Advanced Research + Invention Agency ARIA

Request for Proposal: Universal Fabricators Metrology Partnerships

18 November 2026

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SECTION 1: THE REQUIREMENT AND CONDITIONS

Introduction

We are pleased to invite you to take part in this Request for Proposal (RFP).

Launched in January 2023, ARIA is a Research & Development (R&D) funding agency designed to take bold bets that complement and amplify the UK's world-class research ecosystem. We fund transformative science and technology capabilities that will benefit the UK and help humanity thrive.

This RFP seeks proposals from metrology partners able to supply the specialist services required by the Universal Fabricators (UF) programme at ARIA. An overview of the goals and objectives of the programme can be found in the publicly available Call for Proposals available here. The Programme aims to develop scalable processes that use proteins as the manufacturing tools, leveraging them with external fields and flows to assemble advanced inorganic and composite materials.

The partnership will support the programme, and the projects funded by the programme, by providing third party metrology:

1. To ensure that the overall goals of the programme are met.
2. To compare performance across the projects.
3. To maximise the likelihood of success of each project.

Definition: "Creators" is the word ARIA uses to refer to the project teams and their members.

The Requirement (the "Services")

The programme funds 11 projects in three different application areas for 36 months.

Application area	Description
Hollow core fibre (HCF) (4 teams)	These teams will use proteins to grow hollow-core optical fibres, of the kind used in telecommunications, interconnects, lasing, and sensing cables, with shapes and features that conventional fibre-drawing processes cannot produce.
Separation membranes (3 teams)	These teams will use proteins to grow defect-free protein

	sheets, hardened with minerals, into filters with precisely sized pores. One example target is separating lithium from magnesium, two ions of almost identical size, which could make the separation stage of lithium refining more efficient.
Magnets (4 teams)	These teams will use proteins as nanoscale scaffolds to grow and align magnetic crystals, with the aim of producing high-performance magnets that do not rely on rare-earth elements.

Within the application areas, the specific target applications are subject to change during the program duration according to technical progress and further learnings in our ongoing commercial translation work. An example is whilst the current industry application for membranes is lithium beneficiation, it could change at M18 to an alternative separation challenge.

We are seeking proposals from metrology partners able to provide, for each relevant application:

1. Advice to ARIA and the Creators on protocols, standards, and best practices for metrology for a given application.
2. The required metrology for that application.
3. An analysis and contextualisation of the data given the partners understanding of the application in question.

This RFP sets out ARIA's current view of the metrology requirements for the Universal Fabricators programme. These requirements are intended as a starting point and may develop through engagement with prospective partners.We are keen to adapt our metrology requirements to recommendations from partners particularly regarding application areas with the aim of maximising the success of the UF programme.

Structure of the RFP

The detailed requirements for each application area are laid out in the appendices as follows:

- Appendix 1: Hollow Core Fibres
- Appendix 2: Separation Membranes
- Appendix 3: Magnets

Applicants can submit a proposal to one or more of the above application areas.

Programme Structure

Creators will be assessed at two formal points during the programme with benchmarking tests at Month 18 (M18) and Month 36 (M36). Outcomes will be presented by the Creators at demonstration days held at each of these stages. From months 18-36, metrology partners could be used by the Creators for advisory and testing as part of their continuous R&D. We have laid out this as provisional testing schedules where relevant. Metrology partners will also be used in an advisory capacity with ARIA to develop metrology techniques and M36 test schedules.

M18 milestones have been agreed with the Creators. These milestones are geared towards proving the fundamental principles of the Universal Fabricator technology. Indicative M36 milestones have also been established but will be reviewed and agreed following the M18 assessment. These milestones are geared towards an application-specific demonstration of the technology. This review will ensure that the final-stage milestones remain appropriately ambitious, achievable and aligned with the objectives of the individual projects and the Universal Fabricators programme as a whole. ARIA welcomes relevant advice and input from delivery partners on the development of M36 milestones when this review takes place.

Implementation and Deployment Timeline

The initial contract will commence in April 2027 and will continue until the end of the Universal Fabricators programme by August 2029, for a total term of 28 months.

The supplier will be expected to start work, engaging with our teams immediately after contracting is completed, but metrology services will not be expected to be delivered before June 2027.

As with the specific requirements, the expected metrology schedule for each target application area can be found in the relevant appendix.

