CT AEE 2018 Energy Trends Fair

Bringing Fault Detection and Diagnosis (FDD) Tools into the Mainstream: Retro Commissioning & Continuous Commissioning of HVAC and Refrigeration Systems

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What is FDD?

- Fault Detection and Diagnosis (FDD) is the process of identifying fault(s) in the system by sensing key performance parameters, diagnosing and communicating them.
- FDD is similar to “Engine Check Light” or “Low Tire Pressure” or “Low Oil Indicator” in your car, but **even better**

Why FDD in HVAC&R?

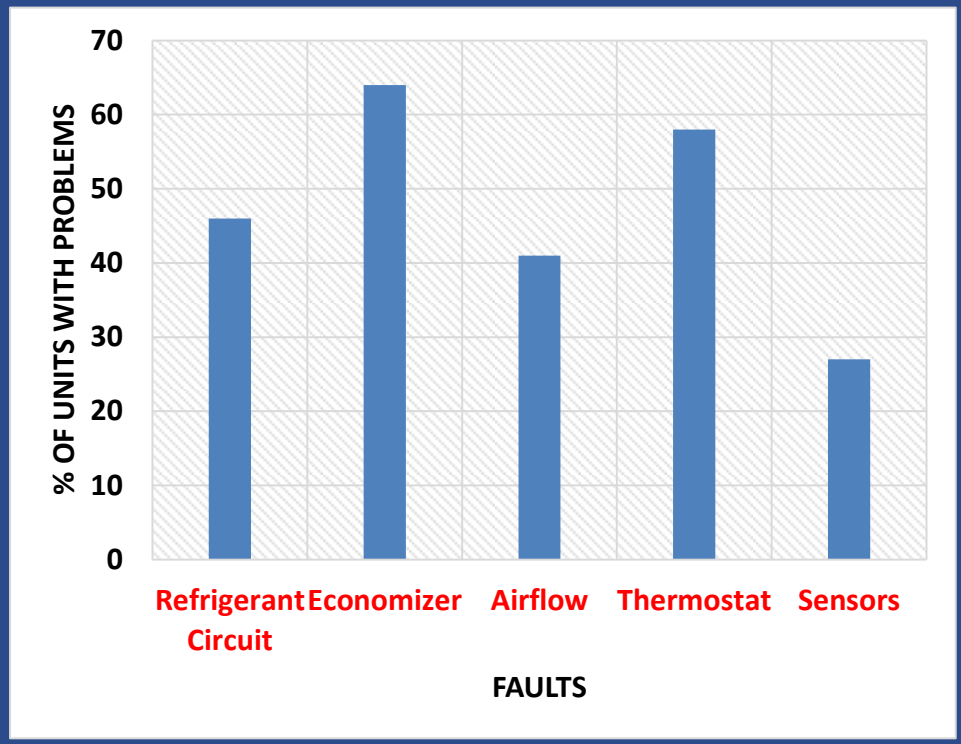
- HVAC accounts for over 30% of all commercial building energy costs
- Packaged rooftop air-conditioning units (RTUs) provide cooling for over 60 percent of the commercial building space (87 billion ft^2) in the U.S. and consume 2.6 quads of primary energy
- Refrigeration accounts for 10-16% of energy consumption in restaurants and 44-62% in supermarkets.
- HVAC&R Systems invariably suffer from Faults
- Has the potential for saving energy and preventing catastrophic failures

Why FDD in HVAC&R?

Common Faults

- Restricted indoor airflow
- Restricted outdoor airflow
- Incorrect refrigerant charge
- Refrigerant line blockage
- Malfunctioning expansion device
- Compressor valve leakage
- Non-condensable gases
- Short cycling
- **Economizer Faults**

Fault Prevalence



Source: "Automated Fault Detection & Diagnostics for Rooftop Packaged Air Conditioners," A Case Study, California Energy Commission's Public Interest Energy Research Program.

Economizer Faults – Energy Codes

- **California Energy Code's Title 24, Part 6 Section 120.2(i) requires that economizer fault detection and diagnostic functions (FDD) be installed on air-cooled unitary air conditioning systems over 4.5 tons cooling capacity.**
- Enacted in 2008 but specified requirements in 2014
- Economizer Faults: 1. Air temperature sensor failure/fault; 2. Not economizing when it should; 3. Economizing when it should not; 4. Damper not modulating; 5. Excess outdoor air

HVAC FDD Technologies

- On-Board (Factory Installed/Retrofit), Portable In-Field FDD
- Software as a Service (SaaS) FDD – Use BMS/BEMS
- Automated FDD (AFDD), Manual FDD

