Computer Centre Upgrade

Status & Plans

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Agenda

- Some History
- Vault
  - Conversion
  - Migration
- Electrical Supply Upgrade
  - Requirements
  - Backup supply arrrangements
  - Substation planning

Some History

Computer Centre Upgrade — History

- **LHC computing requires additional space, power and air conditioning capacity in B513.**
- Following studies in 2000/2001, we developed this **plan**:
  - **Convert the tape vault to a machine room** area in 2002
  - **Use this space from 2003**, both for new equipment and to empty part of the existing machine room
  - **Upgrade the electrical distribution in the machine room** during 2003-2005, using the vault space as a buffer.
  - **Create a dedicated substation** to meet power needs.
- For air conditioning reasons, **the vault should be used for bulky equipment with low heat dissipation.**
  - e.g. Tape robotics.

Vault Conversion

Vault Conversion Status

- **Almost complete.** Just need to
  - add a few more perforated false floor tiles
  - test air conditioning units
  - test fire detection and smoke extraction

- **Hand over to IT ~21st October.**
  - But no access control as yet. Doors at either end will be locked.
    - » **Access control will be strict**. The vault is not a corridor!
      - Badge required to go in and out.


ALEPH
ALEPH
ALEPH


Geschirr

Using the Vault

- Now we have this space, **we can use it**.
- Remember, aim is to **free space in the machine room** to **enable upgrade** there.

- Migrate equipment from "right hand side" of the machine room.
  - PCs first, robots to move from January.
  - Big SHIFT systems to be removed.

Practical Details

- **Migration being coordinated by FIO/OPT**
  - **Regular item in CCSR meetings** since July
    - » **First discussion** with FIO for **batch servers**, DS for **disk servers** and CS for network infrastructure.
    - » Will need to **handle external networking area carefully**.
- **Aim is for more control over equipment.** We should **know where** it is, **what** it is and **why** it is there!
- **Network infrastructure is "decentralised"**—with switches next to equipment.
  - **All equipment in a rack on the same network service.**
- CS plans for most **network services** in the vault to be **on the "unrouted" network** (172.17)
  - This means **no outgoing access**. Is the impact for, e.g., Grid Services understood?

And then?

- **Upgrade the cleared area of the machine room.**
  - Clean out under the false floor.
  - Upgrade the electrical distribution.
  - Upgrade network infrastructure.
- **Move equipment from the left half**
  - **If to the machine room, aligned with normabarres!**
- **Upgrade the left half of the machine room.**
- An air conditioning upgrade is probably needed as well.
- All of this work is being planned now. **More details in Spring 2003.**

Questions?

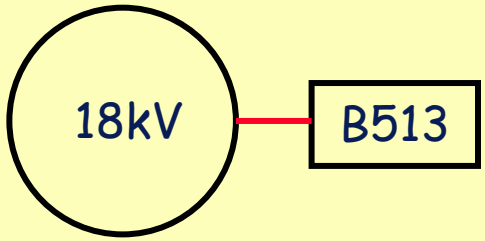
New Substation

What are the demands?

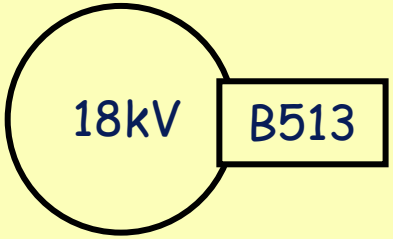
- LHC requirements in Hoffmann Review are for CPU capacity of 2.3MSI95 in 2007, plus disk storage and tape drives and robotics.
  - And don't forget the general infrastructure.
- **The prediction in 2000** was 15,000±5,000 boxes for physics.
  - @100W/box⇒**2MW equipment load**, constant (or even falling) over LHC lifetime.
- **With LHC delayed, the box count has gone down**, **but** we now think **PC power is constant at ~1W/SI95.**
  - ⇒**2.4MW for physics in 2008** and **rising** over LHC lifetime.
- **Fortunately, the "natural" substation arrangement allows for an active load of up to 2.5MW.**
  - **We plan to support an active load of up to 2.5MW.**
    - » We are being careful not to exclude an expansion to 4MW. However, cooling is a major problem and a lot of space is needed for all the electrical equipment.

