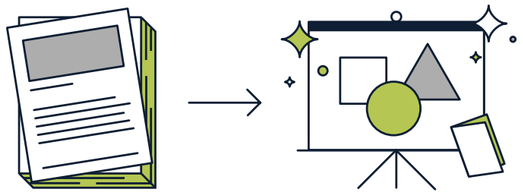
What is TA&D?

TA&D is a process developed by Electric Power Research Institute (EPRI) for sharing the story of the California Energy Commission's (CEC) Electric Program Investment Charge (EPIC) projects funded by Southern California Edison (SCE) rate payers.

TA&D presents learnings and opportunities from each project, distilled into engaging presentations and materials that provide real-time updates on the latest advancements from EPIC integrated demand side management (IDSM) and distributed energy resource (DER) technologies.



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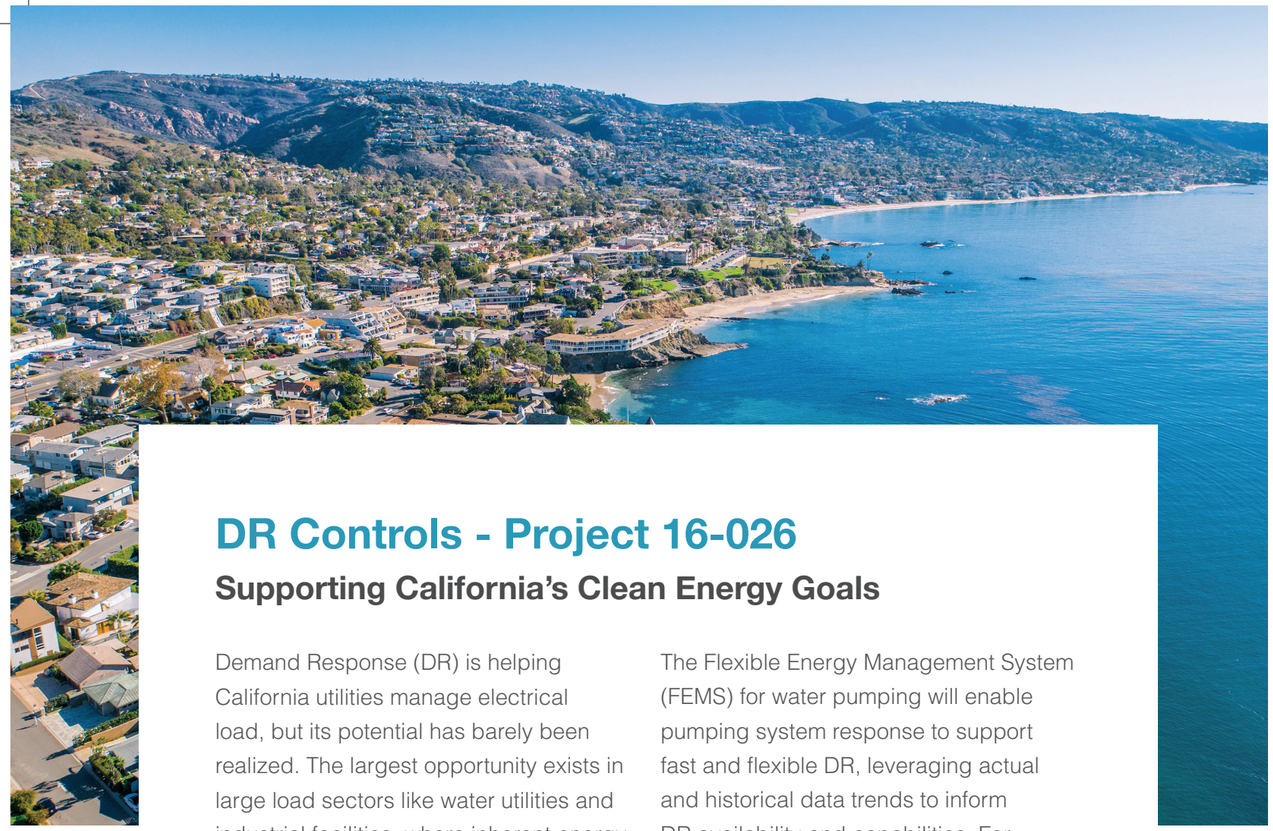
Technology Assessment & Delivery

Demand Response Control Strategies (DR Controls)

Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants.

