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CERN - Unique devices manufactured in ZTS VVU Kosice, a.s.

ZTS VVU KOSICE a.s., Slovakia

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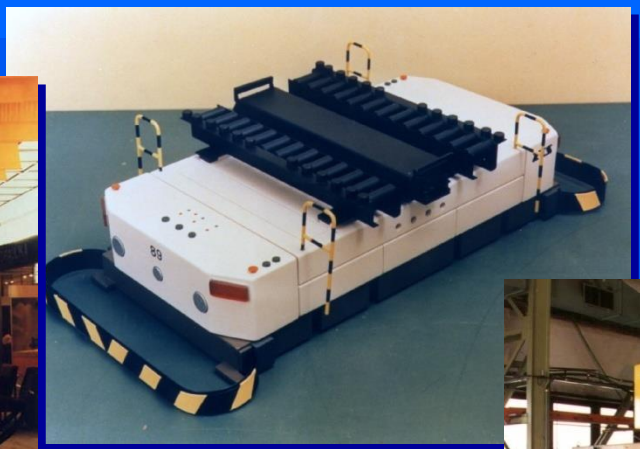
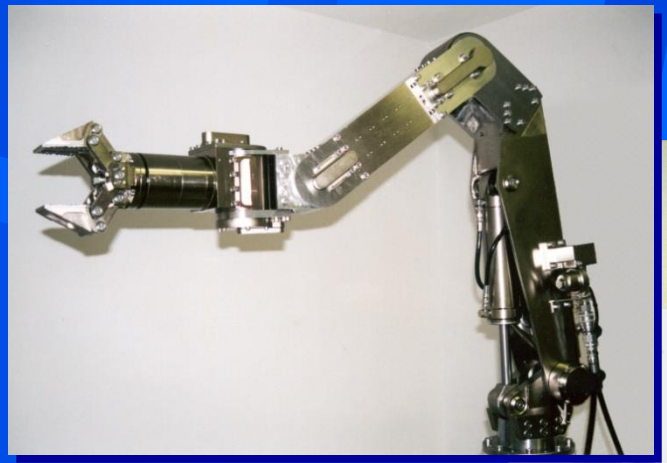
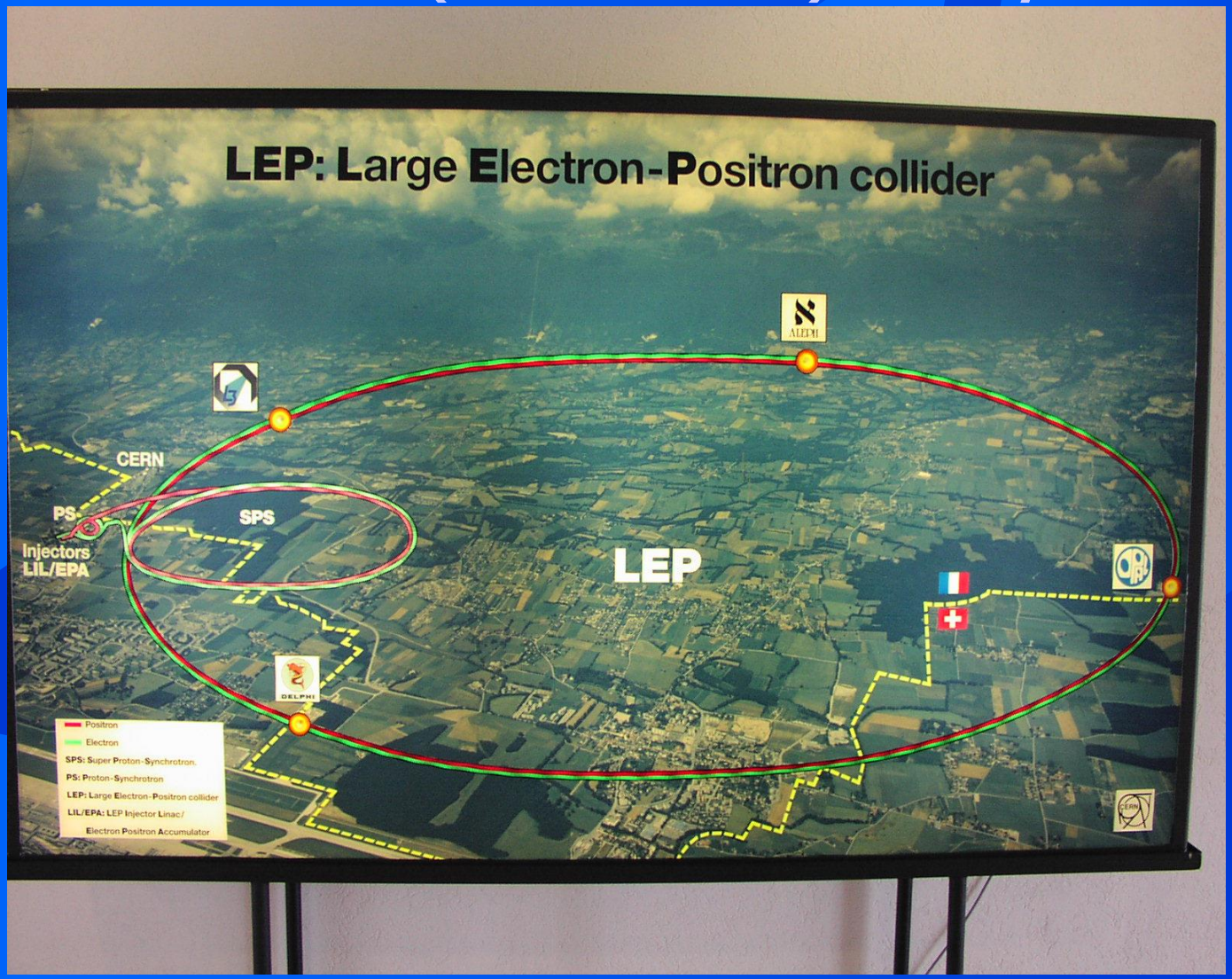




LEP → Large Hadron Collider = LHC

Why LHC? Because of Hadros!

Hadros (from the Greek) = Heavy



To keep heavy particles in their tracks, new magnets were developed:

MAIN DIPOLE – 16 m long / 34 t mass / almost 1m dia

Main Dipole cross section

Main Dipole - storage after manufacturing

Main Dipole – Transport to the tunnel access point

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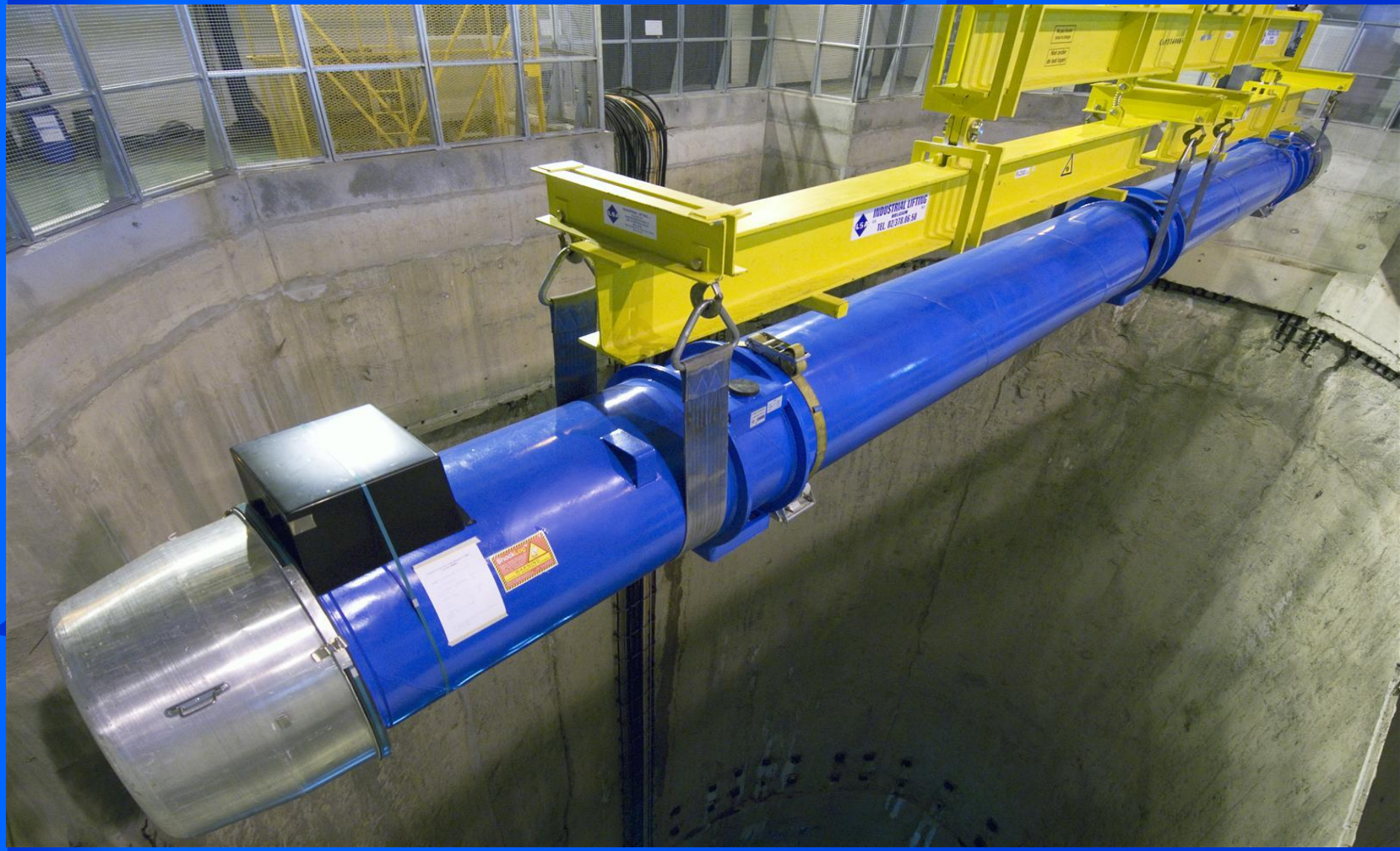
Main Dipole – lowering into the tunnel



Main Dipole – transfer to the installation point

Cryomagnet installation point - three support jacks:
- each cryomagnet must be placed very carefully on its own jacks

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Installation of components in 27 km long tunnel includes:

- 1232 pieces of Main Dipole … 16m / 34 tons
- 360 pieces of Short Straight Section – SSS Arc … 7,5m / 8 tons
- 64 pieces of SSS DS … 8,7 – 10,1m / 11 – 16 tons
- 64 pieces of LSS … 8,5 – 13,2m / 4,7 – 22,7 tons

- very restricted space in tunnel designed for LEP

- fragile and heavy cryo-magnets, very sensitive for damaging

- extreme installation precise versus load dimensions required

- final precision for three support jack points +/- 1mm required

- due to horizontal cryo-magnets interconnection, very stable and precise installation trajectory is required

- tender for cryo-magnets installation tooling set was released

- **Transfer Equipment Set (TES)** – subject of tender = delivery the set of devices which fully satisfied requirements and conditions mentioned above

