

UPS network perturbations in SX2

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Outline

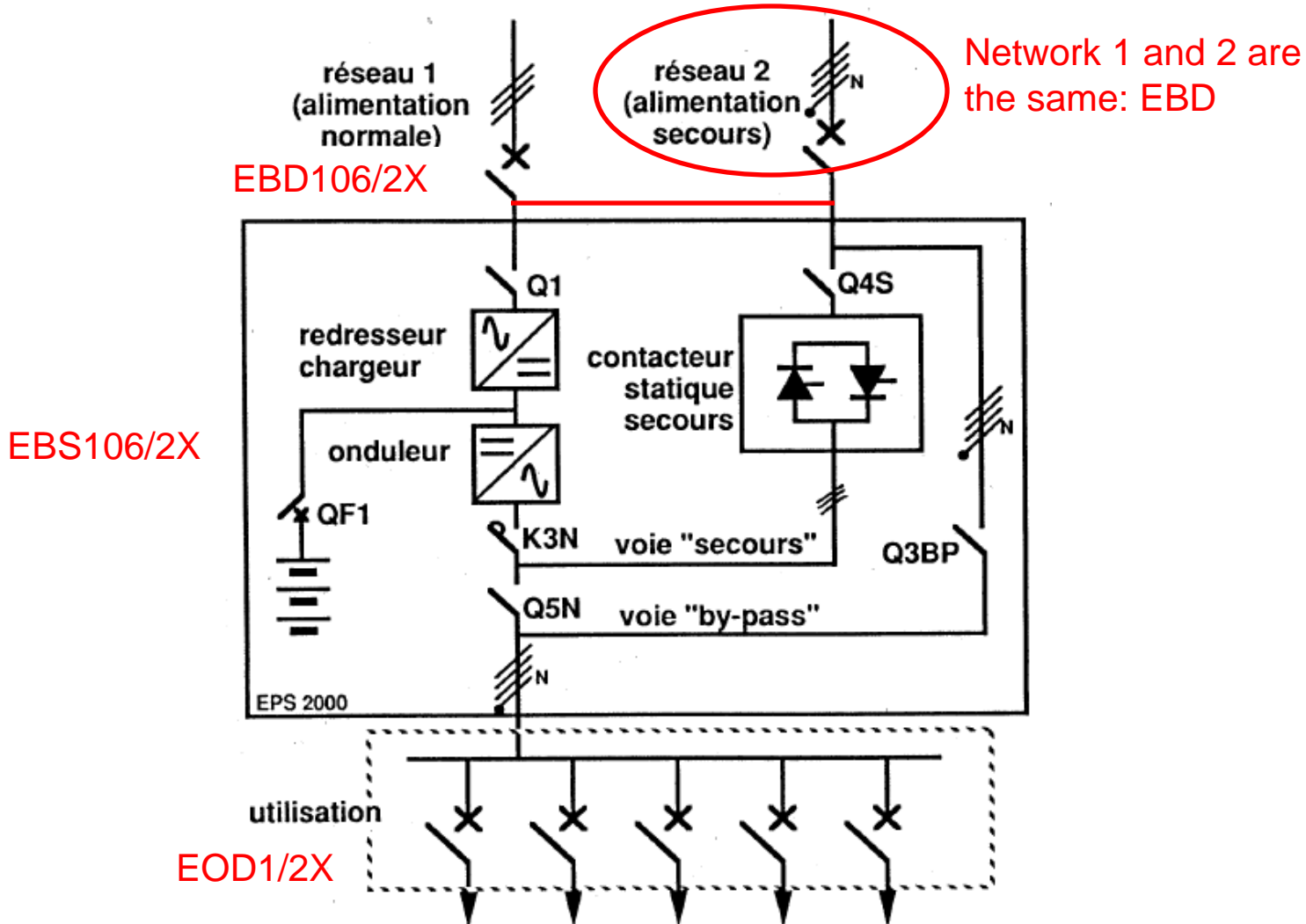
- UPS identification and technology
- Electrical distribution in November 2009
- Request for modifying UPS power supply of EOD1/2X and EOD1/20
- Current electrical distribution
- Perturbations on EOD1/2X
- Investigations
- Attempts for identifying the problem
- Perturbations measurements
- MGE UPS Systems intervention
- Stand-by service intervention
- Current situation
- Conclusion



