EUROPEAN COMMISSION
Research Executive Agency

Director

GRANT AGREEMENT

NUMBER 859983 — EAGRE

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 Innovative Training Networks, Klaus-Guenther BARTHEL,

and

on the other part,

1. 'the coordinator':

UNIVERSITY OF LEEDS (UNIVLEEDS), established in WOODHOUSE LANE, LEEDS LS2 9JT, United Kingdom, VAT number: GB613451470, represented for the purposes of signing the Agreement by Director of Research and Innovation Development, Ceri WILLIAMS

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

2. **MARIN ACADEMY BV (MARINBV)**, established in Haagsteeg 2, WAGENINGEN 6708 PM, Netherlands, VAT number: NL811941024B01,

Unless otherwise specified, references to 'beneficiary' or 'beneficiaries' include the coordinator.

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

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

The Agreement is composed of:

Terms and Conditions

Annex 1 Description of the action

Annex 2 Estimated budget for the action

2a Additional information on the estimated budget

Annex 3 Accession Forms

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 beneficiaries for implementing the action set out in Chapter 2.

CHAPTER 2 ACTION

ARTICLE 2 — ACTION TO BE IMPLEMENTED

The grant is awarded for the action entitled '**Eagre/Aegir: high-seas wave-impact modelling**' — '**EAGRE**' **('action')**, as described in Annex 1.

ARTICLE 3 — DURATION AND STARTING DATE OF THE ACTION

The duration of the action will be **48 months** as of 1 January 2020 ('**starting date of the action**').

ARTICLE 4 — ESTIMATED BUDGET AND BUDGET TRANSFERS

4.1 Estimated budget

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

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

4.2 Budget transfers

The estimated budget breakdown indicated in Annex 2 may be adjusted by transfers of amounts between beneficiaries.

This does not require an amendment according to Article 55, if the action is implemented as described in Annex 1.

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 606 345.12** (six hundred and six thousand three hundred and forty five EURO and twelve 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 **606 345.12** (six hundred and six thousand three hundred and forty five EURO and twelve eurocents).

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

(a) for **costs for recruited researchers** (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 rates to the eligible costs

The reimbursement rate (see Article 5.2) is applied to eligible costs (unit costs; see Article 6) declared by the beneficiaries 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 grant amount by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the maximum grant amount set out in Article 5.1.

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

- the amount obtained following Steps 1 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**' for the beneficiary concerned by the findings.

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 for the beneficiary concerned;

- in case of **reduction of the grant**: by calculating the concerned beneficiary's share in the grant amount reduced in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations (see Article 43.2).

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

ARTICLE 6 — ELIGIBLE AND INELIGIBLE COSTS

6.1 General conditions for costs to be eligible

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 recruited researchers (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 researchers on the research training activities and

(ii) does not exceed 36 months (per researcher), and

(iii) are, for each researcher, spent to at least 50% with one or more beneficiaries or partner organisations from the non-academic sector;

(iv) if spent on inter-sectoral mobility between academic and non-academic beneficiaries (i.e. not partner organisations): are international (i.e. spent between beneficiaries established in different countries).

(b) the recruited researchers comply 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;

(ii) be employed for at least 3 months;

(iii) be employed full-time, unless the Agency has approved a part-time employment for personal or family reasons;

(iv) be working exclusively for the action;

(v) not have resided in the country of the recruiting beneficiary for more than 12 months in the 3 years immediately before the recruitment date (and not have carried out their main activity (work, studies, etc.) in that country) — unless as part of a procedure for obtaining refugee status under the Geneva Convention[1].

For beneficiaries that are international European interest organisations or international organisations: not have spent with the beneficiary more than 12 months in the 3 years immediately before the recruitment date.

(vi) be — at the date of recruitment — an '**early stage researcher**' (i.e. in the first four years of his/her research career and not have a doctoral degree);

(vii) be enrolled in a doctoral programme.

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

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}

[1] 1951 Refugee Convention and the 1967 Protocol.

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}.

The family allowance is due if the researcher has a family at the time of recruitment.

'Family' means persons linked to the researcher by marriage (or a relationship with equivalent status to a marriage recognised by the legislation of the country where this relationship was formalised) or dependent children who are actually being maintained by the researcher.

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

7.2 Consequences of non-compliance

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

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

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

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

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

- call upon entities with a capital or legal link to the beneficiaries[2], to implement certain action tasks described in Annex 1 (i.e. hosting and training of researchers);
- call upon partner organisations to implement certain action tasks described in Annex 1 (i.e. hosting and training researchers during secondments).

In this case, the beneficiaries retain sole responsibility towards the Agency for implementing the action.

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

Not applicable

ARTICLE 10 — PURCHASE OF GOODS, WORKS OR SERVICES

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

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

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

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

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

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

  (i) changes in its legal, financial, technical, organisational or ownership situation (or those of 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 a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

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

ARTICLE 18 — KEEPING RECORDS — SUPPORTING DOCUMENTATION

18.1 Obligation to keep records and other supporting documentation

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

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

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

The beneficiaries must keep the original documents. Digital and digitalised documents are considered originals if they are authorised by the applicable national law. The 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 beneficiaries must keep records and other supporting documentation on scientific and technical implementation of the action in line with the accepted standards in the respective field.

18.1.2 Records and other documentation to support the costs declared

The beneficiaries must keep adequate records and other supporting documentation to prove the number of units declared and that the costs for recruited researchers (living allowance, mobility allowance, family allowance) have been fully incurred for the benefit of the researchers.

18.2 Consequences of non-compliance

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

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

ARTICLE 19 — SUBMISSION OF DELIVERABLES

19.1 Obligation to submit deliverables

The coordinator must:

- submit a '**progress report**' within 30 days after one year from the starting date of the action;
- organise a '**mid-term meeting**' between the beneficiaries, entities with a capital or legal link, partner organisations and the Agency before the deadline for the submission of the report for RP 1 (reporting period 1);
- establish a **supervisory board** of the network;
- submit any **other deliverables** identified in Annex 1, in accordance with the timing and conditions set out in it.

The beneficiaries must:

- submit a '**researcher declaration**' within 20 days after the recruitment of each researcher.

19.2 Consequences of non-compliance

If a beneficiary or the coordinator breaches any of its obligations under this Article, the Agency may apply any of the measures provided for in Chapter 6.

ARTICLE 20 — REPORTING — PAYMENT REQUESTS

20.1 Obligation to submit reports

The coordinator must submit to the Agency (see Article 52) the technical and financial reports set out in this Article. These reports include the requests for payments 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
- RP2: from month 25 to month 48

20.3 Periodic reports — Requests for interim payments

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

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

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

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

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

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

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

The report must indicate the communication activities;

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

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

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

(i) an '**individual financial statement**' (see Annex 4) from each beneficiary, for the reporting period concerned.

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

The beneficiaries 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 individual financial statement will not be taken into account by the Agency.

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

Each beneficiary must **certify** that:

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

(ii) not applicable;

(iii) not applicable;

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

20.4 Final report — Request for payment of the balance

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

The final report must include the following:

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

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

(ii) the conclusions on the action, and

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

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

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

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

20.8 Consequences of non-compliance

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

If the coordinator breaches its obligation to submit the reports and if it fails to comply with this obligation within 30 days following a written reminder, the Agency 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 coordinator:

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

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

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

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

The amount of the pre-financing payment will be EUR **485 076.10** (four hundred and eighty five thousand seventy six EURO and ten eurocents).

The Agency will — except if Article 48 applies — make the pre-financing payment to the coordinator within 30 days 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).

An amount of EUR **30 317.26** (thirty thousand three hundred and seventeen EURO and twenty 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 coordinator the amount due as interim payment within 90 days from receiving the periodic report (see Article 20.3), except if Articles 47 or 48 apply.

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

The **amount due as interim payment** is calculated by the 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 beneficiaries (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 beneficiaries for the implementation of the action.

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

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

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

21.5 Notification of amounts due

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

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

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

21.6 Currency for payments

The Agency will make all payments in euro.

21.7 Payments to the coordinator — Distribution to the beneficiaries

Payments will be made to the coordinator.

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

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

Pre-financing may however be distributed only:

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

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

21.8 Bank account for payments

All payments will be made to the following bank account:

Name of bank: BARCLAYS BANK PLC
Full name of the account holder: UNIVERSITY OF LEEDS
IBAN code: GB83BARC20484646149855

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 beneficiaries are entitled to **late-payment interest** at the rate applied by the European Central Bank (ECB) for its main refinancing operations in euros ('reference rate'), plus three and a half points. The reference rate is the rate in force on the first day of the month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

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

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and

local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

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

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

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

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

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

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

22.1 Checks, reviews and audits by the 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. The Agency or the Commission may request beneficiaries to provide such information to it directly.

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

22.1.2 Right to carry out reviews

The 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 coordinator or beneficiary concerned 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 coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

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

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

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

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

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

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

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

22.1.3 Right to carry out audits

The 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 coordinator or beneficiary concerned 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 coordinator or beneficiary concerned of the identity of the external persons or bodies. They have the right to object to the appointment on grounds of commercial confidentiality.

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

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

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

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

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

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

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

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

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

Under Regulations No 883/2013[3] and No 2185/96[4] (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[5], 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).

[3] 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).

[4] 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).

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

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

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

22.5.3 Procedure

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

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

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

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

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

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

(ii) does not submit revised financial statements.

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

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 concerned 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.

If the Agency or the Commission accepts the alternative flat-rate proposed by the beneficiary concerned, it will formally notify the application of the accepted alternative flat-rate.

22.6 Consequences of non-compliance

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

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

ARTICLE 23 — EVALUATION OF THE IMPACT OF THE ACTION

23.1 Right to evaluate the impact of the action

The 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 coordinator or beneficiaries.

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

23.2 Consequences of non-compliance

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

Beneficiaries that are universities or other public research organisations must take measures to implement the principles set out in Points 1 and 2 of the Code of Practice annexed to the Commission Recommendation on the management of intellectual property in knowledge transfer activities[6].

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

The beneficiaries must ensure that the researchers, entities with a capital or legal link and partner organisations are aware of them.

23a.2 Consequences of non-compliance

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

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

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

[6] 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.

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

24.2 Consequences of non-compliance

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

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

ARTICLE 25 — ACCESS RIGHTS TO BACKGROUND

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

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

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

Waivers of access rights are not valid unless in writing.

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

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

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

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

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

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

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

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

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

25.4 Access rights for affiliated entities

Unless otherwise agreed in the consortium agreement, access to background must also be given

— under fair and reasonable conditions (see above; Article 25.3) and unless it is subject to legal restrictions or limits, including those imposed by the rights of third parties (including personnel) — to affiliated entities[7]established in an EU Member State or '**associated country**'[8], if this is needed to exploit the results generated by the beneficiaries to which they are affiliated.

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

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

25.5 Access rights for researchers

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

25.6 Consequences of non-compliance

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

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

SUBSECTION 3 RIGHTS AND OBLIGATIONS RELATED TO RESULTS

ARTICLE 26 — OWNERSHIP OF RESULTS

26.1 Ownership by the beneficiary that generates the results

Results are owned by the beneficiary that generates them.

'**Results**' means any (tangible or intangible) output of the action such as data, knowledge or

[7] For the definition, see Article 2.1(2) 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): '**affiliated entity**' means any legal entity that is:

- under the direct or indirect control of a participant, or
- under the same direct or indirect control as the participant, or
- directly or indirectly controlling a participant.

'Control' may take any of the following forms:

(a) the direct or indirect holding of more than 50% of the nominal value of the issued share capital in the legal entity concerned, or of a majority of the voting rights of the shareholders or associates of that entity;

(b) the direct or indirect holding, in fact or in law, of decision-making powers in the legal entity concerned.

However the following relationships between legal entities shall not in themselves be deemed to constitute controlling relationships:

(a) the same public investment corporation, institutional investor or venture-capital company has a direct or indirect holding of more than 50% of the nominal value of the issued share capital or a majority of voting rights of the shareholders or associates;

(b) the legal entities concerned are owned or supervised by the same public body.

[8] For the definition, see Article 2.1(3) Rules for Participation Regulation No 1290/2013: '**associated country**' means a non EU-country (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.

information — whatever its form or nature, whether it can be protected or not — that is generated in the action, as well as any rights attached to it, including intellectual property rights.

26.2 Joint ownership by several beneficiaries

Two or more beneficiaries own results jointly if:

(a) they have jointly generated them and

(b) it is not possible to:

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

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

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

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

(a) at least 45 days advance notice and

(b) fair and reasonable compensation.

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

26.3 Rights of third parties (including personnel)

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

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

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

26.4 Agency ownership, to protect results

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

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

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

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

Before the results are disseminated and unless any of the cases above under Points (a), (b) or (c) applies, the beneficiary must formally notify the 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 concerned within 45 days of receiving notification.

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

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

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

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

A beneficiary that intends to stop protecting results or not seek an extension must — unless any of the cases above under Points (a) or (b) applies — formally notify the 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 concerned within 45 days of receiving notification.

26.5 Consequences of non-compliance

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

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

ARTICLE 27 — PROTECTION OF RESULTS — VISIBILITY OF EU FUNDING

27.1 Obligation to protect the results

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

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

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

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

27.2 Agency ownership, to protect the results

If a beneficiary intends not to protect its results, to stop protecting them or not seek an extension of protection, 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 a 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 Skłodowska-Curie grant agreement No 859983".

27.4 Consequences of non-compliance

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

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

ARTICLE 28 — EXPLOITATION OF RESULTS

28.1 Obligation to exploit the results

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

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

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

(c) creating and providing a service, or

(d) using them in standardisation activities.

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

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

If results are incorporated in a standard, the beneficiary concerned must — unless the 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 received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 859983".

28.3 Consequences of non-compliance

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

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

29.3 Open access to research data

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

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

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

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

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

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

As an exception, the beneficiaries do not have to ensure open access to specific parts of their research data 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.

ARTICLE 30 — TRANSFER AND LICENSING OF RESULTS

30.1 Transfer of ownership

Each beneficiary may transfer ownership of its results.

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

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

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

Unless agreed otherwise (in writing) for specifically-identified third parties, any other beneficiary

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

30.2 Granting licenses

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

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

(b) not applicable.

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

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

30.3 Agency right to object to transfers or licensing

Not applicable

30.4 Consequences of non-compliance

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

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

ARTICLE 31 — ACCESS RIGHTS TO RESULTS

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

The conditions set out in Article 25.1 apply.

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

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

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

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

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

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

31.4 Access rights of affiliated entities

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

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

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

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

The beneficiaries must give access to their results — on a royalty-free basis — to 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 beneficiaries for communication and publicising activities (see Article 38.2).

31.6 Access rights for researchers

The beneficiaries must — on a royalty-free basis — give access to the recruited researchers to results necessary for their research training activities under the action.

31.7 Consequences of non-compliance

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

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

SECTION 4 OTHER RIGHTS AND OBLIGATIONS

ARTICLE 32 — RECRUITMENT AND WORKING CONDITIONS FOR RECRUITED RESEARCHERS

32.1 Obligations towards recruited researchers

The beneficiaries must respect the following recruitment and working conditions for the researchers 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[9] and ensure that the researchers are aware of them;

[9] 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).

(b) advertise and publish vacancies internationally, including on the web-sites requested by the Agency;

(c) recruit the researchers, following an open, transparent, impartial and equitable recruitment procedure, on the basis of:

(i) their scientific skills and the relevance of their research experience;

(ii) the impact of the proposed training on the researcher's career;

(iii) a fair gender representation (by promoting genuine equal access opportunities between men and women throughout the recruitment process);

(d) ensure that no conflict of interest exists in or arises from the recruitment;

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

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

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

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

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

(iv) the obligation of the researcher not to receive for activities carried out in the frame of the action, other incomes than those received from the beneficiary (or other entity mentioned in Annex 1);

(v) 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);

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

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

(viii) 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);

(g) assist the researchers in the administrative procedures related to their recruitment;

(h) inform the researchers 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 training — the evaluation questionnaire and — two years later — follow-up questionnaire provided by the Agency;

(i) ensure that the researchers do not receive, for activities carried out in the frame of the action, other incomes than those received from the beneficiaries (or other entity mentioned in Annex 1);

(j) ensure that the researchers do not have to bear any costs for the implementation of the action as described in Annex 1;

(k) host the researchers at their premises (or at the premises of an entity with a capital or legal link);

(l) 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);

(m) ensure that the researchers are adequately supervised;

(n) ensure that a career development plan is established and support its implementation;

(o) ensure an appropriate exposure to the non-academic sector;

(p) limit secondments to a maximum of 30% of the actual months spent implementing the research training activities under the action.

32.2 Consequences of non-compliance

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

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

ARTICLE 33 — GENDER EQUALITY

33.1 Obligation to aim for gender equality

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

33.2 Consequences of non-compliance

If a 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 beneficiaries must carry out the action in compliance with:

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

and

(b) applicable international, EU and national law.

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

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

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

(a) aim at human cloning for reproductive purposes;

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

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

In addition, the beneficiaries must respect the fundamental principle of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity[10].

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

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

34.2 Activities raising ethical issues

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

[10] 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

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

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

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

needed for implementing the action tasks in question.

The documents must be kept on file and be submitted upon request by the coordinator to the 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 coordinator has obtained explicit approval (in writing) from the Agency (see Article 52).

34.4 Consequences of non-compliance

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

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

ARTICLE 35 — CONFLICT OF INTERESTS

35.1 Obligation to avoid a conflict of interests

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

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

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

ARTICLE 36 — CONFIDENTIALITY

36.1 General obligation to maintain confidentiality

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

If a beneficiary requests, the 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 beneficiaries may disclose confidential information to their personnel, entities with a capital or legal link or partner organisations 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[11], 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

[11] 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).

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

36.2 Consequences of non-compliance

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

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

ARTICLE 37 — SECURITY-RELATED OBLIGATIONS

37.1 Results with a security recommendation

Not applicable

37.2 Classified information

Not applicable

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

Not applicable

37.4 Consequences of non-compliance

Not applicable

ARTICLE 38 — PROMOTING THE ACTION — VISIBILITY OF EU FUNDING

38.1 Communication activities by beneficiaries

38.1.1 Obligation to promote the action and its results

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

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

Before engaging in a communication activity expected to have a mainstream media coverage the beneficiaries 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 EU emblem and

(b) include the following text:

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 859983".

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 859983".

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

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

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

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

38.1.3 Disclaimer excluding 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 beneficiaries' 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 any beneficiary (including in electronic form).

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

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

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

(a) **use for its own purposes** (in particular, making them available to persons working for the 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[13], 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).

Where applicable (and if provided by the beneficiaries), 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 a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 43).

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

ARTICLE 39 — PROCESSING OF PERSONAL DATA

39.1 Processing of personal data by the Agency and the Commission

Any personal data under the Agreement will be processed by the Agency or the Commission under Regulation No 45/2001[14] 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).

[13] 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.

[14] 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).

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 the Commission websites.

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

39.2 Processing of personal data by the beneficiaries

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

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

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

39.3 Consequences of non-compliance

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

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 beneficiaries from their 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 — DIVISION OF BENEFICIARIES' ROLES AND RESPONSIBILITIES — RELATIONSHIP WITH COMPLEMENTARY BENEFICIARIES — RELATIONSHIP WITH PARTNERS OF A JOINT ACTION

41.1 Roles and responsibility towards the Agency

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

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

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

41.2 Internal division of roles and responsibilities

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

(a) Each **beneficiary** must:

(i) keep information stored in the Participant Portal Beneficiary Register (via the electronic exchange system) up to date (see Article 17);

(ii) inform the coordinator immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 17);

(iii) submit to the coordinator in good time:

- individual financial statements for itself and, if required, certificates on the financial statements (see Article 20);
- the data needed to draw up the technical reports (see Article 20);
- ethics committee opinions and notifications or authorisations for activities raising ethical issues (see Article 34);
- any other documents or information required by the Agency or the Commission under the Agreement, unless the Agreement requires the beneficiary to submit this information directly to the Agency or the Commission.

(b) The **coordinator** must:

(i) monitor that the action is implemented properly (see Article 7);

(ii) act as the intermediary for all communications between the beneficiaries and the Agency (in particular, providing the Agency with the information described in Article 17), unless the Agreement specifies otherwise;

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

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

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

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

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including entities with a capital or legal link and partner organisations).

41.3 Internal arrangements between beneficiaries — Consortium agreement

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

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

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

41.4 Relationship with complementary beneficiaries — Collaboration agreement

Not applicable

41.5 Relationship with partners of a joint action — Coordination agreement

Not applicable

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

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

ARTICLE 42 — REJECTION OF INELIGIBLE COSTS

42.1 Conditions

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

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

42.2 Ineligible costs to be rejected — Calculation — Procedure

Ineligible costs will be rejected in full.

If the rejection of costs does not lead to a recovery (see Article 44), the Agency will formally notify the coordinator or beneficiary concerned of the rejection of costs, the amounts and the reasons why (if applicable, together with the notification of amounts due; see Article 21.5). The coordinator or beneficiary concerned may — within 30 days of receiving notification — formally notify the 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 **after termination of the participation of a beneficiary**, it will deduct them from the costs declared by the beneficiary in the termination report and include the rejection in the calculation after termination (see Article 50.2 and 50.3).

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

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

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

ARTICLE 43 — REDUCTION OF THE GRANT

43.1 Conditions

The Agency may — **after termination of the participation of a beneficiary**, **at the payment of the balance** or **afterwards** — reduce the grant, if :

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

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under the Agreement or during the award procedure

(including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or

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

43.2 Amount to be reduced — Calculation — Procedure

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

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

- informing it of its intention to reduce the grant, the amount it intends to reduce and the reasons why and

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

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

If the 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 for the beneficiary concerned (see Article 5.4). If the revised final grant amount for the beneficiary concerned is lower than its share of the final grant amount, the 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 — after **termination of the participation of a beneficiary, at the payment of the balance** or **afterwards** — claim back any amount that was paid, but is not due under the Agreement.

