GREEN Computing: a Central IT Service Perspective

Che-Hoo CHENG
ITSC
CUHK

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GREEN in CUHK

- The Chinese University of Hong Kong (CUHK) is committed to go GREEN
- Governance is under Committee on Campus Sustainability
- Coordination is under Campus Planning and Sustainability Office (CPSO), with the support of Campus Development Office (CDO), Estate Management Office (EMO), Information Technology Services Centre (ITSC) and other departments
- http://www.cuhk.edu.hk/cpso/policies.html

4 Focus Areas of GREEN Office Programme

- Energy Conservation
- Waste Reduction
- Green Purchasing
- Awareness and Engagement

- GO! Checklist
  - http://www.cuhk.edu.hk/cpso/go!/gop.html#checklist

Energy Consumption by IT

- Computers and monitors represent the SECOND highest power consumption in offices after lightings
- Data Centres which house a lot of servers and equipment are consuming as large amount of energy as science laboratories

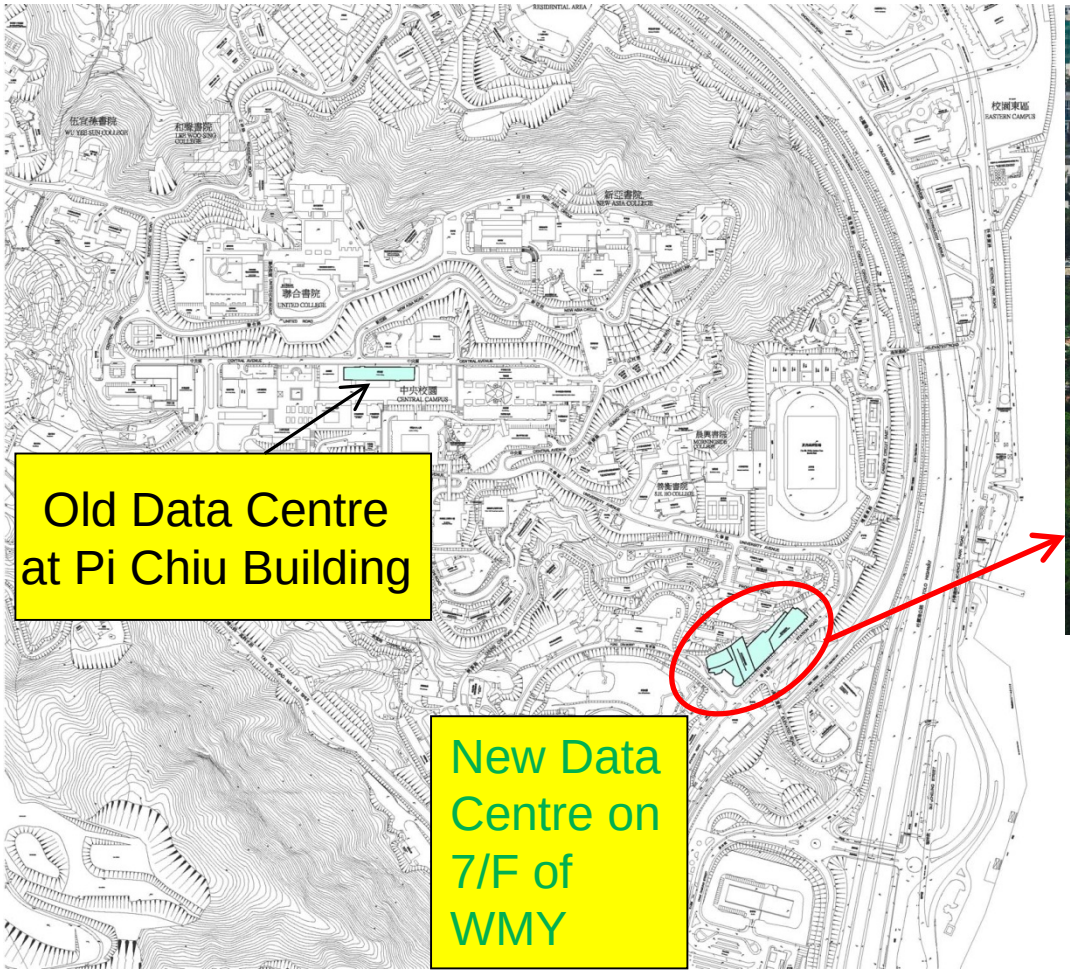
Old Data Centre in Pi Chiu Building

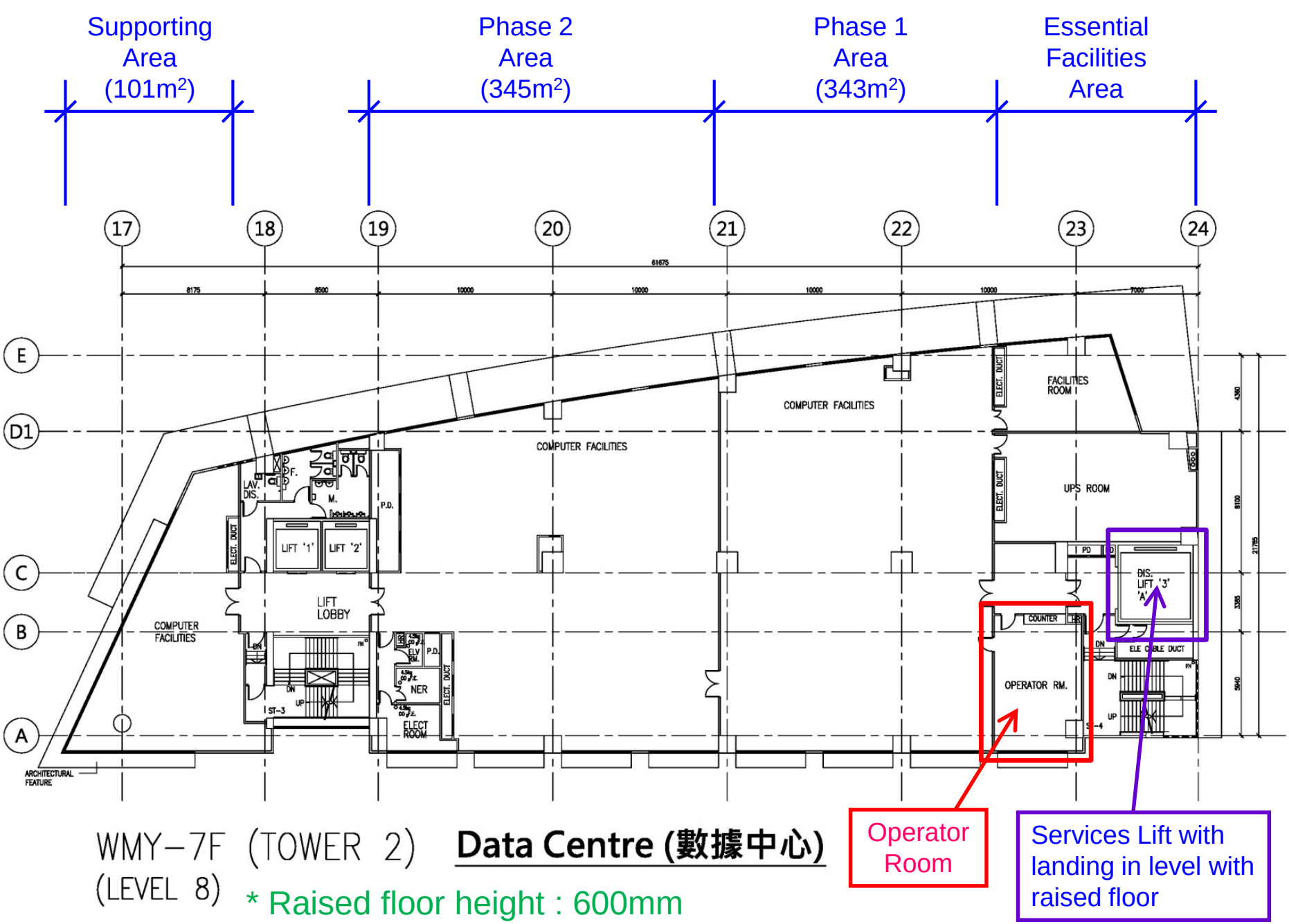
- Previously called Central Computer Room (CCR)
- Now called Central Data Centre #1 (CDC1)
- As centre of CUHK IT infrastructure
- 30+ years old
- <400m²
- Non-standard raised floor
  - 24" x 24"
  - 10" deep
- UPS: 300KVA + 400KVA
- Gen Set: 300KVA (for A/C) + 800KVA (for UPS)
- CRAC Unit: 7 (air-cooled)
- FM200
- Housing around 1,000 physical servers
- Data Centre Management Improvement
  - Stricter Physical Security
  - Keep track of all machines installed inside Data centre, plus move-in & move-out records
  - All new cabinets locked
    - Some using CU Link Card as door keys
  - Starting to observe Hot Aisle / Cold Aisle
  - No more new data cabling underneath raised floor to improve airflow
- As HKIX1 site

