Outline

- RP1711/G36 to CDL
- Overview of chiller plant sequences
- Chiller plant control sequence package structure
- Controller architecture
- Generalization and problems - arrays
- How you can contribute
- Library structure demo

What is a control sequence?

A control sequence is a comprehensive system control algorithm formulated using primarily English with some mathematical expressions.

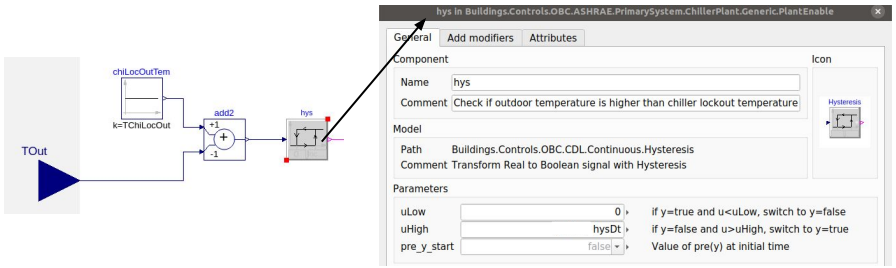
Example English language specification from ASHRAE's primary system control sequence specification document (RP 1711) with the corresponding CDL implementation:

Hysteresis:

"Control some signal to be:

True if T_out>T_loc + 1°F

False if T_out<T_loc"



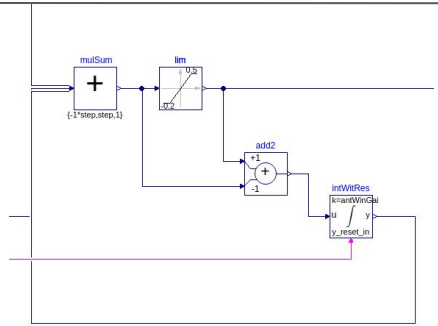
Lack of explicit definitions in RP1711 sequences

To implement sequences in CDL sometimes one needs to implement additional calculations. These might need to get specified in the Guideline in the future. Often the reason behind it are ALC EIKON features, such as a hysteresis inbuilt in quantity comparison blocks. Two examples:

- When doing stepwise integration with limiters, an anti-windup needs to be implemented:

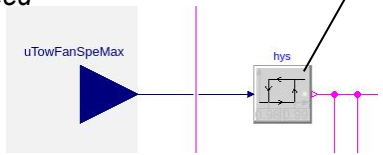
  "Increase "m" by 0.02 when the economizer is disabled if the economizer remained enabled for less than 30 minutes ...

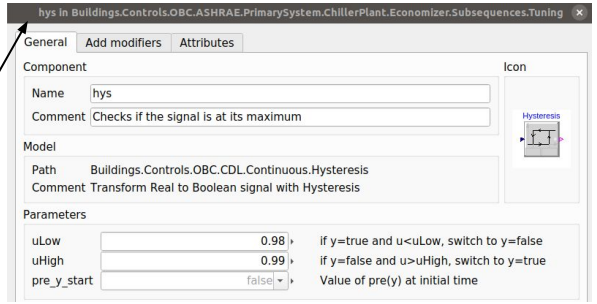
  "m" shall be limited to the range of -0.2 to 0.5."



- When performing quantity comparisons on analogue values (real numbers, for example fan speed), such as greater and smaller than, a hysteresis block needs to be implemented to account for effects such as sensor noise. This is not applicable for time measurement (for example when timing delays). [Click to see more info from user guide.]

  "WseTower-MaxSpeed did not decrease below 100% speed"





Example chiller plant

Control intent:

- Supply chilled water to cover cooling demand

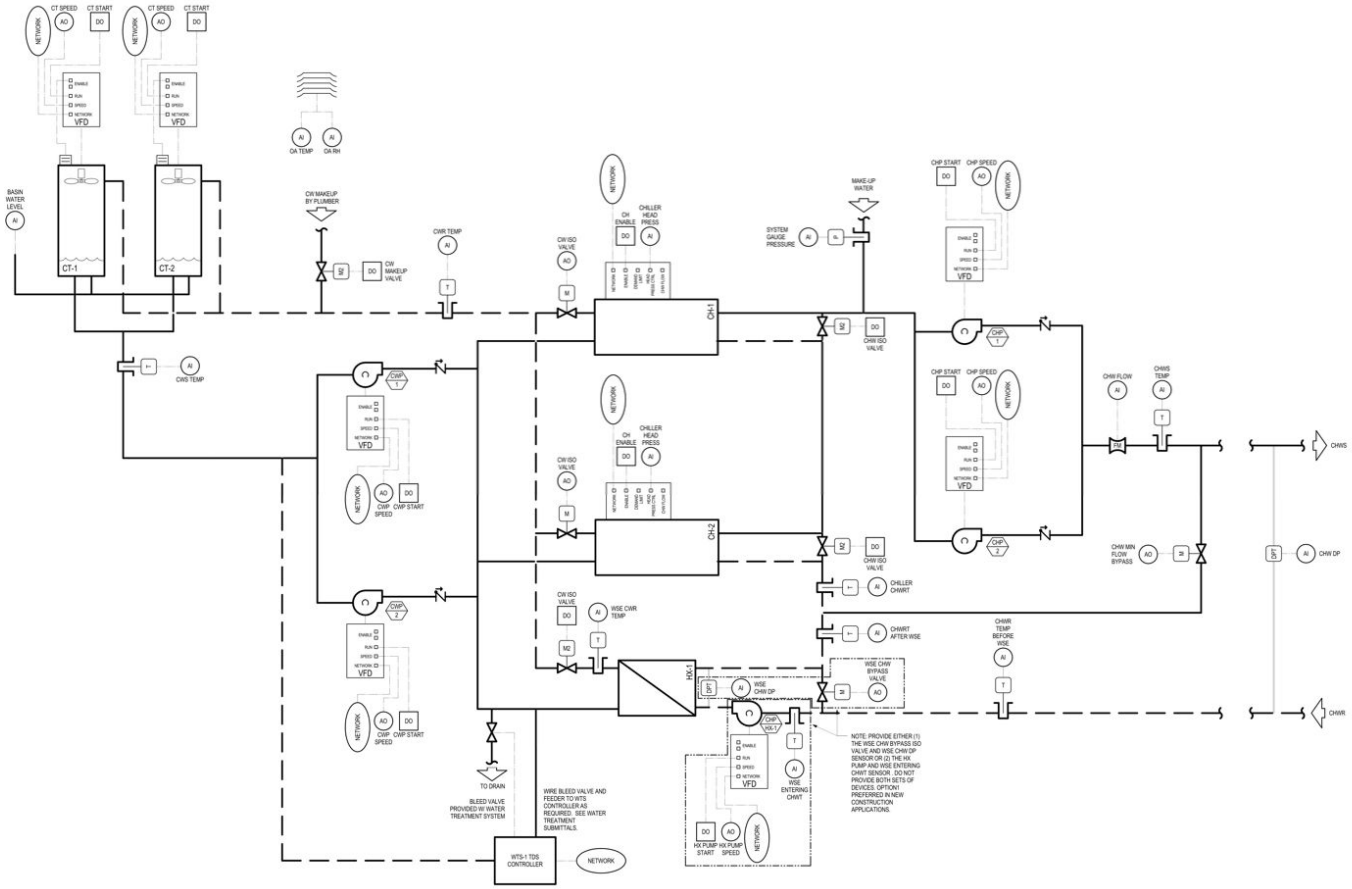
Refrigeration cycle and mechanical constraints:

- Minimum lift (controlled on the condenser side)
- Minimum chilled water flow (evaporator side)
- Equipment ramp-up times and system inertia

