GSI
GESELLSCHAFT FÜR SCHWERIONENFORSCHUNG

FAIR

Terms and Conditions for the Exchange of Mechanical Engineering Data

DRAFT

as agreed between
FAIR, Darmstadt
and
COMPANY, LOCATION

on

2008/07/31

V1.0

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Other applicable documents

The terms and conditions for the exchange of data laid down in this document are valid in conjunction with the following minimum set of documents:

- Cooperation and/or supplier contracts (orders), as applicable
- Design guidelines
- Operational guidelines for the FAIR data exchange portal

Other specifications can be found in section 3.5 and Appendix G. The requirements and specifications stipulated in these terms and conditions do not invalidate any requirements or specifications included in the referenced documents. If there is a conflict between the statements made in the various documents, FAIR must be notified immediately so that the circumstances can be clarified and the situation rectified.

Glossary and abbreviations

German	English	Meaning
Änderung	Change	Any changes made to a document or part must be documented if the document or part in question has already been approved. If a change is to be made, a change process must be completed. Certain forms must be used for the change processes, and the revision number must always be updated.
Baugruppe	Assembly	Part that comprises at least two subparts.
Bauraum	Installation space	This term is used as a synonym for envelope geometry. The installation space describes constraining contours and interfaces to other components of the accelerator, the building structures and/or building service connections.
Beschleuniger	Accelerator	All the components that comprise the FAIR accelerator facility. The term includes all the parts managed by FAIR-Acc as opposed to the components comprising the building services and parts of the physical building (that are managed by FAIR-CC). Interfaces between components belonging to the accelerator and the components belonging to the building structure must be given due consideration.
Prozess	Process	The flow of activities in a specific order and subject to internal and external influences and decisions.
Qualitätssi-cherung	Quality assurance	All actions performed with the aim of ensuring a certain quality level, which has been specified using predefined quality criteria.
Revisionsstand	Revision number	The revision number documents the change history of a document or part.
Stammdaten	Master data	In this context, master data is used as a synonym for metadata. Master data is used to describe, classify and identify data (documents, parts, processes).

V1.0

Abbreviation	Meaning
ASCII	American Standard Code for Information Interchange
BoM	Bill of Materials
CAD	Computer Aided Design
CAE	Computer Aided Engineering
CE	Communauté Européenne (in accordance with Article 95 of the EC Treaty)
CSV	Comma/Character Separated Values
DE	Data Exchange
DIN	Deutsches Institut für Normung
DMU	Digital Mock-Up
DWG	Drawing
DXF	Drawing Interchange Format
ECAD	Electronic CAD
EDMS	Engineering Data Management System
FAIR	Facility for Antiproton and Ion Research
FAIR-Acc	FAIR- Accelerator department
FAIR-CC	FAIR- Civil Construction department
FI	Functional Integration
GI	Geometric Integration
GSI	Gesellschaft für Schwerionenforschung
IGES	Initial Graphics Exchange Specification
ISO	International Organization for Standardization
MCAD	Mechanical CAD
NC	Numerical Control
PDF	Portable Document Format (according to ISO 15930-x, 19005-x)
PI	Process Integration
GL	Guideline
RTF	Rich Text Format
STEP	Standard for the Exchange of Product Model Data (according to ISO 10303-x)
TIFF, TIF	Tagged Image File Format
XLS	Excel spreadsheet

1 Introduction

1.1 Purpose of this document

The terms and conditions for data exchange laid down in this document describe the minimum demands that FAIR places on design data, i.e. the minimum requirements that data transferred to or from FAIR within the context of the FAIR project for the construction of the new accelerator facility must satisfy. They provide the basis for harmonization between the partners and are intended to ensure that the transfer of design data to and from FAIR by all partners involved in the cooperation is standardized with the partners.

It is intended that the communication processes be accelerated and improved so that any reworking by either FAIR or the partners is kept to a minimum. The objective is to achieve a high level of quality in a uniform manner (e.g. for master data, data formats), as well as optimize the processes (e.g. approval, DMU, quality control, change management).

The document describes the minimum requirements placed on data structures, their representation and the documentation. The measures described are intended to ensure the reliability of the design data and information for both parties.

The modalities stipulated in this document between the company named on the cover page – referred to in the following as the "COMPANY" – and FAIR apply to the entire design and engineering-related scope of the project.

1.2 Overview of the terms and conditions for data exchange

The terms and conditions describe the basic principles and main requirements relating to data exchange between FAIR and the project partners (**Section 1**).

Section 2 describes the responsibilities, the project management tasks and the administrative information stipulated between the partners.

Section 3 describes the legal aspects of the data exchange. Stipulations regarding the binding nature of the data transferred, the archiving of the documents and the protection of company know-how are made. In addition, responsibilities regarding the provision of declarations and certificates and compliance with standards and specifications are established.

Section 4 provides an overview of the project phases. The exchange of data in the various phases of the project must be performed subject to the partner model in Appendix D.

Section 5 describes the documents to be exchanged. These are primarily intended to safeguard the design, DMU and release processes. The scope of the documents to be exchanged for the various partner models is described in Appendix D. Section 5.1 provides a general overview of the documents to be exchanged. Section 5.2 describes the handling of BoMs, part master data and document master data during communication with partners.

Section 6 describes the processes involved in transferring the documents and when making changes to documents or parts. It also describes approval and quality assurance measures.

Section 7 provides information about the various data exchange options available including the use of the data exchange portal. Transfer methods, transfer media, transfer times and responsibilities are specified.

Section 8 provides information about the systems used for communication, design and documentation. This includes information about networks as well as specifications for secure transfer via the Internet. Furthermore, reference is also made to the use of the forms provided for compiling information about the corresponding system environments maintained by the partner.

Section 9 describes specifications relating to the creation of documents. These refer in particular to the file format and model accuracy to be selected. Specifications relating to the design itself will be provided in separate design guidelines.

Section 10 describes specifications relating to terminology, file names, nomenclature and the identification of parts and documents.

The Appendixes provide overviews, information and references, as well as a description of methods and of the forms used to stipulate the data exchange parameters and describe them in more detail.

1.3   Basic principles and main requirements

The overall development of the entire FAIR facility is based on 3D models. These models will be used for digital mockup (DMU), among other things, and are therefore essential.

In order to process incoming documents, FAIR requires a minimum set of master data (see Section 5) for each 3D model, every 2D drawing derived from the model, a BoM and other documents as well as their approval status from the COMPANY.

In addition, FAIR assumes that the COMPANY is able to generate and deliver neutral formats in the form described in section 9.1.2 for both the models and all the other documents to be exchanged. Delivery of the data in the required neutral formats is one of the minimum requirements that must be satisfied by the COMPANY. The documents in the neutral format are considered binding once they have been approved by the COMPANY.

The complete and uniform documentation of the data exchange operations is intended to make a significant contribution towards increasing the level of paperless communication between the FAIR partners.

As part of the terms and conditions for data exchange, the data exchange parameters are compiled using forms and stipulated as an appendix to this document.

Descriptions of the forms used, for example, to identify contact persons or the systems used by a partner can be found in Appendix A. If necessary, partner-specific stipulations can be made using the data exchange parameters. Additional expense and effort should, however, be avoided as far as possible.

2 Project management

Every partner in the project is responsible for the quality of his work results. They must ensure that the specified processes are followed (see section 6). The partner must ensure that the components, systems, designs (also in digital form) and documents they deliver meet the quality requirements stipulated by FAIR and comply with technical guidelines.

The requirements placed on quality and execution with regard to data exchange must be taken from these terms and conditions as well as the specifications, standards, design guidelines referenced in this document.

2.1 Contact

FAIR must make a list of the appropriate contact persons and their contact data available together with the terms and conditions for data exchange. To ensure reliable communication, the COMPANY must also name appropriate contact persons (in accordance with Appendix A – "Contacts") and must inform FAIR of these names and the appropriate contact data. If a problem should occur, the appropriate contact person is to be contacted immediately.

2.2 Exchange of administrative data

The COMPANY is obligated to inform FAIR immediately of any changes relating to contact persons, schedules or other administrative data. As a rule, an e-mail can be used to notify FAIR of any changes. If changes are made to project planning (schedules), the project plan must be appended to the e-mail as an attachment and must be agreed upon.

Schedules must be created using Microsoft Project™. The version of the programs to be used can be found in Appendix A.

Notification of required specifications and options regarding the use of MS project will be provided separately.

The project plans created must correspond to the contractually agreed scheduling.

In any case, the contact person responsible for project management at the COMPANY must inform FAIR immediately of any deviations from or noncompliance with the schedules.

2.3 Common project language

The common language to be used in the project by data exchange partners in German-speaking countries is "German". The common project language mandatory for data exchange partners in other countries is "English" unless legal regulations stipulate the use of another language. Deviations are not permitted.

The common project language is stipulated as a data exchange parameter (in accordance with Appendix A – Section A.2 "Language").

The stipulated project language is to be used for both preliminary technical documentation (calculations, tests, etc.), administrative information, all other documentation, as well as for communication and correspondence between partners.

Master data, BoMs, models and derived drawings must be created in English.

The final project documentation upon expiration of the contract must be created in "**English**" – even if stipulated otherwise in the data exchange parameters – with the exception of individual documents for which other legal regulations apply (e.g. CE verification).

3   Legal aspects

This section describes stipulations relating to the binding character of the information to be exchanged and about the archiving of the documents. The stipulations made in this document do not infringe upon contractual agreements or stipulations made by higher authorities (e.g. legislation, framework agreements). In case of doubt, the corresponding stipulation is to be interpreted in accordance with existing law.

3.1   Binding character of information

The information that FAIR communicates to the COMPANY is binding in nature except in cases in which this information is clearly and evidently marked as being non-binding (e.g. by the approval status of the transferred document).

The information, models, drawings and other documents transferred to FAIR by the COMPANY are binding in nature if they have been designated "approved" by the COMPANY. FAIR is also to be informed of intermediate results within the framework of the task being performed by the COMPANY even if they have not yet been given "approved" status. FAIR is aware of the non-binding nature of such information.

The design guidelines (process agreements) stipulate which information the COMPANY is expected to deliver to FAIR or FAIR must deliver to the COMPANY as either intermediate results or with the status "approved" and at which point in time. Section 5.1 provides an overview of the information and documents that are generally exchanged. A description of special requirements for the partner model of the COMPANY can be found in Appendix D.

3.2   Stipulations regarding archival

FAIR assumes responsibility for archiving all the documents are in the possession of and at the disposal of FAIR which pertain the project scope agreed between FAIR and the COMPANY.

The COMPANY is responsible for archiving documents and products which were created within the framework of the project but which do not become the property of FAIR and/or come under the control of FAIR. Archival must be carried out in due form in accordance with the legal requirements of the Federal Republic of Germany. If any questions arise with regard to the requirements, the COMPANY is specifically responsible for obtaining the appropriate information (with the help of FAIR if necessary).

3.3 Know-how protection and copyright

The contractual agreements relating to copyrights, patent rights and know-how protection between the COMPANY and FAIR are also valid in particular for the data, information and documents of any kind described in this document. Documents received and sent within the framework of data exchange are strictly confidential and are to be handled in such a way that they cannot be accessed by the public or third parties. The contractual partner must do everything technically possible and economically feasible to protect the confidentiality of the data. This stipulation remains in force even after the contractual relationship has ended. The dissemination of documents, data and information to third parties requires the explicit written permission of FAIR.