Delivery of Results and Data

ARIA requires all data to be delivered to ARIA and its Creators following the FAIR principle: Findable, Accessible, Interoperable, and Reusable.

We break down delivery of metrology information as continuous delivery and benchmarking delivery.

Benchmarking delivery: ARIA is the primary beneficiary for raw and processed data alongside collated reports for M18 and M36 metrology for all Creator teams. Beyond ARIA, benchmarking data and reports will be shared only with the Creator team that submitted the samples.

Continuous delivery: For any metrology services outside of M18 and M36 benchmarking tests, Creators are the primary beneficiaries of their respective metrology information and reports. ARIA reserves the right to access all information. ARIA requires the metrology partner to inform them when metrology is performed for a Creator team.

Non disclosure terms

All test data and reports is to be treated as confidential. Metrology partners must agree suitable non-disclosure agreements with each individual Creator team that ensure their information is treated as confidential and protects each Creator team's IP. Metrology partners should also ensure their processes keep each Creator team's confidential information separate from other Creator teams.

Key Criteria for a Metrology Partner

We are looking for a single metrology partner for each application area. The aim is for a single partner to deliver all of the required services. Proposals that do not cover all metrology for an application area will be considered out of scope. We require the applicant to have substantial expertise in the application area.

We will not accept a prime contractor model in which the bidder subcontracts a significant proportion of the required services. Bidders must demonstrate that they will deliver all, or the substantial majority, of the work themselves.

Key Contract Terms

Terms and Conditions

The contract will be placed on terms and conditions (T&Cs) provided by ARIA to the preferred bidder. The proposed terms will include the following principles:

- ARIA shall have the right to terminate the contract or part of the contract for convenience upon one month's prior notice.
- ARIA shall have the right to terminate the contract or part of the contract where the supplier fails to provide the service contracted, with immediate effect.
- Any Intellectual Property generated in the performance of the contract shall vest in ARIA.
- The supplier shall indemnify ARIA, its employees, officers and agents against the supplier's infringement of third party Intellectual Property Rights.

All information shared with the supplier shall be subject to confidentiality terms.

SECTION 2: PROPOSAL RESPONSE STRUCTURE AND SELECTION CRITERIA

Bidders are invited to set out how they propose to deliver the Services outlined within this RFP.

The format below is set out as a guide and represents a maximum length response. If bidders chose to respond in a different format this will be acceptable as long as sufficient information is provided to be comparable to this format of response.

The appointed provider will be selected against both their written response and presentation according to the criteria as set out below with the following weightings.

An organisation is not limited to one application area. If a bidder has the capability and capacity to deliver, they can submit a bid for each relevant application area. The proposal submitted must address the following points in detail:

Criteria A - Background, Profile and Experience (5% weighting)

- Demonstrate that the proposed team has the scientific judgement, measurement expertise, motivation and experience required to deliver the Services.

Criteria B - Your Approach to Service Delivery (40% weighting)

- The specific requirements and timeline of the addressed application area as laid out in the relevant appendix, this includes outlining how tests will be conducted and with what equipment.
- The specific questions associated with each appendix.
- A description of how the applicant envisions the partnership and their role in it.
- Provide your management and oversight structures that you would apply to this service.

Criteria C - Demonstration of Resource (25% weighting)

- Demonstrate your expertise and resources for delivering the services, including your ability to provide operational and executional resources without requiring internal ARIA resources, with supporting examples.

- Evidence of how you will meet the required experience, specialist subject matter, or market expertise.

Criteria D - Commercial Proposal (30% weighting)

- Commercial terms that demonstrate value for the tax-payer, through transparent pricing models with no hidden costs and a proven ability to offer cost-effective solutions without compromising quality. This should include a clear pricing structure, including:

- Rates per hour (ex VAT)
- Costing for our benchmark test packages
- Costing for ad-hoc testing (e.g. our provisional testing schedules)
- Costing for planned advisory work
- Costing of individual tests and pro-rata advisory outside of the work specified in the appendices
- Any additional costs which are likely to be incurred through the life of the contract
- Any critical assumptions, dependencies and exclusions required by the bidder in order to successfully execute any resultant Contract

Additional requirements

The Bidder shall confirm as part of its submission adherence to the following requirements. Evidence in the form of copies of relevant certification must be provided as part of the submission and can be uploaded directly into the spaces provided in application portal:

Mandatory

- All ARIA data to be stored within the UK or EEA
- Disaster Recovery and Business Continuity Plans
- Confirmation of adherence with the Government's Supplier Code of Conduct
- Cyber Essentials

Desirable

- Cyber Essentials Plus, ISO 14001, ISO 27001, ISO 9001 (Quality Management) and ISO 22301.

