The ISIS First Target Station Project

Update for ISIS Users – February 2016

This paper provides an update for the ISIS user community on the ISIS First Target Station Project. This is the largest single project being undertaken within the ISIS Neutron and Muon Source at the moment, with an overall timescale of over 5 years. The current state of the project means it is timely to provide more detailed information on the plans to the ISIS user community for information and comment.

What is the ISIS First Target Station Project?

ISIS is a world centre for studies in the physical and life sciences using neutrons and muons. The facility consists of around 30 neutron and muon instruments. The neutron instruments are based around two target stations where neutrons are produced by the interaction of a high-energy proton beam with a solid metal target. One of these target stations – Target Station 2 (TS2) – was constructed relatively recently and has been operating since 2009. The First Target Station (TS1) was constructed in the mid-1980s and has been operating for around 30 years. Over this period there has been no significant work carried out to maintain or develop the internals of TS1 - the moderators, reflector and target infrastructure, including cryogenic and cooling circuits, etc., have remained largely untouched. The First Target Station Project will develop and upgrade key elements of TS1, following an extended period of understanding and modelling of the workings of the target station as-is.

The project has been presented previously at the UK Neutron and Muon Science and User Meeting, and at other ISIS user group meetings over the past year.

What will actually be done during the project?

The project will see a complete refurbishment of the internals of the First Target Station, including the design of the target and its cooling systems, the moderators and the reflector and all their associated services. This also includes the monitoring instrumentation within the target station vessel, target station controls, the trolley that the target, moderator and reflectors sit on, and the large area of plant which deals with the target station services which sits behind the target station.

The project does not include any significant modifications to the ISIS instrument suite. Development of instruments will carry on as normal in parallel with the first target station project. ISIS has taken the decision to separate instrument developments from the refurbishment of the target station itself to ensure the target station project is realisable within likely funding available. As described below, some instruments will see a gain in neutron flux as a result of the project, and the project aims to ensure that no instrument’s capabilities are reduced by changes to the target and moderator assembly.
Why are we doing the ISIS First Target Station Project – and why now?

There are several reasons why it is timely for ISIS to be doing a refurbishment of the first target station:

1. **To secure the future of TS1 and enable it to operate for many more years**
   - TS1 is 30 years old and has had no significant work done on it during this time. In the TS1 project we will do the work necessary to keep TS1 operating for many years to come. It is good stewardship of ISIS to ensure that the first target station can operate well into the future.

2. **To provide improved future flexibility**
   - Renewing our engineering drawings of TS1, and refurbishing the target and moderator assembly, will enable us to make future changes more easily. This includes dealing with any unplanned failures within the target station, as well as doing other moderator changes, within certain constraints, in the future.

3. **To provide operational improvements**
   - The project will give greater knowledge and experience of TS1 to help with its normal operational running. It will decrease the complexity of target station operations, and in particular it will improve methane moderator changes which we need to perform regularly after a period of operation, reducing the time for changes and hence increasing the flexibility as to when they can happen.

4. **To provide a neutron flux increase**
   - A neutron flux increase is expected, of up to a factor of 2 or so, on some TS1 instruments. This will enable faster and more productive experiments.

5. **To further develop our knowledge, skills and experience in the area of target station design**
   - ISIS already has very significant experience in neutron target station design following the successful design, construction and operation of TS2. The neutronics, engineering and instrument simulation that will go into the new TS1 design will enable us to further develop our experience in this area, feeding into future projects including further ISIS upgrades and the European Spallation Source.

When will all this happen, and what stage is the project at now?

The First Target Station Project has been divided into several phases.

- Over the past couple of years or so, ISIS has been conducting a feasibility study as to whether the project is viable. This has included updating all the existing engineering drawings of the internals of the target station (these were over 30 years old); performing neutronics simulations of the target station neutron production so that we understand its present performance; matching these simulations to the actual neutron flux and spectra observed on the TS1 instruments; and doing simulations and studies of possible changes to the target, moderator and reflector assembly to provide a new design. We have periodically asked for this work to be reviewed by experts outside the facility to ensure we are going along sensible lines.

- All of this work has resulted in the ISIS Management Committee (IMC) having confidence that the project is sensible, feasible and the right thing to go ahead with. The IMC decided in October 2015
that it would like to move the project from its feasibility phase into implementation – which then means doing more detailed planning and design to finalise exactly what would happen.

- In December 2015 the ISIS Facility Board, which oversees the management and operations of the facility, commented on the proposed project and gave its approval to it. Over the next few months, STFC senior management will discuss the project and consider their approval of it. The ISIS User Committee discussed the project in December 2015, and recommended wider briefing and consultation with the community. It is therefore a good moment to provide a more detailed update and information on the project to the ISIS user community for comment.

Assuming that approval for the project is given within STFC, the detailed design and planning, the procurement of components, and the production of mock-ups and test assemblies, etc., will then take several years. At current estimates, we would aim to do the actual refurbishment work in 2020 – 2021. The project would take around one year to actually complete, during which time the ISIS First Target Station would not be operating. It is likely, however, that the Second Target Station would operate for some of the period of the refurbishment of TS1, depending on what other work within the facility was required.

How will all this affect me and my science programme?

- Our key aim is to ensure the viability of the ISIS First Target Station for many years to come. In the long term the proposed work will therefore benefit the science programmes of the ISIS user community.

- The project has come key constraints. These include ensuring that the overall risk to ISIS TS1 operations of making an intervention within the target station is as low as possible. They also include ensuring that no instrument is worse off, in terms of its neutron characteristics, as a result of the changes. Some instruments will see neutron flux increases of up to a factor of two, benefiting science programmes.

- The primary effect on science programmes will be the 1-year shutdown of TS1, currently envisaged for 2020-2021. This will clearly require planning, and notification of the exact dates of the shutdown as far in advance as possible so that users can make alternative provision for their science programmes. ISIS will do its best to liaise with other European neutron facilities to try to avoid TS1 being off at the same time as other major facilities also have extended off periods.

FAQs . . .

How is the project being run?

ISIS is currently setting up a project board which will have overall oversight of the project. This board will include ISIS and STFC senior staff, senior staff from other STFC departments and a user community representative. The board membership will be publicised once it has been finalised. Within the project, there are 20 separate work packages for all its different aspects, with ISIS staff as work package leaders.
What will the project cost?

The estimated cost for the full refurbishment is around £16.5M. This money will come from ISIS and STFC funds, and is part of STFC’s stewardship of its large science facilities, ensuring that they remain viable into the future.

If I want to know more, or comment, what can I do?

If you’d like to know more, or if you have comments on the proposed project, please contact Sean Langridge (sean.langridge@stfc.ac.uk) or Philip King (philip.king@stfc.ac.uk), ISIS Science Division Heads, or ask an ISIS scientist!

Further updates on the project, and chances for comment, will be given at the UK Neutron and Muon Science and User Meetings, at other user group meetings, via the ISIS website and through ISIS newsletters.