

Summary of Chamonix 09

Steve Myers





Topics for Discussion/Decisions

- Schedule
- Repair Scenarios
- Dipole Field for Operation
- “Precautions for Running”
- **Beam Conditions for Physics**
- Future Improvements for increased availability



Physics Running Time

With Strictly No running of the machines in the winter months

– Present baseline schedule

- schedule allows very limited physics in 2009/2010 (24 weeks)
- Any slip of >1 month in the S34 repair will delay first LHC physics till August/September 2010!!
- Repair schedule has no contingency

Year	2009												2010											
Month	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
Baseline	Shutdown									SU	PH	Shutdown (Relief V)						SU	PH					SH
24 weeks physics possible																								

- **Must** have the possibility of running during winter months



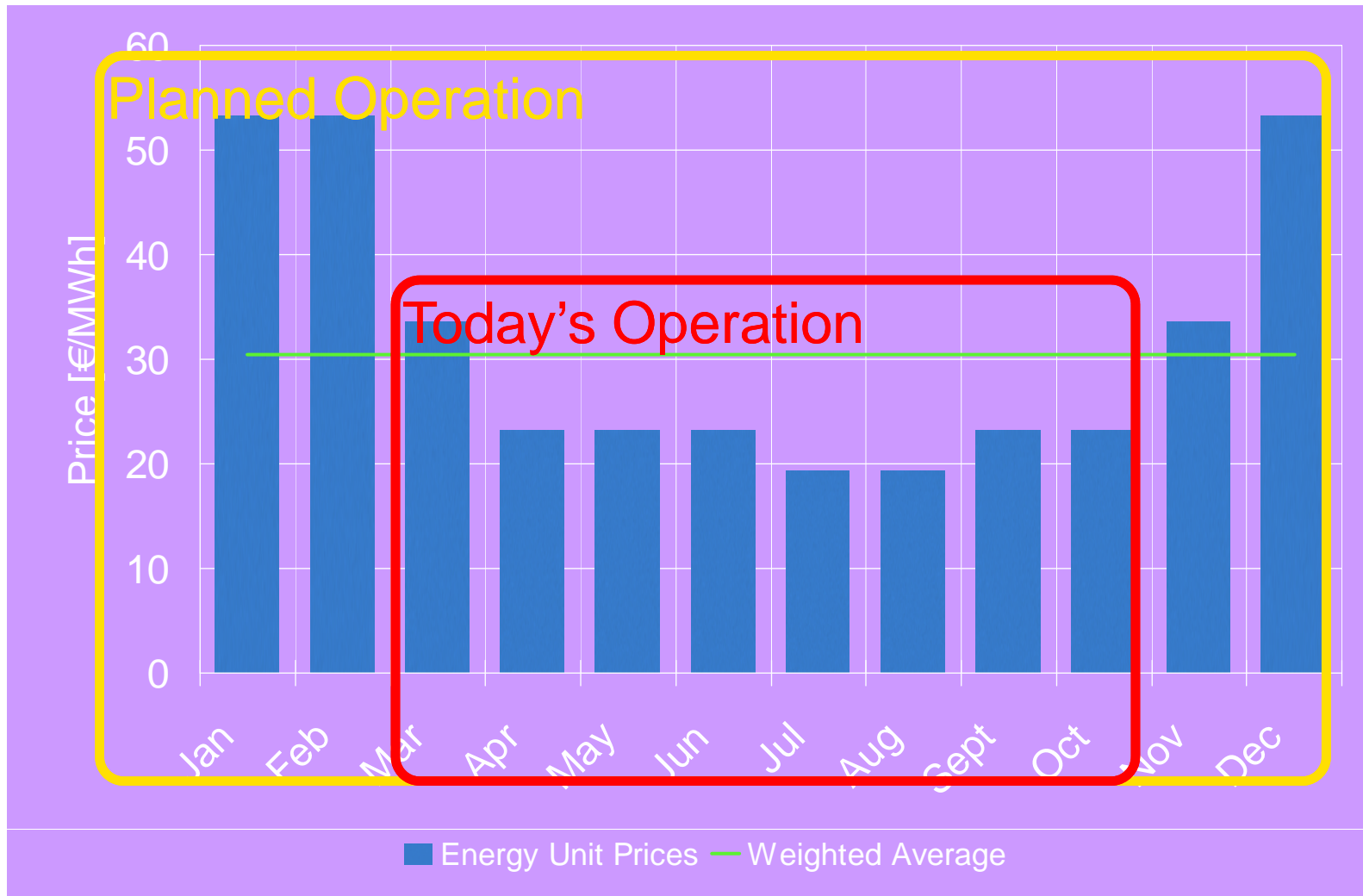
Schedule with running in winter months

- Gains 20 weeks of LHC physics (independent of “slip”)

Year	2009												2010													
Month	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
Baseline	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	SH	SH	SH	SH	
	24 weeks physics possible																									
Base '1	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SH	
	44 weeks physics possible																									
Gain 20 weeks of physics in 2010 by running during winter months																										
													HIGH price Electricity													
Delay (4W)	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SH
Delay (8W)	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SH

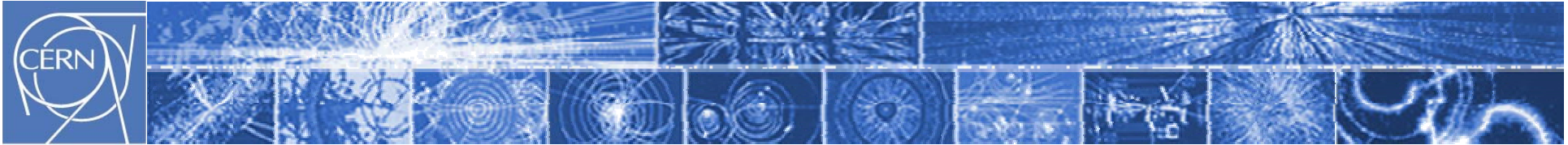