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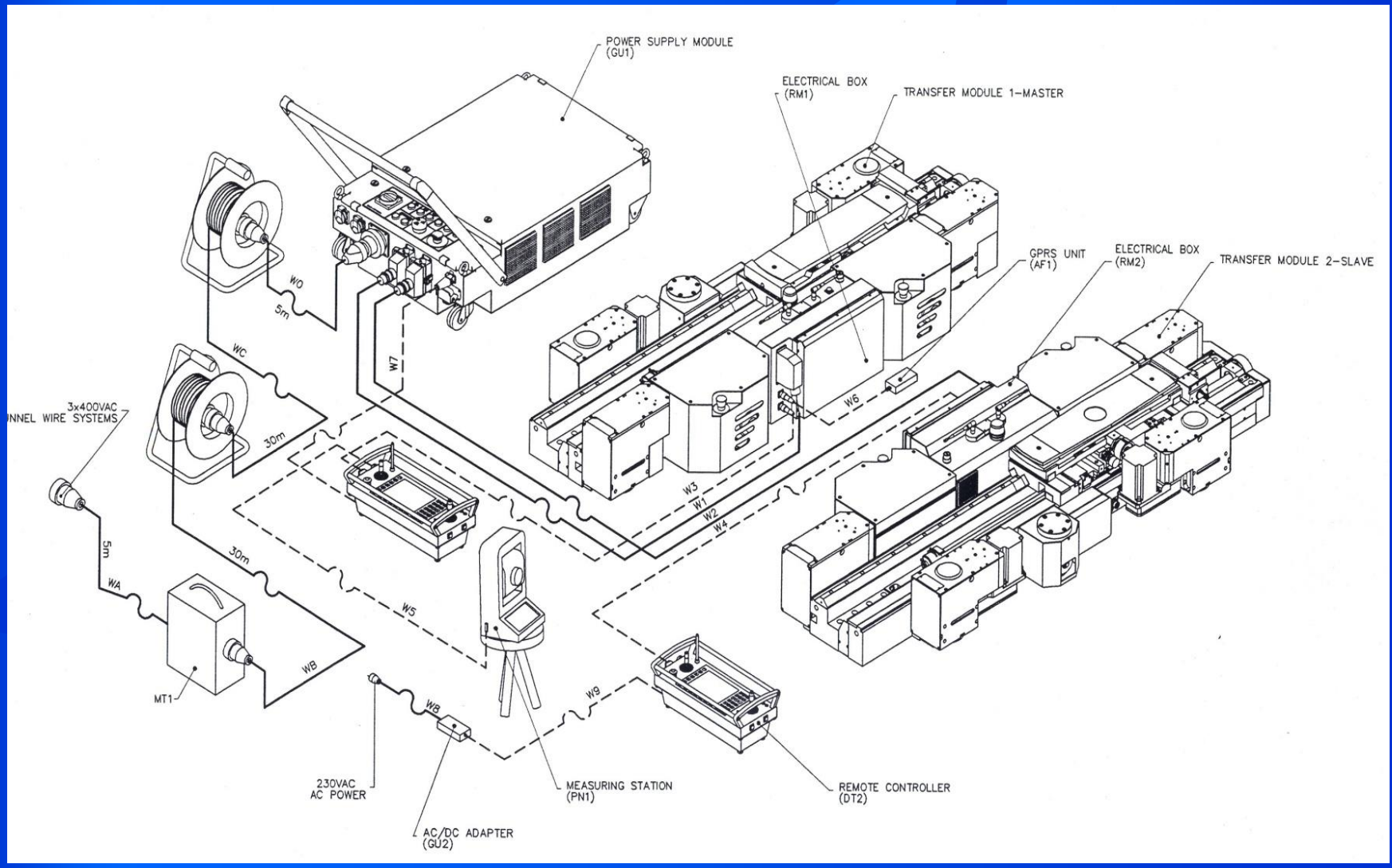
TRANSFER EQUIPMENT SET

TES – The basic idea on the white paper



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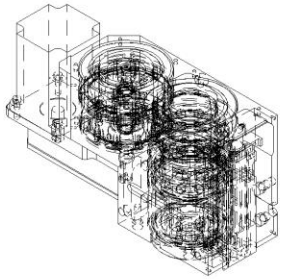
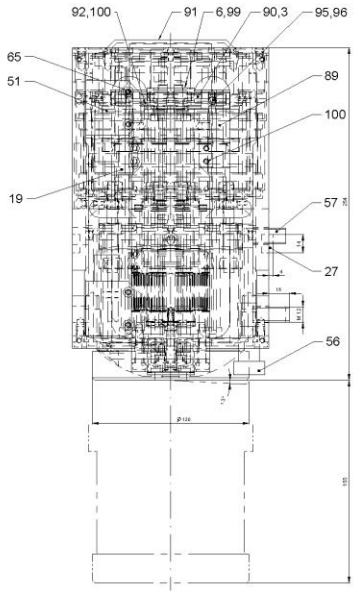
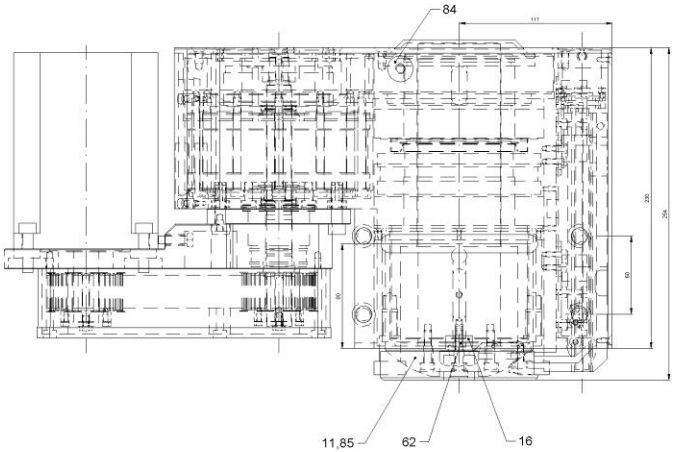
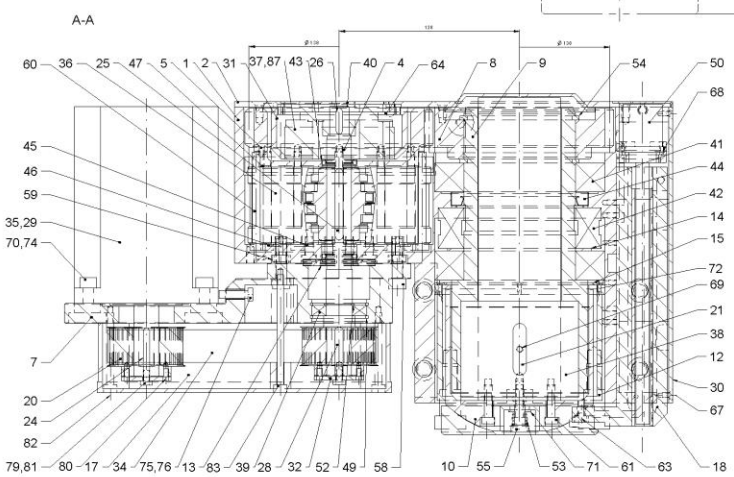
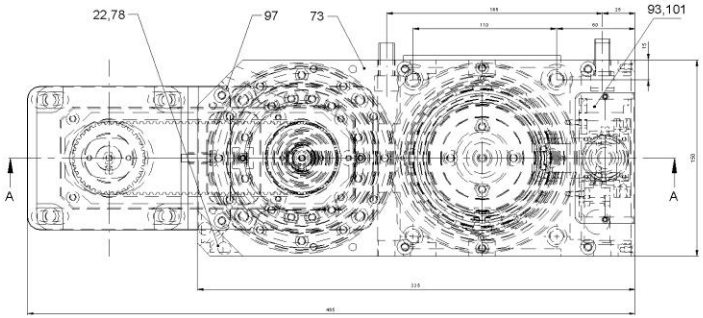




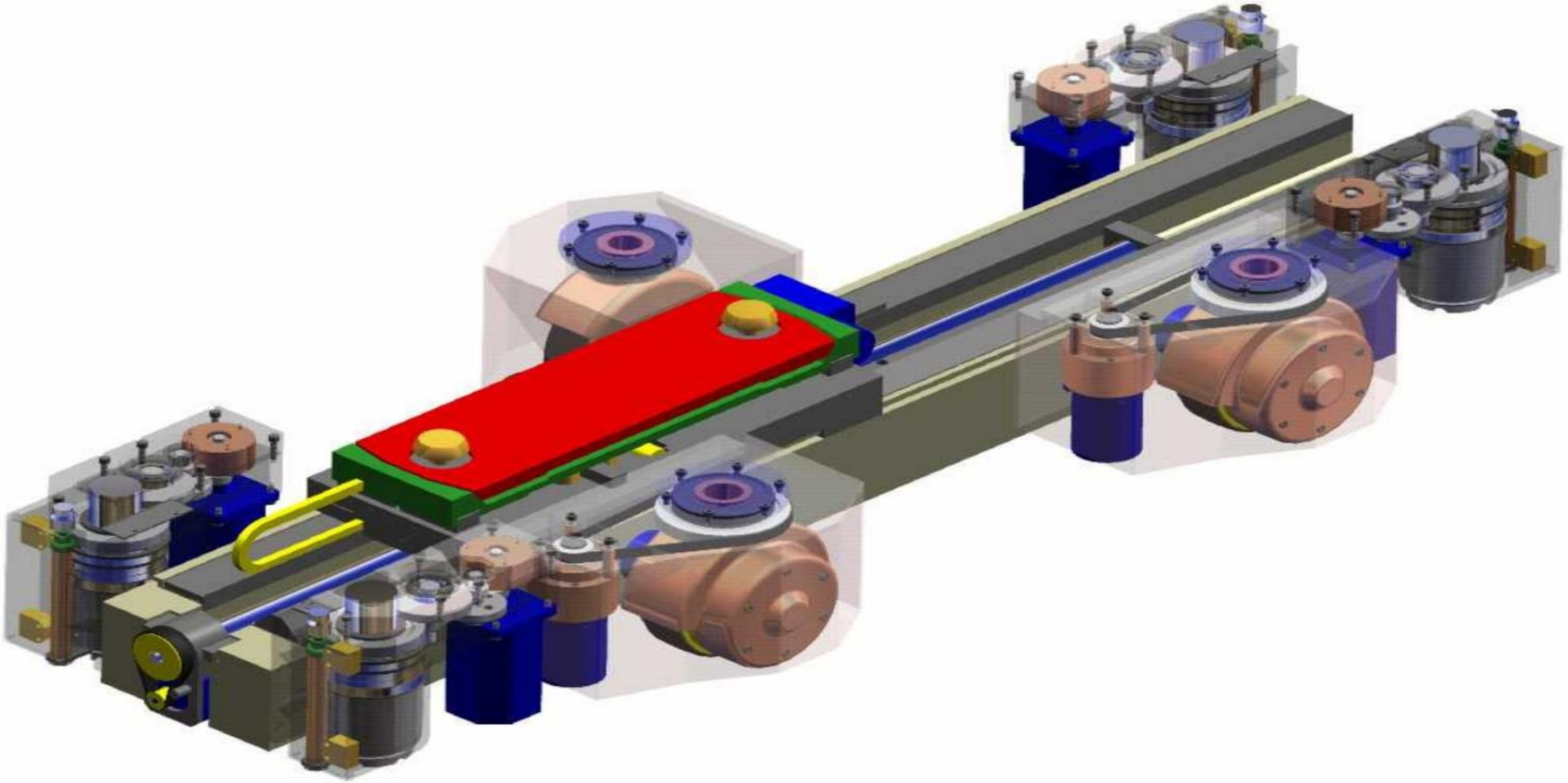






LIFTING LEG SHORT 0-44-7500-303

TES – 3D design of Transfer Module, main component which will manipulate with cryo-magnets



TES – the very first steps performed on the real module at the ZTS VVU workshop

TES – Transfer Modules ready for tests

Tests at manufacturer workshop – ZTS VVU Kosice:

- all required parameters and conditions must be satisfied at manufacturer factory before TES exporting
- total 202 items include the test report
- simulation of all tunnel conditions were done during factory tests including restricted area, tunnel slope and full load

Manufacturer factory tests – Main Dipole as well as SSS Arc

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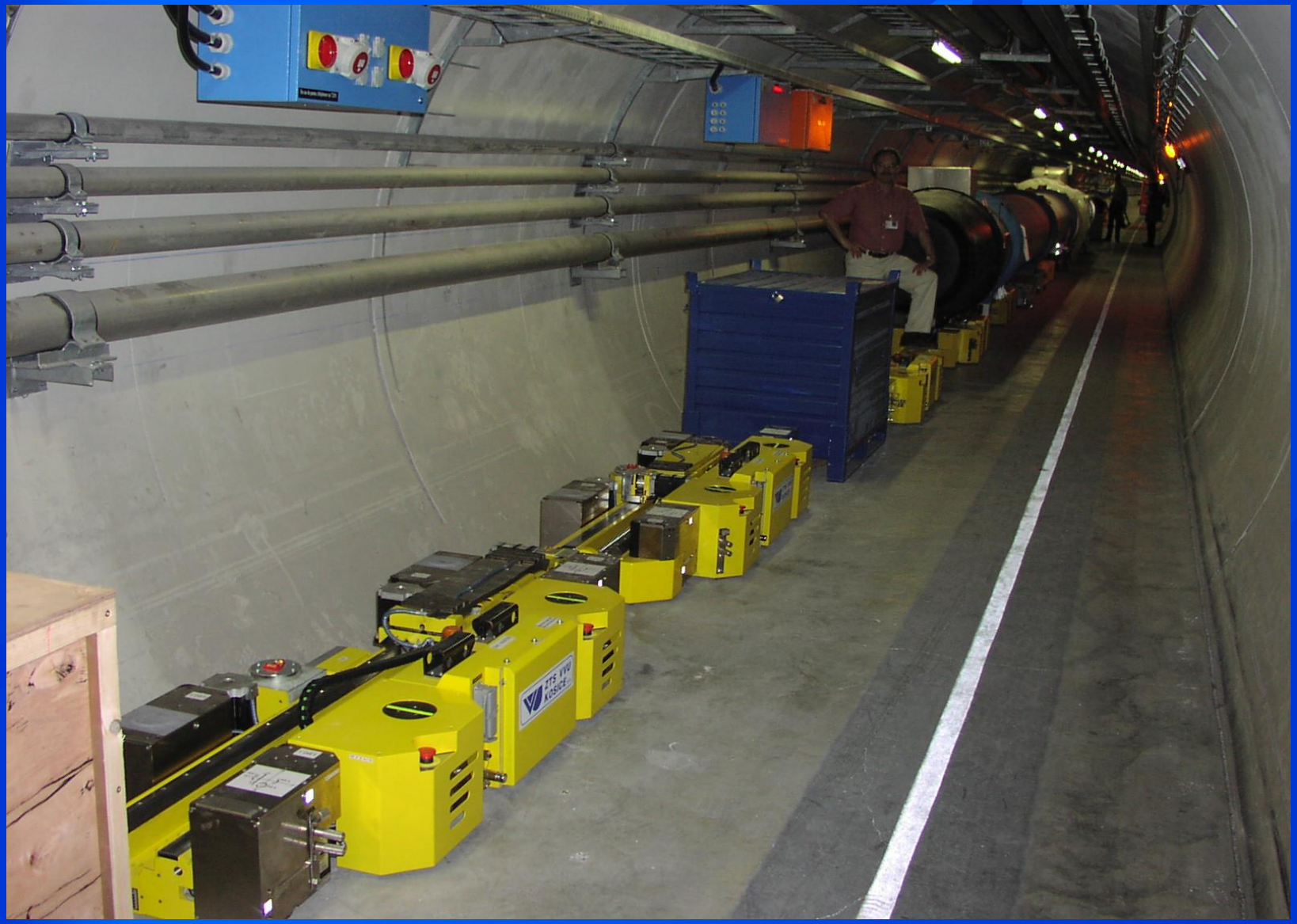
TES – delivery to the CERN for the tunnel test



TES – waiting for Main Dipole transported

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TES – Main Dipole take over procedure

TES – Main Dipole taken over by Transfer Modules

TES – Main Dipole horizontal direction transfer process

TES – Main Dipole placed above support jacks, checking process for correct position of support jacks versus support plate holes.

