EUROPEAN COMMISSION
Research Executive Agency

**Director**


# GRANT AGREEMENT

# NUMBER 896811 — BIOIMD

This **Agreement** ('the Agreement') is **between** the following parties:

**on the one part,**

the **Research Executive Agency (REA)** ('the Agency'), under the powers delegated by the European Commission ('the Commission'), represented for the purposes of signature of this Agreement by Head of Unit, Research Executive Agency , Excellent Science, Marie Skłodowska-Curie Individual Fellowships: European, Jean-Bernard VEYRET,

**and**

**on the other part,**

'the beneficiary':

**CONSIGLIO NAZIONALE DELLE RICERCHE (CNR)**, established in PIAZZALE ALDO MORO 7, ROMA 00185, Italy, VAT number: IT02118311006, represented for the purposes of signing the Agreement by LUCIA SORBA.

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

By signing the Agreement, the beneficiary accepts the grant and agrees to implement it under its 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

Annex 4 Model for the financial statements

Annex 5 Not applicable

Annex 6 Not applicable

# TERMS AND CONDITIONS

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# CHAPTER 1 GENERAL

## ARTICLE 1 — SUBJECT OF THE AGREEMENT

This Agreement sets out the rights and obligations and the terms and conditions applicable to the grant awarded to the beneficiary 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 '**Bioresorbable Self-powered Implantable Device — BIOIMD**' **('action')**, as described in Annex 1.

## ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION

The duration of the action will be **24 months** as of the effective starting date notified by the beneficiary, which must be within 12 months from the date the Agreement enters into force ('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, budget category (see Articles 5, 6)

### 4.2 Budget transfers

Not applicable

# 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 171 473.28** (one hundred and seventy one thousand four hundred and seventy three EURO and twenty eight eurocents).

### 5.2 Form of grant, reimbursement rate and form 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 **171 473.28** (one hundred and seventy one thousand four hundred and seventy three EURO and twenty eight eurocents) .

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

(a) for **costs for the recruited researcher** (living, mobility and family allowances): on the basis of the amount(s) per unit set out in Annex 2 ('**unit costs**') and

(b) for **institutional costs** (research, training and networking costs and management and indirect costs): on the basis of the amount per unit set out in Annex 2 (**unit costs**).

### 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 Agency — when the payment of the balance is made (see Article 21.4) — in the following steps:

Step 1 – Application of the reimbursement rate to the eligible costs

Step 2 – Limit to the maximum grant amount

Step 3 – Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

#### 5.3.1 Step 1 — Application of the reimbursement rate to the eligible costs

The reimbursement rate (see Article 5.2) is applied to the eligible costs (unit costs; see Article 6) declared by the beneficiary and approved by the Agency (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 substantial errors, irregularities or fraud or serious breach of obligations — Reduced grant amount — Calculation

If the grant is reduced (see Article 43), the Agency will calculate the reduced maximum 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 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 and 2 or
- the reduced grant amount following Step 3.

### 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 Agency rejects costs (see Article 42) or reduces the grant (see Article 43), it will calculate the '**revised final grant amount**'.

This amount is calculated by the Agency 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 Agency;
- in case of **reduction of the grant**: 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 will be the lower of the two amounts above.

## ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS

### 6.1 General conditions for costs to be eligible

Unit costs are eligible ('**eligible costs**') if:

(a) they are calculated as follows:

{amounts per unit set out in Annex 2

multiplied by

the number of actual units}.

(b) the number of actual units complies with the following:

- 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).

### 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 two budget categories:

A. **Costs for the recruited researcher** (A.1 Living allowance, A.2 Mobility allowance and A.3 Family allowance) are eligible, if:

(a) the number of units declared:

(i) corresponds to the actual number of months spent by the recruited researcher on the research training activities and

(ii) does not exceed 24 months;

(b) the recruited researcher complies with the following conditions:

(i) be recruited by the beneficiary under an **employment contract** (or other direct contract with equivalent benefits, including social security coverage) or — if not otherwise possible under national law — under a fixed amount fellowship agreement with minimum social security coverage, including periods of secondment to partner organisations.

(ii) be employed full-time, unless the Agency has approved a part-time employment for professional, personal or family reasons (see Article 55), and

(iii) be working exclusively for the action.

(c) the costs have been fully incurred for the benefit of the recruited researcher.

This latter condition is met if:

{{{**total remuneration costs** (salaries, social security contributions, taxes and other costs included in the remuneration under the employment contract or other direct contract) or **total fixed-amount fellowship costs** for the researcher during the action

plus

**total mobility costs** (household, relocation and travel expenses and, if they must be paid under national law, taxes, duties and social security contributions) for the researcher during the action}

plus

**total family costs** for the researcher during the action}

divided by

the number of actual units}.

is equal to or higher than the following amount:

{{amount per unit cost set out in Annex 2 as living allowance

plus

amount per unit cost set out in Annex 2 as mobility allowance}

plus

if it is due, amount per unit cost set out in Annex 2 as family allowance}.

B. **Institutional costs** (B.1 Research, training and networking costs and B.2 Management and indirect costs) are eligible if the costs for the recruited researcher (living allowance, mobility allowance, family allowance; see above) are eligible.

### 6.3 Ineligible costs

'Ineligible costs' are:

(a) costs that do not comply with the conditions set out above (in Article 6.1), in particular costs incurred during suspension of the action implementation (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

Agency 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.

### 6.4 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 beneficiary 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 the 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 beneficiary must have the appropriate resources to implement the action.

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

- call upon entities with a capital or legal link to the beneficiary[1], to implement certain action tasks described in Annex 1 (i.e. hosting and training of the researcher);

- call upon partner organisations to implement certain action tasks described in Annex 1 (i.e. hosting and training the researcher during a secondment).

In this case, the beneficiary retains sole responsibility towards the Agency for implementing the action.

[1] '**Entities with a capital or legal link**' are entities that have a link with the beneficiary, in particular, a legal or capital link, which is neither limited to the action nor established for the sole purpose of its implementation.

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

Not applicable

### ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES

Not applicable

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

Not applicable

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

Not applicable

### ARTICLE 13 — IMPLEMENTATION OF ACTION TASKS BY SUBCONTRACTORS

Not applicable

### ARTICLE 14 — IMPLEMENTATION OF ACTION TASKS BY LINKED THIRD PARTIES

Not applicable

### ARTICLE 15 — FINANCIAL SUPPORT TO THIRD PARTIES

Not applicable

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

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 beneficiary must provide — during implementation of the action or afterwards — 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

The 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.

The beneficiary must immediately inform the Agency 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 an entity with a capital or legal link);

(ii) changes in the name, address, legal form or organisation type of an entity with a capital or legal link;

(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 the 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 beneficiary 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 it declares as eligible.

It 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 Articles 22), the beneficiary must keep the records and other supporting documentation until the end of these procedures.

The beneficiary must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The Agency 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 beneficiary 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 beneficiary must keep adequate records and other supporting documentation to prove the number of units declared and that the costs for the recruited researcher (living allowance, mobility allowance, family allowance) have been fully incurred for the benefit of the researcher.

### 18.2 Consequences of non-compliance

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

## ARTICLE 20 — REPORTING — PAYMENT REQUESTS

### 20.1 Obligation to submit reports

The beneficiary must submit to the Agency (see Article 52) the report(s) set out in this Article. They include the 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 24

### 20.3 Periodic reports — Requests for interim payments

Not applicable

### 20.4 Final report — Request for payment of the balance

The beneficiary must — within 60 days following the end of the reporting period — submit a final report to the Agency.

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

(a) a '**final technical report**' containing:

(i) an **overview of the results** 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 also detail the exploitation and dissemination of the results.

The report must indicate the communication activities.

(ii) a **summary** for publication by the Agency;

(iii) 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 '**final financial report**' containing a ' **financial statement**' (see Annex 4) which includes the **request for payment of the balance**.

The financial statement must detail the eligible costs (see Article 6) for each budget category (see Annex 2).

The beneficiary must declare all eligible costs, even if they exceed the amounts indicated in the estimated budget (see Annex 2). Amounts which are not declared in the financial statement will not be taken into account by the Agency.

The beneficiary must certify that:

- the information provided is full, reliable and true;
- the costs declared are eligible (see Article 6), and
- 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).

### 20.5 Information on cumulative expenditure incurred

Not applicable

### 20.6 Currency for financial statements

Financial statements must be drafted in euro.

### 20.7 Language of reports

The report(s) (including financial statements) must be submitted in the language of the Agreement.

### 20.8 Consequences of non-compliance

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

If the beneficiary breaches its obligation to submit the report(s) and if it fails to comply with this obligation within 30 days following a written reminder sent by the Agency, it may terminate the Agreement 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 beneficiary:

- 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 beneficiary 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 **120 031.30** (one hundred and twenty thousand thirty one EURO and thirty eurocents).

The Agency will — except if Article 48 applies — make the pre-financing payment to the beneficiary 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 **8 573.66** (eight thousand five hundred and seventy three EURO and sixty six eurocents), corresponding to 5% of the maximum grant amount (see Article 5.1), is retained by the Agency from the pre-financing payment and transferred into the '**Guarantee Fund**'.

### 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 Agency will pay to the beneficiary 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 Agency 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 beneficiary (see Article 20) and approved by the Agency (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 beneficiary 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 Agency 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 Agency 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 beneficiary 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 beneficiary
- is negative, it will be recovered.

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

### 21.5 Notification of amounts due

When making payments, the Agency will formally notify to the beneficiary 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 Agency will make all payments in euro.

### 21.7 Payments to the beneficiary

Payments will be made to the beneficiary.

Payments will discharge the Agency from its payment obligation.

### 21.8 Bank account for payments

All payments will be made to the following bank account:

Name of bank: BANCA NAZIONALE DEL LAVORO S.P.A.
Full name of the account holder: CONSIGLIO NAZIONALE DELLE RICERCHE
IBAN code: IT75N0100503392000000218150

### 21.9 Costs of payment transfers

The cost of the payment transfers is borne as follows:

- the Agency 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 Agency 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 Agency does not pay within the payment deadlines (see above), the beneficiary is 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 beneficiary only upon request submitted within two months of receiving the late payment.

Late-payment interest is not due if the beneficiary is an EU Member State (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 Not applicable

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

### 22.1 Checks, reviews and audits by the Agency and the Commission

#### 22.1.1 Right to carry out checks

The Agency or 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 Agency or the Commission may be assisted by external persons or bodies.

The Agency or the Commission may also request additional information in accordance with Article 17.

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 Agency or 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 beneficiary and will be considered to have started on the date of the formal notification.

The Agency or 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 beneficiary of the identity of the external persons or bodies. It has the right to object to the appointment on grounds of commercial confidentiality.

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

For **on-the-spot** reviews, the beneficiary must allow access to its 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 Agency or the Commission will formally notify the review report to the beneficiary, 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 Agency or 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 beneficiary and will be considered to have started on the date of the formal notification.

The Agency or 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 beneficiary of the identity of the external persons or bodies. It has the right to object to the appointment on grounds of commercial confidentiality.

The beneficiary must provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement.

For **on-the-spot** audits, the beneficiary must allow access to its 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 Agency or the Commission will formally notify the draft audit report to the beneficiary, which has 30 days to formally notify observations ('**contradictory audit procedure**'). This period may be extended by the Agency or the Commission in justified cases.

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

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

The Agency or the Commission may also access the beneficiary' 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[2] and No 2185/96[3] (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[4], 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

Not applicable

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

#### 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).

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[2] 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).

[3] 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).

[4] 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).

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

(a) the beneficiary 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 — 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 Agency or the Commission will formally notify the beneficiary 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 Agency or the Commission on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected if the beneficiary:

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

(ii) does not submit revised financial statements.

The beneficiary 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 Agency or the Commission in justified cases.

The Agency or 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.

If the Agency or the Commission accepts the alternative correction method proposed by the beneficiary, it will formally notify the application of the accepted alternative correction method.

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 Agency or the Commission intends to apply according to the principle of proportionality.

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

The Agency or 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 the 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 Agency or the Commission may carry out interim and final evaluations of the impact of the action measured against the objective of the EU 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 beneficiary.

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

### 23.2 Consequences of non-compliance

If the beneficiary breaches any of its obligations under this Article, the Agency 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

If the beneficiary is a university or other public research organisation it 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[5].

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

The beneficiary must ensure that the researchers and the third parties mentioned in Annex 1 are aware of them.

### 23a.2 Consequences of non-compliance

If the beneficiary breaches its obligations under this Article, the Agency 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 beneficiary must identify (in writing) the background for the action.

'**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 beneficiary before its accession to the Agreement, and

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

[5] 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.

### 24.2 Consequences of non-compliance

If the 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

Not applicable

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

Not applicable

### 25.4 Access rights for affiliated entities

Not applicable

### 25.5 Access rights for the researcher

The beneficiary must — on a royalty-free basis — give access to the recruited researcher to background necessary for their research training activities under the action.

### 25.6 Consequences of non-compliance

If the 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

Not applicable

### 26.3 Rights of third parties (including personnel)

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

If a third party generates results, the beneficiary 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 Agency ownership, to protect results

26.4.1 The Agency may — with the consent of the beneficiary — assume ownership of results to protect them, if the 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 a third party established in an EU Member State or associated country[6], 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 Agency 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 Agency decides to assume ownership, it will formally notify the beneficiary within 45 days of receiving notification.

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

[6] For the definition, see 2.1(3) of 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)" ('**Rules for Participation Regulation No 1290/2013**') (OJ L 347, 20.12.2013 p.81): '**associated country**' means a third country which is party to an international agreement with the Union, as identified in Article 7 of the H2020 Framework Programme Regulation No 1291/2013. Article 7 sets out the conditions for association of non-EU countries to Horizon 2020.

26.4.2 The Agency may — with the consent of the beneficiary — assume ownership of results to protect them, if the 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.

The 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 Agency 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 Agency decides to assume ownership, it will formally notify the beneficiary within 45 days of receiving notification.

### 26.5 Consequences of non-compliance

If the 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

The 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.

### 27.2 Agency ownership, to protect the results

If the beneficiary intends not to protect its results, to stop protecting them or not seek an extension of protection, the Agency 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 the beneficiary must — unless the Agency requests or agrees otherwise or unless it is impossible — include the following:

> "The project leading to this application has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 896811".

### 27.4 Consequences of non-compliance

If the 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

The 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 must — unless the Agency 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 have received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 896811".

### 28.3 Consequences of non-compliance

If the 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 its legitimate interests, the 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.

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

### 29.2 Open access to scientific publications

The 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 "Marie Skłodowska-Curie Action";
- the project name, acronym and grant number;
- the publication date and, if applicable, length of embargo period;
- a persistent identifier.

### 29.3 Open access to research data

Regarding the digital research data generated in the action ('**data**'), the beneficiary 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) 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

beneficiary 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 beneficiary does not have to ensure open access to specific parts of its research data 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 Agency 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 European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 896811".

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

For the purposes of its obligations under this Article, the beneficiary may use the EU emblem without first obtaining approval from the Agency.

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

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

### 29.5 Disclaimer excluding Agency responsibility

Any dissemination of results must indicate that it reflects only the author's view and that the Agency 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 breaches 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

The 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.

### 30.2 Granting licenses

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

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

(b) not applicable.

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

### 30.3 Agency right to object to transfers or licensing

Not applicable

### 30.4 Consequences of non-compliance

If the 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

Not applicable

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

Not applicable

### 31.4 Access rights of affiliated entities

Not applicable

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

The beneficiary must give access to its results — on a royalty-free basis — to EU institutions, bodies, offices or agencies, for developing, implementing or monitoring EU policies or programmes.