UPS identification and technology

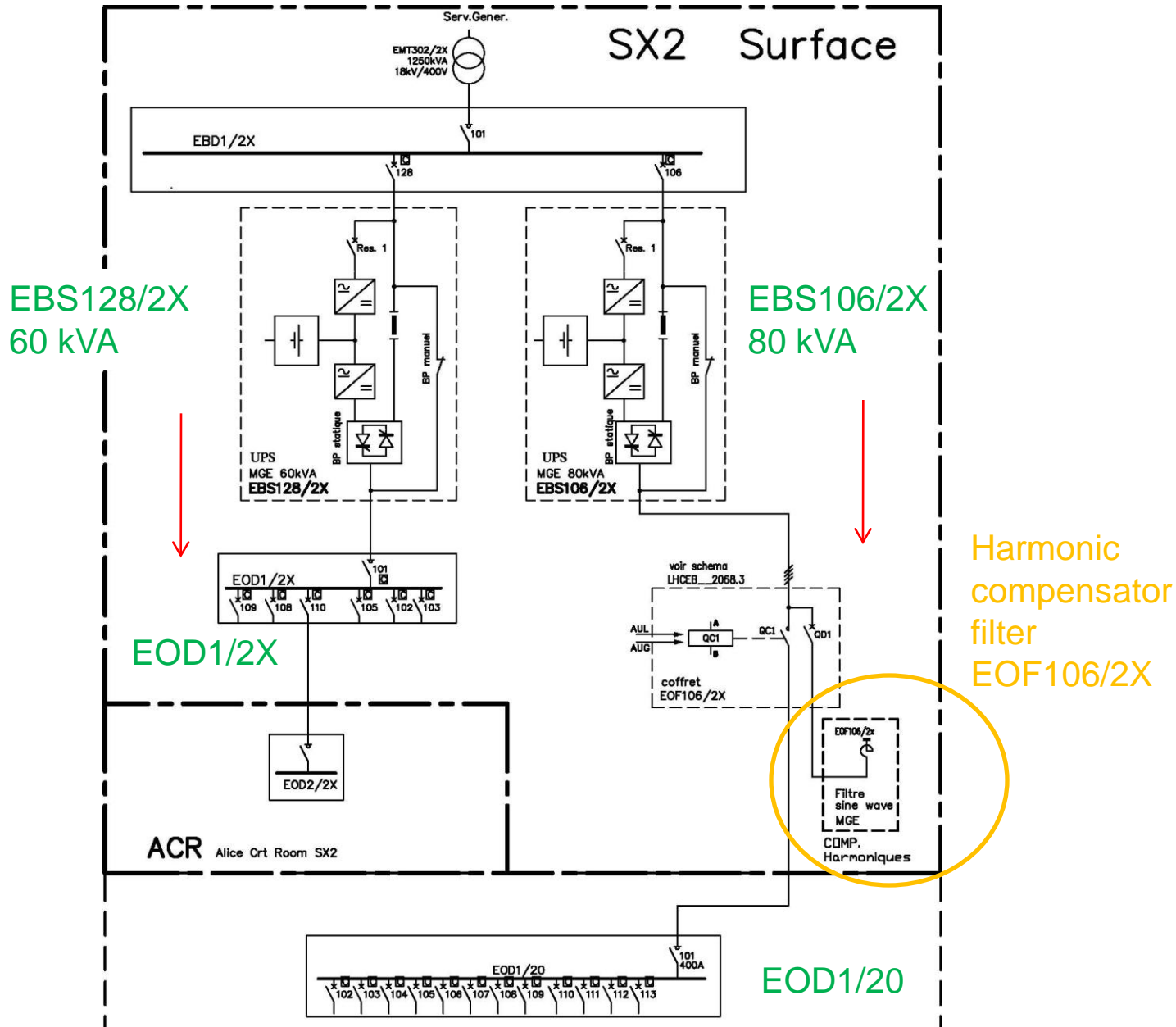


- Equipments concerned: EBS106/2X (80 kVA) and EBS128/2X (60 kVA)
- MGE EPS 2000 Double Conversion





Electrical distribution in November 2009





Request for modifying UPS power supply of EOD1/2X and EOD1/20



- November 2009: Stop of EBS128/2X
- Reason: UPS (60 kVA) loaded at more than 100%
- Temporary solution: 10 kW removed from the switchboard EOD1/2X
- Observations:
 - 60 kVA UPS powering EOD1/2X loaded at 100%
 - 80 kVA UPS powering EOD1/20 loaded at 50%
- Request for modifying the UPS distribution and balancing UPS loads:
Cross UPS power supply of EOD1/2X and EOD1/20
- EN-EL study, see EDMS report No. 1057135
- Current distribution not balanced on the 3 phases
- Phase balancing does not solve the problem
- Green light to cross UPS power supplies
- Works planned in January 2010, done on 28 January 2010