Format of Proposal Submission

Format	PDF. Pages should be numbered, and the response should include the bidder's name inserted as a header
Page Guide	**4 pages**, plus 2 pages Commercial Proposal per application area applied to.
Responses to	ARIA's application portal In case of any technical issues with the portal please contact clarifications@aria.org.uk

If you are disabled or have a long-term health condition, we can offer support to help you engage

with ARIA, navigate our RFP process, or carry out the services, you can find more information here.

SECTION 3: TIMELINES, REVIEW AND SELECTION PROCESS

Procurement Timeline

The dates in the following timetable are provisional and may be subject to change at the reasonable discretion of ARIA.

Event	Date
Deadline for submission of clarification questions	07 January 2027 (14:00 GMT)
Deadline for proposal submission	13 January 2027 (14:00 GMT)
Notification of selection for presentation	12 February 2027
Presentation by bidders to ARIA selection panel	22 to 26 February 2027
Preferred bidder(s) chosen and informed	03 March 2027
Target Award date	16 April 2027
Target Contract Start date	30 April 2027

Review Stages

This review is intended to consist of 4 stages:

- Stage 1 - Written proposal
- Stage 2 - Presentation by shortlisted respondents to ARIA selection panel. A maximum of 5 responses will be shortlisted to present to ARIA at this stage.
- Stage 3 - Preferred bidder chosen and informed.
- Stage 4 - discussions and negotiations with preferred bidder, onboarding planning and contract agreement.

The ARIA selection panel will be chaired by the Programme Director.

Clarification Questions

Bidders are urged to review the RFP documentation, identify and submit any clarification requests no later than 07 January 2027 (14:00 GMT), via email to clarifications@aria.org.uk. Clarification requests received after this date will not be reviewed.

Any clarification request or responses containing information that is of relevance to all bidders will be provided to all bidders that confirm their intention to participate. A new version of this RFP document with the answers to clarification requests will also be posted to the ARIA website, following the deadline for submission of clarification requests. If bidders do not wish a query or response to be disclosed to other bidders, they must communicate this and the reason why, with the clarification question.

CONDITIONS OF RFP

Confidentiality, Publicity, Conduct and Conflicts of Interest:

ARIA will treat the information you provide in your Proposal as confidential and will not disclose it other than as necessary for the purposes of this RFP, the associated procurement process and ARIA's functions. ARIA may use the information you provide to assess and compare submissions, administer this RFP, agree and manage any resulting Contract, and support ARIA's operational activities, including the development, testing and improvement of internal tools, systems and processes.

ARIA may share Proposals with relevant employees, contractors, advisers and third-party expert reviewers for evaluation purposes. Any such recipients will be subject to appropriate confidentiality, non-use and conflict of interest obligations. ARIA will process any personal data contained in your Proposal in accordance with applicable data protection legislation and its privacy notice and may contact individuals named in the Proposal using the details provided.

In support of its internal processes and operations, ARIA may use secure* generative AI tools. This may include using information from Proposals to assist with assessment, comparison, analysis, summarisation and identification of themes, risks or opportunities, and to support the development and improvement of internal tools and processes. Any AI-assisted outputs will be reviewed by ARIA staff and will not be used as the sole basis for contract award decisions.

*For ARIA, "secure" means enterprise-approved generative AI tools that have undergone ARIA's Technology Security Assessment Process to ensure appropriate security controls, transparency over data storage and processing, and that ARIA data is not used to train external AI models or shared beyond authorised environments.

Although ARIA will treat Proposals as confidential, bidders are advised not to submit potentially patentable or highly commercially sensitive information before appropriate protections are in place. ARIA may disclose confidential information where required in order to meet its obligations as a public body, including for parliamentary, ministerial, judicial or audit purposes (including disclosure to the Comptroller and Auditor General). ARIA may publish statistics or high-level information relating to this RFP or any resulting Contract, but will not publish confidential or personal data.

