PAUL SCHERRER INSTITUT

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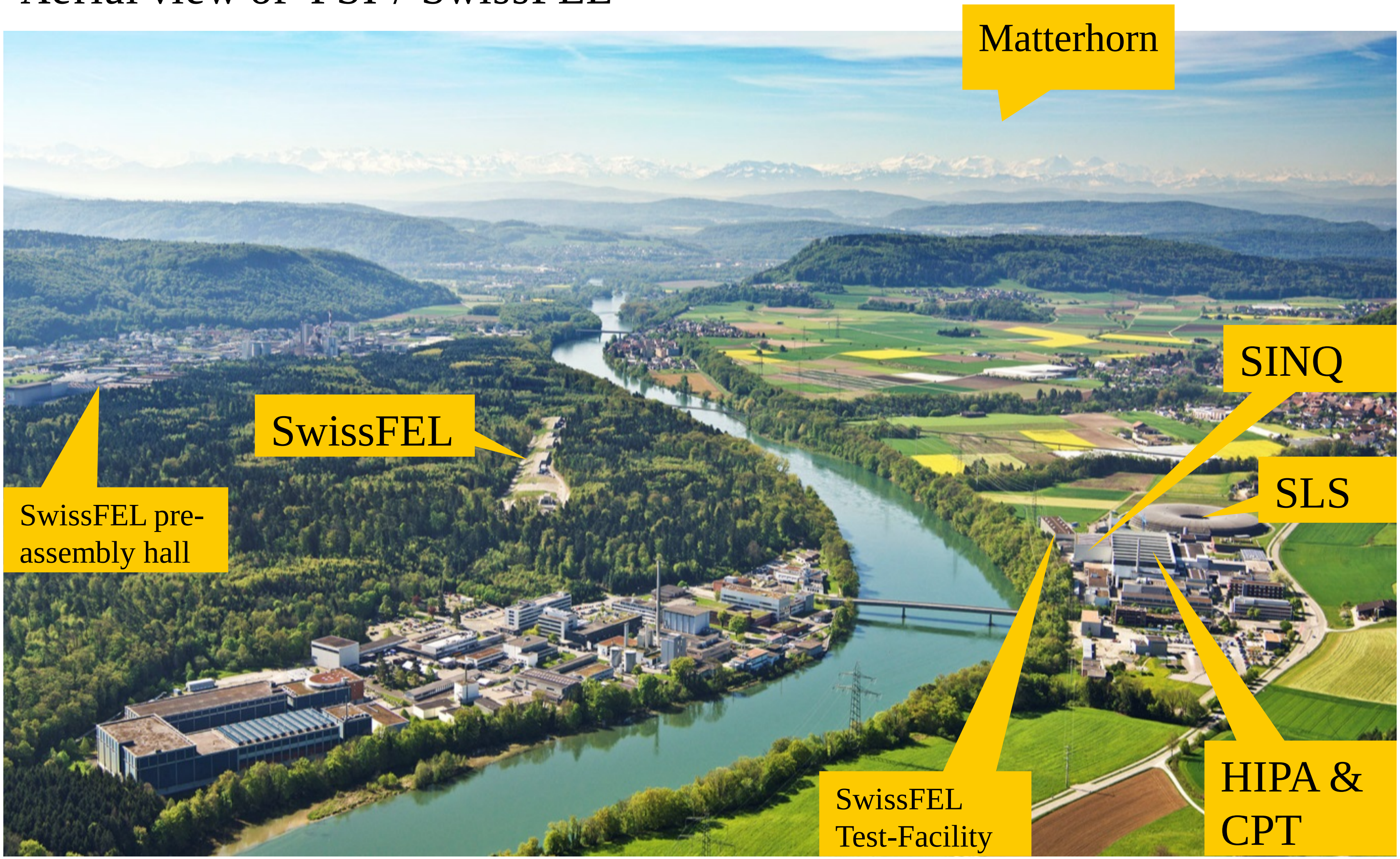
SwissFEL Installation Coordination

2^{nd} BrightnESS Best Practice Workshop: Installation aspects of large-scale In-Kind projects, 13.+14.06.2017, INFN Catania Italy