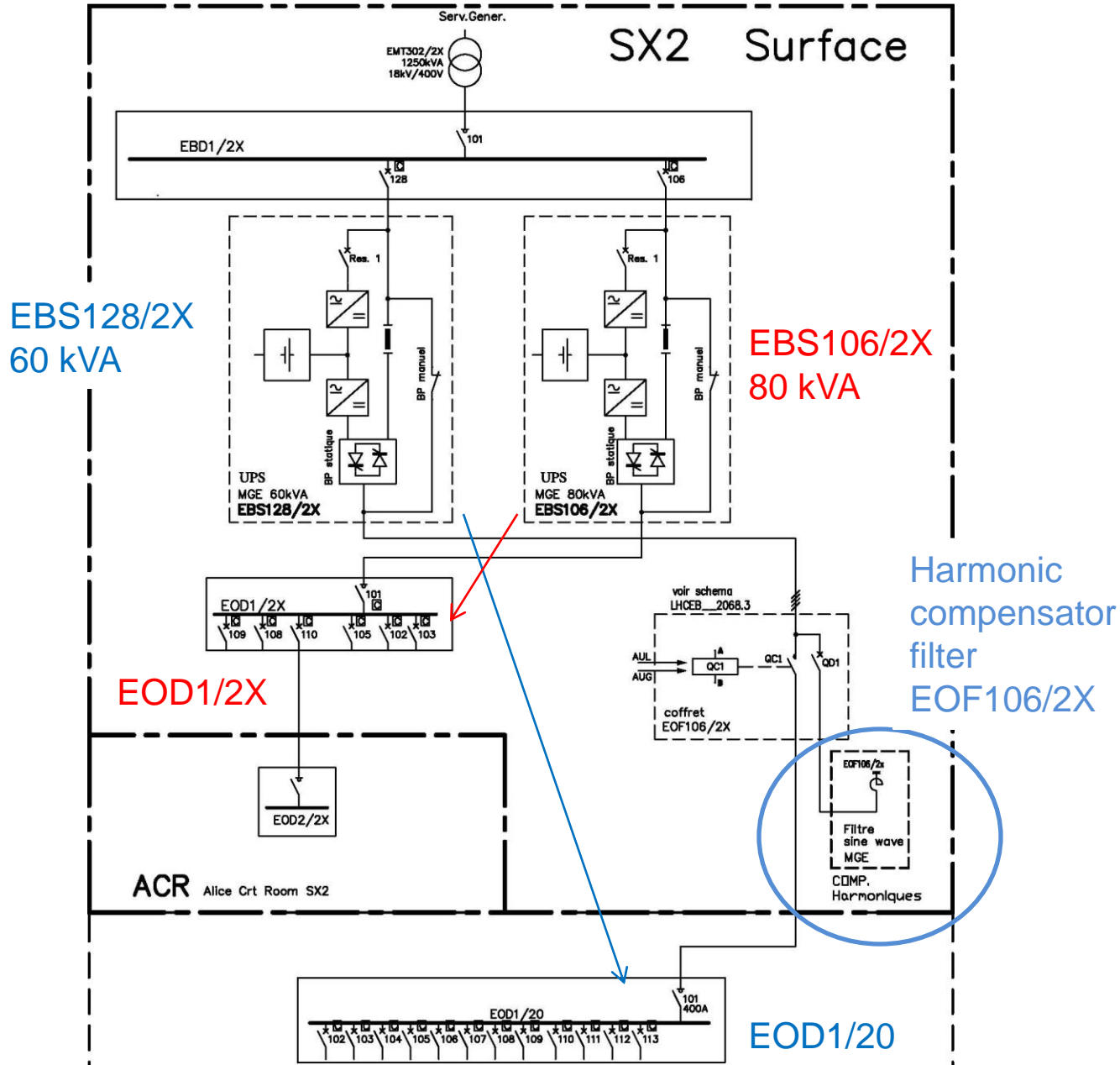
Current electrical distribution



- New distribution:
 - UPS EBS106/2X (80 kVA) powers EOD1/2X
 - UPS EBS128/2X (60 kVA) powers EOD1/20
- Both UPSs loaded at around 70%
- EN-EL recommendation: current phase balancing!
- Both switchboards generate high rate of current harmonics
THDI around 23% rejected on UPS
- THDI significantly reduced by compensation filter
- Exact reason for having a filter on the UPS 80 kVA: unknown!
- Decision to keep the filter attached to EOD1/20 in order to avoid overloading the UPS 60 kVA