CEC EPC 16-026

February 2020



DR Controls - Project 16-026

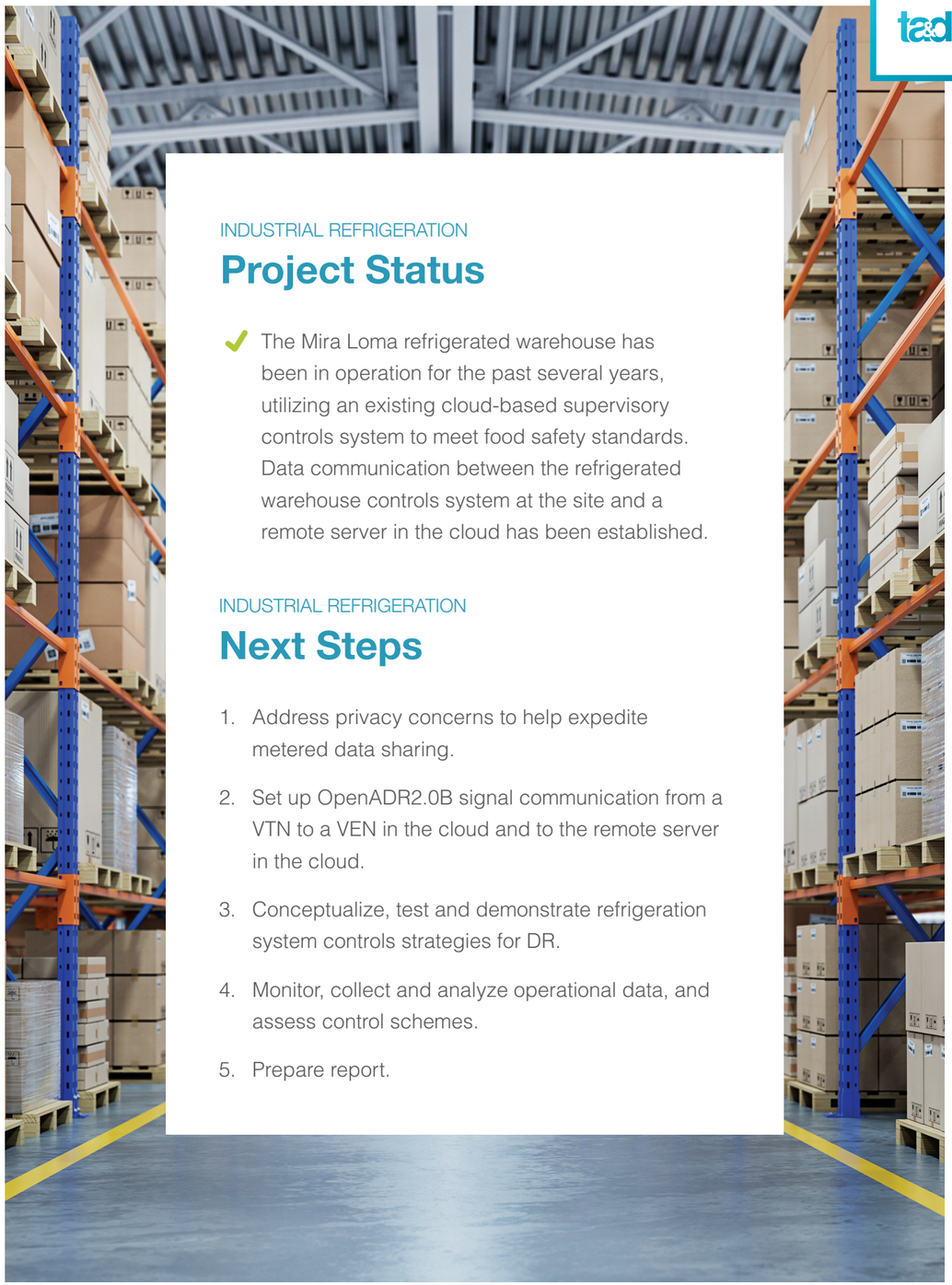
Supporting California's Clean Energy Goals

