Collimation Remote Handling

Highlights from work for collimation remote handling and remote survey. Plans

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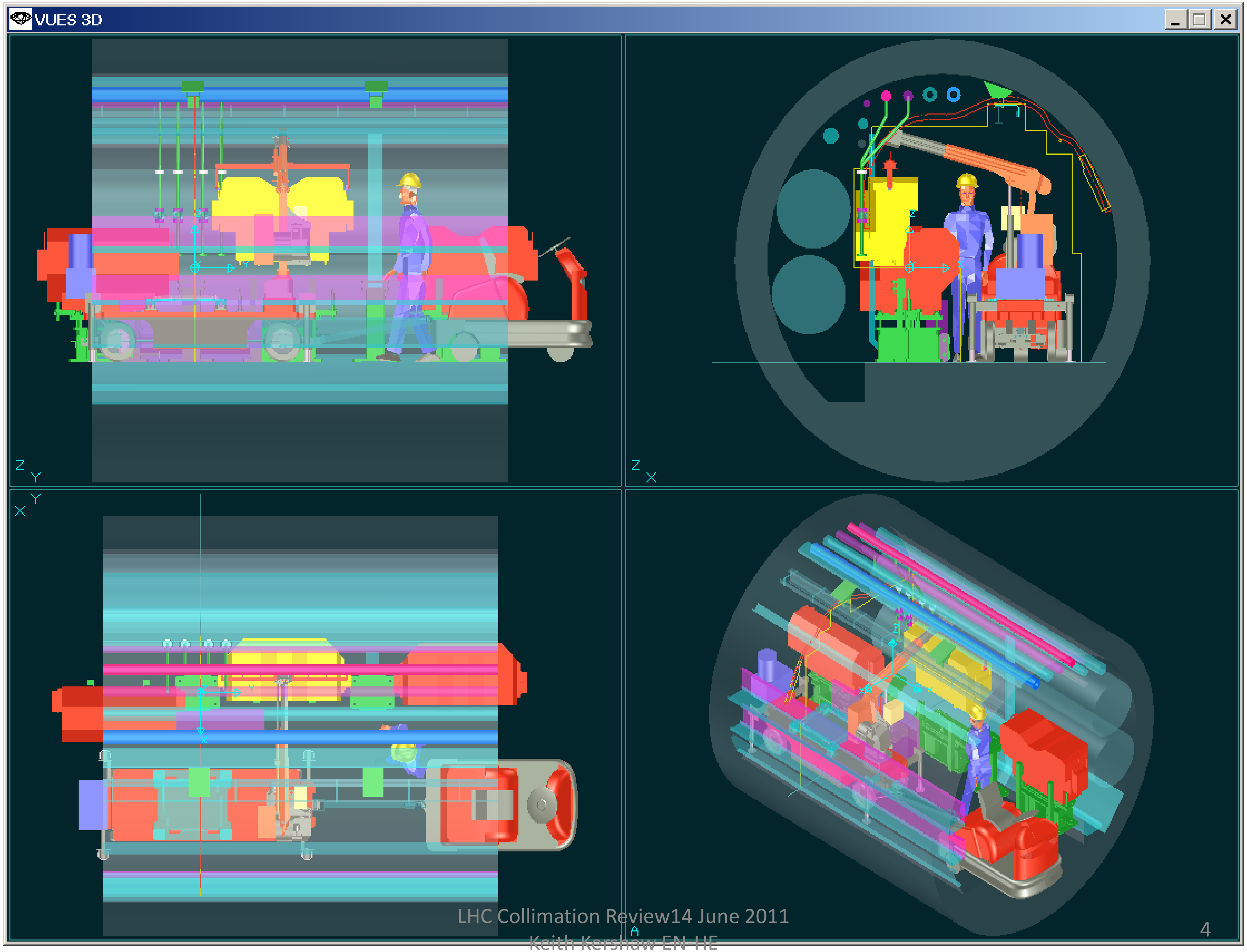
Contents