Today's cheapest applicable EDF Tariff



Impacts of Running During Winter Months (2009-2010)

- **Electrical Costs!!**
 - Assuming Full running through December to February
 - dedicated running of the injectors during winter and
 - reduced cryo power from 8MW to 5MW
 - **additional electricity bill of 8MEuros (+ possible 8%)**
- **Impact on Scheduled Shutdown Work on other CERN accelerators**
 - » POPS (PS motor Generator)
 - » LINAC4 connection to PSB
 - » ...
- **Impact on Necessary Maintenance**
 - » Cooling towers
 - » Electrical Network



FIRST PROPOSAL

**Pay for Electricity for Running in
Winter 2009-2010**



Repair Scenarios

- Enhanced Quench Protection (Detection)
 - Busbar Detection (Protection)
 - “Symmetric” quench protection

The FULL Quench System must be operational for beam collisions in 2009-2010 (unanimously agreed)

DN200 Pressure Relief Valves in Arcs

A: install 4 sectors (09-10) + 4 sectors (10-11)

- + present schedule allows calorimetry measurements in 23, 45 much sooner
- + first physics sooner: detectors debugging.. earlier warning
- + first beam sooner: ramp, squeeze, .. Sooner... earlier warning
- + focuses attention of repair teams

B: Installation 8 sectors (09-10)

- + reduced amount of collateral damage in event of a splice problem in 2010
- + reduced additional electricity bill
- + reduced overall shutdown time
- + reduced ALARA problems (2nd order)

No consensus in Chamonix



Discussion on Schedule

- Key Drivers for schedule;
 - Safety constraints, access, transport,...
 - Helium storage
 - Maintenance: cooling towers, electrical network...
 - Cryo maintenance, PIMs...

