Report of the 18th Meeting of the ESS Technical Advisory Committee Lund, 17-19 October 2018

1. Introduction

The 18th meeting of the ESS Technical Advisory Committee (ESS-TAC) took place in Lund on 17-19 October 2018.

The meeting followed the agenda given in Annex 1. The Committee was given a specific charge (Annex 2), addressed in the meeting and answered in the oral report presented in the closeout session on 19 October 2018. The report constitutes section 3 of this document.

2. Participants in TAC

Present:

Maud Baylac (CNRS, France) Cyrille Berthe (GANIL, France) Tim Broome (ISIS, UK-retired) Michael Butzek (FZJ, Germany) Alberto Facco (INFN-LNL, Italy) Phillip Ferguson (SNS, USA) Masatoshi Futakawa (JAEA, Japan) Frank Gerigk (CERN, Switzerland) Mark Heron (Diamond, UK) Shane Koscielniak (TRIUMF, Canada) Roland Mueller (HZB, Germany) Graeme Murdoch (SNS, USA) Bernd Petersen (DESY, Germany) Michael Plum (SNS, USA) Igor Syratchev (CERN, Switzerland) Szabina Török (MTA EK, Hungary) Hans Weise (DESY, Germany) Jörg Welte (PSI, Switzerland) Karen White (SNS, USA)

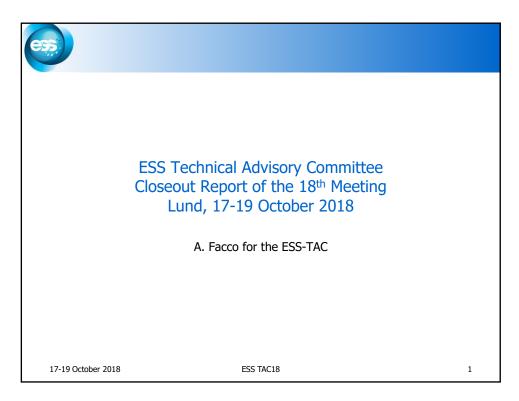
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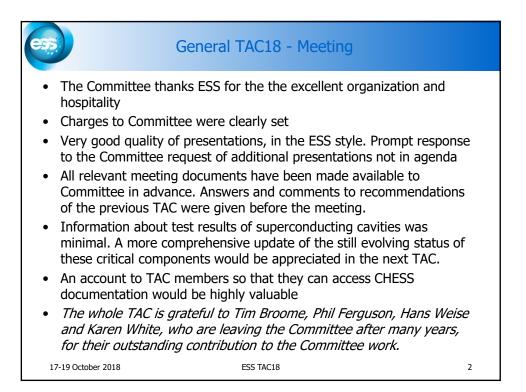
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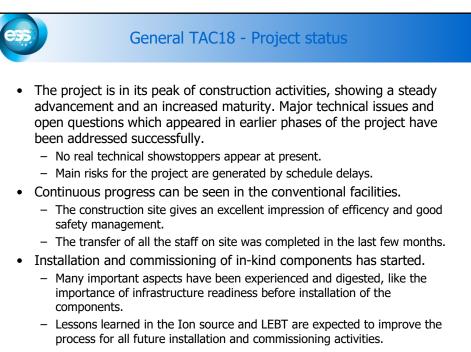
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Excused: Francisco Martin Fuertes (CIEMAT, Spain), Jurgen Neuhaus (TUM, Germany).

3. Report of TAC18



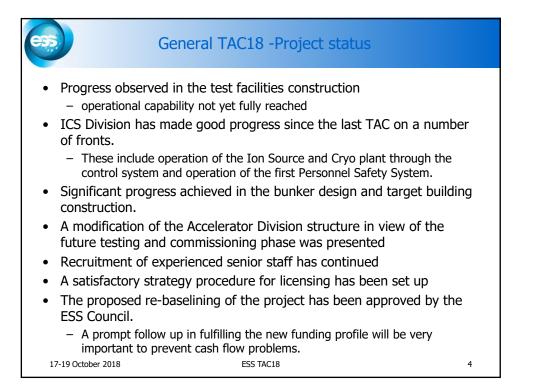


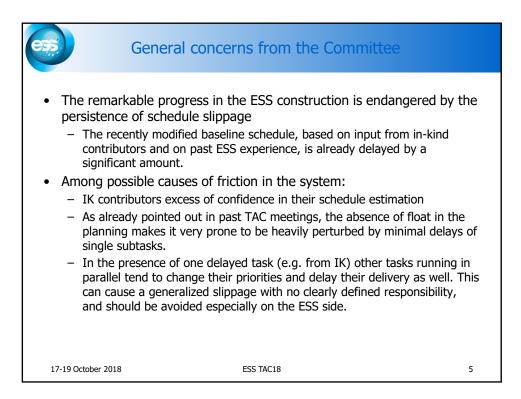


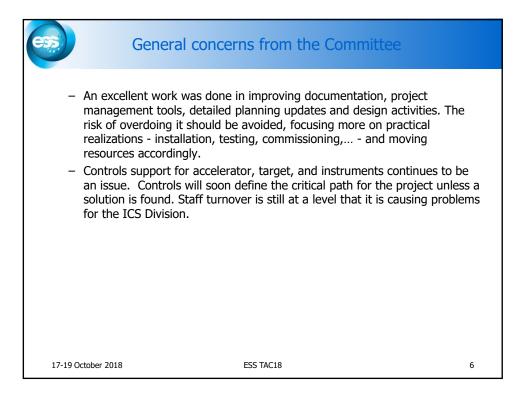
17-19 October 2018

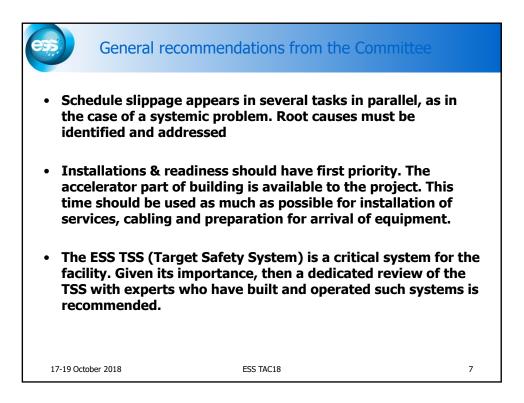
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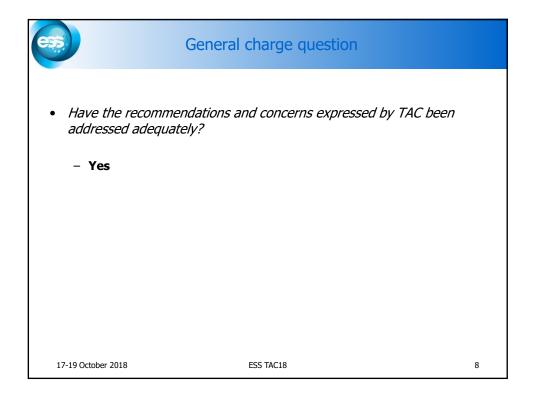
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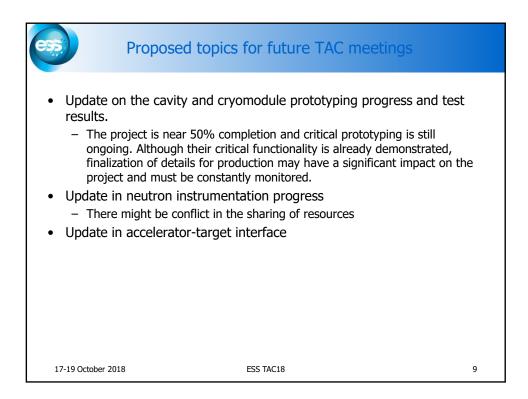