- Introduction
- Four areas of work as proposed and agreed in 2010

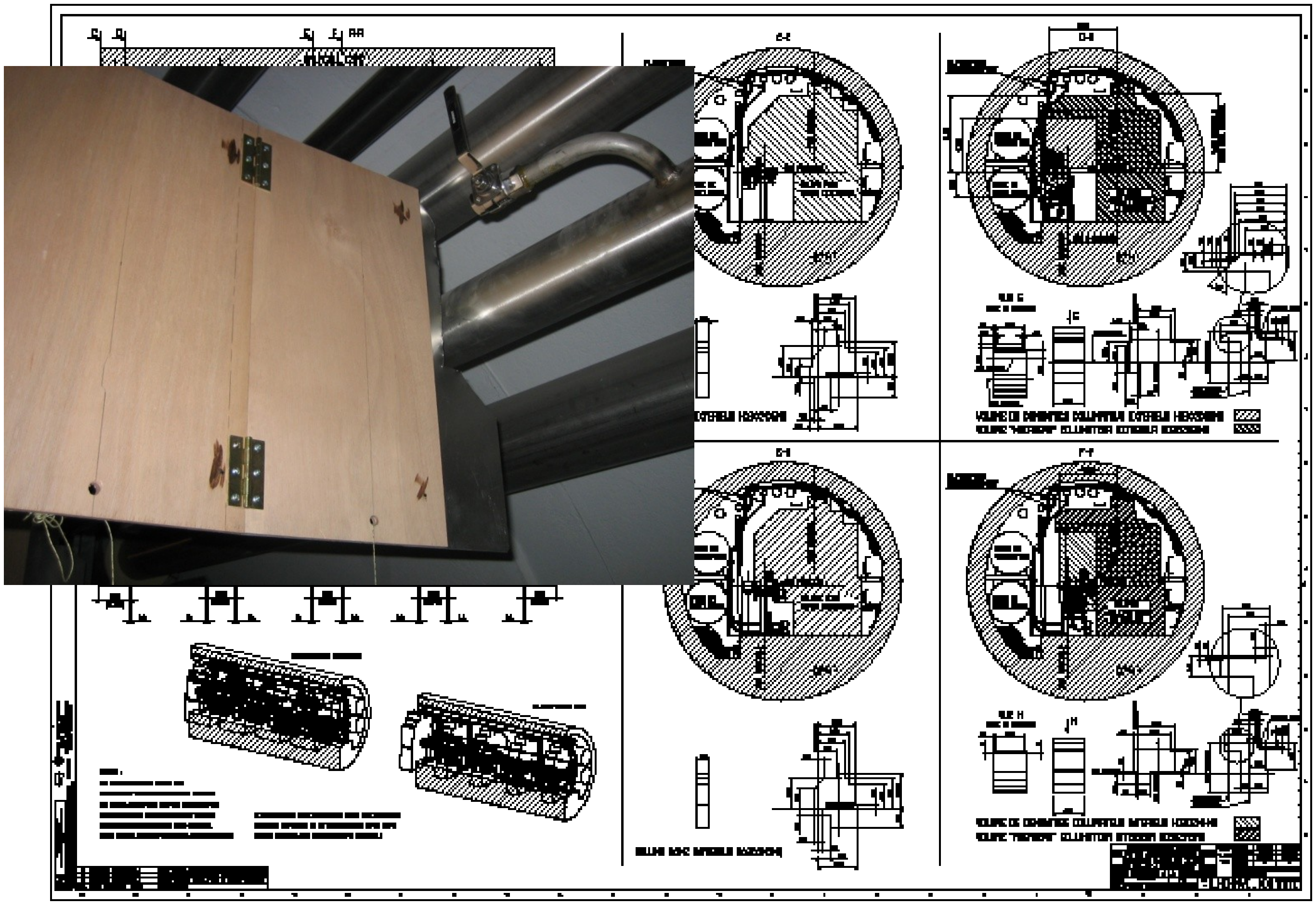
First mock up tests – remote handling of collimator

Dummy collimator installed on base using modified truck loader crane fitted with hoist and spreader rotation.

Operation with only camera viewing and remote controls


VUES 3D
Z
Y
Z
X
Y
X

Reserved space for collimator handling LHCHMUMC_0001



Implications for infrastructure

Implications for collimator dimensions

It was necessary to modify water pipes

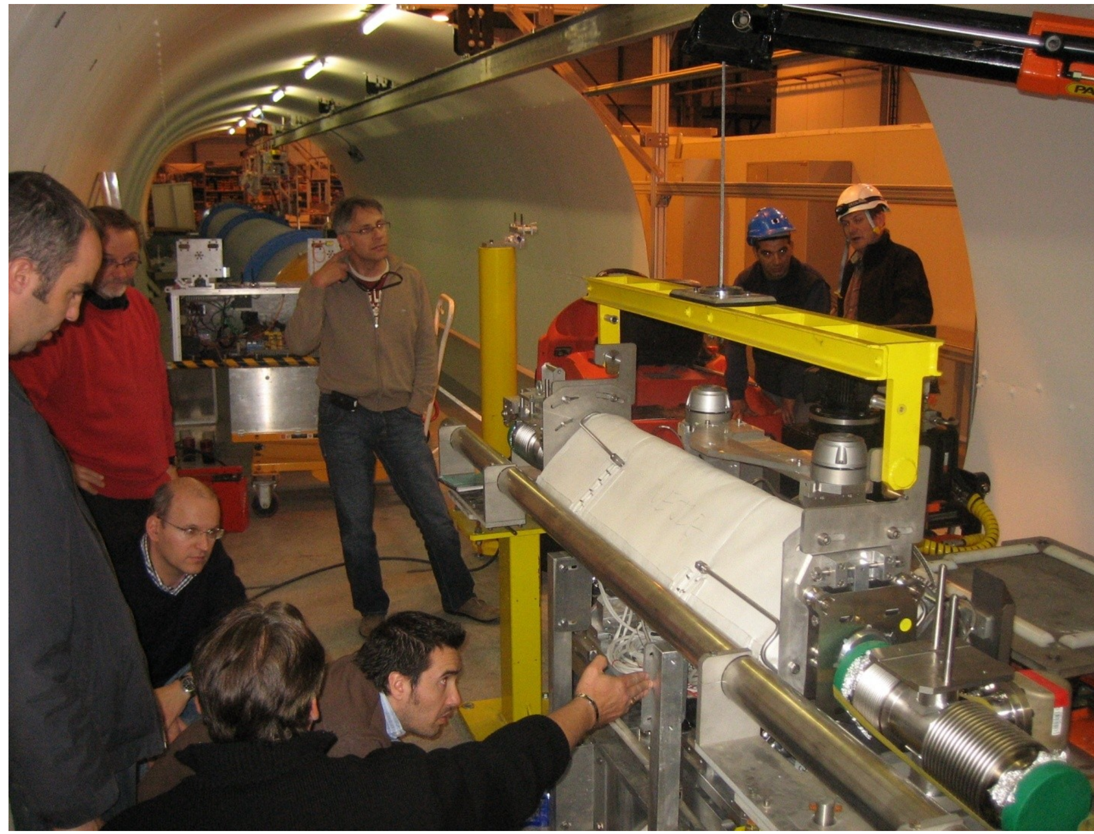
Installation using specially designed trailer cranes

