



Situation of the power converters of the SPS and PS experimental areas

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SPS NORTH and PS EAST AREAS POWER CONVERTERS

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 - Equipments presentation
 - New control system
 - Start-up problems
 - Operation in the coming years

- ◆ PS EAST AREA
 - Equipments presentation
 - Main concerns

- ◆ CONCLUSION

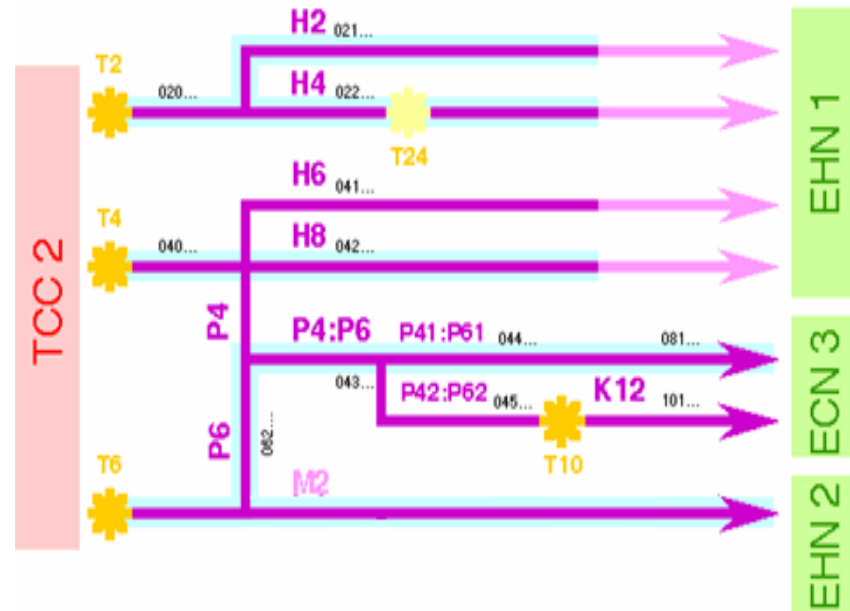


SPS NORTH AREA POWER CONVERTERS

- ◆ 330 PC (25kW → 3.6MW)
- ◆ 3 buildings: BA80, BA81, BA82
- ◆ 8 power converter types:
 - C11 250A / 100V
 - R11 500A / 150V
 - R12 500A / 300V
 - R13 500A / 225V
 - R21 1000A / 300V
 - R22 1500A / 250V
 - R31 2500A / 255V
 - R41 6000A / 600V
- ◆ 2 voltage booster types:
 - D21 1500A / 200V
 - D31 2500A / 285V

SECONDARY BEAMS

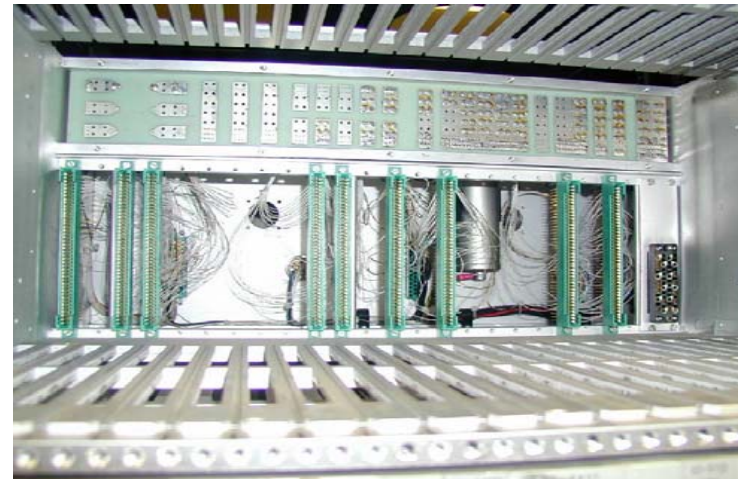
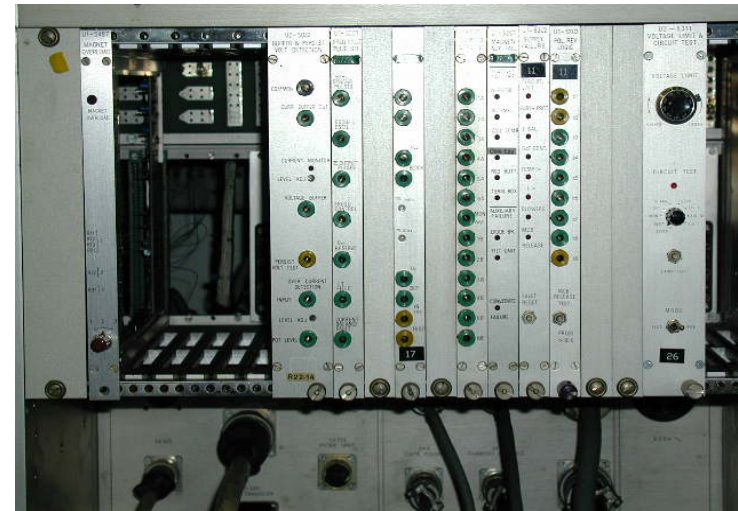
NORTH AREA