3.4 Verification and declarations

If so stipulated, the COMPANY must take care of the necessary and/or stipulated verification and declarations (e.g. CE verification, machine guidelines, conformity declarations) independently and must provide the verification and/or declarations to FAIR no later than the point in time at which the data, documents and information are transferred and approved.

3.5 Standards and specifications

Due to the variety of organizations participating in the FAIR project, every partner must comply with certain standards and specifications corresponding to the state of the art. In general, if there are deviations between the standards, DIN standards take precedence over international standards (e.g. ISO, IEC) and these, in turn, take precedence over local standards of other countries (e.g. ANSI, BSI).

The COMPANY is responsible for procuring the relevant standards. A non-exhaustive list of the standards and specifications which, at a minimum, must be complied with for data exchange can be found in Appendix G.

4 Project phases

The information and documents to be exchanged depend on the phase of the project at the time in question. The data exchange requirements to be fulfilled will be different, depending on the partner model (Appendix D) involved.

A brief description of the project phases (Figure 1) up to and including commissioning is provided below. The representation makes no claim to being complete and merely serves as an aid to orientation and classification of the data exchange requirements. The description of the scope of delivery and services is part of the cooperation and/or supplier contracts and depends on the order involved.
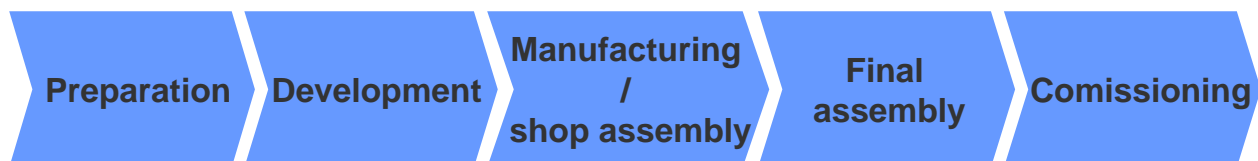
| Preparation | Development | Manufacturing / shop assembly | Final assembly | Comissioning |

Figure 1: FAIR project phases during collaboration with partners

During the preparatory phase, FAIR selects the partners and places orders. In addition to developing a concept and evaluating costs, this phase also involves setting up communication, including data exchange, in accordance with the terms and conditions stipulated in this document.

The development phase is primarily characterized by the following:

- Predevelopment

- Development and calculations

- Digital mockup (DMU)

- Development testing

- Validation and design approval

- Handling of development changes

- Documentation and verification

In the manufacturing/shop assembly phase, the parts and components for the facility are manufactured according to the specifications, and the manufacturing process is documented.

Once the parts and components for the facility have been delivered and accepted, final assembly is performed. Another quality check ensures correct interaction between the components of the facility before final acceptance and commissioning.

In the manufacturing and assembly phases, as well as during subsequent operation, all changes must be documented and agreement between the documentation, the actual execution of the construction work and the required permits must be established.

5 General requirements relating to documents and their contents

All documents must be created in such a way that the volume of data is kept to a minimum.

5.1 Documents and data exchange formats

The following requirements apply equally to all suppliers and partners regardless of the partner model involved.

In order for a design to be accepted, the COMPANY must always transfer the following documents to FAIR in accordance with the list in Appendix C:

- 3D models in the native (original) data format with the levels of accuracy specified in section 9.2

- 3D models in the appropriate neutral format (ISO10303-214 – STEP AP214) with the levels of accuracy specified in section 9.2
- Derived drawings in CATdrawing or IGES format
- Drawings in the neutral PDF/A format
- BoMs as MS Excel tables
- BoMs in PDF/A format
- Document master data as an MS Excel table
- Document master data in PDF/A format

The following documents must also be supplied if so stipulated in the agreement and/or mandated by law:
- Certificates, warranties, declarations (e.g. declaration of conformity), etc. in PDF/A format
- Instructions, assembly instructions, manufacturing information, etc. in RTF format
- Instructions, assembly instructions, manufacturing information, etc. in PDF/A format
- Calculations, NC data, etc. in the agreed format
- Test reports in PDF/A format

A general description of the accepted native and neutral formats for the above-mentioned and other documents is provided in section 9.1[1].

5.2 Requirements relating to BOMs, part master data and document master data

The requirements relating to the contents of the documents to be exchanged are the subject of the cooperation and/or supplier contracts, depending on the respective order, and they are also governed by design guidelines, construction work specifications and other technical agreements.

Therefore, only the basic requirements valid for everyone and necessary for efficient data exchange between partners are mentioned specifically in the following explanations.

Assemblies, individual parts and documents must be numbered and named as specified in section 10.

5.2.1 Requirements relating to BoMs

The COMPANY must supply FAIR with BoMs for every assembly it delivers. The BoMs are managed at FAIR as supplementary documents for the CAD models. It is not permitted that the BoMs be delivered as part of the drawing.

The BoMs must be maintained carefully at all times and must be consistent with the corresponding 3D model.

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[1] An option for exchanging documents in 3D PDF format is currently being planned

BoMs should be created on the basis of the template for BoMs provided by FAIR. The COMPANY is provided with the template, in the form of an MS Excel file, together with these terms and conditions for data exchange.

If BoMs are not created using the template provided by FAIR, they must always include at least all of the data stipulated in the template, and it must be possible to print them in DIN A4 portrait format.

Irrespective of whether or not a BoM has been created using the template provided by FAIR, it must be sent to FAIR in both MS Excel format and PDF format.

5.2.2 Requirements relating to the master data sheet

The COMPANY will be provided with a template for compiling part and document master data. This template will be provided in MS Excel format as an attachment to the terms and conditions for data exchange.

Transfer of the completed master data sheet provides the basis for other processes at FAIR. The COMPANY must therefore ensure that it contains all available information and is always up to date. This means that some information that has already been entered in the BoM will have to be entered again.

Without a minimum set of master data, FAIR can neither approve nor accept the design data. In this case, all the documents transferred will be rejected.

Some master data in the Excel table is mandatory. Other data is, in some cases, not available. If the data is available, it must be provided.

Entry of the following minimum set of information in the master data sheet is mandatory:

- Part number (in accordance with section 10.5)
- Drawing numbers (in accordance with section 10.5)
- Number of the 3D model (in accordance with section 10.5)
- Revision numbers for the documents and parts (in accordance with section 6.4)
- Names of the documents and parts (in accordance with sections 10.2, 10.3 and 10.4)
- Approval status of the documents and parts at the COMPANY (in accordance with section 6.2)
- Weight of the part
- Material of the individual part
- Number of drawing sheets and BoMs
- Editor
- Date of edit
- Inspector
- Date of inspection
- Approved by
- Date of approval
- Single part or assembly

Furthermore, the following entries are mandatory if the appropriate information is available:

- Order number
- Replacement for
- Replaced by
- Document numbers and names of other attached documents

6 Processes

Processes, e.g. data exchange processes, are documented in this document using the swimlane methodology (see Appendix F).

6.1 Data exchange process

Subsequent to the test phase, data is exchanged in contractually agreed cycles or at contractually agreed points in time/milestones. The large number of parties involved in the project and the complexity of the project itself require that FAIR always be kept appraised of the progress being made and always be informed of any deviations (e.g. geometrical), interfaces to other components and any delays.

In the event of changes that affect the part of the project being handled by the COMPANY, FAIR will inform the COMPANY of this fact without delay and will provide the COMPANY with the appropriate information.
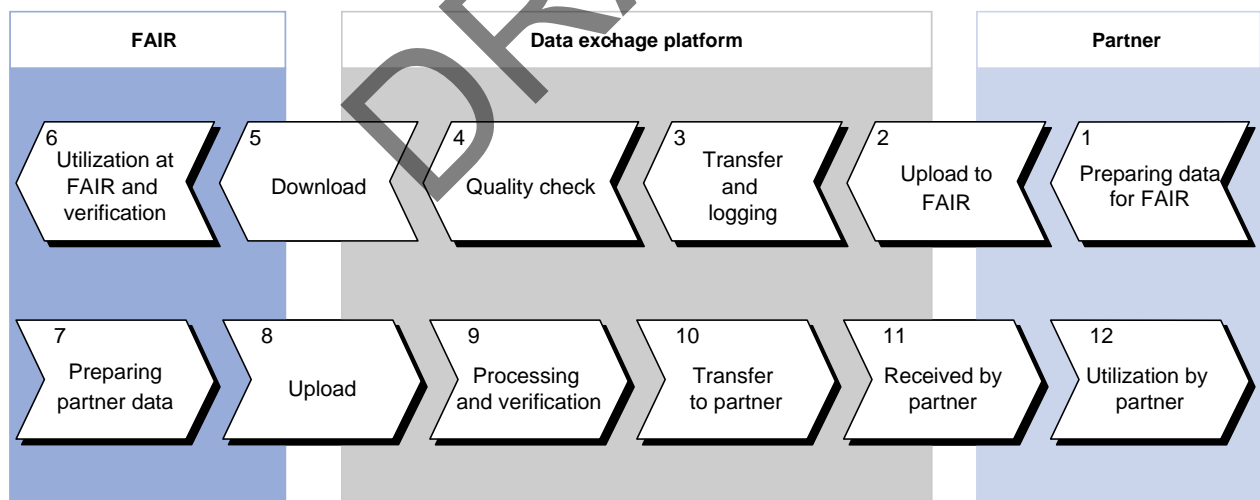

Figure 2: Data exchange process

The data exchange process from the point of view of the COMPANY can be described as follows (cf. Figure 2):

1. **Preparing data for FAIR**
   Performed by and responsibility of: COMPANY

Add any missing master data and information on the level of maturity to the documents
Convert the data to a neutral format
Perform internal quality check on the data
Check the documents for viruses
A detailed description can be found in Appendix F ("Preparing data for FAIR").

2. **Upload to FAIR**
   Performed by and responsibility of: COMPANY (upload) and data exchange portal (logging)
   Upload the partner data to the data exchange platform. The upload is logged and confirmed.
   A detailed description can be found in Appendix F ("Upload to FAIR").

3. **Transfer and logging**
   Performed by: data exchange portal, responsibility of: FAIR
   Logging of the data transfer and notification of FAIR about the incoming data.

4. **Quality check**
   Performed by: data exchange portal, responsibility of: FAIR
   Check performed regarding the quality and completeness of the data in accordance with agreements and, if necessary, an error log is sent to the partner.

5. **Downloading**
   Performed by and responsibility of: FAIR
   Downloading and check-in of the data at FAIR.

6. **Utilization of the data at FAIR and verification**
   Performed by and responsibility of: FAIR
   Verify the quality of the data and the ability to use the data for DMU. If verification is successful, the data is approved and accepted.

The steps 7 to 12 describe the reverse process involving the transfer of documents from FAIR to the COMPANY. Therefore, responsibility for the process steps "11 – Received by partner" and "12 – Utilization by partner" lies with the COMPANY (see descriptions in Appendix F).

This means that the COMPANY must down load the incoming data once he has been notified by the system via an e-mail from the data exchange portal.

6.2 Approval designation

All documents and parts that are sent to FAIR must always be designated "approved" or "for information". Designation is performed in the documents and in the master data sheet.

Documents and/or parts declared as approved undergo an internal approval process at FAIR, which if successful culminates in the acceptance of the documents and/or parts. Documents that are only transferred for information purposes (e.g. intermediate results as stipulated) are not subject to explicit acceptance and aid harmonization in the development and design process.

