DATA MANAGEMENT PLAN

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Project full title	Metrology for the harmonisation of measurements of environmental pollutants in Europe
Data management plan	1st ☐ 2nd ☒
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1 Data management plan

1.1 Data summary

Questions	Answers
1 Will you re-use any existing data and what will you re-use them for? State the reasons if re-use of any existing data has been considered but discarded.	This project re-used internal data from the participants: • Activity concentration of radioactive standards used for the preparation of material for the intercomparisons in WP1 • Quality systems which cover the requirements for reference material production based on ISO 17034 and ISO 33405 in WP3 and WP4. This project re-used publicly available data 1. Isotope ratios of publicly available reference materials. This dataset was re-used in A2.1.1. 2. A paper describing the synthesis path for the solid reference material. This dataset was re-used in A3.3.1 to A3.3.2.
2 What types and formats of data will the project generate or re-use?	The project collected: • Raw data in ASCII format • Processed data in XLSX or CSV format • Uncertainty calculations in XLS or MSU format • Text in DOCX or PDF format • Presentations in PPT or PDF format • Figures and pictures in JPG format
3 What is the purpose of the data generation or re-use and its relation to the objectives of the project?	*Purpose of the data generation or re-use* The data generated and re-used was from measurements, calibrations, comparisons and validations. They were used in meeting the project's objectives and in conference and peer-reviewed publications. *Data generated in relation to the objectives of the project* Data were generated by the consortium to meet objectives 1 - 4. Measurement and calibration data resulted from objectives 1 and 2 and comparison and validation data from objectives 3 and 4. Data from professional workshops were used to support end-user uptake (objective 5). The project generated the following datasets: 1. Additional data for the deliverable "D1: Inter-laboratory comparison report for low-level radionuclide detection by mass spectrometry." https://oar.ptb.de/resources/show/10.7795/720.20260113 Contributed to meeting objective 1. 2. Additional data for the deliverable "D6: Inter-laboratory comparison report, describing sample preparation requirements, sample introduction methods, and uncertainty budgets." https://doi.org/10.7795/720.20260121. Contributed to meeting objective 3. *Data re-used in relation to the objectives of the project* Measurement, calibration, comparison and validation data were re-used by the consortium to meet objectives 3 and 4. The project re-used 2 datasets from outside of the project for the purposes specified in question 1 above. Their relation to the objectives of the project is specified below: 1. Isotope ratios of publicly available reference materials. Contributed to meeting objective 1. 2. A paper describing the synthesis path for the solid reference

	material. Contributed to meeting objective 3.
4 What is the expected size of the data that you intend to generate or re-use?	The overall size of the generated data was approximately less than 1TB.
5 What is the origin/provenance of the data, either generated or re-used?	*Data generated in the project* The data generated was from measurements, calibrations, comparisons and validations and are published in the seven Deliverables D1 -D7 and are available in the trusted repository PTB-OAR under the Links: https://doi.org/10.7795/120.20251017C https://doi.org/10.7795/120.20251017D https://doi.org/10.7795/120.20251017A https://doi.org/10.7795/120.20251017B https://doi.org/10.7795/110.20250603 https://doi.org/10.7795/810.20251106 https://doi.org/10.7795/120.20251218 The project generated 2 datasets extracted from the deliverables. The provenance of both datasets are “Data from an inter-laboratory comparison”. *Re-used data* The existing data originated from several sources, which included: participant’s pre-existing data, data from the scientific literature, real-world measurement data and data from simulation experiments The project re-used 2 datasets which originated from the following external sources (from outside of this project): 1. Isotope ratios of publicly available reference materials (as listed in Table 1 of Deliverable D3). 2. A paper describing the synthesis path for the solid reference material. Harms, A., Gilligan, C., 2012. Development of synthetic environmental radioactivity reference materials. Appl. Radiat. Isot., Proceedings of the 18th International Conference on Radionuclide Metrology and its Applications 70, 1940–1943. https://doi.org/10.1016/j.apradiso.2012.02.055
6 To whom might your data be useful ('data utility'), outside your project?	The data will be suitable for use by other research groups working on the following topics: measurement of stable and radioactive isotopes in the environment. It will also be useful for standards committees including BIPM CCQM IRWG, BSI RMI/1, CEN/TC 230 (Water quality), CEN/TC 264 (Air quality), CEN/TC 444 (characterisation of solid matrices), CIAAW, EURAMET TC-IR, EURAMET TC-MC, ISO/REMCO, ISO/TC 085/SC 02/WG 17 (Radioactivity Measurements) and ISO/TC 147/SC 3 (Water quality- radioactivity measurements). Data were provided to: CCQM-IAWG, CCQM-IRWG, CCQM-TG-Food, CCRI(II)-TG-MS, CEN TC 460 (Food authenticity), CIAAW, DIN NA 062-08-15 AA "Grundlagen der Atomspektroskopie", and ISO/TC 147/SC 3 (Water quality- radioactivity measurements) The data might be useful to: • Stakeholders from industry: Manufacturer of Mass Spectrometry Systems • Standardisation bodies as listed above • NMIs/Dis engaged in CCRI and CCQM