Such access rights are limited to non-commercial and non-competitive use.

This does not change the right to use any material, document or information received from the beneficiary for communication and publicising activities (see Article 38.2).

### 31.6 Access rights for the researcher

The beneficiary must — on a royalty-free basis — give, access to the recruited researcher to results necessary for the research training activities under the action.

### 31.7 Consequences of non-compliance

If the 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 THE RECRUITED RESEARCHER

### 32.1 Obligations towards the recruited researcher

The beneficiary must respect the following recruitment and working conditions for the researcher recruited under the action:

(a) 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[7] and ensure that the researcher is aware of them;

(b) ensure that the researcher enjoys at the place of the implementation at least the same standards and working conditions as those applicable to local researchers holding a similar position;

(c) ensure that the employment contract, other direct contract or fixed amount fellowship agreement (see Article 6) specifies:

(i) the name of the supervisor for the research training activities as indicated in Annex 1;

(ii) the starting date and duration of the research training activities under the action;

(iii) the monthly support for the researcher under this Agreement (in euro and, if relevant, in the currency in which the remuneration is paid);

(iv) the obligation of the researcher to work exclusively for the action;

(v) the obligation of the researcher not to receive for activities carried out in the frame of

[7] 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).

the action, other incomes than those received from the beneficiary (or any other entity referred to in Annex 1);

(vi) the obligation of the researcher to inform the beneficiary as soon as possible of any events or circumstances likely to affect the Agreement (see Article 17);

(vii) the arrangements related to the intellectual property rights between the beneficiary and the researcher — during implementation of the action and afterwards;

(viii) the obligation of the researcher to maintain confidentiality (see Article 36);

(ix) the obligation of the researcher to ensure the visibility of EU funding in communications or publications and in applications for the protection of results (see Articles 27, 28, 29 and 38);

(d) assist the researcher in the administrative procedures related to the recruitment;

(e) inform the researcher about:

- the description, conditions, location and the timetable for the implementation of the research training activities under the action and the name of the supervisor;
- the rights and obligations of the beneficiary toward the researcher under this Agreement;
- the obligation of the researcher to complete and submit — at the end of the research training activities — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the Agency;

(f) ensure that the researcher does not receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiary (or any other entity referred to in Annex 1);

(g) ensure that the researcher does not have to bear any costs for the implementation of the action as described in Annex 1;

(h) host the researcher at its premises (or at the premises of an entity with a capital or legal link);

(i) provide training and the necessary means for implementing the action (or ensure that such training and means are provided by entities with a capital or legal link);

(j) ensure that the researcher is adequately supervised;

(k) ensure that — at the beginning of the research training activities — a career development plan is established together with the supervisor;

(l) support the secondment of the researcher to a partner organisation in a Member State or associated country as set out in Annex 1:

- for actions with a duration up to 18 months: for a maximum of three months or
- for actions with a duration of more than 18 months: for a maximum of six months;

### 32.2 Consequences of non-compliance

If the 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 33 — GENDER EQUALITY

### 33.1 Obligation to aim for gender equality

The beneficiary must take all measures to promote equal opportunities between men and women in the implementation of the action. It 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.

### 33.2 Consequences of non-compliance

If the beneficiary breaches its obligations under this Article, the Agency 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 beneficiary 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 beneficiary must ensure that the activities under the action have an exclusive focus on civil applications.

The beneficiary 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 beneficiary must respect the fundamental principle of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity[8].

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

and means that the beneficiary 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, the 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 beneficiary to the Agency (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 beneficiary has obtained explicit approval (in writing) from the Agency (see Article 52).

[8] The 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

### 34.4 Consequences of non-compliance

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

It must formally notify to the Agency 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 Agency 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 the beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43) and the Agreement 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 the beneficiary requests, the Agency 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 beneficiary may disclose confidential information to its personnel, third parties mentioned in Annex 1 or a partner organisation 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 Agency 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[9], 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:

(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 the 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

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

### 37.4 Consequences of non-compliance

Not applicable

## ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING

### 38.1 Communication activities by the beneficiary

#### 38.1.1 Obligation to promote the action and its results

The beneficiary 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 mainstream media coverage the beneficiary must inform the Agency (see Article 52).

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

Unless the Agency 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 European Union emblem and

(b) include the following statement:

> For communication activities: “This project has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 896811”.
>
> For infrastructure, equipment and major results: “This *[infrastructure][equipment][insert type of result]* is part of a project that has received funding from the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 896811”.

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

For the purposes of its obligations under this Article, the beneficiary may use the EU emblem without first obtaining approval from the Agency.

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

Moreover, it 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 Agency and Commission responsibility

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

### 38.2 Communication activities by the Agency and the Commission

### 38.2.1 Right to use the beneficiary' materials, documents or information

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

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

(a) **use for its own purposes** (in particular, making them available to persons working for the Agency, 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[11], 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 Agency or 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).

[11] 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.

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

> "© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the Research Executive Agency (REA) and the European Union (EU) under conditions."

### 38.3 Consequences of non-compliance

If the 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 Agency and the Commission

Any personal data under the Agreement will be processed by the Agency or the Commission under Regulation No 45/2001[12] and according to the 'notifications of the processing operations' to the Data Protection Officer (DPO) of the Agency or the Commission (publicly accessible in the DPO register).

Such data will be processed by the '**data controller**' of the Agency or 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 Agency and 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 beneficiary

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

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

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

### 39.3 Consequences of non-compliance

[12] 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).

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

### ARTICLE 40 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE AGENCY

The beneficiary may not assign any of its claims for payment against the Agency to any third party, except if approved by the Agency on the basis of a reasoned, written request.

If the Agency 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 beneficiary from its obligations towards the Agency.

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

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

#### 41.1 Roles and responsibility towards the Agency

The beneficiary has full responsibility for implementing the action and complying with the Agreement.

The beneficiary is itself responsible for:

(a) monitoring that the action is implemented properly (see Article 7);

(b) informing the Agency immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 17);

(c) submitting the deliverables and report(s) to the Agency (see Articles 19 and 20);

(d) submitting to the Agency in good time any documents or information required by it

and may not delegate or subcontract these tasks to any third party (including entities with a capital or legal link and partner organisations).

#### 41.2 Internal division of roles and responsibilities

Not applicable

#### 41.3 Internal arrangements between beneficiaries — Consortium agreement

Not applicable

#### 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 Agency will — **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 Agency will formally notify the beneficiary 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 beneficiary may — within 30 days of receiving notification — formally notify the Agency of its disagreement and the reasons why.

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

### 42.3 Effects

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

If the Agency rejects costs **after the payment of the balance**, it will deduct the amount rejected from the total eligible costs declared, in the 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 Agency may — **at the payment of the balance** or **afterwards** — reduce the maximum grant amount (see Article 5.1), if:

(a) the 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) the 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 Agency will formally notify a '**pre-information letter**' to the beneficiary:

- 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 Agency 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 Agency 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 Agency reduces the grant **after the payment of the balance**, it will calculate the revised final grant amount (see Article 5.4). If the revised final grant amount is lower than the final grant amount, the Agency will recover the difference (see Article 44).

## ARTICLE 44 — RECOVERY OF UNDUE AMOUNTS

### 44.1 Amount to be recovered — Calculation — Procedure

The Agency will — **at the payment of the balance** or **afterwards** — claim back any amount that was paid, but is not due under the Agreement.

### 44.1.1 Recovery after termination of a beneficiary's participation

Not applicable

### 44.1.2 Recovery at payment of the balance

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

- 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; and
- inviting it to submit observations within 30 days of receiving notification.

If no observations are submitted or the Agency 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 beneficiary 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 payment is not made by the date specified in the debit note, the Agency or the Commission will **recover** the amount:

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

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

(b) by **drawing on the Guarantee Fund**. The Agency or the Commission will formally notify the beneficiary 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) 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 Agency or 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[13] applies.

### 44.1.3 Recovery of amounts after payment of the balance

If, the revised final grant amount (see Article 5.4) is lower than the final grant amount, the beneficiary must repay the difference to the Agency.

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

- 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 Agency decides to pursue recovery despite the observations it has received, it will **confirm** the amount to be recovered and formally notify to the beneficiary 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 Agency or the Commission will **recover** the amount:

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

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

(b) by **drawing on the Guarantee Fund**. The Agency or the Commission will formally notify the beneficiary 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) 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 Agency or 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.

[13] 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).

## ARTICLE 45 — ADMINISTRATIVE SANCTIONS

In addition to contractual measures, the Agency or 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 Agency

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

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

### 46.2 Liability of the beneficiary

Except in case of force majeure (see Article 51), the beneficiary must compensate the Agency 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 Agency 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 report has not been submitted or is not complete or additional information is needed, or

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

### 47.2 Procedure

The Agency will formally notify the beneficiary of the suspension and the reasons why.

The suspension will **take effect** the day notification is sent by the Agency (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 beneficiary may request the Agency if the suspension will continue.

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

## ARTICLE 48 — SUSPENSION OF PAYMENTS

### 48.1 Conditions

The Agency may — at any moment — suspend payments, in whole or in part, if:

(a) the 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) or

(b) the 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).

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 Agency will formally notify the beneficiary:

- 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 Agency 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 Agency.

If the conditions for resuming payments are met, the suspension will be **lifted**. The Agency will formally notify the beneficiary.

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

## ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION

### 49.1 Suspension of the action implementation by the beneficiary

#### 49.1.1 Conditions — Procedure

49.1.1.1 The beneficiary 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.

In this case, the beneficiary must immediately formally notify suspension to the Agency (see Article 52), stating:

(a) the reasons why and

(b) the expected date of resumption.

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

Once circumstances allow for implementation to resume, the beneficiary must immediately formally notify the Agency 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 Articles 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).

49.1.1.2 The beneficiary may request suspension of the action implementation (or any part of it) for professional, personal or family reasons (including parental leave).

For this purpose, the beneficiary must formally notify a request for **amendment** (to make the necessary changes and to set the date of resumption) in accordance with Article 55.

The suspension **will take effect** on the date set out in the amendment.

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

### 49.2 Suspension of the action implementation, by the Agency

#### 49.2.1 Conditions

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

(a) the 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) the 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 Agency will formally notify the beneficiary:

- 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 Agency 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 by the beneficiary (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 beneficiary 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 beneficiary may not claim damages due to suspension by the Agency (see Article 46).

Suspension of the action implementation does not affect the Agency's right to terminate the Agreement (see Article 50), reduce the grant or recover amounts unduly paid (see Articles 43 and 44).

## ARTICLE 50 — TERMINATION OF THE AGREEMENT

### 50.1 Termination of the Agreement by the beneficiary

#### 50.1.1 Conditions and procedure

The beneficiary may terminate the Agreement.

The beneficiary must formally notify termination to the Agency (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 Agency 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 beneficiary must — within 60 days from when termination takes effect — submit: the report under Article 20.3.

If the Agency does not receive the reports within the deadline (see above), only costs which are included in the report will be taken into account.

The Agency will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the report(s) 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 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.

### 50.2 Termination of the participation of one or more beneficiaries, by the beneficiaries

Not applicable

### 50.3 Termination of the Agreement, by the Agency

#### 50.3.1 Conditions

The Agency may terminate the Agreement, if:

(a) not applicable;

(b) a change to the beneficiary's legal, financial, technical, organisational or ownership situation or those of its third parties mentioned in Annex 1 is likely to substantially affect or delay the implementation of the action or calls into question the decision to award the grant;

(c) not applicable;

(d) implementation of the action is prevented by force majeure (see Article 51) or suspended by the beneficiary (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) the 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) the 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) the 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) the 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) the beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed:

(i) substantial errors, irregularities, 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) the beneficiary (or the 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 Agency, the beneficiary does not request an amendment to the Agreement to end the participation of a partner organisationor an entity with a capital or legal link that is in one of the situations under points (e), (f), (g), (k), (l) or (m) and to reallocate its tasks;

(o) the beneficiary has not started the action or notified the effective starting date of the action within the period indicated in the Article 3;

(p) the researcher cannot continue implementing the research training activities, or has committed fraud, including submission of false information or failure to provide required information for the purpose of the action.

### 50.3.2 Procedure

Before terminating the Agreement, the Agency will formally notify the beneficiary:

- **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 Agency of the measures to ensure compliance with the obligations under the Agreement.

If the Agency does not receive observations or decides to pursue the procedure despite the observations it has received, it will formally notify to the beneficiary **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), (e), (g), (h), (l.ii) and (o) above: on the day specified in the notification of the confirmation (see above);
- for terminations under Points (d), (f), (k), (l.i), (m), and (p) above: on the day after the notification of the confirmation is received by the beneficiary.

### 50.3.3 Effects

The beneficiary must — within 60 days from when termination takes effect — submit: the report under Article 20.3.

If the Agreement is terminated for breach of the obligation to submit report(s) (see Articles 20.8 and 50.3.1(l)), the beneficiary may not submit any report(s) after termination.

If the Agency does not receive the reports within the deadline (see above), only costs which are included in the report will be taken into account.

The Agency will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the report(s) 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 Agency'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 Agency (see Article 46).

After termination, the 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 Agency 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, the 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 Agency and the Commission websites.

#### 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 Agency will formally notify the beneficiary in advance any changes to this URL.

**Formal notifications on paper** (only after the payment of the balance) addressed **to the Agency** must be sent to the official mailing address indicated on the Agency's website.

Formal notifications on paper (only after the payment of the balance) addressed **to the beneficiary** must be sent to its legal address as specified in the Particiapnt 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

Not applicable

## ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES

In accordance with Regulation No 1182/71[14], 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

[14] 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).

### 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.

The beneficiary may, in particular, request a change of the time spent on the action (part-time employment) for professional, personal or family reasons (including parental leave).

### 55.2 Procedure

The party requesting an amendment must formally notify a request to the other party (see Article 52).

The notification must include:

(a) the reasons why;

(b) the appropriate supporting documents.

The Agency may request additional information.

The party receiving the request must formally notify its agreement or disagreement, within 45 days of receiving notification (or any additional information the Agency has requested). This 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 by the Agency or the beneficiary, depending on which is later.

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

Not applicable

## ARTICLE 56a — TRANSFER OF THE AGREEMENT TO A NEW BENEFICIARY

### 56a.1 Conditions

The beneficiary may request that the research training activities are transferred to a new beneficiary, if there are serious reasons affecting its capacity to implement the action (without being entitled to any additional EU funding for doing so).

### 56a.2 Procedure

The beneficiary must formally notify a **request for amendment** to the Agency (see Article 55).

The request must include:

- the reasons why;
- the date the change takes effect;
- the opinion of the researcher and its supervisor;
- a proposal for the necessary changes, including — if necessary — the appointment of the new supervisor and the Accession Form for the new beneficiary(see Annex 3).

The change **will take effec** on the day set out in the amendment.

### 56a.3 Effects

If the request for amendment is accepted by the Agency, the Agreement will be **amended** to introduce the necessary changes in order to reallocate the tasks of the former beneficiary (see Article 55).

In this case, the former beneficiary must:

- transfer immediately the remaining contribution to the new beneficiary and
- submit — within 30 days from the change — a '**transfer report**', containing an overview of the progress of the work and the individual financial statement (see Article 20).

The maximum grant amount will be split between the former beneficiary and the new beneficiary, on the basis of the number of actual units in line with Article 6.

The former and the new beneficiary must agree on arrangements concerning the management of intellectual property rights and other issues under the Agreement.

