## Biased Economizer Sensor: Mixed Temperature

### Description

def description

return “When sensors drift and are not regularly calibrated, it causes a bias. Sensor readings often drift from their calibration with age, causing equipment control algorithms to produce outputs that deviate from their intended function. This measure simulates the biased economizer sensor (mixed air temperature) by modifying the SetpointManager object assigned to the economizer. The fault intensity (F) defined as the biased temperature level (K)."

end

### Modeler Description

def workspaceer\_description

return “Two user inputs are required and, based on these user inputs, the setpoint temperature at the mixed air temperature node will be replaced by the following equation, Tma\_setpoint,F, = Tma\_setpoint – F, where Tma\_setpoint,F is the mixed air temperature setpoint affected by the bias, Tma\_setpoint is the actual mixed air temperature setpoint, and F is the fault intensity. To use this Measure, choose the Controller:OutdoorAir object to be faulted. Set the level of temperature sensor bias that you want at the mixed air duct for the economizer during the simulation period. Positive value of F means sensor is reading higher value than the actual temperature. The algorithm checks if a real sensor exists in the mixed air chamber, and set up the bias at the sensor appropriately if it exists. For instance, SetpointManager:MixedAir does not model a real temperature sensor in the mixed air chamber, and will not be affected by this model."

end

### Measure Type

EnergyPlus Measure

**Taxonomy**

HVAC.HVAC Controls

### Arguments

def arguments(workspace)

args = OpenStudio::Ruleset::OSArgumentVector.new

#make choice arguments for economizers

controlleroutdoorairs = workspace.getObjectsByType("Controller:OutdoorAir".to\_IddObjectType)

chs = OpenStudio::StringVector.new

controlleroutdoorairs.each do |controlleroutdoorair|

chs << controlleroutdoorair.name.to\_s

end

econ\_choice = OpenStudio::Ruleset::OSArgument::makeChoiceArgument('econ\_choice', chs, true)

econ\_choice.setDisplayName("Choice of economizers.")

econ\_choice.setDefaultValue(chs[0].to\_s)

args << econ\_choice

#make a double argument for the temperature sensor bias

mix\_temp\_bias = OpenStudio::Ruleset::OSArgument::makeDoubleArgument("mix\_temp\_bias", false)

mix\_temp\_bias.setDisplayName("Enter the bias level of the mixed air temperature sensor. A positive number means that the sensor is reading a temperature higher than the true temperature. (K)")

mix\_temp\_bias.setDefaultValue(2) # default bias level at 2K

args << mix\_temp\_bias

return args

end

### Initial Condition

#Select economizer object that is being faulted.

runner.registerInitialCondition("Imposing Sensor Bias on "+econ\_choice+".")

### Final Condition

#Impose sensor bias on the economizer object.

runner.registerFinalCondition("Imposed Sensor Bias on "+econ\_choice+".")

### Not Applicable

#When fault measure is not applicable in the economizer model,

runner.registerAsNotApplicable("BiasedEconomizerSensorMixedT is not running for "+econ\_choice+" because of inapplicability. Skipping......")

### Warning

n/a

### Error

#When the node (mixed temperature) name is found in the nodelist instead of node,

runner.registerError("Nodelist is found instead of node. Exiting......")

#When selected economizer cannot be found in the model,

runner.registerError("Measure BiasedEconomizerSensorMixedT cannot find "+econ\_choice+". Exiting......")

### Information

* Works with,
  + SetpointManager:OutdoorAirReset
  + SetpointManager:SingleZone:Reheat
  + SetpointManager:SingleZone:Heating
  + SetpointManager:SingleZone:Cooling
  + SetpointManager:OutdoorAirPretreat
  + SetpointManager:MultiZone:Cooling:Average
  + SetpointManager:MultiZone:Heating:Average
  + SetpointManager:Warmest
  + SetpointManager:Coldest
  + SetpointManager:WarmestTemperatureFlow
  + SetpointManager:FollowOutdoorAirTemperature
  + SetpointManager:FollowGroundTemperature
  + SetpointManager:FollowSystemNodeTemperature
  + SetpointManager:SingleZone:OneStageCooling
  + SetpointManager:SingleZoneOneStageHeating SetpointManager:Scheduled
  + SetpointManager:Scheduled:DualSetpoint
  + SetpointManager:ReturnAirBypassFlow
  + SetpointManager:MixedAir
* Leakage at the downstream of zone terminal unit.

### Code Outline

* Define arguments (economizer where fault occurs, fault level in constant value).
* Find the economizer where the fault occurs.
* Find the node name of the mixed air chamber.
* Verify the type of SetpointManager object used at the mixed air chamber.
* Impose sensor bias according to the type of SetpointManager Object as shown below.

|  |  |
| --- | --- |
| SetpointManager:OutdoorAirReset  SetpointManager:SingleZone:Reheat  SetpointManager:SingleZone:Heating  SetpointManager:SingleZone:Cooling  SetpointManager:OutdoorAirPretreat  SetpointManager:MultiZone:Cooling:Average  SetpointManager:MultiZone:Heating:Average  SetpointManager:Warmest  SetpointManager:Coldest  SetpointManager:WarmestTemperatureFlow  SetpointManager:FollowOutdoorAirTemperature  SetpointManager:FollowGroundTemperature  SetpointManager:FollowSystemNodeTemperature  SetpointManager:SingleZone:OneStageCooling  SetpointManager:SingleZoneOneStageHeating | Reduce the setpoint in each object by the value of sensor bias to impose fault.  Setpointfault = Setpoint - bias |
| SetpointManager:Scheduled  SetpointManager:Scheduled:DualSetpoint  SetpointManager:ReturnAirBypassFlow | Use EMS to impose fault.   * Define sensor object (storing actual sensor values). * Define program object (calculate faulted sensor measurement). * Define ProgramCallingManager object (define EMS calling point). * Define Actuator object (apply sensor bias to economizer object(s)). |

### Tests

* Test model with several SetpointManager objects shown in above table.
* Test invalid user argument values to make sure measure fails gracefully.