SEU related Shutdown Work

LHC-PerfC – 29.10.2008
on behalf of the R2E-Taskforce

(http://ab-div.web.cern.ch/ab-div/Meetings/r2e)

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SEU Related Shut-Down Work

• Report from the **R2E Taskforce** and based on the outcome of:
  – **criticality** of installations (machine safety)
  – expected **radiation levels** and scaling
  – **prioritization** of areas/actions

• Focusing on **this year’s shutdown** activities

• Presenting an **overview** of all foreseen activities with details to be found through existing documents/presentation and responsible

• With the goal to **collect all details** required to finalize the shutdown planning

• This presentation is a **summary of many people’s work**
  -> thanks for all their input!

• Many more details can be found through the **R2E website**
Some General Comments

- Any **optimization** found at one location where actions are needed will also help minimizing the work (and budget) load for all other (future) locations — this requires more than one ingredient:
  - **Radiation Levels**: Calculations & Monitoring
  - Knowledge about the **sensitivity** (lower boundary)
  - **Shielding** effectiveness
  - **Integration** possibilities/constraints
  - **Relocation** options
  - **Split** of equipment (e.g., sensitive/less sensitive racks)
  - **Redesign**

- Work can be grouped in Preparation/Relocation/Shielding/Monitoring

- Depending on the final length of the **(LHC) shutdown** we propose a “**reserve list**” of work to be used for integration in the ongoing planning in case needed

**Activity Status**
- Good & Ongoing
- Partly Scarce
- Good & Ongoing
- Limited & Ongoing
- Scarce

10/29/2008
R2E Summary - SEU Related Shutdown Work
LHC Cryo-Installation @UX85 [S. Claudet]
• The **Electro-pneumatic controllers** are used for the QURC at the level of the beam (+3m) in UX85 and for the QUI at the bottom of the UX85 cavern

• SEE cross-sections are known (high) and failures are expected at the early stage of LHCb operation

• **Remote valve controllers** can be installed and solution is known

• **ECR** ([LHC-QI-EC-0007, EDMS #819444](#)) exists with Phase-II to be implemented,

• Some months were required for the **order and preparations**, respective work is on track

• Installation work foreseen for **January/February** [J.F. Bel]

• **Costs:** estimated in ECR as ~160kCHF
UJ76/TZ76 – Phase I [S. Weisz]
UJ76/TZ76 – Phase I [S. Weisz]

- Services to be rerouted
- Air duct and separation wall to be removed
- Collimation racks in place over
- Separation wall and air duct to be removed
- Zone modified ~100m

extracted from: ST0105522-01 & ST0129594-01
JP.Corsio le 13.10.2008
Most of the equipment installed in the UJ76 is sensitive to SEUs.

Given the criticality, relocation will be prepared as much as possible now.

“Safe-Room” requires a special solution.

UPS are considered as most critical as their failure could lead to machine damage.

Work to be performed during this shutdown:

- protection of racks/equipment already installed in the TZ76
- TZ76 wall removal, dismantling of ventilation ducts, installation of supplies (power, cooling), necessary cable trays
- additional shielding for the SafeRoom
- UPS equipment to be moved
- AC units to be installed where required
- installation of additional radiation monitors (RadMons, High-Level Dosimetry)

ECR (LHC-EC-UJ76) in its final preparation.

Study: evaluated in detail through ICL, integration planning well advanced.

Planning: detailed draft version available.

Costs: This shutdown: ~500kCHF
        (305 [TZ76 preparation] + 160 [UPS +AC] + 35 [shielding])

Next shutdown: ~500kCHF
        (to be finalized, strongly depending on final relocation!)

Further relocation depending on final shut-down time.

Additional FLUKA calculations for possible additional shielding and optimization.
RR73/77 – [S. Weisz, T. Wijnands]
This shutdown: **RR shielding will be installed** in its (almost) full version:

- **chicane** as originally conceived
- **long-side** and **90-degree** iron wall
- Height **at first limited to ~2m** (last part to be decided on)
- **Study**: evaluated in detail through ICL, integration planning finished
- **Planning**: detailed version available
- **Costs**: ~320 kCHF (final sum depending on the amount of shielding >2m)

**Future**: **RADWG meeting** held this Monday to identify possible additional needs:

- RR equipment **not fully characterized** in terms of SEU sensitivity
- components critical for machine safety **NOT** concerned, possible failures would lead to machine downtime
- any possible relocation from the RRs into the TZ76 implies **very high costs and time** (even technically possible only to a certain extend -> cabling, cooling,...) -> to be addressed only after detailed study
- **development** of radiation hard long-term solution is considered as crucial and to be started as soon as possible
- additional **radiation testing** required (costs minor compared to full relocation!)
- **RadMon measurements** to be compared with actual loss distributions and FLUKA calculations
- Discussions during the RADWG meeting suggested that besides ‘non-critical’ CRYO equipment, it seems that there is a chance to **survive the first year(s) of operation** -> to be confirmed
Closing of “Holes” [S. Weisz]