Current electrical distribution





Perturbations on EOD1/2X

- Perturbation on EOD1/2X powered by EBS106/2X (80 kVA)
- First event on 2 February 2010
- Power cut on a few computers powered via three feeders of EOD1/2X
- No breaker opened
- No alarm at the level of the Electrical Network Supervisor (ENS)

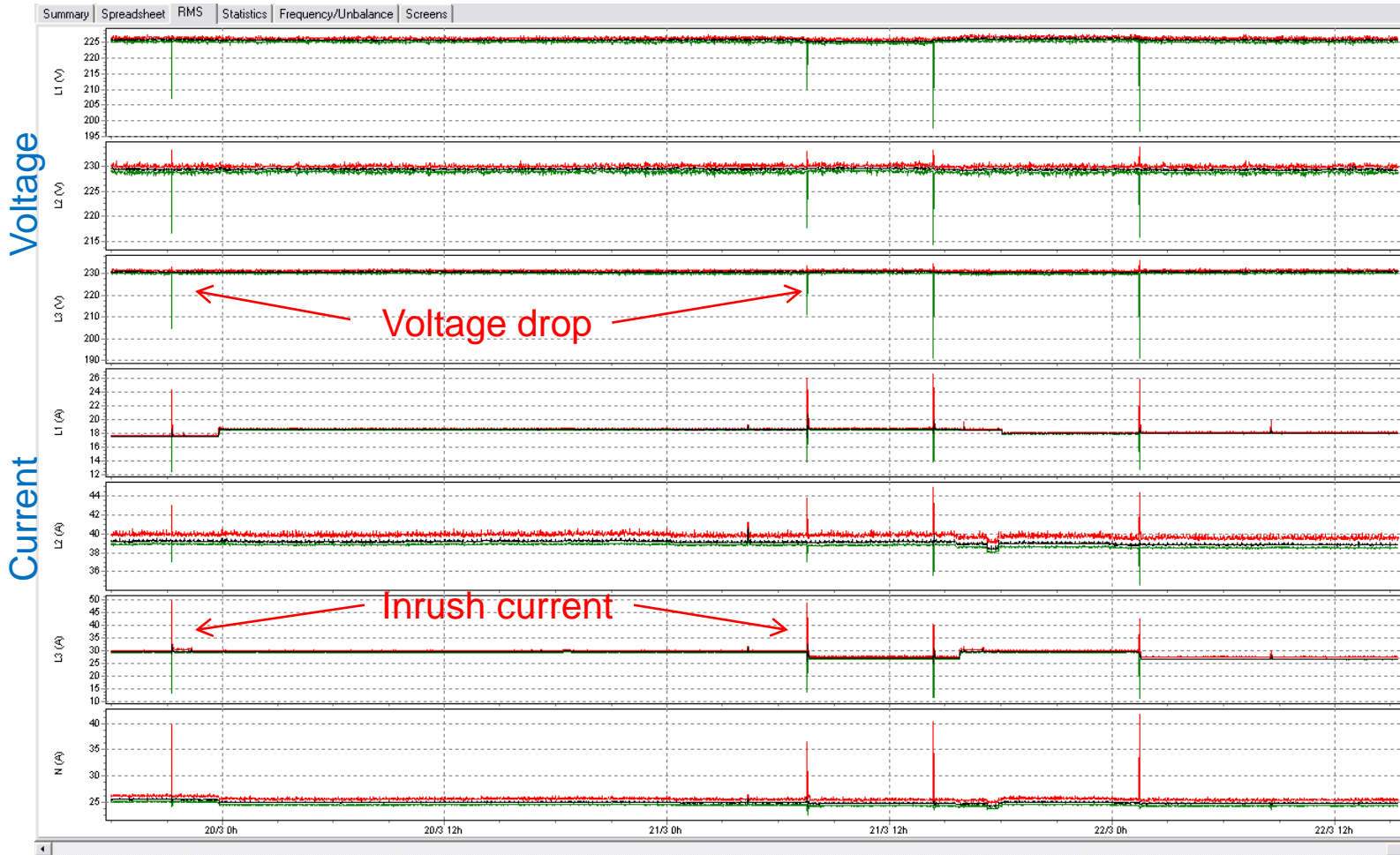
- Next weeks: more events at random frequency
- Always a few computers OFF powered via some feeders
- No breaker opened, no alarms, other loads never impacted



Investigations



- Power network analyzer connected on the feeder EOD102/2X



- One example: 4 events over one week-end!