Plug – ins:

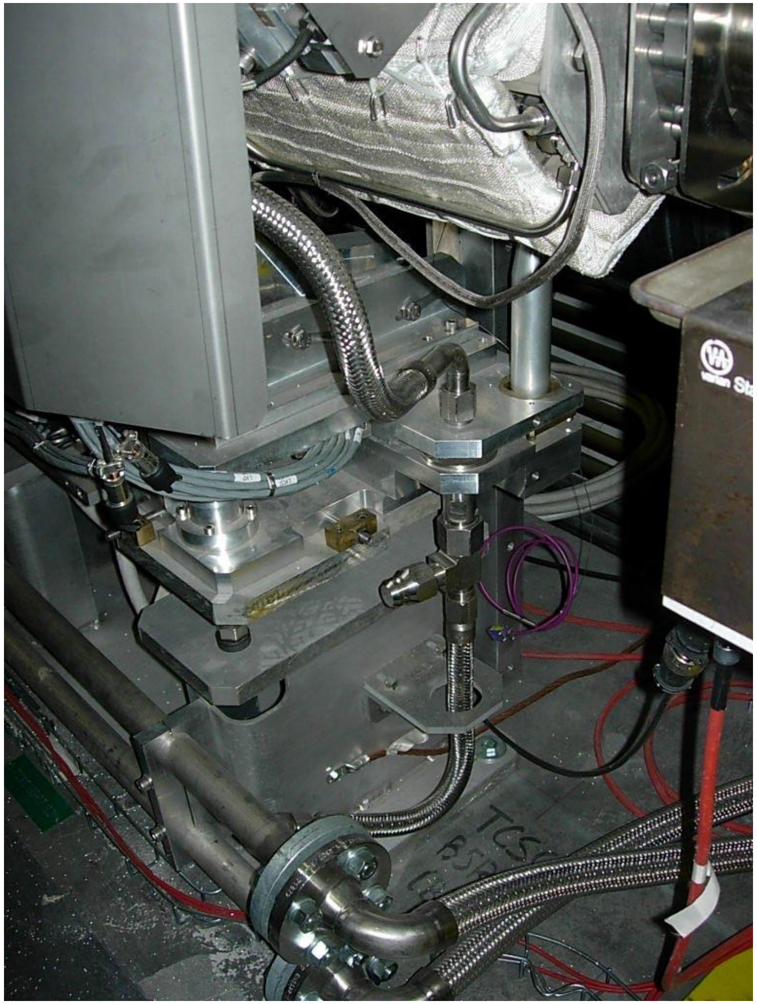
Close observation + careful guidance during LHC installation (not ideal for the future)