6.3 Quality assurance

Quality criteria for the data provided by development partners or the parts delivered by parts or component suppliers are stipulated when an order is placed (i.e. when a cooperation or supplier agreement is concluded).

The COMPANY is obligated to carry out appropriate quality assurance measures before transferring the data to FAIR to ensure that the stipulated quality criteria have been met. The COMPANY is liable for any additional costs and effort incurred by a delay to the project due to inadequate data quality.

The quality of CAD model data is automatically monitored during transfer via the data exchange portal (see section 7.3 for information on using the data exchange portal). In the event of inadequate quality after (and before) data conversion, the COMPANY is obligated to provide the data again without delay and with the stipulated level of quality. The COMPANY will be informed of the inadequate quality of the data immediately by the data exchange portal and/or via e-mail. The information includes an indication of the reasons for rejection.

Inadequate quality, which can lead to files being rejected, is the result of, for example:

- File formats that do not correspond to those stipulated in these terms and conditions
- File names that are too long
- File names that include special characters, blanks, etc.
- Missing BoMs, drawings, master data, neutral formats, etc.
- Errored and/or incompatible conversions to the neutral STEP format (ISO10303-214)
- Non-compliance with the design guidelines (e.g. missing test dimensions, incorrect dimensioning)

6.4 Change process

The COMPANY will be advised of change processes separately. Change processes are controlled by change requests and change notices, which must be transferred in addition to the documents specified in section 5.1.

The revision number of the document must be documented in a manner that is easily understood and transparent. FAIR must be advised of the reversioning methodology used.

At FAIR, the documents are assigned an internal revision number that starts with "-" for the original document followed by "A", "B", etc. (where "J" and "Q" are omitted).

7 Data exchange (portal)

This section describes general requirements relating to the transfer of information relevant to the project (cf. section 5.1 and Appendix D), in particular the design-relevant documents (files).

For reasons of security and confidentiality, among others, documents relating to the facility (e.g. 3D models, drawing, specifications) must not under any circumstances be sent via-mail without special permission from FAIR.

7.1   Data transfer method

Documents relevant to design and manufacturing must always be transferred via the data exchange portal provided. Files not directly connected with the design (e.g. project plans, contact persons) can be sent via e-mail provided they are not relevant to security or subject to separate agreements.

7.2   Data transfer medium

The transfer of information and data pertaining to the design is always performed digitally and in encrypted form (HTTPS) via the Internet (TCP/IP protocol) using the formats stipulated in section 9.1. The transfer of drawings in paper form, via CD, DVD or any other media is only permitted in special cases after consulting with FAIR and only in addition to digital transfer.

7.3   Using the data exchange portal

A data exchange portal is available for data exchange. The contact person responsible for IT/Data Exchange at provides the COMPANY with the access data and access address for the data exchange portal at the start of the cooperation. A data exchange test is subsequently performed.

The data exchange portal allows the COMPANY and FAIR to upload files that can then be downloaded by the respective addressee. The uploading of files by the COMPANY requires the input of additional data needed for identification purposes (e.g. company name, department, person) in a predefined mask, which can be displayed by the COMPANY in the standard Internet browser. The data exchange portal checks the data to see whether it satisfies the quality criteria stipulated by FAIR and agreed upon with the COMPANY (completeness, file formats, length of file names, etc.). If this check is successful, the data is transferred to FAIR.

The data exchange portal always informs the COMPANY of the success or failure of the data transfer. If transfer was successful, the data exchange portal sends the COMPANY confirmation, and the transfer is logged by the data exchange portal. If the transfer was not successful due to the fact that the quality criteria were not satisfied, a message to this effect is issued by the data exchange portal.

Irrespective of the formal quality control performed by the data exchange portal, FAIR reserves the right to reject files after performing a manual check. In this case, FAIR will inform the COMPANY via e-mail of the reason for the rejection.

Examples of why inadequate quality might be determined are listed in section 6.3.

If errors occur during data transfer that are not due to inadequate data quality, the COMPANY must contact the person responsible for IT/Data Exchange at FAIR (see Appendix A – "Contacts" in the data exchange parameters).

The data exchange portal must be used as specified in the "FAIR Data Exchange Portal" manual, which the data exchange partner will be given prior to the start of the project.

7.4 Access data for the data exchange portal and security

At the beginning of the project, the contact person responsible for IT/Data Exchange will provide the COMPANY with access data (password and user name) for the data exchange portal via e-mail for the purpose of transferring data from the COMPANY to FAIR.

Employees at the COMPANY who are given access must ensure that the access data is not made available to other persons. FAIR (IT/Data Exchange contact person) must be contacted if new users need to be set up. FAIR checks whether the prerequisites for access are satisfied and sets up new users.

The instructions provided in section 8.6. must be observed to ensure secure data transfer.

7.5 Reciprocal duty to supply information about failed data exchange operations

FAIR and the COMPANY are obligated to inform each other as soon as an error message is received from the data exchange portal. This agreement refers in particular to data that is part of the contractually agreed scope of delivery regarding intermediate and final results, such as, for example, master data, BoMs, other documents directly related to the design and construction documents.

7.6 Timeframe for data transfer

As a rule, data can be transferred via the data exchange portal 24 hours a day – providing there are no problems with the system. The contact person responsible for IT/Data Exchange will inform the COMPANY of any downtimes and service times in good time.

7.7 Test data exchange

Test data must always be transferred before the first productive data is transmitted via the data exchange portal (see section 7.3). This also includes initial testing of the functionality of the quality assurance systems and conversion mechanisms using test data. The number, scope and contents of the required tests are specified in the data exchange parameters (see Appendix A – "Testing data exchange").

7.8 Handling of large models

If CAD models larger than 2 GB[2] are to be exchanged and the transfer of the data via the data exchange portal fails, a different data exchange method must be selected if the model cannot be broken down into smaller units without losing information. The method to be used must be agreed upon separately with the contact person for IT/Data Exchange at FAIR.

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[2] 2 GB can be processed by the data exchange portal on a 32-bit operating system.

8 Systems

The description of the systems used by FAIR contained in this section and the information provided by the COMPANY serve as reciprocal information. If different systems are used, the harmonization and adaptation measures required, as well as possible sources or errors, can be identified quickly. In principle, FAIR provides no other systems aside from the data exchange portal.

The systems used are made known in the data exchange parameters in accordance with Appendix A.

8.1 Means of communication

E-mails, fax and telephone are the normal means of communication for reciprocal agreements. E-mail addresses, fax and telephone numbers for the contact persons at both FAIR and the COMPANY must be specified in accordance with Appendix A – "Contacts".

The data exchange portal must always to be used to exchange design-relevant data (see section 7).

8.2 CAD tools used

The systems listed in section 8.2.1 are the systems to be given preference when creating drawings and geometry data.

In cases in which these tools cannot be used due to the fact that they are not available or due to special system-related or technological circumstances, the systems listed in section 8.2.2 and agreed upon with FAIR must be used.

Irrespective of whether or not the CAD system used by the COMPANY is the same as the CAD system used by FAIR, the exact version and the full name of the software being used in the project must be communicated.

8.2.1 Preferred CAD tool

The CAD system CATIA V5 (release, see Appendix A – A.4 "CAD systems used") from Dassault Systèmes is used by FAIR.[3] If possible, this CAD system should also be used by the COMPANY for the design. As a rule, FAIR will provide start models if CATIA V5 is being used unless this is not required for the task being performed by the COMPANY. Start models must be used by the COMPANY as the basis for the design.

EPLAN is used at FAIR for electrical/electronic design.

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[3] AutoCAD 2007 from Autodesk is only used for civil construction and building services.

8.2.2 Other CAD tools

If CAD systems other than those listed in section 8.2.1 need to be used, these systems are to be communicated to FAIR in the data exchange parameters (in accordance with Appendix A – "CAD systems used").

The systems stipulated in the data exchange parameters at the time this document is signed, and that are to be used to perform the tasks for which FAIR has commissioned the COMPANY, are binding for the duration of the project. If a version change or update of any kind is planned, FAIR must be informed prior to the change being made, and the COMPANY must wait for approval. Otherwise, there is a risk that information cannot be read, processed and/or saved at FAIR, which can lead to additional outlay in terms of time and money or even to FAIR being unable to use any of the information.

The systems listed in Appendix A are those which, from the point of view of FAIR, provide neutral formats with a sufficient level of quality to allow FAIR to make further use of the data, e.g. for DMU. The information provided in Appendix E must be given due consideration when generating neutral formats that provide a sufficient level of quality.

8.3 CAE systems used

ANSYS is used at FAIR for FEM. If the COMPANY requires information about other CAE tools (simulation, calculation, testing), this information can be requested separately. This is in particular the case if FAIR needs to supply information from this type of system in order to facilitate, improve, accelerate or enable the design or manufacture of the subject of the contract by the COMPANY.

8.4 Management systems used for design data

FAIR uses SAP CDI internally as the PDM system for design data. EDMS is used for communication with customers. The PDM system used by the COMPANY can be connected, upon request, via the data exchange portal for the automated exchange of master data. For this purpose, information about the PDM system used must be provided in accordance with Appendix A –"PDM systems used".

8.5 Other software

MS Office products are used at FAIR for other information such as text, tables, simple calculations, presentations, etc. To ensure problem-free access to this kind of information, the Office system used must be communicated to FAIR by the COMPANY when these terms and conditions are signed.

Furthermore, the operating systems currently being used by the COMPANY must be made known for information purposes. This information is primarily intended to avoid errors and to clarify the source of errors in the event of a problem.

The corresponding software must be specified in the data exchange parameters in accordance with Appendix A – "Other software used".

8.6 Network and security

To safeguard data communication, information about the selected transmission method and bandwidth must be made known (see Appendix A – A.7 "Information about network technology").

The COMPANY must ensure that data transmission is secure. In addition to the use of the latest firewalls and anti-virus software, this also includes the careful handling of access data (see also sections 3.3 and 7.2).

Before a file that is to be transferred is uploaded to the data exchange portal that has been made available, sent via e-mail or another communication media, it must be checked using the latest anti-virus software. If files are infected with corrupt data, the corrupt parts must be removed, and FAIR is to be informed immediately of the measures undertaken.

Furthermore, FAIR is to be informed of any blacklists used and is to be advised of the maximum size permitted for incoming e-mails in order to ensure secure e-mail traffic.

Test data must be transmitted in the run-up to productive data transfer to ensure that the data transfer is secure (see section7.7).

If, in exceptional circumstances, it should become necessary to sent confidential and/or security-related information via e-mail or other media instead of via the data exchange portal, certificates and encryption technology as agreed with FAIR (contact person responsible for IT/Data Exchange) must be used.

9 Formats and accuracy

When creating design documents in the FAIR project, particular attention must be paid to ensuring that file formats that can be processed by FAIR in other process steps are used (see section 9.1).

To enable the reuse of large models, e.g. in DMU processes, it may be necessary that the models be created and transferred in several levels of abstraction (tessellations) (see section 9.2).

The design must be fully documented before it can be accepted (see section 5.1). The checklist in Appendix C must be used to check that the documentation is complete.

The documents referred to in the following and which are generally designated "design-relevant" include, for example:

- 3D models
- drawings
- BoMs and master data
- calculations, simulations, etc.
- NC data
- instructions, manuals, etc.
- (manufacturers') declarations, certificates, machine guidelines, test reports, etc.

