Session V: **Shutdown Modifications 2008/9 and Future shutdowns**

A summary. Reported by S. Baird on behalf of

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Session V

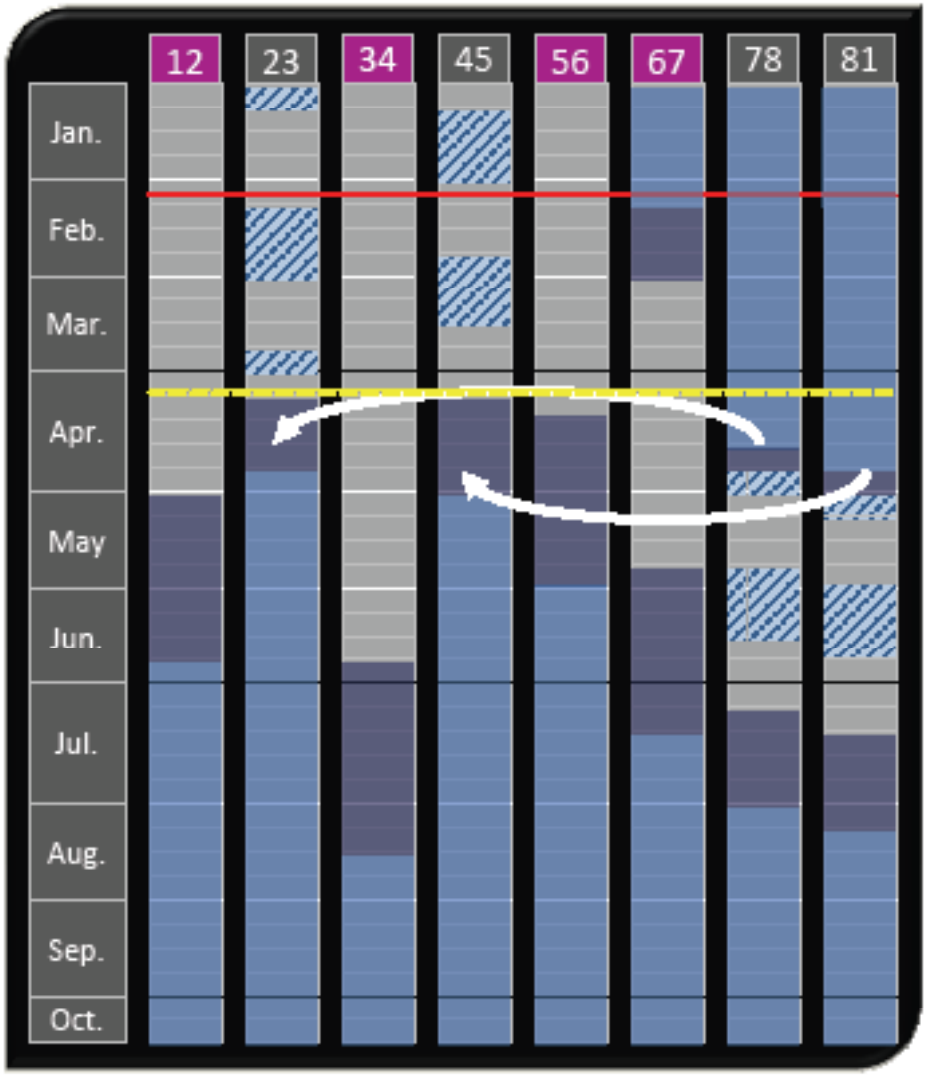
- The current shutdown (J. Coupard & K. Foraz)
- Alternative scenarios for the current shutdown (J. Coupard & K. Foraz)
- Running through the winter 2009/10? Is it just a cost issue? (M. Batz)
- How do we keep track of upgrades/changes? (R. Schmidt)
- Consequences of warm-up of a sector above 80K (P. Strubin)
- Critical spares (R. Saban)

The current shutdown

- Key drivers:-
  - 3-4 repair (critical path)
  - CV & Cryo maintenance
  - Intermediate cool-down during CV and Cryo maintenance
    - Maintain temperature below 100K for PIMs & ELQA
    - 6 weeks needed for 3 weeks work
  - Helium storage capacity (6 of 8 sectors)
  - Cannot refill 1-2 until all magnets are back in the tunnel
    - Transport activity through 1-2

Shutdown 08-09

Key Drivers Maintenances Priorities Activities – service areas, LSS, Arcs Schedule Critical Points



Sectors warm to R.T = 4

- Sectors 12, 34, 56
- Sector 67 in February

Current satus = 5 sectors empty

Helium Storage = max. 6 sectors

Cool-down of sectors 12, 23, 34, 56 and 67 cannot be done as long as there are transports of dipoles for sectors 34 and 67

Last dipole = week 15

For sectors not warmed to R.T.

