FAIR Commissioning & Control Working Group

Notes from the meeting held on 27th January 2016

e-mail distribution: FAIR-C2WG-ALL at GSI.de, attendance list

Agenda:

- FAIR (Re-)Commissioning (in 2018) – Strategy & Concepts (jump below), Ralph J. Steinhagen
- AOB (jump below)

1. FAIR (Re-)Commissioning (in 2018) – Strategy & Concepts, Ralph J. Steinhagen

In his presentation (see slides), R. Steinhagen outlined the proposed FAIR commissioning strategy. The proposed Dry-Run strategy should be already applied to the SIS18 recommissioning in 2018 in order to get familiar and test the concepts involved (request by P. Spiller). R. Steinhagen summarised some of the FC2WG topics that have been discussed during the last year (see slides for details). The purpose of this presentation is to iterate/agree on the common terminology and proposed structure for the SIS18/ESR re-commissioning in 2018.

In particular, he stressed the necessity for improving upon the present mode-of-operation paradigm in order to be able to guarantee a reasonable beam-on-target (BoT) efficiency for FAIR. While the 70% BoT efficiency of the existing facility is adequate for the present type of physics experiments, due to the long cascaded accelerator chains (e.g. HESR being the 5th accelerator in a long beam production chain), the simple scaling of the status quo paradigms may lead to efficiencies dropping well below 50%. This needs to be obviously improved upon. The dry-run and commissioning procedures as a tool shall help analysing, improving, and to define more efficient operation concepts of FAIR.

The proposed FAIR commissioning procedures define de facto a shared MoU between the various stake-holders (equipment groups, machine experts, operation, ...) of when, where and how the individual accelerator systems should fit in and which order they are being boot-strapped. These procedures build also the basis of the future routine operation of FAIR. The procedures are divided into 'hardware commissioning' (HWC, further divided into 'initial hardware acceptance tests', Dry-Runs and 'machine check-out') and 'commissioning with beam' (Beam Commissioning, BC).

The 'initial HWC acceptance tests' fall into the scope of the existing project structure (MPLs etc.) and check the conformity of the delivered devices with contractual design targets. This is typically done once, or only after major upgrade or modifications (see FATs & SATs).

These initial tests are followed by a series of Dry-Runs and Machine-Checkout tests whose main aim is to check the conformity of individual system's controls integration and readiness from a beam operation point of view. During these phases the machine (excluding not-yet-available systems) is put into a beam-ready state, in order to test as much control system functionality as

possible without beam. Unavailable systems are initially bypassed, replaced by appropiate workarounds, noted down (!! → documentation, traceability), and followed-up at a defined later stage.

'Dry-Runs' are a rehearsal of the accelerator function and with an initial frequency of typically 1-2 dedicated days per month, starting about 6 months before the scheduled commissioning with beam. Their frequency increase depending on the outcome of the initial dry-run tests. The period between Dry-Runs is used to follow-up and fix issues potentially found during these tests. Beside of identifying and fixing potential problems early on (and in parallel), one of the important advantages of these tests is to provide a realistic heads-up information of the actual readiness for beam of the given accelerator. These tests may need to by (partially) repeated after every shut-down or longer technical stop with substantial modifications (e.g. re-cabling, opening of cryogenic, control system changes …). Documentation and recording of the tests results is necessary requirement in view of repeatability and traceability.

The 'Machine Checkout' is a more intense continuation of the Dry-Runs (e.g. machine patrols, magnet/PC heat runs, etc.), starting typically two weeks before the targeted BC. These steps are common practise and are also repeated as part of the routine operation of existing accelerators.

The HWC is followed by the Commissioning with Beam (BC) which is grouped into three stages:

A) 'Pilot Beams': the main aim of this stage is to drive the beam expeditiously through the facilities Beam Production Chain (BPC) with “easily available” ions (e.g. U28+, Ar) and with always 'safe' ie. low-intensity and low-brightness beams. In particular, this stage is used to check as much of the basic 'accelerator mechanics' (threading, injection, capture, cool, convert, acceleration/decelerate, stripping & extraction) as possible and to identify beam-related limitations linked to polarity errors, RF, beam instrumentation, machine alignment, effective physical machine aperture, etc. that can be followed up during a scheduled technical stop following this stage (N.B. Stage A impact on beam schedule).

