TE Department Meeting 2012

- 6th December 2012
Agenda

- Safety ("Safety always first")
- TE organisation and TE in numbers
- Personnel and material budgets, MPP, MARS 2012
- Training in 2012

- Group activity highlights in 2012
- Machine Operation in 2012
- LS1
- Conclusions
- Q&A

“A mind once opened never loses”
Accident Statistics 2012
(status 26. 11. 2012)

- 271 Accidents at CERN
- 31 by TE Members at work (all personnel categories)
  - (136 days of absence)
- 4 by TE Members on the way to work
  - (82 days of absence)
- Less, but more severe accidents
Manual handling

- 2012: 34 accidents at CERN
- More than 170 days of absence (> 130 in TE)
- A new Safety Training, Sensibilisation aux gestes et postures de travail (8 hours) is available
Trips and Falls

- 2012: 53 accidents in CERN
- More than 40 days of absence
- Our buildings have many “traps” (here 2 examples from Bld. 30)
- Request repair by the “Service Portal” (77777)
## Safety Officers for TE

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas Otto</td>
<td>DSO, Radiation SO</td>
<td>160648</td>
</tr>
<tr>
<td>Francesco Castronuovo</td>
<td>Deputy DSO</td>
<td>164735</td>
</tr>
<tr>
<td>Michael Jonker</td>
<td>Deputy Radiation SO</td>
<td>160606</td>
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<tr>
<td>Goran Perinic</td>
<td>Cryogenic SO</td>
<td>164263</td>
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<tr>
<td>Fabrice Fayet</td>
<td>(Dept. EN) Flammable Gas SO</td>
<td>163782</td>
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<tr>
<td>Steve Hutchins</td>
<td>(Dept. BE) Laser SO</td>
<td>163061</td>
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</table>

... and 65 TSOs, to whom I extend my gratitude for their continuous efforts
Agenda

• Safety ("Safety always first")
• **TE organisation and TE in numbers**
  • Personnel and material budgets, MPP, MARS 2012
  • Training in 2012

• Group activity highlights in 2012:
  • Machine Operation in 2012
  • LS1
• Conclusions
• Q&A
Human resources

<table>
<thead>
<tr>
<th>Category</th>
<th>2011</th>
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<tr>
<td>Staff</td>
<td>408</td>
<td>433</td>
</tr>
<tr>
<td>Fellows</td>
<td>52</td>
<td>58</td>
</tr>
<tr>
<td>Students &amp; Apprentices</td>
<td>34</td>
<td>45</td>
</tr>
<tr>
<td>Associates</td>
<td>74</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>568</td>
<td>631</td>
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(+25) (+63)

29%

29%
## Arrivals in 2012

**Staff Members: 38**

<table>
<thead>
<tr>
<th>MIROSLAV GEORGEV</th>
<th>ATANASOV</th>
<th>VITALIANO</th>
<th>INGLESE</th>
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<tr>
<td>GRAEME</td>
<td>BARLOW</td>
<td>SUSANA</td>
<td>IZQUIERDO BERMUDEZ</td>
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<tr>
<td>NICOLAS FIORI</td>
<td>BELLEGO</td>
<td>THOMAS</td>
<td>KRAMER</td>
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<tr>
<td>JEAN-PIERRE</td>
<td>BOIVIN</td>
<td>ANDREW JOHN</td>
<td>LEES</td>
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<td>SEBASTIEN</td>
<td>BRESSON</td>
<td>SIMON FRANCOIS</td>
<td>MARTIN</td>
</tr>
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<td>ANDREW GEORGE LEE</td>
<td>BRUTON</td>
<td>PIERRE</td>
<td>MAURIN</td>
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<td>STEFANO</td>
<td>CENGARLE</td>
<td>ROSS HEDLEY</td>
<td>MORGAN</td>
</tr>
<tr>
<td>EMILIN</td>
<td>COLOT</td>
<td>KAROL JAN</td>
<td>MOTALA</td>
</tr>
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<td>JOSE</td>
<td>DE LA GAMA SERRANO</td>
<td>KONSTANTINOS</td>
<td>PAPASTERGIOU</td>
</tr>
<tr>
<td>JEAN-BAPTISTE</td>
<td>DESCHAMPS</td>
<td>JAIME</td>
<td>PEREZ ESPINOS</td>
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<td>LUDOVIC</td>
<td>FAVIER</td>
<td>DAVID ANDRE</td>
<td>RANCHIN</td>
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<td>STEPHANE</td>
<td>GABOURIN</td>
<td>PAULO MANUEL</td>
<td>REI CERDEIRAL</td>
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<tr>
<td>SPYRIDON</td>
<td>GEORGAKAKIS</td>
<td>ALEXIS GERARD</td>
<td>RODRIGUES</td>
</tr>
<tr>
<td>THIERRY PAUL</td>
<td>GHARSA</td>
<td>IVAN</td>
<td>ROMERA RAMIREZ</td>
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<td>VASCO</td>
<td>GOMES NAMORA</td>
<td>MLADEN</td>
<td>STJEPIC</td>
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<td>ANTHONY</td>
<td>HARRISON</td>
<td>ALBAN RENE MAURICE</td>
<td>SUBLET</td>
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<td>JEROME ANDRE</td>
<td>HEBERT</td>
<td>NICOLAS CLAUDE</td>
<td>THAUS</td>
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<td>VICENTE RAUL</td>
<td>HERRERO GONZALEZ</td>
<td>NIKOLAOS</td>
<td>TRIKOUPIIS</td>
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<td>STEPHANE</td>
<td>HUON</td>
<td>GEERT PIETER</td>
<td>WILLERING</td>
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</table>
# Mobility in 2012

## To TE: 1

<table>
<thead>
<tr>
<th>Name</th>
<th>Name</th>
<th>Code</th>
<th>Code</th>
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</thead>
<tbody>
<tr>
<td>DELIO LUIS</td>
<td>DUARTE RAMOS</td>
<td>EN-MME-ES</td>
<td>TE-MSC-CMI</td>
</tr>
</tbody>
</table>

## To other Departments: 3

<table>
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<tr>
<th>Name</th>
<th>Name</th>
<th>Code</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>NURIA</td>
<td>CATALAN LASHERAS</td>
<td>TE-MPE-EI</td>
<td>BE-RF-KCA</td>
</tr>
<tr>
<td>SHAUNA</td>
<td>DILLON</td>
<td>TE-RPA-AA</td>
<td>DG-DI-DAT</td>
</tr>
<tr>
<td>GERHARD</td>
<td>SCHNEIDER</td>
<td>TE-VSC-LBV</td>
<td>BE-BI-ML</td>
</tr>
</tbody>
</table>
Other movements in 2012

