study	WP5	16 - KIT	Report	Public	24
D5.5	Report on assessment of nuclear data needs	WP5	3 - CEA	Report	Public	36
D5.6	Report on correlations between integral experiments	WP5	1 - CIEMAT	Report	Public	30
D5.7	Report on reactor and shielding C/E validation and nuclear data trends	WP5	32 - UPM	Report	Public	42
D5.8	Report on critical benchmark C/E validation and nuclear data trends	WP5	19 - NRG	Report	Public	42
D5.9	Report on C/E validation and nuclear data trends	WP5	32 - UPM	Report	Public	48
D5.10	Report on experiments at JRC Geel using MINERVE samples	WP5	3 - CEA	Report	Public	42
D5.11	Report on integral experiments at LR-0	WP5	7 - CVREZ	Report	Public	42
D5.12	Report on integral experiments at TAPIRO	WP5	8 - ENEA	Report	Public	42
D5.13	Report on new integral experiments and needs	WP5	3 - CEA	Report	Public	48

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D6.1	Web for the project	WP6	1 - CIEMAT	Websites, patents filling, etc.	Public	9
D6.2	Report on a sustainable framework for the coordination of the European nuclear data research	WP6	3 - CEA	Report	Public	36
D6.3	Report on school on nuclear data research methods and tools and E&T activities	WP6	13 - JRC	Report	Public	12
D6.4	Project presentation	WP6	1 - CIEMAT	Report	Public	3
D6.5	Project "Communication and Dissemination Action Plan"	WP6	1 - CIEMAT	Report	Public	6
D6.6	Project "Data Management Plan"	WP6	1 - CIEMAT	ORDP: Open Research Data Pilot	Public	6

1.3.3. WT3 Work package descriptions

Work package number [9]	WP1	**Lead beneficiary** [10]	5 - CNRS
Work package title	Developments of new innovative detector devices		
Start month	1	**End month**	48

Objectives

Detector development is a key and basic activity to address the issues in nuclear data improvement for either nuclear energy or non-energy applications. In particular, devices which allow high precision measurements for main actinides present in advanced reactor fuels and/or for new isotopes present in closed cycles are still required. In the previous EC project CHANDA, the design and construction of several new devices for the measurement of reaction cross sections or fission yields or decay data was performed. They will be commissioned and used in the coming years and especially during the present project that concentrates on measurements and nuclear data production. Nevertheless, there are still some needs for further development of new detectors in relation with the needs expressed by the energy and non-energy application communities. In this work package, support is thus primary given to detector developments leading to immediate measurements (sometimes directly related to actions supported in WP2) but also to the development of new innovative detectors which will be able to tackle the remaining challenges in nuclear data measurements.

Description of work and role of partners

WP1 - Developments of new innovative detector devices [Months: 1-48]
CNRS, CIEMAT, CEA, CERN, HZDR, JYU, PTB, UPC
Description of the work
Task 1.1: Innovative devices from fission cross section to fission products decay studies
Task coordinator: CEA/DRF/IRFU, partners: CEA/DAM, CNRS/CENBG, CEA/LNE-LNHB, JYU, UPC
Subtask 1.1.1: fission cross section
The target accuracy requirements for the integral parameters characterizing new fast reactor systems imply to reduce by a factor of 2 to 4 the uncertainty on actinide fission cross section measurements. This goal can be reached by the development of new detector devices which allow the use of the very precise standard H(n,p) cross section for the determination of induced neutron flux. Further, innovative fission detectors like time projection chamber have also to be developed to obtain better and more accurate nuclear data on fission observables. For accurate fission cross section measurements on actinides, two new setups, GRPD - gas recoil proton detector and a MicroMegas-based time projection chamber, will be then developed by respectively the CNRS/CENBG and the CEA/DRF/IRFU.
Subtask 1.1.2: fission yields and decay data studies
Fission yield studies for modelling and more accurate data for evaluation are of importance and requested for spent fuel heat prediction. In this task, CEA/DRF/IRFU will couple the FALSTAFF spectrometer (developed in the CHANDA project) with the FIPPS gamma spectrometer at ILL. This new setup will allow the production of new accurate nuclear data on 235U and thus the improvement of the fission process modelling. This measurement is also supported in the WP 2.
The JYU will improve the quality of the neutron induced fission product collection at IGISOL by the design of a new gas cell with electric field guidance. This new device will allow better efficiency which is expected to be of the order of 100 compared to what exist today. This improvement will benefit greatly for the fission products studies.
Finally, for fission product decay data, UPC will build a new version of the BELEN detector (based on the Bonner sphere principle) optimized for maximum total efficiency and spectrometric response and will measure beta-delayed-neutron spectra and Pn for selected fission product. This measurement is also supported in the WP 2.
Within the decay data evaluation community a lack of suitable half-life and nuclear decay data measurement facilities has been highlighted and in order to answer this shortfall, the LNE-LNHB intends to contribute in this field. The measurement work at LNE-LNHB is undertaken with highly calibrated detectors, at a metrological level of precision, for all types of radiation. A new measurement facility composed of a dedicated ionisation chamber and an automated sample changer will be constructed by the CEA/LNE-LNHB and will allow half-life measurements for a number of radionuclides important to the nuclear medicine community, as well as the nuclear industry. With such a detector system and sample changer, half-lives with uncertainties of 0.1% are attainable.
Task 1.2: Innovative devices for neutron emission studies
Task coordinator: CERN, partners: CEA/DEN, CEA/DAM

The accurate knowledge of the neutron population and its energy distribution is necessary to properly estimate reactor core key parameters like Keff or radial power distribution. New neutron or secondary particles detector with high performances can be developed to make progress in the knowledge of neutron emission.
Subtask 1.2.1 fast neutron spectrometer
A new compact broad band fast neutron spectrometer will be developed by the CEA/DEN with the aim of being used in various environments like nuclear reactor or near neutron beam facilities to characterize neutron flux.
Subtask 1.2.2 neutron detectors
For measurements at spiral2/NFS, a new innovative setup based on plastic scintillator bars wrapped with a Gd loaded material is under development by the CEA/DAM. This device will perform (n,xn) cross section measurements for very radioactive actinides like 239Pu for which new precise data are requested.
Subtask 1.2.3 gamma detectors
The prompt-gamma ray spectroscopy is a powerful indirect method to study (n,xn) reaction. Up to now, despite the very good characteristics of the CERN/n_TOF neutron beam for the study of these reactions, the method couldn't be developed there due the presence of a very intense -flash. Some instrumental developments are thus required to adapt Germanium detectors to the intense background. A new HPGe prototype, developed by CERN, with adapted electronics will thus be designed and tested at CERN/n_TOF.
Task 1.3: innovative devices for capture cross section measurement on actinides
Task coordinator: CIEMAT, partners: UPC
The new 20-m long n_TOF EAR-2 neutron beam line built with the support of the CHANDA project, is ~300 times more intense (30 times more fluence and 10 times shorter flight path) than the 200-m long flight path of n_TOF EAR-1. Such a high neutron flux allows measurements with very low sample masses (1 mg or even lower) but has the drawback of having 10 – 100 times larger neutron background compared to EAR-1. For this reason, it is critical to have detectors capable of standing high reaction rates and better background rejection capabilities. Two new detectors will thus be developed for capture cross section measurements on actinides.
The first prototype, developed by CIEMAT, is based on a Cs2LiYCl6:Ce (CLYC) inorganic scintillator and will allow measurement as gamma-ray calorimeter but also as total energy detector for cross sections determination.
The second line of detector development, undertaken by UPC, concerns a new technique based on novel total energy detectors with high energy resolution and gamma-ray imaging capability (i-TED). These two new devices will allow measurements on actinides for which only low mass sample are available.
Task 1.4: detectors for non-energy application
Task coordinator: PTB, partners: HZDR
Double differential cross section (DDX) data on the neutron-induced emission of light charged particles are required for assessing the risk of secondary tumours in particle radiation therapy. The n_TOF facility can be used to provide experimental DDX data with continuous neutron energy coverage. Such data would significantly improve the scarce data base for neutron energies close to and above 100 MeV and allow the improvement of the intranuclear cascade model for the relevant low-mass nuclei and composite ejectiles. This action, led by HZDR and PTB, thus aims to extend the techniques developed so far at n_TOF EAR1, to a measure DDX data for the neutron-induced emission of light charged particles from carbon, nitrogen and oxygen. The measurement itself is also supported in WP2.

Participation per Partner

Partner number and short name	WP1 effort
1 - CIEMAT	13.30
3 - CEA	36.10
4 - CERN	1.20
5 - CNRS	4.50
9 - HZDR	4.50
15 - JYU	9.00
22 - PTB	5.70
31 - UPC	6.50
Total	80.80

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D1.1	Report on the study and construction of new devices for precise fission cross section measurements	5 - CNRS	Report	Public	48
D1.2	Report on the design of the large gas cell for IGISOL	15 - JYU	Report	Public	24
D1.3	Report on the performances of new devices for precise study of fission products and their decay in view of measurements	3 - CEA	Report	Public	24
D1.4	Report on the commissioning of a compact broad-band fast neutron spectrometer	3 - CEA	Report	Public	36
D1.5	Report on the performance of the SCONE setup at NFS	3 - CEA	Report	Public	48
D1.6	Report on the performance of the HPGe equipped with newly developed electronics	4 - CERN	Report	Public	48
D1.7	Report on the development and performances of the new detectors for capture cross section measurements at n-TOF	1 - CIEMAT	Report	Public	48
D1.8	Report on the development and performances of the new detectors for non-energy applications	22 - PTB	Report	Public	24

Description of deliverables

Deliverables:
D.1.1 “Report on the study and construction of new devices for precise fission cross section measurements”; CNRS; M48
D.1.2 “Report on the design of the large gas cell for IGISOL”, JYU; M24
D.1.3 “Report on the performances of new devices for precise study of fission products and their decay in view of measurements”; CEA; M24
D.1.4 “Report on the commissioning of a compact broad-band fast neutron spectrometer”; CEA; M36
D.1.5 “Report on the performance of the SCONE setup at NFS”, CEA; M48
D.1.6 “Report on the performance of the HPGe equipped with newly developed electronics”, CERN; M48

D.1.7 “Report on the development and performances of the new detectors for capture cross section measurements at n-TOF”; CIEMAT; M48
D.1.8 “Report on the development and performances of the new detectors for non-energy applications”; PTB; M24

D1.1 : Report on the study and construction of new devices for precise fission cross section measurements [48]

Report on the study and construction of new devices for precise fission cross section measurements

D1.2 : Report on the design of the large gas cell for IGISOL [24]

Report on the design of the large gas cell for IGISOL

D1.3 : Report on the performances of new devices for precise study of fission products and their decay in view of measurements [24]

Report on the performances of new devices for precise study of fission products and their decay in view of measurements

D1.4 : Report on the commissioning of a compact broad-band fast neutron spectrometer [36]

Report on the commissioning of a compact broad-band fast neutron spectrometer

D1.5 : Report on the performance of the SCONE setup at NFS [48]

Report on the performance of the SCONE setup at NFS

D1.6 : Report on the performance of the HPGe equipped with newly developed electronics [48]

Report on the performance of the HPGe equipped with newly developed electronics

D1.7 : Report on the development and performances of the new detectors for capture cross section measurements at n-TOF [48]

Report on the development and performances of the new detectors for capture cross section measurements at n-TOF

D1.8 : Report on the development and performances of the new detectors for non-energy applications [24]

Report on the development and performances of the new detectors for non-energy applications

Schedule of relevant Milestones

Milestone number[18]	**Milestone title**	**Lead beneficiary**	**Due Date (in months)**	**Means of verification**
MS1	Completion of the simulation for the coupling of FALSTAFF and FIPPS at ILL	3 - CEA	12	Completion of the simulation for the coupling of FALSTAFF and FIPPS at ILL
MS2	Completion of simulations for new gas cell with electric field guidance at IGISOL	15 - JYU	18	Completion of simulations for new gas cell with electric field guidance at IGISOL
MS3	Completion of a new measurement facility by CEA/ LNE-LNHB	3 - CEA	18	Completion of a new measurement facility by CEA/ LNE-LNHB
MS4	Completion of the design of the fast neutron spectrometer at CEA/DEN	3 - CEA	24	Completion of the design of the fast neutron spectrometer at CEA/DEN
MS5	Completion of GRPD - gaz recoil proton detector at CNRS/CENBG	5 - CNRS	24	Completion of GRPD - gaz recoil proton detector at CNRS/CENBG
MS6	Completion of simulations for a MicroMegas-based time projection chamber at CEA/ DRF/IRFU	3 - CEA	24	Completion of simulations for a MicroMegas-based time projection chamber at CEA/ DRF/IRFU

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS7	Completion of the design of the new version of the BELEN detector at UPC	31 - UPC	24	Completion of the design of the new version of the BELEN detector at UPC
MS8	Completion of the commissioning of the HPGe equipped with newly developed electronics at CERN	4 - CERN	24	Completion of the commissioning of the HPGe equipped with newly developed electronics at CERN
MS9	Completion of the installation of the SCONE setup at NFS	3 - CEA	24	Completion of the installation of the SCONE setup at NFS
MS10	Completion of the new detectors for capture measurements at n-TOF	9 - HZDR	36	Completion of the new detectors for capture measurements at n-TOF

Work package number [9]	WP2	**Lead beneficiary** [10]	1 - CIEMAT
Work package title	New nuclear data measurements for energy and non-energy applications		
Start month	1	**End month**	48

Objectives

As demonstrated by international (OECD-NEA, IAEA), EC (CHANDA, ANDES, ERINDA, EUFRAT), regional (JEFF, ENDF/B, JENDL) and national nuclear data projects (GEDEPEON, NEEDS, TRAKULA) the nuclear data measurement requirements (High Priority Request List for nuclear data of the OECD-NEA) are very challenging. It was concluded that in many cases, despite significant improvements achieved in the above-mentioned projects, substantially improved experimental methods, setups and facilities were required to bridge the gap between measurement need and experimental result.
In this work package new measurements will be carried out to significantly improve the accuracy of nuclear data needed in energy and non-energy modelling applications, mainly in the field of fission, radiation protection, safety, sustainability and enhancement of nuclear technologies. Thus, at the end of the project a number of new high precision nuclear data sets will be available for the major actinides present in advanced reactor fuels, to reduce uncertainties in new isotopes in closed cycles with waste minimization, to better assess the uncertainties and correlations in their evaluation. The measurements to be carried out will use extensively the instrumentation (detectors, data acquisition systems), methodologies, new techniques and new facilities (n_TOF EAR2 and NFS) developed during the project and at the CHANDA project.
The tasks of this work package are accurate measurements of: neutron-induced fission and charge particle production cross sections, neutron capture cross sections total, neutron elastic and inelastic scattering and neutron multiplication cross sections, decay data (fission product β-delayed γ-rays and neutrons), fission yields, medical and other non-energy applications.

Description of work and role of partners

WP2 - New nuclear data measurements for energy and non-energy applications [Months: 1-48]
CIEMAT, CEA, CNRS, CSIC, CVREZ, ENEA, IFIN-HH, IRSN, IST-ID, JRC, JYU, NPI, NPL, NTUA, PTB, SCK-CEN, ULODZ, UMANCH, UOI, UPC, USC, USE, UU
Task 2.1: Neutron induced fission and charged particle production cross sections
Task coordinator: UMANCH, partners: CNRS/CENBG, CNRS/LPCC, CVREZ, NPI-CAS, NTUA, UOI, UU

Task 2.1.1: Neutron induced fission cross sections
UU will perform a high accuracy measurement of the energy dependence of the nubar for the 235U(n,f) cross section at JRC-Geel. The accuracy in the nubar is crucial for determining the uncertainty in the criticality of a nuclear reactor. The measurement will be carried out with the MONET setup and a technique developed within CHANDA, which allow for the suppression of systematic effects present in previous data.
CNRS/CENBG will apply the surrogate reaction analysis technique for providing new excitation functions and cross sections for the 239Pu(n,f), 241Pu(n,g) and 241Pu(n,f) reactions.
Three (n,f) cross section measurements will be carried out at the CERN n_TOF EAR2 built and equipped with support of the CHANDA project. The NTUA will perform a new measurement of the poorly know 230Th(n,f) cross section. The measurement is linked to the design of new reactors exploiting the Th fuel cycle. The UOI will carry out a new measurement on the 241Am(n,f) cross section. High quality data are needed for determining the destruction rate of 241Am in thermal and fast reactors and the associated high-level waste inventories.
The UMANCH will perform a new measurement of the high priority 239Pu(n,f) cross section. The measurement will be carried out with the STEFF spectrometer and

Task 2.1.2: Neutron induced charged particle production cross sections
CNRS/LPCC will perform a new measurement on the 16O(n,a) reaction in the energy range from the threshold up to 20 MeV. Such a reaction is responsible for 25% of the production of He in current reactors and the available data show discrepancies of 30%. The need of new cross section data for this reaction is listed in the OECD-NEA high priority request list. The measurement will improve significantly the accuracy reached in previous measurements.
UU will perform a new measurement on the natC(n,lchp) reaction at NFS facility supported by CHANDA and provide high quality data for improving cross section standards. Such standards are very important for the normalization of other cross sections in the high neutron energy range (i.e. above a few MeV).

NPI CAS will provide new (n,chp) cross section data with a powerful array of hyper pure germanium detectors constructed recently.
CVREZ will obtain information on the prompt fission neutron spectra above 10 MeV by performing activation measurement with well-known threshold reactions at a nuclear reactor. Such an information is highly requested since data for the 235U(n,f) prompt fission spectra above 10 MeV are almost non existing.

Task 2.2: Neutron capture cross sections
Task coordinator: ENEA, partners: CIEMAT, JRC, ULODZ, IRSN

Subtask 2.2.1. Capture measurements of fissile isotopes.
CIEMAT, ULODZ and JRC will perform various cross section measurements at GELINA and n_TOF on the high priority reactions 239Pu(n,g) and 239Pu(n,f). The methodology developed within CHANDA for the absolute measurement of the 235U alfa ratio will be applied to the 239Pu case. A new ionization chamber built by ULODZ will be tested in a 239Pu(n,f) measurement at JRC, which also deliver the 239Pu samples. The combined measurement of the 239Pu(n,g) and 239Pu(n,f) cross sections will be carried out at CERN with the use of the Total Absorption Calorimeter.

Subtask 2.2.2. Capture measurement of stable isotopes.
ENEA will measure the 92,94,95Mo(n,g) cross sections at GELINA and at the n_TOF facility with the high performance total energy detectors developed during the CHANDA project. The impact of the new evaluated nuclear data and their uncertainties will be verified in criticality safety and reactor applications at IRSN as end-user. The data will be part of an evaluation done in WP4 by IRSN.

Task 2.3: Neutron elastic and inelastic scattering and neutron multiplication cross sections
Task coordinator: IFIN-HH, partners: CNRS/IPHC, JRC

Precise knowledge of the neutron inelastic scattering and (n,2n) reaction cross sections is required due to their impact on the criticality coefficient of the fission reactors. IFIN-HH, CNRS/IPCH and JRC will perform neutron inelastic cross section measurements on several isotopes of interest for development of nuclear facilities: 239Pu, 233U, 14N and 35,37Cl. The 239Pu cross section measurements are of high priority for the development of the fast reactors which enable an indirect burning of 238U through 239Pu. Cross section data for 233U are known poorly and needed because it is the main isotope of relevance to the Th/U fuel cycle. 14N represents 99.63% in natural nitrogen and is part of uranium nitride (UN, U2N3 and UN2) which is considered as potential fuel for Generation IV Reactors. Last, but not least, neutron-induced reactions on 35,37Cl is very important for the development of the Fast Spectrum-Molted Salt Reactors based on chloride salts. The GRAPhEME and the GAINS germanium arrays upgraded within the CHANDA project will be used at the neutron source GELINA of JRC-Geel for producing high quality data. The new data acquisition system based on 14 bit/500 MSamples/s digitisers developed within CHANDA will be also used.

JRC will perform high accuracy measurements of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross sections at GELINA in response to specific requests based on the output of sensitivity studies of keff CHANDA.

Task 2.4: Decay data measurements
Task coordinator: CSIC, partners: CEA/LNHB, CNRS/Subatech, CSIC, JRC, SCK, UPC

Subtask 2.4.1. Beta decay measurements with TAGs.
CSIC and CNRS/Subatech provide high precision decay data for fission products from major and minor actinides present in working and future advanced reactor fuels. It will contribute to a better determination of the decay heat in reactors and consequently will contribute to the overall safety of the nuclear industry. The data obtained will also be of relevance for the calculation of neutrino spectra, necessary both for inspection technologies under development and for fundamental science. A proven combination of the total absorption gamma spectroscopy technique (TAGS) and high-resolution radioactive beam purification schemes techniques improved during the CHANDA project will be applied. The DTAS detector and the GASIFIC data acquisition system, also supported by CHANDA, will be used in the measurements.

Subtask 2.4.2. Beta delayed neutron measurements.
UPC and CSIC will perform new measurements with the BELEN detector and the GASIFIC data acquisition, both supported by CHANDA, and develop a new technique for extracting low resolution energy spectra with long counters following the Bonner sphere principle. Such a methodology will allow extracting information on the beta delayed neutron energies even of very short-lived fission fragments.

Subtask 2.4.3. Measurement of half-live and gamma-ray emission probabilities of beta emitters.
CEA/LNHB will undertake decay data measurements using the existing and calibrated gamma spectroscopy facility at LNE-LNHB. The current facility is to be used for the measurement of half-lives for a range of radionuclides prioritary for reactor safety and medical applications: 106Ru, 153Sm, 166Ho, 186Re6, 212Pb, 225Ac and 223Ra .

Accurate nuclear data are also important for a proper estimation of the main source terms of interest for the final repository for SNF (decay, heat, neutron and gamma-ray emission rate, fissile material content, volatile nuclides). Priorities are currently being defined in the framework of NFRP-2018-6. JRC and SCK will carry out high accuracy measurements of the high priority isotopes.

Task 2.5: Fission yields measurements
Task coordinator: UU, partners: CEA/IRFU, CNRS/LPSC, UJY, USC

Subtask 2.5.1. Fission yield studies in (n,f) reactions.
CEA/IRFU will perform an innovative experiment on 235U at the research reactor of the ILL by coupling the first arm of FALSTAFF to the brand new FIPPS gamma-ray spectrometer. A part of the FALSTAFF spectrometer was built and tested within the CHANDA project. The goal is to provide evaluate the performance of FALSTAFF (work in WP1) and at the same time provide new nuclear data and to improve the modelization of the fission process thanks to the association of those new detection systems on a high neutron flux beamline. FALSTAFF will measure the fragment kinetic energy and will identify the fragment mass after evaporation. FIPPS will measure the cascade of gamma-rays emitted by the fragments. It will give access to direct comparisons with fission and deexcitation models, prompt gamma-ray spectra with a good identification of the atomic number and mass of the fragments and information on the angular momentum of the fission fragments.

CNRS/LPSC will develop new program with the LOHENGRIN spectrometer at the Laue Langevin Institute (ILL) allowing to test deeply the assumption of the models used in the fission yield evaluations. The program will be the measurements of kinetic energy dependency of yields, isomeric ratios or isotopic distributions. The Gas Filled Magnetic spectrometer developed within CHANDA will be used in the measurements coupled to the LOHENGRIN spectrometer for purification of the extracted beam.
Recently, a new ion manipulation method, Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR), has been developed for Penning traps. It allows faster and more accurate measurement
of atomic masses, as compared to the more traditional techniques. The achieved high mass resolving power allows to resolve isomers separated only by a few tens of keV's.
JYU has begun to apply a pioneering technique called Phas-Imagin Ion-Cyclotron-Resonance (PI-ICRS) for determining isomeric yield ratios (IYR) in fission. In a CHANDA-supported experiment isomeric ratios of neutron rich indium and cadmium isotopes in proton-induced fission were measured. JYU will develop a method based on the PI-ICR technique for general fission product yield studies. The UU will perform fission yields measurements as a follow up of the developments achieved with CHANDA. Independent fission yields in neutron induced fission will be performed using the IGISOL/JYFLTRAP facilities at JYU.

Subtask 2.5.2. Fission yield studies in inverse kinematics.
USC will perform an experiment to demonstrate the use of (p,2p) as surrogate reactions for fission experiments and identify key nuclei accessible by the new FAIR facility for fission experiments induced by (p,2p) reactions. The experiment will allow investigating the fission of 237Pa, determining the resolution achieved in excitation energy of the fissioning compound nucleus and the possibility to determine fission barriers. The data are relevant for fission models concerning the damping of shell effects with excitation energy and their impact in the potential energy surface and level densities.

Task 2.6: New measurements for non-energy applications
Task coordinator: USE, partners: IST, NPL, PTB

The recent reviews from IAEA (INDC(NDS)-0591 and INDC(NDS)-0596) indicate that of the most important nuclear data needs are for the production of medical radioisotopes. Among the medical radionuclides of interest, the most relevant are currently gamma and positron emitters for both diagnostic and therapeutic applications. Several charged-particle and neutron production routes exist for the production of medical radioisotopes but sometimes no data or only one data set is available. New measurements of the excitation functions and thick-target yield measurement for validation of the recommended data are needed.

Subtask 2.6.1. Spectrum averaged cross sections for dosimetry.
NPL will perform spectrum-averaged benchmark measurements of the activity induced in foils by neutrons from a 252Cf source via the 117Sn(n,inl)117mSn and 60Ni(n,p) reactions. Such measurements have been prioritized by the IAEA in order to mitigate known shortcomings in the data in the reactor dosimetry file IRD.

Subtask 2.6.2. Measurement of cross sections relevant for hadron therapy.
PTB and IST will collaborate in the research of secondary high neutron production in particle radiation therapy of cancer. Secondary neutrons with energies up to about 200 are produced by beam interaction in the treatment head and in the target volume. The risk of secondary tumours induced by these neutrons is important, in particular for young

patients. The measurement of double-differential charged-particle emission cross sections will be carried out at the CENR n_TOF facility in the neutron energy range from 20 MeV to 200 MeV. Part of the necessary equipment will be developed by HZDR within WP1.

Subtask 2.6.3. Measurement of beta+ emitters.
USE will perform measurements of production cross sections of beta+ emitters used for range verification in proton therapy. The list of isotopes covers the high priorities of IAEA: 11C, 13N, 15O, 30P produced by protons with energies up to 250 MeV. The gamma-ray detection set-up will consist of a medical PET scanner, or equivalent, and successful preliminary tests have been carried out already at CNA. Other recently proposed isotopes for range verification, with shorter half-lives such as 10C, 12N, 38mK and 29P will be considered along the project.

Participation per Partner

Partner number and short name	WP2 effort
1 - CIEMAT	14.30
3 - CEA	7.10
5 - CNRS	21.00
6 - CSIC	14.40
7 - CVREZ	11.70
8 - ENEA	15.00
10 - IFIN-HH	11.20
11 - IRSN	1.50
12 - IST-ID	4.00
13 - JRC	17.20
15 - JYU	5.00
17 - NPI	17.30
18 - NPL	2.30
20 - NTUA	6.00
22 - PTB	4.00
23 - SCK-CEN	2.20
27 - ULODZ	12.00
29 - UMANCH	10.00
30 - UOI	6.00
31 - UPC	1.80
33 - USC	10.00
34 - USE	10.00
35 - UU	9.00
Total	213.00

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D2.1	Report on the (n,f) cross section measurements	29 - UMANCH	Report	Public	48
D2.2	Report on the (n,chp) cross section measurements	5 - CNRS	Report	Public	48
D2.3	Report on the 239Pu(n,g), 92,94,95Mo(n,g) cross measurements at n_TOF and GELINA	8 - ENEA	Report	Public	40
D2.4	Report on the 239Pu, 233U, 14N and 35,37Cl inelastic cross section measurements at GELINA	10 - IFIN-HH	Report	Public	48
D2.5	Report on the measurements of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross sections at GELINA.	13 - JRC	Report	Public	48
D2.6	Report of the decay data measurements performed with DTAS and BELEN	6 - CSIC	Report	Public	42
D2.7	Report on the development of a new technique for obtaining low resolution information on the beta delayed neutron energies with BELEN-like detectors.	31 - UPC	Report	Public	30
D2.8	Report on the method based on the PI-ICR technique for general fission product yield studies at JYFL	15 - JYU	Report	Public	36
D2.9	Spectrum averaged cross sections for dosimetry	18 - NPL	Report	Public	44
D2.10	Report on the measurement of double-differential charged-particle emission cross sections at the CERN n_TOF facility in the neutron energy range	22 - PTB	Report	Public	48

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	from 20 MeV to 200 MeV				
D2.11	Report on the production cross sections of beta+ emitters used for range verification in proton therapy.	34 - USE	Report	Public	30
D2.12	Report on the fission yield studies with the LOHENGRIN spectrometer at ILL	5 - CNRS	Report	Public	36
D2.13	Report on fission yield studies with FALSTAFF at ILL	3 - CEA	Report	Public	48
D2.14	Report on fission yield studies in inverse kinematics at FAIR	33 - USC	Report	Public	34
D2.15	Report on the of half-live and gamma-ray emission probabilities of beta emitters measurement	3 - CEA	Report	Public	40

Description of deliverables

D.2.1 Report on the (n,f) cross section measurements (UMANCH) M48
D.2.2 Report on the (n,chp) cross section measurements (CNRS) M48
D.2.3 Report on the 239Pu(n,g), 92,94,95Mo(n,g) cross measurements at n_TOF and GELINA (ENEA) M40
D.2.4 Report on the 239Pu, 233U, 14N and 35,37Cl inelastic cross section measurements at GELINA (IFIN-HH) M48
D.2.5 Report on the measurements of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross sections at GELINA. (JRC) M48
D.2.6 Report of the decay data measurements performed with DTAS and BELEN (CSIC) M42
D.2.7 Report on the development of a new technique for obtaining low resolution information on the beta delayed neutron energies with BELEN-like detectors. (UPC) M30
D.2.8 Report on the method based on the PI-ICR technique for general fission product yield studies at JYFL. (JYU) M36
D.2.9 Spectrum averaged cross sections for dosimetry (NPL) M44
D.2.10 Report on the measurement of double-differential charged-particle emission cross sections at the CERN n_TOF facility in the neutron energy range from 20 MeV to 200 MeV. (PTB) M48
D.2.11 Report on the production cross sections of beta+ emitters used for range verification in proton therapy. (USE) M30
D.2.12 Report on the fission yield studies with the LOHENGRIN spectrometer at ILL (CNRS) M36.
D.2.13 Report on fission yield studies with FALSTAFF at ILL (CEA) M48
D.2.14 Report on fission yield studies in inverse kinematics at FAIR (USC) M34
D.2.15 Report on the of half-live and gamma-ray emission probabilities of beta emitters measurement (CEA) M40

D2.1 : Report on the (n,f) cross section measurements [48]

Report on the (n,f) cross section measurements

D2.2 : Report on the (n,chp) cross section measurements [48]

Report on the (n,chp) cross section measurements

D2.3 : Report on the 239Pu(n,g), 92,94,95Mo(n,g) cross measurements at n_TOF and GELINA [40]

Report on the 239Pu(n,g), 92,94,95Mo(n,g) cross measurements at n_TOF and GELINA

D2.4 : Report on the 239Pu, 233U, 14N and 35,37Cl inelastic cross section measurements at GELINA [48]

Report on the 239Pu, 233U, 14N and 35,37Cl inelastic cross section measurements at GELINA

D2.5 : Report on the measurements of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross sections at GELINA. [48]

Report on the measurements of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross sections at GELINA.

D2.6 : Report of the decay data measurements performed with DTAS and BELEN [42]

Report of the decay data measurements performed with DTAS and BELEN

D2.7 : Report on the development of a new technique for obtaining low resolution information on the beta delayed neutron energies with BELEN-like detectors. [30]

Report on the development of a new technique for obtaining low resolution information on the beta delayed neutron energies with BELEN-like detectors.

D2.8 : Report on the method based on the PI-ICR technique for general fission product yield studies at JYFL [36]

Report on the method based on the PI-ICR technique for general fission product yield studies at JYFL

D2.9 : Spectrum averaged cross sections for dosimetry [44]

Spectrum averaged cross sections for dosimetry

D2.10 : Report on the measurement of double-differential charged-particle emission cross sections at the CERN n_TOF facility in the neutron energy range from 20 MeV to 200 MeV [48]

Report on the measurement of double-differential charged-particle emission cross sections at the CERN n_TOF facility in the neutron energy range from 20 MeV to 200 MeV

D2.11 : Report on the production cross sections of beta+ emitters used for range verification in proton therapy. [30]

Report on the production cross sections of beta+ emitters used for range verification in proton therapy.

D2.12 : Report on the fission yield studies with the LOHENGRIN spectrometer at ILL [36]

Report on the fission yield studies with the LOHENGRIN spectrometer at ILL

D2.13 : Report on fission yield studies with FALSTAFF at ILL [48]

Report on fission yield studies with FALSTAFF at ILL

D2.14 : Report on fission yield studies in inverse kinematics at FAIR [34]

Report on fission yield studies in inverse kinematics at FAIR

D2.15 : Report on the of half-live and gamma-ray emission probabilities of beta emitters measurement [40]

Report on the of half-live and gamma-ray emission probabilities of beta emitters measurement

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Completion of the simulation for the coupling of FALSTAFF and FIPPS at ILL	3 - CEA	12	Completion of the simulation for the coupling of FALSTAFF and FIPPS at ILL
MS3	Completion of a new measurement facility by CEA/ LNE-LNHB	3 - CEA	18	Completion of a new measurement facility by CEA/ LNE-LNHB

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS5	Completion of GRPD - gaz recoil proton detector at CNRS/CENBG	5 - CNRS	24	Completion of GRPD - gaz recoil proton detector at CNRS/CENBG
MS9	Completion of the installation of the SCONE setup at NFS	3 - CEA	24	Completion of the installation of the SCONE setup at NFS
MS11	Activation measurements for the extraction of prompt fission neutron spectra above 10 MeV	7 - CVREZ	24	Activation measurements for the extraction of prompt fission neutron spectra above 10 MeV
MS12	Measurement of the energy dependence of the nubar with the MONET setup	13 - JRC	24	Measurement of the energy dependence of the nubar with the MONET setup
MS13	Completion of the measurements with FALSTAFF at ILL	3 - CEA	36	Completion of the measurements with FALSTAFF at ILL
MS14	Completion of the measurement on the (p,2p) fission induced reactions at FAIR	33 - USC	30	Completion of the measurement on the (p,2p) fission induced reactions at FAIR
MS15	Measurement of the 230Th(n,f) cross section at n_TOF	20 - NTUA	36	Measurement of the 230Th(n,f) cross section at n_TOF
MS16	Measurement of the 241Am(n,f) cross section at n_TOF	30 - UOI	36	Measurement of the 241Am(n,f) cross section at n_TOF
MS17	Measurement of the 239Pu(n,f) cross section at n_TOF	29 - UMANCH	36	Measurement of the 239Pu(n,f) cross section at n_TOF
MS18	Measurement of the 16O(n,alpha) cross section at NFS, GENESIS and AMANDE	5 - CNRS	36	Measurement of the 16O(n,alpha) cross section at NFS, GENESIS and AMANDE
MS19	Measurement of the natC(n,lchp) at NFS	35 - UU	42	Measurement of the natC(n,lchp) at NFS
MS20	Completion of the (n,chp) cross section measurements at NPI CAS with germanium detectors	17 - NPI	36	Completion of the (n,chp) cross section measurements at NPI CAS with germanium detectors
MS21	Measurement of the 239Pu(n,g) at n_TOF	1 - CIEMAT	36	Measurement of the 239Pu(n,g) at n_TOF
MS22	Measurement of the Mo isotopes at GELINA and n_TOF	8 - ENEA	34	Measurement of the Mo isotopes at GELINA and n_TOF
MS23	Completion of the 239Pu, 233U, 14N and 35,37Cl	10 - IFIN-HH	40	Completion of the 239Pu, 233U, 14N and 35,37Cl

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
	inelastic and (n,2n) cross section measurements at GELINA			inelastic and (n,2n) cross section measurements at GELINA
MS24	Completion of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross section measurements at GELINA	13 - JRC	40	Completion of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross section measurements at GELINA
MS25	Completion of the measurements with TAGS and BELEN	6 - CSIC	40	Completion of the measurements with TAGS and BELEN
MS26	Completion of the measurements at the CEA-LNHB	3 - CEA	36	Completion of the measurements at the CEA-LNHB
MS29	Decision on targets to be manufactured	13 - JRC	18	Decision on targets to be manufactured

Work package number [9]	WP3	**Lead beneficiary** [10]	21 - PSI
Work package title	Target Preparation for Improvement of Nuclear Data Measurements		
Start month	1	**End month**	48

Objectives

The demand for high-quality targets, specially designed for the envisaged experiment and targets manufactured for nuclear reaction studies in a broad variety of application fields is constantly increasing, with the production of radioactive samples comprising particular challenges due to the special requirements arising from the emitted radiation. Only a handful of laboratories in Europe are capable and equipped to meet these special requirements. Resource sharing, knowledge transfer as well as tight interaction with the end-users in order to fabricate tailored samples are a MUST for a more efficient and qualitatively improved delivery of urgently needed targets. Moreover, intensive R&D work has to be triggered for new innovative solutions of target preparation and characterization. In particular, we aim to develop a dedicated mass separator device in order to provide the community with isotopically pure targets for special applications.

Description of work and role of partners

WP3 - Target Preparation for Improvement of Nuclear Data Measurements [Months: 1-48]
PSI, JRC, UMAINZ
Task 3.1: Intensification of the "producer – user – interaction"
Task coordinator: PSI, partners: JRC

The, as exact as possible, knowledge on the specific conditions of an envisaged experiments is crucial for the manufacturing and characterization of "tailored targets". For instance, very often, experimenters only rely on information from commercial suppliers concerning impurities in samples or materials for irradiation. Later on, in their real experiment, they observe that unexpected impurities cause side effects which make their initially wanted signal invisible. Moreover, using radioactive isotopes as target material, users should be aware about the problems caused by the emitted radiation from the target itself, in particular the impacts on detectors and additionally induced background. In many cases, these boundary conditions caused by the specific requirements of the envisaged experiment have to be considered already for the way, how the isotope is produced, separated and purified. Later one, the selection of the target preparation method, the kind of backing and the final characterization of the isotope content are crucial parameters to pave the way for a successful experiment. We intend to trigger a series of regular meetings of target makers with the users to better communicate the requirements from both sides, including both partners of SANDA but also other research groups that might be interested and might contribute to the discussions in the network. We intend to support bilateral meetings and organize user workshops (annual or every second year) after identifying interested users.

Task 3.2: Fostering the network of target makers
Task coordinator: JRC, partners: PSI

Sharing knowledge, equipment and resources is a key issue for efficient work in high-cost and man-power intensive fields. Especially for producing radioactive targets, there are only a few laboratories in Europe, which are able and allowed to handle such material. Production of radioactive isotopes and handling of radioactive material is, due to the measures to be taken for radiation protection, extremely time consuming and cost-intensive. In addition, storage and transport of radioactive material get more complicated due to the more strict regulations within the European Union. Networking of target makers will, therefore, be mandatory to become more efficient. First synergies identified in the frame of the CHANDA project will be maintained and extended; more synergies between target producers will be identified and new partners will be included into the network if possible, including both partners of SANDA but also other research groups that might contribute to the discussions in the network. Moreover, we want to establish a joint database of TP (target preparation) facilities and suppliers of enriched isotopes. The web platform of the International Nuclear Targets Development Society (INTDS) will be used for distributing information and offers. This society and its internet platform gives additional opportunities to establish also contacts with groups outside Europe, for instance with target makers from USA (Oakridge and Argonne) or South Africa (iTembaLabs), to exchange knowledge, learn from their experience and broaden the possibilities for young researchers (students, postdocs) to go abroad for improving or complete their knowledge and skills. Regular exchange on progresses at meetings and workshops is foreseen.

Task 3.3: Target production
Task coordinator: JRC, partners: PSI

A limited number of targets can be produced according to requests from collaboration members. Both PSI and JRC will be responsible for the manufacturing of the final target. The target manufacturer will be in close contact concerning the special requirements of the envisaged experiment using the possibilities of user-producer interaction provided in the frame of task 3.1. Resources will be allocated according to the effort. Target requests can be submitted to the TP task leader. Both requests related to energy (minor actinides, 233U, 239Pu or fission products like 79Se) and non-energy applications (for instance 179Ta) will be considered. Each target request will be evaluated on the basis of the relevance of the target and the possibilities of the TP facilities.
During the first 12 months of the project, target request from collaborators will be collected and evaluated. As an essential milestone, the decision on which targets can be manufactured will be made after this time span.

Task 3.4: Development of an isotope separator
Task coordinator: PSI, partners: UMAINZ

Demands to improve the nuclear data basis are observed in numerous fields of nuclear applications. In particular, in the field of nuclear energy, high precision data with low uncertainties for minor actinides and fission products are urgently needed. Key players in the corresponding fields name 238/236U, 245Cm, 239/240/242Pu as relevant for minor actinides, Cs, Mo and other element isotopes as examples for fission products. This list is of course not complete. In some cases, these isotopes are also of interest in other nuclear data domains like nuclear astrophysics. A prominent example is the neutron capture cross section of 135Cs which is important both for the determination of the amount of radioactive cesium in burnt fuel elements of fast reactors, and it contributes to a quantitative interpretation of the isotopic Ba abundances in terms of the temperature during stellar He burning, as well as of the presence of radioactive isotopes in the Early Solar System.
A considerable number of these reactions is not possible to study, because the target isotope cannot be produced in pure form. A dedicated modern high efficiency, high transmission, high throughput mass separator designed for these special applications would improve the situation considerably, and, in a certain number of cases, would allow measurements with these isotopes for the first time. An additional advantage is the possibility to directly implant the separated isotope into the wanted backing in the wanted dimensions.
A considerable number of urgently wanted isotopes are available at PSI, where currently 30 l of spent nuclear fuel solutions containing up to 100mg of Pu isotopes, 10 mg of 135Cs or 1 mg 245Cm, each per liter, are stored.
Since the available starting material is normally limited, the machine has to be designed meeting the special requirements, delivering e.g. high ion current, highest ionization efficiency and transmission as well as offering the possibility for recovery of the remaining sample material after implantation. Our final aim is to install such a facility at PSI and make separated material available for the nuclear data community in Europe in a proportional way to the investment from EC. The site is best suited due to the central position in Europe and the existing infrastructure including laboratory space with the necessary permission for working with highly-radioactive samples including actinides. The goal of the present effort is the definition and development of the design meeting the requirements for the special application as target production facility and the preparation of the site for the installation.
PSI is responsible for the site specification in the PSI hotlab, UMAINZ will develop the design, additional support for consulting on specific scientific and engineering topics will be subcontracted by PSI.

Participation per Partner

Partner number and short name	WP3 effort
13 - JRC	15.20
21 - PSI	27.00
28 - UMAINZ	24.00
Total	66.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D3.1	Report on the meetings performed in the frame of (“Producer – user – interaction”)	21 - PSI	Report	Public	36
D3.2	Report on the meetings performed in the frame of “Network of target producers”	13 - JRC	Report	Public	42
D3.3	Report on produced targets	13 - JRC	Report	Public	30
D3.4	Documentation of the design of a mass separation tool for target preparation	28 - UMAINZ	Report	Public	48
D3.5	Documentation of the site specification for installation of a mass separator in the Hotlab of PSI	21 - PSI	Report	Public	36

Description of deliverables

D.3.1 Report on the meetings performed in the frame of (“Producer – user – interaction”) (PSI): M36
D.3.2 Report on the meetings performed in the frame of “Network of target producers” (JRC): M42
D.3.3 Report on produced targets (JRC): M30
D.3.4 Documentation of the design of a mass separation tool for target preparation (UMAINZ): M48
D.3.5 Documentation of the site specification for installation of a mass separator in the Hotlab of PSI (PSI): M36

D3.1 : Report on the meetings performed in the frame of (“Producer – user – interaction”) [36]

Report on the meetings performed in the frame of (“Producer – user – interaction”)

D3.2 : Report on the meetings performed in the frame of “Network of target producers” [42]

Report on the meetings performed in the frame of “Network of target producers”

D3.3 : Report on produced targets [30]

Report on produced targets

D3.4 : Documentation of the design of a mass separation tool for target preparation [48]

Documentation of the design of a mass separation tool for target preparation

D3.5 : Documentation of the site specification for installation of a mass separator in the Hotlab of PSI [36]

Documentation of the site specification for installation of a mass separator in the Hotlab of PSI

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS27	Scheduling regular user-producer meetings	21 - PSI	6	Scheduling regular user-producer meetings

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS28	Scheduling regular target maker meetings	13 - JRC	6	Scheduling regular target maker meetings
MS29	Decision on targets to be manufactured	13 - JRC	18	Decision on targets to be manufactured

Work package number [9]	WP4	Lead beneficiary [10]	21 - PSI
Work package title	Nuclear data evaluation and uncertainties		
Start month	1	End month	48

Objectives

Nuclear data evaluation is the necessary step to ensure that the experimental information is passed on simulation tools for a variety of applications. Many international evaluation libraries exist from different national and international organizations, all of them being regularly updated, demonstrating the importance of such process. The CHANDA project had recognized this essential work by dedicating part of its efforts in supporting the update of the OECD/JEFF library. In this work, it is proposed to continue the work started in the CHANDA project, making use of the experimental and theoretical achievements obtained during these 4 years, as well as combining them with and experimental observations from WP1, WP2 and new model developments developed in this WP.

In this work package, it is proposed (1) to continue the development of open-source evaluation tools by improving the phenomenological and microscopic models (TALYS and EMPIRE for reaction nuclear data; and specific codes for decay and structure data, as well as fission yields), (2) to perform evaluation work for important isotopes (actinides and fission products, to be proposed to different international libraries), (3) to provide processed data ready to be used by simulation codes for validation purposes, (4) to provide sensitivity vectors for feedback analysis, and (5) to recommend a set of preferred systems (or benchmarks) for the validation of the new evaluations (see WP5).

The tasks of this work package are dedicated to support the above goals, using previous developments combined with new theoretical and experimental insights obtained during the progress of this project. The outcomes such as evaluation tools, input files, evaluation files or sensitivity vectors will be available to all interested institutions, for possible inclusion in various libraries and databases. A few international projects and groups apart from the participants are potentially interested in these results: the IAEA Nuclear Data Section for nuclear data coordinated research projects, the OECD/NEA data bank with the projects under the Working Party on International Nuclear Data Evaluation Co-operation and the JEFF library, the US Cross Section Evaluation Working Group for the ENDF/B library.

Description of work and role of partners

WP4 - Nuclear data evaluation and uncertainties [Months: 1-48]
PSI, CIEMAT, ATOMKI, CEA, CNRS, IFIN-HH, JSI, Sofia, TUW, UB, UPM, USC, UU
Task 4.1: Nuclear reaction code developments and evaluations
Task coordinator: PSI, partners: CEA/DAM/DIF, CEA/DEN, PSI, CNRS/IPHC, TUW, UB, UU

Task 4.1.1: TALYS development
The development of TALYS for better modelling and its associated model parameter database will be performed in contact and coordination with the TALYS collaboration. Examples of important observables are the spectra and multiplicities of gamma and neutron. They are essential for nuclear applications such as criticality but also for shielding. In this context, efforts on statistical decay of fission fragments using TALYS were initiated during the ANDES project, and continued during the CHANDA project. For this new project, the goal is to make use of the previously developed codes and TALYS interfaces to test the influence of different theoretical prescriptions for the initial conditions for the decay (fragment mass, charge, excitation energy end spin distributions) on prompt fission neutron and gamma observables. Inputs from the GEF model, from the “scission point model” SPY, and from microscopic dynamical fission calculations will be tested and compared along with more phenomenological prescriptions.

Task 4.1.2: Nuclear reaction evaluation
Prior the production of nuclear reaction evaluations (in the form of ENDF files), different methods will be studied and compared. CEA/DAM, PSI and CEA/DEN will work together to improve evaluation methodologies for nuclear data and the associated uncertainties, by making use of Bayesian inference method with differential as well as carefully selected integral constraints. These groups have a large experience in ENDF file productions.
These applied methods can be complemented by “model defect” methods, as presented by TUW. TUW is well known for its developments of Bayesian evaluation techniques and associated uncertainties accounting also for model deficiencies. But despite recent progress there are still important problems not solved, especially for light nuclei and the resonance regime. Such developments will be based on the most recent version of the nuclear model code TALYS and the hybrid R-matrix code GECCCOS thus consistently extending the evaluation regime beyond statistical model calculations. The Uppsala University (UU) has also recently invested large efforts in studying the possibility of using model defect

methods in evaluations. In this context, UU will combine its resources with the previous partners. To continue to develop the so-called TENDL methodology, by including new functionality to treat model defects and inconsistent experimental data. This will allow incorporating reliable and quantitative methods for the use of calibration data and hence produce justified co-variances for the evaluated nuclear data.
These studies will define the tools used by the different partners to produce (or support) the evaluation work: new (n,xng) for the main actinides (CNRS/IPHC and CEA/DEN), Cr evaluations (UU), major and minor actinides (such as U235, U238, Pu239, and Am241: CEA/DEN, CEA/DAM/DIF, CNRS), some important fission products (Sm, Nd, Cs, Mo, Ru, Eu, Gd, Rh: CEA/DEN, PSI) and the Pu isotopic chain (Pu238 to Pu244: UB and IAEA). As a standard practice, all evaluations will be provided with covariance information, processed and used in task 4.3.

Task 4.2: Fission yields and nuclear structure and decay data evaluations
Task coordinator: IFIN-HH, partners: IFIN-HH, CEA/LNHB, CNRS/LPSC, Sofia, Atomki, CNRS/Subatech

Task 4.2.1: Evaluation of Fission yields
The analysis and evaluation of fission yields is also of prime importance for many applications (e.g. correct estimation of the content of spent nuclear fuel). The CEA/DEN, CNRS/LPSC have a large experience in measuring, analysing and evaluating thermal neutron-induced fission yields. In the framework of a collaboration between the Physical Studies Laboratory (LEPh) of the CEA (France), the Subatomic and Corpuscular Physics lab (LPSC of CNRS) of Grenoble (France) and others, a program of actinide fission yield measurements of interest for the current and innovative nuclear reactors has been initiated for several years. In this task, the proposed work will allow to deeply test some model assumptions used in the fission yield evaluations. The program will be based on the measurements of kinetic energy dependency of yields, isomeric ratios or isotopic distributions. It is defined in three parts: two experimental, and the last one dealing with the improvement of the modelling of the fission products used in the evaluations (e.g. modelling of the fission products from the FIFRELIN Monte Carlo code).

Task 4.2.2: Evaluation of nuclear structure and decay data
Together with the fission yields, evaluations of nuclear structure and decay data can have an important impact on specific applications, such as decay heat calculations. Additionally, it is important that the (cumulative) fission yields are evaluated together with decay data. In this context, a few experienced groups will join efforts to perform ENSDF (Evaluated Nuclear Structure Data File) evaluations. ENSDF constitutes the main source of nuclear structure information used in RIPL (The Reference Input Parameter Library), the major library used by TALYS and EMPIRE. It should be noted that some of these groups also have experimental and simulation programs which are combined with the evaluation efforts. For instance, new TAGS data will be analysed to develop the calculation of the experimental uncertainties associated to these experiments, in order to be able to provide nuclear databases with covariance matrices for beta decay data. These covariance matrices are mandatory for the propagation of decay data uncertainties on the decay heat, antineutrino spectra and beta-delayed neutron emission fractions of reactors (CNRS/Subatech). Evaluation activity will be performed by CEA/LNHB, ATOMKI, Sofia and IFIN-HH: theoretical calculations, evaluations, modern evaluation tools (and training) and nuclear data library production (e.g. evaluated decay scheme), to improve the next version of the JEFF Radioactive Decay Data Library and the Evaluated Nuclear Structure Data File.

Task 4.3: Processing and sensitivity
Task coordinator: UPM, partners: CIEMAT, UPM, CNRS/Subatech

The processing step is strongly linked to the evaluation process and allows basic evaluations (in the ENDF-6 format) to be used by a variety of simulation codes. In the CHANDA project (Task 9.4), quality-assured processing routes for PREPRO and NJOY nuclear data processing codes were established; however, the AMPX code system was neglected because AMPX was not freely distributed with SCALE at that time. As a continuation of the work done in CHANDA and in consonance with efforts done by OECD-NEA, CIEMAT proposes to define and validate a processing route for AMPX and GEANT4 in order to process state-of-the-art nuclear data. Best processing parameters will be identified and input decks for processing CE libraries with the AMPX system will be generated. Additionally, state-of-the-art nuclear data libraries (e.g., JEFF-3.3, ENDF/B-VIII.0 and JENDL-4.0u2) will be processed and validated using the same criticality validation suite used by MCNP. Additionally, UPM will perform the checking, processing and verification of evaluated nuclear data files: (1) review of the processing tools, (2) processing and verification of evaluated nuclear data files and covariances, and (3) verification of covariance nuclear data in criticality, shielding and spent nuclear fuel assay data. The second part of this task will concern the sensitivity calculations and uncertainty propagation based on the processed files. Such sensitivity will be performed for fission yields (CNRS/Subatech).

Task 4.4: Applications
Task coordinator: CIEMAT, partners: UPM, CIEMAT, JSI

To complete this work package and provide a suitable link with the Work Package on validation (WP5), recommendations for preferred benchmark for thermal and high energy (up to 20 MeV) will be proposed. Whereas nuclear data validation has been in the recent years mostly restricted to critical benchmarks, this effort will also focus on other types of measurements, such as shielding benchmarks and kinetics. The code such as SUS3D (JSI) will be used for shielding calculations, with improved S/U analysis of the impact of the uncertainties in the secondary angular and energy distributions. For criticality and kinetic parameters, a review of different suites of inputs used in ICSBEP will be performed (CIEMAT and UPM), with selection/classification of benchmarks for different levels of nuclear data sensitivities for benchmarking and validation of nuclear data. For shielding, and spent nuclear fuel, a review of the SINBAD and SFCOMPO databases will be performed (JSI).

Task 4.5: High-energy model uncertainties
Task coordinator: CEA/DRF, partners: CEA/DRF, USC

Finally, the higher energy part (above 20 MeV) and especially the propagation of uncertainties from the high-energy models (and parameters) will be studied (CEA/DRF, USC). Codes used for the simulation of Accelerator-Driven Systems (ADS) and for number of other applications, such as for instance radiation protection or hadron therapy, are usually Monte Carlo transport codes, in which the probability of the occurring high energy nuclear reactions and characteristics of the reaction products are provided by nuclear physics models and not through nuclear data bases as at lower energies. This implies that specific methods have to be developed to assess the uncertainties due the parameters and approximations used in these nuclear models.
During the last Nuclear Data projects, an important effort has been devoted to the development, improvement and validation of the high energy nuclear models, in particular the INCL-ABLA combination of models that are now widely used for high energy applications. In CHANDA, for the first time, a study has been conducted to investigate a possible methodology for quantifying the uncertainties linked to high energy models and propagating them in Monte Carlo transport codes. A Bayesian framework has been proposed and tested on INCL for a few varying parameters. In this project, it is proposed to investigate if the methodology can be generalized to the whole set of parameters of INCL and extended to ABLA.

Participation per Partner

Partner number and short name	WP4 effort
1 - CIEMAT	16.60
2 - ATOMKI	8.60
3 - CEA	43.20
5 - CNRS	11.50
10 - IFIN-HH	5.00
14 - JSI	7.20
21 - PSI	6.00
24 - Sofia	5.30
25 - TUW	5.00
26 - UB	35.00
32 - UPM	11.80
33 - USC	5.00
35 - UU	13.00
Total	173.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D4.1	Report on code development, methods	21 - PSI	Report	Public	40
D4.2	Report on new nuclear reaction data evaluation	3 - CEA	Report	Public	48
D4.3	Report on the evaluation for fission yields	3 - CEA	Report	Public	36
D4.4	Report on the evaluation for nuclear structure and decay data	10 - IFIN-HH	Report	Public	36
D4.5	Report on the processing and sensitivity analysis	32 - UPM	Report	Public	36
D4.6	Report on the applications: recommendation	1 - CIEMAT	Report	Public	36
D4.7	Report on the possibility to generalize the high-energy model uncertainties methodology	3 - CEA	Report	Public	48

Description of deliverables

D.4.1 “Report on code development, methods” (PSI): M40
D.4.2 “Report on new nuclear reaction data evaluation” (CEA): M48
D.4.3 “Report on the evaluation for fission yields” (CEA): M36
D.4.4 “Report on the evaluation for nuclear structure and decay data” (IFIN-HH): M36
D.4.5 “Report on the processing and sensitivity analysis” (UPM); M36
D.4.6 “Report on the applications: recommendation” (CIEMAT): M36
D.4.7 “Report on the possibility to generalize the high-energy model uncertainties methodology” (CEA): M48

D4.1 : Report on code development, methods [40]

Report on code development, methods

D4.2 : Report on new nuclear reaction data evaluation [48]

Report on new nuclear reaction data evaluation

D4.3 : Report on the evaluation for fission yields [36]

Report on the evaluation for fission yields

D4.4 : Report on the evaluation for nuclear structure and decay data [36]

Report on the evaluation for nuclear structure and decay data

D4.5 : Report on the processing and sensitivity analysis [36]

Report on the processing and sensitivity analysis

D4.6 : Report on the applications: recommendation [36]

Report on the applications: recommendation

D4.7 : Report on the possibility to generalize the high-energy model uncertainties methodology [48]

Report on the possibility to generalize the high-energy model uncertainties methodology

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS30	availability of TALYS modules	3 - CEA	32	availability of TALYS modules
MS31	availability of new EMPIRE modules/models	26 - UB	32	availability of new EMPIRE modules/models
MS32	availability of evaluated files for important actinide isotopes	3 - CEA	32	availability of evaluated files for important actinide isotopes
MS33	availability of evaluated files for important fission products	3 - CEA	36	availability of evaluated files for important fission products

Work package number [9]	WP5	Lead beneficiary [10]	3 - CEA
Work package title	Nuclear data validation and integral experiments		
Start month	1	End month	48

Objectives

Nuclear data validation is considered here as a subset of the broader Verification, Validation and Uncertainty Quantification (VVUQ) process in Modelling and Simulation. In this VVUQ general process, validation is defined as the assessment of a computational model accuracy by comparison with experimental data assumed to represent reality faithfully. In nuclear engineering, it is generally further implied that this model fidelity assessment relates to a specific application domain (i.e., the intended use).
For complex engineering systems such as reactors, the VVUQ process formally requires a constructive approach with a validation hierarchy, validation metrics and criteria, a validation domain, etc. Different system tiers have to be considered, from low-level subtiers to the full-scale system. Corresponding models and representative experiments have to be identified, from simple single-physics "benchmarks" to full-scale multi-physics experiments. In such a framework, nuclear data are just one set of model parameters among others that influence the global simulation outputs. Requirements are initially expressed only in terms of high-level systems responses. In principle, sensitivity and uncertainty analyses have to be performed for the different system tiers while accounting for the different sources of errors.
As JEFF evaluated nuclear data are used in many applications, and as sensitivities of system responses to nuclear data can vary considerably depending on specific design choices, it would be impractical to attempt a "general" catch-all validation approach. Instead, it is necessary to proceed by parts, beginning with the most sensitive data. As a common goal for this project, we set out to validate a few selected nuclear data for some applications. In order to have reasonably realistic plant models and target performance criteria to use, we chose reactor systems for which a significant amount of (pre-)design work had already been done, while trying to have some system diversity.
As single-physics benchmarks (sensitive only to a few nuclides and reactions) are more and more commonly integrated in the evaluation process itself (see WP4), together with differential experiments, they have to be excluded from the validation experiments, not to be used twice.
Error and uncertainties in nuclear data (important actinides, fission products and structural materials) are known to have a major impact on some high-level nuclear system parameters. When high-fidelity models are used, these errors and uncertainties can be the dominant component in the aggregate performance. The careful assessment of these errors and uncertainties via the validation process is therefore essential. This is not a straightforward task, however, as there are well-known difficulties and many potential pitfalls. One of which being hidden error compensations, which typically occur when the validation relies only on very global experiments.
As nuclear data evaluations produced in WP4 will come with covariances, it will be possible to incorporate this information directly in the computational analysis, as should be done. Then, the process calls for ensemble computing, and finally assessment of uncertainty in the outputs by statistical inference. As this represents a large effort, the partnership will be harnessed to leverage additional resources. No data adjustment or assimilation will be attempted.
In the end, we should be able to quantify the impact of (WP4) nuclear data errors and uncertainties on the selected system outputs, and to suggest relevant additional validation experiments if the target performance is not met.
This work package is subdivided into three tasks, each of them containing some subtasks :
- Task 5.1: Sensitivity analyses, impact studies, uncertainty estimates, and expected gains. The objective is to relate improvements in (JEFF-3.3) nuclear data to performance gains in the operation, design, licensing of innovative reactors or concepts, such as ASTRID, MYRRHA, JHR, and possibly also ALLEGRO, ALFRED/LEADER, MSFR (thorium fuel cycle). The scope covers not only the reactors, but also criticality-safety, nuclide inventories in subassemblies or waste streams.
- Task 5.2: Validation studies for the above applications, by performing detailed analyses of available relevant benchmarks and integral experiments (not already used in the evaluation process), and inferring trends in nuclear data. The objective is the validation of the files produced under WP4, as well as the identification of gaps in the validation domain.
- Task 5.3: New validation experiments and needs for new integral data. The objective is to find some means of obtaining the required validation data, in a general context of dwindling experimental reactor capabilities. The work includes innovative experiments in existing facilities, for the purpose of filling the gaps.