TES – Support jacks fit to support plate holes

TES – Main Dipole lowering down to the support jacks, installation process completed.

Camera system for magnet correct position checking

Camera system display - jacks versus support plate position

TES – Main Dipole installation.

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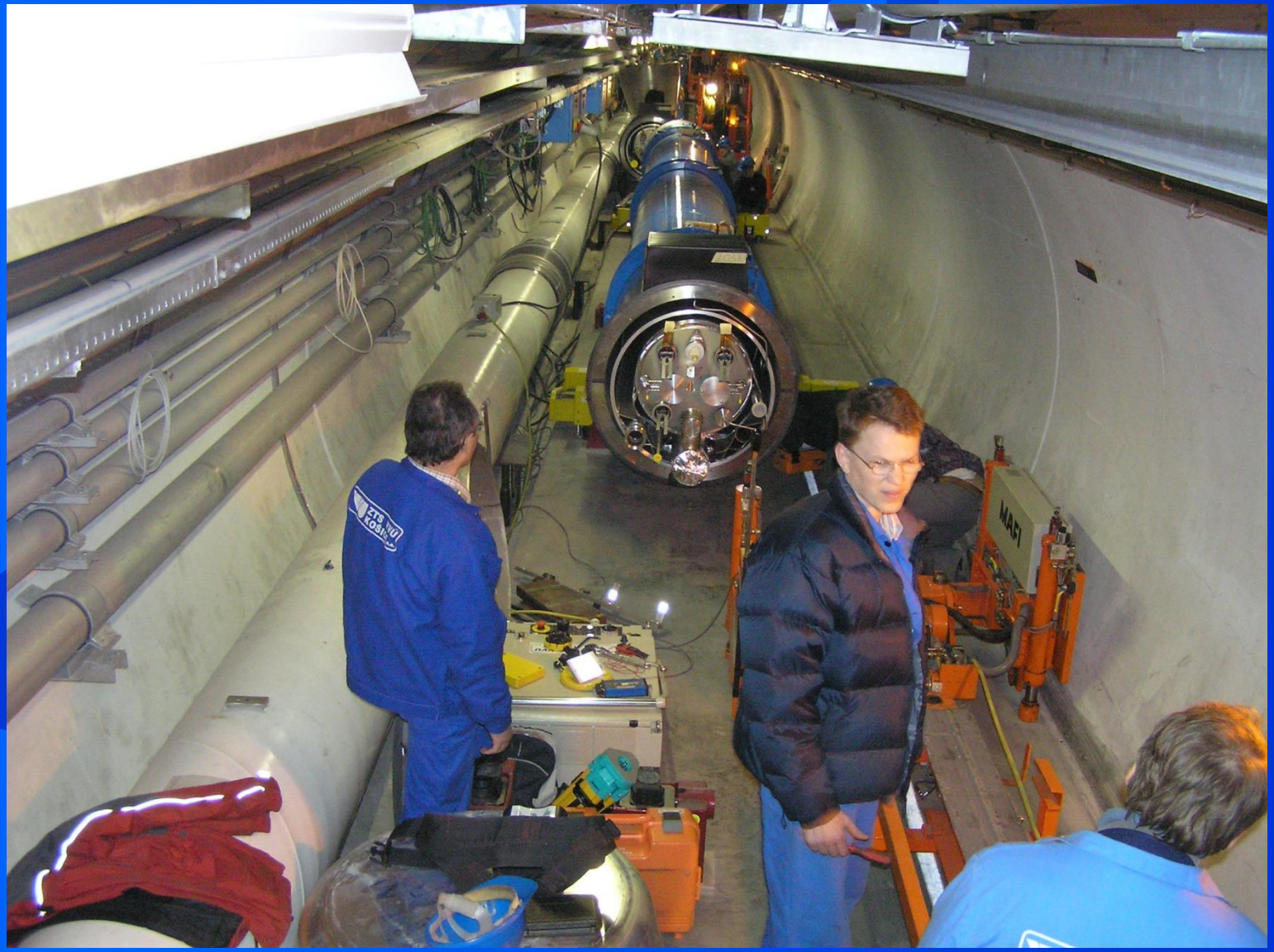
TES – Main Dipole installation.

TES – Main Dipole installation.



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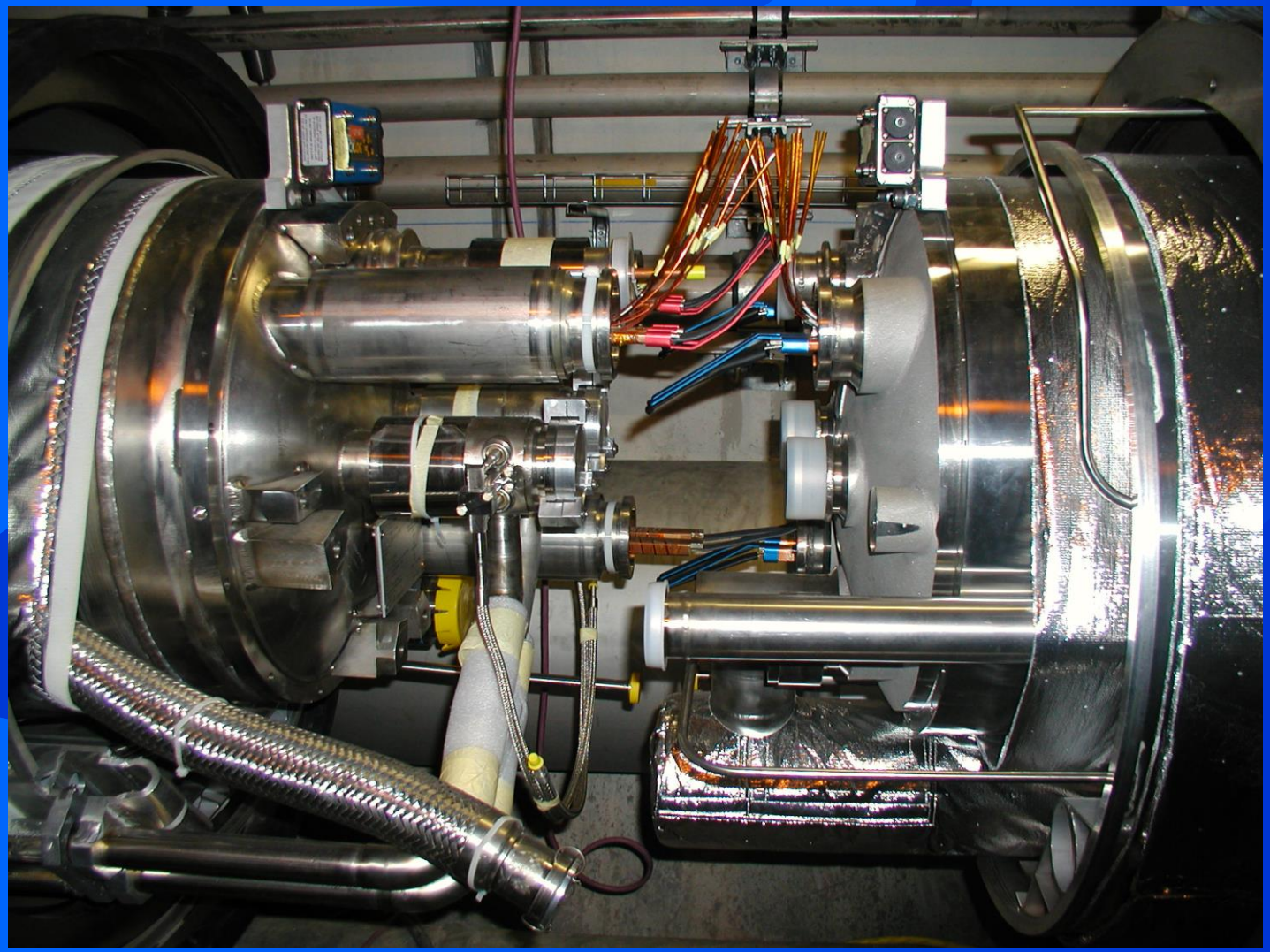
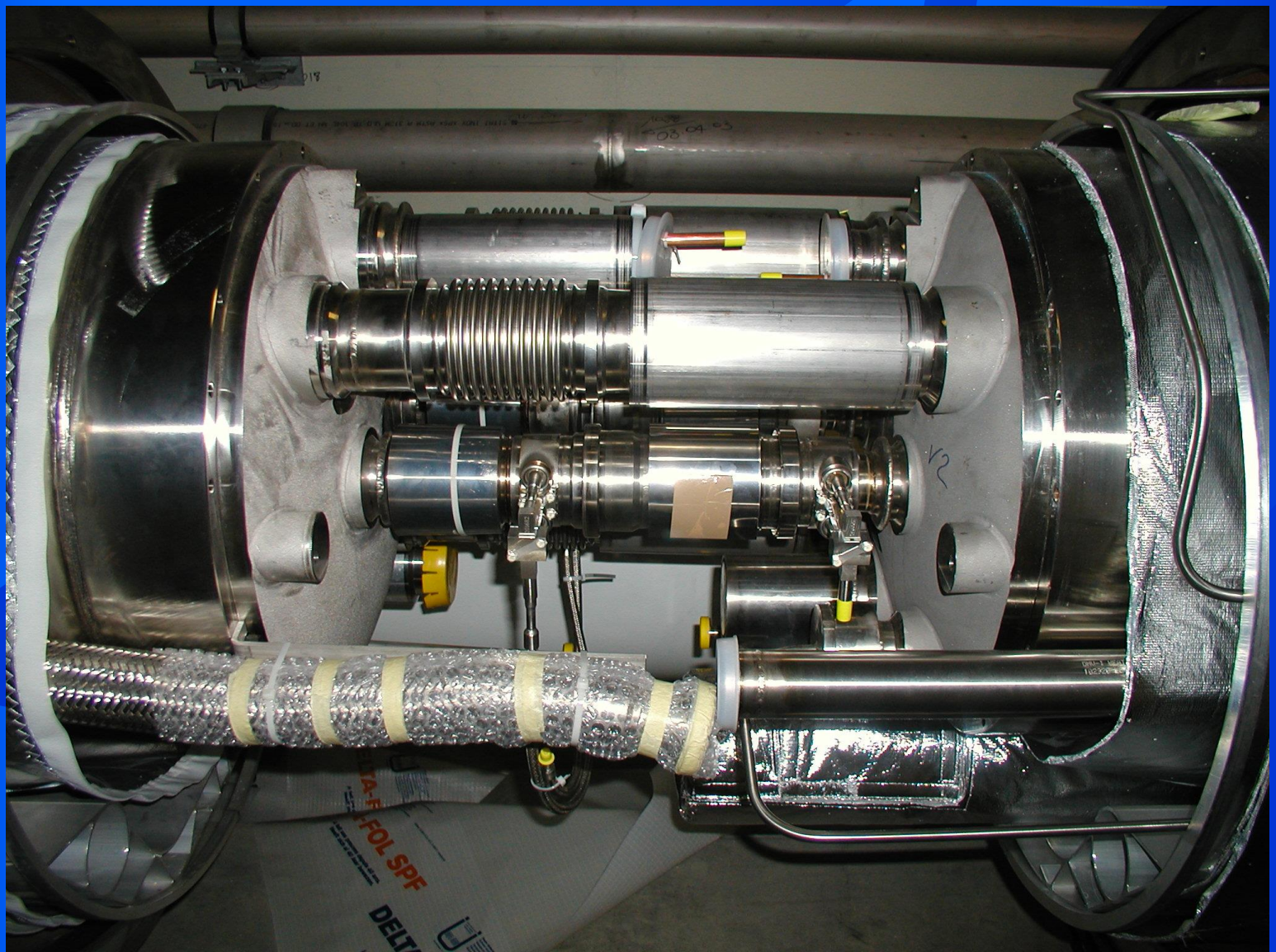
TES – Main Dipole installation.

