TECHNICAL REPORT

# ISO/TR 52120-2

First edition

# Energy performance of buildings — Contribution of building automation, controls and building management —

## Part 2: Explanation and justification of ISO 52120-1



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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 205, *Building environment design*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 247, *Building Automation, Controls and Building Management*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

A list of all parts in the ISO 52120 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

 

# Introduction

The CENSE project, the discussions between CEN and the concerted action highlighted the high page count of the entire package due to a lot of “textbook” information. This resulted in flooding and confusing the normative text.

A huge amount of informative contents should indeed be recorded and available for users to properly understand, apply and nationally adapt the EPB standards

The detailed technical rules in CEN/TS 16629 ask for a clear separation between normative and informative contents:

— to avoid flooding and confusing the actual normative part with informative content;

— to reduce the page count of the actual standard;

— to facilitate understanding of the package.

Therefore, each EPB standard should be accompanied by an informative technical report, like this one, where all informative contents is collected. See Table 1.

**Table 1 — Position of this standard within the EPB set of standards**



| | **Over-arching** | **Building (as such)** | **Technical Building System** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Submodule** | **Descriptions** | **Descriptions** | **Descriptions** | **Heating** | **Cooling** | **Ventilation** | **Humidification** | **Dehumidification** | **Domestic Hot waters** | **Lighting** | **Building automation and control** | **PV, wind, ..** |
| **sub1** | **M1** | **M2** | | **M3** | **M4** | **M5** | **M6** | **M7** | **M8** | **M9** | **M10** | **M11** |
| **1** | General | General | General | | | | | | | | | |
| **2** | Common terms and definitions; symbols, units and subscripts | Building Energy Needs | Needs | | | | | | | | | |
| **3** | Application | (Free) Indoor Conditions without Systems | Maximum Load and Power | | | | | | | | | |
| **4** | Ways to Express Energy Performance | Ways to Express Energy Performance | Ways to Express Energy Performance | | | | | | | | x | |
| **5** | Building Functions and Building Boundaries | Heat Transfer by Transmission | Emission and control | | | | | | | | x | |
| **6** | Building Occupancy and Operating Conditions | Heat Transfer by Infiltration and Ventilation | Distribution and control | | | | | | | | x | |

**Table 1** *(continued)*

| | **Over-arching** | **Building (as such)** | **Technical Building System** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Submodule** | **Descriptions** | **Descriptions** | **Descriptions** | **Heating** | **Cooling** | **Ventilation** | **Humidification** | **Dehumidification** | **Domestic Hot waters** | **Lighting** | **Building automation and control** | **PV, wind, ..** |
| **sub1** | **M1** | **M2** | | **M3** | **M4** | **M5** | **M6** | **M7** | **M8** | **M9** | **M10** | **M11** |
| **7** | Aggregation of Energy Services and Energy Carriers | Internal Heat Gains | Storage and control | | | | | | | | x | |
| **8** | Building Partitioning | Solar Heat Gains | Generation and control | | | | | | | | x | |
| **9** | Calculated Energy Performance | Building Dynamics (thermal mass) | Load dispatching and operating conditions | | | | | | | | x | |
| **10** | Measured Energy Performance | Measured Energy Performance | Measured Energy Performance | | | | | | | | x | |
| **11** | Inspection | Inspection | Inspection | | | | | | | | | |
| **12** | Ways to Express Indoor Comfort | | BMS | | | | | | | | | |
| **13** | External Environment Conditions | | | | | | | | | | | |
| **14** | Economic Calculation | | | | | | | | | | | |



 

# Energy performance of buildings — Contribution of building automation, controls and building management —

## Part 2: Explanation and justification of ISO 52120-1

## 1 Scope

This document contains information to support the correct understanding, use and adoption of ISO 52120-1[1)].