Description of work and role of partners

WP5 - Nuclear data validation and integral experiments [Months: 1-48]
CEA, CIEMAT, CNRS, CVREZ, ENEA, IRSN, JSI, KIT, NRG, SCK-CEN, UPM
Task 5.1: Impact studies, sensitivity analyses, and assessment of needs for various applications
Task coordinator: CIEMAT, partners: CEA, CNRS/LPSC, SCK-CEN, JSI, KIT, UPM, IRSN

Subtask 5.1.1: Impact studies and sensitivity analyses
Under this task, the impact of (JEFF) nuclear data uncertainties and systematic errors on reactor engineering design and safety parameters will be evaluated in a quantitative manner. The focus is on innovative nuclear systems (and fuel cycles): sodium-cooled fast reactors such as ASTRID or ESFR, lead-cooled fast reactors such as MYRRHA or ALFRED, the JHR water-cooled MTR under construction in France. Other reactors which have also undergone at least some preliminary engineering design work will be included, if the project can leverage external resources: advanced light-water cooled reactors, ALLEGRO gas-cooled fast reactor, thorium-233U fuelled molten salt reactor (SAMOFAR project).
We aim for a diversity of systems, as it is well-known that the impact of nuclear data largely depends on the specific design choices, even within a given “family” of systems. It is therefore essential to consider different systems and to perform systematic sensitivity studies to appreciate relative differences. Yet, we fully realize that our selection is only partially representative of the vast spectrum of nuclear plants and facilities.
Reactor parameters of interest are typically core power distribution, critical mass, control rod worth, Doppler coefficient, coolant void reactivity, burnup swing, decay heat, etc. Reactor operating conditions corresponding to the most conservative state will be selected, depending on the parameter; for instance, depleted core conditions for sodium void estimation. The focus will be on steady-state operation, but reactor transient conditions with feedback will also be considered, if readily-available calculation models can be found.
Additionally, the impact of nuclear data on neutron propagation into reflectors and shields will be addressed, as this has important implications for predicting quantities such as local heating, pressure vessel damage or radiation dose rate.
Nuclear data needs for plant decommissioning and waste storage will also be assessed, to a smaller extent.
In general, the work will rely on already-developed computational models of the reactor, component or system. Advantage will be taken of models developed under past EC-funded projects, or as part of separate engineering design studies, for which target uncertainties and design/safety margins should be available.
The particular methods used for performing the sensitivity and impact studies are left with the contributing organizations, which all have a proven record in this respect. Each of them will be free to choose their preferred (well-tested) method and code. Classical (forward) sensitivity calculation capabilities have become routine in many deterministic and Monte Carlo code packages (cf. DICE & NDaST), including fuel depletion studies. Generalized sensitivity and perturbation capabilities are less commonly used, but this is not expected to be a serious hindrance for the present purpose. Nonetheless, some consideration will be given to advanced methodologies and to errors which arise from various approximations.
The JEFF-3.3 evaluated file will be used throughout as a reference, including covariance data (when available). When new evaluations will become available from WP4, they will be substituted and tested. Discrepancies with JEFF-3.3 may be used (with due care) to estimate systematic errors and assess their impact.
Methods of sensitivity analysis: CIEMAT, LSPC, UPM and CEA/DEN will compare their methods of sensitivity studies CNRS/LPSC will use generalized sensitivities computed by the Monte Carlo method. Recent developments make it possible to calculate sensitivities of almost any output to various nuclear data. The availability of such reference solutions opens up the possibility of investigating the impact of classical approximations, such as the use of group-wise cross sections and macro-group sensitivity coefficients, the neglect of some nuclear data correlations, the neglect of uncertainties in secondary distributions, etc.
UPM will use the SCALE system for reactor physics calculations and S/U analysis. They will compare sensitivities computed with Monte Carlo calculations in both multi-group and continuous-energy modes, assessing biases and pointing out the configurations/energy ranges for which an accurate resonance self-shielding still remains a challenge, which is of interest for calculation schemes based on deterministic codes.
CIEMAT will investigate a hybrid method coupling Monte Carlo simulations with the Equivalent Generalized Perturbation Theory, in order to account for the impact of nuclide inventory errors on end-of-life reactor parameters. This hybrid method, which has already been tested in CHANDA, will be used to quantify other classical approximations. CEA/DEN will contribute to these comparisons with their own sensitivity calculation method and results.
SFR: CEA/DEN and UPM will perform sensitivity and impact studies for a PuO2-UO2-fuelled ASTRID-type sodium-cooled fast reactor Advantage will be taken of the CP-ESFR reactor model developed under ESFR-SMART. If possible, a SUPERPHENIX model, also used in ESFR-SMART, will be included for comparison purposes. A convenient starting point will be the work performed in WP2.1 of ESFR-SMART, which considered the impact of nuclear data.
JHR: CEA/DEN will perform a similar study for the U3Si2/UMo-fuelled light-water cooled JHR MTR reactor. A detailed JHR model is available in Camprini’s PhD thesis, for instance.

MYRRHA: SCK-CEN, CIEMAT and UPM will perform sensitivity studies for MYRRHA, the lead-cooled PuO2-UO2-fuelled lead-bismuth-cooled developed by SCK-CEN. The reactor model used in the CHANNDA project will be used as a starting point. A more detailed model may be necessary, however.
ALFRED: UPM will perform sensitivity, uncertainty analysis and quantitative evaluation of nuclear data improvements on safety-related parameters of the PuO2-UO2-fuelled lead-cooled fast reactor ALFRED demonstrator. This work will build upon the results of the FP7 LEADER and FP7 ESNII+ projects, which include a calculation model.
Criticality-safety: IRSN will also contribute to this task by performing nuclear data sensitivity/impact studies for criticality-safety applications.
Decommissioning and waste disposal: KIT will investigate nuclear data needs which arise in connection with nuclear plant decommissioning and waste disposal operations. Indeed, with the aging of the nuclear fleets, several states prepare for the shutdown and decommissioning of nuclear power plants and facilities, and for the final disposal of HLW and LLW/MLW. These topics involve the radiological characterization of various materials, mostly by simulations using inventory codes. In general, the nuclei involved are different from those that are important for nuclear reactor operation and fuel cycle, they are sometimes not even present in standard evaluated nuclear data libraries. Therefore, simulations have to rely on evaluated files derived from basic physics models with little or no validation. The study will consider actinide inventory, fission products, isomeric state production cross sections, 14C production, tritium production, etc.
Subtask 5.1.2: Assessment of (JEFF) nuclear data needs
At the conclusion of Subtask 5.1.1, the findings will be compiled and cross-analyzed in a synthesis document, which will be published. This document may be viewed as an update of the well-known OECD/WPEC/SG26 report, based on more recent data and on better-substantiated reactor models.
We will discuss the importance of the a priori covariance data used, and the implications of the results. Recommendations will be made as to which nuclear data are in need of improvement and what "performance" gains can be expected as a consequence.
These results will be communicated to the OECD/NEA for consideration by the JEFF community (JEFF-4 perspective) and for inclusion in the HPRL.

Task 5.2: Validation studies (using existing experiments)
Task coordinator: UPM, partners: CEA/DEN, CIEMAT, JSI, KIT, NRG, IRSN

The various actions in this Task 5.2 will make systematic use of the JEFF-3.3 evaluated files, with their associated covariances. As new evaluations will progressively become available from WP4, they will be substituted and the validation calculation will be repeated.
Subtask 5.2.1: Assessing correlations in integral experiments
While a considerable effort has been given to nuclear data covariances in recent years, much less attention has been paid to correlations in integral experiments used in validation, adjustment, and assimilation studies. In point of fact, correlation coefficient data for criticality cases are available for only 93 integral experiments of the DICE database associated with the ICSBEP Handbook.
Although this project will not attempt to produce adjusted nuclear data libraries nor to assimilate validation information, CIEMAT, JSI, CEA/DEN, and UPM will share their best experts' opinions on the "missing correlations in integral experiments" problem, with the goal of assessing its impact on nuclear data validation studies. Simulations will be made to estimate the correlations between the experimental uncertainties of integral experiments and quantify their impact on some reactor concept.
Subtask 5.2.2: C/E validation and trends
UPM and CEA/DEN will use a carefully-selected set of reactor physics experiments (from reactor benchmarks or models in IRPhE or other sources such as reactor startup experiments, etc.) for performing nuclear data validation. JEFF-3.3-based C/E results will be analyzed for possible biases and reactor performance. The same set of experiments will be analyzed again with new (WP4) evaluations when they become available, and trends will be inferred.
JSI: will perform cross section sensitivity/uncertainty analysis of selected shielding benchmarks (from the SINBAD database in particular), known to be more sensitive to scattering reactions than criticality experiments. New WP4 evaluations will be compared with JEFF-3.3, and the reasons for the differences will be investigated.
NRG will perform Monte Carlo calculations and C/E calculations of criticality benchmarks. The benchmarks will be grouped according to sensitivity profiles, to facilitate the C/E analysis. NRG is uniquely positioned to perform this task because of its large collection of benchmarks already integrated in a database.

IRSN will perform a similar study for a subset of their large suite of criticality-safety benchmarks.
CIEMAT will use a Monte Carlo procedure recently developed in the CHANDA project to validate fission product nuclear data against MINERVE/CERES pile oscillation experiments available in IRPhE.
The results derived from these studies will be combined in such a way that the same experimental information is not included twice. Gaps in the validation will be identified and discussed.

Task 5.3: New integral experiments
Task coordinator: CEA/DEN, partners: CVREZ, ENEA

Subtask 5.3.1: Experiments at GELINA and CEA/DEN
The proposed experiments will consist in performing neutron transmission measurements at the JRC Geel GELINA facility using the same samples as those used in the CEA Cadarache MINERVE reactor as part of the past CERES Burnup Credit programme. Preliminary studies show that such experiments should be feasible. Each sample is made of a UO2 matrix with a small admixture of a fission product: Sm, Nd, Cs, Mo, Ru, Eu, Gd, or Rh. The expected outcome will be a set of transmission data for each sample. These data will be first used to determine the amount of contaminants in the samples by Neutron Resonance Transmission Analysis (NRTA). The knowledge of the relative amount of such contaminants will help improve the analysis of the past MINERVE measurements. In a second step, a combined analysis of the MINERVE spectrum-averaged data and the GELINA microscopic energy-dependent data will help improve the fission product cross section data in the resonance region.
Subtask 5.3.2: Experiments at LR-0, CVREZ and CEA/DEN
The flexible zero-power LR-0 critical facility at Rez and its well-defined neutron spectrum will be used to create benchmark-quality nuclear data validation conditions:
- Full characterization of a critical 235U-fuelled configuration (criticality, power distribution and spatial distribution of flux and reaction rates) for an IRPhEP-quality type benchmark;
- Direct and indirect measurements of the 235U prompt fission neutron spectrum, especially the high-energy tail. The direct method uses neutron spectrometry techniques while the indirect method uses low uncertainty flux monitors. Some of the neutron detectors developed under WP1 could also be tested on that occasion;
- Measurements of spectrum-averaged cross sections in well-characterized neutron spectra (from fast to thermal), obtained by spectrum shaping arrangements using high-purity graphite moderation.
Subtask 5.3.3: Experiments at TAPIRO, ENEA and CEA/DEN
The TAPIRO fast neutron source reactor at the ENEA Casaccia centre near Rome will be used to measure minor actinide spectrum-averaged cross sections. The program, called AOSTA, will consist of minor actinide irradiations and fission cross section measurements. Reference major actinides will be also measured in the same spectral conditions. Delayed gamma peak spectrometry will be used to infer capture cross sections, while dedicated miniature fission chambers containing pure deposits of actinides will be used to measure fission cross sections. As for Subtask 5.3.2, the AOSTA program could provide the opportunity to test some of the neutron detectors developed in WP1.
Although only the leading organizations are named across each subtask, it is expected that other project partners will be interested and will volunteer contributions to the above experimental programs in due course.
At the outcome of this Task 5.3, valuable new validation data are expected and will be made available broadly. The subsequent use of this experimental information for nuclear data validation will provide some indication of the remaining gaps to improve evaluated files and meet target performance. Recommendations will be made as to the best course of action to bridge this gap, knowing that there is only a very small number of zero-power experimental reactors still in operation worldwide.
Should difficulties arise with one of the above subtasks, resources could be redirected to experiments in another facility. In particular, innovative (semi-)integral transmission-type experiments could be considered at one of the JRC Geel facilities, in the GELINA target hall or at the MONET tandem Van-de-Graaff. Such experiments would consist in studying transmitted beams of MeV-energy neutrons thru a stack of plates made of pure material (238U, Fe, Na, MgO…). The stack thickness would be optimize for maximizing the activation detectors sensitivity to neutron inelastic scattering in the stacked material. Preliminary simulations suggest that such an experiment would be feasible.
Under Task 5.3, there is a risk that one of the three facilities will not be available for the intended experiments. Such a risk is considered to be rather low. Should it happen, the resources could be redirected to expand on the experiments in one of the other two facilities.

Participation per Partner

Partner number and short name	WP5 effort
1 - CIEMAT	15.20
3 - CEA	8.70
5 - CNRS	3.00
7 - CVREZ	16.30

Partner number and short name	WP5 effort
8 - ENEA	3.00
11 - IRSN	1.90
14 - JSI	6.00
16 - KIT	3.00
19 - NRG	3.90
23 - SCK-CEN	1.10
32 - UPM	7.10
Total	69.20

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.1	Report on sensitivity analysis methods	1 - CIEMAT	Report	Public	24
D5.2	Report on ESFR, MYRRHA, and ALFRED sensitivity and impact studies	23 - SCK-CEN	Report	Public	24
D5.3	Report on JHR sensitivity and impact study	3 - CEA	Report	Public	24
D5.4	Report on HLW sensitivity and impact study	16 - KIT	Report	Public	24
D5.5	Report on assessment of nuclear data needs	3 - CEA	Report	Public	36
D5.6	Report on correlations between integral experiments	1 - CIEMAT	Report	Public	30
D5.7	Report on reactor and shielding C/E validation and nuclear data trends	32 - UPM	Report	Public	42
D5.8	Report on critical benchmark C/E validation and nuclear data trends	19 - NRG	Report	Public	42
D5.9	Report on C/E validation and nuclear data trends	32 - UPM	Report	Public	48
D5.10	Report on experiments at JRC Geel using MINERVE samples	3 - CEA	Report	Public	42
D5.11	Report on integral experiments at LR-0	7 - CVREZ	Report	Public	42

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.12	Report on integral experiments at TAPIRO	8 - ENEA	Report	Public	42
D5.13	Report on new integral experiments and needs	3 - CEA	Report	Public	48

Description of deliverables

D.5.1 Report on sensitivity analysis methods; CIEMAT, LPSC, UPM, CEA; M24
D.5.2 Report on ESFR, MYRRHA, and ALFRED sensitivity and impact studies; SCK, CEA, UPM; M24
D.5.3 Report on JHR sensitivity and impact study; CEA; M24
D.5.4 Report on HLW sensitivity and impact study; KIT; M24
D.5.5 Report on assessment of nuclear data needs; CEA, CIEMAT, UPM, SCK, KIT; M36
D.5.6 Report on correlations between integral experiments; CIEMAT, JSI, CEA, UPM; M30
D.5.7 Report on reactor and shielding C/E validation and nuclear data trends; UPM, JSI, CEA; M42
D.5.8 Report on critical benchmark C/E validation and nuclear data trends; NRG, IRSN; M42
D.5.9 Report on C/E validation and nuclear data trends; UPM, CEA, JSI, NRG, IRSN; M48
D.5.10 Report on experiments at JRC Geel using MINERVE samples; CEA; M42
D.5.11 Report on integral experiments at LR-0; CVREZ, CEA; M42
D.5.12 Report on integral experiments at TAPIRO; ENEA, CEA; M42
D.5.13 Report on new integral experiments and needs; CEA, JRC, CVREZ, ENEA; M48

D5.1 : Report on sensitivity analysis methods [24]

Report on sensitivity analysis methods

D5.2 : Report on ESFR, MYRRHA, and ALFRED sensitivity and impact studies [24]

Report on ESFR, MYRRHA, and ALFRED sensitivity and impact studies

D5.3 : Report on JHR sensitivity and impact study [24]

Report on JHR sensitivity and impact study

D5.4 : Report on HLW sensitivity and impact study [24]

Report on HLW sensitivity and impact study

D5.5 : Report on assessment of nuclear data needs [36]

Report on assessment of nuclear data needs

D5.6 : Report on correlations between integral experiments [30]

Report on correlations between integral experiments

D5.7 : Report on reactor and shielding C/E validation and nuclear data trends [42]

Report on reactor and shielding C/E validation and nuclear data trends

D5.8 : Report on critical benchmark C/E validation and nuclear data trends [42]

Report on critical benchmark C/E validation and nuclear data trends

D5.9 : Report on C/E validation and nuclear data trends [48]

Report on C/E validation and nuclear data trends

D5.10 : Report on experiments at JRC Geel using MINERVE samples [42]

Report on experiments at JRC Geel using MINERVE samples

D5.11 : Report on integral experiments at LR-0 [42]

Report on integral experiments at LR-0

D5.12 : Report on integral experiments at TAPIRO [42]

Report on integral experiments at TAPIRO

D5.13 : Report on new integral experiments and needs [48]

Report on new integral experiments and needs

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS34	Report on assessment of nuclear data needs	3 - CEA	36	Report on assessment of nuclear data needs

Work package number [9]	WP6	**Lead beneficiary** [10]	1 - CIEMAT
Work package title	Management, ND research coordination at EU level and Education and Training		
Start month	1	**End month**	48

Objectives

This work package has four complementary objectives of coordination.
-This WP will be dedicated to the general management of the project, the follow-up and validation of quality and timing of deliverables and milestones. It will also provide the tools for management, information exchange and external visibility including a dedicated web,
- the second objective will be the preparation of a framework for the coordination of the European nuclear data research in a sustainable structure well beyond the duration of the project, and, as far as possible, covering all the domains of applications of nuclear data,
-the third objective will be the coordination of the education and training activities, covering both the promotion and follow-up of training in the other tasks and work-packages of the project, and the organization of dedicated open training courses during the duration of the project, and
- the fourth objective will be the coordination and follow-up of the dissemination and communication activities all over the project.

Description of work and role of partners

WP6 - Management, ND research coordination at EU level and Education and Training [Months: 1-48]
CIEMAT, CEA, CNRS, JRC
Task 6.1: Management; CIEMAT, JRC
This task will handle the management of the consortium, including the administrative and financial operations, the notification of the consortium agreement preparation, the draft version for the rules of operation of the different management bodies and the reporting to the EU. One specific objective will be the coordination of the three periodic reports and the final report of the project. To facilitate the dissemination of the project progress and results and the exchange of information within the project a Web site will be prepared and open by the project. All consolidated information will be fully open, but a restricted access area will be reserved for materials under discussion within the project participants. The project will also prepare a detailed 'Communication Action Plan'.

Task 6.2: Sustainable framework for the coordination of the European nuclear data research; CIEMAT, CEA CNRS and JRC
This task will include:
- the identification of potential partners and contact points at the different Member States, MS.
- the follow-up and identification of tools for joint programing for FP9: EJP or similar
- the identification of potential program for the ND community in a 5 to 10 years horizon covering all the domains of applications of nuclear data
- the preparation of documentation and visits to Member States (MS) representatives with influence on the EURATOM programs, European technological platforms and other bodies of influence on the EURATOM programs, to explain the ND community, its needs of a long-standing framework for coordination, and the possible instruments to stablish that framework
- the preparation of one meeting of the ND community with interested Member States (MS) representatives, European technological platforms and other relevant stakeholders
- maintaining and clarifying the link to the JEFF project
- the identification of ways and frameworks to maintain our community effort and to reinforce links between experimentalists, theoreticians and evaluators around a common ambition

Task 6.3: Coordination of Education and training activities, JRC, CIEMAT
This task will promote that the research activities within the project result in PhD and Master theses and to favour the training of young scientist with working visits to the facilities associated to the project. A special event of the task will be the organization of one training course specialized in Nuclear Data for increased Safety of the nuclear and radiological EU installations. It will be open to the participants in other EU projects related to the field. This school will be organized as special edition of known schools on nuclear R&D. Initial contacts had been made with the organizers of the series

of the Nuclear Resonance Analysis schools. No fee will be requested and financial support will be allocated to provide travel support to a fraction of the students. Cooperation with ENEN will be set-up.

Task 6.4: Coordination of Dissemination and Communication activities, CIEMAT
This task will prepare a Communication and Dissemination Action Plan to be implemented by all the tasks and partners. The dissemination plan will make sure that the results are readily available for end-users, as soon as possible and well beyond the project duration in the standard formats (EXFOR, ENDF, ENSDF,…) and as much as possible using open repositories operated by international organizations like IAEA or NEA/OECD.
The communication plan will make sure that the general information of the project, its progress and main results reach to the potential end-users in the EU, both for classic end-users and for new potential end users.
Scientific Journals, international scientific and technical conferences, PhD and master theses and courses, sectorial conferences, national nuclear and radioprotection societies, and technological platforms will be included in both dissemination and communication actions.

In addition, a Data Management Plant, DMP, will be prepared to comply with the principles of the Open Research Data Pilot, ORDP. The DMP will explain that the digital research data generated in the action associated to a number of deliverables whose main results are data will be deposited in a research data repository (EXFOR of IAEA, and others of IAEA or NEA/OECD) and the measures that will be taken to make possible for third parties to access, mine, exploit, reproduce and disseminate, free of charge for any user: (i) the data, including associated metadata, needed to validate the results presented in scientific publications, as soon as possible; (ii) other data, including associated metadata, as specified and within the deadlines laid down in the 'data management plan', DMP. The selected repositories will be available long after the completion of the project by agreements with international organizations IAEA or NEA/OECD. Together with these organizations the consortium will provide information about tools and instruments at the disposal of the beneficiaries and necessary for validating the results.

In addition a web page will be prepared for the project both for the internal communication within the project and as an open window for external researchers and general public that wants to get updated on the activities and publications from the project. Although working versions of deliverables, publications and other materials might be password protected during the project execution all technical final results (compatible with regulations) will be openly available from the project web pages. The project web will be maintained at least 5 years after the project finalization.

Participation per Partner

Partner number and short name	WP6 effort
1 - CIEMAT	23.30
3 - CEA	1.80
5 - CNRS	2.00
13 - JRC	0.30
Total	27.40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D6.1	Web for the project	1 - CIEMAT	Websites, patents filling, etc.	Public	9
D6.2	Report on a sustainable framework for the coordination of the	3 - CEA	Report	Public	36

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
	European nuclear data research				
D6.3	Report on school on nuclear data research methods and tools and E&T activities	13 - JRC	Report	Public	12
D6.4	Project presentation	1 - CIEMAT	Report	Public	3
D6.5	Project “Communication and Dissemination Action Plan”	1 - CIEMAT	Report	Public	6
D6.6	Project “Data Management Plan”	1 - CIEMAT	ORDP: Open Research Data Pilot	Public	6

Description of deliverables

D.6.1 Web for the project: CIEMAT, M9
D.6.2: Report on a sustainable framework for the coordination of the European nuclear data research: CEA, M36
D.6.3 Report on school on nuclear data research methods and tools and E&T activities: JRC, M12
D.6.4: Project presentation: CIEMAT, M3
D.6.5: Project “Communication and Dissemination Action Plan”: CIEMAT, M6
D.6.6: Project “Data Management Plan”: CIEMAT, M6

D6.1 : Web for the project [9]

Web for the project

D6.2 : Report on a sustainable framework for the coordination of the European nuclear data research [36]

Report on a sustainable framework for the coordination of the European nuclear data research

D6.3 : Report on school on nuclear data research methods and tools and E&T activities [12]

Report on school on nuclear data research methods and tools and E&T activities

D6.4 : Project presentation [3]

Project presentation

D6.5 : Project “Communication and Dissemination Action Plan” [6]

Project “Communication and Dissemination Action Plan”

D6.6 : Project “Data Management Plan” [6]

The DMP will explain that the digital research data generated in the action associated to a number of deliverables whose main results are data will be deposited in a research data repository (EXFOR of IAEA, and others of IAEA or NEA/OECD) and the measures that will be taken to make possible for third parties to access, mine, exploit, reproduce and disseminate, free of charge for any user: (i) the data, including associated metadata, needed to validate the results presented in scientific publications, as soon as possible; (ii) other data, including associated metadata, as specified and within the deadlines laid down in the ‘data management plan’, DMP. The selected repositories will be available long after the completion of the project by agreements with international organizations IAEA or NEA/OECD. Together with these organizations the consortium will provide information about tools and instruments at the disposal of the beneficiaries and necessary for validating the results.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

1.3.4. WT4 List of milestones

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS1	Completion of the simulation for the coupling of FALSTAFF and FIPPS at ILL	WP1, WP2	3 - CEA	12	Completion of the simulation for the coupling of FALSTAFF and FIPPS at ILL
MS2	Completion of simulations for new gas cell with electric field guidance at IGISOL	WP1	15 - JYU	18	Completion of simulations for new gas cell with electric field guidance at IGISOL
MS3	Completion of a new measurement facility by CEA/LNE-LNHB	WP1, WP2	3 - CEA	18	Completion of a new measurement facility by CEA/LNE-LNHB
MS4	Completion of the design of the fast neutron spectrometer at CEA/DEN	WP1	3 - CEA	24	Completion of the design of the fast neutron spectrometer at CEA/DEN
MS5	Completion of GRPD - gaz recoil proton detector at CNRS/ CENBG	WP1, WP2	5 - CNRS	24	Completion of GRPD - gaz recoil proton detector at CNRS/CENBG
MS6	Completion of simulations for a MicroMegas-based time projection chamber at CEA/DRF/ IRFU	WP1	3 - CEA	24	Completion of simulations for a MicroMegas-based time projection chamber at CEA/ DRF/IRFU
MS7	Completion of the design of the new version of the BELEN detector at UPC	WP1	31 - UPC	24	Completion of the design of the new version of the BELEN detector at UPC
MS8	Completion of the commissioning of the HPGe equipped with newly developed electronics at CERN	WP1	4 - CERN	24	Completion of the commissioning of the HPGe equipped with newly developed electronics at CERN
MS9	Completion of the installation of the SCONE setup at NFS	WP1, WP2	3 - CEA	24	Completion of the installation of the SCONE setup at NFS
MS10	Completion of the new detectors for capture measurements at n-TOF	WP1	9 - HZDR	36	Completion of the new detectors for capture measurements at n-TOF
MS11	Activation measurements for the extraction of prompt fission neutron spectra above 10 MeV	WP2	7 - CVREZ	24	Activation measurements for the extraction of prompt fission neutron spectra above 10 MeV

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS12	Measurement of the energy dependence of the nubar with the MONET setup	WP2	13 - JRC	24	Measurement of the energy dependence of the nubar with the MONET setup
MS13	Completion of the measurements with FALSTAFF at ILL	WP2	3 - CEA	36	Completion of the measurements with FALSTAFF at ILL
MS14	Completion of the measurement on the (p,2p) fission induced reactions at FAIR	WP2	33 - USC	30	Completion of the measurement on the (p,2p) fission induced reactions at FAIR
MS15	Measurement of the 230Th(n,f) cross section at n_TOF	WP2	20 - NTUA	36	Measurement of the 230Th(n,f) cross section at n_TOF
MS16	Measurement of the 241Am(n,f) cross section at n_TOF	WP2	30 - UOI	36	Measurement of the 241Am(n,f) cross section at n_TOF
MS17	Measurement of the 239Pu(n,f) cross section at n_TOF	WP2	29 - UMANCH	36	Measurement of the 239Pu(n,f) cross section at n_TOF
MS18	Measurement of the 16O(n,alpha) cross section at NFS, GENESIS and AMANDE	WP2	5 - CNRS	36	Measurement of the 16O(n,alpha) cross section at NFS, GENESIS and AMANDE
MS19	Measurement of the natC(n,lchp) at NFS	WP2	35 - UU	42	Measurement of the natC(n,lchp) at NFS
MS20	Completion of the (n,chp) cross section measurements at NPI CAS with germanium detectors	WP2	17 - NPI	36	Completion of the (n,chp) cross section measurements at NPI CAS with germanium detectors
MS21	Measurement of the 239Pu(n,g) at n_TOF	WP2	1 - CIEMAT	36	Measurement of the 239Pu(n,g) at n_TOF
MS22	Measurement of the Mo isotopes at GELINA and n_TOF	WP2	8 - ENEA	34	Measurement of the Mo isotopes at GELINA and n_TOF
MS23	Completion of the 239Pu, 233U, 14N and 35,37Cl inelastic and (n,2n) cross section measurements at GELINA	WP2	10 - IFIN-HH	40	Completion of the 239Pu, 233U, 14N and 35,37Cl inelastic and (n,2n) cross section measurements at GELINA
MS24	Completion of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross	WP2	13 - JRC	40	Completion of the branching ratio for 209Bi, 208Pb(n,tot) and 238U(n,inel) cross

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
	section measurements at GELINA				section measurements at GELINA
MS25	Completion of the measurements with TAGS and BELEN	WP2	6 - CSIC	40	Completion of the measurements with TAGS and BELEN
MS26	Completion of the measurements at the CEA-LNHB	WP2	3 - CEA	36	Completion of the measurements at the CEA-LNHB
MS27	Scheduling regular user-producer meetings	WP3	21 - PSI	6	Scheduling regular user-producer meetings
MS28	Scheduling regular target maker meetings	WP3	13 - JRC	6	Scheduling regular target maker meetings
MS29	Decision on targets to be manufactured	WP2, WP3	13 - JRC	18	Decision on targets to be manufactured
MS30	availability of TALYS modules	WP4	3 - CEA	32	availability of TALYS modules
MS31	availability of new EMPIRE modules/ models	WP4	26 - UB	32	availability of new EMPIRE modules/models
MS32	availability of evaluated files for important actinide isotopes	WP4	3 - CEA	32	availability of evaluated files for important actinide isotopes
MS33	availability of evaluated files for important fission products	WP4	3 - CEA	36	availability of evaluated files for important fission products
MS34	Report on assessment of nuclear data needs	WP5	3 - CEA	36	Report on assessment of nuclear data needs

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
1	The start of the NFS facility has not yet been approved by the French nuclear regulatory body because of a long licensing process for the SPIRAL2 components needed for the NFS operation. There is a risk that NFS will not start its operation during the execution period of the project.	WP1, WP2	If NFS start of operations is delayed, the activities of the experimental program foreseen at NFS, related to D.1.5 and D.2.2, will be relocated to different facilities. The activities related to D.1.5 at NFS are mainly related to the commissioning of a neutron detector and can be done in several other laboratories of the members of the consortium. The measurement related to D.2.2 are already distributed between several experimental facilities (NFS, GENESIS, AMANDE and NPI CAS) and if NFS is not available we will try to make the proposed measurement in another one of those facilities. In addition, a narrow collaboration is being discussed with the ARIEL EURATOM-H2020 project, to open additional opportunities to organize experimental campaigns in the Nuclear DATA facilities open by ARIEL, that can contribute to the education and training of new nuclear professionals and students and at the same time contribute to make relevant measurements aligned with the priorities of SANDA.
2	CERN will shut down its accelerator complex during 2019 and 2020 for increasing the luminosity of LHC and n_TOF will build a new spallation target during that period. The new target will have to be commissioned and characterised before running the cross-section measurements. The delay in the upgrade of the CERN accelerators will propagate in the realisation of the measurements, part of D.2.1, and of D.2.3.	WP2	CERN holds very high-level standards keeping the schedules, and taking into account that all CERN experiments depend on this system it is very unlikely a long delay. Should it happen, some of the measurements could be moved to JRC facilities or other facilities. In addition, a narrow collaboration is being discussed with the ARIEL EURATOM-H2020 project, to open additional opportunities to organize experimental campaigns in the Nuclear DATA facilities open by ARIEL, that can contribute to the education and training of new nuclear professionals and students and at the same time contribute to make relevant measurements aligned with the priorities of SANDA. In the very unlikely case that the original experiments cannot be performed in any of the available facilities, an equivalent measurement will be proposed to redirect these resources.
3	Under Task 5.3 for New Integral Experiments, there is a risk that one of the three facilities will not be available for the intended experiments or it could experience long delays. Such a risk is considered to be very low.	WP5	The risk of not being to operate the integral experiments is low but should it happen, the resources foreseen for the integral measurements in the defaulting facility would be redirected to expand on the experiments in one of the other two facilities.
4	The ability and capacity to provide targets foreseen in WP3 to facilitate needs of	WP3	The user-producer network proposed in WP3 is there to ensure that an appropriate compromise is found between need and feasibility of a target, in

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
	SANDA and EU Member States in nuclear data experiments are resource limited and may be limited by the regulatory framework at the producer and at the user institute. For radioactive and nuclear targets users need to ensure that the regulatory requirements are met at the institute hosting the target(s) and that the post-project regulatory requirements (waste management, return shipments) are met. So, it is possible to experience delays in target production due to late specification of needs, missing confirmation of permissions for working with radioactive samples or transport permissions issues.		terms of availability of base-material, equipment for processing material, technical parameters of the target, means of characterisation and in terms of prioritization of the available staff and technical and financial resources. The WP3 in fact exists to deal with the risk that a nuclear data measurement project needs an appropriate target. So, these risks specific to WP3 can be considered 'business as usual' for WP3, and experience at the participating laboratories has shown that significant and adequate solutions tend to be found for most requests of interest, after adequate discussion.
5	Some of the new data expected for the new evaluation might not be available in time for the evaluations to be completed during the duration of the project.	WP4	Depending on the evaluation affected and the missing data, we could propose to still complete the proposed evaluation, in the case that the rest of new available data and new theoretical and mathematical framework - including nuclear physics models - provide sufficient improvements respect to the existing data, or we might propose to evaluate a different but similar isotope where the new available data will provide significant improvements versus the present evaluated libraries.

1.3.6. WT6 Summary of project effort in person-months

	WP1	WP2	WP3	WP4	WP5	WP6	Total Person/Months per Participant
1 - CIEMAT	13.30	14.30	0	16.60	15.20	23.30	82.70
2 - ATOMKI	0	0	0	8.60	0	0	8.60
3 - CEA	36.10	7.10	0	43.20	8.70	1.80	96.90
4 - CERN	1.20	0	0	0	0	0	1.20
5 - CNRS	4.50	21	0	11.50	3	2	42
· UNICAEN	0	0	0	0	0	0	0
· G-INP	0	0	0	0	0	0	0
· UBx	0	0	0	0	0	0	0
· IMT Atlantique	0	0	0	0	0	0	0
· Univ Nantes	0	0	0	0	0	0	0
6 - CSIC	0	14.40	0	0	0	0	14.40
7 - CVREZ	0	11.70	0	0	16.30	0	28
8 - ENEA	0	15	0	0	3	0	18
9 - HZDR	4.50	0	0	0	0	0	4.50
10 - IFIN-HH	0	11.20	0	5	0	0	16.20
11 - IRSN	0	1.50	0	0	1.90	0	3.40
12 - IST-ID	0	4	0	0	0	0	4
13 - JRC	0	17.20	15.20	0	0	0.30	32.70
14 - JSI	0	0	0	7.20	6	0	13.20
15 - JYU	9	5	0	0	0	0	14
16 - KIT	0	0	0	0	3	0	3
17 - NPI	0	17.30	0	0	0	0	17.30
18 - NPL	0	2.30	0	0	0	0	2.30

	WP1	WP2	WP3	WP4	WP5	WP6	Total Person/Months per Participant
19 - NRG	0	0	0	0	3.90	0	3.90
20 - NTUA	0	6	0	0	0	0	6
21 - PSI	0	0	27	6	0	0	33
22 - PTB	5.70	4	0	0	0	0	9.70
23 - SCK-CEN	0	2.20	0	0	1.10	0	3.30
24 - Sofia	0	0	0	5.30	0	0	5.30
25 - TUW	0	0	0	5	0	0	5
26 - UB	0	0	0	35	0	0	35
27 - ULODZ	0	12	0	0	0	0	12
28 - UMAINZ	0	0	24	0	0	0	24
29 - UMANCH	0	10	0	0	0	0	10
30 - UOI	0	6	0	0	0	0	6
31 - UPC	6.50	1.80	0	0	0	0	8.30
32 - UPM	0	0	0	11.80	7.10	0	18.90
33 - USC	0	10	0	5	0	0	15
34 - USE	0	10	0	0	0	0	10
35 - UU	0	9	0	13	0	0	22
Total Person/Months	80.80	213	66.20	173.20	69.20	27.40	629.80

1.3.7. WT7 Tentative schedule of project reviews

No project reviews indicated

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Euratom). Please note that if a fixed starting date is used, you will be required to provide a written justification.

5. Duration

Insert the duration of the project in full months.

6. Call (part) identifier

The Call (part) identifier is the reference number given in the call or part of the call you were addressing, as indicated in the publication of the call in the Official Journal of the European Union. You have to use the identifier given by the Commission in the letter inviting to prepare the grant agreement.

7. Abstract

8. Project Entry Month

The month at which the participant joined the consortium, month 1 marking the start date of the project, and all other start dates being relative to this start date.

9. Work Package number

Work package number: WP1, WP2, WP3, ..., WPn

10. Lead beneficiary

This must be one of the beneficiaries in the grant (not a third party) - Number of the beneficiary leading the work in this work package

11. Person-months per work package

The total number of person-months allocated to each work package.

12. Start month

Relative start date for the work in the specific work packages, month 1 marking the start date of the project, and all other start dates being relative to this start date.

13. End month

Relative end date, month 1 marking the start date of the project, and all end dates being relative to this start date.

14. Deliverable number

Deliverable numbers: D1 - Dn

15. Type

Please indicate the type of the deliverable using one of the following codes:

R	Document, report
DEM	Demonstrator, pilot, prototype
DEC	Websites, patent fillings, videos, etc.
OTHER	
ETHICS	Ethics requirement
ORDP	Open Research Data Pilot
DATA	data sets, microdata, etc.

16. Dissemination level

Please indicate the dissemination level using one of the following codes:

PU	Public
CO	Confidential, only for members of the consortium (including the Commission Services)
EU-RES	Classified Information: RESTREINT UE (Commission Decision 2005/444/EC)
EU-CON	Classified Information: CONFIDENTIEL UE (Commission Decision 2005/444/EC)
EU-SEC	Classified Information: SECRET UE (Commission Decision 2005/444/EC)

17. Delivery date for Deliverable

Month in which the deliverables will be available, month 1 marking the start date of the project, and all delivery dates being relative to this start date.

18. Milestone number

Milestone number:MS1, MS2, ..., MSn

19. Review number

Review number: RV1, RV2, ..., RVn

20. Installation Number

Number progressively the installations of a same infrastructure. An installation is a part of an infrastructure that could be used independently from the rest.

21. Installation country

Code of the country where the installation is located or IO if the access provider (the beneficiary or linked third party) is an international organization, an ERIC or a similar legal entity.

22. Type of access

VA	if virtual access,
TA-uc	if trans-national access with access costs declared on the basis of unit cost,
TA-ac	if trans-national access with access costs declared as actual costs, and
TA-cb	if trans-national access with access costs declared as a combination of actual costs and costs on the basis of unit cost.

23. Access costs

Cost of the access provided under the project. For virtual access fill only the second column. For trans-national access fill one of the two columns or both according to the way access costs are declared. Trans-national access costs on the basis of unit cost will result from the unit cost by the quantity of access to be provided.

History of changes

	HISTORY OF CHANGES
10-May-2019	**Implementation of Project Officer request of April 30th and May 10th 2019.**
	Annex 1 Part A
	- Remove from WP6 deliverables D6.1, D6.2, D6.3, D6.4 (periodic and final reports) - Change type of deliverables ORDP <-> R on deliverables of WP2 and WP6
	Annex 1 Part B
	- Remove the indication of ILL as potential subcontractor from the PSI description, section 4.1.21 page 73.
12-April-2019	**Implementation of Legal Officer message of April 2nd 2019.**
	- Removed all references to ILL in Part A of Annex 1: Workpackage WP3, tasks 3.3.
24-March-2019	**Implementation of Legal Officer requests Ref. Ares(2019)1520427 - 06/03/2019 and message of March 14th 2019.**
	Annex 1 Part A
	- CEA sectors are described with a consisting nomenclature across the Annex 1 part A and B. Changes in Workpackage WP4, task 4.2.1 and task 4.5 - Removed all references to collaborators in Workpackage WP3, tasks 3.1 and 3.2 - Change on the description of the relation with the TALYS collaboration and removal of nominal reference of non-beneficiaries in Workpackage WP4 task 4.1.1 - Removed all references to ILL as selected subcontractor in Part A of Annex 1. The choice of subcontractor is left open. Workpackage WP3, tasks 3.1, 3.2 and 3.4 and Workpackage WP4 task 4.2.1.
	Annex 1 Part B
	- Removed most references to ILL as selected subcontractor in Part B of Annex 1. The choice of subcontractor is left open at section 3.3 page 23, section 3.3 i) page 24 and section 4.2 page 94. However ILL is mention as potential subcontractor at 4.1.21 page 73 - Cost of the certificate of financial statement are included for CIEMAT, CEA and PSI at table 3.4b pages 26 and 27 - Additional details of travel costs are included at table 3.4b pages 26 and 27 - Information on resources dedicated to Education and Training actions included at section 3.4 page 28
1-March-2019	**Change from the proposal format to DoA format and adding some information requested/suggested on the Evaluation and Ethics summary reports**
	Annex 1 Part A
	- Several deliverables had been reclassified as of type Open Research Data Pilot, ORDP: D2.1 to D2.6, D2.10 and D2.15 - An additional deliverable has been included in WP6 to describe the Data Management Plan, DMP, following the principles of the Open Research Data Pilot - Include additional critical risks and risk-mitigation measures in particular for WP3 and WP4
	Annex 1 Part B
	- Removed cover page and list of participants - Added history of changes and table of contents at page 1 - Added at the bottom of each page the proposal number, the acronym and the page number - Removed tables 3.1a, 3.1b and 3.1c from section 3.1 - Removed tables 3.2a and 3.2b from section 3.2 - Removed table 3.4a from section 3.4 - Added sections 4 and 5 from the proposal to this file starting on page 29 - Some additional details are indicated in section 2.2 to describe the contribution of SANDA for the ORDP at page 14 - Additional elements are included in the section 2.2 to address the Evaluation Summary Report comment of detail dissemination aspects for particular end users

	such as medical physicists at page 17 - Also, in section 2.2 new elements for the management of potential innovations (e.g. new instrumentation) had been included at page 15 - An explanation of how SANDA addresses the Ethics issues, Protection of the environment indicated in the Ethics Summary Report, is included in section 5.1 at page 95 - Several small typos had been corrected

Table of Contents

1. Excellence

1.1 Objectives

The proposal will address aspects of nuclear data research to produce accurate and reliable tools including data, codes and methodologies that can be used to simulate, analyse, optimize, exploit and evaluate the safety of nuclear energy and non-energy applications. The proposal is built taking into account the High Priority Nuclear Data needs list from OECD/NEA and IAEA to provide the final users with immediately usable data and tools for the cases where this is feasible during the project duration. Also the proposal aims to prepare experimental infrastructures, detectors, measurement capabilities and methodologies to enable the European nuclear data community to be able to provide the data to meet other high priority needs within the shortest possible delay. The proposal has been prepared in close contact with OECD/NEA, the IAEA Nuclear Data Section and the various organizations contributing to the JEFF project. It is planned to maintain a close collaboration with these institutions in order to favour synergies, optimize the use of resources, and maximize the dissemination of the results, tools and know-how developed within the project. In fact, we consider our proposal as a significant contribution towards a very ambitious challenge for the present generation of scientists: the construction of a unified, evaluated nuclear database and infrastructure that can be used in all fields, from basic research to applications.

1.2 Relation to the work programme

The proposal is related to NFRP-2018-4: "Improved nuclear data for energy and non-energy modelling applications". In order to address the specific challenge the project will include experimental measurements of new or improved quality data, evaluation, validation and dissemination of the data to produce libraries, computer codes and IT tools and methodologies that can be used by safety authorities, research institutions, the nuclear energy industry, health organizations, other non-energy applications and the EU society at large. The proposal has taken into account the High Priority Nuclear Data needs list from OECD/NEA and IAEA and covers the most important needs originating from the fields of fission energy generation, radiation protection, safety assessment, waste management including geological disposal and sustainability of the nuclear fuel cycle. The proposal has been prepared in close contact with OECD/NEA, the IAEA Nuclear Data Section and the JEFF project and it is organized to maintain a close collaboration with these institutions to optimize the dissemination and long-term support of results, tools and know-how developed within the project.

The scope of the project covers all the aspects of the nuclear data cycle, from new detectors and improved infrastructures, to actual measurements, specific evaluation and integration into nuclear data libraries, models to be used in the evaluation, validation with benchmarks of pre-existing and new integral experiments, models to be used at high energies, and integration within the international organizations (OECD/NEA and IAEA) tools for data and computer codes dissemination and archiving. To be able to cover such a wide range of aspects of the nuclear data field a wide collaboration with 35 institutions from all over Europe has been put together on a concerted effort where each institution contributes on the fields where they have demonstrated experience and capacity.

The proposal will address different types of isotopes including actinides important both for present reactors but also for advanced reactors, their nuclear fuels and fuel cycle facilities, in particular different type of nuclear assemblies with fast neutron spectra propose in closed nuclear cycles with significant contributions to waste minimization. It will also cover structural materials, fission fragments and lighter isotopes for non-energy applications. In most cases the proposed actions in the project are oriented towards the reduction of the uncertainties of the calculations involving these isotopes but also towards a better assessment of these uncertainties and the correlations associated to the new data to be produced.

A large fraction of the resources, well over 5%, will be directly contributing to the Education and Training activities. The main mechanism will be to support the work of PhD Students, Master Students and postdoctoral researchers within the actions of the project. In the recently completed project, CHANDA, of a similar consortium for nuclear data research this action resulted in over 50 PhD and Master Theses. For the present proposal we estimate that this number will also exceed 20. The experience of other earlier similar nuclear data projects, like ANDES, shows that many of these students will develop a career as scientists and engineers in research on nuclear data and in nuclear technologies at large. This main action will be complemented with direct actions by organizing dedicated schools to train on specific tools and know-how associated to the nuclear data research.

1.3 Concept and approatch

(a) Concept

Nuclear data and associated tools are a critical element of the nuclear energy industry and research, playing an essential role in the simulation of nuclear systems or devices for nuclear energy and non-energy applications, for the calculation of safety and performance parameters of existing and future reactors and other nuclear facilities, for the innovation of the design of those nuclear facilities and the innovation on radioactive devices and use of radioactive materials in non-energy applications, and for the interpretation of measurements in these facilities and systems.

Nuclear data final users are most often nuclear engineers and scientists working for nuclear safety authorities, radioactive waste management institutions, operators of nuclear and radioactive facilities, engineering companies developing innovative nuclear devices and applications, hospital health physics and nuclear medicine units, institutes involved in nuclear technologies research, basic research, environmental nuclear applications and other non-energy nuclear applications.

The nuclear data themselves and the associated tools included in the present proposal will contribute to research in a wide range of Technology Readiness Levels, TRLs, covering from TRL 1 in the basic measurements of isotopes of potential contribution to new designs and the contributions to basic research for nuclear physics or astrophysics, to TRL8 as in the support of the operation of industrial complete systems like the optimization of the operation and fuel loading of the nuclear reactors on operation. The proposal will also cover contributions at intermediate level like new detector systems for the TRLs 2, 3 and 4, the validation on integral experiments for intermediate TRL5, or their use for the design of prototypes of new facilities for waste management and improved safety of the nuclear energy and their use in the design and optimization of new nuclear health diagnose and treatment devices with TRL 6 and 7.

No matter how sophisticated the tool is, no simulation, calculation or interpretation of measurements can be better than the limit imposed by the nuclear data they use. Several parameters, particularly safety parameters of reactors and other nuclear facilities, need to be known with a precision well below 0.1% resulting in nuclear data precisions better than a few percent, sometimes better than 2%, and this is a serious challenge. In other cases the precision needed can range from 5 to 20% but the isotope or material to be measured is highly radioactive or very scarce raising a different but also important challenge. To address these challenges the proposal will use the recent developments from the previous projects ANDES, ERINDA and CHANDA where many of the current proposal´s partners had participated. The proposal includes actions to improve the samples of materials needed for measurements, and the detectors, neutron sources and methodologies to be used for experimental determination and validation of nuclear data. An additional challenge is to perform an evaluation of the experimental measurements that provides the highest accuracy possible, being compatible with nuclear theory, without bias and with a consistent evaluation of the uncertainties. The most recent models and tools will be improved and applied within the project to this evaluation effort that will receive a significant fraction of the effort of the proposal.

In order to have nuclear data available to applications several steps are needed in what is known as the nuclear data cycle, see figure below. The nuclear data are typically deduced from differential measurements (a more or less direct measurement of the reaction of interest separated from other effects). This requires preparation of a high purity sample of the isotope to measure, often radioactive and scarce, as well as the availability of sophisticated detection systems and controllable sources of neutron and other radiations (often based on particle accelerators). Then the data are analyzed and the results are provided to international databases (like EXFOR, in particular at the OECD/NEA and IAEA). Putting together several measurements and using nuclear theories, the data are further analyzed, assimilated into evaluated files having a standard format, and finally assembled into what is known as "evaluated nuclear data libraries". These libraries are available from the same international organizations, through the contributions and direct concerted efforts provided by countries and research organizations, and using methods and tools developed by projects like the previous CHANDA. These evaluated data are then validated by comparing their predictions to integral experiments (complex systems, typically experimental reactors, where many effects are important but which are able to closely reproduce conditions and parameters of direct applications to the operation and safety of the industrial nuclear systems). From the differences between predictions and integral experiments, we can deduce corrections to the basic nuclear data and develop better evaluated libraries. This validation process can also reveal the possible need for additional differential measurements or evaluations, repeating the process until the required accuracy is achieved.

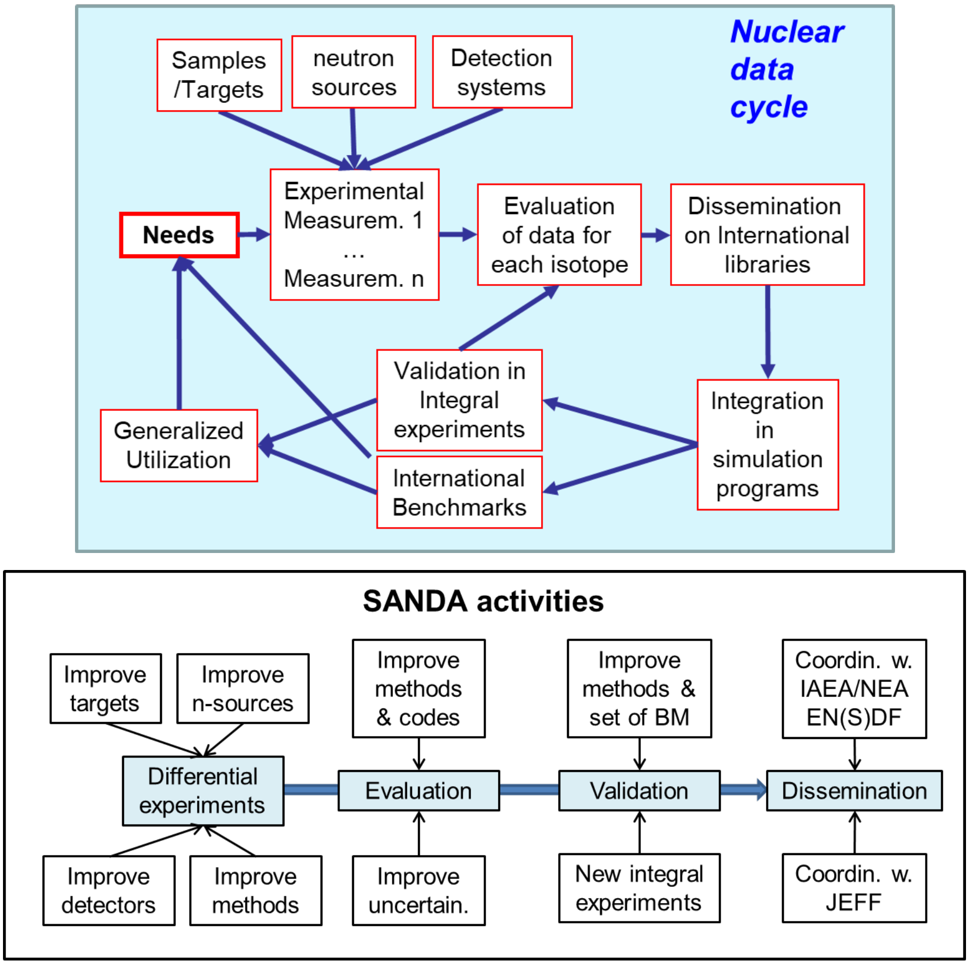

Figure: Nuclear data cycle and objectives of SANDA

Producing high quality data requires a combination of many different know-hows (target production, detectors, neutron sources, analysis, evaluation, nuclear theory, nuclear reactors, simulation codes, …) and a substantial time from the moment a specific need is pointed out to the moment when the evaluated and validated data can be distributed to final users. The whole process can take several years. In most cases, developing and characterizing a new neutron source takes more than 5 years and a new detector system can take from several months to few years. To schedule, perform, analyze and make public a differential experiment takes one to several years. Then, updating a particular evaluation to integrate new measurements can take again several months depending on the isotope (actinides are more complex due to their nuclear structure and the number of possible nuclear reactions). Finally, the time to validate the new evaluated data depends very much on the availability of previous benchmarks or integral experiments well suited for the isotope and reaction of interest. If the experiments are available the validation can be made within a few months, however if a new integral experiment is needed, it may take several years to license the new configuration of the experimental reactor, prepare the measurements and analyze the results.

In addition, it is important to realize that the necessary expert know-how is widely distributed within many research teams, particularly in Europe, and that most of these teams specialize only on one or few components of the nuclear data cycle. There are groups specialized on theory and evaluation, other on validation, some research organizations are specialized on differential experiments and others on integral experiments.

Therefore, in order to build an efficient system to provide the nuclear data that the EU society requires, its nuclear industry, the health system and other applications of nuclear technologies, it is important to prepare a very well structured wide and well synchronized collaboration between the key EU expert institutions. The collaboration needs to have close connections with the international organizations and the final users to clearly identify the nuclear data needs, priorities and schedules. Then it has to organize the actions from each partner (measurements, detector developments, evaluations or validations) with much anticipation and make sure that these actions are actually doable.

This proposal builds on previous experience and previous projects of the participants, particularly ANDES and CHANDA, that have prepared detector designs, new neutron sources, new evaluation methodologies and new validation concepts. The proposal is a comprehensive collaboration of 35 EU institutions having the know-how, experience and tools for nuclear data research in the EU. An efficient work plan is proposed to contribute to the production of high quality nuclear data to respond to priority needs, particularly those included in the OECD/NEA and IAEA priority lists.

A large fraction of the work will concentrate on delivering the final project results to the end-users. This implies capitalizing on experiments for which detectors and neutron sources had been prepared in CHANDA or other projects. It also means a much larger evaluation efforts than in previous nuclear data projects, and significant efforts on validation, including experiments on experimental reactors already available and known, as well as the corresponding dissemination.

In addition, the proposal intends to contribute to the development of instruments like new detectors, new laboratories for target preparation, including the design of an isotopic separator, commissioning of new neutron sources and new devices for integral experiments and new IT codes. These developments are important to make possible in the near term, but not necessary within the project duration, the measurement and preparation of well-identified nuclear data that cannot be made with the presently available tools.

The new proposal will use the results from CHANDA that validated new detector concepts, commissioned new neutron source (n_TOF-EAR2@CERN), developed new experimental methods to improve the accuracy of differential measurements, developed new evaluation methods and tools, provided improvements on the integral experiments methods and on the use of high energy models. We note that the CHANDA scientific activities resulted in over 125 peer reviewed publications and 50 PhD and Master theses.

The proposal will collaborate with the three largest international entities in the field of nuclear data that have significant European participation: JEFF (Joint Evaluated Fission and Fusion Nuclear data library), OECD/NEA data activities including the High Priority Request List (HPRL) and the IAEA International Nuclear Data Committee (INDC) and the Nuclear Data Section (NDS). The nuclear data evaluations will be prepared in a collaborative effort with JEFF to make sure that the results from this proposal are well aligned with the multiyear JEFF-4 file roadmap, integrated and disseminated. The results of the proposal will also be made available to other nuclear data libraries. The collaboration with OECD/NEA is evident from the conception of the proposal, as members of the proposal consortium are the coordinator and main participants in JEFF, their inputs have been used to define the deliverables and, as in previous projects, we intend to organize some of the general meetings of the proposal jointly with the OECD/NEA Nuclear data weeks, the JEFF meetings or the HPRL review meetings. Similarly the collaboration with the IAEA INDC and NDS has started already during the proposal preparation phase as one of the IAEA staff members (R.C.) participated in the discussion of the proposal technical choices and selection of deliverables to be proposed, the continuation of the collaboration is guaranteed by the participation of several partners, including the coordinator of the proposal, as members of the INDC.

Similarly to the relation between ANDES and ERINDA in the early EURATOM FP7, if the proposal is accepted, the new project will collaborate with other initiatives on nuclear data supported by EURATOM in particular with any project supporting the access to facilities responding to the NFRP-2018-7 (Availability and use of research infrastructures for education, training and competence building). The present proposal is based on the assumption of the availability of the required infrastructures and the resources within the proposed collaboration to perform the experiments included in the proposal. Nevertheless, it has also a lot of potential capacity to offer collaboration on training and competence building to initiatives responding to NFRP-2018-7 in areas covering nuclear data and in this way enhancing the expected results from both proposals.

(b) Approach

The proposal will combine actions at all the different elements of the nuclear data cycle to achieve the maximum possible impact on the nuclear data availability and improvement for the highest priority needs of the EU, both for nuclear energy and for non-energy applications.

The proposed actions, tasks and deliverables have been defined by taking into account the available tools, detectors, materials and know-how at the beginning of the project, the available resources, and the time required to complete the work and provide the final products to the end-users.

The actions will start in parallel on all the work-packages, WP, (detector development, target development, measurements, evaluation and validation) to produce the necessary tools and validation results in due time.

The priority has been given to delivering data and tools readily useable by the end-users at the conclusion of the project, and over 70% of the effort is directed to this type of actions. This translates, depending on the present status of the particular nuclear data for one isotope or reaction, into different schemes.

In a most favorable case, when there are recent or sufficient experimental measurements, the effort will concentrate on updating the evaluation methodology and tool and then applying it to the isotope of interest. This will be followed by making the result available to international organizations like IAEA or OECD/NEA as evaluated nuclear data files. In parallel new validation methods and selection of integral experiments will be prepared, and when a new evaluated file becomes available, these tools will be used for its validation.

In many cases, however, new differential measurements are needed. In this situation there will be actions within the detector´s work-package to develop specific detectors or adapt the existing experimental setups to perform the new measurements. If needed, the samples for the measurements will be prepared in parallel. Most measurements can be performed within the laboratories of the project partners and, thanks to investments made in previous EURATOM projects, only limited additional effort on new detector development will be needed. Then the actual measurement campaign will take place and the results will be analyzed. These experimental results will be provided to the international EXFOR database with the associated reports (deliverables). In some cases, the new data will be enough to improve the evaluation of the isotope in question and then they will follow the scheme indicated in the previous paragraph. However, for some of the more complex cases, it will not be possible to complete the full evaluation and validation within the time frame of the project. In such cases, the EXFOR files will be the main project output. However, because of their relevance and high value, we have the assurance that they will be used by the scientific community to continue the evaluation and validation in the framework of separate collaborative projects (JEFF notably). This process, which relies on voluntary contributions within internationally organized frameworks, is however significantly slower and is likely to receive lower priority than when the evaluation and validation is performed within a funded collaborative project, for example, within the EURATOM framework.

In addition, there is a fraction of the resources that are earmarked for improving the capacities of the European nuclear data community in terms of new detectors, new facilities for target preparation, experimental setups, validation experiments and new methodologies and tools to prepare future measurements, evaluation and validations of very important data not feasible with the present tools. All work-packages include in different amount this type of actions: the detectors WP will include some developments of detectors that have been defined for specific types of experiments but need long development times, the measurement WP will use current methods to validate difficult measurements where there is no other alternative, the evaluation WP will improve several models and tools used for better uncertainty and correlations assessment and the validation WP will prepare the basis for future integral experiments and new analysis tools to be used in the evaluation and validation processes.

In this respect the proposal includes a particular effort for designing an isotope separator. For many measurements a challenge comes from the difficulty to prepare a good quality sample of the isotope of interest without contaminations from other isotopes. This is always a difficult task requiring expensive and complex mass separator devices, but it becomes even more challenging when the isotopes involved are radioactive. Developing this capacity is therefore paramount with respect to several important nuclear data needs. This requires that the hosting laboratory is licensed to work with radioactive materials, has a stock of them or possibilities to get access to these materials and the interest to provide this type of service. At present there is no such facility in Europe and only limited possibilities in laboratories in Russia or USA, which causes a serious handicap and limitation to European laboratories. In the preparation of the proposal one of the partners was identified with the required characteristics and will for hosting a mass separator for radioactive isotopes, taking the responsibility of finding the resources to build it if the facility can be designed and shown to be feasible on the basis of the shared effort. So, the targets proposal includes a task for a feasibility and pre-design study of such a facility.

In addition to these technical actions, the proposal will include coordination actions to organize the collaboration between the different laboratories able to produce targets and also between these laboratories and the users. During the CHANDA project, this has proven to be a key element for an efficient response to the experimental needs for targets.