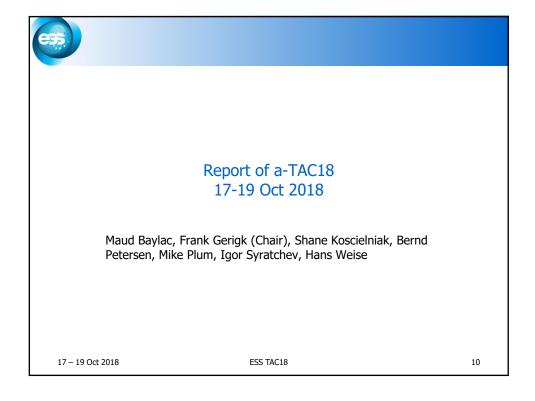


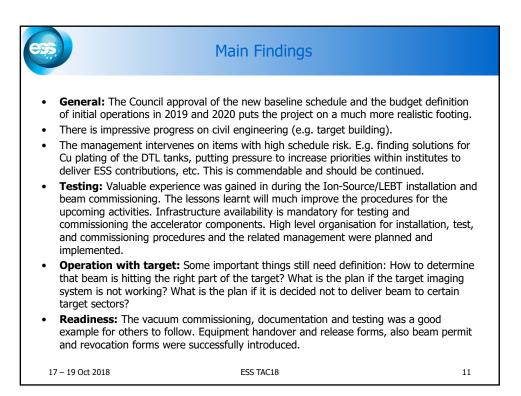


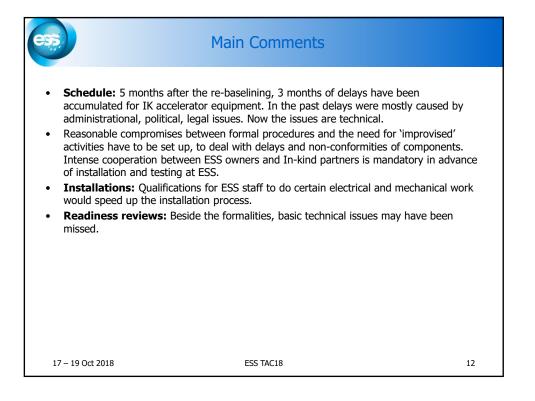


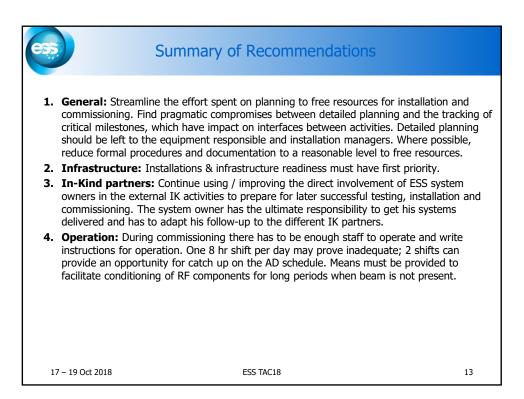


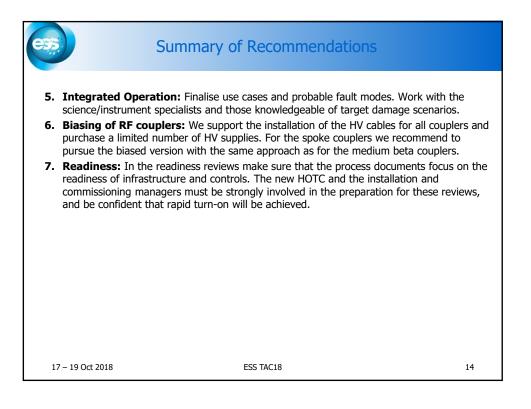


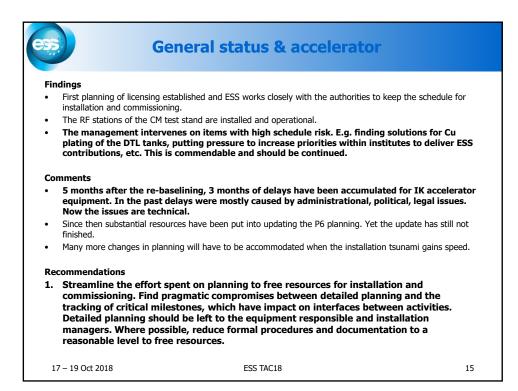




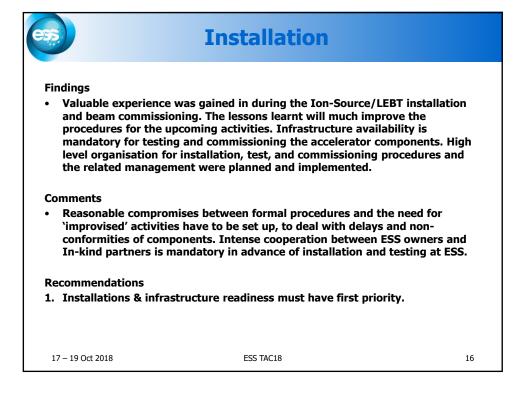


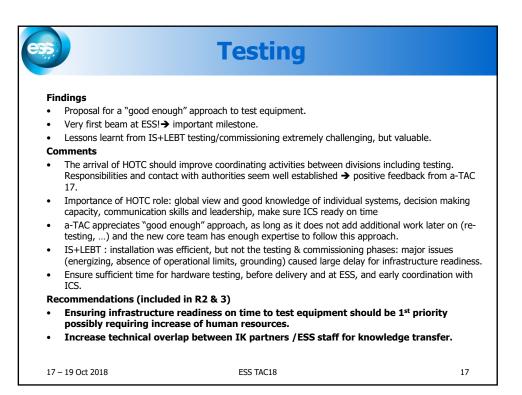


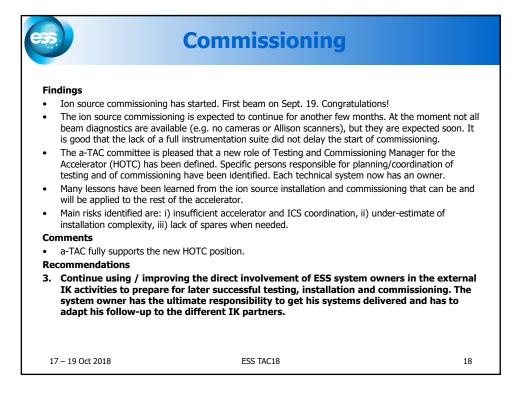




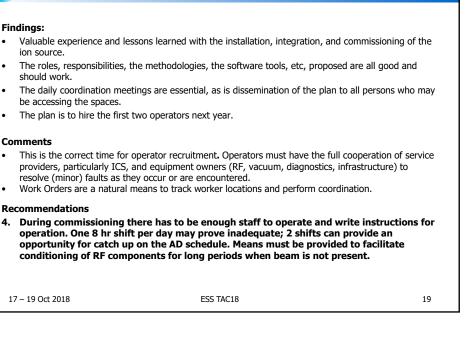
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Operation: Integrated operation of Accelerator and Target Findinas: The concepts being introduced (beam modes, destinations, pattern) are useful. Extending/refining the definition of "destination" to particular target sectors will prove useful. An early understanding of the timing/synchronization needs will also benefit the project. The operating scenarios are still being defined (e.g. how to do the initial alignment of target with probe beam, how to operate the accelerator/target interface in production). Some important things still need definition: How to determine that beam is hitting the right part of the target? What is the plan if the target imaging system is not working? What is the plan if it is decided not to deliver beam to certain target sectors? Comments The parameters (upper and lower thresholds) for the Target Safety System (TSS), and whether any should depend on beam power, are still being defined. These should be specified and clarified. Recommendations Finalise use cases and probable fault modes. Work with the science/instrument 5. specialists and those knowledgeable of target damage scenarios. 17 - 19 Oct 2018 ESS TAC18 20