Maintain the T. under 100K for the PIMs = 2 weeks of intermediate cool-down / 4 weeks

Warm-up of the stand-alone and QRL = + 1 week

It's a 6 weeks cycle: only 3 weeks of works !

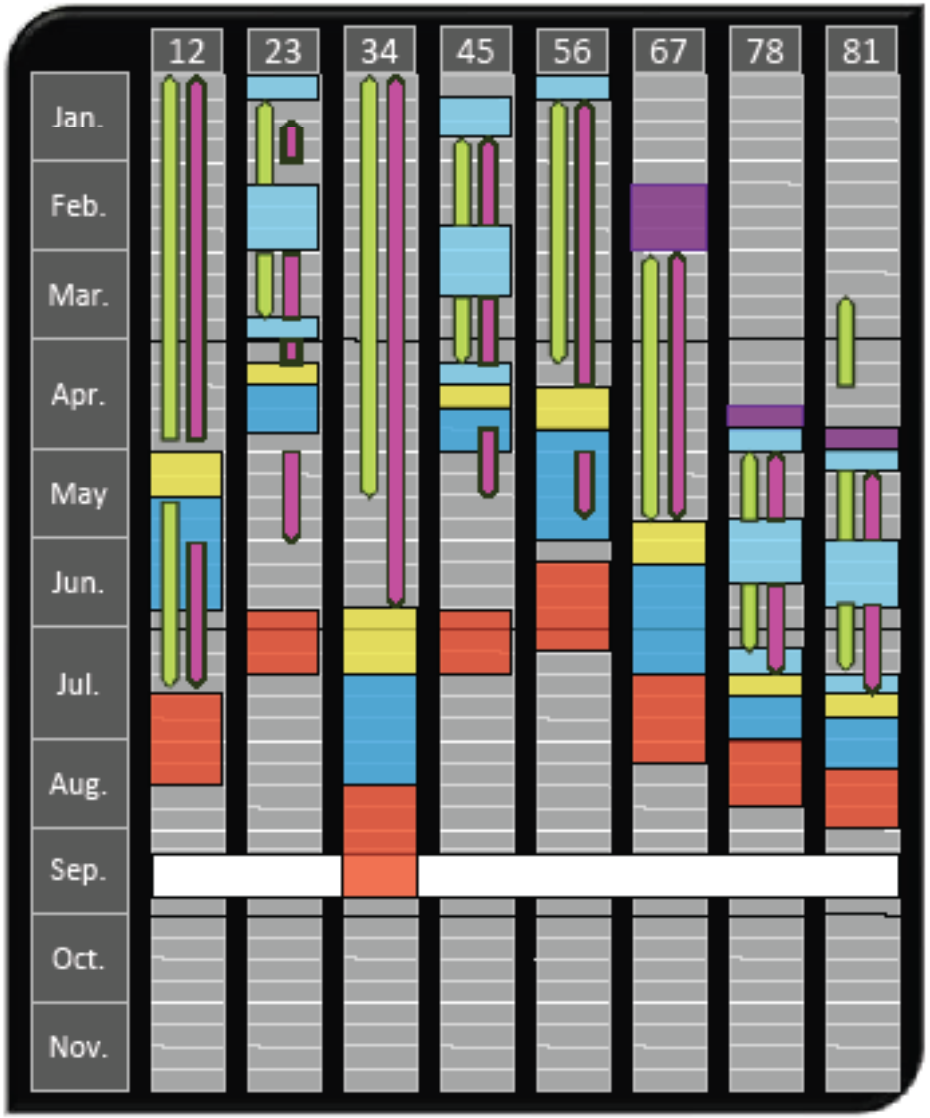
Machine cold in August

The current shutdown

- Discussion
  - Venting helium from 7-8 and 8-1
    - cost 600kCHF per sector
    - plus possible re-supply problems in August

- Final schedule for current shutdown
  - This includes
    - Upgraded QPS everywhere
    - DN200 relief valves in 4/8 sectors
    - Jack re-enforcement everywhere
    - 50 & 100nOhm dipoles replaced in 1-2 and 6-7
    - No work in sectors adjacent to main circuit power tests
  - Discussion
    - Can circuits be tested at low power with work in adjacent sectors???
    - Need to define this power level