There will also be coordination efforts to make sure that there is a coherent organization and support of the partners and other European nuclear data research groups, projects and financing programs to guarantee that the data, tools and methods produced will effectively serve the end-users, and will become part of a sustainable vehicle for nuclear data research within the EU.

Finally, there will also be some coordination action to make sure that the proposal is used as an efficient education and training tool.

1.4 Ambition

The proposal is designed to help making significant progress beyond the state of the art in various ways:

- First, it will provide new evaluated files/libraries for a number of key isotopes in a form ready to be applied by the end-users, including actinides. In particular, it will include some key isotopes for present and advanced nuclear reactors and nuclear waste management, like Plutonium isotopes, structural materials like Chromium, and several fission fragments, but also new evaluations of nuclear structure of isotopes of relevance for nuclear waste management. Plutonium isotopes produce a large fraction of the nuclear fissions and power at the end of the fuel irradiation, the fission fragments contribute to the decay heat at short and long term and the structural materials contribute to the reactivity balance and to the production of radioactive wastes of intermediate half-life. So, the new data will allow a more precise assessment of the safety and performance of the nuclear reactors under operation, help reduce excessive margins in new designs of advanced reactors, and allow a more precise description of waste management streams and options. This includes the characterization of the composition and characteristics of the spent nuclear fuel to be stored in the deep underground final disposal but also options for closed fuel cycles with advanced waste minimization elements.
- Second, it will provide differential measurements of several isotopes to improve the data to be evaluated (actinides like Pu, Am and Th isotopes), but it will also provide other important missing data that can be directly used by experts involved in evaluation and validation work as part of international efforts (IAEA, NEA and JEFF). These measurements will include cross section of potential components of new fuels designed to be more tolerant to accident conditions, decay properties of isotopes important to understand the radioactivity (neutrons, alpha, beta and gamma radiations) and heat source of spent nuclear fuel, which are of importance to the design of waste disposal facilities. The measurements will also provide new data needed for non-energy applications in particular for two aspects of health applications of nuclear technology: the secondary doses in medical therapeutic irradiations and the efficiency and innovation on production of standard and new isotopes for medical nuclear diagnostics and therapy.
- Third, the proposal will develop new tools to be used within the proposal and beyond in various aspects of the preparation of nuclear data. In particular, it will lead to new versions of nuclear modeling codes for evaluation of nuclear data such as TALYS, high energy models, and the methodologies to fully include uncertainties and correlations in the nuclear data evaluation systems. These improvements will open the possibility of best-estimate predictive calculations with realistic uncertainties on the final outputs, more broadly applicable to safety assessments and innovative design of new reactors and components, instead of using conservative calculation schemes. Progress

on the high energy models and the assessment of their uncertainties included in the proposal is also a key element for ADS-based waste transmutation and minimization options.

- Forth, better networking target-producing laboratories and their users, each having very different backgrounds and understandings for the target characteristics, will allow having more efficient definition of the target specifications and a better identification of the best technique and best laboratory for the production of each particular target. In addition, the feasibility study of an isotope mass separator will be a major contribution towards a real break-through facility, possibly opening the doors to measurements and experiments, which have not been considered despite their relevance because of the impossibility of having the appropriated material targets. It would also allow to improve the accuracy of some measurements that at present have to be made using targets which are far from pure because of a large contamination due to other isotopes than the one to be measured.
- Considering all these lines of improvements together, the proposal will be a significant step forward towards improved simulations of neutron and radiation transport and towards a more faithful modelling of the basic processes taking place in many different applications. This should translate into gains in applications such as plant safety assessment, reactor core and shielding designs, waste processing and storage facilities, and health applications, among others.
- The ambition is that the project also contributes to several non-energy applications with particular attention to health applications.
- Finally, as this joint initiative addresses important R&D challenges, it should yield valuable lessons which will help the nuclear data research community in formulating robust science-based policy recommendations to decision makers.

2. Impact

2.1 Expected impacts

The project is expected to contribute, directly or indirectly, to the enhancement of the safety and competitiveness of the European nuclear industry by significantly improving the accuracy of nuclear data. Benefits should result in particular from better data for actinides like the Plutonium isotopes and some fission products, which are among the main components of the irradiated nuclear fuel inside the present reactors and in nuclear wastes. These isotopes have been proposed as components, sometimes with high fractions, in several advanced reactors and fuel cycles allowing waste minimization. Better nuclear data improve the accuracy of the predictions derived from simulation codes and analysis tools used by the regulatory bodies for safety assessment and by the industry to implement preventive safety actions. In addition, by producing reliable nuclear data uncertainties and correlations for many important isotopes, the project will contribute to the replacement of legacy calculation procedures by best-estimate evaluations with appropriate uncertainties, which should lead to less conservatism in safety assessments, operation and design of nuclear facilities. Indeed, these best-estimate-type calculations allow to reduce the unnecessary safety and design margins, resulting in more competitive operation of the present nuclear installations without sacrificing safety standards, and in more competitive designs of new reactors, nuclear facilities or their components.

This enhancement of safety and competitiveness applies not only to reactor operation and construction but also to the waste management, storage, reprocessing or disposal, and also in some sense to the decommissioning of nuclear facilities.

The project will also contribute to make nuclear energy more efficient and durable by improving the data and tools needed for the design and demonstration of advanced reactors (fast critical or subcritical) proposed for more sustainable nuclear fuel cycles. These advanced reactors may reduce the use of natural resources (Uranium) in large factors (60-100) by recycling the actinides in the fuel. The concentration of Pu in these reactors is usually increased as compared with present reactors by factors larger than 10. There are also proposals to improve the use of natural resources by complementing or replacing the U-Pu cycle by the Th-U cycle. The project will have an impact there too, by improving the accuracy and uncertainties of the nuclear data for those isotopes.

The project will also contribute to the improvement of the cost effectiveness of nuclear energy in two senses. As already indicated, the data will allow to reduce safety and operation margins and this will result in savings in refueling, in the implementation of safety upgrades and in nuclear waste management, including transport, storage and final disposal. On the other hand, the availability of high quality nuclear data with reliable uncertainties can boost confidence in the simulations and engineering calculations allowing a simplification of the process of nuclear development and innovation. Because of safety considerations, in the traditional development of new components, fuels or designs for nuclear reactors or facilities, there is a significant effort going to different levels of prototyping and demonstration campaigns that are costly, lengthy and not without risks. With reliable nuclear data and simulations, the number of prototypes and demonstration steps can be reduced, thereby reducing delays and costs.

The project will also contribute to improve the efficiency and cost effectiveness of non-energy applications. Although several non-energy fields are addressed in the proposal, the clearest example comes from the health applications where the project can help to find more cost effective ways to produce and use radioactive isotopes needed for medical diagnostics and therapy. A better evaluation of neutron interactions with the light isotopes present in the patient tissues will allow a more efficient planning of therapeutic irradiations, which will in turn help improve the health of patients after the irradiation by optimizing the secondary doses resulting from the irradiation.

Furthermore, as a consequence of the project contribution to extend the use of best-estimate calculations with reliable uncertainty assessment instead of scoping or conservative calculations, the project will reinforce the responsibility of the research community in formulating robust science-based policy recommendations to decision makers. By approaching Member State representatives at different national and CE committees and bodies, as proposed within the project, a case will be made for a sustainable coordination of nuclear data research. It will also be a good opportunity to inform decision-makers on the progress made and the value of the science-based recommendations as a basis for sound policy decisions.

The project will strengthen the competitiveness of the European nuclear data community by focusing its resources on common goals aligned with the needs identified by the Member States and the EURATOM project, and taken on board the JEFF-4 roadmap. This synergy effect will be further enhanced by a specific action (under the coordination WP) towards outlining a proposal for sustainable nuclear data research in Europe beyond the duration of the project.

On the other hand, the development of new detectors, better experimental methods, better coordination of the target preparation, possibly new facilities such as an isotope separator, should create new opportunities and enhance the competitiveness of the European nuclear research institutions.

The results from the proposal will also contribute to the basic understanding of nature as it will contribute with data useful for basic physics research and nuclear astrophysics and cosmology.

Finally, the project will contribute to the training of a significant number of professionals who can be expected to join the nuclear energy industry and research community. In the recent similar project CHANDA over 50 PhD and Master theses had been prepared on the basis of the project data.

On the basis of all the above arguments, we claim that the project results will be of high value for EU Member States, independently of their choices with respect to the use of nuclear technology for electricity generation and independently of the future policy and choice of cycle for the nuclear reactors operation.

The project is not expected to face particular barriers from regulators who are clearly in favor of high quality data, allowing well-defined standards. There is no particular concern regarding public acceptance either.

The main difficulty and obstacle to achieve the maximum impact from the result of the project is probably the long time and effort needed to complete a nuclear data cycle, i.e., the process leading from the preparation of the experiments to the availability of the final evaluated files to the end user. In this sense, there is a risk that the results of some of the more complex measurements and some of the detector developments do not reach their full impact within the time frame of the project, but they will do so later provided there is continued support for the associated research lines from Member States or EURATOM.

To handle these risks, first we have maximized the efforts towards activities that can reach the end-users within the project duration (more than 70%); second, we have included within the project an initiative to prepare a framework for a lasting European R&D cooperation on nuclear data that would guaranty that the available resources and financing through the EU are available to complete the longer term actions, and third we have involved IAEA, OECD/NEA and members of the JEFF community in the project.

In this way, we think that the project can reach its full impact rather shortly if the proposed sustainable coordination framework can be developed. If not, the full impact will be reached later, within the framework of international organizations.

Regarding the isotope separator whose construction is most needed but will depend on funding sources external to the project, PSI has proposed to act as host laboratory and express their interest to build and operate such a facility. PSI has the necessary experience and licensing conditions to handle radioactive materials and is used to provide similar services through Europe. PSI is also committed, should the feasibility study conclude favorably, to take action to secure the necessary funding to construct and operate the isotope separator, see the letter from PSI below. Yet, the feasibility study will be done without prior assumption on construction siting, so as to cover the risk that for unknown reasons PSI could not host finally the isotope separator.

Finally, one additional risk is related to the use of the NFS neutron source at GANIL for some experiments. The facility uses the SPIRAL II accelerator that is presently pending its operating license from the ASN, the nuclear regulatory authority in France. NFS is expected to get a license shortly, before the project starts. However, in the unlikely event that NFS were not to be available during the project, the experiments would have to be performed at another neutron source, with the drawback of a lower beam intensity and longer irradiation time.

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To: to whom it may concern
cc: Dr. D. Schumann,

Villigen PSI, 19. September 2018

Memorandum

Letter of support
To whom it may concern

Dear Madam/Sir,
I'm writing here to express our full support for the feasibility study for a future RMS facility at PSI as envisaged by the SANDA project. With support from Paul Scherrer Insitute the Laboratory of Radiochemistry will try to find the resources for the construction of the Isotope Separator if the feasibility study is positive. The facility is of fundamental interest for the future of Radiochemistry at Paul Scherrer institute and for future joint Euratom activities. The nuclear data community will get rights of use of the facility proportional to the investment from EC and based on collaboration agreements.
The focus of the entire project follows one of our laboratories main research lines and has therefore our full support and utmost priority.
With my best regards,

(Robert Eichler)

2.2 Measures to maximise impact

a) Dissemination and exploitation[1] of results

The project will include different mechanisms to exploit and disseminate its results.

The main scientific and technical results for the exploitation of the project are of 6 types:

1) Raw and analyzed data from differential measurements in EXFOR standard format
2) Evaluated data files, either as cross sections, fission yields, or decay data in ENDF6 standard format, or nuclear structure data in ENSDF standard format
3) Models and computer codes for the different activities of the nuclear data cycle, including the implementation of the high energy models
4) Methodologies for differential and integral experiments and for evaluation processes
5) Results and description of integral experiments, ideally in IRPhE-style format
6) New designs for detector and experimental setups and possibly the actual detectors or experimental setups themselves.

All the deliverables and results of the types 1, 2, 4, 5 and 6 will be made fully public and free, and will be transferred to international open databases, open web pages or will be accessible from the project web space. The models and computer codes, in many cases, would also be openly available, but in some cases access restrictions may be imposed on the sources of the codes by the developing teams. Even distribution of the compiled codes might be limited by training and maintenance constraints.

The targeted communities for the dissemination actions are of different types:

a) nuclear scientists and engineers performing simulations of nuclear reactors or other fuel cycles facilities and activities. This includes applications for evaluation of safety of reactor and other nuclear facilities, validation of processes, reloading and other normal operations in nuclear facilities, dismantling and decommissioning of present reactors, spent fuel storage, waste management and disposal, design of new reactors, etc.
b) nuclear or health scientists performing simulations of nuclear treatments or diagnostic for medical applications. This includes applications for principal and secondary doses from irradiation treatment, optimization of the irradiation sequence for treatments, interpretation of nuclear diagnose devices, design and optimization of nuclear medicine devices and procedures, etc.
c) nuclear physicists developing radiation detectors, nuclear facilities and various methods to measure, evaluate, or validate basic nuclear data
d) nuclear scientists and engineers performing simulations to optimize isotope production for medical therapy or diagnosis
e) nuclear scientists in environmental or other industries designing or analyzing results from radiative tools
f) students and people in training period
g) research organizations, public organizations, technological platforms and industry using nuclear technologies
h) international organizations like NEA and IAEA, responsible for the storage and dissemination of nuclear data

[1] See participant portal FAQ on how to address **dissemination and exploitation** in Horizon 2020

Different vehicles will be used to communicate and disseminate the different results of the project to the different communities mentioned above. The main deliverables of the project will be highly specialized data which will be used mainly by expert scientists and engineers for research, industrial, medical and academic purposes. For this reason our dissemination and communication action will take the form of files on international databases, technical papers and reports published in scientific journals, PhD theses or possibly other self-contained recording forms that would ease their utilization and preservation. Still, several other communication paths will be used to attract attention of wider communities to try to reach all the segments of the society that might be interested in of the project activities and results.

In the following paragraphs we describe some of the instruments that will be used by the project to communicate its activities, progress and to disseminate results.

Dissemination of experimental data and evaluated files/libraries via international organizations

For the nuclear data produced by the project, either experimental or evaluated, the main dissemination path is the well-established international libraries and international nuclear data centers coordinated by IAEA, https://www-nds.iaea.org/, and by the NEA Data bank, https://www.oecd-nea.org/databank/. These organizations maintain on their own resources an infrastructure that receives, tests, archives, stores and distribute both experimental nuclear data in the EXFOR format and evaluated nuclear data libraries in the standard formats of ENDF and ENSDF. This mechanism assures that the project output data will be available broadly and well beyond the end of the project.

The project will communicate all experimental data to the EXFOR nuclear database of the IAEA. The Experimental Nuclear Reaction Data (EXFOR) is an open database maintained and operated by IAEA, https://www-nds.iaea.org/exfor/exfor.htm. It is also a standard format to describe the experimental information which is necessary to analyze the "raw" nuclear data measurements. The transmission of data to EXFOR is the responsibility of each data producer, but the project will stress to its partners the need for early communication to this database and will help liaise with IAEA if special support is needed. Providing the data to EXFOR is the most efficient dissemination method that the project can use to warranty early availability of its experimental data to the evaluators and users.

For most evaluated data (cross sections, decay data, fission yields,...) the project will liaise with the JEFF project (NEA/OECD) to make sure that the results (transmitted in the form of ENDF-formatted evaluated files) received priority consideration for inclusion in the JEFF-4 library. There will then be available from the NEA data Bank and from the IAEA ENDF area https://www-nds.iaea.org/exfor/endf.htm. These are the standard locations any interested user will search for to get the latest versions of the evaluated libraries.

Finally, for the evaluated nuclear structure data the project will update ENSDF files and update them to the IAEA data repository and distribution http://www.nndc.bnl.gov/ensdf/.

All data from IAEA nuclear data databases (EXFOR, ENDF, ENSDF,…) are openly available.

By these mechanisms the project will comply with the with the principles of the Open Research Data Pilot, ORDP. The digital research data generated in the action associated to a number of deliverables whose main results are data will be deposited in the previously escribed research data repository open for third parties to access, mine, exploit, reproduce and disseminate, free of charge for any user, including associated metadata, and the tools and instruments necessary for accessing and validating the results.

Dissemination of computer codes for the different activities of the nuclear data cycle and to implement the high energy models

The nuclear data analysis, evaluation and particle transport codes used in the project (such as TALYS, EMPIRE, AMPX, CONRAD, FIFRELIN, MCNP, SCALE, NDaST, GEANT4, etc.) are developed and maintained continuously by various groups and organizations. Most of them are already broadly available and used. To every possible extent, the project will facilitate the inclusion of new models, algorithms and methods in future versions of these codes for improved capabilities. So, for the dissemination of new methods and models via these codes, the responsibility will lie with the development teams. Most of the codes have corresponding web pages that provide detailed information of the capacities, details for use and updates. In addition, some of the codes are also archived in and can be retrieved from the NEA Data bank.

In general, the codes are openly available, but in some cases some access restrictions may apply, imposed by the code owners and parent organizations because training and maintenance constraints.

Scientific journal articles

For the methodologies and detector developments, where there is no pre-organized dissemination structure the main dissemination pathway will be a combination of peer review scientific journal articles, communications to conferences, PhD and Master theses and the project web pages.

Peer-reviewed articles published in scientific journals will be the main mechanism for dissemination and communication of results to the scientific community interested in the project results. These articles are also an efficient way to provide to all the end-users additional details on the quality, scope, range of validity, precision and reliability of the results of the project. The articles will cover reports on:

- methods newly developed,
- description of progress on detector designs and experimental setups,
- improvements of neutron facilities used for measurements,
- validation of nuclear data using integral experiments or pre-existing international benchmarks,
- improvements and uncertainties of high energy models.

Although in principle all the results and development of the project will be ultimately public, in the case that some of the innovations need to be protected (new instrumentation, detector, experimental setup, target fabrication methods,…), the time and scope of publications and public reports will be carefully managed together with the team making the development to allow efficient protection and industrial exploitation of those innovations.

In addition, these scientific journals will also be used to complement the information provided to the international data bases for the data and codes disseminated by international databases, such as:

- results of the differential nuclear data measurements, with detailed information on setup, sources or errors, calibration, background noise, signal corrections, etc,
- evaluated nuclear data files, with details on the methods and approximations used in the data selection, normalization and reduction process,
- computer simulation tools used for modelling nuclear physics phenomena, detectors, experiments, and simultaneously accounting for uncertainties and errors,
- examples of applications of all the above.

The papers will consider journals such as: EUROPEAN PHYSICAL JOURNAL, NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT, PHYSICAL REVIEW C, PHYSICAL REVIEW LETTERS, etc.

The members of the collaboration of the proposal have demonstrated in the past an excellent efficiency at stimulating the production of many high-quality journal articles. For example, the previous project CHANDA produced more than 125 articles in 54 months.

All the articles published will be by definition open-access, but some publishers sometimes request a fee to provide access to the full text of the article. If such a limitation is deemed unacceptable, the project will either make available a copy of the manuscript to open-access archives, like the CERN archives, for actions and measurements developed in that facility, or establish a link to similar information using the project web space.

PhD and Master theses

For the scientific and research community, and in particular for the students and academic communities that are a significant part of the nuclear data end-users a complementary method to the scientific journal articles is the preparation of PhD and Master theses. They will cover the same topics but can provide significantly more details on the methodologies used, the range of application and the interpretation of the results.

The members of the collaboration of the proposal have also demonstrated in the past a high efficiency in supporting PhD and Master theses. For example, more than 50 theses were associated to the previous project CHANDA. These theses are of open access in most universities.

Sustainable framework for nuclear data research at Europe

The previous methods are the main dissemination paths, that will be complemented by tools described below both for dissemination and communication of the project results, its progress and to make it know to new end-users.

From the point of view of the exploitation of results, the storage and dissemination of data via reference databases operated by international organizations guarantees long-term availability and excellent visibility. The collaboration of the project members with those organizations also implies support from these international organizations to the exploitation of the project outputs, for mutual benefits.

In addition, the project includes an action to outline and propose a sustainable framework for nuclear data research in Europe beyond the duration of the project. This will be done by seeking support for joint programing at the level of the Member States, including also EURATOM. The main incentive would be to guarantee the continuation of the long-term basic research lines of the project within Europe and an enhancement of the exploitation and impact of the project results.

Communications to specific conferences

Communications at specialized conferences in the fields of nuclear data, nuclear instrumentation, nuclear simulations and nuclear data for other applications will be used to inform about the progress made on the same topics as those indicated on the section of the Scientific Journal Articles.

These communications will help prepare the integration of the project results in a broader framework. In addition, they will also serve to collect early feedback on the methods, solutions and tools developed as part of the project. These conferences will also contribute to the dissemination of the project results.

International nuclear data conferences will be “natural” targets of the project, especially the ND2019, to present planned activities, and ND2022, to present results. These are the next two editions of the Nuclear Data conference. ND2019 will be organized in China and will take place at an early stage of the project, so the main focus of the project participants will be on the ND2022 conference.

Communications to wider conferences

Communications to wider conferences will include conferences and workshops on general nuclear science and nuclear applications, general discussions on experimental techniques and organization of international experiments and collaborations. This will include global energy conferences like the European Nuclear Conference (ENC) series, the GLOBAL conference series, IAEA and NEA generic conferences, events organized by EC like FISA or EuradWaste, but also workshops and meetings of national nuclear societies and national radioprotection societies with wider participation of non-energy end-users of the project results.

The main purpose is to make professionals and a broad public aware of the project activities and results, explaining how the results can be beneficial to many applications, including nuclear safety, efficiency of energy generation systems, accuracy of nuclear medicine protocols, etc. These meetings also contribute to dissemination of the results to new end-users.

We are also interested in the feedbacks collected at these events for improving the methods used by the project and identifying new nuclear data needs beyond those already considered within the project.

Communications of activities, plans, progress, methods to international organizations NEA and IAEA

The project members are already deeply involved in international expert groups and organizations responsible for collecting, testing and disseminating nuclear data worldwide within both the OECD/NEA and the IAEA agencies. The project will continually inform these organizations on the activities, plans, progress, methods and results being produced. In the case of the OECD/NEA, the communication will include different working groups, but special attention will be given to the JEFF working groups and to the WPEC high priority nuclear data list. In the case of IAEA special attention will be given to the International Nuclear Data Committee, INDC, the Nuclear Data Section and the EXFOR data base.

To facilitate the communication with the JEFF groups, and to make sure that the project activities remained fully aligned with the JEFF-4 work plan, some of the project general meetings will be organized in conjunction with the JEFF periodic meetings and events.

Regular communication with the above international organizations will facilitate the integration of the project priorities into the international priority lists. It will also shorten the time required to make the data produced by the project adopted in official evaluated nuclear libraries and by the final users.

Participation in generic events with partners of the technological platforms SNETP and NUGENIA

The meetings organized by or with large participation of the European Nuclear Technological Platforms, SNETP and NUGENIA, are a special forum with many opportunities to make professionals and researchers aware of the project activities and results. Special attention will be devoted to explain how the results can be beneficial for the applications of the professionals and researchers.

Dissemination to health and medical physicists:

The project will contact reference networks of health and medical physicists, like EURADOS, and the European Federation of Organizations for Medical Physics, EFOMP, to jointly identify nuclear data of relevance for the applications of these research and applied community and also to make sure that these experts are aware of the progress on nuclear data provided by SANDA. For these contacts SANDA will benefit from the participation of health physicists and members of those associations in several teams of the participants in the project.

WEBSite of the project

A set of web pages will be setup both for the internal communication within the project and as an open window for external researchers and a wider public interested in the activities and publications of the project.

Although working versions of deliverables, publications and other materials might be password protected, all final technical results (compatible with applicable regulations) will be made openly available on the project web pages. The project web will be maintained for at least 5 years after the project end.

Dissemination to students:

The project will prepare specific actions to facilitate that the research performed within the project contributes to the education and training of students. The most important action will be to involve students as participants in the research performed within the project in activities that contribute to their PhD and Master theses. In addition, the project will organize specific E&T courses on topics related to the project research.

b) Communication activities[2,3]

Several of the tools already described in the above dissemination section will also be used for the broader communication and promotion of the project. In particular:

- communications to specific conferences,
- communications to wider conferences,
- communications of activities, plans, progress, methods to international organizations NEA and IAEA,
- participation in generic events with partners of the technological platforms SNETP and NUGENIA,
- the WEBSite of the project,
- and also in a certain sense, the PhD and master theses and the Scientific journal articles.

[2] See participant portal FAQ on how to address **communication activities** in Horizon 2020

[3] For further guidance on communicating EU research and innovation for project participants, please refer to the H2020 Online Manual on the Participant Portal.

3. Implementation

3.1 Work plan

The proposal will combine actions on all the different stages of the nuclear data cycle required to produce and validate the nuclear data needed to improve the safety and performance of nuclear energy reactors and fuel cycle facilities, and more generally, the competitivity of the European industry both in nuclear energy and in non-energy applications.

In preparing the project detailed actions and work plan we have taken into account the long delays between detector design, measurement, evaluation, validation and dissemination. We also took into considerations the data needs for which there are already enough new data and model developments to warrant new evaluations, and the cases where new detectors, models, and measurements for which it would not be possible to complete the evaluation or validation process within the project time frame. So, the project is organized in work-packages, WP, corresponding to the different types of activities making up the nuclear data cycle. This division of the work has the advantage that the participants on each WP can share models, tools, experience and the same infrastructures, which should make the collaborative activities more efficient.

A key aspect of the project organization is efficient communication and timely transfer of information across WPs, as some tasks in a given WP are conditioned by the results coming from another WP. The coordinator with the help of the executing committee will be responsible for this inter-WP coordination. Some of the milestones of the project will help to the coordination and synchronization of the different WP inputs/outputs so as to deliver the final results.

The project will include five technical work-packages plus one WP dedicated to management and coordination tasks:

The WP1 “Developments of new innovative detector devices” will be devoted to detector development and improvements of experimental setups. It will cover the design and construction of new devices for the measurement of fission, capture, (n,xn) and double differential cross sections. An important part of the WP will be dedicated to detector developments leading to immediate measurements (sometimes directly related to actions in WP2) but it will also include the development of more innovative detectors which will be necessary to tackle some of the difficult challenges in nuclear data measurements beyond the project duration.

The WP2 “New nuclear data measurements for energy and non-energy applications” will include new measurements to significantly improve the accuracy of nuclear data needed in energy and non-energy modelling applications, mainly in the field of fission, radiation protection, safety, sustainability and enhancement of nuclear technologies. Some of the experiments in this WP will use detectors prepared in WP1 and targets prepared in WP3. Some of the measurement results will then be used to improve the evaluation of the corresponding nuclear data. However, the project will end before some of the measurements performed in the later phase of the project can be evaluated and tested. These data will be published in peer review journals and stored in the EXFOR open international database for use in future evaluations conducted in new projects or as part of the international efforts within JEFF, NEA or IAEA.

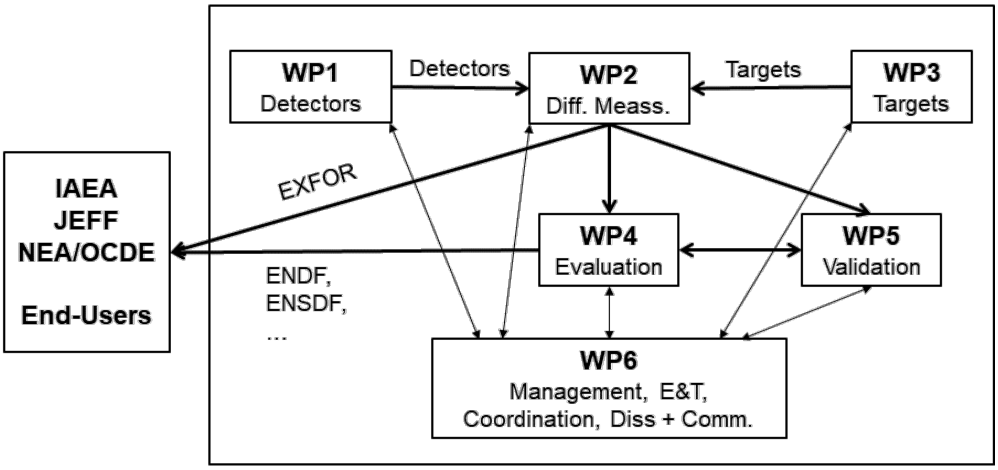
The WP3 “Target Preparation for Improvement of Nuclear Data Measurements” will include actions to facilitate the interaction between target producing laboratories and the various teams using them to make measurements. WP3 will also coordinate the target producers’ activities to optimize the target designs and the use of European resources for their fabrication. In addition, the WP3 activities will include the fabrication of some targets needed in the experiments of WP2. Moreover, the WP will address a long-standing problem, namely the lack of a facility for producing the high-purity materials needed for some radioactive targets, by making the first critical step towards the construction of an isotope separator in Europe. The project will prepare a feasibility study that if successful will be used by PSI for the construction of a facility able to fabricate isotopically enriched radioactive materials needed for some nuclear data measurements.

The WP4 “Nuclear data evaluation and uncertainties” will complete the development of open-source evaluation tools by improving the phenomenological and microscopic models (like TALYS, EMPIRE and INCL/ABLA for reaction nuclear data; and in specific codes for decay and structure data, as well as for fission yields). Then it will perform actual evaluations of important isotopes (actinides and fission products, to be proposed for inclusion in different libraries) and will provide processed data ready to be used by simulation codes for validation purposes (in particular to WP5) including covariance information. Some of the necessary data for the evaluation will be provided by the WP2. In addition, the WP will provide sensitivity analyses for simple systems (or benchmarks) used as part of the evaluation process itself, that will also be made available to the IAEA. For high-energy reaction modeling of interest for ADS simulation and radiation protection and medical applications, WP4 will focus on developing methods for model uncertainties assessment.

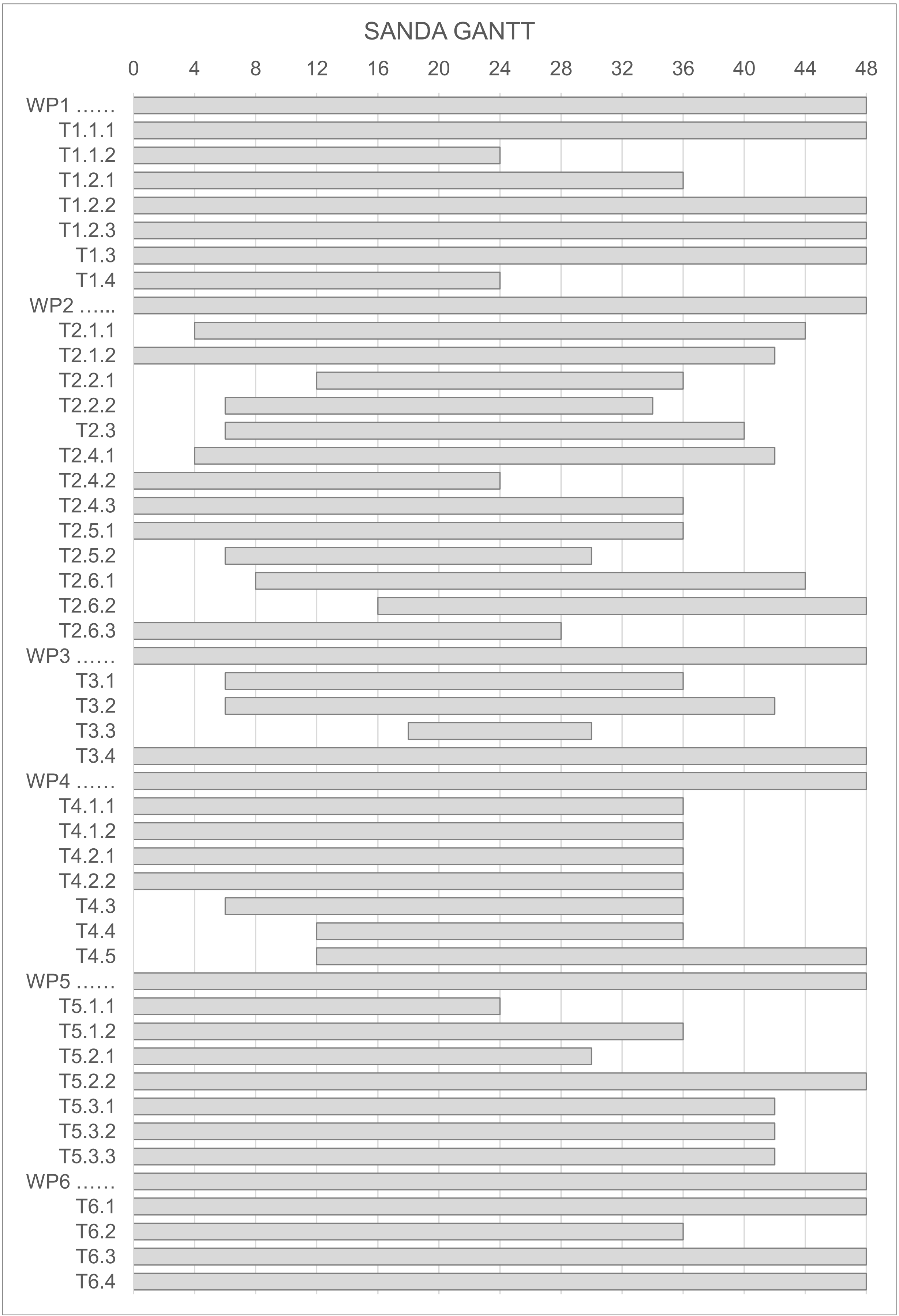
The WP5 “Validation and integral experiments” addresses the validation step using integral experiments and benchmarks, in connection with the end-user needs and applications. This will include the use of existing integral experiments (possibly with a new analysis), including criticality and shielding experiments. The WP will also include performing new data validation experiments in existing experimental facilities, in particular on actinides and structural materials. In addition, the WP will include sensitivity analyses and impact studies, for both generic and specific systems, and will derive quantitative statements as to the performance of the WP4 nuclear data files for such systems.

Finally, the WP6 “Management, ND research coordination at EU level and Education and Training” will include the project management and inter-WP coordination, a group reflection on a future framework for European nuclear data research in a sustainable structure well beyond the duration of the project, the coordination of the education and training activities and the coordination and follow-up of the dissemination and communication activities performed directly by the different WPs.

The interdependencies between the various WPs are sketched in the following Pert chart.



The various tasks of the project will proceed in parallel in all the work-packages starting for different isotopes, reactions and data from a different status of the required elements. For some isotopes, the evaluation tasks in WP4 can start immediately however in some cases they will have to wait from new data from WP2 of from new integral experiments of WP5. In the same manner, the validation tasks in WP5 will have to wait for new experimental results, or be updated when new evaluated files are supplied by WP4. Similarly, some of the experiments in WP2 can start immediately, whereas other experiments will have to wait for some detector development or for target fabrication. Working in parallel and on different isotopes and reaction channels will favor inter-WP communication, help anticipate possible difficulties, and thus lower the risks of getting into a deadlock. A more detailed description of the timing of the different work packages and their components can be found in the following Gantt chart.


SANDA GANTT
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WP1 ……
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T1.1.2
T1.2.1
T1.2.2
T1.2.3
T1.3
T1.4
WP2 ……
T2.1.1
T2.1.2
T2.2.1
T2.2.2
T2.3
T2.4.1
T2.4.2
T2.4.3
T2.5.1
T2.5.2
T2.6.1
T2.6.2
T2.6.3
WP3 ……
T3.1
T3.2
T3.3
T3.4
WP4 ……
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T4.1.2
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T4.5
WP5 ……
T5.1.1
T5.1.2
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WP6 ……
T6.1
T6.2
T6.3
T6.4

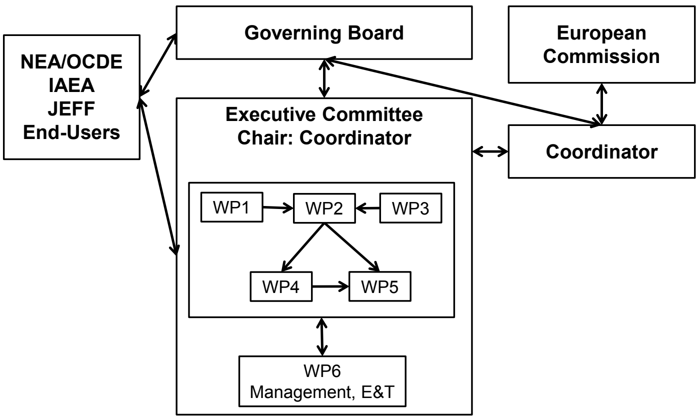
3.2 Management structure and procedures

The organization structure of the proposal Consortium comprises the following main bodies, see figure:

- Governing Board is the uppermost decision-making and arbitration body of the Consortium. Each partner has one voting representative to the Governing Board. The Chairperson will be elected during the Kick-off Meeting which will take place at the latest one month after the start of the project. The coordinator will not stand for election of the chair person.
- Executive Committee, as the supervisory body for the project execution will have the responsibilities for implementing the general policy and strategic orientations decided on by the Governing Board, for establishing the Project Deliverables for the Commission, and for preparing progress reports of the Project for the Commission and the Governing Board. The Executive committee will guarantee the integration of the activities and the coordination of the technical activities. It is composed of the Work Package leaders plus the project Coordinator, who chairs this committee. It may invite international experts to its meetings as appropriate, in particular from IAEA, JEFF and NEA depending on the topics on the agenda.
- The Coordinator manages the project, chairs the Executive Committee, and reports to the Governing Board. He also liaises with the European Commission.
- Training: The Executive committee will directly follow the progress and quality of the training activities organized by WP6.

Organizational Levels: The management structure of the project has two levels: the Governing Board and the Executive Committee. This structure focuses responsibilities and channels information. For each of the two levels, the taking of decisions, the dissemination of results, and the exchange of information is clearly identified and controlled by people and bodies. This structure concentrates responsibilities for day-to-day management in the Executive Committee, which is accountable to the Governing Board. In the Governing Board all partners have their voice and vote to influence in the strategic and financial decisions and to provide detailed guidance for the Executive Committee.

Critical situations: The management structure in organizational levels allows the Executive Committee to detect unexpected developments and critical situations, which might occur during the lifetime of the Project and which might endanger to planned course of activities, so early that the Coordinator and the Responsible Committees are able to react flexibly and to take the appropriate actions.



Governing Board

The Governing Board is the ultimate decision-making body of the Consortium. It decides on matters relating to:

- the preparation and final approval of the management reports related to financial statements and technical advancement of the project prior to the submission to the EC,
- all budget-related matters,
- the acceptance of new partners as well as the exclusion of partners,
- the restructuring of the work-packages, should that be necessary,

- proposals to the partners for the alteration of the Consortium Agreement,
- proposals to the partners for the premature completion / termination of the project.

The Governing Board meets on a regular schedule this being at least every 12 months. In due time before each meeting, it is anticipated that an Executive Committee meeting will be held, in order to review all technical issues shortly before the Board meets. If needed and upon request from the Executive Committee, the Governing Board may call for an extraordinary meeting.

The Governing Board may decide to invite international experts to its meetings in particular representatives from IAEA, JEFF and NEA.

General meetings

In addition to the Governing Board meetings, the project Coordinator will organize with the same frequency and normally at contiguous dates general meetings of the project. In these meetings there will be a progress report of each work-package with technical and administrative progress at the task level and informing of the achievement of the milestones, status of deliverables, and possible difficulties.

In addition, individual participants in the project will be invited to attend and present their contribution and the technical results they have achieved. Furthermore, international experts from IAEA, JEFF and NEA will be invited to these project general meetings.

Executive Committee

The Executive Committee is the supervisory body for the technical execution of the project. The responsibilities of the Executive Committee include:

- Ensure the scientific monitoring and progress review of the project, the training activities,
- Approval of the WP work schedules and co-ordination of the work programmes within and between the technical work packages,
- Preparation, where necessary, of revisions to the detailed work programmes,
- Preparation of multi-purpose use of projects instruments, such as workshops, topical meetings, etc.
- Address problems and/or issues arising from the WPs, identify issues that need to be referred to the Governing Board,
- Identification of technical developments which are related to patents and the development of design, component, or process issues,
- Schedule meetings supporting the effective conduct of the work programme,
- Contribution to management reports,
- Contribution to activity and financial reports
- Inform the Governing Board concerning contractors presenting financial or technical difficulties within a work-package,
- Should the need arise, propose new scientific orientations to the Governing Board and implement the agreed-upon orientations,
- Information across the project of any other difficulty arising in connection with the conduct of the work-packages,
- Follow up of any publication/communication on work done within the project.

The Executive Committee meets on a regular schedule, being at least every six months. It may invite international experts to its meetings in particular from IAEA, JEFF and NEA as a function of the topics to discuss.

Immediately before these Executive Committee meetings it is anticipated that the work packages may hold technical meetings.

Project Coordinator

The project Coordinator assisted by the Executive Committee is responsible for the overall (technical and financial) management of the project. Moreover, the Coordinator will:

- Act as the project contact with the EC,
- Act as the intermediary between all the project participants and the EC, since all information related to the project will be transmitted to the EC through the project Coordinator,
- Establish the contracts with the project partners,

- Receive all payments made by the EC and administer the EC contribution,
- Process the invoicing, and exercising the payment to all project partners,
- Inform the EC of the distribution of payments to the partners,
- Establish provisions for support of the Governing Board and the Executive Committee, and respective meetings,
- Establish and update the project Web site, the contractors' address lists, etc.,
- Organize registration and central deposit of all documents prepared under the project,
- Prepare and submit the contractually required periodic activity and financial reports; supplementary reports as necessary,
- Prepare the Consortium Agreement which regulates the internal organization and management of the consortium,
- Handle all other administrative and financial matters related to the project contract,
- If the need arises: prepare and publish calls for tenders in case of competitive calls for new contractors, pre-evaluation of the proposals and negotiation of contracts,
- Act as a focal point for all kinds of project external and internal requests.

Milestones

The milestones are described within each work-package and are summarized in the table 3.2a.

3.3 Consortium as a whole

One of the main assets of the proposal is the consortium of partner organizations involved in the proposal. Indeed, this consortium includes most of the EU institutions with significant experience and capacity to develop the EU capabilities in all the steps of the nuclear data cycle: detection systems, analysis tools, evaluation tools, models of intermediate and high energy reactions, integral experiments, simulation tools ... and the scientists and professionals capable of developing and using all these tools. This consortium was built based on the experience of the ANDES and the CHANDA projects, including also the capabilities and laboratories required to perform differential measurements, integral experiments and for target preparation (this last one from the network organized within the CHANDA project). In fact, 29 from the 35 partners of the proposal were already members of CHANDA. So, the consortium is used to work together and has already demonstrated the complementarity of the partners and the efficiency to achieve the proposed objectives as well as a significant added value for joining the efforts and producing a large number of high-quality results, publications and trained scientists.

The consortium includes research teams with considerable expertise in detector developments like CEA (Micromegas, FALSTAF, neutron detectors, LNHB …), CERN (n_TOF, gamma fast detectors …), CIEMAT (for neutron detectors and photon detectors from capture reactions,…), CNRS (GRPD and photon detectors,…), HZDR (large facility and detectors for DDX), JYU (IGISOL), UPC (BELEN), and PTB (laboratory of standards and detectors for DDX).

To perform the proposed experiments covering many different reactions, the consortium includes more than 20 partners with specific know-how and capacities. There are partners that operate the experimental facilities (neutron sources or isotope sources and complex experimental setups) needed for the measurements proposed like JRC (Geel), CNRS (Surrogate experiments facilities), CERN (n_TOF), JYU (IGISOL/JYFLTRAP), NPI (CAS), and teams like CEA or USC that will perform experiments in the ILL and FAIR, respectively. In addition, the consortium includes teams with large experience in the analysis of the proposed measurements like CIEMAT (capture measurements on actinides), CNRS (surrogate reactions), CSIC (TAS and decay data), CEA (on many channels), UU and NPI (on n,lxhp), IFIN-HH, NTUA and JRC (on inelastic and n,2n), USE, IST and PTB (on reactions for non-energy applications), ENEA (on capture for non-actinides), and others like UPC, ULODZ, USC, NPL for their experience on specific detectors that need to be developed or adapted for the experiments.

For the target activities all the main target producers in Europe, JRC, PSI and UMAINZ, are included in the consortium, and in addition a combined effort of PSI, UMAINZ and one subcontractor of PSI is proposed for the feasibility study of the isotope separator, intended to be ultimately built at PSI.

The consortium has also included many key partners in the WP on evaluation, covering the different areas of expertise needed. It will include teams with experience on basic developments and new tools like TUW, CEA, PSI and JSI; experts on reaction cross section evaluations like CEA, CNRS, UU, PSI and UB; experts on fission yield and neutron structure evaluation like IFIN-HH, Sofia, Atomki, CEA and CNRS; experts on processing and applications like UPM, JSI and CIEMAT; and experts on high energy models like USC and CEA.

Also, several partners have been included in the consortium for their expertise on validation, integral experiments and nuclear data needs. The experience for the validation studies is provided by the teams of CEA, CIEMAT, JSI, NRG, UPM and IRSN. For the integral experiments the consortium includes the owners and operators of the facilities hosting the experiments CEA (MINERVE…), CVREZ (LR-0) and ENEA (TAPIRO…). In addition, SCK-CEN, JSI, KIT, UPM, CEA and CIEMAT, that have been very active in recent years in sensitivity studies and associated evaluations of nuclear data needs, will contribute to these activities again for WP5.

Furthermore, the proposal includes several large research organizations (CEA, CERN, CIEMAT, CNRS, ENEA, JRC ...) acting, *de facto,* as funding agencies, and institutions (CEA, SCK-CEN, ENEA ...) responsible for important new systems proposed to be built in the next years like MYRRHA, ASTRID or ALFRED. In addition, several institutions (CEA, CIEMAT, ENEA, JRC, NRG, NTUA, PSI and USC) have important multidisciplinary activities that allow them to establish bridges between safety-oriented nuclear data research and other applications, in many cases relating to health, security and environmental protection. Adding several institutions from other countries finally brings together a very comprehensive and relevant consortium to develop the activities proposed in the proposal, representing the different interests, programs and organizations involved in nuclear data research for nuclear safety in the EU. Based on this consortium, the project will undoubtedly have the best assets to propose a sustainable framework for long-term nuclear data research in the EU.

i) Sub-contracting:
PSI will subcontract some activities related to the design of the isotope separator. Some research groups had been tentatively contacted as candidate for that subcontracting because of their scientific and engineering experience in this type of systems.

ii) **Third parties:**
Part of the work of CNRS will be performed by the following linked third parties:

- Grenoble INP

LPSC, Unité Mixte de recherche or Joint Research Unit (UMR/JRU 5821) is set up by Centre National de la Recherche Scientifique (CNRS), Université Grenoble Alpes (UGA) and Institut National Polytechnique de Grenoble (Grenoble INP). Since Pr. Grégoire Kessedjian (WP2 & 4) and Pr Adrien Bidaud (WP5), Grenoble INP employees, will be active in the project, CNRS requests the inclusion of Grenoble INP as Linked Third Party in line with the Article 14 of the Grant Agreement.

- Université de Bordeaux

Université de Bordeaux will also participate in the project as third party contractually linked with CNRS through the joint research unit n°5797, also called "CENBG". This involvement is due to the fact that Mr Mourad Aiche is employed by Université de Bordeaux as a university professor, and will be involved in WP1. Moreover, a contract has been signed between Université de Bordeaux & CNRS regarding the JRU5797 ("Quinquennal contract" of a five-year period) stating the resources (human, financial, infrastructures...) allocated by each institution to the laboratory for research purposes."

- Université Caen Normandie

The laboratory LPC is a joint research unit (JRU6534) between CNRS, UNICAEN and ENSICAEN. As François-René Lecolley is lecturer at the University of Caen and will work on WP2, UNICAEN will be linked to the main beneficiary CNRS.

- IMT Atlantique

UMR6457 SUBATECH is a joint research unit of CNRS, Université de Nantes and IMT Atlantique. Amanda Porta (WP2) and Lydie Giot (WP4) are employed by IMT Atlantique.

- Université de Nantes

UMR6457 SUBATECH is a joint research unit of CNRS, Université de Nantes and IMT Atlantique. Muriel Fallot, involved in WP2 an WP4, is employed by Université de Nantes.

3.4 Resources to be committed

Table 3.4b: 'Other direct cost' items (travel, equipment, other goods and services, large research infrastructure)

Please complete the table below for each participant if the sum of the costs for' travel', 'equipment', and 'goods and services' exceeds 15% of the personnel costs for that participant (according to the budget table in section 3 of the proposal administrative forms).

1 CIEMAT	Cost (€)	Justification
Travel	18000	10000 to participate in project meetings, 10 person*trips at 1000 euros each, and 8000 to participate in detector tests (WP1) and differential measurements (WP2), 4 person*travel at 2000 euros each.
Equipment		
Other goods and services	8000	5000 for consumables for detector tests (WP1) and differential measurements (WP2) and 3000 for certificate of financial statement
Total	26000	

4 CERN	Cost (€)	Justification
Travel	3000	For participating in meetings, 4 person*trips at 750 euros each.
Equipment	32000	Special solid-state detector able to operate at short times after γ flash
Other goods and services	15000	5000 for consumables for detector tests and 10000 for a design study of the detector and electronics able to operate at short times after γ flash
Total	50000	

5 CNRS	Cost (€)	Justification
Travel	36400	Travelling costs for key members listed in section 4 to make experiment, and to assist project meetings, 40 person*trips at 810 euros each and 4 person*trips at 1000 euros each
Equipment		
Other goods and services	7000	Consumables for the construction of a new detector and actinides sample purchase
Total	43400	

7 CVREZ	Cost (€)	Justification
Travel	5000	For participating in meetings and experiments, 5 person*trips at 1000 euros each
Equipment		
Other goods and services	13000	Consumables related to experiments and utilization of LR-0 experimental reactor
Total	18000	

13 JRC	Cost (€)	Justification
Travel	29000	4000 for travels to meetings, 4 person*trips at 1000 euros each, of the project plus 25000 to support for the travel of participants in the meetings for the targets producer-user interaction in WP3, 25 person*trips at 1000 euros each.
Equipment		
Other goods and services	27000	2000 for the organization of a workshop and 25000 for the support to the E&T course
Total	56000	

18 NPL	Cost (€)	Justification
Travel		
Equipment		
Other goods and services	15636	Purchase of foils for activation by neutrons, foils will have to be chemically pure and possibly isotopically enriched.
Total	15636	

21 PSI	Cost (€)	Justification
Travel	22500	Support for the travel of participants in the meetings for the targets producer coordination in WP3, 20 person*trips at 1000 euros each plus 5 person*trips at 500 euros each.
Equipment		
Other goods and services	2500	For certificate of financial statement
Total	25000	

27 ULODZ	Cost (€)	Justification
Travel	6389	For attendance at collaboration meetings, 4 person*trips at 750 euros each, and for travel to experiments, 2 person*trips at 1694.5 euros each.
Equipment		
Other goods and services		
Total	6389	

29 UMANCH	Cost (€)	Justification
Travel	10000	4000 for attendance at data-analysis collaboration meetings,4 person*trips at 1000 euros each, and 6000 for travel to experiments, 3 person*trips at 2000 euros each.
Equipment		
Other goods and services		
Total	10000	

30 UOI	Cost (€)	Justification
Travel	3750	2000€ for participating in meetings (analysis meetings, collaboration meetings, conferences), 4 person*trips at 500 euros each, and 1750 € for travel expenses for performing experiments, 2 person*trips at 875 euros each in average.
Equipment		
Other goods and services		
Total	3750	

In addition, CEA foresees a cost of 1500 Euros for certificate of financial statement and other direct costs that will not exceed 15% of their personnel costs.

Please complete the table below for all participants that would like to declare costs of large research infrastructure under Article 6.2 of the General Model Agreement[4], irrespective of the percentage of personnel costs. Please indicate (in the justification) if the beneficiary's methodology for declaring the costs for large research infrastructure has already been positively assessed by the Commission.

Participant Number/Short Name	**Cost (€)**	**Justification**
Large research infrastructure		

As an additional clarification of the resources we provide the intended distribution of the costs between CNRS and its associated linked third parties:

	PM	personnel costs	other direct costs
CNRS	21.5	138,764 €	43,400 €
Grenoble INP	9	58,500 €	- €
Université de Bordeaux	1.5	9,750 €	- €
Université de Nantes	4.5	29,250 €	- €
IMT Atlantique	3.5	22,750 €	- €
Université de Caen Normandie	2	13,000 €	- €
TOTAL CNRS	21.5	138,764 €	43,400 €
TOTAL third parties	20.5	133,250 €	- €
TOTAL	42	272,014 €	43,400 €

In addition to the personnel and other direct costs described in the tables the consortium will provide free of charge for the project the access to the facilities required for the differential measurements and the integral experiments as well as the access to the laboratories required to develop and test the detector developments. This includes the experimental reactors MINERVE, LR-0, and TAPIRO, and the experimental neutron infrastructures of n_TOF, JRC-Geel, IGISOL.

As indicated in section 1.2, a large fraction of the resources, well over 5%, will be directly contributing to the Education and Training activities. The main mechanism will be to financially support the work of PhD Students, Master Students and postdoctoral researchers within the actions of the work packages 1 to 5 of the project. In the recently completed project CHANDA, of a similar consortium for nuclear data research this action resulted in over 50 PhD and Master Theses. For the present proposal we estimate that this number will also exceed 20 PhD and Master Theses. In addition, as indicated in the table 3.4b, JRC foresees to dedicate 25000 Euros for the support to the E&T course indicated in task 6.3 of the work package 6.

[4] Large research infrastructure means research infrastructure of a total value of at least EUR 20 million, for a beneficiary. More information and further guidance on the direct costing for the large research infrastructure is available in the H2020 Online Manual on the Participant Portal.

4. Members of the consortium

4.1. Participants

1. CIEMAT

The CIEMAT, an Organism of the Ministry of Economy and Competitiveness, is a Public Research Agency for excellence in energy and environment, as well as in many vanguard technologies and in various areas of fundamental research.
The group involved in the project is the Nuclear Innovation Unit of the Nuclear Division, belonging to the Energy Department. The group works in nuclear data research since its formation in 1997, participating in the EU projects NTOF-ND-ADS of FP5 and the CANDIDE network of FP6 and coordinating the NUDATRA Domain of IP-EUROTRANS and the ANDES project. It has also participated in the nuclear data experiments n_TOF at CERN, at the JRC and the preparation of experiments at FAIR. The nuclear data activity is part of a wider research program on nuclear advanced nuclear cycles including the nuclear waste transmutation and advanced reactors for sustainable nuclear energy. The group has contributed to FEAT and TARC FP4 projects at CERN, the MUSE4, PDS-XADS y ADOPT of FP5; in EUROTRANS, PATEROS, RED-IMPACT, JHR-CA, MTR-I3 and SNF-TP of FP6; ANDES (as coordinator), CP-ESFR, CDT, MAXSIMA and FAIRFUELS of FP7 as well as several ISTC projects. The Nuclear innovation group also participates in the NEA Working Party on scientific issues of Advanced Fuel Cycles, WPFC previously WPPT, and in several expert groups of IAEA. Finally CIEMAT is founder member of the Sustainable Nuclear Energy Technological Platform, SNETP, with representation on the Governing Board and on the Executive committee.
CIEMAT will contribute with the experience in nuclear data measurements at n_TOF where it is responsible for the actinides capture measurements. CIEMAT is responsible of an innovative experimental technique for measuring capture cross sections of fissile materials and of an experiment performed on 235U.
CIEMAT participates in several international research projects and expert groups on advanced fuel cycles and their influence in the nuclear waste management. CIEMAT has developed the EVOLCODE2 system designed to simulate any type of advanced fuel cycle and which is able to propagate the uncertainties in the simulations, taking into account any form of covariance matrices. CIEMAT has developed the experimental experience in fast critical and subcritical systems within the experimental facilities MASURCA, YALINA and the VENUS-F reactor, developing methodologies for reactivity monitoring and specific measurement technologies.

Finally, its participation in RED-IMPACT, PATEROS, CANDIDE, WPFC, SNETP, NUGENIA, ANDES and CHANDA provided this team with the know-how and experience to identify the relevance and potential impact of the progress in nuclear data for the reactor systems, its fuel cycle and the final disposal.

In this project CIEMAT will act as coordinator, coordinate WP2 and WP6 and participate in WP1, WP4, and WP5.

Prof. Dr. E. Gonzalez-Romero (M), head of the Nuclear Fission Division, coordinator of CHANDA and ANDES EURATOM projects, chairman of the n_TOF collaboration Board, former chairman of the SNETP Executive Committee and present member of the SNETP Board, member of the WPFC/NEA, member of the INDC of the IAEA. He acts as coordinator of the SANDA proposal.

Dr. D. Cano-Ott (M), head of the Nuclear Innovation Unit an international expert in neutron cross section measurements, decay data, neutron detectors and gamma-ray detectors. He is spokesperson of the MONSTER collaboration. He is author of co-author of more than 200 international publications and has participated in most of the FP5, FP6 and FP7 nuclear data projects and coordinated WP8 of CHANDA. He is a regular consultant of international agencies like IAEA and OECD/NEA, referee of Q1 journals in the field and member of various expert groups.

Dr. D. Villamarin (M), responsible of the experimental activities in the experimental reactors, MASURCA and YALINA, and coordinating the participation of CIEMAT in the MYRTE and FREYA projects and responsible of the activities on integral experiments in ANDES and CHANDA.

Dr. F. Alvarez (M), author of the EVOLCODE2 system, expert in the evaluation of nuclear data needs and fuel cycle calculations, and participant in various European projects such as IP-EUROTRANS, ANDES, CHANDA, CDT-FASTEF, CP-ESFR, ARCAS, ESFR-SMART.

Dr. E. Mendoza (M), researcher. He has participated in CHANDA, ANDES, ENSAR and ENSAR-2 FP7 projects. He is responsible of the data analysis of the ^{235}U measurements at n_TOF. Dr. V. Bécares (M), researcher. He is participating in the ANDES and FREYA projects and is heavily involved in the experimental programme carried out at the VENUS-F reactor.

Publications

- J.Allison et al., Nucl. Instr. Meth. A 835 (2016) 186-225
- E. Mendoza et al, Phys. Rev. C 97, 5 (2018) 054616
- J. Lerendegui et al., Phys. Rev. C 97, 2 (2018) 024605
- M.B. Chadwick et al., Nuclear Data Sheets 148 (2018) 189
- R. Capote et al., Nucl. Data Sheets 148 (2018) 254

Significant infrastructures

Laboratorio de patrones neutrónicos: It is a metrologic facility with a very intense ^{252}Cf neutron source which will allow to perform tests of equipment and electronics before carrying out the experiments.

Laboratorio de datos nucleares: The Nuclear Data Laboratory at CIEMAT is a facility which has the state of art equipment for detector assembly and characterisation: a glove box for assembling and filling neutron detectors in a nitrogen or argon atmosphere, an X/Y robot embedded in a dark chamber which allows scanning detectors and photomultipliers (PMTs) with a submilimetric precision, a large variety of neutron and gamma sources, a high performance neutron time of flight spectrometer and a high performance digital data acquisition system based on 14 bits digitisers (developed by CIEMAT).

The EULER supercomputer, a constellation cluster with 1920 cores with nearly 4 TB of RAM memory, interconnected by Infiniband and fully devoted to the execution of jobs. A parallelised version of MCNPX is available, thus being able to perform the very time consuming simulations involved in the modelling of a spallation target and shielding problems.

No third parties involved.

2. ATOMKI

The Institute for Nuclear Research (MTA Atomki) is one of the member institutes in the research network of the Hungarian Academy of Sciences. The primary activity of the Institute is devoted to both experimental and theoretical research in nuclear physics and related fields. Today, our activity focuses on both fundamental and applied research, covering a broad range of modern physics: atomic and subatomic physics, materials science, and several other areas employing the techniques of physics research, such as the environmental and biomedical sciences. This multidisciplinarity has been gradually built on the basis of particle accelerators and the associated analytical facilities.
Atomki is actively involved in producing high-quality new nuclear reaction and nuclear structure data, as well as in the critical evaluation of such data published worldwide. Atomki is one of the evaluation centres of the International Network of Nuclear Structure and Decay Data (NSDD). Since 2012, the team in Atomki has been responsible for the evaluation of the isotopes belonging to the A = 101 – 105 mass chains.

The library of Atomki subscribes for all the major journals publishing nuclear structure data. We have the necessary computers and codes for the evaluation work. Besides these, as an NSDD evaluation centre, we can rely on the expertise and help of NSDD.

Dr János Timár is member of the Hungaria Academy of Sciences and Scientific Adviser of the Institute for Nuclear Research (Atomki). He is author or co-author of more than 130 publications, which received more than 1600 independent citations. He's a world-recognised expert in experimental nuclear physics in the field of gamma-ray spectrometry with multidetector systems and heavy-ion induced fusion-evaporation reactions.

<u>Publications</u>

- Negret A, Balabanski D, Dimitriou P, Elekes Z, Mertzimekis TJ, Pascu S, Timár J, Nuclear structure and decay data evaluation in Europe, EPJ WEB OF CONFERENCES 146: Paper 02042. (2017)
- Elekes Z, Timár J, Nuclear Data Sheets for A = 128, NUCLEAR DATA SHEETS 129: pp. 191-436. (2015)
- Timár J, Elekes Z, Singh B, Nuclear Data Sheets for A = 129, NUCLEAR DATA SHEETS 121: pp. 143-394. (2014)
- Elekes Z, Timár J, Singh B, Nuclear Data Sheets for A=50, NUCLEAR DATA SHEETS 112:(1) pp. 1-131. (2011)
- Abriola D, Bostan M, Ertürk S, Fadil M, Galan M, Juutinen S, Kibédi T, Kondev F, Luca A, Negret A, Nica N, Pfeiffer B, Balraj S, Sonzogni A, Timár J, Tuli J, Venkova T, Zuber K, Nuclear Data Sheets for A = 84, NUCLEAR DATA SHEETS 110:(11) pp. 2815-2944. (2009)

No third parties involved.