9.1 Specifying the exchange formats

For the exchange of information, stipulations are made in the following sections regarding the file formats that are made available by FAIR and which can be accepted by the COMPANY.

Native file formats are described in section 9.1.1. Native file formats are system-specific, original (usually proprietary) formats. Only after conversion (normally via neutral formats) can they be used in a system other than the original system.

In any case (especially for 3D models and BoMs), neutral, i.e. standardized and open, file formats are to be used, in addition, for data exchange. Which neutral formats are accepted or made available for which type of file is described in section 9.1.2.

The transfer of neutral formats allows information to be processed in the systems used by FAIR and ensures the availability of the information over long periods of time, e.g. for electronic verification and long-term archiving.

An overview of the file formats accepted by default is provided in Appendix B. Any file that is to be exchanged must not be compressed.

Section 5.1 provides an overview of which files must be transferred to FAIR, and in which format(s), in order for documentation to be complete.

9.1.1 Native formats

Native file formats that can be provided by FAIR are listed below. The COMPANY must provide native files for 3D models in particular even if these cannot be used by FAIR directly. Furthermore, native files must be transferred if further processing of the original data at FAIR is required (e.g. in the case of BoMs). To document the status of the information at the time of data transfer, the neutral formats described in section 9.1.2 must, however, be delivered in addition to the native formats even if the native data can be used directly at FAIR.

3D models

3D models are the standard method used to work on designing the accelerator facility in the FAIR project. This means that 3D models must always be created to ensure that the downstream processes at FAIR can be provided with the data they required.

FAIR can only provide CATIA V5 files in native 3D format.

In the case of individual parts, CATIA V5 files are CATpart files and in the case of assemblies, they are CATproduct files.

When creating CAD models, compliance with the design guidelines laid down by FAIR is mandatory.

The COMPANY must always transfer a 3D model in its native format – regardless of the CAD system the COMPANY is using.

BoMs

BoMs must be created as MS Excel tables using the template provided by FAIR. They must be transferred as both an MS Excel file and as a file in the neutral format specified in section 9.1.2 together with the corresponding 3D model. A BoM must be included for each assembly.

Drawings

Drawings must always be delivered together with the corresponding 3D models. Drawings must be created by projecting 3D models; the link between the model and the projection must be preserved.

FAIR can provide and process CATIA V5 CATdrawing files as the native format for drawings.

In the event that the COMPANY is unable to provide CATdrawing files, neutral formats in accordance with section 9.1.2 must be delivered.

Office documents

RTF format is to be used to create text-based documents that must be provided in editable form (e.g. manufacturing documents, instructions). MS Excel format is to be used for tables. MS Office is used at FAIR to create the appropriate documents. Office documents must always be formatted in such a way that they can be printed on DIN A4 or DIN A3 without having to be adapted.

CAE, calculations, tests

As a rule, calculations, tests and simulation results are adequately represented if they are transferred to FAIR in non-editable form and in a neutral format. In other cases, separate agreements regarding the formats must be reached.

9.1.2   Neutral exchange formats

3D models, drawings, Office documents and BoMs must also always be delivered in an appropriate neutral format. This makes the further use of 3D models, e.g. in DMUs, possible regardless of the CAD systems used.

BoMs, Office documents and drawings in the appropriate neutral format are used for documentation purposes and to ensure the long-term availability of the information they contain. Documents that do not have to be edited by FAIR (e.g. certificates) must be transferred exclusively in the appropriate neutral format.

The partner must deliver derived drawings and CAE documents in the appropriate neutral format if his native formats are different to the formats listed in section 9.1.1.

The table in Appendix B provides an overview of the neutral formats supported. The person creating a document or the owner of a document, as appropriate, is responsible for converting the document to the appropriate neutral format.

3D models

ISO10303-214 (STEP AP214) is to be selected as the neutral format for exchanging 3D models. The information provided in Appendix E must be taken into consideration in order to achieve high-quality STEP export that allows further use of the data.

After consulting with the COMPANY, FAIR can also transfer 3D PDF (U3D/RPC) data to the COMPANY.

BoMs

For archival and documentation purposes, BoMs must always also be transferred as PDF/A[4] files.

Drawings

For archival and documentation purposes, drawings must always also be transferred as PDF/A files. The drawings must be derived beforehand from the model.

If CATIA V5 is not being used as the CAD system, a derived drawing in IGES format must be delivered in addition to the PDF/A format.

Office documents

PDF/A must be used as the neutral format for Office documents that are to be exchanged.

Subject to agreement, files in CSV format can also be used to transfer tables. Files in CSV format must be formatted with column headings in the first line and ";" (semicolon, ASCII-Code $0x3B_{Hex}$) used as the separator.

CAE

PDF/A files are to be used for the entire CAE domain unless agreed otherwise.

9.1.3   Print formats

PDF/A or PDF/E[5] and TIFF-G4[6], as appropriate, are stipulated as the standard formats for printing 2D and 3D documents.

9.1.4   NC data

The party responsible for generating NC data and its format are to be stipulated separately.

9.2   Accuracy of the models

The COMPANY must always transfer geometry in a non-abstract and exact form. The levels of accuracy stipulated in the data exchange parameters must be observed (see Appendix A – "Required level of CAD accuracy"). Under no circumstances may inaccuracies in the model restrict the functionality of the constructed components or the geometry deviate from the stipulated level of accuracy to such a degree that interfaces cannot be used or parts assembled as calculated.

In the case of models that exceed 100 KB, abstracted, data-reduced models must also be delivered, in addition to the other models, for the purpose of DMU at FAIR. These models must, however, be accurate with regard to interfaces to other

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[4] PDF Archive: Format for long-term archival; standardized as ISO 19005-1 (2005)

[5] PDF Engineering: Format for technical documents; ISO standardization expected mid-2008

[6] Tagged Image File Format compressed using CCITT G4

components of the accelerator and the building service connections as well as with regard to the external dimensions. Abstraction must be performed in areas that are not influenced by and which have no impact on other components not designed and/or manufactured by the COMPANY.

In the case of models that exceed 1 GB, constraining and connecting contours must be transferred. These must accurate with regard to the connecting dimensions and must be suitable for DMU.

An overview of the levels of accuracies that must be provided for the models is given in Table 1. Please note that data-reduced geometry or constraining and connecting contours must be transferred **in addition to** the exact geometry.

Model size	Exact geometry	Data-reduced geometry	Constraining and connecting contours
> 1GB	x		x
>100KB, < 1GB	x	x	
<100KB	x		

Table 1: The level of accuracy to be provided for the 3D models depending on the model size

The following information provides general recommendations for reducing the volume of data. However, in individual cases, these recommendations must be ignored if certain information must be preserved to ensure further use.

In general, the following elements can be suppressed to reduce the volume of data:

- Elements with a great deal of detail (e.g. chamfers, fillets, mold inclines)
- Elements that are very small in relation to the whole part
- Elements that are of no significance for further use (e.g. typeface, designations used within the company)
- Elements that are located inside the assembly and are not relevant for DMU

The suppression of elements can be simplified if the model tree is created as follows:

- First the reference elements,
- then the rough geometry,
- lastly, the fine geometry not relevant for DMU

10 Nomenclature and numbering systems

FAIR makes certain stipulations regarding the nomenclature used for installations, equipment and facilities, documents and files, the terminology used in the project, as well as with regard to numbering methodologies. More detailed information can be found in the following sections and in the design guidelines given to the COMPANY.

10.1 General terminology

To avoid any possible misunderstandings, the terminology used in the project is explained under Glossary and abbreviations.

Contact FAIR if there are any questions regard the terminology used.

10.2 Nomenclature for installations, equipment and facilities at FAIR

The nomenclature to be used for installations, equipment and facilities is stipulated in FAIR's design guidelines. The guidelines are referenced here merely as applicable documents and must be observed by the COMPANY.

10.3 Nomenclature for documents and files

All documents sent to FAIR must be given unique and meaningful names. The length of the name must not exceed 35 characters.

The names of files must be no longer than 100 characters. Only letters and digits from the standard ASCII character set may be used. Blanks and other special characters are not permitted. The last of the maximum 100 characters are reserved for the file name extension after the "." (dot). Please refer to Appendix B for the permitted file name extensions.

10.4 Nomenclature for individual parts

Information on the nomenclature to be used for individual parts and assemblies is stipulated in the design guidelines.

10.5 Identifying parts and documents

Numerations are used to identify parts and documents. Normally, the numbering methodology used by FAIR is to be applied (see section 10.5.1). In special cases, the methodology used by the COMPANY can also be stipulated. In this case, consideration must be given to section 10.5.2. The selected methodology must be documented in the data exchange parameters (in accordance with Appendix A – "Numbering documents and parts").

10.5.1 Numbering methodology used by FAIR

The numbering methodology used by FAIR must be observed for all technical documents and parts within the framework of the project unless explicitly stipulated otherwise. The COMPANY is responsible for ensuring use of and compliance with the appropriate numbering methodology.

The COMPANY is provided with information on the numbering methodologies used by FAIR in the design guidelines.

10.5.2 Numbering methodology used by the COMPANY

If the data exchange parameters stipulate that the numbering methodologies used by the COMPANY are to be retained when the data is transferred, the documents and parts are assigned another, internal FAIR number at the time at which FAIR accepts

the data. The correlation between the numbers is stored so that it is always possible to establish a correlation between the internal FAIR numbers and the partner-specific identification used for documents and parts.

FAIR must be provided with a description or explanation of the numbering methodologies used by the COMPANY.

The contents of the terms and conditions for data exchange are hereby agreed upon between FAIR and the COMPANY:

_____

_____

Signature, date (representative of GSI mbH)

_____

Signature, date (representative of the partner company)

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Appendixes

A Description of the "Data Exchange Parameters" form

B Overview of supported file formats and file extensions

C Overview of deliverables

D Partner model-specific conditions

E Instructions for achieving reusable STEP export

F Data exchange processes

G References to standards, guidelines and directives

H Trademarks

I Copyright

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Appendix A

A Description of the "Data Exchange Parameters" form

This section contains a number of lists. The data exchange partner in question and FAIR must complete these lists, which can be found on the "Data Exchange Parameters" form. The information provided facilitates collaboration and, at the same time, stipulates important conditions that must be satisfied in order for data to be exchanged successfully.

If there are differences between the systems used by FAIR and those used by the data exchange partner in question, the systems explicitly noted in the lists are given priority during collaboration. If the data exchange partner has to choose the "other systems" option, additional tests must be completed successfully and configurations changed. Therefore, the modalities for these combinations must be given separately.

The information provided on the "Data Exchange Parameters" form can be limited to only those contacts, systems, software and hardware that have an impact on the collaboration or which are being used during the course of the FAIR project.

A.1 Contacts

a) Contacts for the data exchange partner at FAIR:

Domain	Contact	Telephone No.	E-mail	Fax No.
Quality assurance				
Engineering				
Purchasing/Contracting				
IT/Data exchange				
Project management				
Change management				

b) Contacts for FAIR at the data exchange partner:

Domain	Contact	Telephone No.	E-mail	Fax No.
Quality assurance				
Engineering				
Purchasing/Contracting				
IT/Data exchange				
Project management				
Change management				

Appendix A

A.2 Language

Final documentation, bills of materials and drawings must always be supplied in English.

