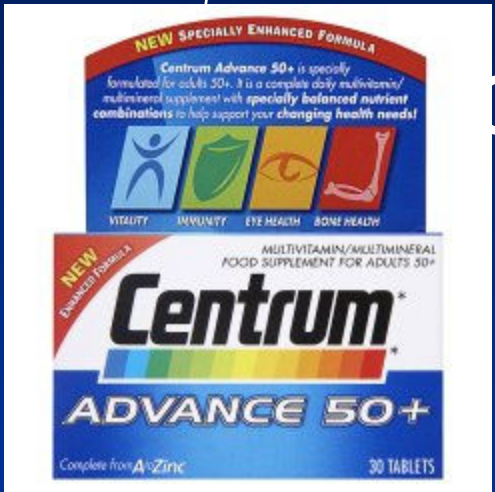
How to keep the Injectors running for another 25 years

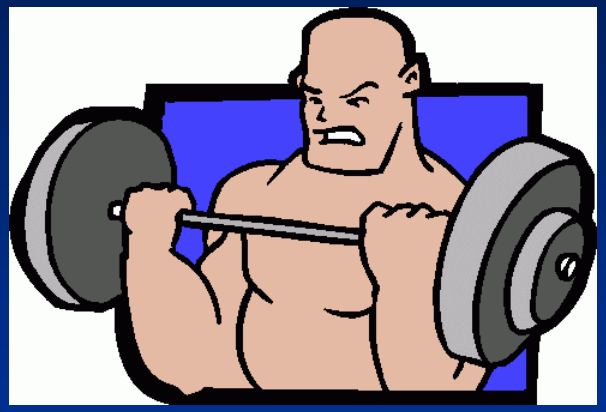
S Baird
(on behalf of EN/MEF/ABA)

LHC Performance workshop
Chamonix January 2010

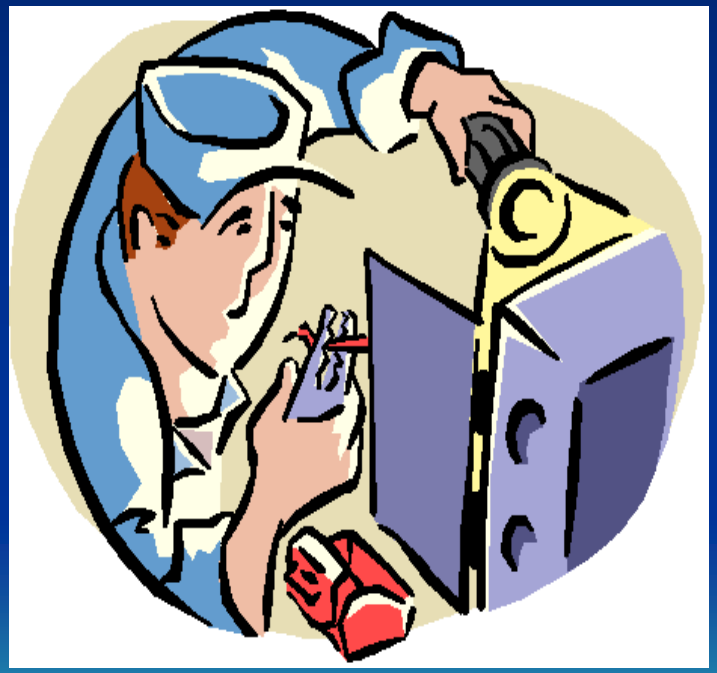
How does one keep a ~~50~~ 51 year old running for another 25 years?



or



How does one keep a ~~50~~ 51 year old accelerator running for another 25 years?



How to keep the injectors running for another 25 years?

- Full session @ IEFC workshop 10-12 Feb.
  - Information collected by Machine Superintendents (EN/MEF/ABA)
- No upgrade in performance considered (treated elsewhere)
- Maintain current beam performance and availability for LHC lifetime
- LINAC2 not treated here
  - LINAC4 will be covered in Feb.

How to keep the injectors running for another 25 years?

- Huge amount of information collected
- Review system by system = 12 slides
  - Vacuum, RF, Magnets, Kickers & septa, Beam Instrumentation, Interlocks, Cooling & Ventilation, Electricity, Power Convertors, Cabling, Handling, Dumps, RP, Tunnel Infrastructure etc….

Vacuum

- A report is in preparation for the injector chain
- First “estimate”
  - Operation to 2022 replace 50-70% of system hardware
  - Operation to 2035 replace 100%
- SPS
  - Spares (windows in target areas?)
  - TIDVG upgrade
  - MKE?
- Any major consolidation campaign (ABT, MSC, RF etc…) would involve a lot of vacuum activity

RF

- PSB: Major work on C02, 4 & 16 systems
  - HV power supplies, tuning supplies, interlocks, servos, plus cables, low-level & dampers etc.
  - 12-15MCHf
- PS: Systems must be modernised
  - C10 drivers, gap relays, ferrites, RF bypasses, Digital low-level systems, new feedback systems, cables
  - >10MChf
- SPS:
  - Power couplers, replace tetrodes, wave-guides, replace low-level (200 & 800MHz), controls, dampers….
  - Plus major upgrades needed to increase intensity

Magnets (EDMS no: 1057909)