3. CEA

CEA, the French Atomic and Alternative Energy Commission is a public government-funded research organization established in 1945. Through its nine established centres spread throughout France, the CEA is a key player in research, development and innovation in four main areas: Defence and security, low carbon energies (nuclear and renewable energies), technological research for industry, fundamental research in the physical sciences and life sciences. CEA is a prominent player in the European Research Area, with an internationally acknowledged level of expertise in its core competencies. CEA is engaged in numerous cross-disciplinary and collaborative projects with leading academic and industrial partners worldwide.

The CEA is organized in four research and development sectors: nuclear energy (DEN), technological research (DRT), fundamental research (DRF) and defence (DAM). The nuclear energy programmes are devoted to the support for nuclear power stations in operation, design of systems for the future, studies for waste management and dismantling of obsolete installations. CEA has recognised and long scientific and technological experience in the field of nuclear safety and nuclear data. The synergy between its different components allows CEA to cover all the aspects of nuclear data: fundamental measurements, theory, integral measurements, evaluation, simulation code development and validation.

CEA DRF conducts fundamental research in the fields of energy, climate, fundamental laws of the Universe, condensed matter and nanoscience. The IRFU (Institut de Recherches sur les lois Fondamentales de l'Univers) is responsible for experimental and theoretical research in nuclear and particle physics, astrophysics, and instrumentation (see also: http://www.irfu.cea.fr). The nuclear physics department (DPhN) plays a leading role in developing instrumentation and carrying out research at several European facilities. It conducts a program of basic research on nuclear reactions involving neutrons, photons and protons over a wide energy range. DPhN groups have also recognised experience in the modelling of nuclear reactions, validation and benchmarking of reaction models for applications to nuclear energy, transmutation of nuclear waste, non-proliferation, non-destructive characterization of waste packages, nuclear medicine, etc... The following key experts will be involved in SANDA:

- S. Leray: Directeur de Recherche CEA, has expertise in high-energy nuclear reactions and was WP leader in FP7 ANDES and CHANDA. She will be involved in WP4 and WP6.
- J.C. David: physicist specialist of model validation and high-energy transport codes will coordinate T4.5.
- Frank Gunsing, Eric Berthoumieux and Emmeric Dupont, are nuclear physicists working on neutron-induced reaction measurements at neutron time-of-flight facilities, nuclear data, and detector development. They have been involved in related FP5, FP6 and FP7 European programs and will be involved in WP1.
- D. Doré: Experimental nuclear physicist working on fission yield and delayed neutron measurements. Leader of the FALSTAFF collaboration, will be involved in WP1 and 2.

Publications:

- D. Doré et al., Nuclear Data Sheets Vol. 119 (2014) 346-348
- L. Thulliez, et al., EPJ Web of Conf. 146 04028 (2017)
- J.C. David, et al., Eur. Phys. J. A 49, 29 (2013)
- A. Boudard, et al, Phys. Rev. C 87 014606 (2013)
- D. Mancusi, et al., Phys. Rev. C 91, 034602 (2015)
- F. Belloni et al., Mod. Phys. Lett. A 28 SI (2013) 13
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- F. Gunsing et al., , Eur. Phys. J. Plus 131 (2016) 371

CEA DEN (Nuclear Energy Division). Within the CEA, the Nuclear Energy Division (DEN) provides the public authorities and the industry with the expertise and innovation needed to develop improved nuclear power generation systems. CEA/DEN is responsible for research and innovation programmes in two key areas: supporting the French nuclear industry, and developing future nuclear systems. As part of a large multidisciplinary simulation programme, DEN research units are actively working on basic physics data, models, and validation experiments for improved simulation tools. In the area of nuclear energy, the research is primarily being conducted by teams of the DEN. Within DEN, the Innovation and Nuclear Support

Division (DISN) is the Program Division in charge of the strategy, development and follow-up of basic research, simulation tools and associated experimental facilities which are necessary as a support for present and future nuclear power plants. One of them is the Simulation Program of DEN which aims at improving the legacy codes (such as APOLLO, CRONOS, ERANOS, TRIPOLI, CATHARE, FLICA…) and developing a new generation of codes. This program includes the development of predictive physical models, advanced numerical techniques, new software architectures, experimental validation of the calculations and basis data improvement Nuclear data evaluation (especially in the resonance range) and validation activities at CEA Cadarache are an essential subset of this programme. They are performed by a group of nuclear physicists in the Reactor Department (DER), in close connection with experimentalists, neutronics code developers and users, as well as reactor and fuel cycle physicists. The validation activities make use of an extensive database of measurements, many of them performed in the CEA critical facilities (EOLE, MINERVE, MASURCA) or derived from power reactors and other facilities. The group is well known for its many years of contributions to the JEFF-3 files and to past EC projects on nuclear data (CANDIDE, EUROTRANS, ERINDA, ANDES, CHANDA). In the neutronic field of this Simulation Program, an important amount of work has been done, and is on-going, to provide improved Nuclear Data to the JEFF community and to develop a new evaluation code CONRAD. In parallel several dedicated integral experiments have been performed in the EOLE, MINERVE and MASURCA facilities to assess the neutronic behaviours of different types of reactor cores.
The following key DEN experts will be involved in SANDA:

- C. De Saint Jean, head of the physics section, who is in charge of the CONRAD nuclear data modelling and evaluation code, also in covariance evaluation, in WP4 and WP6,
- G. Noguere, nuclear data evaluation specialist, in WP4,
- O. Bouland, fission reaction and evaluation specialist, in WP4,
- P. Tamagno, nuclear reaction modelling (CONRAD code), in WP4,
- O. Serot, fission reaction and fission yield specialist, in WP4,
- A. Chebboubi, fission yield specialist, in WP4
- O. Litaize, fission modelling specialist (FIFRELIN code), in WP4,
- P. Leconte, experimental reactor physicist and validation specialist (in charge of the physical design and interpretation of integral experiments in EOLE & MINERVE reactors), will be in WP1 and WP5,
- B. Geslot, experimental reactor physicist, in WP1 and WP5,
- A. Gruel, experimental reactor physicist, in WP5,
- G. Truchet, reactor physicist, in WP5,
- P. Blaise, experimental reactor physicist, in WP5,
- D. Bernard, reactor physicist and validation specialist, (Expert in Nuclear Data as well as in the interpretation of integral experiments, former WP3 leader in ANDES) will be involved in WP5,

Publications:

- D. Bernard, *et al*. NSE **179** 3, 302 (2015).
- P. Tamagno, *et al*., EPJA **51**, 12 (2015).
- G. Noguère, *et al*. Phys Rev C **92**, 1 (2015).
- O. Litaize, *et al*., NDS **118**, 216 (2014).
- O. Bouland, *et al*., NDS **118**, 211 (2014).
- C. De Saint Jean, *et al*. NDS **148**, 383 (2018).
- P. Leconte, *et al*. JNST **52**/42 (2015).
- R. Jacqmin, *et al*., NIMPR A **280**, 210 (2017).
- G. Truchet, *et al*., ANE 85 17 (2015).
- O. Serot, *et al*., NDS **123**, 225 (2015).
- A. Chebboubi, *et al*., EPJ **146** (2017).
- B. Geslot, *et al*., ANE **108**, 268 (2017).
- A. Guel, *et al*., EPJ NST **3**, 11 (2017).
- P. Blaise, *et al*., ANE **110**, 290 (2017).

The CEA DAM (Direction des Applications Militaires or Division of Military Applications) is primarily involved in defence applications like the French Simulation program. The development of the Simulation

program relies on extensive modelling of physical processes as well as systematic experimental validation of each of the individual models with laboratory experiments. That effort encompasses the fields of nuclear physics and nuclear data which are relevant to the SANDA project, as it was for the HINDAS, EUROTRANS/NUDATRA, CANDIDE, EFNUDAT, ERINDA, ANDES, and CHANDA projects. CEA DAM also provides evaluated nuclear data files to the JEFF project jointly with CEA DEN and collaborates with NRG, PSI and IAEA on the development of the TALYS nuclear reaction code. The section of CEA DAM involved in SANDA is the Service de Physique Nucléaire of the CEA DIF (DAM Ile-de-France) [Nuclear Physics News Vol.18, No 4, 2008, p. 5,]. The following key experts will be involved in SANDA:
- E. Bauge (Head of Laboratory) specialized in the modelling of direct nuclear reactions and nuclear data covariances.
- S. Hilaire, specialist of the microscopic modelling of nuclear reactions, more specifically of level densities, gamma strength functions and fission modelling. One of the authors of the TALYS code.
- G. Belier, experimentalist specialized in neutron induced reactions on actinides.
- J. Taieb, experimentalist leader of the SOFIA experiment on fission fragment yields at GSI

Publications:

- E. Bauge, *et al*. Eur. Phys. J. A **48** 113 (2012).
- D. Rochman, *et al*. EPJ Nucl. Sci. Tech. **4**, 7 (2018).
- J.F. Lemaitre,*et al.* Phys. Rev. C **98**, 024623 (2018).
- M. Martini**,** *et al.,* Phys. Rev. C **94**, 014304 (2016).
- P. Romain, Nucl. Data Sheets **131**, 227 (2016).
- S. Goreily, *et al.*, Phys. Rev. Lett**. 111** 242502 (2013).
- X. Ledoux, *et al.*, Nucl. Inst. And Meth. **A 844**, 24 (2017).
- E. Pellereau, *et al.*,Phys. Rev. C **95** 054603 (2017).
- A. Ebran, *et al*, Nucl. Inst. And Meth. A **728**, 40 (2013).

The CEA DRT (Technological Research Direction) tackles the major societal and industrial issues of the 21st century by developing and disseminating technologies, for all industrial sectors and all types of companies, which contribute to the development of digital technology in society, improving public health or respecting the planet. The DM2I (Department of Metrology, Instrumentation and Information), is one of the five departments within the DRT and forms part of the Carnot Institute LIST, specialized in the development of measurement chains, from sensor to information processing, and intelligent decision support systems in the three major areas of energy, health and safety. The LNHB laboratory, within DM2I, has a major role in the field of metrology: it is the national metrology laboratory for ionizing radiation, in association with the LNE. The LNHB has measurement capabilities which include measurements of radioactivity, neutron source emission rate and dosimetry of charged photons and particles and is made up of the following three entities: the Radioactivity Metrology Laboratory (LMA) in charge of primary metrology for the measurement of activity and the transfer of references to accredited calibration laboratories, having a technical platform which includes the means of preparing primary and secondary sources and measurements adapted to the diversity of physical forms of radionuclides, their half-life and their decay scheme; the Fundamental Data Unit (CDF), in charge of the evaluation and the publication, through the Bureau International des Poids et Mesures (BIPM), of nuclear and atomic data for the metrology community associated with the decay of radionuclides (half-lives, energies and emission intensities of the different radiations emitted, decay schemes…) and the Dosimetry Metrology Laboratory (LMD) in charge of primary metrology for the dose and transfer of references to accredited calibration laboratories, having a technical platform which includes radiation sources adapted to different problems, as well as equipment and dosimetric techniques adapted to the transfer of references in these fields. The activities dedicated to the field of radiotherapy are located on the DOSEO platform. The following key experts will be involved in SANDA:

- M.A. Kellett (Head of Laboratory): specialized in the field of nuclear decay data evaluation and nuclear data library production. Has produced the JEFF radioactive decay data library for the past 15 years. Coordinator of the “Decay Data Evaluation Project” collaboration and the EMPIR project “MetroBeta”.
- X. Mougeot: specialized in the field of beta spectra measurements, theoretical studies of beta spectral shapes and author of the BetaShape code.

- M.-C. Lépy: Directeur de Recherche CEA, expert in X- and γ-ray spectroscopy.
- V. Chisté: specialized in the field of measurement of radionuclides with ionization chambers and nuclear decay data evaluation.
- V. Lourenço: specialized in radiochemical separation techniques and radioactive source production.

Publications

- M.A. Kellett, O. Bersillon, EPJ Web of Conferences 146 (2017) 02009.
- M.A. Kellett, A.L. Nichols, IAEA Report STI/PUB/1618 (2013).
- M.A. Kellett, Appl. Radiat. Isot. 70 (2012) 1919.
- X. Mougeot, Phys. Rev. C 91 (2015) 055504.
- X. Mougeot, C. Bisch, Phys. Rev. A 90 (2014) 012501.
- M.-C. Lépy, et al., Appl. Radiat. Isot. 134 (2018) 131.

No third parties involved.

4. CERN

CERN operates the largest complex of particle accelerators. The 60-year history of CERN is marked with impressive achievements in the construction and operation of powerful linear and circular accelerators. In 2008, CERN brought into operation the Large Hadron Collider (LHC) installed in a tunnel of almost 27 km circumference. Experiments at other accelerators and facilities than LHC are pillars of laboratory's activities, as well new technology development, i.e. R&D of new detection systems. In this context, the n_TOF facility at CERN, an intense source of neutrons, generated by the spallation mechanism induced by 20 GeV/c protons from the PS accelerators onto a solid lead target, provides two different beam lines, EAR-1 and EAR-2, for performing (n,f), (n,gamma), (n, charged particles) and (n,xn) neutron induced reaction cross-sections. The facility was built with the support of the NTOF-ND-ADS project of the European Commission and the second neutron beam line n_TOF EAR-2 was built and equipped with the support of the CHANDA EC project.

Dr. Enrico Chiaveri (M) research physicist, Spokesperson of n_TOF Collaboration. Project leader of EAR2 (Experimental Area 2), member of ERINDA and coordinator of the CHANDA project WP7. He is author of co-author of more than 200 refereed publications.

Dr. Massimo Barbagallo (M) is currently a CERN Research Fellow at n_TOF, where he is in charge of managing the two experimental areas and beam lines and he provides supports to non-local members of the Collaboration performing experiments at n_TOF. As former Post-Doc for INFN, his activities have been including R&D of detection systems used to carry on frontier cross-section measurements on highly radioactive isotope, both of interest for Nuclear Technologies and Nuclear Astrophysics. He is author of more than 50 publications on referred journals.

Publications

- E. Mendoza et al., Measurement and analysis of the ^{241}Am neutron the n_TOF facility at CERN, Phys. Rev. C 97, 054616 (2018).
- T. Wright et al., Measurement of the ^{238}U(n,γ) cross section up to 80 keV with the To-tal Absorption Calorimeter at the CERN n_TOF facility, Phys. Rev. C 96, 064601 (2017).
- M. Sabate-Gilarte et al., High accuracy determination of the neutron flux in the new ex-perimental area n_TOF-EAR2 at CERN, Eur. Phys. J. A. (2017) 53: 210
- C. Weiss et al., The new vertical beam line at the CERN n_TOF facility design and out-look on the performance, Nucl. Instrum. Methods Phys. Res. A 799 (2015) 90-98.
- U. Abbondanno et al., n_TOF Performance Report, CERN/INTC-O-011, INTC-2002-037, 2002

Previous projects or activities

CERN has participated in the most relevant EC projects in the field of nuclear data for nuclear technologies like CHANDA (FP7), ANDES (FP7) and NTOF-ND-ADS (FP5)

Significant infrastructures

The neutron time-of-flight (n_TOF) facility at CERN is an intense source of neutrons from thermal energies up to 1 GeV, generated by the spallation mechanism of 20 GeV/c protons (with a time resolution of 6 ns RMS) from the PS accelerators onto a solid lead target. The unique features of the n_TOF facility (very high instantaneous neutron flux in the two experimental areas, low duty cycle, high resolution and low background) allow the measurement of cross-section of neutron induced reactions. In addition, the availability of the state-of-the art CERN laboratories for detectors development provide the perfect playground to accomplish the task proposed.

The detection system to be developed within this proposal for performing (n,xn) measurements is currently undergoing test beam at the n_TOF facility and a dedicated more performant electronic is under study in parallel. Following this phase, the final construction of the detector will follow.

No third parties involved.

5. CNRS

The Centre National de la Recherche Scientifique (National Centre for Scientific Research) is a government-funded research organisation, under the administrative authority of French Ministry of Research. As the largest fundamental research organisation in Europe, CNRS carries out research in all fields of knowledge through ten Institutes, three of which are national, what is the case of the National Institute of Nuclear and Particle Physics (IN2P3). Its own laboratories as well as those it maintains jointly with universities, other research organisations, or industry are located throughout France, but also overseas with international joint laboratories located in several countries.

Measured by the amount of human and material resources it commits to scientific research or by the great range of disciplines in which its scientists carry on their work, the CNRS is clearly the hub of research activity in France. It is also an important breeding ground for scientific and technological innovation, and has been one of the most active participants to previous and current European Framework Programmes. Over the past years, the CNRS has acquired an outstanding experience in coordinating FP Projects.

The CNRS National Institute of Nuclear and Particle Physics (IN2P3) seeks to promote and bring together research activities in nuclear physics, high-energy physics and their applications. The Institute coordinates programs in this field on behalf of CNRS and universities, in partnership with the French Atomic Energy and Alternative Energies Commission (CEA). Particularly, CNRS/IN2P3 with its partners is involved in EURATOM programs since decades, covering various domains of research, from the management and disposal of nuclear waste, nuclear safety, environmental protection and nuclear innovation. Basic nuclear physics research pursued in CNRS/IN2P3 laboratories has lead the research teams to propose innovative techniques to develop state-of-the-art nuclear data research in the framework of several EURATOM European projects (HINDAS, EUROTRANS/NUDATRA, ANDES, CHANDA). The new SANDA project will take advantage of all the skills developed in CNRS/IN2P3 in the field of nuclear data both for the experimental side of the nuclear data projects with activities of detector developments and measurements and more recently, for the evaluation side. This particularity allows integrated actions from measurements to evaluation performed by R&D team with the aim to better fulfil evaluated nuclear data requirements. These more "integrated" actions will be a real benefit for improvement of nuclear data production and its communication to industrials, and will contribute to a real share experience between all the actors of the nuclear data community at the European level.

Dr Maëlle Kerveno (F) is a Nuclear Physics Physicist of the « Institut Pluridisciplinaire Hubert Curien » (Nuclear data for reactors group, CNRS/IN2P3, Université de Strasbourg). She completed her Ph. D. thesis in 2000 at University of Nantes. Since she joined CNRS in 2002, she developed skills in experimental nuclear physics and became a specialist in nuclear data for innovative nuclear power plants and nuclear waste incineration systems. She is scientific coordinator of the NFS project at IPHC. She is the co-leader of the national integrated project NACRE in the frame of the NEEDS challenge and responsible of the master project OPALE in IN2P3. She was also the CNRS national scientific responsible of the European CHANDA project. She will conduct projects on cross section evaluation in WP 4 and will participate to measurements project in WP2 in SANDA. She will act as national scientific responsible for CNRS in SANDA but also as WP1 leader and as local scientific responsible of SANDA at IPHC. She will also participate to WP 6 in SANDA for management and to prepare nuclear data coordination at European level.
Dr Grégoire Kessedjian (M) is a Nuclear Physics Physicist of the « Laboratoire de Physique Subatomique et de Cosmologie » (reactor physics group, CNRS/IN2P3, Université Grenoble Alpes, Grenoble INP). He defends his Ph. D. thesis in 2008 at University of Bordeaux. Since he joined Grenoble INP in 2009 as associate professor position, he developed skills in experimental nuclear physics and became a specialist in nuclear data and evaluations dedicated to nuclear fuel cycle studies. He is scientific coordinator of projects on fission studies at LPSC and co-proposer of fission yields experiment program at ILL. He is responsible of the nuclear master degree "IEN" in Grenoble INP. He is member of the LPSC scientific council and the French national university council (CNU). He will conduct projects on fission yields measurements and evaluation in WP 2 and 4 in SANDA. He will be the local scientific responsible of SANDA at LPSC.

Dr Ludovic MATHIEU (M) is a Nuclear Physic physicist at the «Centre d'Etudes Nucléaires de Bordeaux Gradignan, CENBG». He joined the CNRS in 2009 as an experimental physicist, after completing his PhD in 2005 on molten salt reactor simulations. His experience in numerical simulations was found to be very useful for experimental research, in order to design experiments or analyze data. He developed skills in accurate measurements of neutron-induced cross sections, and is now developing a new type of proton recoil detector. He is the local contact at the CENBG of the NEA for 10 years, as well as the local scientific responsible of the CHANDA European project. He will conduct project on fission cross section measurements in WP 1 and 2 in SANDA.

Dr Mourad Aiche (M) is a physicist of the "Centre d'études nucléaires de Bordeaux-Gradignan" (CNRS-IN2P3, University of Bordeaux), graduated from Université Louis Pasteur at Strasbourg before he completed his Ph. D thesis in 1991 at CRN Strasbourg. He joined in 1993 the " High-Spin, high-deformation" group in Bordeaux, France, where his main activities were the design and the data analysis of experiments dedicated to the super deformed nuclei in the A=150 region .In 2000, he joined as a founding member the "aval du cyle et énergies nouvelles" in Bordeaux. He has expertise in nuclear fission, reaction mechanisms as well as neutron and γ detection techniques related to nuclear data for nuclear energy studies. During this time, he was the CNRS scientific coordinator of the ERINDA European project from 2011 up to 2013. He will participate to project on fission cross section measurements in WP 1 in SANDA.

Dr Beatriz Jurado (F) is CNRS researcher at the «Centre d'Etudes Nucléaires de Bordeaux Gradignan, CENBG», which she joined in 2004. She completed her Ph. D. thesis in 2002 at the GSI in Darmstadt, Germany. She is expert in indirect measurements of neutron cross sections with surrogate reactions and in nuclear fission, experiments and modelling. She leads the research on surrogate reactions of the CENBG collaboration, which is one of the worldwide leaders on the topic. She has been the spokesperson of many experiments on surrogate reactions carried out at the IPN Orsay and the University of Oslo, and has supervised the work numerous master students, PhD students and post-docs on the study of surrogate reactions. She will conduct project on fission cross section measurements by surrogate method in WP 2 in SANDA. She will be the local scientific responsible of SANDA at CENBG.

Dr. Adrien Bidaud (M) is a Nuclear Reactor Physicist of the Laboratoire de Physique Subatomique et Cosmologie (CNRS/IN2P3, Université Grenoble Alpes, Institut Polytechnique de Grenoble). He is associated professor in Grenoble Institute of Technology since 2006. His PhD (University of Paris-Orsay, 2006) was about nuclear data sensitivity and uncertainty analysis. Since then, he developed activities in the field of nuclear energy prospective scenarios by setting up interdisciplinary project associating nuclear reactor physicists, geologists experts in uranium and energy economists. He kept on contributing to the field of Nuclear Data sensitivity and uncertainty analysis and participated to various OECD/NEA expert groups. As co-chair for CNRS of the Nuclear Systems and Scenarios of the NEEDS challenge, he coordinates research activities funded by CNRS, CEA, IRSN, Framatome, Orano and EDF in the fields of nuclear data, integral experiments, instrumentation, innovative reactor concept design and simulation tools, as well as scenarios studies. He will conduct project on nuclear data sensitivity in WP 5 in SANDA.

Dr. Philippe Dessagne (M) is a Nuclear Physics Physicist of the « Institut Pluridisciplinaire Hubert Curien » (Nuclear data for reactors group, CNRS/IN2P3, Université de Strasbourg). He completed his Ph. D. thesis in 1982 at University of Paris Sud. Since he joined CNRS in 1983, he developed skills in experimental nuclear physics (nuclear structure, beta decay) and became a specialist in nuclear data for innovative nuclear power plants and nuclear waste incineration systems. He is coordinator of DNR team at IPHC. He is the french coordinator of the Collaboration Agreement with Romania. He is also a member of the collaboration board of the SPIRAL2-NFS project and he was responsible of the WP8.3 for the FP7-CHANDA European project. He will conduct project on neutron inelastic cross section measurement in WP 2 in SANDA.

Dr. Greg Henning (M) is a Nuclear Physics Physicist at the « Institut Pluridisciplinaire Hubert Curien » (Nuclear data for reactors group, CNRS/IN2P3, Université de Strasbourg). He completed his Ph. D. thesis in 2012 at the University Paris Sud (Orsay) and joined the CNRS in 2015. His researches focus on nuclear physics and nuclear reactions, specifically for reaction of interest in nuclear reactors. He teaches "nuclear physics for nuclear reactor" to master students and is the leader of EEDIN collaboration in the national integrated project NACRE in the frame of the NEEDS challenge. He will participate to projects on neutron inelastic cross section measurement and evaluation in WP 2 and 4 in SANDA.

Dr François-René Lecolley (M) is a Nuclear Physics Physicist of the « Laboratoire de Physique Corpusculaire de Caen » (ENSICAEN, CNRS/IN2P3, Université Caen Normandie). He completed his Ph. D. thesis in 1996 at University of Caen. Since he joined University of Caen in 1998 as an assistant professor, he developed skills in experimental nuclear physics and became a specialist in nuclear data for nuclear power plants. He is scientific coordinator of the SCALP project at CNRS/IN2P3. He will conduct project on (n,alpha) cross section measurement in WP 2 in SANDA. He will be the local scientific responsible of SANDA at LPCC.

Dr Gregory Lehaut (M) is a Nuclear Physics Physicist of the "Laboratoire de Physique Corpusculaire de Caen" (Fondamental Interaction and neutrino properties group, and “Aval du cycle électro-nucléaire” group, CNRS/IN2P3, Université de Normandie/ENSICaen). He completed his Ph. D. thesis in 2009 at Caen University. Since he joined the CNRS/IN2P3 in 2011, he developed skills in experimental nuclear and particle physics, particularly in detection system and data analysis. He is involved in several experiments: SCALP (cross section measurement for nuclear reactor), SoLid (search for short baseline neutrino oscillation). He will participate to project on (n,alpha) cross section measurement in WP 2 in SANDA.

Dr Muriel Fallot (F) is Assistant Professor in the Department of Physics and of the SUBATECH laboratory at the University of Nantes, France. She received her Ph.D. in nuclear physics from the Pierre and Marie Curie University of Paris in 2002. As a nuclear and reactor physicist, she has spent her career chasing reactor antineutrinos at the Double Chooz, Nucifer and SoLid experiments (as the coordinator of the Reactor and Spectrum Working Groups), bringing her nuclear and reactor physics expertize. She has contributed to predictions of reactor antineutrino spectra with the development of reactor and spectrum models, and the acquisition of new nuclear data with the Total Absorption Gamma-ray Spectroscopy technique. She coordinates the third Work Package of the NEEDS/NACRE nuclear data project. She is head of the Nuclear Structure and Energy group of the Subatech laboratory and coordinates the Master 2 “Nuclear Dismantling and Modelling” of the University of Nantes. She will conduct projects on decay data measurements and evaluation in WP 2 and 4 in SANDA

Dr Magali Estienne (F) is a Nuclear Physics Physicist of the Subatech laboratory (CNRS/in2p3, Univ. of Nantes, IMTA). She received her Ph.D. in 2005 in nuclear physics from the University of Nantes. As a nuclear physicist she has spent her career studying the physics of the quark gluon plasma at Brookhaven within the STAR experiment and then at CERN within the ALICE experiment. She has been head of the High-Pt group of Subatech for 3 years and directed the EMCal and DCal detector projects for 8 years at Subatech. Since nearly two years, she has joined the Nuclear Structure and Energy group of Subatech to bring her expertize to the research projects of the group. She has contributed to reactor antineutrino spectrum predictions with nuclear data since 2012 and has become an expert in this field. She also participates to the experimental activities of the team (TAGS experiments and E-Shape project). She will participate in projects on decay data measurements and evaluation in WP 2 and 4 in SANDA

Lydie Giot (F) is an assistant professor in nuclear reactor science and engineering at the engineering school IMTA and SUBATECH Laboratory since 2007. She completed her Ph. D. thesis in 2003 at University of Caen in experimental nuclear physics. She was the head of the nuclear reactor engineering program at IMTA from 2009 to 2017. Her research work is mainly focussed on reactor simulations and associated depletion calculations using Monte Carlo codes. She participated in modeling several types of reactors such as N4-PWR, research reactors (CEA-OSIRIS, SCK-CEN-BR2) within the Double Chooz, Nucifer and SoLid experiments. Since 2014, she develops decay heat calculations using the summation method mainly on PWR/BWR reactors on the U/Pu cycle especially with the Monte Carlo code SERPENT aiming also to the impact of different data libraries (JEFF and ENDF) and of new decay data measurements performed with the Total Absorption Spectroscopy Method. She will participate in projects on decay data evaluation in WP 4 in SANDA

Dr Amanda Porta (F) is a Nuclear Physics Physicist of the Subatech laboratory (group SEN, CNRS/IN2P3, Université de Nantes, IMT Atlantique). She discussed her Ph. D. thesis in 2005 at University of Turin (Italy) in neutrino physics. She had the opportunity to change from neutrino to nuclear physics in 2009 when she arrived in the Nantes’s group as an assistant professor at the IMT Atlantique (engineer school), since then she developed skills in experimental nuclear physics, in particular in beta decay measurements for nuclear power plant safety. She has been the SEN group responsible in interim for 3 months at the end of 2015, she represented the SEN group in the in2p3's nuclear data community in the same period. She is responsible of the organisation of the classes on reactor's physics and operation in the SNEAM (Sustainable Nuclear Engineering - Applications and Management) international master at the IMT Atlantique. She will participate in projects on decay data measurements in WP 2 in SANDA

M Sylvain David (M) is researcher at CNRS in IPN Orsay. Since 1999 he is working on reactor physics, more specifically on innovative systems and fuel cycles and associated scenarios. He supervised around 6 PhD in reactors physics, neutronics or scenario studies. Since 2014, he is deputy director at CNRS/IN2P3 in charge of interdisciplinary, in particular nuclear physics for energy application (nuclear data, reactor physics, energy scenarios …). He will participate in the WP 6 in SANDA to prepare nuclear data coordination at European level.

Publications

- A collision history-based approach to sensitivity/perturbation calculations in the continuous energy Monte Carlo code SERPENT, M. Aufiero 1 A. Bidaud 1 M. Hursin J. Leppänen G. Palmiotti S. Pelloni P. Rubiolo 1, Annals of Nuclear Energy, Elsevier Masson, 2015, 85, pp.245-258.
- Investigation of the $^{238}U(d,p)$ surrogate reaction via the simultaneous measurement of γ-decay and fission probabilities, Q. Ducasse, B. Jurado,et al., Phys. Rev. C 94 (2016) 024614
- From gamma emissions to (n,xn) cross sections of interest: the role of GAINS and GRAPhEME in nuclear reaction modeling, M. Kerveno, A. Bacquias, C. Borcea, Ph. Dessagne, G. Henning, L.C. Mihailescu, A. Negret, M. Nyman, A. Olacel, A. J. M. Plompen, C. Rouki, G. Rudolf, and J.C. Thiry, European Physical Journal A 51, 167 (2015)
- Total Absorption Spectroscopy Study of ^{92}Rb Decay: A Major Contributor to Reactor Antineutrino Flux , A.-A. Zakari-Issoufou et al., Phys. Rev. Lett. 115, 102503 (2015)
- Development of a gaseous recoil-proton detector for neutron flux measurements between 0.2 and 2 MeV neutron energy, P. Marini, L. Mathieu, M. Aiche, T. Cheron, P. Hellmuth, J.L. Pedroza, S. Czajkowski, B. Jurado and I. Tsekhanovich, EPJ Web of Conferences 146, 03015
- Fission fragment yield distribution in the heavy-mass region from the 239Pu (nth,f) reaction, Y.K. Gupta, D.C. Biswas, O. Serot, D. Bernard, O. Litaize et al., Phys.Rev.C, 2017, 96 (1), pp.014608

Previous projects or activities

IN2P3/CNRS is involved for twenty years in European nuclear data projects. Successively IN2P3 teams have participated to the FP5-EURATOM ADOPT/HINDAS, FP6-EURATOM EUROTRANS/NUDATRA, FP7-EURATOM/ANDES and CHANDA. It was also the coordinator of the FP6-EURATOM/NUWASTE/EFNUDAT project. The IN2P3 teams have thus developed large skills in the nuclear data fields for energy applications and became major actors in this thematic.

Significant infrastructures

IN2P3/CNRS offers three nuclear facilities through its technology platforms (AIFIRA@CENBG, ALTO@IPNO and GENESIS@LPSC) where a large variety of nuclear data measurements are possible. These platforms are included in the submitted H2010-NFRP2018 CSA project ARIEL. The AIFIRA platform offers high intensity (up to 50 μAe) beams of light ions (H+,D+, He+) with excellent beam brightness and energy stability. These characteristics make AIFIRA a very valuable tool for neutron-induced reaction measurements. The ALTO facility of the IPN Orsay consists of a 15 MV tandem capable of accelerating heavy ion beams from protons to iodine. The LICORNE convertor at ALTO platform produces intense, kinematically focused, quasi-monoenergetic beams of neutrons over an energy range of 0.5 to 4 MeV, ideal for energy applications. The GENESIS platform is provided by the GENEPI 2 electrostatic accelerator and can deliver 220 keV deuterons, analyzed by a magnet and guided onto a deutered or tritiated target. Subsequent D(d,n)3He or T(d,n)4He reactions produce fast neutrons of 3.1 MeV or 15.2 MeV respectively (at 0° for 220 keV incident neutrons) which are suitable for measurements relative to energy applications.

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	N
Does the participant envisage that part of its work is performed by linked third parties[5]	Y

If yes, please describe the third party, the link of the participant to the third party, and describe and justify the foreseen tasks to be performed by the third party

- Grenoble INP

LPSC, Unité Mixte de recherche or Joint Research Unit (UMR/JRU 5821) is set up by Centre National de la Recherche Scientifique (CNRS), Université Grenoble Alpes (UGA) and Institut National Polytechnique de Grenoble (Grenoble INP). Since Pr. Grégoire Kessedjian (WP2 & 4) and Pr Adrien Bidaud (WP5), Grenoble INP employees, will be active in the project, CNRS requests the inclusion of Grenoble INP as Linked Third Party in line with the Article 14 of the Grant Agreement.

- Université de Bordeaux

Université de Bordeaux will also participate in the project as third party contractually linked with CNRS through the joint research unit n°5797, also called "CENBG". This involvement is due to the fact that Mr Mourad Aiche is employed by Université de Bordeaux as a university professor, and will be involved in SANDA (WP1). Moreover, a contract has been signed between Université de Bordeaux & CNRS regarding the JRU5797 ("Quinquennal contract" of a five-year period) stating the resources (human, financial, infrastructures...) allocated by each institution to the laboratory for research purposes."

- Université Caen Normandie

The laboratory LPC is a joint research unit (JRU6534) between CNRS, UNICAEN and ENSICAEN. As François-René Lecolley is lecturer at the University of Caen and will work on WP2, UNICAEN will be linked to the main beneficiary CNRS.

- IMT Atlantique

UMR6457 SUBATECH is a joint research unit of CNRS, Université de Nantes and IMT Atlantique. Amanda Porta (WP2) and Lydie Giot (WP4) are employed by IMT Atlantique.

- Université de Nantes

UMR6457 SUBATECH is a joint research unit of CNRS, Université de Nantes and IMT Atlantique. Muriel Fallot, involved in WP2 an WP4, is employed by Université de Nantes.

Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N
Does the participant envisage that part of the work is performed by International Partners[6] (Article 14a of the General Model Grant Agreement)?	N

[5] A third party that is an affiliated entity or has a legal link to a participant implying a collaboration not limited to the action. (Article 14 of the Model Grant Agreement).

[6] 'International Partner' is any legal entity established in a non-associated third country which is not eligible for funding under Article 10 of the Rules for Participation Regulation No 1290/2013.

6. CSIC

The CSIC (Spanish National Research Council) is Spain's largest public research institution, and ranks third among Europe's largest research organization. The CSIC is attached to the Spanish Ministry of Science, Innovation and Universities through the State Secretariat for Research, Development and Innovation, and plays a key role in scientific and technological policy in Spain and worldwide. CSIC has 10.940 employees, including 3.764 researchers. CSIC has 120 Institutes spread across the country and covering different areas of Science and Technology. 67 of them are fully-owned institutes and 53 are Joint Research Units in partnership with other Spanish universities or research institutions. CSIC has also a delegation in Brussels.

CSIC supports research and training across a wide range of knowledge, from the most basic or fundamental aspects of science to the most complex technological developments; from human and social sciences to food science and technology, including biology, biomedicine, physics, chemistry and materials, natural resources and agricultural sciences. As the third largest research organization in Europe, CSIC carries out research in all fields of knowledge.

CSIC produces 20% of the national scientific output (more than 12.000 ISI paper in 2014). CSIC remains the leading patent filer among research bodies in Spain with more than 180 patent requests published in 2014.

In addition, CSIC has a broad experience in conducting R&D projects funded by national and international public agencies and industry. CSIC is a major player in the development of the European research area and therefore a significant contributor to the European integration process. Within the 7th Framework Programme CSIC has signed 726 actions (including 70 coordinated by CSIC). As to the number of projects, CSIC is listed the 1st organisation in Spain and the 4th in Europe within the research organizations, with a total FP7 contribution of over 264 million euros (E-CORDA).

As to the funding obtained by CSIC within each programme, the distribution is People 20%, Cooperation 47%, Capacities 8% and Ideas 25%. Taking into account the research areas, the most relevant ones in terms of funding have been Physical Science and Technology and Biology and Biomedicine.

In H2020 (2014-2018) CSIC has obtained 446 projects with a total EU financial contribution of 181 million euros. As E-CORDA points out CSIC is listed the 1st organisation in Spain and the 3rd participant within the research organization by number of projects. CSIC is a major player in the ERC programme with a total of 87 projects signed as Host Institution in all areas of knowledge. CSIC is also an active member in Knowledge and Innovation Communities (KIC), such as Raw Materials and Food of the European Institute for Innovation and Technology (EIT). The Instituto de Fisica Corpuscular (IFIC) is one of the largest Institutes at CSIC dedicated to basic and applied research in subatomic physics.

Dr. Alejandro Algora is a staff researcher at the Instituto de Fisica Corpuscular (CSIC-Univ. of Valencia), Spain. He completed his PhD at the MTA ATOMKI, Debrecen, Hungary, 1996. He is an experienced researcher in experimental physics, and has lead many experiments in large facilities around the World (LNL-Legnaro, ISOLDE-CERN, GSI, Univ. of Jyväskylä, RIKEN). In recent years he has contributed to a revitalization of total absorption measurements of beta decays related to the prediction of the decay heat and the antineutrino spectrum. He has acted as member and he is presently member of several international and collaboration committees (RISING(GSI), PRESPEC(GSI), ISOLDE Collaboration Committee (ISOLDE-CERN), IDS(ISOLDE), JEFF, etc.).

He is one of the leaders (spokespersons) of new measurements related to the prediction of the decay heat and the antineutrino spectrum of relevance for the WP2 and acted as expert in beta decay in several meetings at the IAEA and NEA (years: 2005, 2006, 2009, 2014, 2015, 2017, 2018).

Dr. Jose L. Tain is leading since more than 25 years the experimental nuclear physics group working on several applications of advanced experimental techniques to the improvement of reactor technology. With more than 160 publications he has contributed decisively to the improvement of techniques for the measurement of neutron capture cross sections at neutron time of flight facilities with improved accuracy. Particularly relevant for this proposal are his experimental studies of decay data for fission products. He has developed new analysis methodologies for beta decay total absorption gamma ray spectroscopy, which have a direct impact on the improvement of reactor decay heat summation calculations. He has also developed a new neutron counter for accurate measurements of beta delayed neutron emission probabilities, for improved calculations of the reactor delayed neutron fraction. He is a consultant of IAEA, NEA and JEFF for these matters.

Publications

- Algora, et al., Decay Heat in Pu-239: Solving the gamma Discrepancy in the 4-3000-s Cooling Period. PHYSICAL REVIEW LETTERS. 105, 202501 (2010) (published November 2010) This article was selected for a Viewpoint article, and received the editor mark of wide interest
- Algora and J. L. Tain, Decay heat and nuclear data.
- Book Chapter, in Nuclear Reactors, Editor Amir Mesquita, IntechOpen, DOI: 10.5772/34622 (published February 2012)
- Available from: https://www.intechopen.com/books/nuclear-reactors/decay-heat-and-nuclear-data
- Fallot, M. et al., New Antineutrino Energy Spectra Predictions from the Summation of Beta Decay Branches of the Fission Products. PHYSICAL REVIEW LETTERS. 109, 202504 (2012) (published November 2012)
- Zakari-Issoufou, A. -A. et al., Total Absorption Spectroscopy Study of Rb-92 Decay: A Major Contributor to Reactor Antineutrino Spectrum Shape. PHYSICAL REVIEW LETTERS. 115, 102503 (2015) (published September 2015)
- Tain, J. L. et al., Enhanced gamma-Ray Emission from Neutron Unbound States Populated in beta Decay. PHYSICAL REVIEW LETTERS. 115, 062502 (2015)— (Published August 2015)

No third parties involved.

7. CVREZ

Research organization Centrum Výzkumu Řež s.r.o. (CVREZ), UJV Group Member, was established in 2002 as a daughter company of ÚJV Řež a.s. Its principal mission is to perform applied R&D in energy (mainly nuclear) and neutron physics as well as act as Czech Technical Safety Organization (TSO).
Two research reactors and a set of experimental equipment (probes and loops) form the backbone of the research infrastructure of the company. This makes CVREZ able to participate in sophisticated research projects and participate in the development of new technologies for GEN IV and the fusion reactor. CVREZ participates in Jules Horowitz Reactor Project (hot laboratories development and supply), and has new research infrastructure SUSEN, which it was built by large ERDF project "Sustainable Energy" (SUSEN) with the budget of nearly 95 MEUR.
CVREZ was involved in 14 FP7 projects and 18 projects in H2020. CVREZ represents the Czech Republic in the Executive Committee of EERA, European Energy Research Alliance and in the ETSON association. CVREZ is a member of SNETP and NUGENIA.

In this project the CVREZ will be participating in a work package WP2 experiments and WP5 validation focused on the experimental work, evaluation of the experimental data for validation and following validation of selected cross sections. The LR-0 reactor together with attached detector infrastructures (2x HPGe, Organic scintillation detector (n/g) and hydrogen proportional counter (neutrons 0.1 – 1.3 MeV will be employed.

Ing. Michal Košťál PhD (male) master degree (2006), PhD (2012) at Czech Technical University in Prague; Faculty of Nuclear Science and Physical Engineering, department of Nuclear Reactors. 2007 – Present – Research centre Rez, Czech Republic; Physicist at LR-0 reactor, focused on neutron and gamma spectrometry. Scientific advisor of reactor dosimetry group. Supervisor of student's diploma thesis and other activities, reviewer in ANE, NIM-A, FED, JRNC. From 2014 Associate Editor, Journal of Nuclear Engineering and Radiation Science, ASME; from 2016 – 2017 Guest Editor, Fusion Engineering and Design, Elsevier.

Ing. Martin Schulc Ph.D. (male) master degree (2010), PhD (2016) at Czech Technical University in Prague; Faculty of Nuclear Science and Physical Engineering, Department of Physics. 2014 – Present – Research centre Rez, Czech Republic; Physicist at LR-0 reactor, focused on neutron and gamma spectrometry. Supervisor of students' bachelor thesis and other activities, reviewer and guest editor in Journal of Nuclear Engineering and Radiation Science.

Publications

- Validation of zirconium isotopes (n,g) and (n,2n) cross sections in a comprehensive LR-0 reactor operative parameters set; M. Košťál, M. Schulc, V. Rypar et al; Appl. Rad. and Isot., Vol. 128, 2017, pp. 92-100
- Neutron deep penetration through reactor pressure vessel and biological concrete shield of VVER-1000 Mock-Up in LR-0 reactor; M. Košťál, F. Cvachovec, B. Jánský et al; Ann. of Nucl. En., Vol. 94, 2016, pp. 672-683
- On similarity of various reactor spectra and 235U prompt fission neutron spectrum; M. Košťál, Z. Matěj, E. Losa et al; Appl. Rad. and Isot., Vol. 135, 2018, pp. 83-91
- Measurement of neutron spectra in a silicon filtered neutron beam using stilbene detectors at the LVR-15 research reactor; M. Košťál, J. Šoltés, L. Viererbl et al; Appl. Rad. and Isot., Volume 128, 2017, pp. 41-48
- Measurement of various monitors reaction rate in a special core at LR-0 reactor, M. Košťál, M. Schulc, J. Šimon et al; Ann. of Nucl. En., Vol. 112, 2018, pp.759-768
- The Influence of Changes in Iron Cross Section in the Thermal Region between CENDL-3.1 and ENDF/B-VII.0, Kostal, M., Milcak, J., Rypar, V., et al, Nuclear Data Sheets, Vol. 118, (2014), pp 561-563

<u>CVREZ has participated in the projects</u>:

- Reactor Dosimetry, CEZ, Validation of calculational models for Dukovany NPP 2017
- Nuclear data validation, EDF, Measurement of neutron fluxes in various iron arrangements for validation of EDF calculational tools, 2016
- Heavy reflector benchmark, EDF, Benchmarking of neutron and gamma fluxes in PWR geometry, (2016-2017)
- VVER-1000 benchmarking, CV Rez, Benchmarking of selected reactor physics parameters under IRPhEP (2013 – 2018)
- CRP, IAEA – NDS, measurement of 89Y(n,2n) cross section (2016-2017)

<u>CVREZ has relevant infrastructures for the project such as</u>:

- LR-0 reactor, pool type zero power reactor with flexible operational parameters
- Silicon filtered neutron spectra. It is neutron field in LVR-15 reactor (Its neutron MW reactor) which is formed in radial channel by use of 1m thick Si filter. This kind of field ideal for energy calibration of neutron spectrometric detectors
- HPGe in vertical position, well characterized detector suitable for measurements of gamma activities of irradiated foils and samples
- HPGe in horizontal position, well characterized detector suitable for measurement of gamma activities of fission products in fuel pins
- FD-11 neutron spectrometric detector, can be used with various crystals (Stilbene, NE-213; p-terfenyl) for measurement of fast neutron flux

No third parties involved.

8. ENEA

The ENEA main research themes are: energy efficiency; renewable energy; nuclear energy; climate and environment; safety and health; new technologies; and electric system research. In 2009, pursuant to Law n. 99 July 23 2009, the new ENEA was set up inheriting expertise, skills and capability of previous research bodies (CNRN-National Committee for Nuclear Research, CNEN-National Committee for Nuclear Energy, and former ENEA-National Committee for Research and Development of Nuclear and Alternative Energy). At national level ENEA coordinates a project funded by the Ministry of Economic Development (MISE) devoted to maintain the present expertise and increase it, where applicable, in the fields of safety, security and sustainability of nuclear installations. At European level, ENEA has an agreement with the IRSN, a bilateral collaboration on several aspects of severe accidents, nuclear fission safety, nuclear data, code validation and application. In the domain of various EURATOM Framework Programs, ENEA has been involved in several projects within the field of nuclear safety, such as SARNET 1 and 2 (Severe Accident Research Network of Excellence), NURESAFE (Nuclear Reactor Safety Simulation Platform), IVMR (In Vessel Melt Retention Severe Accident Strategy for existing and future NPPs), CESAM (Code European for Severe Accident Management), FASTNET (Fast nuclear emergency tools), CHANDA (Solving Challenges in Nuclear Data for the Safety of European Nuclear Facilities). ENEA is also member of CSARP (Cooperative Severe Accident Research Program), MCAP (MELCOR Code Assessment Program) and CAMP (Code Applications and Maintenance Program) with the USNRC.
ENEA is the Italian representative at the Committee on the Safety of Nuclear Installations (CSNI) and at the Nuclear Science Committee (NSC) of OECD/NEA, and participates in a number of working and expert groups, such as the Working Group on Analysis and Management of Accidents (WGAMA), the Working Group on Risk Assessment (WGRISK), the Senior Expert Group on Safety Research Opportunities Post-Fukushima (SAREF), the Joint CNRA/CSNI Ad-Hoc Group on the Safety of Advanced Reactor (GSAR), the Working Group on Fuel Safety (WGFS), the Working Group on Advanced Fuel Cycle Scenarios (AFCS), the Working Party on International Nuclear Data Evaluation Co-operation (WPEC), the Working Party on Nuclear Criticality Safety (WPNCS), the Expert Group on Improvement of Integral Experiments Data for Minor Actinide Management (EGIEMAM-II), amongst others.
ENEA is a member of the CERN n_TOF Collaboration since its establishment, in the year 1999.

Alberto Mengoni (male, born 1957) is a senior researcher at ENEA, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development. From 2009 to 2017, he served as Science and Technology Attaché at the Embassy of Italy in Tokyo, for the Italian Ministry of Foreign Affairs and International Cooperation. He has been, previously, appointed as Head of the Nuclear Data Services Unit at the International Atomic Energy Agency (IAEA) in Vienna, a position held from 2005 to 2009. From 2001 to 2005 he coordinated, for CERN - the European Center for Nuclear Research in Geneva - the "Nuclear Data for Accelerator Driven Systems", an FP5 project initiated by Carlo Rubbia. His fields of research have been nuclear structure and reactions for applications to basic science and technology. Dr. Mengoni has performed a significant fraction of his research activity in nuclear physics at Japanese research institutions (the Japan Atomic Energy Agency, RIKEN and the University of Tokyo), after starting his career as researcher at ENEA Bologna, in Italy.
Mario Carta (male, born 1954) has a master degree in Physics (1979) from the University of Rome "La Sapienza". ENEA researcher starting from June 1983, from 1979 to 1990 is involved in fast reactor physics. From 1986 to 1990 (being detached at CEA-CEN Cadarache – France from 1986 to 1988), is member of the international SPX-1 start-up analysis group. From1991 to 1995 is involved in the analysis of severe accident consequences in thermal reactors. From 1996 to 2013 is involved in the analysis of Accelerator Driven Systems neutronics, with different coordination roles at national and international level. Since 2013 is Head of the ENEA Research Nuclear Reactors Laboratory. TPC member for several international conferences, is author/co-author of more than 180 publications among reviews, conferences, and technical reports.

Donato Maurizio Castelluccio (male, born 1973) holds a M.Sc. in Physics, the Specialization Diploma in Medical Physics (IV year) and the III degree Qualified Expert (QE) Certification. Since 2015 he is member of the Italian Delegation at the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) based in Vienna, and member of the Italian National Data Center (NDC) for the same Organization as Radionuclide Expert. Since 2010 he is serving the Laboratory for Design and Technical Support for Nuclear Safety and Sustainability (FSN-SICNUC-PSSN) of the Italian National Institute for New Technologies, Energy and

Sustainable Economic Development - ENEA in Bologna. Currently he is also involved in neutronic analyses for safety assessment and for design margins definition and optimization of the European Demonstrator Lead-cooled Fast Reactor (ALFRED). He is INFN Associate for the n_TOF experiment and since November 2017 a PhD candidate at the University “Tor Vergata” in Rome. During his professional career he has gained experience in many national and international laboratories in the field of experimental physics.

Publications

- Measurement and resonance analysis of the ^{33}S(n,α)30Si cross section at the CERN n_TOF facility in the energy region from 10 to 300 keV, J. Praena et al. (The n_TOF Collaboration) Phys. Rev. C 97, 064603 (2018), DOI: 10.1103/PhysRevC.97.064603
- Neutron capture cross section measurement of ^{238}U at the CERN n_TOF facility in the energy region from 1 eV to 700 keV, F. Mingrone et al. (The n_TOF Collaboration), Phys. Rev. C 95, 034604 (2017). DOI: 10.1103/PhysRevC.95.034604
- ^{62}Ni(n,γ) and ^{63}Ni(n,γ) cross sections measured at the n_TOF facility at CERN
- C. Lederer et al. (n_TOF Collaboration), Phys. Rev. C 89, 025810 (2014), DOI: 10.1103/PhysRevC.89.025810
- New Measurement of the ^{25}Mg (n,γ) Reaction Cross Section, C. Massimi et al. (The n_TOF Collaboration), Nuclear Data Sheets 119, 110-112 (2014), DOI: 10.1016/j.nds.2014.08.031
- M. Carta et al., "Research Reactors for the development of materials and fuels for innovative nuclear energy systems", IAEA NUCLEAR ENERGY SERIES NO. NP-T-5.8, International Atomic Energy Agency, Vienna, September 2017.

ENEA has participated in previous relevant projects like:

- CHANDA - Solving Challenges in Nuclear Data for the Safety of European Nuclear Facilities
- EU-FP7 Euratom-Fission Project. http://www.chanda-nd.eu/
- CESAM - Code for European Severe Accident Management
- EU-FP7 Euratom-Fission Project
- EVITA (European Validation of the Integral Code ASTEC)
- EU-FP5 Euratom-Fission Project

No third parties involved.

9. HZDR

Helmholtz-Zentrum Dresden - Rossendorf e. V. (HZDR) founded in 1992 is a registered, non-profit institution supported by the German Federal Government and the Free State of Saxony. HZDR pursues interdisciplinary research in the fields matter, health and energy. It has 1100 employees including 500 scientists in eight research institutes. The largest research facility at HZDR is the international user facility ELBE, a 40 MeV superconducting electron accelerator delivering a beam intensity of up to 1 mA in continuous wave mode. ELBE is a world-wide unique instrument providing a compact, accelerator-driven photon and particle source. The variety of secondary radiation being offered extends from high-energy gamma rays, to infrared and THz radiation, to neutron, positron and electron beams. ELBE is operated as user facility, providing more than 50% of the beamtime to external user groups.

HZDR is involved in double-differential cross section section data of high energy neutrons impinging on light nuclei (nitrogen, oxygen, carbon), which are relevant for the absorbed dose outside of the target volume in radiation therapy. HZDR will contribute to the development of the experimental setup for the measurement of DDX data for the neutron-induced emission of light charged particles from C,N,O, i.e. a scattering chamber and telescopes suitable for the measurement of hydrogen and helium ions with low cutoff energies (Task 1.4) . After the restart of CERN n_TOF the experimental activities should begin by measuring data for a small number of angles. This set of angles can already provide valuable benchmarks for testing nuclear models, in particular the INCL model in the low energy range. This would also be a valuable input for the work package focusing on high-energy modelling.

HZDR operates facilities that are very well suited for the proposed tasks: The photo-neutron source nELBE is the first one at a superconducting electron accelerator. The excellent pulse structure of ELBE allow to perform neutron time of flight measurements with high resolution and a short flight path. The nELBE neutron source has a source strength of 5*1011 n/s with a fast neutron spectrum from ca. 100 keV to 8 MeV. HZDR operates a laboratory for the development of particle detectors e.g. gaseous drift chambers, ionization chambers, resistive plate chambers and the corresponding analogue and digital read-out electronics.

Dr. Arnd R. Junghans (male), has experience in nuclear physics experiments with electron accelerators, low energy van de Graaffs and relativistic heavy ion synchrotrons ,measuring cross sections of particle and neutron induced reactions. He is the leader of the HZDR “nuclear data” group.

Dr. Roland Beyer (male) has experience in neutron time-of-flight measurements including development of detectors and experiment electronics. He is the beam line scientist for the nuclear physics beam lines at the ELBE user facility.

Dr. Ronald Schwengner (male) has more than 25 years of experience in nuclear-structure experiments at more than 10 heavy-ion and electron accelerators in Europe using gamma and particle spectroscopy.

Publications

- “The γ-ray angular distribution in fast neutron inelastic scattering from iron” Beyer, R., Dietz, M., Bemmerer, D. et al. Eur. Phys. J. A (2018) 54: 58. https://doi.org/10.1140/epja/i2018-12492-7
- “Fast-neutron-induced fission of 242Pu at nELBE” Toni Kögler, Roland Beyer, Mirco Dietz, Arnd R. Junghans, Christian Lorenz, Stefan E. Müller, Tobias P. Reinhardt, Konrad Schmidt, Ronald Schwengner, Marcell P. Takacs and Andreas Wagner, EPJ Web Conf., 146 (2017) 11023 https://doi.org/10.1051/epjconf/201714611023
- “Breaking of axial symmetry in excited heavy nuclei as identified in giant dipole resonance data” Grosse, E., Junghans, A.R. & Massarczyk, R. Eur. Phys. J. A (2017) 53: 225. https://doi.org/10.1140/epja/i2017-12415-2
- “Nuclear deformation and neutron excess as competing effects for dipole strength in the pygmy region” Massarczyk, R., Schwengner, R., Dönau, F., Frauendorf, S., Anders, M., Bemmerer, D., Beyer, R., Bhatia, C., Birgersson, E., Butterling, M., Elekes, Z., Ferrari, A., Gooden, M.E., Hannaske, R., Junghans, A.R., Kempe, M., Kelley, J.H., Kögler, T., Matic, A., Menzel, M.L.,

Müller, S., Reinhardt, T.P., Röder, M., Rusev, G., Schilling, K.D., Schmidt, K., Schramm, G., Tonchev, A.P., Tornow, W., Wagner, A. (2014) Physical Review Letters, 112 (7), art. no. 072501, https://link.aps.org/doi/10.1103/PhysRevLett.112.072501

HZDR has participated in previous projects like

- HZDR has been involved in a large number of large EU projects, as partner as well as in the role of the coordinator. The most important ones with respect to the present proposal are listed below.
- ERINDA (GA No. 269499) European Research Infrastructures for Nuclear Data Applications
- CHANDA (GA No. 605203) solving CHAllenges in Nuclear DAta
- CALIPSOplus (GA No. 730872) Convenient Access to Light Sources Open to Innovation, Science and to the World
- SPIRIT (GA No. 227012) Support of Public and Industrial Research using Ion Beam Technology
- Start-up KIC Raw Materials (SUGA 2015 EIT RM) Start-up activities in order to set up the EIT Raw Materials Knowledge and Innovation Community - EIT RM

No third parties involved.

10. IFIN-HH

IFIN-HH is one of the most important R&D organizations in Romania, contributing with almost 10% to the national scientific output. The institute is mainly dedicated to research and development in nuclear physics and nuclear engineering, and in related areas including astrophysics and particle physics, field theory, mathematical and computational physics, atomic physics and life and environmental physics. The institute operates four accelerators: a 9-MV TANDEM accelerator, an 1-MV TANDETRON accelerator dedicated to AMS measurements, a 3-MV TANDETRON accelerator dedicated to IBA measurements and a cyclotron capable of producing intense beams at 13 MeV/amu. These are mainly used for nuclear structure and atomic physics studies but also for applied research. Other facilities of the institute are the Radioactive Waste Treatment Plant (STDR), the IRASM centre for R&D and gamma industrial irradiation services.

In the field of nuclear data, IFIN-HH has significant know-how in the field of nuclear reactions including experimental and theoretical study of neutron-induced cross sections. IFIN-HH also hosts a Data Centre of the Nuclear Structure and Decay Data (NSDD) Network, the collaboration producing and maintaining the Evaluated Nuclear Structure Data File (ENSDF) under the coordination of IAEA.

Dr. Alexandru NEGRET is the leader of the experimental nuclear reactions group involved in neutron cross section measurements. During the last decade the group enlarged and produced extensive highly precise nuclear data sets. A. Negret is also the responsible of the NSDD Data Centre operating in IFIN-HH.

Dr. Adina OLACEL is a female scientist at the end of her postdoc, currently having a permanent position in IFIN-HH. She did her PhD and postdoc within the nuclear reactions group and is specialized in experimental neutron cross section measurements, data processing and simulations.

Dr. Marian BOROMIZA concluded his PhD in 2018 with a thesis dedicated to neutron cross section measurements and to the comparison between the charged particle and the neutron induced reactions. He also holds a good know-how in the field of data analysis while showing great interest to the theoretical investigation of nuclear reactions.

Dr. Catalin BORCEA is a senior scientist, with extensive experimental and theoretical know-how in the field of nuclear reactions, precise nuclear data and also nuclear structure.

Dr. Sorin PASCU is a nuclear structure experimentalist involved in data evaluation. He is member of the NSDD Data Centre form IFIN-HH and will be involved in nuclear structure evaluation for the current project.

Publications

- Olacel, C. Borcea, M. Boromiza, Ph. Dessagne, G. Henning, M. Kerveno, L. Leal, A. Negret, M. Nyman, and A. J. M. Plompen, Neutron inelastic scattering on ^{54}Fe, accepted for publication to European Physics Journal (2018).
- Negret, M. Sin, C. Borcea, R. Capote, Ph. Dessagne, M. Kerveno, N. Nankov, A. Olacel, A. J. M. Plompen, and C. Rouki, Cross-section measurements for the ^{57}Fe(n,nγ)^{57}Fe and ^{57}Fe(n,2nγ)^{56}Fe reactions, Phys. Rev. C96, 024620 (2017).
- Olacel, F. Belloni, C. Borcea, M. Boromiza, P. Dessagne, G. Henning, M. Kerveno, A. Negret, M. Nyman, E. Pirovano, and A. J. M. Plompen, Neutron inelastic scattering measurements on the stable isotopes of titanium, Phys. Rev. C96, 014621 (2017).
- Negret, L.C. Mihailescu, C. Borcea, Ph. Dessagne, K.H. Guber, M. Kerveno, A.J. Koning, A. Olacel, A.J.M. Plompen, C. Rouki, and G. Rudolf, Cross section measurements for neutron inelastic scattering and the (n, 2nγ) reaction on ^{206}Pb, Phys. Rev. C91, 064618 (2015).
- Negret and B. Singh, Nuclear Data Sheets for A=86, Nuclear Data Sheets 124, 1-156 (2015).