Each beneficiary's financial responsibility in case of recovery is limited to its own debt, except for the amount retained for the Guarantee Fund (see Article 21.4).

44.1.1 Recovery after termination of a beneficiary's participation

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

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

(a) by '**offsetting**' it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the 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) not applicable;

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

If payment is not made by the date specified in the debit note, the amount to be recovered (see above) will be increased by **late-payment interest** at the rate set out in Article 21.11, from the day following the payment date in the debit note, up to and including the date the 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[15] applies.

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 coordinator:

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

If no observations are submitted or the Agency decides to pursue recovery despite the observations it

[15] 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).

has received, it will **confirm recovery** (together with the notification of amounts due; see Article 21.5) and:

- pay the difference between the amount to be recovered and the amount retained for the Guarantee Fund, **if the difference is positive** or

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

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

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

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

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

divided by

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

multiplied by

the final grant amount (see Article 5.3)},

minus

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

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

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

divided by

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

multiplied by

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

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

(a) by **offsetting** it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the 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 concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) not applicable;

(ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) 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 applies.

44.1.3 Recovery of amounts after payment of the balance

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

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

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

divided by

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

multiplied by

the final grant amount (see Article 5.3)}.

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

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

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

If no observations are submitted or the 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 concerned a **debit note**. This note will also specify the terms and the date for payment.

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

(a) by **offsetting** it — without the beneficiary's consent — against any amounts owed to the beneficiary concerned by the 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 concerned the debit note on behalf of the Guarantee Fund and recover the amount:

(i) not applicable;

(ii) by **taking legal action** (see Article 57) or by **adopting an enforceable decision** under Article 299 of the Treaty on the Functioning of the EU (TFEU) 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.

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 beneficiaries 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 any of the beneficiaries or third parties involved in the action, as a consequence of implementing the Agreement.

46.2 Liability of the beneficiaries

Except in case of force majeure (see Article 51), the beneficiaries must compensate the 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 technical or financial reports have not been submitted or are not complete or additional information is needed, or

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

47.2 Procedure

The Agency will formally notify the coordinator 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 coordinator may request the Agency if the suspension will continue.

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

ARTICLE 48 — SUSPENSION OF PAYMENTS

48.1 Conditions

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

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

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under the Agreement or during the award procedure

(including improper implementation of the action, submission of false information, failure to provide required information, breach of ethical principles) or

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

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

48.2 Procedure

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

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

If the 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 coordinator or beneficiary concerned.

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

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

ARTICLE 49 — SUSPENSION OF THE ACTION IMPLEMENTATION

49.1 Suspension of the action implementation, by the beneficiaries

49.1.1 Conditions

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

49.1.2 Procedure

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

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

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

Once circumstances allow for implementation to resume, the coordinator 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 Article 50).

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

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

49.2 Suspension of the action implementation, by the Agency

49.2.1 Conditions

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

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

  (i) substantial errors, irregularities or fraud or

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

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

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

49.2.2 Procedure

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

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

If the 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 (or on a later date specified in the notification).

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

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

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

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

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

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

ARTICLE 50 — TERMINATION OF THE AGREEMENT OR OF THE PARTICIPATION OF ONE OR MORE BENEFICIARIES

50.1 Termination of the Agreement, by the beneficiaries

50.1.1 Conditions and procedure

The beneficiaries may terminate the Agreement.

The coordinator must formally notify termination to the 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 coordinator must — within 60 days from when termination takes effect — submit:

(i) a periodic report (for the open reporting period until termination; see Article 20.3) and

(ii) the final report (see Article 20.4).

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

The Agency will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Improper termination may lead to a reduction of the grant (see Article 43).

After termination, the beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

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

50.2.1 Conditions and procedure

The participation of one or more beneficiaries may be terminated by the coordinator, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must formally notify termination to the Agency (see Article 52) and inform the beneficiary concerned.

If the coordinator's participation is terminated without its agreement, the formal notification must be done by another beneficiary (acting on behalf of the other beneficiaries).

The notification must include:

- the reasons why;
- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing);
- the date the termination takes effect. This date must be after the notification, and
- a request for amendment (see Article 55), with a proposal for reallocation of the tasks and the estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination takes effect after the period set out in Article 3, no request for amendment must be included unless the beneficiary concerned is the coordinator. In this case, the request for amendment must propose a new coordinator.

If this information is not given or if the Agency considers that the reasons do not justify termination, the participation will be considered to have been **terminated improperly**.

The termination will **take effect** on the day specified in the notification.

50.2.2 Effects

The coordinator must — within 30 days from when termination takes effect — submit:

(i) a report on the distribution of payments to the beneficiary concerned and

(ii) if termination takes effect during the period set out in Article 3, a '**termination report**' from the

beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Articles 20.3 and 20.4).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the Agency, (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the Agency, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Agency will — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

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

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary in the termination report and approved by the Agency.

Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Agency will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

If the payments received **exceed the amounts due**:

- if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The Agency will formally notify the amount unduly received and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the Agency will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- in all other cases, in particular if termination takes effect after the period set out in Article 3, the Agency will formally notify a **debit note** to the beneficiary concerned. If payment is not

made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due and the Agency will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:

  - termination takes effect after an interim payment and

  - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

  In this case, the Agency will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due. The Agency will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the Agency does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the Agency does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that

- the beneficiary concerned must not repay any amount to the coordinator.

Improper termination may lead to a reduction of the grant (see Article 43) or termination of the Agreement (see Article 50).

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

50.3 Termination of the Agreement or the participation of one or more beneficiaries, by the Agency

50.3.1 Conditions

The Agency may terminate the Agreement or the participation of one or more beneficiaries, if:

(a) one or more beneficiaries do not accede to the Agreement (see Article 56);

(b) a change to their legal, financial, technical, organisational or ownership situation (or those of an entity with a capital or legal link) is likely to substantially affect or delay the implementation of the action or calls into question the decision to award the grant;

(c) following termination of participation for one or more beneficiaries (see above), the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants (see Article 55);

(d) implementation of the action is prevented by force majeure (see Article 51) or suspended by the coordinator (see Article 49.1) and either:

(i) resumption is impossible, or

(ii) the necessary changes to the Agreement would call into question the decision awarding the grant or breach the principle of equal treatment of applicants;

(e) a beneficiary is declared bankrupt, being wound up, having its affairs administered by the courts, has entered into an arrangement with creditors, has suspended business activities, or is subject to any other similar proceedings or procedures under national law;

(f) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has been found guilty of professional misconduct, proven by any means;

(g) a beneficiary does not comply with the applicable national law on taxes and social security;

(h) the action has lost scientific or technological relevance;

(i) not applicable;

(j) not applicable;

(k) a beneficiary (or a natural person who has the power to represent or take decisions on its behalf) has committed fraud, corruption, or is involved in a criminal organisation, money laundering or any other illegal activity;

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

(i) substantial errors, irregularities or fraud or

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

(m) a beneficiary (or 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, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of a partner organisation or 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.

50.3.2 Procedure

Before terminating the Agreement or participation of one or more beneficiaries, the Agency will formally notify the coordinator or beneficiary concerned:

- informing it of its intention to terminate and the reasons why and

- inviting it, within 30 days of receiving notification, to submit observations and — in case of Point (l.ii) above — to inform the 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 coordinator or beneficiary concerned **confirmation** of the termination and the date it will take effect. Otherwise, it will formally notify that the procedure is not continued.

The termination will **take effect**:

- for terminations under Points (b), (c), (e), (g), (h), and (l.ii) above: on the day specified in the notification of the confirmation (see above);

- for terminations under Points (a), (d), (f), (k), (l.i) and (m) above: on the day after the notification of the confirmation is received.

50.3.3 Effects

(a) for **termination of the Agreement**:

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a periodic report (for the last open reporting period until termination; see Article 20.3) and

(ii) a final report (see Article 20.4).

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

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

The Agency will **calculate** the final grant amount (see Article 5.3) and the balance (see Article 21.4) on the basis of the reports submitted. Only costs incurred until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

This does not affect the 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 beneficiaries' obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

(b) for **termination of the participation of one or more beneficiaries**:

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a report on the distribution of payments to the beneficiary concerned;

(ii) a request for amendment (see Article 55), with a proposal for reallocation of the tasks and

estimated budget of the beneficiary concerned (see Annexes 1 and 2) and, if necessary, the addition of one or more new beneficiaries (see Article 56). If termination is notified after the period set out in Article 3, no request for amendment must be submitted unless the beneficiary concerned is the coordinator. In this case the request for amendment must propose a new coordinator, and

(iii) if termination takes effect during the period set out in Article 3, a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work, an overview of the use of resources, the individual financial statement and, if applicable, the certificate on the financial statement (see Article 20).

The information in the termination report must also be included in the periodic report for the next reporting period (see Article 20.3).

If the request for amendment is rejected by the Agency, (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the Agreement may be terminated according to Article 50.3.1(c).

If the request for amendment is accepted by the Agency, the Agreement is **amended** to introduce the necessary changes (see Article 55).

The Agency will — on the basis of the periodic reports, the termination report and the report on the distribution of payments — **calculate** the amount which is due to the beneficiary and if the (pre-financing and interim) payments received by the beneficiary exceed this amount.

The **amount which is due** is calculated in the following steps:

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

The grant amount for the beneficiary is calculated by applying the reimbursement rate(s) to the total eligible costs declared by the beneficiary in the termination report and approved by the Agency.

Only costs incurred by the beneficiary concerned until termination takes effect are eligible (see Article 6). Costs relating to contracts due for execution only after termination are not eligible.

Step 2 — Reduction due to substantial errors, irregularities or fraud or serious breach of obligations

In case of a reduction (see Article 43), the Agency will calculate the reduced grant amount for the beneficiary by deducting the amount of the reduction (calculated in proportion to the seriousness of the errors, irregularities or fraud or breach of obligations, in accordance with Article 43.2) from the grant amount for the beneficiary.

If the payments received **exceed the amounts due**:

- if termination takes effect during the period set out in Article 3 and the request for amendment is accepted, the beneficiary concerned must repay to the coordinator the amount unduly received. The Agency will formally notify the amount unduly received

and request the beneficiary concerned to repay it to the coordinator within 30 days of receiving notification. If it does not repay the coordinator, the Agency will draw upon the Guarantee Fund to pay the coordinator and then notify a **debit note** on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- in all other cases, in particular if termination takes effect after the period set out in Article 3, the Agency will formally notify a **debit note** to the beneficiary concerned. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due and the Agency will notify a debit note on behalf of the Guarantee Fund to the beneficiary concerned (see Article 44);

- if the beneficiary concerned is the former coordinator, it must repay the new coordinator according to the procedure above, unless:

  - termination takes effect after an interim payment and

  - the former coordinator has not distributed amounts received as pre-financing or interim payments (see Article 21.7).

  In this case, the Agency will formally notify a **debit note** to the former coordinator. If payment is not made by the date in the debit note, the Guarantee Fund will pay to the Agency the amount due. The Agency will then pay the new coordinator and notify a debit note on behalf of the Guarantee Fund to the former coordinator (see Article 44).

If the payments received **do not exceed the amounts due**: amounts owed to the beneficiary concerned will be included in the next interim or final payment.

If the Agency does not receive the termination report within the deadline (see above), only costs included in an approved periodic report will be taken into account.

If the Agency does not receive the report on the distribution of payments within the deadline (see above), it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that

- the beneficiary concerned must not repay any amount to the coordinator.

After termination, the concerned beneficiary's obligations (in particular Articles 20, 22, 23, Section 3 of Chapter 4, 36, 37, 38, 40, 42, 43 and 44) continue to apply.

SECTION 4 FORCE MAJEURE

ARTICLE 51 — FORCE MAJEURE

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,

- was unforeseeable, exceptional situation and beyond the parties' control,

- was not due to error or negligence on their part (or on the part of third parties involved in the action), and

- proves to be inevitable in spite of exercising all due diligence.

The following cannot be invoked as force majeure:

- any default of a service, defect in equipment or material or delays in making them available, unless they stem directly from a relevant case of force majeure,
- labour disputes or strikes, or
- financial difficulties.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

The party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

CHAPTER 7 FINAL PROVISIONS

ARTICLE 52 — COMMUNICATION BETWEEN THE PARTIES

52.1 Form and means of communication

Communication under the Agreement (information, requests, submissions, 'formal notifications', etc.) must:

- be made in writing and
- bear the number of the Agreement.

All communication must be made through the Participant Portal **electronic** exchange system and using the forms and templates provided there.

If — after the payment of the balance — the 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, each beneficiary must have designated — before the signature of this Agreement — a 'legal entity appointed representative (LEAR)'. The role and tasks of the LEAR are stipulated in his/her appointment letter (see Participant Portal Terms & Conditions).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Agency and 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 coordinator and beneficiaries 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 beneficiaries** must be sent to their legal address as specified in the Participant Portal Beneficiary Register.

ARTICLE 53 — INTERPRETATION OF THE AGREEMENT

53.1 Precedence of the Terms and Conditions over the Annexes

The provisions in the Terms and Conditions of the Agreement take precedence over its Annexes.

Annex 2 takes precedence over Annex 1.

53.2 Privileges and immunities

Not applicable

ARTICLE 54 — CALCULATION OF PERIODS, DATES AND DEADLINES

In accordance with Regulation No 1182/71[16], periods expressed in days, months or years are calculated from the moment the triggering event occurs.

[16] 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).

The day during which that event occurs is not considered as falling within the period.

ARTICLE 55 — AMENDMENTS TO THE AGREEMENT

55.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

55.2 Procedure

The party requesting an amendment must submit a request for amendment signed in the electronic exchange system (see Article 52).

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3).

If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why;
- the appropriate supporting documents, and
- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The Agency may request additional information.

If the party receiving the request agrees, it must sign the amendment in the electronic exchange system within 45 days of receiving notification (or any additional information the Agency has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date agreed by the parties or, in the absence of such an agreement, on the date on which the amendment enters into force.

ARTICLE 56 — ACCESSION TO THE AGREEMENT

56.1 Accession of the beneficiaries mentioned in the Preamble

The other beneficiaries must accede to the Agreement by signing the Accession Form (see Annex 3) in the electronic exchange system (see Article 52) within 30 days after its entry into force (see Article 58).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 58).

If a beneficiary does not accede to the Agreement within the above deadline, the coordinator must — within 30 days — request an amendment to make any changes necessary to ensure proper implementation of the action. This does not affect the Agency's right to terminate the Agreement (see Article 50).

56.2 Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 55. It must include an Accession Form (see Annex 3) signed by the new beneficiary in the electronic exchange system (see Article 52).

New beneficiaries must assume the rights and obligations under the Agreement with effect from the date of their accession specified in the Accession Form (see Annex 3).

ARTICLE 57 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

57.1 Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

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 beneficiaries 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 coordinator, depending on which is later.

SIGNATURES

For the coordinator

Ceri WILLIAMS with ECAS id nwiliace signed in the Participant Portal on 12/12/2019 at 13:02:53 (transaction id SigId-169028-NPgzIM3bcnU8sYW34b6l3mWJrahk5tJNOlWogis47x62Nb1mOuBeVp024PL6fp4VAilkUgT72lEuWgV5J4oYiO-jpJZscgsw0KqszaRezgPjqG-AcpKT70e2Pi82Nbryu28JzvBkNkBVN1NZMcW3Zt7rWY). Timestamp by third party at Thu Dec 12 13:03:00 CET 2019

For the Agency

Signed by Klaus-Guenther BARTHEL with ECAS id barthkl as an authorised representative on 12-12-2019 15:24:56 (transaction id SigId-174930-dxzPINV7i4Fc7egChsxq5ayh5lzwDLSuctzZXiFHtwCIajtAthzu0k7MVv4WZp8Jcq3POgnEIlkncoTQkVdf4xy-jpJZscgsw0KqszaRezgPjqG-Nmq7ls9w8jKF4E0hUzeybNYzazhTwqe6RgcPrEVNe008) Thu Dec 12 15:24:59 CET 2019

EUROPEAN COMMISSION
Research Executive Agency

Marie Skłodowska-Curie Innovative Training Networks

ANNEX 1 (part A)

European Industrial Doctorates

NUMBER — 859983 — EAGRE

Table of Contents

1.1. The project summary

Project Number [1]	859983	Project Acronym [2]	EAGRE

One form per project

General information	
Project title [3]	Eagre/Aegir: high-seas wave-impact modelling
Starting date [4]	01/01/2020
Duration in months [5]	48
Call (part) identifier [6]	H2020-MSCA-ITN-2019
Topic	MSCA-ITN-2019 Innovative Training Networks
Fixed EC Keywords	Scientific Computing, Numerical analysis, simulation, optimisation, modelling tools, Maritime engineering
Free keywords	Maritime engineering, water waves, rogue waves, wave impact on wind turbines, finite-element modelling

Abstract [7]

The overall objective is to create and deliver computational/mathematical modelling tools for solving problems in maritime engineering, based on advanced mathematical/numerical analysis and efficient implementation and testing in a general finite-element simulation environment offered by Firedrake (Imperial College with Leeds). Our key task is to offer training/research such that a so-called "numerical wavetank" is established by two ESRs for use in maritime-engineering wave basins, such as operational for consulting at the Maritime Research Institute Netherlands (MARIN Academy). Our research will provide the ESRs with a skill set that is highly attractive in the job market to employers engaged in high-end consulting. The integrated objectives are to create: (i) a numerical wavetank “ExtremeWaves” (ESR1) concerning modelling of extreme or rogue waves in wave basins integrated with (ii) a numerical wavetank “WaveTurbineImpact” (ERS2) concerning wave-structure interactions, especially wave-impact, on a dynamic wind-turbine mast. The overall objectives build on our recent and current collaborative work (between U. of Leeds and MARIN Academy) on the modelling of water waves and wave-structure interactions with (dis)continuous Galerkin finite-element methods. The above objectives offer challenging demands, not least because the prediction of wave motion around moving or flexible structures is a difficult computational task as a result of the requirement to track (generally using a sophisticated approximation) the a-priori-unknown nonlinear air-water and water-structure interfaces (and their cross-section, the waterline). Conquering these demands is timely because numerical simulations are cheaper than laboratory tests. Moreover, because in realistically motivated challenges mathematical modelling, laboratory testing and cross-validation via computational simulation are inextricably entwined, we view them all as essential components in our so-called "Research Trinity".

1.2. List of Beneficiaries

Project Number [1]	859983	Project Acronym [2]	EAGRE

List of Beneficiaries

No	Name	Short name	Country	Project entry month[8]	Project exit month
1	UNIVERSITY OF LEEDS	UNIVLEEDS	United Kingdom	1	48
2	MARIN ACADEMY BV	MARINBV	Netherlands	1	48

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	ExtremeWaves: Extreme water-wave computational modeling using advanced geometric methods with wave generation, breaking, and currents.	2 - MARINBV	8	44
WP2	WaveTurbineImpact: water-wave impact on dynamics and flexible (wind-turbine) structures.	1 - UNIVLEEDS	8	44
WP3	Management	1 - UNIVLEEDS	1	48
WP4	Outreach	2 - MARINBV	1	48
WP5	Open Research Data	1 - UNIVLEEDS	1	48

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	Scientific: Reformulation/ reproducing & HPC	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	16
D1.2	Scientific: Benchmarking 1	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D1.3	Scientific: Benchmarking 2	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	20
D1.4	Scientific: Wave breaking 1	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	22
D1.5	Scientific: Mathematical formulation	WP1	1 - UNIVLEEDS	Report	Public	24
D1.6	Scientific: Open access tool 1	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	30
D1.7	Scientific: Validation 1	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D1.8	Scientific: Validation 2	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	43
D1.9	Scientific: Validation 3	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium	43

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
					(including the Commission Services)	
D1.10	Scientific: Numerical formulation	WP1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	44
D1.11	Scientific: Validation 4	WP1	1 - UNIVLEEDS	Report	Public	44
D1.12	Scientific: Various conferences (WP1)	WP1	2 - MARINBV	Other	Public	44
D1.13	Scientific: Dissertations/Vivas in mathematics (WP1)	WP1	1 - UNIVLEEDS	Other	Public	44
D1.14	Training: MSc courses 1&2 (WP1)	WP1	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	13
D1.15	Training: MSc courses 3 (WP1)	WP1	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	16
D1.16	Training: Skill workshops (WP1)	WP1	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	26
D1.17	Training: Hydrodynamics workshop (WP1)	WP1	2 - MARINBV	Other	Public	38
D1.18	Training: Ship hydrodynamics Workshop (WP1)	WP1	2 - MARINBV	Other	Public	38
D1.19	Training: Professional development log (WP1)	WP1	2 - MARINBV	Other	Confidential, only for members of the consortium (including the Commission Services)	44
D1.20	Training: Burgers' Centre courses (WP1)	WP1	2 - MARINBV	Other	Confidential, only for members of the consortium	40

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
					(including the Commission Services)	
D1.21	Training: Dissertations (WP1)	WP1	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	44
D2.1	Scientific: Mathematics	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	16
D2.2	Scientific: Numerics/ Mathematics 1	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	19
D2.3	Scientific: Numerics/ Mathematics 2	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	23
D2.4	Scientific: Wave breaking 2	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	30
D2.5	Scientific: Open Access Tool	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	32
D2.6	Scientific: Validation 5	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D2.7	Scientific: Validation 6	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the	40

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
					Commission Services)	
D2.8	Scientific: Validation 7	WP2	1 - UNIVLEEDS	Report	Public	44
D2.9	Scientific: Numerics/ Mathematics	WP2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	44
D2.10	Training: MSc courses 1&2 (WP2)	WP2	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	16
D2.11	Training: MSc Courses 3 (WP2)	WP2	2 - MARINBV	Other	Public	38
D2.12	Training: Skill workshops (WP2)	WP2	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	26
D3.1	Management: Recruitment (WP3)	WP3	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	9
D3.2	Management: Kick-off meetings	WP3	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	2
D3.3	Management: Team workshop management (WP3)	WP3	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	16
D3.4	Management: Team Workshop (WP3)	WP3	2 - MARINBV	Other	Confidential, only for members of the consortium (including the Commission Services)	40
D3.5	Management: Closing Meeting (WP3)	WP3	2 - MARINBV	Other	Confidential, only for members	44

Deliverable Number[14]	Deliverable Title	WP number[9]	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
					of the consortium (including the Commission Services)	
D3.6	Management: Consortium Agreement	WP3	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	2
D3.7	Management: Supervisory Board	WP3	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	2
D3.8	Management: Team workshop management 2 (WP3)	WP3	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	20
D3.9	Management: Mid-term Progress report & preparation (WP3)	WP3	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	13
D4.1	Outreach: Launch public media pages	WP4	1 - UNIVLEEDS	Other	Public	9
D4.2	Outreach: Event 1	WP4	1 - UNIVLEEDS	Other	Public	20
D4.3	Outreach: Event 2	WP4	1 - UNIVLEEDS	Other	Public	32
D4.4	Outreach: Event 3	WP4	1 - UNIVLEEDS	Other	Public	44
D5.1	Management: Data Management Plan (WP5)	WP5	1 - UNIVLEEDS	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]	2 - MARINBV
Work package title	ExtremeWaves: Extreme water-wave computational modeling using advanced geometric methods with wave generation, breaking, and currents.		
Start month	8	**End month**	44

Objectives

For WP1 "ExtremeWave", the proposal offers the following innovations.