Operation: Accelerator operation

Findings:

Comments

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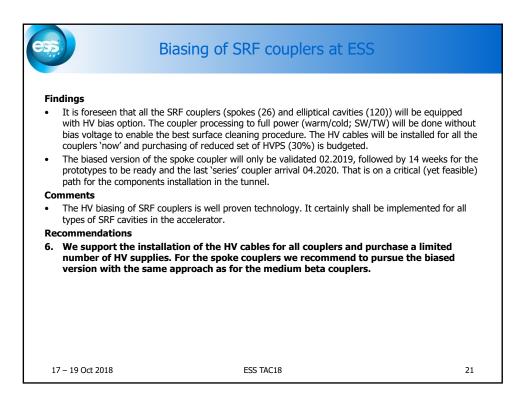
should work.

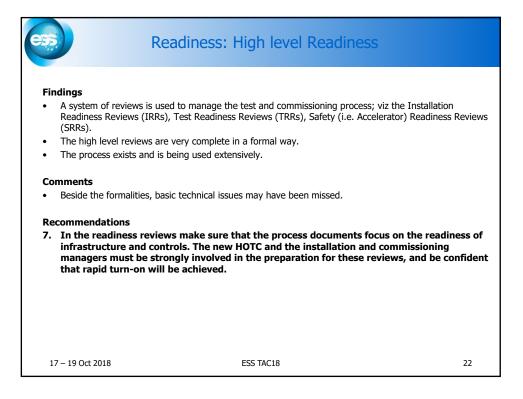
Recommendations

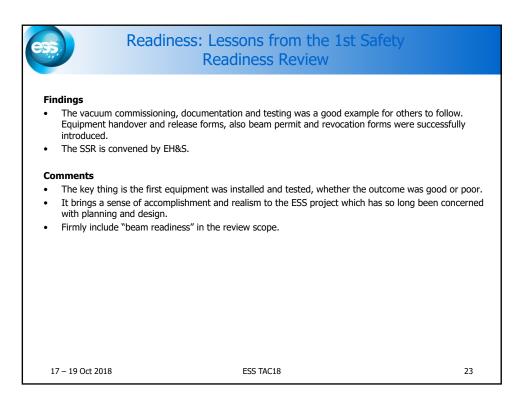
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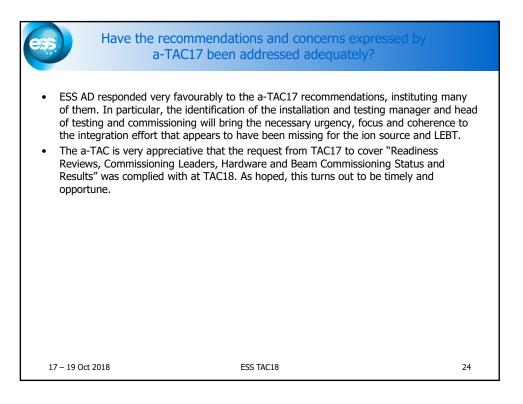
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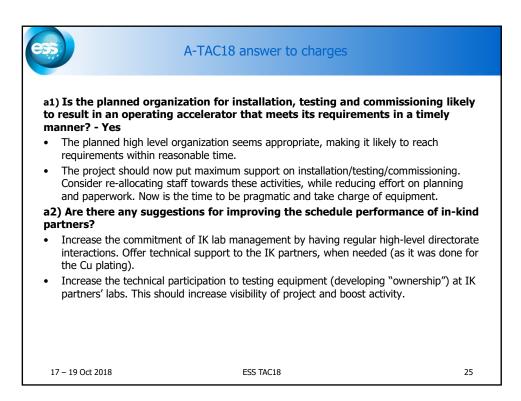
The plan is to hire the first two operators next year.