Outline

1. Introduction
2. SwissFEL timeline
3. Locations - accessability - preassembly
4. Organisation
5. Planning tools
6. Installation tools
7. Installation procedere
8. Lessons learned

Aerial view of PSI / SwissFEL

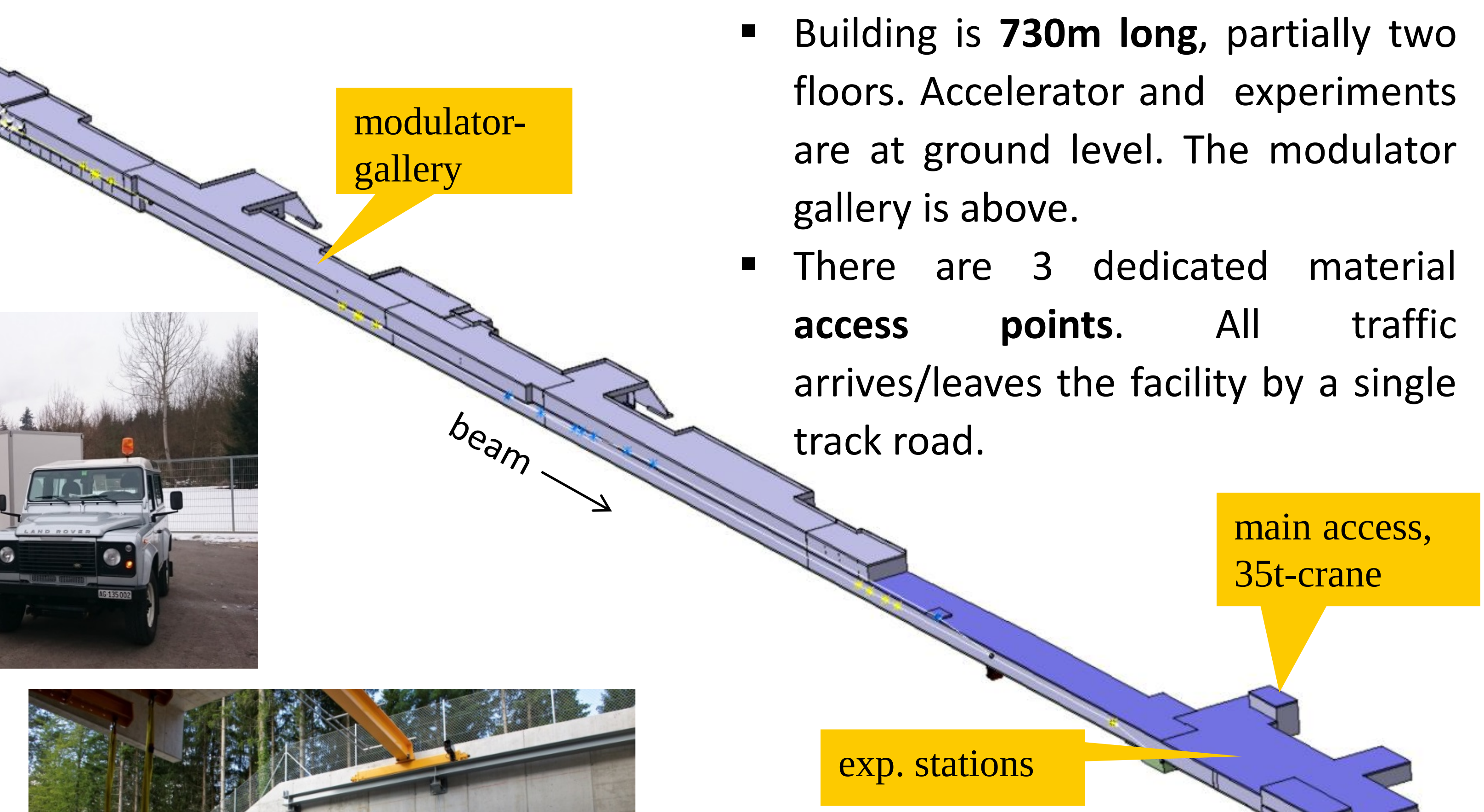


timeline – in brief

- Initially a **Test Facility** (Injector) was built to proof feasibility. SwissFEL had to be short enough to reach an affordable budget. (280Mio.Fr. excl. Manpower).
- In **autumn 2012** Swiss Parliament approved the project (-budget), and shortly afterwards the forest clearance started. (4-year parliament election-cycle triggers budget-desicion dates).
- At the moment the **modulator installation** is ongoing. By the end of this year most of the 26 C-Band-Stations should be installed (Injector is already in commissioning), and a so called '**pilot experiment**' shall bring a first beam to an experimental station.
  - 15th May: lasing at 4.1nm wavelength, 302eV photon engergy reached
- Next goal is to reach nominal energy, **5.8GeV, in march 2018** and to start with user operation with two experimental stations in October 2018.

locations

- Building is **730m long**, partially two floors. Accelerator and experiments are at ground level. The modulator gallery is above.
