Fact Sheet: Central Heating Plant Control Strategies

This document provides an overview of some strategies for controlling central heating plants. Senior maintenance staff and energy managers should be familiar with these strategies in order to guide operations and maintenance of central heating systems. This includes asking the right questions of site staff, third-party service contractors, and development teams at project hand-off. This document should be used as an internal reference. It is intended to provide some background information to better understand how central heating plants should be operated. Once site staff understand how their buildings are meant to operate – they are more likely to identify equipment issues when control systems do no work as intended.

Heating Loop Temperature Control Strategies

- **Outdoor Reset** – Outdoor reset is a control strategy for central boiler plants which utilizes the outdoor air temperature as the input. The temperature of the hot/chilled water loop is changed in response to changes in outdoor air temperatures. For hydronic heating systems, as the outside temperature drops, the temperature of the hot water loop is increased in order to provide more heat to the building. An outdoor reset control strategy improves energy efficiency by reducing the heat input to the loop during mild weather.

  **Important Vocabulary:**
  - **Design Supply Temperature**: The hottest temperature which the heating system will produce. This is the temperature needed on the coldest day of the year (design day).
  - **Design Outdoor Temperature**: The outdoor temperature at which the boiler must produce temperature is the Design Outdoor Temperature. Design outdoor temperature will depend on local climate...
    - Typical Values:
      - Washington D.C.: 17°F
      - Chicago, IL: 0°F
      - Dallas, TX: 24°F
  - **Outdoor Cutoff Temperature**: The outdoor temperature at which heating begins. When the outdoor temperature is warmer than this value – the heating system will not operate.
  - **Reset Ratio**: A ratio which controls how much hotter the heating loop water temperature gets in response to changes in outdoor air temperature.

  **Helpful Resources:**

- **Constant Setpoint** – A constant setpoint control strategy means that the heating water loop is maintained at the same temperature throughout the season – regardless of weather conditions. This type of control strategy is more common on smaller, less complicated hydronic systems, which serve only a small number of zones, with very similar heat requirements. Sometimes a constant setpoint system is equipped with a controller which will vary the amount of time that
the system is on in response to outdoor temperature. In these cases – the system will run for longer when it is colder outside.

**Important Vocabulary:**

- **Setpoint**: The temperature of the loop. The heating system will turn on as the temperature of the water loop falls below this value.

**Indoor Temperature Lockout** – Indoor temperature lockout control strategies use temperature sensors within the building as the main input to the controller (thermostats are a simple example). The heating system is turned on when the indoor temperature falls below a desired setpoint. The controller calls for heat as long as the temperature is below the setpoint. Once the indoor temperature rises above the setpoint – the heating system shuts down. For larger buildings – this type of control strategy often relies on a network of indoor temperature sensors installed throughout the building. Typically the heating controller will take the average temperature of the different sensors when “deciding” whether or not to energize the heating system. In systems that utilize an average of several sensors – it is imperative that the sensors are spread evenly throughout the building. If they are not – some areas of the building may be drastically over or under-heated.

**Important Vocabulary:**

- **Setpoint/Target Temperature**: The desired temperature (or average of temperatures) that the controller is trying to maintain in the building. If the temperature in the building is above the desired setpoint – the heating system will not turn on.

**Night Setback** – Night setbacks are a strategy for reducing the indoor temperature at night. The idea behind this strategy is that during nighttime periods, people are generally sleeping – so the building does not have to be kept as warm. Night setbacks can be applied in several different control strategies. For heating systems utilizing an outdoor air reset strategy – the control parameters can be adjusted for nighttime periods (e.g. require a colder outside temperature in order for the heating system to cycle on at night). Similarly, the reset ratio can be adjusted so that the loop temperature increases at a slower rate in response to changes in outdoor temperature. Night setback can also be used with an indoor temperature lockout system. Under these conditions – the target indoor setpoint is usually lower during nighttime periods.

**Pump Control Strategies**

- **Constant Speed** – The most common strategy for controlling central pumps. In this set-up the pump operates at full speed (100%). Often the pumps remain on throughout the heating season, and are always circulating water throughout the loop. Constant speed pump control works best with outdoor reset temperature control strategies.

- **Variable Speed** – In at variable speed system, the pump motor speeds up or slows down the pump in response to changes in the system. In order for a variable speed system to operate properly – there must be some way of reducing the flow rate at the fan coils. This is typically accomplished by valves which close when heat is not needed in a specific room/area of the
building. If the terminal units have valves that close as they shut off – then a variable speed control strategy can result in pumping energy savings. A variable speed pumping strategy requires that the motor controlling a pump be equipped with a variable-speed-drive (VSD), sometimes called a variable-flow-drive (VFD). A properly functioning VSD will decrease the speed of the pump in order to reduce the pressure it is creating in the system to move the water. As the pump motor slows down – the amount of water moving through the system is reduced.