Science and Technology Facilities Council

ISIS Neutron and Muon Source

ISIS Industrial Collaborative R&D (ICRD) Scheme

Review 2020

Christopher Frost and Graham Appleby

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Introduction

The ISIS Industrial Collaborative Research and Development Scheme (ICRD Scheme) was started by the ISIS Neutron and Muon Source in 2011. It was started in response to the realisation at ISIS that addressing the needs of industrial researchers at ISIS, whilst strong through the many academic and industrial collaborations using the facility, could still be innovated further and improved.

To improve the offer to industry by large scale neutron facilities like ISIS the ICRD Scheme proposed a new, additional, access mechanism to the facility in addition to the ones already in place (see table below).

Proposal Route	Users	Frequency	Review	Cost to Proposer	Expected Outcome
Direct Access [Rapid and Xpress]	Academic Academic + Industry ('Grey')	Twice yearly proposal round	Peer review by Facility Access Panel on the basis of **scientific** merit.	**No cost**, free at the point of access	Research outcomes put into the **public domain** by publication in peer review journals
Proprietary Access	Industrial	Anytime	**Technical review** by Facility staff, management approval for beamtime	**Fee charged**, based on ISIS operating costs	Research kept **proprietary** by company

The ICRD scheme's access was constructed with the aim of better meeting the needs of the industrial community and to address some of the issues concerning the use of large scale neutron facilities by that community, namely:-

- Neutrons were perceived as an esoteric and difficult scientific technique where the 'value' to industry of the results had not been established and where industry had relatively little experience.
- Access to large scale facilities where commercial confidentially could be assured was perceived as expensive (i.e. proprietary access).

Both of these factors contributed to the use of neutrons at large scale facilities being perceived as high risk for many industrial users.

Use of the 'Direct Access' mechanism, in collaboration with an academic partner, by industry lowered this risk for research that could be published, but the remit of the Facility Access Panels to judge and rank proposals on scientific excellence tended to exclude some industrial research that had very high economic value.

Where confidentiality was required 'Proprietary Access' by industry was used, but this only occurred where 'value' to that industry had been well established (by academic/industrial collaboration) and so the cost of beamtime and investment in scientific knowledge were seen as low risk.

The ICRD Scheme should therefore lower the risk for industry to access large scale neutron facilities and allow it to exploit the unique capabilities that neutron science has to offer. In doing so it should widen the use of neutron facilities by industry, and

provide information to the ISIS Facility and its stakeholders about the benefits that industrial use of a large scale neutron facility has to the UK. The ICRD Scheme also had the remit to:-

- Focus primarily on economic impact of the use of neutron science
- Build long-term partnerships with industry
- Engage with a diverse industrial user base

ICRD Scheme Design

The key features of the ICRD Scheme from the industrial perspective are:

- Beamtime is initially free at point of access
- It allows quick access to the beamlines
- The main criteria for judging the proposals will be its potential economic benefit to the UK
- The results remain confidential during the period of the experiment and the subsequent data analysis

These provide the incentive for companies to explore the potential for neutron research within their industrial sectors. This has to be balanced with the position of the ISIS Facility as a UK publicly funded research facility within the Science and Technology Facilities Council's Rutherford Appleton Laboratory campus. Research proposals under the ICRD Scheme therefore had two accessibility criteria:-

- The ICRD Scheme was only open to industrial companies with a UK manufacturing or research base within the UK.
- A company applying to the scheme must ensure (and demonstrate) that is had deployed in-kind matching funding to the cost of the ISIS beamtime within the overall project requiring neutron beamtime. The company must demonstrate it has deployed in-kind matching funding to the cost of the ISIS beamtime supplied

Whilst free at the point of access, research results undertaken under the ICRD Scheme would eventually either result in the research being put into the public domain, primarily through peer review publication, or kept confidential by the company which would require purchase by the company.

An innovative and unique aspect of the design of ISIS's ICRD scheme is that the decision to put the results in the public domain or to keep them confidential through purchase is taken by the company after the experiment/measurement has been made and after some analysis undertaken to ascertain the commercial 'value' of the results to the company. The timescale for this decision is detailed within a Collaborative Research Agreement which is signed between the company and the Science and Technology Facilities Council and is based on information contained within the ICRD proposal.

The ICRD Scheme is designed to complement the Direct Access and Proprietary Access mechanism and had an initial value of £1M. This equates to approximately

50 days of beamtime allocation by the ICRD Scheme across the whole ISIS instrument suite.

ICRD Scheme Application Process

Application for the ICRD Scheme can be made at any time and are made through a separate route to the normal online Direct Access. ICRD proposals use a template document [ICRD Application Document - see Appendix A] and are submitted to the ISIS Industrial Liaison person.

The ICRD proposal document comes in two parts, the first is almost identical to the standard online ISIS Direct Access application and is concerned with the scientific, technical and safety information required to assess whether an experiment is feasible on the ISIS instruments.

The second part is specific to the ICRD Scheme and is concerned with providing the assessment panel with information on the economic benefits and impact of the research. This part asks a further six questions divided into Research (Q1-Q3) and Project Plan (Q4-Q6):-

Research	
Q1	Give a brief description of your company (or consortium) and its activities in the UK. Include the total employment, and the turnover within the UK. [250 words max]
Q2	Describe the background to the proposed research, and how the proposed ICR&D programme first within this context. The goals of the project should be given, which may be long or short term. [400 words max]
Q3	Estimate the potential economic benefit to both your company (or consortium) and the UK if the proposed collaborative research is successful.

Project Plan	
Q4	Describe the in-kind contribution that your company (or consortium) will make the to project. This should be in the form of a simple table showing each in-kind contribution which can be staff time spend on the project, or related equipment, samples or service. The description should also include a simple total (in £k) for the in-kind contribution. (In the case of consortium the table should include contribution for all industrial partners and identify the roles of each partner).
Q5	Identify the industry project leader (and provide their email address). This person is responsible for the management of the overall project, its costs and schedule and is the main contact point for the project. This person should be a company employee.
Q6	Provide a simple time-line of key milestones for the collaboration This will include the totoal duration of the experiment including the data analysis. The may be expressed as a fixed period from the first results being obtained. (This period defines the window during which the ‘option to prevent STFC publishing the data’ may be exercised). [e.g. a simple Gantt Chart].

A two page Experimental description is also required as part of the ICRD proposal in exactly the same way as for normal Direct Access proposals. This serves the same purpose of allowing a scientific and technical assessment of the proposal even though there is an emphasis in the ICRD Scheme on economic impact.

ICRD Scheme Application Process

Single Access Proposals

Assessment of ICRD proposals is managed by the ISIS Industrial Liaison Manager and is a streamlined email based process designed to be completed within two weeks. Any initial issues with the proposal (e.g. not enough detail) are dealt with by the ISIS Industrial Liaison Manger prior to the proposal being submitted to the assessment panel.

The assessment process involves a small panel of assessors with different roles reporting directly back to the ISIS Industrial Liaison Manager who then approves or rejects the proposal or seeks further guidance from ISIS Management.

Assesor	Role
ISIS Senior Manager (Science Divisions)	Provides scientific assessment and also enables tension with Direct Access proposals given beamtime through the Facility Access Panel assessment
STFC Business and Innovation Department	Provides the economic assessment of the proposal
ISIS Group Leader	Provides scientific and technical feasibility assessment of the proposal and can also tension the proposal with the scientific programmes on the instruments
External Academic Assessor (often drawn from Facility Access Panel)	Provides an independent assessment of the proposal and can comment on scientific, technical and economic aspects of the proposal

To maintain confidentiality the External Academic Assessor is often required to have a Non-Disclosure Agreement with STFC. Any existing Non-Disclosure Agreements, potential conflicts of interest and concerns over confidentiality are discussed with the ICRD proposers prior to the assessment process.

External assessment is not required if the ISIS Senior Manager or ISIS Group Leader advise that it is not required. Typically this is because:-

- The proposed experiment is a straightforward and short (one day or less) measurement.
- The proposed research is a direct, simple continuation of previous measurements

Multiple Access Proposals

Fairly early in the programme, in 2012, a request was made by a company for a more multiple style access under the ICRD Scheme. This was to avoid submissions of several proposals with virtually identical information where it clearly made more

sense to group similar, strongly related experiments under a single overarching proposal

The ICRD Scheme was expanded to allow such multi-access or 'framework' proposals to extend over a number of year or experiments, or both (e.g. an agreement that the company accesses 15 days of beamtime at one/several instruments over 5 years). In this case the 'framework' proposal is assessed in the same way as the single access proposal but clearly with more emphasis and scrutiny of the project's longer term experimental plan. Each individual experiment under such 'framework' proposals requires an experimental description to be written and assessed by the ISIS Group Leader to ensure scientific and technical feasibility.