Commercially Available Products

- More than 100 FDD tools available
- Residential and commercial
- Several of them with only Economizer faults
- About 40 commercial FDD tools

But “Market Penetration” is lagging behind

Solution → Bringing Fault Detection and Diagnosis (FDD) Tools into the Mainstream: Retro Commissioning & Continuous Commissioning of HVAC and Refrigeration Systems

- Current Project Funded by the US Department of Energy under “Scaling-Up the Next Generation of Building Energy Efficiency Packages”

- Cost-Share by Energize CT through Eversource and UI, UNH, UCONN and UTRC

- Three Year Project

The Project Scope

- **Demonstrate technical and economic feasibility of Automated Fault Detection and Diagnosis (AFDD) technologies for retro-commissioning and continuous commissioning of HVAC&R through field testing.**
- **Identify pathways and commercialization strategies to promote widespread adoption of AFDD by bringing together all stakeholders to identify/analyze and address market barriers.**
- **Support the development and roll out of utility incentive programs for the use of AFDD to promote energy efficiency in commercial buildings.**
- **Contribute to stakeholder education, outreach and dissemination; undertake workforce development and training.**

The Team

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Technical Project Officer: Amy Jiron
Project Engineer: Robin Gross
U.S. Department of Energy / EERE

Advisory Board

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Jesus Amado, Undergraduate Student – Team Leader
Amanda Rimkunas – Technology/Communications
Albert Blank – Technology Leader
Other support staff

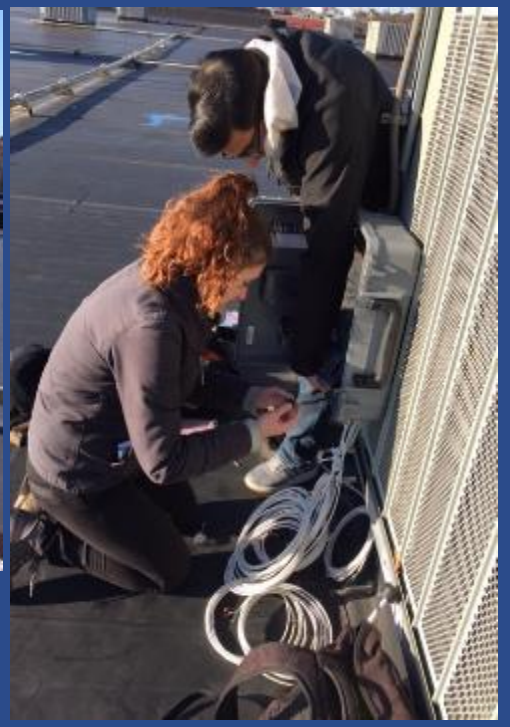
Advisory Board

- **Michael Deru**, National Renewable Energy Laboratory
- **Marco Pritoni**, Lawrence Berkeley National Laboratory
- **Vance Payne**, National Institute of Standards and Technology
- **Srinivas Katipamula**, Pacific Northwest National Laboratory
- **David Yuill**, University of Nebraska-Lincoln
- **Others** – to be recruited from the Industry

Related Experience

- Current FDD pilot sponsored by United Illuminating/Eversource
- Installation at two sites completed, third is planned
- This DOE project is comprehensive and builds on the foundation laid by the UI/Eversource project

