

# Introduction to the BDF-TSAC1

<https://indico.cern.ch/e/BDF-TSAC-2025>

**Marco Calviani (CERN, SY-STI)**

**4-6 March 2025**



# A very warm welcome to committee, speakers and participants

## 1st Beam Dump Facility (BDF) Targetry Systems Advisory Committee (TSAC)

 4 Mar 2025, 08:30 → 6 Mar 2025, 17:00 Europe/Zurich

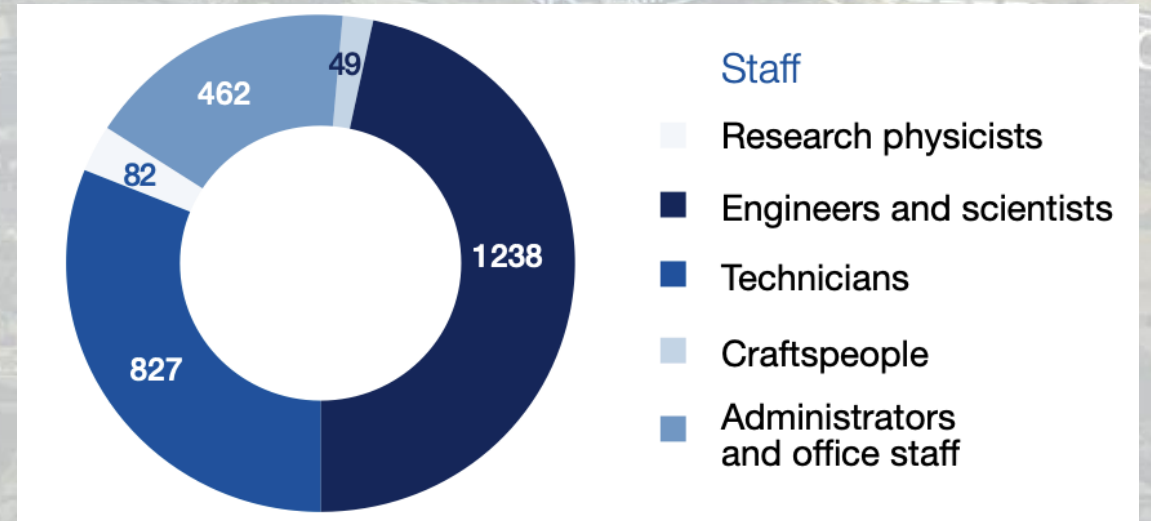
 30/7-018 - Kjell Johnsen Auditorium (CERN)

 Marco Calviani (CERN)