If the Agency considers that the reasons provided do not justify the transfer, it will reject the request specifying the grounds for the rejection.

## 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.

### 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).

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 44, 45 and 46), the beneficiary must bring action before the General Court — or, on appeal, the Court of Justice of the European Union — under Article 263 TFEU. Actions against offsetting and enforceable decisions must be brought against the Commission (not against the Agency).

## ARTICLE 58 — ENTRY INTO FORCE OF THE AGREEMENT

The Agreement will enter into force on the day of signature by the Agency or the beneficiary, depending on which is later.

SIGNATURES

For the beneficiary

LUCIA SORBA with ECAS id nsorbalu signed in the Participant Portal on 12/03/2020 at 16:48:46 (transaction id SigId-107333-AnjXF52zQNDtzx5ODXEy0hyOT3YNka7zXxJBCKECBrrlSAlNi49zphWcranZv67Z39PwCbnG0cjn0HgEKpZWXzg-jpJZscgsw0Ku5x8AwUVVTm-HYnxeQXOl0Ci39zPDOgSd8HJzatQrUyT8ng3m7K9iGJ0). Timestamp by third party at Thu Mar 12 16:48:55 CET 2020

For the Agency

Signed by Kaisa Helena HELLEVUO with ECAS id helleka as an authorised representative on 13-03-2020 15:27:31 (transaction id SigId-118387-MAO4t71Zd440Uzr7EzitL0nJS9tcP97NAB18zq04pSZoPDC3W4JGeUtZikj4e1hpeA3IOkseQaFKrdjZXsjt9SW-jpJZscgsw0Ku5x8AwUVVTm-lZokVYbKWMoeSrFhwYySKYWqbHSPtGKlSCGvgNvmwp4)
Fri Mar 13 15:27:37 CET 2020

EUROPEAN COMMISSION
Research Executive Agency

**The Director**

# ANNEX 1 (part A)

## Standard European Fellowships

## NUMBER — 896811 — BIOIMD

# Table of Contents

# 1.1. The project summary



| Project Number [1] | 896811 | Project Acronym [2] | BIOIMD |
|---|---|---|---|

One form per project

| General information | |
|---|---|
| Project title [3] | Bioresorbable Self-powered Implantable Device |
| Starting date [4] | Start date to be notified; must lie within 12 months of grant agreement signature |
| Duration in months [5] | 24 |
| Call (part) identifier [6] | H2020-MSCA-IF-2019 |
| Topic | MSCA-IF-2019<br>Individual Fellowships |
| Fixed EC Keywords | Nanophysics: nanoelectronics, nanophotonics, nanomagnetism, nanoelectromechanics, etc., Biomaterials, biomaterial synthesis, Materials for sensors, Nanotechnology: nanomaterials, tools and techniques, applications of nanotechnology, Energy collection, conversion and storage, renewable energy |
| Free keywords | piezoelectric energy harvesting, biomedical device |

Abstract [7]

The interaction between medicine and technology allows the development of new implantable medical devices (IMDs) to detect or monitor diseases inside the human body. The key challenge is to supply continuous power to the IMDs. Conventional strategy to use the implantable battery suffers from limited lifetime, maintenance problem, hazardous chemicals and requirement of periodic replacement through surgery which eventually increase patient health risk. In this context, scavenging electricity from biomechanical energy sources using piezoelectric energy harvester is a smart strategy for realizing self-powered implantable bioelectronics, since it can harvest electric energy from inexhaustible slight motions of organs such as heart, lungs, and diaphragm. In this regard, the devices should be flexible and at the same time biodegradable to avoid invasive removal surgery that can damage directly interfaced tissues. Despite recent achievements in self-powered electronic devices, there is still a tremendous need to develop an efficient self-powered IMD which only relies on safe medical materials. In this context, the focus of the project is to develop high performance natural piezo-electric polymer based biodegradable IMD which can be absorbed by the body after certain period of time without any adhere toxicity. In addition, we will emphasize on material science, underlying concepts in mechanics and associated engineering strategies in device construction. The key design strategies for the piezoelectric device based self-powered IMD will adopt interdisciplinary approach from materials science (nanopillar configurations), chemistry (organic bio-polymers processing), applied physics (modeling, theoretical simulation), engineering (IMD circuit design) and biology (device implantation). This collective concept suggests a promising future across a range of fields, particularly in biomedical engineering, nanoneurotechnology and next-generation wireless implantable biomedical device.

# 1.2. List of Beneficiaries



| Project Number [1] | 896811 | Project Acronym [2] | BIOIMD |
|---|---|---|---|

List of Beneficiaries

| No | Name | Short name | Country | Project entry month[8] | Project exit month |
|---|---|---|---|---|---|
| 1 | CONSIGLIO NAZIONALE DELLE RICERCHE | CNR | Italy | 1 | 24 |

# 1.3. Workplan Tables - Detailed implementation

## *1.3.1. WT1 List of work packages*

| WP Number[9] | WP Title | Lead beneficiary[10] | Start month[12] | End month[13] |
|---|---|---|---|---|
| WP1 | Ethics requirements | 1 - CNR | 1 | 24 |
| WP2 | Data Management | 1 - CNR | 1 | 24 |

## *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 | A - Requirement No. 1 | WP1 | 1 - CNR | Ethics | Confidential, only for members of the consortium (including the Commission Services) | 19 |
| D2.1 | Data Management Plan | WP2 | 1 - CNR | ORDP: Open Research Data Pilot | Confidential, only for members of the consortium (including the Commission Services) | 6 |

## 1.3.3. WT3 Work package descriptions

| | | | |
|---|---|---|---|
| **Work package number** [9] | WP1 | **Lead beneficiary** [10] | 1 - CNR |
| **Work package title** | Ethics requirements | | |
| **Start month** | 1 | **End month** | 24 |

### Objectives

The objective is to ensure compliance with the 'ethics requirements' set out in this work package.

### Description of work and role of partners

**WP1 - Ethics requirements** [Months: 1-24]
**CNR**
This work package sets out the 'ethics requirements' that the project must comply with.

### List of deliverables

| Deliverable Number[14] | Deliverable Title | Lead beneficiary | Type[15] | Dissemination level[16] | Due Date (in months)[17] |
|---|---|---|---|---|---|
| D1.1 | A - Requirement No. 1 | 1 - CNR | Ethics | Confidential, only for members of the consortium (including the Commission Services) | 19 |

### Description of deliverables

The 'ethics requirements' that the project must comply with are included as deliverables in this work package.

D1.1 : A - Requirement No. 1 [19]

General information on the nature of the experiments and the procedures to ensure animal welfare and adherence to the Three R's principle must be provided. Copies of relevant authorisations for animal experiments (covering also the work with genetically-modified animals, if applicable) must be submitted. Copies of training certificates/personal licenses of the staff involved in animal experiments must be submitted.

| | | | |
|---|---|---|---|
| **Work package number** [9] | WP2 | **Lead beneficiary** [10] | 1 - CNR |
| **Work package title** | Data Management | | |
| **Start month** | 1 | **End month** | 24 |

## Objectives

To improve and maximise access to and re-use of research data generated by the action

## Description of work and role of partners

**WP2 - Data Management** [Months: 1-24]
**CNR**
To develop a Data Management Plan, outlining how research data will be handled during the action, and after it is completed. The Plan is not a fixed document; it evolves and gains more precision and substance during the lifespan of the project.

## Participation per Partner

| **Partner number and short name** [10] |
|---|

## List of deliverables

| **Deliverable Number**[14] | **Deliverable Title** | **Lead beneficiary** | **Type**[15] | **Dissemination level**[16] | **Due Date (in months)**[17] |
|---|---|---|---|---|---|
| D2.1 | Data Management Plan | 1 - CNR | ORDP: Open Research Data Pilot | Confidential, only for members of the consortium (including the Commission Services) | 6 |

## Description of deliverables

The Data Management Plan describes the data management life cycle for all data sets that will be collected, processed or generated by the action. It is a document describing what data will be collected, processed or generated and following what methodology and standards, whether and how this data will be shared and/or made open, and how it will be curated and preserved.

D2.1 : Data Management Plan [6]

The Data Management Plan describes the data management life cycle for all data sets that will be collected, processed or generated by the action. It is a document describing what data will be collected, processed or generated and following what methodology and standards, whether and how this data will be shared and/or made open, and how it will be curated and preserved.

**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 Agency). 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.

## 1. Excellence

### *1.1 Quality and credibility of the research/innovation project; level of novelty, appropriate consideration of inter/multidisciplinary and gender aspects*

### 1.1.1 Introduction[1]

Implantable medical devices (IMDs) are designed for monitoring biological parameters, drug delivery, or improving the function of certain organs in the human body [1]. Implantable electronics are widely used in various parts of the patient's body as medical remedy tools, such as deep brain stimulation, cardiac pacemaker, visual prosthesis, and cochlear implant, by electric stimulation of nerve/muscle and monitoring of health condition. The interaction between medicine and technology allows the development of new IMDs to detect or monitor diseases inside the human body [1–3]. For instance, an implantable glucose sensor permits diabetics to obtain real-time, accurate glucose readings without pricking their finger [3]. In this regard, an implantable device needs a reliable supply of power for long term operation. However, the conventional implanted batteries have limited lifetime, fixed energy density, large volume, maintenance problem, hazardous chemicals, and requirement of periodic replacement through repeated surgery which eventually increase patient health risk [4]. Piezoelectric device based energy harvesting technology stands as a promising solution which scavenges electricity from biomechanical energy sources to eliminate the implantable batteries or directly stimulate nerve/muscle (Fig. 1) [5]. A flexible piezoelectric energy harvester is a promising candidate for the realization of self-powered implantable bioelectronics, since it can harvest electric energy from inexhaustible slight motions of organs such as heart, lungs, and diaphragm. Established strategies to deploy the highest performance of the energy harvesters were based on the use of inorganic/lead-based piezoelectric materials whose device architectures were mechanically hard, brittle and sometimes heavy, with limited biocompatibility to the human body [5,6]. In contrast, ferroelectric bio-polymer based energy harvesters enjoy their inherent advantages, such as adequate flexibility, light weight, low cost, biocompatibility and even biodegradability [7]. Therefore, the use of bio-polymers as a self-powered non-invasive biomedical sensor is strongly recommended for the realization of the next generation biomedical prostheses. In order to implement bio-polymers as energy harvesters, the main issue to face with is their low piezoelectric charge co-efficient (~ 0.07–28 pC/N) when compared to traditional ceramic/lead based materials (~ 225–590 pC/N) [8,9]. In this context, nanostructure based piezoelectric energy harvesting approach is especially appealing due to the apparent strain confinement effect and improved strain tolerance capability in nanostructures which is usually not achievable with their bulk counterpart [10]. For instance, in piezoelectric polymers, where the application of mechanical stress along one axis may causes strain also in orthogonal directions, the selective reduction of the structural size may improve strain confinement which, in turn, leads to improved dipole alignment that increased piezoelectric potential and energy conversion efficiency [10]. An array of nanostructures such as, nanopillars, with aspect ratio in the interval 2 - 4 and its integration into small scale device could hence enable direct harvesting of biomechanical energy with improved piezoelectric response. However, meeting the materials selection criteria for efficient bio-piezoelectric element is challenging since, to date, the origin of piezo-electricity in biomaterials is not completely revealed and do not follow the classic models of piezoelectric theories based on idealized, crystalline structures. The most promising piezoelectric bio-polymers in this regard are, cellulose, chitin and gelatin because of their abundance in nature, higher piezoelectricity compared to other bio-polymers and ease of processing even at large scale [7]. In addition, the aforementioned bio-polymers as biocompatible and biodegradable materials are also attractive for edible electronics. Therefore, this proposal aims to (i) unveil and investigate the piezoelectric properties of the most abundant bio-polymers in nature both in the form of bulk and nanopillars, (ii) select the most performing one to build devices based on arrays of nanopillars, (iii) perform *in-vitro* tests.

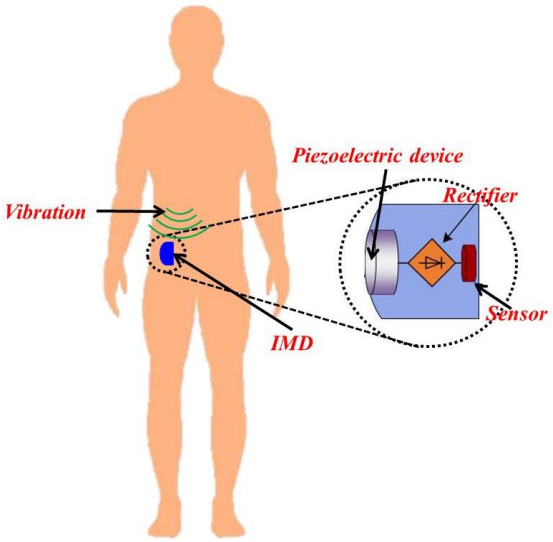


*Fig. 1 Schematic representation of the piezoelectric device based IMDs*

[1] [1] Ledet *et al.*, J. Am. Acad. Orthop. Surg. 20 (2012) 383; [2] Gerrish *et al.*, IEEE Trans. Device Mater. Reliab. 5 (2015) 435–44; [3] Guiseppi-Elie *et al.*, IEEE Sens. J. 5 (2005) 345–55; [4] W. H. Ko, ACM J. Emerg. Technol. Comput. Syst. 8 (2012) 8; [5] Parvez Mahmud *et al.*, Adv. Energy Mater. 8 (2018) 1701210; [6] Fan *et al.*, Adv. Mater. 28 (2016) 4283–4305; [7] Maiti *et al.*, Adv. Energy Mater. 9 (2019) 1803027; [8] Rajabi *et al.*, Acta Biomaterialia 24 (2015) 12–23; [9] Kim *et al.*, Sens. Actuators A 2008, 147, 304−309; [10] Kim *et al.*, Appl. Phys. Lett. 101 (2012) 013104; [11] Kargarzadeh *et al.*, Prog. Polym. Sci. 87 (2018) 197–227; [12] Pillai *et al.*, Prog. Polym. Sci. 34 (2009) 641; [13] Huang *et al.*, Trends Food Sci. Technol 86 (2019) 260–269; [14] Ghosh *et al.*, Nano Energy 36 (2017) 166; [15] Sultana *et al.*, J. Mater. Chem. B 5 (2017) 7352; [16] Maji *et al.*, Phys. Chem. Chem. Phys. 17 (2015) 8159; [17] S. K. Ghosh and D. Mandal, Appl. Phys. Lett. 2016, 109, 103701 (Press release by AIP News Staff); [18] S. K. Ghosh and D. Mandal, Nano Energy 2016, 28, 356–365; [19] S. K. Ghosh and D. Mandal, Appl. Phys. Lett. 2017, 110, 123701; [20] S. K. Ghosh and D. Mandal, ACS Sustainable Chem. Eng. 2017, 5, 8836−8843; [21] Garcia *et al.* Circ Res. 2016, 118, 1273.