Departures: 3 LD contract holders
Retirements: 10

Piotr Doniec (TECH),
Michael de Sousa (APPR)
Gilles Trachez (STAF)  

sadly passed away
Other movements in 2012

Arrivals | Departures
---|---
**Fellows:** | **Tech. Students:**
Fellows: 28 | Tech. Students: 27
Doct. Students: 9 | Doct. Students: 5

**Indefinite** | **Limited duration**
---|---
ABT | Accelerator Beam Transfer | 40 | 13
CRG | Cryogenics | 47 | 27
EPC | Electrical Power Converters | 56 | 15
HDO | Machine Protection & Electrical Integrity | 33 | 16
MSC | Magnets, Superconductors & Cryostats | 76 | 22
RPA | Resources, Planning & Administration | 12 | 1
VSC | Vacuum, Surfaces & Coatings | 48 | 24
Department Head | 1 | 1

**Grand Total:** | **Indefinite** | **Limited duration**
---|---|---
315 | 118

DCRB (November): 7 opened slots

IC 73%
LD 27%
2012 Some numbers

- **LD Recruitment**
  - *No. posts open in TE*: 45
  - *No. candidates selected*: 37
  - *No. longlisted candidates*: ~1900
  - *No. candidates invited to interview*: ~190

- **IC Recruitment**
  - *No. posts open in TE in 2012*: 7
  - *No. candidates invited to interview*: 15

- **Internal Mobility**: 11

- **Appointments / Discussions with HRA**: ~220
Fellows & Students
Current Number of Fellows and Students in TE Department

Newcomers in the next 4 months:
- 13 fellows
- 18 technical students
- 9 doctoral students
- 1 admin. student

Next committees in 2013:
- TSC 23-04 & 01-10
- AFC 24-05 & 12-11
Staff members with 25 years’ service at CERN in 2012

2 from TE

Etienne Carlier
Volker Mertens
More than 90 VIP Visits in SM18

Dr Kassym-Jomart Tokayev
Director-General UNO

Monsieur Jean-Marc Nollet
Vice-President of the Wallon Government

Professor Nuno Crato
Minister for Education and Science
Portuguese Republic

Ambassadors to Switzerland

STS-134 Astronauts

Cardinale Riuni

E. Schmidt - Google Management
Team Executive Chairman

Her excellency Ms Iveta Radicova
Prime Minister Slovak Republic

TE Department Plenary meeting
6th December 2012
And also some other visits....

Some of the guides:
Davide Aguglia
Marta Bajko
Amalia Ballarino
Vladislav Benda
Frédéric Bordry
Luca Bottura
Jean-Paul Burnet
Marco Buzio
Juan Casas Cubillos
Miguel Cerqueira Bastos
Serge Claudet
Knud Dahlærup-Petersen
Gijs de Rijk
Paulo Gomes
Friedrich Haug
André Jacquemod
Jose Miguel Jimenez
Glyn Kirby
Quentin King
Volker Mertens
David Nisbet
Thomas Otto
Antonio Perin
Goran Perinic
Lucio Rossi
Stephan Russenschuck
Rudiger Schmidt
Andrzej Siemko
Laurent Tavian
Jean-Philippe Tock
Ezio Todesco
Davide Tommasini
Arjan Verweij
Louis Walckiers
Markus Zerlauth
Thomas Zickler

Among visits organized in SM18 by CERN press and media services

22 June 2012 – Katie Kemp visiting CERN owing to “Make a Wish”. “Katie was particularly fascinated by the magnets in SM-18”. The visit was guided by Glyn Kirby.

27 July 2012 The American singer Belinda Carlisle

28 September 2012 – Researchers Night Poster produced by 13-year old student
Agenda

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2012 Operation Budget
For Material Recurrent (Operation) budget (MCHF)

Situation End November

Initial Allocation
- 36,492

Carryforward + Receipts end 2011
- 39,942

Budget Increase following TEEP
- 42,549

Industrial Support Commitment for the year

Situation End November
2012 Projects Budget
(Total 40.4 MCHF)

* TE Infrastructure = Buildings 107 & 867, Magnet facilities, Upgrade HE Infrastructure, Renewal of tooling for TE-MPE-EM & Maintenance Management Project
## 2013 Budget

### Preliminary First Material Budget Release:

- **2.5% DG cut on ALL activities, including projects** and the CVI for Materials will be around **-2.5%**
- **~44 MCHF** for Recurrent budget (to be compared to a request of 49 MCHF)
- **~95 MCHF** for Projects
2013 Projects Budget
(Total ~95 MCHF)

* TE Infrastructure = Buildings 107 & 867, Magnet facilities, Upgrade He Infrastructure, Renewal of tooling for TE-MPE-EM & Maintenance

Consolidation & Spares Total Envelope ~24 MCHF

- LHC, 26%
- SPS, 21%
- PS, 14%
- Others, 14%
- Spares, 20%
- AD, 8%
- HL-LHC, 15%
- LINAC4, 7%
- LIU, 6%
- CLIC, 5%
- ELENA, 2%
- HIE-ISOLDE, 7%

* TE Infrastructure*, 12%
TE Department Staff Needs by Activity in FTEs

The following tables give the detailed figures for MPP’13 and MPP’12, at departmental and group level.

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
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<tbody>
<tr>
<td>Operation</td>
<td>250.5</td>
<td>191.6</td>
<td>234.1</td>
<td>268.8</td>
<td>269.7</td>
<td>284.1</td>
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<tr>
<td>Consolidation</td>
<td>87.8</td>
<td>164.5</td>
<td>113.7</td>
<td>66.6</td>
<td>62.6</td>
<td>58.6</td>
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<tr>
<td>Projects</td>
<td>95.2</td>
<td>121.0</td>
<td>125.5</td>
<td>134.1</td>
<td>130.8</td>
<td>123.7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>433.5</td>
<td>477.1</td>
<td>473.3</td>
<td>469.5</td>
<td>463.1</td>
<td>466.4</td>
</tr>
<tr>
<td>Staff evolution</td>
<td>411.4</td>
<td>428.1</td>
<td>427.1</td>
<td>420.4</td>
<td>417.7</td>
<td>402.6</td>
</tr>
</tbody>
</table>

Table 6.1 TE Staff needs (MPP’13)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>267.4</td>
<td>211.0</td>
<td>256.4</td>
<td>270.0</td>
<td>266.0</td>
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<tr>
<td>Consolidation</td>
<td>70.9</td>
<td>124.2</td>
<td>65.0</td>
<td>50.4</td>
<td>50.2</td>
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<tr>
<td>Projects</td>
<td>117.0</td>
<td>138.4</td>
<td>135.2</td>
<td>134.1</td>
<td>136.9</td>
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<tr>
<td>Total</td>
<td>455.3</td>
<td>473.6</td>
<td>456.6</td>
<td>454.5</td>
<td>453.1</td>
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<td>Staff Evolution</td>
<td>407</td>
<td>403</td>
<td>400</td>
<td>395</td>
<td>390</td>
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</tbody>
</table>