	• Decision makers responsible for EU regulations and directives

1.2 Findable, Accessible, Interoperable and Re-usable (FAIR) Data

1.2.1 Making data findable, including provisions for metadata

Questions	Answers
7 Will data be identified by a persistent identifier?	Yes, each of the project's deposited datasets is identified by: DOI
8 Will rich metadata be provided to allow discovery? What metadata will be created? What disciplinary or general standards will be followed? In case metadata standards do not exist in your discipline, please outline what type of metadata will be created and how.	The metadata created for all of the project's deposited datasets was open under a Creative Commons Public Domain Dedication (CC 0) or equivalent (to the extent legitimate interests or constraints are safeguarded), in line with the FAIR principles (in particular machine-actionable) and provided information at least about the following: datasets (description, date of deposit, author(s), venue and embargo); the European Partnership on Metrology funding; grant project name, acronym and number; licensing terms; persistent identifiers for the dataset, the authors involved in the action, and, where possible, for their organisations and the grant. Where applicable, the metadata included persistent identifiers for related publications and other research outputs.
9 Will search keywords be provided in the metadata to optimise the possibility for discovery and then potential re-use?	Yes, the following search keywords were provided in the metadata to optimise the discovery and potential re-use of the deposited datasets: environmental pollutants, European Green Deal, mass spectrometry, reference material, traceability, measurement uncertainty, detection limit.
10 Will metadata be offered in such a way that it can be harvested and indexed?	Yes, the data/research outputs were deposited and published in the trusted repository PTB-OAR.

1.2.2 Making data accessible

Questions	Answers
Repository:	
11 Will the data be deposited in a trusted repository?	The data and associated metadata, documentation and code are deposited in the trusted open access repository PTB-OAR (https://oar.ptb.de).
12 Have you explored appropriate arrangements with the identified repository where your data will be deposited?	No, the data were uploaded via a standard procedure and required no special arrangements.
13 Does the repository ensure that the data are assigned an identifier? Will the repository resolve the identifier to a digital object?	Yes, the PTB-OAR and Zenodo assigned an identifier (DOI) to each of the project's deposited datasets. Both repositories resolve the identifier to a digital object.
Data:	
14 Will all data be made openly available? If certain datasets cannot be shared (or need to be shared under restricted access conditions), explain why, clearly separating legal and contractual reasons from intentional restrictions. Note that in	All the data that were needed to validate the results presented in scientific publications were made openly available as the default, unless there was a specific reason not to publish the data.

