How to achieve higher redundancy of the UPS for QPS ?

-The lack of redundancy concerns the supply lines from UPS to consumer but equally parts of the UPS itself.

-Interruption of a line for powering of Quench Detectors by opening of the upstream CB is not just a theoretical possibility; it actually occurred twice in 2008 during HWC– fortunately without consequences !

-Another incident lead to destruction of quench detector electronics by accidental presence of 400 V on the UPS phase line.

-Reminder 1: Heater firing is exclusively triggered by the QDet, which needs UPS power for detection and firing. The QHDS's require UPS power for firing and charging.

-Reminder 2: In each sector each individual QDet is powered through separate, single (non-redundant) power lines, from 4 UPS units, 1 in each Alcove, 1 in UA and 1 in RR. A complete UPS failure may lead to a large number of magnets being unprotected during the energy extraction

(≈4.5τ). A single CB opening will leave one magnet unprotected.

Options:

-Local energy storage in QPS: Exists already but covers only typically 100ms. To cover 6 minutes of consumption (18 kJ) the capa banks would be too large. In this case the QPS system would substitute the role of the UPS, which makes no sense.

-All other considered solutions require the introduction of a second, parallel supply line (Line-2) from the same UPS unit as Line-1, combined with an upgrade of the UPS in order to provide full redundancy as from the ac power input.

-The extension of the supply lines from one alcove to the opposite end of the arc OR from the UA (or RR) to the middle of the arc would be too long (voltage drop). Consequently, redundancy between two different UPS systems is no option.

-Power switching between two feeder lines from the same UPS at the input to the QDet, depending on availability, has been discarded as the necessary Industrial power switches are excessively expensive (totaling 3.7 MCHF) and lack the necessary radiation resistance (solid state drivers).

-Our retained proposal consists in separate powering of the existing DQLPU and the new, additional layer of QPS electronics (the 'Upgrade').

Some details:

-The proposed scheme is based on the fact that the new QDet for aperture-symmetric quench detection ALSO detects 'normal' asymmetric quenches (by 4-magnet comparison, threshold 200 mV).

-The new, Distributed Busbar Detector is not affected as linked to FPA and not to heater firing.

Topology:

1) At the place of the upgraded LPU (i.e. under each dipole 'B' and a few other places, total 436 crates):

-Existing Quench Prot. Crate shall be powered from UPS Line-1 only, as before.

-Two dipole DQHDS shall be powered from UPS Line-1, the two others from UPS Line-2. For the Main Quads one DQHDS shall be powered from each line.

-The new DQLPU-typeS crates shall be powered from both Line-1 AND Line-2 (one line per power-pack, one additional power-pack to be foreseen).

2) At the place of all other existing LPU's (1188 total):

-Same separation of the powering lines for the DQHDS as above. The existing Quench Protection Crate shall be powered from the existing Line-1 only, as protection of the associated magnet in case of UPS Line-1 failure is assured by the 'symmetric' quench detector board in the new DQLPU-typeS.

Drawbacks:

1) A 'normal' asymmetric quench might be detected slightly later than 'usual' in case of a UPS Line-1 loss.

2) The PM data from the existing DQLPU will be lost in case of a UPS Line-1 trip. However, the PM data from the new DQLPU-typeS will be available due to parallel powering from UPS Line-2.

3) The redundancy of the Quench Heater Power Supplies is lost in case of rupture of one of the two UPS Lines.

Consequences:

The task involves installation of about 25 km of new power lines, > 1700 new circuit breakers, a large number of electrical distribution boxes, a redundancy upgrade of (at least) 32 UPS units.

For QPS: 436 additional power packs, cables and patches.

The estimated cost is exceeding 2 MCHF for EN/EL, ~ 220 kCHF for QPS.

About UPS Redundancy Improvements for IPQ's/IPD's/IT: If the UPS supply lines are also doubled here the ~ 70 detectors can be relatively easily modified as they already contain redundant LV power supplies.

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