Demand Response (DR) is helping California utilities manage electrical load, but its potential has barely been realized. The largest opportunity exists in large load sectors like water utilities and industrial facilities, where inherent energy storage is present and may potentially be leveraged to provide demand response at a large scale. Specific end use sectors, such as water-pumping utilities and cold storage warehouses, could become key DR resources to support California's grid management goals. There has been little testing of DR technology to date, and automation development is another key component for success.

Led by the Electric Power Research Institute (EPRI), EPC Project 16-026 is developing and testing integrated control strategies for fast and flexible DR for two important end-use sectors: water delivery and refrigerated warehouses.

The Flexible Energy Management System (FEMS) for water pumping will enable pumping system response to support fast and flexible DR, leveraging actual and historical data trends to inform DR availability and capabilities. For refrigeration, electricity usage and control schemes will be integrated into the existing supervisory energy management and control system and will use these data inputs to inform fast and flexible control of the refrigeration equipment on receipt of a DR signal.

Successful development and adoption of these systems will enable faster and more flexible demand response, resulting in optimized on-site operations and energy bill savings. The solution integrates controls, customer site electricity costs, historical load data, retail tariff information, and utility DR signals to facilitate optimized demand response utilization.



INDUSTRIAL REFRIGERATION

Project Status

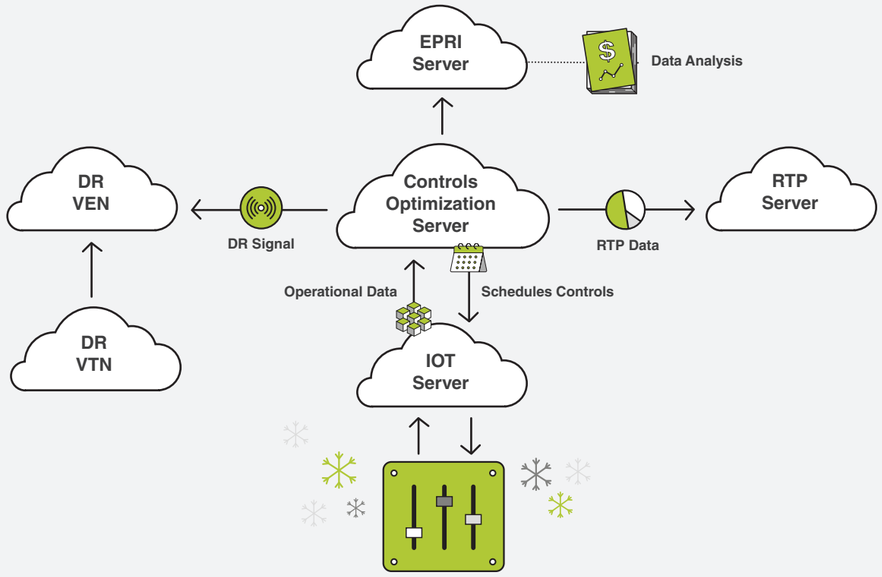
- ✓ The Mira Loma refrigerated warehouse has been in operation for the past several years, utilizing an existing cloud-based supervisory controls system to meet food safety standards. Data communication between the refrigerated warehouse controls system at the site and a remote server in the cloud has been established.

INDUSTRIAL REFRIGERATION

Next Steps

1. Address privacy concerns to help expedite metered data sharing.
2. Set up OpenADR2.0B signal communication from a VTN to a VEN in the cloud and to the remote server in the cloud.
3. Conceptualize, test and demonstrate refrigeration system controls strategies for DR.
4. Monitor, collect and analyze operational data, and assess control schemes.
5. Prepare report.