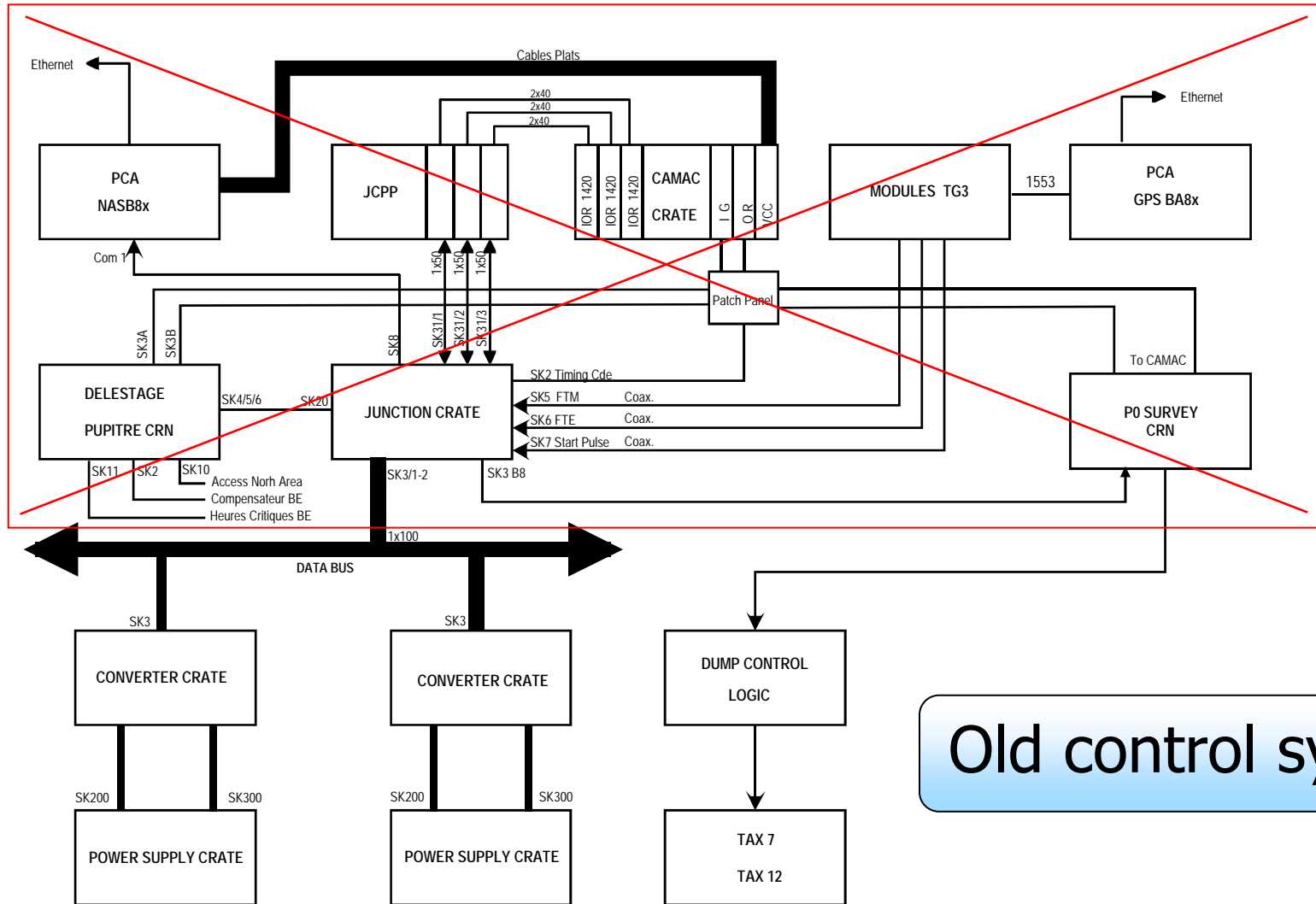
SPS NORTH AREA POWER CONVERTERS

- ◆ In operation since 1976
- ◆ Original analog & digital electronics
- ◆ Wire wrap technology