B) 'Intensity Ramp-up & Special Systems': The main aim of this stage is to achieve and to maintain the nominal as-designed machine performance for a limited number of reference beams. During this stage the accelerator design and systems are verified against whether they can achieve (near) nominal beam parameters, e.g. beam intensities, nominal transmission and beam losses (for e.g. U^{28+} & proton beams). This stage also includes the commissioning of specialised equipment (e.g. e-cooler, if not needed earlier), slow extraction, transverse fast feedbacks, and commissioning and validation of machine protection and interlock systems. As a general policy: unsafe or untested operations will always be preceded by checks with safe low-intensity beam. These checks will need to be repeated during regular operation to ensure a safe and reliable intensity ramp-up for new experiments or beam conditions.

C) 'Production operation with nominal intensities': the main aim of this stage is to establish a reproducible nominal beam operation, pushing physics and beam parameter performance, while identify and improve upon bottlenecks impacting FAIR's 'figure-of-merit' within safe

limits. N.B. larger optimisation or new concepts will need to be addressed through stepping back and reiterated during the 'intensity ramp-up' phase. N.B. the first time this stage is counted as 'commissioning' or 'assisted operation', while on the long-term will gradually shift towards a 'regular operation' that can handled by a limited operation skeleton crew.

As an example for the various commissioning phases, corresponding procedures, and the targeted level-of-detail, R. Steinhagen discussed the first phase 'Stage A) Injection & First Turn'. The main aim is to keep the top-level specification as general as possible to be applicable to all ring machine, and to add specific machine details where necessary. Each procedure outlines, the required entry conditions, the specific procedures ("accelerator cookbook recipes") and resulting exit conditions for the subsequent phases. The procedures are further maintained and kept up-to-date on the FC2WG website: https://fair-wiki.gsi.de/FC2WG/BeamCommissioning/BCStageA1

The next steps are to continue and complete the other procedure phases. It is hoped to be able to establish a first tentative initial commissioning plan by Q3/Q4-2016. The FAIR commissioning and operation depends on many different systems, and ultimately the responsibility for commissioning is shared collectively among many GSI & FAIR colleagues involved. It is thus paramount that these procedures are not developed by single individuals in a 'one man show' fashion but collectively in order to aid their dissemination and impact on real-world FAIR operation. R. Steinhagen thus urges for an active participation and – in particular – volunteers to aid the coordination, further development and fleshing out the individual procedures.

The further coordination and distribution of tasks will be discussed during the upcoming FC2WG meeting.

Discussion:

S. Pietri mentioned that it would be useful to present and discuss the accelerator commissioning concepts also with the experiments. [N.B. post-meeting comment: scheduled for 9th of March 2016, R. Steinhagen].

C. Omet and S. Pietri expressed that while the detailed procedure may be adequate for the initial commissioning of new machines, they could be possibly done quicker for the recommissioning of the existing machine.

D. Ondreka and R. Bär remarked that recommissioning in 2018 will likely require a few months due to substantial hardware and control system changes. In the first instance, the new control system and data-supply modelling will not include 'therapy mode' type operation which may come only at a later stage. J. Stadlmann confirmed that the bio-physics communities will have to wait to get this requirement being reimplemented. However, other wishes may be be implemented earlier.

R. Steinhagen reckoned that commissioning of the whole FAIR accelerator chain (all three Stages) in less than three month might be unrealistic. Thus, one aspect of developing the commissioning procedures is to establish a more realistic estimates of the required individual commissioning steps. In addition, the available man-power and required time to follow-up issues and errors that are

found during commissioning may be insufficient to support a 24/7 commissioning of all accelerator in parallel. U. Weinrich replied that one should not exclude 'parallel' or 'full-time commissioning' of multiple accelerators. D. Ondreka commented that experience with the recommissioning of SIS18, ESR and HEST in 2018 could be used to leverage the efforts required for the FAIR-HEBT commissioning. J. Stadlmann anticipates that the existing (recommissioned) part of the FAIR facility would be in regular operation, and one SIS18 cycle being dedicated for commissioning of subsequent FAIR accelerators and transfer-lines. R. Steinhagen emphasised that often there is only one or very limited number of experts available for a given equipment or controls sub-system, and that we may not be able to call for them on a 24/7 basis. U. Weinrich replied that one should plan/expect a higher man-power availability for FAIR commissioning. R. Bär commented that for the time being CSCO can plan only with the existing available people. Further discussions on available resources for commissioning is needed (N.B. outside the scope of the FC2WG).

