SELECTION PROCESS FOR SECOND TARGET STATION PROJECT INSTRUMENTS

1. INTRODUCTION

The Second Target Station (STS) at the Oak Ridge National Laboratory (ORNL) Spallation Neutron Source (SNS) will be a pulsed neutron source optimized for the production of cold (long-wavelength) neutrons. The STS Project will build 8 initial instruments ready to transition to operations and begin commissioning with neutron beam by the end of the project. This document describes a two-stage process for selecting these initial 8 instruments that begins with submission of a preliminary instrument proposal.

The preliminary proposal stage emphasizes establishment of instrument science cases that lead to definition of the requirements needed to conduct the research along with a relatively brief description of the proposed instrument. Preliminary proposals for possible instruments to be included in the STS Project will be solicited via an announcement followed by an informational webinar. Submitted proposals will be evaluated by the STS Instrument Review Committee (STS-IRC) and scored according to the selection criteria described below. A technical and feasibility review will be provided to the STS-IRC for their consideration by STS staff and additional instrumentation experts (selected to avoid any conflicts of interest and with specific expertise matched to the instrument under consideration). Based on the STS-IRC evaluation, STS Project and ORNL Neutron Sciences Directorate (NScD) management will select proposals to proceed to second stage development of full proposals. The goal in this stage is to provide feedback to the proposal teams and advance a sufficient number of proposals so as to produce a reasonably comprehensive set of instrument concepts in the full proposal phase.

Developers of approved preliminary proposals will be invited to submit full instrument proposals that in addition to expanding on content included previously, will include a more complete physics and engineering description of the desired instrument. Full proposals will be evaluated in a similar fashion as preliminary proposals. Final decisions for the STS Project instruments will be made by STS Project and NScD management. A timeline for the entire process is outlined in Section 6.

Although the STS project will construct only the 8 initial instruments, the facility will provide the capacity for 22 total beamlines and the project must plan for a future full build-out of the beamlines. Instrument concepts not selected as the 8 project instruments will be used to help develop a roadmap leading to a future, more complete build-out of the STS beamlines. Instrument concepts developed during the full proposal phase will be used to help refine facility interfaces and requirements, including moderator optimization, space needs, floor loading, and possible arrangement of instruments in the STS instrument buildings.

2. GUIDING PRINCIPLES

The goal of the STS instrument selection process is to choose instruments for inclusion in the STS Project that use the distinctive characteristics of the STS source to provide world-leading capabilities to address a compelling science case. As discussed in the *First Experiments: New Science Opportunities at the Spallation Neutron Source Second Target Station* report,[1] STS will provide unique capabilities for experiments that require:

- Time-resolved measurements of kinetic processes and beyond-equilibrium matter

[1] *First Experiments: New Science Opportunities at the Spallation Neutron Source Second Target Station*, Oak Ridge National Laboratory, December 2019, Available at https://neutrons.ornl.gov/sites/default/files/STS_First_Experiments_Report.pdf (accessed April 24, 2020).

- Simultaneous measurements of hierarchical architectures from the atomic scale to microns and beyond
- Measuring small samples of newly discovered or synthesized materials
- Examining new frontiers in materials at extreme conditions.

This report illustrates science opportunities enabled at the STS by describing examples of first experiments that could be conducted. It discusses the unique capabilities of the STS source and how these can be used to provide transformative new capabilities for research and includes a brief discussion of STS neutron beam production, instrumentation, and technologies. It also includes short descriptions of several representative instruments that illustrate how the unique STS source parameters can be used. The report serves as a good reference source for proposal teams.
The selection process has the following objectives:

- Engage the research community to identify the best science opportunities to pursue at STS and the capabilities and performance parameters that need to be enabled by STS instruments
- Engage instrument designers and technical experts to develop instrument concepts that make the best use of the STS source characteristics to deliver new, world-leading capabilities that address these science opportunities
- The process is communicative, open, transparent and fair
- Engage key stakeholders to advise management on STS scientific directions and recommend prioritization for instrument construction
- The process is integrated with relevant project milestone dates and critical decision points and aligned with available project resources

To ensure the last objective, final decisions of instruments to be built within the STS Project will be made by STS Project and NScD management.