Shutdown 08-09

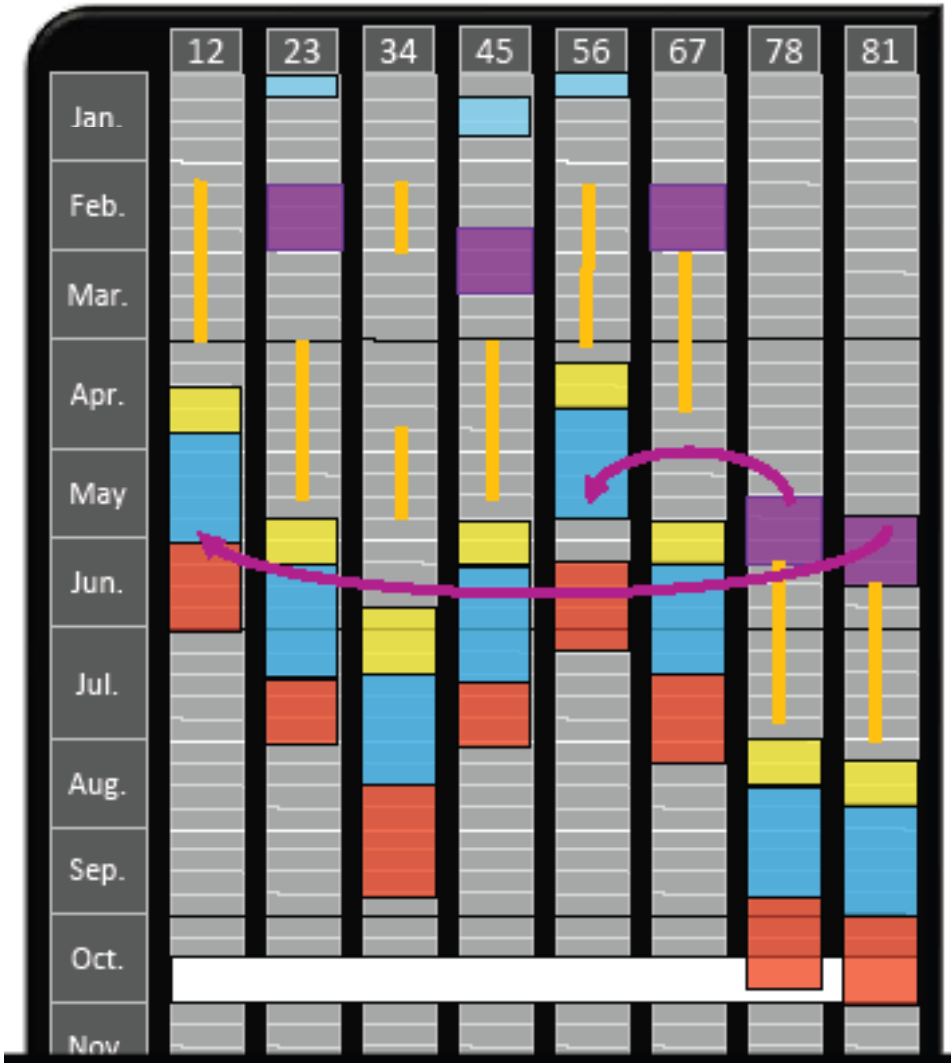


- Intermediate cool-down & QRL warm-up (Stand Alone)
- Activities
  - Arc
  - LSS
- Flushing & ELQA at warm
- Cool-down
- Powering tests
- Cold check-out

Alternative Shutdown options (2008-9 and 2009-10)

- Current shutdown schedule leaves work for 2009-10
  - DN200 in 4 sectors
  - Some outstanding stand-alone consolidation activity
  - Y-lines in 7-8 & 8-1
- Leads to 24 weeks for 2009-10 shutdown
- If we do all this now?
  - Less risk of over-pressure in insulation vacuum for 50% of the machine
  - ALARA radiation issues for machine components that have seen beam (after 10 month run??)
- How would the revised 2008-9 schedule look?

Total warm-up



- The emptying of sectors 78 & 81 can only occur when the first 2 sectors are cold: i.e sectors 12 & 56
- Critical points - Changes
  - Gaining 5 wks margin on sector 34
  - Sectors 12, 56, 78 & 81 on the critical path
- Delay w.r.t current schedule = + 5wks

Flushing / warm-up
Consolidation
Cool-down
Intermediate CD
ELQA & flushing
Powering tests

- Animated discussion on groups buying in to such a schedule…
  - Need contingency
  - Extra work leads to more surprises
  - Teams already over-loaded
  - The length of the shutdown does not affect operational beam energy for the run
    - This is determined by QPS performance

Both schedules imply operation through the winter 2009-2010…. concerns raised

- CV annual water tower cleaning is obligatory
  - Temporary compensatory measures (regular bacterial measurements and stop for system cleaning at predefined levels)
  - Cleaning takes 3 days,
  - But it would take several weeks to re-establish cryogenic conditions for beam operation.
- EL annual maintenance (400KV and AUG) can be delayed
- Cryogenics designed for at least 8000 hours of continuous operation
- Electricity costs between 8 & 14Meuros
  - For an LHC run from October 2009 to October 2010 (very similar for start in November)
  - Injectors only run for LHC in winter
  - Difference due to a possible 35% reduction in LHC cryogenic power (using 4 instead of 8 plants during stable operation) and a potential 8% electricity cost increase.