We are working on these issues both for the present shutdown and future ones



Summary on Schedule

Year	2009												2010												2011																								
Month	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D														
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Delay (8W)	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	
8 sectors (5W)	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	
8sectors (8W)	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH
8 sectors (12W)	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH	SH	SH	SH	SH	SU	PH	PH	PH	PH	PH	PH	PH	PH	PH	PH

Earlier PH may be possible due to changes in safety constraints and additional shifts for power testing

Immediately after Chamonix the management decided on scenario A

Here it is assumed that these shutdowns will be long enough in case of problems seen during the preceding PH running



Energy Level for Operation

- Dipole field which can be reached
 - Time needed, reliability, and efficiency
- Risks associated with operating at field
 - Splices stability (thermal runaway...)
 - Detection of poor splices (see later)
- Operational efficiency of other systems
 - Cryo recovery time etc



Dipole quenches during HWC

Sector	1 st training quench [A]	I_max [A]	# training quenches	Starting in:		
				# ALS	# ANS	# NOE
1-2	-	9310	0	0	0	0
2-3	-	9310	0	0	0	0
3-4	-	8715 (bus)	0	0	0	0
4-5	9789	10274	3	0	0	3
5-6	10004	11173	27	0	1	26
6-7	-	9310	0	0	0	0
7-8	8965	9310	1	0	1	0
8-1	-	9310	0	0	0	0

Excluding S34, all sectors reached 8965 A (5.3TeV) without a quench

Excluding S34, all sectors reached 9310 A (5.5TeV) with 1 quench



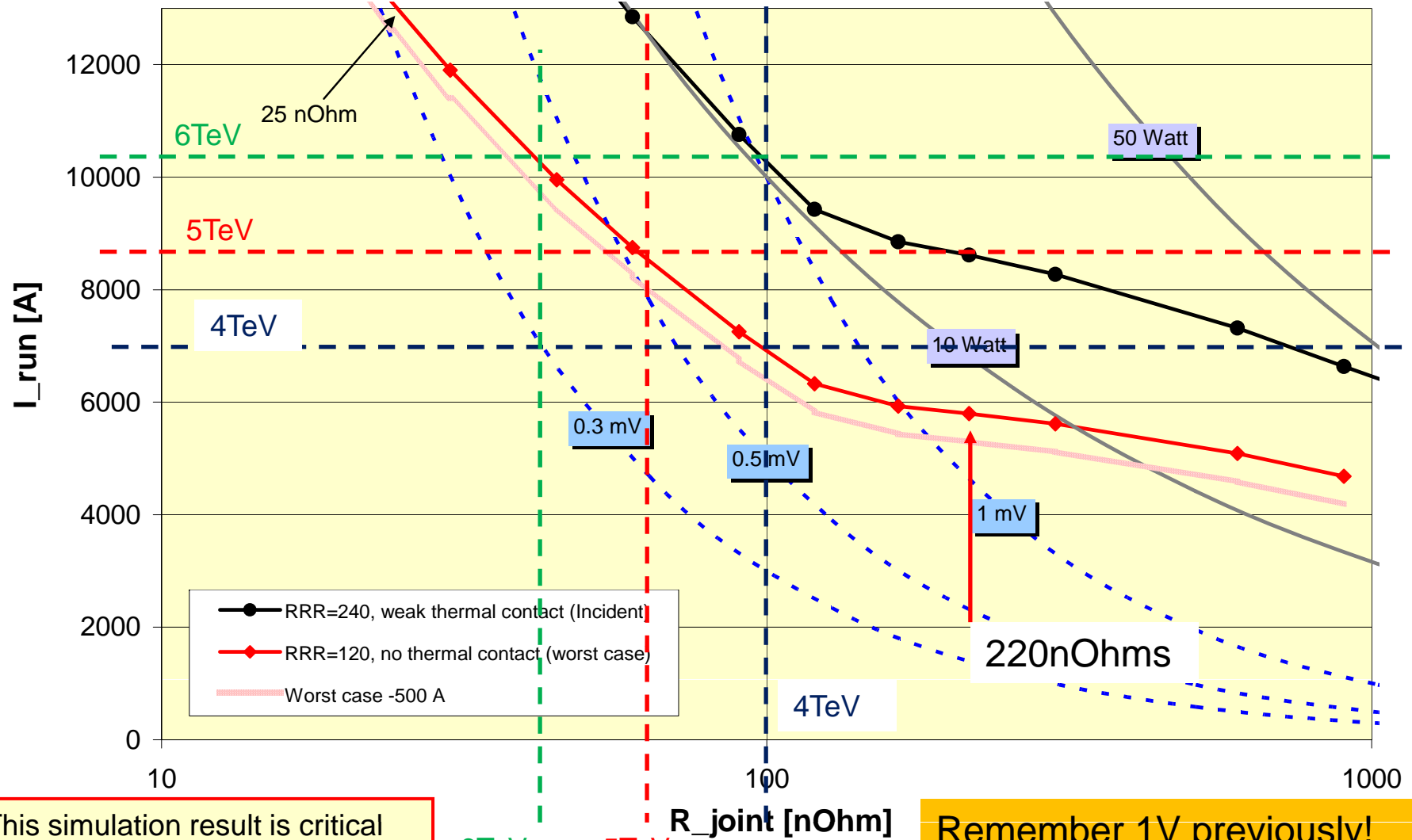
Estimated dipole training to reach 6 and 6.5 TeV

