NSS Guideline for Instrument Construction Projects - Tollgate 2 Review and Decision

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SUMMARY

This document describes the Tollgate 2 (TG2) review for Instrument Construction projects, the process (refer to glossary for a definition of the word “process” as used in this document) leading up to it and the decision process. This review allows ESS management to make the decision on moving instrument projects from “Phase 1, Preliminary Design” to “Phase 2, Final Design” with a well-defined budget, scope and work plan for the duration of the instrument project.

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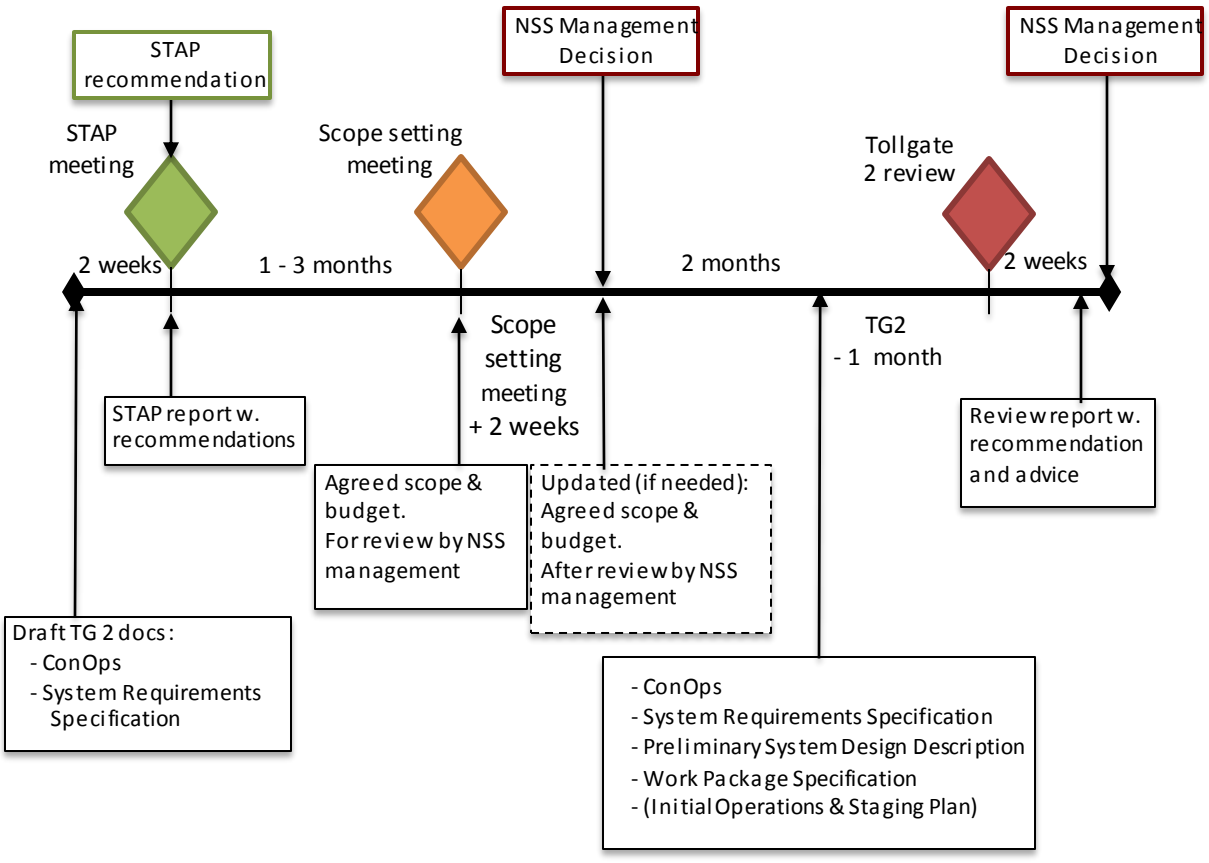
1. GENERAL DESCRIPTION

The process ESS uses for running instrument construction projects details a set of project reviews. These reviews help management to ensure that projects 1) are going to produce the desired result (world-class neutron scattering instruments); 2) are feasible and defensible to our governing and advice-giving bodies; 3) have well defined budgets, schedules, and goals. This document describes the second such review and decision process after review and approval of the instrument proposal by the SAC, ESS, and ESS-Council, which is Tollgate 1 (TG1). Phase 1, Preliminary Engineering Design, follows a successful TG1 review with an expected duration of six to twelve months. The second review is Tollgate 2 (TG2), with the purpose to review the instrument's preliminary design together with the scope, budget and schedule, in order to assess whether the instrument project[1] can move from preliminary engineering into final engineering and early procurement. Following the TG2 review, the scope, budget and schedule of the instrument project are set by NSS project management.