WP1.1 Create a complete numerical finite-element wavetank for high-amplitude potential-flow water waves. The state-of-the-art concerns direct numerical solvers of potential-flow dynamics in 2D and 3D simulations, based on compatible discretizations, with a piston wave-maker (Gagarina et al. 2014, Gidel 2018) or wave-breaking parameterizations (Papoutsellis and Athanassoulis 2017, 2018) or wave-beach interactions in 2D (Gidel et al. 2019). Building upon these results, the innovation consists of combining all these elements in a 3D Firedrake solver. Furthermore, exploration of coordinate transformations and dynamic mesh motion, first in 2D, will be original and will greatly enhance the performance robustness and scope of the methodology available for investigating water-wave problems born of a variety of applications.to be investigated.
WP1.2 Develop and deliver a series of (novel) benchmark cases. Benchmarking using the two- and three three-soliton splashes will be original. The innovation in exploring irregular waves, random waves and short-crested waves lies in its use for testing scale models and the robustness of the potential potential-flow solvers. This step can be done with existing solvers, as well as the improved ones (cf. WP1.1); it is a crucial step to facilitate widespread use of our methodology/ tools.
WP1.3. Derive the mathematical and variational/Hamiltonian formulation of wave-current interactions. Extending classical work on geometric structures for water-wave equations (Luke 1967; Miles 1977; Cotter and Bokhove 2010; Gagarina et al. 2013) to wave-current interactions will be a valid doctoral- training step and introduction to the topic for the ESR, yet it will also contain innovative new elements, i.e. the extension to the wave-current flows.
WP1.4. Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool. This delivery will focus on innovative computer- science elements and make the tool more robust and operational, e.g. in Leeds and at MARINBV. Testing and improving the tool's robustness is an important and practical innovation, because its subsequent usage feeds directly into the design and testing of maritime-engineering hardware.
WP1.5. Validation of our 3D numerical potential-flow water-wave-tank against existing and/or new measurements at MARINBV will be a challenging and novel endeavor. New measurements will tentatively include measurements those that can be used to assess the damping/dynamics of the waves at the a beach.
WP1.6. Similarly, as in WP1.5, , validation of our 2D numerical potential-flow water-wave-current tank against existing and/or new measurements at MARIN will provide novel insights into testing maritime structures in waves and currents.
WP1.7. Explore compatible/variational numerical formulations of wave-current interactions. These space-time finite-element discretizations based on the geometric wave-current models of WP1.3 will be entirely novel (optional).

Description of work and role of partners

WP1 - ExtremeWaves: Extreme water-wave computational modeling using advanced geometric methods with wave generation, breaking, and currents. [Months: 8-44]
MARINBV
Research: Both UoL and MARINBV will contribute evenly to WP1. UoL will lead WP1.1 (subject to MARINBV's high-power-computing HPC demands), WP1.3 (mathematical focus at UoL), WP1.7 (wave-current numerics requires MARIN current-generation settings); MARINBV will lead WP1.2 (setting of benchmark tests for MARINBV's wave basins), WP1.5 (measurements at MARINBV with simulations from UoL) and WP1.6 (measurements at MARINBV). The open-access tool WP1.4 requires will require UoL/MARIN's equal input.

Training: 3 courses from MSc programme at UoL, various professional development workshops; two maritime maritime-engineering workshops at MARIN; upkeep of reflective professional development module/log throughout, cf. such a module at the Centre for Doctoral Training in Leeds.

Management: regular scheduled formal meetings, see Milestone list in Table 3.1c. Oversight via supervisory committee. ESR1 18 months at UoL and then 18 months at MARIN.

Communication and Dissemination: two bespoke activities per year involving will aim to involve local schools, science fairs, bespoke wave tank related to research; continued upkeep of social media.

Participation per Partner

Partner number and short name [10]
1 - UNIVLEEDS
2 - MARINBV

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D1.1	Scientific: Reformulation/ reproducing & HPC	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	16
D1.2	Scientific: Benchmarking 1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	18
D1.3	Scientific: Benchmarking 2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	20
D1.4	Scientific: Wave breaking 1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	22
D1.5	Scientific: Mathematical formulation	1 - UNIVLEEDS	Report	Public	24
D1.6	Scientific: Open access tool 1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	30
D1.7	Scientific: Validation 1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D1.8	Scientific: Validation 2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including	43

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
				the Commission Services)	
D1.9	Scientific: Validation 3	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	43
D1.10	Scientific: Numerical formulation	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	44
D1.11	Scientific: Validation 4	1 - UNIVLEEDS	Report	Public	44
D1.12	Scientific: Various conferences (WP1)	2 - MARINBV	Other	Public	44
D1.13	Scientific: Dissertations/ Vivas in mathematics (WP1)	1 - UNIVLEEDS	Other	Public	44
D1.14	Training: MSc courses 1&2 (WP1)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	13
D1.15	Training: MSc courses 3 (WP1)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	16
D1.16	Training: Skill workshops (WP1)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	26
D1.17	Training: Hydrodynamics workshop (WP1)	2 - MARINBV	Other	Public	38
D1.18	Training: Ship hydrodynamics Workshop (WP1)	2 - MARINBV	Other	Public	38
D1.19	Training: Professional development log (WP1)	2 - MARINBV	Other	Confidential, only for members of the consortium (including the Commission Services)	44
D1.20	Training: Burgers' Centre courses (WP1)	2 - MARINBV	Other	Confidential, only for members of the consortium (including	40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
				the Commission Services)	
D1.21	Training: Dissertations (WP1)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	44

Description of deliverables

Deliverables D1-D3 (report [updates] in months 8,10,12,14) concern a step-by-step division of WP1.1, the creation of the numerical wave tank, as well as the benchmark testing of WP1.2, culminating in WP1.4-D6 with a draft paper B (month ~18). Report II on the theoretical formulation and training in classical works yields deliverable D5 and draft note A (month 16). Focus on the 3D validation, split into experiment WP1.5 and simulations of experimental data WP1.6 are found in deliverables D8 and D9 (months ~24 and ~32) with the final wave-current experiments (WP2.6) undertaken at the end (month ~35).

D1.1 : Scientific: Reformulation/ reproducing & HPC [16]

Row in original table (month count starts at month 9): "D1; Reformulation/reproducing & HPC; WP1.1; UoL (ESR1); Maths/Simulation; Interim Report I; 8" Added: Interim Report Type: Maths/Simulation Scientific deliverable Explanation: D = scientific deliverable DT = training deliverable DD = outreach deliverable DM = management deliverable

D1.2 : Scientific: Benchmarking 1 [18]

Row in original table (month count starts at month 9): "D2; Benchmarking; WP1.2; UoL (ESR1); Waves; Update Report I; 10" Added: Update Report I on WP1 per the above. Type: Waves Scientific deliverable

D1.3 : Scientific: Benchmarking 2 [20]

Row in original table (month count starts at month 9): "D3' Benchmarking; WP1.2; UoL (ESR1); 3-soliton; Update Report I; 12" Added: Update Report I on WP1.2 per the above. Type: 3-soliton Scientific deliverable

D1.4 : Scientific: Wave breaking 1 [22]

Row in original table (month count starts at month 9): "D4; Wave breaking; WP1.1; UoL (ESR1); Maths/Simulation; Update Report I; 14" Added: Update Report I on WP1.1 per the above. Type: Maths/Simulation Scientific deliverable

D1.5 : Scientific: Mathematical formulation [24]

Row in original table (month count starts at month 9): "D5; Mathematical formulation; WP1.3; UoL (ESR1); Maths Report II/note draft A; 16" Added: Report II/note draft A on WP1.3 per the above. Type: Maths Scientific deliverable

D1.6 : Scientific: Open access tool 1 [30]

Row in original table (month count starts at month 9): "D6; Open access tool; WP1.4/WP1.1; UoL (ESR1); Simulation/HPC; Report I/ paper draft B 18, <22- TBA" Added: Report I/ paper draft B on WP1.1/WP1.4 per the above. Type: Simulation/HPC Scientific deliverable

D1.7 : Scientific: Validation 1 [36]

Row in original table (month count starts at month 9): "D7; Validation; WP1.5; UoL (ESR1); experiment; Interim report III; 24, <28 TBA" Added: Experiment - Interim report III on WP1.5 per the above. Type: Experiment Scientific deliverable

D1.8 : Scientific: Validation 2 [43]

Row in original table (month count starts at month 9): "D8; Validation; WP1.5; UoL (ESR1); Simulation; Report III; 32, <35 TBA" Added: Report III on WP1.5 per the above. Type: Simulation Scientific deliverable

D1.9 : Scientific: Validation 3 [43]

Row in original table (month count starts at month 9): "D9; Validation WP1.6; UoL; (ESR1); Experiment; Interim report IV; 35 TBA" Added: Interim report IV on WP1.6 per the above. Type: Experiment Scientific deliverable

D1.10 : Scientific: Numerical formulation [44]

Row in original table (month count starts at month 9): "D10; Numerical formulation; WP1.7; UoL (ESR1); Simulation; Interim report V; 36 TBA (optional)" Added: Interim report V on WP1.7 per the above. Type: Simulation Scientific deliverable

D1.11 : Scientific: Validation 4 [44]

Row in original table (month count starts at month 9): "D11; Validation; WP1.5; UoL (ESR1); Writing; Paper draft C; 32-36" Added: Paper draft C on WP1.5 per the above. Type: Writing Scientific deliverable

D1.12 : Scientific: Various conferences (WP1) [44]

Row in original table (month count starts at month 9): "D21; Various conferences; WP1 & WP2; MARIN (ESR1 & ESR2); Presentation; Presentations 12-36" Added: Note that this deliverables holds for both ESR1 and ESR1 so for WP1 and WP2 per the original proposal. Presentations Type: Presentations external Scientific deliverable

D1.13 : Scientific: Dissertations/Vivas in mathematics (WP1) [44]

Row in original table (month count starts at month 9): "D22; Dissertations in mathematics; WP1 & WP2 UoL (ESR1 & ESR2); PhD vivas; PhD vivas 36-48" Added: Note that this concerns both WP1 and WP2 as per the original proposal. PhD Thesis submission can take place between 44-56 months since the formal UoL deadline for thesis submission is four years. Scientific deliverable

D1.14 : Training: MSc courses 1&2 (WP1) [13]

Row in original table (month count starts at month 9): "DT1; MSc courses 1&2; WP1; UoL (ESR1); Exam; Exam results; 5" Added: Exam Results Type: Exam Training deliverable.

D1.15 : Training: MSc courses 3 (WP1) [16]

Row in original table (month count starts at month 9): "DT3; MSc courses 3; WP1 UoL (ESR1); Exam; Exam results; 8" Added: Exam Results Type: Exam Training deliverable

D1.16 : Training: Skill workshops (WP1) [26]

Row in original table (month count starts at month 9): "DT5; Skill workshops; WP1; UoL (ESR1); Workshops; Attendance/log;1-18" Added: Attendance/log Type: Workshops Training deliverable

D1.17 : Training: Hydrodynamics workshop (WP1) [38]

Row in original table (month count starts at month 9): "DT7; Hydrodynamics workshop; WP1&2; MARIN (ESR1&2); Workshop; MARIN Certificate; 19-30 " Added: Note: for both WP1 and WP2/ESRs. MARIN Certificate Type: Workshop Training deliverable

D1.18 : Training: Ship hydrodynamics Workshop (WP1) [38]

Row in original table (month count starts at month 9): "DT8; Ship hydrodyn.; Workshop; WP1&2; MARIN (ESR1&2); Workshop; MARIN Certificate;19-30 " Added: Note: for both WP1 and WP2/ESRs. MARIN Certificate Type: Workshop Training deliverable

D1.19 : Training: Professional development log (WP1) [44]

Row in original table (month count starts at month 9): "DT9; Professional development log; WP1&2; MARIN (ESR1&2); biweekly log Reflection/2028feedback; 1-36" Added: Note: for both WP1 and WP2/ESRs. Reflection/ feedback Type: Biweekly log Training deliverable

D1.20 : Training: Burgers' Centre courses (WP1) [40]

Row in original table (month count starts at month 9): "DT10; Burgers' Centre courses; WP1&2; MARIN (ESR1&2) Workshop; Attendance/log; 19-32; (optional) " Added: Note for both ERSs Attandance/log Type: Workshop Training deliverable

D1.21 : Training: Dissertations (WP1) [44]

Row in original table (month count starts at month 9): "DT11; Dissertations; WP1&2; UoL (ESR1&2); Vivas; Vivas; 36-48" Added; Note for both WP1 and WP2 for both ESRs. Vivas can take place between 44-56 months since the formal UoL deadline for thesis submission is four years. Theses are put online by UoL well after successful vivas. Training deliverable

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS6	Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool Report I ESR1 for D3-D4, finalised.	1 - UNIVLEEDS	22	The report will be submitted to the EU; however, the interim report also forms the basis (its content) for the mid-term review report; as such its content can be assessed. As stated in the original proposals, it pertains to WP1.1-1.2, WP1.4 and D3-D4, D6= make open access tool. Report I by ESR is on and finalisation of WP1.2 i.e. "Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool. "
MS7	Derive the mathematical and variational/Hamiltonian formulation of wave-current interactions Report II ESR1 for D5, finalised.	1 - UNIVLEEDS	24	Mid-term rev./submitted to EU The report will be submitted to the EU; however, the interim report also forms the basis (its content) for the mid-term review report; as such its content can be assessed. As stated in the original proposal it pertains to WP1.3 and D5, being finalisation of WP1.3 "Derive the mathematical and variational/Hamiltonian formulation of wave-current interactions".
MS9	Submission of Paper A/B ESR1 finalised	1 - UNIVLEEDS	30	ArXiv (put draft papers A/B for ESR1 in open archives) before we submit. This is a milestone because submitting papers is a milestone in the career of any ESR. The final papers are build on the reports I and II. The step from report to paper for submission is a significant one.
MS10	Validate the open-access numerical water-wave tank against (new) wave basin measurements in 3D at MARIN BV Report III ESR1 for D8, finalised.	2 - MARINBV	40	This is the preparation phase for any periodic reports which will go online (www/EU). Report is on and finalisation of WP1.5 "Validate the open-access numerical water-wave tank against (new) wave basin measurements in 3D at MARIN BV."

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS11	Explore basin measurements at MARIN BV with currents, in 2D (optional); compare with open-access numerical wave-current tank against (new) waveReport IV ESR1 for D9, finalised.	1 - UNIVLEEDS	44	This work pertains to WP1.6 and D9 and will likely become a chapter of the PhD thesis and the final EU report. Report IV for ESR1 is on (not a finalisation but an exploration of) WP1.6 "Explore basin measurements at MARIN BV with currents, in 2D (optional); compare with open-access numerical wave-current tank against (new) wave". Tentative.
MS17	Dissertations submitted	1 - UNIVLEEDS	48	PhD vivas are happening and after approval of the thesis, theses are put online as PDFs at UoL site. Submission of PhD theses at UoL is between 44 - 56 months.

Work package number [9]	WP2	Lead beneficiary [10]	1 - UNIVLEEDS
Work package title	WaveTurbineImpact: water-wave impact on dynamics and flexible (wind-turbine) structures.		
Start month	8	End month	44

Objectives

For WP2 "WaveTurbineImpact", the proposal offers the following innovations.
WP2.1. Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam. Extending Salwa's preliminary results (Salwa 2019) with a full and concise derivation of the nonlinear equations of motion, as well as incorporating our new asymptotic two-way coupling based on one monolithic variational principle, constitutes be a novel and innovative step forwards, one that allows our approach to solve the problem in not only a mathematically consistent and justified manner, but also one in which the new asymptotics offer a means of incorporating implicitly prescribed boundary conditions to a controllable (and high) degree of accuracy, thus enhancing computational efficiency and speed.
WP2.2 While piston wave-makers have now been successfully included in theoretical and numerical variational principles for water waves, the mathematical and computational counterpart inclusion of a (more realistic and relevant to deep-water maritime engineering) waveflap into the mathematical and computational counterparts is a new challenge. MARIN's most prominent wave basins have waveflaps on two basin sides to create focussed waves. Both the coordinate transforms and the mesh motion integrated in the VP will be explored and developed (cf. Bokhove 2019).
WP2.3 Development of a compatible finite-element discretization of the coupled wave-structure system using a monolithic VP is an innovation with immediate application for testing wave impact on wind-turbine masts. The iterative asymptotic approach of WP2.1 will be integrated within the numerical approach to obtain faster numerical computations. Integrating mesh motion within the overall VP using distinctive equations for mesh motion will be completely entirely novel.
WP2.4 The inclusion of wave breaking parameterizations into our numerical wave-structure modeling will complete our numerical tool for elaborate and novel testing against experimental measurements of wave impact on wind-turbine masts.
WP2.5 Open-access, fast and easy-to-use water-wave-structure simulation and scientific-computation tool. Establishing and completing the numerical tool in WP2.4 with benchmark tests will complete our main innovative approach on wave-impact modeling using compatible numerical techniques.
WP2.6 The validation of our new monolithic geometric water-wave-beam model is novel since such a model has to date never been validated.
WP2.7 Variational formulation of mixture theory water-wave model in the Eulerian framework. Through this project we will be the first to work on geometric and metricplectic formulation of mixture-theoretic air-water models coupled to hyperelastic beams. Our variational modelingo approach of water-air wave dynamics based on a compressible Van-der-Waals-fluid (cf. Salwa 2019) is novel and requires some ingenuity in the time-stepping schemes to smooth out acoustic wrinkles (e.g. by offsetting mid-point integrators towards backward Euler schemes). It has the potential to lead to a fast and straightforward method for wave-structure interactions by breaking waves; but the research naturally contains some risk, even though a classical non-variational approach has shown proved to be fruitful yet quite dissipative (cf. Golay et al. 2015) without costly mesh refinements. We seek to combine the best of both variational and classical worlds in order to create a robust method for wave propagation with minimal spurious damping (NB optional work; when successful it allows a more direct (than hitherto devised) way to consider wave-impact on wind-turbine structures).

Description of work and role of partners

WP2 - WaveTurbineImpact: water-wave impact on dynamics and flexible (wind-turbine) structures. [Months: 8-44]
UNIVLEEDS
Research: Both UoL and MARINBV will contribute evenly to WP2. UoL will lead on WP2.1 (mathematical theory), WP2.2 (numerical method for waveflap with settings from MARINBV), WP2.3 (numerical method) and WP2.7 (novel pseudo-compressible multiphase mathematical and numerical modelling); MARIN will lead WP2.5 (open open-access benchmarking requirements by MARIN) and WP2.6 (measurements at MARINBV with simulations from UoL), WP2.4 relies will rely evenly on contributions from both organisations regarding the wave-breaking parameterizations.
Training: 3 courses from MSc program at UoL, various professional development workshops; two maritime-engineering workshops at MARINBV; upkeep of reflective professional development module/log throughout, cf. such a module at the Centre for Doctoral Training in Leeds.

Management: regular scheduled formal meetings, see Milestone list in Table 3.1c. Oversight via supervisory committee. ESR2 18 months at UoL and then 18 months at MARINBV.
Communication and Dissemination: two bespoke activities per year involving school, science fairs, bespoke wave tank related to research; continued upkeep of social media.

Participation per Partner

Partner number and short name [10]
1 - UNIVLEEDS
2 - MARINBV

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D2.1	Scientific: Mathematics	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	16
D2.2	Scientific: Numerics/ Mathematics 1	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	19
D2.3	Scientific: Numerics/ Mathematics 2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	23
D2.4	Scientific: Wave breaking 2	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	30
D2.5	Scientific: Open Access Tool	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	32
D2.6	Scientific: Validation 5	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	36
D2.7	Scientific: Validation 6	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including	40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
				the Commission Services)	
D2.8	Scientific: Validation 7	1 - UNIVLEEDS	Report	Public	44
D2.9	Scientific: Numerics/ Mathematics	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	44
D2.10	Training: MSc courses 1&2 (WP2)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	16
D2.11	Training: MSc Courses 3 (WP2)	2 - MARINBV	Other	Public	38
D2.12	Training: Skill workshops (WP2)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	26

Description of deliverables

The first report and draft A on the theoretical foundation on WP2.1 is deliverable D12 (month 8) and builds on Salwa (2019) and existing unpublished notes of the UoL-advisors. The numerical discretisation thereof is split into two tasks (W2.2 and WP2.3) because this is quite challenging), for D13 and D14 (months 11 and 15). Risk mitigation can be a reduction to 2D at first or, as an alternative, via a relaying to WP2.7, currently optional, and also partially worked out in Salwa (2019), with further discussion ongoing between the UoL advisors and Firedrake. The wave wave-breaking addition is found in WP2.4 and the Report III for D15 (month 19). A draft paper B based on reports II and III is set as D16 (month 24). The validation is split into experiments (WP2.5) and simulations (WP2.6) as D18 and D19 (months 28 and 32). See Table 3.1b.