New Data Centre – CDC2

- At WMY Building, close to University Station
- Around 800 m^2
- Handed over to ITSC in Oct 2014
- More advance than CDC1
- CDC1 & CDC2 together become twin sites
  - Active-active
- CDC2 will be manned gradually
- HKIX have a POP there, as HKIX1b site
- Equipment rack rental for departments
  - Not encourage departments to set up their own server rooms or data centres
  - Promote remote hands and eyes service

New Data Centre – CDC2





WMY–7F (TOWER 2)
(LEVEL 8)

Data Centre (數據中心)

* Raised floor height : 600mm

Operator Room

Services Lift with landing in level with raised floor

Facilities of CDC2

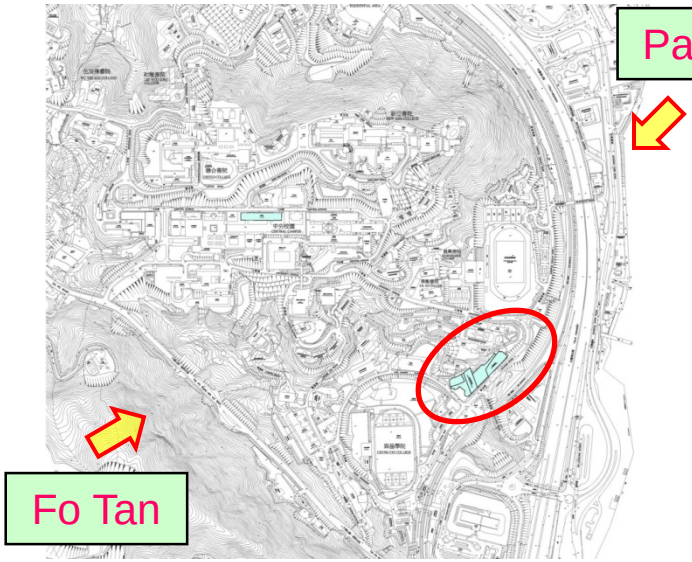
Dedicated M/E infrastructure services

- Power supply:
  - 2 Nos. Transformers from CLP
  - Emergency generators for network equipment & air conditioning services
  - Uninterrupted power supply for network equipment
- Air conditioning system
  - 3 Nos. of dedicated chiller units
  - 13 Nos. of floor supply CRAC unit (Phase 1)
  - 10 Nos. of floor supply CRAC unit (Phase 2)

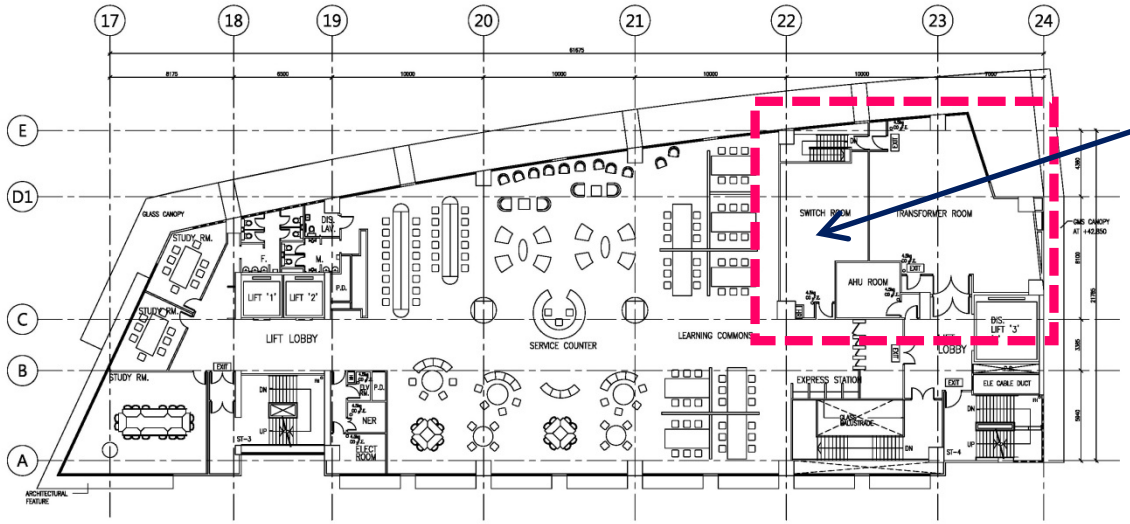
Facilities of CDC2

- Fire Services: FM200 Gas protection system
- Water leakage detection system inside raised floor
- Security: access control at both doors and lifts
- Infrastructure lead-in services
  - Dual telecom lead-in services and ducts
  - 10 Nos. of telecom services providers' lead-in ducts from Station Road to Data Centre on 7/F

Successfully Liaise with CLP to get Dual sources/feed in supply



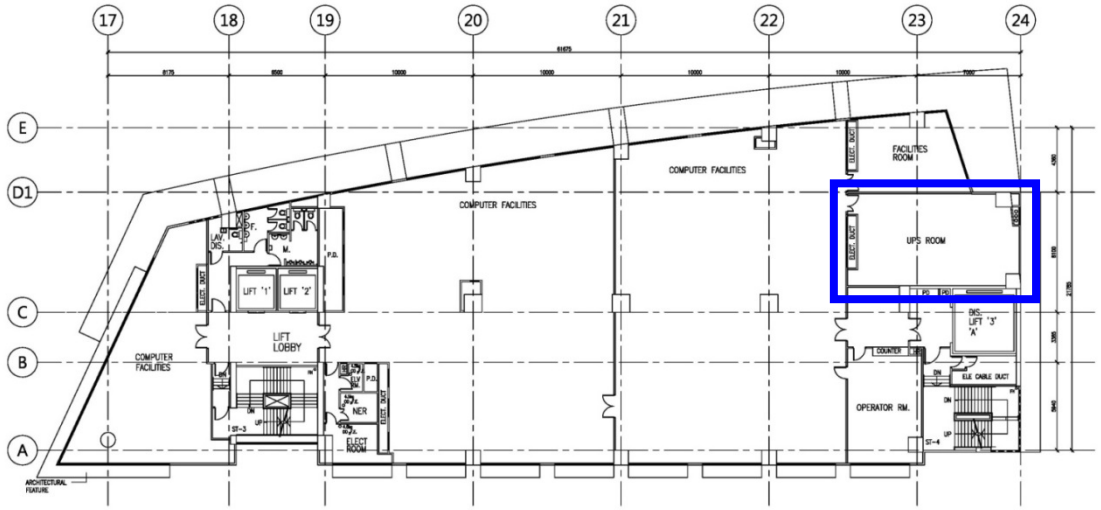
Dual Sources from CLP Fo Tan and Pak Shek Kok Substation to Increase System Reliability