# About CERN

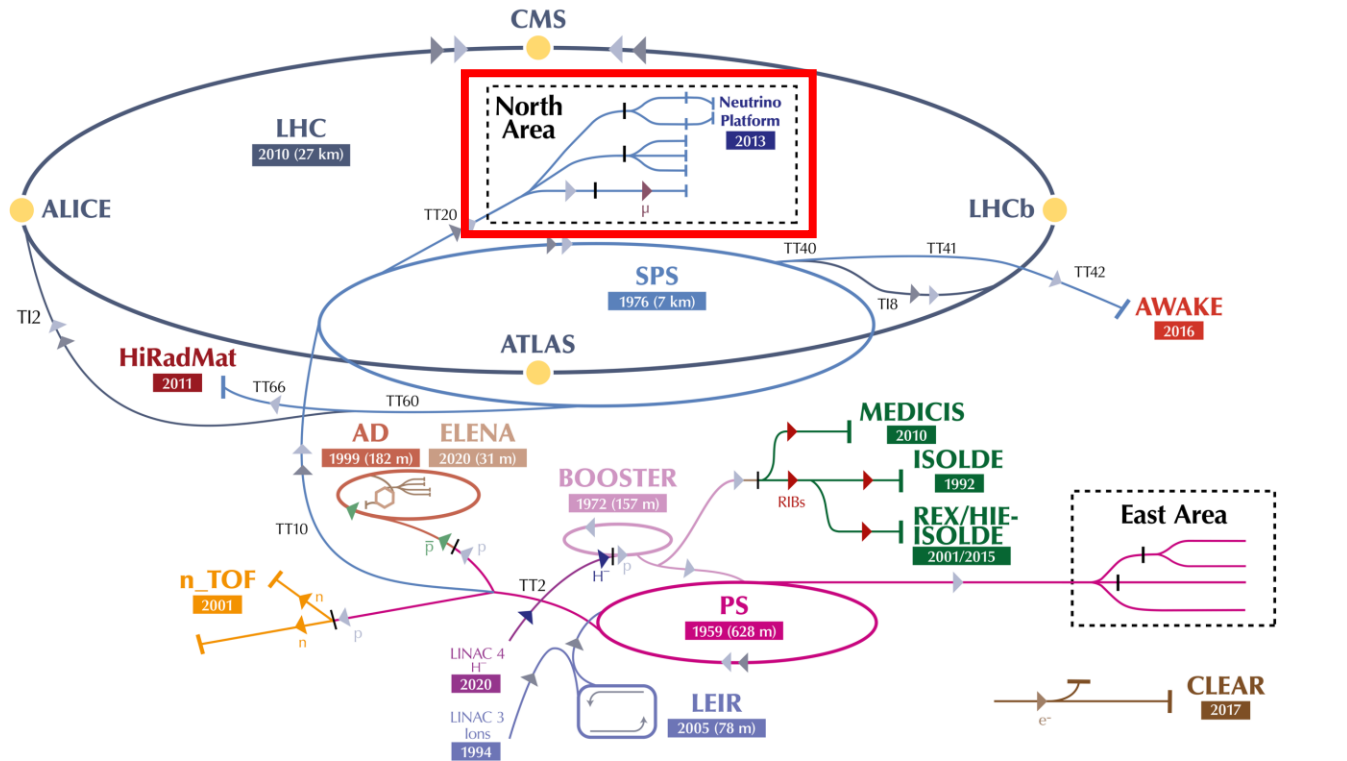
- European Organization for Nuclear Research
- Founded in 1954 in Geneva (Switzerland)
- Primary mission – advance the **understanding of fundamental physics** via a **state-of-art accelerator complex, collider** and **fixed-target physics**

- **23** Member States + 10 Ass. MS
- Annual budget of **1200 MCHF**
- **2600** staff
- **900** fellows
- **~12000** users



# The CERN accelerator complex

## Complexe des accélérateurs du CERN



▶  $H^-$  (hydrogen anions) ▶ p (protons) ▶ ions ▶ RIBs (Radioactive Ion Beams) ▶ n (neutrons) ▶  $\bar{p}$  (antiprotons) ▶  $e^-$  (electrons) ▶  $\mu$  (muons)

LHC - Large Hadron Collider // SPS - Super Proton Synchrotron // PS - Proton Synchrotron // AD - Antiproton Decelerator // CLEAR - CERN Linear Electron Accelerator for Research // AWAKE - Advanced WAKEfield Experiment // ISOLDE - Isotope Separator OnLine // REX/HIE-ISOLDE - Radioactive Experiment/High Intensity and Energy ISOLDE // MEDICIS // LEIR - Low Energy Ion Ring // LINAC - LINear ACcelerator // n\_TOF - Neutrons Time Of Flight // HiRadMat - High-Radiation to Materials // Neutrino Platform

## Accelerator-based experiments

- LHC** 6.8+6.8 TeV Large Hadron Collider, 27 km in circumference  
9 active experiments: ALICE, ATLAS, CMS, FASER, LHCb, LHCf, MoEDAL-MAPP, SND and TOTEM
- SPS** 450 GeV Super Proton Synchrotron, 6.9 km in circumference, 6 active experiments include: NA58/COMPASS, NA61/SHINE, NA62, NA63, NA64, UA9; HiRadMat material test facility, plus shorter-term exploitation of the beamlines for tests; 2 in preparation: AMBER/NA66, DsTau/NA65
- PS** 26 GeV Proton Synchrotron: CLOUD experiment and n\_TOF facility (2 experimental areas)
- ISOLDE** Booster-ISOLDE isotope separator 61 data taking, 61 in preparation
- AD** Antiproton Decelerator: 100 keV with ELENA  
5 active experiments: AEGIS, ALPHA, ASACUSA, BASE and GBAR; 2 in preparation: BASE-STEP, PUMA

## Non-accelerator experiments and detector developments

CAST, OSQAR and CERN Neutrino Platform

## Advanced engineering and accelerator technologies

- AWAKE** at the SPS: Using 400 GeV protons to drive plasma wakefield acceleration
- CLEAR** 150 MeV test-facility electron beam: Accelerator R&D and irradiation tests
- HFM** high-field superconducting magnets: R&D to extend the range of operation of accelerator magnets