- In the period 2011/12 to 2019/20 The ICRD Scheme had 5 'Framework' proposals completed (2 were consecutive from the same company)

'Additional' Proposals

The ICRD Scheme is also used for other industrial access to ISIS where Direct Access is not appropriate. There have been two main programmes that used this route:-

- STFC's B4I Programme: The Bridging for Innovators (B4I) is an Industrial Strategy Challenge Fund (ISCF) programme run by the Science & Technology Facilities Council (STFC) to support UK industry. ISIS was part of the B4I programme and the requirements for access to ISIS via the programme were integrated into the ICRD Scheme.
- I-SEC Project: This is an ISIS project to develop an Engineering Centre based around a new Engineering instrument. Industrial access to ISIS as part of the development of this project was integrated into the ICRD Scheme.

In both cases the application process and assessment were similar to the ICRD Scheme (and influenced by it) so it was decided that ISIS did not require additional completion of an ICRD proposal or full assessment by the ICRD panel.

ICRD Scheme Agreements and Experimental Scheduling

Successful proposals under the ICRD Scheme are required to either enter into a Collaboration Agreements (Appendix B) that set out the terms of the research at ISIS (based on the proposal and its programme of work), or if it clear that the research will be put into the public domain can sign a letter stating this (Appendix C).

Once the agreement has been made or letter has been signed the ICRD proposal is put into the normal ISIS scheduling system to allow the experiment(s) to take place. ICRD Scheme proposals have a designated experimental number (RB number) that ensures that the system is aware that they are industrial proposal and that confidentiality is maintained.

Analysis of ICRD Scheme

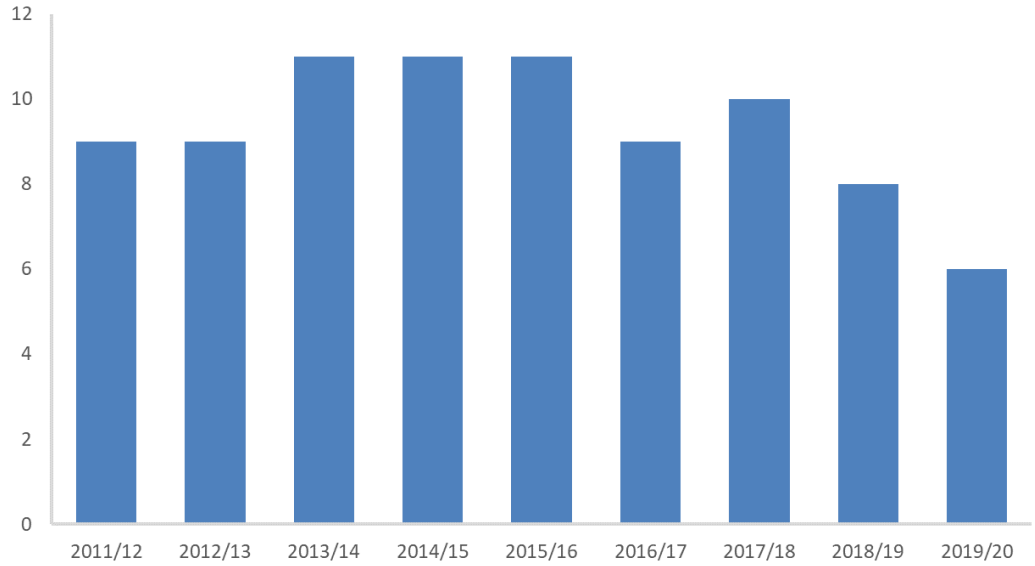
What are the Headline Statistics of ICRD Scheme?

Since 2011 the ICRD Scheme has attracted industrial researchers, for the last nine years the headline statistics are:-

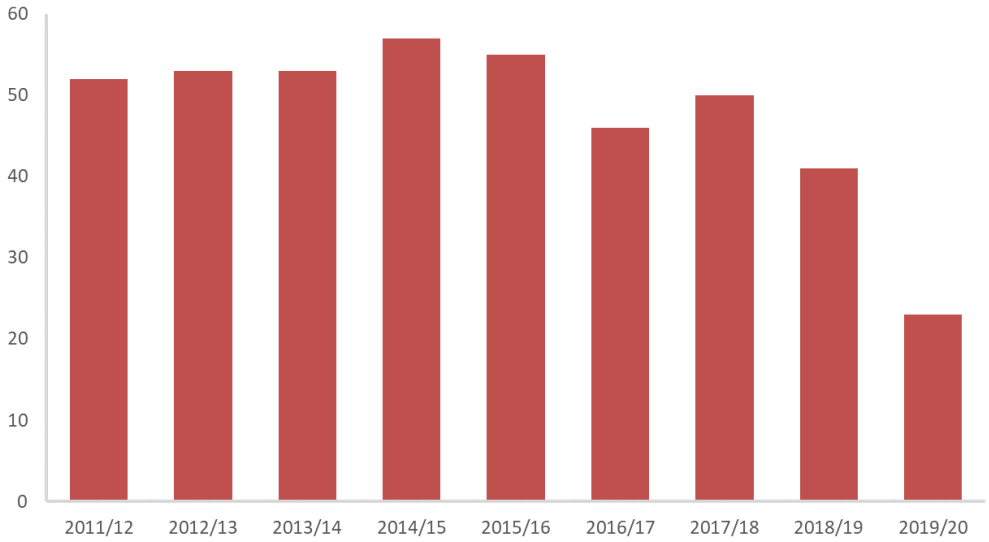
Total Number of ICRD Proposals	69
'Additional' ICRD Proposals*	4
Number of Companies Using the Scheme	46
Total Number of Beam Days	430
Number of Proposals Using the Post-Experimental Purchase Option	5

This is industrial research in addition to that carried out through the Direct Access route which has not seen any decrease over the same period (in fact a moderate increase has been seen).

The headline figures can be further broken down to provide a more detailed picture of the scheme over the last nine years. The figures below shows the number of ICRD proposals and days allocated per financial year since 2011.



Number of ICRD proposals per (financial) year



Number of days allocated to ICRD experiments per (financial) year

From which the headline averages are also summarised in the table below:

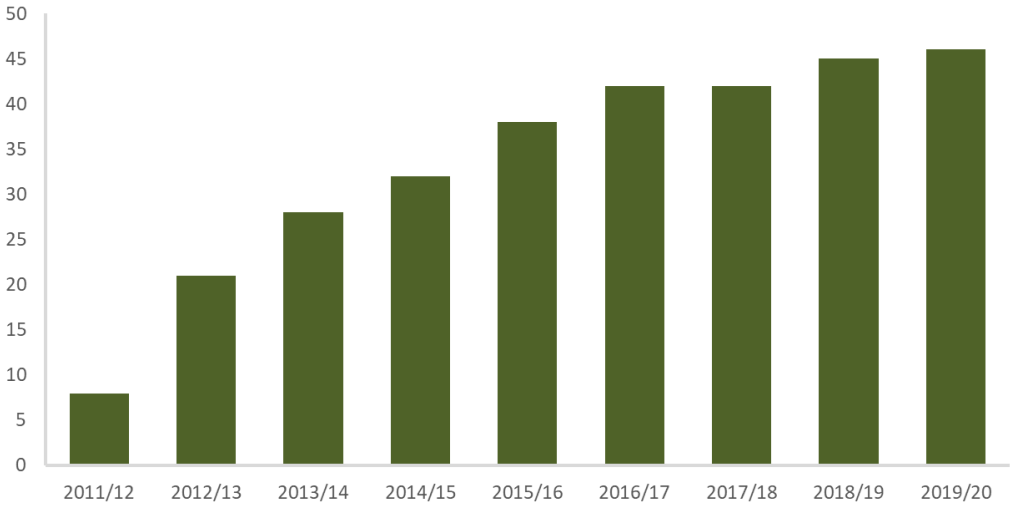
Average proposal per year	9
Average number of ICRD days per year	48
Average number of days per proposal	5 (with range 1-15)

Notes:

- *Where there are ICRD proposals that operate as 'Framework Proposal' a single proposal has been allocated to each year and an appropriate number of days also allocated to that year.*
- *The 'Additional' ICRD proposals are included in the numbers*
- *The 2019/20 figure are strongly affected by the ISIS long shutdown which was due in 2020 (and then moved to 2021/22 as a result of delay and the COVID pandemic)*

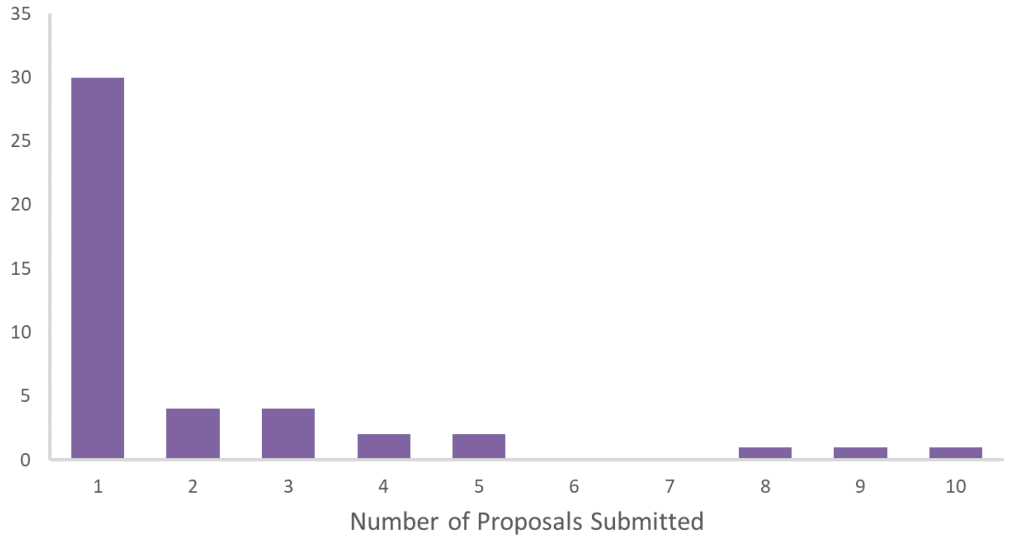
How are Companies Using the ICRD Scheme?