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 52120-1, *Energy Performance of Buildings — Contribution of Building Automation, Controls and Building Management — Part 1: Modules M10-4,5,6,7,8,9,10*



EN ISO 7345, *Thermal insulation — Physical quantities and definitions (ISO 7345:1987)*

EN ISO 52000-1, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures*



## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 52000-1 and ISO 52120-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

## 4 Symbols and abbreviated terms

### 4.1 Symbols

For the purposes of this document, the symbols given in ISO 52000-1, in ISO 52120-1 apply.

### 4.2 Abbreviated terms

For the purposes of this document, the abbreviations in ISO 52120-1 apply.

1) Under preparation. Stage at the time of publication: ISO/DIS 52120-1:2020.

# 5 Method description

## 5.1 Effect of building automation and control (BAC) and technical building management (TBM)

### 5.1.1 General

The key-role of building automation and control and TBM is to ensure the balance between the desired human comfort, which should be maximal, and energy used to obtain this goal, which should be minimal.

The scope of BAC and TBM covers in accordance with their role from one side all technical building systems (where the effect of the BAC is used in the calculation procedures) and from another side the global optimization energy performance of a building.

We could identify several categories of controls:

— Technical building systems specific controls: these controllers are dedicated to the physical chain of transformation of the energy, from generation to storage, distribution and emission. We find them in the matrix starting with the Modules M3-5 to M9-5 and finishing with M3-8 till M9-8. We could consider that one controller exists by module, but sometimes one controller does the control among several modules. More often, these controllers are communicating between them via a standardized open bus, such as BACnet, KNX or LON.

— BAC used for all or several technical building systems that do multidiscipline (heating, cooling, ventilation, DHW, lighting) optimization and complex control functions. For example, one of them is INTERLOCK, a control function that avoids heating and cooling at the same time.



— If all technical building systems are used in the building, we have (depending of the size of the building) a technical building management system. Specific global functions are implemented here and are necessary to reach the key-role mentioned above. Usually, in this case, an interrelation with the building as such (Module M2) will occur, mainly to take in consideration the building needs; for example, due to outside temperature, taking into account the inertia of the building when the control will reach the set point in a room.

In a control system dedicated to a building, in this case BAC and TBM, we can distinguish three main characteristics as described in 5.1.2, 5.1.3 and 5.1.4.

### 5.1.2 Control accuracy

Control accuracy is the degree of correspondence between the ultimately controlled variable and the ideal value in a feedback control system. The controlled variable could be any physical variable such as a temperature, humidity, pressure, etc. The ideal value is in fact the setpoint established by the user (occupant) when he determines his level of comfort. It is clear that the entire control loop is concerned with all the elements constituent, such as sensors, valves and actuators. The equipment itself is another important element and usually specific equipment asks for a specific controller. For the energy carrier hot water, an important issue is the balancing of the hydraulic circuits. For that purposes, balancing hydraulic valves are need it.

The temperature control accuracy (CA) for a zone temperature is a key number that allows calculating the additional energy needed for heating or cooling caused by the inaccuracy of zone temperature control. The temperature control accuracy (CA) can be calculated from control variation (CV) and control set point deviation (CSD) as described in the main text of EN 15500-1:2017. The compliance with CA is also defined in EN 15500-1. This is an important input for EN 15316-2 and for EN 16798-7, where the effect of the control for heating, cooling and ventilation is taken into account.

The same standard (EN 15500-1:2017) describes also the four operations modes that deal with the levels of temperatures: comfort, pre-comfort, economy and frost/building protection. These four predefined operation modes are parameters that could be set by the users (occupant) (e.g. the

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temperature allocated to each operation mode). These operations modes are important for the control strategy used for intermittence, which will be described below.

### 5.1.3 Control function

The control function is the ability of a controller (or set of communicative controllers) to perform a determined task(s). Usually the functions implemented in the controllers are parametric or freely programmable. The functions could be performed by a single controller or by a set of communicative controllers. A controller could perform several functions.