Attempts for identifying the problem

- Power network analyzer not sufficient to localize the problem
- Several wrong leads followed due to coincidences in facts:
 - Cooling pumps in UX25
 - Additional PLC in UX25 commissioned in February
- Investigations not simple:
 - Random event occurrence
 - No access to UX25
 - Many computers and systems powered via EOD1/2X
- Bypass of the UPS not allowed by ALICE management!
- UPS EBS106/2X could not be suspected or dismissed!



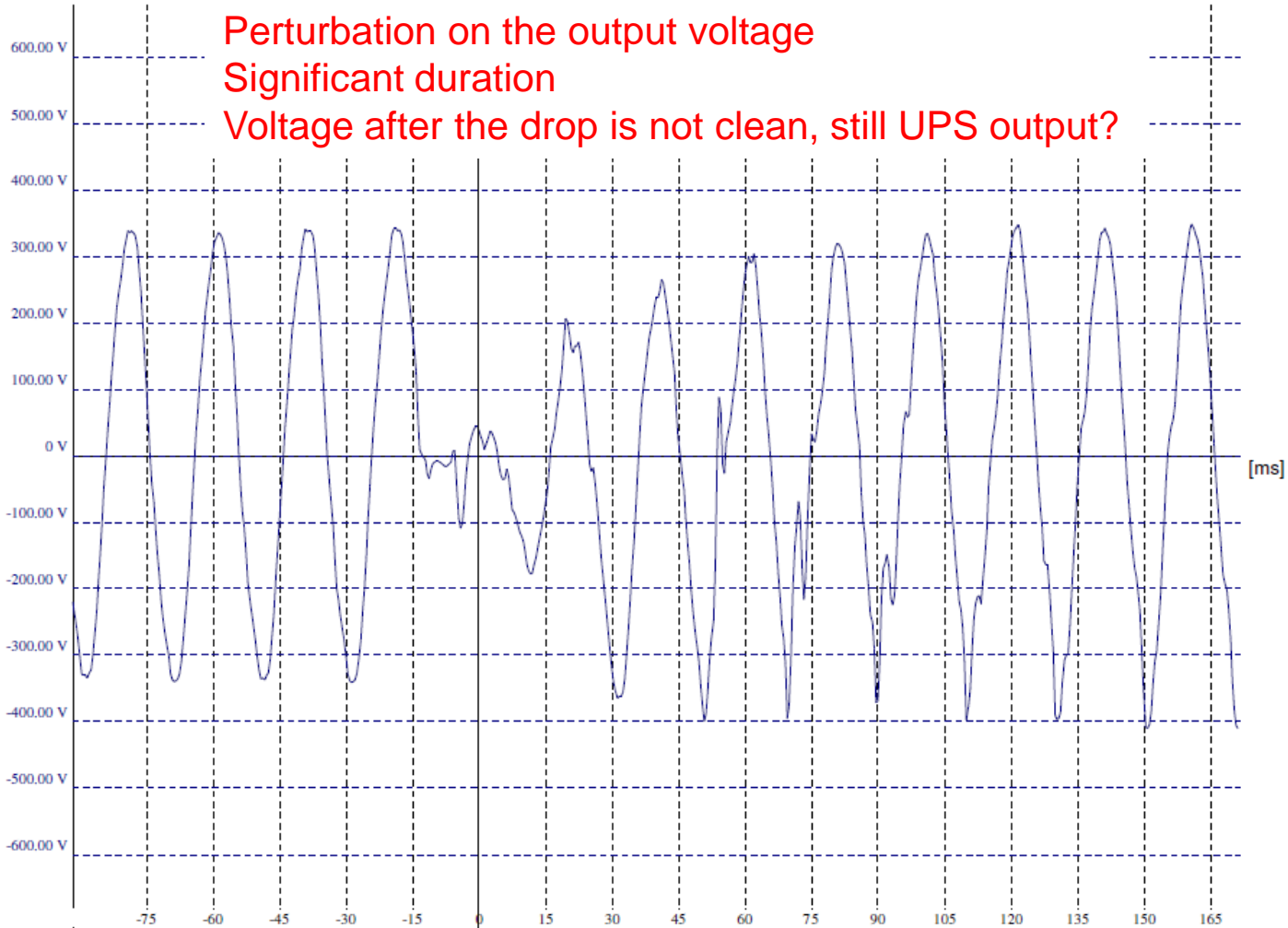
Perturbation measurements



- Voltage on EOD1/2X recorded by perturbation analyzer at point 2

Oscillostore LHC2, P530
Fréquence d'échantillonnage: 2400Hz

UC 2





MGE UPS Systems intervention



- Request of MGE UPS Systems intervention for checking the UPS
- Intervention done on 25 March 2010, authorization to bypass the UPS
- All maintenance tests performed on UPS EBS106/2X: **OK**
- **One parameter “masque de limitation” enabled on UPS EBS106/2X**
- **Same parameter disabled on the UPS EBS128/2X (60 kVA)**
- **Limitation mask: Inrush current at the level of the load, current limited to $1.5 \hat{I}_n$ (245 A) without switching to static bypass (network 2)**
- **Conclusion: parameter disabled on 25 March 2010**
- Parameter not visible on UPS control display
- Only MGE UPS Systems can check and modify this parameter!
- Feedback from MGE UPS Systems:
 - Parameter never enabled on this type of UPS!
 - Potential source of problems!
- Why had this parameter been modified in the past?





Stand-by service intervention (1/3)



- CCC phone call on Saturday 27 March 2010, alarms from EBS106/2X
- **UPS OFF, output fuses 1 and 3 melted, loads on static by-pass**
- No power cut of the loads according to ALICE control room
- Request of MGE UPS Systems intervention
 - Change of fuses on phases L1 and L3
 - UPS switch on not loaded, EOD1/2X switched to manual by-pass
 - UPS OFF, output fuses 1 and 2 melted, inverter #2 broken down
 - Change of the inverter and fuses
 - **UPS restarted, tests OK, EOD1/2X switched back to UPS**
- According to MGE UPS Systems:
 - Failure not related to previous perturbations
 - Inverter may have been overstressed by inrush currents generated by loads. No switch to static by-pass since the limitation mask was enabled.