D2.1 : Scientific: Mathematics [16]

Row in original table (month count starts at month 9): "D12; Mathematics; WP2.1; UoL (ESR2); Maths; Report I/ draft2028note A; 8" Added: Report I/draft2028 note A on WP2.1 per the above. Type: Maths Scientific deliverable

D2.2 : Scientific: Numerics/ Mathematics 1 [19]

Row in original table (month count starts at month 9): "D13 Numerics/ Mathematics; WP2.2; UoL (ESR2); Mathsl Interim report II; 11" Added: Interim report II on WP2.2 per the above. Scientific deliverable

D2.3 : Scientific: Numerics/ Mathematics 2 [23]

Row in original table (month count starts at month 9): "D14; Numerics/Mathematics; WP2.3; UoL (ESR2); Simulation; Report II update; 15" Added: Report II update on WP2.3 per the above. Type: Simulation Scientific deliverable

D2.4 : Scientific: Wave breaking 2 [30]

Row in original table (month count starts at month 9): "D15; Wave breaking; WP2.4; UoL (ESR2 & ESR1); Maths/ Simulation; Interim report III; 19,<22" Added: Interim report III on WP2.4 per the above. Type: Maths/Simulation Scientific deliverable

D2.5 : Scientific: Open Access Tool [32]

Row in original table (month count starts at month 9): "D16; Open access tool; WP2.5/WP2.3; UoL (ESR2); Maths/ Simulation; Reports II/III, draft paper B; 24" Added: Reports II/III, draft paper B on WP2.5/WP2.3 per the above. Type: Maths/Simulation Scientific deliverable

D2.6 : Scientific: Validation 5 [36]

Row in original table (month count starts at month 9): "D17; Validation; WP2.6; UoL (ESR2); Experiment; Interim report III; 28" Added: Interim report III on WP2.6 per the above. Type: Experiment Scientific deliverable

D2.7 : Scientific: Validation 6 [40]

Row in original table (month count starts at month 9): "D18; Validation; WP2.6; UoL (ESR2); Simulation; Report III; 32" Added: Report III on WP2.6 per the above. Type: Simulation Scientific deliverable

D2.8 : Scientific: Validation 7 [44]

Row in original table (month count starts at month 9): "D19; Validation; WP2.6; UoL (ESR2); Writing; Paper draft C; 32-36" Added: Paper draft C on WP2.6 per the above. Type: Writing Scientific deliverable

D2.9 : Scientific: Numerics/Mathematics [44]

Row in original table (month count starts at month 9): "D20; Numerics/Mathematics; WP2.7; UoL (ESR2); Maths/ Simulation; Interim report IV; 32-36; (optional)" Added: Interim Report IV on WP2.7 per the above. Note that WP2.7 may be modified, see the Annex. Type: Maths/Simulation Scientific deliverable

D2.10 : Training: MSc courses 1&2 (WP2) [16]

Row in original table (month count starts at month 9): "DT2; MSc courses 1&2; WP2; UoL (ESR2); Exam; Exam results; 5" Added: Exam Results Type: Exam Training deliverable

D2.11 : Training: MSc Courses 3 (WP2) [38]

Row in original table (month count starts at month 9): "DT4; MSc courses 3; WP2; UoL (ESR2); Exam; Exam results; 8" Added: MARIN Certificate Type: Workshop Training deliverable

D2.12 : Training: Skill workshops (WP2) [26]

Row in original table (month count starts at month 9): "DT6; Skill workshops; WP2; UoL (ESR2); Workshops; Attendance/log; 1-18" Added: Attendance/log Type: Workshops Training deliverable

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS12	Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam Report I ESR2, finalised.	1 - UNIVLEEDS	18	Preparatory report that forms the basis of the periodic reports to be submitted to the EU, which will also form the content basis for the mid-term review, as such this is verifiable and pertains to (the finalisation of) WP2.1. "Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam."
MS13	Derive compatible numerical discretization of potential-flow water-wave motion and nonlinear hyperelastic beam (or waveflap) motion in 2D, using asymptotic/full two-way coupling Report II ESR2, finalised.	1 - UNIVLEEDS	22	Preparatory report that forms the basis of the periodic reports for to be submitted to the EU, which will also form the content basis for the mid-term review, as such this is verifiable and pertains to WP2.3. Report II for ESR2 is on and the

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				finalisation of WP2.3 "Derive compatible numerical discretization of potential-flow water-wave motion and nonlinear hyperelastic beam (or waveflap) motion in 2D, using asymptotic/full two-way coupling.".
MS14	Submisison of Papers A/B ESR2 finalised	1 - UNIVLEEDS	36	Archiving of Papers A/B for ESR2 before submission to scientific journal. The step of making reports (I and II for ESR2) into papers for submission is a significant one and as such a milestone.
MS15	Validate the wave-structure numerical tool against experimental measurements of wave-impact on elastic beams Report III ESR2, finalised.	2 - MARINBV	40	Pertaining to work for WP2.6, a report number III; also forming the basis or periodic/final reports for the EU, pertaining to saying "Online (www/EU)". Report III for ESR2 is on and the finalisation of WP2.6 "Validate the wave-structure numerical tool against experimental measurements of wave-impact on elastic beams.".
MS17	Dissertations submitted	1 - UNIVLEEDS	48	PhD vivas are happening and after approval of the thesis, theses are put online as PDFs at UoL site. Submission of PhD theses at UoL is between 44 - 56 months.

Work package number [9]	WP3	Lead beneficiary [10]	1 - UNIVLEEDS
Work package title	Management		
Start month	1	End month	48

Objectives

Run the project efficiently

Description of work and role of partners

WP3 - Management [Months: 1-48]
UNIVLEEDS
Meetings: organize interim meetings, mid-term and final meetings; take and disseminate minutes; at MARIN: by MARIN/UoL; at UoL: by UoL.
Reports: accept and deliver reports, UoL.
Web-activities: organize and maintain web-pages and such, UoL.
Risk mitigation and overview: inform and activate supervisory board (UoL/All); adjust the research plans according to new insights (UoL & MARIN).
Budget: set, maintain and manage the budget (UoL with MARIN).

Participation per Partner

Partner number and short name [10]
1 - UNIVLEEDS
2 - MARINBV

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D3.1	Management: Recruitment (WP3)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	9
D3.2	Management: Kick-off meetings	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	2
D3.3	Management: Team workshop management (WP3)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	16
D3.4	Management: Team Workshop (WP3)	2 - MARINBV	Other	Confidential, only for members of the consortium (including	40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
				the Commission Services)	
D3.5	Management: Closing Meeting (WP3)	2 - MARINBV	Other	Confidential, only for members of the consortium (including the Commission Services)	44
D3.6	Management: Consortium Agreement	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	2
D3.7	Management: Supervisory Board	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	2
D3.8	Management: Team workshop management 2 (WP3)	1 - UNIVLEEDS	Other	Confidential, only for members of the consortium (including the Commission Services)	20
D3.9	Management: Mid-term Progress report & preparation (WP3)	1 - UNIVLEEDS	Report	Confidential, only for members of the consortium (including the Commission Services)	13

Description of deliverables

Meetings: Kick-off meeting and final meeting at MARIN; mid-term at UoL; interim meetings at MARIN.
Factual delivery of reports: take care interim reports, mid-term report and final report are delivered.
Delivery of theses: Regular GRAD-updates and organize (UoL), run professional module (UoL & MARIN)
Risk mitigation and overview: information/reports for supervisory boards (UoL); approve and report research-plan adjustments (UoL & MARIN).
Budget: budget overviews to partners and EU (UoL).

D3.1 : Management: Recruitment (WP3) [9]

Row in original table (month count starts at month 9): "DM1; Recruitment; WP3; UoL (ESR1&2); Interviews; Hiring ESRs; 0" Added: Note this is for both ESRs Hiring ESRs - Interviews Type: Admin Management deliverable

D3.2 : Management: Kick-off meetings [2]

Row in original table (month count starts at month 9): "DM2; Kick-off meeting; WP3; UoL (All); Meeting; Minutes; 0" Added: There will be two kick-off meetings one in months 1 and one in month 9 (with all ESRs and advisors). Minutes of Meeting; minutes are necessary for every meeting to check that the meeting took place and to establish the necessary action points, whether these action points require further actions and/or are completed. Type: Admin Preliminary meeting in month 1-2 without the ESRs with as goals: - check that supervisory board is in place or established within a few months. - check/confirm that consortium agreement is in place. Management deliverable

D3.3 : Management: Team workshop management (WP3) [16]

Row in original table (month count starts at month 9): "DM3; Team workshop 8management; WP1/2/3/4; UoL (All); Meeting; Minutes; 8" Added: Note for all involved (ESRs and advisors). Minutes; see remark made on minutes before. Type: Meeting Mangement deliverable

D3.4 : Management: Team Workshop (WP3) [40]

Row in original table (month count starts at month 9): "DM6; Team workshop; WP1/2/3/4; MARIN (All); Meeting; Minutes;19, 24, 32" Added: Note: for all involved (ESRs and advisors) Minutes (see earlier comment on minutes) Type: Meeting Management deliverable

D3.5 : Management: Closing Meeting (WP3) [44]

Row in original table (month count starts at month 9): "DM7; Closing meeting; WP1/2/3/4; MARIN (All); Meeting; Minutes; 36-42 " Added: All involved. Minutes Type: Meeting Management deliverable in week 44-48

D3.6 : Management: Consortium Agreement [2]

Added: New deliverable. A Consortium Agreement will be created and signed by all the parties. Management deliverable

D3.7 : Management: Supervisory Board [2]

Added: New deliverable. Document establishing the supervisory board and defining the way of working Management deliverable

D3.8 : Management: Team workshop management 2 (WP3) [20]

Row in original table (month count starts at month 9): "DM4; Team workshop; management; WP1/2/3/4; UoL (All); Meeting; Minutes; 12 " Added: Note for all involved (ESRs and advisors). Minutes Type: Meeting Management deliverable

D3.9 : Management: Mid-term Progress report & preparation (WP3) [13]

Row in original table (month count starts at month 9): "DM5; Mid-term review; WP1/2/3/4; UoL (All/EU); Meeting; Mid-term report; 18" Added: Progress Report submitted to the REA covering the first year of implementation of the project. Including preparation for mid-term report. Note: for all involved. Preparation for progress Report submitted to the REA covering the first year of implementation of the project. This preparation is a significant team effort which needs to be highlighted as such. Management deliverable

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS1	Recruitment finalised	1 - UNIVLEEDS	8	Recruitment completed.
MS2	Kick-off meeting completed	1 - UNIVLEEDS	9	Minutes of meeting with action points so our actions are assessable. Preliminary meeting in month 1/2. Kick-off team workshop/meeting at MARIN or Leeds) where (nearly) all supervisors and ESRs meet face-to-face, which makes these milestones. There will be circa 4 to 6 of these meetings including kick-off meeting and closing meeting. Since we are all together, a little extra work is put in to present work up to date, which makes them special and as such milestones.

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				Dissemination and a way to check what happened: minutes with action points etc., and potentially pdfs of presentations given, per efficient format of meetings as we use them in Leeds and The Netherlands.
MS3	6-month assessment completed	1 - UNIVLEEDS	14	Confirmation in UoL's GRAD (the UoL system to follow progress of PhDs). Completed.
MS4	Team workshop completed	1 - UNIVLEEDS	16	Team workshop at MARIN or Leeds) where (nearly) all supervisors and ESRs meet face-to-face, which makes these milestones. There will be circa 4 to 6 of these meetings including kick-off meeting and closing meeting. Since we are all together, a little extra work is put in to present work up to date, which makes them special and as such milestones. Dissemination and a way to check what happened: minutes with action points etc., and potentially pdfs of presentations given, per efficient format of meetings as we use them in Leeds and The Netherlands.
MS5	12-month assessment completed	1 - UNIVLEEDS	20	Confirmation in UoL's GRAD (the UoL system to follow progress of PhDs).
MS8	Mid-term check completed	1 - UNIVLEEDS	15	Project mid-term check/ preparations at month 13-15. The significance of this milestone is that it draws on a team effort with the entire team pulling together to make the (draft) report.
MS18	Team workshops completed	2 - MARINBV	40	Team workshop at MARIN or Leeds) where (nearly) all supervisors and ESRs meet face-to-face, which makes these milestones. There will be circa 4 to 6 of these meetings including kick-off

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
				meeting and closing meeting. Since we are all together, a little extra work is put in to present work up to date, which makes them special and as such milestones. Dissemination and a way to check what happened: minutes with action points etc., and potentially pdfs of presentations given, per efficient format of meetings as we use them in Leeds and The Netherlands. Minutes of meetings can be requested and can/will be made part of the data management plan. Month 40 is indicative given that there are few team workshops.
MS19	Enrolment in PhD programme completed	1 - UNIVLEEDS	12	All recruited fellows (ESR1 and ESR2) enrolled in PhD programme. Newly added milestone.

Work package number [9]	WP4	Lead beneficiary [10]	2 - MARINBV
Work package title	Outreach		
Start month	1	End month	48

Objectives

Disseminate the scientific research to the public

Description of work and role of partners

WP4 - Outreach [Months: 1-48]
MARINBV
Web-activities: organize outreach aspects of web-activities (Facebook/WordPress Blog/YouTube movies).
Organise and manage outreach activities (e.g., six in total), partake in identified series of activities.

Participation per Partner

Partner number and short name [10]
1 - UNIVLEEDS
2 - MARINBV

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D4.1	Outreach: Launch public media pages	1 - UNIVLEEDS	Other	Public	9
D4.2	Outreach: Event 1	1 - UNIVLEEDS	Other	Public	20
D4.3	Outreach: Event 2	1 - UNIVLEEDS	Other	Public	32
D4.4	Outreach: Event 3	1 - UNIVLEEDS	Other	Public	44

Description of deliverables

Web-activities: deliver outreach dissemination of outreach on web.
Reports: outreach chapter/section in theses.

D4.1 : Outreach: Launch public media pages [9]

Row in original table (month count starts at month 9): "DD1; Launch public media pages; WP4; UoL; Media; Media online; 1" Added: Media Online Type: Media Project main web page will be established in month 1/2. Outreach deliverable

D4.2 : Outreach: Event 1 [20]

Row in original table (month count starts at month 9): "DD2; Outreach events; WP4; UoL (ESRs); Public Presentation; Report online media ; Twice in 1-12" Added: Both ESRs involved. Report online media Type: Presentation Twice in 1-12 Outreach deliverable

D4.3 : Outreach: Event 2 [32]

Row in original table (month count starts at month 9): "DD3 Outreach event WP4 UoL (ESRs); Public Presentation; Report online media ; Twice in 13-24" Added: Both ESRS involved. Report online media Type: Public Presentation Twice in 13-24 Outreach deliverable

D4.4 : Outreach: Event 3 [44]

Row in original table (month count starts at month 9): "DD4 Outreach event WP4 UoL (ESRs); Public Presentation; Report online media ; Twice in 25-36" Added: Both ESRS involved. Report online media Type: Public Presentation Combined in 25-36 Outreach deliverable

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS16	Outreach completed	1 - UNIVLEEDS	44	Media reports of outreach activities undertaken (photo's, reactions, description, etc.).
MS17	Dissertations submitted	1 - UNIVLEEDS	48	PhD vivas are happening and after approval of the thesis, theses are put online as PDFs at UoL site. Submission of PhD theses at UoL is between 44 - 56 months.

Work package number [9]	WP5	Lead beneficiary [10]	1 - UNIVLEEDS
Work package title	Open Research Data		
Start month	1	End month	48

Objectives

Establish data management plan and delivery.

Description of work and role of partners

WP5 - Open Research Data [Months: 1-48]
UNIVLEEDS
Deliver the data management.

Participation per Partner

Partner number and short name [10]
1 - UNIVLEEDS
2 - MARINBV

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.1	Management: Data Management Plan (WP5)	1 - UNIVLEEDS	ORDP: Open Research Data Pilot	Confidential, only for members of the consortium (including the Commission Services)	6

Description of deliverables

Periodic updating of data on bespoke sites, pending the research progress.

D5.1 : Management: Data Management Plan (WP5) [6]

Added: New deliverable. Establish data management plan Periodic updates of Data & Programmes on GitHub/ Firedrake, based on the data management plan etc. Open Data Access. Management deliverable

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification

1.3.4. WT4 List of milestones

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS1	Recruitment finalised	WP3	1 - UNIVLEEDS	8	Recruitment completed.
MS2	Kick-off meeting completed	WP3	1 - UNIVLEEDS	9	Minutes of meeting with action points so our actions are assessable. Preliminary meeting in month 1/2. Kick-off team workshop/meeting at MARIN or Leeds) where (nearly) all supervisors and ESRs meet face-to-face, which makes these milestones. There will be circa 4 to 6 of these meetings including kick-off meeting and closing meeting. Since we are all together, a little extra work is put in to present work up to date, which makes them special and as such milestones. Dissemination and a way to check what happened: minutes with action points etc., and potentially pdfs of presentations given, per efficient format of meetings as we use them in Leeds and The Netherlands.
MS3	6-month assessment completed	WP3	1 - UNIVLEEDS	14	Confirmation in UoL's GRAD (the UoL system to follow progress of PhDs). Completed.
MS4	Team workshop completed	WP3	1 - UNIVLEEDS	16	Team workshop at MARIN or Leeds) where (nearly) all supervisors and ESRs meet face-to-face, which makes these milestones. There will be circa 4 to 6 of these meetings including kick-off meeting and closing meeting. Since we are all together, a little extra work is put in to present work up to date, which makes them special and as such milestones. Dissemination and a way to check what happened: minutes with action points etc., and potentially pdfs of presentations given, per efficient format of meetings

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
					as we use them in Leeds and The Netherlands.
MS5	12-month assessment completed	WP3	1 - UNIVLEEDS	20	Confirmation in UoL's GRAD (the UoL system to follow progress of PhDs).
MS6	Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool Report I ESR1 for D3-D4, finalised.	WP1	1 - UNIVLEEDS	22	The report will be submitted to the EU; however, the interim report also forms the basis (its content) for the mid-term review report; as such its content can be assessed. As stated in the original proposals, it pertains to WP1.1-1.2, WP1.4 and D3-D4, D6= make open access tool. Report I by ESR is on and finalisation of WP1.2 i.e. "Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool. "
MS7	Derive the mathematical and variational/Hamiltonian formulation of wave-current interactions Report II ESR1 for D5, finalised.	WP1	1 - UNIVLEEDS	24	Mid-term rev./submitted to EU The report will be submitted to the EU; however, the interim report also forms the basis (its content) for the mid-term review report; as such its content can be assessed. As stated in the original proposal it pertains to WP1.3 and D5, being finalisation of WP1.3 "Derive the mathematical and variational/Hamiltonian formulation of wave-current interactions".
MS8	Mid-term check completed	WP3	1 - UNIVLEEDS	15	Project mid-term check/ preparations at month 13-15. The significance of this milestone is that it draws on a team effort with the entire team pulling together to make the (draft) report.
MS9	Submission of Paper A/ B ESR1 finalised	WP1	1 - UNIVLEEDS	30	ArXiv (put draft papers A/B for ESR1 in open archives) before we submit. This is a milestone because submitting papers is a milestone in the career of any ESR. The final papers are build on the reports I and II. The step from report

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
					to paper for submission is a significant one.
MS10	Validate the open-access numerical water-wave tank against (new) wave basin measurements in 3D at MARIN BV Report III ESR1 for D8, finalised.	WP1	2 - MARINBV	40	This is the preparation phase for any periodic reports which will go online (www/EU). Report is on and finalisation of WP1.5 "Validate the open-access numerical water-wave tank against (new) wave basin measurements in 3D at MARIN BV."
MS11	Explore basin measurements at MARIN BV with currents, in 2D (optional); compare with open-access numerical wave-current tank against (new) waveReport IV ESR1 for D9, finalised.	WP1	1 - UNIVLEEDS	44	This work pertains to WP1.6 and D9 and will likely become a chapter of the PhD thesis and the final EU report. Report IV for ESR1 is on (not a finalisation but an exploration of) WP1.6 "Explore basin measurements at MARIN BV with currents, in 2D (optional); compare with open-access numerical wave-current tank against (new) wave". Tentative.
MS12	Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam Report I ESR2, finalised.	WP2	1 - UNIVLEEDS	18	Preparatory report that forms the basis of the periodic reports to be submitted to the EU, which will also form the content basis for the mid-term review, as such this is verifiable and pertains to (the finalisation of) WP2.1. "Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam."
MS13	Derive compatible numerical discretization of potential-flow water-wave motion and nonlinear hyperelastic beam (or waveflap) motion in 2D, using asymptotic/full two-way coupling Report II ESR2, finalised.	WP2	1 - UNIVLEEDS	22	Preparatory report that forms the basis of the periodic reports for to be submitted to the EU, which will also form the content basis for the mid-term review, as such this is verifiable and pertains to WP2.3. Report II for ESR2 is on and the finalisation of WP2.3 "Derive compatible numerical discretization of potential-flow water-wave motion and nonlinear hyperelastic beam (or waveflap) motion in 2D, using asymptotic/full two-way coupling.".

