Seminar Teknikal Cawangan Kejuruteraan Mekanikal, Ibu Pejabat JKR Malaysia

"Deliver With Quality"

14 September 2017 (Khamis)

Institute Kefahaman Islam Malaysia, Kuala Lumpur

Session: 30 min

DELIVER HIGH PERFORMANCE BUILDING THROUGH BAS

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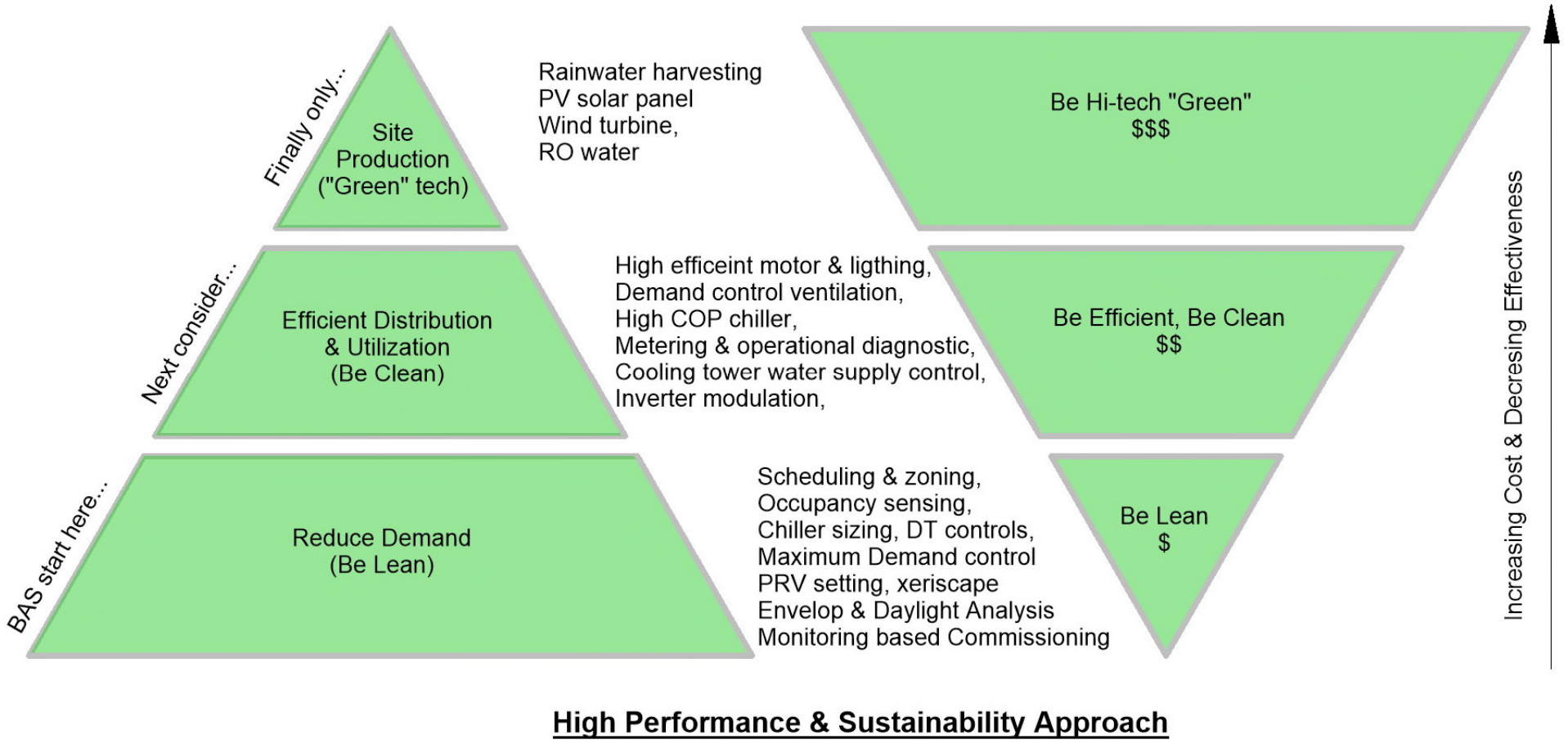
Advisor to BASAM (BAS Association of Malaysia)

Most people may think high performance or green building shall come with high-tech gadgets in order to be recognized…
This is because Owner's Project Requirement is not well understood.



High Performance & Sustainability Approach

Especially for Building Automation System (B.A.S.) current products used in most modern buildings might have built-in features that enable high performance…

Effect of Reduce, Efficient & Production (REP)

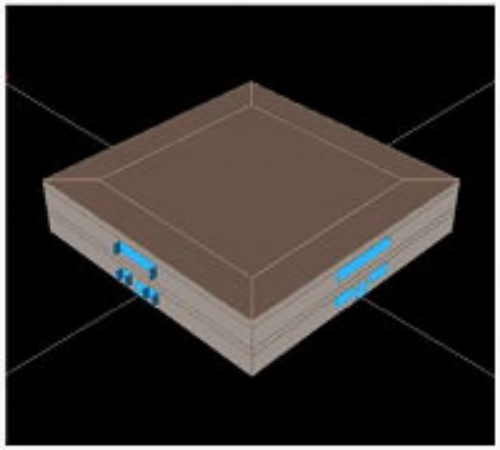
Energy Model

Building type: Professional office

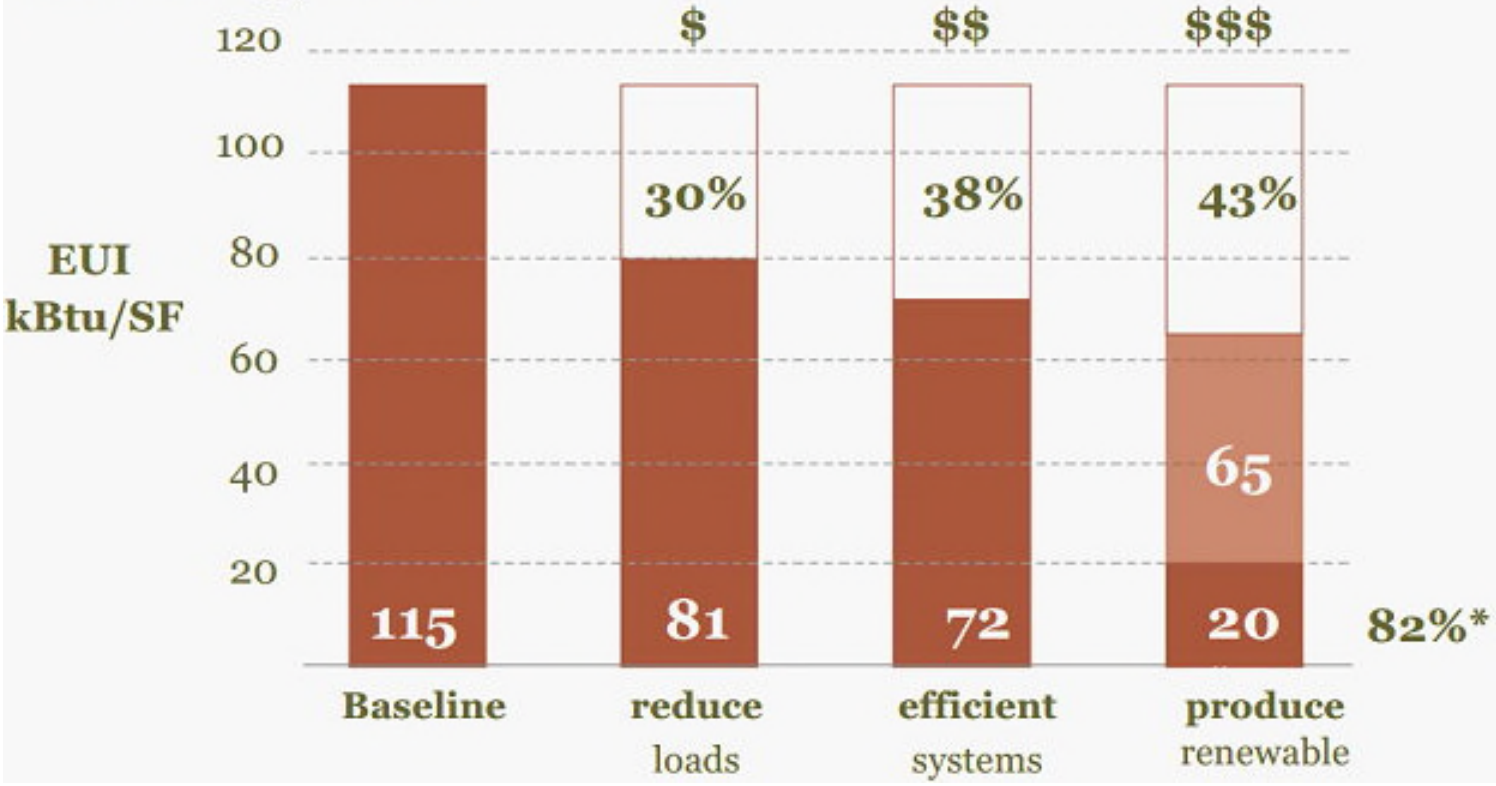
Location: Chicago, IL

Size: 25,000 square feet

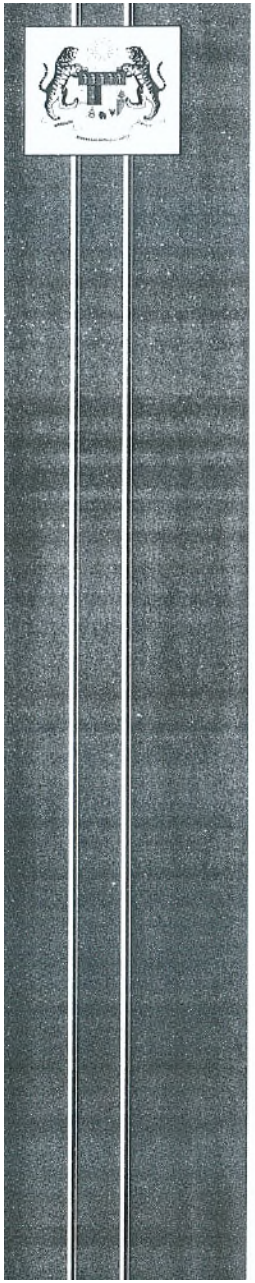
Apply REP principles to baseline case to illustrate reduced energy consumption



REP: Energy Model



Since year 2007, EMS has been specified in MS1525, It is more than energy matters…



MALAYSIAN STANDARD

MS 1525:2007

CODE OF PRACTICE ON ENERGY EFFICIENCY AND USE OF RENEWABLE ENERGY FOR NON-RESIDENTIAL BUILDINGS (FIRST REVISION)

ICS: 90.040.01

Descriptors: energy efficiency, renewable energy, non-residential, buildings, code of practice, energy conservation

DEPARTMENT OF STANDARDS MALAYSIA

9. Energy management control system

9.1 Energy Management System (EMS)

The Energy Management System (EMS) is a subset of the building automation system function. It should be considered for buildings having area greater than 4 000 m^2 of air-conditioned space. Generally, a building automation system has three functions:

a) control of equipment;

b) monitoring of equipment; and

c) integration of equipment sub-systems.

9.2 Control of equipment

The purpose of the control of equipment is to save energy. This is performed by the EMS function of the building automation system.

9.3 Monitoring of equipment

The purpose of monitoring the equipment is to improve the efficiency of operations by:

a) providing centralised information of current equipment conditions;

b) providing historical information of equipment conditions;

c) providing a "management by exception" function to alert the operator of any abnormal equipment conditions; and

d) providing analysis tools to aid the study of equipment operations.

9.4 Integration of equipment subsystems

Equipment subsystems are integrated for the purpose of improving:

a) safety/security; for example, in the event of a fire, air-handling units can be used to create a sandwich system for smoke control;

b) indoor air quality; for example, by utilising the smoke purging system for periodic air purging to achieve good indoor air quality;

c) information management; by allowing information from multiple equipment subsystems to be stored and reported in a consistent format; and

d) overall system reliability; the intelligent controller of an equipment subsystem may be configured to provide redundancy as a standby unit for another system/s without incurring additional cost

In 1997, software of high performance building mentioned: EMS, It was hi-tech then, **not now**…

PECI

O&M BEST PRACTICES SERIES

ENERGY MANAGEMENT SYSTEMS

A Practical Guide

Prepared with funding from the U.S. EPA

October 1997

EMS (Energy Management System):

In modern building, the sophistication in operation has been enhanced by the state-of-art Building Control/Automation/Management System (BCS, BAS or BMS in short) whereby installation of advance sensors & metering devices has greatly improve the ease of operation.

However, many operators have not fully realize the enormous trending & analyzing function of in data logging of such advance system that can produce useful inference on the proper operation of building system. Many green building rating system require the implementation of such function and it is normally summarizing it as Energy Management System (EMS) which actually is a software layer on top of the existing BCS/BAS/BMS.

Locally, the successful implementation of EMS in optimizing operation has been demonstrated in several green buildings that have gone through Completion & Verification Assessment exercise.

The term **Energy Management System** can be refer to a computer system which is designed specifically for the automated control and monitoring of the cooling, ventilation and lighting needs of a building or group of buildings such as university campuses, office buildings or factories. Most of these energy management systems also provide facilities for the reading of electricity, gas and water meters. The data obtained from these can then be used to produce trend analysis and annual consumption forecasts.

Benefits of EMS:

- Facilitate the management of energy usage in the building or facilities
- Trending and monitoring energy consumption
- Automatic and consistent reaction to events
- Provide a means to gather and view information quickly
- To provide an environment for the building occupants that is comfortable and safe.

How is it done?

- Monitor Utility Meters
- Measure Temperatures, Relative Humidity, Pressure, CO2, lux, etc.
- Monitor status of equipment – ON/Off, Open/Closed, VSD speed, etc.
- Digital Control to start and stop equipment
- Analog control to adjust set point values, Control Valves, Dampers and Variable Frequency Drives

What are the EMS strategies?

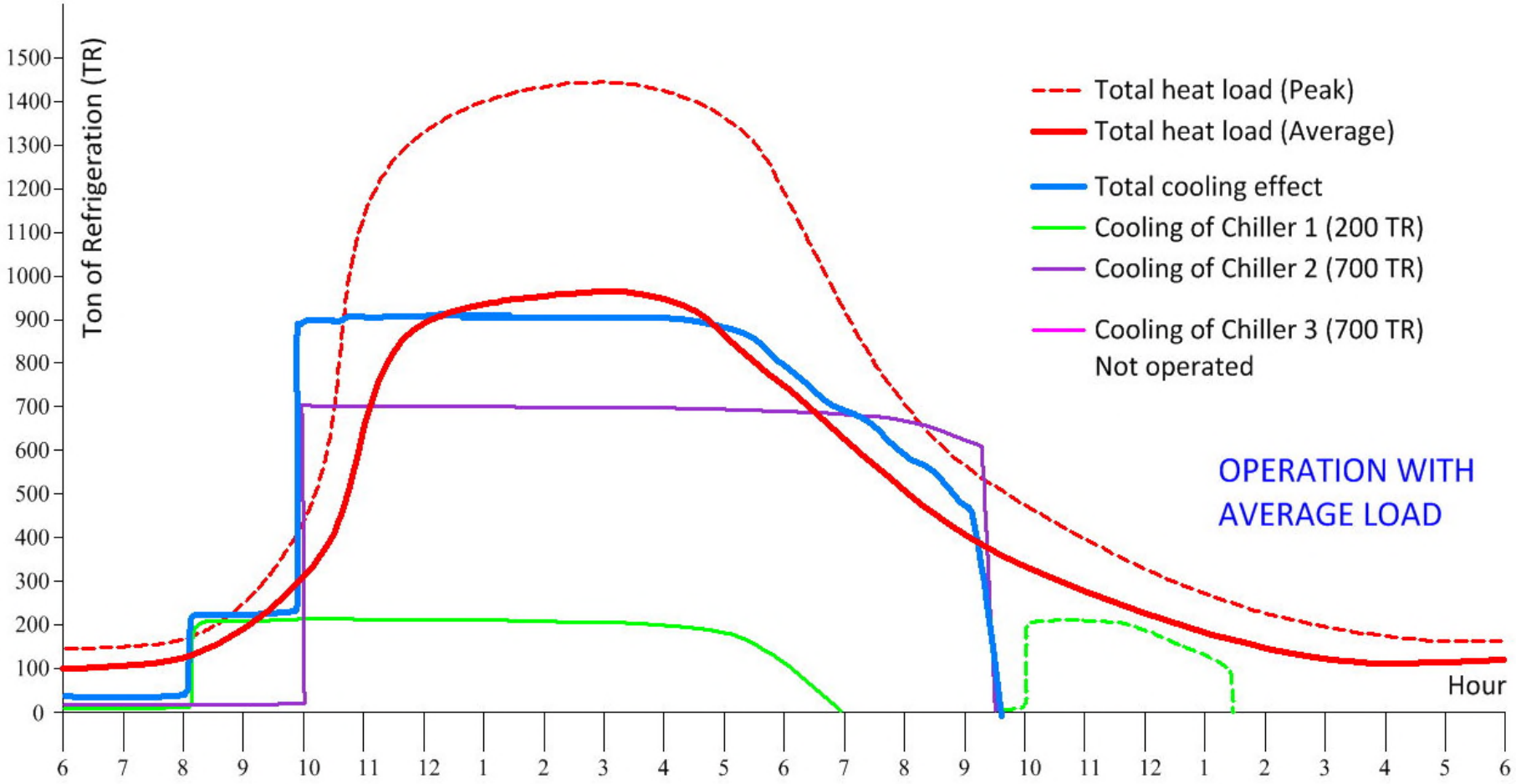
- **Basic Strategies**
  - Time Scheduling
  - Optimum Start and Stop
  - Night set-back on set point values
  - Peak Demand Limiting
- **Advanced Strategies**
  - Major load such as Chiller Plant Optimization
  - Morning Cool-Down sequence
  - Static Pressure & temperature reset
  - Daylight saving monitoring & control
  - CO2 Demand Ventilation control

Results of good EMS strategies :