WMY–6F (TOWER 2)
(LEVEL 7)

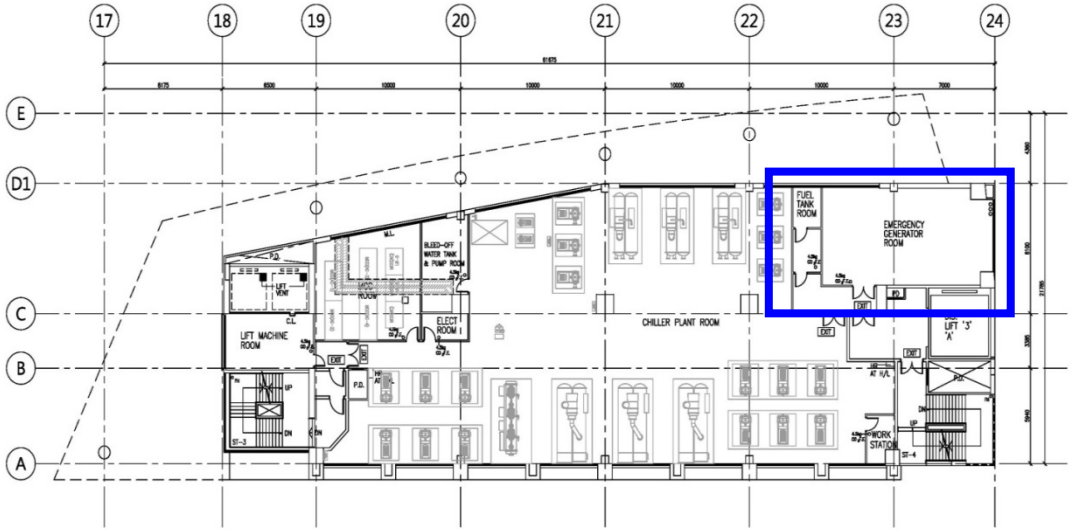
2 Nos. of 1500kVA Transformers for Data Centre (1 duty and 1 standby)

Electricity Supply



WMY–7F (TOWER 2) **Data Centre (數據中心)**
(LEVEL 8)

UPS and Central Battery Room
(2x400kVA for Phase 1)



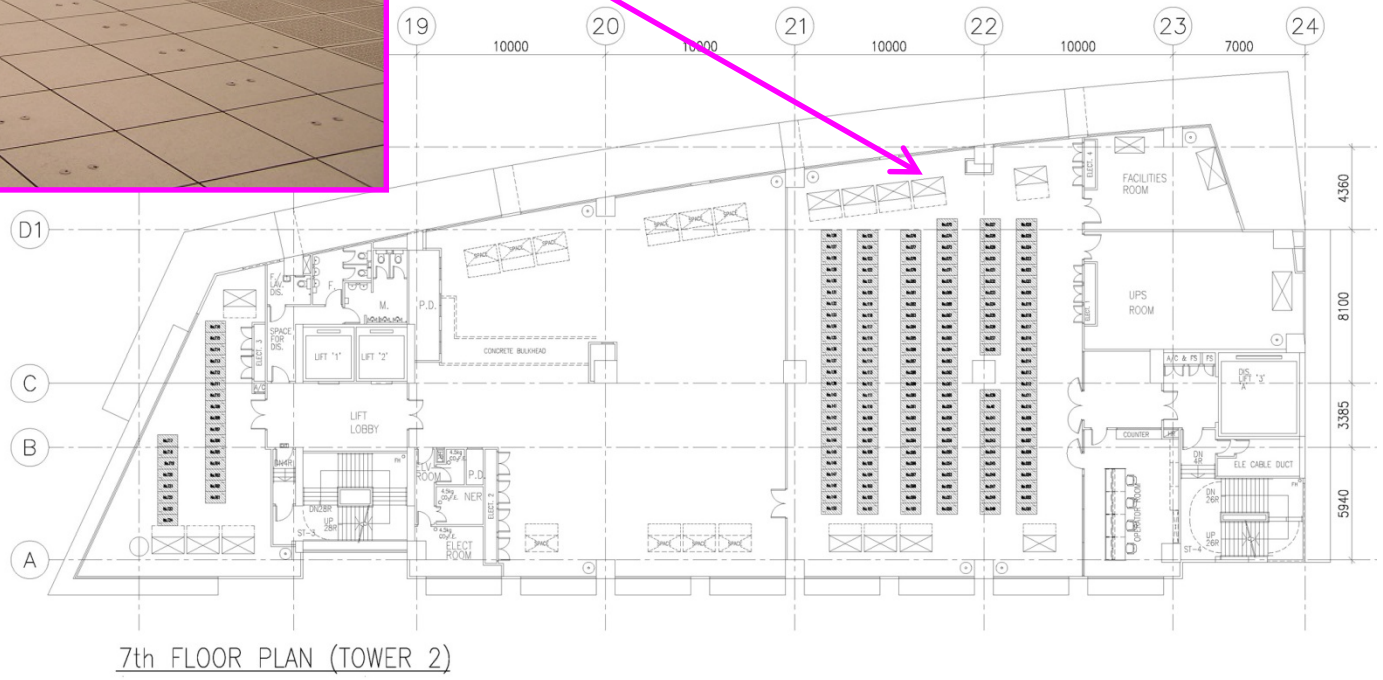
WMY–9F (TOWER 2)
(LEVEL 10)

Emergency Generator (2x800kVA)

Air Conditioning System

13 Nos. of floor standing CRAC units be installed for Phase 1 operation

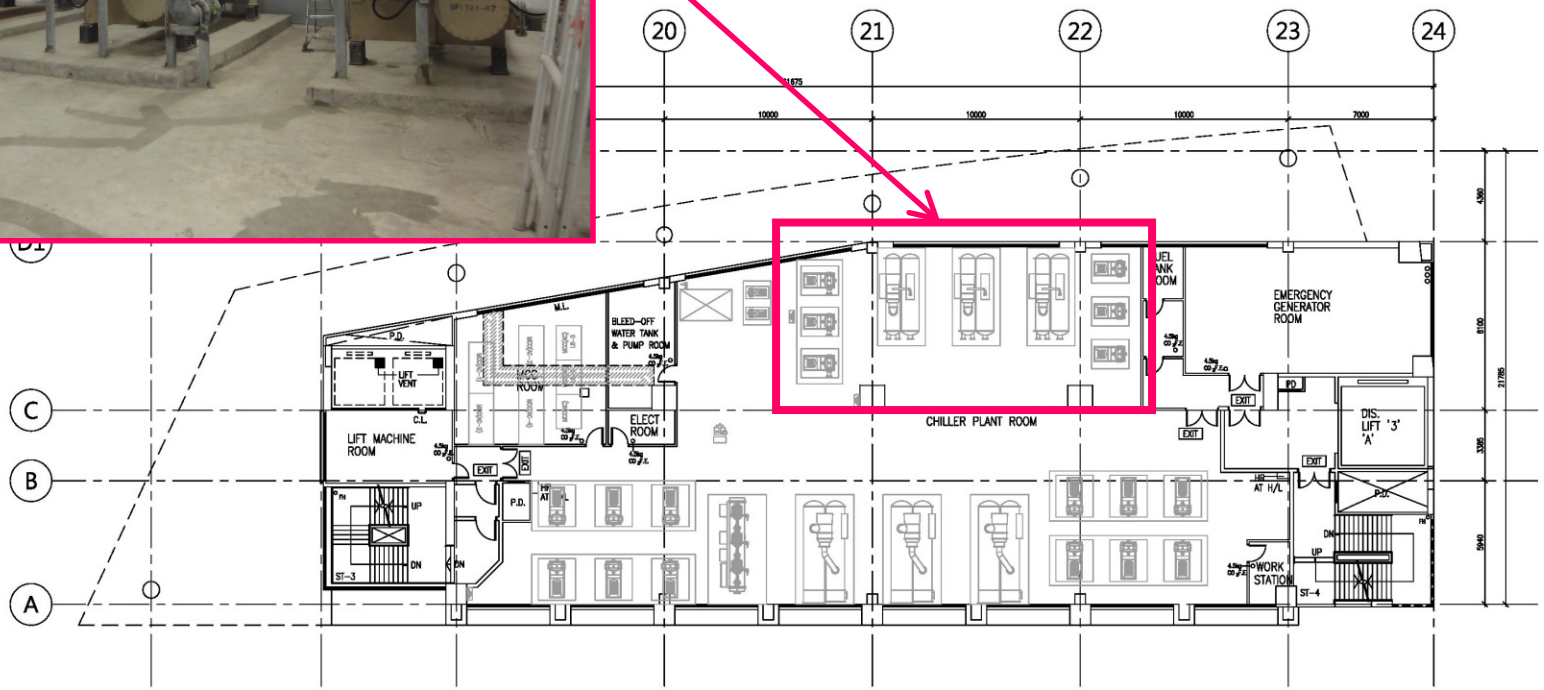
Central plant be provided for both Phase 1 and 2