The control functions present in a BAC or TBM, are present in ISO 52120-1:—, Table 4. These functions are organized in the matrix given by the modular structure of EPB standards. ISO 52120-1:—, Table 4 starts with heating emission, distribution, storage and generation (M3-5, M3-6, M3-7, M3-8) followed by domestic hot water, cooling, ventilation and lighting (M9-5, M9-6, M9-7, M9-8). Each function is described in detail, in accordance with the type (level) of the function: from the lower type (NO AUTOMATIC CONTROL Type = 0) to most advanced types. For each function, an identifier that is the software language for BAC and TBM is also defined, as the destination of the module where the control function has its effect. An abstract from ISO 52120-1:—, Table 4 is given below as an example.

For practical reasons, four different BAC efficiency classes (A, B, C, D) of functions are defined both for non-residential and residential buildings. This is the fastest way to specify a BAC or a TBM.

— Class D corresponds to non-energy efficient BAC. Building with such systems should be retrofitted. New buildings should not be built with such systems.

— Class C corresponds to standard BAC.

— Class B corresponds to advanced BAC and some specific TBM functions.

— Class A corresponds to high-energy performance BAC and TBM.



A building is in class D: If the minimum functions to be in class C are not implemented.

To be in class C: Minimum functions defined in ISO 52120-1:—,Table B.1 are implemented.

To be in class B: Building automation function plus some specific functions defined in ISO 52120-1:—, Table 4 are implemented in addition to class C. Room controllers are able to communicate with a building automation system.

To be in class A: Technical building management function plus some specific functions defined in ISO 52120-1:—, Table 4 are implemented in addition to class B. Room controllers should be able for demand controlled HVAC (e.g. adaptive set point based on sensing of occupancy, air quality, etc.) including additional integrated functions for multi-discipline interrelationships between HVAC and various building services (e.g. electricity, lighting, solar shading, etc.).

In addition, the hydraulic system is properly balanced.

The functions assignment to the BACS efficiency classes is listed in ISO 52120-1:—, Table 5.

BAC functions with the purpose to control or monitor a plant or part of a plant which is not installed in the building do not have to be considered when determining the class even if they are shaded for that class. For example, to be in class B for a building with no cooling system no individual room control with communication is required for emission control of cooling systems.

If a specific function is required to be in a specific BAC efficiency class, it is not required that this function is strictly required everywhere in the building: if the designer can give good reasons as to why the application of a function does not bring a benefit in a specific case then it can be ignored. For example, if the designer can show that the heating load of a set of rooms is only dependant on the outdoor temperature and can be compensated with one central controller, no individual room control by thermostatic valves or electronic controllers is required to be in class C.

 

A reference list of BACS functions to reach is defined in ISO 52120-1:—, Table 6. That table defines the minimum requirements of BACS functions according to BACS efficiency class C of ISO 52120-1:—, Table 5.

Unless differently specified this list is used for the following:

— to specify the minimum functions to be implemented for a project;

— to define the BACS function to take into account for the calculation of energy consumption of a building when the BACS functions are not defined in detail.

— to calculate the energy use for the reference case in step 1 of the BACS efficiency factor method.

### 5.1.4 Control strategy

The control function is the method employed to achieve a given level of control to reach a goal. Optimal control strategies deliver a desired level of control at a minimum cost (minimum energy demand). A control strategy could consist of a control function or a group of control functions. Examples of a control strategy implemented by a control function are optimum start, optimum stop, or night set back described in EN 12098-1 and EN 12098-3. The timer function is described in EN 12098-5.

An example of a control strategy that is realized by a group of control functions is the control strategy used by intermittence. This function uses several control functions, operation modes, optimum start-stop and timer at the same time. All elements together are called either building profile or user pattern. Usually, to implement such building profile, a TBM is a prerequisite.

The most important control strategy described and implemented in ISO 52120-1 is demand-oriented control. Usually these strategies implement the sense of the energy flow (from generation to emission) with flow of calculation (from building needs to delivered energy). Usually for this complex control strategy, a TBM is necessary with a distributed specific control for each Technical Building System that communicates in system architecture via a communication standardized bus such as BACnet, KNX or LON.