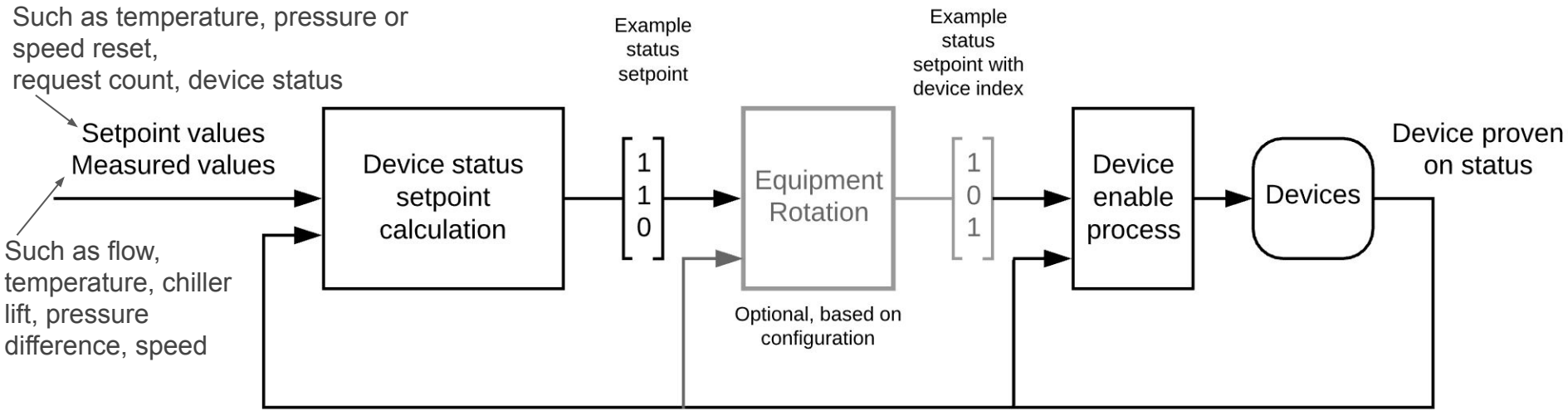
Efficiency constraint:

- Minimize energy use

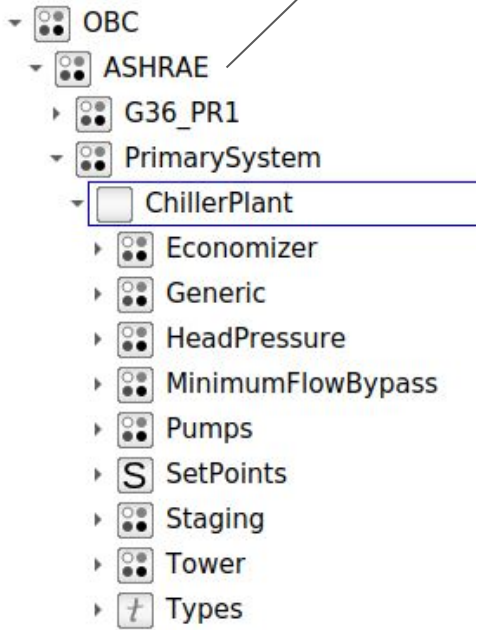
6.5 **Chilled Water Plants: Series Chillers with WSE, Variable Primary CHW, Variable CW, Headered Pumps**



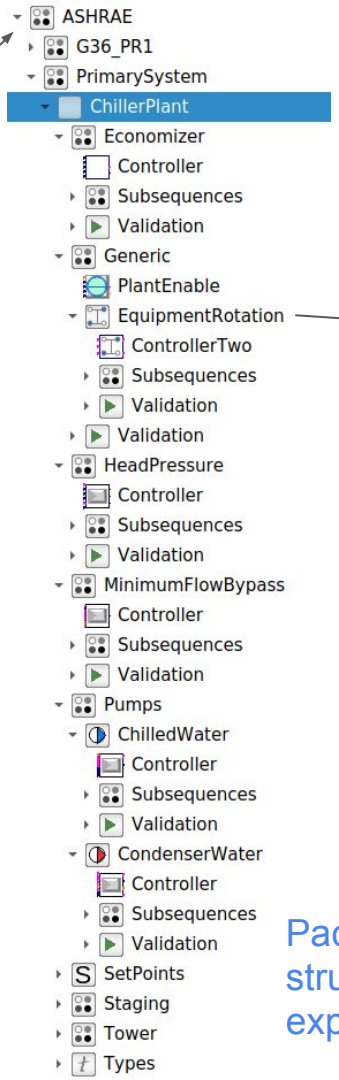
Overarching approach to device status control