Table 6.2 TE Staff needs (MPP’12)
TE Department Staff Needs by Activity

- **LHC** (including LHC experiments, Operation, Consolidation and Spares): 43%
- **New Projects** (including) 18%
- **Injectors** (including Consolidation) 22%
- **General Support** (including electronics design, surface treatments, Infra. Cons, etc.): 7%
- **Administration**: 6%
- **Non-LHC Physics**: 3%

**Staff Budget**
- 406 FTAs paid by TE = 72.3 MCHF
- 3.7 FTEs leave before retirement = 0.7 MCHF
- 3.3 FTAs Ext. Funding = 0.8 MCHF
- Total Staff Budget = 73.8 MCHF
- Fellows Budget = 6.0 MCHF
- Total Staff + Fellows = 79.8 MCHF
### Departmental Post Openings

**Table 4:** Post opening plan in the A&T Sector

<table>
<thead>
<tr>
<th>Post openings</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td><strong>Within target figures</strong></td>
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<td></td>
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<tr>
<td>BE</td>
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<td>8.0</td>
<td>8.0</td>
</tr>
<tr>
<td>EN</td>
<td>6.0</td>
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<tr>
<td>TE</td>
<td>8.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Total within target figures</strong></td>
<td>20.0</td>
<td>18.0</td>
<td>16.0</td>
</tr>
<tr>
<td><strong>Missing posts</strong></td>
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<td></td>
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</tr>
<tr>
<td>BE</td>
<td>14.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>EN</td>
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</tr>
<tr>
<td>TE</td>
<td>19.0</td>
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<td>0.0</td>
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<tr>
<td><strong>Total missing posts</strong></td>
<td>47.0</td>
<td>0.0</td>
<td>0.0</td>
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<tr>
<td><strong>Total post openings</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>BE</td>
<td>20.0</td>
<td>8.0</td>
<td>8.0</td>
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<tr>
<td>EN</td>
<td>20.0</td>
<td>15.0</td>
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<tr>
<td>TE</td>
<td>27.0</td>
<td>4.0</td>
<td>4.0</td>
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<tr>
<td><strong>Total post openings</strong></td>
<td>67.0</td>
<td>18.0</td>
<td>16.0</td>
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</table>
2012 MARS Exercise

TE step distribution

<table>
<thead>
<tr>
<th>Step</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>20</td>
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<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Career Path Changes

- 2 – A-B
- 1 – B-C
- 3 – C-D
- 1 – D-E
- 4 – E-F

Salary Band Changes

- 3 – c-e
- 17 – a-b
- 14 – b-c

76 Premiums, Budget = 65kCHF

- Budget distribution by Career Path (no ASB budget this year)
Agenda

• Safety (“Safety always first”)
• TE organisation and TE in numbers
• Personnel and material budgets, MPP, MARS 2012

• **Training in 2012**

• Group activity highlights in 2012:
  • Machine Operation in 2012
  • LS1
• Conclusions
• Q&A
Requests, days and cost spent on training

All data from HRT, courses status attended or invited from 01.01.2012 to 31.12.2012

1369 courses followed

- Academic: 37%
- Language: 12%
- Management & Communication: 3%
- Safety: 48%
- Technical: 3%

2675 days allocated to training

- Academic: 48%
- Language: 37%
- Management & Communication: 16%
- Safety: 6%
- Technical: 1%

435 kCHF spent

- Academic: 56%
- Language: 30%
- Management & Communication: 11%
- Safety: 6%
- Technical: 3%
Statistics per Group

All data from HRT, courses status attended or invited from 01.01.2012 to 31.12.2012

Courses / person

Days / person

Cost / person
Agenda

• Safety ("Safety always first")
• TE organisation and TE in numbers
• Personnel and material budgets, MPP, MARS 2012
• Training in 2012

**Group activity highlights in 2012:**

Usual disclaimer: impossible to mention the work of ~650 persons in 30 minutes!!... Mea Culpa …, please forgive me if I forgot your favourite topic!

• Main results in 2012
• LS1
• Conclusions
• Q&A
Description of maintenance processes with BPMN

The issue concept

Common key-definitions

A common naming/coding reference

Information management concept

Metadata and search concept

Integration concept (IMPACT and EAM)

Criticality ranking system oriented to the operation/equipment level

The maintenance management roles concept

The Maintenance Implementation Office concept

Pre-analysis: Gather needs, confirm objectives, identify projects, …

GQMO Group Quality/Methods Officer
GMIO Group Maintenance Information Officer
GCO Group Coding officer
GSPO Group Spare Part Officer
MMP - Maintenance Management Project

- **First pilot applications/implementations:**
  - EN/HE – doc. config/upload
  - TE/VSC – leak detector mgmt.
  - EN/EL – cabling process
  - TE/CRG – doc. linking
  - all grps – process modelling

**Design and Implementation:**
Finalize concepts, specify and realize framework, ...

**Framework module developments:**
- doc mgnt.
- labelling
- part mgnt.
- work order mgnt. (EAM-light)

**Your point of contact:** The MFIO (Maintenance Framework Implementation Office)
Main components of the LHC beam dump system (per beam):
- 15 extraction kickers (horizontal deflection 0.27 mrad)
- 15 extraction septa (vertical deflection 2.4 mrad)
- 10 dilution kickers (4 horizontal, 6 vertical, h/v deflections 0.27 mrad)
- 1 dump block

The dump process is triggered by:
- Dump request during normal operation (machine protection for emergencies and timing system for scheduled dumps)
- Internal request in case of system (powering) failure

Beam losses occur if:
- the dump trigger is not synchronized with the abort gap
- the abort gap contains spurious particles
- the MKD kick is not in tolerance (kick strength depends on beam energy)
- the local orbit is out of tolerance

=> Beam losses shall be minimized <=

The main concern for such a critical system is to operate with the highest reliability:
- Fault-tolerant architecture by built in redundancy (system continues to run w/o causing unnecessary dumps; problems will be fixed at earliest possible stop)
- Fail-safe actions and components (responses to failures are aimed at minimizing dangerous consequences)
- Continuous remote surveillance and diagnostics of important parameters (energy, timing, false triggering)
- Post mortem analysis (IPOC/XPOC) (inhibits next injection if parameters out of tolerance)
New Building 107
Surface Treatment & Printed circuits Workshops

“Bird” view
20 November, 2012

From vineyard
20 November, 2012
VSC
72 staff
17 Fellows + Doct. + Tech. Students
Consolidation of LHC Long Straight Sections

Getting closer with a major overhaul program…

Validation of hundreds of components: RF fingers, pumps, modules, beam equipment, etc.

