Collimator handling in LHC tunnel

K Kershaw, 5 March 2007

Scope / content

- Introduction – section

Phases of work

1. Coordination with collimator / plug-in design
2. Design and build special equipment for collimator tunnel transport and initial installation
3. Study and test work for collimator remote handling
4. Design and build equipment for remote handling
Introduction / section

- Section TS-IC-IS
- Heavy handling studies for LHC machine and experiments
- Specialised overhead travelling cranes
- Cryomagnet transport and handling –surface and tunnel installation
- Remote handling

AEA TECHNOLOGY
Combining Technology and Applications for Value

ARTISAN™ HEAVY DUTY TELEROBOTIC MANIPULATOR SYSTEM

AEA Technology’s ARTISAN™ telerobotic heavy-duty telemanipulators and control systems are specifically for hazardous environment material handling applications. It is rugged and for tasks such as:

- Hot cell decontamination
- Volume reduction of fuel
- Waste retrieval

Key features of the ARTISAN™

- Manipulator
- Heavy duty payload
- Evolutional Escalation
- Modular component design
- Various mounting configurations
- Hands-free material handling applications

- Control system
- Joystick controls
- Telematching functionality
- Joint-world/tool mode of operation

- Tooling
- Standard industrial tooling interface
- Use a variety of tools (pens, drills, grinders, etc.)
ATLAS surface crane

ATLAS cavern cranes
Alice Crane

Cryomagnet installation - concept
Cryomagnet tunnel transport

Cryomagnet transfer and installation
1) Coordination with collimator / plug-in design

Basic principles agreed with R Perret:

Guidance pins on plug in allow coarse positioning by handling equipment
Design collimator lifting points so that they can be lifted by a spreader beam suspended from a single crane hook – C of G.
Vertical guidance rails guide collimator in zone above conical pins – protect beam pipe

2) Design and build special equipment for collimator tunnel transport and initial installation

Use trailer crane to take collimator from tunnel access point to installation point, and then transfer collimator onto supports

• Needs to fit in space available for towing and for lifting and transfer.
Mock up tests (1)

Mock –up tests (2)
Outcomes of tests

• Collimator supported on cable can be guided and lowered onto pins without unwanted side forces.
• Two-stage guidance works
• Powered rotation of the spreader requires a lot of height
SEQUENCE DE MONTAGE DES COLLIMATEURS - PHASE 1 DE LA MACHINE LHC

F. DELSAUX 20 Nov 2006
SEQUENCE DE MONTAGE DES COLLIMATEURS - PHASE 1 DE LA MACHINE LHC

F. DELSAUX 20 Nov 2006
Photos trailer - crane

- Modified Palfinger crane with hoist, on heavy trailer with stabilisers + special spreader
3) Study and test work for collimator remote handling

Programme of work considers 2 main tasks:
• Collimator removal and replacement
• Geometrical and radiation remote survey

Collimator remote handling - outline

• Remove collimator from supports and transport to handling or storage area (where?)
• Take replacement collimator from access point and install it on supports
• Vacuum (dis)connection
LHC remote survey

Transport measurement equipment to known position and take readings (measurement equipment provided by others)
- Radiation survey – autonomous package also used on CNGS crane – go in before personnel access
- Geometrical survey – LSS initially, future possibility of measurements in arc during operation

Remote handling study and test work - background
- Change from “hands-on” to remote handling
- Operator control at a distance
- Need to drive/control all degrees of movement
- Need control communication
- Need good vision equipment and vision communication
Remote handling study and test work – main tasks

• Develop and demonstrate communication, control, vision - TIM
• Mock up tests and studies for mechanical handling and transport

TIM (Train Inspection Monorail)

• Proves feasibility of communication in LHC tunnel with existing infrastructure
• Used for visual inspection during pressure testing and cool-down of sector 7-8
Collimator mechanical handling

Two main requirements

• Transport along tunnel
• Transfer from vehicle onto supports and vice versa
Collimator remote transport along tunnel

• Passage is narrow with low clearances
• Aim to avoid need for driver
• To simplify guidance of transport vehicle try to suspend from monorail
• Alternative is floor-running automatically guided vehicle

Collimator remote installation handling

1) Need to be able to:
• position collimator in 3 axes
• orient collimator in two axes
(third axis is guaranteed by support points)
2) Ensure
• Sufficient travel
• Fit in space available
3) Avoid jamming forces – cable support
CHANGEMENT D’UN COLLIMATEUR

MANIPULATION A DISTANCE

FREDERIC DELSAUX
FEVRIER 2007
Conclusions from studies and tests to-date

- Remote control/communication demonstrated by TIM
- Remote installation and removal of collimators appears feasible (more detailed design study to be carried out for higher confidence)
- Integration checks including survey scans needed
- Monorail-based solution for remote transport of collimators looks promising

4) Design and build equipment for remote handling

- Work to-date has aimed at proving feasibility, influencing design and infrastructure while still possible.
- This is still underway, but need to consider next steps…
Next stages

• Prepare mock-up area to allow development of remote survey and remote handling equipment
• Design and build handling / transport equipment according to industrial standards, consider radiation implications
• Develop modules to cover:
  – Transport and handling
  – Viewing
  – Communication etc
• Prepare complete scenario for collimator exchange including storage (repair?) area.