It is envisaged that three meetings will take place towards the end of Phase 1 Preliminary Engineering Design. In chronological order, these are the STAP meeting, scope-setting meeting and the TG2 review meeting itself.

2. TG2 TIMELINE AND FLOWCHART

Below is a flowchart visualizing events and timeframes related to the TG2 review.



3. STAP MEETING

The Scientific and Technical Advisory Panel (STAP) [[2]] is an external advisory body which will follow all instrument construction projects within a given instrument class.

The participants of the meeting are the core instrument team (i.e. the lead scientist and engineer), the instrument STAP, and representatives of the instrument partners, the ESS technical groups and ESS management. The meeting is chaired by the STAP chair.

Draft versions of the Concept of Operations document and the System Requirements Specification, described further below, shall be prepared and distributed two weeks in advance of the STAP meeting, with a completion level that reflects the maturity of the instrument design at that point in time. The documents will be reviewed by the STAP to make sure that they accurately reflect the high-level scientific requirements.

The core instrument team should present the current status of the instrument project including early cost estimates. Comments and recommendations on all aspects of the instrument shall actively be sought, with a particular emphasis on the scientific scope and capabilities. The advice of the STAP will be sought to assist the instrument team in establishing the science case associated with the various technical capabilities being considered for inclusion in the instrument project scope. The instrument team shall ensure that sufficient information is obtained to allow an informed decision to be made shortly afterwards on the instrument scope and budget.

This STAP meeting shall be held sufficiently before the TG2 review so that there is enough time to receive and adapt to the recommendations – 2-3 months is recommended. A written STAP report with clear recommendations should be received shortly after the meeting.

4. SCOPE-SETTING MEETING

The participants are the instrument team, instrument partners (as applicable), representatives of the ESS technical groups and NSS project management. The core instrument team presents the scope and budget for up to three instrument configurations: baseline (i.e. within cost category) as well as additional configurations as chosen by the instrument team to elaborate on cost versus performance. For each configuration, the following questions need to be evaluated:

- is the scientific performance competitive with the current state of the art?

- to what extent does it correspond to the scope outlined in the approved instrument proposal?
- to what extent is it upgradeable to the scope outlined in the approved instrument proposal?

The scope-setting meeting needs to take place sufficiently before the TG2 review so that there is enough time to adapt the work and prepare the documentation – about 2 months before TG2 is recommended. The meeting deliverable is an agreed scope and budget for presentation at TG2.

The Scope Setting Meeting is further detailed in ref [4].

5. TOLLGATE 2 REVIEW MEETING

NSS project management organises the meeting and provides a secretary. The participants are the core instrument team, the review committee, and representatives of the instrument partners, the ESS technical groups and NSS project management. The meeting, apart from the closed committee session(s), shall be open to observers. The core instrument team, supported as necessary by technical groups and partners, presents the proposed baseline for the instrument project. All TG2 Review documentation will be made available to the review committee two weeks prior to the review.

5.1. Review Committee

The committee shall be composed of a chairman chosen by NSS management, two to three representatives of the STAP, one or more project engineers (external to the instrument) that have built neutron instruments, and an engineer for industrial and nuclear safety. The chairman of the review is chosen for strong experience in delivering neutron instrument projects.

5.2. Scope of the Meeting

The TG2 consists of a Preliminary Design Review (PDR) and a review of the budget and scope as agreed at the scope-setting meeting. The meeting outcome is to define the baseline scope, budget and work plan and allow NSS project management to determine if the instrument project can move into Phase 2. In order to do that, the following high-level questions need to be answered:

- has adequate planning been done to move the project into Phase 2?
- is the proposed budget consistent with the proposed scope?