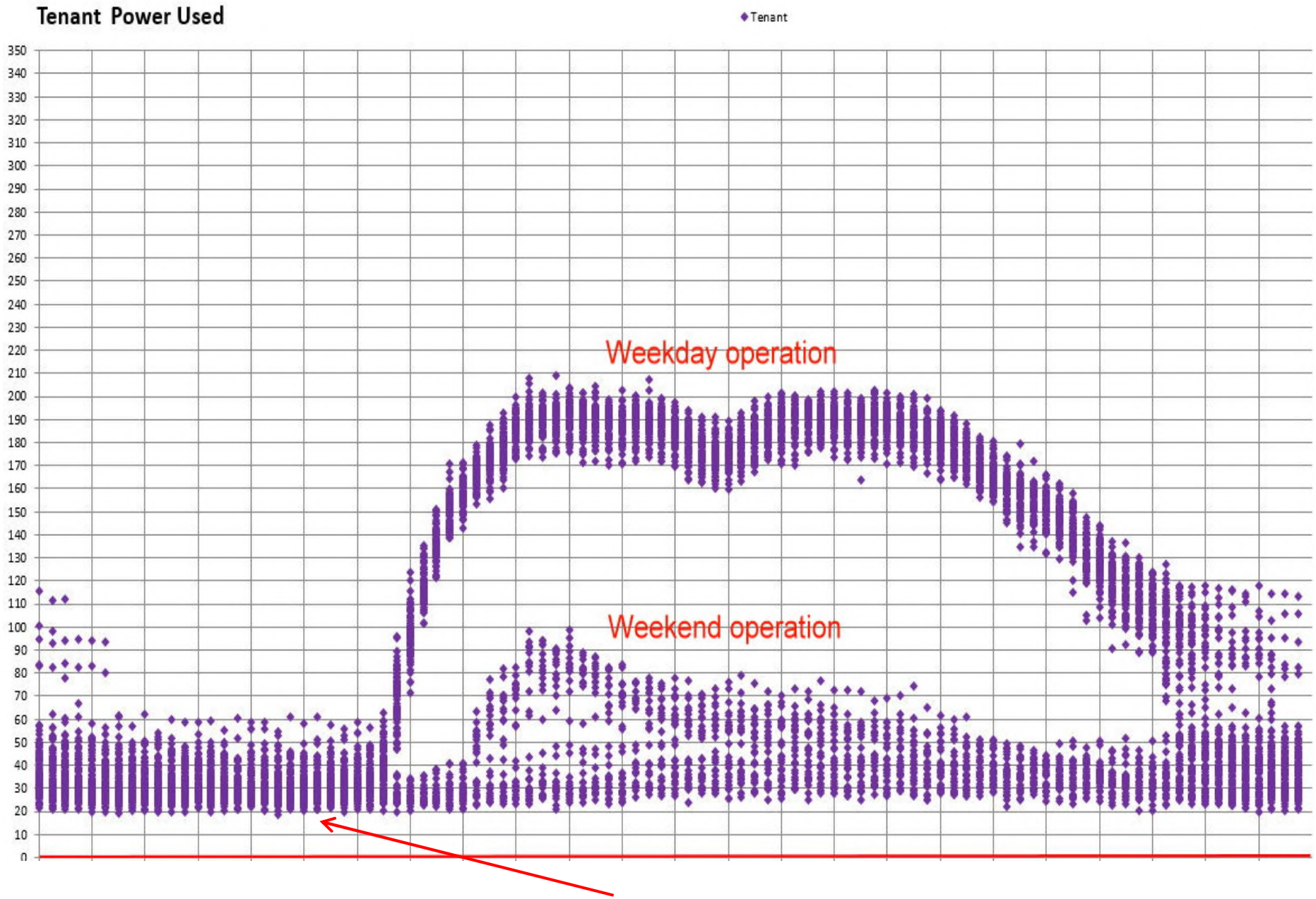
- **A comfortable and safe environment for the building occupants for the lowest possible cost.**

All building systems are designed for maximum anticipated load:

This is applicable to AC, lighting, water systems, etc…
It is this hard fact that optimization opportunity available for part loads…

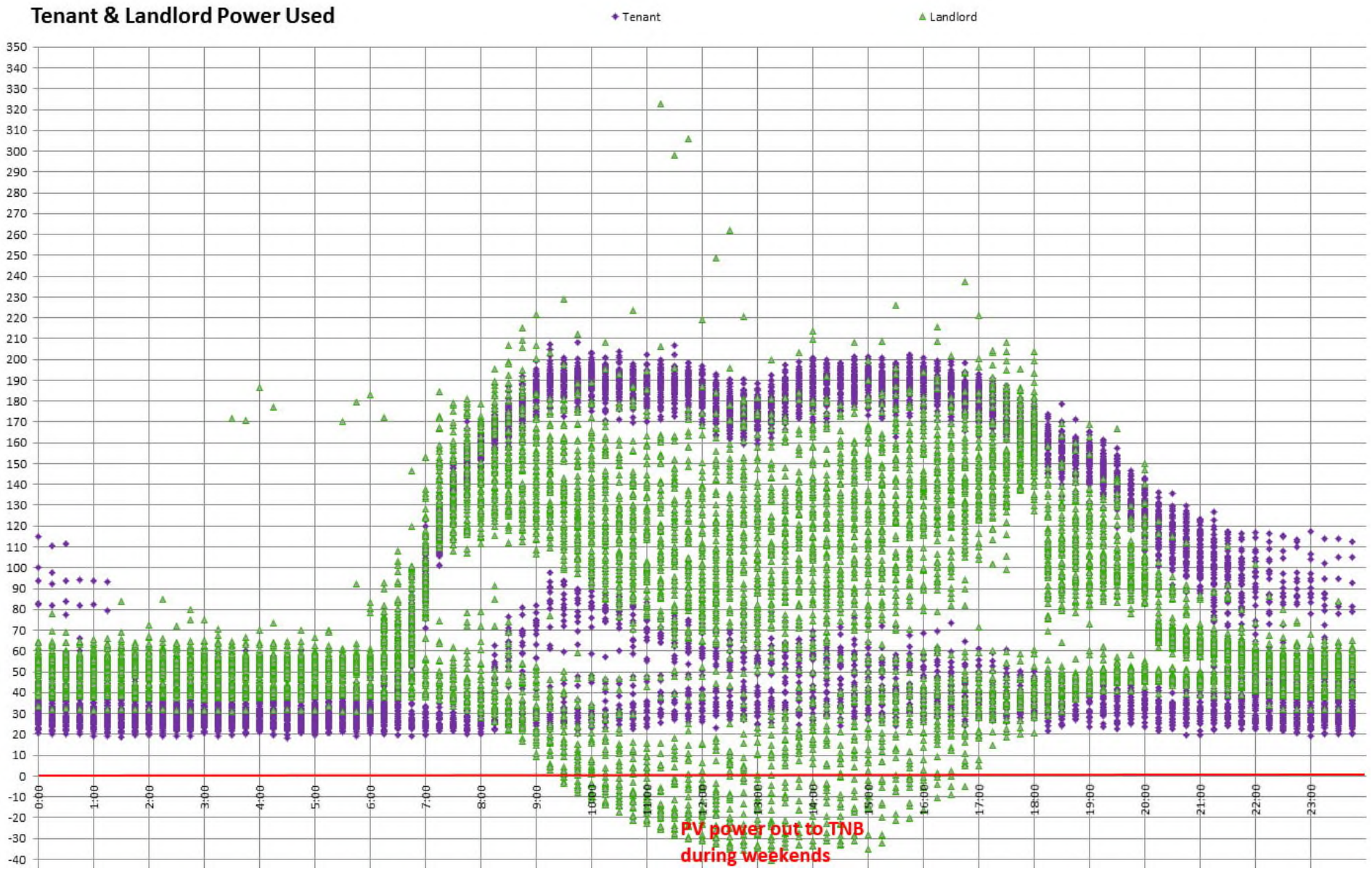


Examples of **Reduce**: Scheduling - switch off when not required

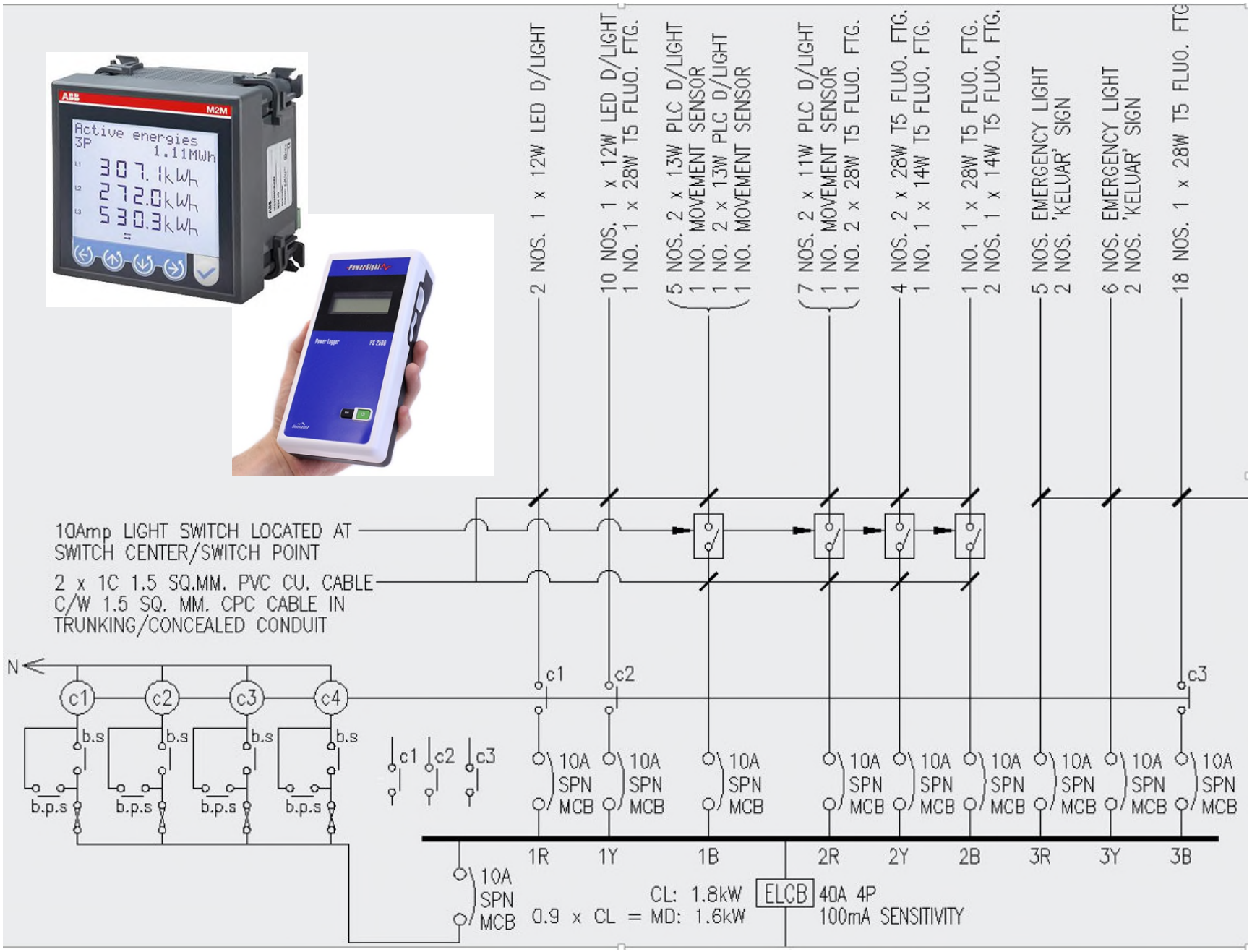


This minimum load is security & essential elements or unnecessary load…?

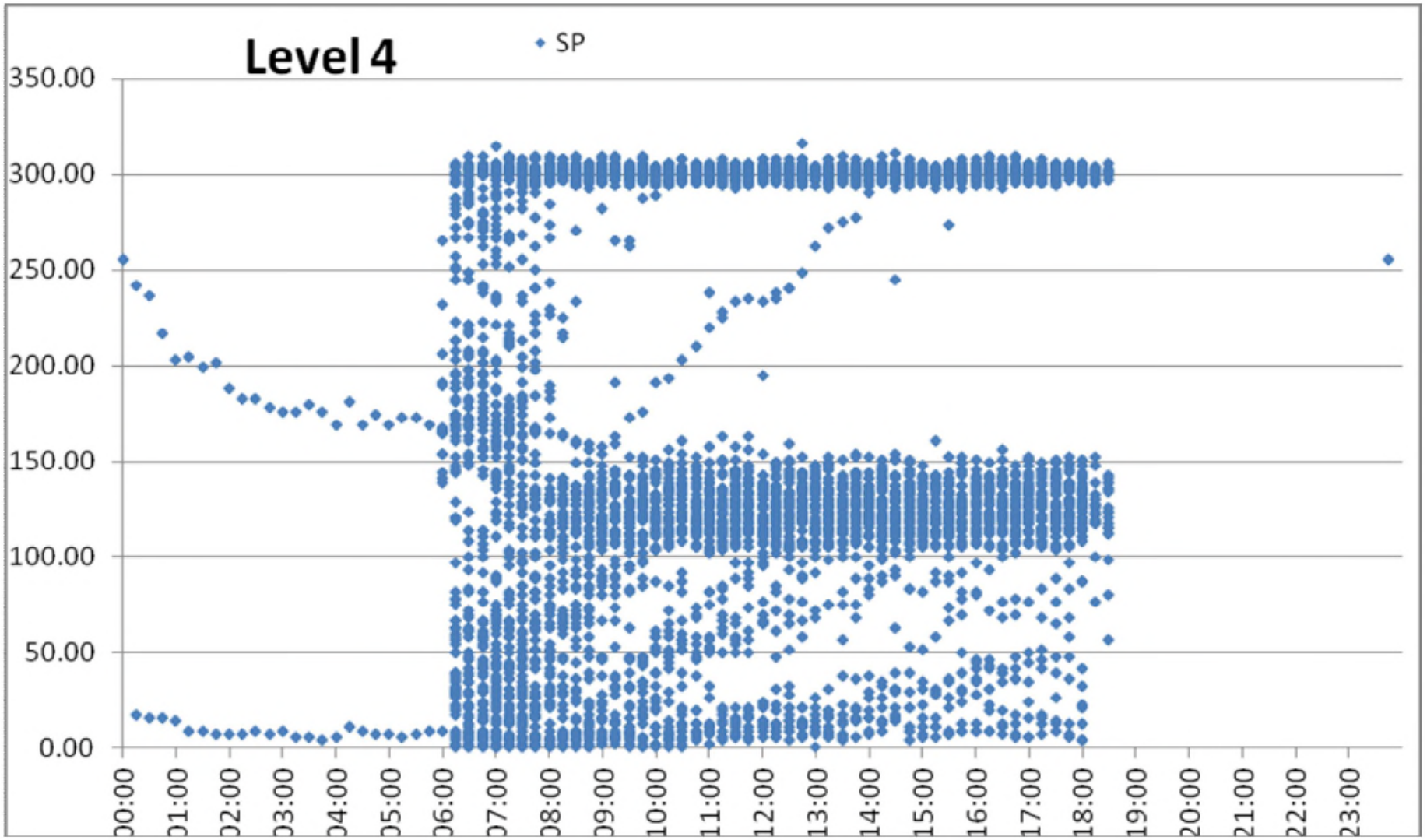
Examples of **Reduce**: Scheduling - switch off when not required



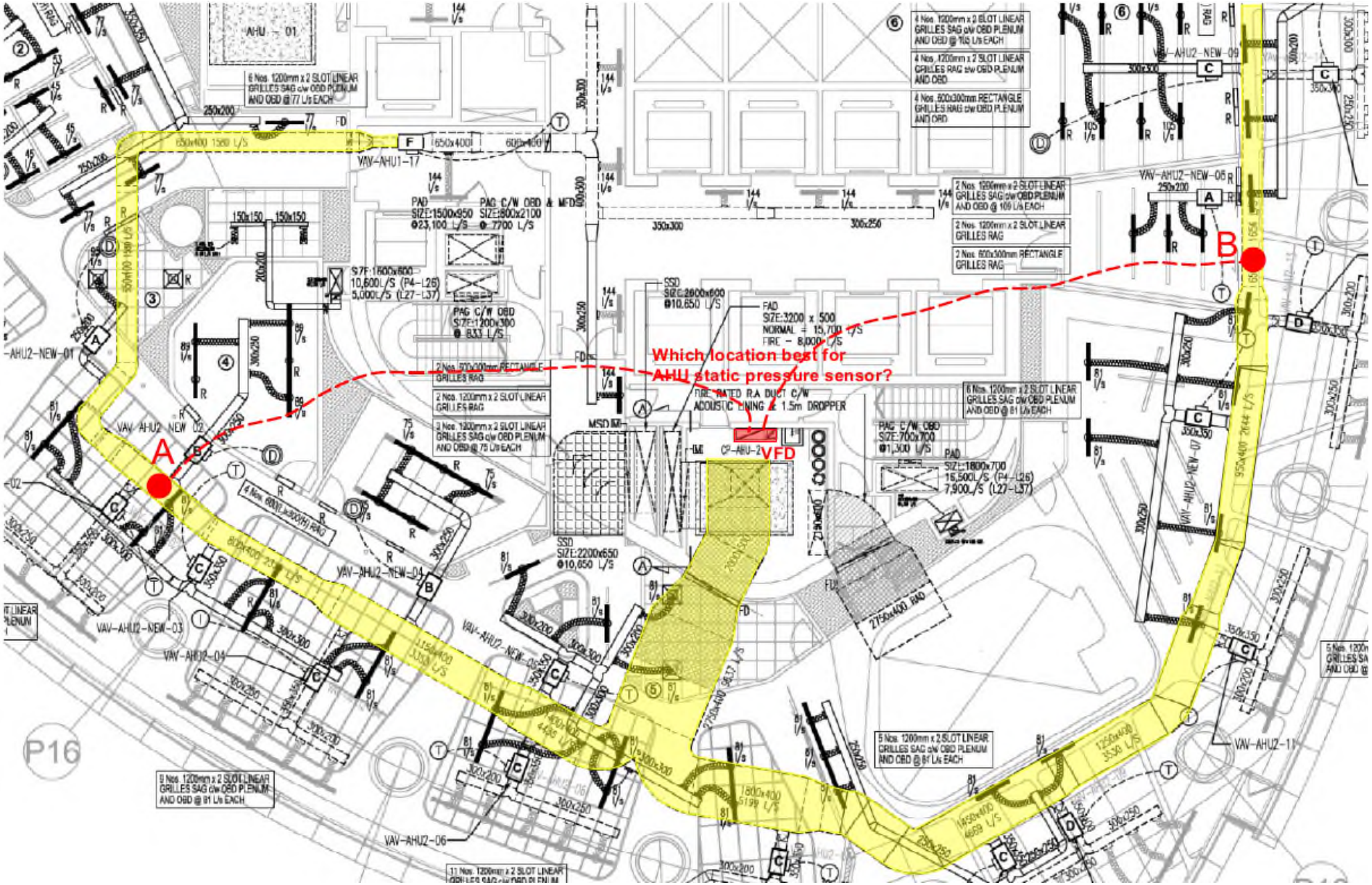
Examples of **Reduce**: Scheduling - switch off when not required, need power meter?