- There are 3 dedicated material **access points**. All traffic arrives/leaves the facility by a single track road.



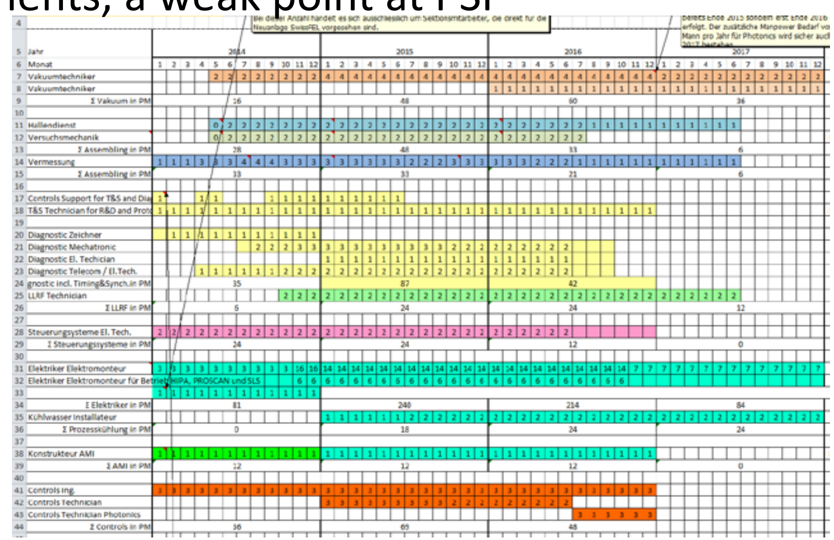
locations – storage and preassembly

- For pre-assembly and storage PSI rent an **external hall** nearby (former concrete company; picture from 2015),
- used 2012 til 2017, only 2 miles away,
- **1600m²** (87x19m), 20t crane (hook at 7m),
- Area for girder assembly. Clean room for **RF-Girder assembly** work. Storage area for deliveries (and electro-racks).

organisation

specifically PSI

- PSI covers a wide range of tasks with its own **technical groups** (vacuum, cabling, magnets, controls, diagnostics, etc). This specialists are typically involved in operational-tasks as well as new projects. Key components typically designed/meassured/commissioned by PSI.
  - To increase the manpower needs during project phases, **additional temporary personell** was hired, based on a work package analysis (over 3 years 10 Mio.Fr. were spent for that).
- **External suppliers** / producers need an effort on progress-control, checks (FAT/SAT) and regularly interface contacts.
  - Quality control of delivered components, a weak point at PSI
  - Have in house what you paid for
  - Take your time for the preparation of world-trade-bids (WTO)