Plug-in behaviour tests 2010

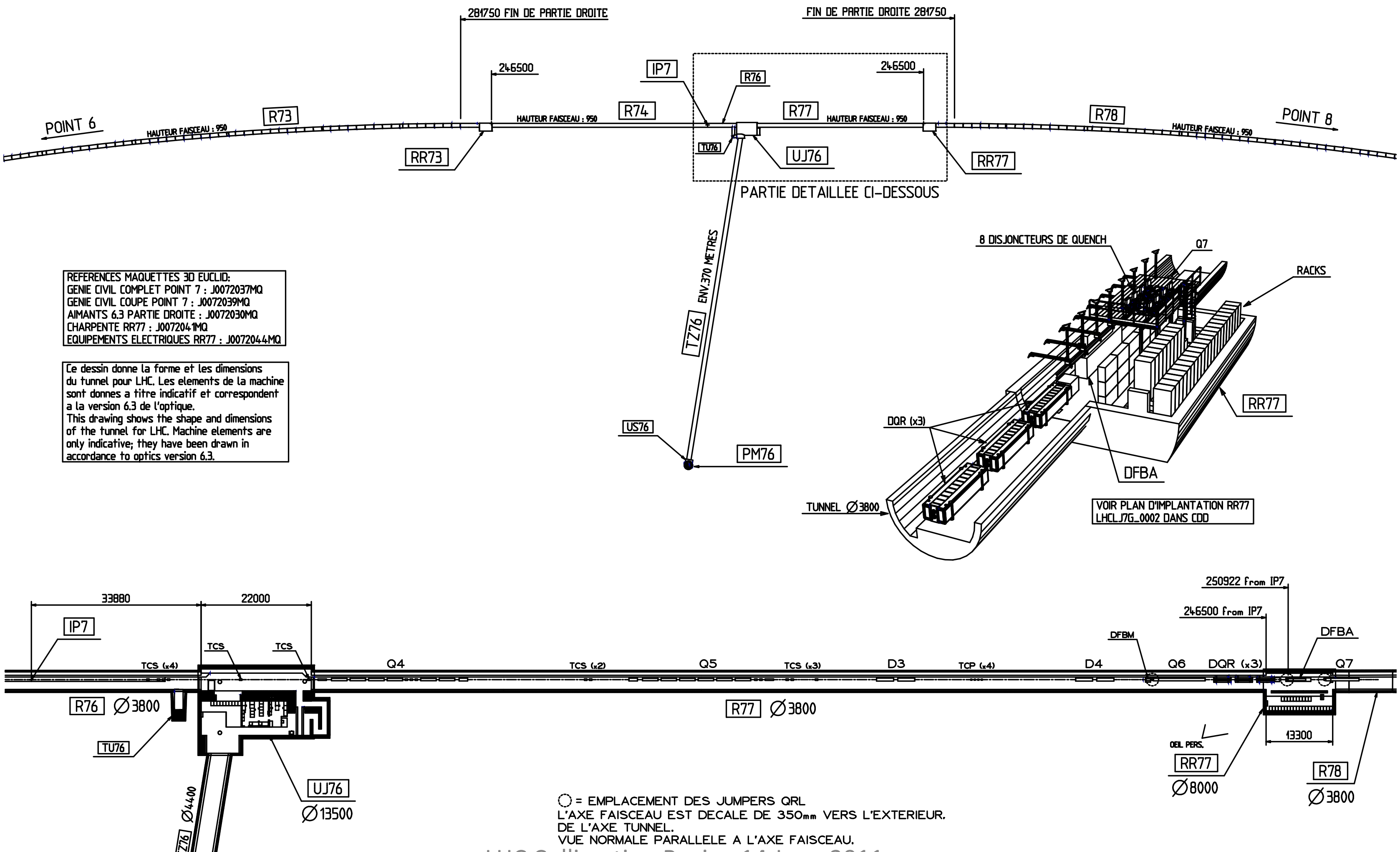
Practical investigations in LHC tunnel mock-up by EN-STI, EN-MME and EN-HE.



Water plug - ins



Infrastructure P7 (need to pass via TZ76)



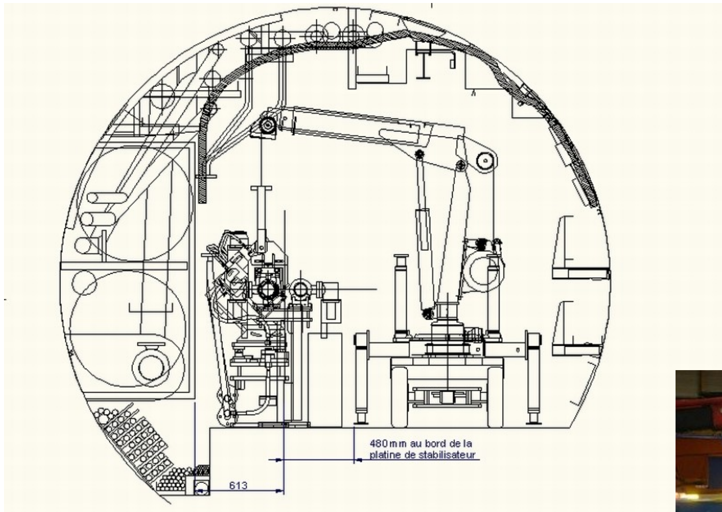
Passage at point 7

-

Improvement of entry to UJ 76. Need to move grille

Shorter push-pull bar and push attachment point on Palfinger

1000kg trailer - crane



- Custom design for collimator handling
- Increased capacity
- Better control with radio control
- Asymmetric stabilizers to reduce width