**1.1.3 Objectives:**

The objective of this proposal is to develop and implement efficient arrays of nanopillars based on bio-polymers to be used as (i) biodegradable energy harvester and (ii) implantable biomedical device. The proposal is structured in 3 interlinked work planes (WPs) over 24 months. The co-applicant, Dr. Luana Persano, (energy-harvesting team coordinator) has access to an unparalleled suite of nanofabrication cleanroom, chemistry and biology laboratories and characterization facilities at the host institution, CNR-Nanoscienze at NEST laboratory of Scuola Normale Superiore in Pisa (Italy). The full infrastructure with extensive know-how of Dr. Persano on soft lithography and application-led roadmap is in place to achieve the targets of this proposal. Specifically, the objectives are to:

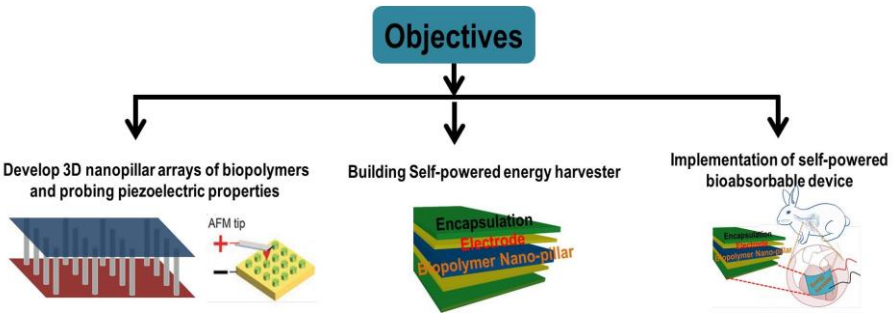


*Fig. 2 Technical flowchart of the proposed objectives*

(a) Develop for the first time, 3D nanopillar arrays of bio-polymers (cellulose, gelatin and chitin) on flexible substrates using soft-mold based low-pressure reverse nanoimprint lithography process and probing their piezoelectric properties at nanoscale;

(b) Integration of piezoelectric nanopillars towards energy harvester with its application in self-powered consumer electronics;

(c) Implement the developed device as a self-powered IMD with bioabsorbability test and performance estimation by *in-vitro* study.

The objectives of our proposed work are shown schematically in Fig. 2.

**1.1.4 Research methodology and approach:**

The 3 work plans (WPs) target ground-breaking new knowledge that underpins the implementation of nanopillar arrays as novel energy harvesting device. Together these WPs serve to translate new knowledge into scalable nanofabrication processes and advanced device design leading to a novel driving tool for self-powered IMD.

**1.1.4.1 <u>WP1: Development of cellulose, gelatin and chitin based 3D nanopillar arrays and probing piezoelectric properties (0-8 months)</u>**

Cellulose ($[C_6H_{10}O_5]_n$) is the most abundant biopolymer on earth [11]. Chitin [poly-β-(1,4)-N-acetyl-D-glucosamine] is the second most abundant bio-polymer [12] and gelatin produced through the partial denaturation of collagen is one of the most abundant natural piezoelectric materials [13]. The hydrogen bonding between the –OH groups of polymeric network structure is mainly responsible for direct and converse piezoelectricity [7]. Thus, it is expected that differences in the molecular conformation, chain orientation and crystallinity due to nanopillar structures result in different surface charge density, giving rise to improved piezoelectricity. Polydimethylsiloxane (PDMS) soft-mold based low-pressure reverse nanoimprint lithography process is a unique technique to produce 3D ferroelectric polymer nanostructures on flexible substrates. The specific benefits of this process in contrast to conventional nanoimprint lithography are: (i) it is based on the use of PDMS soft molds that are low-cost, easily replicable, and highly customizable, (ii) surfactant pretreatment is not often required (iii) the soft, non-sticking, PDMS mold enables conformal contact with the substrates even at very low pressures, which makes it compatible with flexible substrates coated with conductive thin film bottom electrodes, (iv) it leaves little or no residual layer, fully isolating the nanopillars thus avoiding cross-talk and (v) additional etching is not required. A scheme of the process is reported in Fig. 3. The PDMS molds will be prepared from silicon nanostamps, and then coated with the target bio-polymers. The coated PDMS mold will then be placed face-down on top of the ITO-coated PET substrate and heating will be performed at temperatures enabling the bio-polymer crystallization. Crystallisation within the confined environment of the PDMS mold leads to nanostructures with aspect ratio >2, often exhibiting preferential chain alignment and, in the case of piezoelectric polymers, some spontaneous remnant polarisation [14]. Finally, the sample will be separated from the mold and a freestanding film will be achieved. The preliminary studies performed on chitin extrated from crab shell (Fig. 4a,b) shows the formation of

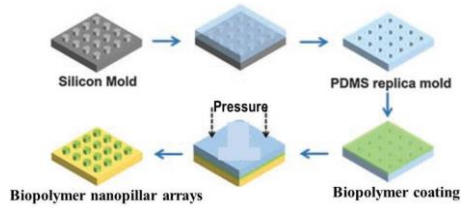


*Fig. 3 Schematic diagram of PDMS soft-mold based low-pressure reverse nanoimprint lithography process*

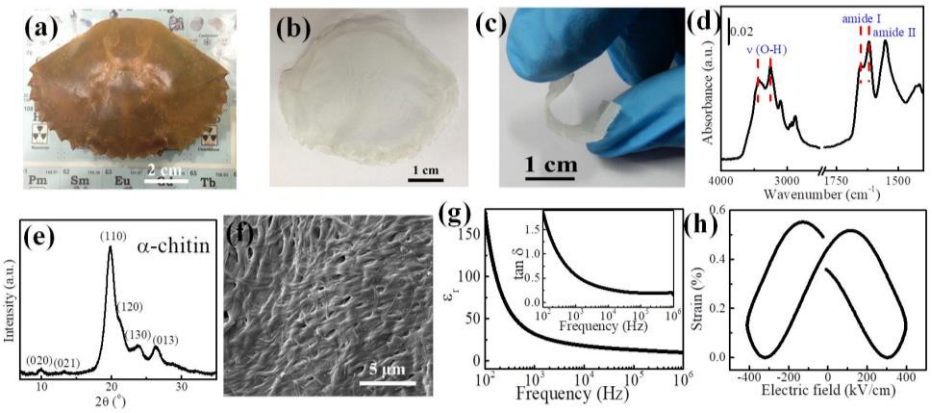


*Fig. 4 (a) original crab shell, (b) white chitin-only crab shell, (c) flexible demonstration of the chitin-only crab shell, (d) FT-IR, (e) XRD, (f) FE-SEM image, (g) dielectric constant with loss tangent in the inset and (h) strain vs electric field of the α-chitin based crab shell*

flexible chitin flat films (Fig. 4c), stable strucutural properties with the presence of piezoelectric α-chitin (Fig. 4d,e), fibril surface morphology (Fig. 4f), good dielectric properties (Fig. 4g) and converse piezoelectric strain vs electric field hysteresis loop (Fig. 4h). Furthermore, the scanning probe microscopy (SPM) technique suitable for soft nanoscale materials [14] available in NEST laboratory at CNR-Nanoscienze, will be used to fully probe the ferro- & piezo-electric properties of the biopolymer based nanopillars at nanoscale. To make the nanopillar arrays to be electrically accessible via metallic electrodes, an intermediate non-piezoelectric dielectric layer will be coated by spin coating in order to prevent short-circuit and to share less voltage drop across the multilayer capacitor during the DC poling process. The dielectric layer-coated nanopillar arrays will then be covered with top electrode by sputtering through a shadow mask. The applicant has substantial expertization on imaging piezo-electric and ferro-electric properties using piezoresponse force microscopy (PFM) which is reflected from his recent publications [14-16]. The vertical and lateral PFM signals with imaging as well as local PFM switching spectroscopy will be implemented to the nanopillars in order to probe the local electromechanical activity at the nanometer scale. Finite element modelling using COMSOL Multiphysics will be used to predict and optimise the electromechanical behaviour of the nanopillar arrays for device implementation.

### 1.1.4.2 WP2: Manufacturing self-powered implantable device and applications towards self-powered electronics (9–14 months)

The array of nanopillars from WP1 with fully resolved piezoelectric properties will be integrated into small scale device energy harvester (about 1 cm in length and width). In this case, metal-insulator-metal structure will be used for the device fabrication, as shown in Fig. 5a. At first, nanopillars will be transferred to sheets of silk fibroin which will be used as a substrate and encapsulating layer for device fabrication. Magnesium metal as biodegradable electrode will be deposited by electron beam evaporation. The performance of the fabricated energy harvester will be characterized by measuring the relevant parameters, such as, open-circuit output voltage, short-circuit output current, power output, mechanical durability and efficiency under a range of conditions, such as, applied pressure (~ kPa), frequency (~1-20 Hz ) and humidity (~ 30-60 %). Expected power densities are in the range 10 μW/cm$^2$- 1 mW/cm$^2$. The faraday cage based probe stations for electrical characterization will be used in this case, to reduce electrical noise. In parallel, the energy harvesting performance of the energy harvester will be established via suitable analytical model and numerical simulations by COMSOL multiphysics software. The self-powered implantable medical device (IMD) will be designed using an on-chip circuit with rectifier, capacitor and micro-battery. The battery charging performance will be tested using the power output generated by the fabricated mechanical energy harvester. The fabricated IMD can be used as self-powered wearable e-skin for non-invasive monitoring of human physiological signals such as, swallowing movements of the human throat, detecting temperature fluctuation of breathing, vocal cords vibration during coughing, specific phonation recognition and radial artery wrist pulses for blood pressure as well as heart rate measurements. The applicant has already

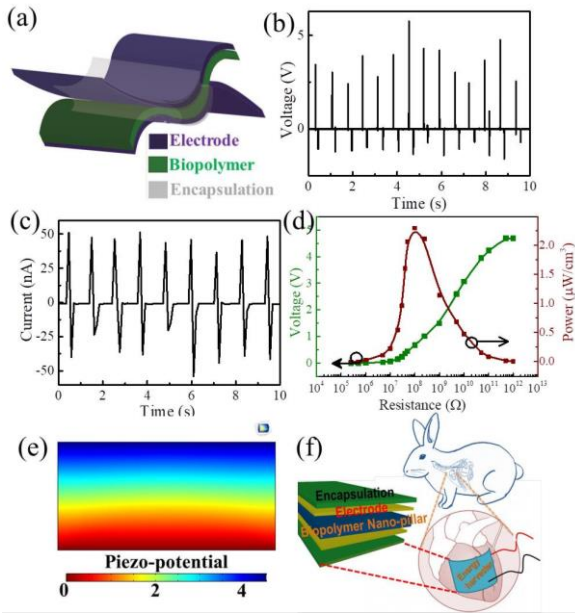


*Fig. 5 (a) Schematic of the energy harvester device, (b) open circuit voltage response, (c) current output (d) power output and (e) COMSOL based simulated result and (f) proposed target of the harvesting device.*

performed several energy harvesting experiments and implementation towards e-skin applications with polymer based devices which are reflected in his recent publications [14,15,17-20]. In addition, preliminary results on energy harvesting performance of crab-shell extracted α-chitin film based device have also shown in Fig. 5. The output voltage (Fig. 5b), current (Fig. 5c) and power output (Fig. 5d) are compatible with implantable device application. In addition, the COMSOL based simulation also supports the experimental results (Fig. 5e).

**1.1.4.3 WP3: In-vitro studies and implementation of energy harvester** (15–24 months)

Depending on the energy harvesting performance of the fabricated devices using cellulose, gelatin and chitin nano-pillars, the best one will be chosen for *biological tests*. The biocompatibility of the chosen nanopillars arrays will be assessed by cell viability. The optical density values will be studied after incubation day by day. The attachment, proliferation and morphology of the cells which will be cultured on the nanopillars arrays will be investigated using immunofluorescence staining. The biodegradability and bioabsorbability of the devices will be studied *in vitro* using phosphate buffered saline (PBS). A preliminary study on cell viability of the crab-shell extracted chitin film has been conducted using E. coli bacteria cell (Fig. 6). This preliminary result suggests that the chitin film is biocompatible and helps cells proliferation. This will be strengthened during the present project by extensive *in-vitro* tests on commercially available mammal cell lines, such as the H9c2, a rat myocardium-derived cell line, able to differentiate in cardiac-like tissue. Experiments will include MTT, MTS, immunofluorescence staining, pH measurements, and check of cell viability or differentiation against a proper pool of functionality markers (such as, myosin, actin and troponin families). Starting from Month 19, in collaboration with Dr. Silvia Burchielli (Animal Welfare Manager of the Animal Facility Experimental Biomedicine Centre of National Research Council - CNR) a committee of expert will be set-up with the purpose to define the more appropriate animal model to choose according to the achieved results in terms of (i) biocompatibility/biodegradability tests and (ii) device size and (iii) generated power output. Mice model is indeed not appropriate due to the limited size of its internal organs. Once the model will be defined, in-vitro experiments will be performed on cardiac and lung animal tissues. The research will comply with ethical principles and applicable international, EU and national law (in particular, EU Directive 2010/63/EU and D. Lgs. n. 26/2014). Finally, depending upon the quality and consistency of the measured performances, simultaneous efforts will be taken to publish the results in reputed international/national journals or to file patents.

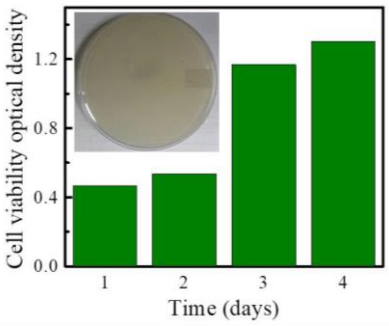


*Fig. 6 Cell viability test of the crab shell based chitin film*

**1.1.5 Originality and innovative aspects of the planned research**

Nearly all classes of active wearable and implantable biomedical devices rely on some form of battery power for operation. Heart rate monitors, pacemakers, implantable cardioverter defibrillators, and neural stimulators together represent a broad subset of bio-electronic devices that provide continuous diagnostics and therapy in this mode. The battery power not only is limited by life time but also increases patient's health risks and expanses. This project proposed a self-powered implantable device that can harvest electric energy from inexhaustible slight motions of internal organs such as heart, lungs, and diaphragm and thus can replace battery for next generation IMD. Importantly, the proposed IMDs will be composed of 3D nano-pillar of *biodegradable natural polymer materials* which, according to our preliminary results, are not expected to damage living tissues during and after implantation. The design of the device will be optimized to target power densities up to $mW/cm^2$ and specific in-vitro test have been planned to verify its viability as IMD and its absorption from tissues after certain period of time. In addition, here for the first time, *we propose nanostructuring of natural polymer materials as an efficient method to enhance the piezoelectric response through increased strain confinement and improved dipole alignment.* While years of research have provided lots of study for organic, inorganic and lead based synthetic piezoelectric device based IMDs, the nanostructured biodegradable polymer materials based IMDs is rarely studied. On this perspective, our proposal is original and innovative from materials to device implementation point of view.

**1.1.6 Contribution of the planned research**

The focus of the proposed research proposal is to design and develop a self-powered implantable device which can harvest power from movements of internal organs of the body, such as heart and lung. Therefore, the primary beneficiaries are common people both directly and indirectly. According to a recent survey in the United States, cardiovascular disease (CVD) continues to be the leading cause of death in women, with a worsening risk factor profiles in young women (< 55 years) [21]. *Compared with men, CVD risk in women is increased to a greater extent* by some traditional factors such as hypertensive pregnancy disorders, diabetes and hypertension, but also socioeconomic and psychosocial factors seem to strongly impact on cardiovascular disease in women. In this perspective, the gender dimension is highly relevant to our research as it relates to clinical practice in the prevention, diagnosis, and treatment

of CVD, through mini-invasive monitoring of physiological signals. From the industrial point of view, one of the main targeted beneficiaries is the medical sector. The developed implantable device could be widely used in various parts of the patient's body as medical remedy tools, such as deep brain stimulation (DBS), cardiac pacemaker, visual prosthesis, and cochlear implant, by electric stimulation of nerve/muscle and monitoring of health condition. Additionally, as the device can harvest green and clean mechanical energy, therefore, it can also be used in the field of defense technology, aerospace power electronics division, telecom industry, personal portable electronic gadgets manufacturer sector, solid state technology to name a few. Compared with previously existing solutions based on inorganic/semiconducting/lead-based materials with limited bio-compatibility, which use toxic compounds for synthesis, harsh conditions and/or complex fabrication steps, higher cost factor, our strategies with 3D nanostructured bio-polymers are eco-friendly, cost effective and one step approach for facile fabrication of efficient and scalable energy harvester with superior output performances. Thus, there is a huge opportunity for economic impact, providing both a knowledge base as well as an insight into future technologies in these sectors for a competitive advantage. We believe that our proposed device could find wide range of applications, particularly in biomedical engineering, nano-neurotechnology and next-generation wireless IMD near future.