Other documentation/communication will be provided/performed in:

Language	
German	☐
English	☐

A.3 Numbering documents and parts

The table contains information about the numbering methods used by the data exchange partner during the project. The data exchange partner can use either the approach used by FAIR or his own approach. Using the approach used by FAIR as the default reduces the effort involved in mapping the internal FAIR numbers to the external numbers. The numbering methods refer to the numbering methods used to identify documents and those used to identify parts.

The "Reference Spec." cell must contain the identifier of the current specification for numeration methods including the revision number of the specification contained in the "Rev." cell.

Numbering using the approach used by …	Yes	Reference Spec.	Rev.
FAIR	☐		
Data exchange partner	☐		

A.4 CAD systems used

a) By FAIR:

CAD System:	Used	Release
MCAD		
CATIA V5	☒	Release 16, Service Pack 5, Build Number 16
ECAD		
EPLAN	☒	Electric P8 Professional

b) By the data exchange partner:

If EPLAN is used during the project, at least version "5 professional" or "21 professional" has to be used by the data exchange partner

CAD System:	Used	Release	Comments
MCAD			
CATIA V4	☐		

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CATIA V5	☐		
AutoCAD	☐		
Pro/ENGINEER	☐		
I-DEAS	☐		
Unigraphics	☐		
Inventor	☐		
SolidWorks	☐		
OneSpace Designer	☐		
Other:			
	☐		
	☐		
ECAD			
EPLAN	☐		
Other:			
	☐		

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A.5 PDM systems used

a) By FAIR:

PDM System:	Used	Release
SAP CDI	☒	
EDMS	☒	

b) By the data exchange partner:

PDM System:	Used	Release	Comments
eMATRIX	☐		
Pro/INTRALINK	☐		
Windchill	☐		
TeamCenter	☐		
mySAP/PLM	☐		
Agile	☐		
EnoviaVPM	☐		
SmarTeam	☐		
Other:			
	☐		
	☐		

Appendix A

A.6 Other software used

a) Other systems used by FAIR:

Office Software:	Release:
MS Office	2003 and 2007
Operating Systems:	
MS Windows	XP/SP2
Linux	Debian, SUSE, Red Hat; each version up-to-date Q4/2007
UNIX AIX	Release 5.2

b) Other systems used by the data exchange partner:

Version 2003 or higher of the MS Office product suite must be used during the project. The use of MS Project version 2000 is sufficient.

Office Software:	Used	Release:
MS Office	☐	
Other:	☐	
Project Management Software		
MS Project	☐	
Operating Systems:		
MS Windows	☐	
Linux	☐	
UNIX (AIX, HP-UX, Sun-UX)	☐	
Other:		
	☐	
	☐	

A.7 Information about network technology

a) Network technology used by FAIR:

Transmission method:	Comments
Bandwidth max:	
100 MBit	
Firewall:	
yes ☒ no ☐	
Encryption:	
https	
Addresses:	
URI of data exchange portal:	

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FAIR

E-mail:	
Max. size per e-mail (in MB): 100	

b) Network technology used by the data exchange partner:

Transmission method:	Comments
Bandwidth max:	
Firewalls:	
Encryption:	
Addresses:	
Server addresses:	
E-mail:	
Max. size per e-mail (in MB):	
Antivirus software used:	

A.8 Testing data exchange

The table indicates the individual test cases that have to be performed by the data exchange partner and FAIR before the first project-relevant data is transferred via the data exchange portal. This ensures that the data sent can be read by both parties and transfer networks.

If a data format needs to be tested (because it is going to be used during the project), an "X" must be entered in the "Test" column. The "Sender" column indicates who has to send data with the corresponding format. The "Quantity" and "Size" columns indicate how often the transfer has to be performed and how big the test file has to be. The "Size" should correspond to the file sizes that can be expected during the project.

Transfer of files must be tested in CATdrawing or IGES format.

File format	Test	Sender	Quantity	Size
STEP AP214	☒	Data exchange partner and FAIR		
CATpart	☐	Data exchange partner and FAIR		
CATproduct	☐	Data exchange partner and FAIR		
CATdrawing	☐	Data exchange partner and FAIR		

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PDF/A	☒	Data exchange partner and FAIR		
XLS	☒	Data exchange partner and FAIR		
RTF	☒	Data exchange partner and FAIR		
CSV	☐	Data exchange partner and FAIR		
TIFF G4	☐	Data exchange partner and FAIR		
IGES	☐	FAIR		
3DDXF	☐	FAIR		
DXF	☐	FAIR		
DWG	☐	FAIR		
3D-PDF	☐	Data exchange partner and FAIR		

A.9 Required level of CAD accuracy

When designing parts and assemblies, the following levels of accuracy must be reflected by the settings in the CAD system used:

CAD accuracy	Used	Context
1mm	☐	
$1*10^{-1}$mm	☐	
$1*10^{-2}$mm	☐	
$1*10^{-3}$mm	☒	Standard
$1*10^{-4}$mm	☐	
$1*10^{-5}$mm	☐	
$1*10^{-6}$mm	☐	

Appendix B

FAIR

B Overview of supported file formats and file extensions

This table provides an overview of the file formats supported during the project. Formats in brackets can only be accepted in exceptional cases after separate negotiations. In addition, file formats and their respective extensions are accepted for 3D models generated by CAD systems other than CATIA V5. However, FAIR cannot deliver these formats.

Application	Native format	Neutral format
3D model	CATpart, CATproduct	STEP AP214
Drawing	CATdrawing	PDF/A, IGES
Bill of materials	Excel	PDF/A
Text document	RTF	PDF/A
Sheet (not BoM)	Excel	CSV
Calculation/Engineering	By mutual agreement	PDF/A
Plot	By mutual agreement	PDF/A, PDF/E, TIFF-G4
NC	By mutual agreement	By mutual agreement

The supported file formats lead to a restricted set of accepted file extensions. The file extension must indicate the corresponding file format (e.g. a document in PDF/A format must have the file extension ".pdf"; an MS Excel file must have the file extension ".xls"). The following table provides an overview of the file extensions that are accepted by the data exchange portal by default:

Application	File extension
3D model	CATpart, CATproduct, stp, step
Drawing	CATdrawing, igs, pdf
Spreadsheets, text, documentation	csv, pdf, rtf, xls
Plot	pdf, tif, tiff

Appendix C

C Overview of deliverables

The following list can be used as a checklist to verify that every document that must be sent to FAIR in order to deliver a complete and approved design has been transferred:

Document
3D model (exact geometry) in native data format (in the original format of the CAD system used by the data exchange partner)
3D model (exact geometry and reduced data or constraining contour) in neutral data format (ISO10303-214/STEP AP214)
Drawing in PDF/A format
Drawing in CATdrawing or IGES format
Bill of materials in Excel format (for assemblies only)
Bill of materials in PDF/A format (for assemblies only)
Master data in Excel format
Master data in PDF/A format

The following documents must also be send if stipulated by FAIR or mandated by law:

Document
Certificates in PDF/A format
Warranties in PDF/A format
Declaration of conformity in PDF/A format
Assembly instructions in PDF/A and RTF format
Manufacturing instructions in PDF/A and RTF format
Machinery directive in PDF/A and RTF format
Inspection records in PDF/A and RTF format
Test charts in PDF/A or CSV format
Calculations in the stipulated file format
NC data in the stipulated file format
All other documents stipulated by FAIR
All other documents mandated by law

Appendix D

D Partner model-specific requirements

In the FAIR project, there are different kinds of cooperative partnerships, which are referred to as partner models. The partner models will have an impact on data exchange.

The assignment to a partner model(s) depends on the cooperation agreements between the data exchange partner in question and FAIR.

The recommendations for data exchange will differ depending on the partner model involved. This is due to different integration depths and information/documents that need to be exchanged. The integration aspects are defined in section D.1. The information that must be exchanged between FAIR and the data exchange partner is specified in sections D.2.

D.1 Integration aspects

Geometrical integration (GI)

Geometrical integration, i.e. spatial integration, provides a safeguard for:

- Geometric, static requirements
- Geometrically oriented states
- No conflicts with regard to building structure or during installation
- Service requirements, e.g. for later installation or de-installation
- Consistency of tolerances
- Ergonomics

Functional integration (FI)

Functional integration means providing support for the analysis, evaluation and optimization of the concepts involved in the design of the accelerator with the help of methods supported by virtual hardware and/or methods based on experience (e.g. simulation, trials, expert appraisal). Its objective is to integrate qualitative and quantitative targets, and it ensures that the functional requirements of the product are fulfilled.

The following aspects must be taken into consideration with regard to functional integration (depending on the order(s) involved):

- Active and passive security
- Acoustic and vibration characteristics
- Functionality regarding installation engineering
- Safeguarding performance parameters and behavior of the facility
- Leak-tightness of supply units (e.g. water, gas)

Appendix D

Integration of mechanical engineering-related components in the construction of the facility

Manufacturing integration ensures a target-oriented process for the construction of the facility by the individual trades giving due consideration to all manufacturing resources:

- Concrete building

- Installation engineering

- Mechanical engineering

- Logistics

Process integration (PI)

Process integration ensures target-oriented supplier and development cooperation. It differs with regard to the depth of integration of the data exchange partner in the processes involving the design and construction of the facility used by FAIR.

D.2 Consortium partner (CP)

The CP coordinates the participation of other partners and plays the role of the general contractor and is normally responsible for entire sections of the facility. The CP functions as the main contact for FAIR.

If necessary, direct communication between FAIR and the CP's subcontractors is possible.

The CP delivers construction services, parts, assemblies or complete systems for the accelerator. The CP coordinates and supervises installation.

Normally any information and documents which are relevant for design, manufacturing or construction must be taken into consideration.

The CP is responsible for geometric and functional integration and is closely integrated in the processes used by FAIR. The CP is closely involved in and/or responsible for integration of components during construction of the mechanical engineering-related portions of the facility, the building structures and technical building services.