F. Herfurth expressed that the Dry-Run and commissioning of CRYRING would profit from such procedures, albeit in a maybe simpler version of it. R. Bär replied that for CRYRING – due to the short time remaining – we may need to apply a methodology of 'driving the car while building it'.

C. Omet asked whether the sector tests for SIS100 could be included in the Dry-Run procedures.

S. Pietri asked whether these procedures could be also be used for Super-FRS. R. Steinhagen affirmed that the generic aspects of the procedures (magnets, power converters, timing, etc.) could be equally applied to commissioning of the experiments. However, while being confirmed and mandated for SIS18, SIS100 and CRYRING, whether this is done or planned for Super-FRS is at the discretion of the Super-FRS MPL.

R. Bär commented (referring to the SIS18 retrofitting for FAIR and planned GAF measures) that it would be beneficial to know which accelerator systems will become available again during the last 6 month before operation with beam starts. This information is needed for Dry-Runs planning. R. Steinhagen concurred that we need to include and synchronise the re-commissioning activities in 2018 with the MPLs, machine schedule and hardware availability. While the hardware commissioning procedures are probably more machine specific, for the commissioning with beam we should aim at having one general procedure that fits most aspects of all accelerators and to supplement the procedures with specifics where necessary.

<general discussion> It was agreed to use the proposed structure. Volunteers should come forward or be identified during the next meeting to help coordinate the work of establishing the procedures of the given phases in parallel.

D. Ondreka and R. Bär stressed the importance of the system integration and good diagnostics possibilities which is a prerequisite for an efficient commissioning. Dry-Runs are important milestones for that and shouldn't be skipped. The individual commissioning steps are not necessarily sequential.

2. AOB, FC2WG-all

R. Bär inquired about the 'Accelerator & Beam Mode' specification. R. Steinhagen commented that the document has been circulated to all FC2WG members (specifically MCs & MPLs) and the experiments. The received feedback was positive and the existing document should be considered as de-facto approved base-line. The official approval procedure needs to be clarified in the new project structure.

C. Omet inquired about the new top-level applications that are being planned and their priorities. R. Steinhagen commented that the list is being kept on the FC2WG website: https://fair-wiki.gsi.de/FC2WG/BeamBasedApplications

Actions:

- ***R. Steinhagen:*** organise special FC2WG meeting including experiments to present Accelerator & Beam Mode, machine-experiment interface and commissioning concepts (→ tentative target: 9th March 2016)
- ***R. Steinhagen, MPLs, GL, GF****: discussion on available resources for commissioning needed in view of if a 24/7- or parallel commissioning of multiple accelerators should be targeted for FAIR.*
- ***S. Pietri & R. Steinhagen:*** *clarify mandate of whether FRS (in 2018) and Super-FRS (>2020) should be included into the FC2WG accelerator commissioning planning. → confirmed by Ch. Scheidenberger for FRS (as of 2016-02-04).*
- ***SIS-18 & ESR MCs & R. Steinhagen:*** *synchronise the re-commissioning activities in 2018 with the SIS18/ESR machine schedule and hardware availability.*
- ***MPLs. MCs. FC2WG-all****: Volunteers needed to help coordinate the development of the individual Stage-A commissioning phases. Topic list is available at: https://fair-wiki.gsi.de/FC2WG/BeamCommissioning/WebHome*
- ***R. Steinhagen:*** *clarify the FC2WG specification/procedure approval and reporting structure.*

The next meeting is planned for: Wednesday 23 February 2016, 15:00-17:00 (SE 1.124c)

Reported by J. Fitzek, R. J. Steinhagen