SPS NORTH AREA POWER CONVERTERS



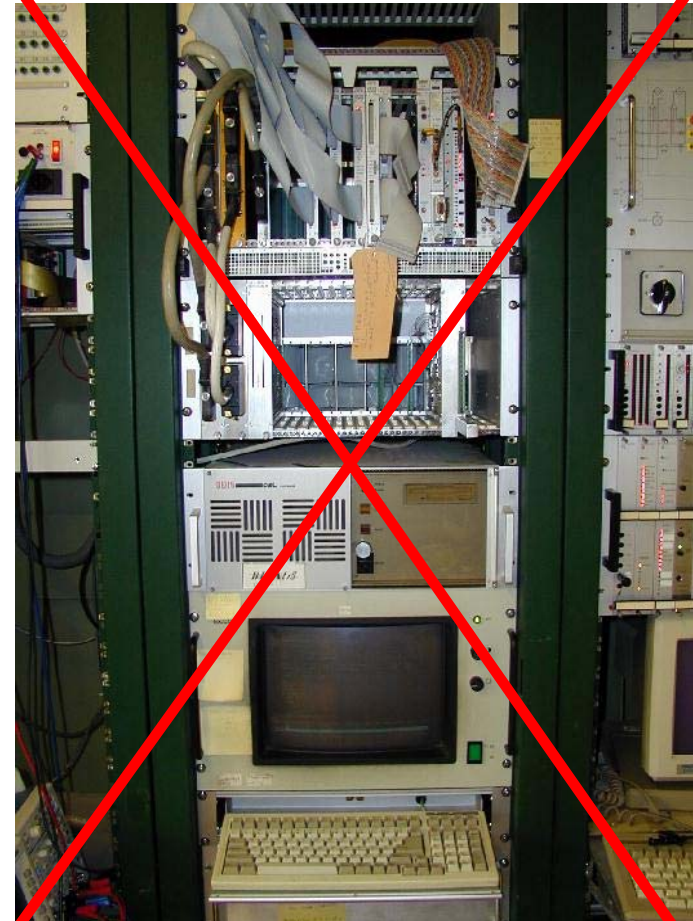


SPS NORTH AREA POWER CONVERTERS

- ◆ Junction Crate : Digital Electronic uP 6809, Flex based system

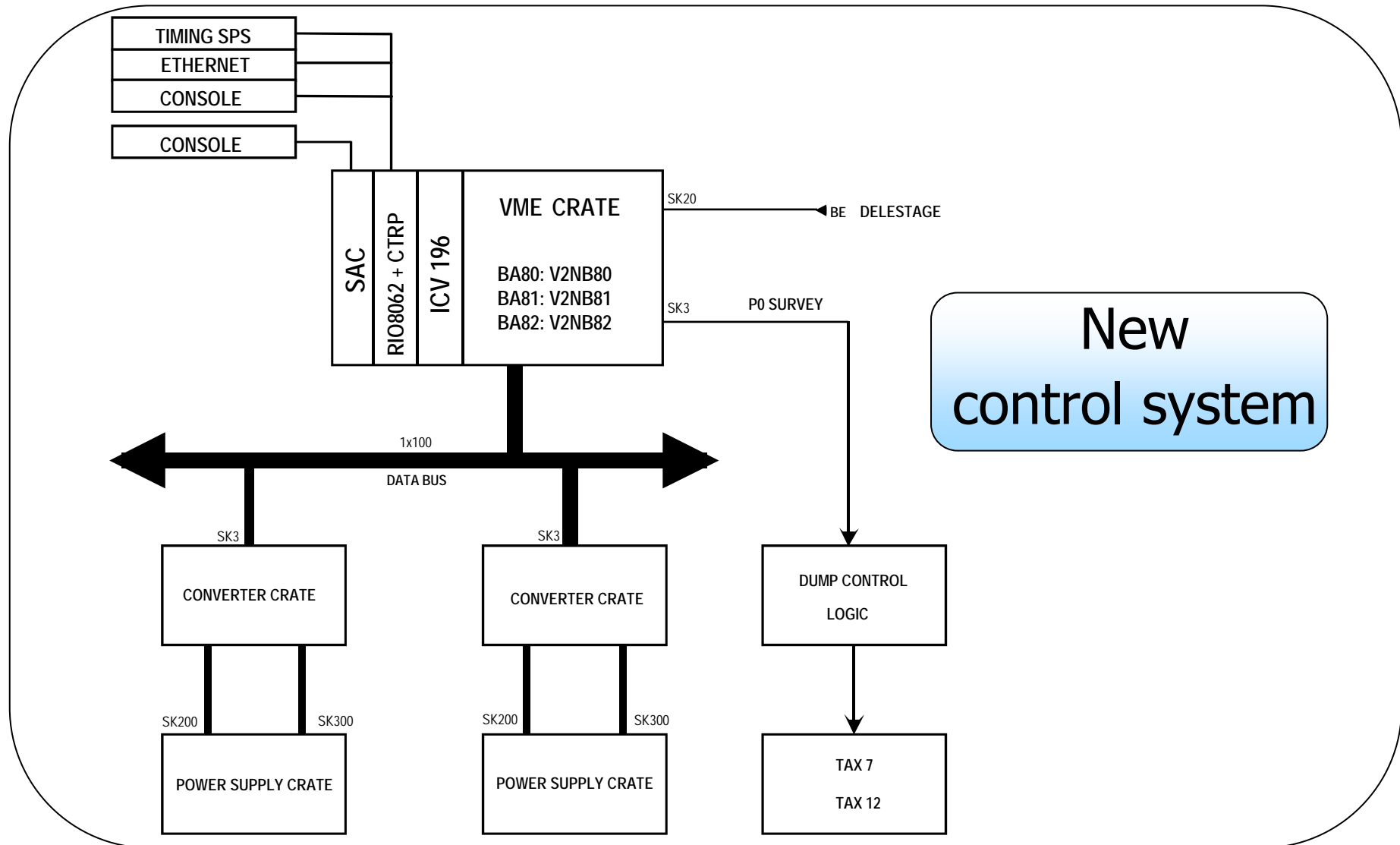


- ◆ CAMAC + PCA





SPS NORTH AREA POWER CONVERTERS





SPS NORTH AREA POWER CONVERTERS

START UP PROBLEMS

- ◆ DATABUS timing synchronization problem
 - Problem: The address trigger signal came too early
 - Consequence: Several converters were commanded simultaneous
 - Solution: The address signal was slowed down in POWJC

- ◆ DATABUS current load