TES – very precise installation trajectory to avoid crash of interconnection components

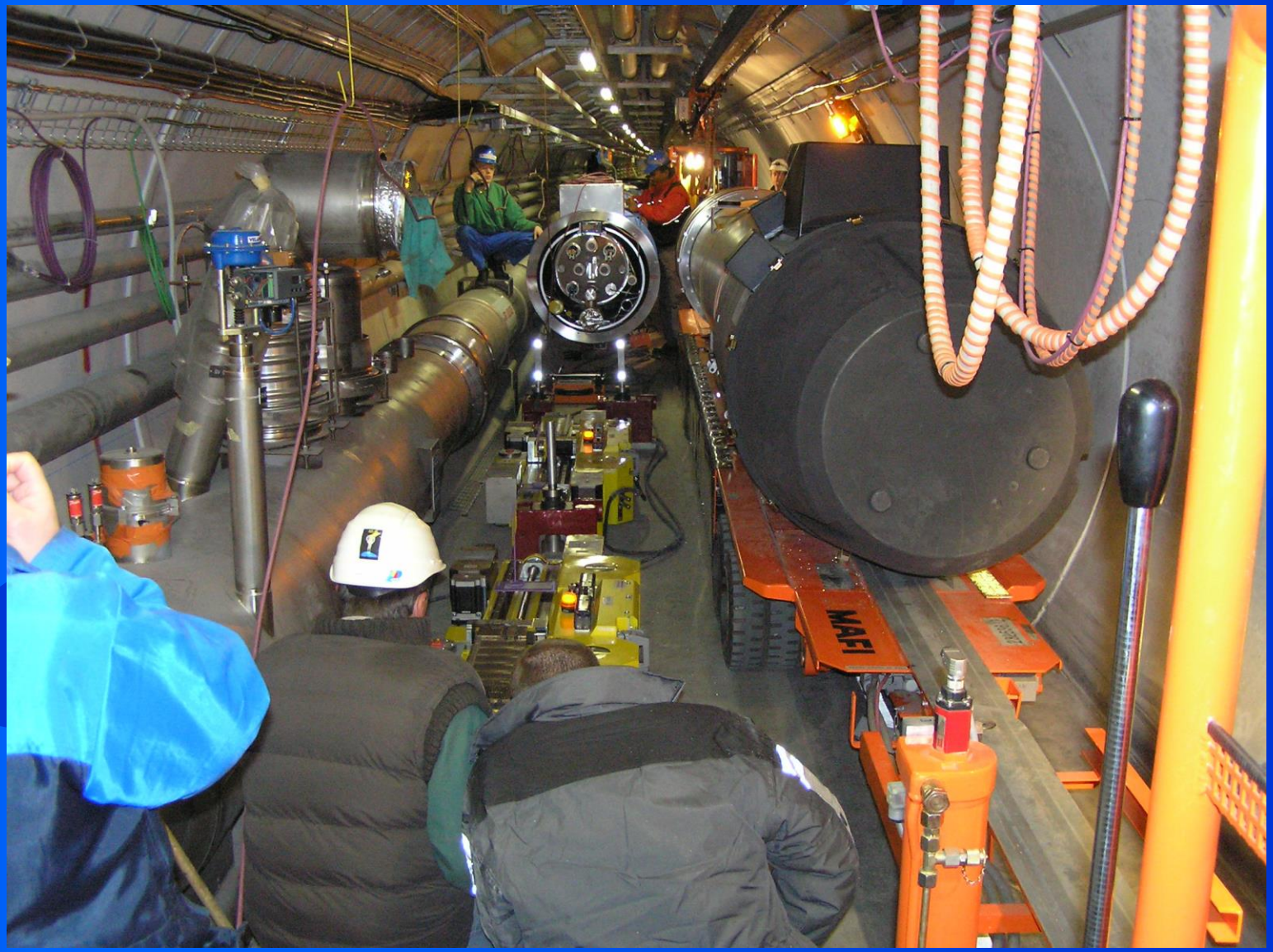


TES – Main Dipole interconnection.



TES – Short Straight Section (SSS) installation

TES – SSS installation, very restricted working area



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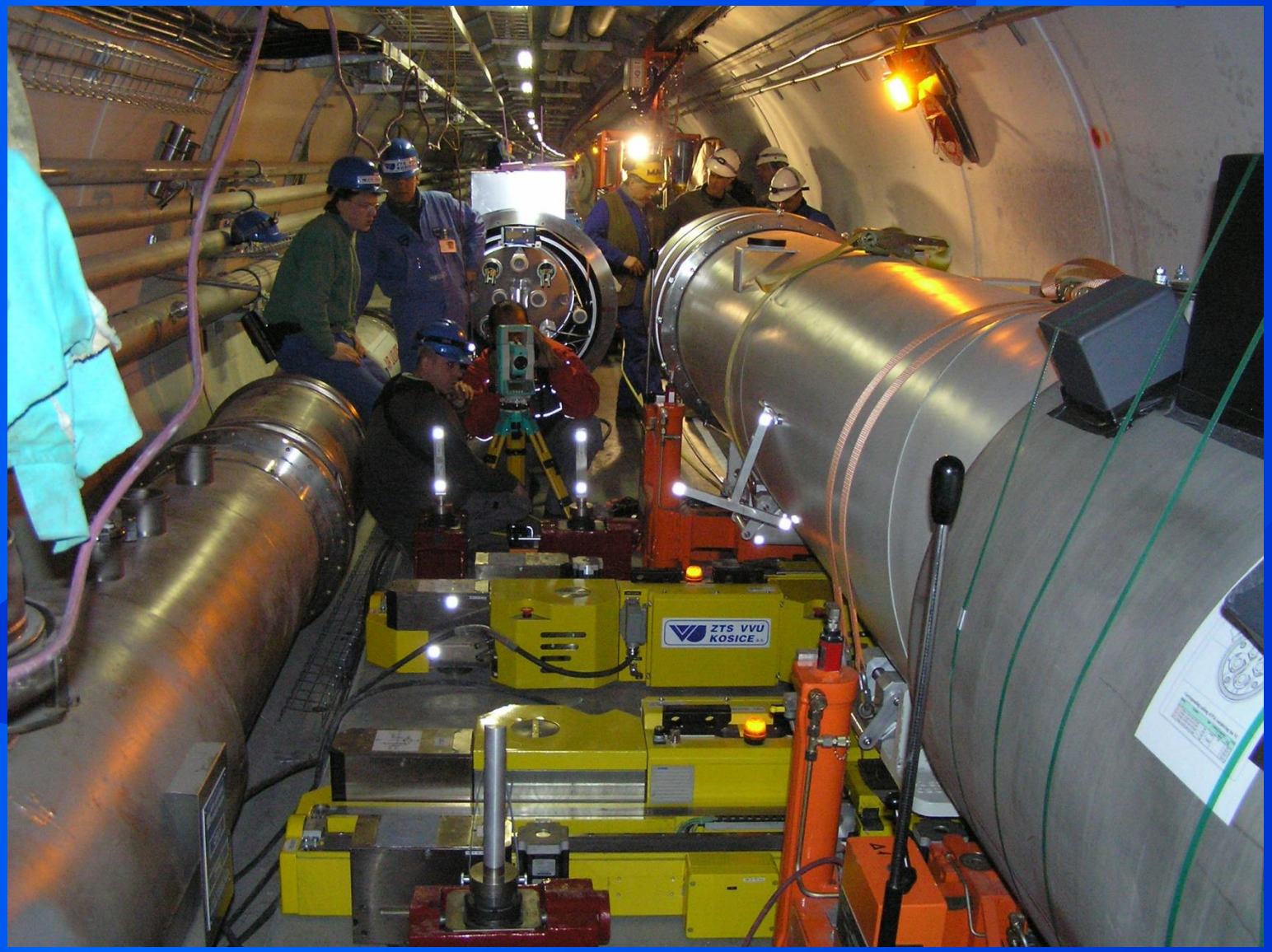
TES – SSS installation, reference points measuring for automatic mode installation



TES – tunnel work, the only way how to get from point to point during cryomagnet installation

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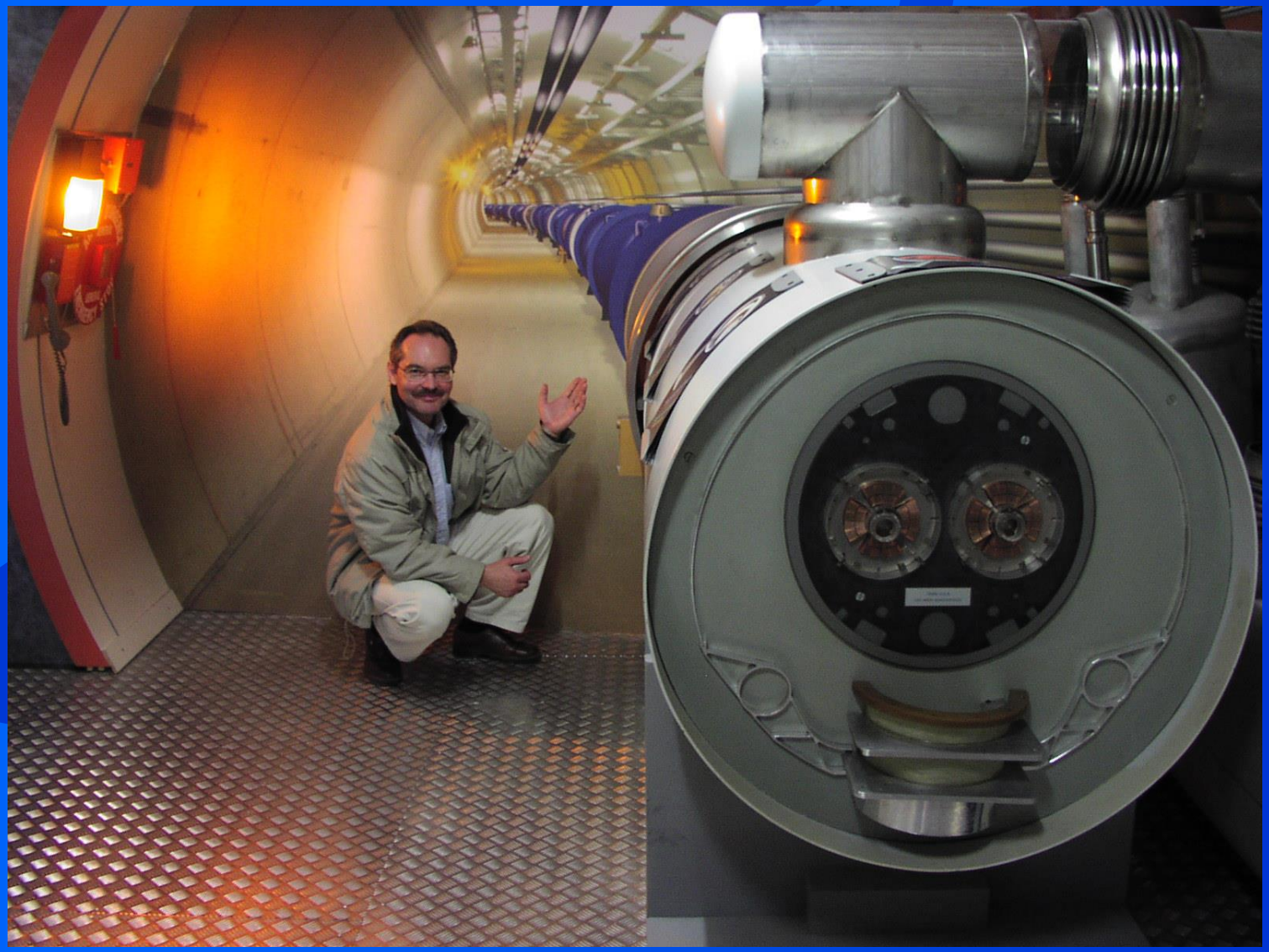
TES – tunnel work, very restricted and thin work place

TES – tunnel work, „lying" in the tunnel

TES – tunnel work, „sitting" in the tunnel

2001 – Former LEP tunnel space prepared for LHC, new generation accelerator technology

2003 – CERN Microcosmos show room: Tunnel 3D animation how it should be!



2006 – Tunnel view, it's done.