- does the preliminary design satisfy the requirements?
- is the presented baseline technically sound?
- has anything been forgotten or neglected?
- In case where several In-kind partners are collaborating - are roles and responsibilities adequately defined and agreed?

A number of lower-level questions, forming a subset of the above list, also need to be answered:

- have safety-related aspects in accordance with [[6]] been appropriately considered?
- to what extent have appropriate connections been made with the critical project interfaces, such as software, data storage hardware and sample environment?
- Has the instrument context been appropriately considered in terms of physical interfaces, such as bunker, beam extraction, ICS etc. ?
- to what extent have available engineering standards been implemented appropriately?
- are the cost and duration estimates reasonable?
- to what extent has the team planned appropriately for the risks, both technical and otherwise?
- to what extent have RAMI aspects in accordance with [6] been appropriately considered?

5.3. TG2 Review Documentation

The documentation for TG2 must present the project's technical maturity and should provide sufficient information for the TG2 review panel to make an assessment of the questions raised in the section above. The documents should form a natural part of the project engineering process and be sufficiently comprehensive that the review panel can make an initial assessment of the TG2 questions before the review meeting.

The documentation shall be written by the instrument team with input from the appropriate technical groups at ESS and at partner labs. The documentation shall be reviewed by the ESS technical groups. Draft versions of the documentation must be made available to the reviewers in sufficient time for the review process and subsequent potential changes to be made before the TG2 review meeting, it is considered that at least one month will be sufficient time.

Documents describing the technical standards and constraints (i.e non-functional requirements) of the technical components will be used for drafting the TG2 documentation and will be provided as supporting material for the review. They are listed in [6].

The TG2 documentation shall be assembled into a document package of a readable length so that the review panel can consider the contents before the review. The page lengths given below are typical expected lengths, but instead of stipulating a recommended maximum length it is proposed that the documentation is content driven rather than length driven. If the necessary information can be conveyed in a more concise way, that is to be encouraged.

The TG2 Documentation shall consist of the following documents:

5.3.1. Concepts of Operations (ConOps)

15-25 pages in length (of actual content – not including preface, table of content etc) , describing the instrument. It is derived from the instrument proposal widening the perspective from the scientific case of the instrument to include the context in which it intends to be designed, constructed and operated. Described with its complete life-cycle in mind. The ConOps should be reviewed by STAP prior to TG2 and serve as the driving document for deriving and/or justifying the requirements. It should include, but may not be limited to the following:

- Brief overview of the science case listing the high level scientific requirements. This will assist in further deriving system (=the instrument) functional requirements and/or confirming already identified functional, performance and constraint requirements (otherwise refer to the proposal)

- Outline of the high level system requirements, that have been identified so far. These will be further developed and/broken down in the forthcoming System Requirement Specification, described below.

- The life-cycle of the instrument described and aligned with the overall ESS development phases and in accordance with the Process for Neutron Instrument Design and Construction, ESS-0051706, ref [1].

- A system overview describing the different main building blocks of the instrument; outlining main design considerations and consideration with respect to the installation.

  Future upgrade options/possibilities and the impact those have on the selected design solution.

  Foreseen key interfaces with the surroundings (e.g target station, bunker, site infrastructure (SI/CF), neighbouring instruments, ICS, DMSC and sample related equipment and activities).

- A stakeholder analysis that will identify entities and/or persons that that have an interest/stake in the development or operation of the instrument in one way or another. The analysis in the Conops should focus on stakeholders affecting the design, construction, operation and decommissioning of the instrument.

- A description of the context within which the instrument will be designed and operated.

- A step-by-step description of how the instrument is operated for one or two typical as well as the most complicated experiment/-s to be performed. This also includes descriptions of expected sample related activities (sample environment and laboratories) and software expectations.

- Instrument specific maintenance philosophy based on and further refined from the overall ESS wide maintenance philosophy. It should consider aspects of ESS RAMI (Reliability, Availability, Maintainability, Inspectability) guidelines, ref [6].

- A description of foreseen training needs for operation, maintenance and repairs.

The above described content of the Conops will assist and facilitate further derivation of functional requirements of the instrument. It will also facilitate the awareness and/or generation of constraint requirements, which will then go into the design of the instrument. Constraint requirements do not impact on the functionality of the instruments. They will however have a lesser or greater impact on the design choices of the instrument in order to achieve the intended functionality.