A key objective of the ICRD Scheme was to attract new companies and grow the scheme; the figure below shows this, showing the cumulative growth of the ICRD users (to reach the value of 46 in 2019/20).



Cumulative Growth of the Number of Companies Using the ICRD Scheme per (financial) year

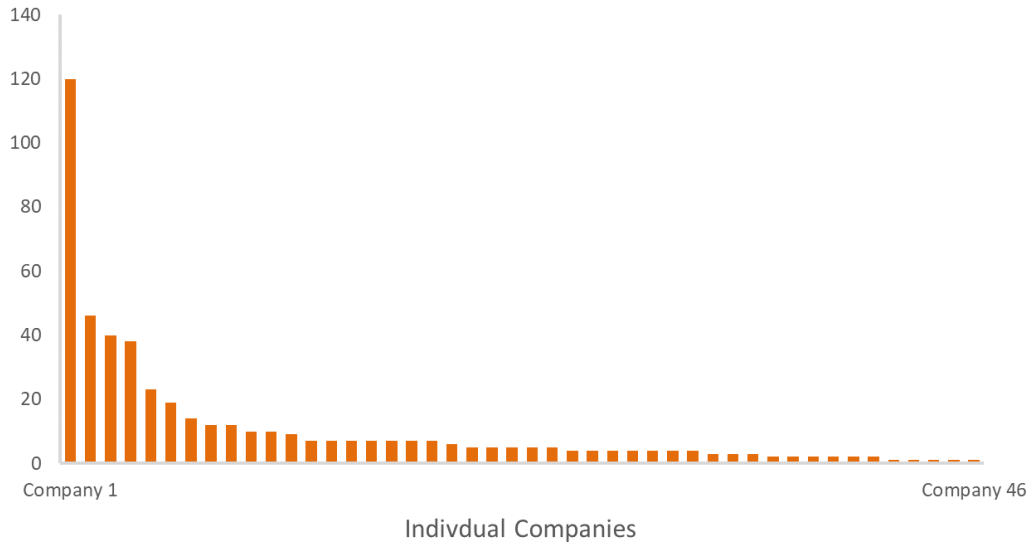
Whilst the total and average use of the ICRD is quite consistent between 2011/12 and 2019/20 a view of the more detailed use of the ICRD Scheme by individual companies is important. The figures below show the numbers of proposals in which the 46 companies are involved, and the number of days requested between 2011/12 and 2019/20 by the companies. (Multiple access proposal are counted for each year they are active in this case).



Total Number of Proposals Submitted by Individual Companies (2011/12 to 2019/20)

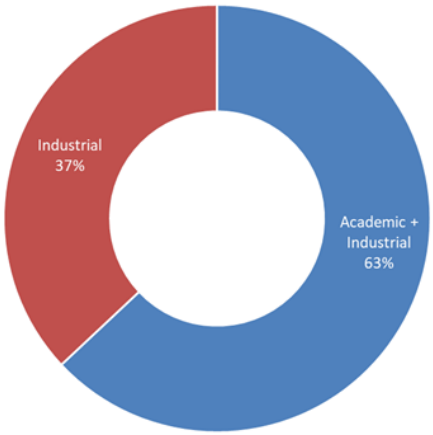
It is evident that most companies (31) have used the ICRD process through involvement in a single proposal with several (12) putting in more than one proposal. A small number (3) are involved in a large number of proposals (greater than 8 proposals) over the period. One of these is a multi-access or framework proposal but the other two show use of the ICRD process over the whole of its time.

The number of days used by individual companies is shown below. This shows a single company with a large use of the ICRD Scheme which is a direct consequence of two consecutive 'framework' agreements over four years by this company. The other companies show a wide distribution of requested days, but it should be remembered that different experimental techniques at ISIS require different number of days of beamtime.



Number of Days Requested by Individual Companies (2011/12 to 2019/20)

The ICRD Process allows applications from industrial companies with or without an academic collaborator. The proportion of ICRD proposals in these two categories are shown below. The academic category does not include ISIS Facility staff but refers to external academic institutions (UK and non-UK). It is clear that whilst the majority of ICRD proposals involve an academic partner, just like the 'grey' Direct Access proposals which feature industrial involvement, a significant proportion (just over a third) are from just industrial companies.



Percentage of 'Academic + Industrial' or 'Industrial' Proposals (2011/12 to 2019/20)

What Industrial Sectors are Using the ICRD Scheme?

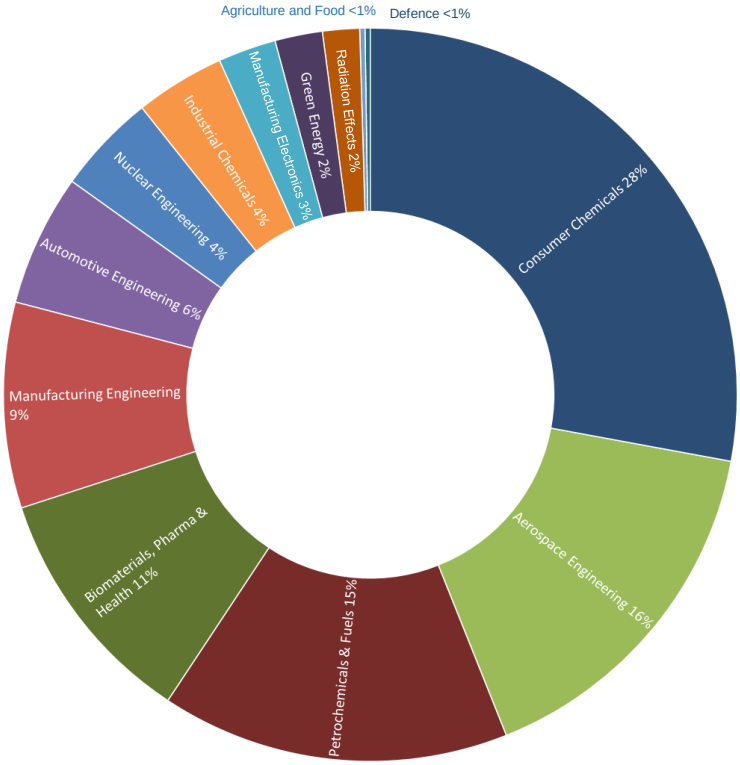
The use of the ICRD Scheme by industrial sector is show in the figures below, both in terms of the number of proposals and the number of days. The proposals are categorised into an industrial sectors with some wide sectors, like engineering and chemicals, further divided (see table below).

Industrial Categories	% by Proposal	% by Days
Nuclear Engineering	7%	4%
Manufacturing Engineering	10%	9%
Aerospace Engineering	21%	16%
Automotive Engineering	7%	6%
Manufacturing Electronics	3%	3%
Industrial Chemicals	5%	4%
Consumer Chemicals	9%	28%
Petrochemicals & Fuels	20%	15%
Biomaterials, Pharma & Health	9%	11%
Green Energy	3%	2%
Agriculture & Food	2%	<1%
Radiation Effects	2%	2%
Defence	1%	<1%

Cleary some proposals will potentially cross several categories and in such cases the proposal is put into the single most appropriate category.

Use of ICRD Scheme by Sector (2011/12 to 2019/20) by Proposals

The distribution of ICRD proposals by sector shows the scheme has strong use by high value Aerospace Engineering and Petrochemical sectors, about 40%, with an even use of the remaining 60% by the other sectors.



