

Measuring Distributed Electrical Loads in Buildings

TLC ENGINEERING SOLUTIONS (Pty) Ltd

Commercial Buildings

- At time of construction reticulation system often represents “state of the art”
- Many buildings are decades old – e.g Carlton Centre in downtown Johannesburg was constructed in the 1960’s
- Nature of loads has changed over the years
- Modifications have been made to reticulation systems – sometimes undocumented
- Building owners and managers often unsure of what capacity is available

Emergency Power

- Historically was provided for “safety”
 - Lighting
 - Elevators
- Many older buildings have minimal emergency reticulation
- Supply was often centralized in a basement with a standby generator

Modern Tenants

- New business reality is 24/7/365
- Loss of power is a significant loss of revenue
- Critical loads can now include
 - Lighting
 - Computers, servers, workstations, printers etc
 - Networking and communication
 - HVAC

Building Monitoring

- Systematic way to determine loads
- Profile loads by
 - Building type
 - Tenant
 - Time of day
 - Day of Week
 - Season
 - Other factors (e.g ambient temperature)

Monitoring Objectives

- Need to determine monitoring objective
 - New tenant requirements
 - Documentation
 - Refurbishment
 - Energy consumption
 - Potential for savings
 - Planning & Research

Monitoring Plan

- Based on the objectives we may need to measure:
 - Entire Building
 - Representative floor
 - Specific office
 - Particular load
 - Some combination of the above

Monitoring Points

- Depending on the objective it may be impractical to monitor every required load
- Practicality of access – can the required load be measured
- May need to establish a representative load
- Can measure by “subtraction”

INCOMING SUPPLY EXAMPLE

INCOMING HT SUPPLY

INCOMING HT SUPPLY

Equipment:

24 x CT's

6 x Voltage

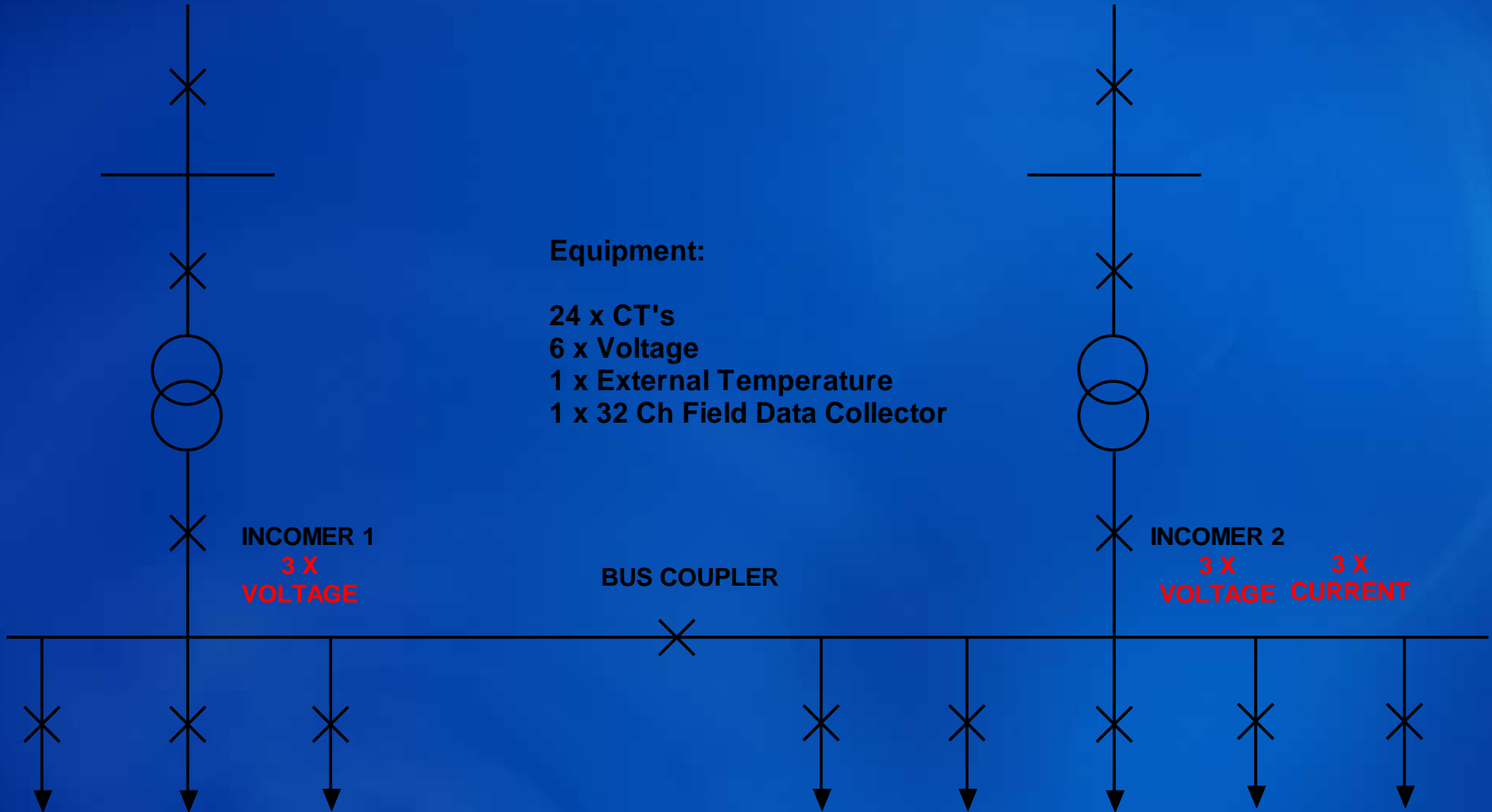
1 x External Temperature

1 x 32 Ch Field Data Collector

INCOMER 1
3 X
VOLTAGE

INCOMER 2
3 X
VOLTAGE 3 X
CURRENT

BUS COUPLER



DB1
(Underground
Parking etc)
3 X
CURRENT

DB2
COMPUTER
ROOM
3 X
CURRENT

DB3
BUILDING
S FLOORS
3 X
CURRENT

DB4
BUILDING
N FLOORS
3 X
CURRENT

DB5
EMERGENCY
UPS SUPPLY
3 X
CURRENT

DB6
CHILLER
PLANT
3 X
CURRENT

DB7
BUILDING
FLOORS
3 X
CURRENT

PHASE 2
BUILDING
(NOT
METERED)

