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Optimizing VI Mitigation Design and Performance – A Case Study

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Overview

- Why **Smart** VIMS Data Matter
- Site Background
- System Overview
- **Smart** Data during Design
- **Smart** Data during Installation
- **Smart** Data during O&M
- Summary

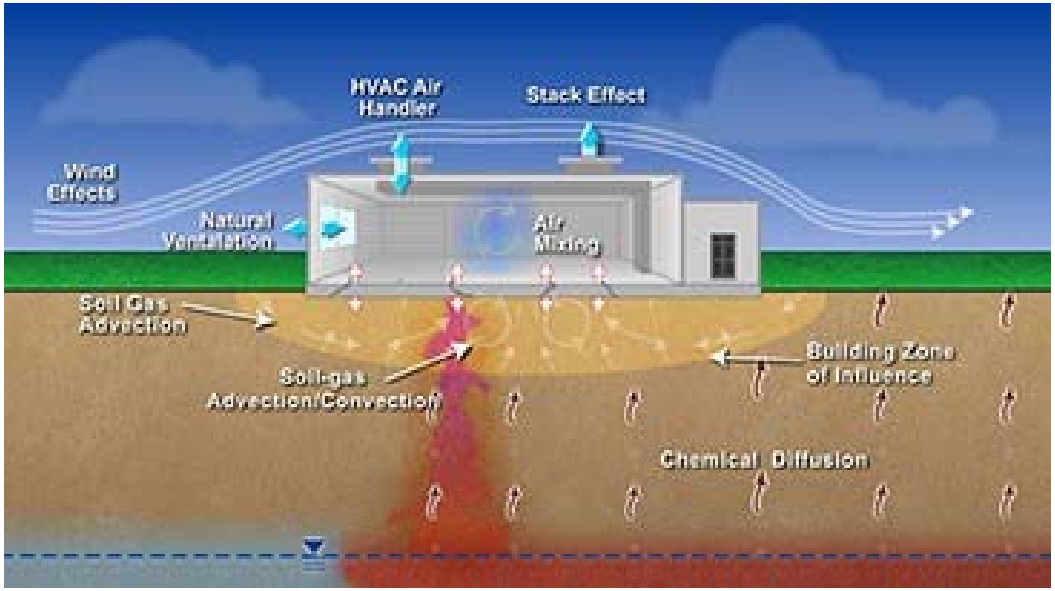

Image: NAVFAC

VIMS = Vapor Intrusion Mitigation Systems
O&M = Operations and Maintenance

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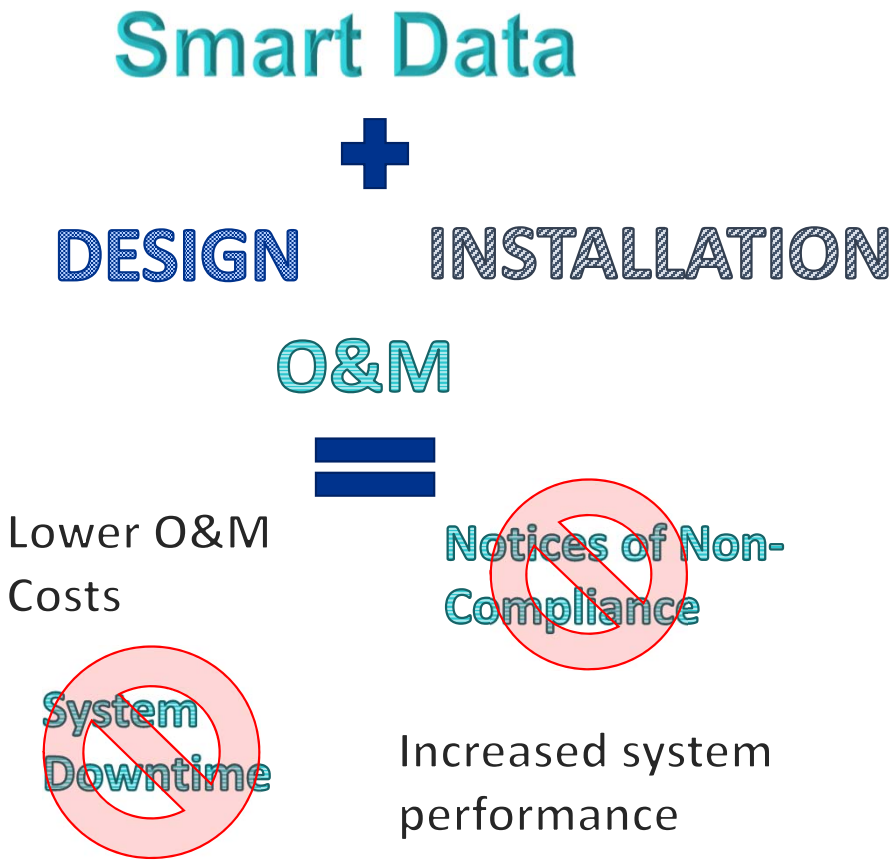
Why **Smart** VIMS Data Matter

- Liability does not end once mitigation system starts.
- Operational issues during VIMS lifetime increase O&M costs
- Many approaches utilized in VIMS design adapted from Radon mitigation systems and SVE design
  - Not fully accounting for the VI pathway and variability of site CSMs