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
MS14	Submisison of Papers A/B ESR2 finalised	WP2	1 - UNIVLEEDS	36	Archiving of Papers A/B for ESR2 before submission to scientific journal. The step of making reports (I and II for ESR2) into papers for submission is a significant one and as such a milestone.
MS15	Validate the wave-structure numerical tool against experimental measurements of wave-impact on elastic beams Report III ESR2, finalised.	WP2	2 - MARINBV	40	Pertaining to work for WP2.6, a report number III; also forming the basis or periodic/final reports for the EU, pertaining to saying "Online (www/EU)". Report III for ESR2 is on and the finalisation of WP2.6 "Validate the wave-structure numerical tool against experimental measurements of wave-impact on elastic beams.".
MS16	Outreach completed	WP4	1 - UNIVLEEDS	44	Media reports of outreach activities undertaken (photo's, reactions, description, etc.).
MS17	Dissertations submitted	WP1, WP2, WP4	1 - UNIVLEEDS	48	PhD vivas are happening and after approval of the thesis, theses are put online as PDFs at UoL site. Submission of PhD theses at UoL is between 44 - 56 months.
MS18	Team workshops completed	WP3	2 - MARINBV	40	Team workshop at MARIN or Leeds) where (nearly) all supervisors and ESRs meet face-to-face, which makes these milestones. There will be circa 4 to 6 of these meetings including kick-off meeting and closing meeting. Since we are all together, a little extra work is put in to present work up to date, which makes them special and as such milestones. Dissemination and a way to check what happened: minutes with action points etc., and potentially pdfs of presentations given, per efficient format of meetings as we use them in Leeds and The Netherlands. Minutes of meetings can be requested and can/will be made part

Milestone number[18]	Milestone title	WP number[9]	Lead beneficiary	Due Date (in months)[17]	Means of verification
					of the data management plan. Month 40 is indicative given that there are few team workshops.
MS19	Enrolment in PhD programme completed	WP3	1 - UNIVLEEDS	12	All recruited fellows (ESR1 and ESR2) enrolled in PhD programme. Newly added milestone.

1.3.5. WT5 Critical Implementation risks and mitigation actions

Risk number	Description of risk	WP Number	Proposed risk-mitigation measures
1	Delay in recruitment	WP3	Re-advertise; use paid advertisements e.g. Researchgate
2	Illness at group/management meetings/staff departure	WP3	Covered given pool of 2x2 supervisors; ESRs join forces; Prof Steve Tobias is back-up supervisor
3	Delay in Report I, M6	WP1	Scope objective wide enough to arrange meaningful scientific subset (e.g. using Benney-Luke or current codes); intensify contacts with Firedrake team at Imperial College
4	Delay in Report II, M7	WP1	Contribution of UoL supervisors can be adjusted accordingly
5	Delay in Report III, M10	WP1	Contribution of MARIN supervisors can be adjusted accordingly
6	Delay in Report IV, M11	WP1	Contribution of supervisors can be adjusted accordingly; i.e. validation is benchmark for MARINs cluster (Dr Duz); intensify involvement with Firedrake team, Imperial College
7	Delay in Report I, M12	WP2	More input from advisors
8	Delay in Report II, M13	WP2	3D vs 2D adjustment; relaying to option WP2.7; coupling issue is high on Firedrake agenda; intensify contacts with Firedrake team
9	Delay in Report III, M15	WP2	Reassess experiments; small-scale

1.3.6. WT6 Summary of project effort contribution

	WP1	WP2	WP3	WP4	WP5
1 - UNIVLEEDS	✓	✓	✓	✓	✓
2 - MARINBV	✓	✓	✓	✓	✓

1.3.7. WT7 Tentative schedule of project reviews

No project reviews indicated

1. Project number

The project number has been assigned by the Commission as the unique identifier for your project. It cannot be changed. The project number **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

2. Project acronym

Use the project acronym as given in the submitted proposal. It can generally not be changed. The same acronym **should appear on each page of the grant agreement preparation documents (part A and part B)** to prevent errors during its handling.

3. Project title

Use the title (preferably no longer than 200 characters) as indicated in the submitted proposal. Minor corrections are possible if agreed during the preparation of the grant agreement.

4. Starting date

Unless a specific (fixed) starting date is duly justified and agreed upon during the preparation of the Grant Agreement, the project will start on the first day of the month following the entry into force of the Grant Agreement (NB : entry into force = signature by the Commission). 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.

Marie Skłodowska-Curie Actions (MSCA)
Innovative Training Networks (ITN)
H2020-MSCA-ITN-2019

Annex 1 to the Grant Agreement
(Description of the Action),
EID
Part B

"Eagre/Aegir: high-seas wave-impact modelling"
Acronym: Eagre
Grant Agreement number: 859983

HISTORY OF CHANGES

Date of modification	Modified section	Description of modification	Page
01-01-2019	All	Some editing to adjust from rtf-format to word-format.	All
07-10-2019	1.1.3	Reviewers' remark on Impact*: Employability of ESRs in maritime related industry is not appropriately elaborated. For example there is no convincing discussion on the industry demand for specialists trained within the proposal.* Reply: See the next item; we also further highlighted the employability of the ESRs in maritime engineering, given the bespoke applications in that area.	10
07-10-2019	1.1.3 1.2.1	Reviewers' remark on Impact: *Employability of ESRs in maritime related industry is not appropriately elaborated. For example there is no convincing discussion on the industry demand for specialists trained within the proposal.* Reply: Training at European level is facilitated by construction because the training of the ESRs takes place at the two places involved, University of Leeds and MARIN Academy BV, in the former, through enrolment on identified advanced courses and in the latter through the two professional workshops identified and offered, as well as through professional development whilst the ESRs are at MARIN Academy BV. We have added (in italics bold): "***Professional development at MARIN Academy BV includes regular meetings, in MARIN BV's biweekly focus groups, with professionals involved in maritime-engineering consulting in order to exchange practical expertise***." Furthermore, through the professional module identified, continued professional development as well as the transfer from an academic to a consulting environment is facilitated and monitored. We have added the following to the text (in italics bold): ***That professional development, bespoke to the maritime engineering sector, further enhances the employability of the ESRs. In more concrete terms, the level of both training and attainment expected of the ESRs is such that MARIN Academy BV would be keen to consider them for potential employment.***	10 18

07-10-2019	1.1.4 1.4.2	Reviewers' remark on Quality and efficiency of the implementation: *The risks associated with some of the core technical activities, e.g. related to availability of high performing computing [HPC] resources and the relevant mitigation actions are not sufficiently assessed.* Reply: We have emphasized the HPC facilities better (in bold italics), and also added "***and access to two HPC centres also serves as risk mitigation"***. I.e. one HPC is at UoL and one HPC at MARIN Academy BV.	12 22
07-10-2019	-	Reviewers' remark on Quality and efficiency of the implementation: *The end-user needs are not fully incorporated in the proposal* Reply: WP2.7 is currently optional, depending on the progress of ESR2. The proposal is to consider replacing WP2.7 at the mid-term review by a particular applied and end-user topic of interest to MARIN Academy BV, to be defined by the MARIN Academy BV supervisors depending on the progress at the time in discussion with ESR2 and the academic advisors. The goal is ensure that newly defined applied topics instigate research that is suitable for high-profile dissemination, e.g. as a tentative conference proceeding submission, e.g., to the International Conference on Ocean, Offshore and Arctic Engineering (OMAE).	-
09-10-2019	-	Summary tables for WP3 and WP4 have been added (but have not been indicated in bold-italics) online.	-
09-10-2019	All Online tables. Tables w. months in Annex.	Adjusted the month counting, which is why we used relative counting in the original proposal to coincide with the academic year start in September when the ESR1 & ESR2 will arrive.	All
09-10-2019	1.2.2	Tables 1.2 updated: word ESR added and months adjusted	19 20
11-10-2019	All	Tuned use of MARIN (Academy) BV and (Stichting) MARIN in several places.	All
11-10-2019	-	Added subsection Declarations	5
11-10-2019	3.1	Updated Tables 3.1d with ***"University of Leeds will issue a PhD certificate for each ESR to be recruited after the ESR has successfully defended his/her PhD thesis."***	28-29
11-10-2019	3.2	Moved section on IP to section 3.2.	31

23-10-2019	Table 1.1	Changed 44 to month 48 for WP3/WP4	17
23-10-2019	3.1	"Deleted the sentence "This information is explicitly given in Tables 3.1a/3.1b and is summarised here", as tables 3.1a and 3.1b do not appear in the document anymore. Deliverables counting fixed and matching online counting.	29/30
23-10-2019	1	Added "(Description of the Action)"	1
23-10-2019	All	Added EAGRE859983 to header	All
23-10-2019	TOC	Changed page numbers in TOC	5
29-10-2019	3.1	Deleted sentence "This information is explicitly given in Tables 3.1a/3.1b and is summarised here"	29

TABLE OF CONTENTS

LIST OF PARTICIPANTS

Consortium Member	Legal Entity Short Name	Acade-mic	Non-aca-demic	Awards Doctoral Degrees	Country	Dept./ Division / Laboratory	Scientist-in-Charge	Role of Partner Organisation
Beneficiaries								
School Mathematics University Leeds	UoL	X		X	UK	Applied Mathematics	Prof Bokhove	
Maritime Research Institute Netherlands Academy BV	MARIN (Acad-emy) BV		X		The Netherlands	Seakeeping Ocean Engineering	Dr Bunnik	
Partner								
Stichting Maritiem Instituut Nederland	MARIN	x			The Netherlands	Seakeeping Ocean Engineering	Dr. Van Essen	Training; Stichting MARIN's maritime-engineering professional workshops

Data for non-academic beneficiaries:

Name	Location of Research premises (city / country)	Type of R&D activities	No. of full-time employees	No. of employees in R&D	Web site	Annual turnover (in Euro)	Enterprise status (Yes/No)	SME status (Yes/ No)
MARIN Aca-demy BV	**The Ne-therlands**	**Consulting**	**370+**	**56+**	**www. marin.nl**	**43M Euros**	**Yes**	**No**

Declarations

MARIN Academy BV, the industry partner, is a linked third party of MARIN ("Stichting Maritiem Instituut Nederland", a foundation), and MARIN is 100% owner of MARIN Academy BV. In the text we sometimes shorten MARIN Academy BV to "MARIN BV" and Stichting Maritiem Instituut Nederland to MARIN.

1. Excellence

1.1 *Quality, innovative aspects and credibility of the research programme*

1.1.1 Introduction

Motivation. The maritime industry has, unnoticed by many, enjoyed a resurgence in importance more important in recent decades. A little-known fact is that "shipping … [is] the invisible industry that brings you 90% of everything" (George 2014). Maritime engineering is the expertise underlying this maritime increase in activity and applied mathematical modelling is, in turn, one of the pillars underlying such engineering. Scale tests in wave basins, involving wave impact on scale models of ships and offshore structures (e.g. wind turbines and oil platforms), are essential components of industrial consultancy in maritime consulting hydrodynamics and structural mechanics. Such scale testing is both time-consuming and expensive and, as a result, computational fluid and structural dynamics have therefore become essential tools to be used cleverly in smart combination with wave-basin experiments. This combination reduces research costs and increases the efficiency of (expensive) experiments, whose design phase and execution can be informed by relatively cheap computational simulations cheaper and more efficient in their design phase and execution. *Vice versa*, the experiments provide the necessary (and herein meaningful) validation tests for the computations. In wave-basin experiments, scale models of offshore structures, ships or wind-turbines are tested against target extreme sea waves at a certain location in the basin; all phenomena and manufacture can then be scaled down appropriately.

Extreme waves, though occurring with low frequency, are often extremely destructive to both human life and mechanical infrastructure; such waves have amplitudes at least twice as high as the surrounding ambient sea (Dysthe *et al*. 2008, Khariff *et al*. 2009, Onerato *et al*. 2013). A well-known example of an extreme wave is the "eagre" or "aegir", a high tidal wave or bore. The sea is a dangerous environment for both floating and fixed maritime structures, both floating and fixed ones, which include ships, oil platforms and offshore wind-turbine fields. Wave impact of extreme and breaking waves can inflict serious damage on maritime structures, entirely destroy such structures or simply sink ships (see, e.g., Nikolkina and Didulenkova 2011; two large ships sink in the ocean every week, Allianz 2013). Understanding and predicting extreme waves and their impact is therefore a timely and desirable step forward in improving the design of maritime fixed and floating structures. In the laboratory wave basins typically used for model testing, these extreme waves tend to be generated by wavemakers on one or two sides of the wave basin and are damped (by simulated beaches) to reduce reflections on the other sides, thus creating a laboratory environment that mimics mid-sea conditions.

Key elements of application. In this European Industry Doctorate (EID), a consortium of researchers at the University of Leeds (UoL, Profs Bokhove and Kelmanson) and the Maritime Research Institute Netherlands (MARIN Academy BV, Drs Bunnik, Drummen and Duz) plan to train two Early Stage Researchers (ESRs) in the computational fluid and structural dynamics needed to predict nonlinear water waves and wave impact against dynamic (flexible wind-turbine) structures, also in the presence of intermittent wave breaking and nearly uniform currents. The key novelty is that, because we use a compatible and monolithic approach, all of our modeling will be more robust and trustworthy than classical approaches. The research training will focus on the creation of operational " numerical wave tanks"

(Gidel 2018; Salwa 2019) to be used to model and simulate nonlinear water-wave and wave-structure interactions; a particular focus will be on the simulation and validation of experiments in modeling, in particular focused towards applications in MARIN's wave basins. The ESRs will each work 50%-50% at both sites (UoL and MARIN Academy BV) in order to maximise contact with the spectrum of expertise spanned by the applicants: whilst at MARIN Academy BV, the ESRs will be trained in research relevant to the maritime-engineering consulting practice and their simulation results will be validated against actual maritime wave-basin tests.

Innovative, distinctive and exciting in our research plan is that advanced, high-level numerical and mathematical methods, based on modern and robust geometric and variational finite-element methods, will be developed for water-wave and wave-structure hydrodynamics and then directly applied in, and transferred to the maritime-engineering framework at MARIN Academy BV. Our training plan aims to lead to feasible and bona fide PhD theses based on this range and development from mathematical and numerical modelling to real-life maritime-engineering applications. A unique element of this project is that it will bridge the gap from high-level mathematics to applications in each PhD thesis. Moreover, our objectives (introduced next), deliverables and milestones are carefully planned via a step-by-step development of research outcomes, each underpinned by a focus on education and training of the ESRs, thereby affording them both the skills to solve and opportunities to encounter towards solving exciting, high-risk and high-reward challenges.

1.1.2 Objectives

Two Early-Stage-Researchers (hereafter abbreviated by ESR1 and ESR2; akin to "PhD" students and aiming to defend their PhD dissertations after 3 to 4 years) will be appointed as a team, with both distinct research tasks as well as joint, collaborative themes and work.

The overall objective for the two ESRs is to create computational and mathematical modelling tools, for solving problems in maritime engineering, based on advanced mathematical and numerical analysis and the efficient implementation and testing of this analysis in a general finite-element simulation environment offered by *Firedrake* (https://www.firedrakeproject.org/). Firedrake is developed at Imperial College in London and has been used by Bokhove's group in Leeds, (in collaboration with the Firedrake team at Imperial College over the last five years) to enable a primary focus on maritime-engineering challenges, and their mathematical and numerical development rather than time spent on, effectively, the reconstruction of existing validated code.

Our key task is to offer training and research such that this numerical wavetank can be established by the ESRs for maritime-engineering wave basins, such as those currently operational for consultation at MARIN Academy BV. It will provide the ESRs with a skill set that is highly attractive in the job market to employers engaged in high-end consulting, in addition to the skill set for becoming academics with strong industrial ties. The overall, integrated objectives are to create a numerical wavetank, developed by ESR1 and ESR2, on the modelling of extreme or rogue waves in wave basins (WP1-ESR1) and on wave-structure interactions, especially wave-impact, on a dynamic wind-turbine mast (WP2-ESR2). The overall objectives build on our recent and current collaborative work on the modelling of water waves and wave-structure interactions with (dis)continuous Galerkin finite-element methods (cf. Bokhove, Zweers and Kalogirou 2019; Kalogirou, Bokhove and Ham 2017; Gidel *et al*. 2017;

Gidel 2018; Gidel *et al.* 2019; Salwa *et al.* 2016ab, 2017; Salwa 2019).

The above objectives offer challenging demands, not least because the prediction of wave motions around moving or flexible structures is a difficult computational task, since as a result of the requirement to track (generally using a sophisticated approximation) the a-priori-unknown nonlinear air-water and water-structure interfaces (and their cross-section, the waterline), need to be tracked, either more exactly or approximately. Conquering these demands is timely because numerical simulations are cheaper than running laboratory tests. Moreover, because mathematical modelling, simulation, and laboratory testing and cross-validation via computational simulation are inextricably entwined (in realistically motivated challenges), we view them all as essential components of a so-called *Research Trinity*. The respective detailed objectives are formulated as follows:

ESR1 –"ExtremeWaves": Extreme water-wave computational modeling using advanced geometric methods with wave generation, breaking, and currents.

WP1.1 Create a complete numerical finite-element wavetank for high-amplitude potential-flow water waves with a breaking-wave parameterization, optimized for parallel computing, wave generation and wave damping at beaches, in both two and three dimensions (2D and 3D). Explore coordinate transformations as well as dynamic mesh motion.

WP1.2 Develop and deliver a (new) series of benchmark cases (soliton splashes, Stokes, Rienecker-Fenton, (ir)regular, short-crested waves, random waves, etc.) for the wavetank of WP1.1.

WP1.3. Derive (novel) mathematical and variational/Hamiltonian formulations of wave-current interactions for constant-vorticity flows, both with and without shear, in 2D (i.e. vertical cross section) and, optimally (if time permits), in 3D.

WP1.4. Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool in the finite-element environment Firedrake using its newest features of free-surface and interior-dynamics coupling, in both 2D and 3D for maritime-engineering testing applications at MARIN BV. Include the benchmark cases.

WP1.5. Validate the open-access numerical water-wave tank against (new) wave-basin measurements in 3D at MARIN BV.

WP1.6. Explore wave-basin measurements at MARIN BV with (sheared) currents/flows, in 2D (optional).

WP1.7. Explore compatible/variational numerical formulations of wave-current interactions for constant-vorticity flows, both with and without shear, in 2D and create a bespoke wave-current numerical tool in the finite-element environment Firedrake. Compare experimental data with numerical wave-current tank data (optional explorations). Thus WP1.7 facilitates direct use in maritime-engineering consulting of realistic seas containing waves and currents.

ESR2 –"WaveTurbineImpact": Water-wave impact on dynamic and flexible (wind-turbine) structures.

WP2.1. Formulate the nonlinear mathematical theory of potential-flow water waves coupled to a nonlinear hyperelastic beam (wind-turbine mast) in 2D and 3D, also using the applicants' new asymptotic analysis of the two-way feedback mechanism (cf. Salwa *et al.* 2017; Kelmanson 2018/2019).

WP2.2 Derive a compatible numerical discretization of potential-flow water-wave motion and a prescribed beam (or waveflap) motion in 2D.

WP2.3 Derive a compatible numerical discretization of potential-flow water-wave motion and the nonlinear hyperelastic beam (or waveflap) motion in 2D, also using the asymptotic/full two-way coupling of WP2.1.

WP2.4 Include (modified) wavebreaking parameterizations formulated in ESR1's project to the wave-structures modeling.

WP2.5 Deliver an open-access, fast and easy-to-use water-wave-structure simulation and scientific-computation tool in the finite-element environment Firedrake using its newest features of free-surface and interior interior-dynamics coupling, in both 2D and 3D. Formulate and include benchmark test cases.

WP2.6 Validate the wave-structure numerical tool against experimental measurements of wave-impact on elastic beams, including random waves.

WP2.7 Provide and explore the variational formulation of a mixture-theory water-wave model in the Eulerian framework, using Euler-Poincaré theory and its Euler-Boussinesq-equation limit. Couple the resulting water-wave model variationally to the nonlinear beam (wind-turbine mast). Consider and explore numerical water-wave motion in a compressible Van-der-Waals-fluid model, in its potential-flow limit, and compare this computational model with a classic finite-volume formulation using a continuous equation of state. Explore the imposition of incompressibility (optional explorations).

1.1.3 Overview of the research programme

Project #1, "ExtremeWaves": Linear/nonlinear potential-flow modelling forms a classical way of predicting water waves. Nonlinear simulations using boundary element or related methods are now routinely explored in more idealized settings (cf. Dold and Peregrine (1984); Drimer and Agnon (2006); and Guyenne and Grilli (2006), including varying-bottom topography (Guyenne and Nicholls, 2007).

Potential-flow water waves are succinctly described by variational principles (Luke 1967; Miles 1977; Zakharov and Kuznetov 1997; Bridges and and Donaldson 2011 for overturning waves), that highlight the underlying geometric and conservative structure of water-wave dynamics. Compatible, i.e. structure-preserving or variational, discretizations of water-wave dynamics are more challenging yet more robust than classical/non-compatible ones and have been explored only relatively recently (e.g., based on Zakharov's formulation as in Guyenne and Nicolls, 2007). The applicants are the first to have derived and used a fully spatio-temporally-compatible discretization of these variational principles in both 2D and 3D over varying topography, including piston wavemakers (Gagarina *et al.* 2014, 2016; Gidel 2018; Gidel *et al*. 2019), thus ensuring numerical stability, accuracy and involving complex moving domains. We also use a fully compatible finite-element discretization, in both space (cf. Papoutsellis and Athanassoulis 2017) and in time (which combination is to date uniquely ours). Proposed essential new aspects, required for our maritime engineering wave-basin simulations in WP1.1, are the inclusion of wave-breaking parametrizations, waveflaps and (on the opposite side of the tank) beaches, enhanced computational speed, wave-current interactions and the development of benchmarks to make the wavetank a fully professional maritime-engineering simulation tool. ESR1 will be trained towards reaching that the goal of completing such an advanced tool, en route to obtaining a PhD dissertation. The diverse spectrum of mathematical, computational, analytical and reporting skills

admitted by the project will greatly enhance the ESRs' future employability prospects in a plethora of technical disciplines, ***and especially in maritime engineering***. These skills may be augmented through the offer (standard in Maths at Leeds) to PhD students to undertake tutorial/marking activities with/for undergraduates, in order to strengthen employability prospects for academic careers.