Incoming Supply Panel

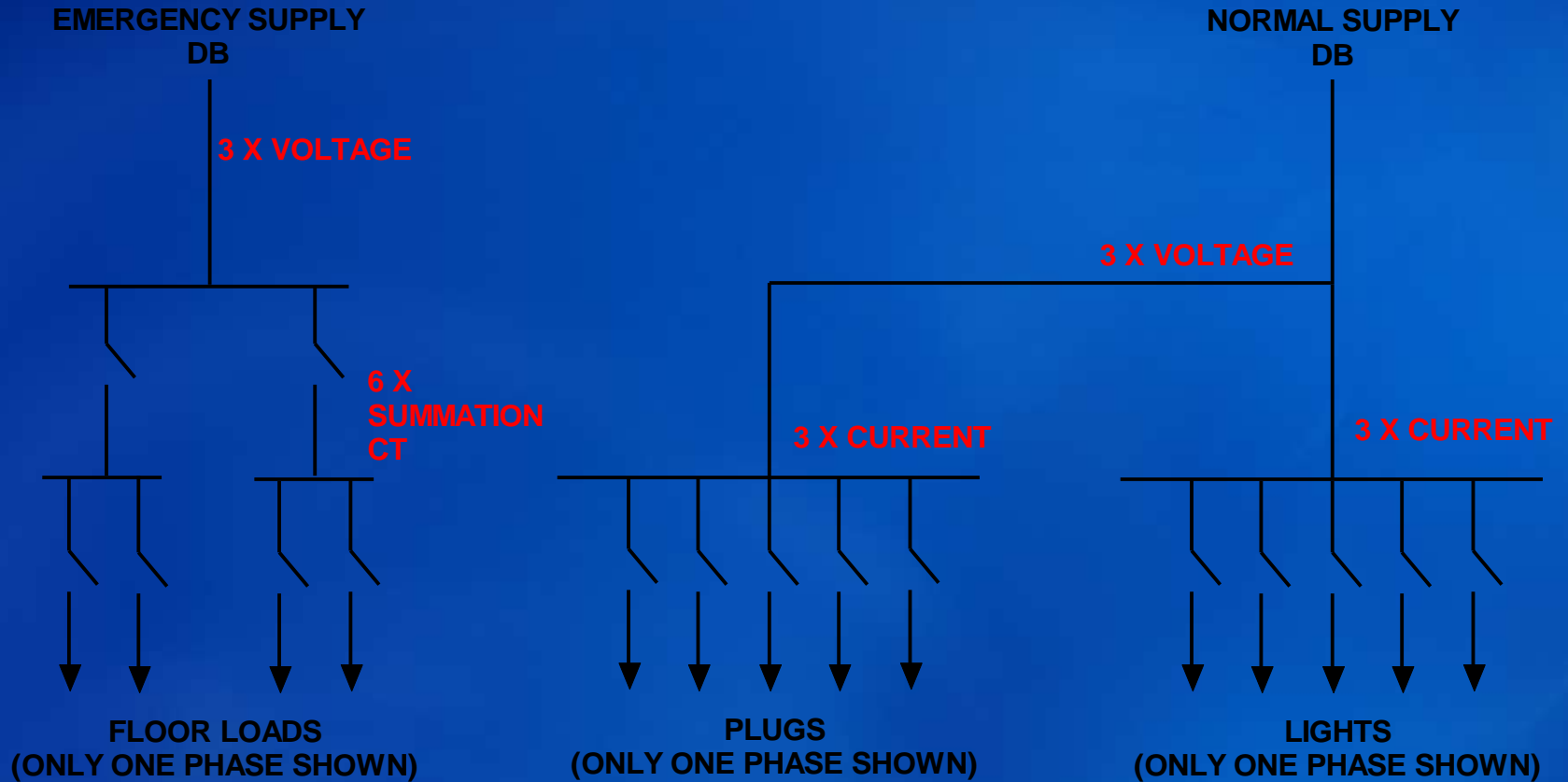


Site Issues

- Where can we monitor voltage?
 - Panel meter
 - Busbar
 - BMS
- Where can we monitor current?
 - Existing CT's
 - Clamp-on CT's
- Location of monitoring system



EXAMPLE BUILDING FLOOR



Equipment:

- 6 x CT's
- 6 x Summation CT's
- 6 x Voltage
- 1 x Internal Temperature
- 1 x 16 Ch Field Data Collector

Emergency Panel



Your Engineering Solutions Partner

Normal Supply Panel



Your Engineering Solutions Partner

Data Acquisition System

- Accept multiple voltage and current inputs
- Measure / calculate kVA, kW, pf, kWh and Maximum Demand
- Able to measure single and three phase (resist temptation to measure only 1 phase on 3 phase)
- Save readings at a selectable interval (usually 5 or 10 minutes)
- Accuracy does not need to be metering class – 5% is usually adequate
- Data capacity for at least 1 month of readings. This must be non-volatile storage
- Does not necessarily need a local display. Configuration could be performed using a PDA or laptop
- Equipment preferably mounted in a lockable enclosure to prevent tampering
- Backup power supply is recommended for internal clock