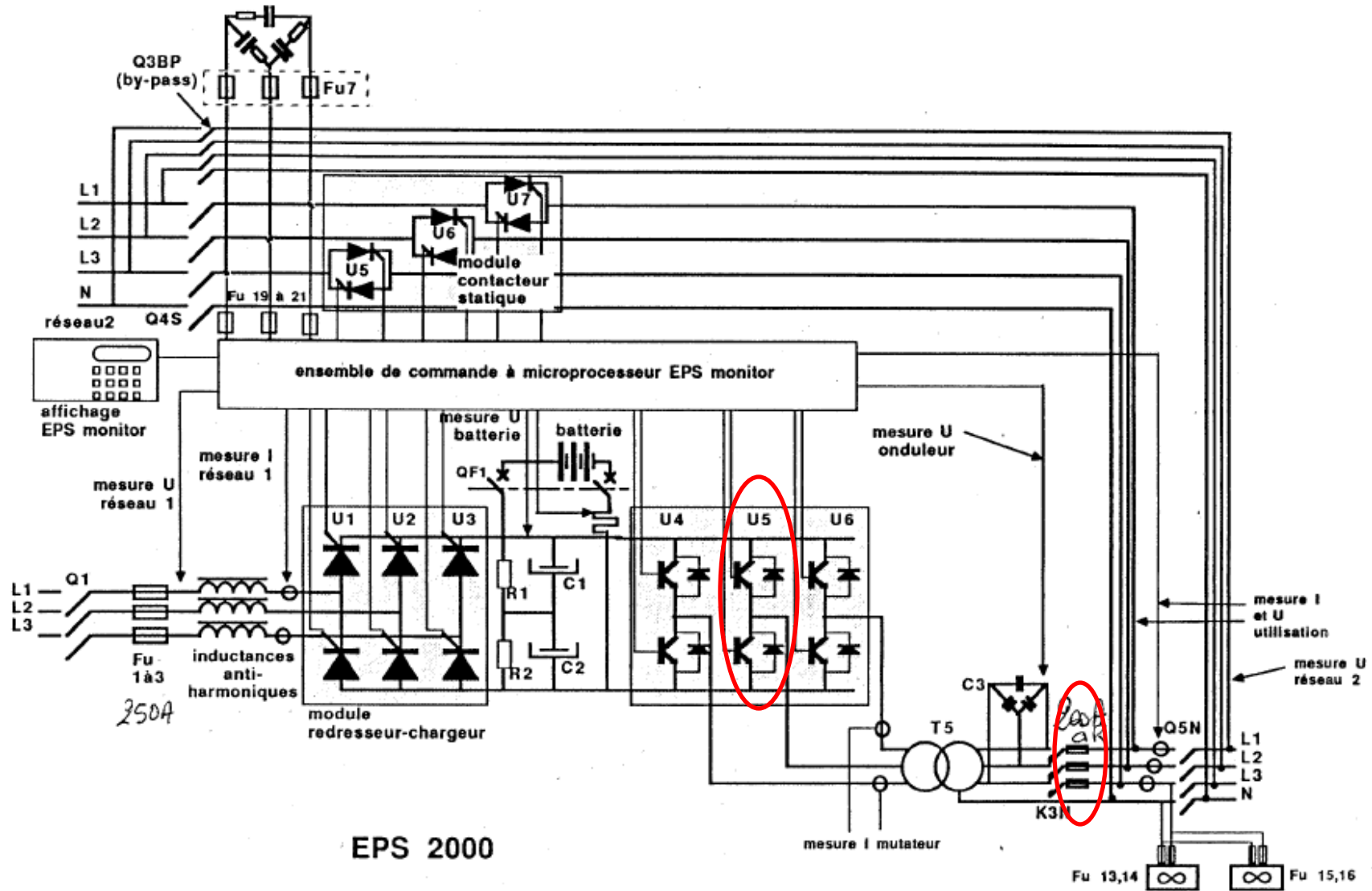




Stand-by service intervention (2/3)



- Internal failure of the UPS



Stand-by service intervention (3/3)