The contents of this RFP are confidential and must not be copied, reproduced, distributed or disclosed except for the purpose of preparing and submitting a Proposal. No publicity regarding this RFP or the award of any Contract will be permitted without ARIA's prior written consent. ARIA may use ideas or concepts contained in a Proposal for any reasonable purpose connected with this RFP or subsequent discussions, provided that it does not disclose the identity of the originating bidder.

ARIA reserves the right to amend, clarify or withdraw this RFP at any time and may extend submission deadlines where appropriate. ARIA may reject any non-compliant Proposal, disqualify any bidder guilty of serious misrepresentation, fraud, regulatory breach or conduct giving rise to material risk to ARIA, re-run the procurement on the same or an alternative basis, choose not to award any Contract, or amend the timetable, structure or content of the procurement process as it considers appropriate. ARIA will not be liable for any costs, expenditure or effort incurred by bidders in connection with this RFP or the procurement process, including where the process is amended or terminated. It is at ARIA's sole discretion as to which, if any, Proposal is accepted.

Any attempt by a bidder or its advisers to influence the contract award process in any way may result in disqualification. Bidders must not enter into any agreement or arrangement with any other person as to the form or content of any other Proposal, offer any inducement to alter another Proposal, enter into arrangements that prevent or restrict another party from submitting a Proposal, canvass ARIA or its employees or advisers in relation to this procurement, or attempt to obtain confidential information concerning another bidder or Proposal. Bidders are responsible for ensuring that no actual or potential conflicts of interest exist between the bidder (or its advisers) and ARIA, its employees or advisers, and must declare any such conflicts in their Proposal. ARIA reserves the right to disqualify a bidder where a conflict cannot be appropriately managed.

ARIA staff (employees, secondees, individual contractors engaged by ARIA in a staff-like capacity, and Board members), and their immediate family members (including spouse, civil partner or unmarried partner; sibling; child whether biological, adopted or step-child; and parent) are not eligible to submit a Proposal. Any entity in which such an individual is a board director or person of significant control (as defined on gov.uk) is also ineligible. Any Proposal falling within these categories will be rejected on eligibility grounds.

Advanced Research + Invention Agency ARIA

Universal Fabricators Metrology Partnerships RFP

Clarification Questions and Responses

Category	Question	Answer
	[To be completed when publishing clarification questions and answers]	

Appendix 1: Hollow Core Fibre Metrology Requirements

More details about the UF approach to hollow core fibres (HCF) can be found on page 10 of the Call for Proposals.

This section first provides a walkthrough of the required metrology, and then provides an overview and a schedule of testing.

HCF Projects

There are four funded projects targeting HCFs. We require metrology for each project for the duration of the programme.

A Note on HCF Sample Length

A core milestone for all the Creators is to have HCF samples **>1m** in length by **M18** of the programme, 01 March 2028. Towards M36, it is expected that samples will get longer.

Target application and Key Parameters

The commercial application we are benchmarking our fibres against is long distance telecommunications networking. The metrology required will need to confirm the objectives of the programme and perform characterisation of the key parameters for the telecommunications application.

The key parameters we have identified for the telecommunications application are:

1. Attenuation at 1550 nm, 532 nm, and 230 nm.
2. Chromatic dispersion at 1550 nm.
3. Low-loss spectral window.
4. Bend performance.
5. Latency.

Metrology before M18

After contracting the metrology partner, there will be a period where exact protocol and processes are established. During this period, the metrology partner will be introduced to the Creators. Tests for sample preparation and metrology might need to be run during this time.

Leading up to M18 starting in November 2027, we would like a period where Creators and the metrology partner can put the metrology into practice so that they are ready for M18 tests.

Metrology at M18 - Benchmarking

As the Call for Proposal states, the metrology the programme requires at M18 the four following tests:

M18-1 Check for traces of organics inside the sample

The samples are produced using proteins. Each team has a process through which these are removed from the fibres in post-processing. We require the metrology partner to verify that proteins as well as any related organic residue have all been successfully removed. To do this, we suggest using methods such as Fourier Transform Infrared (FTIR) spectroscopy.

If this test is fast, then we suggest all submitted samples are tested. If it is slower, then we suggest a random subset of submitted samples are tested. If a random subset is tested, Creators are not to be informed which samples have been tested prior to presentation of the data.