2004 – The very first cryomagnet installation, done by ZTS VVU staff, celebration in the tunnel …

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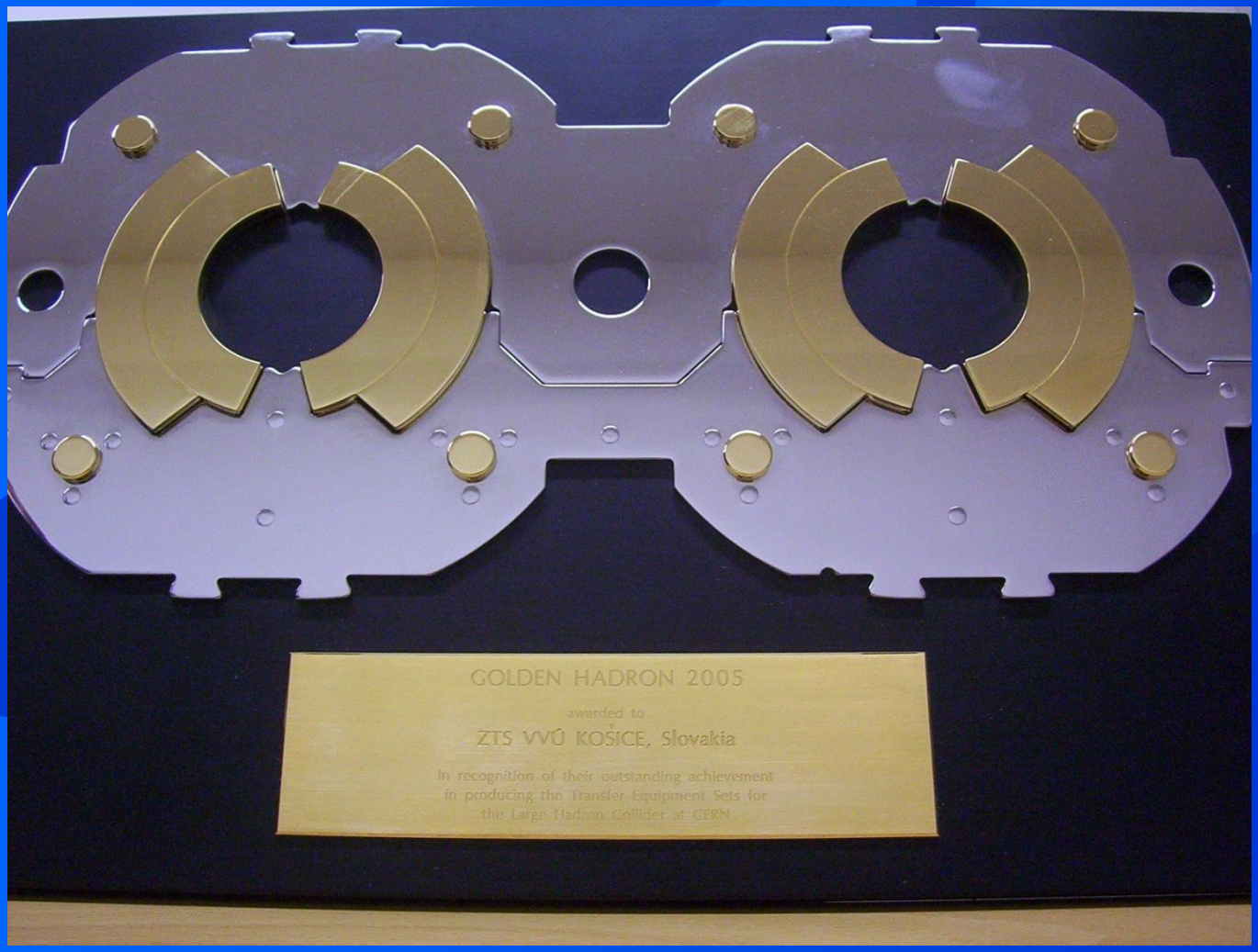
The result of successful hard work in the tunnel:
CERN Award 2005 – Golden Hadron for the best supplier on the LHC project



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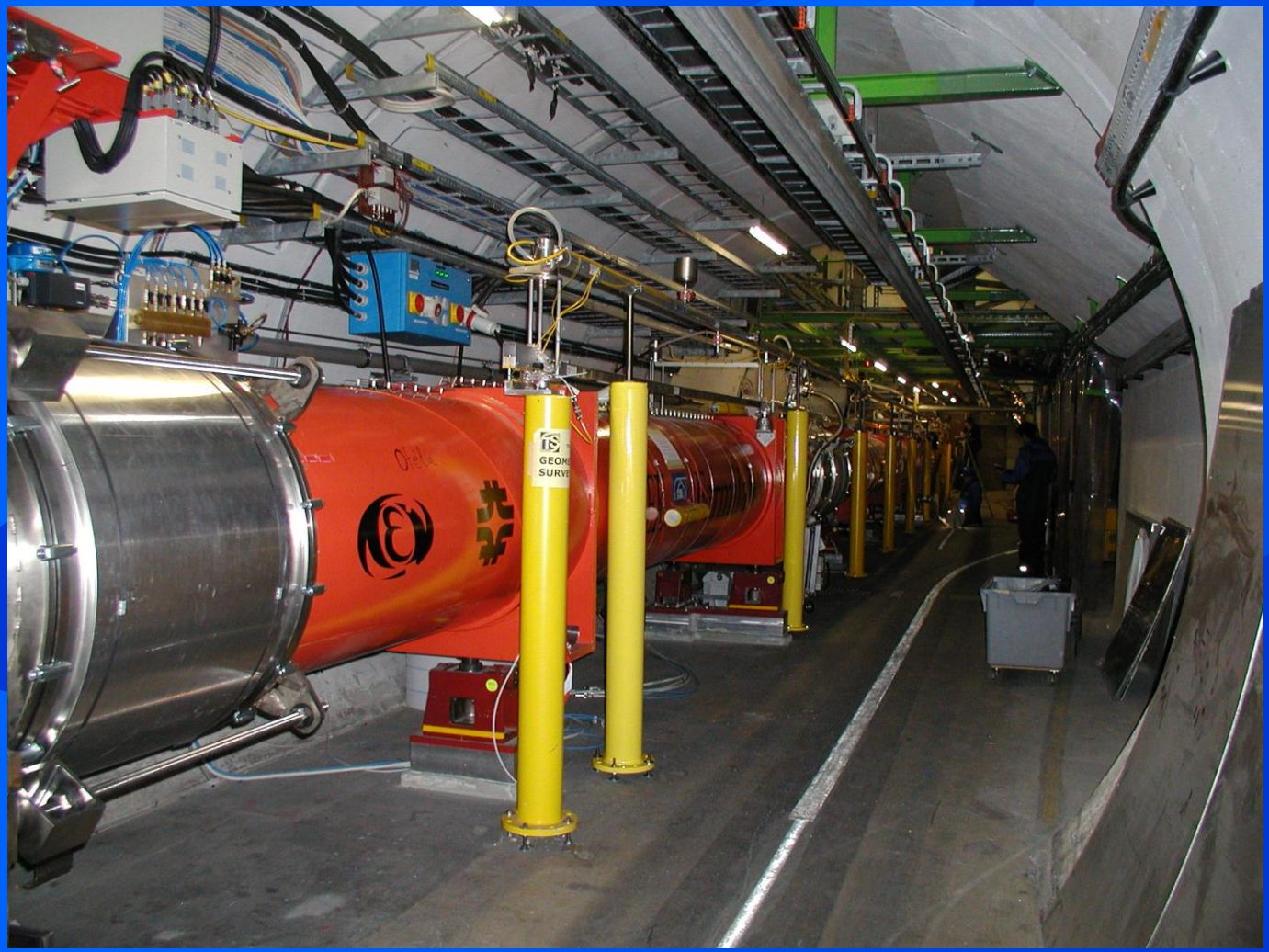
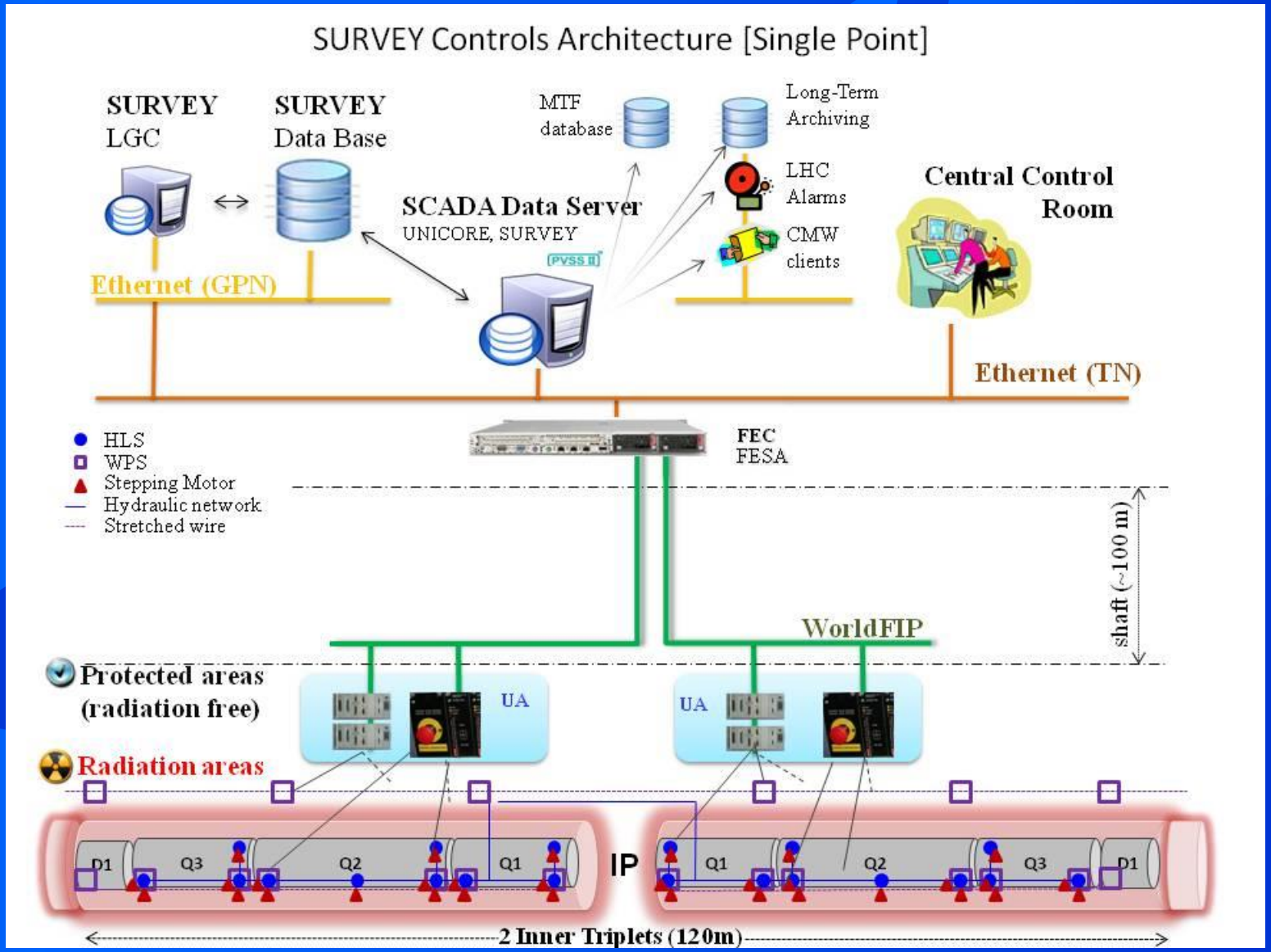
INNER TRIPLETS - LOW BETA QUDRUPOLE POSITIONING

Tender for delivery of 134 Stepper motors and their drivers



Low Beta Qaudrupole positioning – control system layout



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Stepper Motor Assembly:
- 10 um positioning precision
- 6 tons - high payload
- hard radiation resistance