Library package

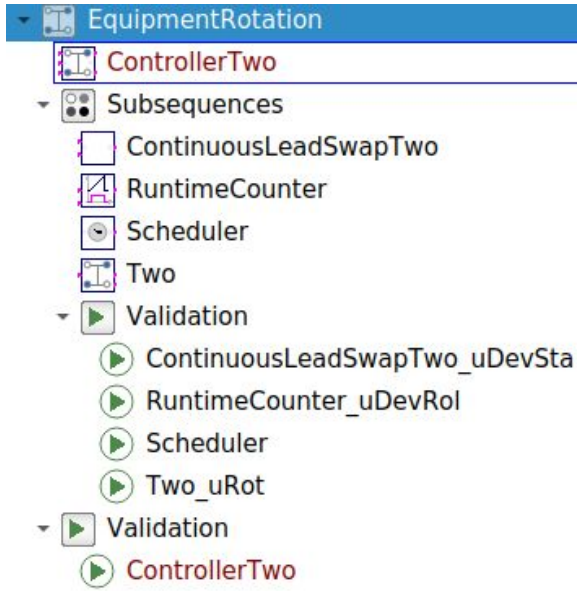


Package structure



Package structure expanded

Subpackage architecture

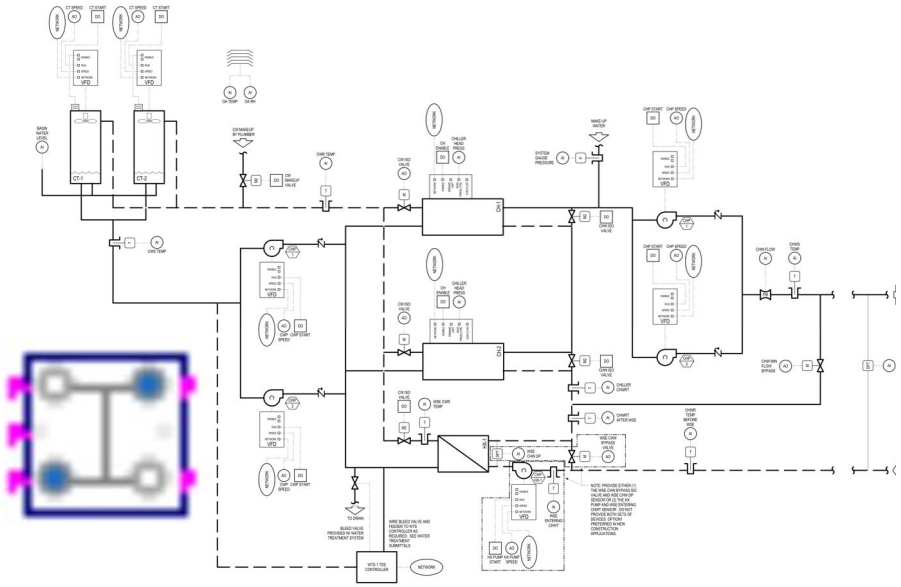


Controller architecture

Master controller

ASHRAE RP-1711:
Advanced Sequences of Operation for HVAC Systems Phase II – Central Plants and Hydronic Systems

6.5 **Chilled Water Plants: Series Chillers with WSE, Variable Primary CHW, Variable CW, Headered Pumps**