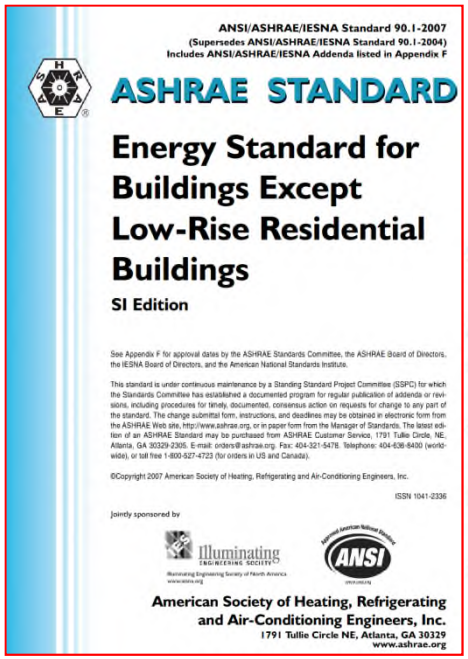
Examples of **Reduce**: Is the excessive duct pressure required?



Examples of **Reduce**: How to avoid excessive pressure yet in comfort zone?



Duct static pressure reset:



Exceptions:

a. For fans less than 4.5 kW, where the first available motor larger than the input kW has a nameplate rating within 50% of the input kW, the next larger nameplate motor size may be selected.

b. For fans 4.5 kW and larger, where the first available motor larger than the input kW has a nameplate rating with 30% of the input kW, the next larger nameplate motor size may be selected.

6.5.3.2 VAV Fan Control (Including Systems Using Series Fan Power Boxes)

6.5.3.2.1 Part-Load Fan Power Limitation. Individual VAV fans with motors 7.3 kW and larger shall meet one of the following:

a. The fan shall be driven by a mechanical or electrical variable-speed drive.

b. The fan shall be a vane-axial fan with variable-pitch blades.

c. The fan shall have other controls and devices that will result in fan motor demand of no more than 30% of design wattage at 50% of design air volume when static pressure setpoint equals one-third of the total design static pressure, based on *manufacturers'* certified fan data.

6.5.3.2.2 Static Pressure Sensor Location. Static pressure sensors used to control VAV fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section 6.5.3.2.3. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure that static pressure can be maintained in each.

6.5.3.2.3 Setpoint Reset. For systems with DDC of individual zone boxes reporting to the central control panel, static pressure setpoint shall be reset based on the *zone* requiring the most pressure; i.e., the setpoint is reset lower until one *zone* damper is nearly wide open.

6.5.4 Hydronic System Design and Control. HVAC hydronic systems having a total *pump system power* exceeding 7.5 kW shall meet provisions of Sections 6.5.4.1 through 6.5.4.4.

6.5.4.1 Hydronic Variable Flow Systems. HVAC pumping systems that include control valves designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to 50% or less of the design flow rate. Individual pumps serving variable flow systems having a pump head exceeding 300 kPa and motor exceeding 37 kW shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.

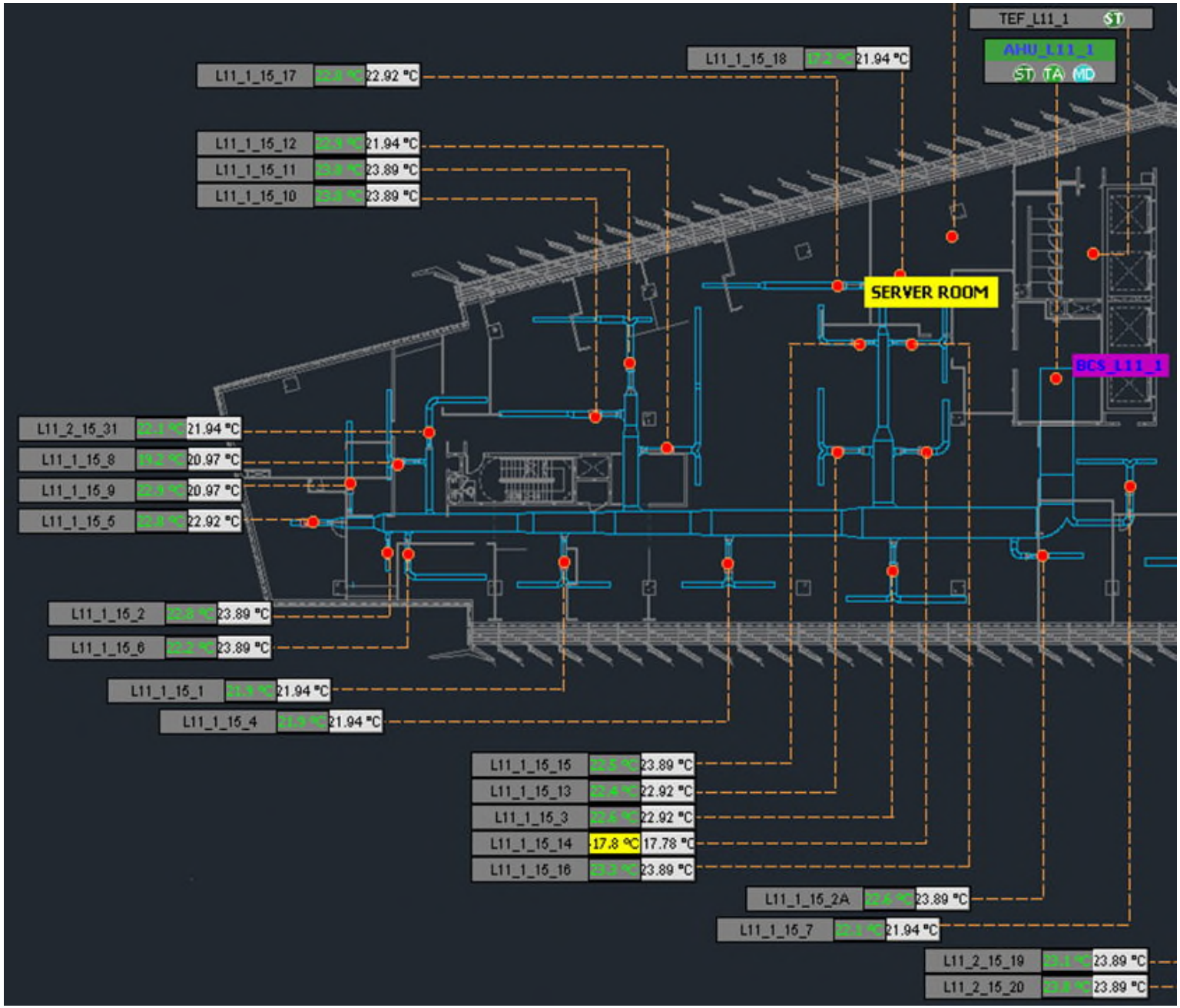
Exceptions:

a. Systems where the minimum flow is less than the minimum flow required by the equipment *manufacturer* for the proper operation of equipment served by the system, such as chillers, and where total pump system power is 60 kW or less.

b. Systems that include no more than three control valves.

6.5.4.2 Pump Isolation. When a chilled-water plant includes more than one chiller, provisions shall be made so that the flow in the chiller plant can be automatically reduced, correspondingly, when a chiller is shut down. Chillers referred to in this section, piped in series for the purpose of increased temperature differential, shall be considered as one chiller.

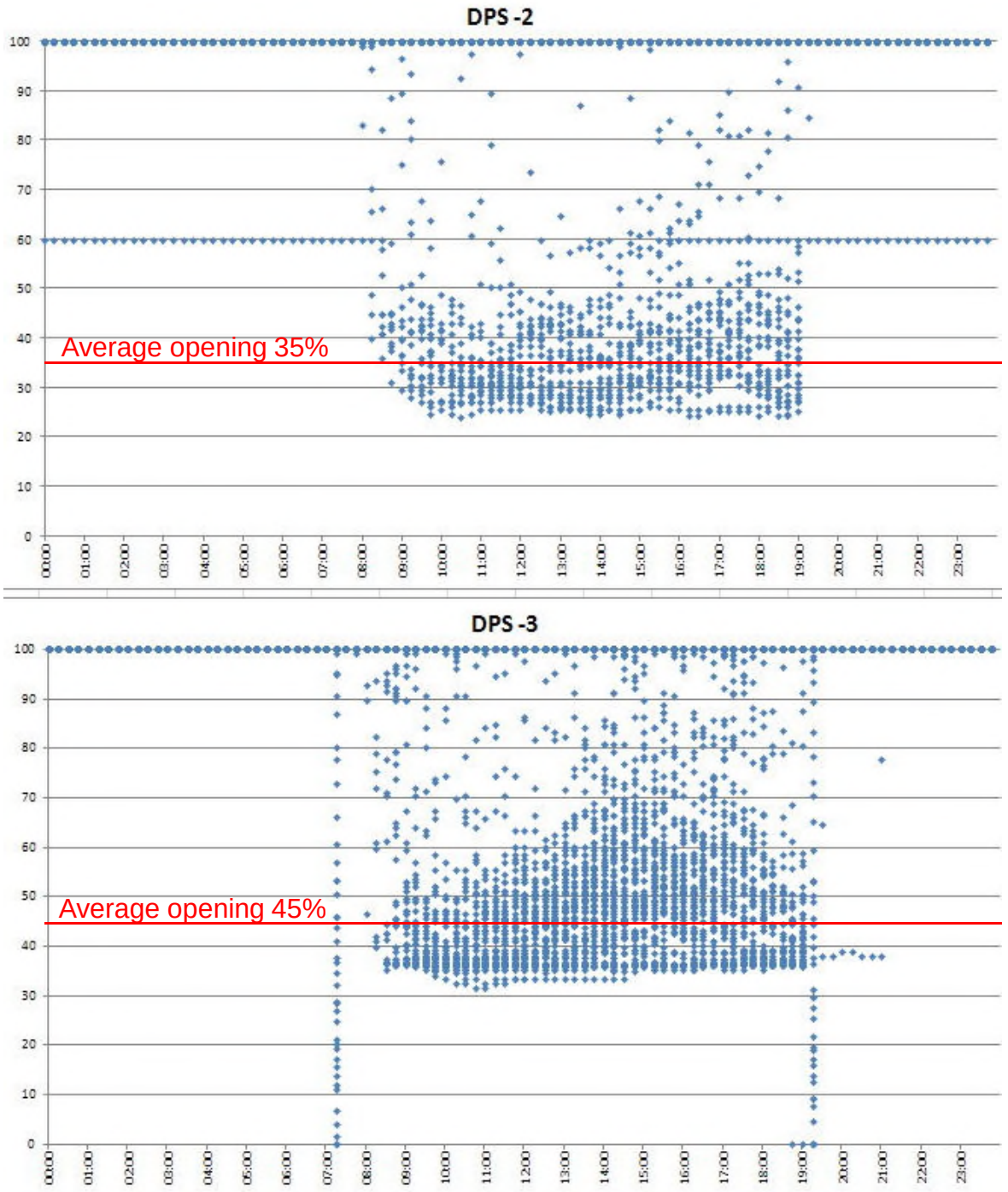
Duct static pressure reset experience:



Duct static pressure reset experience:

Reduce: Excessive duct pressure, ramps up only required.

Damper openings (2 nos. – DPS-2 & DPS-3) **BEFORE** "SP Reset" sub-routine execution



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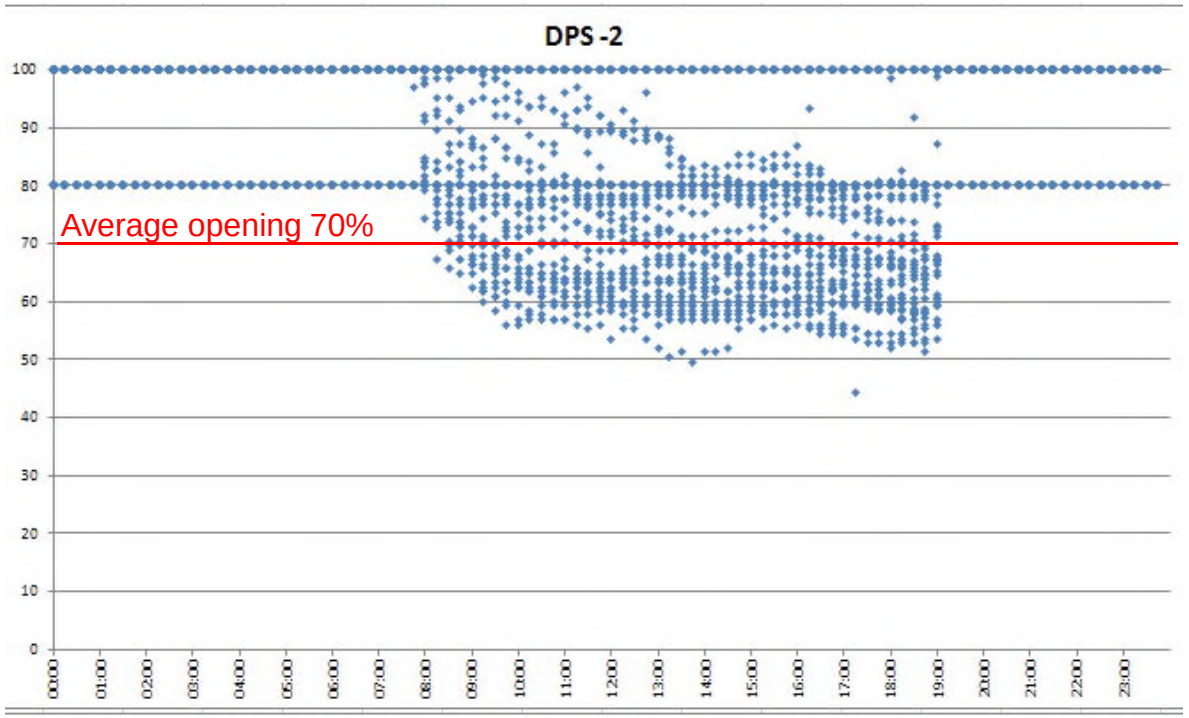
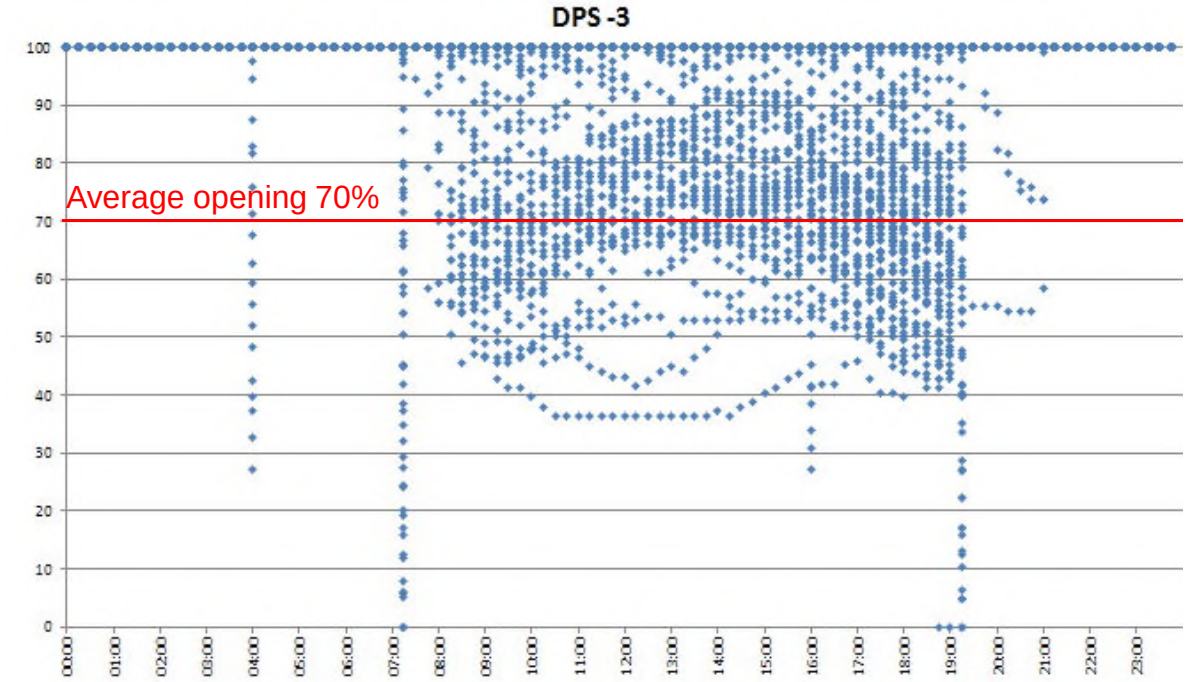
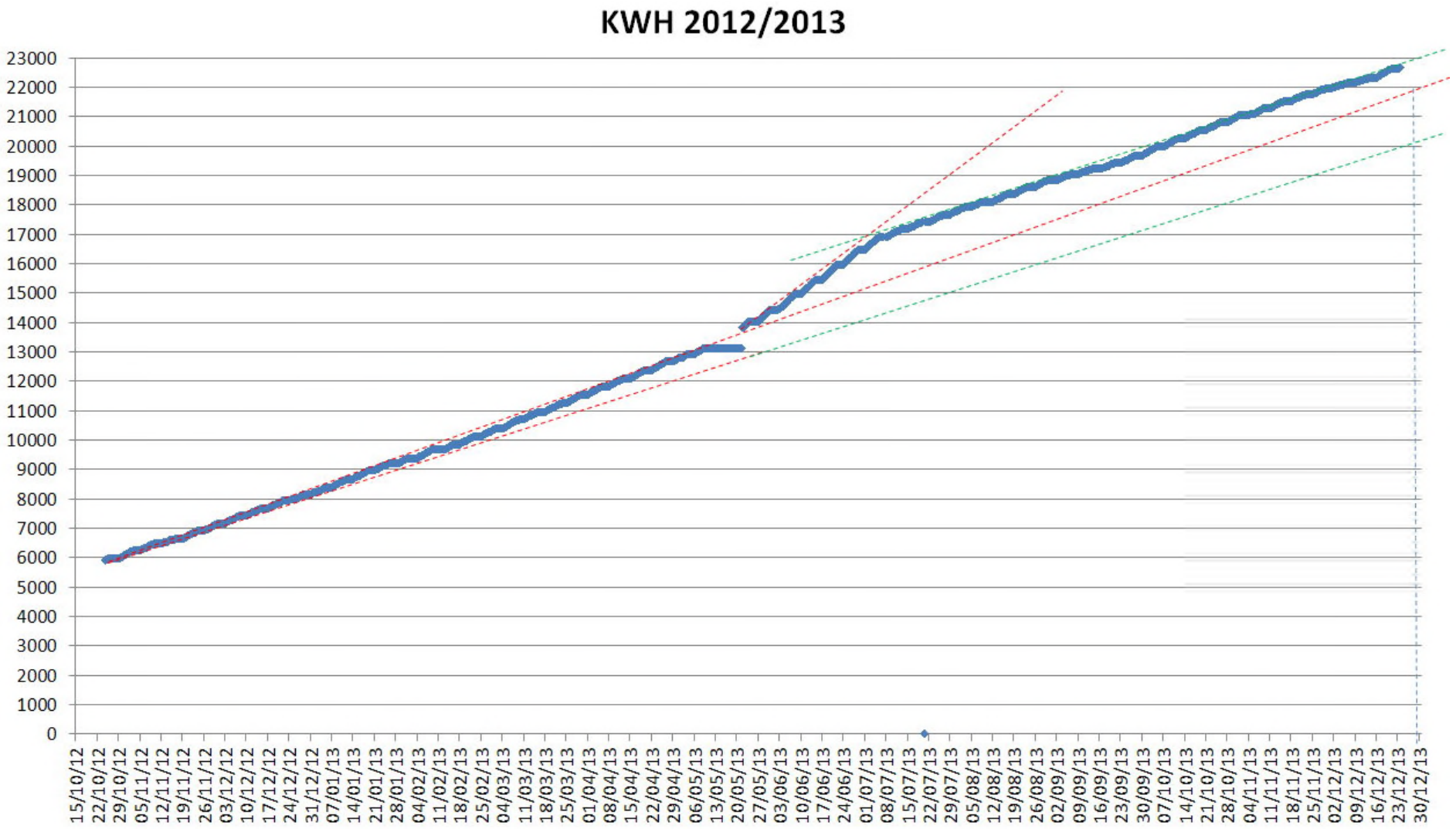
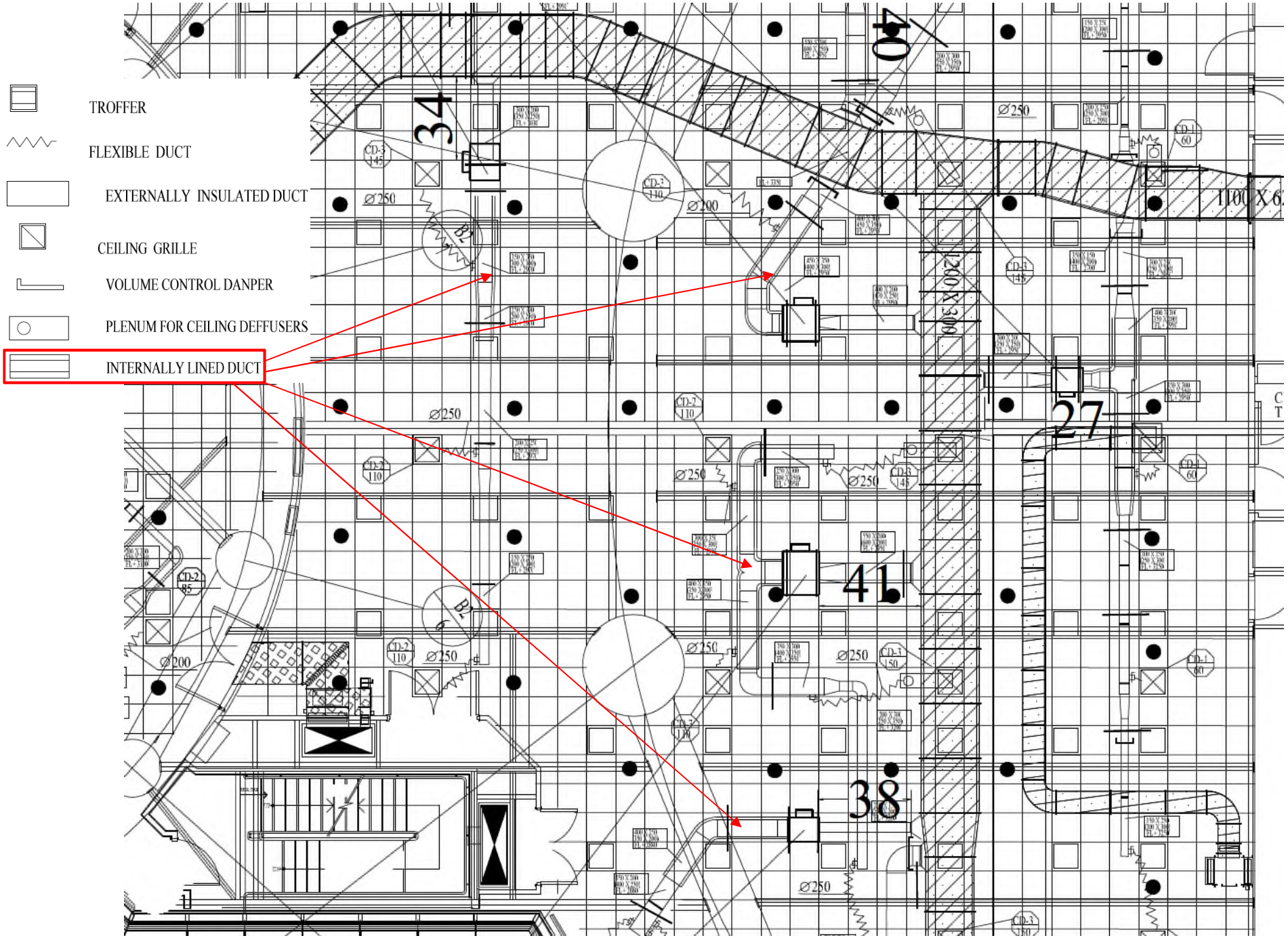