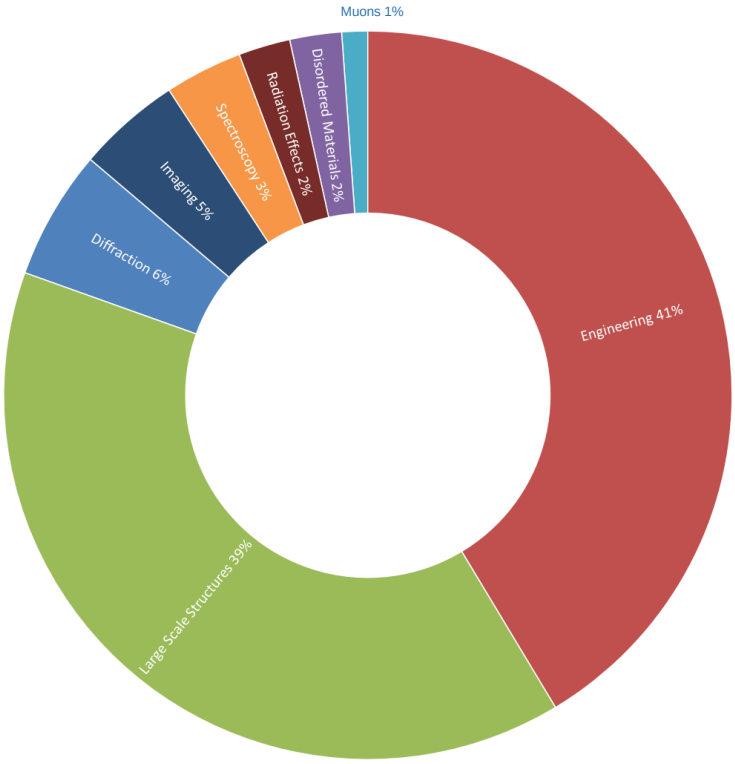
Use of ICRD Scheme by Sector (2011/12 to 2019/20) by Days

The distribution of ICRD days shows as expected from the proposals a strong used of the ICRD scheme by the Aerospace Engineering (16%) and Petrochemical sectors (15%) but with the Consumer Chemical in this analysis showing the highest use (28%).

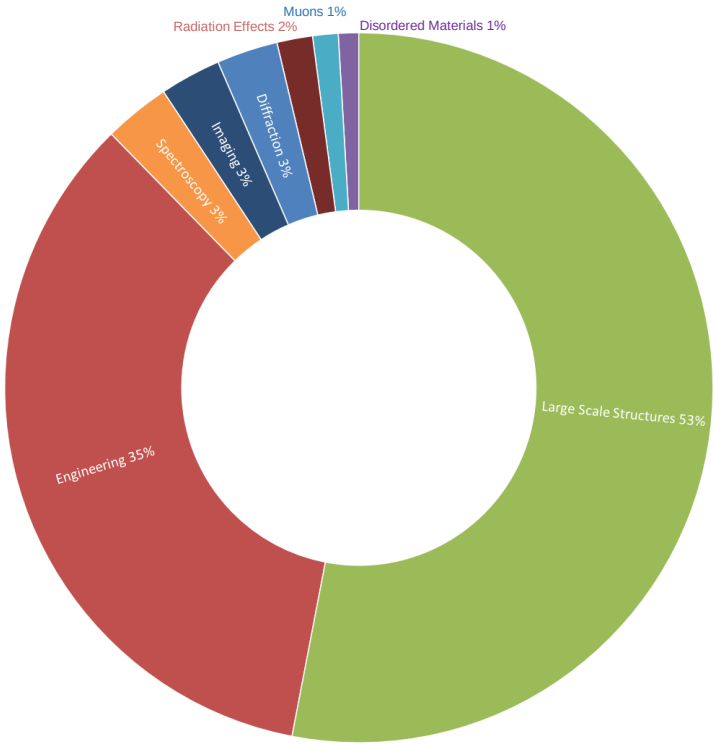
What Techniques are Industry Using?

The use of the beamlines and neutron techniques by the ICRD Scheme indicates how neutrons are creating value for the industrial sector. Clearly with many other material characterisation and analytic techniques available, the obvious complementary one being X-rays, insights into how neutrons are being used is useful in developing the industrial use of neutrons further.

The following figures break the use of the ICRD Scheme down into the neutron technique used, again both in terms of proposals and in terms of days. The categories are broadly based on the group structure within the ISIS facility.



Use of ICRD Scheme by Technique (2011/12 to 2019/20) by Proposals



Use of ICRD Scheme by Technique (2011/12 to 2019/20) by Days

It is clear that the use of the ICRD Scheme is dominated by two techniques. The first is Engineering with the use of ENGIN-X for stress and strain measurements and the second is the use of the suite of instruments for Large Scale Structures (Small Angle Neutron Scattering – SANS and Neutron Reflectometry – NR).

This is an important finding of the analysis of the use of the ICRD Scheme.

The industrial use of neutrons in the ICRD scheme is dominated by the use of two neutron techniques that are directly related to two fundamental properties of the neutron. These properties deliver the 'value proposition' of neutrons for industry:-

- **The ability of the neutron to 'see' light atoms – in particular hydrogen (and enable contrast matching with deuterium) for Large Scale Structures.**

- **The ability of the neutron to penetrate deep into dense materials to elucidate structural information for Engineering.**

The industrial use of ISIS through other access route such as the Direct Access route (the 'Grey' access) also has high use of Engineering and Large Scale Structures, but other techniques such as Diffraction and Spectroscopy also feature very strongly. Such proposals and research are often academically led and further from market so that the economic driver is not so strong.

Impact from the ICRD Scheme

Information related to the impact of the ICRD Scheme is generated by two routes:-

- The first is pre-experimental and is based on information provided in the application process as part of the economic assessment of the proposal
- The second is the post-experimental information that comes from the outcomes of the research.

Pre-Experimental Information

The ICRD Scheme is unique in requesting information about the expected economic impact of the research as part of the application process. Other access routes (e.g. Direct Access) ask about industrial involvement in a proposal but do not seek direct economic information (as it is not part of the assessment process).

The ICRD Scheme was therefore used extensively by the Technopolis Group in 2016 in the preparation of the 'ISIS Neutron and Muon Source – Lifetime Impact Reports' which looked at the economic and social impact of ISIS since its start of operation in 1984. The full report mentions the ICRD thirty times and the summary mentions it ten times.

In the words of the report:-

> "…we have taken advantage of companies' own estimates of value through proposals to the new Industry Collaborative Research and Development (ICRD) programme. **This has provided the most comprehensive basis for estimating likely future benefits."**
>
> "[The ICRD Scheme] has also generated a new proposal system which has provided comprehensive data for this study, as ISIS requires industry applicants to estimate the proposed experiment's likely future benefits to their business."

and it also commented on the wider benefits and impact of the ICRD Scheme:-

> "[The ICRD Scheme] is an option which allows businesses to choose whether or not to publish their results publicly (combining the main user and paid proprietary type access). **This has broadened the use of ISIS by industry, and has quickly developed into the main route through which industry gains direct access to the facility."**
>
> "With the creation of the ICRD programme, **industry has a more 'flexible' means by which to access the ISIS instruments directly."**
>
> **"**All ICRD proposals are required to include a description of anticipated benefits, and 15 of the 36 [as of 2016] proposals (42%) also attempted to quantify future benefits. For those who were able to quantify benefits, together **they forecast more than £500 million in additional income or savings for the participating companies and their supply chains**. In several cases, benefits are anticipated to accrue each year, many years into the future, suggesting that **this group of current ISIS experiments may help secure or expand national economic activity by several billions over the next decade."**

ICRD also provides similar data to the ISIS Management and the wider STFC Business and Innovation Directorate about the industrial use of neutrons at ISIS.

Post-Experimental Information

The wide variety of research carried out under the ICRD Scheme by a variety of companies means that the impact of this research is reported in several ways. This information is obtained by periodic contact with the companies involved in the ICRD scheme after the period of the experimental work is finished. Research that has potential for case-studies or wider public-relation based articles (both for ISIS and STFC) are passed over to the ISIS and STFC communications team for further development.

The different time-scales between experiment, analysis and potential outcomes for different techniques and different sectors, which ranges from months to several

years does complicate this process. The headline figures are given below in the table.

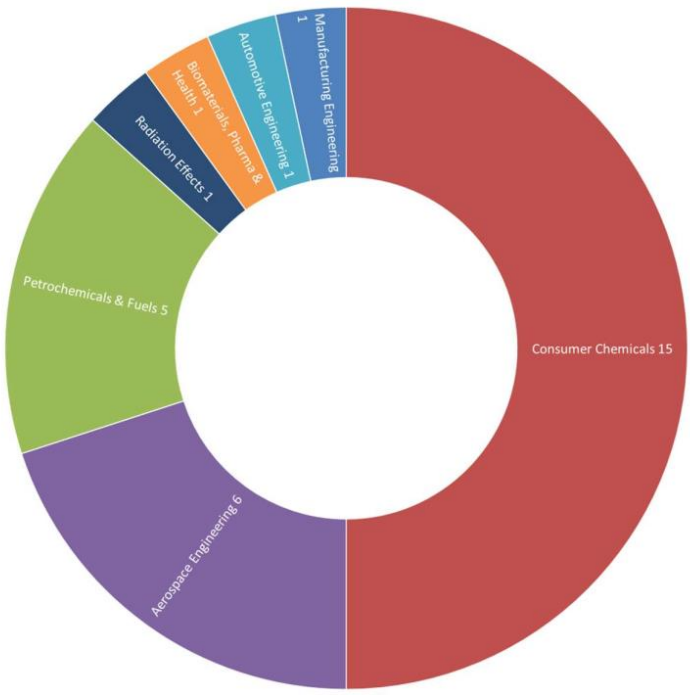
Number of Publications	30
Number of Patents	3
Annual Report Articles	9
ISIS Website Articles	12
PhD Thesis	1

Considering publications, reports and articles the level of output is commensurate with the Direct Access route which sees about 50% of proposals leading to publication.