VI = Vapor Intrusion
SVE = Soil Vapor Extraction
CSMs = Conceptual Site Model

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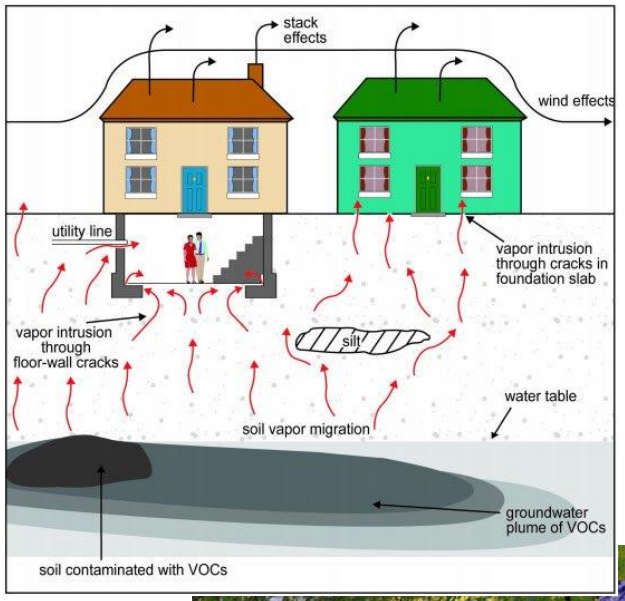
Site Background

- Multiple sites with surficial aquifer CVOCs and PHCs impacts
  - Stable well-defined plumes
  - One site with active remediation
- Coastal plains
  - Variable surficial groundwater table
  - Shallow groundwater (5 – 10 ft. bgs)
- Non-Residential buildings
  - ~1,000 to 60,000 sq. ft
- Multi-Round investigation
  - VIMS installed to address potential future pathway



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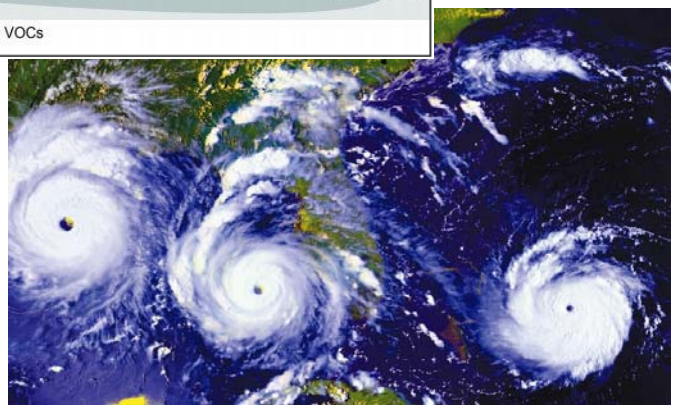

Photo: NASA

CVOC = Chlorinated Volatile Organic Compounds
PHCs = Petroleum Hydrocarbons

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Site Background - System Design

- Retro-fit SSD systems
- Standard PFE testing conducted throughout each target building
- Building layouts/designs
  - Large blowers w/multiple nodes per blower
  - High suction fans connected to one node
  - Exterior access and vertical risers throughout building
  - Most are vertical suction nodes one system horizontal trenched + retrofitted with SVE trenches

Horizontal

Vertical

SSD = subslab depressurization
PFE = Pressure field extension

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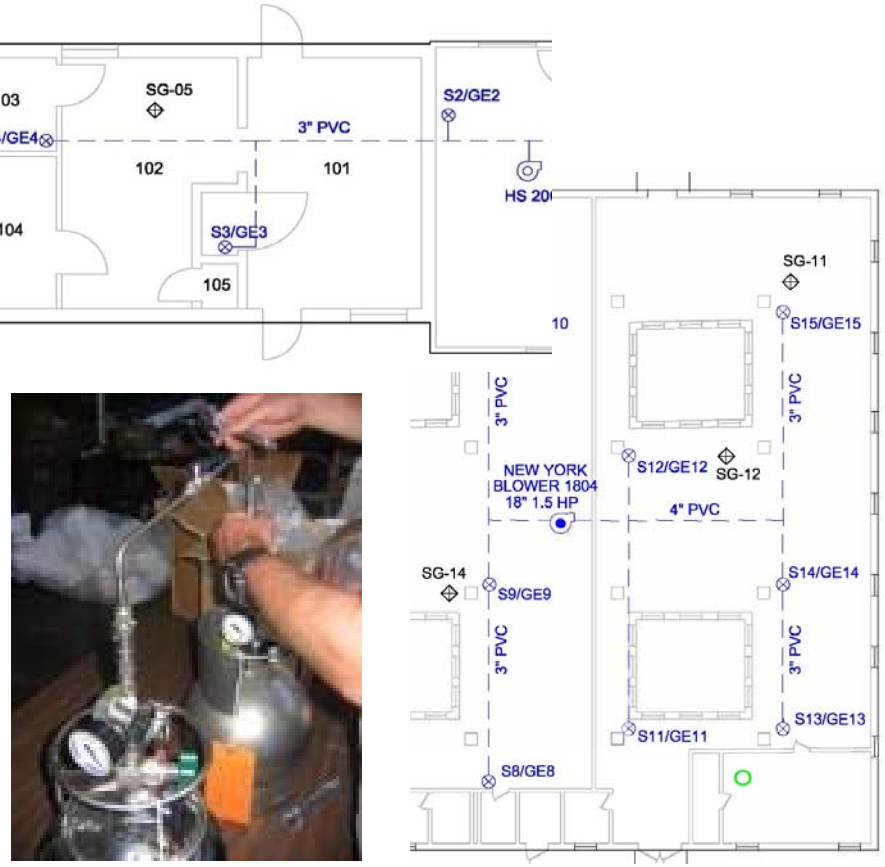
Site Background - System O&M