7th FLOOR PLAN (TOWER 2)

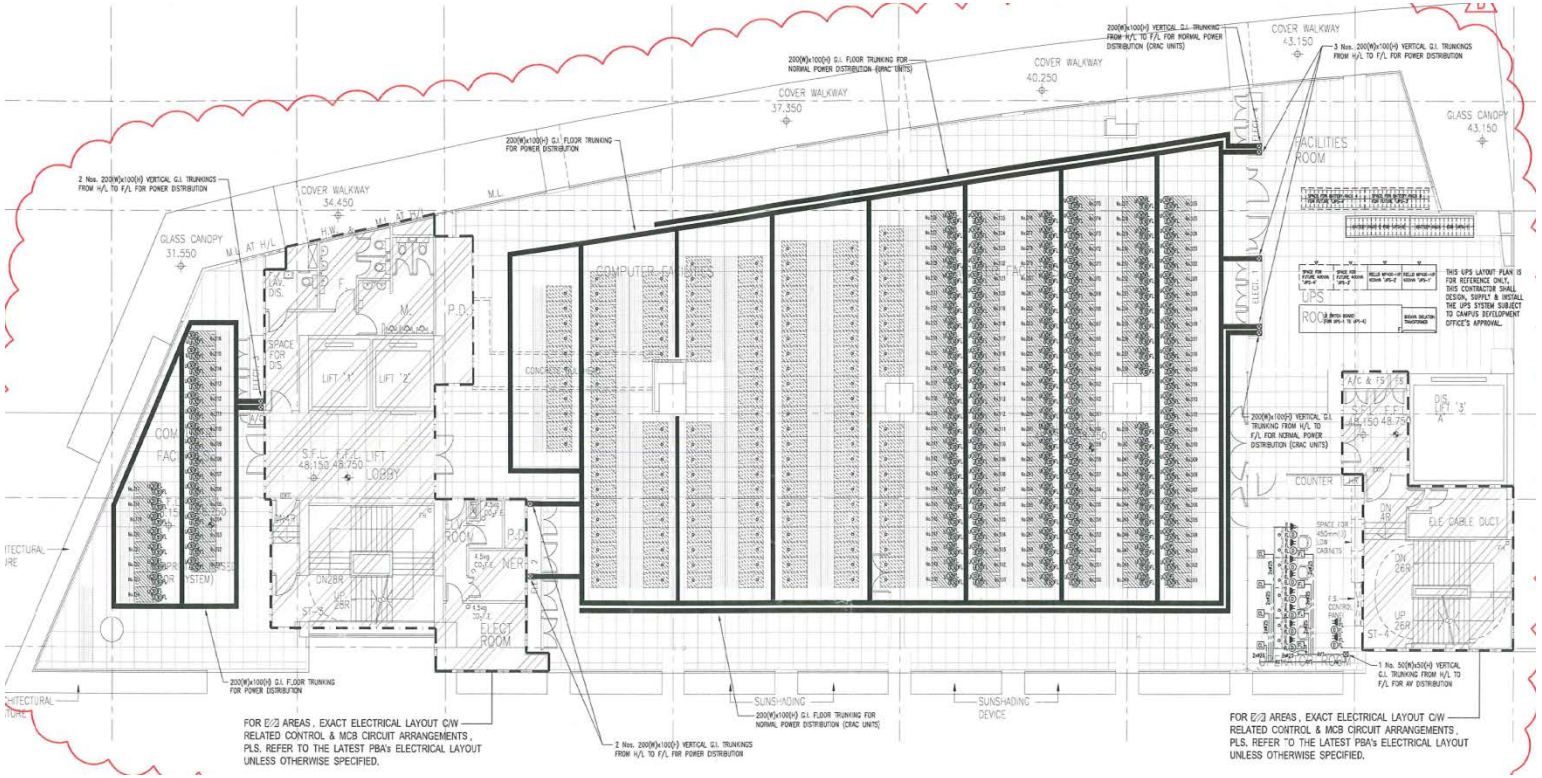
Central Chiller Plant for Data Centre Only

3x200TR. Water Cooled Chillers
(2 Nos. Duty + 1 No. Stand By)

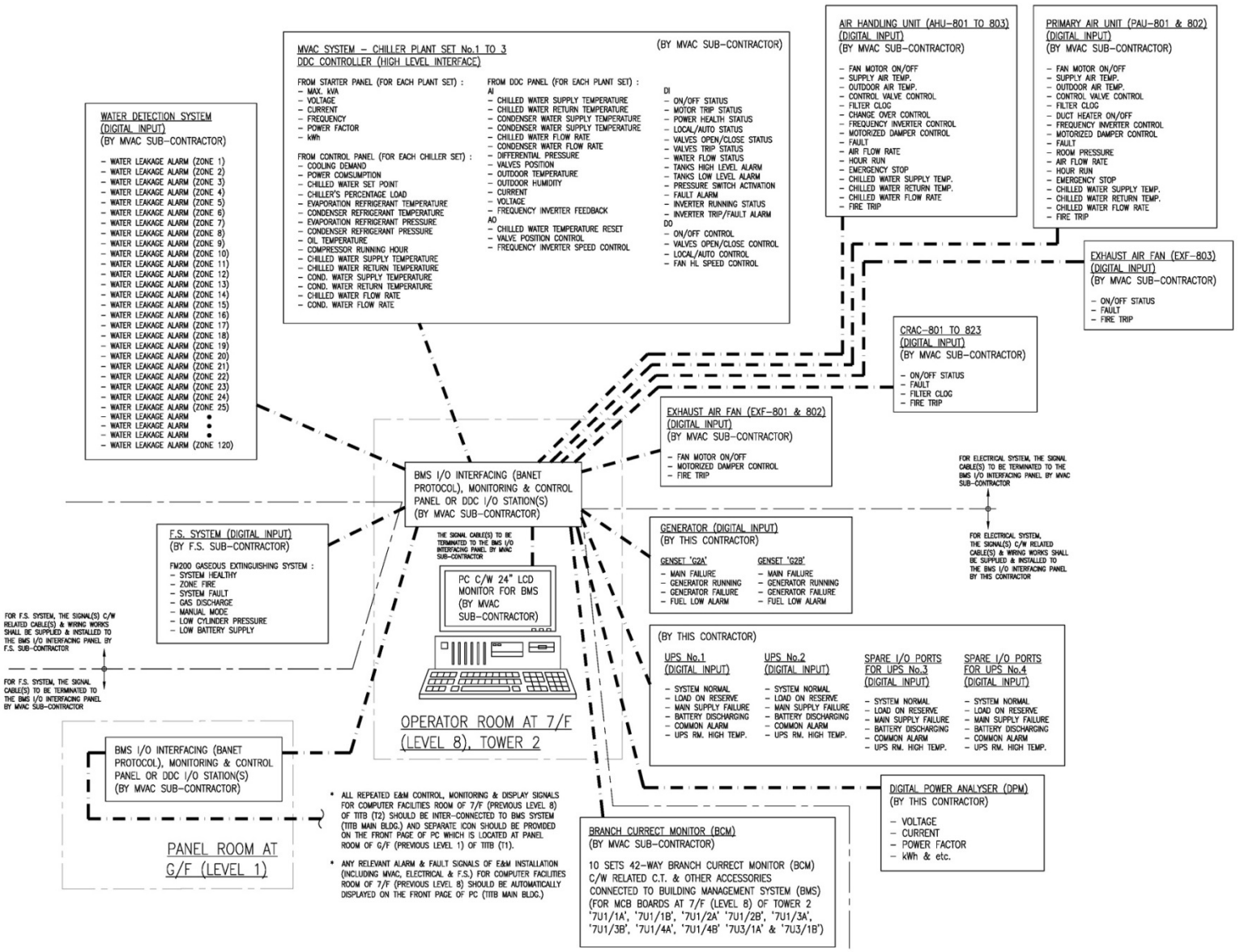


WMY–9F (TOWER 2)
(LEVEL 10)

