EAc1 – Enhanced Commissioning

This report demonstrates compliance of the University of Texas at Austin's district energy system with Energy & Atmosphere Credit 3, Enhanced Commissioning, as defined by "approach 2" on page 8 of the supporting document Treatment of District or Campus Thermal Energy in LEED V2 and LEED 2009 – Design & Construction.

The objective of the DES guidelines for EAc3 is to show that all equipment upstream of the building, including central plants and distribution network, are operated and monitored in a way that ensures ongoing energy efficiency performance meets or exceeds the DES design intent.

UT's district energy system, managed by the Utilities & Energy Management Department (UEM), includes a natural gas powered combined heating and power facility supplying all electricity and heating steam to campus buildings. Electricity and steam are also provided to five chilling stations generating chilled water for campus cooling needs. All utilities are distributed in a distribution network of tunnels, direct-buried piping and duct banks owned and maintained by the Utilities & Energy Management Department.

The University of Texas has been operating a central power plant and distribution on campus since 1929, qualifying for approach: "Pre-existing DES" This approach requires two primary components:

- Show that preventive maintenance, corrective maintenance, and efficiency monitoring programs have been and are in place
- Show that DES energy efficiency performance has been tested, recorded and improved as needed under those programs within the past three years

These components as applied to the UT Utilities & Energy Management Department are detailed in the following sections.

DES efficiency monitoring, preventive maintenance, and corrective maintenance programs

For purpose of this demonstration, UT's district energy system can be divided into two areas:

1. Generation, including the combined heating and power (CHP) plant generating electricity and steam from natural gas, and the chilling stations generating chilled water via chillers driven by electric motors
2. Distribution, including the network of electrical duct banks, and steam, condensate, and chilled water pipes and pumps from generation point to building interface

The preventive maintenance, corrective maintenance, and efficiency monitoring programs that exist for these sections are explained below.

Generation

Efficiency Monitoring

All generation equipment is continuously monitored in real-time to ensure best possible efficiency in a variety of operational scenarios. Several dedicated computer modeling platforms allow for instant

visualization of operating conditions and efficiencies, as well as generating alerts if any equipment is operating below desired efficiency levels.
Thousands of digital data points within the DES, representing the outputs of flow meters, temperature elements, pressure transmitters, etc., are pulled back to the central servers of the Utility & Energy Management's private network. Along with providing real-time monitoring of the equipment within utilities, this data is recorded by Data Historian, allowing ongoing or historical analysis of any operating condition, often down to within 15 second resolution. Specific data sets and correlations can be quickly trended and evaluated by plant engineers and operators, providing the ability to analyze the performance down to even the smallest pumps and fans.

The Plant Health Index (PHI) system is a proprietary software package developed by BNF Technology, Inc. that monitors plant parameters in real time and compares the values to historical data sets. The software is "trained" by combing the historical data and selecting periods of operation where the equipment was operating at the best efficiency. By comparing current operations with these "ideal" data sets, any equipment or instrument degradation can be seen and addressed before failure occurs, greatly increasing the reliability and efficiency of the combined heat and power system.

Specific to the Chilling Station 3, Chilling Station 6 and Chilling Station 7, the newest and largest chilling station on campus, the Optimum Energy System provides real-time monitoring of performance and output of the chillers and primary chilled water pumps. This system can provide recommendations and adjustments to meet the chilled water demand in the most efficient manner possible.

Preventive and corrective maintenance

Many of the efficiency monitoring systems roll over into preventive and corrective maintenance practices. The Optimum Energy System, for example, collects weekly data sets and uploads them to Optimum Energy's main servers, where they are analyzed for any discrepancies and a report is returned indicating any potential problems that warrant investigation.

The maintenance division of the Utilities & Energy Management Department follows both time-based and condition-based maintenance programs. These programs are based on the original equipment manufacturers' guidelines and adjusted to best fit the requirements and constraints of UEM operations.

Time-based maintenance includes scheduled outages of equipment for overhaul, such as replacement of filters, repair or replacement of pump seals, nondestructive evaluation (NDE) of turbine blades and boiler tubes, and many other practices recommended by the manufacturer or judged as best-practice by department staff.

Condition-based maintenance includes the constant monitoring of physical conditions of equipment. This is as simple as hourly visual walkthroughs by plant operators to as complex as vibration monitoring and analysis of equipment and lab sampling of lubrication oils. The Plant Health Index system previously mentioned provides a very useful active monitoring tool for the operators and maintenance

groups. Chilling stations actively inventory all refrigerants and institute an ongoing leak check program to ensure maximum possible performance of the chillers.

Both time and condition based maintenance practices are used to evaluate the necessity of repair or improvement to operating equipment. In the event of necessary repairs and maintenance, UEM will frequently consult or have onsite field service experts from the manufacturer to ensure that the repairs are carried out to meet the original design intent of the equipment.

Distribution

Efficiency Monitoring

Distribution of electricity, steam, and chilled water results in losses that UEM aims to minimize. The campus electrical grid is relatively small and line losses are negligible. Any upset is quickly identified and repaired as a maintenance issue. Losses through steam and chilled water distribution loops are more complex and require more diligent monitoring.

The chilled water distribution loop has been modeled utilizing Termis, a hydraulic modeling package developed by 7T and customized specifically for UEM's chilled water distribution. This model allows for real-time analysis of pressure losses and temperature gradients and can be used to predict optimum valve line-up and pump loads, drastically reducing the energy requirements to distribute chilled water.

Preventive and corrective maintenance

The Termis chilled water distribution model alerts to any conditions where a valve or pump was malfunctioning within the distribution loop, and records of make-up water rates to the closed-loop system would indicate any leaks that need to be tracked down and addressed.

DES energy efficiency performance

Efficiency measurement and recording occur continuously and has been in practice since the plant's inception in 1929. The following data represents data for the past 3 fiscal years, for thermal efficiency of the CHP plant and kW/Ton for the chilling stations.

Annual averages:

Fiscal Year	CHP Thermal Efficiency (HHV)	Chilling Plant Total kW/Ton
2013	54%	0.63
2014	54%	0.62
2015	54%	0.65