organisation – meetings and dms

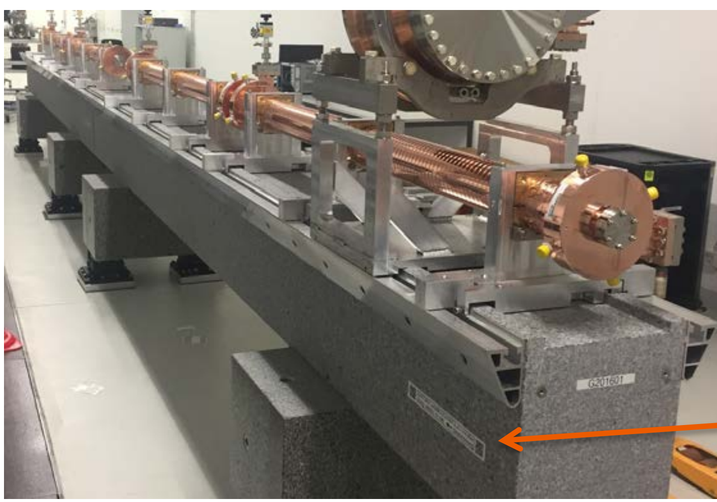
- **regularly meetings** with specific purposes during the project, for example:
  - Project-leader meeting for decisions about change requests, priorities, security aspects, official approvals, budget-control etc.
  - **Interface meeting** with project leaders and work package responsibles as main information plattform, to check progress, discuss technical difficulties.
  - Installations meeting to coordinate all short-term installation work.
- **Document Management Systems**, used for SwissFEL:
  - ALFRESCO as document managment system (development record)
  - INDICO for meeting organisation/presentation
  - MS Project Server for planning-overview as well as detail-planning
  - CATIA for the 3D-model and as design tool (interface checks)
  - Database with all beamline component information: **holy list**

	A	B	C	D	E	F	G	H	I	J	K
1	SYSTEM	PREFIX	SUFFIX	NAME	GRP	S	Z	CATIA_VPM_PART	DESCRIPTION	CNAME	RESPONSIBLE
4508	ATHOS-U40-PHASE1	SATCB01	VVPG	SATCB01-VVPG-A010	Vacuum	357.2707	357.1063	50023.11.081	valve gate viton CF40 DN 16	VS.VGATE-16-35	Lothar Schulz
4509	ATHOS-U40-PHASE1	SATCB01	AGIR	SATCB01-AGIR-010	Alignment	357.2957	357.1313	50023.11.163	Girder 1 Kavitaet Linac 1	AL.GIRDER_1 S10CB	Haimo Joehri
4510	ATHOS-U40-PHASE1	SATCB01	RWVG	SATCB01-RWVG100	Radio Frequency	357.3057	357.1413	50023.11.2183	wave guide system C-band SAT girder 1	RF.C-BAND-WG-SAT-G1	Hans Rudolf Fitze
4511	ATHOS-U40-PHASE1	SATCB01	ZERO	SATCB01-ZERO	Reference	357.3057	357.1413		cell marker, reference point virtuell	XX.CELL-MARKER	Lothar Schulz
4512	ATHOS-U40-PHASE1	SATCB01	RACC	SATCB01-RACC100	Radio Frequency	357.3057	357.1413	50023.11.135	travelling wave cavity C-band vacuum onl	RF.C-BAND-CAVITY-VO	Jean-Yves Raguin
4513	ATHOS-U40-PHASE1	SATCB01	VPNG	SATCB01-VPNG-A010	Vacuum	357.3457	357.1813		NEG pump - NexTorr D 200-5	VS.VNEX-D200	Lothar Schulz
4514	ATHOS-U40-PHASE1	SATCB01	AADF	SATCB01-AADF-010	Alignment	358.2207	358.0563		GIRDER-C-BAND adjustment feet	AL.GIRDER-C-BAND-FEET-NP	Haimo Joehri
4515	ATHOS-U40-PHASE1	SATCB01	AADF	SATCB01-AADF-020	Alignment	358.2207	358.0563		GIRDER-C-BAND adjustment feet	AL.GIRDER-C-BAND-FEET-NP	Haimo Joehri
4516	ATHOS-U40-PHASE1	SATCB01	VPIG	SATCB01-VPIG-A010	Vacuum	358.9457	358.7813		getter pump - noble diode 20 l/s	VS.VPUMP20	Lothar Schulz