Figure 1 indicates the minimum set of information and documents that must be exchanged during the different project stages.
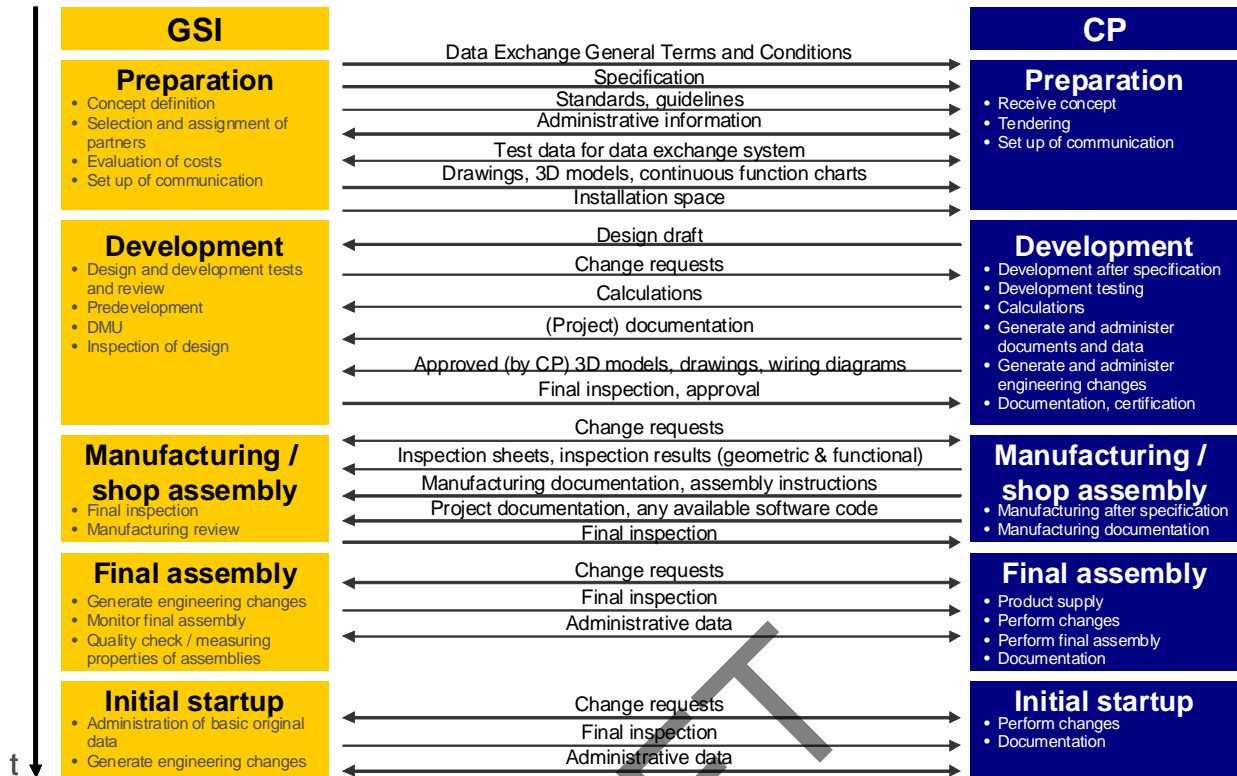
Appendix D

Figure 1: Information exchanged between FAIR and CP

Any other data exchange requirements must be stipulated separately, in addition to this document.

Appendix D

D Partner model-specific requirements

In the FAIR project, there are different kinds of cooperative partnerships, which are referred to as partner models. The partner models will have an impact on data exchange.

The assignment to a partner model(s) depends on the cooperation agreements between the data exchange partner in question and FAIR.

The recommendations for data exchange will differ depending on the partner model involved. This is due to different integration depths and information/documents that need to be exchanged. The integration aspects are defined in section D.1. The information that must be exchanged between FAIR and the data exchange partner is specified in sections D.2.

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Geometrical integration (GI)

Geometrical integration, i.e. spatial integration, provides a safeguard for:

- Geometric, static requirements
- Geometrically oriented states
- No conflicts with regard to building structure or during installation
- Service requirements, e.g. for later installation or de-installation
- Consistency of tolerances
- Ergonomics

Functional integration (FI)

Functional integration means providing support for the analysis, evaluation and optimization of the concepts involved in the design of the accelerator with the help of methods supported by virtual hardware and/or methods based on experience (e.g. simulation, trials, expert appraisal). Its objective is to integrate qualitative and quantitative targets, and it ensures that the functional requirements of the product are fulfilled.

The following aspects must be taken into consideration with regard to functional integration (depending on the order(s) involved):

- Active and passive security
- Acoustic and vibration characteristics
- Functionality regarding installation engineering
- Safeguarding performance parameters and behavior of the facility
- Leak-tightness of supply units (e.g. water, gas)

Appendix D

Integration of mechanical engineering-related components in the construction of the facility

Manufacturing integration ensures a target-oriented process for the construction of the facility by the individual trades giving due consideration to all manufacturing resources:

- Concrete building
- Installation engineering
- Mechanical engineering
- Logistics

Process integration (PI)

Process integration ensures target-oriented supplier and development cooperation. It differs with regard to the depth of integration of the data exchange partner in the processes involving the design and construction of the facility used by FAIR.

D.2 Control engineering component supplier including development (CSID)

The CSID delivers control systems and software for the accelerator including the relevant construction services.

CSIDs are typically partners in (slow) control, high frequency, power supplies or beam diagnostics. The CSID might coordinate and supervise installation.

The primary information delivered by the CSID is any relevant 2D/3D models, calculations, certificates, wiring charts (normally created in EPLAN), specifications (requirement sheets, technical specifications) and guidelines.

The CSID is responsible for functional integration, provides FAIR with support with regard to geometrical integration and is closely integrated in the processes used by FAIR.

Depending on the order involved, the CSID is closely involved in or responsible for the integration of control systems during construction of the facility.

Figure 1 indicates the minimum set of information and documents that must be exchanged during the different project stages.
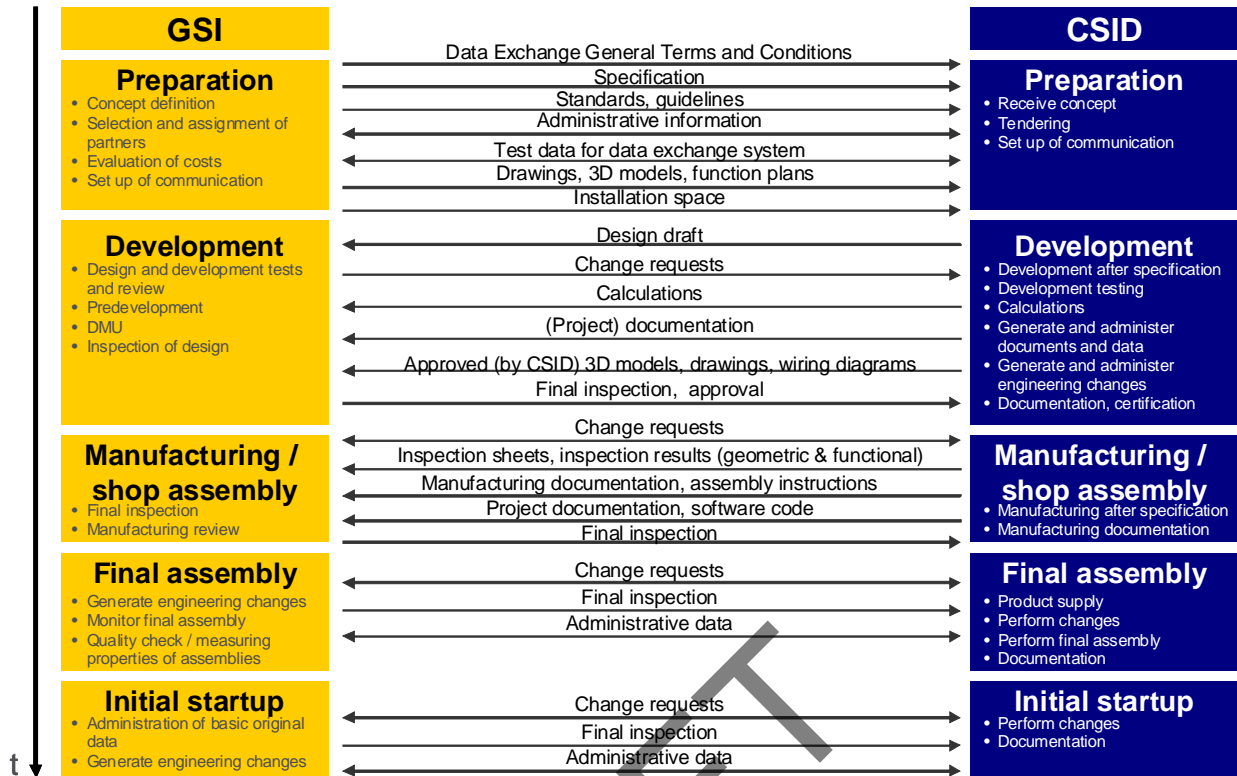
Appendix D

Figure 1: Information exchanged between FAIR and CSID

Any other data exchange requirements must be stipulated separately, in addition to this document.

Appendix D

D Partner model-specific requirements

In the FAIR project, there are different kinds of cooperative partnerships, which are referred to as partner models. The partner models will have an impact on data exchange.

The assignment to a partner model(s) depends on the cooperation agreements between the data exchange partner in question and FAIR.

The recommendations for data exchange will differ depending on the partner model involved. This is due to different integration depths and information/documents that need to be exchanged. The integration aspects are defined in section D.1. The information that must be exchanged between FAIR and the data exchange partner is specified in sections D.2.

D.1 Integration aspects

Geometrical integration (GI)

Geometrical integration, i.e. spatial integration, provides a safeguard for:

- Geometric, static requirements
- Geometrically oriented states
- No conflicts with regard to building structure or during installation
- Service requirements, e.g. for later installation or de-installation
- Consistency of tolerances
- Ergonomics

Functional integration (FI)

Functional integration means providing support for the analysis, evaluation and optimization of the concepts involved in the design of the accelerator with the help of methods supported by virtual hardware and/or methods based on experience (e.g. simulation, trials, expert appraisal). Its objective is to integrate qualitative and quantitative targets, and it ensures that the functional requirements of the product are fulfilled.

The following aspects must be taken into consideration with regard to functional integration (depending on the order(s) involved):

- Active and passive security
- Acoustic and vibration characteristics
- Functionality regarding installation engineering
- Safeguarding performance parameters and behavior of the facility
- Leak-tightness of supply units (e.g. water, gas)

Appendix D

Integration of mechanical engineering-related components in the construction of the facility

Manufacturing integration ensures a target-oriented process for the construction of the facility by the individual trades giving due consideration to all manufacturing resources:

- Concrete building
- Installation engineering
- Mechanical engineering
- Logistics

Process integration (PI)

Process integration ensures target-oriented supplier and development cooperation. It differs with regard to the depth of integration of the data exchange partner in the processes involving the design and construction of the facility used by FAIR.

D.2 Engineering development supplier (EDS)

The EDS delivers construction sheets, but no physical components, based on specifications (requirement sheets), installation spaces and information about interfaces to civil construction, technical building services and adjacent mechanical engineering-related components of the facility.

The primary information delivered by the EDS is any data relevant to construction such as, for example, 2D/3D models, calculations, certificates, wiring diagrams.

The EDS must support FAIR by ensuring the geometric and functional integration of his order in the overall project. The responsibility for integration lies with FAIR.

The EDS is not involved in the actual construction.