Questions	Answers
multi-beneficiary projects it is also possible for specific beneficiaries to keep their data closed if opening their data goes against their legitimate interests or other constraints as per the Grant Agreement.	
15 If an embargo is applied to give time to publish or seek protection of the intellectual property (e.g. patents), specify why and how long this will apply, bearing in mind that research data should be made available as soon as possible.	The data used in scientific publications, posters and oral communications was/will be made available for re-use as soon as is reasonably possible. The data and datasets mentioned in point 3 and 5 of this plan are all part of the seven Deliverables of the project. These deliverables are published on the webpage of MetroPOEM https://www.npl.co.uk/euramet/metropoem as well as in the trusted open access repository PTB-OAR (https://oar.ptb.de)
16 Will the data be accessible through a free and standardised access protocol?	Yes, the PTB Open Access Respository provides access to the data using the free and open OAI-PMH protocol, which is documented here: https://www.openarchives.org/pmh/
17 If there are restrictions on use, how will access be provided to the data, both during and after the end of the project?	There are no restrictions on the use of the published data, but users will be required to acknowledge the project and the source of the data in any resulting publications, according to the CC-BY 4.0 license. As some data have restricted access, access will only be provided after personal contact to the authors via the repository interface.
18 How will the identity of the person accessing the data be ascertained?	If necessary, an authentication system or a data on demand function will be provided.
19 Is there a need for a data access committee (e.g. to evaluate/approve access requests to personal/sensitive data)?	This consortium did not establish a data access committee. The coordinator, with support from the participants, had the overall responsibility for the management of data/research outputs and quality assurance. The coordinator, with support from the participants, was responsible for coordinating updates to the data management plan and for deciding on a case-by-case basis which data/research outputs will be kept and for how long. The participant(s) that produced the data is responsible for organising backup and storage, archiving, and for depositing the data/research outputs within the chosen repositories.
Metadata:	
20 Will metadata be made openly available and licensed under a public domain dedication CC0, as per the Grant Agreement? If not, please clarify why. Will metadata contain information to enable the user to access the data?	In PTB-OAR and Zenodo, metadata are licensed under CC0, except for email addresses. All metadata are exported via OAI-PMH and can be harvested.
21 How long will the data remain available and findable? Will metadata be guaranteed to remain available after data are no longer available?	The data will remain available and findable for the lifetime of the PTB-OAR repository, which is expected to be a minimum of 20 years. If data are withdrawn from PTB-OAR, the DOI and the URL of the original object are retained. In case of closure of the PTB-OAR repository, best efforts will be made by PTB-OAR to integrate all content into suitable alternative

Questions	Answers
	institutional and/or subject based repositories. The data will remain available and findable for the lifetime of the Zenodo repository, which is expected to be a minimum of 20 years. If data are withdrawn from Zenodo, the DOI and the URL of the original object are retained. In case of closure of the Zenodo repository, best efforts will be made by Zenodo to integrate all content into suitable alternative institutional and/or subject based repositories.
22 Will documentation or reference about any software be needed to access or read the data and will this be included? Will it be possible to include the relevant software (e.g. in open source code)?	The data are in a common format (MS office, PDF) and can be read using widely available software (open source or commercial).

1.2.3 Making data interoperable

Questions	Answers
23 What data and metadata vocabularies, standards, formats or methodologies will you follow to make your data interoperable to allow data exchange and re-use within and across disciplines? Will you follow community-endorsed interoperability best practices? Which ones?	The datasets use the trusted repository's basic metadata schema for administrative data, which is compliant with the recommended standards used by DataCite (https://search.datacite.org/) and OpenAIRE (https://www.basesearch.net/). For individual datasets, the following discipline-specific vocabularies, standards, formats, and methodologies are used: • GUM (procedure; subject-independent).
24 In case it is unavoidable that you use uncommon or generate project specific ontologies or vocabularies, will you provide mappings to more commonly used ontologies? Will you openly publish the generated ontologies or vocabularies to allow their re-use, refinement or extension?	Mapping was not required as the terminology used was chosen to be compatible with the existing literature.
25 Will your data include qualified references[1] to other data (e.g. other data from your project, or datasets from previous research)?	Yes, the project's datasets deposited in the chosen repositories included qualified references to other datasets from the same project or from previous research.

1.2.4 Increase data re-use

Questions	Answers
26 How will you provide documentation needed to validate data analysis and	A short README file (e.g. Markdown) was provided together with the data to enable data analysis and to facilitate data re-use.