Length ~ 5.1 km (67 % requested by other groups)

Installation of new beam stoppers - TCDI

148 over 179 vacuum sectors to be baked and NEG activated

- Collimators
- Repair & New BI Equipment
- RF
- ALARA
- TDI Upgrade
- MKI
- NEG & Electron Cloud Pilot Sector
- Experimental Area
- VSC Consolidation & New Layout
- VAX Upgrade
- DFSA intervention
- Hamburg beam Pipe & TOTEM
Consolidation of LHC Experimental Areas

Ready for LS1 in all 4 Experiments

Vacuum validations of Aluminium-based components

First leak test at Materion of ATLAS Beryllium beampipe
Surface Treatments & Cleaning
Many projects competing…

LINAC4 Tank with electroplated copper

Preparation in clean room for Niobium coatings HIE-ISOLDE cavities
HIE-ISOLDE Nb/Cu coatings

*Getting closer to the specifications…*

Several coatings performed with increasing coating power and temperature
Latest: coatings at 8 kW, 300–500 °C on cavity
LINAC 4 Vacuum Controls
Progressing as expected
MolFlow/VACSO/Vacuum-Electrical Analogy
Leading Vacuum Simulations Worldwide…

MolFlow/ HL-LHC inner triplets

The SR-induced gas load is proportional to the photon flux absorbed on the facets

VASCO/ Hamburg beampipe

Electrical Analogy/ Dynamic pressure in LINAC4 Source
MSC
98 staff
38 Fellows + Doct. + Tech. Students
Technical solution fully validated in a dedicated test in SM-18 (20,000 current cycles, 2 thermal cycles, 13 kA)

Components (30000 shunts, 6000 insulation boxes, 12000 pockets), tools (cutting and (de)soldering machines, jigs), detailed procedures (1000 pages) and associated QA/QC tools and plan are ready (or will be in short)

Production Readiness Review: GO!

November 2012

Mock-ups for test and training of new colleagues and collaborators, informatics tools (WISh) for operation and continuous process control
LS1 – magnet replacement

Finished SSS 233, with vacuum barrier: a long story of leaks and repairs (bulk material leak). Successful final pressure test!

All dipoles ready, awaiting diode installation. Preparing for higher intensities.

Only 1 more magnet to test (Q7R3) before the 2012 year end and cryo-shutdown in SM-18.
Among all diode contacts, the mechanical clamping of the quadrupole diode-pack to the magnet bus-bar was found insufficient for LHC operation at high current.

A new mechanical solution was devised, that:
- guarantees long-term stability of the contact
- is suitable for in-situ consolidation (LS1)

Tests on heavily instrumented diode packs have shown the desired stability at high current (13 kA). Final verification is in progress.
Superconductors – some applied science

**Surprising results** from irradiation tests on Nb$_3$Sn wires (no degradation of $J_C$), may lead to ideas for improved pinning at high field (ATI, Vienna)

A **new scaling** for the dependence of Nb$_3$Sn $I_C$ on applied longitudinal strain

\[
s(\varepsilon) = e^{-c_1 \left( \frac{I_2^2 + 2}{I_2 + 1} \right) J_2} + e^{-c_1 \left( \frac{I_1^2 + 2}{I_1 + 1} \right) \frac{I_1^2}{2}}
\]

Measurement principle (Walter spring)

Strands irradiated

Results of data modeling tests on a published database of $I_C (B,T,\varepsilon)$ results
High-field magnet R&D – basic program

FRESCA2: 13 T in 100 mm bore, a unique facility!

Fabrication of coil tooling in progress, structure components and parts for the first coil delivered. Mechanical assembly tests started.

All superconducting wire (120 km) is in production at EU and US manufacturers. Cabling qualified.

RMC: the intermediate step
All components are in procurement, mostly received.

PIT Nb3Sn, 40 strands cable, < 5 % degradation.

Copper coil wound and undergoing heat-treatment to validate components (geometrical stability) and manufacturing procedure.
High-field magnet R&D – LHC magnets

11 T DS-MB: the first Nb3Sn magnet in LHC?

MQXF: large bore IR quads for HL-LHC

150 mm aperture
140 T/m nominal gradient
Bladder and key, Al-shell
A new concept in the LHC

Not quite at 11 T (10.4 T when ramping, SS degradation), there is work to do in 2013!

Superconductor for prototype program in purchasing process, cored cable validated

RRP Nb3Sn, 40 strands < 1 % degradation

Plan:
• Design completed in 2013
• Coil and structure fabrication in 2014-2015
• Assembly and test of first model in 2015
High-$\beta$ cryo-module
completing detailed design
and preparing tender

SC solenoid (potential 500 kCHF saving)

The cryomodule is a difficult object, must be clean-room compatible

Cost and schedule review (November 2012) has identified the highest risk in the lack of experienced engineering and technical manpower for the production and assembly of the cryo-module

SC LINAC
Helium vessel
Support frame

HEBT

New Layout (250 kCHF saving)

<table>
<thead>
<tr>
<th>Magnet type</th>
<th>Quantity Stage 1 (2014)</th>
<th>Quantity Stage 2 (2016)</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dipole 45 deg.</td>
<td>4</td>
<td>6</td>
<td>New magnets</td>
</tr>
<tr>
<td>Quadrupole</td>
<td>23</td>
<td>28</td>
<td>New magnets</td>
</tr>
<tr>
<td>Corrector H/V</td>
<td>12</td>
<td>17</td>
<td>New magnets</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>51</td>
<td></td>
</tr>
</tbody>
</table>
Projects – L4 and ELENA

- **Linac4**
  - 7 types, 73 electromagnets and 15 permanent magnet quadrupoles, mostly in fabrication apart for the TL dipoles (tender)
  - Installation in Linac4 imminent

- **ELENA**
  - Machine layout completed (magnets functional specs)
  - Magnetic and mechanical dipole prototype in progress (design, steel)

---

**Dipole prototype magnet design completed**

- **B**<sub>iron</sub> = 1.2 T
- **B**<sub>gap</sub> = 0.4 T

- Diluted steel to achieve good *homogeneity and reproducibility* at the low field required