How do we keep track of the changes?

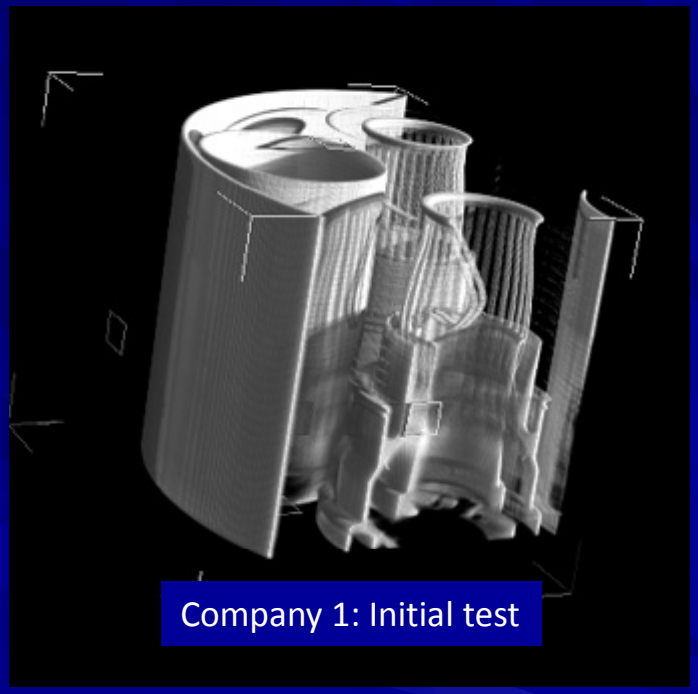
- Tools exist
  - Are they adapted (many, many changes)?
  - Big activities are well covered (lots of small activities are “unknown”)
  - For small activities inform point owners
- Are ECRs being used?
  - Very few are issued for LHC
  - SPS situation is better using a “light version” of the original LHC ECR.
- ECR system should be reviewed and resuscitated
- Where are modifications approved?
  - LMC

Consequences of floating sectors warming up to >80K

- Strategy to consolidate the PIM's
  - Repair systematically the most vulnerable ones
    - Extremities of the arcs and LSS
  - Continue to use the "ball" or "sputnik" test when warm
  - Use X-ray tomography when in doubt
    - Available in August / September 2009
- Recommendation to perform ELQA
  - Full procedure after full warm-up and modifications
  - At least HV test after full warm-up without modifications or partial warm-up

X-Ray Tomography

- Tests on a mock-up very convincing



Order to be placed this week after
- market survey
- invitation to tender
- “fast track” procedure at FC

Delivery expected early September 2009

Consequences of floating sectors warming up to >80K

- Strategy to consolidate the PIM's
  - Repair systematically the most vulnerable ones
    - Extremities of the arcs and LSS
  - Continue to use the "ball" or "sputnik" test when warm
  - Use X-ray tomography when in doubt
    - Available in August / September 2009
    - Potentially useful tool for examining "suspect splices"
- Recommendation to perform ELQA
  - Full procedure after full warm-up and modifications
  - At least HV test after full warm-up without modifications or partial warm-up

Critical spares/areas

- Many (most) of the spare magnets are being used in 3-4 repair
  - Need to reconstitute a new stock by rebuilding damaged cold masses etc.
- No spare DFB's
  - Some spare chimneys and leads
  - Should we worry about over-pressure damage in DFB's?
- SPS 18kV system
  - Supply to TI8 CNGS is a single point of failure
  - Machine loop has redundancy
- PS MPS (rotating machine)
  - In case of failure the PS could run for LHC with a longer filling cycle.
  - Replacement foreseen in 2010 (2011 if there only a short 2009-10 shutdown)
- LHC water cooled cables
  - Premature ageing and Halogen content
  - No strategy for replacement (this is now underway)

Critical spares/areas

- CV systems are inherited from LEP
  - need consolidation for dehumidifiers, pumps etc,
  - System do not conform to European regulations (Legionnaire's disease)
  - Currently cooling system maintenance stops both cryogenic system and experimental area operations
  - Can a solution be found….

Critical spares/areas

there is an acute critical spare issue for some **LHC components**

a less critical spare but a consolidation issue for some **infrastructure systems**

1. we need the detailed inventory of
   a) the existing spares and spare components of the LHC elements
   b) the existing spare components of the LHC infrastructure systems
   c) their present weakness
2. we have to assess the quantity of missing spares and the required consolidation
3. we must define the repair strategies

we must secure the budget and start a program to restore the spare inventory and to consolidate the vulnerable infrastructure systems