Previous projects or activities

IFIN-HH is involved in numerous international collaborations in the field of nuclear physics. It is the main contributor to the Romanian participation to FAIR, ISOLDE, n_TOF and SPIRAL2. The list of European projects where IFIN-HH was recently involved includes CHANDA (FP7), ANDES (FP7), ERINDA (FP7), HadronPhysics (FP6) and EURONS (FP6).

No third parties involved.

11. IRSN

IRSN is a French public body with industrial and commercial activities that was set up in 2001. The Institute is placed under the joint authority of the Ministries of Defence, the Environment, Industry, Research, and Health. It is the nation's public service expert in nuclear and radiation risks, and its activities cover all the related scientific and technical issues.

IRSN interacts with all parties concerned by these risks (public authorities, local authorities, companies, research organizations, stakeholders' associations, etc.) to contribute to public policy issues relating to nuclear safety, human and environmental protection against ionizing radiation, and the protection of nuclear materials, facilities, and transport against the risk of malicious acts.

Within the nuclear safety division of IRSN, the Neutronics and Criticality Safety Department performs, amongst other, R&D activities that aim to support safety studies in the frame of criticality and reactor physics. In particular, its activities cover development, verification and validation of reactor physics and criticality safety simulation codes, but also nuclear data evaluation and validation.

Thus, the Monte Carlo transport code MORET is being developed and validated since the 70's and is continuously improved. During the last 3 years, last features of the MORET code were mainly focused on sensitivities/uncertainties studies in order to allow bias and uncertainties estimation and feedback to nuclear data. The experimental validation database of the continuous energy calculation route of the MORET 5 code consist of more than 2000 benchmarks mainly taken from ICSBEP and IRPHE handbooks and French proprietary experimental programs and covers a wide range of media, isotopes and neutron spectrum. The validation database will be used for the workpackage 5 for criticality configurations.

Besides, the Neutronics and Criticality Safety Department has worked on data evaluations for criticality safety and reactor applications. In addition to the data evaluation, IRSN also provides data uncertainties that are used in criticality safety assessments (Calculation bias estimation). Few examples are the 235U, 16O and titanium as shown in the references. These evaluations have been proposed to inclusion in the last JEFF evaluation files. The ^{235}U resonance evaluations in JEFF are that derived at IRSN. The huge validation database of the MORET 5 code is of course used to validate the proposed nuclear data evaluations prior sending them to the JEFF project. As members of the JEFF project, IRSN also contributes to the validation of the new release of the JEFF evaluation files.

This long-lasting experience in the nuclear data evaluation and validation and in criticality safety ensures that the actions foreseen in the SANDA project will be suited to the needs of criticality safety practitioners.

Dr. Luiz Leal (M) is currently deputy head of neutronics laboratory in the Neutronics and Criticality Safety Department at IRSN. He was previously Distinguished R&D Staff in the Nuclear Data and Criticality Safety Group at Oak Ridge National Laboratory (USA). For the past 30 years, he has been performing research activities on nuclear data evaluation for reactor and criticality safety applications. His work consists of data evaluation in the resolved and unresolved resonance regions for actinides, fission products, structural materials, etc. Many JEFF and ENDF evaluation are derived from his work. Recent work includes data evaluation for low-energy neutron interaction with molecules for determination of double differential cross sections. He received many awards, among them the Eugene P. Wigner Reactor Physicist Award in 2016 and the Technical Excellence Award in the Criticality Safety Division of the American Nuclear Society in 2010. He will carry out the nuclear data and covariances evaluation for molybdenum using the new measurements performed in WP1 by ENEA.

Dr. Isabelle Duhamel (F) is currently scientific advisor in the Neutronics and Criticality Safety Department at IRSN, where she is in charge of the IRSN PRINCESS project (PRoject for IRSN Neutron physics and Criticality Experimental data Supporting Safety). She was previously the head of Criticality Research and Neutronics Development Laboratory at IRSN, which was in charge of criticality calculation packages development, verification and validation and of integral critical experiments design for criticality safety. She has more than 20 years of experience in criticality and was mainly involved in nuclear data and code validation, Sensitivity/uncertainties analyses and in critical experiments design. She has been participating in several OECD expert groups (JEFF, UACSA, SG 45 of WPEC) and is currently the coordinator of the SG5 of the WPNCS (Working Party on Nuclear Criticality Safety) that deals on experimental needs. She is an active member of ICSBEP (International Criticality Safety Benchmark project). She will be in charge of the nuclear data validation in the WP5 for criticality issues.

Publications

- Luiz Leal, Adimir Dos Santos, Evgeny Ivanov and Tatiana Ivanova, "Impact of 235U Resonance Parameter Evaluation in the Reactivity Prediction,' Nuc. Sci. Eng., Volume 187, 2017.
- Luiz Leal, Evgeny Ivanov, Gilles Noguere, Arjan Plompen and Stefan Kopecky, "Resonance Parameter and Covariance Evaluation for 16O up to 6 MeV," EPJ Nuclear Sci. Technol. 2, 43 (2016).
- Luiz Leal, Sophie Pignet, Nicolas Leclaire, Isabelle Duhamel (IRSN), and Gary Harms (SNL), "Differential and Integral Data Evaluation for Titanium: An Application to Criticality Safety," Transactions of the American Nuclear Society, Vol. 117, Washington, D.C., October 29–November 2, 2017
- N. Leclaire, I. Duhamel, F.X. Le Dauphin, J.B. Briggs, J. Piot, M. Rennesson and A. Laville, "The MIRTE Experimental Program: An Opportunity to Test Structural Materials in Various Configurations in Thermal Energy Spectrum", Nuclear Science & Engineering, Volume 178, p:429-445, December 2014, http://www.ans.org/pubs/journals/nse/a_36774
- Tatiana Ivanova (IRSN), Isabelle Duhamel (IRSN), Stéphane Evo (IRSN) – "Impact of Nuclear Data on Multiplication Factor and Reactor Physics Parameters Calculation for Experiments Simulating Damp MOX Powders" - Proc. of the International Conference on Nuclear Data for Science and Technology, ND2007, 22-27 April, 2007, Nice, France, http://nd2007.edpsciences.org/
- Duhamel, E. Létang, "The PRINCESS Project: An IRSN Project For Experimental Data Acquisition In The Frame Of Criticality Safety And Reactor Physics", ANS Winter Meeting, November 2016, Las Vegas, NV, USA

No third parties involved.

12. IST-ID

IST-ID, the Association of Instituto Superior Técnico for R&D (http://www.ist-id.pt) is a private not-for-profit institution for which Instituto Superior Técnico (IST) is one of the founding associates. IST is part of the Universidade de Lisboa, and it is the largest and most reputed school of engineering, Science and Technology (S&T) in Portugal. Its mission is to provide top quality higher education in the areas of Engineering, S&T and Architecture, as well as developing RD&I activities that meet the highest international standards.
IST-ID is the host institution of Centro de Ciências e Tecnologias Nucleares (C2TN) where part of the proposed R&D activity will be carried out. Under agreements between IST and IST-ID, IST makes available the majority of facilities, infrastructures and services, where IST-ID R&D activities are carried out. Researchers from the Radiological Protection and Safety Group (GPSR) of C2TN will be involved in the project. They are members of the EU Research Platforms MELODI, EURADOS, Alliance, NERIS, IGD-TP and EURAMET.

Dr. Pedro Vaz (M). Coordinator Researcher of IST with Habilitation. President of Centro de Ciências e Tecnologias Nucleares (C2TN) and Coordinator of the Radiological Protection and Safety Group (GPSR) of C2TN. Ph.D in Physics. Co-author of more than 300 peer-reviewed articles. Has participated in several EU EURATOM funded research projects as well as in CERN experiments related to the measurements of the cross-sections for neutron-induced reactions. Portuguese delegate and representative to several international Committees and Groups under the EU, IAEA, OECD/NEA and EU platforms.

Dr. Isabel F. Gonçalves (F). Senior Researcher of IST. Member of C2TN and GPSR.
PhD in Physics. Has participated in several EU EURATOM funded research projects as well as in CERN experiments related to the measurements of the cross-sections for neutron-induced reactions. Sound experience in neutronics and in Nuclear Engineering and Technology and Reactor Physics related topics.

Publications

- S. Di Maria et al. Area and Prompt Decay Constant Techniques for Reactivity Assessment in Deep Subcritical Configuration: A Case Study within the Framework of the FREYA Project. OECD Proceedings of the Thirteenth Information Exchange Meeting on Actinide and Fission Product Partitioning and Transmutation, Seoul, Republic of Korea, 23-26 September 2014, pp. 262-268.
- G Mila et al. Pulsed Neutron and Source Jerk Experiments for Reactivity Assessment in Deep Subcritical Configuration: A Case Study within the Framework of the FREYA Project. Proceedings of the PHYSOR 2014 Conference on “The Role of Reactor Physics Toward a Sustainable Future”, Kyoto, Japan, September 28 – October 3, 2014, pp. 1-13. doi: 10.11484/jaea-conf-2014-003
- S Barros et al. Comparison of Unfolding Codes for Neutron Spectrometry with Bonner Spheres. Proceedings of the Neutron and Ion Dosimetry Symposium (NEUDOS-12), France, 3-7 June 2013. Radiation Protection Dosimetry (2014), Vol. 161, No. 1–4, pp. 46–52. doi:10.1093/rpd/nct353
- Y Romanets et al. Evaluation of the Radiation Field and Shielding Assessment of the Experimental Area of HIE-ISOLDE. Proceedings of the Neutron and Ion Dosimetry Symposium (NEUDOS-12), France, 3-7 June 2013. Radiation Protection Dosimetry (2014), Vol. 161, No. 1–4, pp. 347–351. doi:10.1093/rpd/ncu031
- S Di Maria et al. Neutronic assessment and criticality analysis of the in-vessel fuel storage facilities in the CDT project. Proceedings of the 15th International Conference on Emerging Nuclear Energy Systems (ICENES-15). Transactions of Fusion Science and Technology, 61(1T), 2012, pp. 298-301. ISSN 1536-1055

IST-ID has participated in several projects like:

- CDT (“Central Design Team”), 7th Framework Programme EURATOM
- ANDES (“Accurate Nuclear Data for nuclear Energy Sustainability”), 7th Framework Programme EURATOM
- FREYA (“Fast Reactor Experiments for hYbrid Applications”), 7th Framework Programme EURATOM

- MARISA (“MYRRHA Research Infrastructure Support Action”), 7th Framework Programme EURATOM
- MYRTE (“MYRRHA Research and Transmutation Endeavour”), Horizon 2020 EURATOM

No third parties involved.

13. JRC

The Joint Research Centre (JRC) is the European Commission's science and knowledge service. Its mission is to support EU policies with independent evidence throughout the whole policy cycle. Its work has a direct impact on the lives of citizens by contributing with its research outcomes to a healthy and safe environment, secure energy supplies, sustainable mobility and consumer health and safety. The JRC hosts specialist laboratories and unique research facilities and is home to thousands of scientists working to support EU policy. The JRC has ten Directorates and is located across five EU Member States (Belgium, Germany, Italy, the Netherlands and Spain).

The Directorate involved in this project is Directorate G - Nuclear Safety and Security. This directorate is responsible for the JRC's nuclear work programme, funded by the EURATOM Research and Training Programme. It contributes to the scientific foundation for the protection of the European citizen against risks associated with the handling and storage of highly radioactive material, and scientific and technical support for the conception, development, implementation and monitoring of community policies related to nuclear energy. Research and policy support activities of Directorate G contribute to achieving effective safety and safeguards systems for the nuclear fuel cycle, enhancing nuclear security and contributing to the goal of low carbon energy production.

The research programmes are carried out at the JRC sites in Germany (Karlsruhe), Belgium (Geel), The Netherlands (Petten) and Italy (Ispra) and consist of research, knowledge management and training activities on nuclear safety, security and safeguards. They are performed in collaboration and/or in support to the EU Member States and relevant international organizations. Today the Directorate G is one of the leading nuclear research establishments for nuclear science and technology and a unique provider of nuclear data measurements.

Dr. Alf Göök is a nuclear physicist working for the ANDANTE work packages FISSION and STANDARDS, with a focus on prompt neutron correlation measurements with fission fragments. His expertise lies in the design and development of high-resolution ionization chambers for charged particle measurements as well as in the detailed characterization of liquid scintillator based neutron detectors. He is an expert in using the GEANT-4 and MCNP software packages.

Dr. Ir. Jan Heyse is work package leader for activities on neutron cross section measurements and on education and training (E&T) at JRC.G.2. His main activities include the organization and follow up of neutron induced reaction measurements, the development of new set-ups for novel nuclear applications and giving support to external users. He coordinates E&T activities within the JRC.G.2 unit.

Dr. Markus Nyman (M) is responsible for conducting elastic and inelastic neutron scattering measurements at the GELINA facility. He also provides support for external users. He has 15 years of professional experience, mostly in neutron scattering experiments and in-beam gamma-ray spectroscopy. He has also been involved in medical radioisotope production, teaching, as well as radiation detector and cyclotron repair and maintenance work.

Dr. Carlos Paradela (M) is a nuclear physicist with 15 years of experience in fission and neutron-induced reactions and more than 100 publications in peer-reviewed journals. He is involved in the measurement and analysis of capture and total cross sections at GELINA facility and non-destructive isotopic composition determination by using neutron resonance transmission analysis (NRTA). He also provides support and training to external users of the facility.

Dr. ir. Arjan Plompen (M) is acting head of the JRC.G.2 unit. He coordinated the activities of Domain C of the CHANDA project and work packages for the ANDES, EUROTRANS, EFNUDAT and CANDIDE EC projects. He is the chairman of the coordination group of the JEFF project. and chairman of WPEC in 2018 and 2019 (both OECD-NEA). He was member for JRC of the INDC (2004-2016, IAEA) and was scientific responsible for coordinating the programs on inelastic scattering and activation cross sections at JRC.

Dr. Peter Schillebeeckx (M) is project leader of the nuclear data activities of the JRC.G.2. His scientific interests include capture and total cross section measurements and the use of neutron resonance analysis for non-intrusive elemental composition determinations. He and his team have actively explored the limits of accuracy in resonance range and have ample experience in resonance range nuclear data evaluation.

Dr. Stephan Oberstedt (M) is a nuclear physicist with 25 years of experience and 200 publications in peer-reviewed journals. He leads the ANDANTE work packages FISSION and STANDARDS. He is responsible for the measurements of nuclear fission cross-section data, fission-fragment yields, and prompt fission neutron and gamma-ray characteristics. He is the JRC representative for neutron metrology at the BIPM CCRI(III) as well as member of the collaboration on neutron metrology between NPL, IRSN, PTB and JRC.

M.Sc. Goedele Sibbens (F) is responsible for the Target Preparation group at JRC.G.2, which has dedicated laboratories for the production and characterization of actinide and stable targets for nuclear measurements. Recent achievements include the production and characterization of U-233, U-235, U-238, Pu-239, Pu-240, Pu-242, Am-241 thin deposits and Li-6, Li-7, B-10 and tristearin thin layers for nuclear measurements of the EC projects ANDES, ERINDA, EUFRAT, METROFISSION and CHANDA. She participates in WP3 for production and characterization of nuclear targets and the coordination thereof.

Publications

- Nyman et al., "Measurement of the 477.6-keV γ-ray production cross section following inelastic neutron scattering by ^{7}Li ", Phys. Rev. C 93 (2016) 024610
- Kim et al., "Neutron capture cross section measurements for ^{238}U in the resonance region at GELINA", Eur. Phys. J. A 52 (2016) 170
- Sirakov et al., "Evaluation of cross sections for neutron interactions
- with 238U in the energy region between 5 keV and 150 keV ", Eur. Phys. J. A 53 (2017) 199
- G. Sibbens et al., " Nuclear targets produced within the project of solving CHAllenges in Nuclear Data ", EPJ Web of Conferences 146 (2017) 04062
- Gatera et al., "Prompt fission gamma-ray spectral characteristics from 239Pu(nth,f)", Phys. Rev. C95, 064609 (2017)
- Kaj Jansson et al., "The impact of neutron emission on correlated fission data from the 2E-2v method", Eur. Phys. J. A 54 (2018) 114

Significant infrastructures

The main contribution will be provided by the JRC.G.2 Unit - Standards for Nuclear Safety, Security and Safeguards (SN3S). The JRC.G.2 Unit hosts two key European laboratories for neutron-induced nuclear reaction measurements and an important facility for the production and characterization of nuclear and radioactive targets. These laboratories are operated and supported as a direct action of the EURATOM program. The GELINA facility is a white pulsed neutron source time-of-flight facility for neutrons with energies from 1 meV to 20 MeV. It combines an excellent time resolution of less than 2 ns with flight paths ranging from 10 to 400 m an unsurpassed neutron energy resolution is obtained. The MONNET facility is a 3.5MV Tandem Generator. At this facility quasi mono-energetic beams of neutrons are produced in the energy range from 10 keV to 24 MeV using binary reactions of protons and deuterons with lithium, deuterium or tritium targets. JRC Geel has dedicated equipment and expertise in the domain of measurements of neutron-induced reactions that cover the total, fission, capture and inelastic scattering processes of interest to this proposal.

Previous projects or activities

The JRC.G.2 Unit is an active participant to European projects with a nuclear data component (ANDES, ERINDA, EUFRAT, CANDIDE, NUDAME, EFNUDAT, EUROTRANS, CHANDA) and has ample experience with coordination of projects, work packages and tasks in these projects. JRC Geel actively collaborates in nuclear data projects operated by the OECD Nuclear Energy Agency and the IAEA Nuclear Data Section and has bilateral collaboration agreements with institutes in Europe, DOE, JAEA and AECL.

No third parties involved.

14. JSI

The Jožef Stefan Institute is the leading Slovenian scientific research institute, covering a broad spectrum of basic and applied research in the fields of natural sciences and technology. The staff of more than 960 specializes in research in physics, chemistry and biochemistry, electronics and information science, nuclear technology, energy utilization and environmental science. The subjects concern production and control technologies, communication and computer technologies, knowledge technologies, biotechnologies, new materials, environmental technologies, nanotechnologies, and nuclear engineering.
The mission of the Jožef Stefan Institute is the accumulation - and dissemination - of knowledge at the frontiers of natural science and technology to the benefit of society at large through the pursuit of education, learning, research, and development of high technology at the highest international levels of excellence.
The main part of the institute is located in Ljubljana. The institute operates a TRIGA research reactor, which is located about three kilometres outside the town. The main research areas of the Reactor Physics Department are theoretical, experimental and applied reactor physics, plasma physics, nuclear fragmentation, neutron dosimetry, neutron radiography, the physics of semiconducting devices and oncology. The department provides services to the Krško Nuclear Power Plant such as nuclear core design verification, physics start-up tests, etc. The staff of the Department has expertise in neutron transport calculations using deterministic and Monte Carlo methods, benchmarking, nuclear data evaluation and processing for applications, sensitivity and uncertainty calculations, applied to criticality as well as shielding problems and fusion (JET, ITER) applications.

JSI has long term expertise in nuclear data (ND) evaluation, processing, use and validation for various nuclear applications and will participate in ND validation and benchmarking, cross section sensitivity/uncertainty (S/U) analysis and ND covariance matrix evaluation and validation.

Prof. Dr. Ivan Aleksander Kodeli is a senior research associate at the Jožef Stefan Institute, Reactor Physics Department, Ljubljana, and visiting professor at the University of Maribor, Slovenia (since 2009). He obtained the Ph.D. degree and University habilitation (HDR) at the University Paris XI, France. He started his professional career at the JSI. He worked later as IAEA representative at the OECD/NEA Data bank (for two and seven years), and at CEA Saclay for seven years.
Scientific expertise: Neutron/gamma transport calculations using deterministic and Monte Carlo methods, nuclear data sensitivity and uncertainty calculations (fission, fusion reactors, ADS, some medical and industrial applications), nuclear data evaluation, processing and benchmarking, benchmark experiment preparation and analysis (fusion shielding, criticality), cross section covariance matrices. He was responsible for the SINBAD project at NEA DB.

Bor Kos is PhD student working at JSI on the Monte Carlo acceleration, using ADVANTG code, cross section sensitivity and uncertainty code development and use, benchmark analysis and nuclear data validation.

Aljaž Čufer is post-doc working on advanced Monte Carlo calculations for fusion applications linked to JET, ITER and DEMO.

Igor Lengar is researcher at JSI specialised in neutronics analysis for fusion applications.

Publications

- Kodeli, L. Plevnik, Nuclear data adjustment exercise combining information from shielding, critical and kinetics benchmark experiments ASPIS-Iron 88, Popsy and SNEAK-7A/7B, Progress in Nuclear Energy 106 (2018) 215 - 230
- Kodeli, Beta-Effective Sensitivity and Uncertainty Analysis of MYRRHA Reactor for Possible Use in Nuclear Data Validation and Improvement, Annals of Nuclear Energy 113 (2018) 425 - 435.
- Kodeli, S. Slavic, SUSD3D Computer Code as Part of the XSUN-2017 Windows Interface Environment for Deterministic Radiation Transport and Cross Section Sensitivity-Uncertainty Analysis, Science and Technology of Nuclear Installations Volume 2017, Article ID 1264736, (2017) 16 pages https://doi.org/10.1155/2017/1264736

- Kodeli, K. Kondo, R.L. Perel, U. Fischer, Cross-Section Sensitivity and Uncertainty Analysis of the FNG Copper Benchmark Experiment, Fusion Engineering and Design, 109-111 (2016) 1222-1226.
- Kodeli, A. Milocco, P. Ortego, E. Sartori, 20 Years of SINBAD (Shielding Integral Benchmark Archive and Database), Progress in Nuclear Science and Technology, Volume 4 (2014) pp. 308-311.
- Kodeli, Sensitivity and Uncertainty in the Effective Delayed Neutron Fraction (beta-eff), Nuclear Instruments and Methods in Physics Research A 715(2013)70-78

JSI participated in a large number of EU projects, such as:

- CHANDA (Solving CHAllenges in Nuclear DAta for the Safety of European Nuclear Facilities);
- ANDES (Accurate Nuclear Data for nuclear Energy Sustainability) project of EC (FP7-Fission-2009, SP5-EURATOM);
- EU fusion programme (ITER) within EFDA, Fusion for Energy (F4E), EUROFUSION (EC fusion benchmark activities performed at the ENEA Frascati FNG facility with the pre- and post-analysis, etc.);
- Joint European Torus (JET) project (NEXP Streaming Benchmark Experiment);
- Our research groups have been taking part in OECD/NEA working group activities (WPEC, EGRTS, UAM, SINBAD, IRPhE, ICSBEP) and in many IAEA CR, TC, training and consultation projects. JSI co-ordinates WPEC WG47 on “Use of Shielding Integral Benchmark Archive and Database for Nuclear Data Validation” (2018-2021)

Significant infrastructures

The institute operates a TRIGA research reactor and the stuff has long term experience in reactor measurements (reactivity, kinetics, neutron & gamma flux using activation foils and spectrometers). JSI has developed a complete cross section sensitivity and uncertainty computational tool and has competences in the nuclear data evaluation & use, and in the evaluation & use of the critical, physics and shielding benchmarks for the SINBAD, IRPhE and ICSBEP databases.

No third parties involved.

15. JYU

The University of Jyväskylä (JYU) with its about 15 000 students and 2500 employees ranks among the five largest universities in Finland. The Accelerator Laboratory (JYFL_ACCLAB) is operated as a part of the Department of Physics (JYFL), the second largest department of the University (800 students, 150 employees). The Department of Physics has mechanical and electrical workshops that in addition to the accelerator laboratory serve also the rest of Department of Physics and faculty-based Nanoscience Center. The Accelerator Laboratory is acknowledged as a national expertise center of accelerators and ionizing radiation.

JYFL-ACCLAB runs two cyclotrons, the K = 130 MeV heavy ion cyclotron and a high intensity K = 30 MeV proton/deuteron cyclotron MCC30/15. The high intensity cyclotron is located next to the Ion Guide Isotope Separator On-Line (IGISOL) facility. The mass separator facility can be served by both cyclotrons.

IGISOL employs a chemically insensitive ion guide technique, capable of forming ions of any element, including the refractory ones. The IGISOL research group, consisting of about 15 researchers, graduate and undergraduate students, concentrates mainly on studies on exotic nuclei far from stability, their ground state properties and decay spectroscopy.

Particle induced fission is used to produce neutron rich isotopes for atomic mass measurements and decay studies; in addition, the fission process itself has been the subject of research. An integral part of the facility is a high mass resolving power Penning trap, called JYFLTRAP, primarily intended for beam purification and atomic mass measurements, that can in addition be used to unambiguously identify the fission products by their mass. This allows determining the isotopic fission yield distributions for all elements. A recent development has been employing the PI-ICR (position imaging ion cyclotron resonance) technique to enhance the mass resolving capabilities for precision mass measurements. The use of the PI-ICR method allows in many cases the identification of the isomeric states on the basis of their mass. The development work to apply the technique to the measurement of isomeric ratios is in progress. In addition, a MR-TOF (multireflection time of flight) device has been build and expected to be installed and commissioned by 2020. The mass resolving of the MR-TOF device is sufficient to be applied in the fission yield measurements. The detailed studies for this adaptation will be started as soon as MR-TOF device will be installed.

In addition, a neutron converter target which makes it possible to induce fission with a simulated fast fission neutron field has been designed and build within the EU funded project CHANDA. Neutrons are typically used to study neutron induced fission reactions, while proton induced fission provides higher yields for neutron rich isotope production for research.

The IGISOL facility is an internationally acknowledged user laboratory, providing annually more than 1000 hours beam time for external users' experiments, selected by an independent Program Advisory Committee on the basis of the scientific quality of submitted proposals. The proposed activities JYU will participate in this program aim to improve the quality of the IGISOL facility to even better to support experiments of external users. In particular, these improvements will increase the capabilities to provide isotopically – even isomerically in some cases – purified radioactive short-lived isotopes for research, as well as determine fission yield distributions. These improvements are essential to provide even more accurate nuclear data in the near future.

The gas cell technique is originally developed in JYU. JYU Accelerator Laboratory has long experience in determining fission yield distributions. The novel technique employing the Penning trap, also developed in JYU, allows fast determination of the isotopic yield distributions. The Penning trap also allows production of ultra-pure radioactive sources of rare neutron rich nuclei for research.

Dr. Heikki Penttilä (M), Docent, University researcher. Ph.D. 1992 University of Jyväskylä. 30 years of experience on mass spectrometry, nuclear spectroscopy and fission research. Post-doctoral appointee in Argonne National Laboratory 1992-94, Senior Assistant University of Jyväskylä 1994-99 (Department of Environmental Sciences) and 1999-2002 (Department of Physics), Fellow of Finnish Academy 2002-2007, Head of Research University of Jyväskylä 2007-2009, University researcher 2009-.

Prof. Ari Jokinen (M), Professor, Ph.D. 1994 University of Jyväskylä. 25 years of experience on nuclear spectroscopy and ion beam manipulation. CERN Fellow 1994-1996, Senior researcher, University of

Jyväskylä 1996-1999, Fellow of Finnish Academy 1999-2004, Senior researcher University of Jyväskylä 2004-2006, Lecturer 2006-2011, Professor 1.8.2011-.

Prof. Iain D. Moore (M), Professor. Ph.D. in Nuclear Structure Physics, 2001, University of Manchester, UK. Expert in laser-based techniques for nuclear physics, ion beam production and manipulation and mass spectrometry of exotic nuclei. Postdoctoral Research Scholar, Argonne National Laboratory 2001-03, Researcher, University of Jyväskylä 2004-06, Senior Researcher, University of Jyväskylä 2006-2012, University Lecturer, University of Jyväskylä 2012-2016, Professor 2016 -.

Dr. Anu Kankainen (F), Fellow of Finnish Academy, PhD 2006 University of Jyväskylä in 2006. Expert in nuclear astrophysics, atomic mass measurements and decay spectroscopy. PI of "MAIDEN" project (ERC Consolidator Grant) 2018-23. Postdoctoral Researcher, University of Jyväskylä 2006-12, University of Edinburgh 2013-14. Fellow of Finnish Academy 2014-

Dr. Tommi Eronen (M), Fellow of Finnish Academy, Ph.D. 2008 University of Jyväskylä. Expert in ion trapping and manipulation techniques and atomic mass measurements of short-lived nuclei, more than 10 years of experience in the field. Currently PI of a research program devoted to beta decay Q-value measurements of transitions that potentially have an ultralow Q-value. Postdoctoral researcher University of Jyväskylä 2009-2011, Alexander von Humboldt Fellow and postdoc at Max Planck Institute for nuclear physics 2011-2014, Senior researcher University of Jyväskylä 2014-2015, Assistant Research Scientist at Texas A&M University 2015-2016, Fellow of Finnish Academy 2016-(2021).

Dr. Sami Rinta-Antila (M), Laboratory engineer. PhD 2006 University of Jyväskylä. 15 years of nuclear spectroscopy experience. Research Associate in University of Liverpool 2007-2009. University of Jyväskylä post-doctoral researcher 2009-2018, Laboratory Engineer 2018.

Publications

- D. Gorelov, et al., Developments for neutron-induced fission at IGISOL-4. Nuclear Instruments and Methods B 376: 46 -51 (2016), DOI: 10.1016/j.nimb.2016.02.049
- Mattera, et al., A neutron source for IGISOL-JYFLTRAP: Design and characterisation. The European Physical Journal A, 53 (8), 173 (2017). doi:10.1140/epja/i2017-12362-x
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- Algora, A., et al., Total absorption studies of high priority decays for reactor applications: 86Br and 91Rb. In ND 2016: International Conference on Nuclear Data for Science and Technology (pp. 10001). EDP Sciences (2017). doi:10.1051/epjconf/201714610001

No third parties involved.

16. KIT

The Karlsruhe Institute of Technology is one of the biggest sciences and engineering research institutions in Europe and funded jointly by the Federal Republic of Germany and the State of Baden-Wuerttemberg. KIT was established on 01/10/2009 from a merger of Universität Karlsruhe (founded in 1825), one of Germany's leading research universities, and Forschungszentrum Karlsruhe GmbH (founded in 1956), one of the largest national research centres in the Helmholtz Association. Higher education, research, and innovation are the three pillars of KIT's activities. Its research and development program is embedded in the superordinate program structure of the Hermann von Helmholtz Association of National Research Centres.

Ron Dagan (M) is Associate Professor at KIT: Karlsruhe Institute of Technology. He received his habilitation degree in Reactor Physics at the year 2009 at IKE Stuttgart. He has been working in the last decades on diverse projects concerning Reactor and nuclear data applications. He participated in the European projects on solutions for nuclear reactors' waste in form of transmutation and incineration. In the last years he has been working on storage optimisation for dedicated disposal. The work concerns the validation of the accurate nuclide vectors to be disposed based on validation of experimental results using updated nuclear data and appropriate nuclear models.

Publications

- Michel Herm, Ron Dagan, Ernesto González-Robles, Nikolaus Müller, Volker Metz
- „Comparison of calculated and measured radionuclide inventory of a Zircaloy-4 cladding tube plenum section", MRS Advances (Material Research society), DOI:10.1557/adv.2018.274, 2018.
- Dagan R., Becker M., Ivanov A." Introduction of a Resonant Up-Scattering Treatment for Multi-group Cross Section Generation", International Conference on Mathematics, Computational Methods & Reactor Physics, (M&C 2017).
- R. Dagan, M. Herm, V. Metz, Maarten Becker, "Determination of minor actinides in irradiated fuel rod components" "Annual Meeting of Nuclear Technologies", Berlin May 2017
- R. Dagan, P. Schillebeeckx, B. Becker, S. Kopecky, F. Gunsing, C. Lampoudis, Y. Danon, "Impact of the Energy Dependent DDXS on Determination of Resonance Parameters", Nuclear Data Sheets 118 (2014) 179–182.

No third parties involved.

17. NPI

The Nuclear Physics Institute of the Czech Academy of Sciences (NPI of the CAS) (http://www.ujf.cas.cz/) is a public research organization with the primary goal to independently conduct research in the scientific disciplines of nuclear physics and related scientific disciplines, and the use of the nuclear physics methods and procedures in interdisciplinary fields of science and research, especially in biology, environmental science, medicine, radio pharmacy, and material sciences. Moreover, NPI contributes to the utilization of research results, training of students, and provides access to large research infrastructures. NPI of the CAS had 314 employees in 2017.

The activities of NPI are gathered around four pillars: theoretical research, multidisciplinary oriented research, operation of large research infrastructures and research facilities and education and training of students. International cooperation is inherent to all of these activities.

On its cyclotrons, NPI conducts a long-term research program with intermediate energy neutrons. The neutrons in the energy range 15-35 MeV are produced using the accelerated proton or deuteron beams on Lithium and Beryllium converters. The protons/deuterons are accelerated using the isochronous U120M and TR24 cyclotrons in the energy range 20-35 MeV, 10muA (U120M) and 18-24 MeV, 150 muA (TR24). The neutron converters are adapted for the maximum intensity of the neutron flux (distance, current). Depending on the choice of the neutron converter, the neutron beams with different spectra can be produced.

Neutron beams with quasi-monoenergetic spectra from the thin Li converter are used mainly for the measurement of the neutron induced cross-sections (reactions (n,xn), (n,charged particle), (n,gamma)). The available detection techniques vary from the neutron activation analysis to direct detection of charged particles using telescopes and HPGe detectors on the collimated neutron beam. The maximum intensity of the neutron field is 109 n/cm^2/s in the monoenergetic peak. Continuous spectra neutron beams from the reaction of protons or deuterons on the thick Be converter are used for the testing of radiation hardness of materials for fusion reactors (DPA measurements), electronics radiation hardness (SEE), development of neutron monitors, irradiation of subcritical assemblies, delayed neutrons measurement, etc. The maximum intensity of the neutron field is 1011 n/cm2/s integrated over the whole spectrum energy range.

A new neutron converter based on the p+Be reaction is under construction (in operation by the end of 2018). The continuous neutron spectrum with the maximum energy of 24 MeV and 1012 n/cm2/s make this neutron generator one of the most powerful neutron sources worldwide in this energy range, and an ideal tool for applications where high neutron integrals are necessary.

Spectral fluxes are determined by the MCNPX simulation, continuous experimental verification is performed using the proton-recoil-telescope method, Time-Of-Flight measurements and the dosimetry foil technique.

Mgr. Mitja Majerle (M), PhD. (H – index 7), is a senior researcher with scientific experience in cross-section extraction procedures for reactions with neutrons (NPI), measurements of neutron spectra from p+Li and p+Be neutron generators at NPI, thermal calculations of the static and rotating targets for SPIRAL2/NFS (NPI), adapting the Rigorous Two Step method (R2S) to calculate residual dose rates based on the superimposed mesh tally (KIT), modelling neutron fluxes for KIT design of the spallation target ESS, Modelling neutron fluxes from the reactions d+Be and d+C for SPIRAL2/NFS neutron facility (KIT), usage of Monte Carlo simulation codes MCNP(X), FLUKA in gamma-spectrometry and spallation experiments (JINR Dubna, TSL Uppsala), measurement of neutron fluxes using neutron activation analysis (JINR Dubna), measurement of the tissue equivalent dose rates with linear accelerator used for cancer treatment (UKC Ljubljana). Mitja Majerle graduated at the Faculty of Mathematics and Physics, Ljubljana, with diploma work Calibration of the Linear Accelerator Philips SL-75/5 for the Needs of the Three-dimensional Planning in the Radiotherapy. He has a PhD. from the Faculty of Nuclear Sciences and Physical Engineering, Prague, with thesis Monte Carlo methods in spallation experiments.

Ing. Jan Novák (M), PhD. (H – index 6) is a senior researcher with scientific experience in measurement and evaluation of differential cross sections in the reactions of charged particles in solid and gas targets using semiconductor detectors, experimental data processing and the development of codes for processing and analysis, analysis of reaction mechanisms at stripping, angular distribution calculations, measurement of spectra of neutron beams using proton recoil telescope, development of the code for neutron spectrum determination, handling scintillation detectors, pulse shape discrimination, measurement of neutron spectra of accelerator driven generators using time of flight method, development of software for detector digital signal Managing, development of software for determining the neutron spectrum from TOF data, scintillation detector efficiency calculation, digitization of multidimensional coincidence measurement. Jan Novák graduated from the Faculty of Nuclear Sciences and Physical Engineering in Prague with a Diploma work: Tunable Microwave Generators in the 1 GHz, and got his PhD. at the Nuclear Physics Institute of the CAS, with the thesis: Study of the ^{31}Si Nuclear Structure in the ^{30}Si(d,p)^{31}Si Reaction.

Mgr. Martin Ansorge (M) is a PhD. student with skills in fast neutron detection and energy calibration of NE-213 probe using TOF technique, sensitivity and uncertainty analysis of TOF technique, energy spectra unfolding with codes GRAVEL and MAXED from UMG package, supported by Monte Carlo code SCINFUL for simulating response matrix of detector, Monte Carlo simulations with MCNPX and Geant4 frameworks and neutron cross-section measurements. In 2017 he graduated from the Czech Technical University with a Master thesis on Neutron field energy spectrum measurement of accelerator driven generators by the Time of Flight Technique. He is working on his PhD. thesis on Development of methodology for studying of reactions (neutron, charged particle) at neutron energies up to 35 MeV.

Publications

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No third parties involved.

18. NPL

The National Physical Laboratory (NPL) is the UK's National Measurement Institute, and is a world-leading centre of excellence in developing and applying the most accurate measurement standards, science and technology available. It employs over 500 scientists, covering a wide range of disciplines in experimental and theoretical sciences.

The NPL Nuclear Metrology Group (NMG) operates a neutron facility where well-characterised neutron fields are produced in a large low-scatter experimental area. We have several radionuclide neutron sources, the output of which has been measured to high precision in the NPL manganese sulphate bath. These include a high output ($>10^7$ s^{-1}) ^{252}Cf source. A pneumatic transfer system is available to introduce and remove this source from the experimental area remotely.
Monoenergetic and thermal neutron fields are produced via a 3.5 MV Van de Graaff accelerator.
The NMG also maintains a suite of gamma spectrometers calibrated with standard solutions.
These facilities are described on the NPL web site (www.npl.co.uk) and are listed in various international databases (NEA, BIPM, NuPECC). They are used for calibrating instruments, research into improving measurement standards, and for measuring nuclear data.
NMG staff also have substantial experience in the Monte Carlo modelling of neutron and gamma behaviour, which can be used to calculate correction factors for geometric and scattering effects.

The NPL NMG will make integral (spectrum-averaged) benchmark measurements of the activity induced in metal foils by neutrons from our high output ^{252}Cf source. There is a need for such measurements because of known shortcomings in, for example, the data in the reactor dosimetry file IRDFF (see IAEA reports INDC(NDS)-0616 and INDC(NDS)-0639, and the High Priority Request List under Special Purpose Quantities). Of the reactions listed in the latter, 50-Sn-117 (n,inl) Sn-117m and 28-Ni-60 (n,p) appear the most promising in terms of combining urgency with practicality.
Foils will be exposed to 252Cf neutrons in the low-scatter area of the neutron facility, and the induced activity will be quantified by gamma spectrometry in calibrated high-resolution spectrometers.
It is envisaged that the NPL NMG will carry out this work without the involvement of subcontractors, third parties or international partners.

Dr. N.P. Hawkes (M) is a Principal Research Scientist working on neutron metrology research and on neutron measurement services. He is the secretary of the UK Nuclear Science Forum, which coordinates nuclear data work in the UK, and has decades of experience in experimental neutron physics. He worked on neutron diagnostics at the JET fusion experiment, and on research for the civil nuclear power programme at the Atomic Energy Research Establishment, Harwell.

Dr. P. Salvador-Castiñeira (F) is a Higher Research Scientist specialising in thermal neutron measurement services and in measurements of neutron-induced and spontaneous fission. She has published several papers in the latter field, including in Phys. Rev. C. She has worked at the Institute for Reference Materials and Measurements (JRC-EC, Belgium) and studied at the Technical University of Catalonia (Spain) and at Uppsala University, Sweden.

Dr. A. Boso (M) is a Higher Research Scientist working on novel neutron spectrometers and on neutron dosimetry around therapy accelerators. Prior to joining NPL he studied experimental nuclear structure physics at Università degli Studi di Padova, and has co-authored publications in Phys. Rev. Lett. And Phys. Rec. C.

Andrew Pearce (M) is a Senior Research Scientist holding an MSc (Dist) in Radiometrics (Instrumentation and Modelling) and a BSc (Hons) in Computational Physics. He has 20 years' experience in providing measurement standards of radioactivity by high resolution gamma spectrometry and coincidence counting, and 14 years' experience in measuring and evaluating nuclear decay data for international collaborative projects such as the DDEP. He is responsible for the technical oversight of the NPL high resolution gamma spectrometry service. From 2003 - 2005 he took part in the development of a mathematical model to improve the Système International de Référence for gamma-emitting radioactivity, in collaboration with BIPM.

Sean Collins (M) is a Research Scientist with 10 years' experience of providing calibrations of surface emission rate for wide area reference standards, and 6 years' experience of providing measurement standards of radioactivity by high resolution gamma spectrometry. He holds a Higher National Diploma in Clinical Science.

Publications

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No third parties involved.

19. NRG

NRG is an internationally operating nuclear service provider. The mission of NRG is to respond to the social need for high quality nuclear research and innovation, safe and reliable nuclear isotope production and services to organisations working with nuclear technology. As such, the company produces isotopes, conducts nuclear technological research, is a consultant on the safety and reliability of nuclear installations and provides services related to radiation protection. Research is performed for governments aimed at developing knowledge about nuclear technology. NRG is a world market leader in the production of medical isotopes. NRG operates the 45 MW High Flux Reactor (HFR) owned by the European Union. The company has around 500 world-class employees with high quality know-how and works for and with partners in healthcare, the energy market, industry, government and science. The company has offices and nuclear facilities located in the Netherlands, in Petten and Arnhem. A complete nuclear infrastructure is available. NRG operates as well as maintains several facilities, not only the HFR but also hot cell laboratories for non-destructive and destructive testing and characterization of irradiated fuel. The hot cell laboratories deploy a series of advanced techniques for characterization and testing of irradiated materials like gamma spectrometry, tomography, transmission electron microscope (TEM), LV-SEM ceramography, profilometry and gas puncturing. NRG has a large experience in numerical modelling and computational engineering in the nuclear field. To this purpose, a large computing cluster is available. Finally, NRG is actively participating to the European nuclear R&D, through memberships and participation in SNE-TP, NUGENIA, ESNII, and NC2I.

NRG will perform benchmark calculations as validation of the nuclear data. The benchmarks will be adapted to be able to generate sensitivity profiles, to provide as much information as possible to benefit nuclear data development. NRG is uniquely positioned to perform this task because of its large collection of benchmark cases.

Dr. Steven van der Marck (M) holds a PhD in theoretical physics. In 2000 he joined NRG, where he has worked in reactor physics and isotope production ever since. He is an expert in the use of Monte Carlo applications in these fields, as well as on the influence of nuclear data libraries on the outcome of simulations. As part of his work, Steven has compiled a large set of benchmark cases to test the quality of nuclear data libraries. In this collection there are more than 2500 criticality safety benchmark cases, more than 60 shielding benchmark cases, and more than 30 delayed neutron benchmark cases. Steven has used these benchmarks to document the quality of the nuclear data libraries ENDF/B (VII.0, VII.1, and VIII.0), JEFF (3.0, 3.1, and 3.3), JENDL (3.3, 4.0), and TENDL (2012, 2017). Steven is a member of the TENDL team, which produces the most extensive nuclear data library in the world. He is (co-) author of 50 peer reviewed articles and more than 30 conference contributions.

Bernard Erasmus (M) is a neutronics specialist with a Master's degree in nuclear reactor physics, who has been working in the field of neutronics since 2009. Previously he formed part of the reactor physics team at the South African Nuclear Energy Corporation (Necsa), and since 2016 he has been part of the reactor physics team at NRG in the Netherlands. During the past two years, Bernard has contributed to the application, testing and verification of nuclear data, with specific focus on uncertainty propagation using various methods such as Total Monte Carlo, covariance sampling methods as well as the sensitivities method. This has led to contributions in the CHANDA project and to the JEFF-3.3 nuclear data library.

Publications

- D.A. Brown et al., Nuclear Data sheets 148 (2018) 1–142, ENDF/B-VIII.0: The 8th Major Release of the Nuclear Reaction Data Library with CIELO-project Cross Sections, New Standards and Thermal Scattering Data
- B. Erasmus, JEF/DOC 1857 November 2017, Benchmarking Results of Uncertainty Propagation Methods on a set of integral experiments
- D. Rochman, A.J. Koning, J.Ch. Sublet, M. Fleming, E. Bauge, S. Hilaire, P. Romain, B. Morillon, H. Duarte, S. Goriely, S.C. van der Marck, H. Sjöstrand, S. Pomp, N. Dzysiuk, O. Cabellos, H. Ferroukhi, and A. Vassiliev, Proc. ND-2016 (11–16 September 2016, Bruges, Belgium), The TENDL library: hope, reality and future

- D. Rochman, W. Zwermann, S.C. van der Marck, A.J. Koning, H. Sjöstrand, P. Helgesson, B. Krzykacz-Hausmann, Nuclear Science and Engineering 177 (2014) 337–349, Efficient use of Monte Carlo: uncertainty propagation
- S.C. van der Marck, Nuclear Data Sheets 113 (2012), 2935–3006, Benchmarking ENDF/B-VII.1, JENDL-4.0 and JEFF-3.1.1 with MCNP6

NRG has participated in projects like:

- The European project CHANDA (http://www.chanda-nd.eu/)
- The TENDL project (https://tendl.web.psi.ch/tendl_2017/tendl2017.html)
- The JEFF project (https://www.oecd-nea.org/dbdata/jeff)

No third parties involved.

20. NTUA

The National Technical University (NTUA) is the oldest and most prestigious technological educational institution of Greece, and has unceasingly contributed to the country's scientific and technical development since its foundation in 1836, as well as in the enrichment and implementation of global education and knowledge.
The Nuclear Physics group of National Technical University of Athens (NTUA) involved in the CHANDA project, consists of two staff members, Prof. R. Vlastou-Zanni and Assoc. Prof. M. Kokkoris, as well as one post-doc and five PhD students. The group has experience in charged-particle and gamma ray spectroscopy, nuclear reactions, neutron induced reactions, detector physics, simulations and theoretical calculations, in collaboration with many Greek and European Nuclear Physics Institutes. The main research activity of the group is currently focused on neutron-induced reactions within the frame of the n_TOF collaboration at CERN and at NCSR "Demokritos" in Athens.

Prof. Rosa Vlastou has been with the National Technical University of Athens since 1980, where she is currently a Professor in the Department of Physics and Director of the Nuclear Physics Laboratory. She has been a visiting scientist in many European Laboratories and Universities and has participated in several European projects (ESSA-30, EUROGAM, EUROBALL, CHANDA) and currently at CERN (n-TOF). Her research activities are focused on Nuclear Structure, Nuclear Reactions and Applications of Nuclear Techniques in Materials Analysis and Environmental studies. She has supervised 12 PhD theses (and 3 more are in progress) and many MSc and Diploma theses. She has been a member of the Organizing Committees of 8 International and 4 Hellenic Nuclear Physics Conferences. Her record includes over 170 publications in scientific journals and over 250 papers in conference proceedings, more than 2000 citations and h factor 24. She was President of the Hellenic Nuclear Physics Society (2012-2016), Vice President (2002-2004) and Secretary (2004-2006, 2010-2012).

Publications

- ^{197}Au(n,2n) reaction cross section in the 15-21 MeV energy range. A.Kalamara, R.Vlastou, M.Kokkoris, N.G.Nicolis, N.Patronis, M.Serris, V.Michalopoulou, A.Stamatopoulos, A.Lagoyannis and S.Harissopoulos. Phys.Rev.C97(2018)034615.
- Measurement of the ^{234}U(n, f) cross-section with quasimonoenergetic beams in the keV and MeV range using a Micromegas detector assembly. A. Stamatopoulos, A. Kanellakopoulos, A. Kalamara, M. Diakaki, A. Tsinganis, M. Kokkoris,V. Michalopoulou, M. Axiotis, A. Lagoyiannis, and R. Vlastou. Eur. Phys. J. A (2018) 54: 7
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- Neutron-induced fission cross section of ^{234}U measured at the CERN n_TOF facility. D.Karadimos, R.Vlastou, M.Diakaki,…., C. Papadopoulos,…A.Tsinganis,… and the n_TOF collaboration. Phys.Rev.C89 (2014)044606
- Measurement of the ^{242}Pu(n,f) cross section at the CERN n TOF facility. A.Tsinganis, …, R.Vlastou… and the n_TOF collaboration. Nucl.Data Sheets 119 (2014)58

NTUA has participated previously in the projects:

- Spokesperson of the research project "Measurement of the ^{230}Th(n,f) reaction cross-section at EAR-1 and EAR-2 of the n_TOF facility" (2017-)
- Spokesperson of the research project "Measurement of the ^{240}Pu(n,f) reaction cross-section at EAR-2 of the n_TOF facility" (2015-)
- Spokesperson of the research project "Isomeric cross section of the 191Ir(n,2n) reaction at the NCSR "Demokritos" (2014-2018)
- Spokesperson of the research project "Cross section measurements of the 197Au(n,2n) reaction at the NCSR "Demokritos" (2014-2017)
- Participation in the CHANDA project (2013-2018).

Significant infrastructures

The Nuclear Physics Laboratory at the National Technical University of Athens employs a large number of detection and computation systems. Among those, the laboratory possesses HPGe detectors with the proper shielding, Si and Micromegas detectors, NaI and liquid scintillators, a variety of NIM modules, an XRF spectrometer, a low background alpha-spectrometer as well as computers for data analysis (e.g. ROOT), theoretical calculations (e.g. TALYS and EMPIRE) and Monte Carlo simulations (e.g. MCNP, GEANT4 and FLUKA). A close collaboration has been established with the Tandem 5.5 MV HV TN-11 Accelerator Laboratory at NCSR "Demokritos" and CERN in the framework of the n_TOF collaboration.

No third parties involved.

21. PSI

PSI is a multi-disciplinary research centre for natural sciences and technology. In national and international collaborations with universities, other research institutes and industry, we are active in solid state physics, materials sciences, elementary particle physics, life sciences, nuclear and non-nuclear energy research, and energy-related ecology.
Being a world-leading scientific institute, PSI is well-equipped with all nuclear physics and chemistry related instrumentations. As the most essential point, PSI operates the most powerful proton accelerator in Europe and, in addition the spallation neutron source SINQ, a facility, which is unique world-wide. From several material research programs performed with this facility, PSI owns now a repository of activated samples, which can serve as benchmarks for nuclear data on the one side, and might be used as a source for the preparation of exotic radioactive targets on the other side. Two Laboratories, both located in the department of Nuclear Energy and Safety (NES), are involved in the project.

Within the NES department, the Laboratory for Reactor Physics and Thermal-Hydraulics (LRT) is the principal research unit and national center of excellence in Switzerland in the domain of simulations of System behaviour of Nuclear Power Plants. Nuclear data are a key element of such simulations and the LRT is investing substantial efforts in the measurements, calculations, evaluations and use of nuclear data. The combination of theoretical approaches for cross section calculations with the applied aspect linked to the simulations of real Power Plants is making the LRT a unique place with a broad overview from fundamental physics to applied simulations. With the production of the TENDL library and the important support to the JEFF community, the LRT is an important and unique partner for nuclear data development and validation.

The working group Isotope and Target Chemistry under the leadership of Dr. Dorothea Schumann (f), Laboratory of Radiochemistry (LRC), is experienced in the radiochemical separation and determination of radionuclides in accelerator waste as well as the manufacturing of radioactive targets. The group contributed to the HINDAS project (High and Intermediate energy Nuclear Data for Accelerator driven Systems) with several determinations of excitation functions of long-lived radio nuclides produced by proton irradiation of natural lead, to ANDES with the determination of the radionuclide inventory of the MEGAPIE target and was/is involved in other international EC-funded projects (EURISOL, EUROTRANS, GETMAT, SEARCH). In the frame of CHANDA, the group was essentially contributing to the establishment of a network for target maker activities.

Dr. Dorothea Schuman is a researcher with a large expertise in the fields of radioanalytical studies of accelerator waste (beam dumps, concrete samples etc.) for licensing of nuclear waste disposal, nuclear data for transmutation of nuclear waste and the development of target preparation techniques.

Dr. Dimitri Rochman is a researcher with a large expertise in the fields of nuclear data evaluation for nuclear technologies, nuclear data uncertainty analysis and propagation, development of theoretical nuclear reaction codes (TALYS) and creator of various of the TENDL releases.

Publications

- How inelastic scattering stimulates nonlinear reactor core parameter behaviour, D. Rochman, A. Vasiliev, H. Ferroukhi, A. Dokhane and A. Koning, Annals of Nuclear Energy 112 (2018) 236.
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The Laboratory for Reactor Physics and Thermal-Hydraulics (LRT) is the principal research unit and national centre of excellence in Switzerland in the domain of simulations of System behaviour of Nuclear Power Plants. Nuclear data are a key element of such simulations and the LRT is investing substantial efforts in the measurements, calculations, evaluations and use of nuclear data. The combination of theoretical approaches for cross section calculations with the applied aspect linked to the simulations of real Power Plants is making the LRT a unique place with a broad overview from fundamental physics to applied simulations. With the production of the TENDL library and the important support to the JEFF community, the LRT is an important and unique partner for nuclear data development and validation. The colleague in charge, Dr. Dimitri Rochman (m) has a long-lasting expertise in the development of the TENDL library and related issues and was already involved in other related projects: CHANDA, JEFF, TENDL, CIELO and EUROfusion.

Subcontracting

PSI will subcontract some activities related to the design of the isotope separator. Some research groups had been tentatively contacted as candidate for that subcontracting because of their scientific and engineering experience in this type of systems.

No third parties involved.

22. PTB

The Physikalisch-Technische Bundesanstalt (PTB) is the German national institute for science and technology and the highest technical authority for metrology and certain sectors of safety engineering. It operates under the auspices of the Federal Minister of Economics and has 2000 employees.
Within division 6 'Ionizing Radiation', the department 6.4 'Neutron Radiation' operates two particle accelerators for producing charged particle, neutron and high-energy photon fields. One of the main tasks is the production of neutron reference fields (ISO) for the characterization and calibration of radiation detectors. Measurements of cross sections for neutron-induced reaction are carried out at the PTB accelerator facility and at external facilities.

Ralf Nolte is head of the working group 6.42 'Neutron Metrology' within department 6.4 'Neutron Radiation'. He holds a PhD degree in physics and more 25 years of experience in neutron metrology and nuclear data measurements. His scientific expertise is documented in about 100 publications in peer-reviewed journals. He was a member of the n_TOF collaboration at CERN until 2018.

Elisa Pirovano is staff member in working group 6.42. She has holds a PhD degree in physics and has four years of professional experience in nuclear data measurements. Her scientific expertise is documented in about seven publications in peer-reviewed journals. She is a member of the n_TOF collaboration at CERN.

Publications

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- W. Mannhart, D. Schmidt: Measurement of neutron activation cross sections in the energy range from 8 MeV to 15 MeV', PTB-Bericht PTB-N-53, Physikalisch-Technische Bundesanstalt Braunschweig January 2007, ISSN 0936-0492
- R. Nolte, M.S. Allie, F.D. Brooks, A. Buffler, V. Dangendorf, J.P. Meulders, H. Schuhmacher, F.D. Smit, M. Weierganz, Cross Sections for Neutron induced fission of 235U, 238U, 209Bi and natPb in the energy range from 33 MeV to 200 MeV measured relative to n p scattering, Nucl. Sci. Eng. 156 (2007) 197 210
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- E. Pirovano, R. Beyer, M. Dietz, A.R. Junghans, S.E. Müller, R. S.E. Müller, R. Nolte, M. Nyman, A.J.M. Plompen, M. Röder, T. Szücs, and M.P. Takacs, Cross section and neutron angular distribution measurements of neutron scattering on natural iron, submitted for publication in Phys. Rev. C.

Previous projects or activities

The PTB has offered transnational access (TA) to PIAF in the EU-funded EFNUDAT, ERINDA and CHANDA projects and contributed to the joint research actions (JRA) of EFNUDAT. On the national level, PTB participated in the TRAKULA project supported by the Federal Ministry for Education and Research (BMBF).

Significant infrastructures

The PTB ion accelerator facility (PIAF) consists of two low-energy ion accelerators and ancillary equipment. The TCC CV-28 variable-energy isochronous cyclotron provides beams of protons ($E < 19$ MeV, $I < 80\ \mu$A), deuterons ($E < 13.5$ MeV, $I < 80\ \mu$A) and alpha particles ($E < 28$ MeV, $I < 20\ \mu$A). Complementary, the same ion beams are available with energies up to 4 MeV (protons, deuterons) or 6 MeV (alpha particles) in the low energy region and with similar currents from a HVEE Tandetron accelerator. Experiments with almost mono-energetic neutrons in the energy range from 20 keV to 20 MeV are performed in the center of a very large experimental hall in open geometry. All ion beams are available in DC or ns-pulsed mode experiments with adjustable repetition rate for time-of-flight (TOF). A multi-detector TOF spectrometer is connected to the main beam line of the cyclotron. This instrument offers unique opportunities for the measurement of angular differential elastic and inelastic neutron scattering cross sections as well as neutron emission cross sections by detection of the scattered neutrons.

No third parties involved.

23. SCK-CEN

The Belgian Nuclear Research Centre, SCK-CEN, is a foundation of public utility. With laboratories in Mol and a registered office in Brussels, it is one of the largest research centres in Belgium. About 700 people work on the development of peaceful applications of ionising radiation. Our statutory mission prioritizes important societal issues: the safety of nuclear installations, solutions for radioactive waste disposal, radiation protection, sustainable development and education. In order to perform its research programme, to provide services to industry, the medical sector, government and third parties, and for training purposes, SCK•CEN operates several nuclear facilities.

Dr. Alexey Stankovskiy, male: Obtained his PhD. in nuclear physics in 1998 working at the Obninsk Institute of Nuclear Power Engineering, Russia. In 2002, he obtained a Doctoral degree in Nuclear Engineering at Tokyo Institute of Technology, Japan. From 2008, he became a member of SCK-CEN as a research scientist. His research is focused on the neutronics design of MYRRHA, including management and support of nuclear data, and the development of the ALEPH2 burn-up code.

Prof. Dr. Ir. Gert Van den Eynde, male: Head of the Expert Group Reactor Nuclear System Physics. He holds a Master degree in Engineering in Computer Science, a Master degree in Nuclear Engineering and a PhD. in Nuclear Engineering. He is involved in the MYRRHA project since 1999 and was task leader in the FP6 IP-EUROTRANS for the XT-ADS core design. His main fields of research are computational methods for neutron transport and reactor core modelling and analysis.

Publications

- Stankovskiy, H. Iwamoto, Y. Çelik and G. Van den Eynde, High-energy nuclear data uncertainties propagated to MYRRHA safety parameters, Annals of Nuclear Energy 120 (2018) 207-218
- H. Iwamoto, A.Stankovskiy, L.Fiorito and G. Van den Eynde, Monte Carlo uncertainty quantification of the effective delayed neutron fraction, Journal of Nuclear Science and Technology, Vol. 55 (5) (2018) 539 – 547
- M. Griseri, L. Fiorito, A. Stankovskiy, G. Van den Eynde, Nuclear data uncertainty propagation on a sodium fast reactor, Nuclear Engineering and Design 324 (2017) 122-130
- L.Fiorito, G. Žerovnik, A.Stankovskiy, G. Van den Eynde, P.-E. Labeau, Nuclear data uncertainty propagation to integral responses using SANDY, Annals of Nuclear Energy 101 (2017) 359-366
- Y. Çelik, A.Stankovskiy, J. Engelen, G. Van den Eynde, B. Şarer, S. Şahin, Radiation source terms of MYRRHA reactor components and equipment, International Journal of Hydrogen Energy, Vol. 41, Issue 17, 11 May 2016, pages 7213-7220

Previous projects or activities

Since 1998 SCK-CEN is collaborating with European laboratories and research centres in the development of MYRRHA. MYRRHA is a heavy liquid metal cooled nuclear system designed to operate as Accelerator Driven sub-critical System (ADS) or as a critical fast reactor. It consists of a proton accelerator proton coupled to a liquid Pb-Bi spallation target in a Pb-Bi cooled and sub-critical fast core. MYRRHA is a basis for the European experimental ADS. It will provide protons and neutrons for many R&D applications, including transmutation studies.

No third parties involved.

24. SOFIA

University of Sofia “St. Kl. Ohridski” is the oldest university in Bulgaria. It was founded in 1888 and ever since it has been the leading university in the country. The University is heading consistently the Bulgarian Universities Ranking in most of the fields taught here, including Physics. Undergraduate and Graduate Physics courses are thought at the Faculty of Physics which is a separate division since 1963, succeeding the Faculty of Physics and Mathematics which was established earlier in 1902. The Faculty consists of 12 Departments, one research centre, and a number of teaching and research laboratories. The Faculty's library is subscribed for the major Nuclear Physics journals, needed for the work to be carried out within the present project.

The Department of Nuclear Engineering, where the activities related to the present project will be performed, is responsible for training and education of students for the needs of the Bulgarian nuclear industry. Since 2017, the Department became a member of the Nuclear Structure and Decay Data (NSDD) network, coordinated and managed by the IAEA's Nuclear Data section and the Brookhaven National Laboratory's National Nuclear Data Centre. As part of NSDD network, our main responsibility is to collect and asses experimental nuclear data, and to compile the best values for inclusion in the Evaluated Nuclear Structure Data File (ENSDF).