M18-2. Outer Diameter Measurements

Three different outer diameter samples will be produced in the 10 - 200 um range. The teams will be submitting samples for three different outer diameter sizes in triplicate, with predictions of the diameter for each triplicate. This results in **nine samples in total**. We require each of the samples presented by each team to have its outer diameter measured in at minimum 5 different points. The consistency of this diameter along the full length of the sample is also of interest. This can be done easily through non-destructive testing.

M18-3 Inner Diameter Measurements and Cross Sectional Imaging

Three different inner diameter samples will be produced in the 1 - 50 um range. The teams will be submitting samples for three different inner diameter sizes in triplicate, with predictions of the diameter for each triplicate. This results in **nine samples in total**. These samples could overlap with the samples used for the outer diameter measurement. For each of the three HCF samples per team, we require the inner diameter to be measured and the cross section imaged at 5 different points along the sample's length. We expect this measurement to be done through destructive means, such as cleaving a fibre at each point.

M18-4 Mechanical Stability in a 10 cm Bend Radius

Fibres need to show mechanical stability to a 10 cm bend radius without fracture. This will be a simulation of the fibre being wrapped around a spool. We require the entirety of each sample to be wrapped around the spool. If fibres do not shear, we expect that at least a subset of the samples submitted is inspected for cracks for example using a microscope by the metrology partner. The potential metrology partner is welcome to suggest other methods to checking this.

Each Creator team will provide at least 3 samples for the mechanical stability test. In addition, we suggest every submitted sample that is not destroyed to measure in the inner diameter is tested by wrapping it around a spool. A subset of these can then be visually inspected.

Number of Samples Necessary for M18

As M18-3 is destructive and M18-4 is potentially destructive, each team will need to submit a minimum of six samples for the required M18 tests to ensure that all tests can be performed. Creators will be offered to submit up to 10 samples for testing, if they so wish. We suggest that every sample that survives the other tests is put through M18-3.

Inner and outer diameter measurements could be done on the same sample if a team choses.

Additional Desirable Testing at M18

We also require the metrology partner to assess which parameters relevant to the target application of telecommunications networking can be measured at M18, and if any are relevant, to take measurements for these as well.

At this stage it might also be relevant to begin to experiment with methods of testing internal surface roughness measurements. See section below.

Between M18 and M36 - Continuous delivery

Advisory

Preliminary targets have been fixed in line with the intended telecommunications application, but these can be changed. To this end, ARIA requires that the metrology partner supports ARIA and the teams, where it is needed around M18. This may include:

1. Understanding the M18 metrology in the context of the target application.
2. Advise on appropriate M36 performance targets.
3. Advising on how to perform the metrology in this context.

ARIA may seek input from the metrology partner on the appropriate M36 performance targets and metrology approach where this is needed.

Testing

In the period between M18 and M36, we require 2 rounds of testing spaced 6 months apart. These are both for the benefit of the teams, but also a means for ARIA to track progress. This will also give ARIA and the metrology partner time to settle on the exact testing schedule for M36.

Timing

The times of these testing rounds will be August and September 2028 for round 1, and February and March 2029 for round 2.

We require the tests available for these to be **as close to the M36 testing suite as possible.** The exact contents of these tests will be agreed upon at the quarterly review, prior to the round of testing between ARIA and the Creators.

Creators will be allowed to submit up to **10 samples** for testing.

Metrology at M36 - Benchmarking

Preparation for M36

Given the testing between M18 and M36, we expect preparation needed for the M36 metrology to be minimal. But in the event that it is needed for certain specific cases, we would like to ensure that the metrology partner is available to support in May and June 2029.

Testing

The general focus for metrology at M36 is functional and related to the target application (see above Section 1). ARIA would like to have the tests provided at M18 available too.

Given the telecommunications networking application, we require the metrology to propose key parameters to be measured, and the means through which they will be measured. Once agreed, we require the metrology partner to carry out these measurements for all the teams.

As explained above, the M36 milestones for each team will first be set in stone at M18. The teams might end up having different milestones.

The Call for Proposal provides two suggested targets for M36:

1. Internal surface roughness <0.1 nm (e.g., by AFM on cleaved sections)
2. Attenuation at 230, 532 and 1550 nm measured targeting <0.14 dB/km @1550nm, below the G.654 standard

As attenuation is in line with the target application, it will not be discussed.