- Recent proposals over the last 3-4 years would not yet be expected to be reporting publications, patents, etc. and so are not expected to appear in the data
- The turnover of staff at companies tends to be higher than at university departments so in a few cases following up the impact of the research can be more difficult (see Improvements to the Scheme section).
- Several multiple access 'Framework' proposals have not yet reported (see Impact from 'Framework' Proposals).

Peer Reviewed Publications and Patents

The ICRD Scheme has generated 30 publications to date the majority coming from the Consumer Chemical sector – which in fact are from one company [Unilever] who entered into a 'framework agreement' and dominated by the Large Scale Structure techniques of Small Angle Neutron Scattering and Neutron Reflectometry.

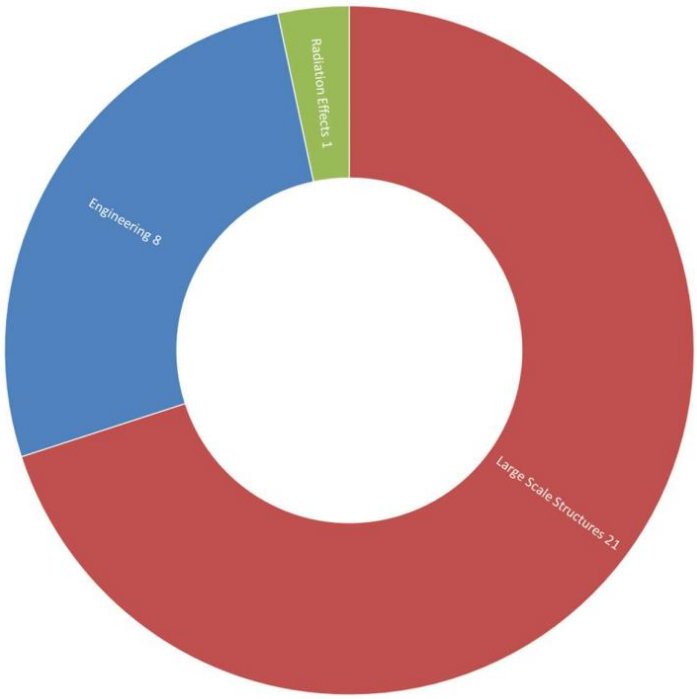


Publications to Date from ICRD Scheme by Sector (2011/12 to 2019/20)

Three patents have also been made, again from the same single company on the basis of ICRD Scheme research.

ISIS Web Site and Annual Review Articles

The ICRD Scheme has contributed 14 articles to the ISIS Web Site and 9 articles to the ISIS Annual Review which includes a specific section on industry.



Publications to Date from ICRD Scheme by Technique (2011/12 to 2019/20)

Other Articles and Reports

Articles and/or reports about or directly related to ICRD Scheme research has also been published:-

- Findings from ICRD research in the oil and gas industry have been submitted to the R6 panel, a group of industrialists and academics working on the development of the UK nuclear industry's fracture integrity assessment procedure [2013 – TWI]
- Net TG4 Project: Residue Stress Measurement using ENGIN-X Neutron Diffractometer at the ISIS Facility [2013 – Open University]. - *Net TG4 is a European Network looking at Neutron Technique Standardisations).*
- PhD thesis, Department of Engineering, University of Leicester, 2015 [with Tata Steel].
- An ICRD Scheme/B4I proposal with Cobham Rad Europe Ltd was featured in UKRI's document "The UK's research and innovation infrastructure: opportunities to grow our capability"

Impact from 'Framework' Proposals

The 'Framework' proposals have multiple experiments and so are expected to generate a wider report on the proposal detailing the publications, patents and any other impact (such as PhDs or Grant applications).

To date five 'Framework' proposals have been completed. One of these from 2011-2017 has reported with the others are in preparation as they are more recent (2016 onwards).

Use of Purchase Option

A feature of the ICRD Scheme is the option to purchase beamtime to ensure the project's confidentiality. To date five options to purchase have been exercised. This has been by a single company using the Large Scale Structure suite of instruments.

Improvements to the ICRD Scheme

Since 2011 the ICRD Scheme has been successful in its aim of increasing the industrial use of the ISIS Facility but can be improved. The following recommendation about the scheme have been made:-

- **The ICRD Scheme is predominantly used by larger companies rather than SMEs**. The reasons for this need to be explored further, but first steps would be to try new promotion strategies to improve awareness of the scheme among SMEs, and to academic users who work closely with industry.

- **The tracking of the outcomes of the research should be improved**. The time-lag from research to either publication or other outcomes is a common problem in assessing industrial research at large-scale facilities but a more regular perhaps more formal framework of tracking the ICRD Scheme proposals should be considered.

- The link between the Facility Access Panels (dealing with Direct Access) and the ICRD Scheme should be improved in order that **Direct Access proposals with significant industrial involvement and therefore more suitable to the ICRD Scheme are considered by the scheme** (and vice versa).

- Only five ICRD measurements have resulted in the company making use of the "buy-back" option to protect the generated IP. The direct implication is that the obtained results have not been consider to be commercially sensitive and so results are published. There is therefore a large amount of joint publications between of ISIS staff employees of the likes of Rolls-Royce and Unilever, which lead to industrial case studies. However, in the future, **stronger post-experiment engagement will be required to receive a clear decision on whether the company wants to purchase the ownership of the generated IP**.

Science and Technology Facilities Council

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Appendix A
Application Document

Science and Technology Facilities Council

ISIS Neutron and Muon Source

ISIS Industrial Collaborative R&D (ICRD) Programme

Guidance for Applicants

Key Points

- Beam time is free at point of use
- Beam time may be obtained very quickly
- Criteria for doing the experiment will be its potential economic benefit to the UK
- The results remain confidential during the period of the experiment and the subsequent data analysis.
- For each experimental proposal, a company must demonstrate it has deployed in-kind matching funding to the cost of the ISIS beam time supplied.

Introduction

A flexible fast-track programme to widen the use of neutron and muon beams for industry research is now available at Oxfordshire's ISIS Neutron and Muon Source at the STFC Rutherford Appleton Laboratory for industries with a UK manufacturing or research base to use ISIS..

The aim of the ISIS Collaborative R&D programme is to widen the use of ISIS by industry in order to increase the economic benefit that ISIS contributes to the United Kingdom.

ISIS is regularly used by a wide range of industries from pharmaceutical and chemical companies to high-end mechanical engineering in the nuclear and aerospace sectors. The neutron and muon instruments at ISIS provide unique and essential information at the atomic and molecular level.

Under the new programme, an industry-ISIS collaboration will be formed to undertake a specific programme of industrially related research. Within this collaboration, ISIS beam time will be provided as an in-kind contribution to the partnership agreement. For the industrial partner, an important requirement will be to estimate the potential economic benefits to the United Kingdom and themselves of the research programme using ISIS.

When a company joins the ISIS Collaborative R&D programme (ICRD programme), requests for beam time can be made at any time, and a decision on access to the facility will be made within two weeks.

Participants in the programme will sign a Collaborative Research Agreement (CRA) with the Science and Technology Facilities Council, which will cover details of the in-kind contributions provided by each side of the partnership.

ICR&D applications will be judged by a small panel with appropriate expertise under strict confidentiality rules, and will be considered outside the normal ISIS academic peer-review process. Applications will be successful if the proposal is technically sound, the company has a UK manufacturing or research base and the partnership has the potential to deliver benefit to the UK economy.

Proposal

The proposed ICRD research programme should be described. In particular it should explain why neutron measurements are required, and how the ISIS measurements will fit within the overall research programme.

If the measurements are required very urgently, this should be highlighted in this section.

In addition, you will also need to supply the following information:

- A brief description of your company (or consortium), and its activities in the UK, including the total employment, and the turnover within the UK.
- An estimate the potential economic benefit to both your company (or consortium) and the UK.
- The in-kind contribution that your company (or consortium) will make to the project. This should be in the form of a simple table showing each in-kind contribution which can be in staff time spent on the project, or related equipment, samples or services. For a consortium, the table should include contributions from all partners and identify the roles of each partner.
- A simple time-line of key milestones for the programme.

Economic benefits

It is appreciated that measures of economic impact are difficult, and generally contingent upon the successful outcome of a programme of research.

However, in this section we ask the industrial partner to estimate the potential economic impact the proposed research might have on their company or the UK. Such impact may be expressed in a variety of measures including reduced costs of production, increased sales, jobs, etc. Since the impact is uncertain it is the order of magnitude of the impact that is needed.