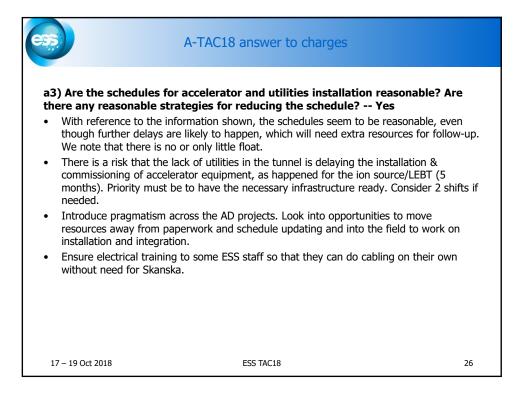


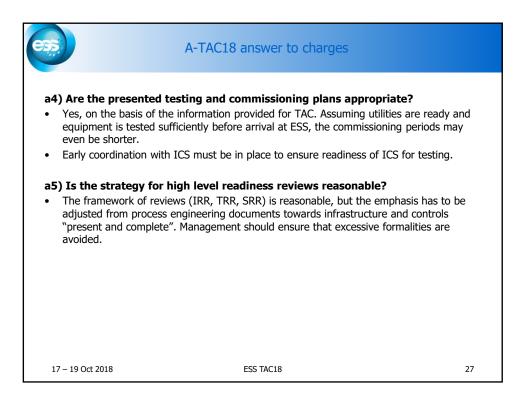


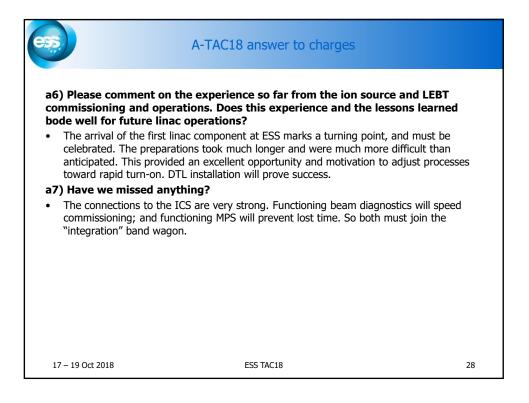


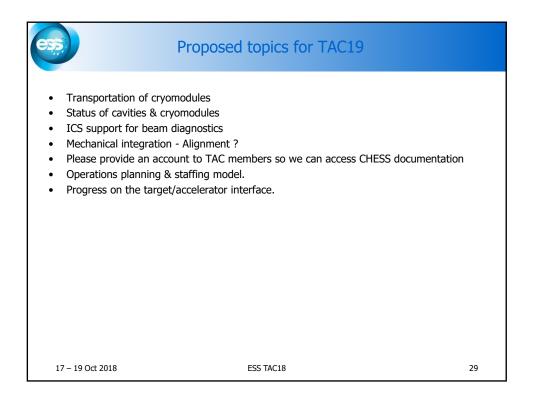


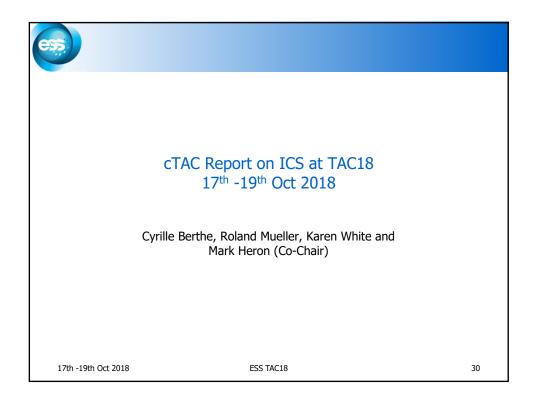


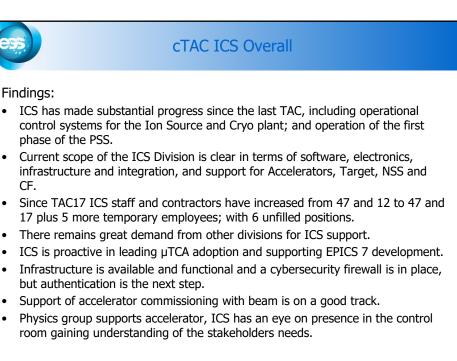








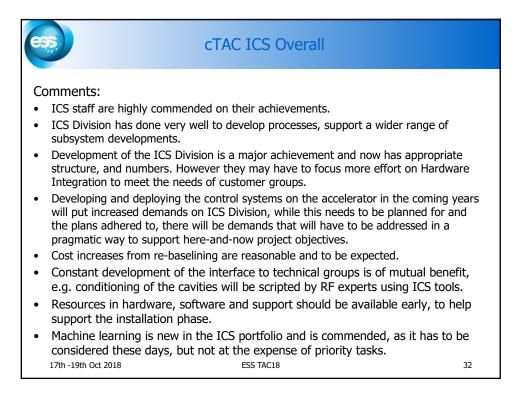


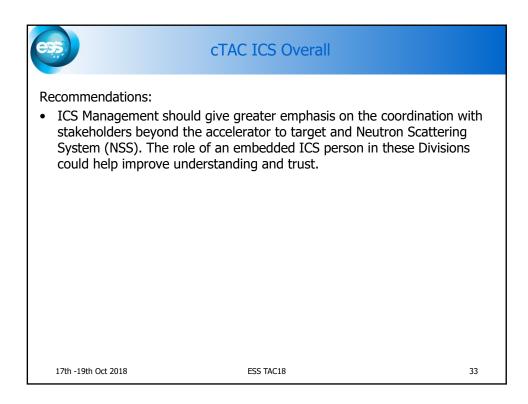


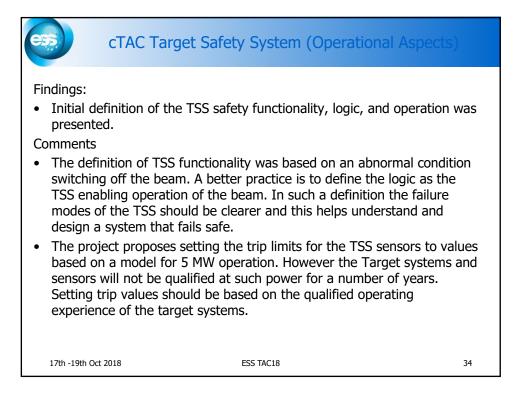
17th -19th Oct 2018

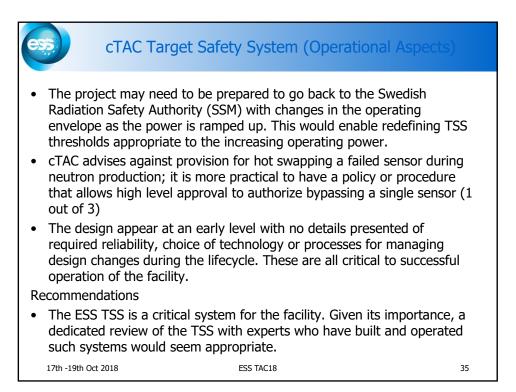
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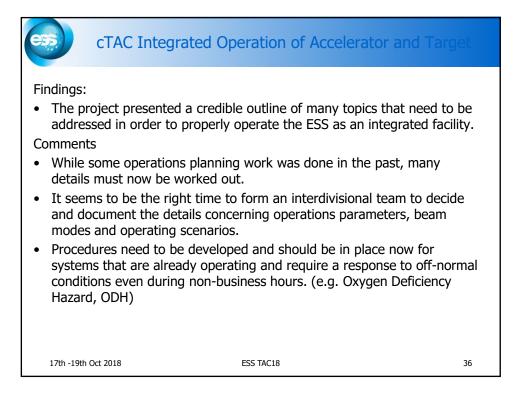
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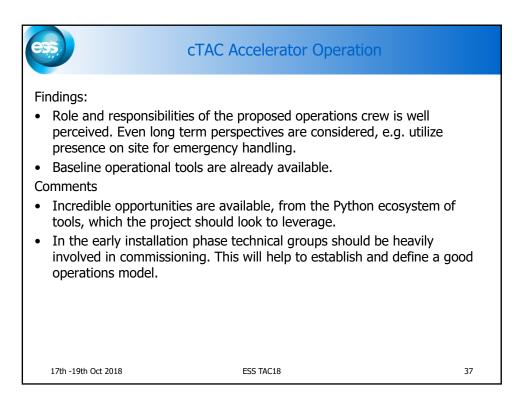