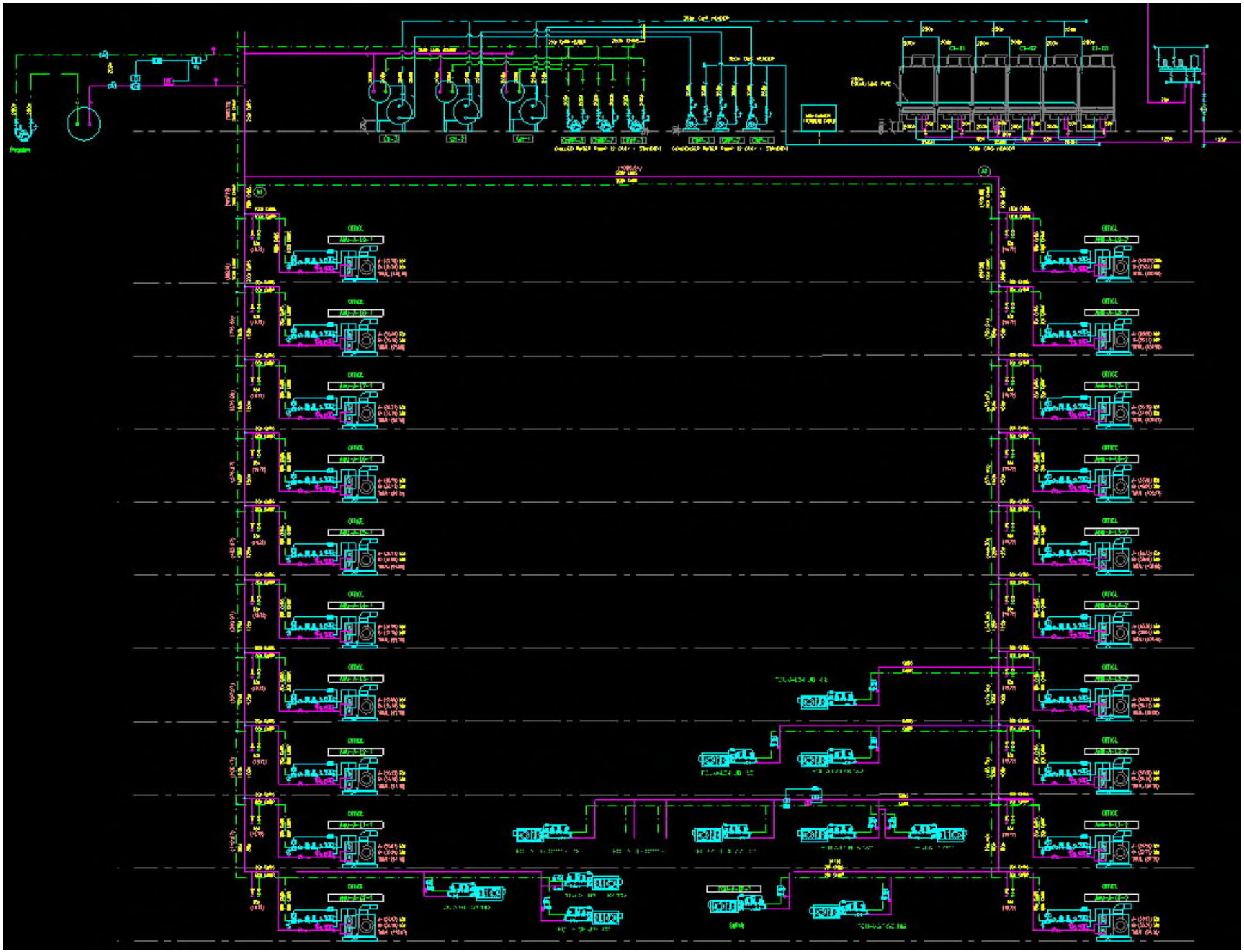
Duct static pressure reset experience: AHU-L11-1-kWh



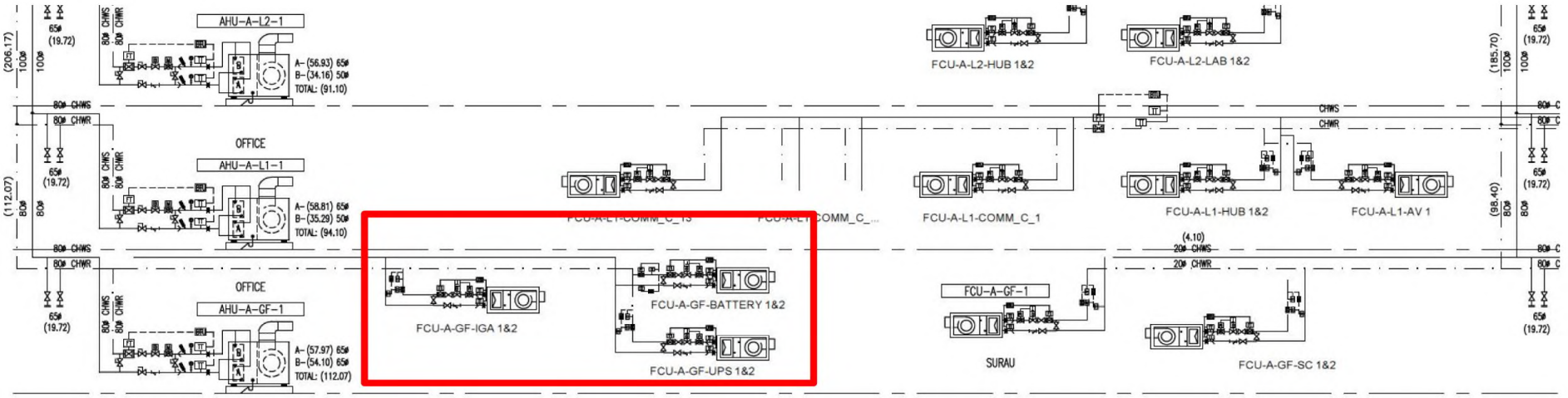
Examples of **Reduce**: How to avoid excessive pressure yet in comfort zone?



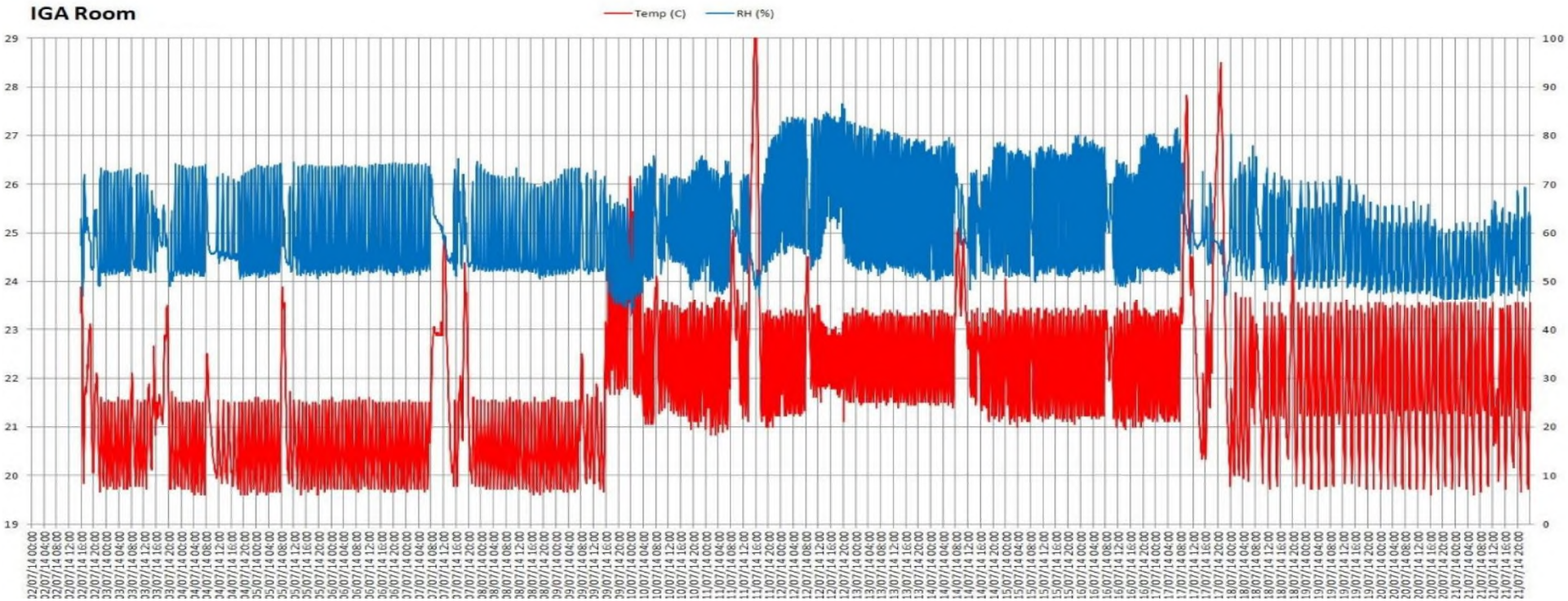
Examples of **Reduce**: Is the excessive pressure required?



Examples of **Reduce**: Is the excessive pressure required?

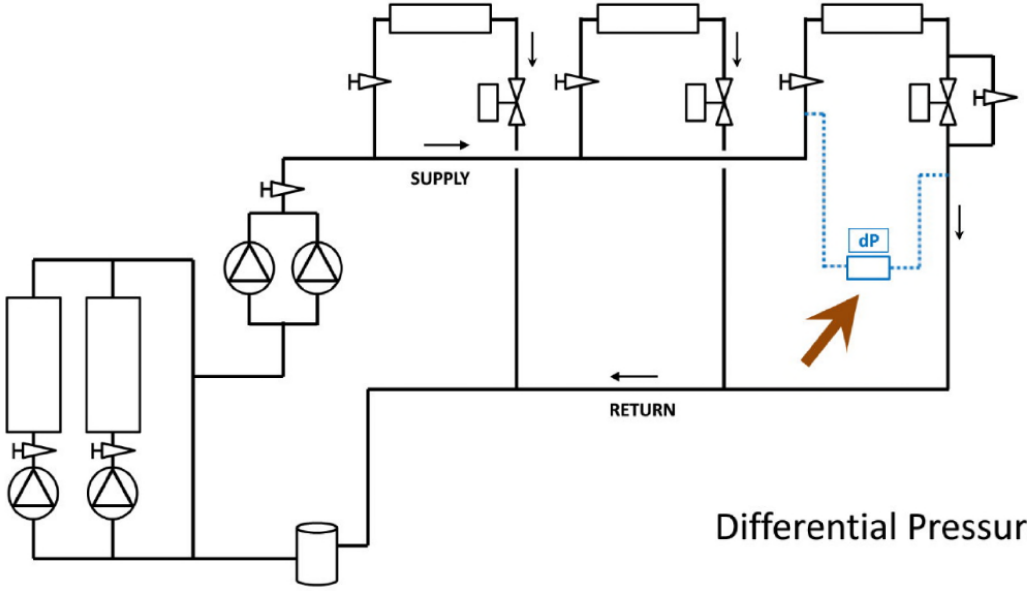


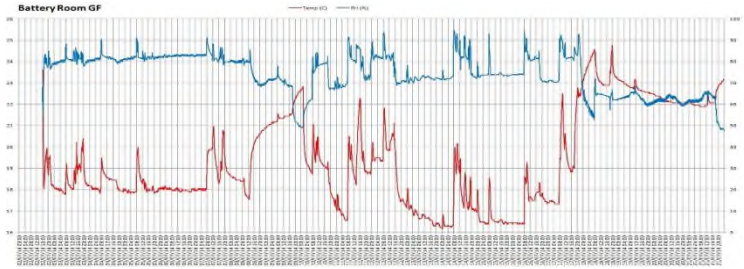
The higher pressure of chiller system may force open the control valves of FCUs at Riser No.1 and causing extra ordinary low space temperature even if the set point is correct.



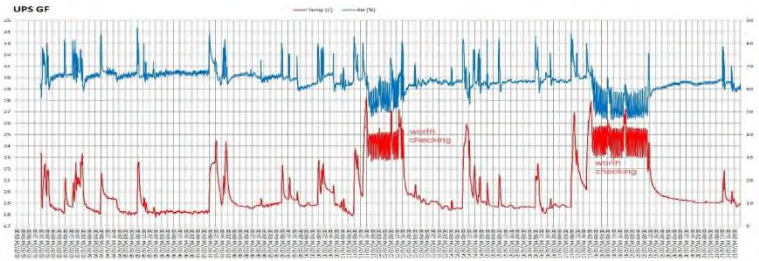
Examples of **Reduce**: Is the excessive pressure required?