**1.1.7 Interdisciplinary aspects of the project**

This proposal benefits from the multidisciplinary approach in addressing challenges on implantation of a self-powered bioresorbable device. We will emphasize on material science, underlying concepts in mechanics and associated engineering strategies in device construction. The design strategy of the proposed devices involves mechanical configurations such as, membrane strain engineering, wavy/buckled configurations, IMD circuit design and so on, which require an in-depth engineering expertise. Furthermore, the fabrication of 3D nano-pillar arrays, bio-polymer processing, etc. will require material science and chemistry background. In addition, the geometrical features of the developed materials will need the engineering and material science expertise. In case of analytical modeling and theoretical simulation, involvement of physics will be also necessary. Furthermore, in-vitro test and the survey on the proper animal model to choose requires extensive involvement of biology and medical science. Consequently, the interdisciplinary nature of the project is strong, involving a combination of materials science, chemistry, physics, engineering and biology. Results from the project are therefore expected to generate scientific publications, and whenever needed to protect technologically-relevant results, patent applications with strong impact in the broad fields of materials science, device engineering, nanotechnologies and biomedical engineering.

***1.2 Quality and appropriateness of the training and of the two way transfer of knowledge between the researcher and the host***

**1.2.1 Outline how a two-way transfer of knowledge will occur between the researcher and the host institution(s):**

- **Explain how the experienced researcher will gain new knowledge during the fellowship at the hosting organization(s).**

The new knowledge that will be gained by the experienced researcher in the framework of this fellowship at the hosting organization will be primarily obtained by training-through-research by the means of an individual personalized project strictly following the research work plan described in Sections 1.1.3 and 1.1.4, under the guidance of the supervisor (Dr. Luana Persano, energy-harvesting team coordinator) and other members of the research staff of the host organization (Dr. Andrea Camposeo and Prof. Dario Pisignano, both grantees of ERC grants). The technical training will include, Lab training procedures, training to main relevant instruments, training to new techniques and research methodologies through teaching courses, internal meeting and Lab experiences. Hands-on training will be additionally offered for developing scientific skills, particularly for new techniques for the applicant such as soft-lithography, nano-imprinting, advanced optical and IR spectroscopies (e.g. Raman mapping of the produced nanomaterials, confocal methods, immunoassys) and transferable skills such as presentation skills, communication capabilities of research results to non-specialist and skills in the preparation of highly competitive research proposal. The researcher will be also involved in the research management and financial aspects of the action. Finally, we point out that the research will be hosted in a highly interdisciplinary environment (CNR-Nanoscienze Institute at NEST laboratory, in collaboration with the Scuola Normale Superiore in Pisa). Very closely to the used facilities, biological and chemical laboratories and materials growth equipment will offer a lot of occasions for interdisciplinary developments. All these aspects will lead to a Career Development Plan to be prepared in line with the European Charter for Researchers, with the well-defined objective. It should aim at achieving a realistic and well-defined objective of significantly widen the competences of the experienced researcher, particularly in terms of multi/interdisciplinary expertise as detailed above. This will be an unequalled occasion for further career advancement, and for attaining a leading independent position after the project.

- **Outline the previously acquired knowledge and skills that the researcher will transfer to the host organisation(s).**

The applicant has a very wide knowledge in piezo-, pyro- , ferro- and dielectric properties of the organic materials including synthetic as well as natural polymers with differently designed energy harvester implementation. More specifically, he has expertise in developing self-powered healthcare monitoring systems based on several piezoelectric natural bio-polymers including collagen, chitin, gelatin and PLLA which is particularly well-suited for the envisaged proposal. The applicant is therefore familiar with the bio-materials and will bring new knowledge on bio-polymer processing, chain orientation, degree of crystallinity, crystal structure of nano-pillar arrays, probing piezoelectric properties of 3D nano-pillars by PFM techniques and coupled field finite element modelling (COMSOL multiphysics software) based simulation techniques which are critically required for the proposed project. The applicant will offer courses and seminars to students and post-docs of the host organization and will work in research team thus sharing day-by-day skills gained in previous international collaboration. The transfer of knowledge between the experienced researcher and the host research group will be very beneficial to the respective host organisations in terms of advancing their core competencies, and exposure to new fields of research and commercialization prospects.

***1.3 Quality of the supervision and of the integration in the team/institution***

Dr. Luana Persano, supervisor of this action, is Ph.D. in Materials and Innovative Technologies and permanent Senior Staff Researcher of the CNR-Nanoscienze in Pisa, where she is responsible of research on energy-harvesting nanomaterials and nanogenerators. She was cofounder of the spin-off Soft Materials & Technologies S.r.l (SM&T), which will provide opportunities for entrepreneurial training also in the framework of the present project. She was Visiting Scientist at the Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, and at the School of Engineering and Applied Sciences, Harvard University. She was Marie Curie fellow (HPMT-CT-2000-00201 "ATOM") at the Foundation for Research & Technology–Hellas (FORTH), Heraklion, Greece. She is author of more than 100 peer-reviewed scientific papers, with *h*-index 25 (Web of Science), 27 (Scholar), and several invited contributions, including plenaries, to international conferences and a TEDx talk.

The design and experimental study of new nanofabrication processes with polymers and nanocomposites, and the investigation of the resulting **light-emitting and electronic properties, and on how these are affected by nano-structuring**, are *leitmotifs* of her research. In particular, the development of specific lithographic processes onto biomolecules (**Biomaterials**, 2016), cells (**Advanced Functional Materials**, 2019) nanocomposite materials incorporating nanocrystals or precursors of them (**Advanced Materials,** 2012) and onto active materials in the form of films (**Advanced Materials,** 2012; **Scientific Reports**, 2019), nanoparticles (**ACS Nano**, 2015) and fibers (**Nature Nanotechnology**, 2008) leading to the first demonstration of distributed feedback lasers being integrated directly on single polymer nanofibers (**Advanced Materials,** 2014). Alternative techniques for sub-100-nm-scale patterning of organic semiconductor crystals were also developed by direct mask less electron-beam writing. In the last ten years, she has also been in charge of extensive tasks on morphological and compositional characterization of materials, through scanning probe and electron microscopies. Since 2010, she initiated a research line devoted to the study of polymer nanostructures for energy harvesting. Such field greatly stimulated the team interdisciplinary approach to scientific challenges, and enabled the establishment of an internationally-recognized research line, evidenced by the publications and invited talks at international conferences achieved in the last years. Among other scientific contributions, as particularly relevant for this proposal we would like to mention the implementation of electrospinning for realizing nanofibers with special focus on energy harvesting materials. This led to developing nanofibrous tissues with high mechanical robustness, energy scavenging capability and exceptional pressure sensitivity (0.1 Pa, **Nature Communications**, 2013), novel mechanophore systems (**Advanced Materials**, 2017) and single piezoelectric fibers in suspended geometries (**Advanced Materials**, 2016). A finite element multiphysics simulation environment describing the complex electromechanical interaction among fibers at microscale was developed to provide quantitative insight into the piezoelectric energy generation mechanism from arrays of nanofibers (**Advanced Materials**, 2014).

**International Collaborations**

D. Anglos (FORTH), C. Dagdeviren (MIT), L. De Lorenzis (Tech. U. Braunschweig), N. C. Frateschi (Campinas U.), Y. Huang (Northwestern U.), R. Luxenhofer (U. Würzburg), J. A. Rogers (Northwestern U.), Y. Su (LNM, Beijing), C. Tekmen (ElMarco s.r.o.), Y. Xia (Georgia Tech.),

**Supervising Activity.** Dr. Luana Persano regularly supervises postdoctoral researchers and other team members with interdisciplinary background (physics, material engineering and biotechnology). She was Supervisor of 8 PhD students (A. Portone, L. Romano, R. Stabile, P. Del Carro, E. Marulli, G. Potente, M. Moffa, S. Lezzi) and 6 Diploma students (D. Lorenzo, S. Pagliara, M. Montinaro, A. Portone, D. Musardo, E. Torre). Other educational and outreach activities included:

2015: Professorship on Functional Polymer Nanofibers, Wroclaw University of Technology (PL).

2012: Lecturer for specialized operators in safety and health division, on "*Artificial Optical Radiation*".

**Coordination of Research Projects**

2019-2021: CNR-Nano coordinator of the Project "Next generation of molecular and supramolecular machines: towards functional nanostructured devices, interfaces, surfaces and materials" (National Project, MIUR D.D. 31 luglio 2019 prot. n. 1554).
2013-2016: National Coordinator of the Project "Cluster for environmental monitoring and healthcare, through a cross disciplinary nanotechnology platform" (National Project, MIUR D.D. n. 3041, 20.12.2013).
2013: CNR scientist in charge, outreach Grant "Realization of a kit of polymer nanofibers to be distributed to high schools for educational purposes" (AIF, Italian Physics Teaching Association, Prot. 6807 13.11.2013).

**Organization of National and International Conferences**

2018-2019: Member of the Organizer committee of the "6th IEEE-EMBS International Conference on Wearable and Implantable Body Sensor Networks (BSN'19, Chicago).
2018-2019: Chair, International Conference on "Advanced Manufacturing Technologies for Micro- and Nanosystems in Security and Defence" SPIE Conference Security+Defence (10-13.09.18, Berlin, DE; 9-12.09.19-Strasburg).
2016-2019: Programme Committee Member, International Conference on "Optical Materials and Biomaterials in Security and Defence Systems Technology", SPIE Conference Security+Defence.
2018-2019: Member of the International Advisory Committee of the International Conference on Electrospinning (January 2018, South Africa; June 2019 China)
2016: Chair, International Conference on Electrospinning (28.06-01.07.2016, Otranto, IT, electrospin2016.unisalento.it/).
2015: Chair, National Workshop on "Interdisciplinary Nanotechnologies for environmental monitoring and healthcare" (29.07.2015, Lecce, IT).

**Commissions of Trust**

Since 2016: Member of the Editorial Advisory Board of the Journal of Applied Polymer Science.
2016-2017: Guest Editor, forthcoming Topical Issue of Macromolecular Materials and Engineering (http://www.mme-journal.com), which will be dedicated to Electrospinning.
2016: Judges Panel Member, "StartCup Puglia", business plan competition for start-up companies.
2015-2016: Honorary Committee Member, Annual Nanophotonics International Conference of the Photonics and Bio-nanotechnology Association (Wroclaw, PL).
Since 2009: Member of about 40CNR Committees for the evaluation of applications for postgraduate, post-doc, technician and researcher positions.

**Hosting arrangements.** The integration of the researcher to his new environment in the premises of the host institution will be full. Lab training procedures, training to main relevant instruments, and training to new techniques will be priorities in order to access experimental facilities with full awareness and full status of user in the NEST center (http://www.laboratorionest.it/). The team will embed the researcher in a complete and interactive way and a continuous monitoring of the research activity will be provided by the supervisor. Training to further equipment, i.e. instruments not initially expected to be use, will be possible at any time during the project depending on the research needs and on the envisaged career development plan. Day-by-day interactions between team-members will be informal and effective, and supervising experts will be close to the team and to the applicant each day. Weakly meeting for progress checking will be scheduled. Special attention will be given to integrate the researcher with the different interdisciplinary expertise needed to carry out the project successfully. The overall environment in the center is international, with scientists, post-docs and students coming from many different countries. Finally, a lot of international networking opportunities will be provided by the many connections of the hosting teams, covering leading research groups, centers, and industrial teams in all the area of interest of this proposal.

### *1.4 Potential of the researcher to reach or re-enforce professional maturity/independence during the fellowship*

The professional experience of the candidate in the last 6 years includes piezo-, pyro- and ferro-electric polymer (both synthetic and natural) materials based energy harvesters. The researcher has adequate knowledge on fabrication of ferro-polymer nano-wires, processing of bio-polymers and designing of energy harvesters with IMD structure. The overall research aim of the candidate is to explain structure-performance correlation of the materials in order to enhance the energy harvesting ability of the devices. The new knowledge and scientific skills such as soft lithography, advanced PFM set up, advanced optical and IR spectroscopies (Raman mapping of the produced nanomaterials, confocal methods, immunoassays), which are prerequisite for the investigation of the self-powered biodegradable polymer based IMD designing proposed in this project, will enrich the current know-how of the candidate. This fellowship will offer to the candidate an unprecedented opportunity to gain research and transferable skills which will strongly re-enforce his professional maturity thus opening new opportunities for independent career in the field. The candidate track record include, 27 scientific peer reviewed publications based on the exploitation of a wide variety of strategies for energy harvester fabrications and their applications towards e-skin based health care monitoring. Some of his articles have been published in reputed peer reviewed journals, such as ***Applied Physics Letter, Nano Energy (IF~13), ACS Applied***

***Materials and Interfaces (IF~8)*** and so on. Few of his works have been selected for *press release* (such as, **ACS press release in August 12, 2015; AIP News Staff, Sep 6, 2016**; selected for APL Editor's pick in the week of Sep 12, 2016 and most read of the month October 2016) and several international electronic (e.g., The Economist, UK based broad casting channel, Gross science video (from NOVA), USA etc.) and print media (e.g., The Nature World News, Nature India, Physics world (*Phys. World* 2016, 29, 5) etc.). In addition, the candidate has presented his works in several international conferences (such as, *2016 MRS Spring Meeting & Exhibit, USA*; *NanoWorld Conference, USA* etc.), meeting (*Lindau Nobel Laureate* Meeting, 2016) and workshops. Also, the candidate has been reviewer of several international journals, such as, Mechanical Systems and Signal Processing, Sensors & Actuators A: Physical, Materials and Design, Energy and Buildings and Nano Energy, illustrating international recognition in the main fields covered by the present proposal. The candidate has achieved outstanding *h*-index (~ 16) with over 800 citations (google scholar). The candidate is an active member of the ASIAN POLYMER ASSOCIATION (APA) (Membership number: S 025). In addition, the candidate has leaded one bi-lateral international projects on energy harvesting jointly founded by British council (UK) and Department of Science and Technology (DST, India) under Newton-Bhabha PhD placements programme (Award no. DST/INSPIRE/NBHF/2016/20) in University of Bath, UK. Additionally, the candidate has worked with several international collaboration such as, D. Schmeisser (Brandenburgische Technische Universität Cottbus-Senftenberg, Cottbus, Germany), V. Sencadas (University of Wollongong, Australia), C. Bowen (University of Bath, UK), P. R. Davies (Cardiff University, UK). Currently, the applicant is working as a post-doctoral research associate in UNIST, South Korea.