It is also appreciated that such information is highly sensitive, and ISIS will not report this figure in such a way that it can be attributed to the proposers. However, this information and the associated monitoring information supplied during and post-project may be reported by ISIS as an aggregated figure across the whole programme. Where significant impacts are achieved, ISIS will request permission for information to be used in a case study.

Collaborative Research Agreement

Participants in the ICRD scheme will sign a Collaborative Research Agreement (CRA) with the Science and Technology Facilities Council (STFC), which will cover details of the in-kind contributions provided by each side of the partnership. The agreement may also include details on how IP is handled by the partnership.

Costs

An outline of the costs borne by each partner (industry, academia, ISIS) in undertaking the ICRD should be given. Staff costs should be expressed at full economic cost (FEC). The total requested ISIS beam time should also be listed.

For an ICRD Collaborative Research Agreement to be signed, the industrial partners must deliver an in-kind contribution at least equal to the total cost of the ISIS beam time supplied to the project.

It should be noted that no cash awards are provided under the ICRD scheme, although travel and subsistence costs of participating academic partners will be met if requested in the proposal.

Safety

It is important that you give accurate information about the safety of the samples and the safety of the proposed experiment.

All ISIS measurements are required to complete an online Experiment Risk Assessment (ERA) before starting work to evaluate experiment and sample safety. Providing this information in advance will allow ISIS staff to ensure that your experiments can go ahead and be safe and successful. Successful proposers will be sent a link to the ERA system in advance of their experiment.

Contact

Before writing an ICRD proposal, please contact the ISIS Industry Liaison Manager to discuss your proposal.
Email: icrd@stfc.ac.uk or christopher.frost@stfc.ac.uk

Science and Technology Facilities Council

ISIS Neutron and Muon Source

ICRD Application – Part 1

ISIS Experimental Proposal

Section 1 - Proposed Experiment

Experimental Title

Please Give a Brief Summary of the Proposal, including key objectives (900 words max)

Section 2 – Experimental Team

Name	PI*	Contact**	Establishment	Email
e.g C D Frost	X		STFC	c.d.frost@stfc.ac.uk

*P.I. = Principal Investigator - Note: Postgraduate and Undergraduate students CANNOT be a PI

**Contact = person in your experimental team that ISIS should contact regarding your Proposal

Section 3 - Instrument Choice

Which Instrument?

Number of Days Required?

Would you like to specify a local contact?

Have you discussed the experiment with the local contact? YES/NO

Any Special requirements of instrument?

Would you consider any other instrument to be suitable for your experiment? YES/NO
If YES Please give details:-

Section 4 - Use of Other Facilities

If you required the use of facilities (listed below) normally available to the academic users of ISIS you should discuss this with the IRCD manager.

The Oxford Isotope Facility for Soft Condensed Matter Systems
Research Complex at Harwell (RCaH)

Section 5 - Experimental Description for Technical Assesment

Please attach a description of your experiment. This should be no more than 2 pages (A4) and in PDF format. Guidance for this can be found on the ISIS web site http://www.isis.stfc.ac.uk .

Section 6 – Submission

Please send this completed form and your experimental description to Christopher Frost christopher.frost@stfc.ac.uk or icrd@srfc.ac.uk

ICRD Application – Part 2

Assessment Questions

Research Q1-Q3
Question 1: Give a brief description of your company (or consortium), and its activities in the UK. Include the total employment, and the turnover within the UK. **[250 words max]**
Question 2: Describe the background to the proposed research, and how the proposed ICRD programme fits within this context. The goals of the project should be given, which may be long or short term. **[400 words max]**
Question 3: Estimate the potential economic benefit to both your company (or consortium) and the UK if the proposed collaborative research is successful. **[200 words max]**
Project Plan (Q4 – Q6)
Question 4: Describe the in-kind contribution that your company (or consortium) will make to the project. This should be in the form of a simple table showing each in-kind contribution which can be in staff time spent on the project, or related equipment, samples or services. The description should also include a simple total (in £k) for the in-kind contribution. (In the case of consortium the table should include contributions from all industrial partners and identify the roles of each partner).
Question 5: Identify the industry project leader (and provide their email address). This person is responsible for the management of the overall project, its costs and schedule and is the main contact point for the project. This person should be a company employee.
Question 6: Provide a simple time-line of key milestones for the collaboration. This will include the total duration of the experiment, including the data analysis. This may be expressed as a fixed period from the first results being obtained. (This period defines the window during which the 'option prevent STFC publishing the data' may be exercised.) **[e.g. simple Gantt Chart]**

Science and Technology Facilities Council

ISIS Neutron and Muon Source

ISIS Industrial Collaborative R&D (ICRD) Scheme

Review 2020

Appendix B
Collaboration Agreement

(1) THE SCIENCE AND TECHNOLOGY FACILITIES COUNCIL

and

(2)

COLLABORATIVE RESEARCH AGREEMENT

THIS AGREEMENT dated [ ] 20[ ] is made **BETWEEN**:

(1) The Science and Technology Facilities Council one of whose offices is at Polaris House, North Star Avenue, Swindon, Wiltshire, SN2 1SZ (**"STFC"**); and

(2) **[.....]** [**LIMITED**], a company registered in [England and Wales] under number [.....], whose registered office is at [.....] (the "**Company**"),

each a **"party"** and together the **"parties"**.

BACKGROUND

(A) STFC owns and operates the ISIS pulsed neutron and muon source ("**ISIS**") at its Rutherford Appleton Laboratory.

(B) The parties to this Agreement wish to collaborate on "[*insert name of project*]" which will make use of ISIS.

(C) This Agreement governs the parties' collaboration in relation to that project.

1. DEFINITIONS AND INTERPRETATION

1.1 In this Agreement the following expressions have the meaning set opposite:

Agreement	this document, including its Schedules as amended from time to time in accordance with clause 9.9;
Background	any Intellectual Property, Know-how and other information, techniques, software and materials (regardless of the form or medium in which they are disclosed or stored) that exist prior to Effective Date or generated outside of the Project and are provided by one party to another for use in the Project (whether before or after the date of this Agreement);
Business Day	Monday to Friday (inclusive) except bank or public holidays in England;
Confidential Information	any Background disclosed by a party to any of the other parties for use in the Project either identified as confidential before or at the time of disclosure or by its nature reasonably determined to be so and, for the Project Period only, the Data;
Contribution	the contribution (including, without limitation, the provision of human resources, materials,

	facilities and equipment) to be made by a party to the Project, as set out in the Project Plan;
Data	Raw Data and Metadata;
Effective Date	the date of this Agreement;
Group Company	any undertaking which is, on or after the date of this Agreement from time to time, a subsidiary undertaking of any of the parties, a parent undertaking of any of the parties or a subsidiary undertaking of a parent undertaking of any of the parties, as those terms are defined in section 1162 of the Companies Act 2006;
Intellectual Property	any invention, patent, copyright, trade mark, trade name, service mark, registered design, design right (in each case whether registered or unregistered), know-how, right of confidence, trade secret, right to extract or exploit data, database rights, any similar rights protected in any jurisdiction, whether now existing or coming into existence at some future date, any application for any of the above, and any accrued rights of action in respect of any of the above but for the avoidance of doubt Intellectual Property shall be deemed to not include Data;
Know-How	unpatented technical information (including, without limitation, information relating to inventions, discoveries, concepts, methodologies, models, research, development and testing procedures, the results of experiments, tests and trials, manufacturing processes, techniques and specifications, quality control data, analyses, reports and submissions) that is not in the public domain;
Metadata	information pertaining to data collected from experiments performed on ISIS instruments as part of the Project, including (but not limited to) the context of the experiment, the experimental team, experimental conditions and other logistical information;
Project	the project described in the Project Plan;
Project Period	the period described in clause 2.1; and
Project Plan	the project plan annexed to this Agreement as Schedule 1, as varied from time to time under the terms of this Agreement;
Public Domain	available to the community at large, unprotected by copyright, patent or any other form of protection and subject to appropriation by anyone; and

Raw Data	data collected from experiments performed on ISIS instruments as part of the Project. This includes data that are created automatically or manually by ISIS-specific software and/or ISIS staff expertise in order to facilitate subsequent analysis of the experimental data.

2. THE PROJECT

2.1 The Project will begin on the Effective Date and will continue until the end date set out in the Project Plan (the "**Project Period**").

2.2 Each of the parties undertakes to each of the others to:

2.2.1 make its Contribution to the Project in accordance with the Project Plan;

2.2.2 carry out the tasks allotted to it in the Project Plan;

2.2.3 comply with its obligations set out in the Project Plan; and

2.2.4 ensure that its employees and/or students (if any) involved in the Project keep complete and accurate records of all research, development and other work carried out in connection with the Project and of all Data and observations, signed by the people who obtained such Data or made those observations.

2.3 No party undertakes that any research will lead to any particular result, nor does it guarantee a successful outcome to the Project.

2.4 Each of the parties warrants to each other party that it has full power and authority under its constitution, and has taken all necessary actions and obtained all necessary authorisations, licences, consents and approvals, to allow it to enter into this Agreement.