- Maintain a vigorous maintenance plan
  - Dielectric tests, endoscopic inspections, inter-turn testing, water hoses, maintain a healthy stock of spare coils and magnets
- PSB
  - Continue maintenance program + purchase spares
- PS
  - Continue maintenance program + purchase 20 additional sets of PFW (gives enough to re-equip all main dipoles)
- SPS: Water erosion, inter-turn shorts & fatigue of pole shim bolts
  - Continue systematic maintenance
  - Study of water erosion problems
  - Spare coils
  - Replace pole shim bolts in maintenance plan

Beam transfer systems

- PSB & PS:
  - LINAC4 project – PSB injection systems new
  - Spare kickers, tanks, HV cables
  - Replace thyratrons, HV switches
  - Replace controls (PLC based solutions?)
- SPS
  - Replace septa HV generators, diluter
  - LSS4&6 new fast pulsed magnets
  - Spare MKDV/H magnets
  - Replace timing systems
  - Buy Thyratrons for 25 years of operation (single supplier)
- Some of this is included in present Consolidation programs

Beam Instrumentation

- Wire scanner
  - New fast BWS prototype developed for installation from 2014, for PS SPS & LHC
- BLM
  - New system for PSB in 2013 (LINAC4)
  - PS and SPS afterwards
- Beam position & trajectory
  - PS system recently replaced
  - SPS replacement planned for 2013
  - PSB to be planned (link to LINAC4?)
- Beam Current Transformers
  - Acquisition systems for PS complex are being replaced
  - Hardware (e.g. BCT torroids) will need replacing

Electricity

- On top of existing Consolidation (44MCHf)
- PSB & PS
  - Replace all cabling (48 MCHF)
  - Replace low voltage switchboards, UPS, safety lighting etc. (14MCHf)
  - Renovate HV substations ME16, ME49 & M76 (2MChF)
- SPS (not including 18kV system actions already covered)
  - Replace 2 400/18kV transformers (8MCHf)
  - Replace SMB 18kV cable network (7MCHf)
  - Replace all TGBT switchboards (7MCHf)
  - Replace 40/72 18/4kV transformers (2.3MCHf)
  - Cable replacement in tunnel (40MCHf)
  - Remove unused cables (30MCHf)

Power Converters

- PSB: 13MCHf installed cost
  - 50% will need to be replaced by 2020 = 7 MCHf
- PS: MPS replaced = POPS
  - Replace TT2 power converters (4MCHf)
  - Auxiliary supplies??
- SPS:
  - MPS renovation 2010 -14 (7MCHf)
  - AuxPS and LHC transfer lines recently upgraded/installed – annual maintenance
  - Two static VAR Compensators will require replacement after 20 years operation (2022 & 2027)
  - North area power converters will need replacing (7MCHf)

Access and safety systems

- PS: PPS renewal has started 2010 - 2013/4
  - Current “obsolete” system will be maintained: outdated G64 systems etc. will be replaced
- SPS: PPS replacement is planned to start in 2011 - 2015/6?
  - Current “obsolete” system will be maintained
- Safety & Fire alarm systems will be maintained as long as necessary

Interlocks

- Today PSB/PS do not have a beam interlock system
  - Studies are just starting on deployment of the LHC BIC type for PS (with new access system)??
- PSB/PS Magnet interlocks
  - New WIC only installed for LINAC3 & LEIR
  - Current PSB/PS system has never been renovated, could be replaced with WIC (250kCHf)
- SPS: BIC is already in operation, the WIC is deployed for transfer lines only
  - Main ring magnet interlocks have never been renovated, could be replaced with WIC (800kCHf)

Dumps, collimators..

- Beam stoppers - Standard maintenance
- Slits: Critical elements
  - Very active, cannot be repaired, mechanics need to be standardised & spares built
- PSB Beam dump critical
  - no spare “history unknown”
- PS beam dump: Under Consolidation
- SPS
  - Scrapers: planned for consolidation
  - TIDVG Improved spare under constructions

- Experimental area equipment, target stations, collimators etc also need urgent maintenance

Cooling & Ventilation

- Major Consolidation effort already planned in coming years
  - 40MCHf, which includes a lot of work for LHC
  - Injectors = Controls, safety requirements for Legionnaire's disease, spare parts, replace piping & valves…
- Additional actions to be considered for another 25 years
  - Complete replacement PS ventilation systems (asbestos!)
  - Replacement of PS chilled water circuits
  - Replace heat exchangers on Meyrin cooling stations
  - Renovate compressed air systems
  - Renovate production for dematerialized water

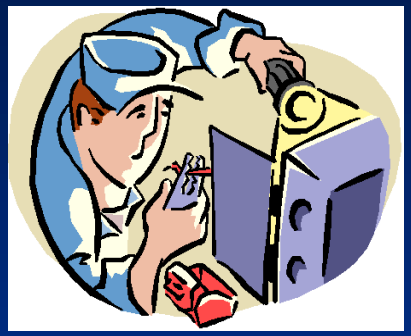
Other systems

- Controls – ACCOR renovation project starting.
  - Should consider an ACCOR2?
- Cranes, lifts, handling equipment are in the existing Consolidation plan
- SC/RP radiation monitoring - Ramses deployment is in the existing Consolidation plan
- Tunnel Infrastructure under study - Civil Engineering

Conclusions

- This is just a start
  - More detailed analysis at the IEFC meeting leading to
    - a list of activities
    - Some more detailed studies
    - first cost/resource estimates
  - Some BUT DEFINITELY NOT ALL of these activities are included in current Consolidation programs.
- Strong and vigorous maintenance programs are very important
- Don’t cut Operations budgets, even if it looks attractive in the short-term….

+



=


©FiBoy.com