M36-1 Internal Surface Roughness

We postulate that a potential method for this would be to cleave a wider section and then use AFM, though we have no idea of the practicalities. We require the metrology partner to suggest methods whereby this measurement is possible.

Number of Samples for M36 Metrology

As the milestones have not been set and the metrology not been established, we cannot be exact about the number of samples. We hypothesise that each team submits 10 samples longer than 1m.

Metrology Schedule

We are expecting the metrology partnership for HCF to progress according to the following schedule:

Dates	Aim	Samples per team
May 2027 - Oct. 2027	Establishing specific metrology protocols, onboarding Creators.	N/A
Nov. 2027 - Jan. 2028	Test metrology to prepare for M18.	6
Feb. 2028 - Mar. 2028	M18 benchmarking.	6 - 10
Sep. 2028	Provisional testing	6
Mar. 2029	Provisional testing	6
May 2029 - Jun. 2029	Test metrology to prepare for M36.	6
Jul. 2029 - Aug. 2029	M36 benchmarking.	10

This totals between 160 and 176 samples that will need testing over the course of the programme.

HCF Questions for the Proposal

HCF-Q1: What key parameters you believe are necessary to measure in the context of a telecommunications application for HCF? These could include ones we have explicitly requested and critical omissions from our request.

HCF-Q2: Are there any parameters that we have requested that you don't feel are necessary to assess industrial application viability?

HCF-Q3: What minimum criteria do the HCF samples need to fulfil for it to become physically feasible to measure the key parameters for application in service of accurately modeling performance at kilometre scale (*e.g.*, minimum fibre length)?

HCF-Q4: How would these measurements be taken? *e.g.*, how would you measure the internal surface roughness of a HCF?

HCF-Q5: Outside of the telecommunications application, what other key parameters would we need to measure for broader application to other high-value industrial sectors?

HCF-Q6: Are there any new metrology techniques or equipment that need to be developed in order to deliver on this RFP?

Appendix 2: Membrane metrology requirements

More details about the UF approach to separation membranes can be found on pages 11 and 12 of the Call for Proposals.

This section first provides a walkthrough of the required metrology, and then provides an overview and a schedule of testing.

Membrane Projects

There are **three funded projects** targeting separation membranes. We require metrology for each project for the duration of the programme, and that the IP of each project is kept separate.

Approach to membrane metrology

We require each test to be performed in triplicate.

It is useful to think about the required metrology for membranes as being separated into two types:

Fundamental testing: This is testing of the core material and structure properties. One key focus of this type of testing is the fulfilment of the aims of the programme. More can be read about these in the Call for Proposals.

Functional testing: This is testing of the separation membranes for commercial application. An example of this could be cross-flow testing with a certain feed solution.

Fundamental Testing Requirements

Proteins organised into 2 dimensional structures form a core part of the Creators' production processes. The quality of the organisation of these 2D structures is important to the goals of the programme. Due to this, we require the following fundamental metrology to be performed on the Creators' samples:

Fundamental metrology	**Suggested method**
Pore size and distribution	SEM
Single domain crystal confirmation	STEM, SEM, GI-WAXS
Lattice order	STEM, GI-WAXS
Protein assembly confirmation	CryoEM

These are particularly important up to M18 of the programme, whereafter the focus shifts more to functional testing.

Functional Testing

We require the Creators' membranes to be tested for function as thoroughly as possible. To that end we have identified the following tests:

1. Cross-flow testing with select flow solutions.
2. Molecular weight cut-off (MWCO)
3. Contact angle (hydrophobicity)
4. Streaming potential (surface charge)

Target Applications and building up a portfolio of test feeds

The primary target application for our separation membranes is post-direct lithium extraction (DLE) concentration of Lithium in brines. We will require functional testing relevant to this application. The main testing for this is a cross-flow test of the membrane with:

1. Actual brines from a DLE operation
2. Synthetic brines

We acknowledge that the commercialisation challenge for membranes is that it is a many-to-many problem between membrane design and most effective target application. As such we anticipate testing membranes for a number of different applications. We thus anticipate adding in to our M36 benchmark schedule a variety of feedstocks, from food to industrial processing feed, as feed targets. The programme team is continually looking for suitable providers of feed samples, and metrology partners are also very welcome to suggest target applications for consideration, as well as providing feedstock partners to provide us with the feeds. This forms part of our question Mem-Q2 at the end of the appendix.