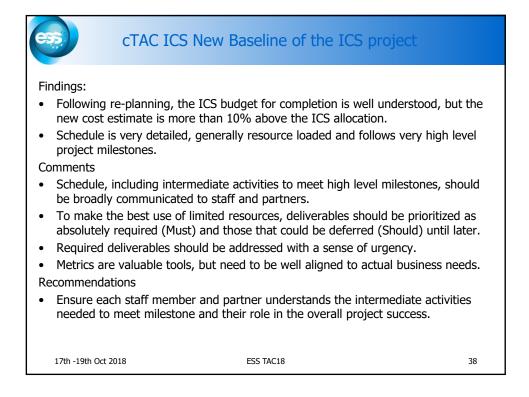


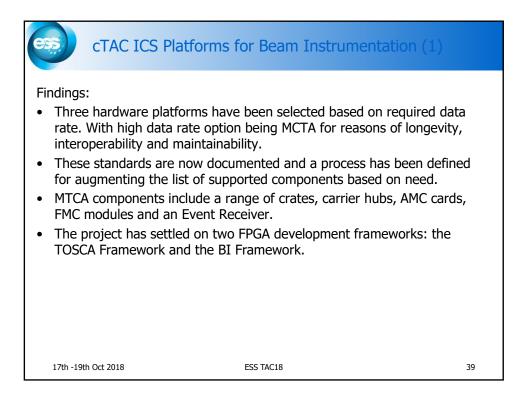


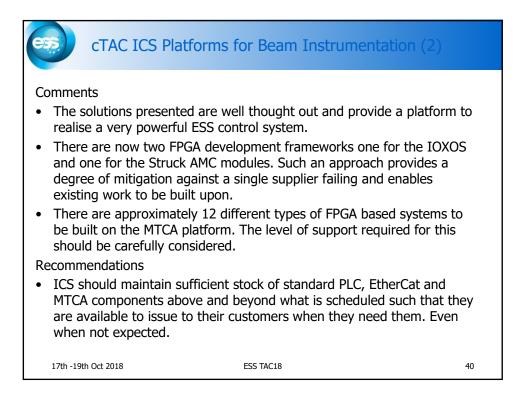


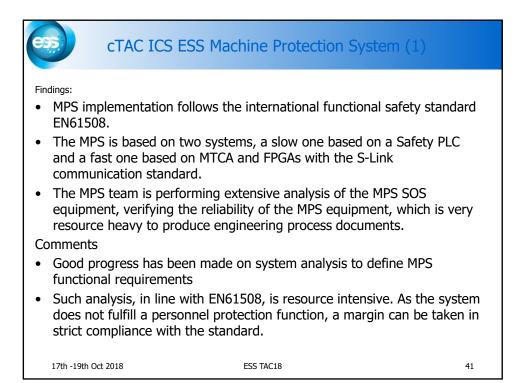


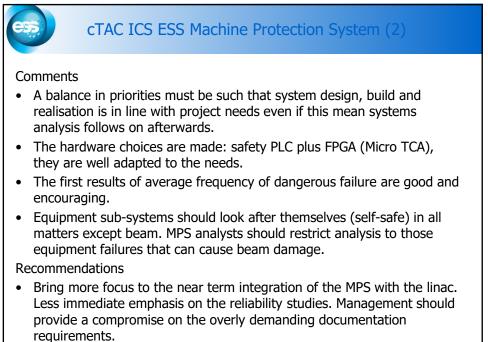












17th -19th Oct 2018

ESS TAC18



cTAC ICS Automation of Control System Configuration

Findings:

- ICS will automate generation of Control System configuration.
- ICS were well aware of benefit and possible pitfalls due to systematic errors, intermediate graphical tools and importance of the sanity checking of the CCDB.
- IOC configuration is already maturing, PLC factory provided functionalities are appealing.
- Possible problems arising from change management of PLC code are already addressed.

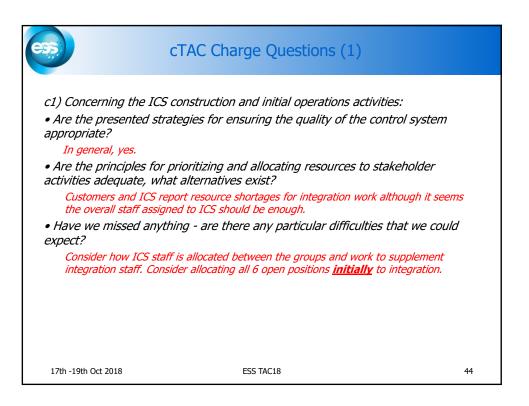
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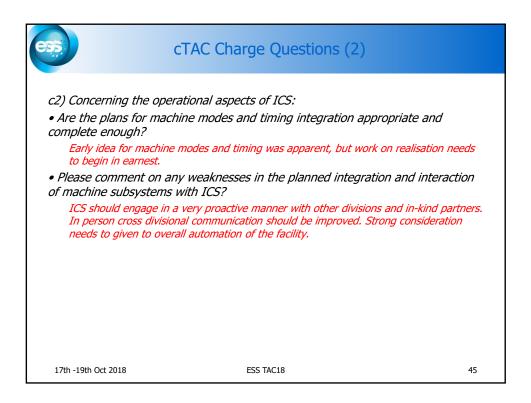
- cTAC endorses this approach which is powerful and offers efficiency gains and consistency of definitions across layers of the Control System.
- Other facilities, e.g. ITER tried similar with varying success. To exploit full potential it could be mutually beneficial to share experiences.

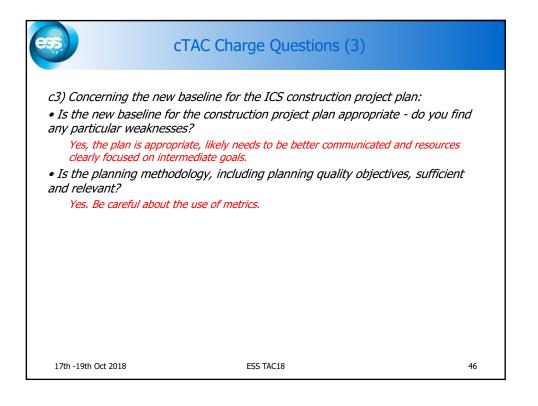
17th -19th Oct 2018

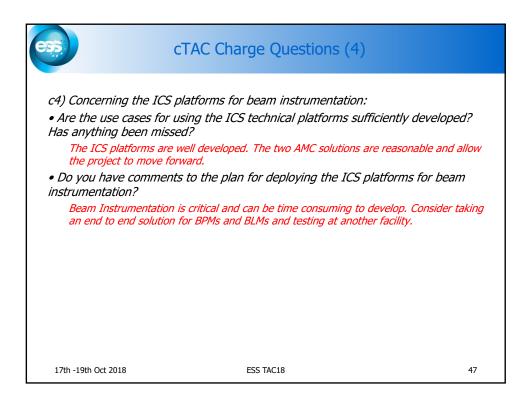
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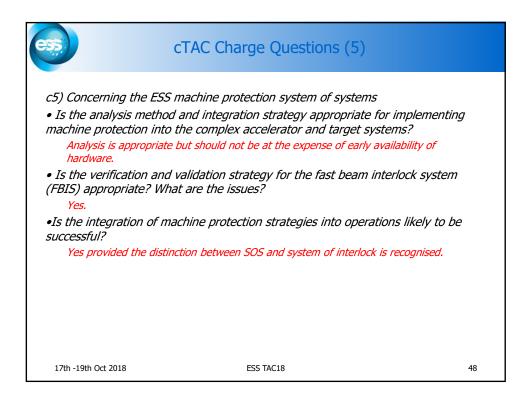
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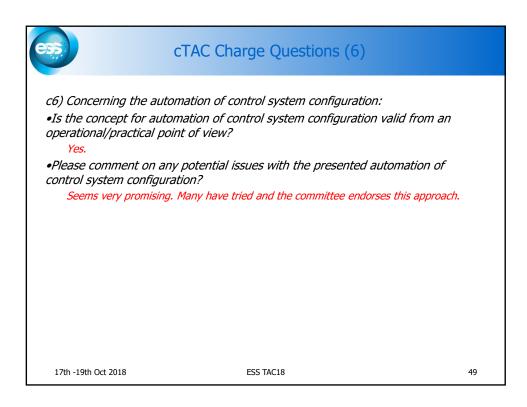


