THE SPECIFICATION PROCESS FOR THE LARGE SCALE ACCELERATOR PROJECT FAIR

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Abstract

The project FAIR is a large scale international accelerator facility with a high complexity within the accelerator complex. The project is owned by the recently founded FAIR GmbH while the project lead of the accelerator part of the facility is under the responsibility of GSI.

The procurement of accelerator components comprises direct tendering as well as in-kind contributions from nearly all partner countries – mainly from Europe and Asia.

To keep an overall consistency for the quality assurance criteria while at the same time assuring a complete and dedicated set of documents for the different procurement processes different document classes were defined.

The presentation will report on the challenges, the strategies, the experience and the outcome of the specification process.

INTRODUCTION

The FAIR Project is a large accelerator project [1]. It will be an extension to the already in Darmstadt, Germany, existing GSI heavy ion accelerator complex.

Figure 1 : Overview of the GSI site after the planned extension with the FAIR complex

The FAIR project comprises the following new accelerator structures:

1. A proton linac in front of the existing synchrotron
2. SIS100 - a synchrotron with a magnetic rigidity of 100 Tm and a circumference of 1083.6 m.
3. HESR - a high energy storage ring for antiprotons of up to 14.5 GeV
4. CR - a collector ring for accumulation and cooling of antiprotons
5. antiproton-separator – a target station with spectrometer to generate and select the antiprotons
6. Super-FRS – a target station with spectrometer to generate and select rare isotopes
7. HEBT – different high energy beam transport lines to connect the other accelerator sections.
8. Common Systems – technical systems like the central accelerator control system, the cryo plant or the magnet testing facility.

The countries contributing significantly to the project founded the FAIR GmbH to manage the project and to become owner of the facility. The FAIR GmbH and GSI as host of the site and major contributor worked out the way how to manage the project together. GSI now took over the project lead for the accelerator part and is responsible for the establishment of the specifications.

Procurement of accelerator components will be done along two major lines:

1. In-Kind-contributions of the partner countries via their partner institutes
2. Direct procurement by the FAIR GmbH

For the In-Kind-Procurement the FAIR GmbH signs a contract with the participating international institute. The money has to be provided by the funding agency of the corresponding country. Once the component is delivered the corresponding shares of the FAIR GmbH will be credited to the concerned country, i.e. its shareholder. The technical follow up of the delivery will be done by GSI.

For the direct procurement the FAIR GmbH will charge the GSI administration to procure the components on a full cost basis. The money will come from the FAIR GmbH.

Specifications have to written for the procurement of more than 20000 components of more than 500 different component classes. In addition the complicated procurement framework has to be respected. It was decided to define separate specification document classes:

1. Documents valid for many or all classes of components
   a. Draft In-Kind-contract
   b. Werkvertrag (standard contract)
   c. General Specifications
   d. Technical Guidelines
2. Documents valid for all components of a specific technical system like power converters
   a. Common Specifications
3. Documents specific for a component class
   a. Detailed Specifications

The combination of documents from all document classes constitutes the set of documents valid for the delivery. Each class of specifications documents and its

establishment process will be described in the next chapter.

SPECIFICATION DOCUMENTS

Documents valid for many or all classes of componenst

The **Draft In-Kind-contract** was established by the FAIR GmbH and presented to all relevant committees of the FAIR Project. It contains all elements of a typical contract like definition of deliverables, contact persons, schedule, reporting, warranty and order of validity of documents. As no real money flow takes place special regulations are given concerning the crediting of the attributed value and escalation rules.

The **"Werkvertrag"** is the standard contract for direct procurement. The tendering process will follow German tendering rules. Notice will be given usually European Union wide and to the partner institutes.

The **General Specifications** is one document defining the general quality assurance measures. Specified are for example the following aspects:

- Basic legal requirements
- Basic engineering and design standards
- general procedure for Factory Acceptance Test
- general procedure for Site Acceptance Tests
- list of activities and milestones for scheduling
- general documentation standards

The establishment process was very difficult since on one hand there was the aim to reach the requested high quality assurance level and on the other hand this document should still allow the procurement of in-Kind-delivery by institutes from different partner countries with their special conditions.