organisation and planning tools

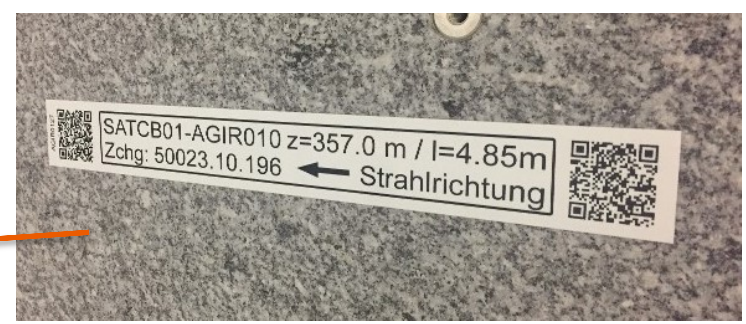
preparation, to-do-list for larger projects

- Conceptional Design Report → **goals** (time - costs - performance)
- project handbook → informations flow, **responsibilities**, meetings, etc.
- work packages → assign them; get back time and budget estimates
- Design Change Report → understand consequences (and record it)
- Meetings → fix meeting times and members (handbook)
- TDR, DMS → organize how to find documents and information
- nomenclature → a **naming convention** helps to clarify what device is meant
- Approvals → have a spezialist for contacts to the aproval authorities
- 3D-Model → keep an overview of what you build



SAT - CB01 - AGIR010

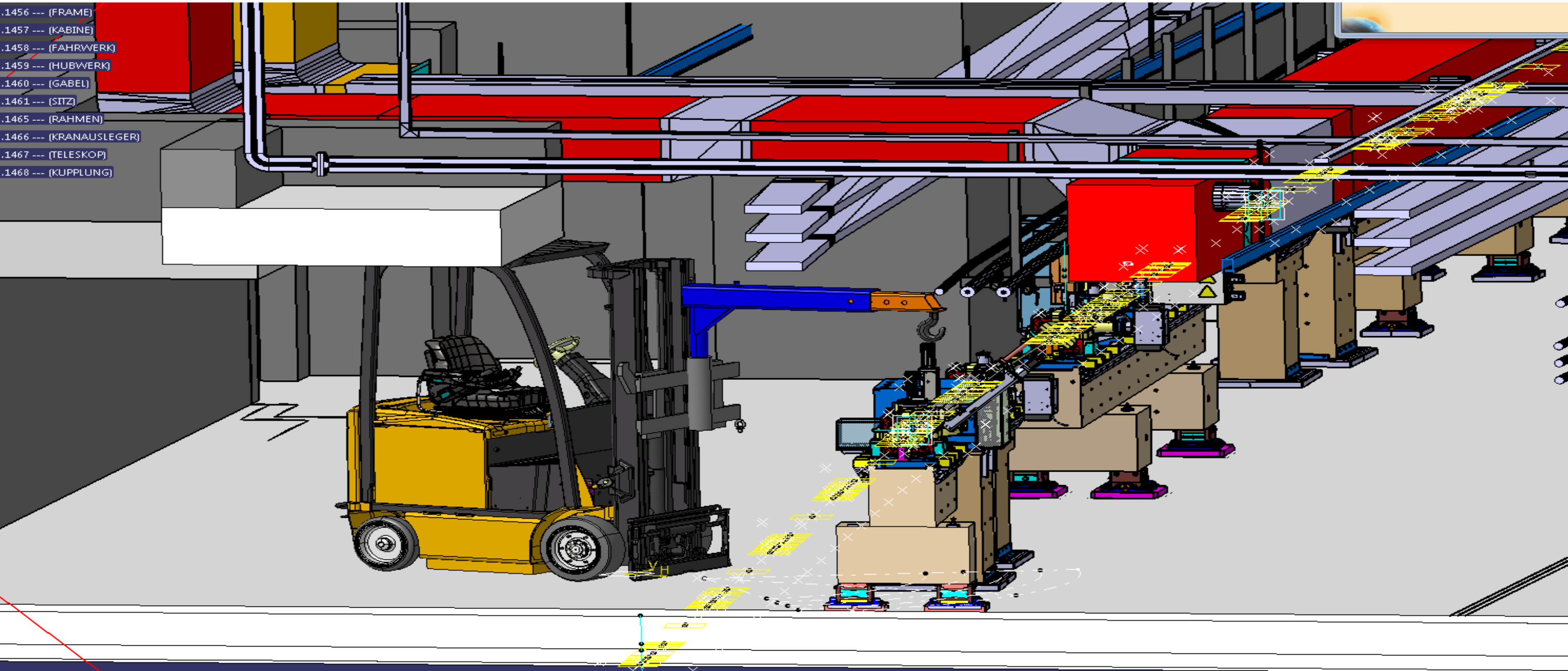
SAT: **S**wissFEL **AT**HOS
CB01: **C-B**and cavity
AGIR010: **A**lignment elem. / **Gir**der