Power Supply Reliability

- Power distribution is via 18kV "loops". These are powered by EdF/EOS with an **autotransfer mechanism to cover failure** of the primary supply.
  - In operation since 2000 (but not in winter for 2001-5).
  - **Switches between supplies in <30s.**
  - **We need a UPS** to cover any such break as well as any micro cuts. **Battery life of 5-10 minutes is sufficient.**
- Today, B513 is on a **spur** from one of these 18kV loops:



- New substation includes B513 in an 18kV loop directly:
  This improves reliability.



What if the Switchover Fails?

- If the switchover mechanism fails (maybe once every 5-10 years) the **sitewide diesels take over within 2 minutes**.
  - Yes, the **diesels have a poor reputation in IT**, but
    - » **the control system is being refurbished in 2003**
    - » **annual real load tests have restarted.**
- A **maximum of 1.4MVA** is available for IT to cover
  - safety systems, air conditioning, … and
  - up to **250kW** of computing load.
- ***A dedicated UPS is required*** for "critical computing equipment" to be powered by the diesels.
  - This has been imagined with a battery lifetime of 2hours, but **we propose a 5-10minute battery lifetime**.
    - » A 2 hour UPS would be a 3rd level backup with significant costs.
      - In terms of both space and batteries (which need replacing periodically).

What is "Critical Computing Equipment"?

- Is:
  - Network Infrastructure
  - Databases for accelerator operation
  - informatics infrastructure (home directory, web, mail, …)
  - "master" servers such as sure/remedy/iss/zephyr (but maybe only one of a primary/backup pair).
- Isn't:
  - Anything that scales with physics computing demand
    - » CPU servers, disk servers, tape servers, …
- Maybe (depends on total load):
  - Things that "scale slowly" with physics demand
    - » "scale slowly" ⇒"one per experiment"?
    - » Castor name servers? POOL infrastructure?

Questions?

Substation Equipment and Space Needs

- **18kV switchgear** (we are now in the loop).
  - **~30m²**
- 18kV→400V **Transformers**
  - Enough to cover machine load, air conditioning and general services.
  - **~150m²**
- **400V switchgear** (for machines, hvac, …)
  - **~180m²**
- **Critical UPS** and batteries (10minutes)
  - **~30m²**
- **Physics UPS** and batteries
  - **~220m²**
- Overall, **~450m²** (Transformers can go outside)
  - c.f. **~220m² today**. And we have to **keep services running** while we build the new substation.
  - **More space needed!** Where?

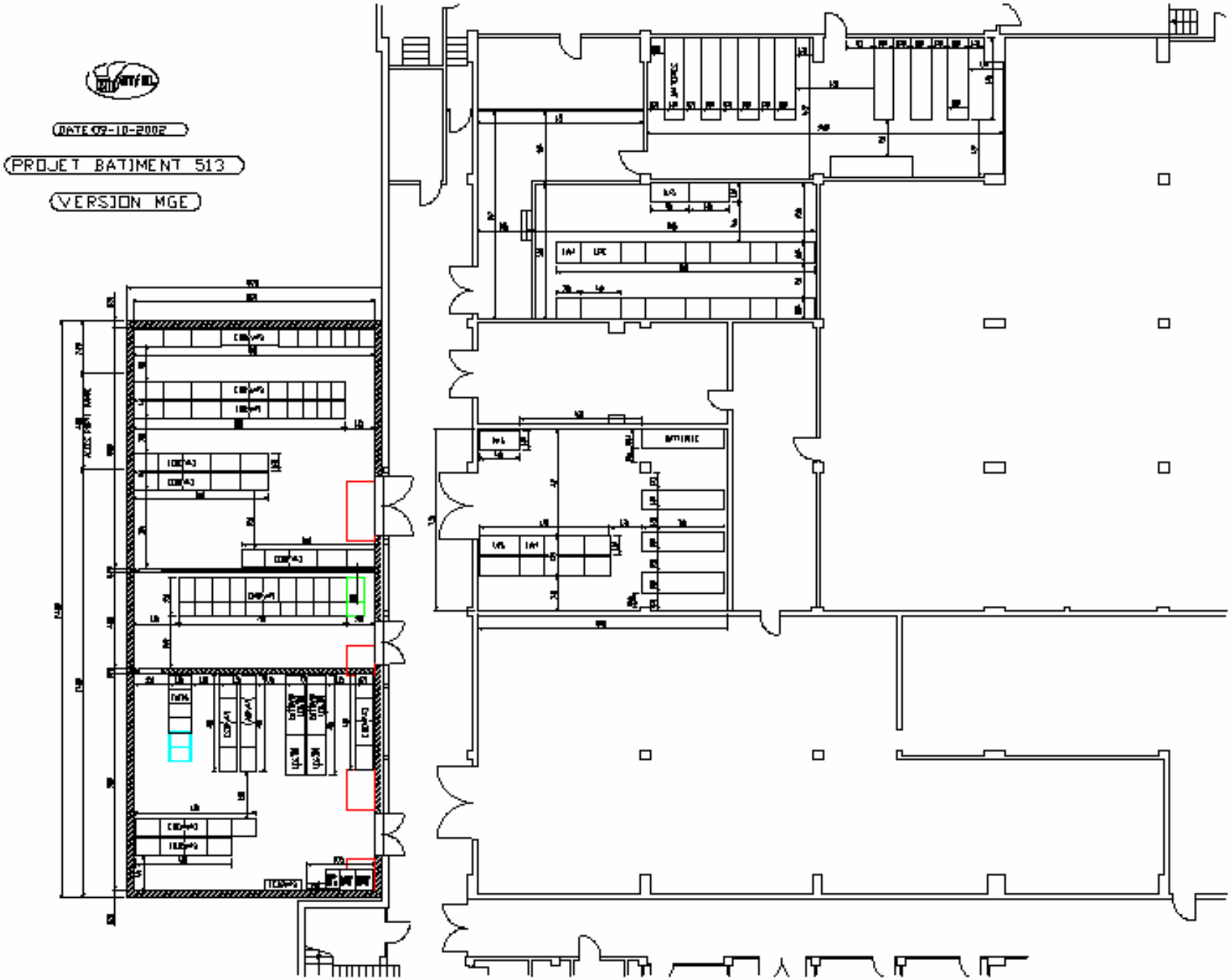
Where to put a Substation?