- System operation began in 2012
- Quarterly monitoring conducted since start-up
  - Grab subslab to indoor air differential pressure monitoring
  - Grab flow rate and vacuum measurements at nodes
  - Indoor/Outdoor/Exhaust discrete air samples



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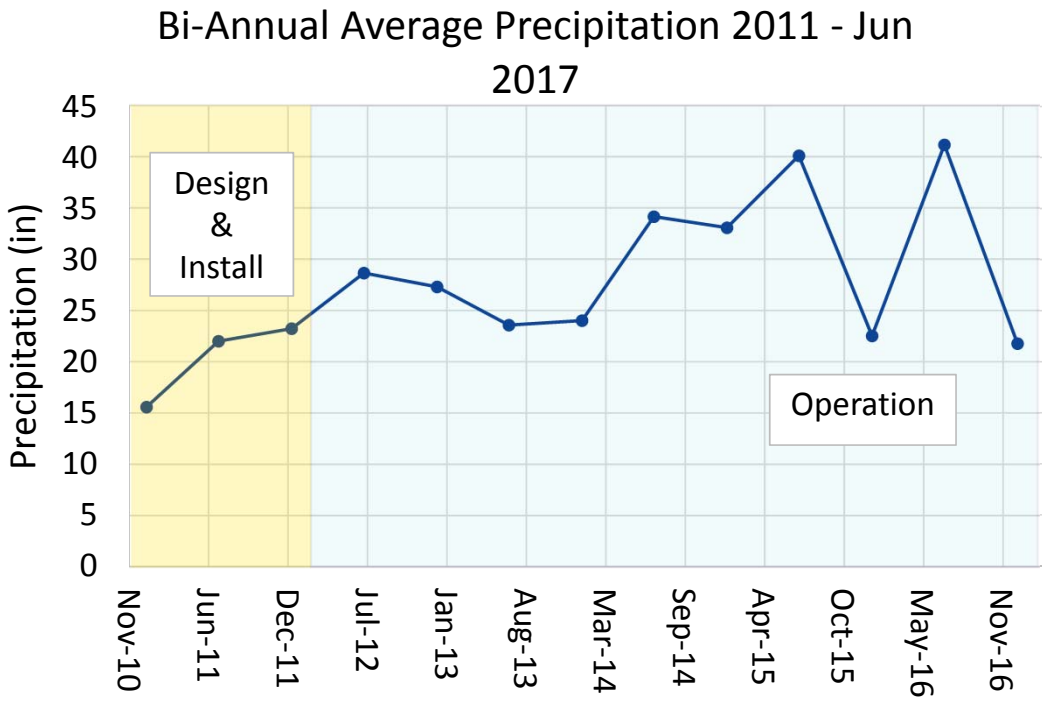
System Operation Summary

- Water entrainment observed following start-up
- Overall, systems have been operating effectively
  - Maintaining negative subslab to indoor differential pressure
  - Downtime < 30 days with most 0 days
- Significantly higher rainfall in 2014 - 2016
  - Water entrainment limited PFE and has periodically affected areas of Buildings (late 2014 – 2017)



What have we learned the last 6 years?

in = inches

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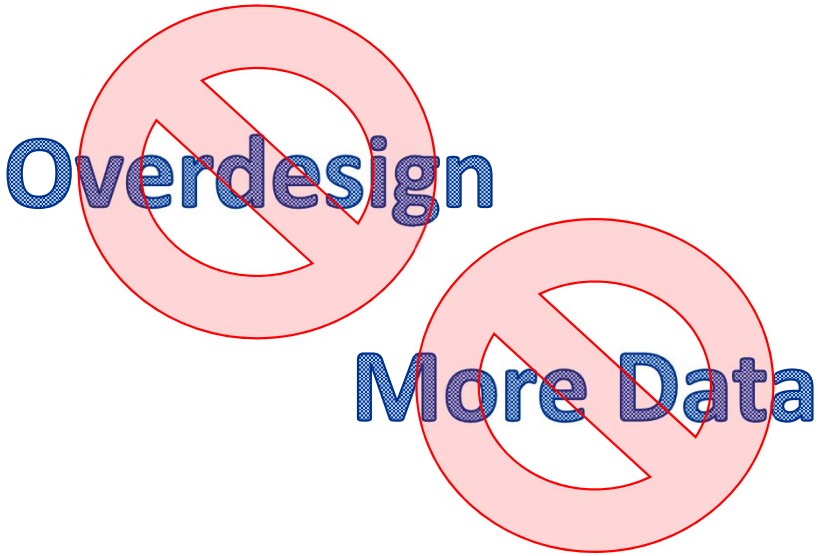
What Have We Learned?

- More Data DOES NOT equal better design and system operation
  - **Smart** Data does
- Overdesign is not the answer
- Not all performance monitoring data are created equal
  - Focus on data that monitors consistent operation and disconnecting VI pathway