**Vibrating wire measurement of the PM quadrupole**

**PM quadrupole**

In production

**TL dipole tender in preparation**

**Iron yoke**
First MedAustron synchrotron dipole

MBH-C Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of magnets</td>
<td>16 + 2 + 2</td>
</tr>
<tr>
<td>Peak field induction</td>
<td>1.5 T</td>
</tr>
<tr>
<td>Vertical aperture</td>
<td>56 mm</td>
</tr>
<tr>
<td>Magnetic length</td>
<td>1.65 m</td>
</tr>
<tr>
<td>Curvature radius</td>
<td>4.23 m</td>
</tr>
<tr>
<td>Current @ peak field</td>
<td>2820 A</td>
</tr>
</tbody>
</table>

A new challenge: 150 magnets for health

Acceptance in 181 operational (NORMATEF)
25 magnets delivered and tested
Started LEBT installation on site, in Wiener Neustadt (A)
A new challenge: 150 magnets for peace

<table>
<thead>
<tr>
<th>Component</th>
<th>$L_{\text{iron}}$ [mm]</th>
<th>2D strength (@ 2.5 GeV)</th>
<th>bore [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bending magnets</td>
<td>2250</td>
<td>1.46 T &amp; -2.8 T/m</td>
<td>40</td>
</tr>
<tr>
<td>32 focusing quadrupoles</td>
<td>280</td>
<td>17.0 T/m</td>
<td>70</td>
</tr>
<tr>
<td>32 defocusing quadrupoles</td>
<td>100</td>
<td>-10.2 T/m</td>
<td>70</td>
</tr>
<tr>
<td>64 sextupoles (with correctors)</td>
<td>100</td>
<td>220 T/m$^2$</td>
<td>75</td>
</tr>
</tbody>
</table>
MPE
48 staff
23 Fellows + Doct. + Tech. Students
Monitorung and follow-up of Machine Protection Systems performance and issues.

2012 (536 dumps until 8.11.2012)

Beam dumps from protection systems due to a failure in the system (incl. SEU)

PSpice modelling of the RQTF circuits

Novel fast method to quantify the collective magnetization in superconducting magnets (Emmanuele Ravaiolli et al.)

Quad diode contact resistance simulations with COMSOL Multiphysics

Contact resistances implemented with COMSOL’s ready-made Contact Impedance boundary condition
TE/MPE/EM – PCB & MPGD Layout Design, Production and Assembly

CMS Full-size GE1/1 Detector Prototype

- GEM active areas: 990 mm × (220-445) mm
- GEM Single-mask technology
- 1D radial strip read-out with 3 × 8 × 128 = 3,072 channels
- Gas mixtures:
  - Ar:CO₂ (70:30; 90:10)
  - Ar:CO₂:CF₄ (45:15:40; 60:20:20)

1 x 1 m² Micromegas for ATLAS

- 1 x 1 m² MM in YE1 nose

Assembly Workshop

- GE1/1 in YE1 nose
- 1 x 1 m² MM being closed in TE/MPE/EM clean room
- 1 x 1 m² MM in H6 test beam facility
- The new reflow oven installed and now fully operational.
LS1: Renovation of SPS Interlocks
New Ring Line Layout

- Smooth operation of all Powering Interlocks, Warm Magnet Interlocks and FMCM systems in 2012, requiring only very few interventions

Interlocks for ELENA

- Conceptual design and budget estimate completed and documented in engineering specifications

SW Quality Efforts
- Introduced Sonar as SW Quality Monitoring tool
- Following MPE initiative now also used by BE-CO
TE/MPE/EP - LHC QPS, BIS and SMP systems

- **Smooth QPS operation in 2012** with much lower fault rate w.r.t. 2011
  - Majority of faults related to R2E problems, which will be consolidated during LS1
  - Most of the observed radiation induced SEU effects affect the DAQ systems and are now mitigated
- Total number of QPS SEU recorded in 2012 - above 200
- Total number of QPS induced beam dumps - 32

**BIS & SMP systems**

- **Smooth operation of BIS and SMP systems in 2012** requiring only very few interventions
- The development of a new functional test system for the SMP receiver module type CISV

**Electronics Development Towards LS1**

- Development of the new protection unit type DQLPU A for MB magnets is almost completed
- Type test of radiation tolerant protection system type nDQQDI, installed during TS#3

---

Photo courtesy J. Korczyk
TE/MPE/EE – Electrical Engineering, Energy Extraction Systems and ELQA for LHC

**LS1 preparations:**

- **ELQA:** New, upgraded TP4 measuring systems are now available for LS1. ELQA will dispose of 8 such test platforms plus two spares.

- **Energy Extraction Systems**
  - 13 kA EE: Ten different campaigns of interventions originate from necessary upgrades and reconfigurations for attaining 7 TeV.
  - 600 A EE: Consolidation of holding coil and thermal overload protection against overheating is in final stage of preparation.

- **Upgrade of the QPS racks during LS1**
  - The new ‘nCrawford’ box (DQLIM)
  - The new Power/Modules (DQLPUR).
  - Pulse transformers for DQHDS supervision upgrade.

- **Diode issues:** Production is concentrating on the last units required for the 15 + 4 cryomagnet replacements during LS1.
ITER Collaboration on Machine Protection

- Prototype for magnet powering interlocks completed and delivered

- Development of 2nd version of User Interface Box, including Profinet connectivity for diagnostic Routing being finalized, production + testing early 2013
EPC
71 staff
6 Fellows + Tech. Students
New transformers for SPS main power converters

Production and delivery of one batch takes 3-4 months
New transformers for SPS main power converters

8 new transformers in operation in 2012
New Thyristor Bridges for SPS main power converters

- 3 thyristor stacks in operation since TS3 (September 2012)
POPS FULLY OPERATIONAL ALL 2012

POPS did all the 2012 run with an availability of 97%. Around 10 millions cycles with beam. Global availability of the PS is 92% over 5700H.

Degraded modes were all tested and all are operational. In case of failure, the repair can be done while POPS is running in degraded mode. Switching from normal mode to degraded mode takes 1h for the standby service.
New PSB multipole converters with FGC3 and Ethernet

Validation of the new Acapulco converters with the new FGC3 platform with Ethernet fieldbus.

Cross talk
DSP: 1 kHz
Regulation: 100 Hz
Current bandwidth: 20 Hz

Cross talk
DSP: 10 kHz
Regulation: 1 kHz
Current bandwidth: 100 Hz

From FGC2 to FGC3
Abnormal oil leakage of the BEQ1 reactor created environmental hazard. The reactor was repaired to operate until its replacement expected for LS2.
LINAC4 Klystron modulator

The first unit of the series received from JEMA (BE) as part of French Special Contribution.