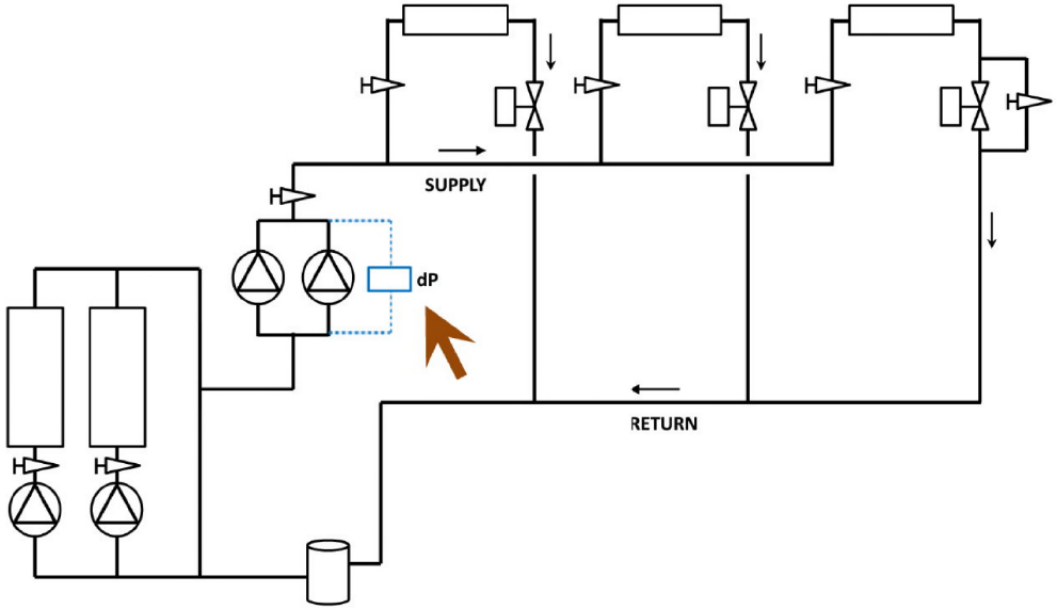
Differential Pressure measured remotely





Differential Pressure measured across pumps



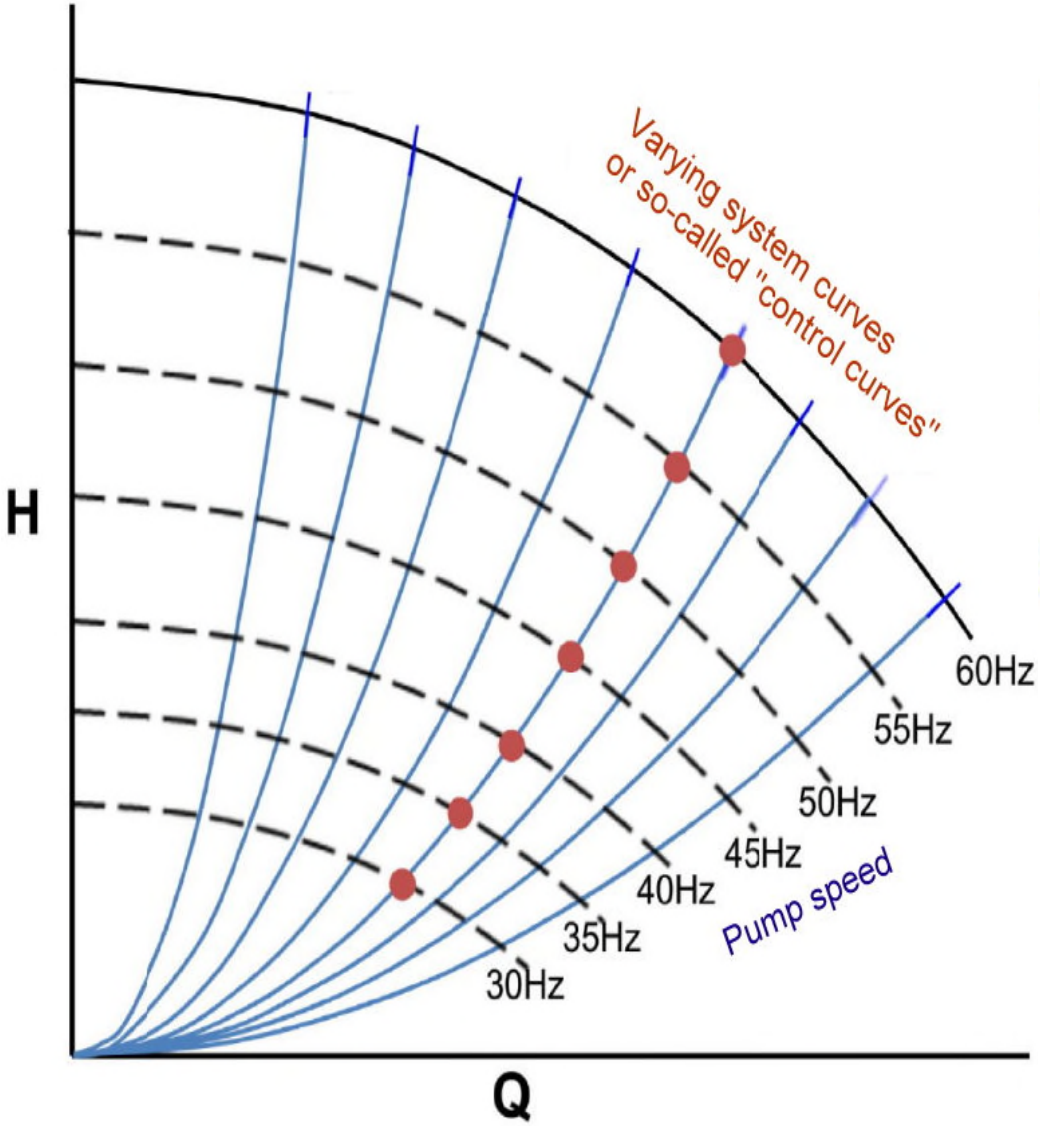


Examples of **Reduce**: Is the excessive pressure required?

HOW VARIABLE SPEED, SENSORLESS PUMPING WORKS

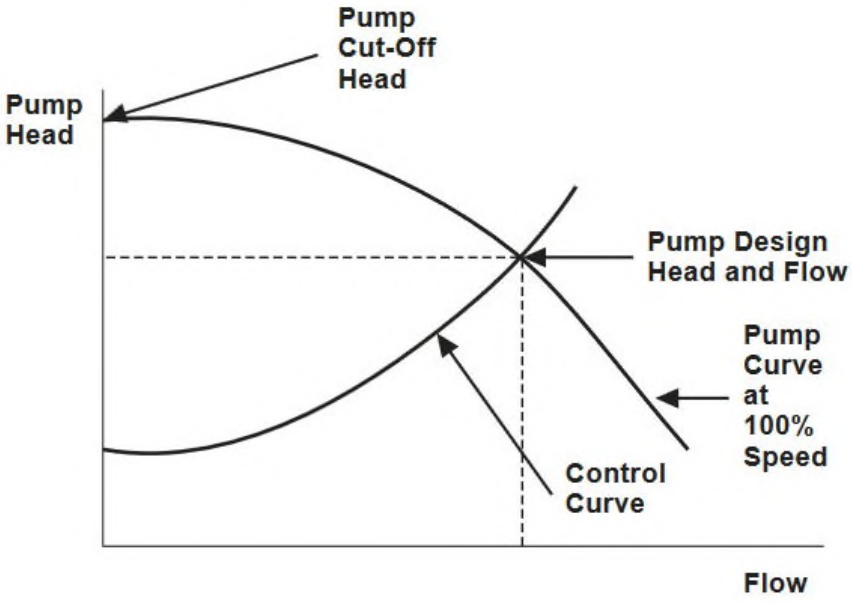
It's time to get rid of external sensors for commercial variable speed pumping applications. New technology from two leading pump manufacturers, Taco and Armstrong, allows for the pump to speed up and slow down all based on pre-programmed logic within a motor-mounted control. Before "SelfSensing" or "Sensorless" technology, an external sensor was required at the furthest terminal unit and wiring was run all the way back to the pump. In a large commercial building, this wiring could be hundreds of feet. This equates to more material cost, labor, and installation coordination. But how does SelfSensing technology work? It is a tough concept to grasp at first. In a dynamic system where zone valves are opening and closing, the pump must recognize something that's changing in order to react.

Examples of **Reduce**: Is the excessive pressure required?

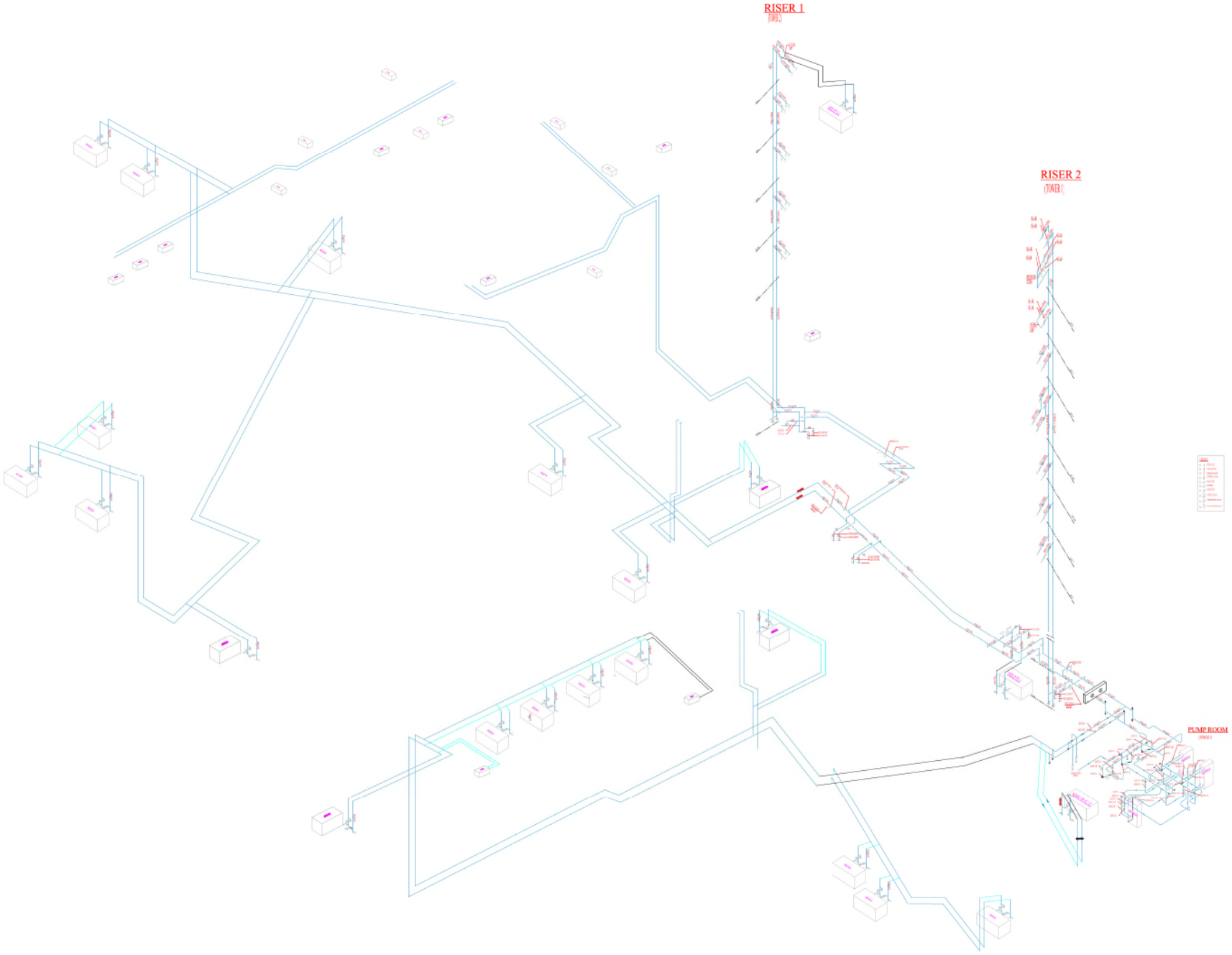


Valve Close-off Rating

The valve close-off rating is the highest pressure differential the control valve will close off against to a high performance leakage. For example, if the sub-circuit closest to the pump experiences a no load condition, while the other sub-circuits in the system are at design load, this valve close-off rating must equal the design head of the pump.

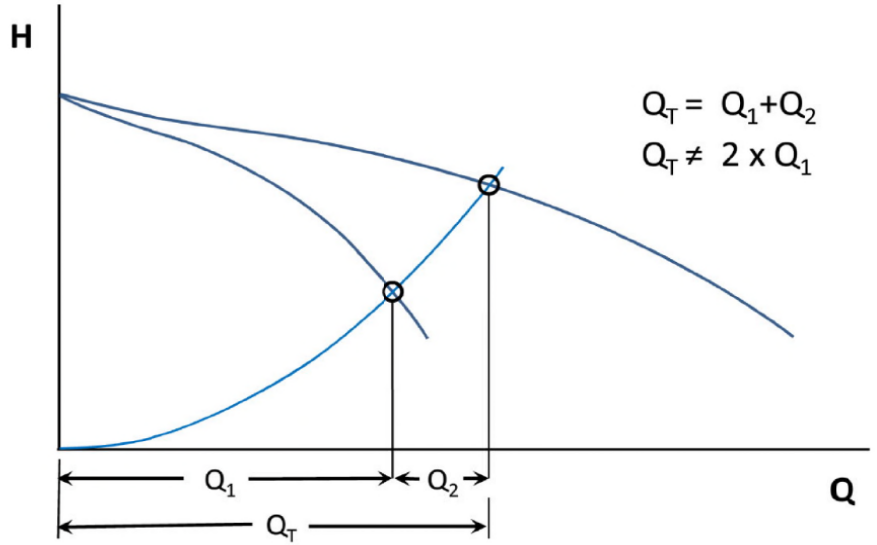


Examples of **Reduce**: How to avoid excessive pressure yet in comfort zone?

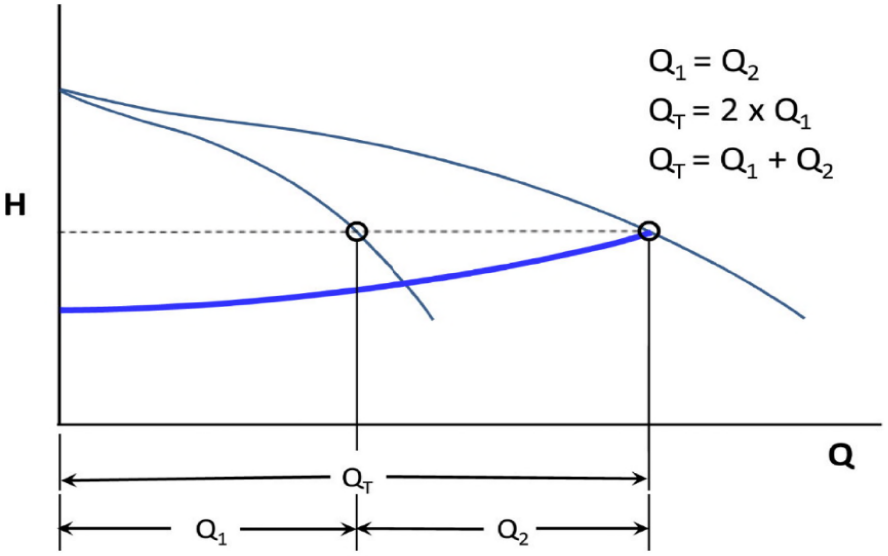


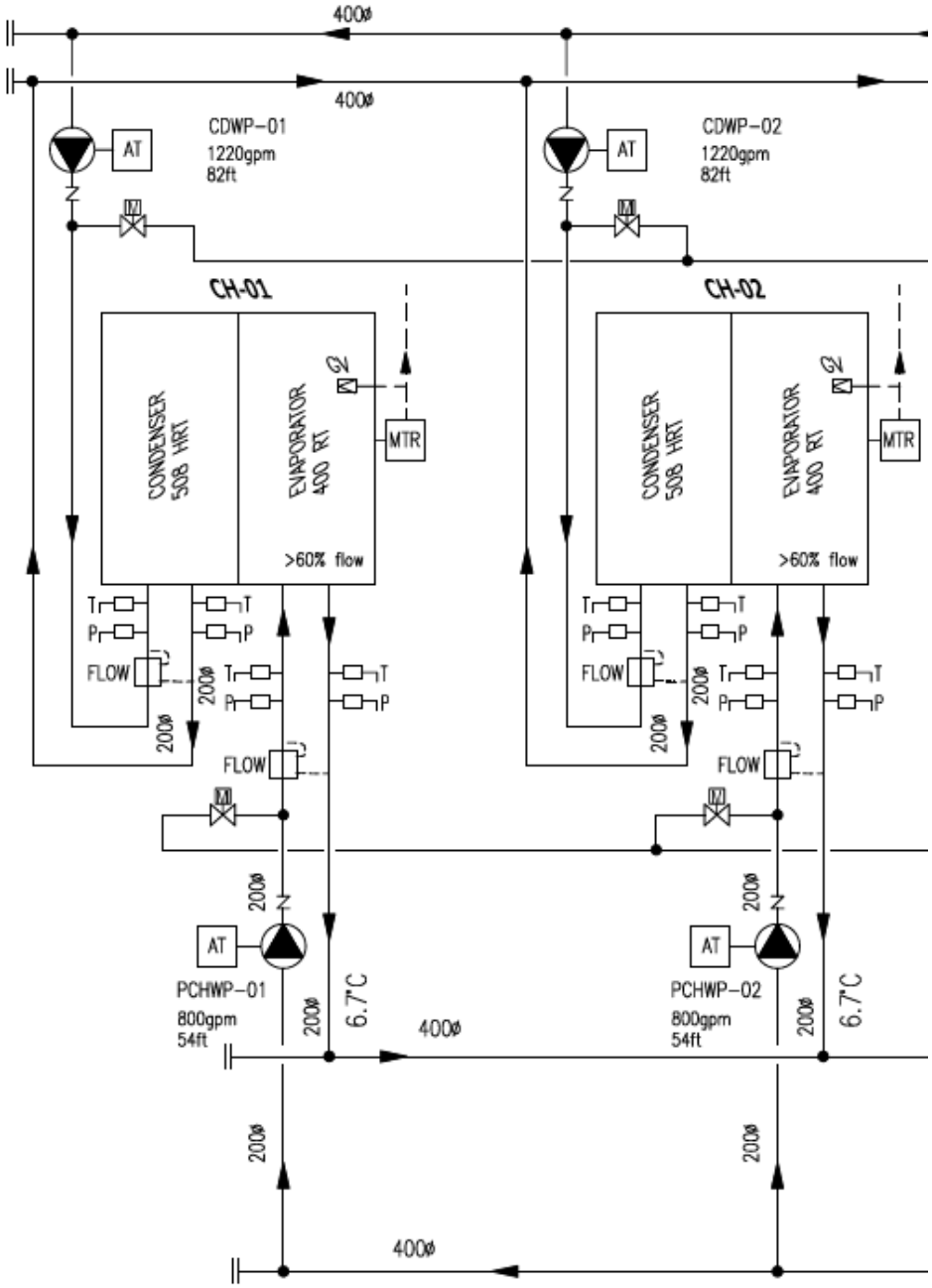
Examples of **Reduce**: Pumps & pressure?