Point 6

Need to fill these ducts with ~1m of iron to protect the dump kicker generation
• **Point 6 partial filling** of critical holes
  – between UA63/67 and RA63/67
  – to be filled with iron rods (1m long)
  – issue with water cooled cables to be clarified
  – **Study**: evaluation started through ICL, integration planning ongoing, details for cables to be clarified
  – **Planning**: first version available
  – **Costs**: ~100kCHf

• **Other Locations:**
  – Previously identified holes were already filled prior to start-up (verification during this shutdown)
Additional RadMon Monitors to be installed

- 4 pre-series are under electrical test at the moment, 50 extra RadMons will be available for the 2008-2009 run (including spares)
- **high-level RadMons** (higher doses, etc...) to be installed in the LSS at P3 and P7 + other critical locations
  - consisting of remote sensing (for inner triplets, TAN, dump, collimation areas etc) allowing to measure fluence and dose at max 250 m distance and up to at least 20 kGy.
- installation of RadMons at **further critical locations**
  - close to critical equipment if not relocated
  - redundancy
- partly relocation of RadMons at critical areas to allow for detailed comparison with simulations and assure that monitors are next to suspected sensitive equipment

High-Level Dosimetry

- Alanin, RPL and/or TLD detectors to be installed to get additional information on integrated radiation doses
Next Priorities

• **US85:**
  – radiation levels might **quickly reach levels close to ‘nominal’** as soon as LHCb physics starts
  – installed **UPS** systems are most probably **not critical** for machine safety, however lead to **downtimes** (CRYO + others)
  – **review** needed of other installed electronics and impact on operation
  – **detailed study** and planning required
  – certain additional sensors (**e.g.,** pressure) in the UX85 to be clarified

• **UJ14/16, UJ56:**
  – In case time is available (longer LHC shutdown) **can one already start with first preparations?**
  – Numerous iterations needed -> **efficient solution imperative!** - > needs ALL mentioned “ingredients”
    • Integration and Simulations -> space envelope, shielding options
    • Prioritization of electronics, criticality, sensitivity, available test data?
    • Relocation options
    • Split/Redesign,…
  – **Staged installation feasible**, first improvements can always give an additional safety margin with respect to very optimistic operation (100fb⁻¹)
### Summary Table

<table>
<thead>
<tr>
<th>Area</th>
<th>Work Description</th>
<th>Period</th>
<th>Time Required</th>
<th>Costs</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>UX85</td>
<td>Phase-II remote controllers</td>
<td>2008/2009</td>
<td>some weeks</td>
<td>~160kCHF</td>
<td>+ ECR: LHC-QI-EC-0007 (EDMS #819444)</td>
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<tr>
<td>UJ76</td>
<td>Phase-I:</td>
<td>2008/2009</td>
<td>five months:</td>
<td>Total: ~500kCHF</td>
<td>+ ECR - final draft to be published early November + detailed planning available</td>
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<tr>
<td></td>
<td>- TZ76 Preparations</td>
<td></td>
<td>- 3 months</td>
<td>- 305kCHF</td>
<td></td>
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<tr>
<td></td>
<td>- UPS+AC</td>
<td></td>
<td>- 2 months</td>
<td>- 160kCHF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- additional Shielding</td>
<td></td>
<td>- in parallel</td>
<td>- 35kCHF</td>
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<tr>
<td>RR73/77</td>
<td>Shielding Finalization</td>
<td>2008/2009</td>
<td>some weeks</td>
<td>~320kCHF</td>
<td>+ only up to 2m first (costs might thus change)</td>
</tr>
<tr>
<td>UA63/67</td>
<td>Ducts to be Shielded</td>
<td>2008/2009</td>
<td>~2 weeks</td>
<td>~100kCHF</td>
<td>+ ICL work ongoing</td>
</tr>
<tr>
<td>Critical Areas</td>
<td>RadMon upgrade and partial relocation</td>
<td>2008/2009</td>
<td></td>
<td></td>
<td>+ TS/LEA looking into</td>
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<tr>
<td>Critical Areas</td>
<td>HLD to be placed</td>
<td>2008/2009</td>
<td></td>
<td></td>
<td>+ SC/RP looking into</td>
</tr>
<tr>
<td>UJ76</td>
<td>Phase II (Relocation, etc.)</td>
<td>2009/2010</td>
<td>several months</td>
<td>~500kCHF</td>
<td>+ costs only include: - main cabling - AC units + detailed planning and optimization requiered</td>
</tr>
<tr>
<td>US85</td>
<td>Phase III</td>
<td>2009/2010</td>
<td></td>
<td></td>
<td>+ UPS, Cryo, additional racks,…to be studied!</td>
</tr>
<tr>
<td>UJ14/16</td>
<td>Phase I</td>
<td>2009/2010</td>
<td></td>
<td></td>
<td>+ study required</td>
</tr>
<tr>
<td>RR at P1/5</td>
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- To be integrated in the shutdown planning