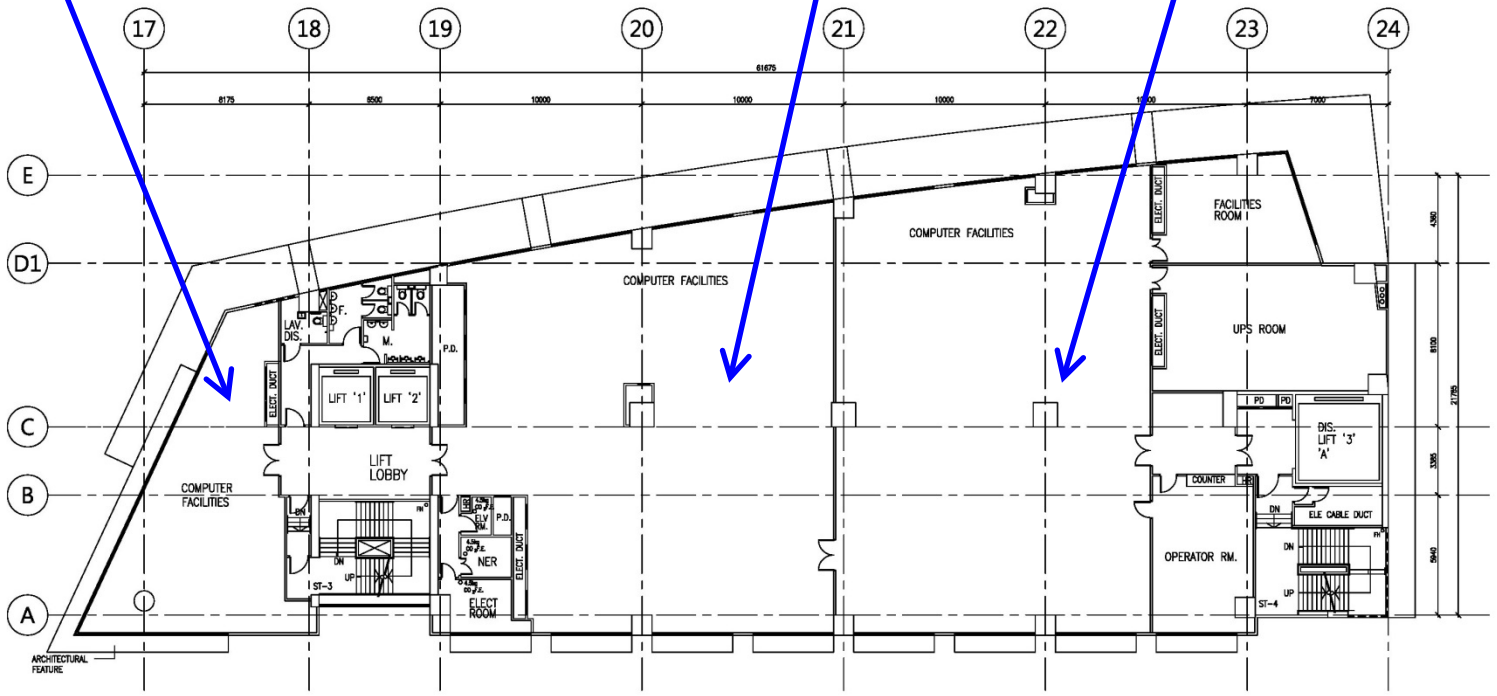
- Branch Circuit Monitoring System (BCM) for each rack (300 Nos. for Phase 1)
- Monitored at the Operations Centre



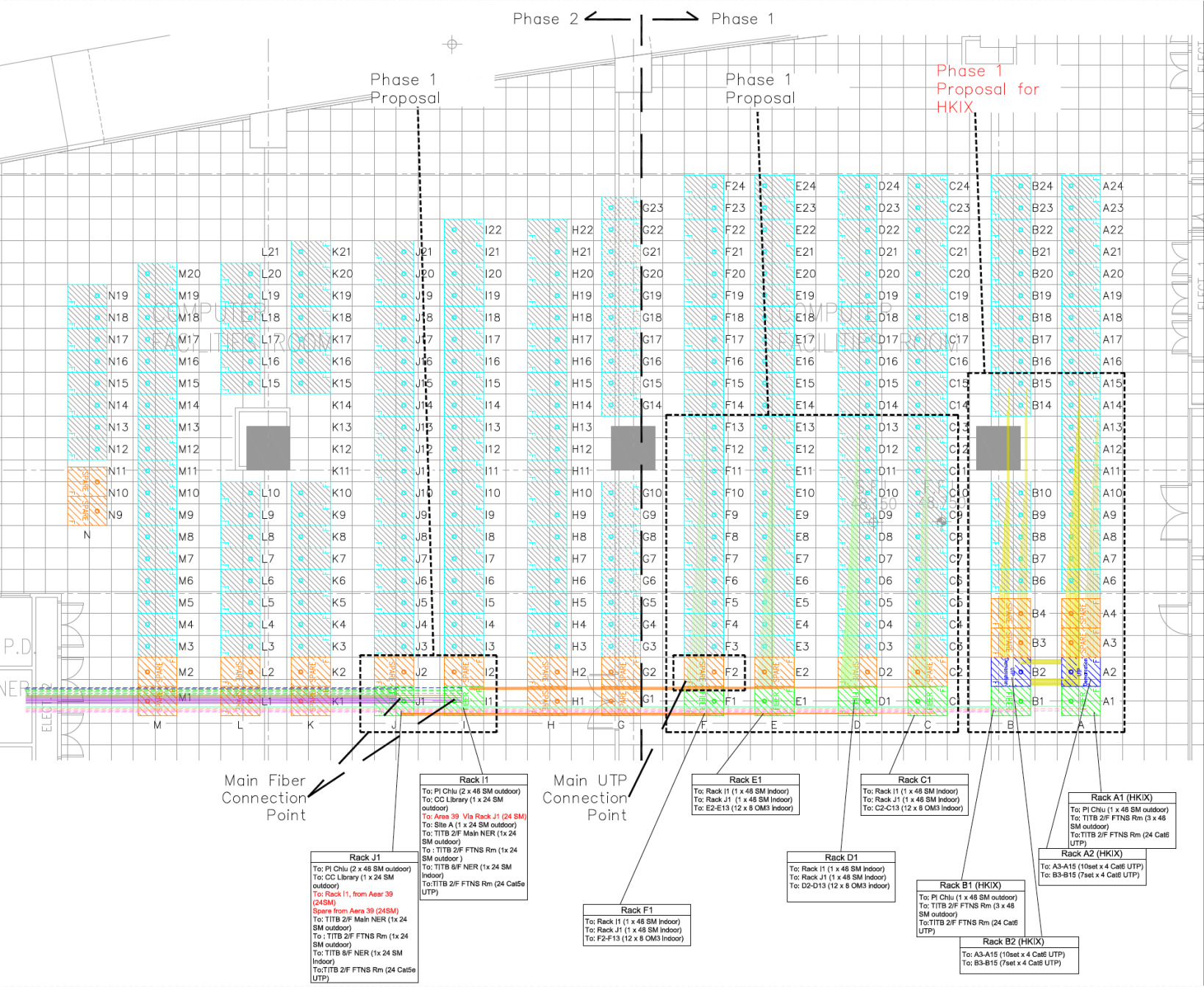
Independent control and energy monitoring for all M/E system and IT equipment at Operations Centre