Dr. Stefan Lalkovski will be the primary responsible for the ENSDF Nuclear Data evaluation activities that will be carried out at the University of Sofia within WP4 of the present project. He is an expert in nuclear physics, nuclear structure and nuclear data evaluation.

Publications

- Lalkovski, S., D., Stefanova, E.A., Kisyov, S., Korichi, A., Bazzacco, D., Bergström, M., Görgen, A., Herskind, B., Hübel, H., Jansen, A., Khoo, T.L., Kutsarova, T., Lopez-Martens, A., minkova, A., Podolyák, Z., Schönwasser, G., Yordanov, O., Structure of the neutron mid-shell nuclei ^{111,113}Ag, (2017) Physical Review C - Nuclear Physics, 96 (6), art. no. 044328
- Lalkovski, S., Ivanova, D., Stefanova, E.A., Korichi, A., Petkov, P., Kownacki, J., Kutsarova, T., Minkova, A., Bazzacco, D., Bergström, M., Görgen, A., Herskind, B., Hübel, H., Jansen, A., Kisyov, S., Khoo, T.L., Kondev, F.G., Lopez-Martens, A., Podolyák, Z., Schönwasser, G., Yordanov, O. Coexisting structures in 105Ru (2014) Physical Review C - Nuclear Physics, 89 (6), art. no. 064312
- Lalkovski, S., Bruce, A.M., Denis Bacelar, A.M., Górska, M., Pietri, S., Podolyák, Z., Bednarczyk, P., Caceres, L., Casarejos, E., Cullen, I.J., Doornenbal, P., Farrelly, G.F., Garnsworthy, A.B., Geissel, H., Gelletly, W., Gerl, J., Grębosz, J., Hinke, C., Ilie, G., Ivanova, D., Jaworski, G., Kisyov, S., Kojouharov, I., Kurz, N., Minkov, N., Myalski, S., Palacz, M., Petkov, P., Prokopowicz, W., Regan, P.H., Schaffner, H., Steer, S., Tashenov, S., Walker, P.M., Wollersheim, H.J. Sub-microsecond isomer in $_{45}^{117}$Rh$_{72}$ and the role of triaxiality in its electromagnetic decay rate (2013) Physical Review C - Nuclear Physics, 88 (2), art. no. 024302, .
- Lalkovski, S., Bruce, A.M., Jungclaus, A., Górska, M., Pfützner, M., Cáceres, L., Naqvi, F., Pietri, S., Podolyák, Zs., Simpson, G.S., Andgren, K., Bednarczyk, P., Beck, T., Benlliure, J., Benzoni, G., Casarejos, E., Cederwall, B., Crespi, F.C.L., Cuenca-García, J.J., Cullen, I.J., Denis Bacelar, A.M., Detistov, P., Doornenbal, P., Farrelly, G.F., Garnsworthy, A.B., Geissel, H., Gelletly, W., Gerl, J., Grebosz, J., Hadinia, B., Hellström, M., Hinke, C., Hoischen, R., Ilie, G., Jaworski, G., Jolie, J., Khaplanov, A., Kisyov, S., Kmiecik, M., Kojouharov, I., Kumar, R., Kurz, N., Maj, A., Mandal, S., Modamio, V., Montes, F., Myalski, S., Palacz, M., Prokopowicz, W., Reiter, P., Regan, P.H., Rudolph, D., Schaffner, H., Sohler, D., Steer, S.J., Tashenov, S., Walker, J., Walker, P.M., Weick, H., Werner-Malento, E., Wieland, O., Wollersheim, H.J., Zhekova, M.
- Core-coupled states and split proton-neutron quasiparticle multiplets in $^{122\text{-}126}$Ag, (2013) Physical Review C - Nuclear Physics, 87 (3), art. no. 034308.
- Lalkovski, S., Isacker, P.V. IBM-1 calculations towards the neutron-rich nucleus ^{106}Zr, (2009) Physical Review C - Nuclear Physics, 79 (4), art. no. 044307.

<u>The SOFIA institution has participated in the previous related activities</u>:

- Lalkovski, S., Kondev, F.G., Nuclear Data Sheets for A=112 (2015) Nuclear Data Sheets, 124, pp. 157-412.
- Kondev, F.G., Lalkovski, S. Nuclear Data Sheets for A = 207 (2011) Nuclear Data Sheets, 112 (3), pp. 707-853.
- Kondev, F.G., Lalkovski, S. Nuclear Data Sheets for A = 200 (2007) Nuclear Data Sheets, 108 (7), pp. 1471-1582.

The work will be carried out in office 220, situated on the second floor of, building A of the Faculty of Physics at the University of Sofia “St. Kl. Ohridski”, blvd “James Bourchier” 5. The working place is equipped with contemporary office equipment, including computers and printers. As staff at the University, SL has access to the Faculty and University libraries. The University is subscribed for the main nuclear physics journals, which is the main resource needed for the data evaluations to be carried out in the present project. Last, but not least, University of Sofia has a status of Nuclear Data Center and SL is member of the Nuclear Structure Decay Data network.

No third parties involved.

25. TUW

The TU Wien is the largest university in Austria for engineering sciences. It is a public university with about 28.000 students, funded by the Austrian Federal Government. It is organized in 8 faculties: Architecture, Civil Engineering, Technical Chemistry, Electrical Engineering and Information Technologies, Informatics, Mechanical Engineering, Mathematics, Physics. The TU Wien is involved in many international and national research projects focussed on different topics related to the expertise of each faculty. The TU Wien has experience in co-ordinating EC-projects.
The Atominstitut (Institute of Atomic and Subatomic Physics) is part of the Faculty of Physics of the TU Wien. Currently 25 university positions for scientific personnel, 29 for non-scientific personnel and about 50 doctoral and diploma students are working at the Atominstitut. The research and training possibilities are grouped around a 250 kW TRIGA research reactor and include x-ray and accelerator installations, quantum optic equipment and highly specialised chemistry and physics laboratories. The institute is participating in a doctorial college programme and has a permanently occupied foreign post at the Institute Laue-Langevin (ILL) in Grenoble. The broad spectrum of research fields represented at the Atominstitut provides a fertile environment for productive scientific collaboration. A strong 'bottom-up' structure has guaranteed a development towards innovative areas of research. In particular there is internationally recognised expertise in the field of Nuclear Physics both in theory and experiment. The research groups at the Atominstitut are well integrated in the international research. Especially, they have successfully participated in several EC and EURATOM contracts, in some of them serving as coordinator. Apart from participation in European and national projects members of the Atominstitut are actively involved in various activities of international organisations, e.g. in the International Nuclear Data Centres (NEA/OECD and IAEA).

Univ. Prof. Dr. Helmut Leeb (1952), Dean of Academic Affairs of the Faculty of Physics of the TU Wien and member of the Atominstitut (Institute of Atomic and Subatomic Physics), TU Wien; specialised in Theoretical Nuclear Physics. The scientific activities are focussed on scattering and reaction theory and its application to nuclear and neutron physics; more than 200 scientific articles on nuclear and neutron physics in international journals. More than 250 talks at universities, research institutes and conferences. Austrian delegate in the Nuclear Science Committee and the MBDAV of NEA/OECD. Leader of several research projects supported by Austrian funding agencies and participant in several EC-projects, in particular coordinator of the Network PANSI3 within EURONS, participant in 3 EFDA projects, 2 F4E grants, 2 EUROfusion grants and the EURATOM projects CHANDA, ANDES, IP_EUROTRANS and NTOF-ND-ADS. Based on his expertise in the development of uncertainty determinations in nuclear data, the role in the SANDA project will be in WP4.

Publications

- A modified general least square method for large scale nuclear data evaluation. G. Schnabel, H. Leeb, Nucl. Instr. Meth. A 841, 87 (2017).
- Differential Cross Sections and the Impact of Model Defects in Nuclear Data Evaluation. G. Schnabel, H. Leeb in Proc. of the 4th Int. Workshop on Nuclear Data Evaluation for Reactor Applications (WONDER 2015), EPJ Web of Conferences 111, 09001 (2016).
- Bayesian evaluation including covariance matrices of neutron-induced reaction cross sections of ^{181}Ta. H. Leeb, G. Schnabel, Th. Srdinko, V. Wildpaner, Nucl. Data Sheets 123, 153 (2015)
- Adequate treatment of correlated experimental data in nuclear data evaluations avoiding Peelle's pertinent puzzle. D. Neudecker, R. Frühwirth, T. Kawano, H. Leeb, Nucl. Data Sheets 118, 364 (2014).
- Impact of model defect and experimental uncertainties on evaluated output. D. Neudecker, R. Capote Noy, H. Leeb, Nucl. Inst. Meth. A 723, 163 (2013).

No third parties involved.

26. UB

The University of Bucharest (UB) is one of the leading institutions of higher education in Romania, and enjoys a considerable national and international prestige. Its various schools are well known for their activities in all important scientific and academic domains. There are over 50 institutes, departments and research centres functioning within UB, most of which work in collaboration with similar centres in other countries. The Faculty of Physics was founded in 1967 as an independent branch of the Faculty of Mathematics and Physics of the University of Bucharest, one century and a half old center of traditions in basic and technical science, teaching and research. The Department of Atomic and Nuclear Physics gives Master and PhD degree in: atomic and molecular interactions, astrophysics, nuclear interactions, elementary particles, and applied nuclear physics. The teaching staff is recognised internationally for their research activities, and collaborations with prestigious institutions in the field (NEA DB Paris, IAEA Vienna, JRC-Geel, PTB Braunschweig, LNHB Saclay, BNL, CERN, GSI, etc.). Within SANDA project, UB will provide theoretical support for obtaining accurate data relevant for the reactor safety.

Mihaela Sin is associate professor at the Department of Atomic and Nuclear Physics, Faculty of Physics since 1989, specialized in nuclear models and data evaluation. Along the years she gave courses and seminars on Nuclear Physics, Nuclear Reaction Models and Fission, Nuclear Data Evaluation, Applications of Nuclear Technologies for undergraduate and master students, being involved also in post-graduate programs of training in Nuclear Radiation and Isotope Applications. Together with her students and co-workers she was involved in several national research contracts, but most of her research activities in the nuclear data field have been carried on in collaboration with the Nuclear Data Section of IAEA and the National Nuclear Data Center, Brookhaven National Laboratory (USA). In the last years she has been participating directly or through support activities in five IAEA Coordinated Research Projects. As member of the developers" team of the nuclear reaction code EMPIRE is co-author of evaluations adopted by ENDF/B-VII, RIPL-3 and other specialized nuclear data libraries. Presently she is also involved in the FP7 project Accurate Nuclear Data for Nuclear Energy Sustainability contributing to new and accurate evaluations of neutron reaction data for U-238 and Am-241.

No third parties involved.

27. ULODZ

The University of Lodz (ULODZ) was established in 1945 and has long been one of the biggest and most popular universities in Poland. The 12 faculties, and a branch unit of the University provide programmes in 90 fields of study and 160 specializations. In addition, the University offers several doctoral programmes, more than 50 postgraduate study programmes (including an MBA programme), as well as studies in English and French. More than 32 000 students attend the University of Lodz.

The ULODZ nuclear physics group is member of n_TOF Collaboration, CERN from 2003 and has a huge expertise in the measurement of (n,f) and (n,chp) cross sections. The ULODZ has also a long standing expertise in the development of charged particle detectors and will develop a new ionisation chamber for fission measurements for the measurement of (n,g) cross sections of fissile isotopes.

Prof Hab Dr Jozef Andrzejewski is head of the Nuclear Physics and Radiological Protection Department of the University of Lodz. He is an active member of the n_TOF collaboration and has a large experience in experimental nuclear physics. He has participated in a large variety of experiments in Russia, Finland, German, Poland and at CERN and is an expert in neutron cross section measurements and ionisation chambers.

Publications

- P. Žugec,J. Andrzejewski, J. Perkowski:Measurement of the 12C(n, p)12B cross section at n_TOF at CERN by in-beam activation analysis, Physical Review C 90, 021601(R) (2014)
- C. Lederer, J. Andrzejewski, J. Perkowski,:Neutron capture reactions on Fe and Ni isotopes for the astrophysical s-process, Nuclear Data Sheets 120 (2014) 201-204
- C. Weiss, J.Andrzejewski, J. Perkowski: A new CVD diamond mosaic-detector for (n, α) cross-section measurements at the n_TOF experiment at CERN, Nucl. Instr. Meth. Phys. Research A 732 (2013) 190–194
- F. Gunsing, J. Andrzejewski,: Measurement of resolved resonances of ^{232}Th(n,gamma) at the n_TOF facility at CERN, Phys. Rev. C85 (2012) 064601
- L. Damone , J. Andrzejewski, J. Perkowski: 7Be(n;p)7Li Reaction and the Cosmological Lithium Problem:Measurement of the Cross Section in a Wide Energy Range at n_TOF at CERN, Physical Review Letters 121, 042701 (2018)

ULODZ has participated in the following related projects:

- Polish Ministry of Science and Higher Education under grant 295/N-CERN/2008/0,
- Narodowe Centrum Nauki (NCN) - Poland, under two the grants: Precise measurements of neutron cross-sections at n_TOF facility, CERN, UMO-2012/04/M/ST2/00700 and UMO-2016/22/M/ST2/00183.

No third parties involved.

28. UMAINZ

JGU is one of the leading research universities in Germany. With more than 150 institutes and clinics, a School of Music and an Academy of Arts, it represents the academic hub of Rhineland-Palatinate. Its main core research areas are particle and hadron physics, the materials sciences and translational medicine. In the natural sciences, JGU is at the top of the ranks in Germany for acquired third-party funding per professor (DFG Förderranking). In Physics, JGU regularly achieves outstanding positions in international research rankings, and the research network "Precision Physics, Fundamental Interactions and Structure of Matter (PRISMA)" was recognized as a national Cluster of Excellence in 2012 which is in the process of renewal for the next 4 years.
The LARISSA research group under the leadership of Prof. Klaus Wendt is well recognized for a variety of relevant contributions in quantum optics, laser physics and laser based studies on exotic nuclei. These concern on-line applications at ISOLDE/CERN and other major research facilities worldwide, radioisotope separation and enrichment for fundamental investigations, e.g. on the neutrino mass, and finally atomic physics studies and ultra-trace analysis on actinides and other radiotoxic nuclides. Research at LARISSA is supported by several externally funded projects, including national funds from the DPG, BMBF and the EC-funded projects ENSAR and MEDICIS-PROMED. Klaus Wendt is also a PI in the German Cluster of Excellence PRISMA.

Prof. Klaus Wendt is a world recognised expert in laser spectroscopy and mass spectrometry. He is Group leader of the Working Group LARISSA – LAser Resonance Ionization for Spectroscopy and Selective Applications and in 2007 has been appointment extraordinary professor (permanent) at JGU Mainz, institute for Physics.

Publications

- On the Hyperfine Structure and Isotope Shift of Radium, K. Wendt, S.A. Ahmad, W. Klempt, R. Neugart, E.W. Otten, H.H. Stroke, Z. Phys. D 4, 227-241 (1987)
- Rapid Trace Analysis of ^{89,90}Sr in Environmental Samples by Collinear Laser Resonance Ionization Mass Spectrometry, K. Wendt, G. K. Bhowmick, G. Herrmann, J. V. Kratz, J. Lantzsch, P. Müller, W. Nörtershäuser, E.-W. Otten, R. Schwalbach, U.-A. Seibert, N. Trautmann, and A. Waldek, Radiochim. Acta 79, 183-190 (1997)
- Resonance ionization spectroscopy of thorium isotopes - towards a laser spectroscopic identification of the low-lying 7.6 eV isomer of ^{229}Th,S. Raeder, V. Sonnenschein, T. Gottwald, I.D. Moore, M. Reponen, S. Rothe, N. Trautmann, K. Wendt, J. Phys. B 44, 16, 165005 (2011)
- Measurement of the first ionization potential of astatine by laser ionization spectroscopy, S. Rothe, A. N. Andreyev, S. Antalic, A. E. Barzakh, A. Borschevsky, L. Capponi, T. E. Cocolios, H. De Witte, J. Elseviers, D. V. Fedorov, V. N. Fedosseev, D. Fink, L. Ghys, M. Huyse, Yu. Kudryavtsev, D. Radulov, M. M. Rajabali, E. Rapisarda, P. Van den Bergh, P. Van Duppen, E. Eliav, S. Fritzsche, N. Imai, U. Kaldor, U. Köster, J. Lane, J. Lassen, V. Liberati, K. M. Lynch, B. A. Marsh, K. Nishio, Y. Wakabayashi, D. Pauwels, V. Pershina, L. Popescu, T. J. Procter, S. Raeder, R. E. Rossel, K. Sandhu, M. D. Seliverstov, A. M. Sjödin, M. Venhart, K. D. A. Wendt, Nature Communication 4, 1835- (2013)
- The electron capture in ^{163}Ho experiment – ECHo, L. Gastaldo, K. Blaum, K. Chrysalidis, T. Day Goodacre, A. Domula, M. Door, H. Dorrer, Ch.E. Düllmann, K. Eberhardt, S. Eliseev, C. Enss, A. Faessler, P. Filianin, A. Fleischmann, D. Fonnesu, L. Gamer , R. Haas, C. Hassel, D. Hengstler, J. Jochum, K. Johnston, U. Kebschull, S. Kempf, T. Kieck, U. Köster, S. Lahiri, M. Maiti, F. Mantegazzini, B. Marsh, P. Neroutsos, Yu.N. Novikov, P.C.O. Ranitzsch, S. Rothe, A. Rischka , A. Saenz, O. Sander, F. Schneider, S. Scholl, R.X. Schüssler, Ch. Schweiger, F. Simkovic, T. Stora , Z. Szücs, A. Türler, M. Veinhard, M. Weber, M. Wegner, K. Wendt, and K. Zuber, Eur. Phys. J. Special Topics 226, 1623–1694 (2017)

No third parties involved.

29. UMANCH

Nuclear physics at the University of Manchester (UMANCH) covers experiment and theory, with 9 academics (4 Prof, 2 Reader, 2 Senior Lecturer, 1 Lecturer), 1 EPSRC Energy Fellow, 5 PDRAs and at present 17 PhD students. We also host a Nuclear Fellow, who works on industrial liaison and outreach. Our current core support includes a technician who runs a large research laboratory and a mechanical workshop technician. We also host a cross-community design engineer. Our research interests are focused on fundamental aspects of nuclear physics ranging from hadrons to exotic nuclear systems. Part of our strategy is to harness this fundamental core capability to also address applied nuclear physics and nuclear skills training, working with the UoM Dalton Nuclear Institute. Nuclear physics at UoM is part of a rich research portfolio in one of the largest UK physics departments. We have strong links to UoM multi-disciplinary institutes (Dalton Nuclear Institute, Photon Science Institute, Wolfson Molecular Imaging Centre) and to the Cockcroft Institute for Accelerator Science and the Christie National Health Service Foundation Trust. UoM is one of seven educational organisations in the UK that work together as the Nuclear Technology Education Consortium (NTEC), to support the UK nuclear energy programme. NTEC provides Master's level courses for young professionals with relevant work experience and students with a science or engineering background, who are aiming to enter the nuclear industry. As well as the MSc option, industry participants can also take individual courses for continuing professional development, which gives UoM a strong connection with many industrial partners.

The measurements as envisaged in the previous EU grant (CHANDA) request for fission dynamics and nuclear data measurements at n_TOF have been performed. Specifically, during the period of the grant STEFF has been relocated from the research reactor at ILL to n_TOF as supported by CHANDA and two ^{235}U(n,f) measurements were performed. Recently, approval has been given by the INTC to run a ^{239}Pu(n,f) experiment late in 2018. Two PhD students will have attachments to n_TOF during this period. This grant will be used to support analysis of the gamma-yield from ^{239}Pu(n,f) data and future measurements with STEFF. These future experiments would involve measurements of fission yields for Pu and Cm isotopes at EAR2 at n_TOF as part of the long-term plan. Manchester will continue to develop a novel high-solid-angle double-gridded Bragg detector (DGBD) for use at n_TOF with a view of performing yield measurements at EAR2 with small samples.

Dr. Gavin Smith (M) is a researcher and expert in Pure and applied Nuclear Physics specializing in the gamma-ray spectroscopy of fission fragments and the development of detection systems for nuclear measurements. This includes the development of techniques and apparatus for g-factor and lifetime measurements in fission fragments. PI for the development of the STEFF spectrometer which has been used at the ILL and n_TOF, CERN for the measurement of fission-fragment distributions. He is also expert in the generation of spin of fission fragments. PI for the UK Nuclear Data Network (from April 2016), which brings together industrial and academic parties with an interest in nuclear data measurements. Co-I on Nuclear Physics consolidated grant. He is author or co-author of 120 publications in referred Nuclear Physics journals (see publication list). Proven track record of PhD supervision. Experience in numerical methods for digital pulse processing. Experienced programmer in C/C++. External examiner for PhD students from universities of Surrey, York, Paisley and Liverpool.

Dr. Tobias Wright (M) is an EPSRC post-doctoral research fellow in the applied nuclear physics group at the University of Manchester. His is an expert in nuclear data measurements, specifically towards UK requirements and has led proposals which have been awarded beam time at n_TOF, CERN and ILL, Grenoble. He has co-supervised one PhD student to completion and am currently co-supervising three further PhD students and is author or co-author of 47 refereed publications.

Publications

- P. Petkov, A. Dewald, O. Moller, I. Deloncle, R. Chapman, S. Pascu, D. Bucurescu, D. Tonev, M. Reese, C. Fransen, S. Y. Araddad, G. Asova, J. Copnell, N. Goutev, M. Hackstein, J. Jolie, J. C. Lisle, J. N. Mo, Th. Pissulla, W. Rother, A. G. Smith, C. Tenereiro, D. M. Thompson, and K. O. Zell. On the quadrupole collectivity in the yrast band of 168yb. Nucl.Phys., A957:240, 2017.

- W. Urban, M. Czerwinski, J. Kurpeta, T. Rzaca-Urban, J. Wisniewski, T. Materna, L. W. Iskra, A. G. Smith, I. Ahmad, A. Blanc, H. Faust, U. Koster, M. Jentschel, P. Mutti, T. Soldner, G. S. Simpson, J. A. Pinston, G. de France, C. A. Ur, V. V. Elomaa, T. Eronen, J. Hakala, A. Jokinen, A. Kankainen, I. D. Moore, J. Rissanen, A. Saastamoinen, J. Szerypo, C. Weber, and J. Aysto. Shape coexistence in the odd-odd nucleus 98y: The role of the g9=2 neutron extruder. Phys.Rev. C, 96:044333, 2017.
- J. N. Wilson, M. Lebois, L. Qi, P. Amador-Celdran, D. Bleuel, J. A. Briz, R. Carroll, W. Catford, H. De Witte, D. T. Doherty, R. Eloirdi, G. Georgiev, A. Gottardo, A. Goasdu, K. Hadynska-Klek, K. Hauschild, H. Hess, V. Ingeberg, T. Konstantinopoulos, J. Ljungvall, A. Lopez-Martens, G. Lorusso, R. Lozeva, R. Lutter, P. Marini, Matea, T. Materna, L. Mathieu, A. Oberstedt, S. Oberstedt, S. Panebianco, Zs. Podolyak, A. Porta, P. H. Regan, P. Reiter, K. Rezynkina, S. J. Rose, E. Sahin, M. Seidlitz, O. Serot, R. Shearman, B. Siebeck, S. Siem, A. G. Smith, G. M. Tveten, D. Verney, N. Warr, F. Zeiser, and M. Zielinska. Anomalies in the charge yields of fission fragments from the 238u(n, f) reaction. Phys.Rev.Lett., 118:222501, 2017.
- E. Murray, A. G. Smith, A. J. Pollitt, J. Matarranz, I. Tsekhanovich, T. Soldner, U. Koster, and D. C. Biswas. Measurement of gamma energy distributions and multiplicities using ste. Nucl.Data Sheets, 119:217, 2014.
- G. Smith, J. L. Durell, W. R. Phillips, W. Urban, P. Sarriguren, and I. Ahmad. Lifetime measurements and nuclear deformation in the a 100 region. Phys.Rev. C, 86:014321, 2012.

<u>The UMANCH has participated in the previous related activities</u>:

- Development of new apparatus and techniques for use in nuclear fission experiments. Design, building and commissioning of the binary SpecTrometer for study of Exotic Fission Fragments (STEFF) (CHANDA WP-8).
- STEFF experimental programs at ILL and the CERN n_TOF facility.
- Lead institution in STFC Grand Challenge Nuclear Data Network UKNDN.
- Member of the UK Nuclear Science Forum (UKNSF): participants from research institutes and industry with common interests in UK nuclear data needs and UKNDN funds the chairperson’s expenses allowing the UKNSF to continue.
- Delivery of training programs in nuclear applications: Neutron Resonance Analysis schools (2014 and 2017) in collaboration with JRC-Geel (CHANDA WP-13), training for MEDICIS fellows (Marie Curie network on radioisotope beams for medicine). NTEC module in Radiation and Radiological Protection for industry. GEANT4 training for research and industry.
- Neutron reaction cross section measurements: ^{238}U(n, gamma) at n_TOF, ^{13}C(n, gamma) at ILL/AMS analysis at VIENNA (UK specific waste application), ^{235}U(n,f) measurements with STEFF at n_TOF and ILL.
- Strong involvement at ISOLDE, CERN on the production of isotopically pure radioactive beams using laser resonance ionization.

No third parties involved.

30. UOI

The University of Ioannina (UoI) consists of 15 departments belonging in seven schools of different scientific disciplines. It is one of the largest Universities of Greece where more than 25 thousand students are enrolled in different levels of studies. The academic staff of UoI consists of about 500 Professors who are in charge of conducting high-level research along with their teaching duties. In the proposed research project the Nuclear Physics Laboratory is involved. The Nuclear Physics Laboratory (NPLAB) of the Department of Physics consists of three Professors (N. Patronis, X. Aslanoglou and N.G. Nicolis), two senior researchers (C. Papachristodoulou& K. Stamoulis) and two PhD students (supervisor N. Patronis). The research activity of Assist. Prof. N. Patronis group is focused on the experimental study of nuclear reactions with emphasis to the neutron induced reactions. In this respect there is experience on data analysis techniques as well as on theoretical modeling of nuclear reactions. Additionally, there is experience on the development of experimental setups, on neutron beam characterization studies, as well as on radiation transportation codes and Monte-Carlo simulation techniques.

Dr. N. Patronis (M). Since 2009, Assistant Professor N. Patronis is one of the faculty members of the NPL of the Physics Department of the University of Ioannina. Within this period, he taught more than eight undergraduate and postgraduate courses. At the moment he is the advisor of two PhD students and has supervised more than 15 bachelor thesis projects, as well as three MSs students. The research activity of N. Patronis is focused on nuclear reaction studies with neutron beams, radioactive ion beams, as well as studies of special interest for nuclear physics applications. The outcome of this research activity resulted in more than 115 publications in peer reviewed journals and more than 2000 citations (h-factor=26).

<u>Publications</u>

- N. Patronis, P.A. Assimakopoulos, D. Karamanis, S. Dababneh, M. Heil, F. Käppeler, R. Plag, P. E. Koehler, A. Mengoni and R. Gallino: Neutron capture studies on unstable 135Cs for nucleosynthesis and transmutation, Physical Review C 69 (2004) 025803.
- N. Patronis, C.T. Papadopoulos, S. Galanopoulos, M. Kokkoris, G. Perdikakis, R. Vlastou, A. Lagoyannis and S. Harissopoulos: Activation cross section and isomeric cross section ratio for the (n,2n) reaction on 191Ir, Physical Review C 75 (2007) 034607.
- N. Andreyev, J. Elseviers, M. Huyse, P. Van Duppen, S. Antalic, A. Barzakh, N. Bree, T. E. Cocolios, V. F. Comas, J. Diriken, D. Fedorov, V. Fedosseev, S. Franchoo, J. A. Heredia, O. Ivanov, U. Koster, B. A. Marsh, K. Nishio, R. D. Page, N. Patronis, M. Seliverstov, I. Tsekhanovich, P. Van den Bergh, J. Van De Walle, M. Venhart, S. Vermote, M. Veselsky, C. Wagemans, T. Ichikawa, A. Iwamoto, P. Moller, and A. J. Sierk: New Type of Asymmetric Fission in Proton-Rich Nuclei, Physical Review Letters 105 (2010) 252502.
- The n_TOF collaboration: Nuclear data activities at the n TOF facility at CERN, Eur. Phys. J. Plus, 131, 371 (2016)
- E. Georgali, Z. Eleme, N. Patronis, X. Aslanoglou, M. Axiotis, M. Diakaki, V. Foteinou, S. Harissopulos, A. Kalamara, M. Kokkoris, A. Lagoyannis, N. Nicolis, G. Provatas, A. Stamatopoulos, S. Stoulos, A. Tsinganis, E. Vagena, R. Vlastou, and S. M. Vogiatzi: 162Er(n,2n)161Er from reaction threshold up to 19 MeV, Phys. Rev. C 98, 14622, (2018)

<u>The infrastructure available at NPLAB</u> are:

- Specialized software installed in Linux machines for data analysis purposes (e.g. ROOT)
- Computer codes for nuclear reaction modeling (TALYS, ECIS, FRESCO, etc)
- Specialized software for detector simulation toolkits (e.g. Geant4, MCNP)
- Two low background HPGe detectors for γ-ray detection.
- More than ten Silicon surface barrier detectors and two PIPS detectors for charged particle detection
- Vacuum chamber equipped with oil-free pumping system (will be available on September 2018)
- Two MCA and DAQ systems for data-taking and data recording
- Event-by-event CAMAC DAQ system

No third parties involved.

31. UPC

Universitat Politècnica de Catalunya · BarcelonaTech* (UPC), is a public institution dedicated to higher education and research, specialised in the fields of architecture, engineering and technology. It is one of the biggest universities in Spain, with over 33.000 students, 30 departments and 216 research groups (academic year 2016-2017).

It is the UPC's mission to create knowledge, innovate, develop technology and make this technology available to society. With this mission in mind, it works to drive innovation and become the preferred technology partner of companies and institutions.

Under the current Horizon 2020 programme (2014-2020), to date the UPC has been granted 147 projects, coordinating 41 (8 of them are funded by the European Research Council). The UPC also has 28 projects (coordinating 4) funded by other European programmes. All of these projects have a total EU financial contribution of EUR 56 million. According to the H2020 country profile and featured projects for Spain, published in February 2018, by the European Commission (EC), the UPC is the top university and third institution in Spain in terms of number of projects and income from the EC for H2020 funded projects.

Since 2013 the UPC has endorsed the European Commission's 'European Charter and Code for Researchers', which seeks to ensure that researchers will continue their professional development, and enjoy research freedom and fulfilment from contractual and legal obligations. Moreover, in the context of the Human Resources Strategy for Researchers (HRS4R) which supports the Charter, the UPC has obtained (July 2017) an official acknowledgment for HR Excellence in Research and has been granted by the European Commission the certified Logo of the program: "HR Excellence in research".
The UPC staff has at their disposal the communication and dissemination services offered by its Media Office whose most outstanding services are the dissemination of the scientific activity and the development of communication campaigns.

The Experimental Nuclear Physics group (ENP) will be responsible of this research project. It is part of the Advanced Nuclear Technologies (ANT). ANT is a "Recognized Research Group" by the Regional Government under reference, 2017 SGR 1179. ENP works on nuclear data measurement of interest for nuclear technology and astrophysics. Experimental activities are all carried out at the world's leading laboratories (CERN, RIKEN, GSI, …) in the framework of international collaborations. The group focuses in three main topics, namely: cross section measurements of neutron induced nuclear reaction, delayed neutron emission measurements, and design of neutron detectors.
UPC is active member of the n_TOF, in charge of CERN's n_TOF, NUSTAR, a large collaboration aiming at exploiting the future FAIR international facility, and BRIKEN (UPC, IFIC, CIEMAT, Oak Ridge National Laboratory, JINRL-Russia y RIKEN-Japan), which was created in 2012 to build and exploit the world's largest neutron delayed detector at the Japanese RIKEN laboratory.

Along the last years, the ENP group has been experiencing a notable expansion in terms of requests to participate in new proposals to measure nuclear data.

Prof Francisco Calviño is head of the ENP group and author and co-author of more than 160 refereed publications. He is professor at the faculty of nuclear engineering since 1987 and a researcher in the fields of neutron cross sections and decay data. He has supervised over 11 PhD thesis and is member of various international collaborations such as n_TOF, NUSTAR, DESPEC and BRIKEN.

Publications

- Conceptual design of a hybrid neutron-gamma detector for study of ß-delayed neutrons at the RIB facility of RIKEN Tarifeño, A.; et al. Journal of instrumentation Vol. 12, num. 4, p. P04006-1-P04006-21. DOI: 10.1088/1748-0221/12/04/P04006
- First Measurement of Several β-Delayed Neutron Emitting Isotopes beyond N=126. Caballero-Folch, R.; et al. (65/11) Physical Review Letters Vol. 117, num. 1, p. 012501-1-012501-6. DOI: 10.1103/PhysRevLett.117.012501

- High-accuracy determination of the U-238/U-235 fission cross section ratio up to approximate to 1 GeV at n_TOF at CERN. Paradela, C; et al. (165/32) Phys Rev C Vol. 91, p. 024602-1-024602-11. DOI: 10.1103/PhysRevC.91.024602.
- Neutron Capture Cross Section of Unstable Ni-63: Implications for Stellar Nucleosynthesis. Lederer, C; et al. (105/16) Physical review letters Vol. 110, p. 22501-1-22501-5. DOI: 10.1103/PhysRevLett.110.022501.
- Neutron physics of the Re/Os clock. I. Measurement of the (n, gamma) cross sections of Os-186,Os-187,Os-188 at the CERN n_TOF facility. Mosconi, et al. (128/21) Physical review C Vol. 82, num. 1, p. 01580201-01580210. DOI: 10.1103/PhysRevC.82.015802. 2010-07-15.

<u>The UPC has participated in the previous related activities</u>:

- Cross section measurement at CERN's nTOF. UPC was leading the radiative capture cross section measurements of $^{203,\ 204,\ \text{and}\ 205}$Tl.
- Delayed neutron emission measurements. Experiment S410 (GSI) has been completely finished using BELEN (BEta deLayEd Neutron detector)-30. $^{208-211}$Hg, $^{211-215}$Tl, $^{214-217}$Pb, $^{217-220}$Po, and $^{223-226}$At were measured. Half-lifes and neutron emission probabilities were determined for some of them.
- Low mass region of the light fission. Accurate determination of beta-delayed neutron emission probabilities has been performed. We used BELEN-48 at the IGISOL-JYFL mass separator in combination with a Penning trap. New results of neutron emission probabilities for ^{91}Br, ^{86}As, ^{85}As, and ^{85}Ge nuclei have been obtained. UPC is also performing measurements at RIKEN-Japan. BELEN is used as a part of a much larger neutron detector.
- Neutron detector development. In the last years UPC has developed three versions of BELEN, each of them with increased number of He-3 counters, to be used in different experiments at GSI and JFYL. During the last 5 years UPC has lead the design and construction of the BRIKEN neutron counter, made of 166 He-3 tubes.

No third parties involved.

32. UPM

The Universidad Politécnica de Madrid (UPM) is the largest Spanish technological university specialized in all engineering fields and architecture. With two recognitions as Campus of International Excellence, its outstanding research activity together with its highly-qualified professionals trainings, make UPM a really competitive university at international level. More than 2.400 researchers carry out their activity at the UPM, grouped in more than 200 Research Groups, 20 Research Centers or Institutes and 55 Laboratories, all of them committed to transform the knowledge generated into innovation advances applied to the productive sector, contributing to solve the challenges of the European citizens.
The intense collaboration with governmental bodies and industry guarantees that research at UPM offers real solutions to real-world problems. The dynamism of R&D&I activity at the UPM, together with the transfer of knowledge to society, are among its lines of strategy.
These two commitments place UPM among the Spanish universities with the greatest research activity, both at national and international level, counting on a International Projects Office that helps and support researchers in the international research arena. UPM highly innovation driven commitment is showed by the application for around 40 patents/year thanks to its Technology Transfer Office and by the generation around 20 spinoff/year (70% survival rate) trained and mentored by the UPM Center for Innovation Support. Moreover, UPM is highly committed to communication and outreach with and specific unit devoted to it.
The UPM research group on Nuclear Data & Reactor Physics has more than 20 years of research and academic experience in the reactor physics and nuclear data activities. They have participated in European projects such as “Accurate Nuclear Data for Nuclear Energy Sustainability” and CHANDA "Solving Challenges in Nuclear Data for the Safety of European Nuclear Facilities". UPM is also participating in many OECD/ NEA activities such as NSC/WPEC, DB/JEFF and WPRS/UAM.

UPM will participate in WP4 “Nuclear data evaluation and uncertainties”, coordinating Task 4.3, participate in Task 4.4, coordinate Deliverable D.4.3 and in WP5 “Validation”, participating in Tasks 5.1 and 5.2.

Oscar Cabellos (M) M.Sc. in Power Engineering and PhD in Nuclear Engineering. Associate Professor at the Energy Engineering Department. His background includes cross-sections uncertainty developments and analysis and nuclear data evaluation. Over 40 papers in international scientific journals with reviewers, and more than 60 papers/presentations in proceedings of international conferences. More than 15 years of research and academic experience in the reactor physics and nuclear data. Nuclear Data Scientist (October 2014-October 2017) at the OECD/ NEA Data Bank, mainly involved in WPEC, EXFOR, JANIS and JEFF activities at the NEA. Currently chairman on Processing and Verification, Benchmarking and Validation working group within the JEFF project and UPM leader of several EU projects.

Nuria Garcia-Herranz (F) M.Sc. in Power Engineering and PhD in Nuclear Engineering. Associate Professor at the Energy Engineering Department. She has more than 15 years of academic and research experience in Reactor Physics. Her scientific work is mainly focused on neutronics calculations for criticality safety and reactor core applications (including light water reactors and Gen-IV fast reactors) as well as the development of methods for sensitivity and uncertainty analysis accompanying those simulations. She has been UPM leader of several EU projects and is member of the Expert Group on Uncertainty Analysis in Modeling of NEA. Over the past years, she has advised and graduated 4 PhD students and 25 MSc students.

<u>Publications</u>

- M.B.Chadwick, R.Capote, A.Trkov, M.W.Herman,D.A.Brown, G.M.Hale, A.C.Kahler, P.Talou, A.J.Plompen, P.Schillebeeckx, M.T.Pigni, L.Leal, Y.Danon, A.D.Carlson,P.Romain, B.Morillon, E.Bauge, F.-.Hambsch, S.Kopecky, G.Giorginis, T.Kawano, J.Lestone, D.Neudecker, M.Rising, M.Paris, G.P.A.Nobre, R.Arcilla, O.Cabellos, I.Hill, E.Dupont, A.J.Koning, D.CanoOtt, E.Mendoza, J.Balibrea, C.Paradela, I.Durán, J.Qian, Z.Ge, T.Liu, L.Hanlin, X.Ruan, W.Haichen, M.Sin, G.Noguere, D.Bernard, R.Jacqmin, O.Bouland, C.DeSaintJean, V.G.Pronyaev, A.V.Ignatyuk, K.Yokoyama, M.Ishikawa, T.Fukahori, N.Iwamoto,O.Iwamoto, S.Kunieda, C.R.Lubitz, M.Salvatores, G.Palmiotti, I.Kodeli, B.Kiedrowski, D.Roubtsov, I.Thompson, S.Quaglioni, H.I.Kim, Y.O.Lee, U.Fischer, S.Simakov, M.Dunn, K.Guber, J.I.Márquez-Damián, F.Cantargi, I.Sirakov, N.Otuka, A.Daskalakis, B.J.McDermott, S.C.van der Marck, “CIELO Collaboration Summary

Results: International Evaluations of Neutron Reactions on Uranium, Plutonium, Iron, Oxygen and Hydrogen". Nuclear Data Sheets, Volume 148, 189-213. (2018)
- Cabellos, O., Alvarez-Velarde, F., Angelone, M., Diez, C.J., Dyrda, J., Fiorito, L., Fischer, U., Fleming, M., Haeck, W., Hill, I., Ichou, R., Kim, D.H., Klix, A., Kodeli, I., Leconte, P., Michel-Sendis, F., Nunnenmann, E., Pecchia, M., Peneliau, Y., Plompen, A., Rochman, D., Romojaro, P., Stankovskiy, A., Sublet, J.C., Tamagno, P., Marck, S.V.D, "Benchmarking and validation activities within JEFF project". EPJ Web of Conferences, 146, art. no. 06004. (2017)
- O. Cabellos. "Processing and Validation of JEFF-3.1.2 Cross-section Library into Various Formats: ACE, PENDF, GENDF, MATXSR and BOXER". Nuclear Data Sheets, Volume 118, 456-458 (2014)
- N. García-Herranz, O. Cabellos, F. Álvarez-Velarde, J. Sanz, J. Juan. "Nuclear data requirements for the ADS conceptual design EFIT: Uncertainty and sensitivity study". Annals of Nuclear Energy, Volume 37, Issue 11, November 2010, Pages 1570-1579
- P. Romojaro, F. Álvarez-Velarde, I. Kodeli, A. Stankovskiy, C.J. Díez, O.Cabellos, N.García-Herranz, J. Heyse, P.Schillebeeckx, G.Van den Eynde, G.Žerovnik. "Nuclear data sensitivity and uncertainty analysis of effective neutron multiplication factor in various MYRRHA core configurations". Annals of Nuclear Energy, Volume 101, March 2017, Pages 330-338

UPM has participated in the projects:

- EUROTRANS: "European Research Programme for the Transmutation of High Level Nuclear Waste in an Accelerator Driven System", FP6.
- ANDES "Accurate Nuclear Data for nuclear Energy Sustainability, FP7-Fission-2009"
- CHANDA "Solving Challenges in Nuclear Data for the Safety of European Nuclear Facilities"
- ESNII+ "Preparing ESNII for HORIZON 2020"
- ESFR-SMART "European Sodium Fast Reactor Safety Measures Assessment and Research Tools"

Significant infrastructures

The group contributing to this project operates the DIN-cluster (320 AMD cores) located at the Energy Technology Engineering (Nuclear Engineering) Department to support the computational analysis in the areas of nuclear data and reactor physics and has also access to Magerit supercomputer at UPM which is providing computer support to national and international research projects.

No third parties involved.

33. USC

The university of Santiago de Compostela is a high education institution offering 63 offcial degrees and developping reserach activities in all areas of knowledge. In particular, the Nuclear and Particle Physics department has a long experience in basic research using the most outstanding European infrastructures in the field like CERN, GSI or GANIL. Scientists from USC have competences in the experimental and theoretical investigations on nuclear physics. In particular they have been highly involved in experiments at GSI and CERN n-TOF dealing with fission and neutron-induced reactions.

The experience gained by USC researchers in experiments related to nuclear data measurements and development of simulation reaction codes clearly justifies its participation in WP2 and WP4.

Dr. José Benlliure, full professor at the University of Santiago de Compostela, obtained his Ph.D. at the University of Valencia in 1995 with work on nuclear multi-fragmentation done at GANIL (France) from 1991 till 1995. Postdoctoral positions at LPC-Caen (France) (1995) and GSI (Germany) (1996-1998). In 1998 he obtained and associated lectureship at the University of Santiago de Compostela, in 2002 a full lectureship and in 2011 was appointed as full professor in the same university. His main scientific activity deals with the investigation of nuclear reactions in particular fission, spallation and fragmentation. He is co-author of more than 215 publications has presented numerous invited talks in international conferences and has supervised eleven PhDs. He has been member the GANIL Scientific Council and the FAIR Council.

<u>Publications</u>

- J.L. Rodriguez-Sanchez, J. Benlliure et al., “Presaddle and postsaddle dissipative effects in fission using complete kinematics measurements”
- Phys. Rev. C 94 (2016) 061601
- J.L. Rodriguez-Sanchez, J. Benlliure et al., “Light charged particles emitted in fission reactions induced by protons on Pb-208”
- Phys. Rev. C 94 (2016) 034605
- J.L. Rodríguez-Sánchez, J. Benlliure et al., “Constraining the level density using fission of lead projectiles”
- Phys. Rev. C 92 (2015) 044612
- J.L. Rodríguez-Sánchez, J. Benlliure et al., “Complete characterization of the fission fragments produced in reactions induced by Pb-208 projectiles on proton at 500A MeV”
- Phys. Rev. C 91 (2015) 064616
- J.L. Rodríguez-Sánchez, J. Benlliure et al., “Proton-induced fission cross sections on Pb208 at high kinetic energies”
- Phys. Rev. C 90 (2014) 064606

<u>The USC has participated in the projects</u>:

- CHANDA, Solving Challenges in Nuclear Data
- CE, FP7 – 605203
- ANDES, Accurate Nuclear Data for nuclear Energy Sustainability
- CE, FP7 - 249671
- EUROTRANS, EUROpean Research Programme for TRANSmutation of High Level Nuclear Waste in an Accelerator Driven System
- CE, FI6W-CT-2004-516520

- HINDAS, High and Intermediate Energy Nuclear Data for Accelerator-Driven Systems
- CE, FIS5-1999-00150

No third parties involved.

34. USE

The University of Seville has a history of more than 500 years and nowadays is a leading institution in both academy and research, hosting more than 70.000 students. Within the Faculty of Physics, the research team working in the Dpt. of Atomic, Molecular and Nuclear Physics has a long tradition on research on nuclear physics including both theoretical (optical model calculations) and experimental (mainly on neutron capture and neutron production) aspects of nuclear reactions. The experiments take place at both international (n_TOF, ILL, LiLiT, BRR, etc.) and the local HiSPANoS neutron source. Recently the type of nuclear data measurements has been extended to proton induced reaction of interest in medical physics, in particular in proton therapy.

In addition, the University of Seville runs the facilities of the National Accelerator Centre (CNA). The CNA is a Spanish joint institution which, since its creation in 1998, has the mission of carrying out research in particle accelerators and its multiple applications. The CNA is recognized as a Spanish Singular Scientific and Technological Facility, and it is a user's-oriented laboratory, open to the Spanish and the international scientific community belonging to universities, public research institutions, public and private companies, hospitals or other institutions that require the use of the facilities. CNA is a pioneering center in Spain in the field of applications of particle accelerators for research. It has three particle accelerators: a 3 MV van de Graaff tandem accelerator, a cyclotron that supplies 18 MeV protons and 9 MeV deuterons, and a 1 MV Cockcroft-Walton tandem accelerator (called Tandetron) which is indeed a mass spectrometer. The tandem is linked to a neutron production target of either Lithium or Deuterium that is the core of the HiSPANoS neutron beam.

The responsible for carrying out the work within this EU project is Dr. Carlos Guerrero, a "Ramon y Cajal" researcher at the University of Sevilla. Prior to his arrival to Sevilla via an EC Marie Curie CIG project in 2014, he carried out a PhD at CIEMAT (Spain) on neutron capture measurements of minor actinides, and then moved to CERN (Switzerland) for 7 years during which he was a CERN Fellow (3 years) and a the Run and Analysis Coordinator (5 years) of the CERN n_TOF facility. As of today he is coordinating the HiSPANoS Collaboration in Spain, carrying out neutron beam experiments at n_TOF, BRR, LiLiT and HiSPANoS, and has launched a research line on measuring nuclear reactions of interest for medical physics, in particular for range verification in proton therapy.

<u>Publications</u>

- J. Lerendegui-Marco et al., "Radiative neutron capture on 242Pu in the resonance region at the CERN n_TOF-EAR1 facility", Phys. Rev. C 97, 024605 (2018)
- C. Guerrero et al., "Prospects for direct neutron capture measurements on s-process branching point isotopes", Eur. Phys. J. A 53:87 (2017)
- M. Barbagallo et al., "7Be(n,alpha) reaction and the Cosmological Lithium Problem: Measurement of the cross section in a wide energy range at n_TOF at CERN", Phys. Rev. Lett. 117, 152701 (2016)
- C. Guerrero et al., "Performance of the neutron time-of-flight facility n_TOF at CERN", Eur. Phys. J. A 49:27 (2013)
- C. Guerrero et al., "Measurement and resonance analysis of the 237Np neutron capture cross section", Phys. Rev. C 85 044616 (2012)

No third parties involved.

35. UU

Uppsala University is the oldest university in the Nordic countries and was founded in 1477. Today it is a large institution with 41 000 students and 6 500 employees. The university conducts education and research within 9 faculties: theology, law, arts, languages, social sciences, educational sciences, medicine, pharmacy, science and technology. Uppsala University – a member of the COIMBRA group (http://www.coimbra-group.eu/) – has been the highest-ranking comprehensive research university in Sweden – and among the top 20 in Europe – for five consecutive years. Some 5,000 scientific publications are produced each year of which about 50 % are articles in international scientific journals.

Uppsala University has a significant presence on the international academic arena, with much collaboration in both education and research. More than 1,000 international universities, primarily in Europe, U.S., and Asia, are involved in more than 3,000 research partnerships with UU. The Faculty of Sciences and Technology alone has about 1600 employees and 10500 students, and has an annual turnover of about 220M€. The nuclear reactions group is part of the Division of Applied Nuclear Physics of the Department of Physics and Astronomy and has a long standing experience in measuring data on neutron induced reactions at several facilities. It has also build up an expertise in nuclear data evaluation and uncertainty quantification. The group has previously participated in FP5 (HINDAS) and FP6 (EFNUDAT, CANDIDE and EUROTRANS), and FP7 (CHANDA). The group has, together with the division of applied nuclear physics, ongoing collaboration with Swedish industry and authority and has a strong activity in contract education, e.g., radiation protection and reactor physics, with external partners.

Stephan Pomp (born 1968, male) is professor in applied nuclear physics. He is head of the applied nuclear physics programme at the Department of Physics and Astronomy and leader of the nuclear reactions research group (currently 13 members). His main research interest are neutron-induced reactions, in particular the fission process and light-ion production. His current experimental research activities are linked to IGISOL (Jyväskylä, Finland), JRC Geel (Belgium) and NFS@GANIL (Caen, France). Stephan Pomp was main or co-supervisor for 12 PhD theses. He has 48 physics publications in refereed international journals and more than 140 contributions to refereed international conferences. He is member of the Programme Advisory Committees for leading conferences in the field of applied nuclear physics and is also member of the board of the Nuclear Physics Division of EPS, and UU representative in the European Radiation Dosimetry Group (EURADOS).

Henrik Sjöstrand (born 1978, male) is Associate Professor at Applied Nuclear Physics and docent since 2015. He is the project leader of the evaluation and nuclear data (ND) uncertainty quantification (UQ) effort at Uppsala University since 2012. He has been the supervisor for four Ph.D. students, two post-docs and a large number of master students. He has 77 peer-reviewed original articles in international journals, and he has a Scopus H-index of 16. In his work, he has addressed ND issues, e.g., today's and the next generation of fission reactors; nuclear fusion; material issues; and dosimetry. He works with EUROfusion consortium in several projects related to ND as well as collaborates directly with the Swedish nuclear industry. He has contributed to JEFF3.3 (Ni59), participated in the IAEA DPA-CRP and is currently a member of WPEC Subgroup 44 (uncertainty quantification) and 46 (Use of Integral Experiments).

Ali Al-Adili (born 1984, male) is a researcher in applied nuclear physics. He obtained his Ph.D. at the Joint Research Centre in Geel, Belgium. His main research interest is nuclear fission. He is the main responsible for the fission neutron investigations carried out at the division and is also involved in experimental activities at the IGISOL facility (Finland) and at LICORNE facility (France). Ali has been a co-supervisor of one Ph.D. student and a few master students. He is the author and co-author of more than 50 articles and proceedings. Ali has received of two awards; the ENEN Ph.D. prize for top three European nuclear technology theses, and the Ångström Premium (given by Uppsala University). For his Ph.D. he received the JRC fellowship grant (3 years research at JRC). For the neutron investigations, he obtained three CHANDA visiting-scientist grants (total of 21 man weeks) and three accepted EUFRAT experimental proposals. He was recently granted the JSPS+STINT grant for a short-term fellowship at RIKEN laboratory in Japan.

Andreas Solders (born 76, male, phd) is a researcher in applied nuclear physics. Andreas main research interest is nuclear fission, in particular the study of fission yields and neutron multiplicity. As the principal investigator he has a leading role in the collaboration between UU and JYU to measure independent isotopic and isomeric fission yields at IGISOL. Andreas Solders has been the main or co-supervisor of three PhD students. He has 12 original publications in refereed international journals and 24 refereed conference contributions (h-index 11).

Alexander Prokofiev (born 1963, male) is a researcher, Ph.D., and docent in applied nuclear physics. His current experimental research activities are linked to the NFS facility at GANIL (Caen, France). His main research interests are (1) neutron-induced nuclear reactions such as fission and light-ion production, in particular in the context of future energy applications, (2) development of facilities and detectors for neutron research, (3) neutron-induced radiation effects in materials and systems. He is a project leader in development of a new neutron facility, NESSA. He has been co-supervisor for two PhD students as well as main supervisor for several diploma and exchange students. He has 57 publications in refereed international journals and more than 80 contributions to refereed international conferences (Scopus H-index 19).

Publications

- Al-Adili et al., ”Fragment-mass, kinetic energy, and angular distributions for 234U(n,f) at incident neutron energies from En = 0.2 MeV to 5.0 MeV”, Phys. Rev. C 93, 034603 (2016)
- V. Rakopoulos et al, ”First isomeric yield ratio measurements by direct ion counting and implications for the angular momentum of the primary fission fragments”, Phys. Rev. C 98, 024612 (2018)
- Tarrío, D., Prokofiev, A.V., Gustavsson, C., Jansson, K., Andersson-Sundén, E., Al-Adili, A., Pomp, S., “Characterization of the Medley setup for measurements of neutron-induced fission cross sections at the GANIL-NFS facility”, EPJ Web of Conferences 146, 03026 (2017)
- Helgesson P., Sjöstrand H., Rochman D.; "Uncertainty driven nuclear data evaluation including thermal (n,alpha): applied to Ni-59"; Nuclear Data Sheets 145, 1-24 (2017)
- P Helgesson, H Sjöstrand, “Treating model defects by fitting smoothly varying model parameters: Energy dependence in nuclear data evaluation”, Annals of Nuclear Energy 120, 35-47 (2018)

Previous projects or activities

The UU group has participated previously in the FP5 (HINDAS) and FP6 (EFNUDAT, CANDIDE and EUROTRANS), and FP7 (CHANDA) projects.

No third parties involved.

4.2. Third parties involved in the project (including use of third party resources)

Please complete, for each participant, the following table (or simply state "No third parties involved", if applicable):

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y
If yes, please describe and justify the tasks to be subcontracted Only PSI will subcontract part of the research for the design of the isotope separator. The details can be found in the description of partner 21 PSI.	
Does the participant envisage that part of its work is performed by linked third parties[7]	Y
If yes, please describe the third party, the link of the participant to the third party, and describe and justify the foreseen tasks to be performed by the third party Only CNRS will have linked third parties to perform part of its work. The details can be found in the description of partner 5 CNRS.	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N
If yes, please describe the third party and their contributions	
Does the participant envisage that part of the work is performed by International Partners[8] (Article 14a of the General Model Grant Agreement)?	N
If yes, please describe the International Partner(s) and their contributions	

[7] A third party that is an affiliated entity or has a legal link to a participant implying a collaboration not limited to the action. (Article 14 of the Model Grant Agreement).

[8] 'International Partner' is any legal entity established in a non-associated third country which is not eligible for funding under Article 10 of the Rules for Participation Regulation No 1290/2013.

5. Ethics and Security

5.1 Ethics

The consortium ensures that the ethical issues identified in the SANDA ethics evaluation are conveniently addressed.

For the Environment protection question:

As indicated in the proposal and in the workpackages description some of the measurements and research activities proposed in the workpackages: WP1 “Developments of new innovative detector devices”, WP2 “New nuclear data measurements for energy and non-energy applications” and WP5 “Nuclear data validation and integral experiments” involve the use of small quantities of radioactive isotopes and sources of radiation (photons, neutrons and charged particles).

The concerned activities and all preparatory operations with those radioactive materials and sources of radiation will be performed at specific facilities, radioactive installations, that have been designed for minimizing down to below the regulatory limits the impact of the experiments to workers, general public and environment.

The facility designs, operation conditions and operation protocols have been validated and the facilities have been authorized to operate with radioactive materials up to well identified limits and to perform a well-defined type of operations, by the corresponding national nuclear regulatory bodies. The proposed experiments are in all cases included in the inventories and scope of operations authorized for the concerned facilities.

Furthermore, all the actions in these facilities are supervised by specially trained and authorized persons, normally from the staff of the radioactive installation and/or staff of the internal radiation protection offices of the respective participants. Radioactive installations and radiation protection offices are controlled by the national nuclear regulatory bodies and must ensure that the experiments are carried out according to national law which ultimately stems from IAEA guidelines.

For the project protection of personal data:
Participants will be informed on the purpose of the personal data requested. Personal Data processing will follow the provisions of the Law 677/2001 on the protection of natural persons with regard to the processing of personal data and the free movement of such data and of EU Regulation 2016/679 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).

5.2 Security[9]

Please indicate if your project will involve:

- activities or results raising security issues: NO
- 'EU-classified information' as background or results: NO

[9] See article 37 of the Model Grant Agreement. . For more information on the classification of Information, please refer to the Horizon 2020 guidance: https://ec.europa.eu/research/participants/data/ref/h2020/other/hi/secur/h2020-hi-guide-classif_en.pdf.