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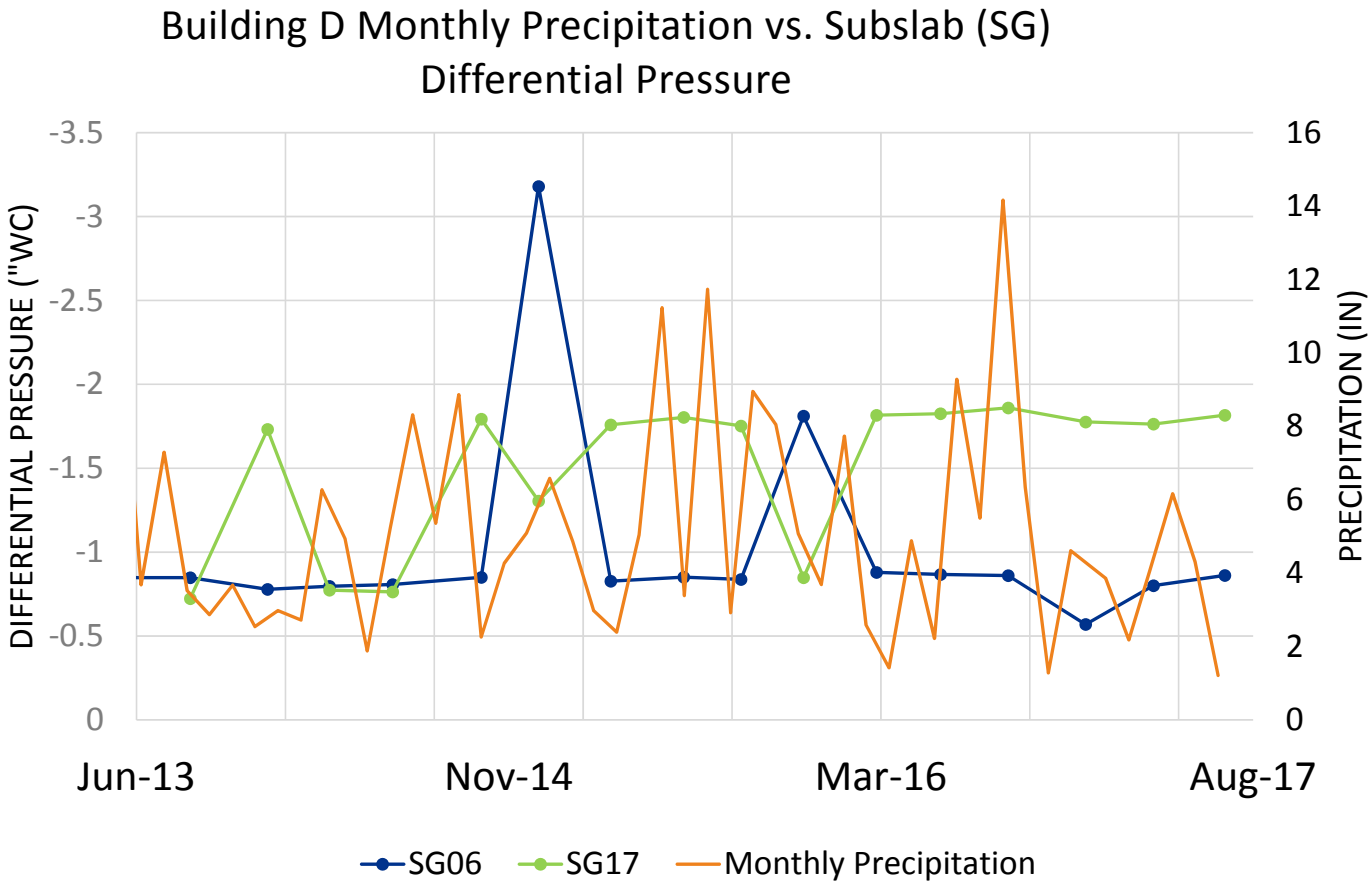
Smart Data During Design

Think you may install a VIMS? Start design data collection NOW!

- Long-term subslab differential pressure
- Site-specific groundwater levels
- Site-specific meteorological data
- Review building drawings



"wc = inches water column
in = inches

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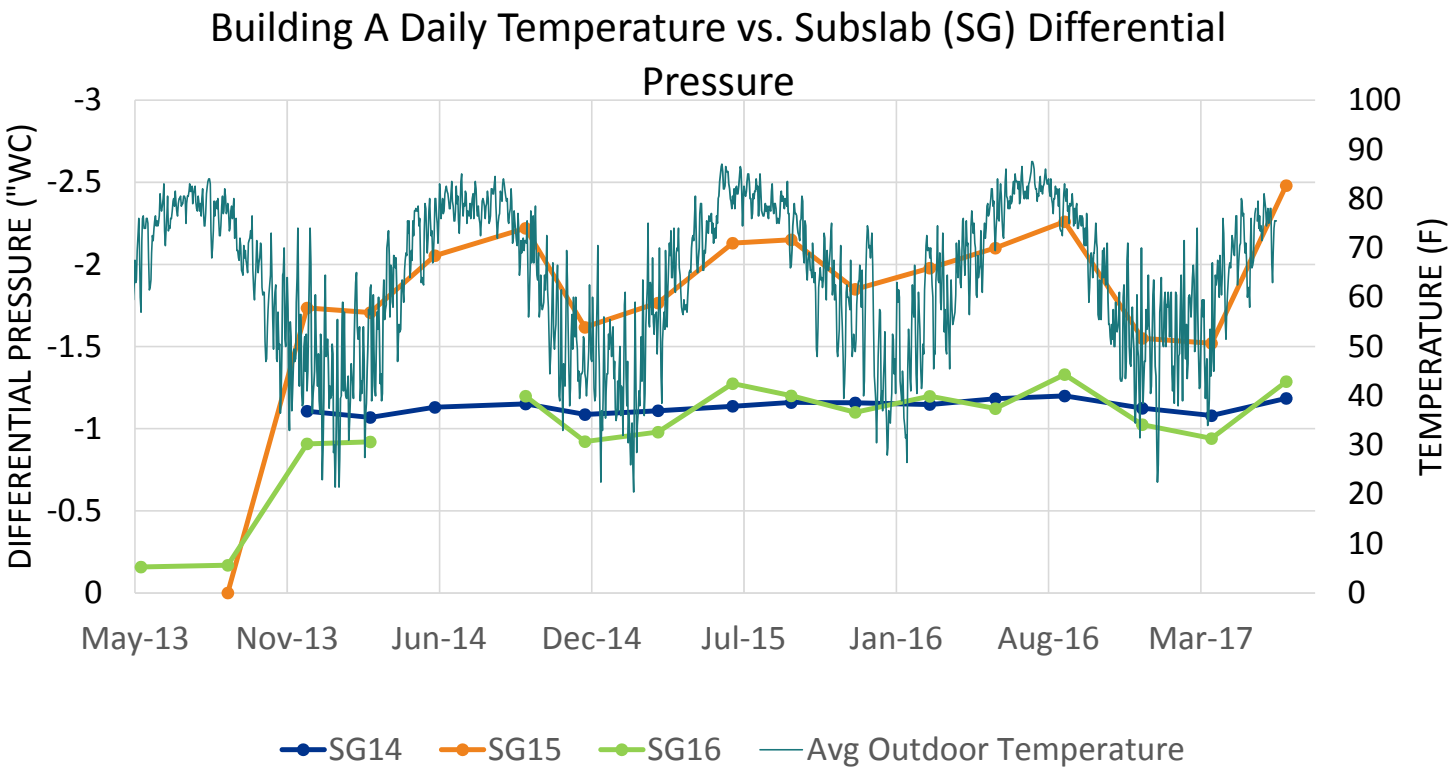
Smart Data During Design – Temperature & Differential Pressure