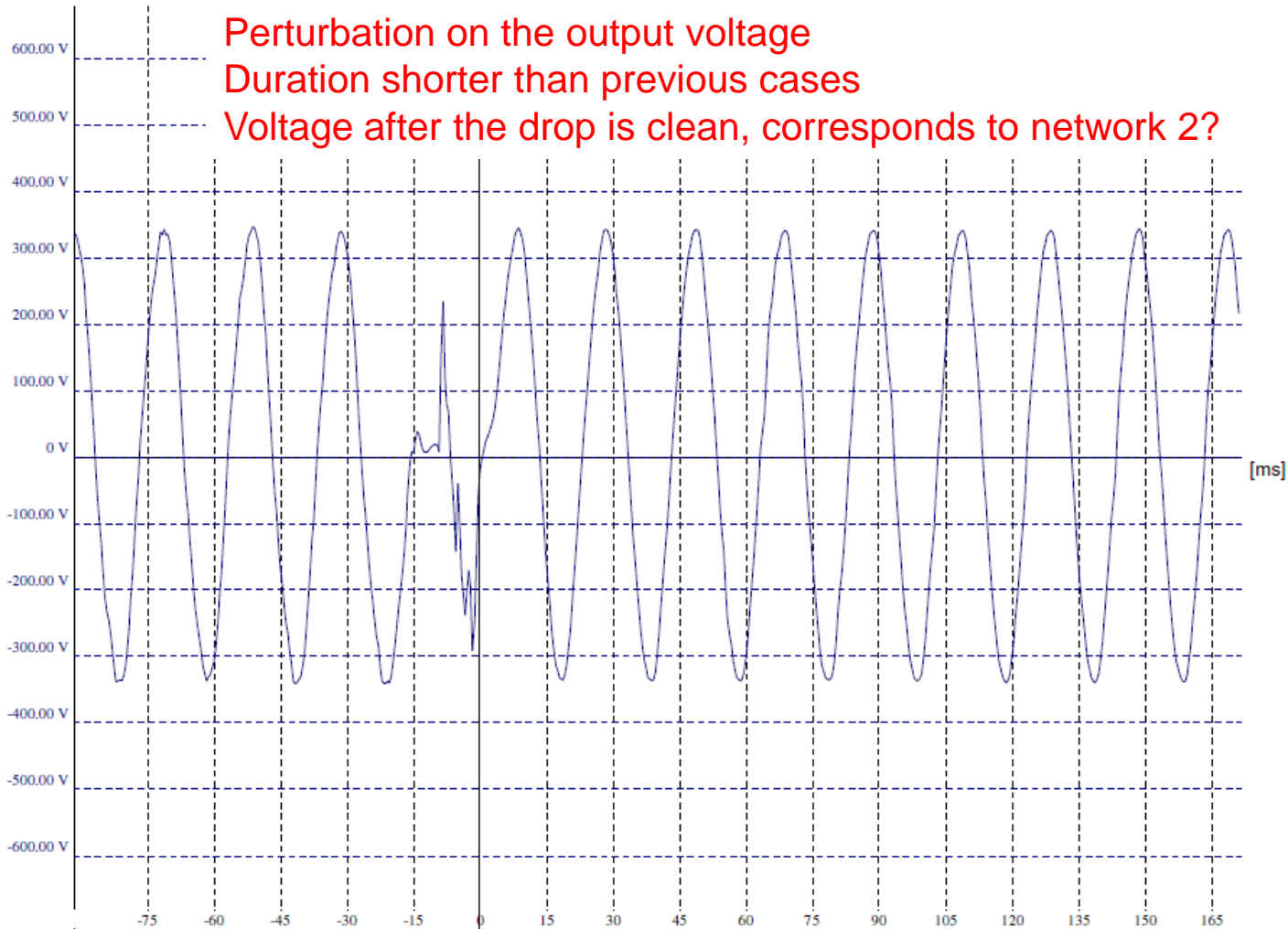


- Voltage on EOD1/2X recorded by perturbation analyzer at point 2

Oscillostore LHC2, P530

UC 2

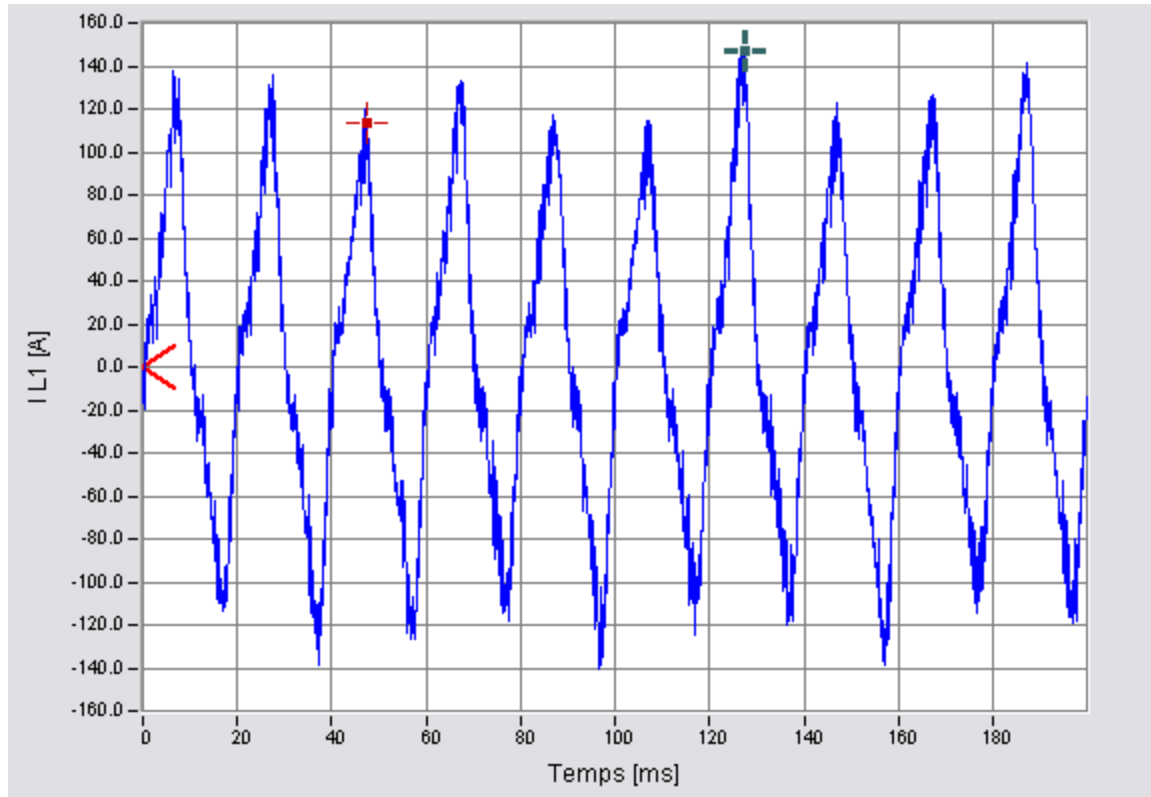
Fréquence d'échantillonnage: 2400Hz



Current situation



- No perturbation detected since 27 March 2010
- Both UPS have the same configuration with limitation mask disabled
- Current measured with a precise power network analyzer



- Maximum peak current measured during 2 weeks: 193 A (< 245 A)



Conclusion

- Problem solved by disabling the limitation mask on the UPS?
- Lack of data before the deactivation of the mask
- However we have never measured a load current exceeding $1.5 \hat{I}_n$
- Needs to continue measurements?
- LHC and experiments in operation: NO interventions on UPS networks!
- MGE UPS Systems investigations in order to analyze UPS behavior when the limitation mask was enabled
- For the future:
 - Adding new loads to this UPS would be risky
 - End of service foreseen in 2013 (manufacturing start date: 1987, end of manufacturing date: 1997)