As outcome of his research experience, the main achievements/strengths of the candidates are:

*a*) More than six years of continuous upgrading in research skills, and research leadership,

*b*) A strong capacity for teamwork, and a growing establishment of fruitful international collaborations,

*c*) The development of an independent, usually experimental-driven philosophy, to address improved mechanical and thermal energy harvesting problems that require step by step approximations and multidisciplinary approaches,

*d*) Twenty-seven research papers in well recognized peer-reviewed international journals that have granted the candidate with national and international recognition in the fields of self-powered flexible energy harvesting technology.

## 2. Impact

### *2.1 Enhancing the future career prospects of the researcher after the fellowship*

The training, management, scientific skills and mentorship that will be provided to the researcher in the host institute will enable the applicant, to consolidate his role in the research community and especially in the field of energy harvesting. Additionally, *the technical training from the host researchers will allow the candidate to write highly competitive research proposals for further funding from European Commission and in particular and ERC Starting Grant application*. In this respect the hosting research group has an impressive record of granted ERC proposal. In addition, they have been hosting an ERC candidate from Slovenia (Nejc Hodnik) who got financial support from his country to join leading group in Europe to gain skills and competencies strengthening the submission of an ERC grant. Nejc was successful and he got the Starting Grant in 2019.

The new competences and skills (as explained in 1.2.1) obtained from the host researchers will be further integrated with different energy sectors, such as, solar, thermal, supercapacitor, electrochemical, storage and so on, which can make the researcher more successful in his long-term career. The applicant will get the opportunity for further collaboration with exchange of knowledge and idea with new researchers across the globe during dissemination of the project results in several seminar, conferences, and meetings. Additionally, the applicant will get the opportunity of participating in career development workshops and weekly scientific seminars at host institution. The new skills and knowledge of the applicant will strongly improve his research track record thus enhancing opportunities for employability and career prospects in academia. In addition, the development of biodegradable IMD is highly innovative and will strongly contribute to Europe's competitiveness and growth in the field.

### *2.2 Quality of the proposed measures to exploit and disseminate the project results*

Particular care will be paid by the applicant researcher and by the supervising experts to disseminate the project results. A first and extensive action of dissemination will be carried out towards the academic scientific community, through publications in leading international journals and presentation of the achieved results in international conferences, seminars, workshops and weekly departmental (open to all) meetings. The applicant researcher and the host institution will be also fully committed to assure Open Access of the project papers, in agreement with European guidelines for Open Science. Suitable resources will be foreseen to this aim. In parallel, a suitable intellectual-property protection policy will be implemented, through specific patent applications whenever technologically-relevant results will be generated by the foreseen research. Intellectual property protection will be performed, patenting those results which will be more likely to find prompt industrial application. Planning for dissemination activities is included in the Gantt chart

at page 9. At least 4 international publications on high-impact international journals in the broad field of materials sciences are expected to be generated by this project.

***2.3. Quality of the proposed measures to communicate the project activities to different target audiences***

Another action, in coordination with press advisors at the host institution, will aim to fascinate the general broad public, since results from this research proposal will be especially suitable to contribute to sensitize people on biomedical science, renewable energy and environmental issues. To this aim, a project website will be established within 6 months from the project start, and it will be updated on a monthly basis. Particular care will be paid to make the here published materials accessible by non-specialists. The applicant researcher will also take part to European Researchers' Night events to present energy-harvesting science and technology to students and to people, in coordination with the host institution. Planning for communication activities is included in the Gantt chart (page 9).

## 3. Quality and Efficiency of the Implementation

***3.1 Coherence and effectiveness of the work plan, including appropriateness of the allocation of tasks and resources***

The 3 interlinked WPs have specific research milestones (M) and deliverables (D) as denoted in the GANTT chart below (M and D, respectively).

*Workpackage 1: Development of cellulose, gelatin and chitin based 3D nanopillar arrays and probing piezoelectric properties (0-8 months)*

*M1.1* (month 5): Optimization of the conditions for fabrication of biopolymer based nanopillars arrays with high crystallinity and orientation via a novel reverse nanoimprint lithography fabrication method.

*D1.1* (month 8) Realization of arrays of nanopillars with lateral size, 500 nm and aspect ratio > 2 and probing the nanoscale piezoelectric properties by PFM.

*Workpackage 2: Manufacturing self-powered implantable device and applications towards self-powered electronics (9–14 months)*

*D2.1* (month 14): Integration of nanopillar arrays into small scale device and characterization of the piezo-electrical performances.

*Workpackage 3: In-vitro studies and implementation of energy harvester (15–24 months)*

*M3.1* (month 20): Animal model defined and in-vitro test on animal tissues start.

*D3.1* (month 24): In-vitro test and bioabsorbability studies completed.

*Management and Dissemination*

The management action including, communication to the SCI indexed journal for publication of key results, attempts for commercialization through specific patent applications and industrial engagement will run through the project since month 1. Dissemination of the data generated during the project will start at month 6.

**Gantt chart**

| | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **WPs** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** |
| WP1 | | | | | **M1.1** | | | **D1.1** | | | | | | | | | | | | | | | | |
| WP2 | | | | | | | | | | | | | | **D2.1** | | | | | | | | | | |
| WP3 | | | | | | | | | | | | | | | | | | | | **M3.1** | | | | **D3.1** |
| *Management and Dissemination* | | | | | | | | | | | | | | | | | | | | | | | | |

***3.2 Appropriateness of the management structure and procedures, including risk management***

To monitor progresses in real-time, the supervising researcher will be updated continuously by all the involved team members, including the applicant researcher, about progress and difficulties of scientific tasks, which will allow unpredictable events to be efficiently faced, as well as the most effective contingency actions to be implemented. Various contingency plans have already been developed with risk assessment.

**Risk 1**: **The fabrication of 3D nano-pillar arrays of bio-polymers and probing piezoelectric properties**

**Contingency plan 1**: In order to modulate degree of crystallinity of the bio-polymers we will fabricate the films by changing several parameters such as, change the polymer-solvent concentration, use of different solvents with different boiling points, modify the duration of the crystallization process. Additionally, the piezoelectricity of the nano-pillars will be probed by changing height, pitch and lateral width of the nano-pillars.

**Risk 2**: **Manufacturing energy harvester**

**Contingency plan 2**: In order to produce an efficient energy harvester from the nano-pillars without leakage a non-polar polymers such as, PVA will be coated by spin coating technique in order to prevent short-circuit and to share less voltage drop across the multilayer capacitor during the DC poling process. Among the various bio-polymers tested, the best one will be chosen as final device for in-vitro tests. Additionally, in order to increase the output power in the range of μW–mW label, multilayer stacking of the energy harvesters will be used.

**Risk 3: In-vitro experiments**

**Contingency plan 3:** Encapsulation of the IMD with bio compatible sheets of silk fibroin material isolates the device them from bodily fluids and tissue, thereby minimizing the risks of failure or immune response and preserve the piezoelectric response

***3.3 Appropriateness of the institutional environment (infrastructure)***

**Existing resources and infrastructure in the Host Institution.** The **CNR-Istituto Nanoscienze** (www.nano.cnr.it) is a cross-disciplinary Research Institute focusing on nanotechnology and nanoscience. The Institute has developed wide integrated facilities and it currently has about 100 units of personnel. Since 2010, the Institute has published more than 2,000 papers on international scientific journals, and, through the group of the Supervisor of this project, created a spin-off company on nanomaterials for biotech applications. The Institute has a few thousands of $m^2$ of laboratories, having as target the development of new concepts and new nano-systems, exploiting either the "bottom-up" (self-assembling and molecular engineering for hybrid organic/inorganic systems) or the "top-down" approaches (state-of-the-art lithography techniques applied to organic and inorganic nanostructures) in the same mainframe. Great attention is paid to the technological potential of the research carried out on new materials, processes, architectures and instrumentation. Most of the work done in recent years generated applications which are presently matter of collaboration with world-leading companies and within several European projects. The most of the Institute funding is got by competitive projects. In the last few years the center achieved national and European funds by many MEuros, including two ERC Starting, four Consolidator, and one Advanced ERC Grant. A large collection of scientific equipment is already available at the Host Institution, including electrospinning, clean-rooms, chemistry labs and microscopy characterization labs which will be fully deployed for this training project. The Scuola Normale Superiore is in the same premises (NEST laboratory in Pisa). Among the advanced equipment, available for this project at Host Institution, we would like to mention:

1. A nanofabrication facility, which relies on class 1000/10000 clean rooms, with evaporators, mask aligners, reactive ion etching, reactors for growth of heterostructured nanowires and chemical vapour deposition of graphene and other 2D-materials, optical and electron-beam lithographies.
2. A molecular device fabrication facility, for the synthesis and film technology of organics, with fume-hoods, spin coating, complete device characterisation (integrating sphere for efficiency measurements, contact inspection, input-output characteristics of organic LEDs and lasers) and state of art biology laboratories including 3 different confocal microscopies.
3. A facility for spectroscopy and for electrical characterization, based on spatially resolved spectroscopies (micro-PL), optical gain measurements, fs and ns spectroscopies, stereomicroscopy, network analyzers, digital multimeters etc.
5. Laboratory of soft matter nanotechnologies, with state-of-the-art equipment for soft lithography (motorized fluid injection, nanoimprinting press, multilevel soft lithography), lasers for multiphoton lithographies on polymer materials, glove-boxes enabling experiments in controlled atmosphere, and electrospinning.
6. Scanning probe and microscopy lab, including state-of-art AFM/STM systems, total internal reflection fluorescence, confocal, scanning and transmission electron microscopies for characterization.

Under this respect, the Host Institution, with its long-standing background in nanofabrication and advanced materials characterization methods and huge instrumentation capital is an almost unique laboratory for having all the necessary expertise and infrastructure to perform the research foreseen in this proposal. In addition to the research supervising and full support to training of the researchers for the needed equipment, support from the host institution will be for day-by-day orders, payments, and contracts. The Host Institution will be responsible for running and monitoring such tasks, and for the prompt submission of his own cost statements and financial auditing.

***Section 4 - CV of the experienced researcher***

### *4.1 Personal information*

*a) Name*: Sujoy Kumar Ghosh
*b) Date of birth*: 28/02/1990
*c) Country/Nationality*: India/Indian
*d) Current place of work*: Ulsan National Institute of Science and Technology (UNIST), 50 UNIST-gil, Eonyang-eup, Ulju-gun, Ulsan, South Korea.
*e) Current position*: Post-Doctoral Research Associate
*f) Personal address*: D/21 BAPUJI NAGAR, 2ND-FR, FL-C3, LP-49/13/5/7/1, Jadavpur, Kolkata 700092, India
*g) Contact no*: +91 9062066209; +91 9733777067
*h) E-mail*: sujoykumarghosh1990@gmail.com

### *4.2 Professional experience*

*2019 (16.06.2019)-to date:* **Post-Doctoral Research Associate** in UNIST, South Korea

*2013 (25.09.2013)-2019 (28.01.2019)*: **Research scholar** in Department of Physics, Jadavpur University, Kolkata, India.

### *4.3 Education*

*2013 (25.09.2013)–to date*: **PhD**, Jadavpur University, Department of Physics, Kolkata 700032, India.
*2010 (12.09.2010)–2012 (12.09.2012)*: **M.Sc. in Physics** (Marks: 77.00 %), Jadavpur University, Department of Physics, Kolkata 700032, India.
*2007 (17.08.2007)–2010 (12.07.2010)*: **B.Sc. in Physics** (Marks: 70.33 %), Jadavpur University, Department of Physics, Kolkata 700032, India.

### *4.4 Other relevant information*

*Language*: The candidate can read, write and speak correctly English and Bengali (mother tongue).
*Post-graduate academic formation*: As part of his academic formation, the candidate has received the following post-graduate courses at Department of Physics, Jadavpur University: Production of Low Temperature & Low Temperature Properties of Materials, Materials Characterization Techniques and Research Methodology & Review of Research Work.

### *4.5 Prizes and Awards*

| | |
|---|---|
| 1. Newton-Bhabha Fellow | 2017 |
| 2. Best Poster award in "Fourth International Symposium on Semiconductor Materials and Devices (ISSMD-4)" | 2017 |
| 3. DST award for participation in the 66$^{th}$ **Lindau Nobel Laureate Meeting**, Lindau, Germany (26$^{th}$ June to 1$^{st}$ July) | 2016 |
| 4. Travel grant award by Centre for International Co-operation in Science (CICS), INSA for attending Nano World Conference 2016, Boston, USA | 2016 |
| 5. Travel grant award by the Science and Engineering Research Board (SERB), DST for participating 2016 MRS Spring Meeting & Exhibit, Phoenix, Arizona, USA | 2016 |
| 6. Materials Horizons Poster Prize by **Royal Society of Chemistry** (RSC) | 2015 |
| 7. INSPIRE Fellow | 2013–2018 |
| 8. DST-INSPIRE Scholar | 2007-2012 |

### *4.6 Funding*

1. Newton-Bhabha fellowship (15.06.2018–15.10.2018) jointly funded by British council (UK) and Department of Science and Technology (DST, India) under Newton-Bhabha PhD placements programme (Award no. DST/INSPIRE/NBHF/2016/20) in University of Bath, UK.

2. INSPIRE fellowship (Award no. IF 130865) (01.10.2013–01.10.2018) funded by DST, India.

3. INSPIRE scholarship (Award no. SR/INSPIRE/09) (2007–2012) funded by DST, India.

### *4.7 Publications*

Total SCI Publications: 27
Total citation: 800
h-index: 16
Conference Proceedings: 10
Conference Presentations: 14 (International) and 09 (National)
**Google Scholar link**
https://scholar.google.co.in/citations?user=F-uSVscAAAAJ&hl=en

#### *4.7.1 List of SCI journals*

1. Ayesha Sultana, **Sujoy Kumar Ghosh**, Md. Mehebub Alam, Priyabrata Sadhukhan, Krittish Roy, Mengying Xie, Chris R. Bowen, Subrata Sarkar, Sachindranath Das, Tapas Ranjan Middya, and Dipankar Mandal, "Methylammonium Lead Iodide Incorporated Poly(vinylidene fluoride) Nanofibers for Flexible Piezoelectric−Pyroelectric Nanogenerator", ***ACS Appl. Mater. Interfaces* (I.F. 8.456) 2019**, **11, 27279−27287**.
2. Krittish Roy, **Sujoy Kumar Ghosh**, Ayesha Sultana, Samiran Garain, Mengying Xie, Chris R. Bowen, Karsten Henkel, Dieter Schmeißer, and Dipankar Mandal, "A Self-Powered Wearable Pressure Sensor And Pyroelectric Breathing Sensor Based On GO Interfaced PVDF Nanofibers", ***ACS Appl. Nano Mater.* 2019**, **2, 2013–2025**.
3. Yan Zhang, Chris Rhys Bowen, **Sujoy Kumar Ghosh** and Dipankar Mandal, Hamideh Khanbareh, Mustafa Arafa, Chaoying Wan, "Ferroelectret materials and devices for energy harvesting applications" ***Nano Energy (I.F. 13.1)* 2018, 57, 118–140.**
4. Ayesha Sultana, Md. Mehebub Alam, **Sujoy Kumar Ghosh**, Tapas Ranjan Middya, Dipankar Mandal, "Energy Harvesting and Self-Powered Microphone Application On Multifunctional Inorganic-Organic Hybrid Nanogenerator", ***Energy* 2019, 166, 963–971**.
5. **Sujoy Kumar Ghosh**, and Dipankar Mandal, "Synergistically Enhanced Piezoelectric Output in Highly Aligned 1D Polymer Nanofibers Integrated All-fiber Nanogenerator for Wearable Nano-Tactile Sensor" ***Nano Energy* (I.F. 13.1) 2018, 53, 245–257**.
6. Md. Mehebub Alam, **Sujoy Kumar Ghosh**, Ayesha Sultana, and Dipankar Mandal, "An Effective Wind Energy Harvester of Paper Ash-Mediated Rapidly Synthesized ZnO Nanoparticle-Interfaced Electrospun PVDF Fiber", ***ACS Sustainable Chem. Eng.* (I.F. 6.97) 2018, 6, 292−299**.
7. **Sujoy Kumar Ghosh**, Mengying Xie, Christopher Rhys Bowen, Philip R. Davies, David J. Morgan and Dipankar Mandal, "A Hybrid Strain and Thermal Energy Harvester Based on An Infra-Red Sensitive $Er^{3+}$ Modified Poly(Vinylidene Fluoride) Ferroelectret Structure", ***Sci. Rep.* (I.F. 4.259) 2017, 7, 16703**.
8. **Sujoy Kumar Ghosh** and Dipankar Mandal, "Sustainable Energy Generation from Piezoelectric Biomaterial for Noninvasive Physiological Signal Monitoring", ***ACS Sustainable Chem. Eng.* (I.F. 6.97) 2017, 5, 8836−8843**.
9. Wahida Rahman,[†] **Sujoy Kumar Ghosh**,[†] **([†]Both contributed equally)** Tapas Ranjan Middya and Dipankar Mandal, "Highly Durable Piezo-Electric Energy Harvester by A Super

Toughened and Flexible Nanocomposite: Effect of Laponite Nano-Clay in Poly(Vinylidene Fluoride)", ***Mater. Res. Express*** **(I.F. 1.068) 2017**, 4, 095305.