Safety checks at the factory

Stability tests at 125%

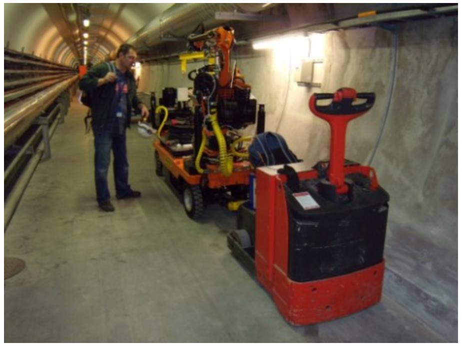
Spreader beam load test

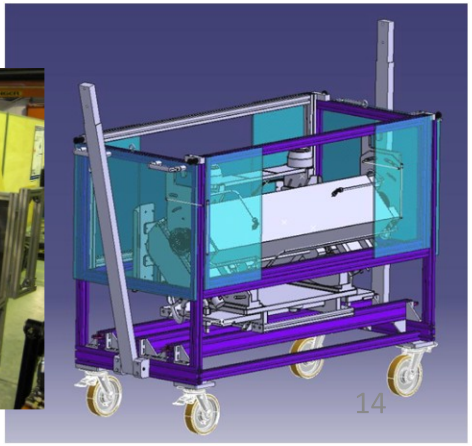
EN-HE radioactive collimator handling equipment development work 2010 onwards

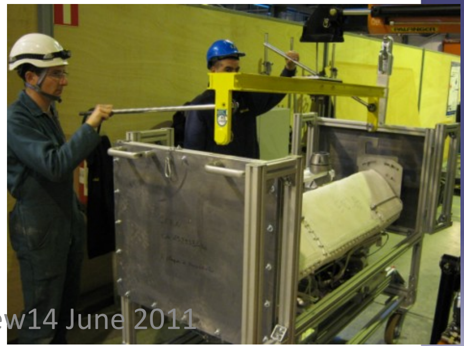
1. Optimisation of collimator transfer etc
2. Remote collimator exchange crane vehicle
3. Vacuum disconnection mobile robot
4. Remote alignment survey (CERN Survey team project)

1) Optimisation of collimator transfer

- Improve remote controls on the two existing 500 kg trailer cranes.
- Compact shielded tractor units to tow the trailer cranes
- Partially shielded trailers for transporting collimators (weight restricted by LHC point 7 1 tonne lift)
- Additional 1000kg capacity trailer crane
- Minor infrastructure modifications to improve passage.





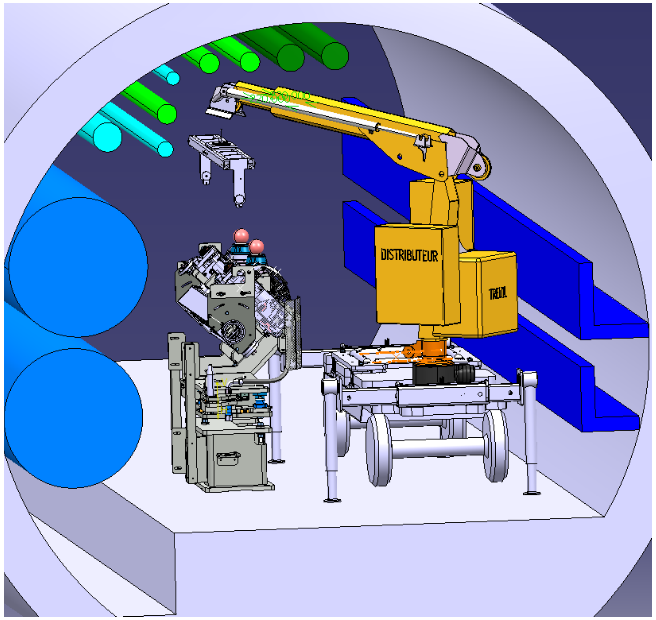


Collimator remote exchange crane vehicle

- 1000kg load capacity
- Remote control of all movements
- Powered rotation of spreader
- Powered extension of stabilisers
- Powered traction
- Powered steering
- Powered from monorail in tunnel (MAFI-type trolley)
- Possible to tow out in event of breakdown