Project #2, "WaveTurbineImpact": There are various computational methods for wave-structure interactions using the Navier-Stokes equations (Benitz *et al*. 2015). These include Smoothed Particle Hydrodynamics (Crespo *et al.* 2017), with the structures modeled as different particles, and immersed boundary methods coupled to dynamic structures. While computationally robust and thus useful, these methods can be too diffusive and do not preserve the underlying conservative structure in the inviscid limit: their artificial viscosity is too high, over-reducing wave amplitude/steepness. Other methods use multiphase and mixture-theoretic models or weakly compressible fluids (Dumbser 2011, Bredmose *et al*. 2015, Golay *et al*. 2015); the latter methods work well when used in combination with interface sharpening akin to the segregation terms in mixture-theoretic models together with local mesh refinement around the interfaces. Accuracy issues arise in intermittently breaking seas because these methods are also more diffusive, or very costly, and wave dispersion and hence propagation is less accurate. We therefore investigate one main approach in this subproject and explore another approach.

First, we combine the variational potential-flow approach and the variational hyperelastic-beam formulation in one nonlinear, monolithic variational principle (Huebner *et al*. 2004). We will investigate and deploy an asymptotic two-way feedback coupling, derived by Kelmanson, in combination with wave-breaking parametrizations (Papoutsellis and Athanassoulis 2017), thus building on developments in the ESR1 subproject. This requires some new meshing strategies, which can be developed by first considering the inclusion of waveflap motion (Bridges and Donaldson 2011, Bokhove 2019), in extension of the current piston wavemaker set-up (Gidel 2018): such an interim step is also better for ESR2 from an educational and training point of view. A second approach centres around developing mixture-theoretic and Van-der-Waals-fluid models (Salwa 2019; Bokhove *et al*. 2016), analyzing and exploring different spatial-temporal integration routines.

1.1.4 Research methodology and approach

Our research methodology is based on our above-mentioned coherent *Research Trinity* (cf. Gidel 2018, University of Leeds Postgraduate of 2017 https://www.youtube.com/watch?v=6gKcWKeZ5Xs) comprising:

1. mathematical theory and modeling;
2. numerical approximation, and;
3. real-life (including experimental) observations and physics.

The components of this Trinity interlink cyclically according to:

- (1-to-2) development of modern and accurate discretization methods of water-wave and wave-impact dynamics, here based on advanced, compatible discretization strategies that preserve the mathematical variational structures of the underlying equations of motion for the wave and structural dynamics;
- (2-to-3) implementation of the accurate and consistent discretizations, and subsequent validation of numerical results against laboratory measurements in

MARIN's wave basins, and;
- (3-to-1) based on comparison between numerical results and experimental observations, refinement if necessary of the dynamical models, and subsequent iteration through the cycle.

Consistency, accuracy and computational efficiency are central demands in water-wave prediction and wave-structure impact modelling.

Consistency will be achieved by formulating the underlying variational structure of the coupled dynamics and preserving this structure in the final numerical discretisation. Conservation laws and phase-space structure are, by construction, therefore sufficiently conserved in the numerics. For the "waves-only" sub-project, wave-maker and water-wave motions are consistently coupled to the beaches, where wave-breaking dampens the waves and thus minimizes reflection; here we extend our preliminary work (in Kristina *et al.* 2014; Gidel 2018; Gidel *et al.* 2019) into three dimensions and include wave-flap motion. For the "wave-impact" sub-project, water-wave motion and the dynamics of the (hyper)elastic beam (or wind-turbine mast) are integrally formulated in one variational principle (Salwa *et al.* 2016ab, 2017); here we make the extension to the nonlinear mathematical numerical modeling based on a new asymptotic two-way coupling and novel ways to move the underlying mesh consistent with the dynamics (cf. Kelmanson 2018/2019 and Bokhove 2019). An innovative inclusion of wave-flap motion into the water-wave dynamics based on this new mesh motion will be a stepping-stone towards this establishing a fully nonlinear model of wave-beam interactions. In both sub-projects, the numerical modeling is compatible and structure-preserving because it is based on a direct discretization of the spatio-temporal variational principles of the respective dynamics, leading to corresponding discretized variational principles, consisting of one nonlinear algebraic expression, whose variations directly yield the final and stable numerical method.

Accuracy is achieved because the compatible discretization yields stable and accurate numerical methods at sufficiently high orders in both space and time, while using higher-order finite-element expansions. Over the last decade, Bokhove, Kelmanson and collaborators have investigated a range of variational (dis)continuous Galerkin finite-element methods and time integrators, which we here aim to develop further to coupled maritime systems (cf. Ambati 2008, Gagarina *et al*. 2014, 2016; Bokhove and Kalogirou 2016; Salwa *et al*. 2017; Gidel *et al*. 2019).

Computational efficiency is guaranteed because we will employ efficient solvers, by developing adequate pre-conditioners and using the automatic parallelization features in the finite-element modelling environment Firedrake (Rathgeber *et al.* 2018). Firedrake "*is an automated system for the solution of partial differential equations using the finite element method (FEM). Firedrake uses sophisticated code generation to provide mathematicians, scientists, and engineers with a very high productivity way to create sophisticated high performance simulations*" (www.firedrakeproject.org). It is maintained and developed under an open-license agreement by a team of researchers at Imperial College and, since 2014, Bokhove's group in Leeds has been one of the first users and application-developers of Firedrake.

The key elements in each work package will are now identified. In work package **WP1**, "ExtremeWave", training will be provided to establish a fully-fledged numerical potential-flow wave tank, including not only various features mimicking MARIN's in-house actual wave basin, and but also a series of (novel) benchmark tests. Details of the sub-packages of **WP1** are now given.

WP1.1 *Create a complete numerical finite-element wavetank for high-amplitude potential-flow water waves*. In a recent series of PhD theses and journal articles, we have developed the first completely spatio-temporal compatible nonlinear finite-element potential-flow solvers with piston wavemakers, varying topography, a dynamic free surface, and a beach with breaking waves/bores in 2D (vertical plane), based on direct discretizations of the fundamental underlying variational principles (Ambati 2008; Gidel 2018; Gagarina *et al*. 2014, 2016; Gidel *et al*. 2019). Extensions to 3D are only partially completed, including and hitherto have included variable topography and dynamic free free-surface motion. ESR1 will be trained to include the following tasks:

- breaking-wave parameterization in first 2D and then 3D (e.g. Papoutsellis and Athanassoulis 2017);
- optimization of the Firedrake application using advanced preconditioning and parallel computing;
- wave generation/wave damping at beaches, along the entire wave basin, and;
- exploration of h-and p-refinement in the vertical direction, and coordinate transformations versus dynamic mesh motion (cf. Bokhove 2019).

WP1.2 *Develop and* deliver *a series of benchmark cases.* Benchmarks will be developed as routine tests for the two- and three-soliton splash; the Rienecker-Fenton travelling periodic wave, as well Stokes, (ir)regular, random and short-crested waves, including 2D and 3D cases. Establishment of these benchmarks comprises new and publishable work and forms also a good training step towards advanced potential-flow water-wave modelling.

WP1.3. *Derive the mathematical and variational/Hamiltonian formulation of wave-current interactions.* Classical variational principles by Luke (1967) and Miles (1977) will be studied and extended to constant-vorticity flows, both with and without shear, in 2D (i.e. a vertical cross section). Clebsch potentials will be used, cf. Cotter and Bokhove (2010) and Gagarina *et al*. (2013), or a Hamiltonian methodology, possibly in unison. This step will serve as a pedagogical building block for a direct finite-element discretization of these weak geometric formulations, extending a study of classics classic problems/configurations towards new wave-current formulations.

WP1.4. *Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool.* The numerical water-wave tank should become one self-contained environment that includes version control and the standard benchmark cases, such as those listed in WP1.2. This environment will be developed, finalised and tested on MARIN BV's ***High-Power-Computing (HPC)*** cluster "marclus5", whereon Firedrake versions have to date been installed.

WP1.5. Simulations of the numerical potential-flow water-wave tank will be validated against existing or new 3D wave-basin measurements at MARIN BV, including obliquely incident waves and beaches that dampen the shorter surface-gravity waves.

WP1.6. A preliminary exploration will be undertaken of (new) wave wave-basin measurements with waves and current at MARIN BV, in a vertical, 2D cross-section.

WP1.7. *Explore compatible/variational numerical formulations of wave-current interactions.* Following the space-time finite-element discretization for potential flow developed hitherto, the 2D extension of compatible numerical finite-element schemes to potential flow plus a constant velocity or vorticity component will be made, for the cases with and without shear. A bespoke wave-current numerical tool

will be developed in the finite-element environment Firedrake.

In work package **WP2**, "*WaveTurbineImpact",* training will be provided on the mathematical theory and a corresponding numerical wavetank for wave-structure interactions. Details of the sub-packages of **WP2** are now given.

WP2.1. *Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam*. The coupling of wave and beam motions can be established by adding the variational principle (VP) for the separate components into one unified principle. The preliminary set-up in Salwa *et al.* (2016ab, 2019) will be finalised and extended by actually deriving the nonlinear equations of motion as well as developing our aforementioned novel asymptotic two-way approach, facilitating an iterative solution to the coupling of waves and structural dynamics, in both 2D and 3D.

WP2.2 *Compatible numerical discretization of potential-flow water-wave and prescribed beam motions in 2D.* As a stepping stone to the fully coupled case and a step in ESR2's training, the beam motion will first be prescribed, which then also serves as a novel method for wave generation by a waveflap, thereby *en passant* finally enabling the modelling of the important case of realistic waveflap motion used in MARIN's wave basin. Two numerical finite-element approaches will be explored in 2D (and possibly 3D), one with a coordinate transformation of the coupled VP to a rectangular fluid domain (cf. Gidel 2018) and one with mesh motion as an integral part of the coupled VP (cf. Donaldson and Bridges 2011; Bokhove 2019); (at least) one will be taken forward in WP2.3.

WP2.3 *Compatible numerical discretization of nonlinear potential-flow water-wave motion and hyperelastic-beam (or waveflap) motions in 2D*. Finally, a compatible finite-element discretization of the coupled wave-structure system will be developed, by extending the chosen approach in WP2.2; simplifications of the intricate coupling will be investigated using the iterative asymptotic approach of WP2.1 within the numerical approach (cf. private notes, Kelmanson 2018/2019). Integrating mesh motion into the VP, the second option in WP2.2, has the benefit of admitting the possibility of wave-overturning.

WP2.4 *Wavebreaking parameterizations for the wave-structures modeling*. All approaches so far developed sofar concern single-valued free-surface motion with a single-valued water depth h(x,y,t). This assumption and corresponding numerical approach break down when water waves become too steep, and we will therefore employ in ESR2's project wavebreaking parameterizations used in ESR1's project (e.g., Gagarina *et al*. 2013, Papoutsellis and Athanassoulis 2017).

WP2.5 *Open-access, fast and easy-to-use water-wave-structure simulation and scientific-computation tool.* The numerical tools developed in WP2.1—2.4 will be folded into a comprehensive simulation tool with benchmark test cases. These benchmark test cases will include 2D and 3D examples with convergence tests as well as validation against (existing) data taken from of wave-beam interactions observed in experiments at MARIN BV (cf. Bunnik et al 2015).

WP2.6 *Validate wave-beam numerical tool.* The numerical-tool coupling of water waves with the motion of the hyperelastic beam, including wave impact, will be validated against existing and/or new bespoke measurements at MARIN BV.

WP2.7 *Variational formulation of mixture-theory water-wave model in the Eulerian framework (optional).* We have formulated a mixture-theoretic approach to water-wave modeling (Bokhove *et al.* 2016) using asymptotic theory. Part of the mathematics of this pseudo-two-phase model contains segregation terms that

enforce lighter fluid to rise as "averaged bubbles" and heavier fluid to sink as "averaged droplets". Under full segregation, the air and water phases are fully distinct and the phase function is 0 (air) or 1 (water). The linear limit of this formulation will be analysed to obtain linear water-wave solutions around a hydrostatic and segregated rest state. We will also explore Euler-Poincaré theory and the use of Clebsch variables in the Euler-Boussinesq-equation limit of the model, in which segregation terms are absent, in addition to exploring a geometric, metricplectic formulation (Morrison 1996) that combines conservative and dissipative/segregation aspects. Given these variational or geometric formulations, the full coupling between this mixture-theoretic water-wave model and nonlinear hyperelastic beam can be completed, unifying the pioneering foray of Salwa *et al.* (2016ab). Alternatively, we have begun to explore a compressible fluid with a Van-der-Waals-type equation of state of a one-phase fluid with a sharp gradient of the density modelling a smoothed air-water interface, including nonlinear numerics for a C-infinity-very smooth equations of state (Salwa 2019). Golay *et al.* (2015) consider a similar approach by using a classical Godunov-type finite-volume numerical scheme with added interface sharpening and mesh refinement around sharp density gradients that model, modeling the water-air interface. A comparison will be made between a classical finite-volume formulation of our van-der-Waals fluid and the geometric potential potential-flow formulation based on discretization of a novel variational principle. We will explore novel and stable time time-integration schemes for this variational approach that are able to deal with spurious acoustic waves. While high-risk research, when it is successful the extension including the coupling to a wind-turbine mast is more straightforward than in WP2.3-2.5, thereby offering an alternative and distinctive way to model breaking-wave impact on wind-turbine masts.

1.1.5 Originality and innovative aspects of the research programme

All work-sub-package objectives are now considered in terms of both originality and relation with what is, to the best of our knowledge, the current state of the art. For **WP1** "ExtremeWave", the proposal offers the following innovations.

WP1.1 *Create a complete numerical finite-element wavetank for high-amplitude potential-flow water waves*. The state-of-the-art concerns direct numerical solvers of potential-flow dynamics in 2D and 3D simulations, based on compatible discretizations, with a piston wavemaker (Gagarina *et al*. 2014, Gidel 2018) or wave-breaking parameterizations (Papoutsellis and Athanassoulis 2017, 2018) or wave-beach interactions in 2D (Gidel *et al*. 2019). Building upon these results, the innovation consists of combining all these elements in a 3D Firedrake solver. Furthermore, exploration of coordinate transformations and dynamic mesh motion, first in 2D, will be original and will greatly enhance the performance robustness and scope of the methodology available for investigating water-wave problems born of a variety of applications.

WP1.2 *Develop and deliver a series of (novel) benchmark cases.* Benchmarking using the two- and three three-soliton splashes will be original. The innovation in exploring irregular waves, random waves and short-crested waves lies in its use for testing scale models and the robustness of the potential potential-flow solvers. This step can be done with existing solvers, as well as the improved ones (cf. WP1.1); it is a crucial step to facilitate widespread use of our methodology/tools.

WP1.3. Deriv*e the mathematical and variational/Hamiltonian formulation of wave-current interactions.* Extending classical work on geometric structures for water-wave

equations (Luke 1967; Miles 1977; Cotter and Bokhove 2010; Gagarina *et al*. 2013) to wave-current interactions will be a valid doctoral- training step and introduction to the topic for the ESR, yet it will also contain innovative new elements, i.e. the extension to the wave-current flows.

WP1.4. *Deliver an open-access, fast and easy-to-use water-wave simulation and scientific-computation tool.* This delivery will focus on innovative computer-science elements and make the tool more robust and operational, e.g. in Leeds and at MARIN BV. Testing and improving the tool's robustness is an important and practical innovation, because its subsequent usage feeds directly into the design and testing of maritime-engineering hardware.

WP1.5. Validation of our 3D numerical potential-flow water-wave-tank against existing and/or new measurements at MARIN BV will be a challenging and novel endeavour. New measurements will tentatively include those that can be used to assess the damping/dynamics of the waves at the a beach.

WP1.6. Similarly, as in WP1.5, validation of our 2D numerical potential-flow water-wave-current tank against existing and/or new measurements at MARIN BV will provide novel insights into testing maritime structures in waves and currents.

WP1.7. *Explore compatible/variational numerical formulations of wave-current interactions.* These space-time finite-element discretizations based on the geometric wave-current models of WP1.3 will be entirely novel (optional).

For **WP2** "WaveTurbineImpact", the proposal offers the following innovations.

WP2.1. *Theory of potential-flow water waves coupled to a nonlinear hyperelastic beam*. Extending Salwa's preliminary results (Salwa 2019) with a full and concise derivation of the nonlinear equations of motion, as well as incorporating our new asymptotic two-way coupling based on one monolithic variational principle, constitutes a novel and innovative step forwards, one that allows our approach to solve the problem in not only a mathematically consistent and justified manner, but also one in which the new asymptotics offer a means of incorporating implicitly prescribed boundary conditions to a controllable (and high) degree of accuracy, thus enhancing computational efficiency and speed.

WP2.2 While piston wavemakers have now been successfully included in theoretical and numerical variational principles for water waves, the inclusion of a (more realistic and relevant to deep-water maritime engineering) waveflap into the mathematical and computational counterparts is a new challenge. MARIN's most prominent wave basins have waveflaps on two basin sides to create focussed waves. Both the coordinate transforms and the mesh motion integrated in the VP will be explored and developed (cf. Bokhove 2019).

WP2.3 Development of a compatible finite-element discretization of the coupled wave-structure system using a monolithic VP is an innovation with immediate application for testing wave impact on wind-turbine masts. The iterative asymptotic approach of WP2.1 will be integrated within the numerical approach to obtain faster numerical computations. Integrating mesh motion within the overall VP using distinctive equations for mesh motion will be entirely novel.

WP2.4 The inclusion of wavebreaking parameterizations into our numerical wave-structure modeling will complete our numerical tool for elaborate and novel testing against experimental measurements of wave impact on wind-turbine masts.

WP2.5 *Open-access, fast and easy-to-use water-wave-structure simulation and scientific-computation tool.* Establishing and completing the numerical tool in WP2.4 with benchmark tests will complete our main innovative approach on wave-impact modeling using compatible numerical techniques.

WP2.6 The validation of our new monolithic geometric water-wave-beam model is novel since such a model has to date never been validated.

WP2.7 *Variational formulation of mixture theory water-wave model in the Eulerian framework.* Through this project we will be the first to work on geometric and metricplectic formulation of mixture-theoretic air-water models coupled to hyperelastic beams. Our variational modeling approach of water-air wave dynamics based on a compressible Van-der-Waals-fluid (cf. Salwa 2019) is novel and requires some ingenuity in the time-stepping schemes to smooth out acoustic wrinkles (e.g. by offsetting mid-point integrators towards backward Euler schemes). It has the potential to lead to a fast and straightforward method for wave-structure interactions by breaking waves; but the research naturally contains some risk, even though a classical non-variational approach has proved to be fruitful yet quite dissipative (cf. Golay *et al*. 2015) without costly mesh refinements. We seek to combine the best of both variational and classical worlds in order to create a robust method for wave propagation with minimal spurious damping (NB optional work; when successful it allows a more direct (than hitherto devised) way to consider wave-impact on wind-turbine structures).

Table 1.1: Work Package (WP) List

WP No.	WP Title	Lead Beneficiary No.	Start Month	End month	Activity Type	Lead Beneficiary Short Name	ESR involve-ment
WP1	*Extreme-Waves*	**MARIN Academy BV**	1	44	Research	MARIN BV	ESR1
WP2	*WaveTurbine-Impact*	**UoL**	1	44	Research	UoL	ESR2
WP3	Management	**UoL**	1	48	Management	UoL	ESR1/2
WP4	Outreach	**MARIN Academy BV**	1	48	Outreach	MARIN BV	ESR1/2

1.2 *Quality and innovative aspects of the training programme*

The training in our programme aims to improve the career prospects and employment potential for our young researchers (ESRs), by developing their consulting skills in general and specifically for maritime engineering, as well as acquiring, applying and demonstrating much-needed more fundamental knowledge in mathematical analysis and computational fluid dynamics. In particular, the mobility of the ESRs involved in this programme brings with it the opportunity for young researchers to start their careers both at a British Russell Group university (University of Leeds) and at a well-established European consulting business (Maritime Research Institute Netherlands –MARIN Academy BV). The two ESRs will commence at the School of Mathematics at the University of Leeds, U.K. for 18

months, and will then finalise their doctorates at MARIN Academy BV, in The Netherlands, for a further 18 months before submitting their PhD dissertations.

1.2.1 Overview and content structure of doctoral programme (EID)

General Principles of the training Environment in Leeds: The School of Mathematics is strongly committed to ensuring that all PhD students receive broad and sound subject-related and generic skills training, maintained as an indispensable part of a PhD degree complementing first-class quality research. This approach is vital in order to keep the PhD programmes competitive in the national and international arena, and to ensure that a PhD awarded in the School of Mathematics at Leeds is recognised to lead to an independent and highly qualified researcher. Both ESRs will obtain their PhD degrees from UoL.