10. Ayesha Sultana, **Sujoy Kumar Ghosh**, Vitor Sencadas, Tian Zheng, Michael Higgins, Tapas Ranjan Middya, Dipankar Mandal, "Human Skin Interactive Self-Powered Wearable Piezoelectric Bio-e-Skin by Electrospun Poly-L-Lactic Acid Nanofibers for Non-Invasive Physiological Signal Monitoring", ***J. Mater. Chem. B*** **(I.F. 4.543) 2017, 5, 7352–7359**.
11. **Sujoy Kumar Ghosh**, Prakriti Adhikary, Santanu Jana, Anirban Biswas, Vitor Sencadas, Sudipto Dutta Gupta, Bipan Tudu, Dipankar Mandal, "Electrospun Gelatin Nanofiber Based Self-Powered Bio-*e*-Skin for Health Care Monitoring", ***Nano Energy*** **(I.F. 12.3) 2017, 36, 166–175**.
12. **Sujoy Kumar Ghosh**, Dipankar Mandal, "Bio-Assembled, Piezoelectric Prawn Shell Made Self-Powered Wearable Sensor for Noninvasive Physiological Signal Monitoring", ***Appl. Phys. Lett.*** **(I.F. 3.3) 2017, 110, 123701**.
13. Biswajit Mahanty, **Sujoy Kumar Ghosh**, Samiran Garain, Dipankar Mandal, "An Effective Flexible Wireless Energy Harvester/Sensor Based on Porous Electret Piezoelectric Polymer", ***Mater. Chem. Phys.*** **(IF: 2.129) 2016, 186, 327-332**.
14. Md. Mehebub Alam, **Sujoy Kumar Ghosh**, Debabrata Sarkar, Shrabanee Sen, Dipankar Mandal, "Improved Dielectric Constant and Breakdown Strength of γ-Phase Dominant Super Toughen PVDF/$TiO_2$ Nanocomposite Film: An Excellent Material for Energy Storage Application and Piezoelectric Throughput", ***Nanotechnology*** **(IF: 3.573) 2017, 28, 015503 (10pp)**.
15. **Sujoy Kumar Ghosh**, Anirban Biswas, Shrabanee Sen, Chittaranjan Das, Karsten Henkel, Dieter Schmeisser, Dipankar Mandal, "$Yb^{3+}$ Assisted Self-Polarized PVDF Based Ferroelectretic Nanogenerator: A Facile Strategy of Highly Efficient Mechanical Energy Harvester Fabrication", ***Nano Energy*** **(I.F. 13.1) 2016, 30, 621-629**.
16. **Sujoy Kumar Ghosh**, Tridib Kumar Sinha, Biswajit Mahanty, Santanu Jana, and Dipankar Mandal, "Porous Polymer Composite Membrane Based Nanogenerator: A Realization of Self-powered Wireless Green Energy Source for Smart Electronics Applications", ***J. Appl. Phys.*** **(I.F. 2.183) 2016, 120, 174501**.
17. Santanu Jana, Samiran Garain, **Sujoy Kumar Ghosh**, Shrabanee Sen and Dipankar Mandal, "The Preparation of γ-Crystalline Non-electrically Poled Photoluminescant Zno–PVDF Nanocomposite Film For Wearable Nanogenerators", ***Nanotechnology*** **(I.F. 3.573) 2016, 27, 445403**.
18. Kuntal Maity, Biswajit Mahanty, Tridib Kumar Sinha, Samiran Garain, Anirban Biswas, **Sujoy Kumar Ghosh**, Smarajit Manna, Samit K Ray and Dipankar Mandal, "Two-Dimensional Piezoelectric $MoS_2$-Modulated Nanogenerator and Nanosensor Made of Poly(vinlydine Fluoride) Nanofiber Webs for Self-Powered Electronics and Robotics", ***Energy Technol.*** **(IF: 2.8), 2016, 5, 234-243**.
19. **Sujoy Kumar Ghosh** and Dipankar Mandal, "Efficient Natural Piezoelectric Nanogenerator: Electricity Generation from Fish Swim Bladder", ***Nano Energy*** **(I.F. 13.1) 2016, 28, 356–365**.
20. **Sujoy Kumar Ghosh** and Dipankar Mandal, "High-Performance Bio-Piezoelectric Nanogenerator Made with Fish Scale" ***Appl. Phys. Lett.*** **(I.F. 3.3) 2016, 109, 103701**. (**Selected for Press release** by AIP News Staff, Sep 6, 2016; selected for **APL Editor's pick** in the week of Sep 12, 2016 and **most read** of the month October 2016); (https://publishing.aip.org/publishing/journal-highlights/fish-biowaste-converted-piezoelectric-energy-harvesters).
21. Tridib Kumar Sinha,[†] **Sujoy Kumar Ghosh**,[†] **([†]Both contributed equally)** Rishi Maiti, Santanu Jana, Basudam Adhikari, Dipankar Mandal and Samit K. Ray, "Graphene-Silver-Induced Self-polarized PVDF-Based Flexible Plasmonic Nanogenerator Toward the Realization for New Class of Self Powered Optical Sensor" ***ACS Appl. Mater. Interfaces*** **(I.F. 8.456) 2016, 8, 14986−14993**.
22. **Sujoy Kumar Ghosh**, Wahida Rahman, Tapas Ranjan Middya, Shrabanee Sen, and Dipankar Mandal, "Improved Breakdown Strength and Electrical Energy Storage Performance of Poly(vinylidene fluoride)/Unmodified Montmorillonite Clay Nano-Dielectrics", ***Nanotechnology*** **(IF: 3.573) 2016, *27,* 215401**.

23. **Sujoy Kumar Ghosh**, Tridib Kumar Sinha, Biswajit Mahanty, and Dipankar Mandal, "Self-poled Efficient Flexible "Ferroelectretic" Nanogenerator: A New Class of Piezoelectric Energy Harvester", ***Energy Technol.*** **(IF: 2.8), 2015, *3*, 1190–1197**.
24. Abiral Tamang,[†] **Sujoy Kumar Ghosh**,[†] **([†]Both contributed equally)** Samiran Garain, Md. Mehebub Alam, Jorg Haeberle, Karsten Henkel, Dieter Schmeisser, and Dipankar Mandal, "DNA Assisted β-phase Nucleation and Alignment of Molecular Dipoles in PVDF film: A Realization of Self-poled Bio-inspired Flexible Polymer Nanogenerator for Portable Electronic Devices", *ACS Appl. Mater. Interfaces* ***(IF: 6.7)*** **2015**, *7*, 16143−16147. (**Selected for ACS press release** in August 12, 2015); (https://www.acs.org/content/acs/en/pressroom/presspacs/2015/acs-presspac-august-12-2015/flexible-biodegradable-device-can-generate-power-from-touch-video.html)
25. Md. Mehebub Alam, **Sujoy Kumar Ghosh**, Ayesha Sultana and Dipankar Mandal, "Lead-free $ZnSnO_3$/MWCNTs-Based Flexible Hybrid Nanogenerator for Piezoelectric Power Generation", ***Nanotechnology*** **(IF: 3.821), 2015, 26, 165403 (6pp)**.
26. Subrata Maji, Piyush Kanti Sarkar, Leena Aggarwal, **Sujoy Kumar Ghosh**, Dipankar Mandal, Goutam Sheet and Somobrata Acharya, "Self-Oriented β-Crystalline Phase in the Polyvinylidene Fluoride Ferroelectric and Piezo-Sensitive Ultrathin Langmuir–Schaefer Film", ***Phys. Chem. Chem. Phys.*** **(IF: 4.493), 2015, 17, 8159-8165**.
27. **Sujoy Kumar Ghosh**, Md. Mehebub Alam, Dipankar Mandal, "The *in situ* Formation of Platinum Nanoparticles and Their Catalytic Role in Electroactive Phase Formation in Poly(vinylidene fluoride): A Simple Preparation of Multifunctional Poly(vinylidene fluoride) Films doped with Platinum Nanoparticles", ***RSC Advances*** **(IF: 3.84), 2014, 4, 41886-41894**.

### *4.7.2 List of conference proceedings*

1. Kuntal Maity, **Sujoy Kumar Ghosh**, Mengying Xie, Christopher Rhys Bowen, and Dipankar Mandal, "Design of flexible piezoelectric-pyroelectric nanogenerator for self-powered wearable sensor" ***AIP Conf. Proc.*** **2115**, 030604 (2019).
2. Chetana Ghosal, **Sujoy Kumar Ghosh**, Dipankar Mandal, and Brajadulal Chattopadhyay, "Protein promoted β-phase nucleation in poly (vinylidene fluoride) for energy harvesting applications" ***AIP Conf. Proc.*** **2115**, 030592 (2019).
3. Biswajit Mahanty, **Sujoy Kumar Ghosh**, Subrata Sarkar, and Dipankar Mandal, "Improved mechanical energy harvesting by Au-nanoparticles interfaced poly(vinylidene fluoride) electrospun fibers" ***AIP Conf. Proc.*** **2115**, 030607 (2019).
4. **Sujoy Kumar Ghosh**, Mengying Xie, Christopher Rhys Bowen, and Dipankar Mandal, "All-Fiber Pyroelectric Nanogenerator" ***AIP Conf. Proc.*****, 2018, 1942, 140025**.
5. Wahida Rahman, **Sujoy Kumar Ghosh**, Tapas Ranjan Middya, and Dipankar Mandal, "Enhanced Mechanical Energy Harvesting Ability of Electrospun Poly(Vinylidene Fluoride)/Hectorite Clay Nanocomposites" ***AIP Conf. Proc.*****, 2018, 1942, 050081**.
6. Biswajit Mahanty, Samiran Garain, **Sujoy Kumar Ghosh**, Dipankar Mandal, "Cost effective-High Performance Inorganic-Organic Hybrid Nanogenerator" ***Advanced Science Letters*****, 2016, 22 (1), 184-187**.
7. **Sujoy Kumar Ghosh** and Dipankar Mandal, "Self Powered Flexible Electronics Based on Self Poled "Ferroelectretic" Nanogenerator" ***MRS Advances*****, 2016, 1 (45), 3083-3088.**
8. Biswajit Mahanti, Samiran Garain, **Sujoy Kumar Ghosh**, and Dipankar Mandal, "The Fabrication of Flexible Hybrid Nanogenerator for Self-Powering Devices" ***IISRR-International Journal of Research, 2015,*** **vol. 1 (2), ISSN 2394-885X, 74-75**.
9. Md. Mehebub Alam, **Sujoy Kumar Ghosh**, and Dipankar Mandal, "Energy Harvesting Performance of A Lead Free Hybrid Piezoelectric Nanogenerator", ***IISRR-International Journal of Research, 2015,*** **vol. 1 (2), ISSN 2394-885X, 53-54**.
10. **Sujoy Kumar Ghosh**, Wahida Rahman, Tapas Ranjan Middya, and Dipankar Mandal, "Montmorillonite Induced γ-phase in PVDF with Superior Dielectric Property", ***IISRR-International Journal of Research, 2015,*** **vol. 1 (2), ISSN 2394-885X, 81-82**.

***4.8 Reviewer of Journals***

**Elsevier:**

- MECHANICAL SYSTEMS AND SIGNAL PROCESSING
- SENSORS & ACTUATORS A: PHYSICAL
- MATERIALS AND DESIGN
- ENERGY AND BUILDINGS
- NANO ENERGY

***4.9 Full-Time Equivalent Research Experience (researcher without a doctorate at the call deadline)***

| **Academic qualifications counting towards the Total Full time postgraduate research experience** | | | |
|---|---|---|---|
| **University degree giving access to PhD: MSc** | **Institution name and country** | **Date of award (a)** | |
| | Jadavpur University, India | 12.09.2012 | |
| **Doctorate: PhD** | **Institution name and country** | **From** | **To** |
| | Jadavpur University, India | 25.09.2013 | 28.01.2019 |
| | Full time research experience | | Duration of research activities expressed in months |
| | | | 64 months |
| **Other research activities counting towards the total full-time postgraduate research experience** | | | |
| **Position: Post-Doctoral Research Associate** | **Institution name and country** | **From** | **To** |
| | Ulsan National Institute of Science and Technology (UNIST), South Korea | 16.06.2019 | 11.09.2019 |
| | Full time research experience | | Duration of research activities expressed in months |
| | | | 2 months |
| **Total full-time postgraduate research experience: number of months** | | | **= 66 months** |