It is expected that a few or more areas mentioned above will not be possible to elaborate as not all information will be known at the time of writing the ConOps, but by having it listed it is a reminder to designers and others that it needs to be covered in the design effort. The Conops is also expected to be further developed as the instrument project progress.

A template for the ConOps document will be provided for the instrument teams, including a worked example.

5.3.2. System Requirements Specification

20-30 pages in length (of actual content – not including preface, table of content etc), containing the High Level Product Breakdown Structure (PBS) and then documenting requirements and rationales in a rigorous manner. Should be reviewed by STAP prior to TG2.

It should include but may not be limited to:

- System Breakdown: High level PBS, only to first sub-system level (e.g. Beam Transport and Conditioning System). Should follow NSS Standard PBS [[3]].

- Functional Requirements: Describes the functional requirements of the system (instrument) and first level sub-systems. Requirements are documented in a standardised manner so that requirements between instruments can be more easily compared. The functional requirements are traced to the top level requirements in the ConOps. In general; all lower level requirements shall have a parent requirement on the next applicable higher level. This traceability is important for verification purposes.
- Non-Functional/Constraint Requirements: Constraint requirements are traced to the ConOps (either to formalized requirements or to the appropriate wording) and/or to ESS documents on various technical standards [[6]]. Not all ESS non-functional requirements will apply to all instruments, so the team should identify which ones are of relevance e.g. crane heights in Hall 3 do not affect an instrument in Hall 2.

A template for the System Requirements Specification will be provided for the instrument teams, including a worked example.

5.3.3. Preliminary System Design Description

Up to 50 pages in length, describing the design at an appropriate level of detail, also addressing how the design meets the requirements, including traceability to any or all requirements that are partly or fully met by the respective design solution, and what the scientific performance will be. It shall include an assessment of safety aspects, a Process and Instrumentation Diagram (P&ID) and identification of interfaces with full PBS where needed to break down sub-systems.

Contents:

- Instrument Overview: Layout drawings and table of positions of components.
- For each Sub-system; 1..N: Description of the preliminary design of first level of sub-system as identified in the System Requirements Specification. Includes drawings, specifications and more detailed PBS as needed.
- System P&ID and Interfaces: Brings together the above sub-systems and identifies interfaces.
- Preliminary safety analysis for the instrument
- Expected scientific performance (incl. calculations, simulations, etc.)

A template for the Preliminary System Design Description will be provided for the instrument teams, including a worked example.

5.3.4. Work Package Specification

Up to 30 pages in length, describing project organization, resourcing (i.e. budget and in-kind plan), schedule and risk assessment. The purpose of this document is to describe how the contents of the Preliminary System Design Description will be produced.

Contents:

1. Project Organization : Project team, partners, suppliers etc.
2. Project Scope : What is included in the instrument project.
3. Work Breakdown : Division of the instrument project into work units that will deliver the various instrument sub-systems identified in Section 3.
4. Project Schedule : High Level Schedule. Overall instrument schedule with high level work unit milestones incorporated.
5. Project Budget : High Level Budget broken down by Work Breakdown structure and time, and by PBS and time if they do not naturally align. Labour and non-labour breakdown. Show in-kind/cash breakdown if appropriate.
6. Description of work units, a…n :
   for each work unit, provide a very brief description to remind the reader, then give budget breakdown and schedule for the work units.
7. Project Risk Analysis : Give top 10 project risks from the instrument risk register. Analysis and scoring as per ESS risk analysis procedure. Risks are selected based on what is within the instrument project's control. If it is outside the instrument project's control it is a concern but not a risk. Risks are to be related to performance, cost and/or schedule.

5.3.5. Initial Operations and Staging Plan

Up to 5 pages, describing any instrument-specific hot commissioning tasks and staging plan.

The staging plan shall indicate an approximate timeline and budget for achieving the full instrument scope as outlined in the instrument proposal. This is outside the instrument scope presented at TG2.

5.4. Review Report

The report from the committee should be received within two weeks of the review meeting. It shall answer all of the questions listed and should include a list of recommendations and advice for the instrument.