Market survey sent out last week

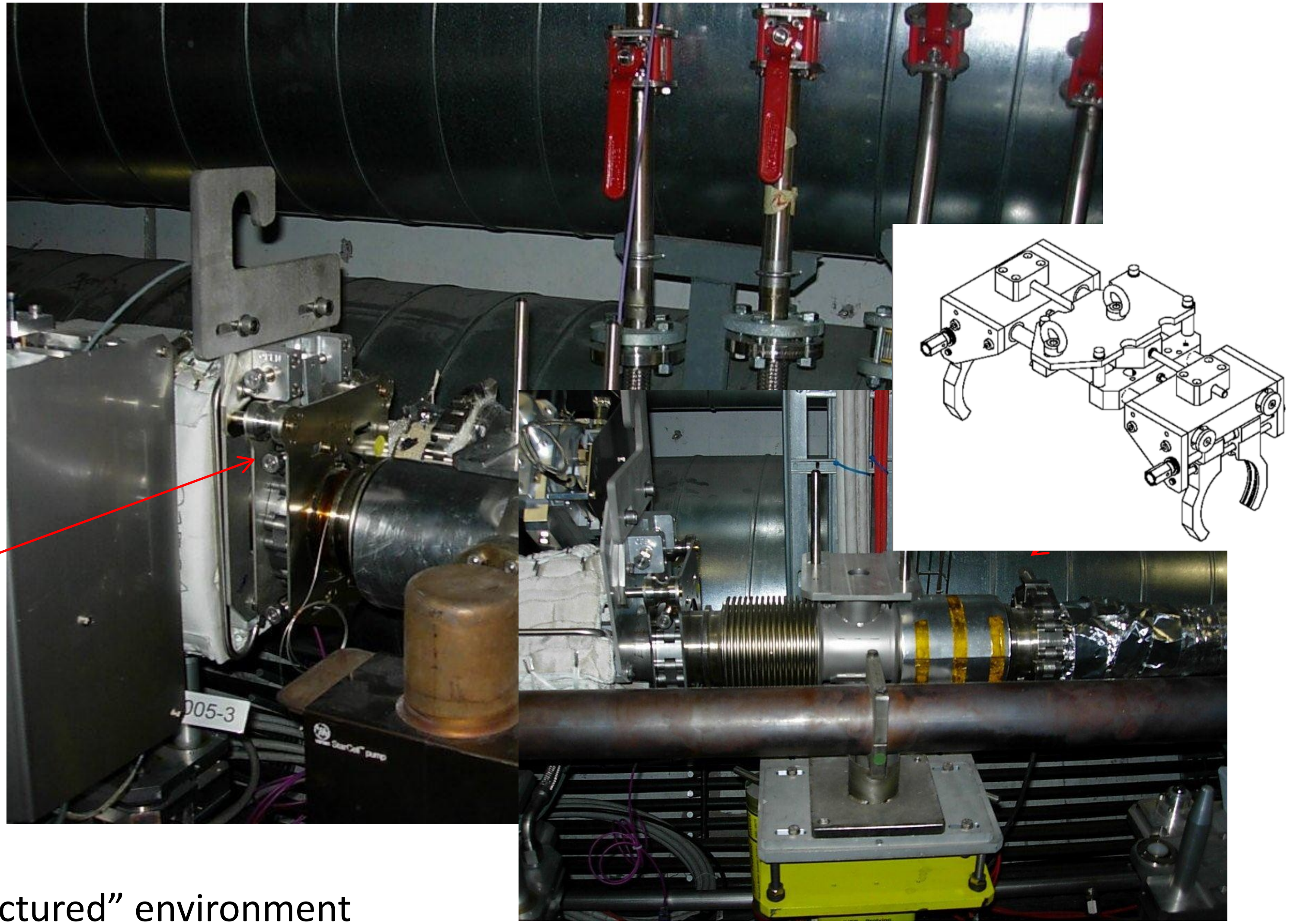
Delivery end 2012



3) Vacuum disconnection mobile robot

- Studies and tests in 2011- 1012
- Then major purchases of equipment in 2013-2014