planning tools

- Central 3D model to check dimmensions, interfaces, available space for maintenance or installations.
  - check or reserve **transport corridors**
  - Check **installation space**
  - visualising cable trays
  - interfaces with building infrastructure / beamline

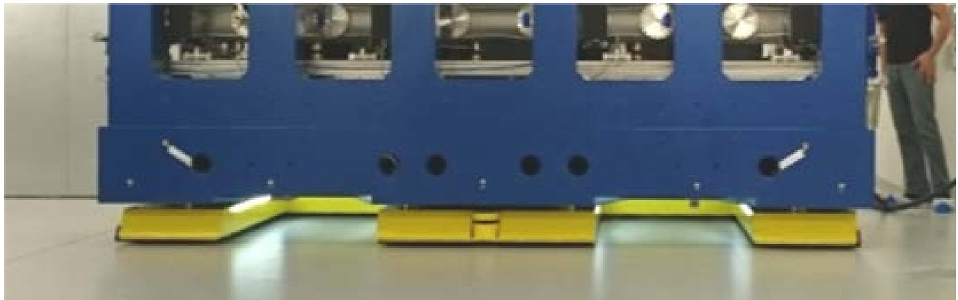
3D-Fotos of beamline tunnel supports later on maintenance planning



installation tools

consequences of beamline designs for the installation

- **Undulators**: Beamline height and undulator-design forced a ACV-solution for the transport. (Air Cushion Vehicle; 20cm height available for transport-solution).
  - groundplates had to be even to the surrounding floor level for ACV-access/operation → installation during building construction phase.
  - SwissFEL Beamline tunnel is a geometrical plane, not follwoing earth-curvature → same adjustment range for all foot systems.
- **Component girder-system**: more or less a copy of the SLS-system. Granite girders up to 5m long, for easier exchange of beamline components (shortens beamtime interruptions), with good vibration damping.
  - All cabling above beamline → easy accessable but also low ceiling for any component exchange (mobilev, forklift, etc.).
  - Special undercarriage had to be designed/developed for girder transport (boogies: lift/drop function, 90° turnable wheels, 3t load capacity).



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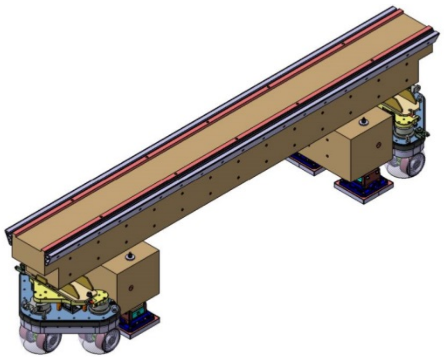
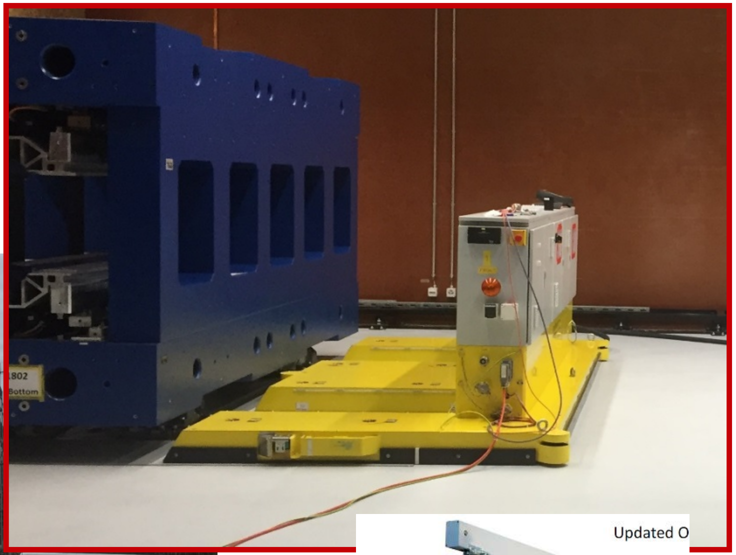
installation tools