Dedicated controllers

ASHRAE RP-1711:
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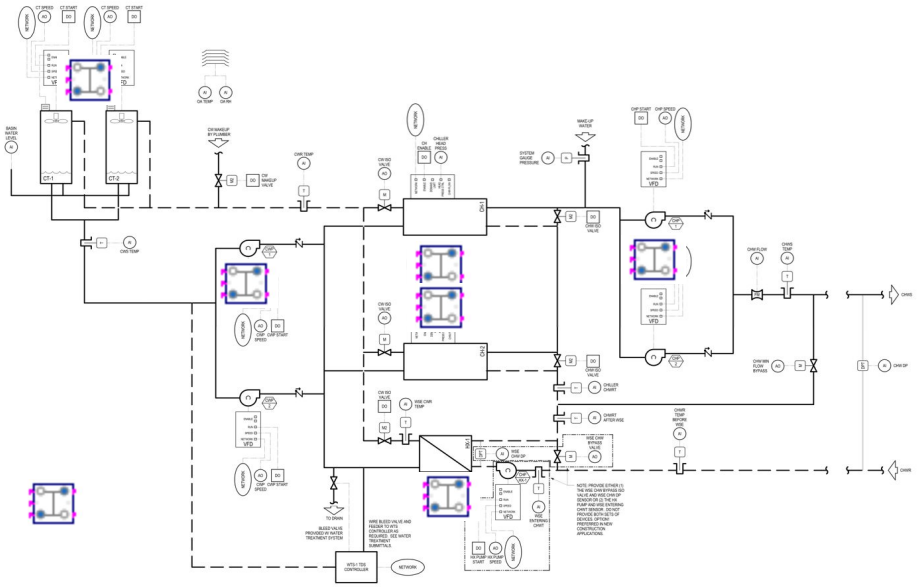
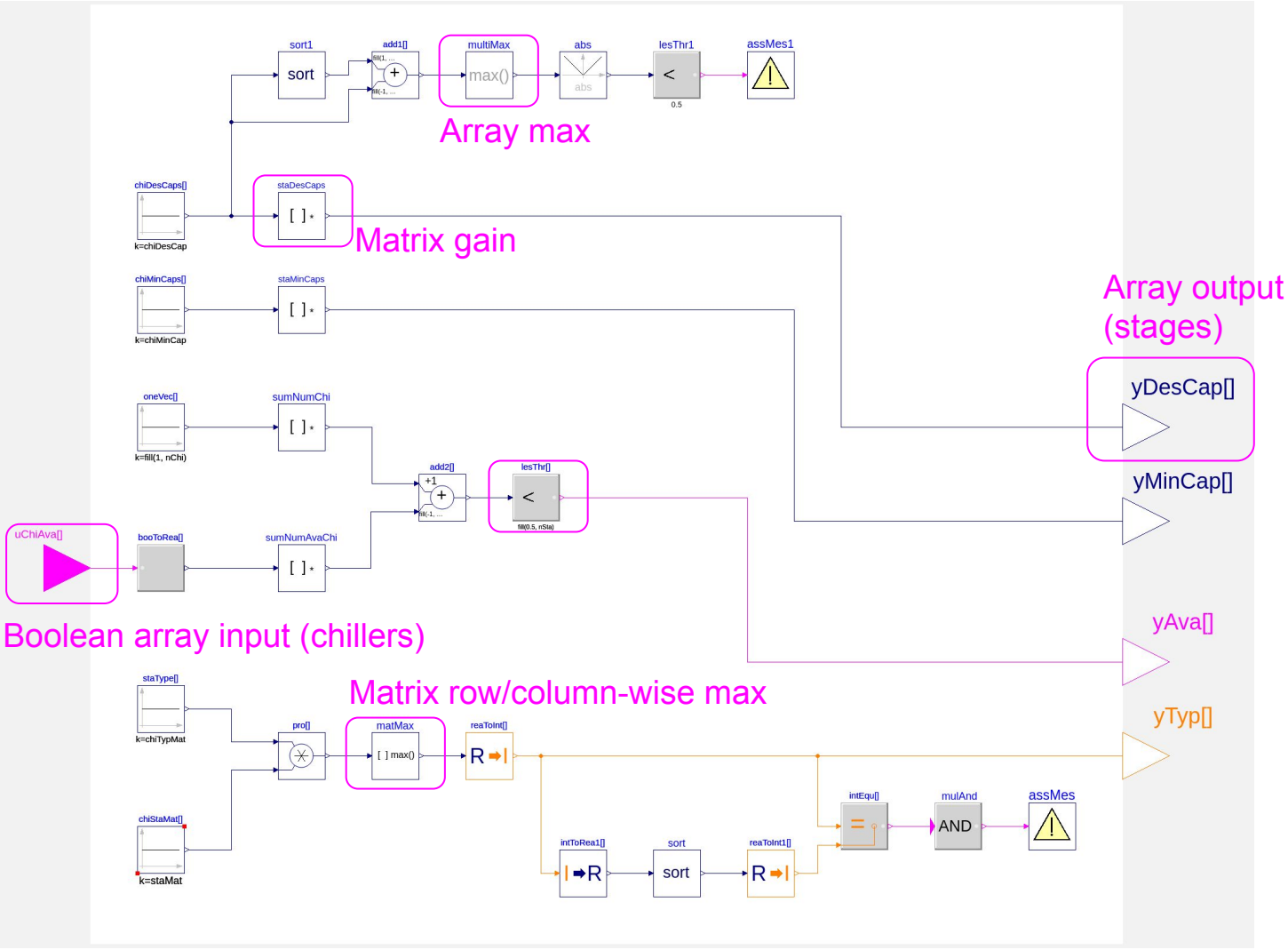
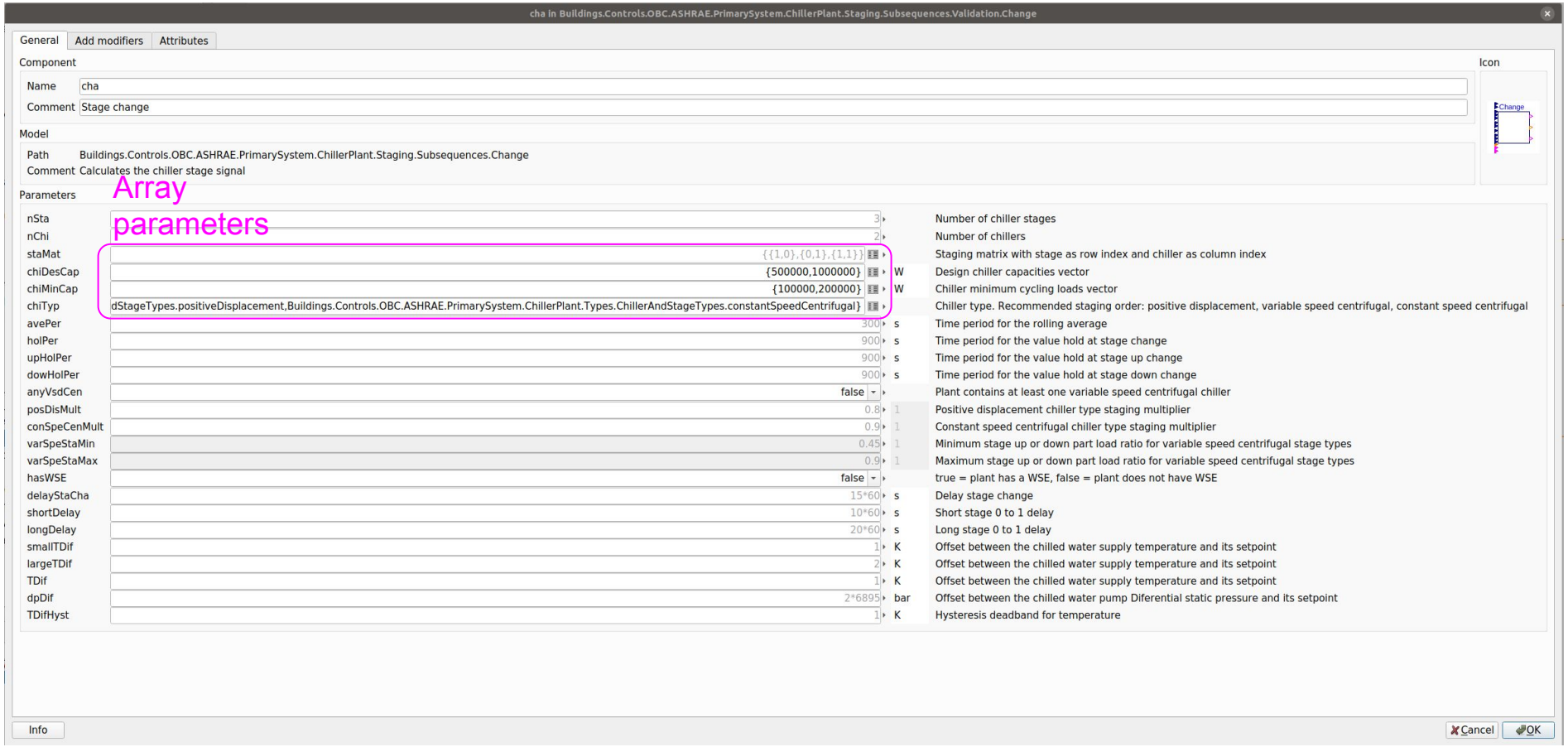
6.5 **Chilled Water Plants: Series Chillers with WSE, Variable Primary CHW, Variable CW, Headered Pumps**



Staging configurator: Involved usage of arrays



Stage change parameterization: usage of arrays



How you can contribute

- Feedback on controller architecture
- Feedback on usage of arrays
- Sequence implementation review (chiller plant)
- Sequence development
  - Boiler plant
  - Basic blocks such as heat recovery, room thermostat
  - Additional sequences for: radiant heating and cooling, secondary

Library structure examples

- Contents:
  - Controller/sequence/subsequence models
  - Validation models
- Secondary sequences:
  - Multi-zone VAV and
  - Single-zone VAV
- Primary sequences
  - Chiller plant