- Evaluate seasonal variability during design

Note: Differential Pressure references subslab to indoor air differential (i.e, the more negative the less likely to have VI)

F = Fahrenheit

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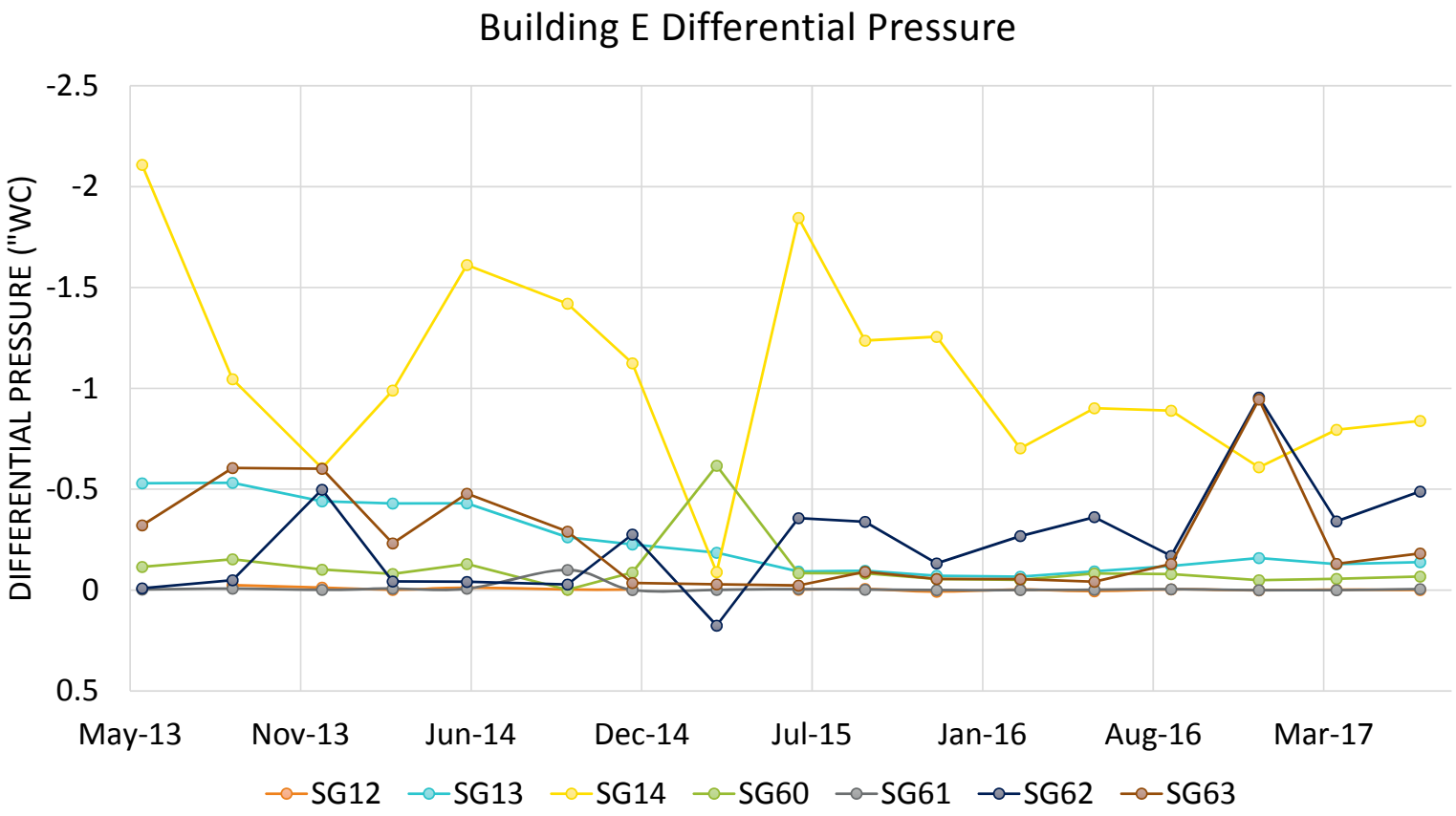
Smart Data During Design – Differential Pressure