What we learned early in our pump hydraulics career

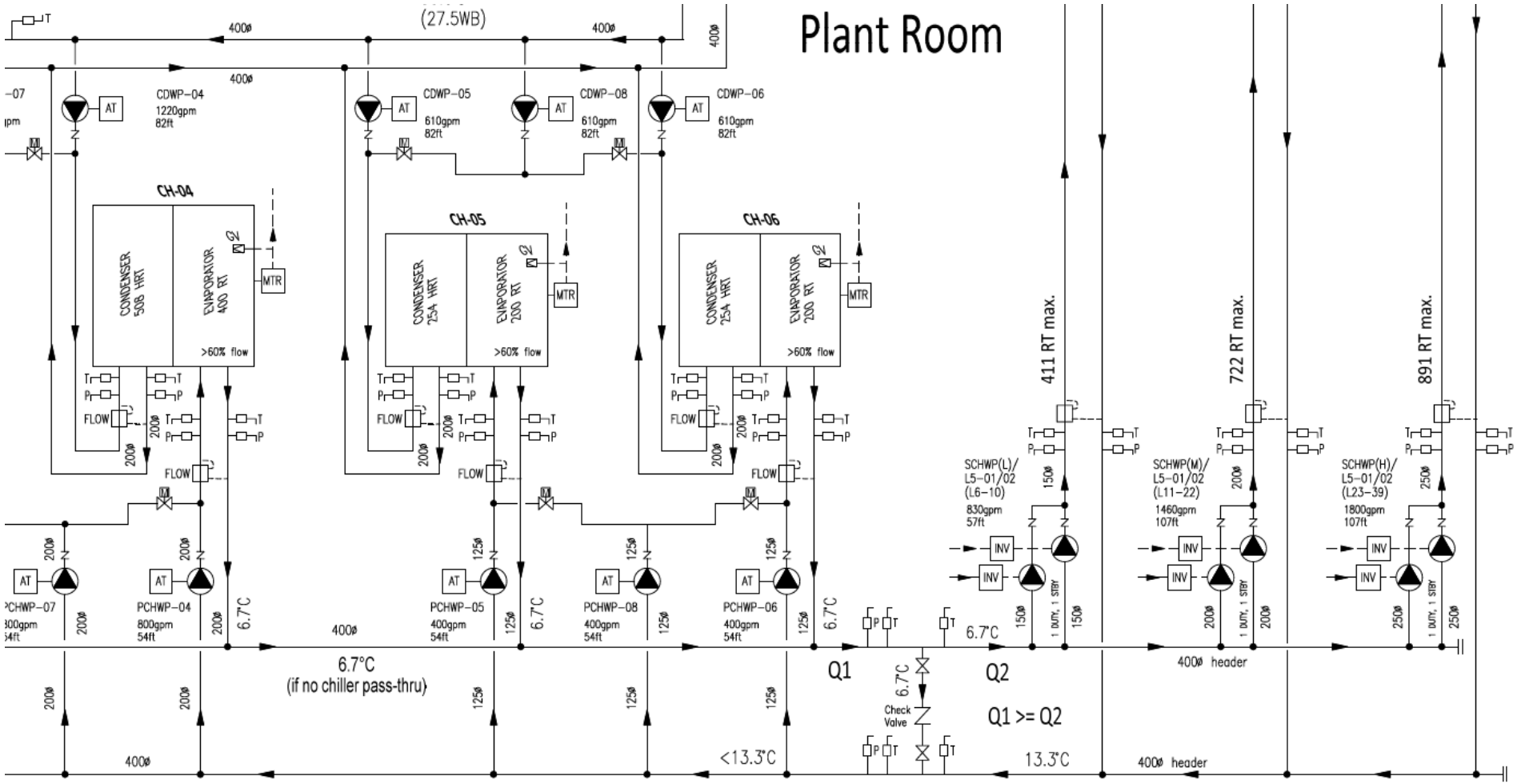


Actual Pump selection process

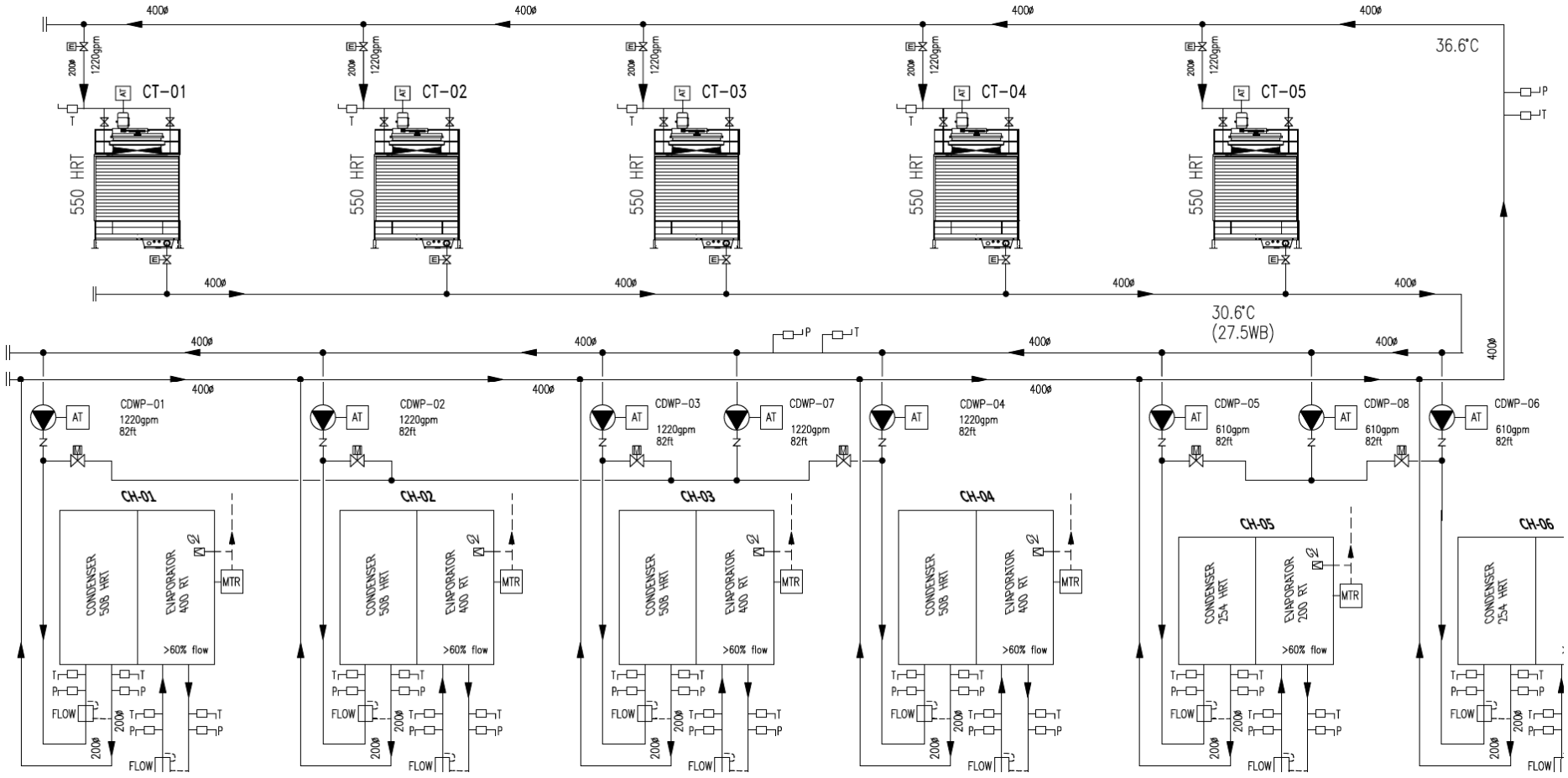




Examples of **Reduce**: Pumps & pressure??



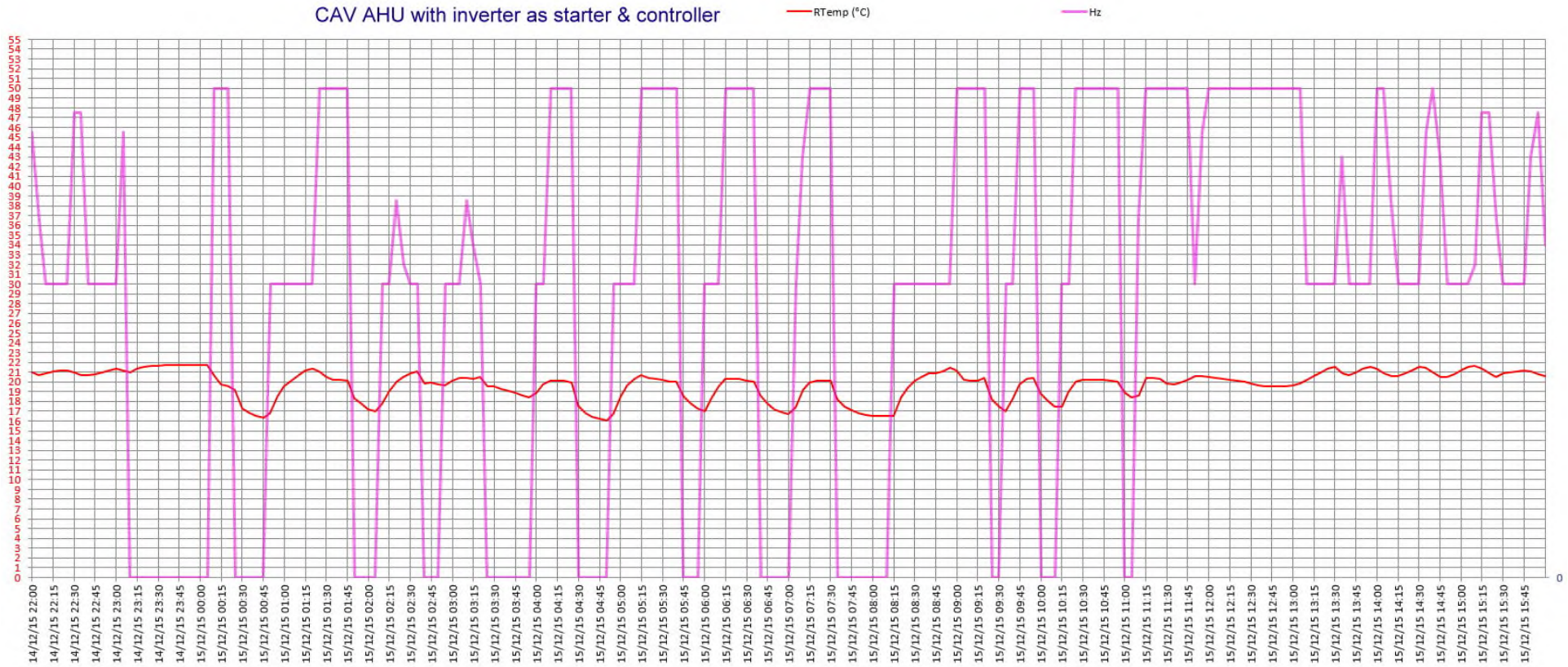
Examples of **Reduce**: Pumps & pressure?



Examples of **Reduce**: Inverter for CAV systems

Many designers nowadays specify inverter to replace conventional motor starter for constant air or water volume systems. This is common as price of inverter is dropping and using inverter can be a better choice than trimming pump impeller or swapping fan pulley during commissioning…

Is the inverter only acts as “soft-starter” or “commissioning ease” for the motor or can the inverter be used to enhance performance further?



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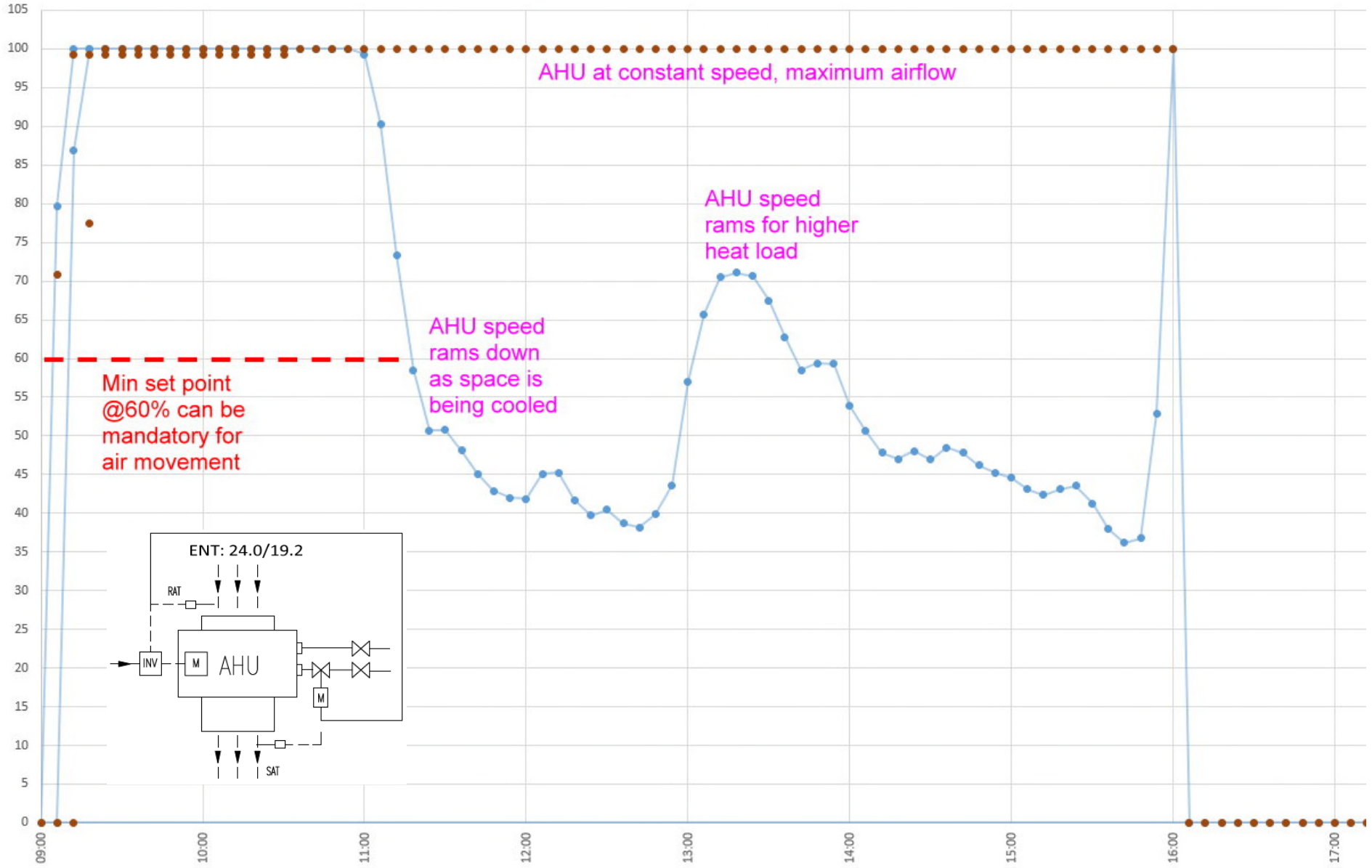
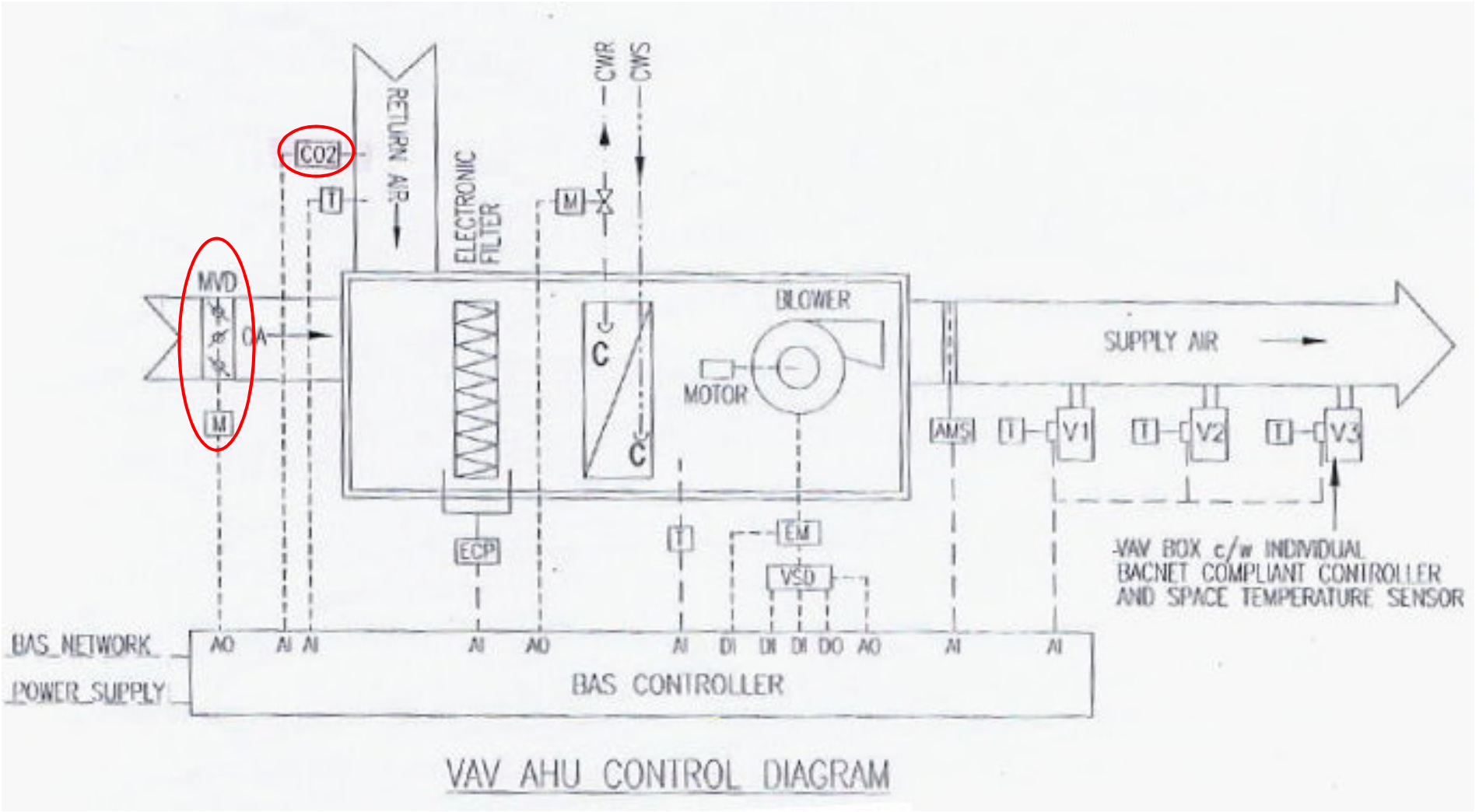
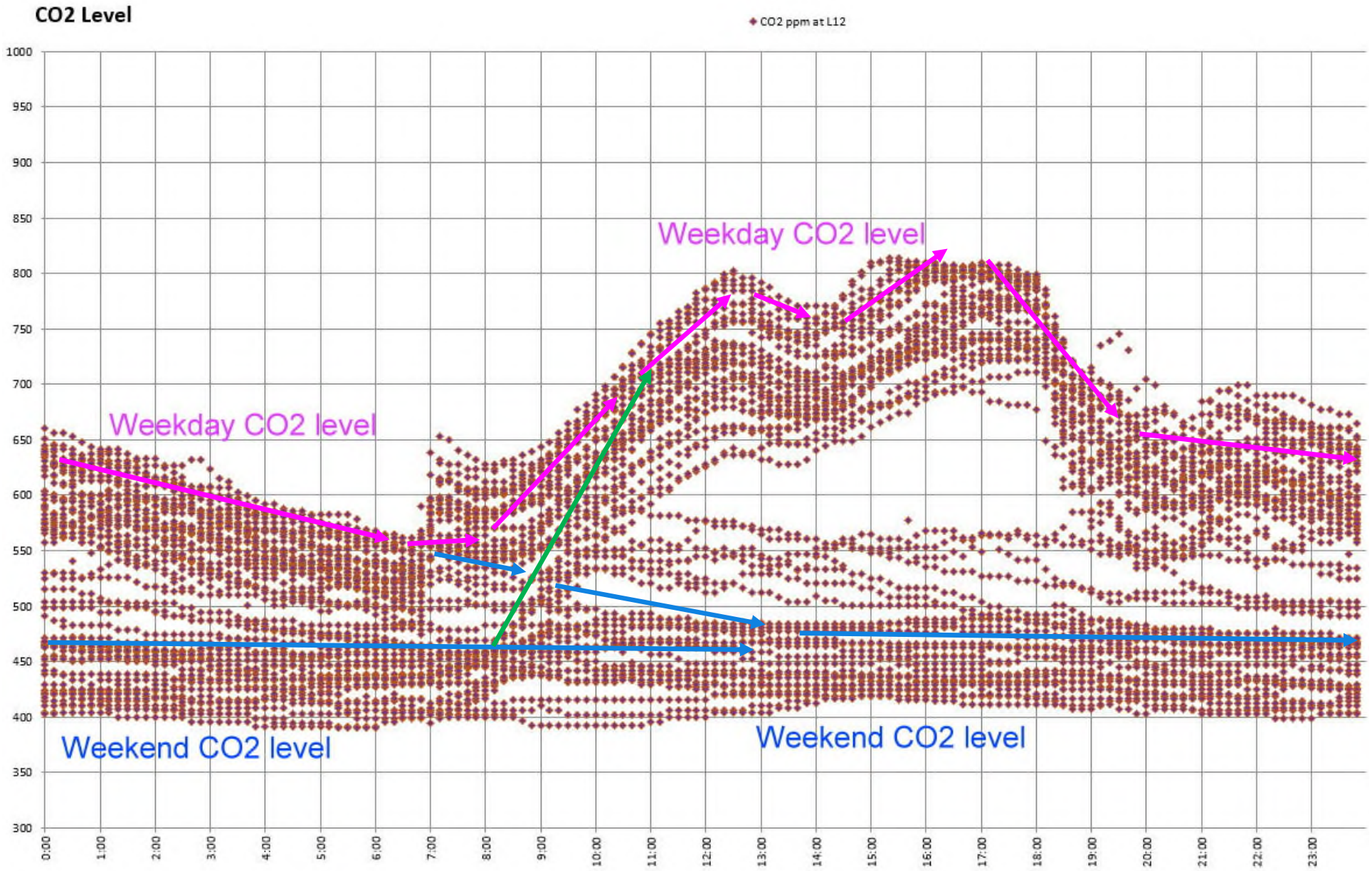