DR Controls Optimization Server for Industrial Refrigeration



Site Control System
(Industrial grade secured architecture)

1. The refrigerated controls system initiates contact with the remote server, establishes credentials and downloads operational data to the remote server, reading controls sequences stored in the remote server in the cloud.
2. The remote server calculates an optimized operation schedule under the real time pricing schedule obtained from the electricity provider's server and operating set points and keeps in a file in the cloud. This file is read the next time the refrigerated controls system connects with the server in the cloud.
3. The refrigeration controls system initiates connection with the remote server in the cloud periodically after a certain time, currently set at 15 minute intervals.
4. The real time pricing server from the electricity provider—the refrigeration warehouse facility is a direct access customer—initiates contact with the remote server in the cloud and downloads the real time pricing schedule, which is used for calculating the optimized operational schedule and set points.

Project Goals

The primary objective is to achieve 20% demand reduction or adjustment in the water delivery and refrigerated food warehouse sectors in support of California's goals for DR, energy efficiency, renewables integration, and greenhouse gas emissions reductions. Project goals include:

Identify control strategies appropriate for fast and flexible demand response.

Advance industry understanding of best practices for employing load control.

Develop a market-signaling interface using open Automated Demand Response 2.0 (OpenADR2.0B).

Test developed strategies in a water pumping station and an industrial refrigeration warehouse.

Design and implement FEMS to integrally manage water pumping or refrigeration warehouse loads while responding to operational and system constraints.

Project Partners

Technology Providers
- CPower
- Aqua Sierra Controls
- CrossnoKaye
- MelRok

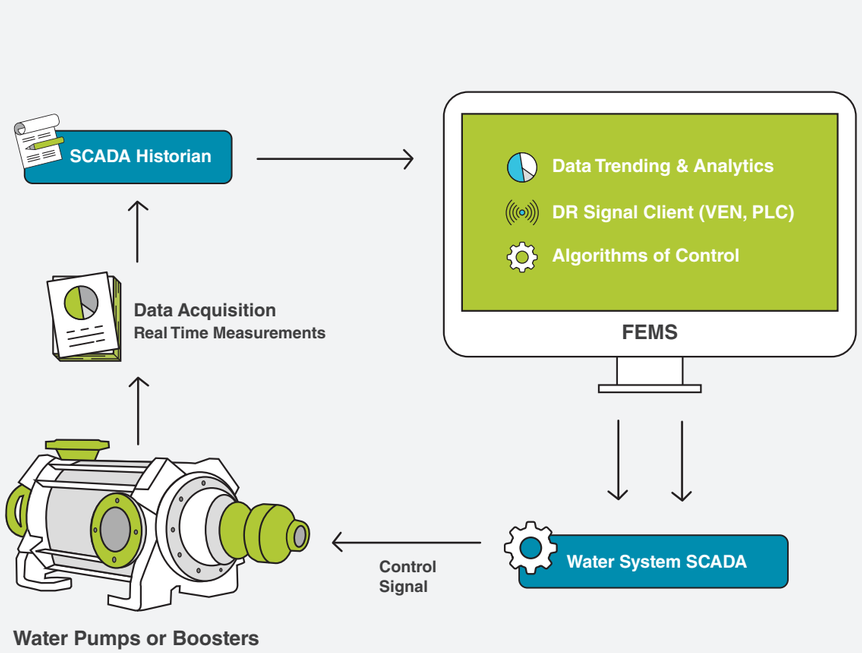
Demonstration Sites
- Cal Water Service
- Lineage Logistics

Utilities
- SCE
- SDG&E

Developing a Technical Framework for Flexible Demand Response

The methodology for EPC 16-062 centers around the development of a technical framework for flexible demand response using FEMS. Two sites have been selected to pilot fast and flexible control strategies. The FEMS at the two sites are slightly different. While the FEMS at the water pumping site is newly built, the FEMS at the refrigeration warehouse has been integrated into an existing cloud-based supervisory controls system.