Transferable skills: The students ESRs are, whilst at Leeds, also required to take at least 30 days (normally 10 days per year) of generic/transferrable skills training over 3 years. Such training includes several compulsory courses of which some, in Masters-level fluid mechanics and numerical methods, are delivered by Bokhove and Kelmanson. At least two of the ESRs' courses must be generic, such as a one-day induction course "PhD Essentials: Getting Started", complemented by a workshop "Starting Your Research Degree" at the University's Staff and Departmental Development Unit (SDDU). Recommended courses also include IT and HPC training, a course on teaching and assessment (compulsory for those accepting teaching duties), and courses on research ethics and scientific and mathematical writing. The School regularly runs a surgery on career paths for final-year students, advising on applying for jobs and postdoc positions. A wide range of courses is available from Faculty training hubs, such as popular courses on research and employability skills, presentation, writing up a PhD thesis, public engagement, etc. A useful source of generic training is the WRISS GRAD School, which is part of the nationwide Vitae organisation (with the Yorkshire and North East Hub hosted and located at the University of Leeds). Generic training also involves participation (especially giving talks) in seminars, workshops and conferences. Organisation of seminars and committee membership also provides valuable opportunities to develop soft skills such as study and organization techniques, communication skills and working in groups. Activities at both Faculty and University levels include Careers Days for Postgraduates and an annual University Postgraduate Conference, enabling students to present their work to a non-specialist audience. There is also a range of regular social activities (e.g., staff/student parties, coffee mornings etc.) promoting better cohesion in the research community and ensuring a rewarding study experience. Finally, the ESRs will partake in an ethics course, including ethics of responsible publication, cf. the course offered within the EPSRC-funded (UK Engineering Council) Leeds' Centre for Doctoral Training in Fluid Dynamics (CDT). In general, the ESRs will become part of the active CDT and fluid dynamics environment in Leeds, thereby greatly expanding their training network beyond the environment offered by their supervisors at both sites.

Inter/multi-disciplinary aspects: On the industrial side, whilst at the MARIN Academy BV in Wageningen, training facilities are offered that are directed more specifically at maritime-engineering consulting practices. These include courses on the hydrodynamics of floating structures and ship hydrodynamics, as well as practical sessions that are part of the diverse range of industry-related projects undertaken at MARIN's wave basins. These courses are offered by the Stichting Maritiem Instituut Nederland (MARIN).

MARIN's Hydrodynamics of Floating Offshore Structures course gives an overview of the latest experiences in a broad range of important fields, such as extreme metocean conditions (hurricane waves, loop currents, wind squalls), motion analysis, wave impact and green-water loads, dynamic positioning, mooring analysis, off-loading operations, shallow-water mooring, and deep-water model testing of Spars, Semis, TLPs and FPSOs. The course is offered by a team of experts from MARIN's offices in Houston and Wageningen.

MARIN's Ship Hydrodynamics course is concerned with the essential role that hydrodynamics play in ship design. This course covers the various hydrodynamic aspects (resistance, propulsion, manoeuvring and seakeeping) and presents them in a balanced and integrated way. Additionally, the physical background, as well as the techniques and tools available today, are thoroughly surveyed. Case studies are offered for direct application of the acquired information to selected practical problems. ***Professional development at MARIN Academy BV includes regular meetings, in MARIN's biweekly focus groups, with professionals involved in maritime-engineering consulting in order to exchange practical expertise. That professional development, bespoke to the maritime engineering sector, further enhances the employability of the ESRs. In concrete terms, the level of both training and attainment expected of the ESRs is such that MARIN Academy BV would be keen to consider them for potential employment.***

Inter-sectoral aspects: The ESRs will also be trained to assist in wave-basin experiments with scaled maritime structures such as model offshore structures. These training sessions will most likely occur under the auspices of the related and prestigious Joint Industry Projects (JIPs) in MARIN's wave basins, and will be lead by experienced MARIN BV technical staff. Laboratory experiments will be selected on the basis that the physical phenomena observed will be relevant for the numerical models that the ESRs are to develop. This training will ensure that the ESRs better understand the physics underlying the numerical models, so that this grounding will prove very extremely beneficial in the execution of various validation tasks that the ESRs will undertake, and in which we they will compare predictions of our numerical models with the laboratory data. The highly transferable broad skill-set – expertise in analysis, programming, experiments, industry and scientific writing – developed by the ESRs clearly offers extreme inter-sectoral mobility in subsequent employment/ activity on an international platform, and across a plethora of sectors.

1.2.2 Role of non-academic sector in the training programme

For the last second 18- months tranche of the 36-month projects, the two ESRs/PhDs will be located at the MARIN Academy BV, i.e. for 50% of the projects' duration, they will be seconded to MARIN Academy BV. The specific contributions of MARIN Academy BV beyond a traditional PhD study at a university include:

- the professional development offered by embedding the ESRs' training within the consulting practice;
- the establishment of open-access simulations tools on MARIN's computing clusters, including validated benchmarking tests,;
- the availability of several types of validating data sets drawn from maritime-engineering practice,;
- the transfer of knowledge in two dedicated courses on maritime hydrodynamics delivered by industrial experts, and;

- the inclusion in measurements and/or public-relation campaigns to obtain new data sets.

Table 1.2 a Recruitment Deliverables per Beneficiary

Researcher No.	Recruiting Participant (short name)	PhD awarding entities	Planned Start Month 0*-45*	Duration (months) 1-44
1.	**ESR1**	**Leeds**	**9**	**9-44**
2.	**ESR2**	**Leeds**	**9**	**9-44**
Total	**2**	**Leeds**	**18**	**72**

** Month 1 is 01-01-2020.*

Table 1.2 b Main Network-Wide Training Events, Conferences and Contribution of Beneficiaries

	Main Training Events & Conferences	ECTS/WP (*if any*)	Lead Institution	Action Month (*estimated*)
1	MSc-Course 1 eg CDTs Fluid Dynamics MATH5453 renewed with fluid-structure interactions	WP1	Leeds	9-12
2	MSc-Course-2 eg Geophys. Fluid Dynamics (GFD) MATH5458	WP1	Leeds	12-16
3	MSc-Course-3 eg Advanced Modern Numerical Methods MATH5476	WP1	Leeds	9-12
4	Generic/transferrable skills/professional development training by University's Staff & Departmental Development Unit; ~4-10days	WP1	Leeds	Within 9-26 (e.g. 14, 18, 22, 24)
5	Hydrodynamics of Floating Offshore Structures	WP1	MARIN BV	2w in 27-38
6	Ship Hydrodynamics	WP1	MARIN BV	2w in 27-38
7	Professional development course with log	WP1	UoL/ MARIN BV	9-44
8	Practical work in measurements campaigns	WP1	MARIN BV	~38 (TBA)
9	Courses at the J.M. Burgers Center for fluid dynamics, 4-5 days each (optional)	WP1	MARI BVN/ Holland	27-40
10	MSc-Course 1 eg CDTs Fluid Dynamics MATH5453 renewed with fluid-structure interactions	WP2	Leeds	9-12
11	MSc-Course-2 eg GFD MATH5458	WP2	Leeds	12-16
12	MSc-Course-3 Advanced eg Modern Numerical Methods MATH5476	WP2	Leeds	9-12
13	Generic/transferrable skills/professional development training by University's Staff & Departmental Development Unit `4-10 days	WP2	Leeds	Within 9-26 (e.g. 14,18, 24,32)
14	Hydrodynamics of Floating Offshore Structures	WP2	MARIN BV	2w in 27-38
15	Ship Hydrodynamics	WP2	MARIN BV	2w in 27-38
16	Professional development log	WP2	UoL/ MARIN BV	9-44
17	Practical work in measurements campaigns	WP2	MARIN BV	~38 (TBA)
18	Courses at the J.M. Burgers Center for fluid dynamics, 4-5 days each (optional)	WP2	MARIN BV/ Holland	27-40
19	ESR/PhD recruitment interviews	WP1&WP2	UoL/ MARIN BV	0-8
20	Kick-off meeting	WP1&WP2	UoL/ MARIN BV	9

21	Training Event/team workshop partners	WP1&WP2	MARIN BV	~16
22	Mid-term review workshop	WP1&WP2	Leeds	~26
23	Training Event/team workshop partners	WP1&WP2	MARIN BV	~27
24	Training Event/team workshop partners	WP1&WP2	MARIN BV	~32
25	Training Event/team workshop partners	WP1&WP2	MARIN BV	~40
26	Conferences/shirt workshops on waves UK/NL; summer schools	WP1&WP2	TBA	20-38
27	Int. Conf. Ocean, Offshore/Arctic Eng.	WP1&WP2	TBA	32-42
28	Int. Conf. Ocean, Offshore/Arctic Eng.	WP1&WP2	TBA	32-42
29	Conference e.g. European General Assembly	WP1&WP2	TBA	32-42
30	ESR/PhD vivas & dissertations	WP1&WP2	Leeds	44-56
31	Outreach ESRs	WP1&WP2	Leeds	9-44

1.3 *Quality of the supervision*

1.3.1 Qualifications and supervision experience of supervisors

The academic supervisors at the School of Mathematics at UoL the University of Leeds are Profs Onno Bokhove and Mark Kelmanson, who have respectively led 11 and 12 PhD students to their PhD degrees; of these 23 students, 2 were jointly supervised on an EU-EID culminating in two dissertations (Gidel 2018 and Salwa 2019). It is noted *en passant* that Gidel's project on water waves led to her winning the University-wide *Postgraduate Researcher of the Year 2017 award.* Joint supervision is the common and preferred method of supervision in the School of Mathematics. Both Profs Bokhove and Kelmanson have followed mandatory teaching and equality-and-diversity training at the beginning of and during (on an ongoing, annual refresher basis) their careers. Prof Bokhove has been co-director of the EPSRC Centre for Doctoral Training in Fluid Dynamics in Leeds, which involves the quality control of teaching and research training of 5 cohorts of PhD students (50 in total) from 2014-2018. Prof Kelmanson has been Head of Applied Mathematics at Leeds since 2016, and he was REF2014 (industrial-)Impact Coordinator for the School of Mathematics and a proactive panellist on the main University "Impact Steering Group"; throughout 2016-17 he also served as an invited member of a national EPSRC Committee that authored the paper "The Era of Mathematics: an Independent Review of KE in the Mathematical Sciences", delivered to the House of Lords in April 2018. Profs Bokhove and Kelmanson are currently joint Impact coordinators for the School of Mathematics' REF2021 submission. In addition, they have considerable experience in teaching both graduate and undergraduate students, and in offering and supervising (jointly and separately) a wide range of projects motivated by societal applications, (e.g. the development of Smartphone apps for innovative mortgage analysis and international tax calculations, and the analysis of public data for modelling improved flood-mitigation schemes). Drs Bunnik and Drummen are the industrial supervisors at MARIN Academy BV seconded by Dr Bulent Duz. They have been involved as external committee members in numerous PhD projects and as industrial supervisors in several MSc and PhD placements, including two EU EID ESRs. Hence, the team of four advisors covers a depth and breadth of supervisory expertise. Prof Bokhove is the overall chair.

1.3.2 Quality of the joint-supervision arrangements

Within one month of arrival, each student must establish a one-year training plan, with their supervisor(s) at Leeds and MARIN Academy BV, including academic (subject-related) courses as well as generic skills training. An agreed plan will be signed and kept on UoL's online monitoring system GRAD, along with subsequent records of completion of training, and is reviewed/updated at each assessment meeting with the student (e.g., in a 6- and 12-month vivas). In line with the UKRI (UK Research and Innovation) and EPSRC (Engineering Council) requirements, all new PhD students (including international ones) are required to take at least 100 lecture hours of assessed taught academic courses over three years. Normally, up to 50 hours are taken and passed in Year 1. Upon completion of each course, the student's understanding of the subject is assessed. Assessment may take various forms (ranging from take-home exams or example sheets to giving presentations) as determined by the lecturer and/or course supervisor. Wherever a numerical (percentage) mark is returned by an examiner/assessor, the pass mark is set at 60% or more; this threshold is also indicative of the standards applicable to other (non-numerical) forms of assessment. Typically, PhD students obtain scores in the mid-80s to high 90s. The choice of suitable taught academic courses varies depending on the student's background, and is driven (but not restricted) by their research project, aiming to build a broader scope and vision in the relevant subject as expected from a modern independent researcher. The courses are normally taught at a postgraduate level and may be taken from several existing MSc programmes within the School of Mathematics or at other Schools (e.g., Physics & Astronomy, Biology, Earth Sciences, Computing, etc. cetera). The MAGIC consortium (https://maths-magic.ac.uk/index.php UK postgraduate courses in mathematics) further offers a wide range of postgraduate-level courses delivered via access-grid interactive technology. Various residential courses are also available at a range of summer schools, as well as occasional UKRI short courses on selected topics, etc. The School of Mathematics also provides a range of advanced graduate courses given by permanent staff and research assistants. In the initial stages of the project, weekly formal meetings with between the individual ESRs and Profs Bokhove and Kelmanson will be arranged and will be recorded in the formal university-wide and electronic postgraduate system GRAD. Prof Bokhove also holds weekly informal group meetings with his research assistants and PhD students, to create a sounding board, e.g. for trialling conference presentations, and to broaden the perspective of his group members beyond their specific projects; often including a socially and intellectually fruitful weekly lunch meeting with the entire group.

1.4 *Quality of the proposed interaction between the participating organisations*

1.4.1. Contribution all participating organisations to research & training programme

Both UoL and MARIN Academy BV will contribute evenly to WP1. The UoL will lead: WP1.1 (subject to MARIN BV's HPC demands); WP1.3 (mathematical focus at UoL) and WP1.7 (wave-current numerics requires MARIN's current-generation settings). MARIN Academy BV will lead: WP1.2 (setting of benchmark tests for MARIN's wave basins); WP1.5 (measurements at MARIN Academy BV with simulations from UoL) and WP1.6 (measurements at MARIN BV with simulations from UoL). The open-access tool in WP1.4 will require equal input from UoL and MARIN Academy BV, as will WP2. The UoL will lead: WP2.1 (mathematical theory); WP2.2 (numerical method for waveflap with settings from MARIN Academy BV); WP2.3 (numerical method) and WP2.7 (novel pseudo-compressible multiphase mathematical and numerical modelling). MARIN Academy BV will lead: WP2.5 (open open-access benchmarking

requirements by MARIN Academy BV) and WP2.6 (measurements at MARIN BV with simulations from UoL). Contributions from both organisations regarding wavebreaking parameterizations will feed into WP2.4. While a training plan will be established upon the arrival of the ESRs, the most relevant main courses will be Fluid Dynamics (UoL's Centre for Doctoral Training in Fluid Dynamics course, partly lectured by Prof Bokhove), Geophysical Fluid Dynamics (lectured by Dr Pegler), Advanced Modern Numerical Methods (taught by Prof Kelmanson) and the Professional Development module (supervised by UoL & MARIN Academy BV supervisors, yielding combined-via-feedback discussions on reflective electronic logs), as well as the two maritime-engineering intensive courses at MARIN BV. This will establish a complementary-yet-integrated training plan for the ESRs with reflections within the professional-development module offering support to bridge the challenging transition from academic to consulting environment midway through the project.

1.4.2. Synergies between participating organisations

Both WP1 and WP2 require an integrated effort by both MARIN Academy BV and UoL, which has been evidenced in section 1.4.1 by highlighting that both organisations alternately take leads on different work-sub-packages, in most of which a shared input is required, as indicated. Consequently, presented training and research programs are synergetic with expertise accruing from both academic and industrial beneficiaries. For example, high-power computing (HPC) in both the UoL HPC-centre and on the HPC cluster at MARIN BV requires a synergetic effort to align the numerical tool in a versatile and transferable manner, ***and access to two HPC centres also serves as risk mitigation***. Crucial benchmark testing on a variety of waves (short-crested, regular/irregular) have been proposed by MARIN Academy BV based on maritime-engineering data. Another example concerns the validating experiments, which are either provided or new bespoke ones are generated via MARIN BV; these measurements are in turn compared with numerical simulations of mathematical scientific-computing tools from UoL.

1.4.3. Exposure of recruited researchers to different (research) environments, and the complementarity thereof

The research and training plans show a balance between the more academic aspects of mathematical and numerical analysis, and the applied mathematics and hydrodynamics required in maritime engineering. The former, training and research, provide the fundamental knowledge required to stimulate the current high-tech maritime maritime-engineering industry. This is also reflected in the 50%-50% division of the ESRs' research time between academic and industrial partners.

In contrast to a traditional PhD- training context, our training is unique to this EID programme. The combined expertise and experience, offered by Drs Bunnik/Drummen and Profs Bokhove/Kelmanson in joint projects, supported in kind by MARIN Academy BV and other institutes and companies, make them well-qualified to assert the importance and timeliness of this project, as follows:

- The Geophysical Fluid Dynamics and Industrial Mathematics Groups at the School of Mathematics at Leeds form a considerable training and research body with a thriving seminar series, and a lively group of junior and senior researchers. Compared with other groups within the EU, The Netherlands and the United Kingdom in particular, this concentration of expertise is unique.
- The research proposed is feasible but recognised to be demanding, in that it requires acquisition of a multidisciplinary body of knowledge, in applied

mathematics and maritime hydrodynamics, comprising, *inter alia*, advanced numerical modelling, variational and Hamiltonian fluid dynamics (ESR1 and ESR2), asymptotics (ESR2), water-wave theory (ESR1) and multiphase fluid dynamics (ESR2), theory of elastic bodies (ESR2) and hands-on expertise to obtain, to interpret and to disseminate laboratory data (ESR1 and ESR2).

- For Applied-Maths PhDs, the augmentation of skills by expert courses on maritime hydrodynamics and practical training sessions at the wave basins, at MARIN Academy BV is unique. While the integration of laboratory fluid dynamics and applied mathematics has been a strong British tradition, the very large-scale wave-basin experiments on maritime hydrodynamics in an industrial- consulting setting at MARIN Academy BV sets our programme apart from its competitors.
- The immersion of the ESRs in the consulting environment of MARIN Academy BV for the second part of the program will be an asset to their professional careers. The ESRs will be strongly encouraged to participate in MARIN BV's informal (bi)weekly focus groups, such as the wave group.
- The ESRs will significantly benefit from being Associate Members of the EPSRC Centre for Doctoral Training (CDT) in Fluid Dynamics at Leeds. Prof Bokhove is a management-board member and has been co-director of the CDT since 2014. Through the CDT, ESRs will be able to access advanced scientific-training courses, professional-development training tailored to PhD students in Fluid Dynamics (and related disciplines) and peer support through interaction with cohorts of 40 CDT students at Leeds. To accommodate a smooth transition between the academic and consulting environments, we will closely monitor the professional development of the ESRs, using an online reflective log, akin to the successful CDTs professional-development module. ESRs will also actively engage with the CDT seminar program, dissemination and communication events such as the annual poster competition, tweet-your-thesis and the annual Fluids Symposium.

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2. Impact

2.1 *Enhancing the career perspectives and employability of researchers and contribution to their skills development*

The training plans and research proposal have a synergy comprising elements of academic expertise from UoL and industrial/consulting practice from MARIN Academy BV. MARIN Academy BV undertakes bespoke consulting for a wide range of commercial maritime companies and the ESRs will be in unique position to establish contact with the international maritime-industry community. Bespoke courses and professional development workshops/day-courses from UoL will provide training to get the ESRs up to speed for commencing a challenging training and research program. The courses provided by and at MARIN Academy BV, also used and available for their own personnel and other professionals, will provide the ESRs with the skills to be employable as high-level consultants in maritime engineering or fluid dynamics, with a focus on applied and numerical mathematics. To facilitate the transition between academia and consultancy, a professional development module, drawing on an existing one in our Doctoral Training Centre, will be employed to reflect (in a (bi)weekly log) on the academic progress in both organizations. Altogether, our integrated research training will make the ESRs very highly employable given the versatile skill they will obtain.

2.2 *Contribution to structuring doctoral/early-stage research training at the European level and to strengthening European innovation capacity including contribution non-academic sector:*

MARIN Academy BV will provide two training courses for the ESRs, provide (bi)weekly supervisions sessions, including discussion of the professional professional-development log. In the last 18 months of during the placement, biweekly sessions at MARIN Academy BV will be augmented by both Skype meetings with (one of) the UoL academic advisors, as well as bimonthly visits by (one of) them to MARIN Academy BV, and, *vice versa*, by bimonthly joint Skype sessions involving industrial supervisors in the first 18 months. Meetings will in general be such that both academic and management sessions will taken place in one bigger session, with the action points made and finalized via (emailed) summaries/minutes. The academic progress will also be logged weekly into the UoL postgraduate GRAD system, as is a mandatory procedure for all PhD students and their advisors.

2.3 *Quality of proposed measures to exploit and disseminate results*

Dissemination of the research results

The research results will be disseminated as follows:

- The final accumulation of our proposed training and research efforts will be two approved PhD dissertations, one each by the two ESRs, with the deadline for submission being four years after the start of the PhD training.
- En route to these dissertations, and also after the PhD vivas, we will be publishing results in academic journals (e.g. fluid dynamical, numerical and engineering journals such as J. of Fluid Mech., J. Comput. Physics, J. Eng. Math.).
- En route to journal article publications, in order also to disseminate findings within the maritime-engineering community, we will submit abstracts to present and/or publish refereed papers to bespoke conferences such as the International Conference on Ocean, Offshore/Arctic Engineering (OMAE), European Geoscience Union (EGU), the International Workshop on Water Waves and Floating Bodies,

Young Mathematician Colloquium and British Applied Mathematics Colloquium (UK), Isaac Newton Institute workshops, etc.
- Research results will be disseminated via the new Leeds Institute for Fluid Dynamics (LIFD) and the industrial liaison within LIFD, of which the ESRs will be members.

2.4 *Quality of the proposed measures to communicate the activities to different target audiences*

Communication and public engagement strategy

The following engagement activities will be developed/maintained:.