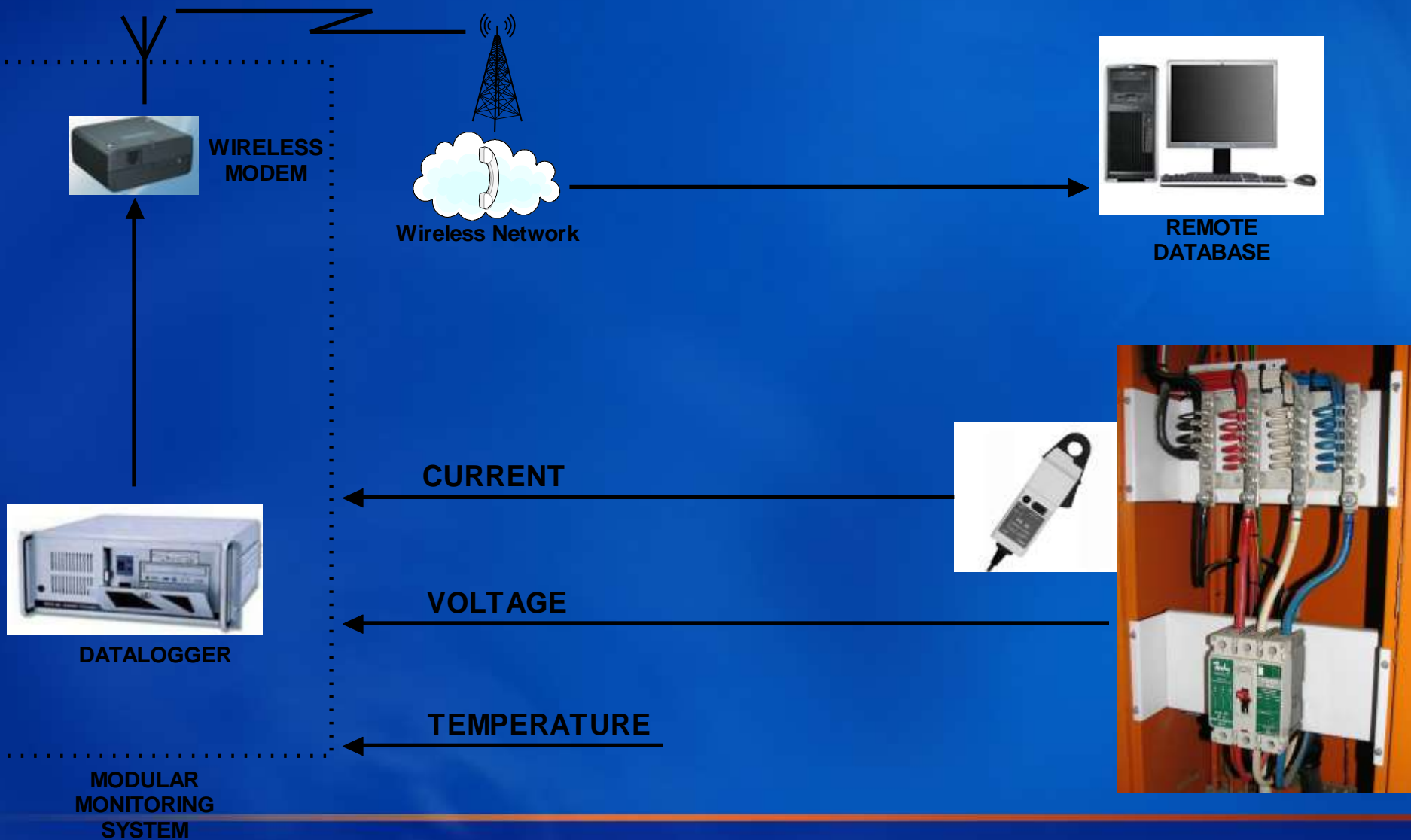
Data Collection

- Data collected by the system can be
 - Manually retrieved (CD rom / memory stick)
 - Remotely collected (Wireless)
 - Automatically transferred (Real or near real time)
- Practicality when numerous measurement points in the building or several buildings
- Data from several systems needs to be centralized