Collimator connections

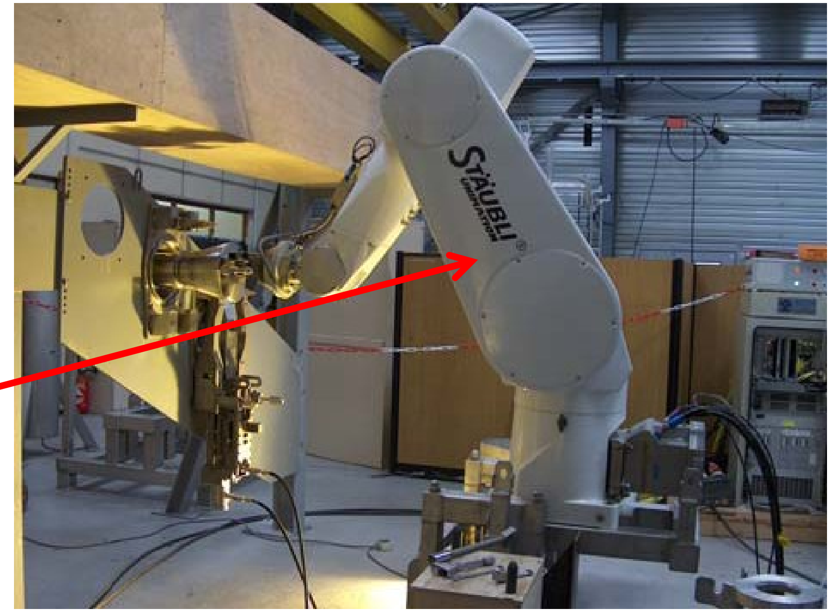


Turn nuts
to release

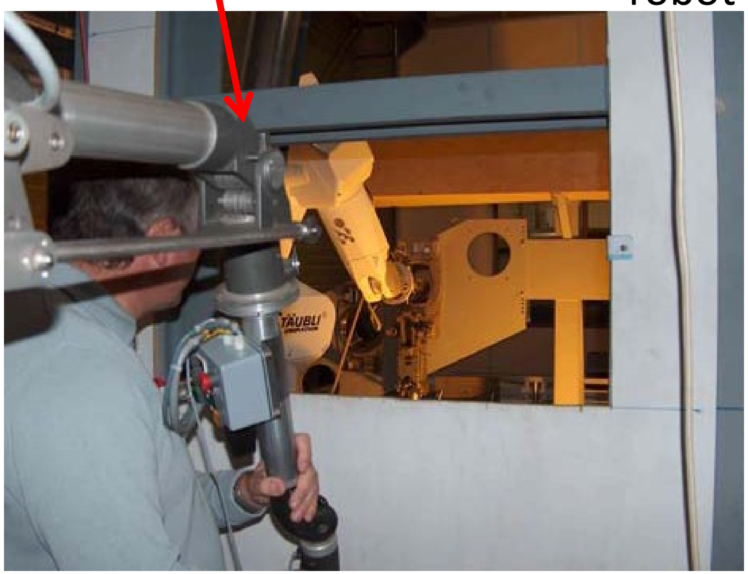
“unstructured” environment

Vacuum disconnection mobile robot

Basic idea for cost estimation:
Industrial robot controlled using force-reflecting master arm mounted on remote control vehicle



Pictures show CEA LIST master arm used with Staubli robot



Remote control vehicle (Kuka shown)

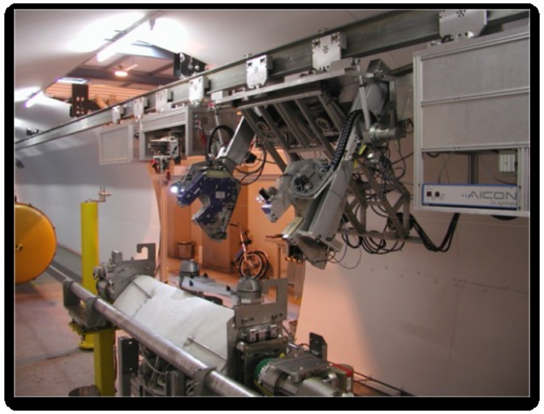
CEA pictures from: Overview of remote handling technologies developed for inspection and maintenance of spent fuel management facilities in France: Philippe DESBATS (CEA-LIST), Gérard PIOLAIN (COGEMA-HAG/DMCO).

Collimator remote disconnection development issues

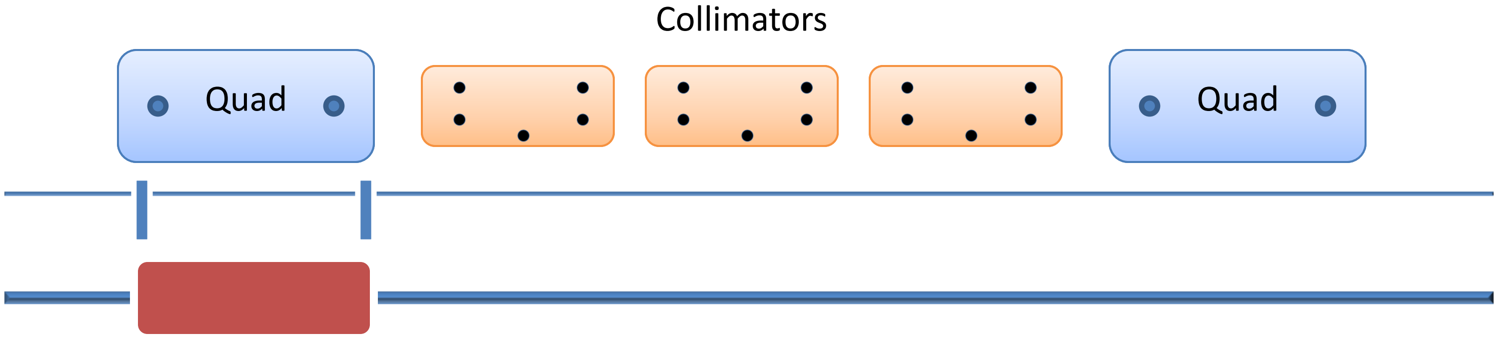
- Determine level of remote handling sophistication and viewing necessary for task (mock up trials)
- Determine geometrical requirements (CATIA etc)
- Navigation and communication issues (EU Marie Curie Fellow)
- Review – options, radiation dose implications, risks etc (case for EU Marie Curie fellows – jointly with RP)

4) Collimator Remote Alignment Survey

(joint project with CERN Survey team)