ESTIMATED BUDGET FOR THE ACTION

	Estimated eligible[1] costs (per budget category)										EU contribution			Additional information		
	A. Direct personnel costs				B. Direct costs of subcontracting	*[C. Direct costs of fin. support]*	D. Other direct costs		E. Indirect costs[2]	Total costs	Reimbursement rate %	Maximum EU contribution[3]	Maximum grant amount[4]	Information for indirect costs	Information for auditors	Other information:
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons *[A.6 Personnel for providing access to research infrastructure]*		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary				D.1 Travel D.2 Equipment D.3 Other goods and services *[D.4 Costs of large research infrastructure]*	D.5 Costs of internally invoiced goods and services						Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving funding/ international partners
Form of costs[6]	Actual	Unit[7]	Unit[8]		Actual	Actual	Actual	Unit[9]	Flat-rate[10] 25%							
	a	Total b	No hours	Total c	d	*[e]*	f	Total g	h = 0,25 x (a +b+c+f+g +*[i1]*[13]+*[i2]*[13]-n)	j = a+b+c+d +*[e]*+f+g+h +*[i1]*+*[i2]*	k	l	m	n	Yes/No	
1. CIEMAT	367 450.00	0.00	0.00	0.00	0.00	0.00	26 000.00	0.00	98 362.50	491 812.50	100.00	491 812.50	368 859.00	0.00	No	n/a
2. ATOMKI	21 354.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5 338.50	26 692.50	100.00	26 692.50	20 019.00	0.00	No	n/a
3. CEA	612 894.00	0.00	0.00	0.00	0.00	0.00	9 000.00	0.00	155 473.50	777 367.50	100.00	777 367.50	583 026.00	0.00	No	n/a
4. CERN	8 666.00	0.00	0.00	0.00	0.00	0.00	50 000.00	0.00	14 666.50	73 332.50	100.00	73 332.50	54 999.00	0.00	No	n/a
5. CNRS	138 764.00	0.00	0.00	0.00	0.00	0.00	43 400.00	0.00	45 541.00	227 705.00	100.00	227 705.00	174 354.11	0.00	No	n/a
- G-INP	58 500.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14 625.00	73 125.00	100.00	73 125.00	52 650.00	0.00	No	n/a
- IMT Atlantique	22 750.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5 687.50	28 437.50	100.00	28 437.50	21 328.13	0.00	No	n/a
- Univ Nantes	29 250.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7 312.50	36 562.50	100.00	36 562.50	27 421.88	0.00	No	n/a
- UNICAEN	13 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3 250.00	16 250.00	100.00	16 250.00	13 487.50	0.00	No	n/a
- UBx	9 750.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2 437.50	12 187.50	100.00	12 187.50	6 459.38	0.00	No	n/a
Total beneficiary	272 014.00	0.00			0.00	0.00	43 400.00	0.00	78 853.50	394 267.50		394 267.50	295 701.00	n/a	n/a	0.00
6. CSIC	52 266.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13 066.50	65 332.50	100.00	65 332.50	48 999.00	0.00	No	n/a
7. CVREZ	71 600.00	0.00	0.00	0.00	0.00	0.00	18 000.00	0.00	22 400.00	112 000.00	100.00	112 000.00	84 000.00	0.00	No	n/a
8. ENEA	99 000.00	0.00	0.00	0.00	0.00	0.00	13 000.00	0.00	28 000.00	140 000.00	100.00	140 000.00	105 000.00	0.00	No	n/a
9. HZDR	27 734.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6 933.50	34 667.50	100.00	34 667.50	26 001.00	0.00	No	n/a
10. IFIN-HH	69 354.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17 338.50	86 692.50	100.00	86 692.50	65 019.00	0.00	No	n/a
11. IRSN	31 000.00	0.00	0.00	0.00	0.00	0.00	1 000.00	0.00	8 000.00	40 000.00	100.00	40 000.00	30 000.00	0.00	No	n/a
12. IST-ID	24 166.00	0.00	0.00	0.00	0.00	0.00	2 500.00	0.00	6 666.50	33 332.50	100.00	33 332.50	24 999.00	0.00	No	n/a
13. JRC	274 666.00	0.00	0.00	0.00	0.00	0.00	56 000.00	0.00	82 666.50	413 332.50	100.00	413 332.50	309 999.00	0.00	No	n/a
14. JSI	60 866.00	0.00	0.00	0.00	0.00	0.00	9 000.00	0.00	17 466.50	87 332.50	100.00	87 332.50	65 499.00	0.00	No	n/a
15. JYU	66 666.00	0.00	0.00	0.00	0.00	0.00	8 000.00	0.00	18 666.50	93 332.50	100.00	93 332.50	69 999.00	0.00	No	n/a
16. KIT	23 666.00	0.00	0.00	0.00	0.00	0.00	3 000.00	0.00	6 666.50	33 332.50	100.00	33 332.50	24 999.00	0.00	No	n/a
17. NPI	21 334.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5 333.50	26 667.50	100.00	26 667.50	20 001.00	0.00	No	n/a
18. NPL	16 364.00	0.00	0.00	0.00	0.00	0.00	15 636.00	0.00	8 000.00	40 000.00	100.00	40 000.00	30 000.00	0.00	No	n/a
19. NRG	38 266.00	0.00	0.00	0.00	0.00	0.00	4 400.00	0.00	10 666.50	53 332.50	100.00	53 332.50	40 000.00	0.00	No	n/a
20. NTUA	23 229.00	0.00	0.00	0.00	0.00	0.00	3 437.00	0.00	6 666.50	33 332.50	100.00	33 332.50	24 999.00	0.00	No	n/a
21. PSI	0.00	309 934.00	0.00	0.00	20 000.00	0.00	25 000.00	0.00	83 733.50	438 667.50	100.00	438 667.50	329 001.00	0.00	No	n/a
22. PTB	56 534.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14 133.50	70 667.50	100.00	70 667.50	53 001.00	0.00	No	n/a
23. SCK-CEN	34 878.00	0.00	0.00	0.00	0.00	0.00	3 000.00	0.00	9 469.50	47 347.50	100.00	47 347.50	35 511.00	0.00	No	n/a
24. Sofia	21 354.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5 338.50	26 692.50	100.00	26 692.50	20 019.00	0.00	No	n/a
25. TUW	52 294.00	0.00	0.00	0.00	0.00	0.00	3 600.00	0.00	13 973.50	69 867.50	100.00	69 867.50	52 401.00	0.00	No	n/a
26. UB	83 626.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20 906.50	104 532.50	100.00	104 532.50	78 399.00	0.00	No	n/a
27. ULODZ	36 277.00	0.00	0.00	0.00	0.00	0.00	6 389.00	0.00	10 666.50	53 332.50	100.00	53 332.50	39 999.00	0.00	No	n/a

ESTIMATED BUDGET FOR THE ACTION

	Estimated eligible[1] costs (per budget category)										EU contribution			Additional information		
	A. Direct personnel costs				B. Direct costs of subcontracting	*[C. Direct costs of fin. support]*	D. Other direct costs		E. Indirect costs[2]	Total costs	Reimbursement rate %	Maximum EU contribution[3]	Maximum grant amount[4]	Information for indirect costs	Information for auditors	Other information:
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons *[A.6 Personnel for providing access to research infrastructure]*		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary				D.1 Travel D.2 Equipment D.3 Other goods and services *[D.4 Costs of large research infrastructure]*	D.5 Costs of internally invoiced goods and services						Estimated costs of in-kind contributions not used on premises	Declaration of costs under Point D.4	Estimated costs of beneficiaries/ linked third parties not receiving funding/ international partners
Form of costs[6]	Actual	Unit[7]	Unit[8]		Actual	Actual	Actual	Unit[9]	Flat-rate[10] 25%							
	a	Total b	No hours	Total c	d	*[e]*	f	Total g	h = 0,25 x (a +b+c+f+g +*[i1]*[13]+*[i2]*[13]-n)	j = a+b+c+d +*[e]*+f+g+h +*[i1]*+*[i2]*	k	l	m	n	Yes/No	
28. UMAINZ	170 666.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42 666.50	213 332.50	100.00	213 332.50	159 999.00	0.00	No	n/a
29. UMANCH	38 000.00	0.00	0.00	0.00	0.00	0.00	10 000.00	0.00	12 000.00	60 000.00	100.00	60 000.00	45 000.00	0.00	No	n/a
30. UOI	22 916.00	0.00	0.00	0.00	0.00	0.00	3 750.00	0.00	6 666.50	33 332.50	100.00	33 332.50	24 999.00	0.00	No	n/a
31. UPC	48 000.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12 000.00	60 000.00	100.00	60 000.00	45 000.00	0.00	No	n/a
32. UPM	80 534.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20 133.50	100 667.50	100.00	100 667.50	75 501.00	0.00	No	n/a
33. USC	49 334.00	0.00	0.00	0.00	0.00	0.00	4 000.00	0.00	13 333.50	66 667.50	100.00	66 667.50	50 001.00	0.00	No	n/a
34. USE	42 000.00	0.00	0.00	0.00	0.00	0.00	6 000.00	0.00	12 000.00	60 000.00	100.00	60 000.00	45 000.00	0.00	No	n/a
35. UU	157 266.00	0.00	0.00	0.00	0.00	0.00	7 000.00	0.00	41 066.50	205 332.50	100.00	205 332.50	153 999.00	0.00	No	n/a
Total consortium	3 076 234.00	309 934.00			20 000.00	0.00	331 112.00	0.00	929 320.00	4 666 600.00		4 666 600.00	3 499 948.00			0.00

1 See Article 6 for the eligibility conditions.
2 Indirect costs already covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.5.(b)) are ineligible under the GA. Therefore, a beneficiary/linked third party that receives an operating grant during the action's duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant, unless it can demonstrate that the operating grant does not cover any costs of the action (see Article 6.2.E).
3 This is the theoretical amount of EU contribution that the system calculates automatically (by multiplying all the budgeted costs by the reimbursement rate). This theoretical amount is capped by the 'maximum grant amount' (that the Euratom decided to grant for the action) (see Article 5.1).
4 The 'maximum grant amount' is the maximum grant amount decided by the Euratom. It normally corresponds to the requested grant, but may be lower.
5 Depending on its type, this specific cost category will or will not cover indirect costs. Specific unit costs that include indirect costs are: costs for energy efficiency measures in buildings, access costs for providing trans-national access to research infrastructure and costs for clinical studies.
6 See Article 5 for the forms of costs.
7 Unit : hours worked on the action; costs per unit (hourly rate) : calculated according to the beneficiary's usual accounting practice.
8 See Annex 2a 'Additional information on the estimated budget' for the details (costs per hour (hourly rate)).
9 Unit and costs per unit : calculated according to the beneficiary's usual accounting practices.
10 Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs (see Article 6.2.E).
11 See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit).
12 See Annex 2a 'Additional information on the estimated budget' for the details (units, costs per unit, estimated number of units, etc).
13 Only specific unit costs that do not include indirect costs.
14 See Article 9 for beneficiaries not receiving funding.
15 Only for linked third parties that receive funding.

ANNEX 2a

ADDITIONAL INFORMATION ON THE ESTIMATED BUDGET

- **Instructions and footnotes in blue will not appear in the text generated by the IT system (since they are internal instructions only).**
- **For options *[in square brackets]*: the applicable option will be chosen by the IT system. Options not chosen will automatically not appear.**
- **For fields in [grey in square brackets] (even if they are part of an option as specified in the previous item): IT system will enter the appropriate data.**

⚠ **Transitory period: Until SyGMa fully supports Annex 2a, you must prepare it manually (using this template by choosing and deleting the options/entering the appropriate data).**
For the 'unit cost tables': either fill them out manually or use currently existing tables from Annex 1 or the proposal.
The document can then be uploaded in SyGMa and attached to the grant agreement.

Unit cost for SME owners/natural beneficiaries without salary

1. Costs for a *[*SME owner*]* *[*beneficiary that is a natural person*]* not receiving a salary

Units: hours worked on the action

Amount per unit ('hourly rate'): calculated according to the following formula:

{the monthly living allowance for researchers in MSCA-IF actions / 143 hours}
multiplied by
{country-specific correction coefficient of the country where the beneficiary is established}

The monthly living allowance and the country-specific correction coefficients are set out in the Work Programme (section 3 MSCA) in force at the time of the call:

- for calls *before* Work Programme 2018-2020:
  - for the monthly living allowance: **EUR 4 650**
  - for the country-specific correction coefficients: see Work Programme 2014-2015 and Work Programme 2016-2017 (available on the Participant Portal Reference Documents page)
- for calls *under* Work Programme 2018-2020:
  - for the monthly living allowance: **EUR 4 880**
  - for the country-specific correction coefficients: see Work Programme 2018-2020 (available on the Participant Portal Reference Documents page)

[additional OPTION for beneficiaries/linked third parties that have opted to use the unit cost (in the proposal/with an amendment): For the following beneficiaries/linked third parties, the amounts per unit (hourly rate) are fixed as follows:

- beneficiary/linked third party [short name]: EUR [insert amount]
- beneficiary/linked third party [short name]: EUR [insert amount]

[same for other beneficiaries/linked third parties, if necessary] ***]***

Estimated number of units: see Annex 2

Energy efficiency measures unit cost

2. Costs for energy efficiency measures in buildings

Unit: m^2 of eligible 'conditioned' (i.e. built or refurbished) floor area

Amount per unit*: see (for each beneficiary/linked third party and BEST table) the 'unit cost table' attached

* Amount calculated as follows:
{EUR 0.1 x estimated total kWh saved per m^2 per year x 10}

Estimated number of units: see (for each beneficiary/linked third party and BEST table) the 'unit cost table' attached

Unit cost table (energy efficiency measures unit cost)[1]

Short name beneficiary/linked third party	**BEST No**	**Amount per unit**	**Estimated No of units**	**Total unit cost** (cost per unit x estimated no of units)

[1] Data from the 'building energy specification table (BEST)' that is part of the proposal and Annex 1.

Research infrastructure unit cost

3. Access costs for providing trans-national access to research infrastructure

Units[2]: see (for each access provider and installation) the ‘unit cost table’ attached

Amount per unit*: see (for each access provider and installation) the ‘unit cost table’ attached

* Amount calculated as follows:

$$\frac{\text{average annual total access cost to the installation (over past two years}^{3}\text{)}}{\text{average annual total quantity of access to the installation (over past two years}^{4}\text{)}}$$

Estimated number of units: see (for each access provider and installation) the ‘unit cost table’ attached

Unit cost table (access to research infrastructure unit cost)[5]

Short name access provider	Short name infrastructure	Installation		Unit of access	Amount per unit	Estimated No of units	Total unit cost (cost per unit x estimated no of units)
		No	Short name				

Clinical studies unit cost

4. Costs for clinical studies

Units: patients/subjects that participate in the clinical study

Amount per unit*: see (for each sequence (if any), clinical study and beneficiary/linked third party) the ‘unit cost table’ attached

* Amount calculated, for the cost components of each task, as follows:

For **personnel costs**:

For personnel costs of doctors: ‘average hourly cost for doctors’, i.e.:

$$\left\{\frac{\text{certified or auditable total personnel costs for doctors for year N-1}}{\{1720 * \text{number of full-time-equivalent for doctors for year N-1}\}}\right.$$

multiplied by

estimated number of hours to be worked by doctors for the task (per participant)**}**

For personnel costs of other medical personnel: **‘**average hourly cost for other medical personnel’, i.e.:

$$\left\{\frac{\text{certified or auditable total personnel costs for other medical personnel for year N-1}}{\{1720 * \text{number of full-time-equivalent for other medical personnel for year N-1}\}}\right.$$

[2] Unit of access (e.g. beam hours, weeks of access, sample analysis) fixed by the access provider in proposal.

[3] In exceptional and duly justified cases, the Commission/Agency may agree to a different reference period.

[4] In exceptional and duly justified cases, the Commission/Agency may agree to a different reference period.

[5] Data from the ‘table on estimated costs/quantity of access to be provided’ that is part of the proposal and Annex 1.

multiplied by
estimated number of hours to be worked by other medical personnel for the task (per participant)**}**

For personnel costs of technical personnel: **'**average hourly cost for technical personnel', i.e.:

{certified or auditable total personnel costs for technical personnel for year N-1
———————————————————————————————————
{1720 * number of full-time-equivalent for technical personnel for year N-1}
multiplied by
estimated number of hours to be worked by technical personnel for the task (per participant)**}**

'total personnel costs' means actual salaries + actual social security contributions + actual taxes and other costs included in the remuneration, provided they arise from national law or the employment contract/equivalent appointing act

For **consumables**:

For each cost item: 'average price of the consumable', i.e.:

{{certified or auditable total costs of purchase of the consumable in year N-1
——————————————————————————————
total number of items purchased in year N-1}
multiplied by
estimated number of items to be used for the task (per participant)**}**

'total costs of purchase of the consumable' means total value of the supply contracts (including related duties, taxes and charges such as non-deductible VAT) concluded by the beneficiary for the consumable delivered in year N-1, provided the contracts were awarded according to the principle of best value- for-money and without any conflict of interests

For **medical equipment**:

For each cost item: 'average cost of depreciation and directly related services per unit of use', i.e.:

{{ certified or auditable total depreciation costs in year N-1 + certified or auditable total costs of purchase of services in year N-1 for the category of equipment concerned}
——————————————————————————————
total capacity in year N-1
multiplied by
estimated number of units of use of the equipment for the task (per participant)**}**

'total depreciation costs' means total depreciation allowances as recorded in the beneficiary's accounts of year N-1 for the category of equipment concerned, provided the equipment was purchased according to the principle of best value for money and without any conflict of interests + total costs of renting or leasing contracts (including related duties, taxes and charges such as non-deductible VAT) in year N-1 for the category of equipment concerned, provided they do not exceed the depreciation costs of similar equipment and do not include finance fees

For **services**:

For each cost item: 'average cost of the service per study participant', i.e.:

{certified or auditable total costs of purchase of the service in year N-1
——————————————————————————————
total number of patients or subjects included in the clinical studies for which the service was delivered in year N-1**}**

'total costs of purchase of the service' means total value of the contracts concluded by the beneficiary (including related duties, taxes and charges such as non-deductible VAT) for the specific service delivered in year N-1 for the conduct of clinical studies, provided the contracts were awarded according to the principle of best value for money and without any conflict of interests

For **indirect costs**:

{{{cost component 'personnel costs' + cost component 'consumables' + cost component 'medical equipment'}

minus

{costs of in-kind contributions provided by third parties which are not used on the beneficiary's premises + costs of providing financial support to third parties (if any)}**}**

multiplied by

25%**}**

The estimation of the resources to be used must be done on the basis of the study protocol and must be the same for all beneficiaries/linked third parties/third parties involved.

The year N-1 to be used is the last closed financial year at the time of submission of the grant application.

Estimated number of units: see (for each clinical study and beneficiary/linked third party) the 'unit cost table' attached

Unit cost table: clinical studies unit cost[6]

Task, Direct cost categories	**Resource per patient**	**Costs year N-1** **Beneficiary 1** **[short name]**	**Costs year N-1** **Linked third party 1a** **[short name]**	**Costs year N-1** **Beneficiary 2** **[short name]**	**Costs year N-1** **Linked third party 2a** **[short name]**	**Costs year N-1** **Third party giving in-kind contributions 1** **[short name]**
Sequence No. 1						
Task No. 1 Blood sample						
(a) **Personnel costs:** - Doctors	n/a					
- Other Medical Personnel	Phlebotomy (nurse), 10 minutes	8,33 EUR	11,59 EUR	10,30 EUR	11,00 EUR	9,49 EUR
- Technical Personnel	Sample Processing (lab technician), 15 minutes	9,51 EUR	15,68 EUR	14,60 EUR	15,23 EUR	10,78 EUR
(b) **Costs of consumables**:	Syringe	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	Cannula	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	Blood container	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(c) **Costs of medical equipment**:	Use of -80° deep freezer, 60 days	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	Use of centrifuge, 15 minutes	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(d) **Costs of services**	Cleaning of XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(e) **Indirect costs** (25% flat-rate)		XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
Task No. 2						
…						
Amount per unit (unit cost sequence 1):		**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**
Sequence No. 2						
Task No. 1						

[6] Same table as in proposal and Annex 1.

XXX						
(a) **Personnel costs:** - Doctors	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
- Other Medical Personnel	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
- Technical Personnel	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(b) **Costs of consumables**:	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(c) **Costs of medical equipment**:	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(d) **Costs of services**	XXX	XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
(e) **Indirect costs** (25% flat-rate)		XX EUR	XX EUR	XX EUR	XX EUR	XX EUR
Task No. 2						
…						
Amount per unit (unit cost sequence 2):		**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**
…						
Amount per unit (unit cost entire study):		**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**	**XX EUR**

]

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

Magyar Tudomanyos Akademia Atommagkutato Intezete (ATOMKI), established in BEM TER 18/C, DEBRECEN H4026, Hungary, VAT number: HU15300344, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('2')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Zsolt DOMBRÁDI with ECAS id ndombrzs signed in the Participant Portal on 30/05/2019 at 07:51:31 (transaction id SigId-84280-YYGQzZ8cw8rIr8mKcEWbbAMqLCXZQIk0LaUJYjgsh7HYhFQtxcGxJWlo5UoaBAaD9KizzM7ExSOb2k70G9hZdnG-jpJZscgsw0Kv1vxGC5zvJV-ppplytp4TczvY912fmJRFqltNTFdKzzqwpzdZwNzI9pfW). Timestamp by third party at Thu May 30 08:51:36 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA), established in RUE LEBLANC 25, PARIS 15 75015, France, VAT number: FR43775685019, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('3')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Gaelle DECROIX with ECAS id ndecroga signed in the Participant Portal on 28/05/2019 at 08:35:39 (transaction id SigId-58705-pzNooorq3434s3m9QsCwWLdtWvkYc4TcyMPzzUqzM4sBlgVn11tjaddU3evEOenMcDaupY2JuJpUlBgeiHy2hOO-jpJZscgsw0Kv1vxGC5zvJV-LszLWOcle6eVDrHNWQfjVWX9fK9f6TEHrJPEVplo9D1). Timestamp by third party at Tue May 28 09:35:43 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH (CERN), established in ROUTE DE MEYRIN CERN, GENEVA 23 1211, Switzerland, (‘the beneficiary’), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No (‘4’)

in Grant Agreement No 847552 (‘the Agreement’)

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community (‘Euratom’), represented by the European Commission ('the Commission'),

for the action entitled ‘Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)’.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Frederick BORDRY with ECAS id nbordrfr signed in the Participant Portal on 17/06/2019 at 08:51:08 (transaction id SigId-65225-tYYVhsuu0hOYOXbBaHzjxSn2O9fIsIyuZ9Cj8sfddwBw0Y3IuJgEoANC79WjIxWPlxcruGbUJBMcvJ7gSpJ1MW-rS0vSrmBGYCzGdnqZKN7zYm-MZfXTyBvTzlEDNg3b2NJY7211a1czHSfVO6QoGeoegOG). Timestamp by third party at Mon Jun 17 09:51:13 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS), established in RUE MICHEL ANGE 3, PARIS 75794, France, VAT number: FR40180089013, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('5')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Reynald PAIN with ECAS id npainrey signed in the Participant Portal on 03/06/2019 at 16:31:18 (transaction id SigId-104081-vrKh8OXyT29y4tOCU33lkcGgBlHNwcXkMIggWfIznnFS6AwDFzH5JKBXQNStuUXzmvYkvwk3v3Ld8KknHJ0zXE8-jpJZscgsw0Kv1vxGC5zvJV-tYRcZHBo7zxjKLOCm0SW6SDGzzs4rF4ckoeDrjokHiUW) . Timestamp by third party at Mon Jun 03 17:31:24 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

AGENCIA ESTATAL CONSEJO SUPERIOR DEINVESTIGACIONES CIENTIFICAS (CSIC), established in CALLE SERRANO 117, MADRID 28006, Spain, VAT number: ESQ2818002D, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('6')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Jesús Marco de Lucas with ECAS id nfianton signed in the Participant Portal on 19/06/2019 at 15:05:39 (transaction id SigId-105902-4V8NI6nlTuHw7Bysvl2guttcA8GhqvA5J7tHN4paYan8ZzUwA9fuzjcvOeAMSEzTunY7NEmSF5pzHdrughiUhKu-rS0vSrmBGYCzGdnqZKN7zYm-kW4ToKqutKmvj03etGQwtcn3fA9ivTdkKWBwU485vE4). Timestamp by third party at Wed Jun 19 16:05:50 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

CENTRUM VYZKUMU REZ S.R.O. (CVREZ), established in HUSINEC-REZ 130, HUSINEC-REZ 250 68, Czech Republic, VAT number: CZ26722445, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('7')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Lukas VESELY with ECAS id nveseluk signed in the Participant Portal on 24/05/2019 at 08:24:34 (transaction id SigId-31643-lBRMNopsPL9cgQPbwPkBnITuEWBdsX6kIcZ6zbthIgcISj vDD8EeZyiM75Z2b9mzzTHl0sj6lvaG1tMD5znY0G-jpJZscgsw0Kv1vxGC5zvJV-cqEJjmN15bCRvIS2hOF40dBi6uG533gf7888KSEvzac). Timestamp by third party at Fri May 24 09:24:39 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE (ENEA), established in LUNGOTEVERE GRANDE AMMIRAGLIO THAON DI REVEL 76, ROMA 000196, Italy, VAT number: IT00985801000, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('8')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Aldo PIZZUTO with ECAS id npizzald signed in the Participant Portal on 03/06/2019 at 09:06:50 (transaction id SigId-94331-
8KLJr6fDVd9JJBh12Cm7zRvjgJjO6TiTTIK7zXG7ejizyaXh
6fR1OyE1tvLmIRahuBSapzIlwtF0xozyEzxTZ7oW-
jpJZscgsw0Kv1vxGC5zvJV-
4VCLYcRDyUJUBNzUNkstzd4K9zsI6zp6q6lSrTfQBeOG).
Timestamp by third party at Mon Jun 03 10:06:55 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF EV (HZDR), established in BAUTZNER LANDSTRASSE 400, DRESDEN 01328, Germany, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('9')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Barbara SCHRAMM with ECAS id nschrabr signed in the Participant Portal on 23/05/2019 at 20:59:12 (transaction id SigId-29962-
FSvJ6JWQmuFBILZgXlZ0tkVIR74hd6XhTDm1k7odcj2zud
zTvNmcjPba3lhU7QojboFeASsQKcSCRL3AtQJH8j-
jpJZscgsw0Kv1vxGC5zvJV-
hxH6jnPfE6bdvozbyZPeGWaXSPzMR0quKyrxV9WntyYG)
. Timestamp by third party at
Thu May 23 21:59:22 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

INSTITUTUL NATIONAL DE CERCETARE -DEZVOLTARE PENTRU FIZICA SI INGINERIE NUCLEARA "HORIA HULUBEI" (IFIN-HH) (IFIN-HH), established in Atomistilor Street 407, MAGURELE RO 077125, Romania, VAT number: RO3321234, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('10')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Nicolae Victor ZAMFIR with ECAS id nzamnico signed in the Participant Portal on 24/05/2019 at 05:52:58 (transaction id SigId-30451-
BMYliurupCSdVqzMVxIJTmmDbV5ulCyTjf6AFNLoxhXYVr2dBcMuGaj3qmimLE5pEowS7oxinax6P1GfzkiphU-jpJZscgsw0Kv1vxGC5zvJV-zZ2rOd1F5AxeHsGKNLO5gneoLPnMSQKozzJK9o8cv5qO). Timestamp by third party at Fri May 24 06:53:07 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

INSTITUT DE RADIOPROTECTION ET DE SURETE NUCLEAIRE (IRSN), established in AV DE LA DIVISION LECLERC 31, FONTENAY AUX ROSES 92260, France, VAT number: FR68440546018, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('11')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Jean Christophe NIEL with ECAS id nnijeanc signed in the Participant Portal on 27/05/2019 at 13:07:34 (transaction id SigId-51061-YGBPaDaNP5zsMxsIhzntZOTvaBstAykSEJhqAQeQ50V6PoivxASQazWxSwfNyIwsJzr9cH7sKFedabeCnzkV8Ko-jpJZscgsw0Kv1vxGC5zvJV-PIV8DrUHFUWiYIE58TgzKWzQGJHUs2scLzem6EhHUnfS). Timestamp by third party at Mon May 27 14:10:40 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ASSOCIACAO DO INSTITUTO SUPERIOR TECNICO PARA A INVESTIGACAO E DESENVOLVIMENTO (IST-ID), established in AVENIDA ROVISCO PAIS 1, LISBOA 1049 001, Portugal, VAT number: PT509830072, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('12')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Arlindo OLIVEIRA with ECAS id nolivarl signed in the Participant Portal on 13/06/2019 at 16:48:00 (transaction id SigId-48808-bLkykq5Da49rAzTNbrvbRcuBeWTVxbYx0MuH6zpm8U0UBzewmAYPzKHY0zjnbdCGzbevKgprTnfzm3lzXgME0Gtg-rS0vSrmBGYCzGdnqZKN7zYm-Imwx9dc9gHO7vdzqlqTaavzaX5zaioYfFpqIOVCOmIOm). Timestamp by third party at Thu Jun 13 17:48:11 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

INSTITUT JOZEF STEFAN (JSI), established in Jamova 39, LJUBLJANA 1000, Slovenia, VAT number: SI55560822, (‘the beneficiary’), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No (‘14’)

in Grant Agreement No 847552 (‘the Agreement’)

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community (‘Euratom’), represented by the European Commission ('the Commission'),

for the action entitled ‘Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)’.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Jadran LENARČIČ with ECAS id nlenjada signed in the Participant Portal on 24/05/2019 at 09:26:54 (transaction id SigId-32945-yQlCvkvvfKCcWOJ0RnWEwN976hE3ijPre7lrgEhlksSecoq28LNqyKdmKzbnCUyewRg5UUS2D6KqdX6AcMf1bG-jpJZscgsw0Kv1vxGC5zvJV-D7PwsWNNzKTnVkOXDoeQtHD1ZogDwYPoQAzLMWEQAzc8). Timestamp by third party at Fri May 24 10:26:58 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

JYVASKYLAN YLIOPISTO (JYU), established in SEMINAARINKATU 15, JYVASKYLA 40100, Finland, VAT number: FI02458947, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('15')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Keijo HÄMÄLÄINEN with ECAS id nhaekeij signed in the Participant Portal on 27/05/2019 at 05:52:31 (transaction id SigId-44408-aKsdjQFSpfvzcD1nYQT7rwV8zbqtkqXSppZEYU7121c4TxqZvdODzNvErdHBLzL8I3BBlY4e36S8Eb9cgyq1fj4-jpJZscgsw0Kv1vxGC5zvJV-knyzIH4zI7NCuMdErvGBA5wsQZPxRHXESouu9zREHzho). Timestamp by third party at Mon May 27 06:52:37 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

KARLSRUHER INSTITUT FUER TECHNOLOGIE (KIT), established in KAISERSTRASSE 12, KARLSRUHE 76131, Germany, VAT number: DE266749428, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('16')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Kristine BENTZ with ECAS id nbentzkr signed in the Participant Portal on 24/05/2019 at 09:07:37 (transaction id SigId-32534-JM984B7gk48sk2Pj8ExGzezzPuG7wKFo65IDzV8X0f3zuhrXg1DfTDPmhWVZvyTyBbGledxLAjTzy0k50JhaKy3G-jpJZscgsw0Kv1vxGC5zvJV-S8ohWUcW8G4QEzGra5uUTaSZBZJcxJuqzoU8fLHDJGs0). Timestamp by third party at Fri May 24 10:07:42 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

USTAV JADERNE FYZIKY AV CR (NPI), established in Husinec - Řež 130, REZ - PRAHA 25068, Czech Republic, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('17')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Petr LUKÁŠ with ECAS id nlukpetr signed in the Participant Portal on 24/05/2019 at 09:35:36 (transaction id SigId-33123-hyTWTOIjqxkfmVms96ZkoEijV8GEzNhZ97zSfQMasEY30CKYzSHzaVrU94rGNvtzltfJ817QDwIuoIJ6XszlOUXG-jpJZscgsw0Kv1vxGC5zvJV-RhTKJJ0aLL4ize5A0PylOfyZprZeTnq5M4SMKmB8IRh). Timestamp by third party at Fri May 24 10:35:43 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

NPL MANAGEMENT LIMITED (NPL), established in HAMPTON ROAD TEDDINGTON, MIDDLESEX TW11 0LW, United Kingdom, VAT number: GB200429166, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('18')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Omolara Popoola with ECAS id n0028xse signed in the Participant Portal on 28/05/2019 at 11:17:49 (transaction id SigId-62374-AEjN5zhV8cbXLYQbxYB7vUm6TzcN7xAnn4xv6nU9SyzIp9zU4b1zKdVaEgptZojpxajXvd0GQK05fO0DYwsD8MZ-jpJZscgsw0Kv1vxGC5zvJV-7KTDw9VINwxDawXqzzjMuENLzzcvq16e5wL01lAzxSen0). Timestamp by third party at Tue May 28 12:17:59 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

NUCLEAR RESEARCH AND CONSULTANCY GROUP (NRG), established in WESTERDUINWEG 3, PETTEN 1755 LE, Netherlands, VAT number: NL807320316B01, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('19')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

ANGELIQUE DE BOER with ECAS id ndeboean signed in the Participant Portal on 27/05/2019 at 08:56:24 (transaction id SigId-45802-LUFo9JVO2RhfIcYdZ0e8ykLdabs0WYbEBCNwzapyQ3xK9OzjAjJ3rBwI4sZCpzzgmBXEzLF6sC9zqziid6yoax3a-jpJZscgsw0Kv1vxGC5zvJV-ra7o4UVmDIh0PHgzNqrP9RVXx4ztyWtsphBrgdI689XG). Timestamp by third party at Mon May 27 09:56:29 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA (NTUA), established in HEROON POLYTECHNIOU 9 ZOGRAPHOU CAMPUS, ATHINA 15780, Greece, VAT number: EL099793475, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('20')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Ioannis PASPALIARIS with ECAS id npaspaas signed in the Participant Portal on 20/06/2019 at 13:10:49 (transaction id SigId-117087-dHNckYzfMTszJFusTXPZYe6GxNjAGPRsF9hOifSDsoRnUziq6Hk0zk6Q0OdWMa2Szt0mfK3Pu1duzyj2G5ffUPI0-rS0vSrmBGYCzGdnqZKN7zYm-lcDTYf5edMYUaSJo224YNyJYcYzvzKY2duQjtMBvDNim).
Timestamp by third party at
Thu Jun 20 14:10:59 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

PAUL SCHERRER INSTITUT (PSI), established in FORSCHUNGSTRASSE 111, VILLIGEN PSI 5232, Switzerland, VAT number: CHE116133392MWST, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('21')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Irene WALTHERT with ECAS id nwalthir signed in the Participant Portal on 26/05/2019 at 04:52:20 (transaction id SigId-43678-ggCJLX2P1HsV4quOtzcucXxzKRDzvujhq3ufAMbxaFns93QsDhzhn27rtczlvlB42UBJWJUtBXfADzuxt3kO4gd0-jpJZscgsw0Kv1vxGC5zvJV-Lp902ppLClUzt90HQHVKR7Qu8NuK09IQZ62uCsiDzm0G). Timestamp by third party at Sun May 26 05:52:37 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT (PTB), established in Bundesallee 100, BRAUNSCHWEIG 38116, Germany, VAT number: DE811240952, (‘the beneficiary’), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No (‘22’)

in Grant Agreement No 847552 (‘the Agreement’)

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community (‘Euratom’), represented by the European Commission ('the Commission'),

for the action entitled ‘Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)’.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Barbara TAFEL with ECAS id ntafelba signed in the Participant Portal on 28/05/2019 at 08:14:42 (transaction id SigId-58332-SRP6Y7Qpf6zpMotVleFQdVjcr9hEKqg0DCqspZGBYBloo MTle8q9E0m1kSJjLfOyzo7abeQzztkU7L9GyIm64Dm-jpJZscgsw0Kv1vxGC5zvJV-xeMybPDL0qx2sUuOzJ10MKaFK3u8MTsL5leCcbzVBbq W). Timestamp by third party at Tue May 28 09:14:47 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

STUDIECENTRUM VOOR KERNENERGIE / CENTRE D'ETUDE DE L'ENERGIE NUCLEAIRE (SCK-CEN), established in AVENUE HERRMANN DEBROUX 40, BRUXELLES 1160, Belgium, VAT number: BE0406568867, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('23')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Eric VAN WALLE with ECAS id nwalleer signed in the Participant Portal on 29/05/2019 at 10:54:03 (transaction id SigId-75473-fNQW0aicC2d5zsnM6JIx01YezeEolgzn2zilc7HcvmzuaXP22191g8DBfI0PfPAyJ4NyaBzthS2uAFzx2WlZ8gLq-jpJZscgsw0Kv1vxGC5zvJV-2gzkrH19zXJGXVFPE6hFW5JUXKxKqwwdxwbZZAqCyzTa). Timestamp by third party at Wed May 29 11:54:09 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

SOFIA UNIVERSITY ST KLIMENT OHRIDSKI (Sofia), established in BUL TZAR OSVOBODITEL 15, SOFIA 1504, Bulgaria, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('24')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Bojil DOBREV with ECAS id ndobrebo signed in the Participant Portal on 24/05/2019 at 13:37:20 (transaction id SigId-38425-kUAhEvi4F0uzOSkzUeGDWX1E4fCYn716uAMGljUEzIOKR60aM9keiTiDbbDC3zf146StDWZ6k8NNYdSVnzqR9JK-jpJZscgsw0Kv1vxGC5zvJV-1rYEYedjIlFGhqsxfQyAb2U6UR2BjoqJKXmDlw0Gwv8). Timestamp by third party at Fri May 24 14:37:27 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

TECHNISCHE UNIVERSITAET WIEN (TUW), established in KARLSPLATZ 13, WIEN 1040, Austria, VAT number: ATU37675002, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('25')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Thorsten SCHUMM with ECAS id nschummt signed in the Participant Portal on 28/05/2019 at 20:27:03 (transaction id SigId-70302-Ih0Hb4t38PLT1EBhrUzZsFjYJYODFizYdXKzIcZ3u2opbhxOonZv4oN1SmzrwSd0xAuLauB7ouuhhUAbjYs4db4-jpJZscgsw0Kv1vxGC5zvJV-FTo8genx67Y0o0GNIshiq8vzGWKGfSfwJL0JARylqta). Timestamp by third party at Tue May 28 21:27:11 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITATEA DIN BUCURESTI (UB), established in MIHAIL KOGALNICEANU STREET 36-46 SECTOR V, BUCURESTI 050107, Romania, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('26')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Dragos DENA with ECAS id ndenadra signed in the Participant Portal on 10/06/2019 at 07:47:10 (transaction id SigId-673-sKLNF3VJHK1mXmzVJomll85qF6MWyHzPgtCq8K2AzqSyS8x1Je40nqNuKauqgRhMGEZYV1XUjqEBEB7PuUIAQAW-rS0vSrmBGYCzGdnqZKN7zYm-kNtLxk7l1xT8qSs84quhwaMmsegXrra8Bsn4TaxUXMS). Timestamp by third party at Mon Jun 10 08:47:19 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIWERSYTET LODZKI (ULODZ), established in UL PREZYDENTA GABRIELA NARUTOWICZA 68, LODZ 90 136, Poland, VAT number: PL7240003243, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('27')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Elżbieta ŻĄDZIŃSKA with ECAS id nzadziel signed in the Participant Portal on 24/05/2019 at 11:21:01 (transaction id SigId-35880-sYzGbv01R1zHcgn2TMysCnxGFeALUWNw8A9AIZoOD7D0x5fgHgtM9TpgG6tvzwA6KFH17CFaRE3u2dik4T5rycG-jpJZscgsw0Kv1vxGC5zvJV-0zVJWvL3nbPMAYsaOkFKkNCBrSQF7kP3Z7emBKzownkm). Timestamp by third party at Fri May 24 12:21:14 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

JOHANNES GUTENBERG-UNIVERSITAT MAINZ (UMAINZ), established in SAARSTRASSE 21, MAINZ 55099, Germany, VAT number: DE149065685, (‘the beneficiary’), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No (‘28’)

in Grant Agreement No 847552 (‘the Agreement’)

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community (‘Euratom’), represented by the European Commission ('the Commission'),

for the action entitled ‘Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)’.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Georg KRAUSCH with ECAS id nkraugeo signed in the Participant Portal on 04/06/2019 at 08:59:39 (transaction id SigId-107444-39oS3PxS74pNI8YlWVqx2fzvKYumSqcKtLWqL2asPJk3kHezIDYQiL1ByCEmPnB4HoNUnLnw3xXRZQA3rF2dHY-jpJZscgsw0Kv1vxGC5zvJV-xcF8WOJq99fr3MYGEo9wwdxi9DauztZ5op69opRa76m). Timestamp by third party at Tue Jun 04 09:59:48 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

THE UNIVERSITY OF MANCHESTER (UMANCH), established in OXFORD ROAD, MANCHESTER M13 9PL, United Kingdom, VAT number: GB849738956, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('29')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Andrew WALSH with ECAS id nwlshadr signed in the Participant Portal on 31/05/2019 at 13:21:47 (transaction id SigId-90956-AxGJ0JYTSmoxYKzIWijMZq9ZgLEWpDFHNdMUbmn7N2A6YzQ2FBX05iDSUkflezu1axDQr5EZxskQ5rYI6R8zr3u-jpJZscgsw0Kv1vxGC5zvJV-vQtq89KB3uBuTTcv69mHXVCsqQQfOqe4yJEmPwgXpIW). Timestamp by third party at Fri May 31 14:21:53 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

PANEPISTIMIO IOANNINON (UOI), established in PANEPISTEMIOYPOLE PANEPISTEMIO IOANNINON, IOANNINA 45110, Greece, VAT number: EL090029284, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('30')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Spyridon Georgatos with ECAS id nlagaisa signed in the Participant Portal on 24/05/2019 at 07:26:16 (transaction id SigId-30861-U9CiIRVkzkUUS45dJ4XbvuyTPyE1Km4K5HIzevxc6tkdf5Me4sYJYKkuTMHqwB3iSqteKbNiQQvJBBjguHLRQa-jpJZscgsw0Kv1vxGC5zvJV-KshazLW6wdVsgqgU3BLDG0MizhLLHBAnIFoRIOKnaVCm). Timestamp by third party at Fri May 24 08:26:21 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITAT POLITECNICA DE CATALUNYA (UPC), established in CALLE JORDI GIRONA 31, BARCELONA 08034, Spain, VAT number: ESQ0818003F, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('31')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Francesc Torres with ECAS id n001zx2t signed in the Participant Portal on 12/06/2019 at 14:59:49 (transaction id SigId-31377-I11Pm2UR382qPGzhsXxWBUM9K1pOoUt49cirPpG4tuL18MaeasbGCBcKzHFMYk3DEsfTuld84N2xcujb4wv6gj-rS0vSrmBGYCzGdnqZKN7zYm-aBYCiBzkqEB9OivLP5IRbYRAWTTzIlWkqjaO3LLoBzia). Timestamp by third party at Wed Jun 12 16:00:00 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSIDAD POLITECNICA DE MADRID (UPM), established in CALLE RAMIRO DE MAEZTU 7 EDIFICIO RECTORADO, MADRID 28040, Spain, VAT number: ESQ2818015F, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('32')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Asunción GÓMEZ-PÉREZ with ECAS id ngomasun signed in the Participant Portal on 29/05/2019 at 07:41:13 (transaction id SigId-71368-URRgMGIwmcMDzbq2kock70El6EvlzrMiqoCZgf8kp6oZonmzwQZJEEYSqyCqNBkWmc9ns8mlaEzyBhtHJXCtljC-jpJZscgsw0Kv1vxGC5zvJV-MQczlK7kzwLLKHcoD8No0dx00wDrPwCKcx6ATKbgKtY0). Timestamp by third party at Wed May 29 08:41:18 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSIDAD DE SANTIAGO DE COMPOSTELA (USC), established in COLEXIO DE SAN XEROME PRAZA DO OBRADOIRO S/N, SANTIAGO DE COMPOSTELA 15782, Spain, VAT number: ESQ1518001A, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('33')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Vicente Perez Muñuzuri with ECAS id nrodrath signed in
the Participant Portal on 24/05/2019 at 13:25:32
(transaction id SigId-38139-
RB6SQbTte8rQMf75zW0KcmBwyPLgbkzkmsZAQVCdo14
pzVh6uzeRH8qu1giyLFhajOCeQfSl101GkIwzIzZlzT9G-
jpJZscgsw0Kv1vxGC5zvJV-
QFMSl6xxwRF3NJcbZZtJAXJNJtOsCwNDZHKAATQVem
C). Timestamp by third party at
Fri May 24 14:25:37 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSIDAD DE SEVILLA (USE), established in CALLE S. FERNANDO 4, SEVILLA 41004, Spain, VAT number: ESQ4118001I, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('34')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Julián MARTÍNEZ FERNÁNDEZ with ECAS id ngarcimw
signed in the Participant Portal on 27/05/2019 at 07:13:14
(transaction id SigId-44673-
qVCi7OknAfYl5AfpQldPbIHfdh0J6tcmKsqBF8jQDRyJzI0c
AkrRQzr0tNXe0PzzOoeq5xPmg040iZczssp0zeG0-
jpJZscgsw0Kv1vxGC5zvJV-
cGK19BLOaSkcP8zVFMECuh1GtDM4cPDFx0vBIwdzijN0
). Timestamp by third party at
Mon May 27 08:13:19 CEST 2019

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UPPSALA UNIVERSITET (UU), established in VON KRAEMERS ALLE 4, UPPSALA 751 05, Sweden, VAT number: SE202100293201, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('35')

in Grant Agreement No 847552 ('the Agreement')

between CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'),

for the action entitled 'Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Per ABRAHAMSSON with ECAS id nabrahap signed in
the Participant Portal on 27/05/2019 at 17:12:05
(transaction id SigId-56284-
rjIJ2PVezlwl96zOczoSArgM49BFNLhMcSOvgwfQ8lvXzW
PzvmozpWfWFZjX3qXcDl51bt2yUYHWLAcxdvHib0qG-
jpJZscgsw0Kv1vxGC5zvJV-
bXhe62TPadHeZi7KzmPiTxHiN49delmrdCbj4DWoY7t).
Timestamp by third party at
Mon May 27 18:12:11 CEST 2019

EUROPEAN COMMISSION
Joint Research Centre (JRC)

Director

ANNEX 3b

ADMINISTRATIVE ARRANGEMENT WITH THE JOINT RESEARCH CENTRE (JRC) FOR A HORIZON 2020 FRAMEWORK PROGRAMME GRANT

This **Administrative Arrangement** is **between** the following parties:

on the one part,

DG Directorate-General for Research and Innovation

represented for the purposes of signature of this Arrangement by Mila BAS SANCHEZ, Head of Unit, Directorate-General for Research and Innovation, Administration and finance,

and

on the other part,

the **Joint Research Centre (JRC)**, represented by the .

With this Administrative Arrangement, the **parties agree** to **consider the JRC** as **beneficiary in Grant Agreement No** 847552 ('the Grant Agreement') **between** CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS-CIEMAT (CIEMAT) **and** the European Atomic Energy Community ('Euratom'), represented by the European Commission ('the Commission'), **for the action "Supplying Accurate Nuclear Data for energy and non-energy Applications (SANDA)"**

The **JRC accepts the grant** and **agrees to implement the action**, as specified in Annex 1 to the Grant Agreement, under its own responsibility and in accordance with the Grant Agreement, with all the obligations and conditions it sets out.

The **parties agree** to the following **specific provisions** for the JRC:

- the JRC becomes part of the Grant Agreement not via an accession form but via an administrative arrangement (Preamble);
- the JRC is considered a 'beneficiary' (preamble);
- the periodic financial report must contain information on the amount of each interim payment and payment of the balance to be paid by the DG to the JRC (Article 20.3);

- the part of the pre-financing payment(s) related to the JRC is not paid to the coordinator, but kept by the DG for the JRC (Article 21.2).

In addition to these specificities, the **parties agree**:

1. Start of participation

The JRC will assume rights and obligations under the Grant Agreement with effect from the date of entry into force of the Grant Agreement.

2. Payments

Payments will be transferred according to the Commission's accounting rules on internal invoicing and will be made from the operational budget line of the DG to the Legal Entity File (LEF) number of the JRC, mentioning the Recovery Order (RO) number. The JRC will submit a debit note for each payment (including the pre-financing).

The DG will make the following payments (see Article 21 of the Grant Agreement) to the JRC:

- a **pre-financing payment** of EUR **165 332.80** (one hundred and sixty five thousand three hundred and thirty two EURO and eighty eurocents), within 30 days from the submission of a debit note by the JRC after the signature of the Administrative Arrangement

  The JRC agrees that the amount of EUR **15 499.95** (fifteen thousand four hundred and ninety nine EURO and ninety five eurocents), representing its contribution to the Guarantee Fund (see Article 21.2 of the Grant Agreement), is transferred in its name by the DG to the Guarantee Fund

- one or more **interim payments** (see Article 21.3 of the Grant Agreement)

- a **payment of the balance** (see Article 21.4 of the Grant Agreement).

3. Late-payment interest

No interest will be paid on delayed payments between the JRC and the DG.

4. Certificate on the financial statements and/or certificate on the methodology

The JRC Quality assurance and risk management unit will act as the competent public officer for providing the certificate pursuant to Articles 18.1.2 and 20.4 of the Grant Agreement.

5. Amendments

Any amendment to the Administrative Arrangement will be signed in the electronic exchange system (see Articles 52 and 55 of the Grant Agreement).

6. Interpretation

If the Grant Agreement conflicts with any provision of the Administrative Arrangement with regard to relations between the DG and the JRC, the latter will prevail.

7. Termination

If the Grant Agreement is terminated (see Article 50.1 or 50.3 of the Grant Agreement), this Administrative Arrangement will terminate automatically in parallel.

If the participation of the JRC is terminated (see Article 50.2 or 50.3 of the Grant Agreement), the Administrative Arrangement will be terminated under the conditions set out in the Grant Agreement — *mutatis mutandis*.

8. Entry into force

The Administrative Arrangement will enter into force on the day of signature by the JRC.

SIGNATURE
For the JRC

Maria BETTI with ECAS id bettimi signed in the Participant Portal on 04/06/2019 at 12:57:37 (transaction id SigId-112830-vHGzS2P9kQ08VZ65MxiQbDPttGrvq6kLCONpMGkEm2Jx5CitGBkJ4aBWJbOBa19i6zwE5X112jxGD7Z52ADbziG-jpJZscgsw0Kv1vxGC5zvJV-O2QWAKQd4UUo3dSmo0Z7opfiZRoRUuUedzwIzaSzLToe). Timestamp by third party at Tue Jun 04 13:57:44 CEST 2019

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FINANCIAL STATEMENT FOR *[BENEFICIARY [name]/ LINKED THIRD PARTY [name]]* FOR REPORTING PERIOD [reporting period]

	Eligible[1] costs (per budget category)														Receipts	EU contribution			Additional information
	A. Direct personnel costs				B. Direct costs of subcontracting	*[C. Direct costs of fin. support]*	D. Other direct costs			E. Indirect costs[2]	*[F. Costs of …]*			Total costs	Receipts	Reimbursement rate %	Maximum EU contribution[3]	Requested EU contribution	Information for indirect costs :
	A.1 Employees (or equivalent) A.2 Natural persons under direct contract A.3 Seconded persons *[A.6 Personnel for providing access to research infrastructure]*		A.4 SME owners without salary A.5 Beneficiaries that are natural persons without salary			*[C.1 Financial support]* *[C.2 Prizes]*	D.1 Travel D.2 Equipment D.3 Other goods and services	*[D.4 Costs of large research infrastructure]*	D.5 Costs of internally invoiced goods and services		*[F.1 Costs of …]*		*[F.2 Costs of …]*		Receipts of the action, to be reported in the last reporting period, according to Article 5.3.3				Costs of in-kind contributions not used on premises
Form of costs[4]	Actual	Unit	Unit		Actual	Actual	Actual	Actual	Unit	Flat-rate[5] 25%	Unit		*[Unit][Lump sum]*						
	a	Total b	No hours	Total c	d	*[e]*	f	*[g]*	Total h	i=0,25 x (a+b+c+f+*[g]* + h+ *[j 1]*[6]+*[j2]*[6]-p)	No units	Total *[j1]*	Total *[j2]*	k = a+b+c+d+*[e]* +*f* + *[g]* +h+ i + *[j1]* +*[j2]*	l	m	n	o	p
[short name beneficiary/linked third party]																			

The beneficiary/linked third party hereby confirms that:
The information provided is complete, reliable and true.
The costs declared are eligible (see Article 6).
The costs can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 17, 18 and 22).
For the last reporting period: that all the receipts have been declared (see Article 5.3.3).

ⓘ Please declare all eligible costs, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Only amounts that were declared in your individual financial statements can be taken into account lateron, in order to replace other costs that are found to be ineligible.

[1] See Article 6 for the eligibility conditions

[2] The indirect costs claimed must be free of any amounts covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.2.E). If you have received an operating grant during this reporting period, you cannot claim indirect costs unless you can demonstrate that the operating grant does not cover any costs of the action.

[3] This is the *theoretical* amount of EU contribution that the system calculates automatically (by multiplying the reimbursement rate by the total costs declared). The amount you request (in the column 'requested EU contribution') may be less,

[4] See Article 5 for the forms of costs

[5] Flat rate : 25% of eligible direct costs, from which are excluded: direct costs of subcontracting, costs of in-kind contributions not used on premises, direct costs of financial support, and unit costs declared under budget category F if they include indirect costs (see Article 6.2.E)

[6] Only specific unit costs that do not include indirect costs

ANNEX 5

MODEL FOR THE CERTIFICATE ON THE FINANCIAL STATEMENTS

- **For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.**
- **For fields in [grey in square brackets]: enter the appropriate data**

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Terms of Reference for an Independent Report of Factual Findings on costs declared under a Grant Agreement financed under the Horizon 2020 Research and Innovation Framework Programme

This document sets out the '**Terms of Reference (ToR)**' under which

[OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')]

agrees to engage

[**insert legal name of the auditor**] ('the Auditor')

to produce an independent report of factual findings ('the Report') concerning the Financial Statement(s)[1] drawn up by the *[Beneficiary] [Linked Third Party]* for the Horizon 2020 grant agreement [insert number of the grant agreement, title of the action, acronym and duration from/to] ('the Agreement'), and

to issue a Certificate on the Financial Statements' ('CFS') referred to in Article 20.4 of the Agreement based on the compulsory reporting template stipulated by the Commission.

The Agreement has been concluded under the Horizon 2020 Research and Innovation Framework Programme (H2020) between the Beneficiary and *[OPTION 1: the European Union, represented by the European Commission ('the Commission')][OPTION 2: the European Atomic Energy Community (Euratom,) represented by the European Commission ('the Commission')][OPTION 3: the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] ('the Agency'), under the powers delegated by the European Commission ('the Commission').]*

The *[Commission] [Agency]* is mentioned as a signatory of the Agreement with the Beneficiary only. The *[European Union][Euratom][Agency]* is not a party to this engagement.

1.1 Subject of the engagement

The coordinator must submit to the *[Commission][Agency]* the final report within 60 days following the end of the last reporting period which should include, amongst other documents, a CFS for each beneficiary and for each linked third party that requests a total contribution of EUR 325 000 or more, as reimbursement of actual costs and unit costs calculated on the basis of its usual cost accounting practices (see Article 20.4 of the Agreement). The CFS must cover all reporting periods of the beneficiary or linked third party indicated above.

The Beneficiary must submit to the coordinator the CFS for itself and for its linked third party(ies), if the CFS must be included in the final report according to Article 20.4 of the Agreement.

The CFS is composed of two separate documents:

- The Terms of Reference ('the ToR') to be signed by the *[Beneficiary] [Linked Third Party]* and the Auditor;

[1] By which costs under the Agreement are declared (see template 'Model Financial Statements' in Annex 4 to the Grant Agreement).

- The Auditor's Independent Report of Factual Findings ('the Report') to be issued on the Auditor's letterhead, dated, stamped and signed by the Auditor (or the competent public officer) which includes the agreed-upon procedures ('the Procedures') to be performed by the Auditor, and the standard factual findings ('the Findings') to be confirmed by the Auditor.

If the CFS must be included in the final report according to Article 20.4 of the Agreement, the request for payment of the balance relating to the Agreement cannot be made without the CFS. However, the payment for reimbursement of costs covered by the CFS does not preclude the Commission *[Agency,]* the European Anti-Fraud Office and the European Court of Auditors from carrying out checks, reviews, audits and investigations in accordance with Article 22 of the Agreement.

1.2 Responsibilities

The *[Beneficiary] [Linked Third Party]:*

- must draw up the Financial Statement(s) for the action financed by the Agreement in compliance with the obligations under the Agreement. The Financial Statement(s) must be drawn up according to the *[Beneficiary's] [Linked Third Party's]* accounting and book-keeping system and the underlying accounts and records;
- must send the Financial Statement(s) to the Auditor;
- is responsible and liable for the accuracy of the Financial Statement(s);
- is responsible for the completeness and accuracy of the information provided to enable the Auditor to carry out the Procedures. It must provide the Auditor with a written representation letter supporting these statements. The written representation letter must state the period covered by the statements and must be dated;
- accepts that the Auditor cannot carry out the Procedures unless it is given full access to the *[Beneficiary's] [Linked Third Party's]* staff and accounting as well as any other relevant records and documentation.

The Auditor:

- *[Option 1 by default:* is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations*]*.
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer:* is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary*]*.
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation:* is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation*]*.

The Auditor:

- must be independent from the Beneficiary *[and the Linked Third Party]*, in particular, it must not have been involved in preparing the *[Beneficiary's] [Linked Third Party's]* Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with this ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the *[Beneficiary] [Linked Third Party]*.

The Commission sets out the Procedures to be carried out by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement, the Auditor does not provide an audit opinion or a statement of assurance.

1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with[2]:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the *[Commission][Agency]* requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there is no conflict of interests in establishing this Report between the Auditor and the Beneficiary *[and the Linked Third Party]*, and must specify - if the service is invoiced - the total fee paid to the Auditor for providing the Report.

1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7).

Under Article 22 of the Agreement, the Commission*[, the Agency]*, the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are declared from [*the European Union*] [*Euratom*] budget. This includes work related to this engagement. The Auditor must provide access to all working papers (e.g. recalculation of hourly rates, verification of the time declared for the action) related to this assignment if the Commission *[, the Agency]*, the European Anti-Fraud Office or the European Court of Auditors requests them.

1.5 Timing

The Report must be provided by *[*dd Month yyyy*]*.

1.6 Other terms

[*The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor's fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.*]

[legal name of the Auditor]	[legal name of the *[Beneficiary][Linked Third Party]*]
[name & function of authorised representative]	[name & function of authorised representative]
[dd Month yyyy]	[dd Month yyyy]
Signature of the Auditor	Signature of the *[Beneficiary][Linked Third Party]*

[2] Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

Independent Report of Factual Findings on costs declared under Horizon 2020 Research and Innovation Framework Programme

(To be printed on the Auditor's letterhead)

To
[name of contact person(s)], [Position]
[[*Beneficiary's*] [*Linked Third Party's*] name]
[Address]
[dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with *[OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')],*

we
[name of the auditor] ('the Auditor'),
established at
[full address/city/state/province/country],
represented by
[name and function of an authorised representative],

have carried out the procedures agreed with you regarding the costs declared in the Financial Statement(s)[3] of the *[Beneficiary] [Linked Third Party]* concerning the grant agreement
[insert grant agreement reference: number, title of the action and acronym] ('the Agreement'),

with a total cost declared of
[total amount] EUR,

and a total of actual costs and unit costs calculated in accordance with the [*Beneficiary's*] [*Linked Third Party's*] usual cost accounting practices' declared of

[sum of total actual costs and total direct personnel costs declared as unit costs calculated in accordance with the *[Beneficiary's] [Linked Third Party's]* usual cost accounting practices] EUR

and **hereby provide our Independent Report of Factual Findings ('the Report')** using the compulsory report format agreed with you.

<u>The Report</u>

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') examined.

[3] By which the Beneficiary declares costs under the Agreement (see template 'Model Financial Statement' in Annex 4 to the Agreement).

The Procedures were carried out solely to assist the *[Commission] [Agency]* in evaluating whether the *[Beneficiary's] [Linked Third Party's]* costs in the accompanying Financial Statement(s) were declared in accordance with the Agreement. The *[Commission] [Agency]* draws its own conclusions from the Report and any additional information it may require.

The scope of the Procedures was defined by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence. Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, the Auditor does not give a statement of assurance on the Financial Statements.

Had the Auditor carried out additional procedures or an audit of the *[Beneficiary's] [Linked Third Party's]* Financial Statements in accordance with International Standards on Auditing or International Standards on Review Engagements, other matters might have come to its attention and would have been included in the Report.

Not applicable Findings

We examined the Financial Statement(s) stated above and considered the following Findings not applicable:

Explanation (to be removed from the Report):

*If a Finding was not applicable, it must be marked as '**N.A.**' ('Not applicable') in the corresponding row on the right-hand column of the table and means that the Finding did not have to be corroborated by the Auditor and the related Procedure(s) did not have to be carried out.*

The reasons of the non-application of a certain Finding must be obvious i.e.

i) *if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable;*
ii) *if the condition set to apply certain Procedure(s) are not met the related Finding(s) and those Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than euro' the Procedure and Finding related to 'beneficiaries with accounts established in euro' are not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.*

List here all Findings considered not applicable for the present engagement and explain the reasons of the non-applicability.
….

Exceptions

Apart from the exceptions listed below, the *[Beneficiary] [Linked Third Party]* provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and evaluate the Findings.

Explanation (to be removed from the Report):

- *If the Auditor was not able to successfully complete a procedure requested, it must be marked as '**E**' ('Exception') in the corresponding row on the right-hand column of the table. The reason such as the inability to reconcile key information or the unavailability of data that prevents the Auditor from carrying out the Procedure must be indicated below.*
- *If the Auditor cannot corroborate a standard finding after having carried out the corresponding procedure, it must also be marked as '**E**' ('Exception') and, where possible, the reasons why the Finding was not fulfilled and its possible impact must be explained here below.*

List here any exceptions and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, include the corresponding amount.
….

Example (to be removed from the Report):

1. *The Beneficiary was unable to substantiate the Finding number 1 on … because ….*
2. *Finding number 30 was not fulfilled because the methodology used by the Beneficiary to calculate unit costs was different from the one approved by the Commission. The differences were as follows: …*
3. *After carrying out the agreed procedures to confirm the Finding number 31, the Auditor found a difference of _____________ EUR. The difference can be explained by …*

Further Remarks

In addition to reporting on the results of the specific procedures carried out, the Auditor would like to make the following general remarks:

Example (to be removed from the Report):

1. *Regarding Finding number 8 the conditions for additional remuneration were considered as fulfilled because …*
2. *In order to be able to confirm the Finding number 15 we carried out the following additional procedures: ….*

Use of this Report

This Report may be used only for the purpose described in the above objective. It was prepared solely for the confidential use of the *[Beneficiary] [Linked Third Party]* and the [*Commission*] [*Agency*], and only to be submitted to the *[Commission] [Agency]* in connection with the requirements set out in Article 20.4 of the Agreement. The Report may not be used by the *[Beneficiary] [Linked Third Party]* or by the *[Commission] [Agency]* for any other purpose, nor may it be distributed to any other parties. The *[Commission] [Agency]* may only disclose the Report to authorised parties, in particular to the European Anti-Fraud Office (OLAF) and the European Court of Auditors.

This Report relates only to the Financial Statement(s) submitted to the *[Commission] [Agency]* by the *[Beneficiary] [Linked Third Party]* for the Agreement. Therefore, it does not extend to any other of the *[Beneficiary's] [Linked Third Party's]* Financial Statement(s).

There was no conflict of interest[4] between the Auditor and the Beneficiary *[and Linked Third Party]* in establishing this Report. The total fee paid to the Auditor for providing the Report was EUR ______ (including EUR______ of deductible VAT).

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance.

[legal name of the Auditor]
[name and function of an authorised representative]
[dd Month yyyy]
Signature of the Auditor

[4] A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:
- was involved in the preparation of the Financial Statements;
- stands to benefit directly should the certificate be accepted;
- has a close relationship with any person representing the beneficiary;
- is a director, trustee or partner of the beneficiary; or
- is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

Agreed-upon procedures to be performed and standard factual findings to be confirmed by the Auditor

The European Commission reserves the right to i) provide the auditor with additional guidance regarding the procedures to be followed or the facts to be ascertained and the way in which to present them (this may include sample coverage and findings) or to ii) change the procedures, by notifying the Beneficiary in writing. The procedures carried out by the auditor to confirm the standard factual finding are listed in the table below.

If this certificate relates to a Linked Third Party, any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

The 'result' column has three different options: 'C', 'E' and 'N.A.':

- 'C' stands for 'confirmed' and means that the auditor can confirm the 'standard factual finding' and, therefore, there is no exception to be reported.
- 'E' stands for 'exception' and means that the Auditor carried out the procedures but cannot confirm the 'standard factual finding', or that the Auditor was not able to carry out a specific procedure (e.g. because it was impossible to reconcile key information or data were unavailable),
- 'N.A.' stands for 'not applicable' and means that the Finding did not have to be examined by the Auditor and the related Procedure(s) did not have to be carried out. The reasons of the non-application of a certain Finding must be obvious i.e. i) if no cost was declared under a certain category then the related Finding(s) and Procedure(s) are not applicable; ii) if the condition set to apply certain Procedure(s) are not met then the related Finding(s) and Procedure(s) are not applicable. For instance, for 'beneficiaries with accounts established in a currency other than the euro' the Procedure related to 'beneficiaries with accounts established in euro' is not applicable. Similarly, if no additional remuneration is paid, the related Finding(s) and Procedure(s) for additional remuneration are not applicable.

