HVAC Energy Efficiency projects - Verification of energy savings – Cost effective sub-metering

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Traditional metering

- Tracking of energy use at facility level
- Minimised costs of metering
- One utility meter per facility
- Locally read
- No information on energy consumption of individual building services

Sub-metering – metering of individual energy consumptions

- High energy cost
- Tightened budgets
- Sustainable energy and energy reduction goals
- Identification of issues and energy saving potential
- Verification of utility bills
- Determination of energy efficiency of equipment and systems
- Verification of energy savings

Sub-metering – metering of individual energy consumptions

Metering on its own does not save energy. Complementary procedures include several actions:

- Collect the data
- Keep records
- Analyse the data
- Take Action

Sub-metering and M & V plan – energy savings

a) Informal M & V Plan – generic

b) Formal M & V Plan in line with EVO's IPMVP:

- Accurate
- Consistent
- Relevant
- Transparent
- Cost effective
- Suitable to the readers level of understanding
- Creation and certification by CMVP

Sub-metering and M & V plan – quantification of energy savings in line with IPMVP

- Option A (Retrofit Isolation: Key Parameter Measurement)
- Option B (Retrofit Isolation: All Parameter Measurement)
- Option C (Whole Facility)
- Option D (Calibrated Simulation)

Energy Savings = Baseline energy consumption – Post-implementation energy consumption (Reporting Period) ± Adjustments (to compensate for different conditions between Baseline and Reporting period)

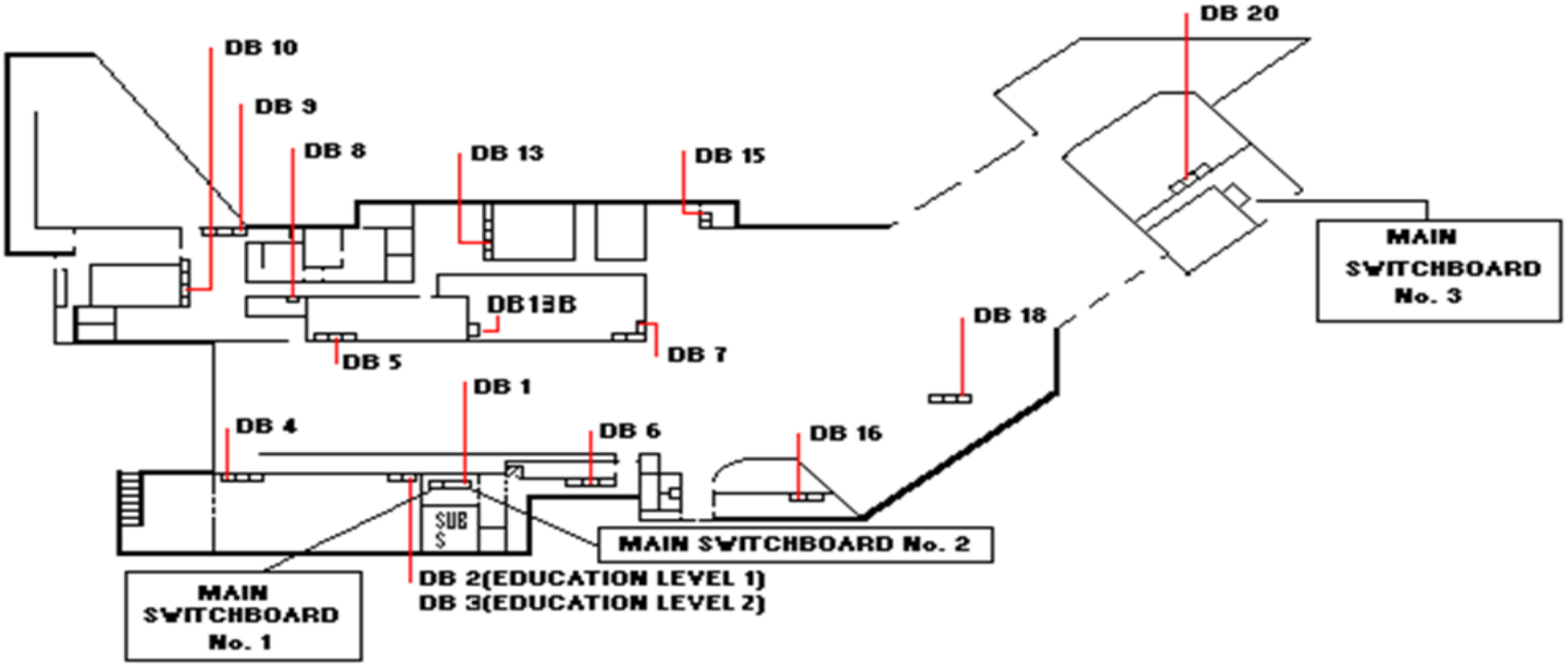
Sub-metering and M & V plan – quantification of energy savings in line with IPMVP

ECM Project Characteristic	Suggested Option			
	A	B	C	D
Need to assess *ECM*s individually	X	X		X
Need to assess only total facility performance			X	X
Expected *savings* less than 10% of utility meter	X	X		X
Significance of some *energy* driving variables is unclear		X	X	X
Interactive effects of ECM are signficant or unmeasurable			X	X
Many future changes expected within *measurement boundary*	X			X
Long term performance assessment needed	X		X	
Baseline data not available				X
Non-technical persons must understand reports	X	X	X	
Metering skill available	X	X		
Computer simulation skill available				X
Experience reading utility bills and performing regression analysis available			X	