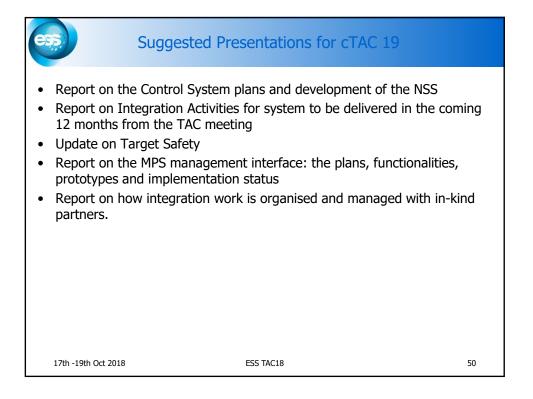


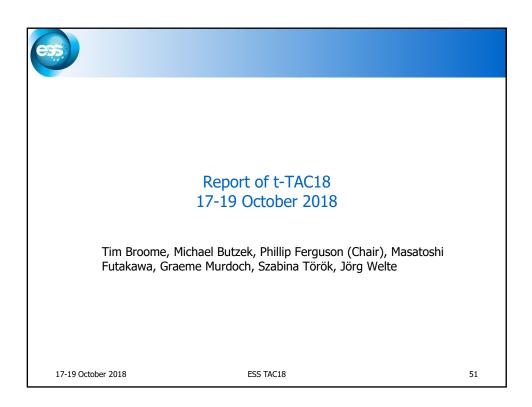


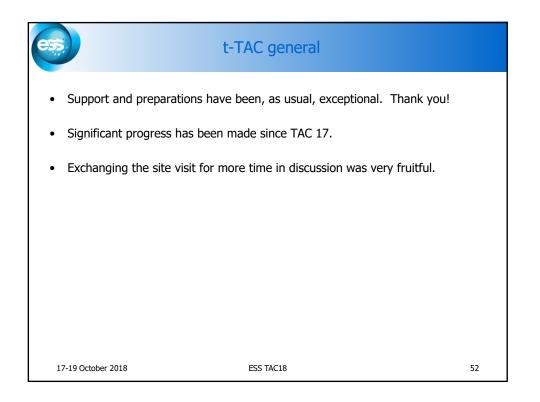


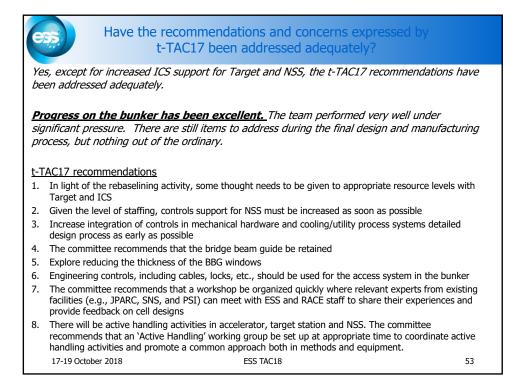


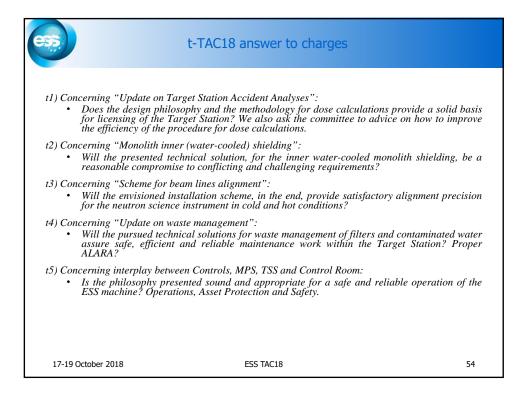


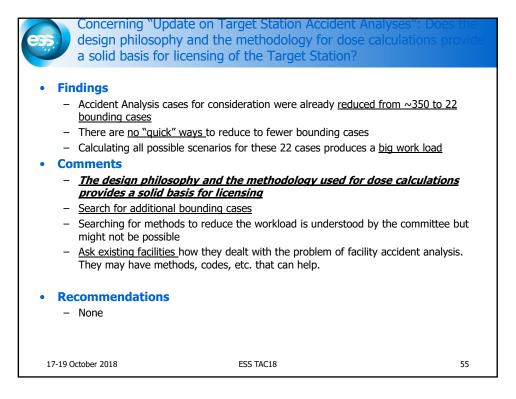


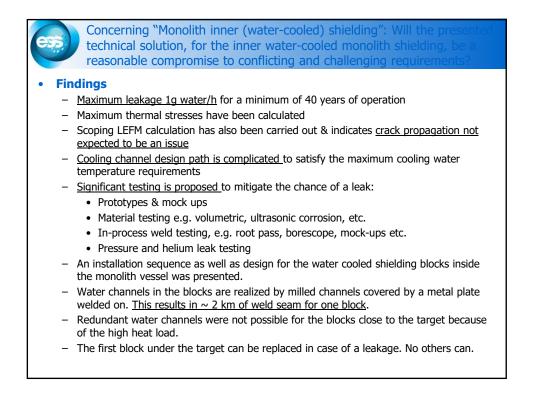


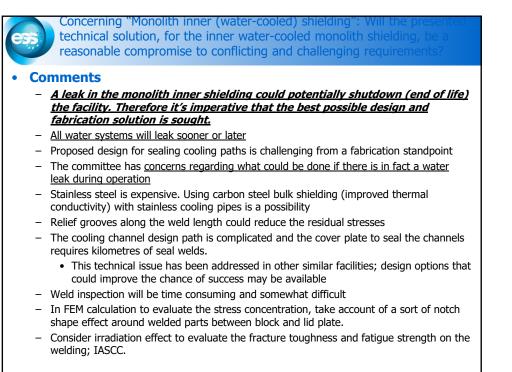


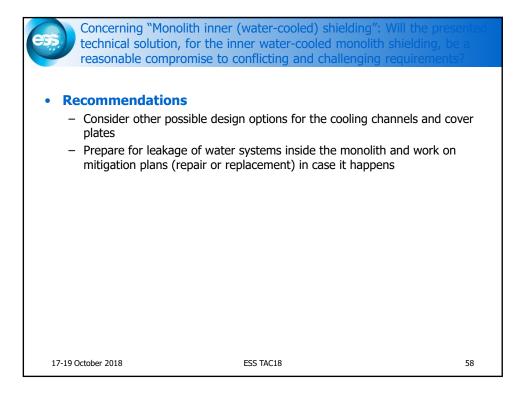


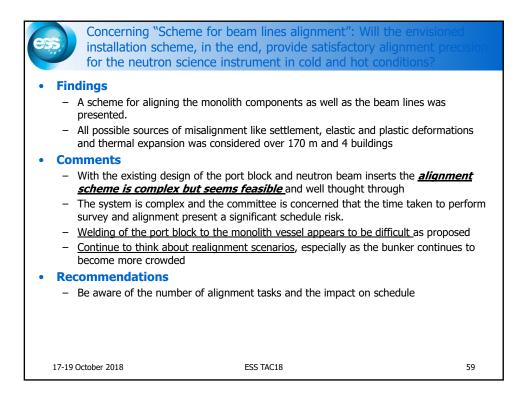


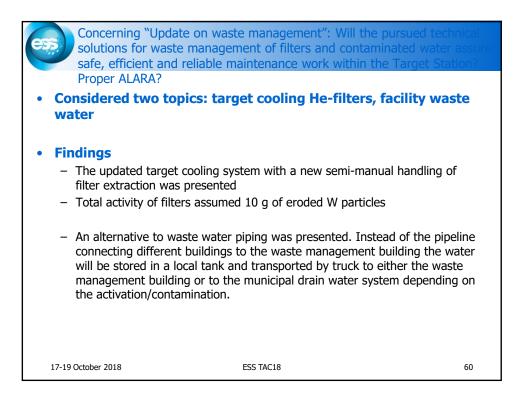














Concerning "Update on waste management": Will the pursued technical solutions for waste management of filters and contaminated water assistance, efficient and reliable maintenance work within the Target Station Proper ALARA?