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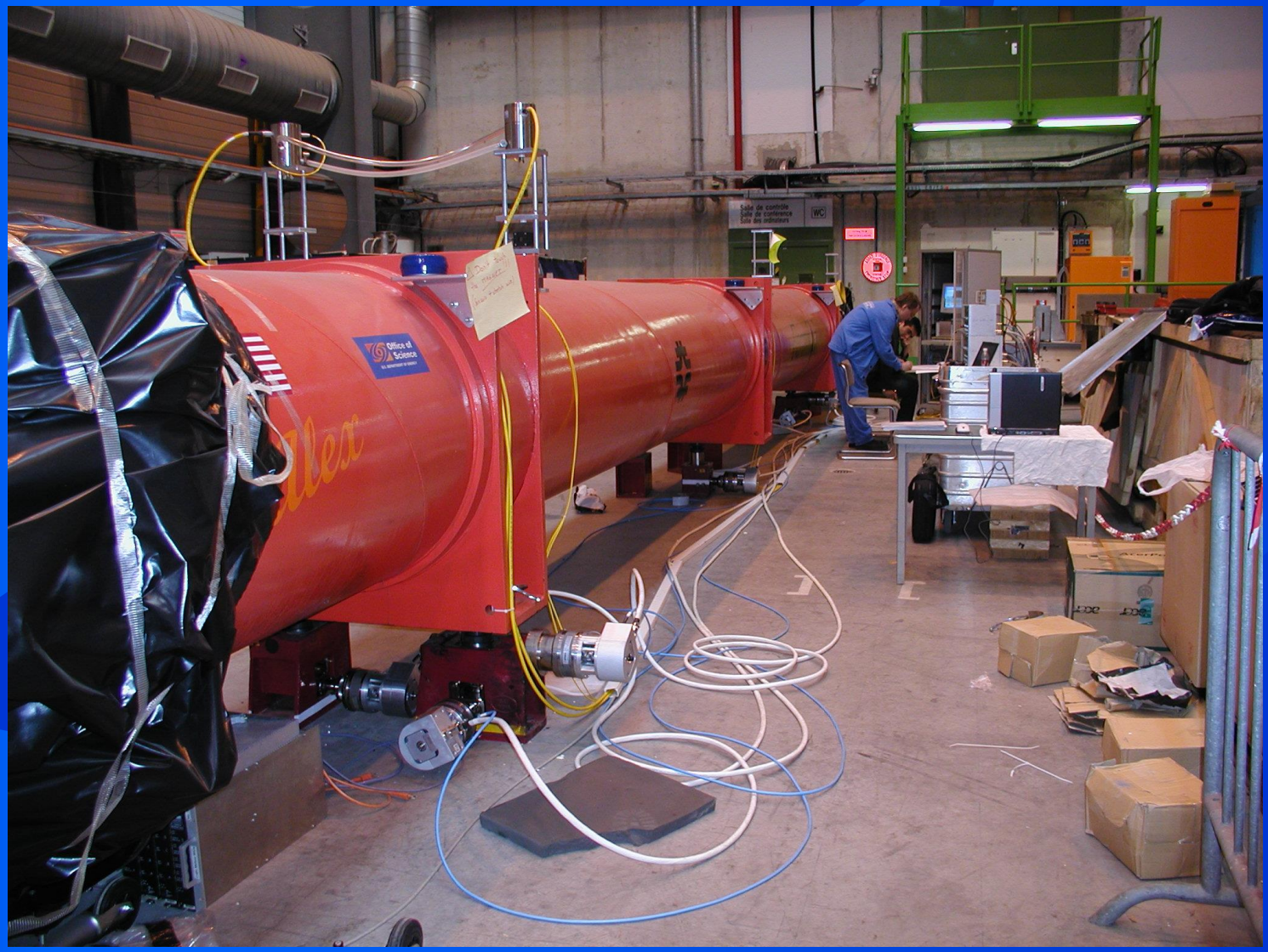
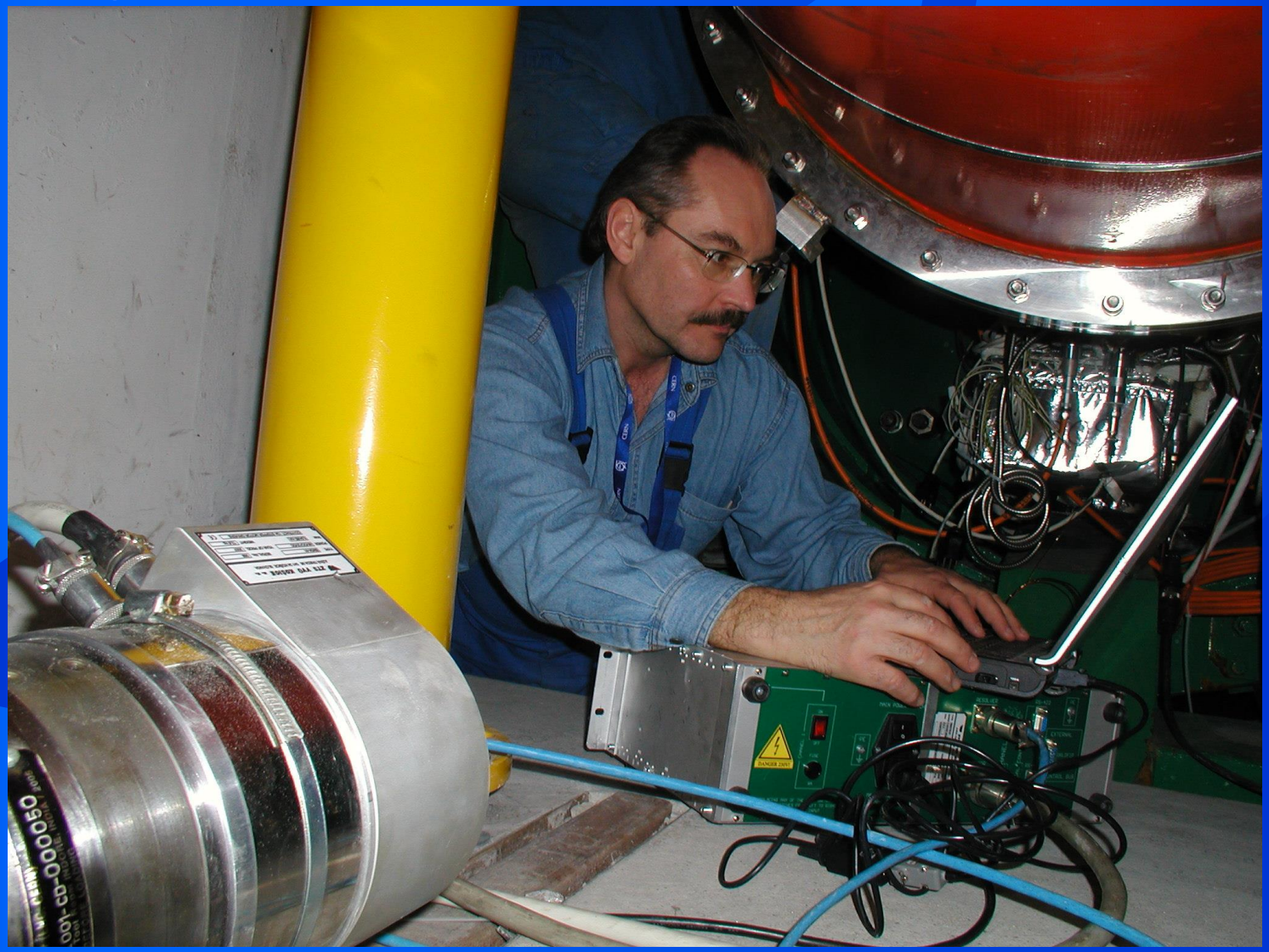
Stepper Motor Drivers:
- 300 m distance between stepper motors and drivers
- position sensor auto calibration function for long cables connection compensation
- WordFIP communication bus with Central Control Room

Stepper Motor & Drivers – tests at CERN laboratory



Stepper Motor Assembly – under magnet installation in the tunnel

Stepper Motor Assembly – under magnet mechanicall calibration



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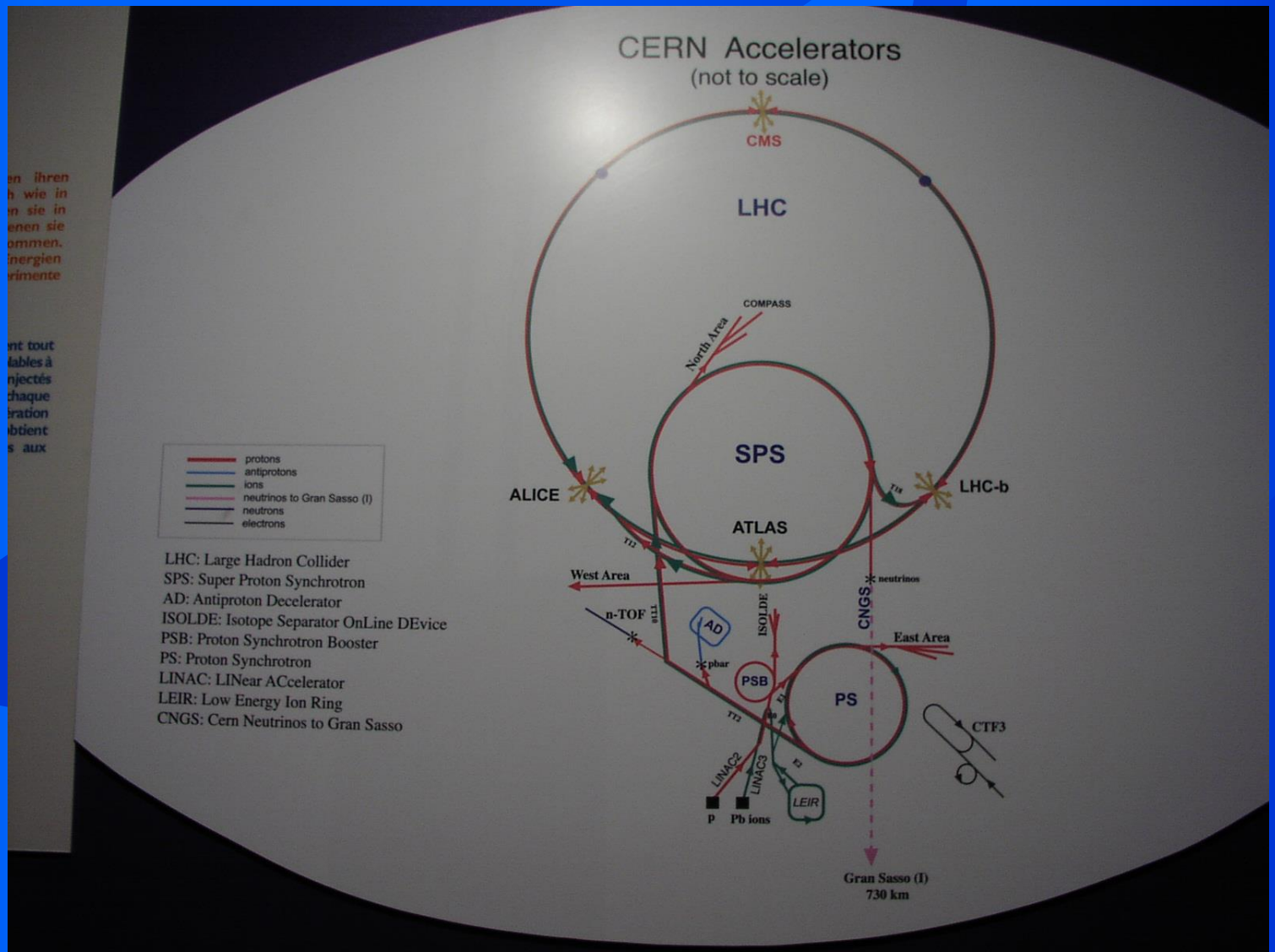
Stepper Motor Drivers – radiation free zone, control system calibration, triplet position system is ready for remote control.

SPS TRACTOR – transport vehicle for heavy load, SPS tunnel technological components and blocks



SPS TRACTOR:

- two independent vehicles / can be operated in tandem with possibility of both side driving
- payload 20 tons / slope 25%
- no computer inside / small dose radiation resistive vehicle

SPS TRACTOR – functional tests, carried out at manufacturer workshop in Kosice
- full load, maximum slope

SPS TRACTOR:
- CERN site functional tests, tandem mode, full load

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SPS TRACTOR – full load + slope test at CERN