Example Measurement System

- Modular field monitoring system
- Signal isolators for 110 / 230V and 1A or 5A
- Clamp-on or split core CT's
- Temperature probes for internal and external building temperature
- Modem for remote data retrieval
- Enclosure with back-up supply
- Back office database for storage of field information

BUILDING ELECTRICAL MONITORING SYSTEM



Database

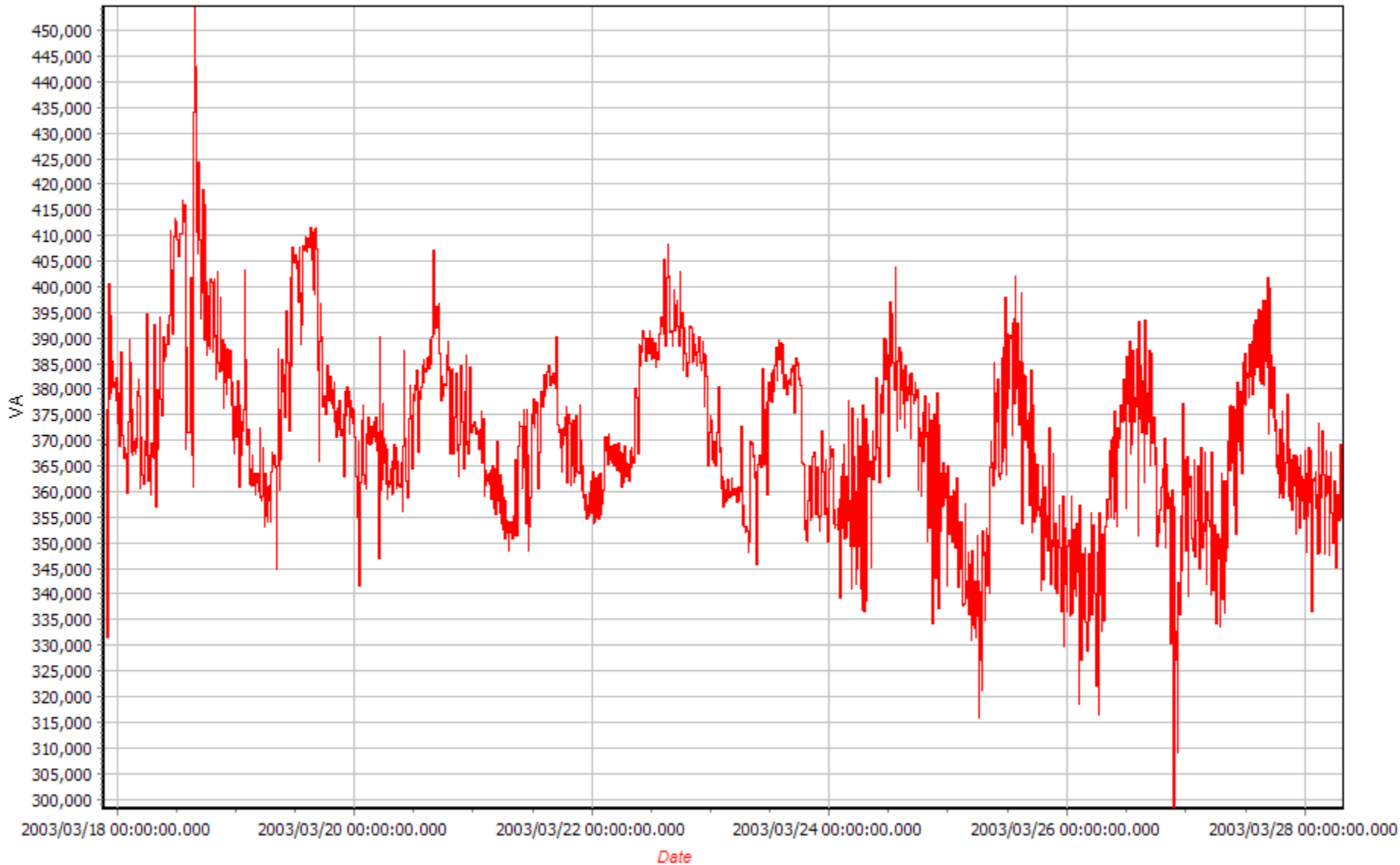
- Able to store data from one or more devices indefinitely
- Open standard (Excel, Access, SQL)
- Reliability and integrity