Examples of **Efficiency**: Demand Control Ventilation



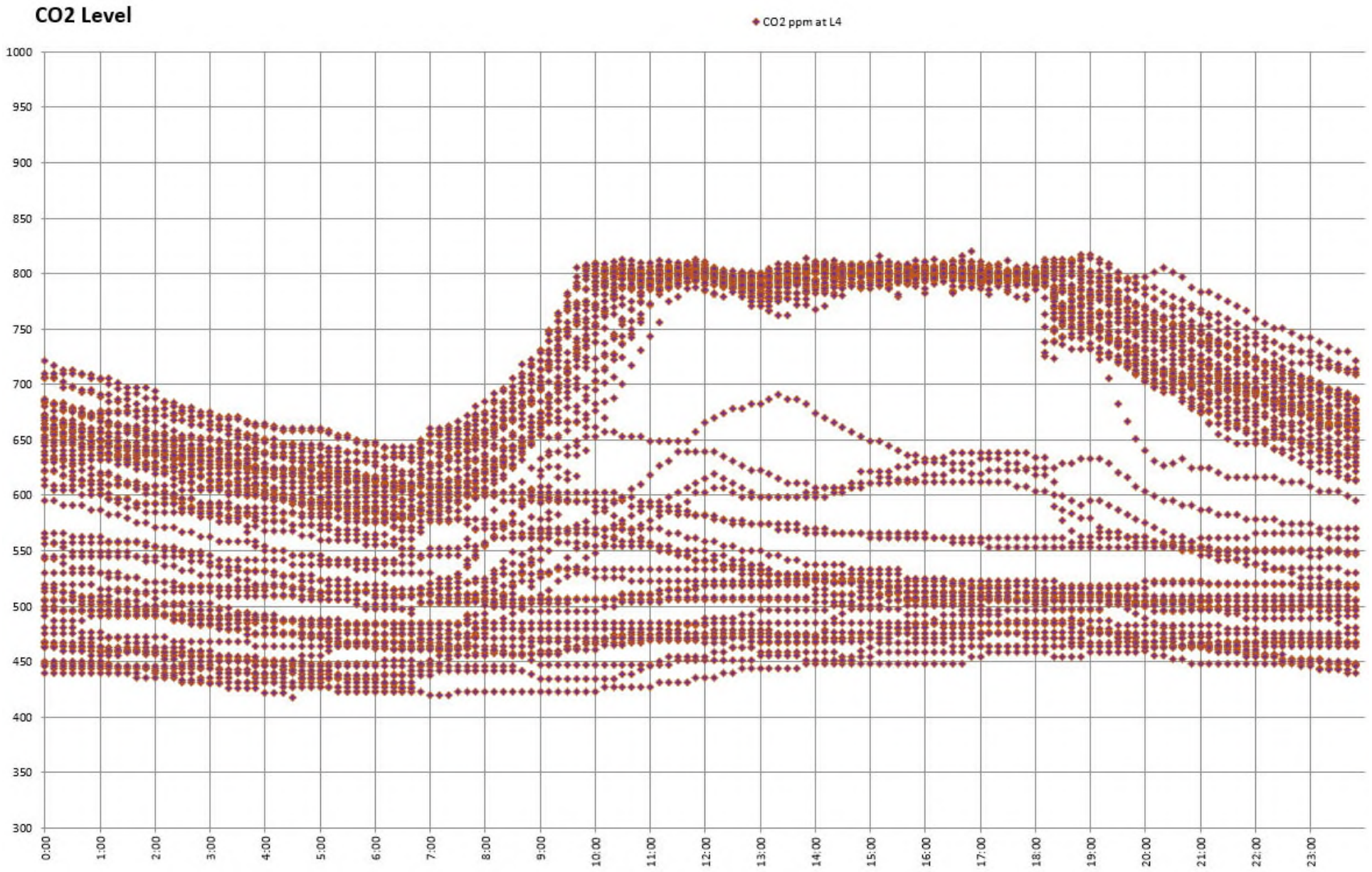
Examples of **Efficiency**: Demand Control Ventilation

Carbon dioxide concentration as reverse indication of ventilation adequacy – ***General office***



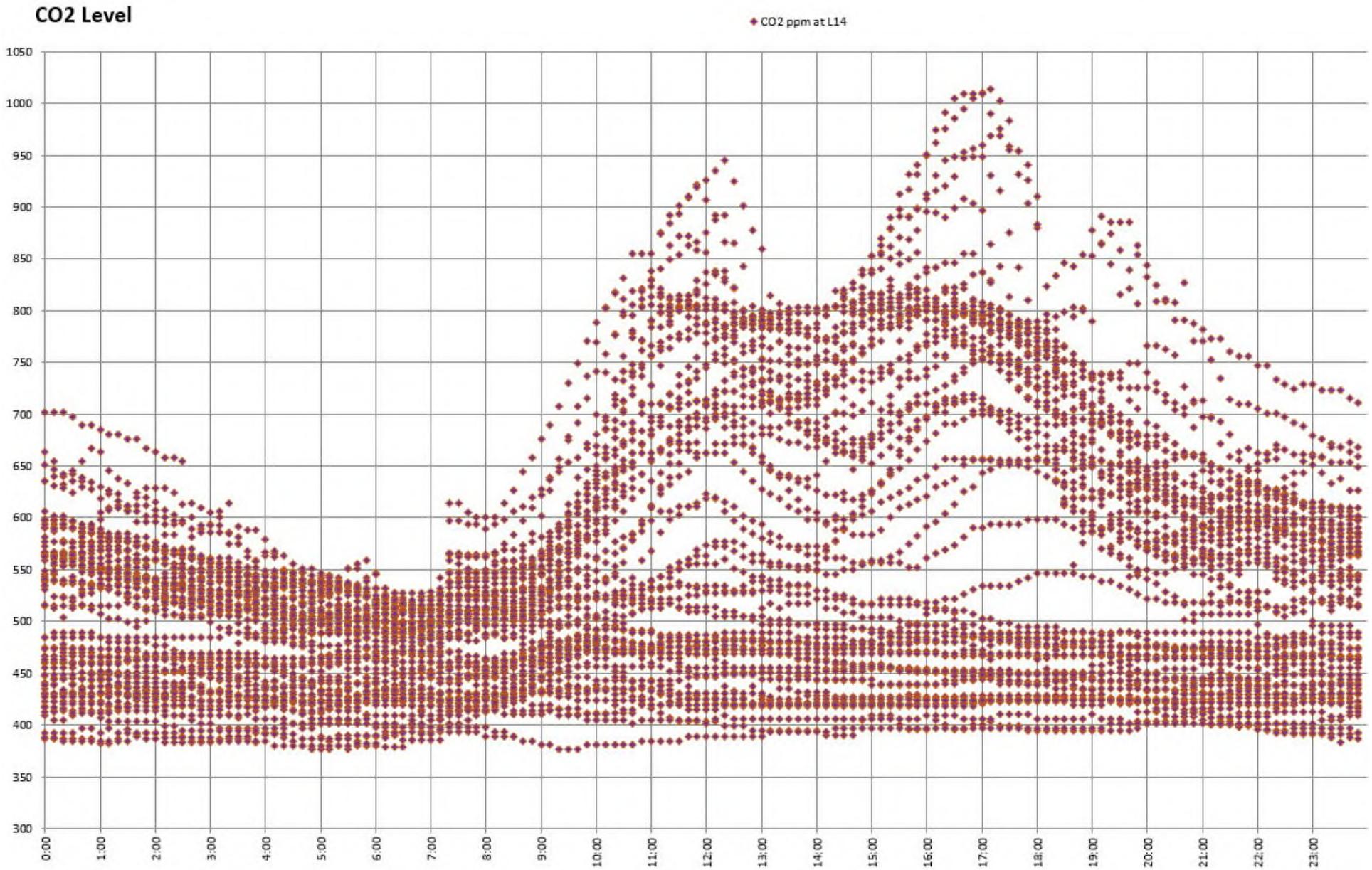
Examples of **Efficiency**: Demand Control Ventilation

Carbon dioxide concentration as reverse indication of ventilation adequacy – ***Call Centre***



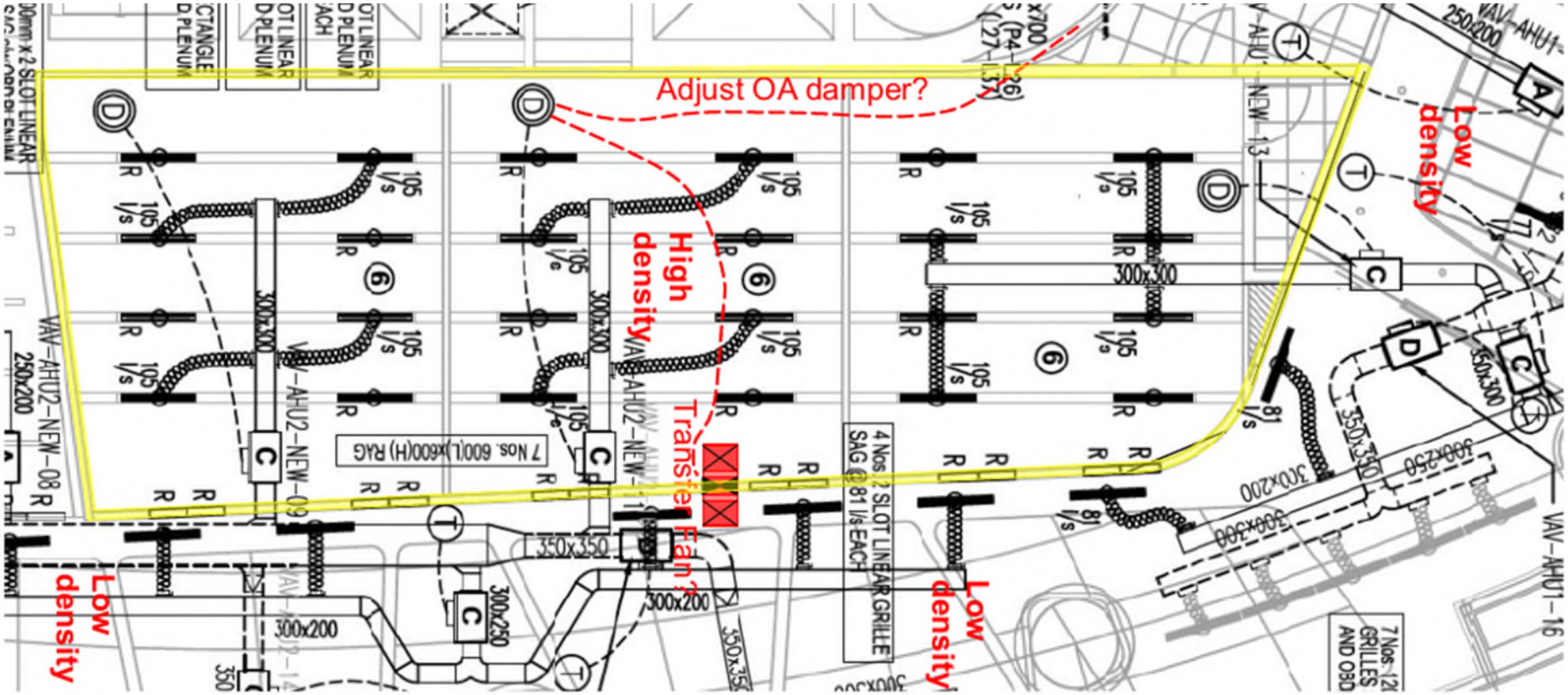
Examples of **Efficiency**: Demand Control Ventilation

Carbon dioxide concentration as reverse indication of ventilation adequacy – ***Conference Floor***

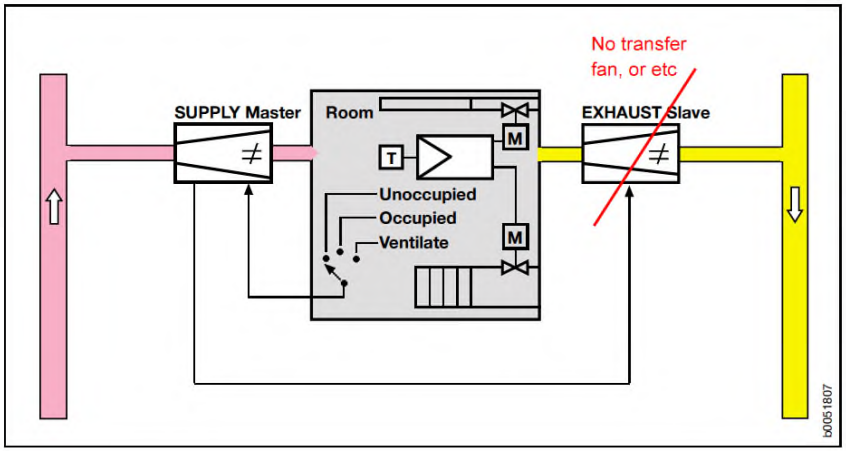


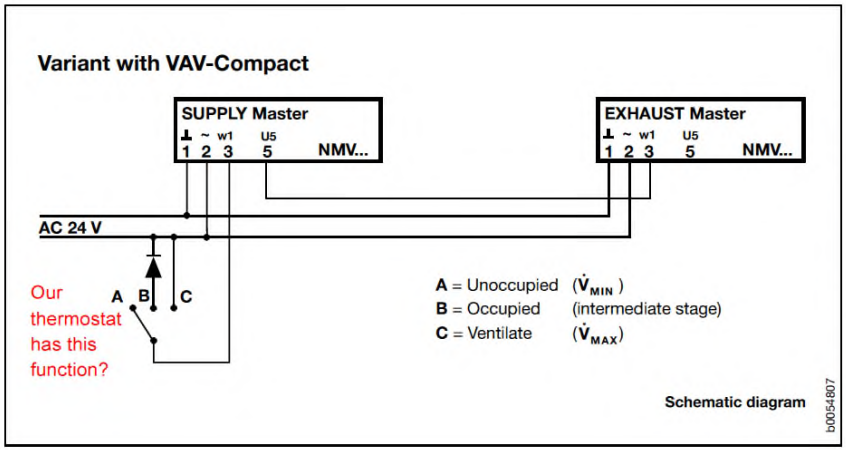
Examples of **Efficiency**: Demand Control Ventilation

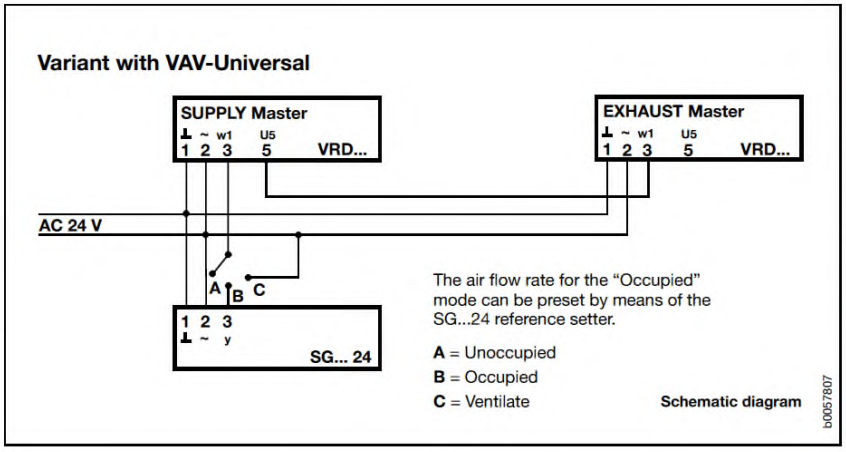
*BAS can do more than just common CO2 concentration monitoring for "**special occupied floor**"*
Such as SA control, temperature control, etc….