Figure 1 indicates the information and documents that must be exchanged during the different project stages.
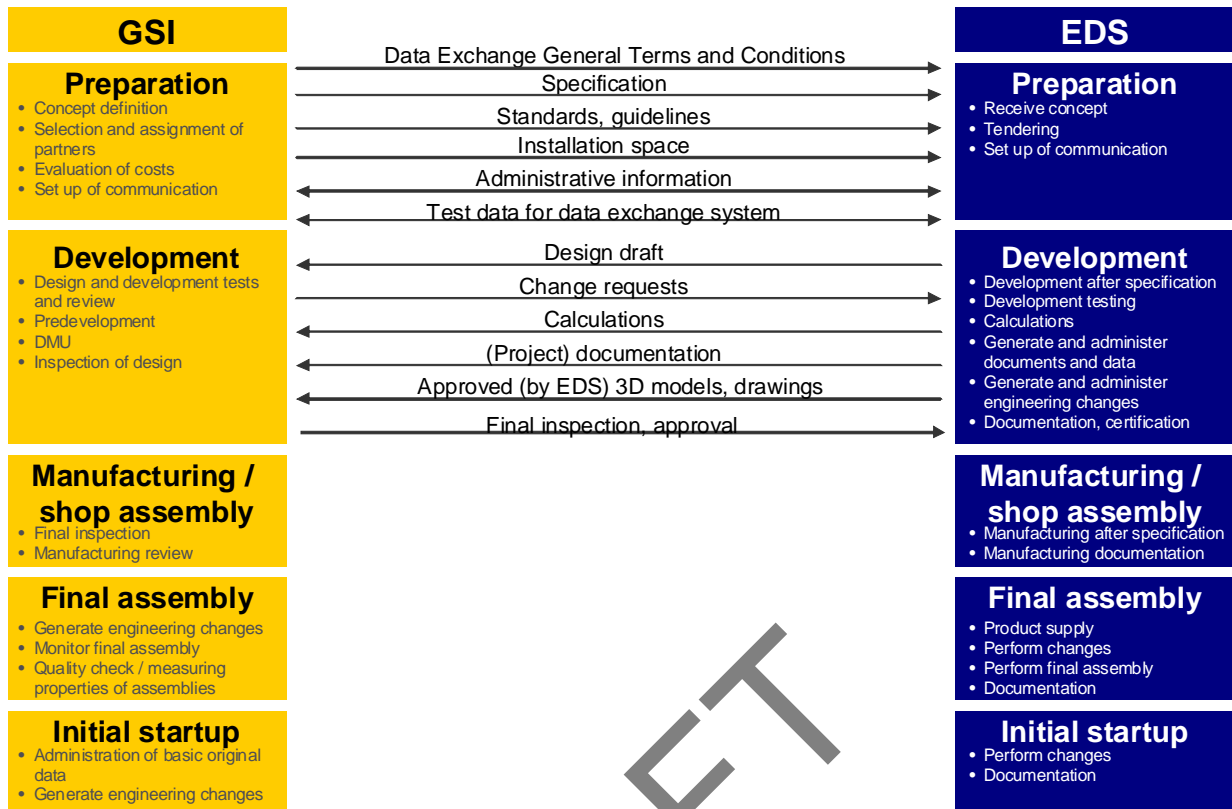
Appendix D

FAIR

Figure 1: Information exchanged between FAIR and the EDS

Any other data exchange requirements must be stipulated separately, in addition to this document.

Appendix D

D Partner model-specific requirements

In the FAIR project, there are different kinds of cooperative partnerships, which are referred to as partner models. The partner models will have an impact on data exchange.

The assignment to a partner model(s) depends on the cooperation agreements between the data exchange partner in question and FAIR.

The recommendations for data exchange will differ depending on the partner model involved. This is due to different integration depths and information/documents that need to be exchanged. The integration aspects are defined in section D.1. The information that must be exchanged between FAIR and the data exchange partner is specified in sections D.2.

D.1 Integration aspects

Geometrical integration (GI)

Geometrical integration, i.e. spatial integration, provides a safeguard for:

- Geometric, static requirements
- Geometrically oriented states
- No conflicts with regard to building structure or during installation
- Service requirements, e.g. for later installation or de-installation
- Consistency of tolerances
- Ergonomics

Functional integration (FI)

Functional integration means providing support for the analysis, evaluation and optimization of the concepts involved in the design of the accelerator with the help of methods supported by virtual hardware and/or methods based on experience (e.g. simulation, trials, expert appraisal). Its objective is to integrate qualitative and quantitative targets, and it ensures that the functional requirements of the product are fulfilled.

The following aspects must be taken into consideration with regard to functional integration (depending on the order(s) involved):

- Active and passive security
- Acoustic and vibration characteristics
- Functionality regarding installation engineering
- Safeguarding performance parameters and behavior of the facility
- Leak-tightness of supply units (e.g. water, gas)

Appendix D

Integration of mechanical engineering-related components in the construction of the facility

Manufacturing integration ensures a target-oriented process for the construction of the facility by the individual trades giving due consideration to all manufacturing resources:

- Concrete building
- Installation engineering
- Mechanical engineering
- Logistics

Process integration (PI)

Process integration ensures target-oriented supplier and development cooperation. It differs with regard to the depth of integration of the data exchange partner in the processes involving the design and construction of the facility used by FAIR.

D.2 Engineering component supplier including development (ESID)

The ESID delivers parts, mechanical and engineering assemblies and complete systems for the accelerator, as well as the corresponding design documentation. He represents the classic supplier of the cryo and vacuum domains, for example. The ESID might coordinate and supervise installation.

The primary information delivered by the ESID is any relevant 2D/3D models, calculations, certificates, wiring charts, specifications (requirement sheets, technical specifications), and guidelines, as well as manufacturing documentation such as complete 2D drawings, 3D models and wiring diagrams.

The ESID must provide FAIR with support for the geometric integration of his order in the overall project and is integrated in the processes used by FAIR to a certain extent.

The functional and manufacturing integration requirements will depend on the order involved.

Figure 1 indicates the minimum set of information and documents that must be exchanged during the different project stages.
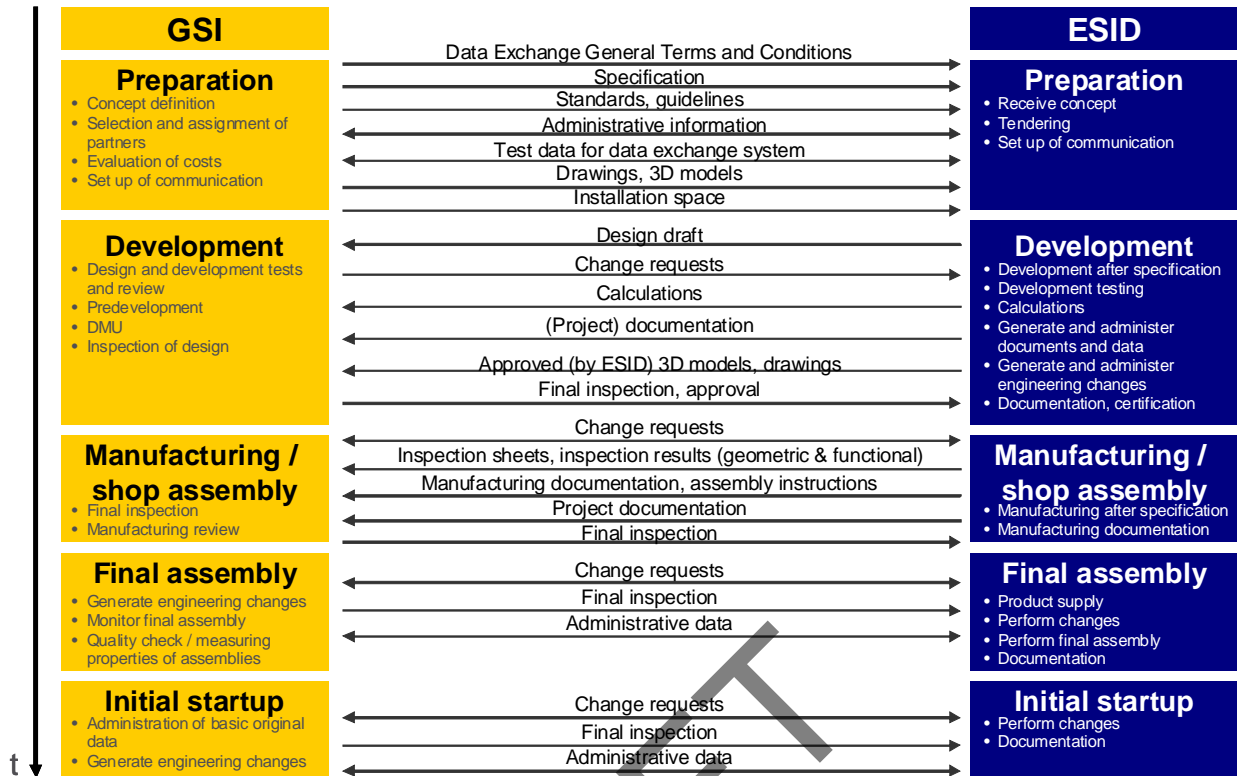
Appendix D

Figure 1: Information exchanged between FAIR and ESID

Any other data exchange requirements must be stipulated separately, in addition to this document.

Appendix D

D Partner model-specific requirements

In the FAIR project, there are different kinds of cooperative partnerships, which are referred to as partner models. The partner models will have an impact on data exchange.

The assignment to a partner model(s) depends on the cooperation agreements between the data exchange partner in question and FAIR.

The recommendations for data exchange will differ depending on the partner model involved. This is due to different integration depths and information/documents that need to be exchanged. The integration aspects are defined in section D.1. The information that must be exchanged between FAIR and the data exchange partner is specified in sections D.2.

D.1 Integration aspects

Geometrical integration (GI)

Geometrical integration, i.e. spatial integration, provides a safeguard for:

- Geometric, static requirements
- Geometrically oriented states
- No conflicts with regard to building structure or during installation
- Service requirements, e.g. for later installation or de-installation
- Consistency of tolerances
- Ergonomics

Functional integration (FI)

Functional integration means providing support for the analysis, evaluation and optimization of the concepts involved in the design of the accelerator with the help of methods supported by virtual hardware and/or methods based on experience (e.g. simulation, trials, expert appraisal). Its objective is to integrate qualitative and quantitative targets, and it ensures that the functional requirements of the product are fulfilled.

The following aspects must be taken into consideration with regard to functional integration (depending on the order(s) involved):

- Active and passive security
- Acoustic and vibration characteristics
- Functionality regarding installation engineering
- Safeguarding performance parameters and behavior of the facility
- Leak-tightness of supply units (e.g. water, gas)

Appendix D

Integration of mechanical engineering-related components in the construction of the facility

Manufacturing integration ensures a target-oriented process for the construction of the facility by the individual trades giving due consideration to all manufacturing resources:

- Concrete building

- Installation engineering

- Mechanical engineering

- Logistics

Process integration (PI)

Process integration ensures target-oriented supplier and development cooperation. It differs with regard to the depth of integration of the data exchange partner in the processes involving the design and construction of the facility used by FAIR.

D.2 Engineering component supplier without development (ESWD)

The ESWD delivers parts, mechanical and engineering assemblies, as well as complete systems for the accelerator. The ESWD functions as an "extended work bench". The ESWD might coordinate and supervise installation.

The primary documents delivered by the ESWD are technical specifications, guidelines and manufacturing documentation such as complete 2D drawings, 3D models and wiring diagrams.

There are no integration requirements (D.1) for the ESWD.