# High Intensity ECN3

- In April 2024, CERN Council has endorsed **the realization of a new high-energy fixed-target infrastructure** aimed at delivering beam for the **SHiP (Search for Hidden Particles) experiment**
  - With **~62 MCHF (over 7 years)** reserved for the HI-ECN3 project in CERN's Medium-Term Plan
  - Approved together with ~170 MCHF for consolidation of the North Area (NA-CONS project)
- **400 GeV/c** beam, slowly extracted (1 s spill),  **$4 \cdot 10^{13}$  ppp** (2.6 MW), **350 kW average beam power on a production target**
  - Beam on target by 2031

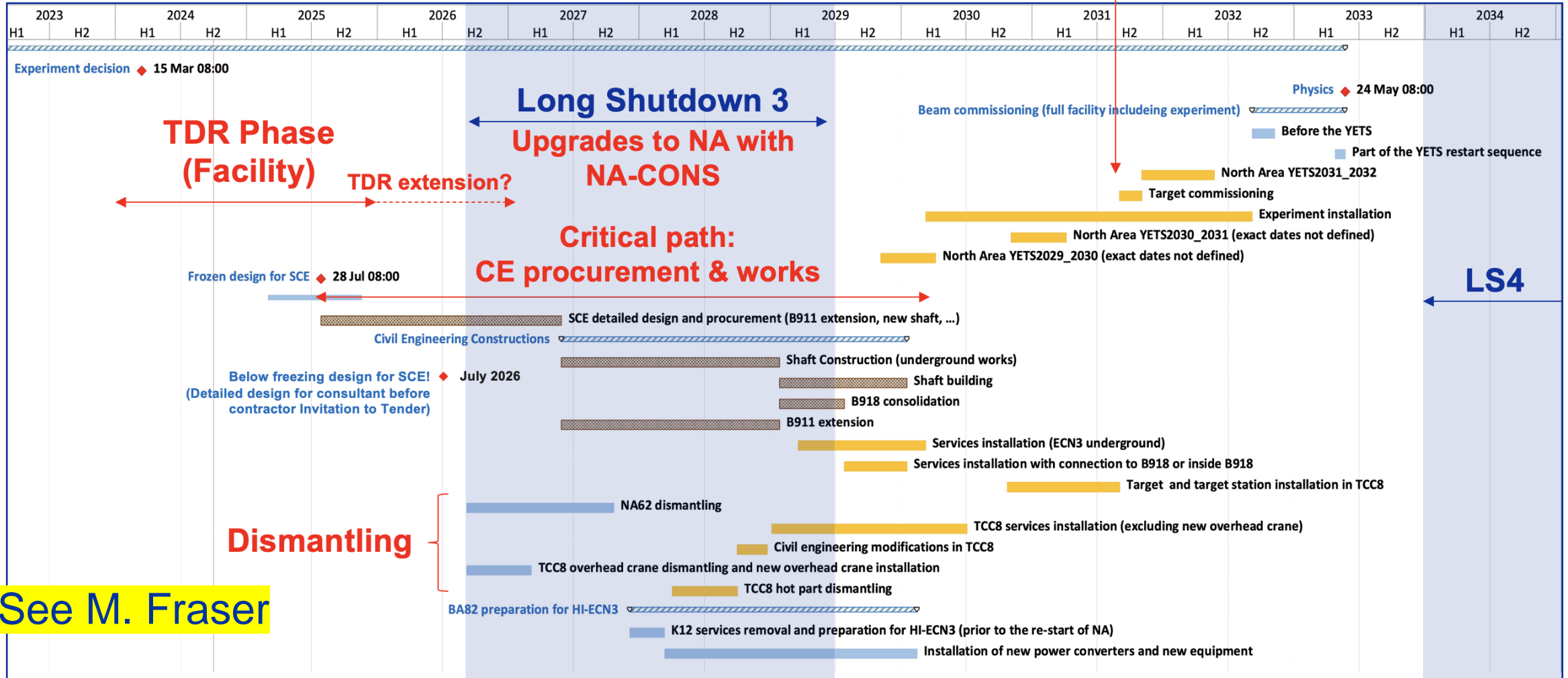
See M. Fraser

*“...broad diverse scientific programme, complementary to the collider and carried out mainly at the injectors: continuously upgraded and expanded (e.g. recently the ECN3 beam intensity upgrade at the North Area).”*