Pilot FDD Project Installations

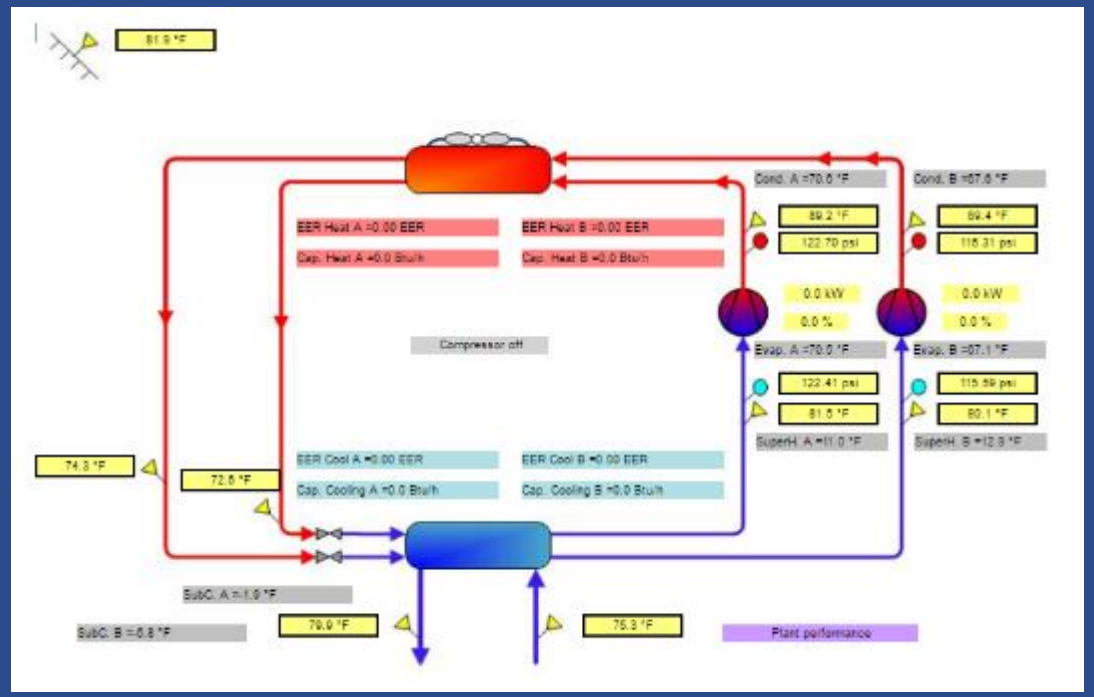


Joann Fabrics Milford, CT

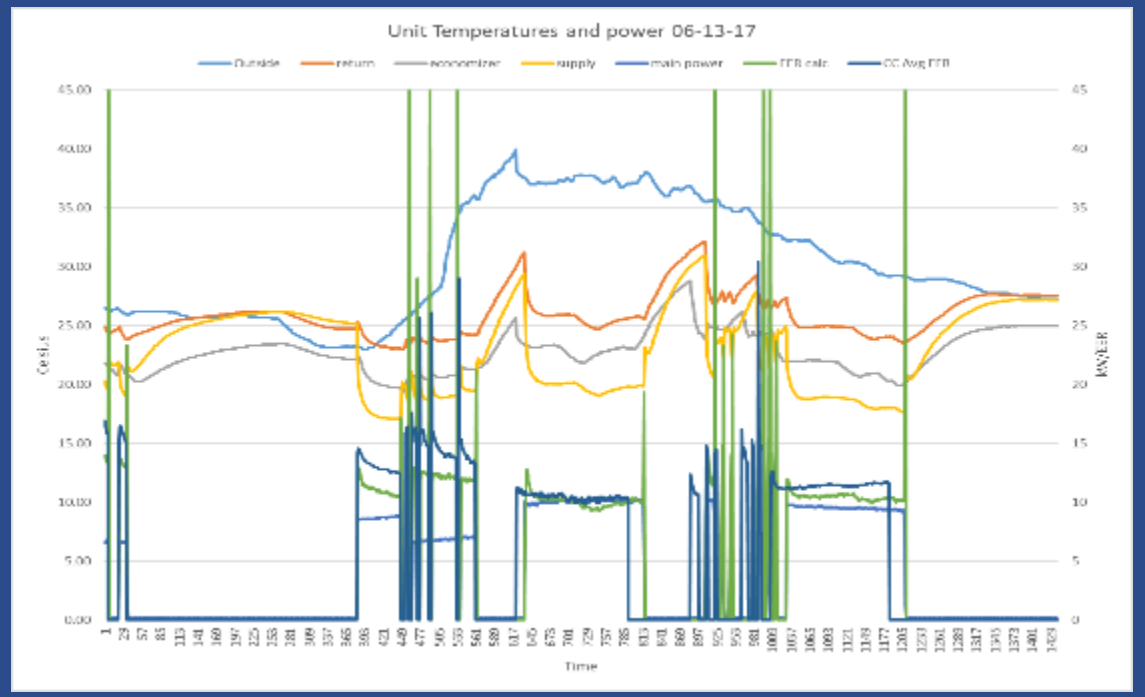
Future Installation

Stamford, CT

Validation



ClimaCheck Data



UNH/ClimaCheck Verification

The DOE FDD Project Tasks

- Identify and select commercially available FDD products
- Identify and select sites (a minimum of 10)
- Develop M&V protocols
- Install, undertake retro-commissioning and continuous commissioning
- Analyze data, help develop utility incentives
- Develop education, outreach and training materials

Opportunities

- Site Study Participants
  - Free FDD installation and service
  - Incentive for participating: ($2,000) – could be used for repairs if faults are detected
- HVAC contractors
  - Subcontracts for installation and support
  - Provide stakeholder input to study through feedback mechanisms: (Surveys, Questionnaires, Workshops)

Follow The Project for Future Opportunities

- Website
  https://www.unewhaven-doe-fdd.com/
- Facebook Page
  Connecticut-FDD-for-HVACR-Demonstration-Project

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