(a) Launching and maintenance of active Wordpress blog, Facebook page, webpages and Twitter account throughout the projects; items for MARIN's/MARIN BV's website and news items, announcement of presentations, new results, activity summaries etc., augmented by the presentation of movies and photo impressions; and, proactive external stimulation to seed invitations invited to give public presentations.
(b) Participation in UoL recruitment open days using our bespoke wavetank.
(c) Participation in open days at MARIN Academy BV.
(d) Presentations at Café Scientifique in Headingley/PubPhD, Leeds, using our bespoke wavetank.
(e) Participation in Be Curious Science festival at UoL with wavetank.
(f) Presentations at schools and the Open University, talks for seniors in the ESRs respective home countries.
(g) Where appropriate, participate participation in competitions for the best research at UoL or the UK fluid-dynamics/research community.
(h) Publication of research in popular science or mathematics community magazines, and in outreach sessions of the bespoke, international maritime-engineering and geophysical conferences mentioned in section 2.3.

The application team has experience of, or has been involved with their students in all of the above activities. The aim is to have two wider-audience activities per year per year, concerning (c)-(h), i.e. six in total, either withe both ESRs acting either together or separately as or in operate activity per ESR, where appropriate, which is summarised in Table 2.4.

Table 2.4 Implementation of outreach activities

Outreach Activity	Target Audience	Expected Impact
(a) Launching of Facebook, Twitter pages and WordPress blog site; MARIN (BV) webpage & news items	Marine/coastal-engineering professionals, maker-designers, artists, students, peers, teachers, interested members of public	Wider audience for water dynamics and its impacts
(b) Continued PR on Blog & Facebook/Twitter pages	Audiences connected to Blog, Facebook, Twitter	Increased awareness arts & science; importance of visualisation in maths
(c,f) Participation in Open Days UoL & MARIN (BV)	Wider audience, clients, prospective students	Awareness of versatility of mathematics
(e,f,g) Lecture-demonstration for Café Scientifique/festivals/Schools.	National, local, regional groups & learning institutions, such as Café Scientifique	Impacts among local/ regional learning institutions and groups
(h) Participate in competitions	Wider scientific & public audience	Communicate beauty of waves & fluid dynamics
(i) Publication popular science journals	Readership popular science journals	Communicate beauty of waves & fluid dynamics

3. Quality and Efficiency of the Implementation

3.1 Coherence and effectiveness of the work plan

Table 3.1d Individual Research Projects

Fellow ***(e.g. ESR1)***	**Host institution**	**PhD enrolment (Y/N)**	**Start date** ***(e.g. Month 6)***	**Duration** ***(e.g. 36 months)***	**Deliverables** ***(refer to numbers in table 3.1b)***
ESR1	**UoL-MARIN Academy BV**	**Y**	**9**	**36**	**D1-D11, D15, D21, D22, D23, D25, D27, D31-D35, D27, D28, D36-D44**

Project Title and Work Package(s) to which it is related: WP1 ExtremeWaves

Objectives: Nonlinear extreme water-wave modelling using geometric mathematics and numerics, and validation, with application for maritime engineering.
WP1.1 Create a complete numerical finite-element wavetank for high-amplitude potential-flow water waves with a breaking-wave parameterization, optimized for parallel computing, wave generation and wave damping at beaches, in both 2D and 3D. Explore coordinate transformations as well as dynamic-mesh motion.
WP1.2 Develop and deliver a series of benchmark cases (soliton splash, Stokes, Rienecker-Fenton, (ir)regular, short-crested waves, etc.) for the wavetank in WP1.1.
WP1.3 Derive mathematical and variational/Hamiltonian formulation of wave-current interactions for constant-vorticity flows, with and without shear, in 2D (i.e. vertical cross section).
WP1.4 Deliver an open-access, fast and easy-to-use water-wave wave-simulation and scientific - computation tool in finite-element environment Firedrake using free-surface/interior interior-dynamics coupling, in both 2D/3D for maritime-engineering testing applications at MARIN BV.
WP1.5 Validate the open-access numerical water-wave tank against (new) wave basin measurements in 3D at MARIN BV.
WP1.6 Explore basin measurements at MARIN BV with currents, in 2D (optional); compare with open-access numerical wave-current tank against (new) wave.
WP1.7 Explore compatible/variational numerical formulations of wave-current interactions for constant-vorticity flows, with and without shear, in 2D; create a bespoke wave-current numerical tool in the finite-element environment Firedrake (optional explorations).

Expected Results: PhD dissertation on nonlinear extreme water-wave modelling and validation; the potential-flow water-wave modelling and breaking-wave parameterizations are common and shared aspects of ESR1 & ESR2 as well as the general context of the mathematics of water waves.

Planned secondment(s): MARIN Academy BV In months 27-44; leads WP1.4, 1.5, 1.6.

Enrolment in Doctoral degree(s): School of Mathematics, UoL, Leeds, UK
University of Leeds will issue a PhD certificate for each ESR to be recruited after the ESR has successfully defended his/her PhD thesis.

Fellow ***(e.g ESR1)***	**Host institution**	**PhD enrolment (Y/N)**	**Start date** ***(e.g. Month 6)***	**Duration** ***(e.g. 36 months)***	**Deliverables** ***(refer to numbers in table 3.1b)***
ESR2	**UoL-MARIN Academy BV**	**Y**	**9**	**36**	**D12-D22, D24, D26, D31-D35, D27, D28, D36-D44**

Project Title and Work Package(s) to which it is related: WP2 WaveTurbineImpact

Objectives: Geometric modelling of water-wave impact on dynamic and flexible (wind-turbine) structures.
WP2.1 Formulate nonlinear mathematical theory of potential-flow water waves coupled to a nonlinear hyperelastic beam (wind-turbines) in 2D/3D, also using asymptotic two-way feedback.
WP2.2 Derive a compatible numerical discretization of potential-flow water-wave motion and prescribed beam (or waveflap) motion in 2D.
WP2.3 Derive compatible numerical discretization of potential-flow water-wave motion and nonlinear hyperelastic beam (or waveflap) motion in 2D, using asymptotic/full two-way coupling.
WP2.4 Include (modified) wave-breaking parameterizations formulated in ESR1's project to the wave-structure modelingodelling.
WP2.5 Deliver an open-access, fast and easy-to-use water-wave-structure simulation and scientific-computation tool in the finite-element environment Firedrake using free-surface and interior-dynamics coupling, in both 2D and 3D. Formulate and include benchmark test-cases.
WP2.6 Validate the wave-structure numerical tool against experimental measurements of wave-impact on elastic beams.
WP2.7 Provide and explore the variational formulation of mixture-theory water-wave model in the Eulerian framework, using Euler-Poincaré theory and given its Euler-Boussinesq-equation limit. Couple this water-wave model variationally to the nonlinear beam (wind-turbine mast). Consider and explore numerical water-wave motion in a compressible Van-der-Waals fluid model, in its potential-flow limit, and compare this computational model with a classic finite-volume formulation using a continuous equation of state. Explore imposition of incompressibility (optional).

Expected Results: PhD dissertation on water-wave impact on dynamic and flexible (wind-turbine) structures; the potential-flow water-wave modelling and breaking-wave parameterizations are common and shared aspects of ESR1 & ESR2 as well as the general context of the mathematics of water waves.

Planned secondment(s): MARIN Academy BV in months 27-44; leads WP2.4, 2.5, 2.6.

Enrolment in Doctoral degree(s): School of Mathematics, UoL Leeds, UK
University of Leeds will issue a PhD certificate for each ESR to be recruited after the ESR has successfully defended his/her PhD thesis.

3.2 Appropriateness of the management structures and procedures

Network organisation and management structure

The financial-management strategy is both straightforward but and already proven to be effective for our compact team of beneficiaries:

- The UoL's EU Financial Office monitors the proposed budget and checks outgoing costs;
- similarly, the Mathematics, and Applied Physical Sciences Faculty (MAPS) manages the budget and checks all outgoing costs, according to the budget set at the start of the project (conferences, salaries, experimental costs, etc.);
- the main costs are the ESRs' salaries, which are set by EU rules, with the only uncertain aspect being the Euro-to-pound-sterling exchange rate, as well as the costs of the experiments budgeted; and,
- further, but much lower, costs are the travel budget and HPC costs.

Hence, within the limits of uncertainty in currency fluctuations, the financial costs are

constrained and manageable, with several built-in safeguards.

The UoL has clear and internationally-recognized rules for dealing with scientific misconduct, including a detailed set of rules for the PhD viva and an obligatory postgraduate-tracking GRAD following system (GRAD). In addition, we have set up a novel professional professional-development log, to enhance reflection on the combined academic and consulting environments that the ESRs will encounter.

Joint governing structure

The governance structure is straightforward yet effective: it consists of the four supervisors, with Prof Bokhove as PI acting as chair, holding regular formal and scheduled meetings (bimonthly in months 1-18, biweekly in month 19-36, via Skype/Facetime, and scheduled vis-à-vis meetings in the Deliverables and Milestone lists). The supervisory board keeps an eye on matters and will moderate in any (rare) cases that demand interventional action.

Supervisory board

We propose that the Supervisory Board will consist of the Director of Research in Applied Mathematics at the School of Mathematics, Prof. Steve Tobias (director of LIFD, co-director of Leeds' CDT in Fluid Dynamics), and MARIN Academy BV's R&D Department Managers, Dr Henk Prins. Upon arrival, a personalised training plan will be drafted for both ESRs, tailored to their specific educational backgrounds. This training plan will be forwarded to the Supervisory Board for advice. The role of the Supervisory Board will be to oversee the supervision of the ESRs. This process will be reinforced by the quality quality-assessment procedures already in place at the School of Mathematics and UoL concerning research assessments of PhD Students. These assessments take place at 6- and 12-months vivas, and involves a small committee (that excludes any direct supervisors) consisting of two staff members, from the School of Mathematics/UoL, with related/cognate expertise.

Recruitment strategy

The hiring of two ESRs consists of making appropriate advertisements together with HR, posting them on various sites (see below), selecting the applications by the hiring committee, and conducting subsequent interviews. The hiring committee envisioned will consist of Profs Bokhove and Kelmanson, Prof Cath Noakes (Civil Engineering, co-director of Leeds' CDT Fluid Dynamics, with ample experience in the Athena-SWAN Charter – the UKs higher-education charter for recognition and advancement of gender equality) and Drs Bunnik/Drummen (electronic attendance) as well as HR-staff (School of Maths' Senior Administrator's lead secretary, given her vast experience). Sample sites are: Researchgate, (mandatory) Euraxess https://euraxess.ec.europa.eu/; Leeds Job Centre Plus http://jobs.leeds.ac.uk/; http://www.ukro.ac.uk/Pages/UKRO.aspx, FindaPhD https://www.findaphd.com/

Progress monitoring and evaluation of individual projects

Four supervisors will assume the role of daily advisors, two each at UoL and MARIN Academy BV. Progress will be monitored via UoL's postgraduate-monitoring system GRAD, with weekly entries, as well as the professional professional-development (bi)weekly log; these two aspects are, respectively evaluated by the UoL and by all supervisors. There are official UoL progress meetings after 6 and 12 months as well as in the last final (3rd) year and at the end of the three years. Each of these meetings is based on reports reviewing the taught-course work progress (first year), the research progress in terms of research progress reports, as well as a detailed

thesis outline plan for the last meeting before the PhD viva. These meetings are part of the standard protocol in the GRAD system, monitored by GRAD staff.

Gender aspects

We aim to satisfy a gender balance, with a minimum of one female appointment, and to uphold a positive bias in favour of hiring women, within the remit of finding candidates with a suitable background to the training and research proposed. Advertisements will be screened towards gender balance, equality and diversity, according to the School of Mathematics' commitment to promoting the enhancement of hiring more women in mathematics, and according to UoL's commitment in the Athena-SWAN charter (advancement of gender equality).

Data-management plan

A data-management plan (DMP) outlining how the project-generated data or software will be handled during and beyond the life of the EID will be prepared by month 6 of the project. It will be reviewed biannually by the Supervisory Board, but also on an ad hoc basis, if new data are generated or new potential users are identified as the project progresses. The DMP will be prepared using online data-management tools, and will contain a description of the dataset and address issues concerned with data sharing, standards and metadata, archiving and preservation.

Exploitation of results and intellectual property

The results will be exploited as follows:

- All codes are intended to be exploited under an open open-license agreement (cf. Firedrake), meaning that bespoke proprietary consulting applications can be based on our codes provided this is clearly acknowledged in public; direct commercial application of developed codes needs to be done in direct and explicit collaboration.
- Under that agreement MARIN Academy BV can build bespoke applications for its own consulting practice, which is one of the aims of the project. Direct consulting applications will in principle not be part of the ESR- project, given its default focus on both training and research purposes.

3.3 *Appropriateness of infrastructure of participating organisations*

Our programme is primarily a computational program augmented by experimental data, existing or novel, for validation. Both beneficiaries have between them the computational resources and infrastructure, including HPC centres, waves basins and wave tanks, to undertake the training and research proposed. In addition, we have budgeted for laptops and workstations for state-of-the-art basic facilities and efficient transferral of information, including for giving presentations world-wide.

3.4 *Competences, experience and complementarity of the participating organisations and their commitment to the programme*

Regarding the training of the ESRs, UoL will assume the lead role in the basic training on water-wave modelling, the numerical and applied mathematics, while MARIN Academy BV will be responsible for the professional maritime maritime-engineering workshops. Pertaining to the research, this division of tasks again holds; see also section 1.4.2 and Table 1.2b. This compatibility of the tasks – including some evenly-balanced, mutually-coherent tasks – has been detailed in section 1.4.

Commitment of beneficiaries and partner organisations to the programme

We have created a well-balanced training and research program, in which the beneficiaries will take the lead on different aspects of the work-packages. This has been indicated in the Milestone list in Table 3.1c. Briefly, the UoL will take the lead on mathematical and numerical training and research, while Academy BV will take the lead on setting the benchmark tests, developing the final open-access simulation tool and conducting the wave wave-basin experiments, all leads being aligned according to the expertise in the partner organisations.

DOCUMENT 2

4. EID specific requirements (for EID only)

For the EID mode the following table should be included indicating for each fellow the time spent in the academic and non-academic sectors confirming that each individual fellow spends at least 50% of their time in the non-academic sector (Check 1) and the mobility between academic and non-academic beneficiaries is international (Check 2). Also indicate the time spent in partner organisations (irrespective of the sector) restricting it to a maximum of 30% of the fellowship duration (Check 3).

Fellow *(e.g. ESR1)*	**Recruiting institution***	**Time spent in Academic beneficiary (ies)****	**Time spent in Non-Academic beneficiary (ies)****	**Time spent in Non-Academic Partner organisa-tions****	***Time spent in Academic partner organisa-tions****	**Check 1**	**Check 2**	**Check 3**
ESR1	University of Leeds	University of Leeds (UK) first 18 months	MARIN Academy BV (NL) last 18 months	-	-	Yes 50%	Yes UK- NL	-
ESR2	University of Leeds	University of Leeds (UK) first 18 months	MARIN Academy BV (NL) last 18 months	-	-	Yes 50%	Yes UK- NL	-

*** - indicate status Academic/Non-academic and country**
****-indicate entity name, country, and number of months to be spent**

6. Ethics Issues

Research at the both MARIN Academy BV and the University of Leeds is conducted according to the principles of academic excellence, integrity, inclusiveness and professionalism. Research and training is always conducted to high ethical standards and supports both the academic freedom of researchers as well as the reputation of both MARIN Academy BV and the University of Leeds as organisations conducting world-class consulting, research and training in a responsible manner, and always within the bounds of relevant legislative and regulatory frameworks.

ESTIMATED BUDGET FOR THE ACTION

Associated with document Ref. Ares(2019)7645804 - 12/12/2019

			Estimated eligible[1] costs (per budget category)											EU contribution		
			A. Costs for recruited researchers						B. Institutional costs				Total costs	Reimburse-ment rate %	Maximum EU contribution[2]	Maximum grant amount[3]
			A.1 Living allowance		A.2 Mobility allowance		A.3 Family allowance		B.1 Research, training and networking costs		B.2 Management and indirect[4] costs					
	Number of units (person-months)	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[6,8]	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. UNIVLEEDS	72.00		4 571.46	329 145.12	600.00	43 200.00	250.00	18 000.00	1 800.00	129 600.00	1 200.00	86 400.00	606 345.12	100.00	606 345.12	n/a
2. MARINBV	0.00			0.00		0.00		0.00	1 800.00	0.00	1 200.00	0.00	0.00	100.00	0.00	n/a
Total consortium	72.00		n/a	329 145.12	n/a	43 200.00	n/a	18 000.00	n/a	129 600.00	n/a	86 400.00	606 345.12	100.00	606 345.12	606 345.12

[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's 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 it can demonstrate that the operating grant does not cover any costs of the action.
[5] See Article 5 for the 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] The amount for the family allowance inserted by the system represents an average (with/without family). For the financial statements (Annex 4), this amount will be adjusted according to the actual family status of the recruited researchers (as specified in the 'researcher declaration').

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-ITN 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-ITN 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:
    - ITN: **EUR 3 110**
  - 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:
    - ITN: **EUR 3 270**
  - 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.

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

MARIN ACADEMY BV (MARINBV), established in Haagsteeg 2, WAGENINGEN 6708 PM, Netherlands, VAT number: NL811941024B01, ('the beneficiary'), represented for the purpose of signing this Accession Form by the undersigned,

hereby agrees

to become beneficiary No ('2')

in Grant Agreement No 859983 ('the Agreement')

between UNIVERSITY OF LEEDS **and** the Research Executive Agency (REA) ('the Agency'), under the powers delegated by the European Commission ('the Commission'),

for the action entitled 'Eagre/Aegir: high-seas wave-impact modelling (EAGRE)'.

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 55.

By signing this Accession Form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and conditions it sets out.

SIGNATURE

For the beneficiary

Bas BUCHNER with ECAS id nbuchnba signed in the Participant Portal on 19/12/2019 at 13:41:43 (transaction id SigId-14397-NeFlOw7vDD015HRRDmgJDo1zn1vOD3jmhcd1Jaow5EL8Iyk4dBetnLPzZZmfc9zWvX1xEUH3WxKWVxsqztdtifC-jpJZscgsw0KNHFpIKRQGQu-XjYxbgFCoZHwVXv2YNscAX9zxAbBXqWWQbh1RxzxczyO). Timestamp by third party at Thu Dec 19 13:41:49 CET 2019

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MODEL ANNEX 4 FOR H2020 MGA MSCA-ITN — MULTI

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

Name of the fellows [6]	Number of units (person-months)
Total beneficiary	

Form of costs [3]	**Eligible** [1] **costs (per budget category)**											**EU contribution**		
	A. Costs for recruited researchers						**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					
	Unit		Unit		Unit		Unit		Unit					
	Costs per unit [4]	Total a [5]	Costs per unit [4]	Total b5	Costs per unit [4]	Total c [5]	Costs per unit [4]	Total d [5]	Costs per unit [4]	Total e [5]	f = a+b+c+d+e	g	h	i
Total 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 or that any underpayments in reporting period 1 will be corrected by the end of the action.

Checkbox 2:	Did you receive any EU/Euratom operating grant during this reporting period?	❍ 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: - the operating grant is a partial operating grant (i.e. does not cover your entire annual budget) - you have used analytical accounting which allows for a cost accounting management with cost allocation keys and cost accounting codes - you have recorded: - all costs incurred for the operating grant (i.e. personnel, general running costs and other operating costs linked to the work programme) and - all costs incurred for the action grants (including the indirect costs linked to the action)~~ion)~~ - 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) - 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 person-months, even if you exceed the estimated budget (see Annex 2). Only person-months 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

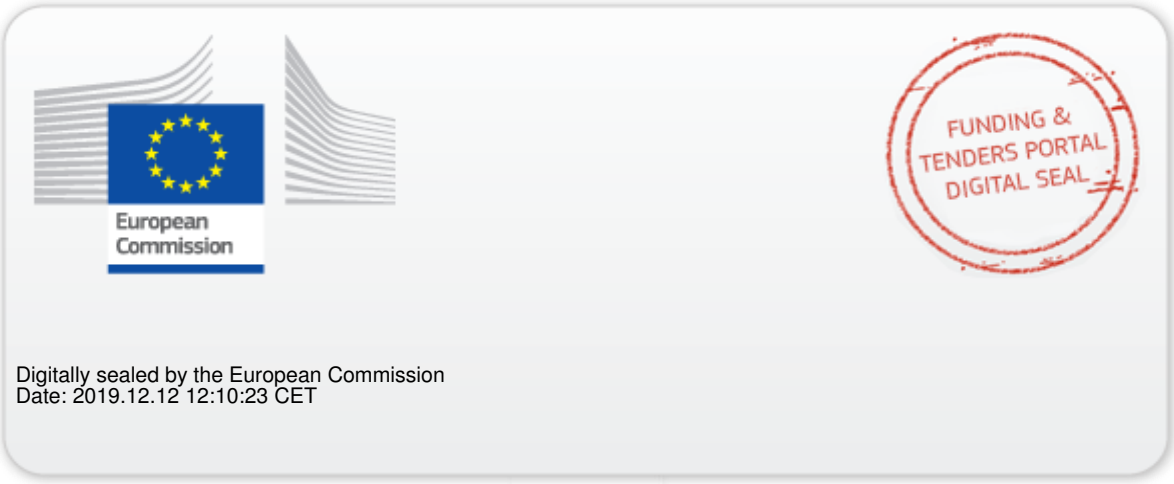
[2] The indirect costs claimed must be free of any amounts covered by an operating grant (received under any EU or Euratom funding programme; see Article 6.3(b)). If you have received an operating grant during this reporting period, indirect costs will not be reimbursed for the person-months incurred 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)

[6] Name of the researcher and related units for living (A.1) and family (A.3) allowances will be prefilled on the basis of the information provided by the beneficiary in the 'researcher declaration'



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