*Fabiola Gianotti*

# High Intensity ECN3 Timeline

**Beam on BDF Target**



See M. Fraser

# What is the BDF-TSAC (excerpts of [EDMS 3166418](#))

- *Given the challenges associated to the HI-ECN3, specifically to the Target Systems, together with the Project it was decided to form a specific advisory committee*
- The BDF Target Systems Advisory Committee (BDF-TSAC) [will] provide **independent advice to the HI-ECN3 Project team and specifically to the BDF Target Systems team** [...] on matters associated with [...] **achieving project goals**, based on the **most recent knowledge, state-of-the-art** and **experience** worldwide
- Target Systems within the scope of the BDF-TSAC includes the **production target assembly** itself as well as the **target station with its shielding, confinement, radiation levels, cooling, ventilation and handling systems**. [...] Target Systems include also the **definition of the processes in the service building** and the handling of highly radioactive components for maintenance and waste packaging

# What is the BDF-TSAC (excerpts of [EDMS 3166418](#))

- The BDF-TSAC is **not a review committee**. A key aim in setting up this committee early in the life of the project is to ensure the committee members develop an **in-depth knowledge of the project and to ensure continuity of advice** [...] throughout the **design** and **construction** phases of the project
- *Formal reviews of the BDF Target Systems will be organized by the HI-ECN3 Project Management at key phases of the project and will be done under a separate initiative to the BDF-TSAC.*
- The project phases within the scope of the BDF-TSAC includes the **design**, **manufacture**, **assembly**, **operation**, and **safety analysis** of the BDF Target Systems
- **It is expected that the BDF-TSAC will accompany the project until the facility starts up and is commissioned**



# Charge for BDF-TSAC1 ([EDMS 3208154](#))

- **Primary objective of BDF-TSAC1**
  - The primary objective of the 1<sup>st</sup> BDF-TSAC is to **make sure the members have a clear understanding of the design choices, specifications and history of the project**. This includes **the BDF/SHiP project scope, operational expectations** and **design** of the various relevant subsystems, including the respective **interfaces**. This also includes aspects associated with **radiation protection, remote handling** and **maintenance scenarios**

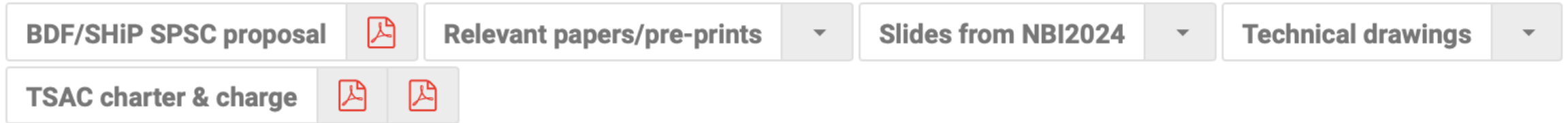
# Charge for BDF-TSAC1 ([EDMS 3208154](#))

- **Secondary objectives of BDF-TSAC1**
  - Comment on the **project's current design and on its state of maturity relative to the objective of delivering a Technical Design Report in early 2026.**
  - Evaluate the **preliminary design of the target assembly**, specifically for the two concepts being investigated in parallel
  - Evaluate the **preliminary design of the target complex and associated subsystems**, including integration, maintenance plans and handling aspects.
  - Address **whether the proposal of a He-cooled full tungsten target is well justified.**
  - Identify **possible limitations and critical items in the current design phase**, among which production techniques, cooling system, thermal behavior, prototyping activities and other technical challenges ahead
  - Comment on **whether the addition of a service cell would be appropriate and useful** for both the safe and reliable operation of the target systems and [...] radioactive waste

# Committee members

- Rikard Linander (ESS) (chair)
- Steve Gallimore (STFC/ISIS)
- Yong Joong Lee (ORNL) (*remote this time*)
- Michael Larmann (FRIB)
- Katsuhiko Haga (JPARC)
- Patrick Hurh (FNAL)

# Available material on INDICO



- Due to the recent approval of the project (and tight schedule) – not too much material has been crystallized in written form (waiting for TDR in 2026) *for the latest design options*
- However relevant material could be found :
  - BDF/SHiP SPSC proposal ([CERN-SPSC-2023-033 ; SPSC-P-369](#))
  - Slides from the Neutrino Beam & Instrumentation 2024 workshop (organized at JPARC, <https://conference-indico.kek.jp/event/270/>)
  - As well as the [BDF-TSAC charter](#) and [BDF-TSAC1 charge](#)
  - Some relevant papers and pre-prints under review & technical drawings

