

## Neutron Chopper System TG2 Review FREIA Instrument

### Review

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TG2 Review (31.01.2018).

Technical Reviewer:  
Erik Nilsson

Input received from  
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### Preamble

This document is the review summary of the instrument neutron chopper system preliminary design. Non-chopper systems aspects of the instrument design have not been considered, except where it is considered that they will significantly influence the performance of the chopper system in question.

#### 1. Executive Summary

The reviewer considers that from the *perspective of chopper systems technologies* the preliminary design is sufficiently complete and mature to be considered for entry into the detailed design phase of engineering.

The overall system performance requirements presented in the concept appear to be technically feasible but challenging, in line with the endorsed variants and solutions by the Neutron chopper group.

Nevertheless, some risks and missing information have been identified and it is considered to be required to go to detailed design.

Therefore the reviewer grades the proposal: "ORANGE".

## 2. Proposal Grading




The proposal is graded as a whole and by subcategory.






















For each item, a grade is given for the preliminary chopper design *as it stands now* (column "grade now"),

"GREEN": All aspects of the criterion have been addressed satisfactorily to permit endorsement by the NCG to the detailed design phase.

"ORANGE": Some aspects of the criterion have not been addressed satisfactorily. However, if additional information is supplied, NCG endorsement of the instrument to the detailed design phase may be possible.

"RED": Some aspects of the criterion have not been addressed satisfactorily and there are reasons to doubt they can be achieved without changes. Currently it is not recommended to proceed.

Grades are indicated as traffic lights:  = green,  = orange,  = red.

Criteria	Project	Mechanical Integration	Control Systems Integration	Technical Feasibility and Neutronics
Overall				
Maturity				
Compatibility				N/A
Feasibility				
Risks				
Budget completeness		N/A	N/A	N/A
Schedule		N/A	N/A	N/A

### 3. Currently identified issues

“A red classification requires a detailed explanation of the reasoning.”

#### **Maturity:**

The technical maturity at this stage of the neutron chopper system project of the instrument meets the expectations of what should be achieved by TG2. The complexity and novelty of the chopper system is bound to pose some questions and potential issues.

#### *Absence of chopper system performance description (Preliminary system design 3.2.)*

The section describing the neutronics performance of the chopper system is currently only showing a time-flight diagram without any further explanation or references. More detailed information about the chopper system performance in relation to the specified requirements are required.

#### *Missing reference (Preliminary system design 3.2.4.)*

The document references to early analysis and calculations of chopper discs but does not reference these.

#### *Delivery plan (Preliminary system design 3.2.4.)*

The project realised early on the complexity of the instruments large chopper discs and has undergone several studies to plan a way forward. The 3.2.4. section of the text describes the delivery plan of the chopper with the potential contribution from commercial suppliers. However it is not clear whether the commercial suppliers are regarded for full system supply or “only” the discs.

#### *Missing control racks (P&ID)*

The downstream choppers are missing control racks in the P&ID

#### **Compatibility:**

The ESS is a complex environment. To be able to comply with this ESS impose, upon the instrument team, a large number of handbooks and requirements from the technical groups. In this situation, clear communication between the instrument team and the technical groups responsible is key for the success of the project. The team has adopted the major concepts of the ESS chopper systems, including the CHIM and CHIC systems.

#### *PBS error (PBS)*

The EPICS IOC is part of the control system, not the support system.

#### **Feasibility:**

The complexity of the system outlined in the proposal is high with large rotor choppers with very high tip-speeds. There is a good communication between the instrument team and NCG assuring the coordinated approach in the design and integration activities.

#### *Potential vibration issues (P&ID and Preliminary system design 3.2)*

Once in operation, the large FREIA choppers have some of the fastest tip speeds in the world. This makes them sensitive to vibrations. Though the common base and shared vacuum is preferable from a handling and neutronics point of view, the potential vibrational issues should be taken into account during the detailed design.

*Integration issue (Preliminary system design 3.2.1.)*

The front-end chopper system of the instrument is complex and will require significant development. It is advised that this development starts as soon as possible with the support from the ESS chopper group.

There is no text or drawing showing the integration of the instrument with respect to its neighbours. The large rotor choppers of FREIA poses a natural constraint where additional integration efforts might be required.

**Risks:**

Some of the most significant risks mentioned in the documentation concerns the technical delivery of the large rotor chopper assemblies. The ESS chopper group concurs in this estimation and agrees that development have to start as soon as possible. Alternative mitigations like the consequences of 1m rotors is advised to be taken into account.

**Budget completeness:**

The total cost indicated previously in the scope-setting documentation for the chopper systems is considered realistic ( $\sim 2.566$ ME) for the 8 chopper assemblies (with 8 axis).

**Schedule:**

If significant effort in frontloading the development of the large rotor chopper is performed the timeline for the project appears to be achievable.

**Other:**

*Reliability:*

The instrument has chosen low-maintenance magnetic bearing choppers with high reliability.

*Availability & Serviceability:*

The instrument deploys many components in the first meters of the beamline and close integration with the neighbouring instruments and the bunker project requires sustaining good communication to avoid space conflicts and ensure serviceability.

*Development:*

The chopper system does involve cases of front-edge development. The success of these developments is essential for the delivery of the project.