***Section 5 – Capacity of the Participating Organisations***

List of participating organisations (one page)

| **Participating organisations** | **Legal Entity Short Name** | **Country** | **Supervisor** | **Role of partner organisation** |
|---|---|---|---|---|
| Beneficiary | | | | |
| Consiglio Nazionale delle Ricerche CNR-NANO | CNR | Italy | Dr. Luana Persano | HO |

| **Consiglio Nazionale delle Ricerche (CNR), Italy** | |
|---|---|
| **General description** | **Consiglio Nazionale delle Ricerche**<br><br>NEST, the National Enterprise for nanoScience and nanoTechnology, is an interdisciplinary research and training centre where physicists, chemists and biologists investigate scientific issues at the nanoscale. This knowledge is exploited to develop innovative nanobiotechnological tools, nanoelectronic and photonic devices and architectures. The NEST initiative comprises three distinct institutions: Scuola Normale Superiore (SNS), Istituto Italiano di Tecnologia (IIT), and Consiglio Nazionale delle Ricerche (CNR-NANO). Although each institution has its own staff and administration facilities and activities are closely coordinated and scientists team up for specific scientific objectives regardless of their affiliation. This concentration of efforts and flexibility allows NEST scientist to address a rather broad range of research activities that span from semiconductor/superconductor nanostructure design, growth and experimental investigation to single-molecule studies in live cells and tissues. Despite this broad scope, NEST scientists adopt a unified approach thanks to the close cultural integration of its multidisciplinary teams which is characteristic of nanoscience. In the last years the Institute of Nanoscience was very successful in obtaining founding via highly competitive projects. 5 ERC (starting and advanced) and >8 Italian FIRB “Futuro in Ricerca” projects have been successfully granted allowing young researchers to start new frontier research activities in autonomy. Another strategic element of the project activity of CNR-NANO is the participation in the Graphene flagship, an initiative recently supported by the EU for the next ten |

| | |
|---|---|
| | years, devoted to the development of graphene for new technologies. |
| **Academic organisation** | NO |
| **Role and profile of key persons (supervisor)** | -Prof. Lucia Sorba, Director of the CNR-NANO, is the legal commitment of the research contract.<br>-Dr. Luana Persano, Staff Researcher at the CNR-NANO Institute is the energy-harvesting team coordinator. |
| **Dept./Division / Laboratory** | *CNR-NANO Istituto Nanoscienze* |
| **Key research facilities, Infrastructure and Equipment** | The infrastructure of NEST has the necessary facilities for the fabrication of the devices including a state-of-the-art cleanroom with 2 SEM/EBL for nanolithography, 1 E-beam evaporator, 2 thermal evaporators, 1 AFM, 1 ALD, 1 sputtering, 1 RIE, 1 ICP, and chemical and bilogical laboratories with 3 different confocal microscopes. It also include: A molecular device fabrication facility, for the synthesis and film technology of organics, A facility for spectroscopy and for electrical characterization, a laboratory of soft matter nanotechnologies and Scanning probe and Microscopy labs |
| **Independent research premises?** | The HO, as stated in the CNR research contract (point 4 of the contract), guarantees to the employ full autonomy without predetermined working hours and all the necessary research environment for an independent research premises. |
| **Previous and current involvement in research and training programmes** | 1. EU-SUPER -Superconducting Magnetic RAM for Next Generation of Supercomputers- MSCA-IF-2017 - Individual Fellowships [2018-2020]<br>2. xPRINT - Dimensional printing for adaptive optoelectronic components- ERC CoG [2016-2021]<br>3. GRAFLEX - Graphene curvature, flexibility and reactivity control by means of external fields; theory and computer simulations Marie Skłodowska-Curie Individual Fellowships (IF-EF)[2015-2017]<br>4. Super-Mag - Cooperation between Superconductivity and Magnetism in Mesoscopic Systems: towards Majorana States. Marie Skłodowska-Curie IndividualFellowships (IF-EF)[2015-2017]<br>5. NANO-JETS- Next-generation polymer nanofibers: from electrified jets to hybrid optoelectronics- ERC StG [2013-2018] |
| **Relevant publications and/or research/innovation products** | 1) "Lineage-Specific Commitment Of Stem Cells With Organic And Graphene Oxide–Functionalized Nanofibers", Authors: Alberto Portone *et al*. Publication: **Adv. Funct. Mater.** 2019, 29, 1806694.<br>2) "Polymer Nanogenerators: Opportunities And Challenges For Large-Scale Applications", Authors: Aurelia Chi Wang et *al*. Publication: **J. Appl. Polym. Sci.** 2017, 135, 45674.<br>3) "Electrostatic Mechanophores In Tuneable Light-Emitting Piezopolymer Nanowires", Authors: Luana Persano et al. Publication: **Advanced Materials** 2017, 29, 1701031. |

| | |
|---|---|
| | 4)"Shear Piezoelectricity In Poly(Vinylidenefluoride-*Co*-Trifluoroethylene): Full Piezotensor Coefficients By Molecular Modeling, Biaxial Transverse Response, And Use In Suspended Energy-Harvesting Nanostructures", Authors: Luana Persano *et al*. Publication: **Advanced Materials**, 2016, 28, 7633–7639.<br>5) "Cooperativity In The Enhanced Piezoelectric Response Of Polymer Nanowires", Authors: Luana Persano *et al*.Publication: **Advanced Materials** 2014, 26, 7574–7580.<br>6) "High Performance Piezoelectric Devices Based On Aligned Arrays Of Nanofibers Of Poly(Vinylidenefluoride-Co-Trifluoroethylene)", Authors: Luana Persano *et al*. Publication: **Nature Communications** 2013, 4, 1633. Nature Publishing Group (UK). |

***Section 6 - Ethical Issues***

This research (including objectives, methodology and impact) involves lead-free and biocompatible nano-materials for clean and green energy harvesting. Therefore, our research approach is environment friendly and does not harm to the environment, plants or even to any research staff involved. This research project entails the use of natural biopolymers such as collagen and cellulose and investigates the capability to build a piezoelectric device fully based on biocompatible/bioabsorbable materials. The piezoelectric device will be integrated with the proper electrical circuit components to realize an energy harvester to be used as implantable device. In-vitro studies will be performed to assess the full biocompatibility and bioabsorbability of materials and device. Starting from month 19, the applicant, under the guidance of the supervisor and in collaboration with the responsible of the animal welfare at the Animal Facility Experimental Biomedicine Centre of National Research Council - CNR, will set-up a committee of experts with the purpose to define the more appropriate animal model to choose according to the achieved results in terms of (i) biocompatibility/biodegradability, (ii) device size and (iii) generated power output. Once the model will be defined, in-vitro experiments will be performed on cardiac and lung animal tissues.

The research will comply with ethical principles and applicable international, EU and national law (in particular, EU Directive 2010/63/EU and D. lgs n.116/92 and D. Lgs. n. 26/2014) implementing the principles of replacement, reduction and refinement. The animal studies will be performed at the Animal Facility Experimental Biomedicine Centre of National Research Council - CNR (authorization decree N ° 114/2003-A 16.09.2003) (Animal Welfare Manager dr. Silvia Burchielli)) and at CNR-Nanoscience.

More specifically, in vitro studies will be performed at CNR-Nanoscience with tissues supplied by the Animal Facility Experimental Biomedicine Centre of National Research Council- CNR. Animal procedures will be performed in strict compliance with protocols approved by Italian Ministry of Public Health, in conformity with the D. Lgs. n. 26/2014. In vitro experiments will be carried out by using organs/tissues explanted by animals used in authorized research projects in accordance with the Italian legislation (D. Lgs. 26/2014 art 18 - sharing of organs and tissues) and with the Reduction principle (minimise the number of animals used). No animal will be sacrificed for the present project. Organs and tissues explanted in the framework of other authorized protocols, will be donated in the form of tissue samples to the purpose of the present project instead of being wasted.

| **Environmental protection and safety** | |
|---|---|
| I confirm that appropriate health and safety procedures conforming to relevant local/national guidelines/legislation are followed for staff involved in this project. | **Yes ¤** |
| I confirm that authorisations for relevant facilities (e.g. security classification of laboratory) have been obtained, and will be kept on file. | **Yes ¤** |

# ESTIMATED BUDGET FOR THE ACTION

| | | | | Estimated eligible[1] costs (per budget category) | | | | | | | | | | | EU contribution | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | A. Costs for the recruited researcher | | | | | | B. Institutional costs | | | | Total costs | Reim-bursement rate % | Maximum EU contrib.[2] | Maximum grant amount[3] |
| | | | | A.1 Living allowance | | A.2 Mobility allowance | | A.3 Family allowance | | B.1. Research, training and networking costs | | B2. Management and indirect[4] costs | | | | | |
| | | | Form of costs[5] | Unit | | Unit | | Unit | | Unit | | Unit | | | | | |
| | | | | Costs per unit[6] | Total a[7] | Costs per unit[6] | Total b[7] | Costs per unit[6] | Total c[7] | Costs per unit[6] | Total d[7] | Costs per unit[6] | Total e[7] | f=a+b +c+d+e | g | h | i |
| 1. CNR | Number of units (person-months) | 24.00 | 1. CNR | 5 094.72 | 122 273.28 | 600.00 | 14 400.00 | 500.00 | 0.00 | 800.00 | 19 200.00 | 650.00 | 15 600.00 | 171 473.28 | 100.00 | 171 473.28 | 171 473.28 |

[1] See Article 6 for the eligibility conditions.
[2] 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 Commission/Agency decided to grant for the action) (see Article 5.1).
[3] The 'maximum grant amount' is the maximum grant amount decided by the Commission/Agency. It normally corresponds to the requested grant, but may be lower.
[4] The indirect costs covered by the operating grant (received under any EU or Euratom funding programme; see Article 6.3(b)) are ineligible under the GA. Therefore, a beneficiary that receives an operating grant during the action duration cannot declare indirect costs for the year(s)/reporting period(s) covered by the operating grant (i.e. the unit cost for management and indirect costs will be halved for person-months that are incurred during the period covered by the operating grant), unless they can demonstrate that the operating grant does not cover any costs of the action.
[5] See Article 5 for forms of costs.
[6] See Annex 2a 'Additional information on the estimated budget' for the details on the costs per unit.
[7] Total = costs per unit x number of units (person - months).
[8] ONLY FOR AMD: To be used if beneficiary changes during the action.

**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.**

## Marie Skłodowska-Curie unit costs

## MSCA-IF unit costs

### Costs for the recruited researcher(s) — Living allowance

Units: months spent by the researcher(s) on the research training activities ('person-months')

Amount per unit *: see Annex 2

* Amount calculated as follows:
{the monthly living allowance for researchers in MSCA-IF actions
multiplied by
country-specific correction coefficient of the country in which the researcher is recruited}

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:
    - IF: **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:
    - IF: **EUR 4 880**
  - for the country-specific correction coefficients: see Work Programme 2018-2020 (available on the Participant Portal Reference Documents page).

Estimated number of units: see Annex 2

### Costs for the recruited researcher(s) — Mobility allowance

Units: months spent by the researcher(s) on the research training activities ('person-months')

Amount per unit[1]: see Annex 2

Estimated number of units: see Annex 2

[1] Same amount for all beneficiaries.
Amount for the mobility allowance set out in the Main Work Programme — MSCA in force at the time of the call.

**Costs for the recruited researcher(s) — Family allowance**

Units: months spent by the researcher(s) on the research training activities ('person-months')

Amount per unit[2]: see Annex 2

Estimated number of units: see Annex 2

**Institutional costs — Research, training and networking costs**

Units: months spent by the researcher(s) on the research training activities ('person-months')

Amount per unit[3]: see Annex 2

Estimated number of units: see Annex 2

**Institutional costs — Management and indirect costs**

Units: months spent by the researcher(s) on the research training activities ('person-months')

Amount per unit[4]: see Annex 2

Estimated number of units: see Annex 2

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2 Same amount for all beneficiaries.
Average based on the amount for the family allowance set out in the Main Work Programme — MSCA in force at the time of the call (half of the number of units with family, half without).

3 Same amount for all beneficiaries.
Amount for research, training and networking costs set out in the Main Work Programme — MSCA in force at the time of the call.

4 Same amount for all beneficiaries.
Amount for management and indirect costs set out in the Main Work Programme — MSCA in force at the time of the call.

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# MODEL ANNEX 4 FOR H2020 MGA MSCA-IF — MONO

## FINANCIAL STATEMENT FOR BENEFICIARY [name] FOR REPORTING PERIOD [reporting period]

| | | | Eligible[1] costs (per budget category) | | | | | | | | | | EU contribution | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A. Costs for the recruited researcher | | | | | | B. Institutional costs | | | | Total costs | Reimbursement rate % | Maximum EU contribution | Requested EU contribution |
| | | | A.1 Living allowance | | A.2 Mobility allowance | | A.3 Family allowance | | B.1. Research, training and networking costs | | B2. Management and indirect[2] costs | | | | | |
| | | Form of costs[3] | Unit | | Unit | | Unit | | Unit | | Unit | | | | | |
| | | | Costs per unit[4] | Total a[5] | Costs per unit[4] | Total b[5] | Costs per unit[4] | Total c[5] | Costs per unit[4] | Total d[5] | Costs per unit[4] | Total e[5] | | | | |
| **Beneficiary** | Number of units (person-months) | **Beneficiary** | | | | | | | | | | | | | | |

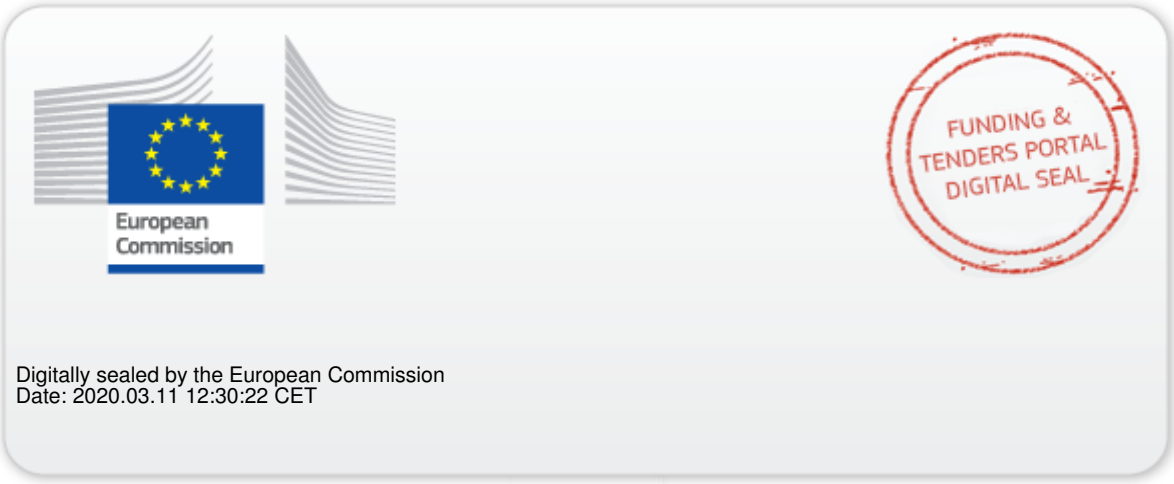
| | |
|---|---|
| **Checkbox 1:** | I confirm that the total amount of the allowances used (including compulsory deductions) for the researcher is equal to or higher than the living allowance, the mobility allowance and the family allowance as set out in Annex 2 of the Agreement. |

| | | | | |
|---|---|---|---|---|
| **Checkbox 2:** | Did you receive any EU/Euratom operating grant during this reporting | ❍ YES ❍ NO | | |
| | If yes, pls indicate how many of the total person-months (see 'total beneficiary' above) were incurred DURING the period covered by the operating grant? | Number of person-months | | |
| | If yes, can you confirm all of the following:<br>- the operating grant is a partial operating grant (i.e. does not cover your entire annual budget)<br>- you have used analytical accounting which allows for a cost accounting management with cost allocation keys and cost accounting codes<br>- you have recorded:<br>- all costs incurred for the operating grant (i.e. personnel, general running costs and other operating costs linked to the work programme) and<br>- all costs incurred for the action grants (including all the indirect costs linked to the action)<br>- you have used allocation keys and cost accounting codes to identify and separate the recorded costs (i.e. to allocate them to either the action grant or the operating grant)<br>- you have done the allocation in a way that leads to a fair, objective, realistic result. | ❍ YES ❍ NO | | |

**The beneficiary 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).

ⓘ Please 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). 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 6.3(b)). If you have received an operating grant during this reporting period, indirect costs will not be reimbursed for the person-months incurred during the period covered by the operating grant, unless you can demonstrate that the operating grant does not cover any costs of the action.
[3] See Article 5 for the forms of costs
[4] See Annex 2a 'Additional information on the estimated budget' for the details on the costs per unit.
[5] Total = costs per unit x number of units (person-months)

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