The **Technical Guidelines** are a set of actually 170 documents which define technical quality assurance standards. They include for example material definitions, design principles and special test procedures. Only parts of them are referenced for each components class. They can be grouped in the following manner:

Table 1: Groups of Technical Guidelines

Technical Group	Number of documents
Control System	5
Cryogenics	41
Electrical design	1
Media supply	3
Transport	3
Vacuum	49
Survey and alignment	12
Stands and support	36
Data exchange	1
Radiation hard Materials	1
Magnet design and tests	18

A lot of effort had to be spent to establish these documents. 20 authors from different technical departments were needed. In addition a lot of meetings were organised by the project office within the GSI accelerator division to elaborate a standard accepted by the different accelerator departments. In Table 1 as an example each document of the survey and alignment guidelines is listed with its corresponding number of pages.

Table 2: Content of Survey and Alignment Guidelines

Content of Survey and Alignment Guidelines	Number of pages
Alignment foot	2
Mechanical Tolerances Dipoles	2
References for fiducialisation of Dipoles	1
Mechanical Tolerances Quadrupoles	1
References for fiducialisation of quadrupoles	4
Tolerances Diagnostic Chambers	1
Mechanical tolerances Sextupoles	2
Bessel Point	1
Layout of fiducial target seat	1
Mechanical design accelerator components	9
Coordinate Systems	20
Components on tilted planes	1
Sum of pages	**45**

The establishment of the full set of documents valid for many or all classes of components was finished in Beginning of June 2011. It now serves as reference for the authors of the other documents and is subject to change management procedures.

Documents valid for all components of a specific technical system

The **Common Specifications** define the requirements for 10 technical systems in 41 documents.

Table 3: Groups of Common Specifications

Technical Group	Number of documents
Power Converters	3
magnets	4
RF systems	12
Cryogenic components	7
Vacuum components	2
Quench detection and protection	2
Beam diagnostics	1
Survey and alignment	8
Control System	1
Upgrade of existing accelerators	1

There are 21 authors of the Common Specifications. As the Common Specifications relate the general documents to the detailed ones it was and still is a difficult task to

assure consistency at this level. Until now only the RF documents have been finalised. The others are still in work but some of them can be used for contract preparation with the in-kind-partners. The documents are released by the concerned technical responsibles and the project leaders of the concerned accelerator sections.

Documents specific for a component class

The **Detailed Specifications** will be the documents defining the component specific requirements. They will mainly consist of lists of technical parameters and their tolerances together and special conditions like the local assembly environment. There will be more than 500 different types of components. Some Detailed Specifications will describe one type, some will describe several types. Since the packages for the different procurement processes art not fully defined yet the final document set is not yet fixed for the Detailed Specifications. It was agreed that the technical experts of the In-kind-partners should help to finalise this process. The parameter lists exist. For many components technical concepts and drawings exist which are currently checked with respect to integration and collision aspects. As soon as this check is done, the procurement processes can be started. The Detailed Specifications will be released by the project leader of the corresponding accelerator section.

SPECIAL REMARKS, SUMMARY AND OUTLOOK

The real work on specifications started in spring 2010 and is not yet finished. During this period still the layout of the accelerator systems and components was not finalised. This is also true for the definition of the in-kind-contributions and the identification of the components with the longest procurement time. In addition several times the priorities for the specification process were changed by the FAIR project leaders. Nevertheless it was possible to finalise the general specification documents until this summer under central coordination. Especially the Technical Guidelines contain a huge amount of know-how gathered by the GSI technical departments over many years.

The establishment of the specifications has now evolved to become more component specific and is mainly driven by the In-Kind-Contracts in preparation. Contacts with the international technical partners are intensified to finalise the set of detailed specifications. The CR Debuncher system – a GSI in-Kind-contribution is ready for tendering including all specification documents.

It is expected that the Common Specifications will be finalised this autumn. The Detailed Specifications mainly depend on the progress of technical layout of the accelerator systems and components and will be available shortly after the component design has been fixed.

REFERENCES

[1] Boris B.Y. Sharkov, "International FAIR – Challenges and Chances in Accelerator Physics and Technologies", IPAC`11, San Sebastian, September 2011, WEPS093; http://www.JACoW.org