CONCEPTUAL DIAGRAM FOR BUILDING MANAGEMENT SYSTEM (BMS)



WMY–7F (TOWER 2) **Data Centre (數據中心)**
(LEVEL 8)



Legend:

- 3x48 SM Outdoor Fiber (HKIX)
- 2x48 SM Outdoor Fiber
- 1x48 SM Outdoor Fiber (HKIX)
- 1x24 SM Outdoor Fiber
- 1x48 SM Indoor Fiber
- 1x24 SM Indoor Fiber
- 1x8 OM3 Indoor Fiber
- 24 Cat5e UTP Cable For Voice Backbone
- 24 Cat6 UTP Cable (HKIX)
- 4 Cat6 UTP Cable (HKIX)

WB00 Rack

WB00 Fiber Rack

WB00 UTP Rack

Rack

Rev:	Date:	Description:
10	18/06/13	Revised Cable Qty
9	17/06/13	Revised Cable Route & Cable Qty
8	26/04/13	Proposed Cable Route Layout
7	11/04/13	Revised 1x24 SM outdoor
6	09/04/13	General Modify
5	01/04/13	General Modify
4	25/03/13	General Modify
3	20/03/13	General Modify

Architect: ALKF+ andrew lee king fun & associates architects ltd. 李景勳·實煥雄建築師有限公司

Main-Contractor:

M&E Engineer: PB PARSONS BRINCKERHOFF

Client: THE CHINESE UNIVERSITY OF HONG KONG

Project Title: Two Integrated Teaching Buildings The Chinese University Of Hong Kong

Site Location: The Chinese University Of Hong Kong

Drawing Title: Proposed 7/F Cable Route Layout

Dwg No: TITB 7F CR01

Rev: 10 | Sheet No: 1 of 1

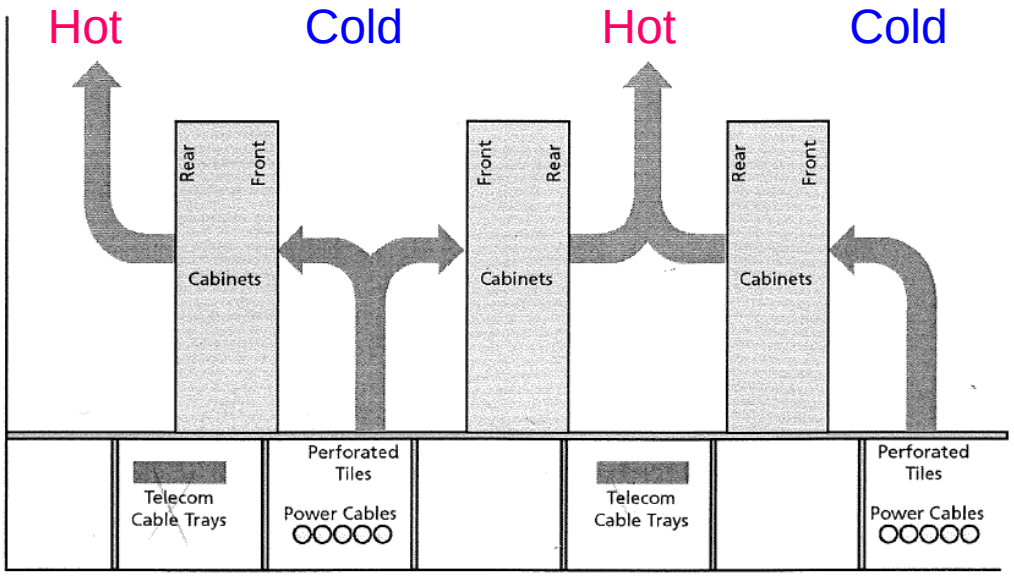
Drawn by: CF | Scale: N.T.S. (A3) | Checked by: KW

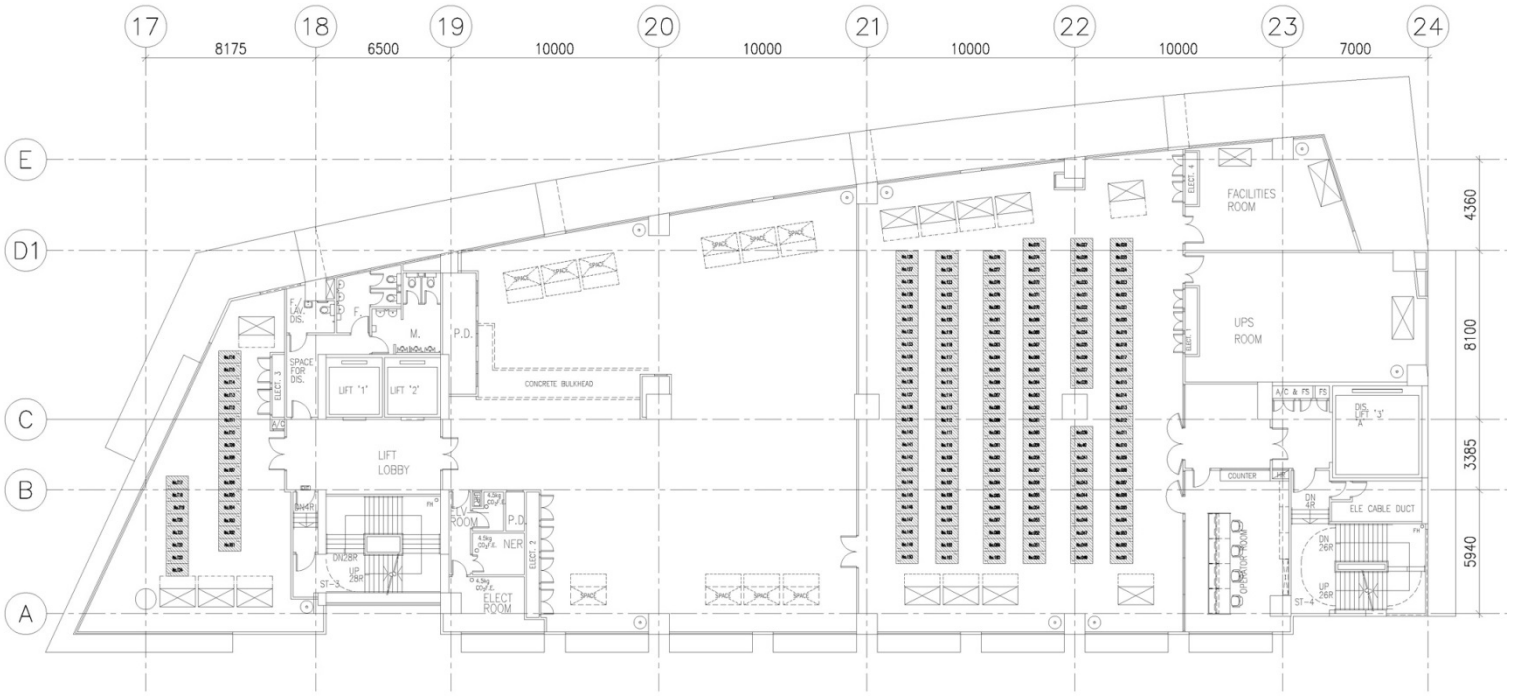
Date: 18 Jun 2013

File Name: TITB 7F CR01_20130618.dwg

GREENer at CDC2

- More efficient power & cooling (with water cooling)
- Cold Aisle / Hot Aisle
  - Cold/hot aisle containment to be done in due course
  - Careful location selection for airflow outlets for better flow of cold air
  - Equipment placement – must not ignore airflow issue
- Airflow underneath raised floor must not be blocked
  - No data cables underneath
  - Only power cables underneath
  - All data cables will be laid above the racks
- No false ceiling
- Windows all blocked to reduce heat dissipation
- Lighting on only when necessary
- *CDC1 to change to water-cooled (under planning)*