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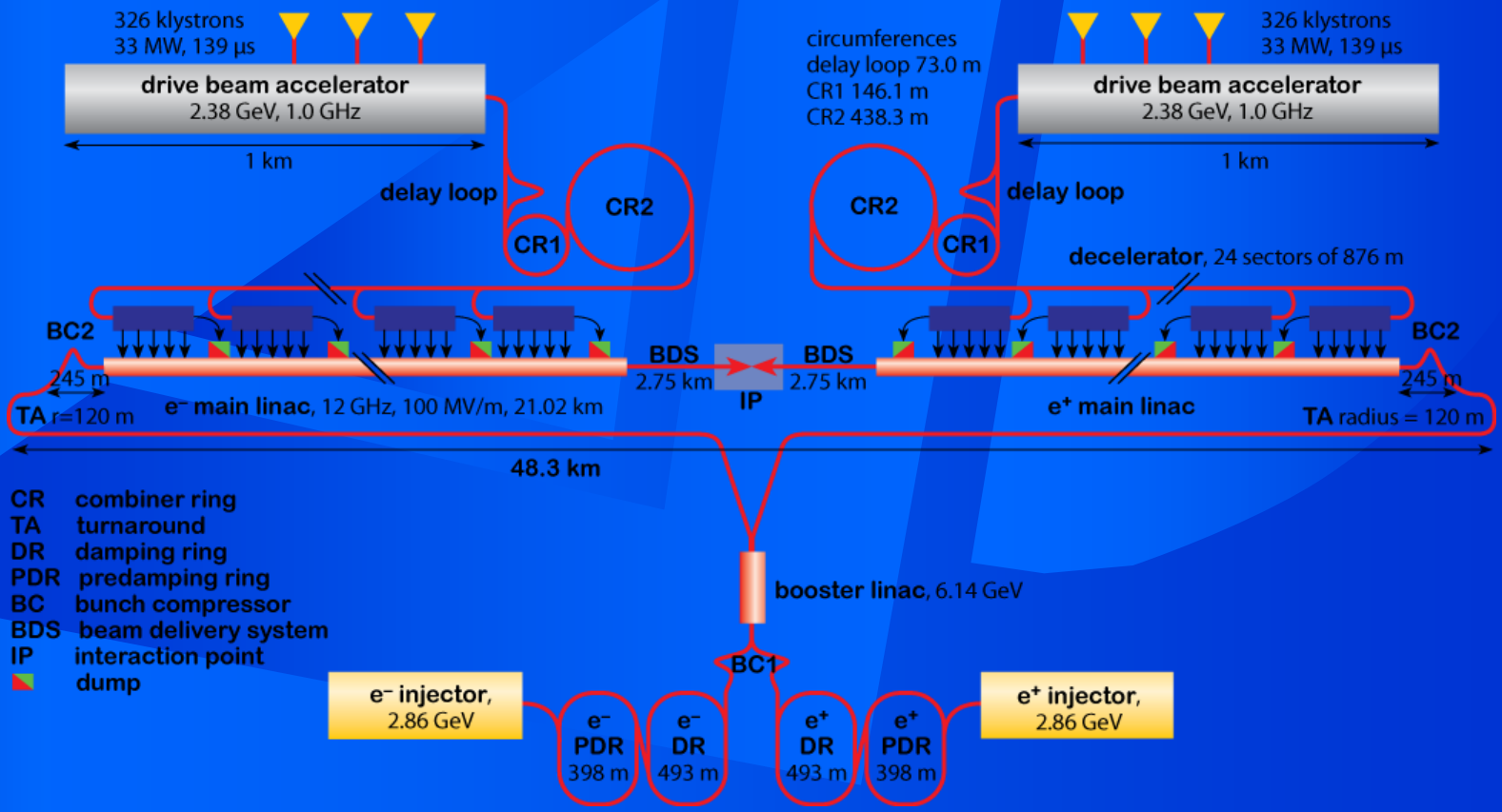
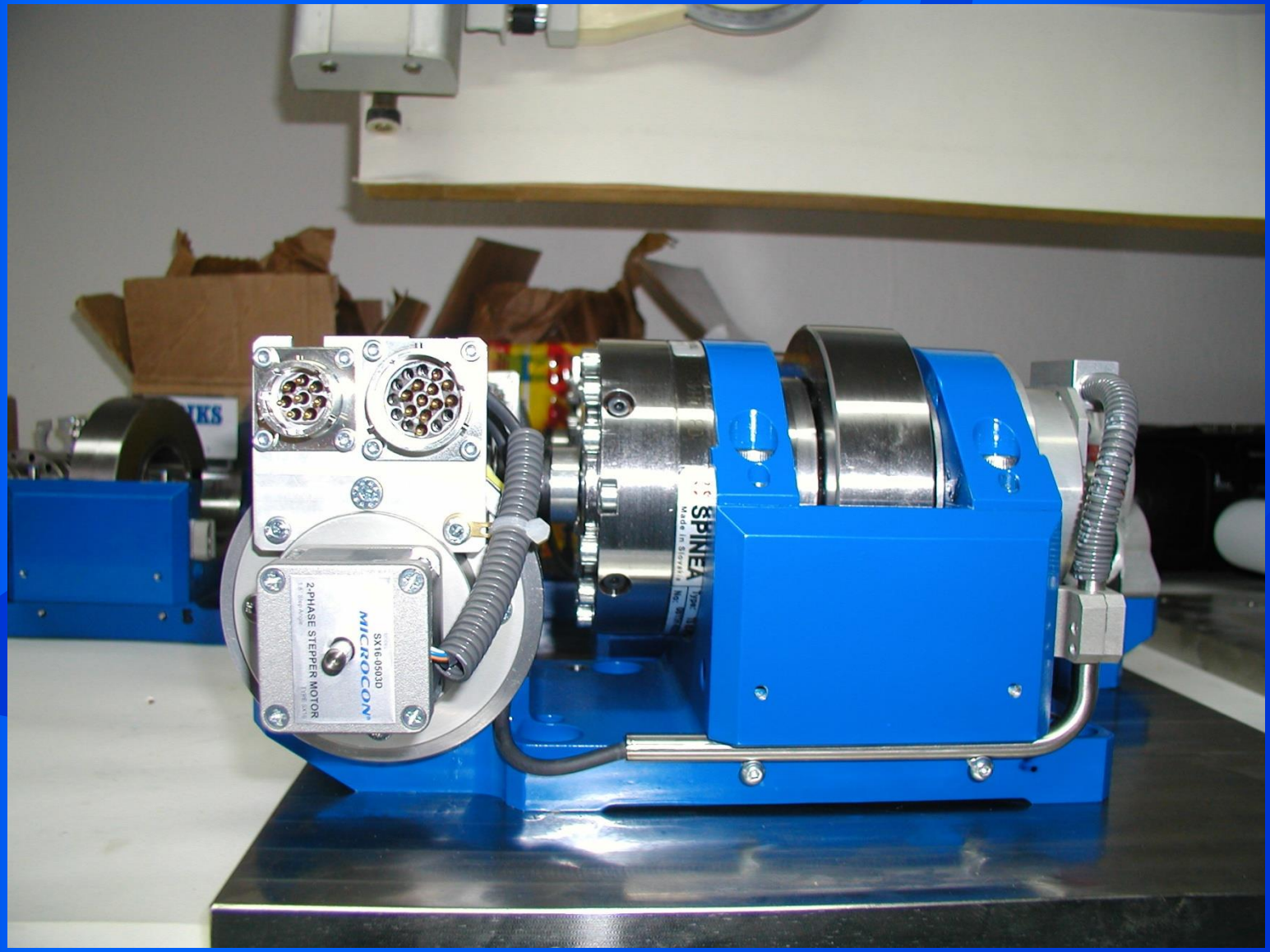
CLIC - Compact Linear Collider

The study of new generation linear collider

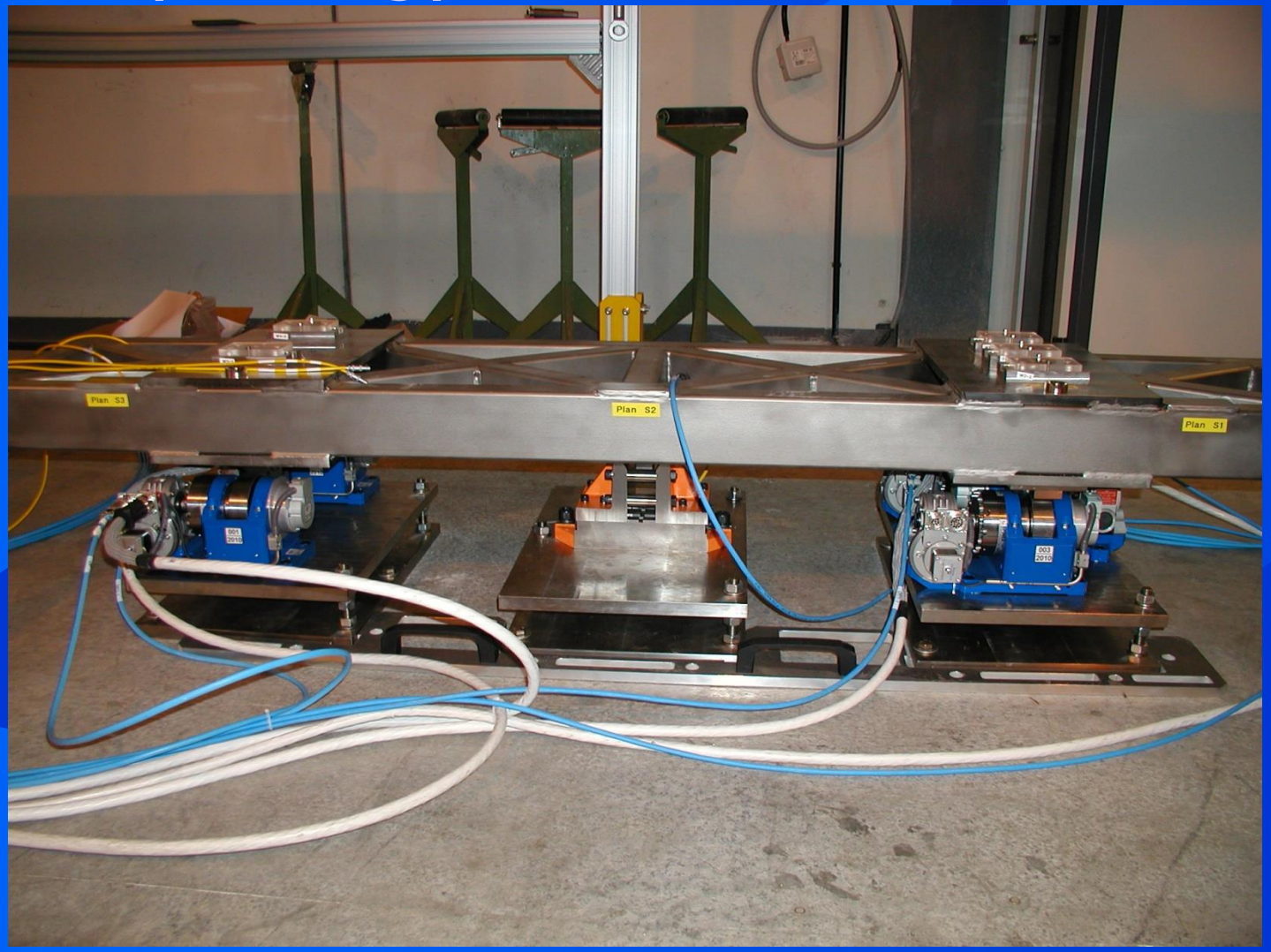
ZTS VVU CLIC study participation – developing of very precise positioning system



CAM MOVER – used for CLIC alignment experiments



CAM MOVER – used for CLIC alignment experiments, + / - 1um positioning precision was reached



LINEAR ACTUATOR & GIRDERS - CLIC SUPPORT SYSTEM

- high position accuracy versus payload ... +/- 1um / 6000N
- hard radiation resistance
- long cable connection / more than 50m
- position sensor auto calibration / cable length compensation
- compact modular control system