3. USE AND EXPLOITATION OF INTELLECTUAL PROPERTY AND DATA

3.1 Background will remain the property of the party that contributes it to the Project (or its licensors). No licence to use any Intellectual Property is granted or implied by this Agreement except the rights explicitly granted in this Agreement.

3.2 Each party grants each of the other parties a royalty-free, non-exclusive licence to use its Background for the purpose of carrying out the Project. None of the parties may grant any sub-licence to use any other party's Background except that any party may allow its Group Companies, and any person working for it or any Group Company, or on its behalf or that of any Group Company, to use any party's Background for the purpose of carrying out the Project, but for no other purpose.

3.3 Subject to the provisions of this clause 3, each party shall have full access to and the right to analyse and use the Data, including but not limited to for the purposes of the Project, however STFC shall not be entitled to release the Data into the Public Domain until the expiry of the Option Period and provided that the Company has not exercised the Option during the Option Period.

3.4 The Company shall have the option (the "**Option**") (subject to payment as set out in clause 3.5) during the period starting on the Effective Date and ending 60 Business Days after the end of the Project Period (the "**Option Period**") to elect to prevent STFC releasing the Data into the Public Domain.

3.5 The Option shall be exercised by the Company:

3.5.1 giving STFC written notice (the "**Exercise Notice**") which shall include:

(a) the date on which the Exercise Notice is given;

(b) a statement to the effect that the Company is exercising the Option; and

(c) a signature by or on behalf of the Company; and

3.5.2 paying to STFC a sum equal to the value of STFC's contribution to the generation of the Data to be protected under the Option and as set out in the Project Plan.

3.6 If the Option is exercised STFC shall not, provided that the Company has paid the Option Fee to STFC within 60 Business Days of the date of exercise of the Option, release the Data into the Public Domain. For the avoidance of doubt, STFC shall retain the right to analyse and use the Data solely for the purposes of academic teaching, academic research and non-commercial research collaborations with third parties (which for the avoidance of doubt includes, subject to the provisions of clause 4 the right to publish any research derived from the Data).

4. ACADEMIC PUBLICATION IF OPTION IS EXERCISED

4.1 If the Option is exercised and STFC wishes to publish any research derived from or relating to its analysis of the Data (the "**Publication**"), STFC will submit to the Company in writing details of the Publication, at least 30 days before the date of the proposed submission of the Publication. The Company may, by giving written notice to STFC (a "**Confidentiality Notice**"), require STFC to:

4.1.1 delay the proposed Publication for such a period that the Company considers, in its reasonable opinion, is necessary in order to seek patent or similar protection for any of its Intellectual Property created through its analysis of the Data; and/or

4.1.2 edit the proposed Publication as the Company considers, in its reasonable opinion, is necessary in order to protect any of its Intellectual Property created through its analysis of the Data.

4.2 The Confidentiality Notice must be given within 15 days after receipt of details of the proposed Publication. If a Confidentiality Notice is not received within that period, the proposed Publication may proceed.

5. Confidentiality

5.1 None of the parties will, during the Project Period, and for 3 years after the end of the Project Period, disclose to any third party nor use for any purpose, except carrying out the Project or as otherwise permitted by this Agreement, any other party's Confidential Information.

5.2 None of the parties will be in breach of any obligation set out in clause 5.1 to the extent that the relevant Confidential Information:

5.2.1 is known to the party making the disclosure before its receipt in connection with the Project, and is not already subject to any obligation of confidentiality to another party;

5.2.2 is or becomes publicly known without any breach of this Agreement or any other undertaking to keep it confidential;

5.2.3 has been obtained by the party making the disclosure from a third party in circumstances where the party making the disclosure has no reason to believe that there has been a breach of an obligation of confidentiality;

5.2.4 has been independently developed by the party making the disclosure;

5.2.5 is disclosed pursuant to the requirement of any law or regulation (provided, in the case of a disclosure under the Freedom of Information Act 2000, none of the exceptions to that Act applies to the information disclosed) or the order of any Court of competent jurisdiction, and the party required to make that disclosure has (where lawful to do so) informed the party whose information it is, within a reasonable time after being required to make the disclosure, of the requirement to make the disclosure and the information required to be disclosed; or

5.2.6 is approved for release in writing by an authorised representative of the party whose Confidential Information it is.

5.3 None of the parties will be in breach of any obligation to keep another party's Confidential Information confidential or not to disclose it to any third party by making it available to any Group Company or any person working for or on its behalf or on behalf of a Group Company who needs to know the same in order to exercise the rights granted in clause 3.2, provided it is not used except as expressly permitted by this Agreement and the recipient undertakes to comply with the provisions of this clause 5 as if it was a party to this Agreement.

5.4 If any party that is subject to the Freedom of Information Act 2000 (the "**Request Recipient"**) receives a request under that Act to disclose any information that is the Confidential Information of another party, it will notify that other party and will consult with it promptly and before making any disclosure under that Act. That other party will respond to the Request Recipient within 5 Business Days after receiving the notice, providing information to assist the Request Recipient to determine whether or not an exemption to the Freedom of Information Act applies to the information requested under that Act. If the other Party has not responded to that request within 4 working days, the Request Recipient will be entitled to assume that no such exemption applies.

5.5 None of the parties will use another party's name, or another party's logo, in any press release or product advertising, or for any other promotional purpose, without first obtaining that other party's written consent.

6. Warranties and liability

6.1 Each of the parties warrants to each of the others that, to the best of its knowledge and belief (having made reasonable enquiry of those of its employees involved in the Project or likely to have relevant knowledge, but not having made any search of any public register) any advice or information given by it or any of its employees or students who work on the Project, and the content or use of any Data, Background or materials, works or information provided in connection with the Project, will not constitute or result in any infringement of any third-party rights.

6.2 Except under the limited warranty in clause 6.1, none of the parties accepts any liability or responsibility for any use which may be made by any other party of any Data, nor for any reliance which may be placed by that other party on any Data, nor for advice or information given in connection with any Data.

6.3 The liability of each party to all of the others for any breach of this Agreement, any negligence or arising in any other way out of the subject matter of this Agreement, the Project or the Data, will not extend to any indirect damages or losses, or to any

loss of profits, loss of revenue, loss of data, loss of contracts or opportunity (whether direct or indirect), even if the party bringing the claim has advised the other of the possibility of those losses, or even if they were within the other party's contemplation.

6.4 The aggregate liability of each party to all of the others for any or all breaches of this Agreement, any negligence, or arising in any other way out of the subject matter of this Agreement, the Project or the Data, will not exceed in total the value of that party's contribution to the Project as set out in the Project Plan.

6.5 Notwithstanding the provisions of any other clause of this Agreement, nothing in this Agreement limits or excludes any party's liability for:

6.5.1 death or personal injury; or

6.5.2 any fraud or for any sort of liability that, by law, cannot be limited or excluded.

6.6 The express undertakings and warranties given by the parties in this Agreement are in lieu of all other warranties, conditions, terms, undertakings and obligations, whether express or implied by statute, common law, custom, trade usage, course of dealing or in any other way. All of these are excluded to the fullest extent permitted by law.

7. Term and termination

7.1 This agreement shall commence on the Effective Date and, subject to clause 7.2, shall continue until the end of the Option Period unless terminated by either party on 30 days' written notice.

7.2 Either party may terminate this agreement immediately by written notice to the other if the other commits a material breach of this agreement which (in the case of a breach capable of a remedy) it does not remedy within 30 days of receiving written notice of the breach.

7.3 On termination of this agreement, each shall immediately and at its own expense safely return to the other all property and information of that party then in its possession or control.

7.4 Termination shall be without prejudice to the accrued rights of either party at the termination date. The obligations set out in clauses 3, 4, 5 and 6 shall survive termination of this agreement, however arising.

8. Force majeure

8.1 Neither party shall be liable for any delay in performing or for failure to perform its obligations under this agreement if the delay or failure results from any cause or circumstance beyond its reasonable control, including any breach or non-performance of this agreement by the other party (**Force Majeure Event**), provided that the same arises without the fault or negligence of such party.

8.2 If a Force Majeure Event occurs, the date(s) for performance of the obligation affected shall be post-poned for as long as is made necessary by the Force Majeure Event, but if such Force Majeure Event continues for a period of or exceeding three months, either party may terminate this agreement immediately by written notice to the other party.

8.3 Each party shall use its reasonable endeavours to minimise the effects of any Force Majeure Event.

9. GENERAL

9.1 **Notices:** Any notice to be given under this Agreement must be in writing, may be delivered to the other party or parties by any of the methods set out in the left hand column below and will be deemed to be received on the corresponding day set out in the right hand column.