We aim to have a minimum of 7 industrially relevant feed samples to benchmark membranes against in M36.

Preparation Periods

We require there to be 2 month periods before the M18 and M36 metrology where the processes around the metrology can be tested. Creators and the metrology partner can test logistics and metrology before the metrology for the contractual milestones needs to take place.

Metrology at M18 - Benchmarking

The milestones for the projects that have been contractually agreed with the Creators for M18 and require third party metrology are as follows:

1. Three different pore sizes produced in the 1-50Å range.
2. Mechanically stable under tangential flow conditions with a transmembrane pressure (TMP) of 20 bar and cross-flow velocity of 0.5 m/s without delamination or compaction.
3. Non-selective leakage < 0.1% of total flux, verified by rejection of 1nm neutral markers.
4. Pore homogeneity is <20% from intended size under a range of different flow conditions.

We require support measuring the above, but the exact method is left up to the metrology partner.

Creators will have membranes large enough to test functionally at M18. As such we require beginning functional testing with a panel of 3 different feed solutions, one of them being a simulated brine.

Number of samples for M18

Each team will need to submit at least 9 samples: three for each pore size in triplicate.

Note on Sample Sizes

We are expecting Creators to be producing membrane coupons with a total area >50cm^2 by M18.

Metrology at M36

Advisory

Preliminary targets are suggested in the Call for Proposals, but these are expected to change depending on chosen applications, of which post-DLE Lithium concentration is just one. To this end, ARIA requires that the metrology partner supports ARIA and the teams, where it is needed around M18. This may include:

1. Understanding the M18 metrology in the context of the target application.
2. Advise on appropriate M36 performance targets.
3. Advising on how to perform the metrology in this context.

ARIA may seek input from the metrology partner on the appropriate M36 performance targets and metrology approach where this is needed.

Testing

At M36, the goal is for each team to have a membrane with a completed proof of concept for at least one commercially relevant application. To this end the focus of the M36 metrology is confirmation of these results for each of the teams.

To this end, the testing will be purely functional testing. Each team will have their membranes tested against a panel of industrially relevant feed solutions. Lithium brines are very likely to be among these. These panels might vary by team based on tailored target applications.

Metrology Schedule

We are expecting the metrology partnership for membranes to progress according to the following schedule:

Dates	**Aim**	**Samples per team**
May 2027 - Oct. 2027	Establishing specific metrology protocols, onboarding Creators.	N/A
Nov. 2027 - Jan. 2028	Test metrology to prepare for M18.	6-9
Feb. 2028 - Mar. 2028	M18 benchmarking.	9 at least
May 2029 - Jun. 2029	Test metrology to prepare for M36.	6-9
Jul. 2029 - Aug. 2029	M36 benchmarking.	9 at least

Membrane Questions for the Proposal

Mem-Q1: How would you test for each of the M18 targets for membranes? What are the sets of equipment needed and the suggested test matrix? What minimum criteria do the samples provided need to fulfill to be physically testable?

Mem-Q2: What panel of commercially relevant feed solutions would you suggest for initial functional testing of our membranes and why? How many of these would you be able to provide in-house or procure from existing connections you have? Which high level feeds would you recommend but would not currently have a clear route to producing/acquiring? What minimum criteria do the samples provided need to fulfill to be physically testable?

Appendix 3: Magnet metrology requirements

More details about the UF approach to magnets can be found on pages 12 and 13 of the Call for Proposals.

This section first provides a walkthrough of the required metrology, and then provides an overview and a schedule of testing.

Magnet Projects

There are **four funded projects** targeting magnets.

Target application

For magnets, we are simply after the best performing magnets possible given the materials that the Creators are working with. As the programme progresses and we learn more about the technologies that we are working with, we will narrow down the possible space of applications.

Approach to Metrology

The timelines and agreed milestones for the funded projects vary, but all have the same set benchmarks.