More clear, this demand-oriented control works as follows: When the comfort is reached in the emission area, the controller from the emission sends the message to the controller in charge of distribution to stop to distribute energy, then the controller in charge of distribution sends the message to the controller in charge of storage to either store the energy or if the storage cannot store more energy, then to send the message to the controller in charge of the generation to stop generating more energy.

Another important control strategy is the control strategy for multi generators either from the same type (e.g. several boilers) or different types (e.g. a boiler and heat pomp) including also the renewable energy sources. The strategy could be based as follow:

— Priorities only based on running time.

— Fixed sequencing based on loads only: For example depending on the generator's characteristics (e.g. hot water boiler vs. heat pump).

— Priorities based on generator efficiency and characteristics: the generator operational control is set individually to available generators so that they operate with an overall high degree of efficiency (e.g. solar, geothermic heat, cogeneration plant, fossil fuels).

— Load prediction-based sequencing: The sequence is based on, for example efficiency and available power of a device and the predicted required power.

The standards enabling to calculate the effect of BACS and TBM functions on energy consumption use different approaches to calculate this impact. The approaches are described in ISO 52120-1:—, 6.4.2.

 

## 5.2 Description of BAC functions

### 5.2.1 General

The numbers in italics refer to the numbers in ISO 52120-1:—, Table 4.

### 5.2.2 Heating control

*1.1* Heating – Emission control

*1.1.0* No automatic control

Description: No automatic control of the room temperature.

*1.1.1* Central automatic control

Description: Central automatic control of temperature in rooms by means of heating, is acting either on the distribution or on the generation. Heating control is performed without consideration of local demand of different rooms, possibly by using one room as reference. This can be achieved, for example by an outside temperature controller conforming to EN 12098-1 or EN 12098-3.

Target: To improve EP by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using central control of temperature and/or flow. This control may be based on outside temperature and/or a reference sensor inside the building and assumes similar demands in different parts/rooms of the building.



*1.1.2* Individual room control

Description: Individual room control by thermostatic valves or electronic controllers. The individual room control of heating temperature in rooms is performed either by thermostatic valves or local (non-communicating) electronic control units. The individual control should/may be combined with scheduler programs providing different operating modes.



Target: To improve EP by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms.

*1.1.3* Individual room control with communication

Description: Individual room control with communication between controllers and to BACS. Individual control of temperature in rooms by means of heating, with communication between controllers and to BACS, allows exchange of setpoints, demand and other status information.

Target: To improve EP by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms. Furthermore, to obtain energy demand for further use to control distribution and generators, keeping run time at minimum and setpoints optimal.

*1.1.4* Individual room control with communication and occupancy detection

Description: Individual room control with communication between controllers and to BACS, and presence control performed by occupancy. Individual control of temperature in rooms by means of heating, with communication between controllers and to BACS, allows exchange of setpoints, demand and other status information.

Target: To improve EP by minimizing emitted heat by emitters (e.g. radiators) or by air in the building using local control of temperature and/or flow in the rooms, thereby adapting to local demand, i.e. different loads in different rooms. Furthermore, to obtain energy demand for further use to control distribution and generators, keeping run time at minimum and setpoints optimal.

*1.2* Heating – Emission control for TABS

*1.2.0* No automatic control

Description: There is no automatic control of the room temperature implemented.

Target: Manual controls of a loop apply.

*1.2.1* Central automatic control

Description: The central automatic control for a TABS zone (which comprises all rooms which get the same supply water temperature) typically is a supply water temperature control loop whose setpoint is dependent on the filtered outside temperature, for example the average of the previous 24 h.

Target: The supply water temperature is set according to the filtered outside air temperature (filtered -weather compensated supply water temperature).

*1.2.2* Advanced central automatic control

Description: This is an automatic control of the TABS zone that fulfils the following conditions.

— If the TABS is used only for heating: The central automatic control is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by the room temperature heating setpoint). "Optimal" means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also is as low as possible to reduce the energy demand for heating.