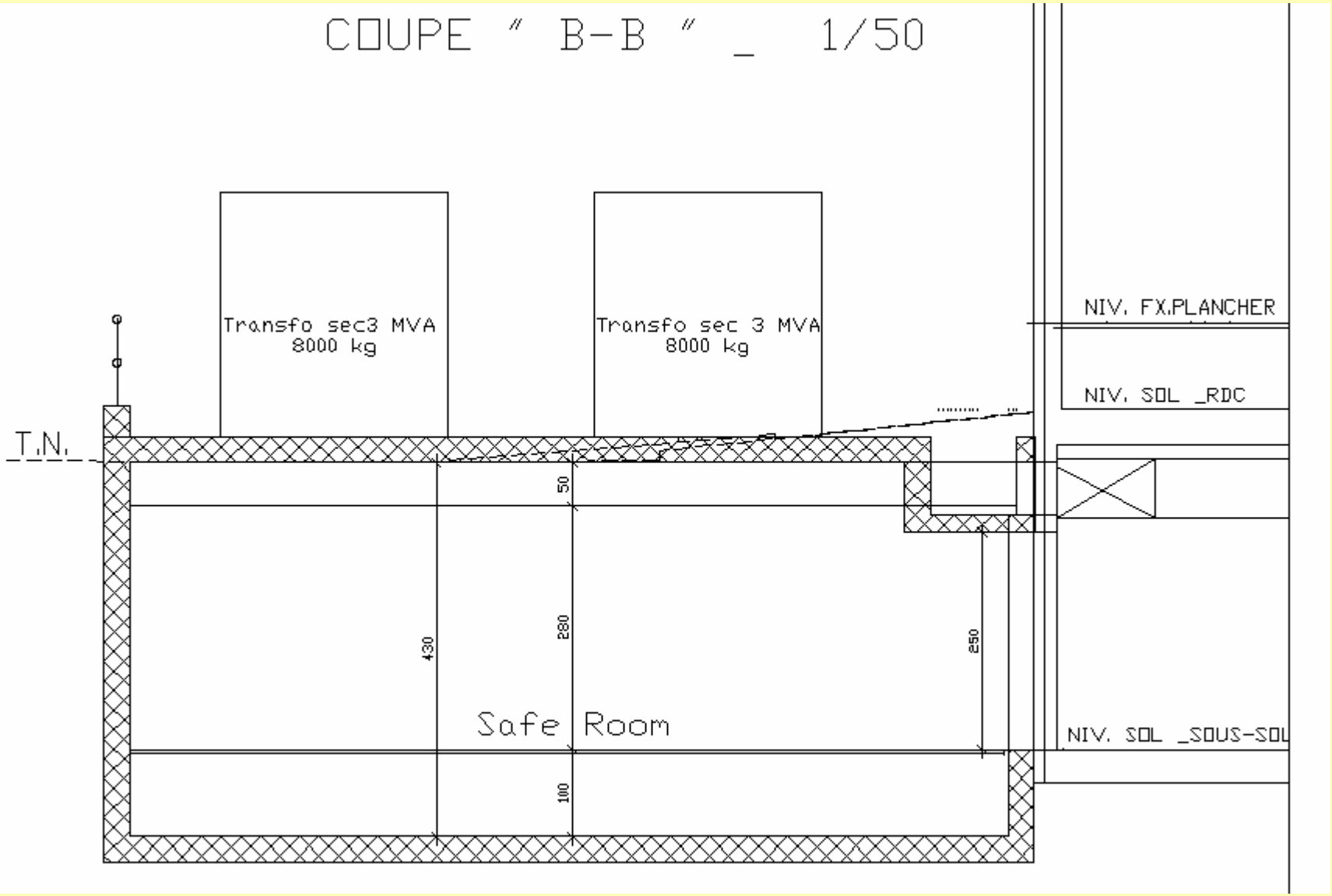
- **Various locations considered**. Overall, the **best solution** is to
  - create more space near the existing substation
  - install new equipment
  - remodel and reuse existing areas.