 - Problem: To many cards connected to ICV196
 - Consequence: Some commands were unsuccessful
 - Temporary solution: P42-K12 converters disconnected
 - Final solution: Drivers will be installed to control the data bus
Ready for next run.



SPS NORTH AREA POWER CONVERTERS

FAULTS STATISTICS

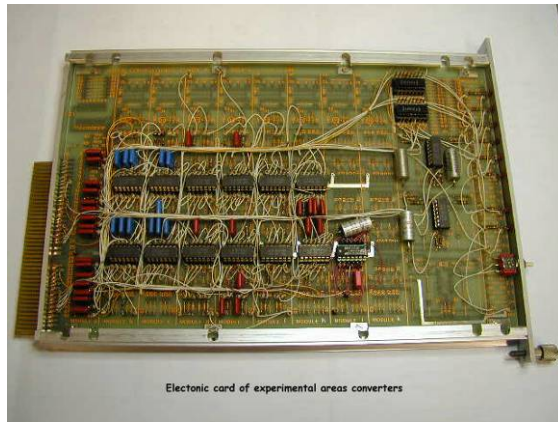
	2004	2006
Exploitation period	26 weeks	20 weeks
Interventions	166	162
Duration of interventions	130 H	155 H
Mean intervention time	47'	57'
Interventions / converters ratio	0.4	0.52
Power faults	21	12
Electronics faults	94	91
Operation faults	6	29
External faults	18	30