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12:40  
13:00  
14:10

**Introduction to the BDF-TSAC**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Marco Calviani

**HI-ECN3 Project**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Matthew Alexander Fraser

**SHiP experiment requirements**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Richard Jacobsson

**Beam delivery to target (inc. final focus system: instrumentation and dilution)**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speakers: Francesco Maria Velotti, Laurie Nevay

**Coffee break**  
Break | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

**Introduction to the BDF target systems**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Rui Franqueira Ximenes

**Beam Matter studies for the target systems**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speakers: Giuseppe Mazzola, Luigi Salvatore Esposito

**BDF target conceptual design**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Mike Parkin

**Lunch break**  
Break | Location: CERN

14:10  
14:35  
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20:30

**Beam target tests in TCC2**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Rui Franqueira Ximenes

**Target materials R&D & procurement**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Stefano Sgobba

**BDF target design concepts**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Luca Gentini

**BDF target cooling concepts**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Francesco Dragoni

**Coffee break**  
Break | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

**+ group photo!**

**BDF Target Instrumentation**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Mike Parkin

**BDF Target WP planning**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Rui Franqueira Ximenes

**Q/A time**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

**Adjourn**  
Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium | Speaker: Marco Calviani

**TSAC apero (all invited)**  
Break | Location: CERN, Glassbox R1



Wednesday 5 March

# ... Focused on target complex and associated subsystems...

08:30	<b>BDF target complex design</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Jean-Louis Grenard
09:05	
09:15	<b>Facility lifecycle &amp; target surface building</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Jean-Louis Grenard
09:35	
09:45	<b>Radiation protection considerations for the target complex</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Claudia Ahdida
10:10	
10:20	<b>Coffee break</b> Break   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium
10:40	
10:40	<b>Target Systems handling</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speakers: Cristina Duran Gutierrez, Roberto Rinaldesi
11:00	
11:05	<b>Target station shielding - Requirements, Design and Sustainability</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Francois Butin
11:20	
11:25	<b>Overview of currently envisaged robotic tasks for Target Systems</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Sergio Di Giovannantonio
11:40	
11:50	<b>Facility safety requirements and constraints</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Melania Averna
12:10	
12:20	<b>Lunch break</b> Break   Location: CERN
13:35	

13:35	<b>Target Systems ventilation system integration</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Nikola Zaric
13:55	
14:05	<b>Opportunities for service cell implementation for waste packaging &amp; autopsy</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Gerald Dumont
14:20	
14:25	<b>BDF Target Complex WP planning</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium   Speaker: Jean-Louis Grenard
14:35	
14:40	<b>Q/A time</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium
15:10	
15:10	<b>Visit to TCC8/ECN3 for TSAC</b> Break   Location: CERN, TCC8 & ECN3
16:25	
16:25	<b>Closed session for advisory committee members</b> Contribution   Location: CERN, 30/7-018 - Kjell Johnsen Auditorium
19:05	
19:35	<b>Committee dinner</b> Break   Location: Café de Peney
21:20	

## Thursday 6 March

08:30

### Q/A time & "homework"

Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

09:00

09:30

### Closed session for advisory committee members

Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

10:55

11:00

### Coffee break

Break | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

11:20

11:30

### Open close-out of the TSAC

Contribution | Location: CERN, 30/7-018 - Kjell Johnsen Auditorium

12:15

12:30

### Lunch break

Break | Location: CERN, Glassbox R1

13:30

14:00

### LHC Point 2 visit for TSAC

Break | Location: CERN

16:30

Open to all!

# Close-out & final report

- The committee chairperson is expected to provide a quick close-out on March 6<sup>th</sup> at 11h30
- A written summary of the event, with a comment on the objectives as well as a reply to all the other questions in the BDF-TSAC1 charge will be provided within 2-3 weeks

# Final remarks to speakers

- In the interest of time, please make sure you **stick with the allotted time on INDICO**
- For committee members:
  - 10 minutes are available at the end of most talks for Q/A
  - 30/45 minutes Q/A time foreseen at the end of each day
- **It is an advisory committee so I would like to encourage a bidirectional exchange between speakers, participants and committee**

I wish you productive  
discussions and exchanges  
during the next 3 days