- "More space near the existing substation"

➔**Build a "bunker"** under the car park between B513 and Restaurant 2.

  - **Many complications**—air ducts, sloping ground, need to maintain access to the barn doors—**but possible**.


DATE 09-10-2002
PROJET BATIMENT 513
VERSION MGE


COUPE " B-B " _ 1/50
Transfo sec3 MVA
8000 kg
Transfo sec 3 MVA
8000 kg
NIV. FX.PLANCHER
NIV. SOL _RDC
T.N.
50
280
430
250
Safe Room
NIV. SOL _SOUS-SOL
100




When to put a Substation?

- **Critical factor is the diesel backup.** Today, this can support ~**500kW**.
  - *Why not 250kW? Not as much hvac equipment.*
- What level of secure power do we need?
  - Computer Centre load today is ~**450kW**.
  - Experiments request **600 CPU servers plus ~100 disk servers** for 2003. **More will be requested in 2004.**
  - Some machines being removed, but shift3 consumption just 1kW.
- **By end-2004 at the latest, we will not be covered by the diesels.**
  - **Unacceptable level of risk for critical services.**
  - **New UPS** (which allows the dedicated diesel connection) **required for critical equipment by mid-2004.**

Substation Construction Timeline

03/03	**Start bunker construction**
09/03	Install 18kV & 400V switchgear plus UPS for critical equipment
02/04	**New substation enters production. Physics on current UPS (640kW)**
04/05	Remodel existing electrical supply areas in B513
1H/06	**Install new 800kW UPS system**
1H/07	**Add 800kW UPS capacity (1.6MW total)**
1H/08	**Add 800kW UPS capacity (2.4MW total)**

How does this affect my services?

- **No power cut**, but all systems connected to the existing electrical infrastructure will be **without UPS cover for 2 days** when the new substation is commissioned.
- Systems in the **critical equipment** area **will have UPS cover** (if at least one power supply is connected to the right normabarre).
- Once the new substation is in service, only equipment in the critical computing area will be connected to the diesel backup supply.

Substation cost

Total	**4,345,000**
Preparation and miscellaneous items	100,000
Civil Engineering	500,000
Air conditioning	80,000
High voltage equipment	785,000
Low voltage equipment	850,000
Monitoring, control and safety	170,000
UPS (300kW for 10 minutes)	140,000
Cabling	350,000
Installation	200,000
UPS (800kW)	390,000
UPS (800kW)	390,000
UPS (800kW)	390,000

What if the load is really 4MW?

- **The substation size doubles.**
  - **No problem**: extend the bunker up to the bike shed and out under the car park (it would be fully underground here). **Can easily find another 360m^2**.
  - **But…** Would **need more diesel power for the air conditioning** during a power cut⇒None left for the critical computing equipment, so new arrangements required here.
    - » **Very difficult (and expensive!) to plan now to cover this**.
- **Not clear that the air conditioning can cope**
  - **Major changes needed** to chilled water piping and air conditioning stations (the noisy bits facing the saleve, not the things on the roof.)
  - Certainly **requires the barn as machine room space**.

Questions?