	V1: 1 ,V2: 2 ,V3: 3 ,I1: 13 ,I2: 14 ,I3: 15						V1: 4 ,V2: 5 ,V3: 6 ,I1: 16 ,I2: 17 ,I3: 18			
	Irms	Vrms	S	P	Q	pf	Irms	Vrms	S	
2003/03/18 04:40:00 AM	513.2682495	234.6568604	360.5032813	-329.7122813	-144.9536406	0.908041477	47.72159195	231.1209259	32.8796679	
2003/03/18 04:50:00 AM	516.7119141	236.0798035	365.011	-333.0739375	-148.4141406	0.913447559	47.72379684	231.2458191	32.6561816	
2003/03/18 05:00:00 AM	524.8422852	236.0332794	370.79325	-339.1861875	-148.9245	0.907932401	47.7306366	231.2414093	32.8837070	
2003/03/18 05:10:00 AM	514.776001	235.7923737	363.3486875	-330.9161875	-149.2641094	0.911139727	47.73671722	231.2096252	32.9103632	
2003/03/18 05:20:00 AM	513.8837891	235.0519867	361.6133125	-330.0797813	-146.9475	0.914894402	47.73854446	231.1459045	32.8997539	
2003/03/18 05:30:00 AM	527.8717041	233.8376465	369.6667813	-339.0671563	-146.565375	0.910572112	47.73030472	231.037384	32.90	
2003/03/18 05:40:00 AM	523.6688232	235.5948792	369.3037188	-336.684625	-150.969875	0.910737872	47.73046112	231.1934357	32.9257890	
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2003/03/18 06:50:00 AM	514.4967041	233.2637634	359.33	-329.312375	-142.9931875	0.916061044	47.76656723	230.9532166	33.0189492	
2003/03/18 07:00:00 AM	525.3202515	234.9160919	369.4478125	-337.9063125	-148.5046563	0.907366097	47.77374649	231.0759735	33.0351523	
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2003/03/18 09:10:00 AM	552.2301636	233.5876007	386.0622188	-351.9630938	-157.618	0.909545243	48.17088318	231.0184937	33.3156171	
2003/03/18 09:20:00 AM	558.0183716	233.5824585	390.2892188	-355.6219063	-159.9913906	0.909023046	47.92377853	231.0827332	33.1532109	
2003/03/18 09:30:00 AM	551.6176147	233.4936523	385.4870625	-351.3752813	-157.5827031	0.90992564	47.82373047	231.0779877	33.0616718	
2003/03/18 09:40:00 AM	552.1459961	233.6006622	386.2345	-352.094875	-157.9985781	0.908877552	47.78728104	231.0829468	33.0234296	