3. REVIEW COMMITTEE

Proposal reviews will be conducted by the STS-IRC, convened for the sole purpose of advising STS and NScD management on the selection of project instruments. The committee membership will represent key stakeholders in the scientific success of the STS. The STS-IRC will provide weighted rankings of each proposal as described below to STS and NScD management. The committee will also provide comments as to the short-comings and strengths of individual proposals that will be communicated only to the proposal teams. These comments are intended to strengthen future proposals. The STS-IRC will be comprised of 12 members including a non-voting chairperson. The makeup of the committee is anticipated to include a current or former member of the SNS-HFIR User Group Executive Committee and four subject matter experts from the ORNL Neutron Sciences Directorate. The remaining 7 committee members will be selected from well-known experts that cover the broad scientific scope of STS. Notification of suggested committee membership will be provided to the BES-program office. Once the committee makeup is finalized, communication will be made to the SHUG-EC and announced on the STS web-site.

4. PRELIMINARY PROPOSALS

As described above, the selection process will begin with an invitation for teams to form and submit their best ideas for the science they want to pursue at the STS and describe the capabilities that need to be enabled by the STS instruments. The emphasis of the Preliminary Proposal is not on the development of a detailed instrument concept. However, it must include a high-level instrument description, as this is a requirement for the full proposal stage. It is encouraged that proposal teams include a member of the neutron sciences staff at ORNL to provide both scientific and technical input and guidance as to what

capabilities can be practically realized. Once a team has formed, the team's spokesperson should contact the STS Instrument Systems Manager (Ken Herwig herwigkw@ornl.gov) to indicate the intent to submit a preliminary proposal, no later than three weeks after the call is announced. This information will be used to track the preparation of preliminary proposals and to manage situations where multiple teams may have formed to pursue similar instrument concepts and capabilities. In this situation, proposal teams will be encouraged to compare goals and combine efforts where appropriate.

4.1 EVALUATION CRITERIA FOR PRELIMINARY PROPOSALS

The following criteria will be used to evaluate the merits of preliminary proposals:

1. Scientific importance and impact
    a. Will the proposed instrument advance the frontiers of knowledge?
    b. What are the broader societal impacts of the proposed science case?
    c. Does the science case identify grand challenges from national studies and reports?
    d. Does the science case include a sufficiently wide application area?
    e. What is the potential for high-impact publications?
2. Strength of the relevant user community
    a. What is the predicted demand?
    b. What research communities will use this instrument? Does this instrument have the potential to expand the neutron user community?
    c. Will inclusion of this instrument maintain a balanced science portfolio across the ORNL neutron sources?
3. Uniqueness of STS source capabilities utilized (cold neutrons, broad bandwidth, high brightness)
    a. Does this instrument make the maximum benefit of the unique STS source capabilities?
    b. Would the capabilities of this instrument be better enabled at another of the ORNL neutron sources?
    c. Does this instrument complement the capabilities of existing instruments at ORNL?
4. Anticipated quality of the proposed instrument (world-leading, competitive, other)

4.2 CONTENT OF PRELIMINARY PROPOSALS

Preliminary proposals should not exceed 10 pages in length in a minimum font size of 11pt (page totals indicated in parentheses are to be taken as guides and not requirements for section length) and they should address the evaluation criteria described above by including the following content:

1. Cover page with title, team member names and affiliations, and an abstract of 150 words or less. The team spokesperson must be identified with complete contact information. This individual will serve as the primary point-of-contact (POC). This information will be made publicly available on the STS website. (1 page, not included in page total)
2. Science case that includes a table of high-level requirements such as neutron beam or sample size, wavelength range, resolution, flux, and need for capabilities such as polarized neutrons and polarization analysis or special requirements for sample environments. (4-5 pages)
3. Instrument description with a discussion of how the initial concept addresses the capability requirements (2-3 pages).
4. Description of the anticipated user community and use of this instrument with respect to existing instrument capabilities at other ORNL neutron sources. (1 page)
5. Discussion of the use of the unique STS source characteristics (cold neutrons, broad bandwidth, high peak brightness, see the First Experiments Report for a more complete description). (1 page)
6. References and team member CVs. (not included in page total, brief NSF-style biographical sketches are encouraged but are not required)