- Evaluate differential pressure by zones within buildings

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Smart Data During Design – Groundwater Data

- Have a shallow water table?
  - Site and even building-specific depth-to-groundwater data
  - Site specific meteorological data

These are not $$$ data

Key Point: Understand seasonal fluctuations and impact of significant rainfall events on groundwater table and future system operation

Photo: NASA

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Smart Data During Design – Groundwater Data

- Have a shallow water table?
  - If feasible conduct diagnostic testing during the season with the highest precipitation
  - Evaluate design with diffuse system vacuums and variable flow rates
  - Don’t fit a square peg into a round hole

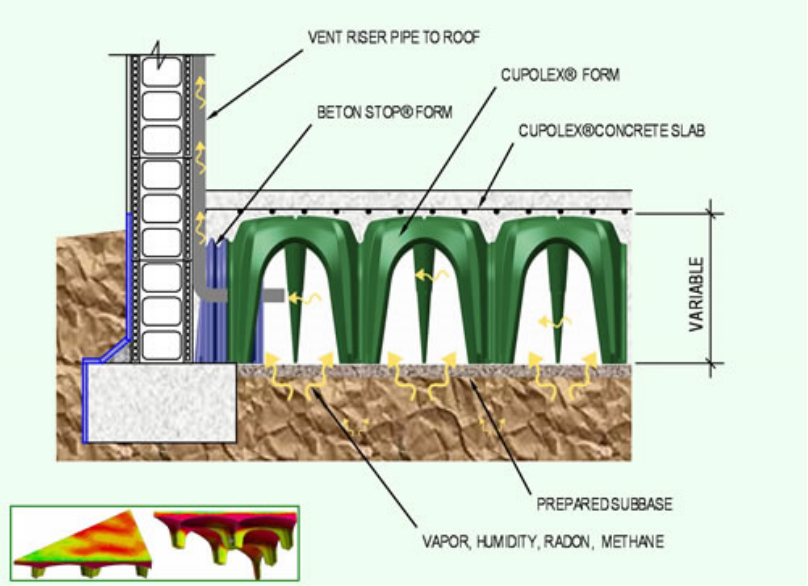

Photo: Cupolex

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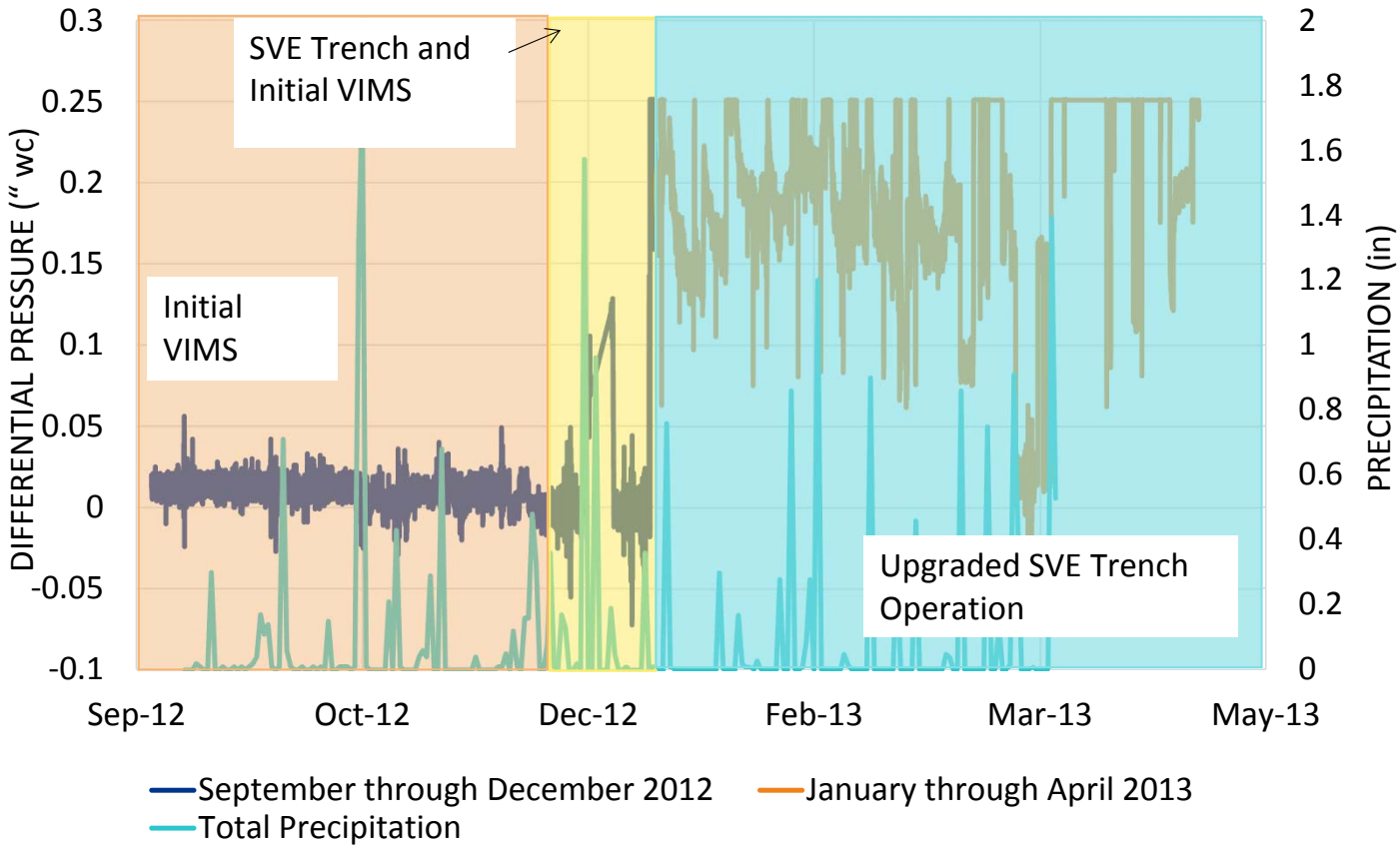
Smart Data During Design