A clear recommendation shall be given in the report on the future of the instrument project, with three options:

A. The instrument project should move into Phase 2 with no changes to what was presented.
B. The instrument project should move into Phase 2 with a list of changes or recommendations to what was presented.
C. The instrument project is not ready for Phase 2.

6. TOLLGATE 2 REVIEW OUTCOME

The outcome will be dependent on the grade given by the review panel in their review report:

A. ESS management may move the instrument project into Phase 2.
B. The instrument team and ESS management will review the recommendations or suggested changes. The instrument team will be given up to three months to implement the agreed changes and appropriately revise the baseline documents, with only internal review required in order to subsequently move the instrument project into Phase 2.
C. The instrument team will be instructed to continue in Phase 1 and prepare for a second TG2 review within six months of the original review. A second C result may result in the recommendation that the instrument team be disbanded and the project stopped.

6.1. Decision

ESS management has the responsibility to ensure the success of the NSS project as a whole and will make decisions on the continuation of the instrument project, based on the outcome of the review. The decision will be made by ESS management with the Instruments Collaboration Board as an advisory body. Until a decision has been made, the instrument project shall remain in Phase 1.

7. GLOSSARY

Term	Definition
P&ID	Process and Instrumentation Diagram
PBS	Product Breakdown Structure
Phase 1	Preliminary design phase
Phase 2	Final design phase including early procurement
Process	Throughout this document, the word process, when not referring to an official ESS process document, describes a set of linked activities along a timeline that culminates in an specific outcome – decision, documentation, tangible asset etc.
RAMI	Reliability, Availability, Maintainability & Inspectability
SAC	Scientific Advisory Committee
STAP	Scientific and Technical Advisory Panel [[2]]
TBD	To Be Defined
TG1	Tollgate 1 review, allowing an instrument project to move from the conceptual design presented in the instrument proposal to Phase 1
TG2	Tollgate 2 review, allowing an instrument project to move from Phase 1 to Phase 2
WIP	Work In Progress

8. REFERENCES

[1] Process for Neutron Instrument Design and Construction, ESS-0051706
[2] MEMO: Roles of STAPs to support instrument construction, ESS-0032507
[3] NSS Generic Instrument PBS Number Designation, ESS-0034841
[4] Instrument Construction Projects – Scope-setting meeting, ESS-0055681
[5] NSS Instrument Design Guide, Draft
[6] Technical Standards & Requirements documentation:

Issuer	Document	ID-number/ estimated release
Neutron Scattering Systems	Neutron Instruments Coordinate System	ESS-0009095
	NSS RAMI Handbook	ESS-TBD
Detector Group	Several documents - WIP	Q3 2015
Chopper Group	Chopper Assembly Requirements	ESS- TBD
	Neutron Chopper Systems, Operational Requirements	ESS- 0045202
	CHIC Communications Requirements Specification	ESS-0042906
Neutron Optics and Shielding Group	Neutron Optics and Shielding Handbook	ESS-0039408
Motion Control & Automation Group	Motion Control Components Standards for ESS Applications	ESS-0037290
	Motion Control & Automation on ESS Neutron Instruments Introduction, Definitions and Guidelines for Phase 1	ESS-0049514
	More to come – WIP	Q3 2015–Q4 2016
Science Support System	ESS Sample Environment Utility Supplies Reference Document	ESS-0038163
	ESS Sample Environment Control System Reference	ESS-0038165
	ESS Sample Environment Mechanical Interfaces for Instruments	ESS-0038078

	ESS Safety and Sample Workflow for Instruments	ESS--0040840
	Science Support Systems WP Specification - section 1.4.2 Interaction to instrument teams	ESS-0000960
DMSC Standards & Requirements	WIP	TBD
ESS Wide Documentation	Handbook Electrical Design	ESS-0015433
	Vacuum Handbook	ESS-0012894--97
	Overview of the ESS Neutron Instrument Personnel Safety System	ESS-0053489
	More to come – WIP	TBD

DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	Rob Connatser	2014
2	Update following lessons learnt from NMX and LOKI TG2 reviews	Ken Andersen, Peter Sångberg	2015-10-30
3	Second revision. General clean-up, update to reflect ESS-wide Management System directives.	Peter Sångberg	2016-04-13