Sector	Number of magnets			Number of quenches	
	ALS	ANS	NOE	@ 6 TeV (± 2)	@ 6.5 TeV ($\pm 30\%$)
1-2	49	96	9	0	4
2-3	56	60	38	1	8
3-4	56	65	33	1	8
4-5	46	46	62	2	12
5-6	28	42	84	1	15
6-7	57	36	61	2	12
7-8	54	40	60	2	12
8-1	64	24	66	2	13
Total	154	154	154	11	84

Estimated 11 (84) quenches to reach 6 (6.5) TeV



Setting for the new QPS upgrade



This simulation result is critical for our decision and should be independently confirmed

Remember 1V previously!



Beam Conditions for Physics

- **Conclusion 5TeV/beam for Physics**
- Machine Protection will be Tested with beam (at 0.5TeV energy levels)
- 4 TeV “on the way” to 5TeV (limited in 2010)
- Estimated integrated luminosity
 - during first 100 days of operation.. $\approx 100\text{pb}^{-1}$
 - » Peak L of $5 \cdot 10^{31} \eta$ (overall) = 10% gives $0.5\text{pb}^{-1}/\text{day}$
 - » Peak L of $2 \cdot 10^{32} \eta$ (overall) = 10% gives $2.0\text{pb}^{-1}/\text{day}$
 - During next 100 days of operation.. $\approx 200\text{pb}^{-1}$?
- Then towards end of year **ions** (to be planned in detail soon)



Precautions before Running with Beam

- Pre-detection of Poor splices in untested sectors
 - Analysis of SM18 data + calorimetry at 7kA
 - Early running of S23 and S45 (weekend calorimetric run in April/May??)
- QPS fully operational 😊
- QPS in event of trip of UPS 😊
- Quench Protection during magnet ramp down 😊
- Pressure valves in DFBs and inner triplets
- Protect RF and injection kickers (vacuum valves)
- Water cooled cables
- Anomalies in electric circuits (K-H. Mess)
- Xray machine available Aug/Sept ?sooner
- Undulator (left of point 4) availability and necessity



Precautions for Running 2

- Long Straight sessions: clarification ?
- Automation of the calorimetry measurements
- Complete set of Ohmic measurements of all splices during Power Tests and Cold check-out
- MQM praying hands splices? Change ?



Future Improvements

- Spares, spares, spares
- SEU; continuation of protection
- Helium storage
- ARCOM-RAMSES replacement
- Improvement in controlled access system
- MQM praying hands splice to be replaced
- Cooling Tower maintenance (LEP/LHC HVAC)
- Vacuum consolidation to reduce collateral damage in case of splice rupture
- Clamping of busbar splices, development followed by campaign of replacements?
- Use of new xray machine
- Centralised radiation workshop



Closing Remarks

- **The Chamonix yearly retreat is crucial**
 - Seeds planted for several collaborations machine-physics groups
- **Strong Recommendations**
 - Beam physics running during winter 2009-2010
 - Long running period of 11 months is possible
 - Enhanced QPS system fully operations for run
 - 10TeV cm; $> 200\text{pb}^{-1}$ (goodbye to competition)
 - Ions at the end of the proton run
- **Future Work-Plan established**
 - Preparation for 2009-2010 run (safely and reliably)
 - Longer term to convert LHC into an “operational” machine
- **Chamonix 2010 already planned!**