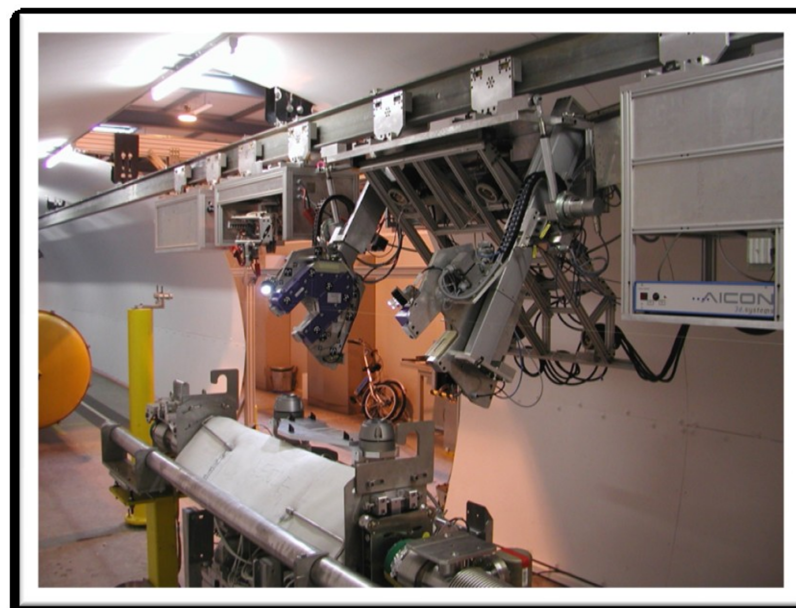


- Train running on overhead monorail (TIM)
- Measurement based on a combination of:
  - Digital close range photogrammetry
    - Fast and non contact measurement of the activated collimators
  - Wire offset measurements to detect train position and link the different aquisition volumes.
    - Reliable straight reference over long distances



Tests

- Benchmark test with real size mock-up
  - System repeatability is well below 0.1mm
  - Comparison of measured and theoretical coordinates (coming from Laser Tracker measurements)
  - Precision better than 0.2mm and already within specs but still some optimisation margin
- Finalising system for first measurements in IR7 during the winter stop 2011/2012
- Preparation for IR 3
- Continuous optimisation and development process will follow



Tunnel infrastructure preparation

- Tunnel infrastructure for IR7 complete
  - 10 pillars
  - 5 overlapping wires
  - Sag modelling
  - 350 Optical targets in place and measured
  - Train tested in IR7
  - IR 3 installation in preparation

Conclusions

- Long-term projects with much preparation work already done to allow use of remote techniques
- Programme of work continues to further optimise handling and measurement in order to reduce radiation doses

Any Questions?

Acknowledgements:

- P Bestmann
- J-M Chevalley
- C Charrondiere
- A Coin
- F Delsaux
- T Feniet
- J-L Grenard
- C Hazelaar - Bal

Extra slide

Collimator exchange with reduced access time

Actions	Time per person (min)	Individual Dose / Person						# of Persons
		1h	8h	1d	1w	1m	4m	
Transport material	2	0.014	0.009	0.005	0.001	0.001	0.000	2
Close manual water valve	1	0.035	0.023	0.019	0.011	0.006	0.003	1
Connect water circuit to pressurized air	1	0.035	0.023	0.019	0.011	0.006	0.003	1
Purge water circuit with air	5	0.130	0.076	0.048	0.018	0.011	0.006	1
Position transport material	2	0.066	0.041	0.032	0.017	0.009	0.004	1
Fix lifting equipment to collimator tank	3	0.210	0.170	0.134	0.086	0.048	0.020	2
Lift the collimator	2	0.070	0.046	0.038	0.022	0.012	0.005	1
place the collimator on the transport unit	2	0.066	0.041	0.032	0.017	0.009	0.004	1
Move the faulty collimator	1	0.026	0.015	0.010	0.004	0.002	0.001	1
Position replacement collimator	1	0.033	0.020	0.016	0.008	0.005	0.002	1
Fix lifting equipment to collimator tank	3	0.098	0.061	0.048	0.025	0.014	0.006	2
Lift the collimator	2	0.076	0.054	0.043	0.024	0.014	0.006	1
Install the collimator with quick plug in	5	0.351	0.284	0.223	0.143	0.080	0.033	2
Check electrical connections	2	0.140	0.114	0.089	0.057	0.032	0.013	1
Open manual water valve	1	0.035	0.023	0.019	0.011	0.006	0.003	1
Check water connections, flow	2	0.070	0.046	0.038	0.022	0.012	0.005	1
2nd Person assistance	22	0.722	0.448	0.350	0.185	0.103	0.043	1
Transport out of material	2	0.014	0.009	0.005	0.001	0.001	0.000	2
Phase2 installation of worst case TCS1 (assumption: installation = 2x reduced exchange)								
Individual Dose:	**1st Person**	2.9	2.1	1.6	1.0	0.5	0.2	
	2nd Person	2.8	2.0	1.5	0.9	0.5	0.2	
Collective Dose		5.8	4.1	3.2	1.8	1.0	0.4	