— If the TABS is used for heating and cooling: The central automatic control is designed and tuned to achieve an optimal self-regulating of the room temperature within the required comfort range (specified by room temperature heating and cooling setpoints). "Optimal" means that the room temperatures of all rooms of the TABS zone remain during operation periods in the comfort range, to meet comfort requirements, but also uses as far as possible the full range to reduce the energy demand for heating and cooling.



— If the TABS are used for heating and cooling: the automatic switching between heating and cooling is not done only dependent on the outside temperature, but also taking at least indirectly the heat gains (internal and solar) into account.

One solution to achieve these requirements can be found in References [7] and [8].

Target: Achieve temperatures within the desired bandwidth for all rooms in the heating/cooling group.

*1.2.3* Advanced central automatic control with intermittent operation and/or room temperature feedback control

Description: Advanced central automatic control with room temperature feedback control:

— Advanced central automatic control with intermittent operation. This is an advanced central automatic control according to 2) with the following supplement: The pump is switched off regularly to save electrical energy, either with a fast frequency - typically 6 h on/off cycle time - or with a slow frequency, corresponding to 24 h on/off cycle time. If the TABS are used for cooling, intermittent operation with 24 h on/off cycle time can also be used to reject the heat to the outside air if the outside air is cold. One solution to achieve this requirement can be found in References [7] and [9].

— Advanced central automatic control with room temperature feedback control. This is an advanced central automatic control according to 2) with the following supplement: The supply water temperature setpoint is corrected by the output of a room temperature feedback controller, to adapt the setpoint to non-predictable day-to-day variation of the heat gain. Since TABS react slowly, only day-to-day room temperature correction is applied, an instant correction cannot be achieved with TABS. The room temperature that is fed back is the temperature of a reference room or another temperature representative for the zone. One solution to achieve this requirement can be found in References [7] and [9].

 

— Advanced central automatic control with intermittent operation and room temperature feedback control.

Target: The goal is to compensate room/zone behaviour into the supply water temperature control in order to optimize emissions taking into account heat gain and radiation.

*1.3* Heating – Control of distribution network hot water (supply or return)

*1.3.0* No automatic control

Description: The distribution network temperature of the hot water is not controlled.

*1.3.1* Outside temperature compensated control

Description: Control of the temperature of the hot water distribution based on outside temperature compensation.

Target: To improve EP by lowering the mean temperature of the flow, thereby minimizing heat losses.

*1.3.2* Demand based control

Description: Control of the temperature of the hot water distribution is based on indoor temperature measurements.

Prerequisite: Communicating system to room control units.

Water based systems in buildings usually supply thermal energy to more than one room or one zone (e.g. distribution network, risers) according to planned use patterns. Class B (or higher) room or zone controls send energy demand to the associated distribution network and require them to run while the demand is present.



Assuming that several rooms or zones are connected to the same network and the room or zone use change overtime, i.e. multiple use, this will result in inefficient operation of the distribution network because the distribution network (e.g. pumps) are eventually running for a very long active time (e.g. tending to 14 h/day to 16 h/day).

Recommendations: consider the space usage profile while modifying distribution networks. This is done in the planning stage prior to relocating people or business activities.

*1.4* Heating – Control of distribution pumps in networks

*1.4.0* No automatic control

Description: Distribution pumps are not controlled (only protection functions).

*1.4.1* On / off control

Description: On / off control. Pumps are switched on and off automatically but once switched on it runs with no control at maximum speed.

Target: To improve EP by avoiding auxiliary energy consumption of pumps while no energy needs to be circulated.

*1.4.2* Multi-stage control

Description: Speed of pumps is controlled by a multi-step control.

Target: To improve EP by reducing auxiliary energy consumption by adapting (in fixed steps) the speed of the pump depending on the system conditions.

*1.4.3* Variable speed pump control

Description: Speed of pumps is controlled depending on different states of the system. This may be done with constant or variable Δ$p$ and with a demand evaluation to reduce the auxiliary energy demand of the pumps.

Target: To improve EP by reducing auxiliary energy consumption of pumps by optimizing their speed according to the current system conditions.