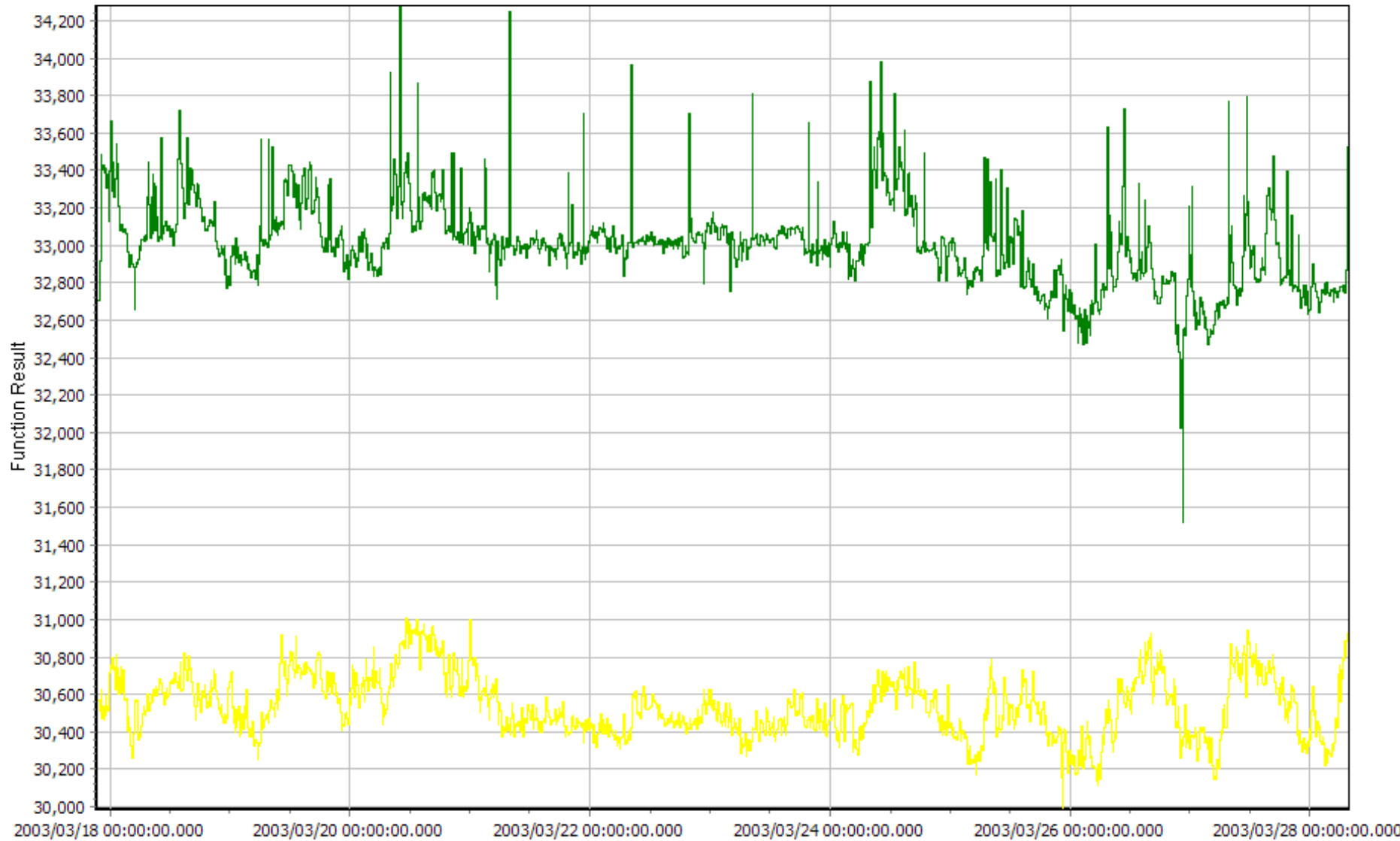
Results

- Graphical presentation of trends, cycles etc
- Summary statistics of mean, maximum, minimum values
- Common data can be used for different stakeholders – building management, maintenance, consultants etc.