TESTS AT THE ZTS VVU KOSICE WORKSHOP

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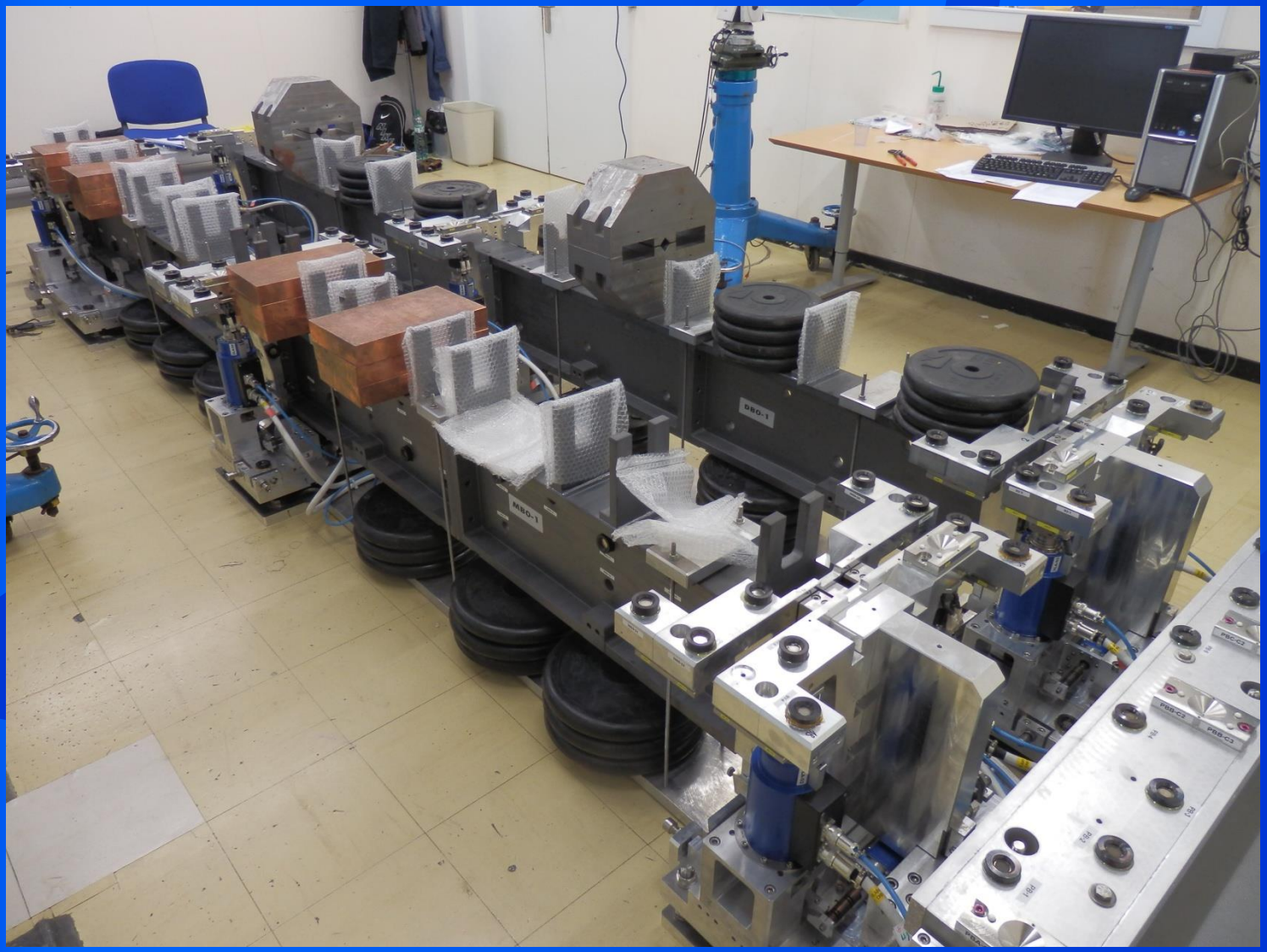
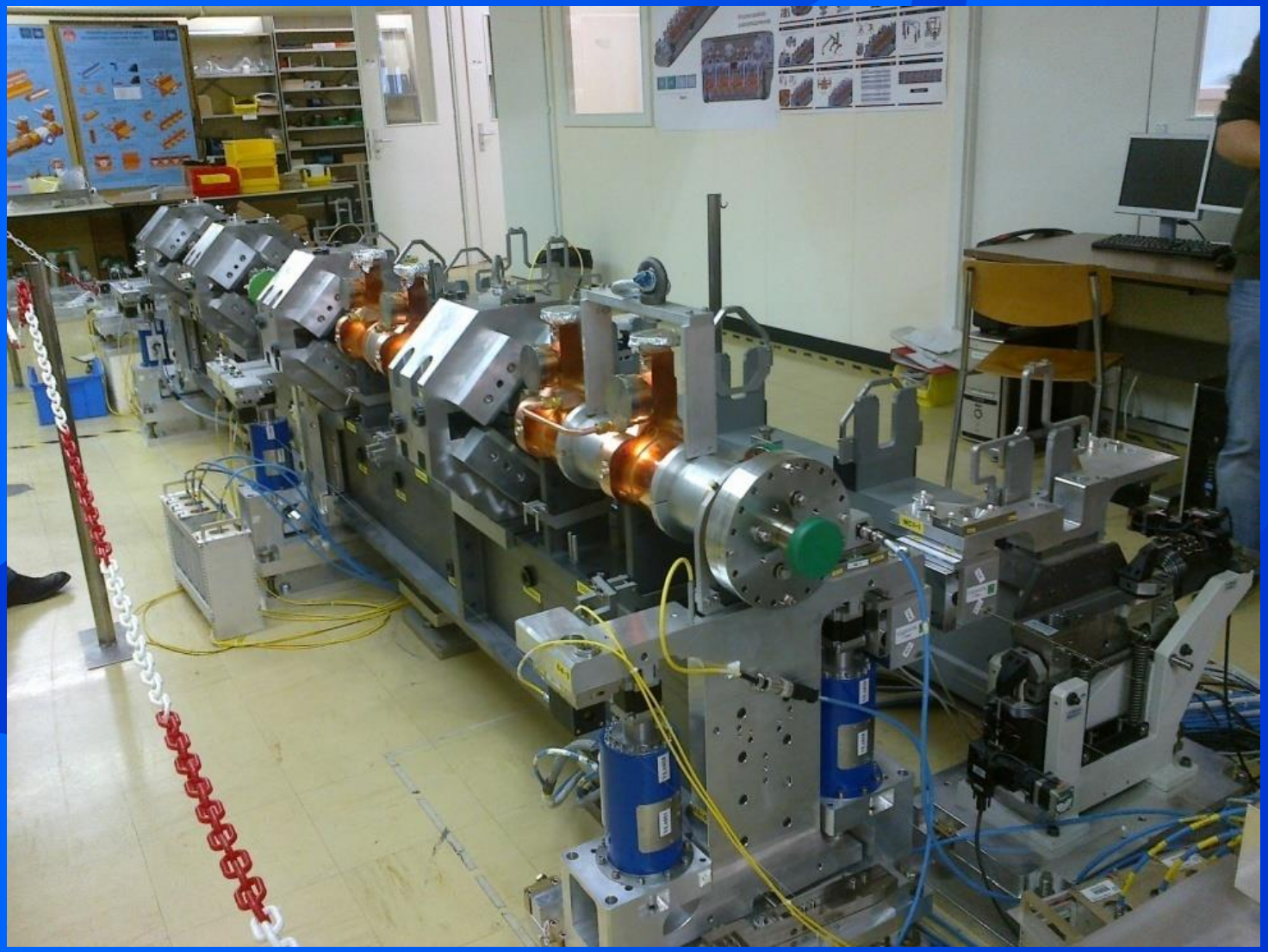
CLIC SUPPORT SYSTEM – tests at CERN laboratory / full load



ZTS WÚ KOŠICE a.s.

CLIC SUPPORT SYSTEM – tests at CERN laboratory



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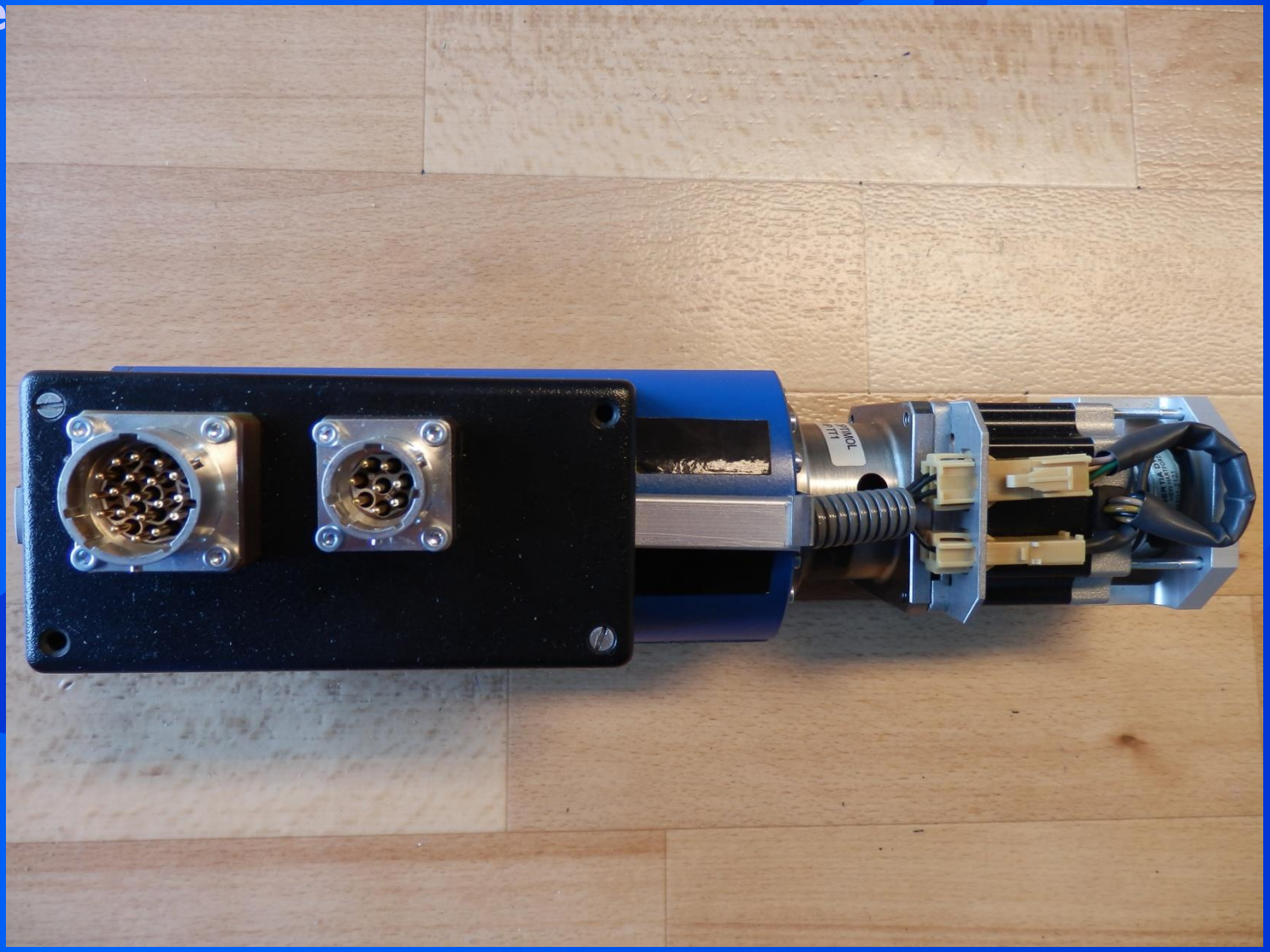
LINEAR ACTUATOR – COMPACT CONTROL SYSTEM

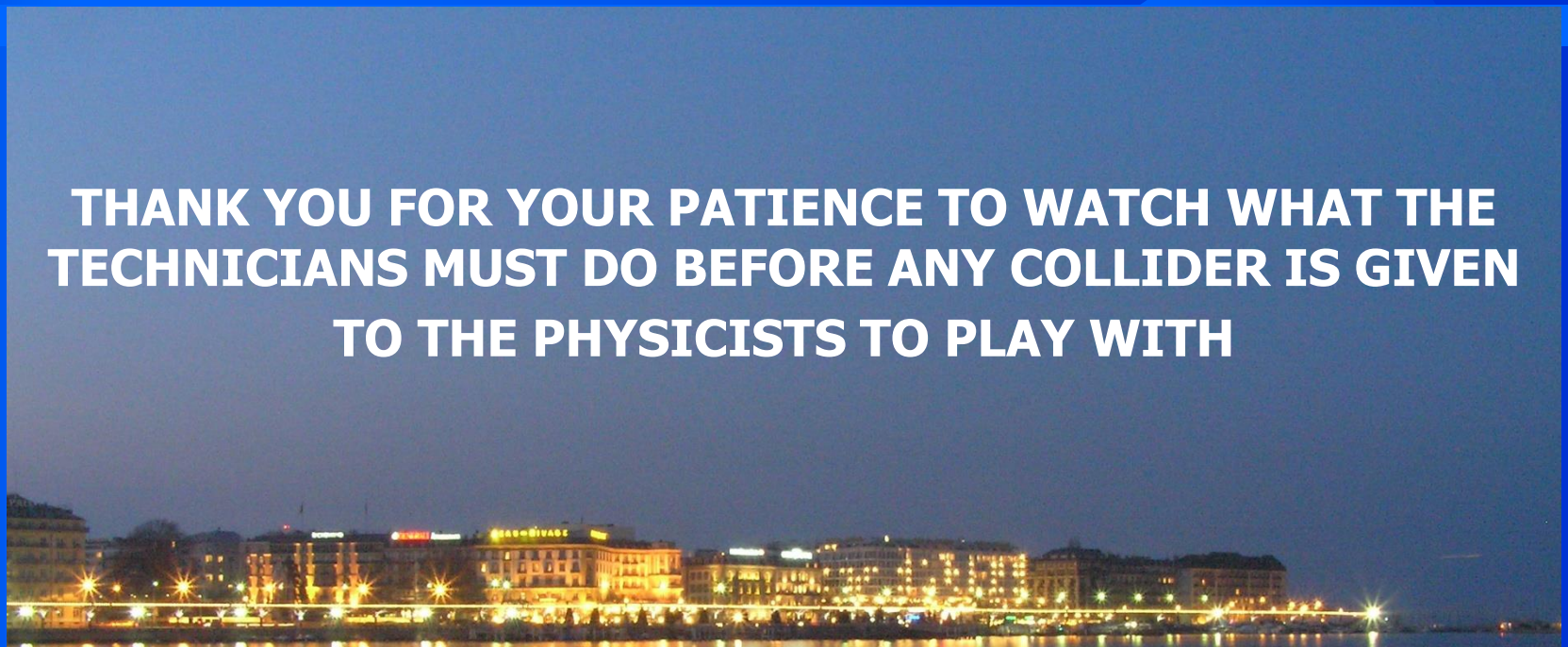
- one subrack = 8 channels
- modular system can be expanded up to 64 channel for one network address
- very easy & simple connection with actuator

LINEAR ACTUATOR – before radiation test

LINEAR ACTUATOR – after radiation test / 10 years cumulated dose



THANK YOU FOR YOUR PATIENCE TO WATCH WHAT THE TECHNICIANS MUST DO BEFORE ANY COLLIDER IS GIVEN TO THE PHYSICISTS TO PLAY WITH



GENEVA LAKE VIEW

See you next time – may be in the tunnel?

THANKS