[1] A qualified reference is a cross-reference that explains its intent. For example, X is regulator of Y is a much more qualified reference than X is associated with Y, or X see also Y. The goal therefore is to create as many meaningful links as possible between (meta)data resources to enrich the contextual knowledge about the data. (Source: https://www.go-fair.org/fair-principles/i3-metadata-include-qualified-references-metadata/)

Questions	Answers
facilitate data re-use (e.g. readme files with information on methodology, codebooks, data cleaning, analyses, variable definitions, units of measurement, etc.)?	
27 Will your data be made freely available in the public domain to permit the widest re-use possible? Will your data be licensed using standard re-use licenses, in line with the obligations set out in the Grant Agreement?	The data (seven deliverable reports D1 -D7 and 2 project generated datasets) were licensed under the Creative Commons Attribution International Public License (CC BY) version 4.0. Users will be required to acknowledge the consortium and the source of the data in any resulting publications.
28 Will the data produced in the project be useable by third parties, in particular after the end of the project?	The data published in open-access journals are usable by third parties as the datasets have been deposited in PTB-OAR or Zenodo. The Deliverables D1 – D7 of the project, which are not peer-reviewed publications, are also stored in PTB-OAR. Other data that do not relate to peer-reviewed publications were not made available.
29 Will the provenance of the data be thoroughly documented using the appropriate standards?	Yes, the provenance and context of the data was thoroughly documented to meet relevant standards using the Provenance and Context Content Standard (PCCS) Matrix. Data were accompanied by information on how they were captured, processed, analysed, and validated. Other information was also provided.
30 Describe all relevant data quality assurance processes.	Data quality was assured through repeated and comparison measurements, adherence to standards for data recording, the use of controlled vocabularies and standard terminology, through the metrological characterisation of the measurement set-ups and through the validation of the data collected. Other quality assurance processes included the provision of test results along with the data and the peer-review of publications based on the data.
31 Further to the FAIR principles, DMPs should also address research outputs other than data, and should carefully consider aspects related to the allocation of resources, data security and ethical aspects.	*Allocation of resources* The costs for making the (data and) other research outputs FAIR was 1 000 € (personnel costs) (see question 34). The costs for making other research outputs FAIR are included in the project's budget and will be claimed if compliant with the Grant Agreement's conditions. *Security of other research outputs* All participants are either accredited to, or work in compliance with, the ISO 17025 standard on the "General requirements for the competence of testing and calibration laboratories". The participants stored other research outputs on their organisations' networks, which are protected by firewall, backups etc. Other research outputs were also stored in the project's SharePoint environment, with a password-protected login. Deposition in public repositories provides additional security as they have multiple replicas in a distributed file system which is backed up on a nightly basis. This project did not generate sensitive other research outputs. The other research outputs are safely stored in open access repositories. *Ethical aspects* There were issues that could impact on the sharing of other research outputs. • Information relating to other research outputs acquired from third parties, e.g. manufacturers, was not shared without their explicit

Questions	Answers
	consent. • Information relating to other research outputs collected by the consortium at commercial sites was not shared without the site owner's explicit consent. Ethical issues were addressed as the project prepared an ethics report. The project did not share other research outputs with identifiable personal information. Sensitive information relating to the other research outputs was collected, separated as soon as possible and kept secure. Please also see the information provided in section 1.3 below.

1.3 Other research outputs

Questions	Answers
32 In addition to the management of data, beneficiaries should also consider and plan for the management of other research outputs that may be generated or re-used throughout their projects. Such outputs can be either digital (e.g. software, workflows, protocols, models, etc.) or physical (e.g. new materials, antibodies, reagents, samples, etc.).	The following new materials are available: • Traceable radioactive standard solutions suitable for calibration of mass spectrometry instruments • Two reference materials containing radionuclides suitable for calibration of mass spectrometry instruments • One certified reference material containing stable isotopes suitable for calibration of the instruments or quality control purposes in laboratories performing isotope ratio measurements.
33 Beneficiaries should consider which of the questions pertaining to FAIR data above, can apply to the management of other research outputs, and should strive to provide sufficient detail on how their research outputs will be managed and shared, or made available for re-use, in line with the FAIR principles.	As far as possible, the FAIR data approaches specified in questions 7-30 above were applied to the management of this project's other research outputs. This commitment was met by placing the new calibration methods, and protocols, the inter-laboratory comparison reports and the good practice guides in a trusted repository including the information about the new materials that were developed in the project (see the answer to question 32 for further details).