Figure 1 indicates the information and documents that must be exchanged during the different project stages.
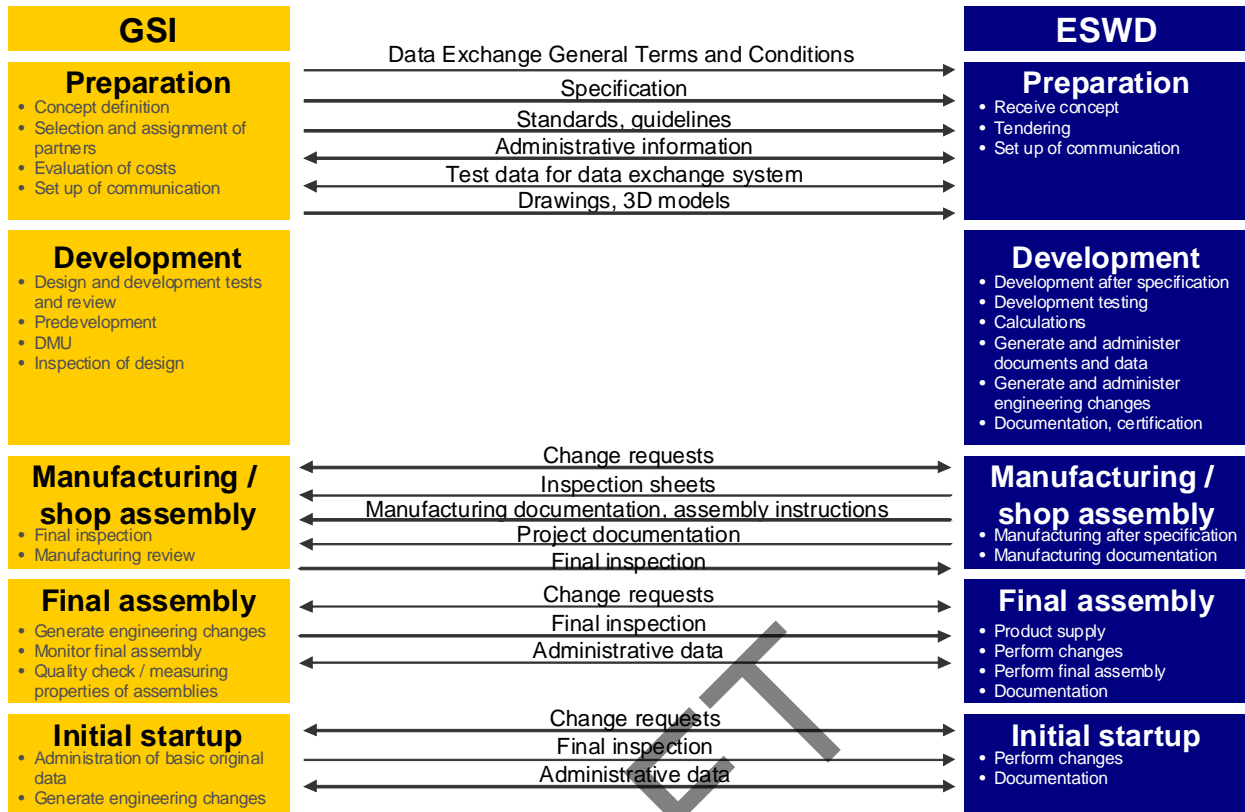
Appendix D

Figure 1: Information exchanged between FAIR and the ESWD

Any other data exchange requirements must be stipulated separately, in addition to this document.

Appendix E

FAIR

E Instructions for achieving reusable STEP export

The following table contains the recommended settings for the preferred CAD systems. Please select your CAD system and follow the instructions relating to the settings for the system(s) and STEP preprocessor(s). This will aid the generation of accurate STEP files for import into CATIA V5.

CAD system	Recommended system settings	Recommended preprocessor settings
I-DEAS NX	- In the case of a multi-solid part, the solids should be joined.	- The default values in the menu **STEPAP214 representations** should only be changed in the event of unsatisfactory results. - The file name, including the path, should be no longer than 80 characters.
AutoCAD / MDT	- Delete all non-referenced geometry. - Please activate all the layers with the features to be exported. - Only standard colors are transferred. Sub-elements of objects can not be colored individually in the systems. - Hybrid models are exported as an assembly. - Please execute **AMUPDATE** to update the model geometry. - Use **AMREPLAY** to re-generate the model step by step. This helps to identify corrupt features in the overall context of the design progress. - Use **AMSANITYCHECK** to count the numbers of shells within the model. Usually a MD model should contain only one shell. Exception: Intended voids. - Use **PURGE** to reduce the file size	- The default setting for STEP export is AP203. For AP214 export, you should always use the latest STEP standard. In this case, AP214.
Inventor	- Only standard colors are transferred. Sub-elements of objects cannot be colored individually in the systems.	- The default setting for STEP export is AP203. For AP214 export, you should always use the latest STEP standard. In this case, AP214 IS. - The export log file "filename.xlo" provides further information.
SolidWorks	- To perform a geometry check, go to **Tools -> Check**…	- **Output as ... Solid/Surface geometry:** The geometry will be exported as solid and surface bodies. This is the recommended option.

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CATIA V4	- No elements should be placed in **NOSHOW/NOPICK**. - Model should be purged of all unused information because the translator exports the complete contents of CATIA parts. Delete unused **DETAILS** and unused elements from **NOSHOW** and drawings. - Update **SOLID-M** into **SOLID-E** with the **CATSOE** utility. - Perform **SOLIDE/UPDATE** even if message **UPDATE ALREADY DONE** appears. - Generate volumes from **SOLID-E** and delete **SOLID-E** in all workspaces. - Scaled and mirrored dittos (**EXPLODE** function) should not be used. - Before export, elements of special CATIA modules (e.g. PIPING, BUILDING DESIGN) need to be converted to STEP-compliant elements. - Use **CATCLN**. - Assembly structures in **SET**s should be transferred to **DETAILS**. - Link all **SET**s if possible (**SETS -> LINK**). - Solids/volumes consisting of separate bodies should be avoided. - Objects used for Boolean operations should exhibit good penetration.	- **INDEX** and **DATA** size should always be set to generous values (50000, 200000). - Choose Solid as target modeling system. - **Geometry and topology:** select G2, G3 and G5, do not select G4 and G7
OneSpace Designer	- Components of an assembly should have names no longer than 16 characters. - System accuracy should be set prior to modeling. Recommended values are 10-6 mm, 10-5 mm, 10-4 mm. - The smallest extent value (e.g. edge length) can be set under **System Setting -> Advisor/Check Setting -> min Edge** - All Advisor Checks (voids, nonmanifold, knife edge, min edge) should be active while modeling the part. - Complete body checks should be performed frequently during design and prior to export to STEP.	- If, when exporting an assembly, the option **Assembly Structure/Shared Parts** is set to **ON**, the individual colors of the instances cannot be exported. - As the target system cannot process assembly structure information or geometric transformation, you should select NO to suppress this information. - Hybrid models must be exported with multiple products. You can also use the Structure Browser to make your selection. If you try to specify a part by clicking in a **viewpart,** you will select only faces or edges instead of the whole part.

Appendix E

Pro/ ENGINEER	- With regard to data exchange, it is recommended that models be created in Pro/ENGINEER with absolute accuracy from the beginning. The values should be 0.01mm or smaller. - The setting "**enable_absolute_accuracy yes**" needs to be included in the configuration file config.pro. - There should be no layer named "255". - Components of an assembly should have names no longer than 16 characters. - To export mixed model structures, each model type should be saved as one part and transferred in assembly mode. - Before export, check for highlighted menu option **Info -> Geom/Check** for design problems. Indicated features are likely to cause problems in the target system. - Delete all non-referenced geometry and external references. Do not use any suppressed construction geometry (activate all layers). - If the model was created with relative accuracy, a conversion to its corresponding absolute accuracy might reveal design problems. - Force re-generation by selecting **Set Up -> Accuracy -> Absolute -> Enter value**. It is recommended that a specific start model be defined.	- The default setting for STEP export is AP203. For AP214 export, the following setting needs to be added to the Pro/ENGINEER configuration file config.pro: step_export_format AP214_DIS - Other recommended config.pro options are: - intf3d_out_default_option solid - intf3d_out_extend_surface yes - intfd_out_blanked_entities no - If not yet included in config.pro, please select Solid or Shell (for surface models), depending on the model type. The options **Surface** (default) and **Wireframe** should not be used. - If exporting an assembly, select **Single File** as **File structure**.
Unigraphics NX2	- Delete blanked elements before preprocessing. - To transfer the colors of assemblies, the colors should be set and saved with the individual components, not the assembly. - Select **Analysis -> Examine Geometry -> all options -> all elements**. The marked elements are likely to cause problems with data exchange.	- For surface models, select "topologically bounded" in the menu **Translation Options -> Surface Output Type**. - The default tolerance value in the menu **General -> B-Spline Aprx. Tol.** of 1.01*10-5 mm can result in extremely large STEP files and should be reduced in such cases (recommended value: 10-3 mm). - Use of the default settings in the menu Translation Control (Tolerant Modeling) is recommended. - Special characters are not permitted in the file name of the STEP file. Otherwise, the model will not be exported.

Appendix F

F Data exchange processes

The following processes are part of the overall data exchange process as described in section 6.1 (Data exchange processes).

F.1 Preparing data for FAIR

Activity	Description	Responsible role
Collect partner data	Partner collects the data to be sent.	Partner
Complete BoM and master data	Complete BoM and master data if information is missing.	Partner
Record approval status	The partner must record the current approval status of the design from his point of view. If the partner approves a design, FAIR will treat this design as binding.	Partner
Quality check of CAD/PDM data	Check whether the engineering data satisifies the quality criteria defined by FAIR.	Partner
Conversions	Conversion of native CAD model data to STEP AP 214. Conversion of native CAD drawing data to PDF/A. Conversion of BoM to PDF/A. Conversion of other documents if necessary as described in the general terms and conditions for data exchange	Partner
Check for malicious software	Before uploading data to the portal, the data must be checked using the latest antivirus software.	Partner
Collection of documentation	Collect any additional documents needed.	Partner

Appendix F

F.2   Upload to FAIR

Activity	Description	Responsible role
Login to data exchange portal	Login to the data exchange portal in order to upload the collected documents.	Partner
Upload engineering data	Upload final or intermediate results of design or manufacturing. This includes models, master data, documentation, reports and possibly calculations and certificates.	Partner
Generate confirmation	If upload was successful, a confirmation message is issued.	Portal
Receive confirmation	The partner is provided with information about successful uploads.	Partner
Record upload	The system log records successful data uploads.	Portal

F.3   Partner receives data from FAIR

Activity	Description	Responsible role
Incoming data for the partner	The partner receives information about incoming data.	Portal
Receive data	The partner visits the portal and downloads the new data.	Partner
Check-out data	The portal checks the data out and records its download. It informs the sender of the data that the data has arrived.	Portal
Check-in data	The partner checks the incoming data into his own systems. He is now responsible for the administration of this data.	Partner

Appendix F

FAIR

F.4   Use of data at partner

Activity	Description	Responsible role
Construction / manufacturing	The partner develops/updates engineering documents. If the partner is a manufacturer, he might also manufacture components.	Partner
Consult construction / production	While the construction is being developed or manufactured by the partner, FAIR might consult with the partner.	FAIR
Send intermediate results	The partner sends intermediate results to FAIR. (Preparation of the data is described in F.1.)	Partner
Send final results	The partner sends complete construction information, which has been "approved" internally, to FAIR. (Preparation of the data is described in F.1.)	Partner
Supply components	If the partner is a manufacturer, he also supplies the components to FAIR.	Partner / Supplier

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Appendix G

FAIR

G References to standards, guidelines and directives

File format specifications:

- ASCII specification (ANSI)
- CSV definition (IETF RFC 4180)
- IGES 5.3 specification (ANSI)
- PDF/A specification (ISO 19005-1:2005)
- PDF/E specification (ISO/PRF 24517-1, publication expected in 2008)
- STEP AP214 specification (ISO 10303-214:2003)
- Tiff 6.0 specification

Guidelines and directives of FAIR:

- Contracts between FAIR and the data exchange partner
- Building regulations of FAIR-CC
- Engineering regulations of GSI-FAIR
- Specifications for nomenclature of documents at FAIR
- Specifications for nomenclature of items at FAIR
- Specifications for the numeration of documents at FAIR
- Non-disclosure agreements
- Data exchange parameters

Relevant standards:

- DIN 476-2 (paper formats)

FAIR

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