7th FLOOR PLAN (TOWER 2)

中大試出伺服器溫度「死線」

數據中心逐步升溫 熱4度省電費機房「暖笠笠」

香港文匯報訊（記者 鄭伊莎）大學校園要達至節能環保，校內每個部門都可以作出貢獻。中文大學資訊科技服務處（ITSC）就從降低數據中心的能源消耗入手，成功將平均最高攝氏23度室溫的中央數據中心，逐步調高至攝氏27度。別看輕這4度，原來試驗過程頗為艱巨，有多部伺服器因抵不住溫度調升而曾經「死機」，但此甚具挑戰性的的節能方法卻為中大省卻了不少電費。此外，ITSC亦推行了一系列節能措施，令其去年在該校舉行的「識綠・更易辦」比賽中，奪得綜合行動獎冠軍，成為中大各部門中的「綠色先鋒」。

■鄭志豪（左）表示調高室溫省卻不少用電量。右為蔡麗施。 鄭伊莎 攝

■數據中心的最高平均溫度維持在攝氏27度。 鄭伊莎 攝

ITSC副處長（基建）鄭志豪接受本報專訪時表示，位於碧秋樓的中央數據中心支援全校電腦網絡，有逾千部伺服器及系統；要維持電腦伺服器順利運作，室內溫度必須保持低溫，避免損害系統的性能，「以前的電腦主要是中央主機，用電量高，所以溫度一般要求在攝氏23度或以下。」

隨着科技發展，電腦系統的用電量降低，其耐溫性能亦有所提高。

最高27度 伺服「不死」

ITSC遂於2013年與物業管理處深入研究如何降低數據中心的能源消耗。鄭志豪指，團隊在過去一年反覆試驗，將中央數據中心的溫度逐步調高，當伺服器過熱時會發出警報，最終發現攝氏27度是中心的最高平均溫度，既不會觸發警報，也不會損害伺服器的運作。

鄭志豪笑言，一年的試驗計劃頗為漫長，團隊抱着戰戰兢兢的心態測試，「機房的伺服器機齡不一，有些已超過10年了，其耐溫性能不如新機，也會影響到整體調溫限制。」要同時兼顧新舊機的耐溫性能，ITSC在試驗過程中也面對一些困難，例如過程中曾有3部至4部伺服器因溫度太高而「死機」，「但我們要求一部都不能死（機），所以總是試完又試。」為了維持數據中心的室內低溫，團隊遮蔽數據中心的窗戶，減少室外熱力透入。

攝氏27度的數據中心，既能環保節能，對於中大舊生來說亦不再是冷冰冰的機房。鄭志豪憶述，以前學生可以入機房使用電腦做功課，曾有舊生分享說在廿多年前，最難忘晚上要穿着棉襖在低溫的機房做功課。現時機房的最高平均溫度已達攝氏27度，自然不再冷冰冰，但因機房已改為伺服器系統，基於安全理由，故中大已不允許學生進入。

換電纜增通風 升能源效益

除了通過調升數據中心的溫度，減低能源消耗外，鄭志豪指樓宇結構的限制亦會浪費能源，ITSC需設法提高節能效果。他舉例指，裝在高架地板下的舊電纜阻礙了地板下的通風，故ITSC近年換掉了使用逾廿年的舊電纜，將所有新電纜架空安裝，令室內更為通風，提升能源效益。

鄭志豪又指，ITSC近年積極向校內各部門推廣可支援操作系統的「虛擬機服務」，即建立一個虛擬伺服器以取代實體伺服器，相對節能及省位置。他指不少部門已習慣使用裝設在辦公室附近的實體伺服器，當ITSC鼓勵他們租用虛擬伺服器時，部分人初時因文件登入系統方式轉變等而感難以適應，需時習慣。

位於伍何曼原樓的新中央數據中心今年啟用，鄭志豪指新數據中心可從零開始規劃，有效提高其能源效益及更節能，例如伺服器系統較先進，耐溫性能較佳，相信可進一步調升其室溫，屆時其最高平均溫度也許會再有突破。

電子表格減紙 回收電腦傢具

■燈光和空調劃分為不同顏色的區域。 鄭伊莎 攝

多招環保

除了調高中央數據中心的室溫以節約能源外，ITSC近年亦致力推行其他綠色措施，包括設計應用程式和文件管理系統、回收可用的電腦及印影機，並重用舊傢具等。每項綠色措施都為中大節省了不少資源，為環保踏出了一大步。

ITSC行政主任蔡麗施表示，為了鼓勵大學各部門減少用紙，ITSC特別設計了應用程式和文件管理系統，例如為財務處度身訂做一些電子表格，供其他部門直接使用，再通過文件管理系統傳送，減少用紙量。

蔡麗施指，有見部分被棄置的電腦及印影機等可重用，ITSC遂將有關機器以投標制予校內部門或內部員工投標，期望為它們找到合適的主人，減少浪費，並鼓勵各部門循環再用電腦零件。此外，當有部門搬遷辦公室，部分不適用的傢具亦需交由其他部門收留。

她笑言，ITSC鼓勵重用傢具，故亦會收留合適的舊傢具，「其實很多傢具如椅子仍然簇新的，只要合用，還可以用一段很長的時間。」記者當日採訪時使用的會議桌和椅子，原來都已使用了逾三十年。

由於ITSC有逾百名員工，ITSC將燈光和空調劃分為不同顏色的區域，蔡麗施指此舉可提醒員工下班時按其區域關掉電源，避免因辦公室的範圍太大而遺漏了部分區域。記者現場所見，辦公室裝設了紗窗，方便員工長期打開窗戶，減少開冷氣，亦可保持空氣流通。這些小小的綠色措施，為中大節省了不少電源，也為環保踏出了一大步。

■記者 鄭伊莎

Coordinated Effort

- To discourage building up and operating unnecessary server rooms or small data centres in campus
  - Space allocation for server rooms or small data centres in departments
  - 24x7 Central Air Conditioning
  - Colocation Racks in CDC1 & CDC2
    - Hosting of Servers for departments
    - 24x7 Remote Hands & Eyes
    - Chargeable Service

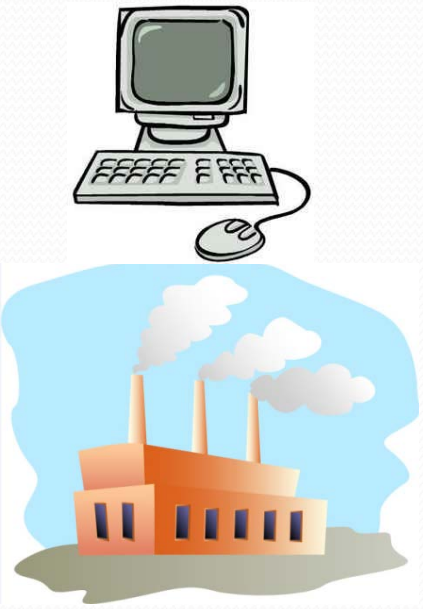
Other trends which help reduce energy consumption

- Virtual Machine – Private Cloud
  - With Storage and Backup
  - Sharing is key
  - Chargeable Service
- Public Cloud
  - IaaS – AWS, Microsoft
  - SaaS – O365, Taleo, ServiceNow, LMS, Library