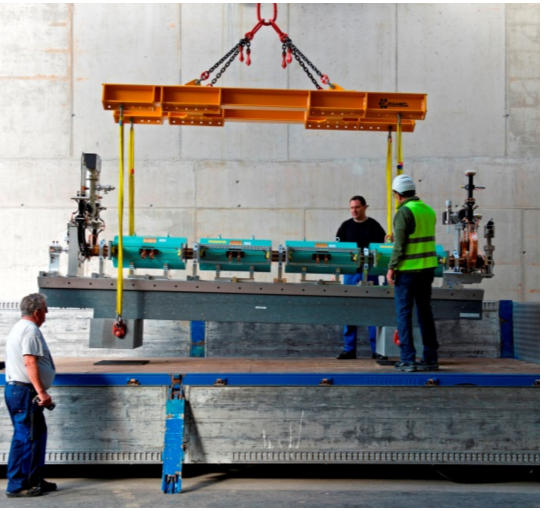


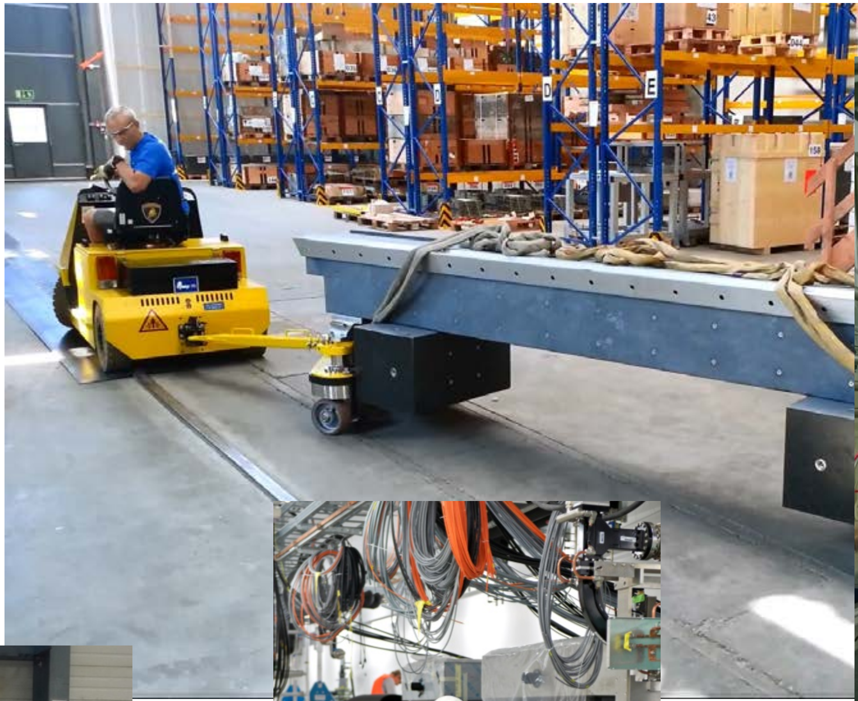


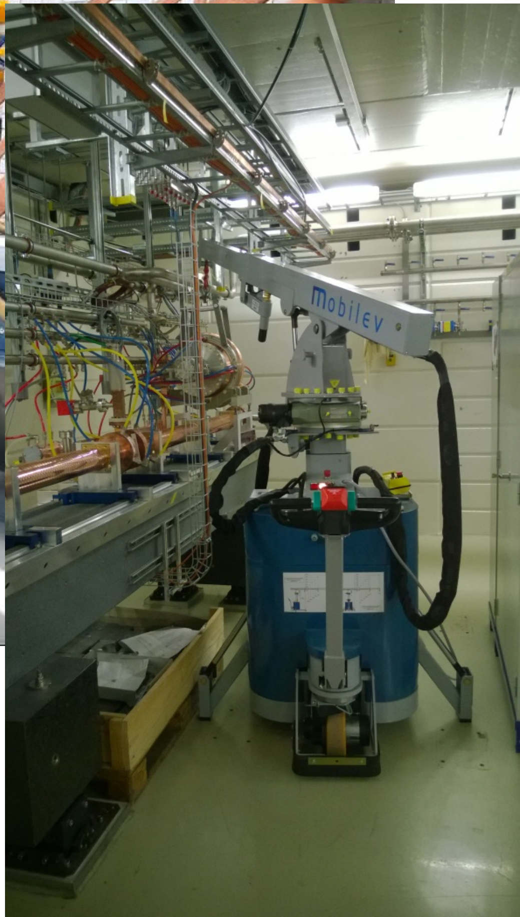
Courtesy by
J.Wickström

installation tools

- Test tools in advance to see whether they ar applicable for their purpose
  - Undulator-dummy, shock recorder, …
- Do not forget lifting spreaders (C-Band-Girders, Modulator-Racks)







Installation procedure

guideline

- **Simple approach for installation scheme**: Main material entrance at z630m, starting with intallations at z0m (gun) and work forward in beam direction with the installation.
  - o Originally plan to handover the whole building to PSI first and then start with the installation failed completely.
- **Check dimmensions** of rooms, floor levels, door positions etc. yourself and ongoing during the building construction.
- Bring in **heavy components as early as possible** (ex. beamdump shieldings where brought in at PSI with a mobile crane before the beamline tunnel's roof was closed
- Bring in all **main cables bevor installing components** (damage risk and cleanliness) → Dirty work first.
- Start Design-developement of frontend-lines and experimental areas early (nearly parallel to the machine part).

Installation procedure


Aramis / Athos
Beamdumps


2014


ARAMIS Beamstopper
May 2015


S10BD Dec 2014

Lessons Learned

What we would consider next time

- **MS-Project** was not used in the detail it was thought at first, but even though all working package responsibles made their planning.
  - ➢ Feedbacks about delays or occuring difficulties need to be teased more efficiently, to save more reaction time.