Method of service	**Deemed day of receipt**
By hand or courier	the day of delivery
By pre-paid first class post	the second Business Day after posting
By recorded delivery post	the next Business Day after posting

The parties' respective representatives for the receipt of notices are, until changed by notice given in accordance with this clause, as follows:

For STFC	**For the Company:**
Name: Legal and Commercial Manager	Name:
Address: Science and Technology Facilities Council, Rutherford Appleton Laboratory, Harwell Oxford, Didcot, Oxfordshire, OX11 0QX	Address:

9.2 **Headings:** The headings in this Agreement are for ease of reference only; they do not affect its construction or interpretation.

9.3 **Assignment etc:** None of the parties may assign or transfer this Agreement as a whole, or any of its rights or obligations under it, without first obtaining the written consent of all of the other parties. That consent may not be unreasonably withheld or delayed.

9.4 **Illegal/unenforceable provisions:** If the whole or any part of any provision of this Agreement is void or unenforceable in any jurisdiction, the other provisions of this Agreement, and the rest of the void or unenforceable provision, will continue in force in that jurisdiction, and the validity and enforceability of that provision in any other jurisdiction will not be affected.

9.5 **Waiver of rights:** If a party fails to enforce or delays in enforcing an obligation of any other party, or fails to exercise or delays in exercising a right under this Agreement, that failure or delay will not affect its right to enforce that obligation or constitute a waiver of that right. Any waiver by a party of any provision of this Agreement will not, unless expressly stated to the contrary, constitute a waiver of that provision on a future occasion.

9.6 **No agency etc**: Nothing in this Agreement creates, implies or evidences any partnership or joint venture between the parties, or the relationship between them

of principal and agent. None of the parties has any authority to make any representation or commitment, or incur any liability, on behalf of any other.

9.7 **Entire agreement:** This Agreement constitutes the entire agreement between the parties relating to its subject matter. Each party acknowledges that it has not entered into this Agreement on the basis of any warranty, representation, statement, agreement or undertaking except those expressly set out in this Agreement. Each party waives any claim for breach of this Agreement, or any right to rescind this Agreement in respect of any representation which is not an express provision of this Agreement. However, this clause does not exclude any liability which any party may have to any other (or any right which any party may have to rescind this Agreement) in respect of any fraudulent misrepresentation or fraudulent concealment prior to the execution of this Agreement.

9.8 **Formalities:** Each party will take any action and execute any document reasonably requested by any other party to give effect to any of its rights under this Agreement, or to enable their registration in any relevant territory provided the requesting party pays the other party's reasonable expenses of doing so.

9.9 **Amendments:** No variation or amendment of this Agreement will be effective unless it is made in writing and signed by each party's representative.

9.10 **Third parties:** No one except a party to this Agreement may enforce any benefit conferred by this Agreement.

9.11 **Governing law:** This Agreement is governed by, and is to be construed in accordance with, English law. The English Courts will have exclusive jurisdiction to deal with any dispute which has arisen or may arise out of or in connection with this Agreement, except that any party may bring proceedings for an injunction in any jurisdiction.

This agreement has been entered into on the date stated at the beginning of it.

SIGNED for and on behalf of **STFC**:	**SIGNED** for and on behalf of **[ ]**:
Name	Name
Position	Position
Signature	Signature

SCHEDULE 1

The Project Plan

[Note – Ensure a project end date is included in the Project Plan]

Science and Technology Facilities Council

ISIS Neutron and Muon Source

ISIS Industrial Collaborative R&D (ICRD) Scheme

Review 2020

Appendix C
Public Letter

Science & Technology Facilities Council
ISIS

ISIS Facility

STFC Rutherford Appleton Laboratory
Harwell Oxford
Didcot OX11 0QX
United Kingdom

www.stfc.ac.uk

XXX

Direct line +44 (0)1235 445296
Local fax +44 (0)1235 5720
E-mail christopher.frost@stfc.ac.uk

Date: XXX

Dear XXXX

ISIS COLLABORATIVE R&D PROGRAMME

I am writing to let you know that your proposal "**XXXXXXXXXXXXXXXXXXXXXXXX**" has been approved. You have been allocated **X days** of beamtime on the **XXXXX** instrument at ISIS under the ISIS Collaborative R&D programme.

As the intention is for you to jointly publish the results with us in a reputable journal and/or to present the research at conferences there is no requirement from ISIS to enter into an explicit 'Collaborative Agreement'.

A key output of the ISIS Collaborative R&D programme is the provision of evidence of actual and potential economic impact arising from the use of ISIS. In addition to the information provided in the initial application, participants will be contacted over a period post-experiment to monitor the outcomes of beam-time awarded under this programme. This information may be use to report, in an aggregated format, about the economic impact arising from the industrial use of ISIS. Where significant impacts are achieved ISIS will request permission for such information to be used in an individual case study.

I would be grateful if you could sign and return a copy of this letter confirming that you accept the terms and conditions applicable to a user of the ISIS facility:-

- I agree that any data collected in the course of the experiment will be managed in accordance with the standard 'ISIS data management policy' (see http://www.isis.stfc.ac.uk/user-office/data-policy11204.html)

- I confirm that trained manpower capable of running the experiment on a 24 hour basis will be available and that the researchers will observe the appropriate regulations, especially on safety, of STFC.

- I certify that the information provided to ISIS on the sample and the safety aspects are correct and complete.

- I agree that STFC may use the personal information provided by me for the purposes of administering my application for beam time. This information may be shared with Diamond Light Source Ltd. of which STFC is a major shareholder, and with other UK Research Councils and the Wellcome Trust to provide information for facility funding processes. (The information will be stored manually or electronically and I understand that any personal information I provide will always be processed in accordance with the UK Data Protection Act 1998. I understand that this information will be used to deliver the services I have requested, or for the lawful, disclosed purposes of STFC).

- I agree to monitor actual economic impact arising from the use of ISIS over a period of time of up to 3 years post-experiment, based upon the estimates of economic impact provided in the approved application for beam time, and to provide evidence of this impact to STFC upon request.

Please do not hesitate to contact me with any questions or requirements that you may have.

Yours sincerely,

Dr Christopher Frost

I accept these terms and condition:-

Signed: Date:

On behalf of:

Science and Technology Facilities Council

ISIS Neutron and Muon Source

ISIS Industrial Collaborative R&D (ICRD) Scheme

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Appendix D
Publications, Patents, Web Articles

Publications

1	Kinetics of Surfactant Desorption at an Air-Solution Interface; Morgan, C. E.; Breward, C. J. W.; Griffiths, I. M.; et al. LANGMUIR Volume: 28 Issue: 50 Pages: 17339-17348 Published: DEC 18 2012
2	How Electrolyte and Polyelectrolyte Affect the Adsorption of the Anionic Surfactant SDS onto the Surface of a Cellulose Thin Film and the Structure of the Cellulose Film. 1. Hydrophobic Cellulose; Tucker, Ian M.; Petkoy, Jordan T.; Penfold, Jeffrey; et al. LANGMUIR Volume: 28 Issue: 29 Pages: 10773-10780 Published: JUL 24 2012
3	Adsorption of Polymer-Surfactant Mixtures at the Oil-Water Interface; Tucker, Ian M.; Petkov, Jordan T.; Jones, Craig; et al. LANGMUIR Volume: 28 Issue: 42 Pages: 14974-14982 Published: OCT 23 2012
4	Interaction of the Anionic Surfactant SDS with a Cellulose Thin Film and the Role of Electrolyte and Poyelectrolyte. 2 Hydrophilic Cellulose; Tucker, Ian M.; Petkov, Jordan T.; Penfold, Jeffrey; et al. LANGMUIR Volume: 28 Issue: 27 Pages: 10223-10229 Published: JUL 10 2012
5	Impact of AlCl3 on the Self-Assembly of the Anionic Surfactant Sodium Polyethylene Glycol Monoalkyl Ether Sulfate in Aqueous Solution ; Xu, Hui; Penfold, Jeffrey; Thomas, Robert K.; et al.; LANGMUIR Volume: 29 Issue: 44 Pages: 13359-13366 Published: NOV 5 2013
6	The impact of alkyl sulfate surfactant geometry and electrolyte on the co-adsorption of anionic surfactants with model perfumes at the air-solution interface; Bradbury, R; Penfold, J; Thomas, RK ;Tucker, IM ; Petkov, JT ; Jones, C JOURNAL OF COLLOID AND INTERFACE SCIENCE Volume 403 Pages 84-90 2013
7	The Formation of Surface Multilayers at the Air-Water Interface from Sodium Diethylene Glycol Monoalkyl Ether Sulfate/AlCl3 Solutions: The Role of the Alkyl Chain Length ; Xu, Hui; Penfold, Jeffrey; Thomas, Robert K.; et al. LANGMUIR Volume: 29 Issue: 41 Pages: 12744-12753 Published: OCT 15 2013
8	The Formation of Surface Multi layers at the Air-Water Interface from Sodium Polyethylene Glycol Monoalkyl Ether Sulfate/AlCl3 Solutions: The Role of the Size of the Polyethylene Oxide Group; Xu, Hui; Penfold, Jeff; Thomas, Robert K.; et al. LANGMUIR Volume: 29 Issue: 37 Pages: 11656-11666 Published: SEP 17 2013
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