IT Applications to help go GREENer

- e-Fax to reduce paper fax
- e-Form to reduce paper forms
- Document Management System to reduce printing of documents and to save space
- Video and web conferencing to reduce travelling
- e-Learning System to reduce paper homework submission
- Systems supporting online submission and approval to reduce paper forms
- e-Survey
- e-Card

Energy used during the life of a PC



Production of one PC w/ CRT monitor consumes around **1800 KWh**

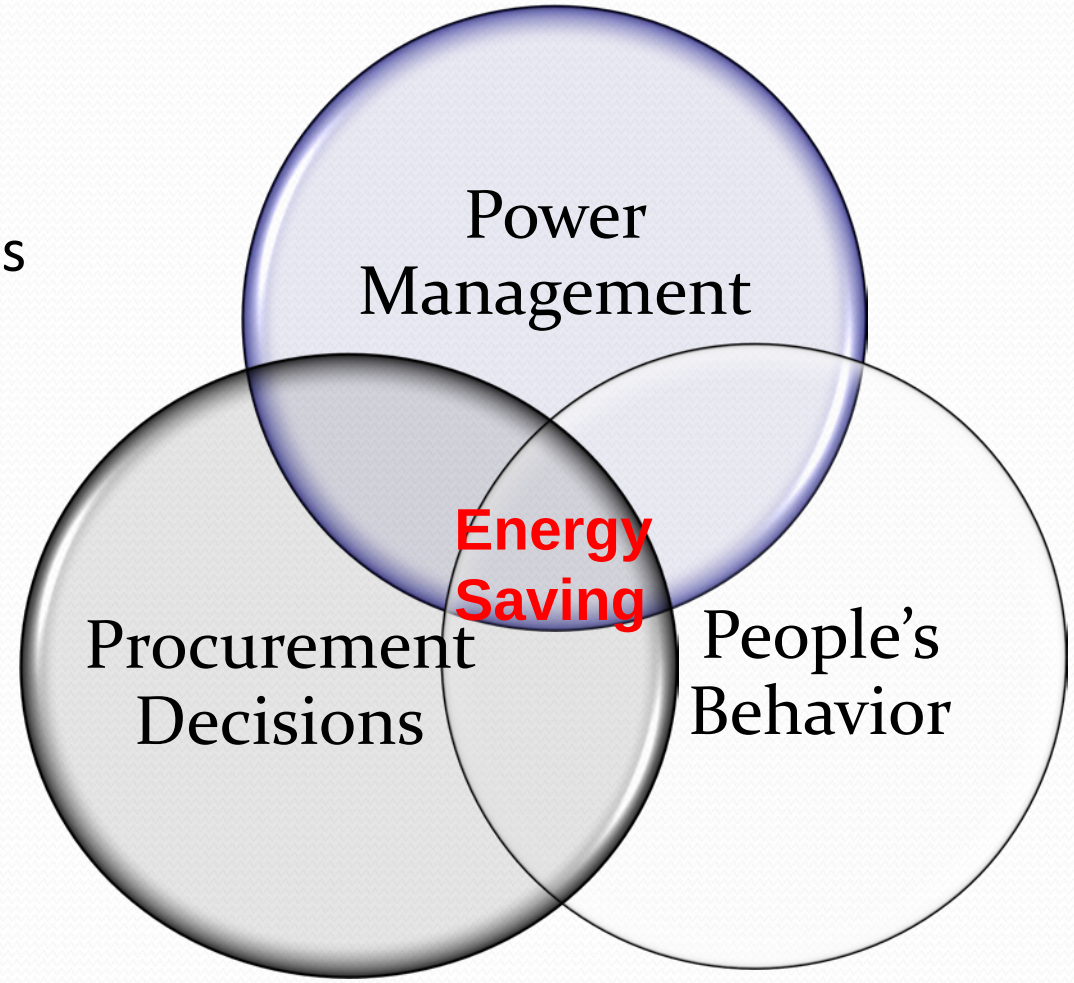
Average annual energy used per PC w/CRT monitor in an office is about **650 KWh**

Around **20%** of computers being recycled annually

Energy Savings – Personal Computers

Can be achieved by 3 Ps:

- **P**ower Management
- **P**rocurement Decisions
- **P**eople's Behavior



Procurement Decisions – the first "P"

- Before you buy, **think twice**.
- Buy **Energy Star** or **EPEAT** rated. EPEAT® is the definitive global registry for greener electronics. It helps to identify greener Computers and other electronic equipment.
- Laptops vs. desktops – **laptops** save at least half of the energy overall.
- Printers – choose the types with **sleep mode/power saving** enabled.
- Refer to **ITSC's tenders** for PCs, notebooks, and printers
  http://www.cuhk.edu.hk/itsc/mcas/hwsw/notebook.html
- Follow **Green Purchasing Guidelines** of the University
  http://www.cuhk.edu.hk/cpso/go!/resources/green_purchasing_guidelines.pdf

Power Management – the second “P”

- Adjust **brightness and contrast settings** on PC screen.
- Use **“Sleep” mode** if you don’t use your computer in another 15 or 20 minutes. Computer uses 2 watts or less during Sleep mode.
- Both monitor and PC can enter this low power mode automatically by configuring **Power Management**.

  https://www.energystar.gov/products/low_carbon_it_campaign/power_management_computer

People's Behavior – the third "P"

- **NO Screen Saver**.
- KEEP your computers in service **at least 3 – 5 years**; upgrade them instead of buying a new one.
- REUSE the **old computers** for low-end functions or DONATE them.
- **TURN OFF the monitor** if you aren't going to use your PC for a while.
- **TURN OFF both the CPU and monitor** if you're not going to use your PC for more than 2 hours. According to EMSD (機電工程署), each computer saves up to **HK$600 per year** if it is switched off after office hours.

People's Behavior – for Printing

- **Use multi-function printer** instead of individual machines for printing, faxing, scanning, and copying.
- **Use network printing (for sharing)**.
- **Unplug printers** from socket outlet during long holidays.
- Enlarge printing **margins**, reduce **font size**, and print on **BOTH sides**.

Wake on LAN and Remote Desktop

- Your PC can be waken up even if it is turned OFF.
- Remotely access your desktop outside your office **WITHOUT leaving the PC power ON overnight**.
- Set up WoL server within the same Local Area Network (subnet).
- ITSC can share the knowledge with departments about the setup.

What more can be done in office to save energy?

- Timers to turn off all network printers and water heaters during non-office hours
- Insect screens in offices and user areas to encourage opening windows to reduce the use of air-conditioning
- Fans for better air circulation in the offices to reduce the use of air-conditioning
- Motion sensors for lights in functional rooms and offices
- Open Office – A/C and lights are divided by zones so that colleagues can turn off their own lights and air-conditioning before they leave for the day

Education to Users

- **Energy saving tips for computer equipment:**
  - http://www.cuhk.edu.hk/itsc/about/energysave.html
- **Paper saving @ User Area:**
  - http://www.cuhk.edu.hk/itsc/about/greenit/papersaving.html
- **Re-use CD jewel cases:**
  - http://www.cuhk.edu.hk/itsc/about/greenit/reuse-case.html

CUHK Internal GREEN Award

- **ITSC** got the **First Prize** in the **Overall Green Actions** of '**GO!**' **Green Award** and also the prize in the category of Green Purchasing:
  - http://www.iso.cuhk.edu.hk/english/publications/sustainable-campus/article.aspx?articleid=61928

External GREEN Award

HONG KONG ICT AWARDS 2011 香港資訊及通訊科技獎

Best Green ICT Award Winners
最佳綠色科技獎各獎項得主

Green ICT Consortium

Certificate of Merit 優異證書

The Chinese University of Hong Kong
香港中文大學

CUHK Document Management System
中文大學文檔管理系統

Final Remarks

- IT can play a key role in going GREEN
- GREEN should be built into the design of all IT Infrastructure, Operations and Applications
- Every small work counts

Thank you!