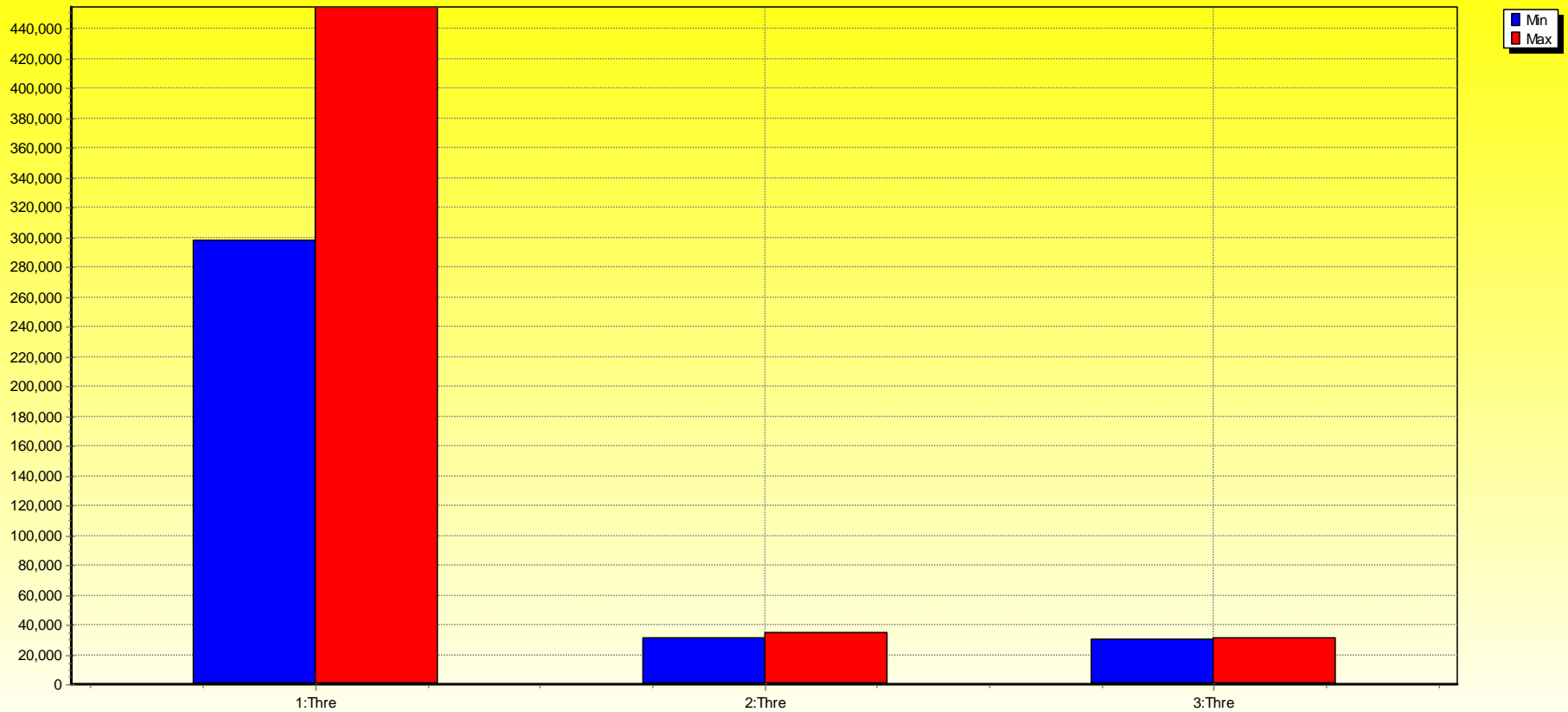
Load Profile: Normal Supply



Load Profile: Emergency Supply



Load Profile: Minimum & Maximum



Analysis

- Tools to
 - Select channels and dates of interest
 - Combine measurements
 - Display data in a simple form
- Based on measurement objectives
 - Is the supply able to meet current and future needs
 - Diversity
 - Requirement for increased capacity

Conclusions

- Emergency and normal electrical loads in commercial buildings can be measured using remote monitoring equipment
- These measurements will assist utilities, consultants and facilities management personnel to design, plan and modify emergency and normal building supplies.

Contact Details

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