Another one in December, 12 in 2013.
LINAC4 H- Source Powering in the 3 MeV test

Power converters delivered on time for the H-source crash program.
Still difficulties with the source (electrical arc at 5kV while designed for 50kV operation)
Spare source under test to be installed in the Faraday cage soon.
LHC radiation mitigation: FGClite

New rad-tolerant version of the present LHC FGC2 is under development. The FGCLite team is now completed and fully operational.

Prototype FGClite was tested under radiation in H4 in November
Testing of semi-conductors... BE/CO, EN/STI, TE/EPC collaboration
≈40% complete, no major surprises so far  ≈60% planned in 2013

Batch testing is foreseen in 2014 in the PS EAIRRAD facility
FGClite deployment is planned for 2016 run
LHC operation

Some figures over 255 days of Proton run in LHC

- 1761 Power Converters in operation
- 143 calls to TE-EPC team LHC Piquet: 269 hours of intervention
- 50% of the interventions have been solved remotely
- One intervention every 1.8 day (compared to 1.4 in 2011)
- Number of intervention decrease, except for Electrical supply and Radiation events
CRG
74 staff
12 Fellows + Doct. +Tech. Students
LHC cryogenic availabilities

<table>
<thead>
<tr>
<th>Year</th>
<th>LHC</th>
<th>ATLAS</th>
<th>CMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 1</td>
<td>89.7%</td>
<td>96.5%</td>
<td>98.5%</td>
</tr>
<tr>
<td>Mar 31</td>
<td>94.5%</td>
<td>98.5%</td>
<td>96.2%</td>
</tr>
</tbody>
</table>

Average 2011 | 2012
LHC          | 89.7% | 94.5% |
ATLAS        | 96.5% | 98.5% |
CMS          | 98.5% | 96.2% |
Cryogenic performance indicators

ATLAS

<table>
<thead>
<tr>
<th>Year</th>
<th>Availability</th>
<th>Unavailability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>96.5%</td>
<td>1.7%</td>
</tr>
<tr>
<td>2012</td>
<td>98.5%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

CMS

<table>
<thead>
<tr>
<th>Year</th>
<th>Availability</th>
<th>Unavailability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>97.3%</td>
<td>1.2%</td>
</tr>
<tr>
<td>2012</td>
<td>96.2%</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

LHC (8 independent sectors)

<table>
<thead>
<tr>
<th>Year</th>
<th>Availability</th>
<th>Unavailability</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>91.5%</td>
<td>5.2%</td>
</tr>
<tr>
<td>2011</td>
<td>89.7%</td>
<td>2.5%</td>
</tr>
<tr>
<td>2012</td>
<td>89.7%</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

Utilities:
- Cryo
- Cryo SEU
- User
- Global availability

LHC helium loss [t]

<table>
<thead>
<tr>
<th>Year</th>
<th>Xmas Stop</th>
<th>Tech Stop</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>16%</td>
<td>20%</td>
<td>64%</td>
</tr>
<tr>
<td>2011</td>
<td>10%</td>
<td>30%</td>
<td>60%</td>
</tr>
<tr>
<td>2012</td>
<td>0%</td>
<td>20%</td>
<td>80%</td>
</tr>
</tbody>
</table>

16 % total inventory
Evolution of Cryo-OK losses of LHC

Evolution:
- 2010: Correcting early Cryo bugs
- 2011: Adapting to SEU (plans to correct @Xmas2011)
- 2012 (preliminary): So far rewarding !!!
New cryogenic infrastructure for RF tests in SM18

Ready for installation in Dec’12-Jan’13
Liquid hydrogen target for COMPASS

- A 2.5-m long 40-mm diameter kapton liquid hydrogen target has been designed, constructed, tested and installed.
- The target is cooled via a new cryo-cooler system (30W@20K).
- System is now running successfully in the COMPASS experiment.
Cryogenic system for HIE-ISOLDE

- Recovery of Aleph cryoplant
- 7 jumper boxes
- Cold box
- Compressors
- Dewar
- Recovery of ex-Block4 dewar
- Helium gas storage
LS1: DFBA consolidations

DFBAs 13 kA Splices
• 136 splices, 16 DFBAs, 8 busbar-lyra modules
• Multidisciplinary/ multi-group project
• Several technical developments ongoing

→ ~2 months remaining for work-readiness !

Tooling for busbar preparation (TE-MSC)

Study for DFBAP splice bypass

Electro-Magneto-mechanical calculations on lyras (TE-MSC)
ABT
53 staff
8 Fellows + Doct. +Tech. Students
ABT – rad. workspace in B867

Most cages operational
Nearly 3 years of transf. work
Still missing non-rad. space
ABT – Beam Transfer Physics I
Many parallel designs, studies and pre-studies underway

Non-local fast-extraction for NA neutrinos

~1.2 km

Beamline design for “AWAKE”

Beamline design for NA neutrinos

Deployment of Q20 optics
(PS extraction, TLs, LHC injection)
ABT – Beam Transfer Physics II

ELENA beam transfer lines (and ABT hardware “hot spots”)

Study for faster SPS MKP rise time

Beamline design for HIE-ISOLDE

Optics studies for 2 GeV PS injection
ABT – Fast Pulsed Systems
Heavy LHC upgrade in preparation, but also many other activities in PS/SPS

SPS
- Last MKE with serigraphed stripes

CT/MTE: refurbished RSG thyatron switches

PS

LHC
- MKI thermal model (M.Garlasche / EN-MME)
- MKI impedance simulations (H.Day / BE-ABP)

MKI beam screen design
ABT – Septa and extraction protection devices

... will be doing many upgrades and preventive replacements in LS1

**HiRadMat test of TPSG4** (SPS extr. prot.) – important for SPS, but also to confirm TCDQ choices (LHC)

**MTE** (PS extraction) – design of “dummy septum” ongoing

**TCDQ** (LHC extraction protection) ultimate design and procurement on schedule
ABT – Electronics and Controls
Highly solicited also for B867, and literally everywhere during LS1

Kicker Timing Routing (KiTR) – from hardware modules and cables to simple FPGA solutions

Testing HIE-ISOLDE 90 kV power MOSFET switch

ABT-EC @ Youtube
(HR “promotion video”)

Participation in CERN’s Open Hardware Initiative
ABT – MedAustron

Electric field devices
Fast deflector and prototype power converters successfully tested in ITS (B184)

Electrostatic septa (ESI /ESE)
assembly progressing well; remote displacement electronics finished

Magnetic field devices (industry)
- last DDR delivered, review pending (MA manpower)
- magnetic septa production started, delivery 01/2013

Chopper power converters
- specification underway, including new requirements
RPA group is responsible for the management and planning of the Technology department resources in budget, personnel and industrial support. RPA group is responsible of the general administration of the department.