- Key Point: Overdesign is not the answer with VIMS
- Operational issues observed primarily at systems with large blower

Note: Differential Pressure references indoor to subslab (i.e, the more positive the less likely to have VI)

Building F Differential Pressure (SG34) and Precipitation



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Smart Data During Installation

- Document subsurface during installation
  - Fill type
  - Native soil type
  - Moisture content
  - Construction history
  - Expansion joints
  - Footing locations
  - Detailed floor plans

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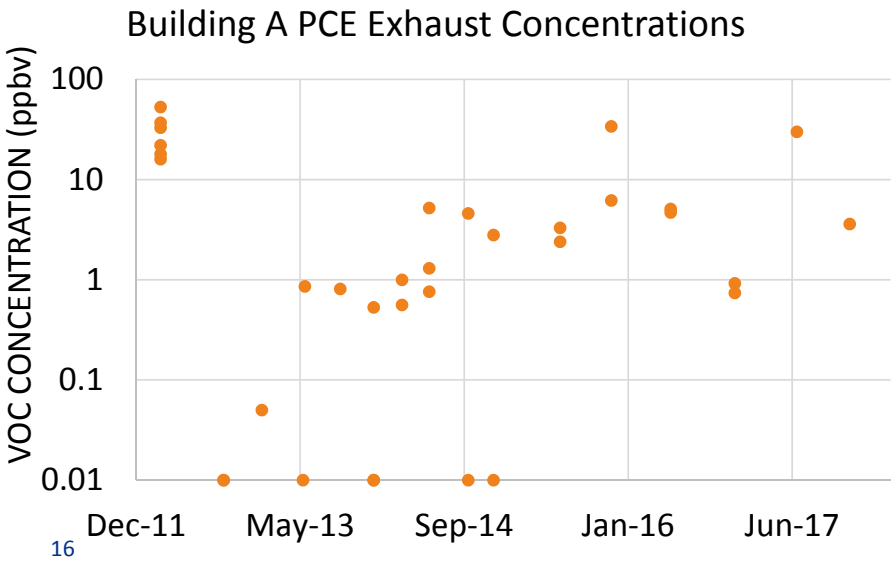
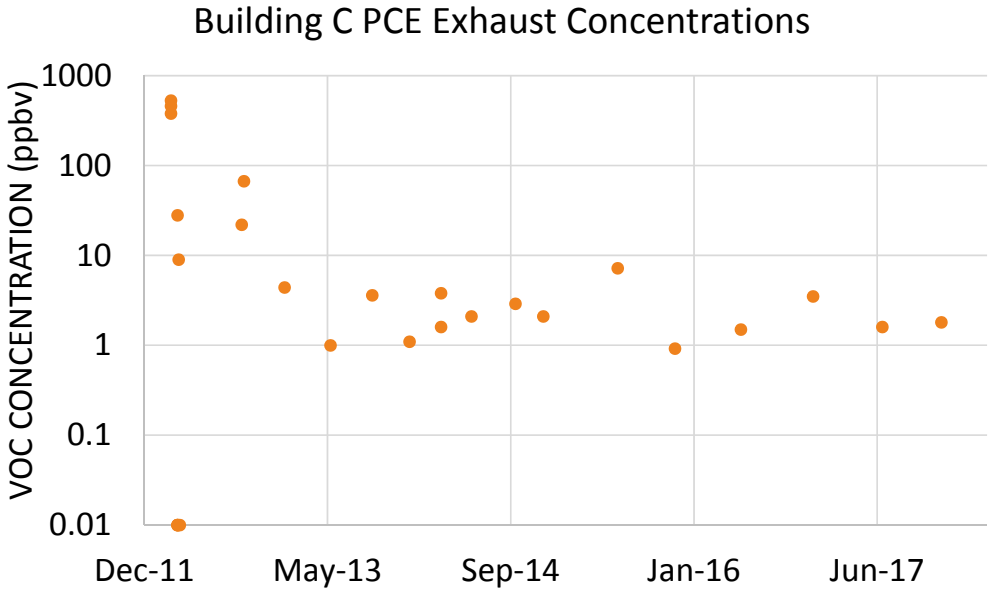
Smart Data During O&M - Exhaust

- Collect exhaust concentrations for insight into long-term subsurface source strength trends and overall system performance

