NORTH AREA CONSOLIDATION STUDY

Results presented to the ATS Management Board on 19th November.


7th Beam Telescopes and Test Beams Workshop, 14-18 January 2019
North experimental Area Location

- Built in the 70’s
- 60000 m², surface and underground
- ~ 7 km of beam lines

Provides particle beams for
- FT experiments
- Test beams for R&D programs
North Experimental Area Consolidation

• Undertake the necessary consolidation actions required prior and during LS2 (2019-2020) in order to guarantee a stable and reliable beam operation until LS3 (2025).

• Prepare cost estimates for a more profound consolidation of the existing facilities, to be executed in (or after) LS3, including all possible staging options.

• Prepare for alternative scenarios covering increased performance linked to the “Physics Beyond Colliders” future requirements and energy optimizations.
A detailed review of the NA complex covering the infrastructure, beam lines and safety has been performed.

- Consolidation requests from technical groups
- Failure statistics (2014-2018)
- User feedback
- Non-conformity reports
- Risk assessments, safety audits, accident reports

An accurate picture of the current state has been obtained.
NACONS: Reliability-Driven

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<thead>
<tr>
<th></th>
<th>2014</th>
<th>2015</th>
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<tbody>
<tr>
<td># events</td>
<td>115 (3m)</td>
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<td>NA HW only</td>
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<td>Av. downtime [h] / event</td>
<td>0.87</td>
<td>1.46</td>
<td>1.35</td>
<td>3.88</td>
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Availability of NA vs beam days scheduled by SPS

Combined with SPS avail.: 66%!

- Try to determine the level of satisfaction wrt beam performance, reliability of facilities, severity of hardware failures since 2014
- Help to investigate the needs of consolidation

Users seem well satisfied by the reliability of the installation and the helpfulness of the support team

Urgent issues highlighted:
- Accelerator
- Magnets / power converters
Main Outcome

1. In order to guarantee the reliability of the NA, it is recommended to carry out the Hardware Consolidation in two phases:

   • **Phase I**, starting after LS2 and lasting up to **LS3 incl.**
     - Electrical network, Handling, C.E., CV, Cryo, Magnets, Power Converters, Beam intercepting devices, Beam Instrumentation and Control
     - Will exclude the consolidation related to building BA80,
     - Will address **88.5%** of the total downtime from faults.

   • **Phase II**, starting after **LS3** and lasting up to **LS4 incl. (2030)**.
     - will concentrate on the consolidation needs for BA80 in synergy with BDF/SHIP (EPC and EL),
     - will address the remaining **11.5%** of downtime.

2. **Safety** being the top priority, it is recommended to start bringing NA to conformity without further delay.

* Upgrade and Energy Optimization actions were identified to adapt the North Area to the new requirements related to PBC and to the CERN energy saving policy.*

*but not in the scope of the consolidation.*
Very preliminary Master Planning

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Phase I

Phase II
New power converters for beam line magnets

• Almost all (324) PC of the NA beam line magnets date back from ~1976
• 1 intervention per day on average => components reaching the end of their life

• Profiting from the East Area consolidation to standardize PC systems (SIRIUS type?)
• Working group organized, detailed study ongoing

• No replacement before LS3 (result of the study, future beam parameters, hardware purchase, long shutdown period preferable for installation,...)
• Possibility of integration of a new machine protection system
• Related infrastructure modifications will have to follow (electrical network, switchboards, Cooling & Ventilation,...)

• Upgrade to be further studied: consider an energy optimization approach, but requiring to replace ~130 magnets by pulsed ones.
New power converters for spectro. magnets

15 PC for experimental magnets (4+2 SC) in NA. Only 4 PC are recent. Old ones from 1976 to 1995. Many troubles from the old ones.

<table>
<thead>
<tr>
<th>YETS + 2018</th>
<th>LS2</th>
<th>Post – LS2 (run 3, LS3,..)</th>
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</thead>
<tbody>
<tr>
<td>• NA58: SM2 power converter</td>
<td>• 3 new power converters (NA61 &amp; ATLAS</td>
<td>• Consolidation most likely during LS3</td>
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<tr>
<td>replaced (2017)</td>
<td>Morpurgo) in EHN1</td>
<td>and LS4 for SM1, MNP22, MNP33, Goliath,</td>
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<td>• M1 pc replaced (2012)</td>
<td>• Implementation of a new energy</td>
<td>David</td>
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<td>extraction system for Vertex and Morpurgo</td>
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F. Gautheron - North Area Consolidation Study - BTTB 7 - January 2019
Beam line magnets

- Adapt the number of spares to the number of magnets.
- Refurbish all concerned magnets with the problem of coil shims.
- Exchange Walther gaskets and water filters for the magnets throughout the NA.
- Replace couplings and filters without any organic material.
- Renew flexible hoses and water hose clamps.
- Ensure that all imperfect interconnections are found and consolidated.
- Conduct temperature analysis at the different locations.
- Exchange all manifold connections,...
## Beam Intercepting Devices ("BIDs")

- Many different and often very old beam intercepting devices: collimators, dumps, convertors, absorbers... with an increasing number of faults during operation (operation with more frequent movement of the jaws).