RPA
13 staff
Administrative assistants support and participate actively to the TE group activities

Workshops, Reviews
Organization,
Conference
Around 500 travels

Welcome of new staff members, associates, visitors …
More than 250 subsistence payments

Education fees, sundry expenses, …
More than 530 reimbursements

And removals, space management, ….

And with the Building 30 refurbishment, a lot of work for the TSO this year!!!
Agenda

• Safety ("Safety always first")
• TE organisation and TE in numbers
• Personnel and material budgets, MPP, MARS 2012
• Training in 2012

• Group activity highlights in 2012:
  • **Machine Operation in 2012**
  • LS1
  • Conclusions
  • Q&A
PSB – availability 2012
PS - nTOF

Integrated Planned Intensity for the 2012 nTOF Run

(1.6x10^{19} requested and 1.55x10^{19} foreseen, based on injector schedule V1.2)

- Planned Integrated Intensity
- Measured Integrated Intensity
- Achievable integrated intensity
- Requested integrated intensity

 Increased flux due to delayed start of DIRAC

Date

0.00E+00 0.00E+18 1.00E+18 2.00E+18 3.00E+18 4.00E+18 5.00E+18 6.00E+18 7.00E+18 8.00E+18 9.00E+18 1.00E+19 1.10E+19 1.20E+19 1.30E+19 1.40E+19 1.50E+19 1.60E+19 1.70E+19 1.80E+19

Courtesy of Mike Lamont
PS – LHC beam

![Graph showing PS Flat top: LHC 50 ns Average Transverse Emittance Evolution](image1)

![Graph showing PS Flat top: LHC 50 ns Average Brightness & Intensity Evolution](image2)

Courtesy of Mike Lamont
SPS fixed target efficiency
CNGS 2012 Daily Cumulated protons on target

Last update: 30-Nov-12 06:01
Current expected intensity: 4.43E19  Achieved intensity: 3.8E19
End of 2012 run expected intensity: 4.5E19
LHC integrated luminosity

LHC 2012 RUN (4 TeV/beam)

- ATLAS 23.130 fb$^{-1}$
- CMS 23.057 fb$^{-1}$
- LHCb 2.178 fb$^{-1}$
- ALICE 9.388 pb$^{-1}$

PRELIMINARY

Delivered integrated luminosity (fb$^{-1}$)

Month in 2012

(generated 2012-12-05 01:26 including fill 3374)

4th July event

2012 goal

2012 Measured vs Predicted

- Integrated Lumi 50 (pb-1)
- Measured 50ns (pb-1)
ATLAS
peak luminosity

CMS
peak luminosity
Pile-up mitigation

Relieve stress on trigger, computing resources, physics object recognition
e.g. CMS $\mu$ and e isolation using P flow

Current strategies run out of steam for $<\mu> > 40$

→ need 25ns (plus detector upgrades)

Pile-up density is a key parameter:
options to spread out the vertex distribution?
Max length of luminous region limited by detector (dimensions, pointing geometry etc.)
Transverse spread impacts on secondary vertex tagging

Courtesy of Austin Ball
LHC efficiency 2012 (so far)

Mode: Proton Physics
Fills: 2469 - 3348 [728 Fills]
SB Time: 71 days 10 hrs 18 mins

- Access - No beam: 13.82%
- Machine setup: 27.47%
- Beam in: 14.83%
- Ramp + squeeze: 7.86%
- Stable beams: 36.02%
LHC operation schedule
Proton-Lead test and run

- A test with 13 colliding p and Pb bunches was done end September 2012 with few hours of first p-Pb collisions.
- A 4 week long run will be made in Jan/Feb 2013.
- Expected beam parameters:
  - 200 ns spacing proton and Pb beams,
  - \ (~350 bunches / beam),
  - p in ring 1 + Pb in ring 2, and vice-versa,
  - Luminosity \( \sim 6 \times 10^{28} \text{ cm}^{-2}\text{s}^{-1} \).
Agenda

• Safety ("Safety always first")
• TE organisation and TE in numbers
• Personnel and material budgets, MPP, MARS 2012
• Training in 2012

• Group activity highlights in 2012:

• Main results in 2012
• LS1
• Conclusions
• Q&A
Long Shutdown 1

Not a project, but a time-frame (13th Feb. 2013 to Dec. 2014)
What is LS1?

- Not a project, but a time-frame (13th Feb. 2013 to Dec. 2014)
- Numerous projects and activities:
  - SMACC (Superconducting Magnets And Circuits Consolidation)
  - R2E
  - Massive shutdown maintenance after more than 3 years of operation
  - Several major consolidations
  - A lot of projects (Linac 4, HIE-Isolde, Elena, LIU, HL-LHC, 107, ….)

- Compared to previous shutdowns, an exceptional number of …
  - Simultaneous activities (co-activities) – **Planning and safety**
  - Non-CERN workers (FSU, collaborations, contracts,…) - **Logistics**: Registration, training, transport, parking, access, dosimeter, EPI, catering, accommodation,…
Main activities in PS & PS Booster

- Full maintenance of all the equipment
- Installation of interlocks
- Upgrade of the RF systems
- Cooling and ventilation renovation
- Installation of the new access systems
- Renovation of the PS vacuum control system
- Improve the radiation shielding over the PS and Septum 16
- ...

PSB - New wide band system of RF power
Courtesy M. Paoluzzi

Access test platform
Courtesy P. Ninin

Goward road shielding
Main activities in SPS

- Full maintenance of all the equipment
- Consolidation of 18kV transformers
- Replacement of irradiated cables in BA1 and in TCC2
- Installing new Fibres systems in BA5, BA6 and BA1
- New coated magnets in BA5
- Major consolidation of the valves – CV
- Vertical realignment in BA6

Magnet exchange in SPS
Courtesy J. Bauche

SPS irradiated cables
Courtesy: D. Ricci
Main activities in LHC

- The main key drivers are:
  - Superconducting Magnets And Circuits Consolidation
    - Interconnections consolidation
      - Total magnet to magnet interconnects in the machine: 1,695
      - Number of splices to be redone: ~1,500 (/10,170 - 15%)
      - Number of shunts to be applied: > 27,000
Main activities in LHC

- The main key drivers are:
  - Superconducting Magnets And Circuits Consolidation
  - Interconnections consolidation
  - 250 persons in the underground for SMACC
  - Magnets exchanged: 19
  - DN200
  - Y line
  - ....
Main activities in LHC

- The main key drivers are:
  - Superconducting Magnets And Circuits Consolidation
  - Radiation To Electronics – R2E

Point 1 – ULs, UJs, RRs
Point 5 – UJ56, UL55, RRs
Point 7 – UJ, TZ

10 groups involved
56 weeks activities
12 groups involved
57 weeks activities
11 groups involved
56 weeks activities