4.3 REVIEW OF PRELIMINARY PROPOSALS

Preliminary proposals will be scored by the STS-IRC using a weighted average of the selection criteria described above according to the following table:

Criteria	Score: 1-5 (1 poorest, 5 best)	Weighting (%)	Weighted Score
Science Case		45	
User Community		25	
Unique use of STS source		15	
Quality of the instrument		15	
		Total	

STS staff and additional instrumentation experts (selected to avoid any conflicts of interest and with specific expertise matched to the instrument under consideration) will prepare a technical and feasibility review for each preliminary proposal. This technical review will be made available to the STS-IRC for their consideration. STS and NScD management will be guided by the rankings provided by the STS-IRC in their choice of preliminary proposals selected to move on to full proposal development. Possible outcomes are described in the table below. Final decisions will be communicated to the STS-IRC, the NScD Neutron Advisory Board (NAB), and the SHUG-EC. The STS website will be updated to reflect proposals and proposal teams proceeding to the full proposal stage.

Decision	Action
Preliminary proposal is accepted	Proposal team is invited to submit a full proposal
Multiple preliminary proposals describe similar instruments or overlapping capabilities and are ranked highly enough to be accepted	Proposal teams are encouraged to combine resources and efforts and submit a full proposal for a single instrument
Preliminary proposal is not recommended to proceed to a full proposal	Proposal team is notified that the proposal is not accepted including the rationale for rejecting the proposal at this time

A key goal for the preliminary proposal phase is to provide guidance derived from the review process that will lead to a stronger full proposal in phase two. Written comments from the STS-IRC will be communicated to each proposal team as well as the technical and feasibility review described above. The technical review is meant to provide advice as the proposal team advances their initial instrument concept to a more complete conceptual design for the full proposal. Proposal teams invited to submit a full proposal will have the opportunity to individually meet with STS-IRC representatives to discuss specific areas where their proposal could be improved.

5. FULL PROPOSALS

Full proposals will be accepted only from teams who previously submitted a preliminary proposal that was approved to proceed to the full proposal phase. Full proposals will expand on the sections included in the preliminary proposal and more fully develop and evaluate an instrument concept. The STS project will work with NScD management to provide technical and modeling expertise to support technical development of the instrument concept subject to availability of resources. The STS project will provide engineering support to produce a model of the instrument concept and its geometry. Evaluation criteria for full proposals will include a heavier emphasis on the quality and anticipated performance of the proposed instrument concept. Proposal teams must include a member of the ORNL neutron sciences staff

to act as a point of contact for ORNL resources and to provide both scientific and technical input and guidance as to what capabilities can be practically realized.

5.1 EVALUATION CRITERIA FOR FULL PROPOSALS

Full proposals will be evaluated according to the criteria used for preliminary proposals with the addition of the following fifth criterion addressing constructability of the proposed instrument:

5. Feasibility of instrument concept
    a. Is there a high degree of certainty that the proposed instrument will achieve its stated performance goals?
    b. Is there R&D required before the instrument can achieve its goals? Will the instrument deliver core aspects of its science mission if constructed using current technology?
    c. Can the instrument be built within the budget and schedule constraints of the STS project?

5.2 CONTENT OF FULL PROPOSALS

Full proposals should not exceed 30 pages in length in a minimum font size of 11pt (page totals indicated in parentheses are to be taken as guides and not requirements for section length) and they should address the evaluation criteria described above by inclusion of the following content:

1. Cover page with title, team member names and affiliations, and an abstract of 200 words or less. The team spokesperson must be identified with complete contact information. This individual will serve as the primary point-of-contact (POC). This information will be publicly available on the STS website. (1 page, not included in page total)
2. Science Case that includes a table of high-level requirements such as neutron beam or sample size, wavelength range, resolution, flux, and need for capabilities such as polarized neutrons and polarization analysis or special requirements for sample environments. (8-10 pages)
3. Description of the anticipated user community and use of this instrument with respect to existing instrument capabilities. (2 pages)
4. Discussion of the use of the unique STS source characteristics (cold neutrons, broad bandwidth, high peak brightness, see the First Experiments Report for a more complete description). (1-2 pages)
5. Description of the conceptual design of the instrument that includes the following elements as a minimum. (8-10 pages)
    a. A discussion of the physics parameters and design of the instrument and how they support the capability requirements derived from the Science Case.
    b. A table of key instrument components and their locations relative to the moderator.
    c. An engineering concept that is illustrated through drawings that describe the geometry, desired location, and footprint of the instrument.
    d. Evaluation of instrument performance typically demonstrated by Monte Carlo simulations modeling neutron transport and scattering from a prototypical sample. This analysis may also include scaling arguments based on existing instrument performance and projected source parameters.
    e. Analysis of the feasibility of the instrument concept that discusses the use of existing technology and the need for R&D to realize the full capability of the instrument design.
6. Estimate of instrument cost (Note: this section will be provided by STS Project staff and is not included in the page total.)
7. References and team member CVs. (not included in page total, brief NSF-style biographical sketches are required for all members of the proposal team)

8. Supporting letters from researchers who intend to use the instrument. (not included in the page total)

5.3 REVIEW OF FINAL PROPOSALS

Full proposals will be scored by the same STS-IRC that evaluated the preliminary proposals. The same technical reviewers described above will prepare a technical and feasibility review of each full proposal. These reports will be made available to the STS-IRC for their consideration. With a more complete description and analysis of the instrument concept, rankings include a heavier emphasis on the quality and anticipated performance of the instrument concept as described in the following table:

Criteria	**Score: 1-5 (1 poorest, 5 best)**	**Weighting (%)**	**Weighted Score**
Science Case		40	
User Community		10	
Unique use of the STS source		10	
Quality of the instrument		20	
Feasibility		20	
		Total	

STS and NScD management will be guided by the rankings provided by the STS-IRC in their choice of instruments to be built within the STS Project. Their considerations will be discussed with the STS-IRC, the SHUG-EC and NAB prior to notification of the final instrument choices. Written comments from the STS-IRC will be provided to proposal teams with the intent to strengthen any future instrument proposals. Any guidance provided by the committee will be incorporated into the physics optimization and design of the selected instruments. Proposal teams for selected instruments will be encouraged to engage with the STS instrument team throughout the development and maturation of the instrument design through regular updates, participation in key system-level reviews and development of commissioning plans.

6. TIMELINE

Time	**Action**	**Communication**
T = 0	Call for Preliminary Proposals	E-mail to the user community and neutron mailing list. Announcement posted on STS and NScD websites.
T = 1 week	Webinar: Expectations for Preliminary Instrument Construction Proposals	Informational webinar giving an overview of the process and an opportunity for live discussion with research community.
T = 3 weeks	Deadline for proposal teams notify the STS Instrument Systems Manager of their intent to submit a proposal	
T = 5 weeks	Identify STS-IRC members	Communicate with BES Program Office and SHUG-EC
T = 8 weeks	Deadline for submission of Preliminary Proposals	Proposal titles, team members, and abstracts posted on the STS website.
T = 9 weeks	Review by STS-IRC	

T = 10 weeks	STS and NScD Management Review (BES Program Office participation)	Proposal teams notified of final outcomes. E-mail to user community and announcement posted on STS and NScD websites.
T = 11 weeks	Webinar: Expectations for Full Instrument Construction Proposals	Informational webinar giving an update on proposals moving forward to full proposal stage and opportunity for live discussion with the research community.
T = 12 weeks	Video meetings for proposal teams with the STS-IRC	Discussion of areas where proposals moving to full proposal stage can be strengthened
T = 35 weeks	Deadline for submission of Full Proposals	Proposal titles, team members, and abstracts posted on the STS website.
T = 37 weeks	Review by STS-IRC	
T = 39 weeks	STS and NScD Management Review (BES Program Office participation)	Discussion with SHUG-Executive Committee and NScD Neutron Advisory Board
T = 40 weeks	Instrument Selection Complete	Proposal teams notified of final outcomes. E-mail to user community and announcement posted on STS and NScD websites.