SPS NORTH AREA POWER CONVERTERS

MAIN CONCERNS

Electronic card reliability

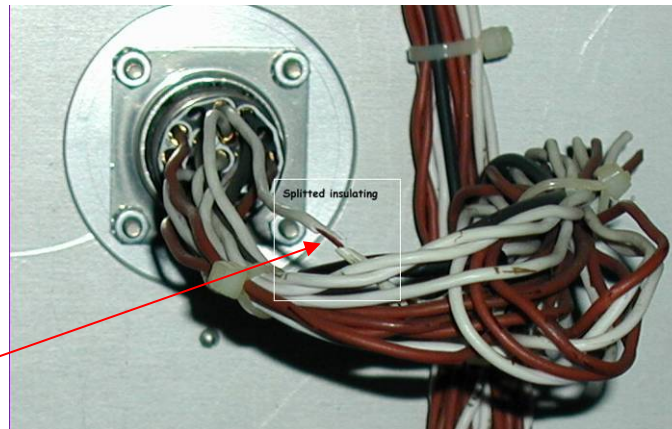


~ 6600 electronic modules of this type are in operation

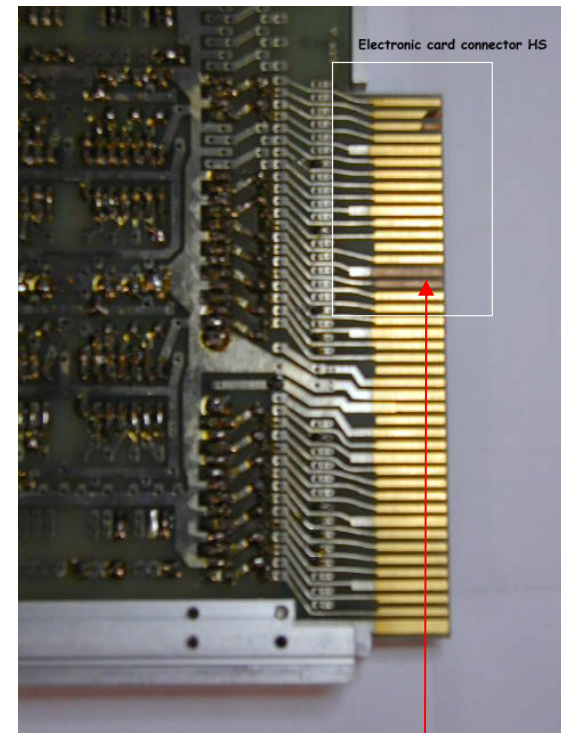
Wire wrap
Obsolete components

Cabling ageing

Split insulation



PCB connector contact



Damaged gilded contacts



SPS NORTH AREA POWER CONVERTERS

- ◆ 100 electronic cards have to be repaired each year
- ◆ The MTBF of the power converter is very low: $\sim 7000\text{H}$
- ◆ Each fault is limited to a beam line (over 6 in north area)



SPS NORTH AREA POWER CONVERTERS

OBJECTIVES FOR THE COMING YEARS

- ◆ Keep the same maintenance level with special actions
 - ⦿ Change obsolete IC of the address cards
 - ⦿ Clean connectors of the address cards

- ◆ Keep the same operation expertise
 - ⦿ First Line training

- ◆ Keep the intervention time of 1 hour

- ◆ Improvements can only come with a consolidation program



SPS NORTH AREA POWER CONVERTERS

FUTURE CONSOLIDATION PROJECT

- ◆ Replace 180 power converters ($\leq 500\text{A}$) by new switch-mode power converters.
- ◆ Renovate 150 thyristor converters.
- ◆ New electronic control.