*1.4.4* Variable speed pump control

Description: Speed of pumps is controlled depending on the different states of the system. This may be done with variable Δ$p$ following an external demand signal, e.g. hydraulic requirements, Δ$T$, energy optimization or a demand evaluation to reduce the auxiliary energy demand of the pumps.

Target: To improve EP by reducing auxiliary energy consumption of pumps by optimizing their speed for the current system conditions.

*1.5* Heating – Intermittent control of emission and/or distribution

*1.5.0* No automatic control

Description: No intermittent control (always full energy consumption).

*1.5.1* Automatic control with fixed time program

Description: Automatic control is carried out to reach intermittent operation of the emission and/or distribution components.



Target: To improve EP by lowering the temperature setpoints during certain conditions (e.g. night). This leads to improved EP due to shortened operation time of the generation/distribution and lower losses of the room(s) due to lower temperature differences to the outside.



*1.5.2* Automatic control with optimum start/stop



Description: Automatic control is carried out to reach optimized start/stop of intermittent operation of the emission and/or distribution components.

Target: To improve EP through optimized start/stop to maximize time for economy mode by considering energy capacity of the building in control.

*1.5.3* Automatic control with demand evaluation

Description: Automatic control is carried out to reach intermittent operation of emission and/or distribution based on demand (occupancy).

Target: To improve EP through maximizing "pre-comfort" and/or "economy" time periods by detecting or using information about real demand (e.g. occupancy).

*1.6* Heating – Generator control for combustion and district heating

*1.6.0* Constant temperature control

Description: Generator temperature is controlled to hold a predefined constant temperature within a defined control deviation.

Target: To improve EP by minimizing the generator operation temperatures and avoiding max boiler temperature (with highest losses), e.g. compared to thermostatic on/off control.

*1.6.1* Variable temperature depending on outside temperature

Description: Generator temperature setpoint is variable depending on outside temperature.

Target: To improve EP by minimizing the generator operation temperatures using outside temperature information.

 

*1.6.2* Variable temperature depending on the load

Description: Generator temperature setpoint is variable depending on the load of the system.

Target: To improve EP by minimizing the generator operation temperatures using information about current demand of the system.

*1.7* Heating – Generator control for heat pumps

*1.7.0* Constant temperature control

Description: Heat generation is not optimized to environmental conditions and control is always towards the maximum allowed temperature.

Inputs: Maximum allowed temperature setpoint.

*1.7.1* Variable temperature depending on outside temperature

Description: The control temperature is calculated with the goal to operate the heat pump with minimized operating temperature setpoints depending on outside temperature.

Target: To improve EP by avoiding unnecessary electrical pumping energy by minimizing the generator operation temperatures using outside temperature information.

*1.7.2* Variable temperature depending on the load

Description: Heat pump temperature setpoint is variable depending on the demand which is based on the load of the system.



Target: To improve EP by optimizing efficiency of the heat pump at given environmental conditions based on current demand of the system.



*1.8* Heating – Generator control for outdoor unit

The goal consists generally in maximizing the heat generator efficiency.

*1.8.0* On/Off-control of heat generator

*1.8.1* Multi-stage control of heat generator

Description: Output of heat generator is controlled depending on the load or demand (e.g. on/off of several compressors).

*1.8.2* Variable control of heat generator

Description: Output of heat generator depends on the load or demand (e.g. hot gas bypass, inverter frequency control).

*1.9* Heating – Sequencing of different generators

*1.9.0* Priorities only based on running time

Description: Priority based sequencing of multiple heating generators. The priority of sequencing is only based on running times of the generators (in order to optimize maintenance).

*1.9.1* Control according to fixed priority list

Description: Priority based sequencing of multiple heating generators. The generators of higher priority are running first. A given generator in the priority list is running only if the generators of higher priority are running at full load. The sequence is fixed - the priority list is arbitrarily created.

Target: To improve EP by only using as many generators as needed at any point in time and drive each generator in its most efficient mode (full load).