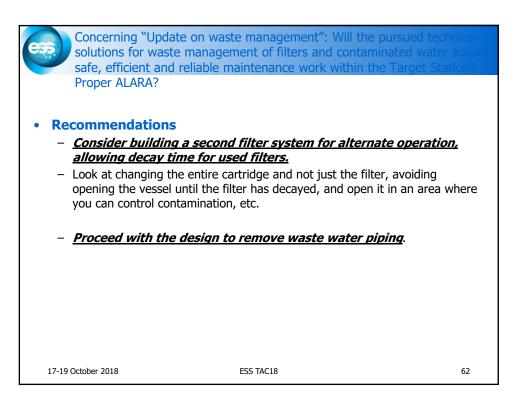
Comments

- Dose rate from the He filters is hard to estimate, but may be high
- The filter pack replacement process may impose unnecessary dose to personnel. <u>Technology can reduce the time (quick release flanges, etc.)</u>.
- Current design of the change process requires opening the loop to change the filters, potentially resulting in particulate contamination.
- <u>Duplicate filters with a valve</u> could allow cool down time before changing a filter.
- Procedures/equipment to control the spread of contamination from the He filters should be developed
- Waste water transport by pipes has been re-assessed; <u>transport tank(s) will be used</u> <u>instead</u>. This is good for multiple reasons.
- This philosophy for the waste water is also implemented at J-PARC & ISIS.
- Storing waste water locally avoids mixing low activity water with high activity and allows segregation into separate waste streams
- <u>Consider tritium treatment</u>, which will be released unexpectedly from everywhere once contaminated.

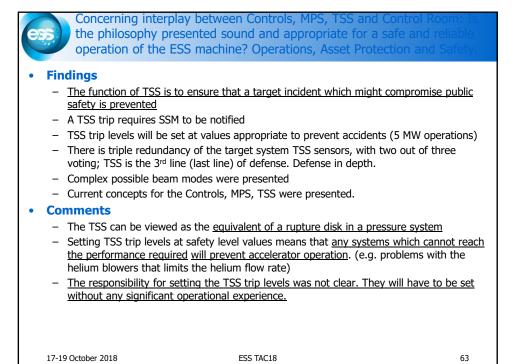
17-19 October 2018

ESS TAC18

61

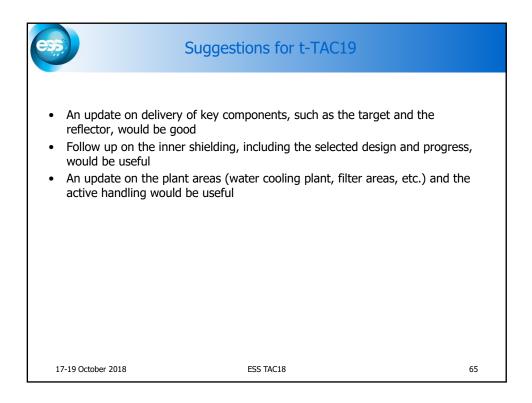


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Concerning interplay between Controls, MPS, TSS and the philosophy presented sound and appropriate for a safe and operation of the ESS machine? Operations, Asset Protection and Comments - Complex synchronization between the accelerator and particular sectors of the target does not seem to be necessary. Setting TSS limits for true safety cases seems to be reasonable in order to not tamper with a system that acts as "last line of defense" For example: during commissioning it could be necessary to operate the helium blower at low flow in order to get temperature readings on the target at the kW level. For these conditions it may be required to over ride the TSS if you really need that data. Review the requirements for data which needs to be shared between Controls, MPS, TSS and the Control Room and only implement those which are essential for commissioning and early operations. More functionality can be added later as needed. Keep TSS as simple and slim as possible but talk to SSM to determine if override mode during commissioning is possible to allow learning about system behavior at very low beam power level. Maybe this requires hardware interlock to not allow higher beam power. **Recommendations** - Establish who is responsible for authorizing the TSS trip levels. 17-19 October 2018 ESS TAC18 64

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Annex1

Agenda TAC#18 October 17-19, 2018 ESS Office, Odarslövsvägen 113, Lund

| | 17 Oktober -18 | |
|-------|---|--|
| 11:45 | Shuttle from Hotel | |
| 12:00 | Light Lunch - TAC Members only | |
| | TAC Closed Session | |
| | Meeting room Saturn | |
| 13:00 | TAC Initial working session - TAC Members only | |
| | Plenary Session | |
| | Meeting room Saturn | |
| 13:30 | Welcome and overall status of ESS -R Garoby | |
| 14:00 | Charge and Organization of meeting -R Garoby | |
| 14:10 | Accelerator - M Lindroos | |
| 14:55 | Coffee | |
| 15:20 | Target - M Anthony | |
| 16:05 | ICS - H Carling | |
| 16:50 | TAC Working session - TAC Members only | |
| 18:30 | Transportation to Dinner | |
| 19:00 | Social Dinner - *By invitation only* - Bryggan Cafe | |
| 21:30 | Walk to Hotel | |

| | 18 Oktober -18 | | | | | | |
|-------|---|--|--|--|--|--|--|
| | Joint session: Concerning interplay between Controls, MPS, TSS and Control Room | | | | | | |
| | Meeting room Saturn | | | | | | |
| 08:00 | Target | Target Safety System (operational aspects) - M. Olsson | | | | | |
| 08:20 | Integrated operation of accelerator and Target - T. Korhonen | | | | | | |
| 08:40 | Accelerator Operation - M. Munoz | | | | | | |
| | Joint, and parallel sessions | | | | | | |
| | Accelerator | ICS - Aries | Target - Tellus | | | | |
| | Saturn | Aries | Tellus | | | | |
| 09:00 | Organization for accelerator installation, testing and commissioning - M. Lindroos | New baseline of the ICS project - H. Novella | Source to sample - F. Rey, I. Sutton, T. Lexholm | | | | |
| 09:20 | Accelerator installation schedule - C. | | | | | | |
| 09:40 | Accelerator installation plan - P. Gustavsson | 1 | | | | | |
| 10:10 | Coffee | | | | | | |
| 10:30 | Testing planning - I. Alonso | ICS platforms for Beam Instrumentation - | Handling of waste water - L. Stenman | | | | |
| 10:50 | Commissioning planning - R. Miyamoto | S. Farina | | | | | |
| 11:00 | | | Helium filter design and handling - U. | | | | |
| 11:10 | High Level Readiness Reviews - J. Weisend | ESS Machine Protection System - A. Nordt | Oden | | | | |
| 11:30 | Results and lessons from the 1st Safety | | Monolith inner (water cooled) shielding | | | | |
| | Readiness Review - L. Tchelidze | | - U. Oden | | | | |
| 11:50 | Results and lessons from Ion Source and | Automation of Control System | | | | | |
| | LEBT testing and commissioning - H. | configuration - K. Vestin | | | | | |
| 12:10 | Biasing of SRF couplers at ESS | | | | | | |
| 12:30 | Lunch | | | | | | |
| | | Joint, and parallel sessions | | | | | |
| | Accelerator | ICS | Target | | | | |
| | | turn | Tellus | | | | |
| 13:30 | Safety induction followed by Site visit - H. Fröderberg | | Update on Target Station Accident analysis - P. Nilsson | | | | |
| 14:15 | | | TAC Working session | | | | |
| 15:00 | VR Room | Coffe | e | | | | |
| | Accelerator | ICS | Target | | | | |
| | Saturn | Aries | Tellus | | | | |
| 15:30 | Coffee | cTAC Working session | tTAC Working session | | | | |
| 15:50 | aTAC Working session | | <u> </u> | | | | |
| 19:00 | Shuttle to hotel - TAC Members only | | | | | | |
| 19:30 | TAC Dinner at hotel - TAC Members only | | | | | | |