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A	**ACTUAL PERSONNEL COSTS AND UNIT COSTS CALCULATED BY THE BENEFICIARY IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICE**		
	The Auditor draws a sample of persons whose costs were declared in the Financial Statement(s) to carry out the procedures indicated in the consecutive points of this section A. (*The sample should be selected randomly so that it is representative. Full coverage is required if there are fewer than 10 people (including employees, natural persons working under a direct contract and personnel seconded by a third party), otherwise the sample should have a minimum of 10 people, or 10% of the total, whichever number is the highest)* The Auditor sampled ______ people out of the total of ______ people.		

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A.1	**PERSONNEL COSTS** <u>For the persons included in the sample and working under an employment contract or equivalent act (general procedures for individual actual personnel costs and personnel costs declared as unit costs)</u> To confirm standard factual findings 1-5 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary: ○ a list of the persons included in the sample indicating the period(s) during which they worked for the action, their position (classification or category) and type of contract; ○ the payslips of the employees included in the sample; ○ reconciliation of the personnel costs declared in the Financial Statement(s) with the accounting system (project accounting and general ledger) and payroll system; ○ information concerning the employment status and employment conditions of personnel included in the sample, in particular their employment contracts or equivalent; ○ the Beneficiary's usual policy regarding payroll matters (e.g. salary policy, overtime policy, variable pay); ○ applicable national law on taxes, labour and social security and ○ any other document that supports the personnel costs declared. The Auditor also verified the eligibility of all components of the retribution (see Article 6 GA) and recalculated the personnel costs for employees included in the sample.	1) The employees were i) directly hired by the Beneficiary in accordance with its national legislation, ii) under the Beneficiary's sole technical supervision and responsibility and iii) remunerated in accordance with the Beneficiary's usual practices.	
		2) Personnel costs were recorded in the Beneficiary's accounts/payroll system.	
		3) Costs were adequately supported and reconciled with the accounts and payroll records.	
		4) Personnel costs did not contain any ineligible elements.	
		5) There were no discrepancies between the personnel costs charged to the action and the costs recalculated by the Auditor.	
	Further procedures if 'additional remuneration' is paid To confirm standard factual findings 6-9 listed in the next column, the Auditor: ○ reviewed relevant documents provided by the Beneficiary (legal form, legal/statutory	6) The Beneficiary paying "additional remuneration" was a non-profit legal entity.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	obligations, the Beneficiary's usual policy on additional remuneration, criteria used for its calculation, the Beneficiary's usual remuneration practice for projects funded under national funding schemes…); ○ recalculated the amount of additional remuneration eligible for the action based on the supporting documents received (full-time or part-time work, exclusive or non-exclusive dedication to the action, usual remuneration paid for projects funded by national schemes) to arrive at the applicable FTE/year and pro-rata rate (see data collected in the course of carrying out the procedures under A.2 'Productive hours' and A.4 'Time recording system'). *'ADDITIONAL REMUNERATION' MEANS ANY PART OF THE REMUNERATION WHICH EXCEEDS WHAT THE PERSON WOULD BE PAID FOR TIME WORKED IN PROJECTS FUNDED BY NATIONAL SCHEMES.* *IF ANY PART OF THE REMUNERATION PAID TO THE EMPLOYEE QUALIFIES AS "ADDITIONAL REMUNERATION" AND IS ELIGIBLE UNDER THE PROVISIONS OF ARTICLE 6.2.A.1, THIS CAN BE CHARGED AS ELIGIBLE COST TO THE ACTION UP TO THE FOLLOWING AMOUNT:* *(A) IF THE PERSON WORKS FULL TIME AND EXCLUSIVELY ON THE ACTION DURING THE FULL YEAR: UP TO EUR 8 000/YEAR;* *(B) IF THE PERSON WORKS EXCLUSIVELY ON THE ACTION BUT NOT FULL-TIME OR NOT FOR THE FULL YEAR: UP TO THE CORRESPONDING PRO-RATA AMOUNT OF EUR 8 000, OR* *(C) IF THE PERSON DOES NOT WORK EXCLUSIVELY ON THE ACTION: UP TO A PRO-RATA AMOUNT CALCULATED IN ACCORDANCE TO ARTICLE 6.2.A.1.*	7) The amount of additional remuneration paid corresponded to the Beneficiary's usual remuneration practices and was consistently paid whenever the same kind of work or expertise was required.	
		8) The criteria used to calculate the additional remuneration were objective and generally applied by the Beneficiary regardless of the source of funding used.	
		9) The amount of additional remuneration included in the personnel costs charged to the action was capped at EUR 8,000 per FTE/year (up to the equivalent pro-rata amount if the person did not work full-time during the year or did not work exclusively on the action).	
	Additional procedures in case "unit costs calculated by the Beneficiary in accordance with its usual cost accounting practices" is applied: Apart from carrying out the procedures indicated above to confirm standard factual findings 1-5 and, if applicable, also 6-9, the Auditor carried out following procedures to confirm standard	10) The personnel costs included in the Financial Statement were calculated in accordance with the Beneficiary's usual cost accounting practice. This methodology was consistently	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	factual findings 10-13 listed in the next column:	used in all H2020 actions.	
	○ obtained a description of the Beneficiary's usual cost accounting practice to calculate unit costs;. ○ reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS;	11) The employees were charged under the correct category.	
	○ verified the employees included in the sample were charged under the correct category (in accordance with the criteria used by the Beneficiary to establish personnel categories) by reviewing the contract/HR-record or analytical accounting records;	12) Total personnel costs used in calculating the unit costs were consistent with the expenses recorded in the statutory accounts.	
	○ verified that there is no difference between the total amount of personnel costs used in calculating the cost per unit and the total amount of personnel costs recorded in the statutory accounts; ○ verified whether actual personnel costs were adjusted on the basis of budgeted or estimated elements and, if so, verified whether those elements used are actually relevant for the calculation, objective and supported by documents.	13) Any estimated or budgeted element used by the Beneficiary in its unit-cost calculation were relevant for calculating personnel costs and corresponded to objective and verifiable information.	
	<u>For natural persons included in the sample and working with the Beneficiary under a direct contract other than an employment contract, such as consultants (no subcontractors).</u> To confirm standard factual findings 14-17 listed in the next column the Auditor reviewed following information/documents provided by the Beneficiary: ○ the contracts, especially the cost, contract duration, work description, place of work, ownership of the results and reporting obligations to the Beneficiary; ○ the employment conditions of staff in the same category to compare costs and; ○ any other document that supports the costs declared and its registration (e.g. invoices, accounting records, etc.).	14) The natural persons worked under conditions similar to those of an employee, in particular regarding the way the work is organised, the tasks that are performed and the premises where they are performed.	
		15) The results of work carried out belong to the Beneficiary, or, if not, the Beneficiary has obtained all necessary rights to fulfil its obligations as if those	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
		results were generated by itself.	
		16) Their costs were not significantly different from those for staff who performed similar tasks under an employment contract with the Beneficiary.	
		17) The costs were supported by audit evidence and registered in the accounts.	
	<u>For personnel seconded by a third party and included in the sample (not subcontractors)</u> To confirm standard factual findings 18-21 listed in the next column, the Auditor reviewed following information/documents provided by the Beneficiary: ○ their secondment contract(s) notably regarding costs, duration, work description, place of work and ownership of the results; ○ if there is reimbursement by the Beneficiary to the third party for the resource made available_(in-kind contribution against payment): any documentation that supports the costs declared (e.g. contract, invoice, bank payment, and proof of registration in its accounting/payroll, etc.) and reconciliation of the Financial Statement(s) with the accounting system (project accounting and general ledger) as well as any proof that the amount invoiced by the third party did not include any profit; ○ if there is no reimbursement by the Beneficiary to the third party for the resource made available (in-kind contribution free of charge): a proof of the actual cost borne by the Third Party for the resource made available free of charge to the Beneficiary such as a statement of costs incurred by the Third Party and proof of the registration in the Third Party's accounting/payroll;	18) Seconded personnel reported to the Beneficiary and worked on the Beneficiary's premises (unless otherwise agreed with the Beneficiary).	
		19) The results of work carried out belong to the Beneficiary, or, if not, the Beneficiary has obtained all necessary rights to fulfil its obligations as if those results were generated by itself..	
		If personnel is seconded against payment: 20) The costs declared were supported with documentation and recorded in the	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	○ any other document that supports the costs declared (e.g. invoices, etc.).	Beneficiary's accounts. The third party did not include any profit.	
		If personnel is seconded free of charge: 21) The costs declared did not exceed the third party's cost as recorded in the accounts of the third party and were supported with documentation.	
A.2	**PRODUCTIVE HOURS** To confirm standard factual findings 22-27 listed in the next column, the Auditor reviewed relevant documents, especially national legislation, labour agreements and contracts and time records of the persons included in the sample, to verify that: ○ the annual productive hours applied were calculated in accordance with one of the methods described below, ○ the full-time equivalent (FTEs) ratios for employees not working full-time were correctly calculated. If the Beneficiary applied method B, the auditor verified that the correctness in which the total number of hours worked was calculated and that the contracts specified the annual workable hours. If the Beneficiary applied method C, the auditor verified that the 'annual productive hours' applied when calculating the hourly rate were equivalent to at least 90 % of the 'standard annual workable hours'. The Auditor can only do this if the calculation of the standard annual workable	22) The Beneficiary applied method [*choose one option and delete the others*] [**A**: 1720 hours] [**B**: the 'total number of hours worked'] [**C**: 'standard annual productive hours' used correspond to usual accounting practices]	
		23) Productive hours were calculated annually.	
		24) For employees not working full-time the full-time equivalent (FTE) ratio was correctly applied.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	hours can be supported by records, such as national legislation, labour agreements, and contracts. *BENEFICIARY'S PRODUCTIVE HOURS' FOR PERSONS WORKING FULL TIME SHALL BE ONE OF THE FOLLOWING METHODS:* **A.** *1720 ANNUAL PRODUCTIVE HOURS (PRO-RATA FOR PERSONS NOT WORKING FULL-TIME)* **B.** *THE TOTAL NUMBER OF HOURS WORKED BY THE PERSON FOR THE BENEFICIARY IN THE YEAR (THIS METHOD IS ALSO REFERRED TO AS 'TOTAL NUMBER OF HOURS WORKED' IN THE NEXT COLUMN). THE CALCULATION OF THE TOTAL NUMBER OF HOURS WORKED WAS DONE AS FOLLOWS: ANNUAL WORKABLE HOURS OF THE PERSON ACCORDING TO THE EMPLOYMENT CONTRACT, APPLICABLE LABOUR AGREEMENT OR NATIONAL LAW PLUS OVERTIME WORKED MINUS ABSENCES (SUCH AS SICK LEAVE OR SPECIAL LEAVE).* **C.** *THE STANDARD NUMBER OF ANNUAL HOURS GENERALLY APPLIED BY THE BENEFICIARY FOR ITS PERSONNEL IN ACCORDANCE WITH ITS USUAL COST ACCOUNTING PRACTICES (THIS METHOD IS ALSO REFERRED TO AS 'STANDARD ANNUAL PRODUCTIVE HOURS' IN THE NEXT COLUMN). THIS NUMBER MUST BE AT LEAST 90% OF THE STANDARD ANNUAL WORKABLE HOURS.* *'ANNUAL WORKABLE HOURS' MEANS THE PERIOD DURING WHICH THE PERSONNEL MUST BE WORKING, AT THE EMPLOYER'S DISPOSAL AND CARRYING OUT HIS/HER ACTIVITY OR DUTIES UNDER THE EMPLOYMENT CONTRACT, APPLICABLE COLLECTIVE LABOUR AGREEMENT OR NATIONAL WORKING TIME LEGISLATION.*	*If the Beneficiary applied method B.* 25) The calculation of the number of 'annual workable hours', overtime and absences was verifiable based on the documents provided by the Beneficiary. 25.1) The Beneficiary calculates the hourly rates per full financial year following procedure A.3 (method B is not allowed for beneficiaries calculating hourly rates per month).	
		If the Beneficiary applied method C. 26) The calculation of the number of 'standard annual workable hours' was verifiable based on the documents provided by the Beneficiary.	

<table>
<tr><th>Ref</th><th>Procedures</th><th>Standard factual finding</th><th>Result (C / E / N.A.)</th></tr>
<tr><td></td><td></td><td>27) The ‘annual productive hours’ used for calculating the hourly rate were consistent with the usual cost accounting practices of the Beneficiary and were equivalent to at least 90 % of the ‘annual workable hours’.</td><td></td></tr>
<tr><td rowspan="2">A.3</td><td rowspan="2">HOURLY PERSONNEL RATES

<u>I) For unit costs calculated in accordance to the Beneficiary's usual cost accounting practice (unit costs):</u>

If the Beneficiary has a "Certificate on Methodology to calculate unit costs " (CoMUC) approved by the Commission, the Beneficiary provides the Auditor with a description of the approved methodology and the Commission’s letter of acceptance. The Auditor verified that the Beneficiary has indeed used the methodology approved. If so, no further verification is necessary.

If the Beneficiary does not have a "Certificate on Methodology" (CoMUC) approved by the Commission, or if the methodology approved was not applied, then the Auditor:

○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates;

○ recalculated the unit costs (hourly rates) of staff included in the sample following the results of the procedures carried out in A.1 and A.2.

<u>II) For individual hourly rates:</u>

The Auditor:

○ reviewed the documentation provided by the Beneficiary, including manuals and internal guidelines that explain how to calculate hourly rates;</td><td>28) The Beneficiary applied [choose one option and delete the other]:

[Option I: “Unit costs (hourly rates) were calculated in accordance with the Beneficiary’s usual cost accounting practices”]

[Option II: Individual hourly rates were applied]</td><td></td></tr>
<tr><td>For option I concerning unit costs and if the Beneficiary applies the methodology approved by the Commission (CoMUC):

29) The Beneficiary used the Commission-approved metho-dology to calculate hourly rates. It corresponded to the organisation's usual cost accounting practices and was applied consistently for all</td><td></td></tr>
</table>

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	○ recalculated the hourly rates of staff included in the sample (recalculation of all hourly rates if the Beneficiary uses annual rates, recalculation of three months selected randomly for every year and person if the Beneficiary uses monthly rates) following the results of the procedures carried out in A.1 and A.2; ○ (only in case of monthly rates) confirmed that the time spent on parental leave is not deducted, and that, if parts of the basic remuneration are generated over a period longer than a month, the Beneficiary has included only the share which is generated in the month. *<u>"Unit costs calculated by the Beneficiary in accordance with its usual cost accounting practices":</u>* *It is calculated By dividing the total amount of personnel costs of the category to which the employee belongs verified in line with procedure A.1 by the number of FTE and the annual total productive hours of the same category calculated by the Beneficiary in accordance with procedure A.2.* *<u>Hourly rate for individual actual personal costs:</u>* *It is calculated following one of the two options below:* *a) [Option by default] by dividing the actual annual amount of personnel costs of an employee verified in line with procedure A.1 by the number of annual productive hours verified in line with procedure A.2 (full financial year hourly rate);* *b) by dividing the Actual monthly amount of personnel costs of an employee verified in line with procedure A.1 by 1/12 of the number of annual productive hours verified in line with procedure A.2.(monthly hourly rate).*	activities irrespective of the source of funding.	
		For option I concerning unit costs and if the Beneficiary applies a methodology not approved by the Commission: 30) The unit costs re-calculated by the Auditor were the same as the rates applied by the Beneficiary.	
		For option II concerning individual hourly rates: 31) The individual rates re-calculated by the Auditor were the same as the rates applied by the Beneficiary. 31.1) The Beneficiary used only one option (per full financial year or per month) throughout each financial year examined. 31.2) The hourly rates do not include additional remuneration.	

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
A.4	**TIME RECORDING SYSTEM** To verify that the time recording system ensures the fulfilment of all minimum requirements and that the hours declared for the action were correct, accurate and properly authorised and supported by documentation, the Auditor made the following checks for the persons included in the sample that declare time as worked for the action on the basis of time records: ○ description of the time recording system provided by the Beneficiary (registration, authorisation, processing in the HR-system); ○ its actual implementation; ○ time records were signed at least monthly by the employees (on paper or electronically) and authorised by the project manager or another manager; ○ the hours declared were worked within the project period; ○ there were no hours declared as worked for the action if HR-records showed absence due to holidays or sickness (further cross-checks with travels are carried out in B.1 below) ; ○ the hours charged to the action matched those in the time recording system. *ONLY THE HOURS WORKED ON THE ACTION CAN BE CHARGED. ALL WORKING TIME TO BE CHARGED SHOULD BE RECORDED THROUGHOUT THE DURATION OF THE PROJECT, ADEQUATELY SUPPORTED BY EVIDENCE OF THEIR REALITY AND RELIABILITY (SEE SPECIFIC PROVISIONS BELOW FOR PERSONS WORKING EXCLUSIVELY FOR THE ACTION WITHOUT TIME RECORDS).*	32) All persons recorded their time dedicated to the action on a **daily/ weekly/ monthly** basis using a **paper/computer-based** system. (*delete the answers that are not applicable)*	
		33) Their time-records were authorised at least monthly by the project manager or other superior.	
		34) Hours declared were worked within the project period and were consistent with the presences/absences recorded in HR-records.	
		35) There were no discrepancies between the number of hours charged to the action and the number of hours recorded.	
	<u>If the persons are working exclusively for the action and without time records</u> For the persons selected that worked exclusively for the action without time records, the Auditor verified evidence available demonstrating that they were in reality exclusively dedicated to the action and that the Beneficiary signed a declaration confirming that they have worked exclusively for the action.	36) The exclusive dedication is supported by a declaration signed by the Beneficiary and by any other evidence gathered.	

<table>
<tr><th>Ref</th><th>Procedures</th><th>Standard factual finding</th><th>Result
(C / E / N.A.)</th></tr>
<tr><td>B</td><td>COSTS OF SUBCONTRACTING</td><td></td><td></td></tr>
<tr><td rowspan="3">B.1</td><td rowspan="3">The Auditor obtained the detail/breakdown of subcontracting costs and sampled ______ cost items selected randomly (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest).

To confirm standard factual findings 37-41 listed in the next column, the Auditor reviewed the following for the items included in the sample:
o the use of subcontractors was foreseen in Annex 1;
o subcontracting costs were declared in the subcontracting category of the Financial Statement;
o supporting documents on the selection and award procedure were followed;
o the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the subcontract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment).

In particular,
i. if the Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC (or 2014/24/EU) or of Directive 2004/17/EC (or 2014/25/EU), the Auditor verified that the applicable national law on public procurement was followed and that the subcontracting complied with the Terms and Conditions of the Agreement.
ii. if the Beneficiary did not fall under the above-mentioned category the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement..</td><td>37) The use of claimed subcontracting costs was foreseen in Annex 1 and costs were declared in the Financial Statements under the subcontracting category.</td><td></td></tr>
<tr><td>38) There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. Subcontracts were awarded in accordance with the principle of best value for money.

(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the caption "Exceptions" of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)</td><td></td></tr>
<tr><td>39) The subcontracts were not awarded to other Beneficiaries</td><td></td></tr>
</table>

Ref	Procedures	Standard factual finding	Result (C / E / N.A.)
	For the items included in the sample the Auditor also verified that: o the subcontracts were not awarded to other Beneficiaries in the consortium; o there were signed agreements between the Beneficiary and the subcontractor; o there was evidence that the services were provided by subcontractor;	of the consortium.	
		40) All subcontracts were supported by signed agreements between the Beneficiary and the subcontractor.	
		41) There was evidence that the services were provided by the subcontractors.	
C	**COSTS OF PROVIDING FINANCIAL SUPPORT TO THIRD PARTIES**		
C.1	**The Auditor obtained the detail/breakdown of the costs of providing financial support to third parties and sampled ______ cost items selected randomly** (*full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest*). The Auditor verified that the following minimum conditions were met: a) the maximum amount of financial support for each third party did not exceed EUR 60 000, unless explicitly mentioned in Annex 1; b) the financial support to third parties was agreed in Annex 1 of the Agreement and the other provisions on financial support to third parties included in Annex 1 were respected.	42) All minimum conditions were met	

<table>
<tr><td>D</td><td colspan="3">OTHER ACTUAL DIRECT COSTS</td></tr>
<tr><td rowspan="4">D.1</td><td rowspan="4">COSTS OF TRAVEL AND RELATED SUBSISTENCE ALLOWANCES

The Auditor sampled ______ cost items selected randomly (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest).

The Auditor inspected the sample and verified that:

o travel and subsistence costs were consistent with the Beneficiary's usual policy for travel. In this context, the Beneficiary provided evidence of its normal policy for travel costs (e.g. use of first class tickets, reimbursement by the Beneficiary on the basis of actual costs, a lump sum or per diem) to enable the Auditor to compare the travel costs charged with this policy;

o travel costs are correctly identified and allocated to the action (e.g. trips are directly linked to the action) by reviewing relevant supporting documents such as minutes of meetings, workshops or conferences, their registration in the correct project account, their consistency with time records or with the dates/duration of the workshop/conference;

o no ineligible costs or excessive or reckless expenditure was declared (see Article 6.5 MGA).</td><td>43) Costs were incurred, approved and reimbursed in line with the Beneficiary's usual policy for travels.</td><td></td></tr>
<tr><td>44) There was a link between the trip and the action.</td><td></td></tr>
<tr><td>45) The supporting documents were consistent with each other regarding subject of the trip, dates, duration and reconciled with time records and accounting.</td><td></td></tr>
<tr><td>46) No ineligible costs or excessive or reckless expenditure was declared.</td><td></td></tr>
<tr><td rowspan="3">D.2</td><td rowspan="3">DEPRECIATION COSTS FOR EQUIPMENT, INFRASTRUCTURE OR OTHER ASSETS

The Auditor sampled ______ cost items selected randomly (full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is the highest).

For “equipment, infrastructure or other assets” [from now on called “asset(s)”] selected in the sample the Auditor verified that:

o the assets were acquired in conformity with the Beneficiary's internal guidelines and procedures;</td><td>47) Procurement rules, principles and guides were followed.</td><td></td></tr>
<tr><td>48) There was a link between the grant agreement and the asset charged to the action.</td><td></td></tr>
<tr><td>49) The asset charged to the action was traceable to the accounting records and the underlying documents.</td><td></td></tr>
</table>

	○ they were correctly allocated to the action (with supporting documents such as delivery note invoice or any other proof demonstrating the link to the action) ○ they were entered in the accounting system; ○ the extent to which the assets were used for the action (as a percentage) was supported by reliable documentation (e.g. usage overview table); The Auditor recalculated the depreciation costs and verified that they were in line with the applicable rules in the Beneficiary's country and with the Beneficiary's usual accounting policy (e.g. depreciation calculated on the acquisition value). The Auditor verified that no ineligible costs such as deductible VAT, exchange rate losses, excessive or reckless expenditure were declared (see Article 6.5 GA).	50) The depreciation method used to charge the asset to the action was in line with the applicable rules of the Beneficiary's country and the Beneficiary's usual accounting policy.	
		51) The amount charged corresponded to the actual usage for the action.	
		52) No ineligible costs or excessive or reckless expenditure were declared.	
D.3	**COSTS OF OTHER GOODS AND SERVICES** **The Auditor sampled ______ cost items selected randomly** (*full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest*). For the purchase of goods, works or services included in the sample the Auditor verified that: ○ the contracts did not cover tasks described in Annex 1; ○ they were correctly identified, allocated to the proper action, entered in the accounting system (traceable to underlying documents such as purchase orders, invoices and accounting); ○ the goods were not placed in the inventory of durable equipment; ○ the costs charged to the action were accounted in line with the Beneficiary's usual accounting practices; ○ no ineligible costs or excessive or reckless expenditure were declared (see Article 6 GA). In addition, the Auditor verified that these goods and services were acquired in conformity with	53) Contracts for works or services did not cover tasks described in Annex 1.	
		54) Costs were allocated to the correct action and the goods were not placed in the inventory of durable equipment.	
		55) The costs were charged in line with the Beneficiary's accounting policy and were adequately supported.	
		56) No ineligible costs or excessive or reckless expenditure were declared. For internal invoices/charges only the cost element was charged, without any mark-ups.	

	the Beneficiary's internal guidelines and procedures, in particular: o if Beneficiary acted as a contracting authority within the meaning of Directive 2004/18/EC (or 2014/24/EU) or of Directive 2004/17/EC (or 2014/25/EU), the Auditor verified that the applicable national law on public procurement was followed and that the procurement contract complied with the Terms and Conditions of the Agreement. o if the Beneficiary did not fall into the category above, the Auditor verified that the Beneficiary followed their usual procurement rules and respected the Terms and Conditions of the Agreement. For the items included in the sample the Auditor also verified that: o the Beneficiary ensured best value for money (key elements to appreciate the respect of this principle are the award of the contract to the bid offering best price-quality ratio, under conditions of transparency and equal treatment. In case an existing framework contract was used the Auditor also verified that the Beneficiary ensured it was established on the basis of the principle of best value for money under conditions of transparency and equal treatment); *SUCH GOODS AND SERVICES INCLUDE, FOR INSTANCE, CONSUMABLES AND SUPPLIES, DISSEMINATION (INCLUDING OPEN ACCESS), PROTECTION OF RESULTS, SPECIFIC EVALUATION OF THE ACTION IF IT IS REQUIRED BY THE AGREEMENT, CERTIFICATES ON THE FINANCIAL STATEMENTS IF THEY ARE REQUIRED BY THE AGREEMENT AND CERTIFICATES ON THE METHODOLOGY, TRANSLATIONS, REPRODUCTION.*	57) Procurement rules, principles and guides were followed. There were documents of requests to different providers, different offers and assessment of the offers before selection of the provider in line with internal procedures and procurement rules. The purchases were made in accordance with the principle of best value for money. *(When different offers were not collected the Auditor explains the reasons provided by the Beneficiary under the caption "Exceptions" of the Report. The Commission will analyse this information to evaluate whether these costs might be accepted as eligible)*	
D.4	**AGGREGATED CAPITALISED AND OPERATING COSTS OF RESEARCH INFRASTRUCTURE** The Auditor ensured the existence of a positive ex-ante assessment (issued by the EC Services) of the cost accounting methodology of the Beneficiary allowing it to apply the guidelines on direct costing for large research infrastructures in Horizon 2020.	58) The costs declared as direct costs for Large Research Infrastructures (in the appropriate line of the Financial Statement) comply with the methodology described in the positive ex-ante assessment report.	

	In the cases that a positive ex-ante assessment has been issued *(see the standard factual findings 58-59 on the next column)****,*** The Auditor ensured that the beneficiary has applied consistently the methodology that is explained and approved in the positive ex ante assessment; ***In the cases that a positive ex-ante assessment has NOT been issued*** *(see the standard factual findings 60 on the next column),* The Auditor verified that no costs of Large Research Infrastructure have been charged as direct costs in any costs category; ***In the cases that a draft ex-ante assessment report has been issued with recommendation for further changes*** *(see the standard factual findings 60 on the next column),* • The Auditor followed the same procedure as above (when a positive ex-ante assessment has NOT yet been issued) and paid particular attention (testing reinforced) to the cost items for which the draft ex-ante assessment either rejected the inclusion as direct costs for Large Research Infrastructures or issued recommendations.	59) Any difference between the methodology applied and the one positively assessed was extensively described and adjusted accordingly. 60) The direct costs declared were free from any indirect costs items related to the Large Research Infrastructure.	
D.5	**Costs of internally invoiced goods and services** **The Auditor sampled cost items selected randomly** (*full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest*). To confirm standard factual findings 61-65 listed in the next column, the Auditor: ○ obtained a description of the Beneficiary's usual cost accounting practice to calculate costs of internally invoiced goods and services (unit costs); ○ reviewed whether the Beneficiary's usual cost accounting practice was applied for the Financial Statements subject of the present CFS; ○ ensured that the methodology to calculate unit costs is being used in a consistent manner, based on objective criteria, regardless of the source of funding; ○ verified that any ineligible items or any costs claimed under other budget categories, in particular indirect costs, have not been taken into account when calculating the costs of	61) The costs of internally invoiced goods and services included in the Financial Statement were calculated in accordance with the Beneficiary's usual cost accounting practice. 62) The cost accounting practices used to calculate the costs of internally invoiced goods and services were applied by the Beneficiary in a consistent manner based on objective criteria regardless of the source of funding. 63) The unit cost is calculated using the actual costs for the good or service recorded in the Beneficiary’s accounts, excluding any ineligible cost or costs included in other	

	internally invoiced goods and services (see Article 6 GA); o verified whether actual costs of internally invoiced goods and services were adjusted on the basis of budgeted or estimated elements and, if so, verified whether those elements used are actually relevant for the calculation, and correspond to objective and verifiable information. o verified that any costs of items which are not directly linked to the production of the invoiced goods or service (e.g. supporting services like cleaning, general accountancy, administrative support, etc. not directly used for production of the good or service) have not been taken into account when calculating the costs of internally invoiced goods and services. o verified that any costs of items used for calculating the costs internally invoiced goods and services are supported by audit evidence and registered in the accounts.	budget categories. 64) The unit cost excludes any costs of items which are not directly linked to the production of the invoiced goods or service. 65) The costs items used for calculating the actual costs of internally invoiced goods and services were relevant, reasonable and correspond to objective and verifiable information.	
E	**USE OF EXCHANGE RATES**		
E.1	a) For Beneficiaries with accounts established in a currency other than euros **The Auditor sampled ______ cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement** (*full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest)*: *COSTS RECORDED IN THE ACCOUNTS IN A CURRENCY OTHER THAN EURO SHALL BE CONVERTED INTO EURO AT THE AVERAGE OF THE DAILY EXCHANGE RATES PUBLISHED IN THE C SERIES OF OFFICIAL JOURNAL OF THE EUROPEAN UNION (https://www.ecb.int/stats/exchange/eurofxref/html/index.en.html), DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.* *IF NO DAILY EURO EXCHANGE RATE IS PUBLISHED IN THE OFFICIAL JOURNAL OF THE EUROPEAN UNION FOR THE CURRENCY IN QUESTION, CONVERSION SHALL BE MADE AT THE AVERAGE OF THE MONTHLY ACCOUNTING RATES ESTABLISHED BY THE COMMISSION AND PUBLISHED ON ITS WEBSITE (http://ec.europa.eu/budget/contracts_grants/info_contracts/inforeuro/inforeuro_en.cfm),*	66) The exchange rates used to convert other currencies into Euros were in accordance with the rules established of the Grant Agreement and there was no difference in the final figures.	

	DETERMINED OVER THE CORRESPONDING REPORTING PERIOD.		
	b) For Beneficiaries with accounts established in euros **The Auditor sampled ______ cost items selected randomly and verified that the exchange rates used for converting other currencies into euros were in accordance with the following rules established in the Agreement** (*full coverage is required if there are fewer than 10 items, otherwise the sample should have a minimum of 10 item, or 10% of the total, whichever number is highest)*: *COSTS INCURRED IN ANOTHER CURRENCY SHALL BE CONVERTED INTO EURO BY APPLYING THE BENEFICIARY'S USUAL ACCOUNTING PRACTICES.*	67) The Beneficiary applied its usual accounting practices.	

[legal name of the audit firm]
[name and function of an authorised representative]
[dd Month yyyy]
<Signature of the Auditor>

ANNEX 6

MODEL FOR THE CERTIFICATE ON THE METHODOLOGY

- **For options [*in italics in square brackets*]: choose the applicable option. Options not chosen should be deleted.**
- **For fields in [grey in square brackets]: enter the appropriate data.**

TABLE OF CONTENTS

Terms of reference for an audit engagement for a methodology certificate in connection with one or more grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme

This document sets out the '**Terms of Reference (ToR)**' under which

[OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')]

agrees to engage

[**insert legal name of the auditor**] ('the Auditor')

to produce an independent report of factual findings ('the Report') concerning the *[Beneficiary's] [Linked Third Party's]* usual accounting practices for calculating and claiming direct personnel costs declared as unit costs ('the Methodology') in connection with grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme.

The procedures to be carried out for the assessment of the methodology will be based on the grant agreement(s) detailed below:

[title and number of the grant agreement(s)] ('the Agreement(s)')

The Agreement(s) has(have) been concluded between the Beneficiary and *[OPTION 1: the European Union, represented by the European Commission ('the Commission')][OPTION 2: the European Atomic Energy Community (Euratom,) represented by the European Commission ('the Commission')][OPTION 3: the [Research Executive Agency (REA)] [European Research Council Executive Agency (ERCEA)] [Innovation and Networks Executive Agency (INEA)] [Executive Agency for Small and Medium-sized Enterprises (EASME)] ('the Agency'), under the powers delegated by the European Commission ('the Commission').].*

The *[Commission] [Agency]* is mentioned as a signatory of the Agreement with the Beneficiary only. The *[European Union] [Euratom] [Agency]* is not a party to this engagement.

1.1 Subject of the engagement

According to Article 18.1.2 of the Agreement, beneficiaries *[and linked third parties]* that declare direct personnel costs as unit costs calculated in accordance with their usual cost accounting practices may submit to the *[Commission] [Agency]*, for approval, a certificate on the methodology ('CoMUC') stating that there are adequate records and documentation to prove that their cost accounting practices used comply with the conditions set out in Point A of Article 6.2.

The subject of this engagement is the CoMUC which is composed of two separate documents:

- the Terms of Reference ('the ToR') to be signed by the *[Beneficiary] [Linked Third Party]* and the Auditor;

- the Auditor's Independent Report of Factual Findings ('the Report') issued on the Auditor's letterhead, dated, stamped and signed by the Auditor which includes; the standard statements ('the Statements') evaluated and signed by the *[Beneficiary] [Linked Third Party]*, the agreed-upon procedures ('the Procedures') performed by the Auditor and the standard factual findings (‘the Findings’) assessed by the Auditor. The Statements, Procedures and Findings are summarised in the table that forms part of the Report.

The information provided through the Statements, the Procedures and the Findings will enable the Commission to draw conclusions regarding the existence of the *[Beneficiary’s] [Linked Third Party’s]* usual cost accounting practice and its suitability to ensure that direct personnel costs claimed on that basis comply with the provisions of the Agreement. The Commission draws its own conclusions from the Report and any additional information it may require.

1.2 Responsibilities

The parties to this agreement are the *[Beneficiary] [Linked Third Party]* and the Auditor.

The *[Beneficiary] [Linked Third Party]:*

- is responsible for preparing financial statements for the Agreement(s) (‘the Financial Statements’) in compliance with those Agreements;
- is responsible for providing the Financial Statement(s) to the Auditor and enabling the Auditor to reconcile them with the *[Beneficiary’s] [Linked Third Party’s]* accounting and bookkeeping system and the underlying accounts and records. The Financial Statement(s) will be used as a basis for the procedures which the Auditor will carry out under this ToR;
- is responsible for its Methodology and liable for the accuracy of the Financial Statement(s);
- is responsible for endorsing or refuting the Statements indicated under the heading ‘Statements to be made by the Beneficiary/ Linked Third Party’ in the first column of the table that forms part of the Report;
- must provide the Auditor with a signed and dated representation letter;
- accepts that the ability of the Auditor to carry out the Procedures effectively depends upon the *[Beneficiary] [Linked Third Party]* providing full and free access to the *[Beneficiary’s] [Linked Third Party’s]* staff and to its accounting and other relevant records.

The Auditor:

- *[Option 1 by default: is qualified to carry out statutory audits of accounting documents in accordance with Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts, amending Council Directives 78/660/EEC and 83/349/EEC and repealing Council Directive 84/253/EEC or similar national regulations].*
- *[Option 2 if the Beneficiary or Linked Third Party has an independent Public Officer: is a competent and independent Public Officer for which the relevant national authorities have established the legal capacity to audit the Beneficiary].*
- *[Option 3 if the Beneficiary or Linked Third Party is an international organisation: is an [internal] [external] auditor in accordance with the internal financial regulations and procedures of the international organisation].*

The Auditor:

- must be independent from the Beneficiary *[and the Linked Third Party]*, in particular, it must not have been involved in preparing the Beneficiary’s *[and Linked Third Party’s]* Financial Statement(s);
- must plan work so that the Procedures may be carried out and the Findings may be assessed;
- must adhere to the Procedures laid down and the compulsory report format;
- must carry out the engagement in accordance with these ToR;
- must document matters which are important to support the Report;
- must base its Report on the evidence gathered;
- must submit the Report to the *[Beneficiary] [Linked Third Party]*.

The Commission sets out the Procedures to be carried out and the Findings to be endorsed by the Auditor. The Auditor is not responsible for their suitability or pertinence. As this engagement is not an assurance engagement the Auditor does not provide an audit opinion or a statement of assurance.

1.3 Applicable Standards

The Auditor must comply with these Terms of Reference and with[1]:

- the International Standard on Related Services ('ISRS') 4400 *Engagements to perform Agreed-upon Procedures regarding Financial Information* as issued by the International Auditing and Assurance Standards Board (IAASB);
- the *Code of Ethics for Professional Accountants* issued by the International Ethics Standards Board for Accountants (IESBA). Although ISRS 4400 states that independence is not a requirement for engagements to carry out agreed-upon procedures, the Commission requires that the Auditor also complies with the Code's independence requirements.

The Auditor's Report must state that there was no conflict of interests in establishing this Report between the Auditor and the Beneficiary *[and the Linked Third Party]* that could have a bearing on the Report, and must specify – if the service is invoiced - the total fee paid to the Auditor for providing the Report.

1.4 Reporting

The Report must be written in the language of the Agreement (see Article 20.7 of the Agreement).

Under Article 22 of the Agreement, the Commission, *[the Agency]*, the European Anti-Fraud Office and the Court of Auditors have the right to audit any work that is carried out under the action and for which costs are declared from *[the European Union] [Euratom]* budget. This includes work related to this engagement. The Auditor must provide access to all working papers related to this assignment if the Commission*[, the Agency]*, the European Anti-Fraud Office or the European Court of Auditors requests them.

1.5 Timing

The Report must be provided by [dd Month yyyy].

1.6 Other Terms

[The [Beneficiary] [Linked Third Party] and the Auditor can use this section to agree other specific terms, such as the Auditor's fees, liability, applicable law, etc. Those specific terms must not contradict the terms specified above.]

[legal name of the Auditor]	[legal name of the [Beneficiary] [Linked Third Party]]
[name & title of authorised representative]	[name & title of authorised representative]
[dd Month yyyy]	[dd Month yyyy]
Signature of the Auditor	Signature of the *[Beneficiary] [Linked Third Party]*

[1] Supreme Audit Institutions applying INTOSAI-standards may carry out the Procedures according to the corresponding International Standards of Supreme Audit Institutions and code of ethics issued by INTOSAI instead of the International Standard on Related Services ('ISRS') 4400 and the Code of Ethics for Professional Accountants issued by the IAASB and the IESBA.

Independent report of factual findings on the methodology concerning grant agreements financed under the Horizon 2020 Research and Innovation Framework Programme

(To be printed on letterhead paper of the auditor)

To
[name of contact person(s)], [Position]
[[Beneficiary's] [Linked Third Party's] name]
[Address]
[dd Month yyyy]

Dear [Name of contact person(s)],

As agreed under the terms of reference dated [dd Month yyyy]

with *[OPTION 1: [insert name of the beneficiary] ('the Beneficiary')] [OPTION 2: [insert name of the linked third party] ('the Linked Third Party'), third party linked to the Beneficiary [insert name of the beneficiary] ('the Beneficiary')]*,

we
[name of the auditor] ('the Auditor'),
established at
[full address/city/state/province/country],
represented by
[name and function of an authorised representative],

have carried out the agreed-upon procedures ('the Procedures') and provide hereby our Independent Report of Factual Findings ('the Report'), concerning the *[Beneficiary's] [Linked Third Party's]* usual accounting practices for calculating and declaring direct personnel costs declared as unit costs ('the Methodology').

You requested certain procedures to be carried out in connection with the grant(s)

[title and number of the grant agreement(s)] ('the Agreement(s)').

The Report

Our engagement was carried out in accordance with the terms of reference ('the ToR') appended to this Report. The Report includes: the standard statements ('the Statements') made by the *[Beneficiary] [Linked Third Party]*, the agreed-upon procedures ('the Procedures') carried out and the standard factual findings ('the Findings') confirmed by us.

The engagement involved carrying out the Procedures and assessing the Findings and the documentation requested appended to this Report, the results of which the Commission uses to draw conclusions regarding the acceptability of the Methodology applied by the *[Beneficiary] [Linked Third Party]*.

The Report covers the methodology used from [dd Month yyyy]. In the event that the *[Beneficiary] [Linked Third Party]* changes this methodology, the Report will not be applicable to any Financial Statement[1] submitted thereafter.

The scope of the Procedures and the definition of the standard statements and findings were determined solely by the Commission. Therefore, the Auditor is not responsible for their suitability or pertinence.

Since the Procedures carried out constitute neither an audit nor a review made in accordance with International Standards on Auditing or International Standards on Review Engagements, we do not give a statement of assurance on the costs declared on the basis of the *[Beneficiary's] [Linked Third Party's]* Methodology. Had we carried out additional procedures or had we performed an audit or review in accordance with these standards, other matters might have come to its attention and would have been included in the Report.

Exceptions

Apart from the exceptions listed below, the *[Beneficiary] [Linked Third Party]* agreed with the standard Statements and provided the Auditor all the documentation and accounting information needed by the Auditor to carry out the requested Procedures and corroborate the standard Findings.

List here any exception and add any information on the cause and possible consequences of each exception, if known. If the exception is quantifiable, also indicate the corresponding amount.

…..

Explanation of possible exceptions in the form of examples (to be removed from the Report):

i. the [Beneficiary] [Linked Third Party] did not agree with the standard Statement number … because…;

ii. the Auditor could not carry out the procedure … established because …. (e.g. due to the inability to reconcile key information or the unavailability or inconsistency of data);

iii. the Auditor could not confirm or corroborate the standard Finding number … because ….

Remarks

We would like to add the following remarks relevant for the proper understanding of the Methodology applied by the [Beneficiary] [Linked Third Party] or the results reported:

Example (to be removed from the Report):

Regarding the methodology applied to calculate hourly rates …

Regarding standard Finding 15 it has to be noted that …

The [Beneficiary] [Linked Third Party] explained the deviation from the benchmark statement XXIV concerning time recording for personnel with no exclusive dedication to the action in the following manner: …

Annexes

Please provide the following documents to the auditor and annex them to the report when submitting this CoMUC to the Commission:

[1] Financial Statement in this context refers solely to Annex 4 of the Agreement by which the Beneficiary declares costs under the Agreement.

1. Brief description of the methodology for calculating personnel costs, productive hours and hourly rates;
2. Brief description of the time recording system in place;
3. An example of the time records used by the [*Beneficiary] [Linked Third Party*];
4. Description of any budgeted or estimated elements applied, together with an explanation as to why they are relevant for calculating the personnel costs and how they are based on objective and verifiable information;
5. A summary sheet with the hourly rate for direct personnel declared by the [*Beneficiary*] [*Linked Third Party*] and recalculated by the Auditor for each staff member included in the sample (the names do not need to be reported);
6. A comparative table summarising for each person selected in the sample a) the time claimed by the [*Beneficiary*] [*Linked Third Party*] in the Financial Statement(s) and b) the time according to the time record verified by the Auditor;
7. A copy of the letter of representation provided to the Auditor.

Use of this Report

This Report has been drawn up solely for the purpose given under Point 1.1 Reasons for the engagement.

The Report:
- is confidential and is intended to be submitted to the Commission by the [*Beneficiary*] [*Linked Third Party*] in connection with Article 18.1.2 of the Agreement;
- may not be used by the [*Beneficiary*] [*Linked Third Party*] or by the Commission for any other purpose, nor distributed to any other parties;
- may be disclosed by the Commission only to authorised parties, in particular the European Anti-Fraud Office (OLAF) and the European Court of Auditors.
- relates only to the usual cost accounting practices specified above and does not constitute a report on the Financial Statements of the [*Beneficiary*] [*Linked Third Party*].

No conflict of interest[2] exists between the Auditor and the Beneficiary *[and the Linked Third Party*] that could have a bearing on the Report. The total fee paid to the Auditor for producing the Report was EUR ______ (including EUR ______ of deductible VAT).

We look forward to discussing our Report with you and would be pleased to provide any further information or assistance which may be required.

Yours sincerely

[legal name of the Auditor]
[name and title of the authorised representative]
[dd Month yyyy]
Signature of the Auditor

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[2] A conflict of interest arises when the Auditor's objectivity to establish the certificate is compromised in fact or in appearance when the Auditor for instance:
- was involved in the preparation of the Financial Statements;
- stands to benefit directly should the certificate be accepted;
- has a close relationship with any person representing the beneficiary;
- is a director, trustee or partner of the beneficiary; or
- is in any other situation that compromises his or her independence or ability to establish the certificate impartially.

Statements to be made by the Beneficiary/Linked Third Party ('the Statements') and Procedures to be carried out by the Auditor ('the Procedures') and standard factual findings ('the Findings') to be confirmed by the Auditor

The Commission reserves the right to provide the auditor with guidance regarding the Statements to be made, the Procedures to be carried out or the Findings to be ascertained and the way in which to present them. The Commission reserves the right to vary the Statements, Procedures or Findings by written notification to the Beneficiary/Linked Third Party to adapt the procedures to changes in the grant agreement(s) or to any other circumstances.

If this methodology certificate relates to the Linked Third Party's usual accounting practices for calculating and claiming direct personnel costs declared as unit costs any reference here below to 'the Beneficiary' is to be considered as a reference to 'the Linked Third Party'.

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	**Procedures to be carried out and Findings to be confirmed by the Auditor**
A. Use of the Methodology I. The cost accounting practice described below has been in use since *[*dd Month yyyy*]*. II. The next planned alteration to the methodology used by the Beneficiary will be from [dd Month yyyy*]*.	**Procedure:** ✓ The Auditor checked these dates against the documentation the Beneficiary has provided. **Factual finding:** 1. The dates provided by the Beneficiary were consistent with the documentation.
B. Description of the Methodology III. The methodology to calculate unit costs is being used in a consistent manner and is reflected in the relevant procedures. *[Please describe the methodology your entity uses to calculate personnel costs, productive hours and hourly rates, present your description to the Auditor and annex it to this certificate]* *[If the statement of section "B. Description of the methodology" cannot be endorsed by the Beneficiary or there is no written methodology to calculate unit costs it should be listed here below and reported as exception by the Auditor in the main Report of Factual Findings:* - *…]*	**Procedure:** ✓ The Auditor reviewed the description, the relevant manuals and/or internal guidance documents describing the methodology. **Factual finding:** 2. The brief description was consistent with the relevant manuals, internal guidance and/or other documentary evidence the Auditor has reviewed. 3. The methodology was generally applied by the Beneficiary as part of its usual costs accounting practices.

<table>
<tr><td colspan="2">Please explain any discrepancies in the body of the Report.</td></tr>
<tr><td>Statements to be made by Beneficiary</td><td>Procedures to be carried out and Findings to be confirmed by the Auditor</td></tr>
<tr><td>C. Personnel costs

<u>General</u>
IV. The unit costs (hourly rates) are limited to salaries including during parental leave, social security contributions, taxes and other costs included in the remuneration required under national law and the employment contract or equivalent appointing act;
V. Employees are hired directly by the Beneficiary in accordance with national law, and work under its sole supervision and responsibility;
VI. The Beneficiary remunerates its employees in accordance with its usual practices. This means that personnel costs are charged in line with the Beneficiary's usual payroll policy (e.g. salary policy, overtime policy, variable pay) and no special conditions exist for employees assigned to tasks relating to the European Union or Euratom, unless explicitly provided for in the grant agreement(s);
VII. The Beneficiary allocates its employees to the relevant group/category/cost centre for the purpose of the unit cost calculation in line with the usual cost accounting practice;
VIII. Personnel costs are based on the payroll system and accounting system.
IX. Any exceptional adjustments of actual personnel costs resulted from relevant budgeted or estimated elements and were based on objective and verifiable information. [Please describe the 'budgeted or estimated elements' and their relevance to personnel costs, and explain how they were reasonable and based on objective and verifiable information, present your explanation to the Auditor and annex it to this certificate].
X. Personnel costs claimed do not contain any of the following ineligible costs: costs related to return on capital; debt and debt service charges; provisions for future losses or debts; interest owed; doubtful debts; currency exchange losses; bank costs charged by the Beneficiary's bank for transfers from the Commission/Agency; excessive or reckless expenditure; deductible VAT or costs incurred during suspension of the implementation of the action.
XI. Personnel costs were not declared under another EU or Euratom grant</td>
<td>Procedure:

The Auditor draws a sample of employees to carry out the procedures indicated in this section C and the following sections D to F.
[The Auditor has drawn a random sample of 10 employees assigned to Horizon 2020 action(s). If fewer than 10 employees are assigned to the Horizon 2020 action(s), the Auditor has selected all employees assigned to the Horizon 2020 action(s) complemented by other employees irrespective of their assignments until he has reached 10 employees.]. For this sample:
✓ the Auditor reviewed all documents relating to personnel costs such as employment contracts, payslips, payroll policy (e.g. salary policy, overtime policy, variable pay policy), accounting and payroll records, applicable national tax , labour and social security law and any other documents corroborating the personnel costs claimed;
✓ in particular, the Auditor reviewed the employment contracts of the employees in the sample to verify that:
i. they were employed directly by the Beneficiary in accordance with applicable national legislation;
ii. they were working under the sole technical supervision and responsibility of the latter;
iii. they were remunerated in accordance with the Beneficiary's usual practices;
iv. they were allocated to the correct group/category/cost centre for the purposes of calculating the unit cost in line with the Beneficiary's usual cost accounting practices;
✓ the Auditor verified that any ineligible items or any costs claimed under other costs categories or costs covered by other types of grant or by other grants financed from the European Union budget have not been taken into account when calculating the personnel costs;
✓ the Auditor numerically reconciled the total amount of personnel costs used to calculate the unit cost with the total amount of personnel costs recorded in the statutory accounts and the payroll system.</td></tr>
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<tr><th>Statements to be made by Beneficiary</th><th>Procedures to be carried out and Findings to be confirmed by the Auditor</th></tr>
<tr><td>(including grants awarded by a Member State and financed by the EU budget and grants awarded by bodies other than the Commission/Agency for the purpose of implementing the EU or Euratom budget in the same period, unless the Beneficiary can demonstrate that the operating grant does not cover any costs of the action).

<u>If additional remuneration as referred to in the grant agreement(s) is paid</u>

XII. The Beneficiary is a non-profit legal entity;
XIII. The additional remuneration is part of the beneficiary’s usual remuneration practices and paid consistently whenever the relevant work or expertise is required;
XIV. The criteria used to calculate the additional remuneration are objective and generally applied regardless of the source of funding;
XV. The additional remuneration included in the personnel costs used to calculate the hourly rates for the grant agreement(s) is capped at EUR 8 000 per full-time equivalent (reduced proportionately if the employee is not assigned exclusively to the action).

[If certain statement(s) of section “C. Personnel costs” cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor in the main Report of Factual Findings:
- …]</td>
<td>✓ to the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, the Auditor carefully examined those elements and checked the information source to confirm that they correspond to objective and verifiable information;
✓ if additional remuneration has been claimed, the Auditor verified that the Beneficiary was a non-profit legal entity, that the amount was capped at EUR 8 000 per full-time equivalent and that it was reduced proportionately for employees not assigned exclusively to the action(s).
✓ the Auditor recalculated the personnel costs for the employees in the sample.

Factual finding:

4. All the components of the remuneration that have been claimed as personnel costs are supported by underlying documentation.
5. The employees in the sample were employed directly by the Beneficiary in accordance with applicable national law and were working under its sole supervision and responsibility.
6. Their employment contracts were in line with the Beneficiary’s usual policy;
7. Personnel costs were duly documented and consisted solely of salaries, social security contributions (pension contributions, health insurance, unemployment fund contributions, etc.), taxes and other statutory costs included in the remuneration (holiday pay, thirteenth month’s pay, etc.);
8. The totals used to calculate the personnel unit costs are consistent with those registered in the payroll and accounting records;
9. To the extent that actual personnel costs were adjusted on the basis of budgeted or estimated elements, those elements were relevant for calculating the personnel costs and correspond to objective and verifiable information. The budgeted or estimated elements used are: — (indicate the elements and their values).
10. Personnel costs contained no ineligible elements;
11. Specific conditions for eligibility were fulfilled when additional</td></tr>
</table>

<table>
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<tr><th>Statements to be made by Beneficiary</th><th>Procedures to be carried out and Findings to be confirmed by the Auditor</th></tr>
<tr><td></td><td>remuneration was paid: a) the Beneficiary is registered in the grant agreements as a non-profit legal entity; b) it was paid according to objective criteria generally applied regardless of the source of funding used and c) remuneration was capped at EUR 8 000 per full-time equivalent (or up to up to the equivalent pro-rata amount if the person did not work on the action full-time during the year or did not work exclusively on the action).</td></tr>
<tr><td>D. Productive hours

XVI. The number of productive hours per full-time employee applied is [delete as appropriate]:
A. 1720 productive hours per year for a person working full-time (corresponding pro-rata for persons not working full time).
B. the total number of hours worked in the year by a person for the Beneficiary
C. the standard number of annual hours generally applied by the beneficiary for its personnel in accordance with its usual cost accounting practices. This number must be at least 90% of the standard annual workable hours.

<u>If method B is applied</u>

XVII. The calculation of the total number of hours worked was done as follows: annual workable hours of the person according to the employment contract, applicable labour agreement or national law plus overtime worked minus absences (such as sick leave and special leave).
XVIII. ‘Annual workable hours’ are hours during which the personnel must be working, at the employer’s disposal and carrying out his/her activity or duties under the employment contract, applicable collective labour agreement or national working time legislation.
XIX. The contract (applicable collective labour agreement or national working time legislation) do specify the working time enabling to calculate the annual workable hours.</td><td>Procedure (same sample basis as for Section C: Personnel costs):

✓ The Auditor verified that the number of productive hours applied is in accordance with method A, B or C.
✓ The Auditor checked that the number of productive hours per full-time employee is correct.
✓ If method B is applied the Auditor verified i) the manner in which the total number of hours worked was done and ii) that the contract specified the annual workable hours by inspecting all the relevant documents, national legislation, labour agreements and contracts.
✓ If method C is applied the Auditor reviewed the manner in which the standard number of working hours per year has been calculated by inspecting all the relevant documents, national legislation, labour agreements and contracts and verified that the number of productive hours per year used for these calculations was at least 90 % of the standard number of working hours per year.

Factual finding:
<u>General</u>
12. The Beneficiary applied a number of productive hours consistent with method A, B or C detailed in the left-hand column.
13. The number of productive hours per year per full-time employee was accurate.

<u>If method B is applied</u>

14. The number of ‘annual workable hours’, overtime and absences was</td></tr>
</table>

<table>
<tr><td colspan="2">Please explain any discrepancies in the body of the Report.</td></tr>
<tr><td>Statements to be made by Beneficiary</td><td>Procedures to be carried out and Findings to be confirmed by the Auditor</td></tr>
<tr><td>If method C is applied

XX. The standard number of productive hours per year is that of a full-time equivalent.
XXI. The number of productive hours per year on which the hourly rate is based i) corresponds to the Beneficiary's usual accounting practices; ii) is at least 90 % of the standard number of workable (working) hours per year.
XXII. Standard workable (working) hours are hours during which personnel are at the Beneficiary's disposal preforming the duties described in the relevant employment contract, collective labour agreement or national labour legislation. The number of standard annual workable (working) hours that the Beneficiary claims is supported by labour contracts, national legislation and other documentary evidence.
[If certain statement(s) of section "D. Productive hours" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:
- …]</td><td>verifiable based on the documents provided by the Beneficiary and the calculation of the total number of hours worked was accurate.
15. The contract specified the working time enabling to calculate the annual workable hours.
If method C is applied
16. The calculation of the number of productive hours per year corresponded to the usual costs accounting practice of the Beneficiary.
17. The calculation of the standard number of workable (working) hours per year was corroborated by the documents presented by the Beneficiary.
18. The number of productive hours per year used for the calculation of the hourly rate was at least 90 % of the number of workable (working) hours per year.</td></tr>
<tr><td>E. Hourly rates
The hourly rates are correct because:

XXIII. Hourly rates are correctly calculated since they result from dividing annual personnel costs by the productive hours of a given year and group (e.g. staff category or department or cost centre depending on the methodology applied) and they are in line with the statements made in section C. and D. above.

[If the statement of section 'E. Hourly rates' cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:
- …]</td><td>Procedure
✓ The Auditor has obtained a list of all personnel rates calculated by the Beneficiary in accordance with the methodology used.
✓ The Auditor has obtained a list of all the relevant employees, based on which the personnel rate(s) are calculated.

For 10 employees selected at random (same sample basis as Section C: Personnel costs):
✓ The Auditor recalculated the hourly rates.
✓ The Auditor verified that the methodology applied corresponds to the usual accounting practices of the organisation and is applied consistently for all activities of the organisation on the basis of objective criteria irrespective of the source of funding.
Factual finding:</td></tr>
</table>

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	**Procedures to be carried out and Findings to be confirmed by the Auditor**
	19. No differences arose from the recalculation of the hourly rate for the employees included in the sample.
F. Time recording XXIV. Time recording is in place for all persons with no exclusive dedication to one Horizon 2020 action. At least all hours worked in connection with the grant agreement(s) are registered on a **daily/weekly/monthly** basis *[delete as appropriate]* using a **paper/computer-based system** *[delete as appropriate]*; XXV. For persons exclusively assigned to one Horizon 2020 activity the Beneficiary has either signed a declaration to that effect or has put arrangements in place to record their working time; XXVI. Records of time worked have been signed by the person concerned (on paper or electronically) and approved by the action manager or line manager at least monthly; XXVII. Measures are in place to prevent staff from: i. recording the same hours twice, ii. recording working hours during absence periods (e.g. holidays, sick leave), iii. recording more than the number of productive hours per year used to calculate the hourly rates, and iv. recording hours worked outside the action period. XXVIII. No working time was recorded outside the action period; XXIX. No more hours were claimed than the productive hours used to calculate the hourly personnel rates. *[Please provide a brief description of the <u>time recording system</u> in place together with the measures applied to ensure its reliability to the Auditor and annex it to the*	**Procedure** ✓ The Auditor reviewed the brief description, all relevant manuals and/or internal guidance describing the methodology used to record time. The Auditor reviewed the time records of the random sample of 10 employees referred to under Section C: Personnel costs, and verified in particular: ✓ that time records were available for all persons with not exclusive assignment to the action; ✓ that time records were available for persons working exclusively for a Horizon 2020 action, or, alternatively, that a declaration signed by the Beneficiary was available for them certifying that they were working exclusively for a Horizon 2020 action; ✓ that time records were signed and approved in due time and that all minimum requirements were fulfilled; ✓ that the persons worked for the action in the periods claimed; ✓ that no more hours were claimed than the productive hours used to calculate the hourly personnel rates; ✓ that internal controls were in place to prevent that time is recorded twice, during absences for holidays or sick leave; that more hours are claimed per person per year for Horizon 2020 actions than the number of productive hours per year used to calculate the hourly rates; that working time is recorded outside the action period; ✓ the Auditor cross-checked the information with human-resources records to verify consistency and to ensure that the internal controls have been effective. In addition, the Auditor has verified that no more hours were charged to Horizon 2020 actions per person per year than the number of productive hours per year used to calculate the hourly rates, and verified that

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	**Procedures to be carried out and Findings to be confirmed by the Auditor**
present certificate[1]]. *[If certain statement(s) of section "F. Time recording" cannot be endorsed by the Beneficiary they should be listed here below and reported as exception by the Auditor:* *- ...]*	no time worked outside the action period was charged to the action. **Factual finding:** 20. The brief description, manuals and/or internal guidance on time recording provided by the Beneficiary were consistent with management reports/records and other documents reviewed and were generally applied by the Beneficiary to produce the financial statements. 21. For the random sample time was recorded or, in the case of employees working exclusively for the action, either a signed declaration or time records were available; 22. For the random sample the time records were signed by the employee and the action manager/line manager, at least monthly. 23. Working time claimed for the action occurred in the periods claimed; 24. No more hours were claimed than the number productive hours used to calculate the hourly personnel rates; 25. There is proof that the Beneficiary has checked that working time has not been claimed twice, that it is consistent with absence records and the number of productive hours per year, and that no working time has been claimed outside the action period. 26. Working time claimed is consistent with that on record at the human-resources department.

[1] The description of the time recording system must state among others information on the content of the time records, its coverage (full or action time-recording, for all personnel or only for personnel involved in H2020 actions), its degree of detail (whether there is a reference to the particular tasks accomplished), its form, periodicity of the time registration and authorisation (paper or a computer-based system; on a daily, weekly or monthly basis; signed and countersigned by whom), controls applied to prevent double-charging of time or ensure consistency with HR-records such as absences and travels as well as it information flow up to its use for the preparation of the Financial Statements.

Please explain any discrepancies in the body of the Report.	
Statements to be made by Beneficiary	**Procedures to be carried out and Findings to be confirmed by the Auditor**
[official name of the *[Beneficiary] [Linked Third Party]****]***	***[official name of the Auditor]***
[name and title of authorised representative]	***[name and title of authorised representative]***
[dd Month yyyy]	***[dd Month yyyy]***
<Signature of the *[Beneficiary] [Linked Third Party]****>***	***<Signature*** *of the Auditor****>***

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