Benchmarking: The bulk of the metrology services will be performed for benchmarking of Creator materials at months 18 and 36.
Continuous delivery (interim milestone testing): Creator teams have at least one interim technical milestone before each of the benchmarking dates of M18 and M36 at differing times, where if needed, they can send material samples to the metrology partner for independent testing. We label this as provisional testing in the metrology schedule.
Continuous delivery (unique capabilities): We anticipate that the metrology partner might have unique capabilities that could help teams as part of their technology development process, especially on bulk magnetic properties. An example could be a rapid throughput testing of magnetic properties that cuts batch test timelines by an order of magnitude. This capability would come to the fore between months 18-36 as the Creator teams start to focus their research on making magnetic materials.

A rough outline of the metrology schedule can be provided here, but we require that a more detailed schedule is developed for each team. This revised schedule would be discussed and planned during initial conversations after each team once the metrology contract has been signed.

Metrics to test

We require metrology for the following:

1. Powder characterisation
2. Material structure measurements
3. Bulk magnetic properties

The metrology partner should provide access to all metrology capabilities relevant to the above throughout the programme, but can expect the metrology to be more focussed on 1) and 2) in the earlier stages and 3) in the later stages.

Powder Characterisation

Creators will produce powders as a part of their production process. We require metrology to study:

- Powder composition
- Grain size distribution down to nanometre scale
- Magnetic properties of the powder

For this we anticipate the use of techniques such as XRD, SEM and VSM.

Bulk Structure Properties

The materials produced are organised using proteins. We require metrology to understand how the materials are organised. This includes:

- Volume fraction
- Phase
- Order and structural arrangement

For this we expect the use of techniques such as TEM, SAXS, XRD, and XCT.

Bulk Magnetic Properties

For this we require measurement of the magnetic properties of the bulk materials produced:

- The hysteresis loop
- Remanence
- Coercivity
- BHmax
- Squareness
- Operating temperature/Curie temperature
- Pull force
- Field at a distance

We require these to be guided by international standards such as for example IEC 60404-5.

Metrology Before M18 - Continuous delivery (interim milestone testing)

Two of the teams have milestones with deadlines before M18, at month 9 (June 2027) and month 12 (August 2027). These require powder characterisation and structural measurements. We require support in verifying these.

Metrology at M18 - Benchmarking

At M18, all teams have major milestones. These generally consist of all three: powder characterisation, material structure measurements, and magnetic property measurements.

Between M18 and M36 - Continuous delivery

Advisory

Preliminary targets are suggested in the Call for Proposals, but these are expected to change depending on chosen applications and the teams' technologies. To this end, ARIA requires that the metrology partner supports ARIA and the teams, where it is needed around M18. This may include:

1. Understanding the M18 metrology in the context of the target application.
2. Advise on appropriate M36 performance target.
3. Advising on how to perform the metrology in this context.

ARIA may seek input from the metrology partner on the appropriate M36 performance targets and metrology approach where this is needed

Interim Milestone Testing

Between M18 and M36, we require another two rounds of provisional testing for all the teams as a means for Creators and ARIA to get external feedback on their progress.

Metrology at M36 - Benchmarking

At M36 the milestones will lean heavily towards magnetic property measurements, but will likely also require material structure measurements and potentially powder characterisation. At this stage, teams are ideally producing magnets in form factors relevant for commercial use.

Metrology Schedule

We are expecting the metrology partnership for magnets to progress according to the following schedule:

Dates	Aim	Estimated samples per team
May 2027 - Oct. 2027	Establishing specific metrology protocols, onboarding Creators.	N/A
Jun. 2027 - Sep. 2027	Provisional testing.	6
Nov. 2027 - Jan. 2028	Test metrology to prepare for M18.	6
Feb. 2028 - Mar. 2028	M18 benchmarking.	6
Sep. 2028	Provisional testing.	6
Mar. 2029	Provisional testing.	6
May 2029 - Jun. 2029	Test metrology to prepare for M36.	6
Jul. 2029 - Aug. 2029	M36 benchmarking.	10

Magnet Questions for the Proposal

Mag-Q1: How would a metrology partner characterise metal powders for production of magnets?

Mag-Q2: What are your requirements for sample preparation in the context of powder characterisation?

Mag-Q3: What are your sample requirements for measurements of bulk magnetic properties?

Mag-Q4: Do you have any specialist capabilities that would enhance this programme, either through augmenting testing throughput, or augmenting the characterisation suite for benchmarking and provisional tests?