Examples of **Reduce**: Zoning rationality, Occupied & Unoccupied Mode







Demand-related ventilation

The example opposite shows a simple but efficient method of demand-related ventilation using BELIMO VAV-Control systems. This application is primarily suitable for when combined air/water systems are being used because only the quality of the air is controlled, not the temperature (so no transfer of energy). A manual control switch is provided in the room for the occupant to adjust according to his or her needs.

Unoccupied

When a room is not being used, the control switch must be set to the "Unoccupied" position. In this position the flow of air is reduced to a minimum; the actual value to which it is reduced can be preset at the VAV controller.

Occupied

When someone wishes to use the room, the control switch must be set to the "Occupied" position. The volumetric flow will then be increased to a pre-defined value that can also be preset at the VAV controller – which will ensure optimum air quality for normal usage.

Ventilate

Should the air in the room become very stale due, say, to excessive smoking, the control switch can be set to the "Ventilate" position so that the air flow rate is increased to an again-preset maximum value.

lighting relay was used as proximity switch in Maxis

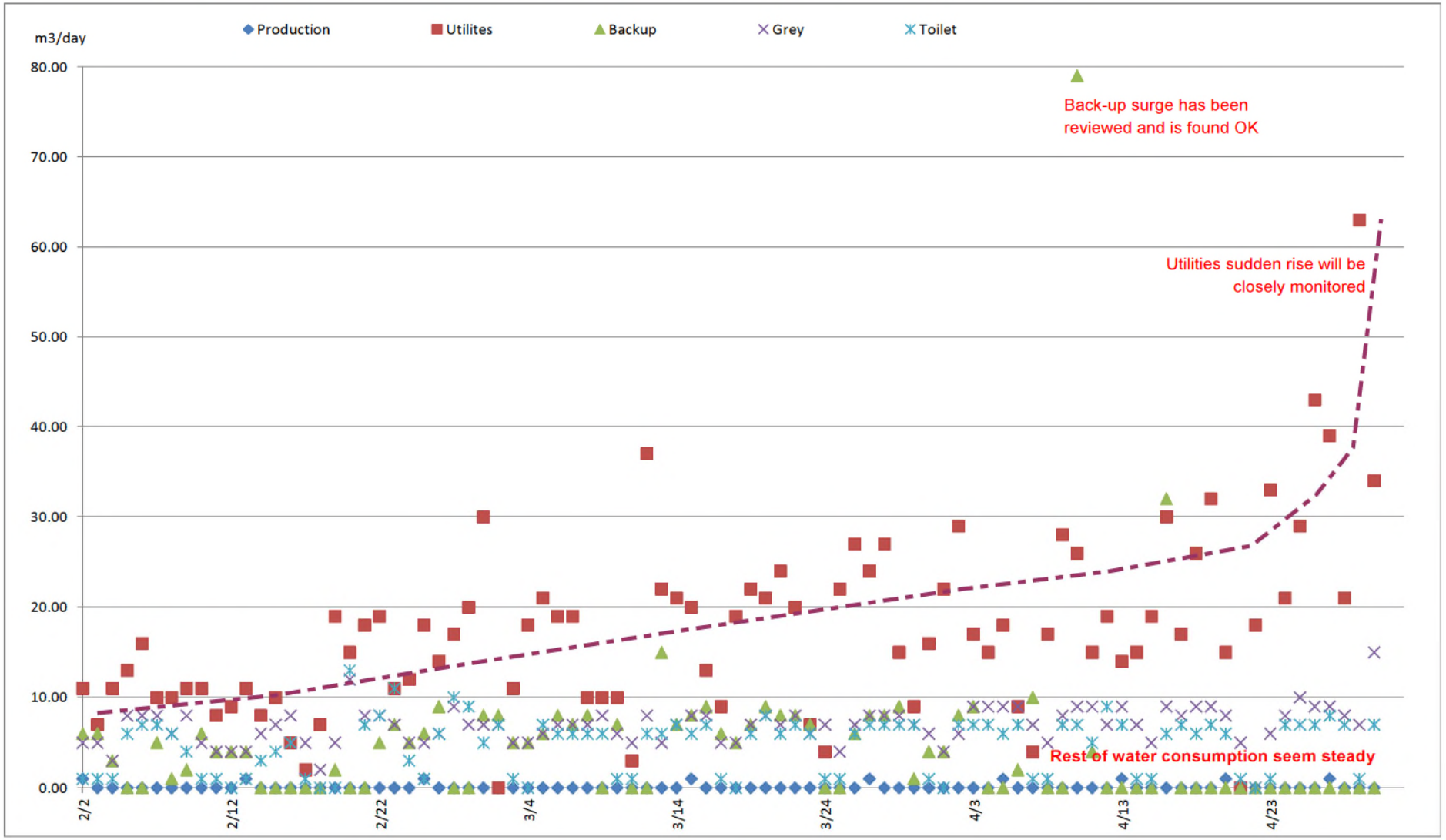
Variants

Instead of a manual switch it is also possible to employ a proximity switch which changes automatically from "Occupied" and "Unoccupied" and vice versa. Another option is for the "Ventilate" mode to be triggered through a time-delay switch so that maximum ventilation does not remain on permanently.

The room exhaust air is linked to the supply air under slave control in order to ensure balanced pressure conditions in the room and so avoid draughts.

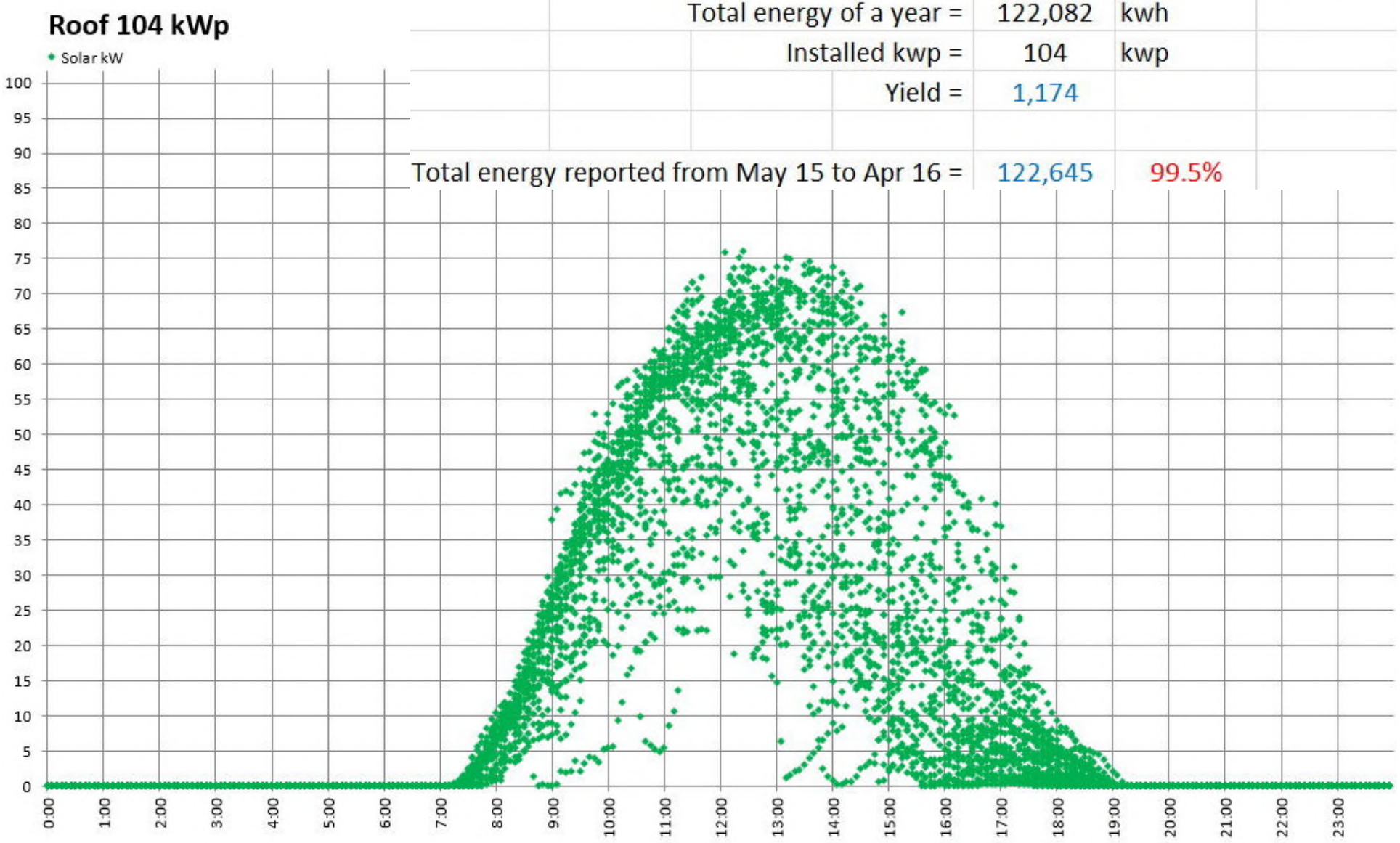
Examples of **Efficiency**: Metering monitoring water usage
This is new to BAS in many aspect …..

Detecting abnormal water consumption rate by on-line digital water meters

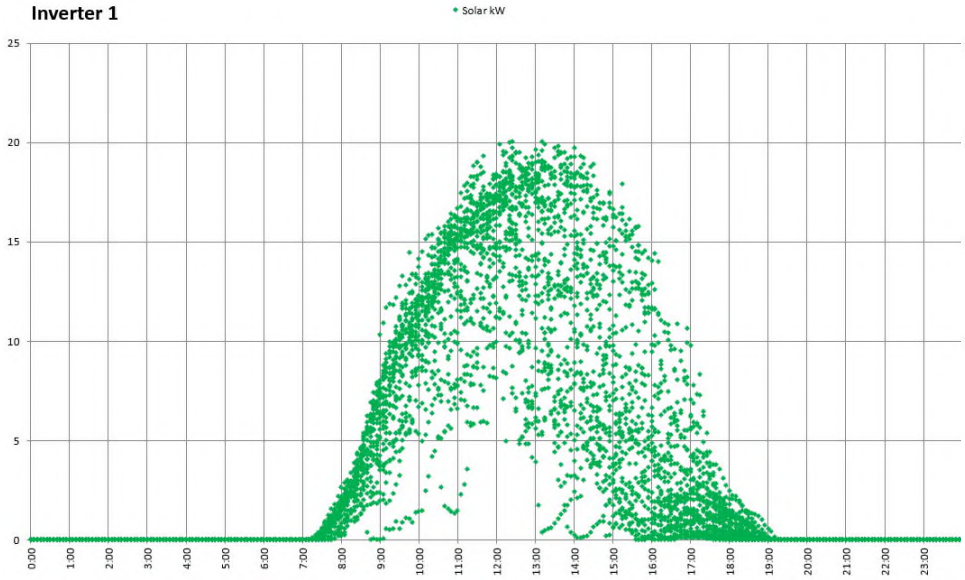


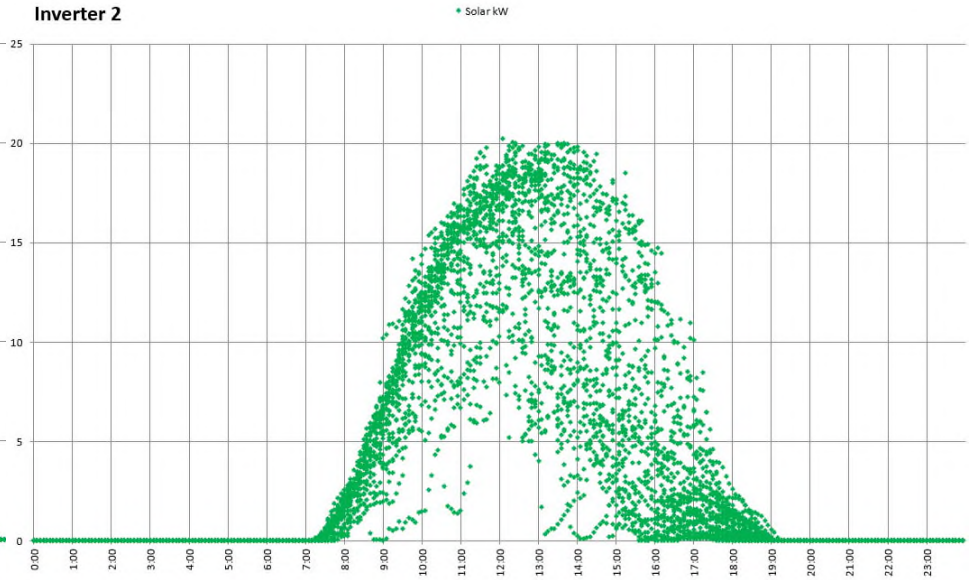
Examples of **Site Production**: PV panel monitoring

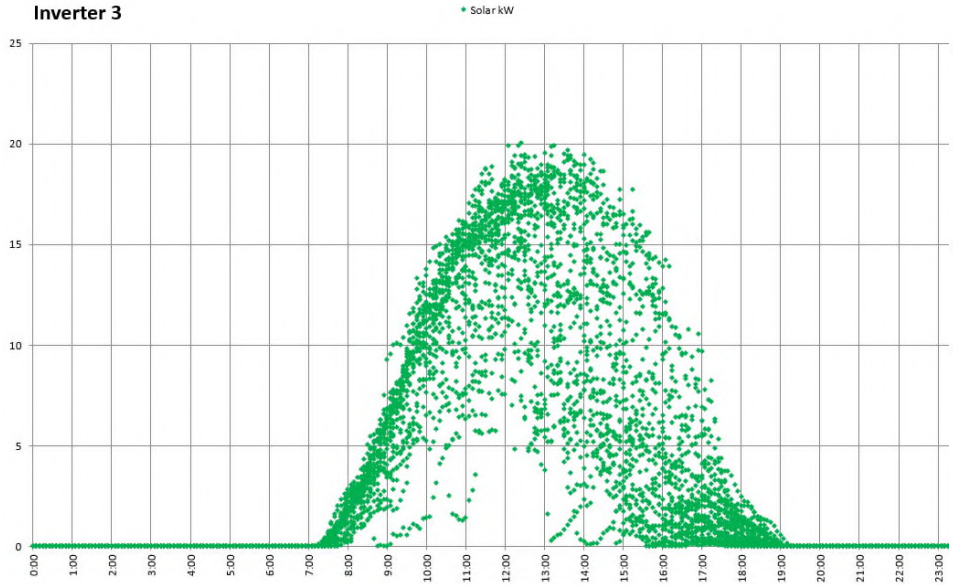
Total energy =	9,149	kwh
Total duration =	27.4	days
Average daily yield =	334	kwh/day for 4 modules
Total energy of a year =	122,082	kwh
Installed kwp =	104	kwp
Yield =	1,174	
Total energy reported from May 15 to Apr 16 =	122,645	99.5%

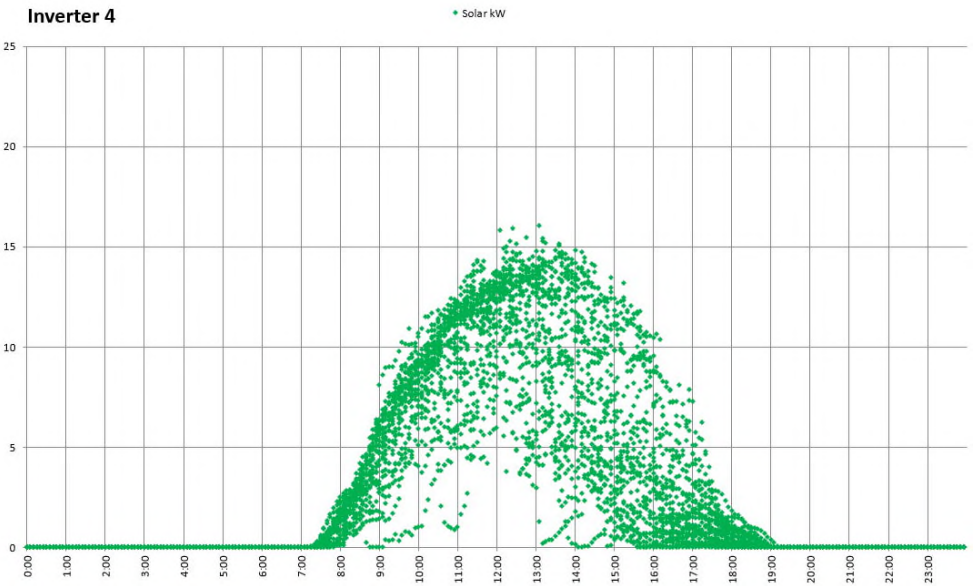


Examples of **Site Production**: PV panel monitoring









THANK YOU

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