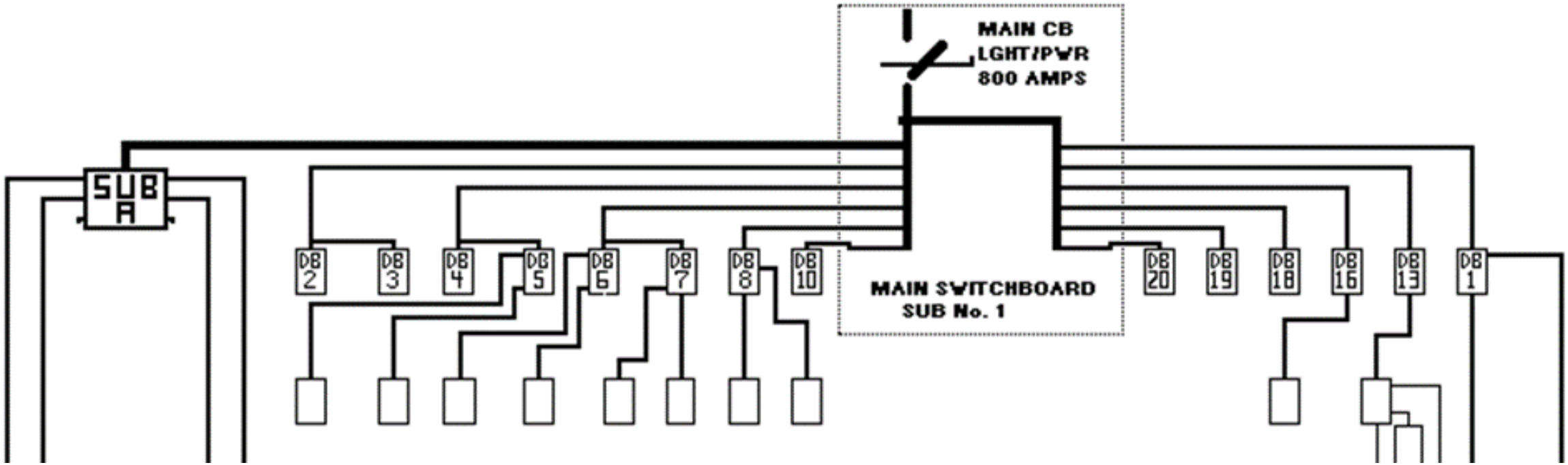
M & V plan – Cost Effective sub-metering

- Thorough knowledge of employed HVAC System (Design and operations of equipment and controls) and other energy systems.
- Thorough knowledge of electrical reticulation/switchrooms and position/loads of HVAC System components in it (represented in Electrical Single Line Diagram)
- Load measurements (to ascertain size of current transformers considering the difference between a maximum load and name plate reading)
- Thorough knowledge about trend of energy use/power demand (using utility bills and smart metering interval data) and its correlation to variable weather conditions (regression analysis using CDD and HDD – Cooling and Heating Degree Days, ands actual energy consumption data.
- Awareness of available budget
- Knowledge on cost effective meters and processing softwares
- Use of existing sub-meters (properly validated) and the likes (VSD controllers for pumps and fans with HLI- High Level Interface, temporary loggers, etc.)
- Creation of virtual meters
- Minimal ongoing fees for analysis and reporting

M & V plan – Cost Effective sub-metering – Case study



M & V plan – Cost Effective sub-metering – Case study



M & V plan – Cost Effective sub-metering – Case study

- **Sydney Museum - Complex Close Control HVAC System** (Central CHW and HW systems with sea water cooling, multiple AHUs, VSD controllers on pumps and fans, humidifiers, space pressurisation, Demand Ventilation, Economy Cycle, Carbon filtration, etc).
- Business as usual to sub-metering design approach from two tenderers
- M & V Plan offered by CMVP
- Comparisons
- Client's decision
- Winning M & V Plan

M & V plan – Cost Effective sub-metering – Case study

	Substation		
Supply No.1		Supply No.2	
Summation Utility Meter No.1		Summation Utility Meter No.2	
Schneider's existing sub-meter		Schneider's existing sub-meter	
MSB 1		**MSB 2**	
MCC1 Plantroom & Chillers			
PCHW pump 1		EWIS,FIB,Lifts Fire Panel	
PCHW pump 2		Remote plantrooms MCC2, MCC3, MCC4, MCC5 & MCC New 2	
PCHW pump 3		AHU 1	MCC2
CW pump 1		AHU 2	
CW pump 2		AHU 3	
CW pump 3		AHU 4	
SCHW Pump 1		AHU 9	
SCHW Pump 2		PFC	
SCHW Pump 3		Light and Power	
SCHW Pump 4			3 x 3x 14.4kW HW
HW pump 1			
HW pump 2			
SWP 1			
SWP 2			
SWP 3			
SWP 4			
AHU 5			
AHU 6			
PFC			
Chiller 1			
Chiller 2			

LEGEND	
	Utility Meter
	Existing Schneider's sub-meters
	New submeters
	Existing VSDs used as submeters via HLI
	New VSDs to be used as sub-meters
	Virtual Meter
	Chillers HLI sub-meter

Q & A