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ENGINEERING AND SOFTWARE REQUIREMENTS OF THE AUTOMATED BUILDING COMMISSIONING ANALYSIS TOOL (ABCAT)

Prepared for the
National Association of State Energy Officials

By

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Table of Contents

Disclaimer **3**

Acknowledgements **4**

Engineering Requirements Error! Bookmark not defined.

Software Requirements **5**

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Engineering Requirements

1. Building and HVAC System Requirements

The building and HVAC systems should have undergone comprehensive commissioning. Both mechanical system conditions and automation control schedules should have been documented. The hourly historical energy data, such as cooling energy consumption, heating energy consumption, and whole building electricity, should be available for model calibration.

2. Metering Requirements

The building should have at least the following metering devices: whole building electricity meter, chiller energy consumption meter or chilled water energy meter,, and gas meter or heating hot water energy meter. These meters can be dedicated meters or part of the building automation system.

3. Automation System Requirements

The building automation system should be able to track and download as many of the following parameters as possible:

a. Return air temperature and relative humidity (required)
b. Fan and pump speeds where VFD is installed.
c. Fan and pump energy consumption from VFD
d. Air handler operating schedules
e. Supply air static pressure set point and supply air temperature set point
f. Water loop differential pressure set point and water temperatures.

Software Requirements

1. Inputs and Simulation Engine

The ABCAT will receive true outside air conditions which include outside air temperature and relative humidity. Inputs to the ABCAT engine will be calibrated so the heating and cooling consumption predicted by the engine closely track measured HVAC consumption and result in zero mean bias error during a defined period when the building is known to be operating correctly. The ABCAT engine will predict the hourly HVAC system energy consumption, which includes both cooling energy consumption and heating energy consumption.

2. Fault detection

The system will detect both energy faults and comfort faults. By comparing the predicted energy consumption with actual energy consumption, ABCAT will identify excessive energy consumption problems, which include:

a. Excessive cooling energy consumption;
b. Excessive heating energy consumption; and sometimes
c. Excessive motor energy consumption

By comparing the measured return air conditions with required air conditions, ABCAT will identify comfort problems, which will include some building zones:

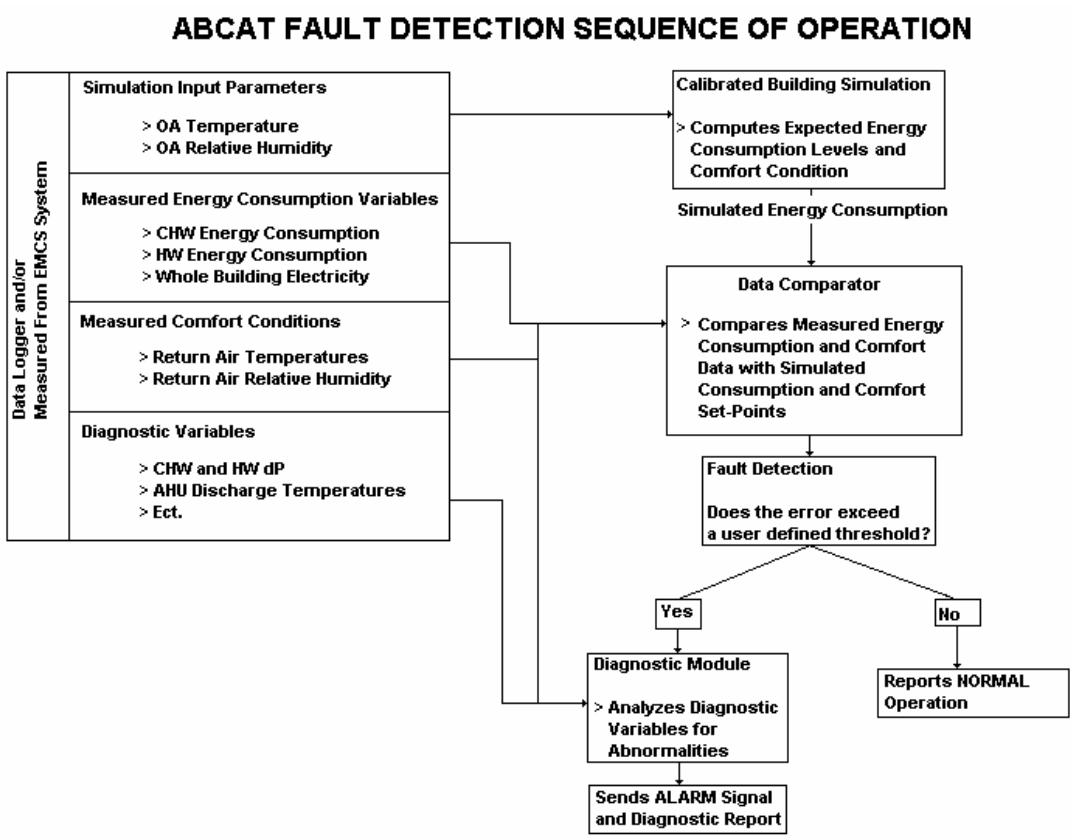
a. Too cold.
b. Too warm.
c. Too humid.

ABCAT will create an input file for further fault diagnostics when a fault is identified. The input file will contain all measured data and simulated data.

3. Fault diagnostics

The ABCAT fault diagnostic procedures will identify mechanical and control faults in the building and HVAC systems that are probable causes for each energy and/or comfort fault identified during fault detection. The mechanical faults and control faults considered will include problems with:

a. Fan speed control
b. Pump speed
c. Outside air control
d. Terminal box minimum air control.
e. Supply air temperature control
f. Supply air static pressure control
g. Control sensors, such as differential pressure sensors, static pressure sensors, and temperature sensors
h. Damper control/leakage
i. Valve leakage

4. ABCAT Process

A conceptual flow diagram of the ABCAT fault dete**ction process is shown below.**