1.4 Allocation of resources

Questions	Answers
34 What will the costs be for making data or other research outputs FAIR in your project (e.g. direct and indirect costs related to storage, archiving, re-use, security, etc.) ?	The costs for making the data and other research outputs Findable, Accessible, Interoperable and Re-usable (FAIR) are 1 000 € (personnel costs). These costs have been kept to a minimum by using a free repository (PTB-OAR) and by making only relevant data and other outputs FAIR.
35 How will these be covered? Note that costs related to research data/output management are eligible as part of the European partnership on metrology grant (if compliant with the Grant Agreement conditions).	The costs for making the data FAIR are included in the project's budget and will be claimed if compliant with the Grant Agreement's conditions.

36 Who will be responsible for data management in your project?	The coordinator had overall responsibility for data management and was responsible for coordinating updates to the data management plan. The coordinator was responsible for organising data backup and storage, data archiving and for depositing the data within the repositories (PTB's Open Access Repository).
37 How will long term preservation be ensured? Discuss the necessary resources to accomplish this (costs and potential value, who decides and how, what data will be kept and for how long)?	Long term preservation was ensured by depositing the data within repositories (PTB's Open Access Repository and Zenodo). There are no costs associated with the long-term preservation of the data in these repositories. The data will increase in value over time because of its fundamental impact in a wide range of applications. It will enable the technologies developed in the project to be taken up by the measurement supply chain and by standards bodies including CEN/TC 230 Water Quality, CEN/TC 264 Air Quality, CEN/TC 444 Characterisation of Solid Materials, ISO/REMCO Committee on Reference Materials, ISO/TC 085/SC 02/WG 17 Radioactivity Measurements, ISO/TC 147/SC 3 Water Quality _Radioactivity Measurements. These standards bodies will need access to the data to justify the robustness of future standards. The data will also be of value as it underpins the results of published datasets. The coordinator decided on a case-by-case basis on what data will be kept and for how long.

1.5 Data security

Questions	Answers
38 What provisions are or will be in place for data security (including data recovery as well as secure storage/archiving and transfer of sensitive data)?	*Data recovery and secure storage* All participants are either accredited to, or work in compliance with, the ISO 17025 standard on the "General requirements for the competence of testing and calibration laboratories". The participants stored data on their organisations' networks, which are protected by firewall, backups etc. Data were also stored in the project's SharePoint environment, with password protected login. Deposition in the PTB-OAR or Zenodo public repositories provided additional security as it has multiple replicas in a distributed file system which is backed up on a nightly basis. *Transfer of sensitive data* This project did not generate sensitive data.
39 Will the data be safely stored in trusted repositories for long term preservation and curation?	Yes, the data are/will be safely stored in the Zenodo open access repository. Yes, the data will be safely stored in PTB's Open Access Repository, which is stored on two physically and geographically separated servers that are regularly backed up. PTB is working towards German Initiative for Network Information (DINI) certification.

1.6 Ethics

Questions	Answers
40 Are there, or could there be, any ethics or legal issues that can have an impact on data sharing? These can also be	There were issues that could impact on data sharing. • Data acquired from third parties, e.g. manufacturers, was not shared without their explicit consent.

Questions	Answers
discussed in the context of the ethics review. If relevant, include references to ethics report(s) and the ethics section in the Annex 1.	• Data collected by the consortium at commercial sites was not shared without the site owner's explicit consent. • The data from the market surveys was made anonymous to comply with the General Data Protection Regulation (GDPR). Ethical issues were addressed as the project prepared and submitted a report on the Dual Use of the project's results.
41 Will informed consent for data sharing and long-term preservation be included in questionnaires dealing with personal data?	Informed consent for data sharing and long-term preservation was included in the market and customer surveys. The project did not share data with identifiable personal information. Sensitive data were collected, separated as soon as possible and kept secure.

1.7 Other issues

Questions	Answers
42 Do you, or will you, make use of other national / funder / sectorial / departmental procedures for data management? If yes, which ones (please list and briefly describe them)?	Data management was compliant with: • The research data policy of the European Partnership on Metrology; • European laws about data security and the protection of privacy (e.g. GDPR); • Institutional guidelines; • Scientific community guidelines.

2 Open science: research data management

Statement	Put an X in the box to confirm	Or, list any exceptions to this
All participants have adhered to the requirements of the project's GA and CA with respect to open science: research data management (GA Article 17 and its Annex 5) for this reporting period	☒	