- Thicker building walls would have made first commissioning steps easier… (expensive Dose-Rate-Protection-System will be ready in autumn).
  - ➢ We were late with **dose rate calculations** for the building construction
- It cost a lot of effort to enable suppliers (for ex. the RF-cups or modulators) to master a quality production for high-tech-parts.
- Prepare standard purchasing specs. This safes time and is more robust if arguments with suppliers occur.

What we would do again

- Increase manpower with temporary personell
- Establish a Naming convention
- System ‘holy list’ (easy for everyone to know what is built)
- One 3D-model with all components, building and infrastructure in it (with viewer-app for non catia-users)

SwissFEL on youtube

- 05.2017: SwissFEL - the new large-scale facility at PSI (5min.)
- 12.2016: SwissFEL Inauguration (2min.)
- 10.2016: **drive through the beamline tunnel** (1min.)
- 01.2016: Installation of C-Band-Girder (4min.)
- 07.2015: delivery of the first undulator (6min.)
- 04.2015: drive through the beamline tunnel (1min.), before comp. installation
- 2013-14: time lapse view of building construction (1min.)
- 07.2013: stacking of c-band-structure-cups (3min.)

Timeline: 12.2012 forst clearance; 2013+2014 building construction; autumn 2014 beamdump-shielding installation; 04.2015 installation of groundplates in tunnel; 06.2015 installation of beamstoppers and heavy girders; 12.2015 injector-girders mechanically brought in; 2016 most beamline girders mechanically installed; 12.2017 pilot experiments

view over SwissFEL site – southbound

Thank you for your attention ☺