Design for Flexible Energy Management System (FEMS)



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Industrial Refrigeration

DR for an industrial refrigeration plant requires developing control strategies that support power reduction during peak load events. System upgrades facilitate monitoring and collecting of current performance data and its communication with a cloud-based platform where data are analyzed, and controls strategies are selected on receipt of a DR signal. OpenADR2.0B facilitates the communication necessary for this data collection but cyber security is a major concern when it comes to food safety and tampering. EPRI is working closely with Lineage Logistics to test DR strategies while managing to cyber security standards for industrial refrigeration.

Activities include:

1. Cloud-based supervisory controls software upgrades implemented.
2. Monitoring and collecting data on:
    - Energy consumption from the utility meter.
    - Refrigerated space temperature.
    - Refrigeration plant operating parameters.
    - Operating set-points, refrigeration ramp rates.
    - Analytics of DR strategies.

WATER PUMPING

Current Findings

- A taxonomy for flexible water pumping illustrates retail water pumping analogous to wholesale water pumping.
- Water system storage embodied in tanks and reservoirs provides the flexibility required for water system DR participation.
- The amount of water system pumping flexibility depends on a case by case basis. For the published study “Flexible Water Pumping”, a wholesale water agency reported a vast amount of storage and could delay pumping for at least a day with advanced preparation (EPRI # 3002014861).
- The decision support tool designed for wholesale water pumping differs from that of retail water pumping, based on the level of sophistication of current water SCADA systems and availability of information to the water system operator.
- The existing variable capacity pump at the Montebello station pilot site is operating very frequently, with existing plans by Cal Water to install a second pump, which would provide more operational flexibility.
- Implementing a cloud-based data exchange architecture was preferred by the pilot site SCADA manager, but required over 6 months to obtain requisite approvals for this first-of-its-kind implementation at Cal Water. Executive and IT department approvals were necessary.

WATER PUMPING

Next Steps

1. Implement cloud server and interface to enable cloud-base data exchange interface with SCADA Historian and FEMS System.
2. Develop and test the FEMS database and software.
3. Demonstrate DR strategies for flexible water pumping within water operational constraints.
4. Understand operator tolerance for engaging response from water pumps.

Pilot Locations

1 Water Pumping Station

The California Water Service, East LA Station in Montebello, CA is currently testing three key technologies:

- Variable Speed Pumping with Zonal Storage Tanks.
- Cloud-based data exchange with Water Control System Historian.
- DR Decision Support Tool for Day-ahead and Day-of Water Operations.

2 Industrial Refrigeration Plant

Lineage Logistics is the largest refrigerated warehouse operator nationwide. Key characteristics of the Mira Loma refrigerated warehouse are:

- 677,000 sq. ft. of temperature controlled refrigerated space.
- Space temperatures range from freezer (below 0o F) to cooler (0 to 32^{o} F), dry storage (above 32^{o} F), and dock areas (40^{o} F).
- Traditional central ammonia refrigeration plant.
- ~2.6MW power demand.
- ~$2.2M utility bill in 2016.

The site will test cloud-based OpenADR2.0B communication for DR event, cloud-based controls decision making, and communication with the site refrigeration plant controller.

1

Water Pumping

Developing control strategies for water pumping stations begins with collecting baseline data to support a system design and, identifying requirements for optimal operation of the water pumping station to meet the needs of the customer.

Activities include:

- Install sub-metering to collect baseline energy data.
- Upgrade control panel.
- Conduct interviews with plant operators to identify operational constraints and systems integration alternatives.
- Implement supervisory control and data acquisition (SCADA) Historian software interfacing system.
- Develop and implement control strategy.

WATER PUMPING

Project Status

Taxonomy for flexible water pumping has been developed as a result of the Pilot site (Cal Water) and input from the Water Technical Advisory Committee (CAISO, SCE, SDG&E, SMUD, and Sonoma Water). Additional activities completed to date include:

- ✓ Identified DR strategies and operational constraints for pilot testing.
- ✓ Designed DR decision support tool for Day-ahead and Day-of Water Operations, which has been vetted by Water Operations personnel.
- ✓ Completed plant operator interviews and collected initial data.
- ✓ Installed sub-metering and implemented SCADA connection.
- ✓ Identified security policy and approved Cloud-based data exchange with SCADA Historian.