| | 19 Oktober -18 | | |
|-------|--|--------|--------|
| | TAC Closed Session | | |
| | Accelerator | ICS | Target |
| | Saturn | Sirius | Tellus |
| 08:30 | TAC Working sessions | | |
| 10:30 | | Coffee | |
| 12:30 | TAC Lunch | | |
| 13:45 | Close out in Saturn - Will be streamed | | |
| 14:45 | End of meeting | | |

Annex2



| Document Type | Agenda |
|-----------------|-------------|
| Document Number | |
| Date | 7 |
| Revision | 1 (1) |
| State | Preliminary |
| Confidentiality | Internal |
| Level | |
| Page | 1 (4) |
| | |

Charge to the TAC for its 18th meeting on October 17-19, 2018

1. Introduction

The ESS construction project is now $\sim 50\%$ complete and progress has continued at a high pace even during the summer months. Concerning Conventional Facilities, the Target station building has reached the height of the high bay floor, the long distance experimental hall and the logistics building are erected, the A2T connection between accelerator and Target is an advanced stage of construction... For Accelerator, Target and ICS, most components are now in construction, either through in-kind partners or directly in industry. Prototypes are being tested (Spoke cryomodule from IPNO in Uppsala, Elliptical cavity cryomodule in Saclay etc.). Klystrons for the Medium beta section of the linac have started arriving. The infrastructure installation organization is fully operational and it is now focusing on the first 100 meters of the klystron gallery.

Beam commissioning of the ion source and LEBT has started in the tunnel. It is managed by the operations team from the Cryogenics control room in G02. The RF Test Stand in the klystron gallery has started being used. Delivery and installation of the concrete blocks for the cryomodule bunker will begin at the end of October.

The new baseline which had been prepared during the first half of the year has successfully passed the review held in May and it has been accepted by the ESS Council. It foresees that Accelerator will be Ready for 570 MeV Beam On Target (Accelerator RBOT) by mid-2021, Target will be Ready for Beam On Target (Target RBOT) during Q1-2022, bunker and test beam line will allow Beam On Target (BOT) by mid-2022 and the Start of User Programme (SOUP) will be at the end of 2023.

A visit of the site in the afternoon of the second day will give to the TAC members the opportunity to judge the status of advancement. More details will be provided by the different subprojects during the meeting.

| Document Type | Agenda |
|-----------------------|-------------|
| Document Number | ESS-0067537 |
| Date | Sep 8, 2016 |
| Revision | 1 (1) |
| State | Preliminary |
| Confidentiality Level | Internal |

2. Charge questions

The following questions to the Committee address present concerns of the different subprojects:

- for the **Accelerator**:

a1) Is the planned organization for installation, testing and commissioning likely to result in an operating accelerator that meets its requirements in a timely manner?

a2) Are there any suggestions for improving the schedule performance of in-kind partners?

a3) Are the schedules for accelerator and utilities installation reasonable? Are there any reasonable strategies for reducing the schedule?

a4) Are the presented testing and commissioning plans appropriate?

a5) Is the strategy for high level readiness reviews reasonable?

a6) Please comment on the experience so far from the ion source and LEBT commissioning and operations. Does this experience and the lessons learned bode well for future linac operations?

a7) Have we missed anything?

- for the **Target**:

t1) Concerning "Update on Target Station Accident Analyses":

• Does the design philosophy and the methodology for dose calculations provide a solid basis for licensing of the Target Station? We also ask the committee to advice on how to improve the efficiency of the procedure for dose calculations.

t2) Concerning "Monolith inner (water-cooled) shielding":

- Will the presented technical solution, for the inner water-cooled monolith shielding, be a reasonable compromise to conflicting and challenging requirements?
- *t3*) Concerning "Scheme for beam lines alignment":
 - Will the envisioned installation scheme, in the end, provide satisfactory alignment precision for the neutron science instrument in cold and hot conditions?
- t4) Concerning "Update on waste management":
 - Will the pursued technical solutions for waste management of filters and contaminated water assure safe, efficient and reliable maintenance work within the Target Station? Proper ALARA?

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|-----------------------|-------------|
| Document Number | ESS-0067537 |
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| Revision | 1 (1) |
| State | Preliminary |
| Confidentiality Level | Internal |

t5) Concerning interplay between Controls, MPS, TSS and Control Room:

• Is the philosophy presented sound and appropriate for a safe and reliable operation of the ESS machine? Operations, Asset Protection and Safety.

- for the Integrated Control System (ICS):

c1) Concerning the ICS construction and initial operations activities:

- Are the presented strategies for ensuring the quality of the control system appropriate?
- Are the principles for prioritizing and allocating resources to stakeholder activities adequate, what alternatives exist?
- *Have we missed anything are there any particular difficulties that we could expect?*

c2) Concerning the operational aspects of ICS:

- Are the plans for machine modes and timing integration appropriate and complete enough?
- Please comment on any weaknesses in the planned integration and interaction of machine subsystems with ICS?

c3) Concerning the new baseline for the ICS construction project plan:

- *Is the new baseline for the construction project plan appropriate do you find any particular weaknesses?*
- Is the planning methodology, including planning quality objectives, sufficient and relevant?

c4) Concerning the ICS platforms for beam instrumentation:

- Are the use cases for using the ICS technical platforms sufficiently developed? Has anything been missed?
- Do you have comments to the plan for deploying the ICS platforms for beam instrumentation?

c5) Concerning the ESS machine protection system of systems

- Is the analysis method and integration strategy appropriate for implementing machine protection into the complex accelerator and target systems?
- Is the verification and validation strategy for the fast beam interlock system (FBIS) appropriate? What are the issues?
- Is the integration of machine protection strategies into operations likely to be successful?

c6) Concerning the automation of control system configuration:

- Is the concept for automation of control system configuration valid from an operational/practical point of view?
- Please comment on any potential issues with the presented automation of control system configuration?

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The Committee is encouraged to provide also suggestions/comments and recommendations on any other subject it would find relevant. Feedback on the follow-up of former TAC recommendations is welcome.

A preliminary version of the TAC report is expected during the close-out session in the afternoon of Friday 19, October. The final report is expected before the end of October. The Chairman will orally present the TAC#18 report to the ESS Council on December 3-4.