SPS NORTH AREA POWER CONVERTERS

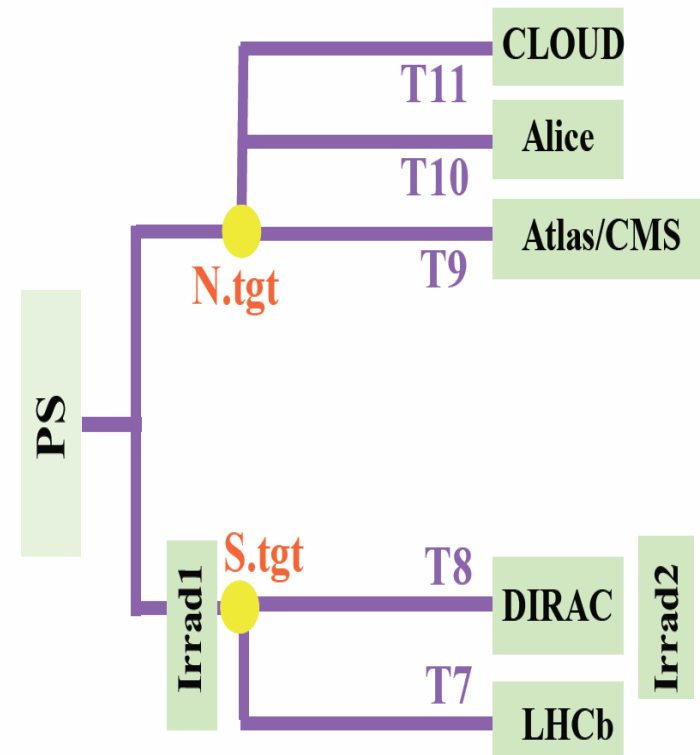
ESTIMATION

- ◆ Budget estimation : 23 MCHF
- ◆ Provisional schedule: 6 years
 - 2 years studies and contracts
 - 4 shutdowns for implementation
- ◆ Manpower: 19 FTE
- ◆ No budget allocated in AB consolidation! (below red line!)
Nothing before 2010!



PS EAST AREA POWER CONVERTERS

- ◆ 80 PC (8kW → 2.5MW)
- ◆ 2 buildings: 251, 263
- ◆ 10 power converters types:
 - T1B 250A / 32V
 - R10 250A / 50V
 - R1 500A / 100V
 - R3 800A / 300V
 - R2 950A / 200V
 - R2A/R2G 1000A / 220V
 - R2B 1000A / 250V
 - R31 2500A / 355V
 - R6 2500A / 500V
 - 5000A / 1000V
- ◆ 1 voltage booster type:
 - D0 1000A / 150V





PS EAST AREA POWER CONVERTERS

- ◆ In operation since 1970
- ◆ Electronics replacement in 1991
- ◆ PS standard control (1553)





PS EAST AREA POWER CONVERTERS

FAULT STATISTICS

	2004	2006
Exploitation period	28 weeks	22 weeks
Interventions	40	41
Duration of interventions	33 H	53 H
Mean intervention time	37'	76'
Interventions / converters ratio	0.61	0.63
Power faults	9	8
Electronics faults	14	8
Operation faults	2	8
External faults	15	17



PS EAST AREA POWER CONVERTERS

MAIN CONCERNS

- ◆ Polarity switches :
 - Blocked with 0A reference
A software modification will be done for next run
 - Some problems with old mechanical position sensors
Studies to install optical sensors are in progress
- ◆ Auxiliary power supplies VERO :
 - Trivolts VERO are not reliable
Studies to install power modules + DC/DC converters are in progress



SPS NORTH and PS EAST AREAS POWER CONVERTERS

CONCLUSION

SPS North area

- ◆ The new control system is operational since April 2006
- ◆ It became stable in September after POWJC corrections
- ◆ Electronic reliability is the main concern
- ◆ Improvements can only come with a consolidation program
- ◆ Project could start in 2010 if a budget is allocated

PS Earth area

- ◆ Old power converters
- ◆ No consolidation program
- ◆ Can we improve diagnostic for magnet faults ? Call the right service!
- ◆ What is the future of EAST areas with PS2?

**Both Areas are using old power converters with not reliable electronics
=> High number of First Line interventions**