Courtesy: A.-L. Perrot, Y. Muttoni

Courtesy of Katy Foraz
Main activities in LHC

- The main key drivers are:
  - Superconducting Magnets And Circuits Consolidation
  - Radiation To Electronics – R2E
  - Full maintenance of all equipment
  - Cabling !!!
    - LHC installation 3’500km 5 years 120 persons
    - LHC LS1 700km 1 year 100 persons
LHC LS1 schedule

13 TeV operation

Courtesy of Katy Foraz
Additional persons during LS1

Overall additional number of persons at CERN during LS1

Overall additional number of persons at CERN during LS1 per status
Industrial support; FSU contracts evolution & forecast

2004 to mid 2011: S107, S108
Since mid-2011: S144, S145, S146

FSU resources (FTE)

LHC Long Shutdown 1

Per Department (FTE)

<table>
<thead>
<tr>
<th>Year</th>
<th>FSUnits</th>
<th>FTE</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>5</td>
<td>69</td>
<td>14%</td>
</tr>
<tr>
<td>EN</td>
<td>8</td>
<td>93.2</td>
<td>18%</td>
</tr>
<tr>
<td>GS</td>
<td>4</td>
<td>52</td>
<td>10%</td>
</tr>
<tr>
<td>PH</td>
<td>3</td>
<td>31</td>
<td>6%</td>
</tr>
<tr>
<td>TE</td>
<td>14</td>
<td>262</td>
<td>52%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>34</td>
<td>507.2</td>
<td>100%</td>
</tr>
</tbody>
</table>

LHC Installation

FSU resources (FTE)

FSU units (FTE)

2011 2012 2013
Many workers in LHC underground
Foreign workers, new to CERN
Co-activities
Mechanical
Handling and transport
Numerous other worksites

Freshen your Safety Training NOW (if required)
Check your Personal protective equipment:
- Boots
- Helmet and lamp
- Self-Rescue Mask
- And a personal dosimeter

Know your procedures
Work safely for yourself and your colleagues

Safety first, Quality second, Schedule third
Agenda

• Safety ("Safety always first")
• TE organisation and TE in numbers
• Personnel and material budgets, MPP, MARS 2012
• Training in 2012

• Group activity highlights in 2012:
  
  Disclaimer: impossible to mention all the activities
• Main results in 2012
• LS 1
• After LS1 & Conclusions
• Q&A
Updating the European Strategy for Particle Physics

At appropriate intervals, at most every 5 years, the European Strategy Session of Council will re-enact the process aimed at updating the medium and long-term European Strategy for Particle Physics, by setting up a Working Group, the **European Strategy Group (ESG)**, similar to the Strategy Group in 2005/2006.

The ESG will be a Working Group of Council which will cease to exist each time Council has adopted the new medium and long-term Strategy. The remit of the ESG will be to establish a **proposal for the European Strategy Session of Council to update the medium and long-term European Strategy for Particle Physics**.

Council, September 2007
Foreseen Steps

• 21-26 January 2013, drafting session of the European Strategy Group in Erice.

• Draft of the updated strategy will be presented to the CERN Council in its March 2013 meeting for discussion.

• Final adoption of the updated strategy by the Council is anticipated on 23rd of May 2013 during the special meeting in Brussels, coincide with the EU Council of ministers competitiveness meeting.

• Outreach event in May in Brussels, also targeting at the EU parliament members.
Machine and experiments upgrades are crucial to fully exploit the physics potential of LHC!

- **LHC startup, √s = 900 GeV**
  - √s=7-8 TeV, L=6x10^{33} cm^{-2} s^{-1}, bunch spacing 50 ns

- Go to design energy, nominal luminosity
  - √s=13-14 TeV, L≈1x10^{34} cm^{-2} s^{-1}, bunch spacing 25 ns

- Injector and LHC Phase-1 upgrade to ultimate design luminosity
  - √s=14 TeV, L≈2x10^{34} cm^{-2} s^{-1}, bunch spacing 25 ns

- HL-LHC Phase-2 upgrade, IR, crab cavities?
  - √s=14 TeV, L≈5x10^{34} cm^{-2} s^{-1}, luminosity levelling

- 2030?
LS2: LIU, Technical Consolidation & HL-LHC up starts

Shut down to overcome beam intensity limitation (Injectors, collimation...) and for Cryo P4 and test CC

SPS test of Crab Cavities and «cold» coating

4-rod
The High Luminosity machine: Performance & Technical Consolidation

New cryoplants in P1 & P5
IR Magnets
MS Magnets
CC in D2-Q4
Collimators & 11T E-lens?

Full upgrade installation

 Courtesy of Lucio Rossi
The super-exploitation of the CERN complex: Injectors, LEP/LHC tunnel, infrastructures
The big leap forward: a new 80 km tunnel!

Optimisation could be at 16 T (20 T) field level:
**collision energy 80 TeV (100 TeV)**
Easier with a new infrastructure. However many costs go linearly, or more, with length. Stored Magnet energy, beam energy would be new stimulating challenges.

Whatever solution, a vigorous accelerator (HFM, kicker, protection, crab cavity, vacuum,...) R&D should start today and will enable to go beyond LHC energy.
LHC

Road beyond Standard Model

At the energy frontier through synergy of:

- hadron - hadron colliders
- lepton - lepton colliders

LHC results crucial for decisions at the energy frontier

Next decades

DG talk 11th January 2012
At the Energy Frontier
At the frontier of our knowledge

Passage au CERN
17-09-2011

Départ le 10-08-2011
Fin le 15-11-2012

The Higher You Go, The Farther You See
Conclusions

- **2012**, a monumental year for the physics and CERN
  The discovery of the Higgs-like particle thanks to the excellent performance of the LHC and its detectors
- All the other facilities at CERN had excellent performance and have exciting programmes and prospects (diversity)
- Good progresses in consolidations and projects

- **LS1 is the next challenge for CERN and TE department**. ("passage obligé")

- During LS1, we must continue to move forward with plans for the future and to position CERN as the laboratory at the Energy Frontier. (Priority full exploitation of LHC)
  Prioritisation after the update of the European Strategy for Particle Physics

- **Europe's Economic Crisis**: its outcome is still uncertain!
  What will be the impact on CERN?
  Science and Technology: the Stimulus Effect!
Your Integrity
Your Commitment
Your Professionalism
Your Creativity
Your Diversity

Thanks Again to All of you!!
Joyeux Noël à vous et à vos familles

Bon courage pour 2013

I am looking at the future with concern, but with good hope. - Albert Schweitzer

Ways guiding to the future are never clearly indicated as ways. They turn to ways by walking it. - Jörg Zink