- Control parts already renovated in [2011-2014] and motors [2017-2018]

### LS2 (2019 – 2020)

<table>
<thead>
<tr>
<th>Urgent needs of consolidation:</th>
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<tbody>
<tr>
<td>• 8 units of 2 blocks coll (XCSH/V) (H2, H4, H6, H8)</td>
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<tr>
<td>• 7 units of 4 blocks coll (XCHV).</td>
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<tr>
<td>• 8 beam dump tables to purchase (XTDV) for H2, H4, H6, H8</td>
</tr>
<tr>
<td>• 3 dump tables to consolidate (H8 &amp; neutrino platform)</td>
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<tr>
<td>• redesign and fabrication of TCSC plugin tables (better remote handling)</td>
</tr>
</tbody>
</table>

### Post LS2

- Troubles with XTAX, to be treated most likely during LS3 or LS4
- XCMH/V to be replaced by collimator under vacuum
- XCBV not in vacuum, not compatible with RF separated beam
- XCLD would be useful for K12 line and KLEVER
- XTDV tables: mechanical problem to solve
- Vacuum: missing sector in M2 (in case of long term program)

### Upgrade:

- define intensity limits on targets and TAX
- Study modifications needed to accommodate the PBC requirements
# Beam Instrumentation consolidation

A working group has been set up in 2018 for the study (EA- BI-SMM):

- Inventory of the present situation, possibility of maintenance & consolidation.
- Evaluation of the state of the hardware and the needs for R&D
- Define baseline requirements for post-LS2 and LS3 & resources

## LS2

| 10 Cherenkov counters “XCET” (H2, H4, H6, H8) (control, design, cabling, various parts) |

## Post-LS2

| XSCI intensity counters with new voltage dividers + signal splitter (users) |
| CEDAR: already renovated for NA58. New gas control and faster readout for other (H2, H6, K12 lines) & thermal insulation. |
| Profile monitors: does not match always with beam rates $10^5$/spill. Some of them could be replaced by motorized scintillating fibre monitors (XBPF). |
| Some scintillating fiber scanner “FISC” could be replaced by XBPF |
| XEMC: read out to be replaced by ADC |
## Cryogenic installations (TE-CRG)

<table>
<thead>
<tr>
<th>LS2</th>
<th>Post- LS2 (run 3, LS3, …)</th>
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<tbody>
<tr>
<td>• Purchase of LN2 tanks to replace rented ones</td>
<td>• Test, qualify and purchase of immersed centrifugal Liq. He pumps for ATLAS H8, Vertex 1 &amp; 2</td>
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<tr>
<td></td>
<td>• Replacement of helium storage balloon in EHN1</td>
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<td></td>
<td>• New GHe volume measurement tools for EHN1</td>
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</table>

In an energy saving scheme (upgrade), the NA helium compressors plant could be replaced by 400V standard screw compressors.
Some other actions to be taken

For LS2 (2019 – 2020)

• The consolidation of the obsolete flammable gas & ODH detection system.
• Bringing the gas network to conformity.
• New radioprotection monitoring system.
• Installation of new radioprotection buffer zones.
• Replacement of lifts and renovation of overhead cranes ( and post – LS2).
• Consolidation of water cooling for beam lines magnets.
• Cooling towers: replacement of the control system.
• Chilled water pipework.

Post - LS2

• Replacement of counting room barracks & false floors in EHN1,
• Renovation of buildings (roof, access ...)
• Decabling, removal of obsolete cables
• Full renovation of the fire safety system & Beam imminent warning system
Conclusion

• Current state of the North Experimental Area has been analyzed.
• Consolidation needs have been identified.
  • Hardware consolidation: reliability
  • Safety: top priority
• A strategy is proposed for the consolidation in 2 phases.
  • **Phase I & Safety** [2017 – 2026]
    • Hardware consolidation (excl. BA80)
    • Civil engineering works
    • Safety (Gas detection, Access control, Fire protection)
  • **Phase II & Safety** [2027 – 2030]
    • consolidation needs for BA80 (synergy with PBC and BDF)
    • remaining safety items (Fire detection, Alarm, Evacuation) and C.E. works.

The present consolidation strategy will allow keeping the North Experimental Area safe, reliable and attractive for future high-energy physics programmes.
Fault Analysis

N of events in 2017
- EN-STI 20
- TE-EPC 141

Estimated downtime in 2017
- EPC 165 h
- STI 70 h
- EN-CV 511 h

N of events in 2018
- TE-EPC 152

Estimated downtime in 2018
- MSC 111 h
- TE-EPC 374 h

(Until October 9th)