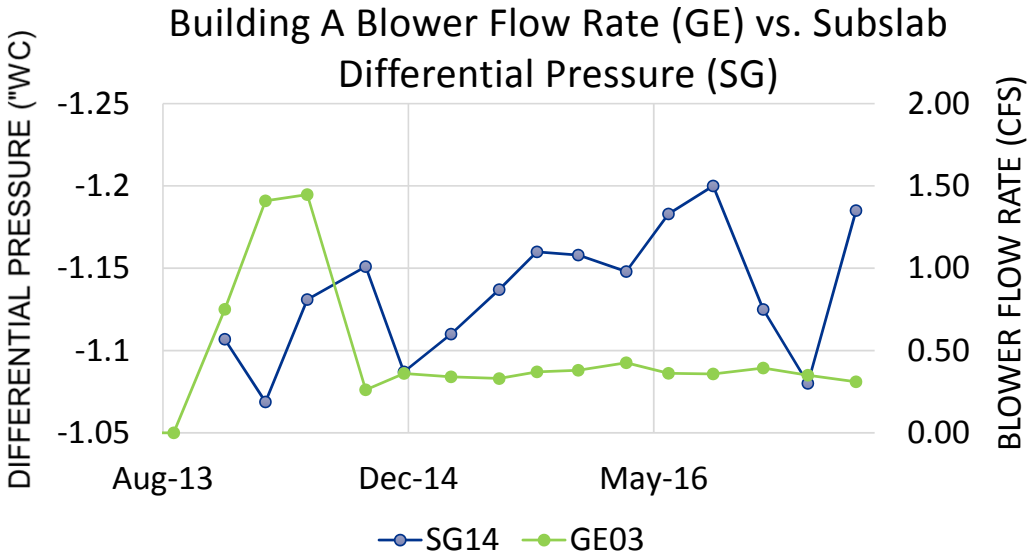


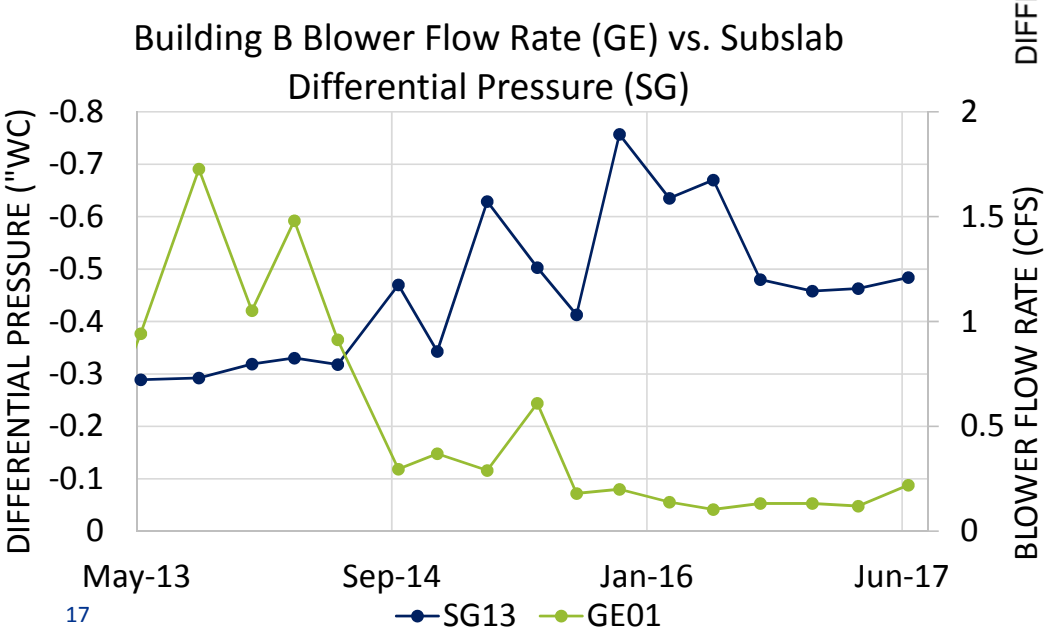


PCE = Tetrachloroethene
ppbv = Parts per billion by volume

Smart Data During O&M

- Blower flow rates do not always correlate with differential pressure





Blower flow rate can help in understanding of system operation

cfs = cubic feet per second

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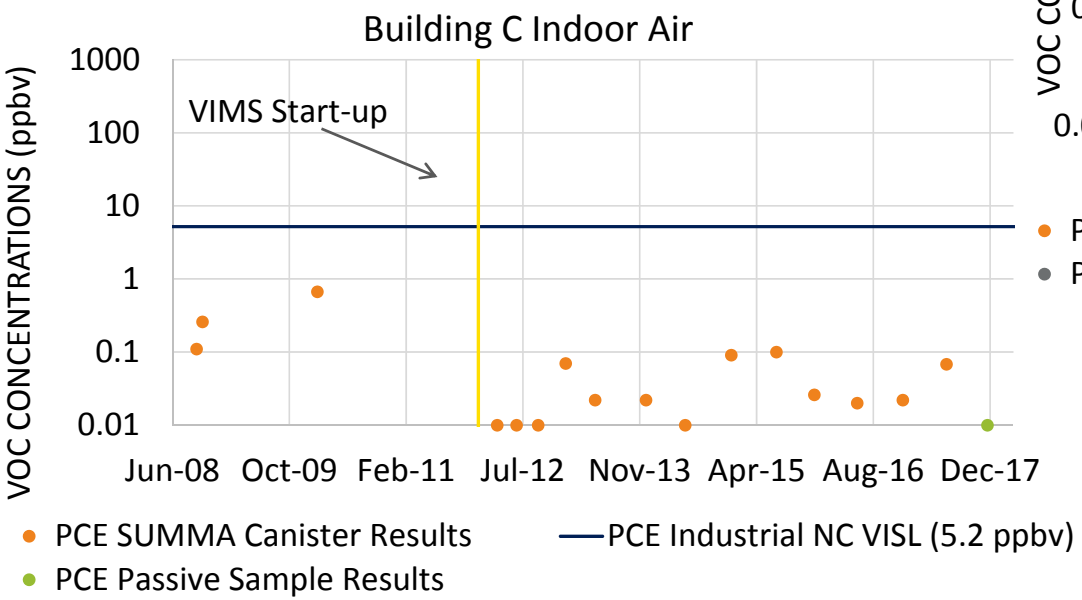
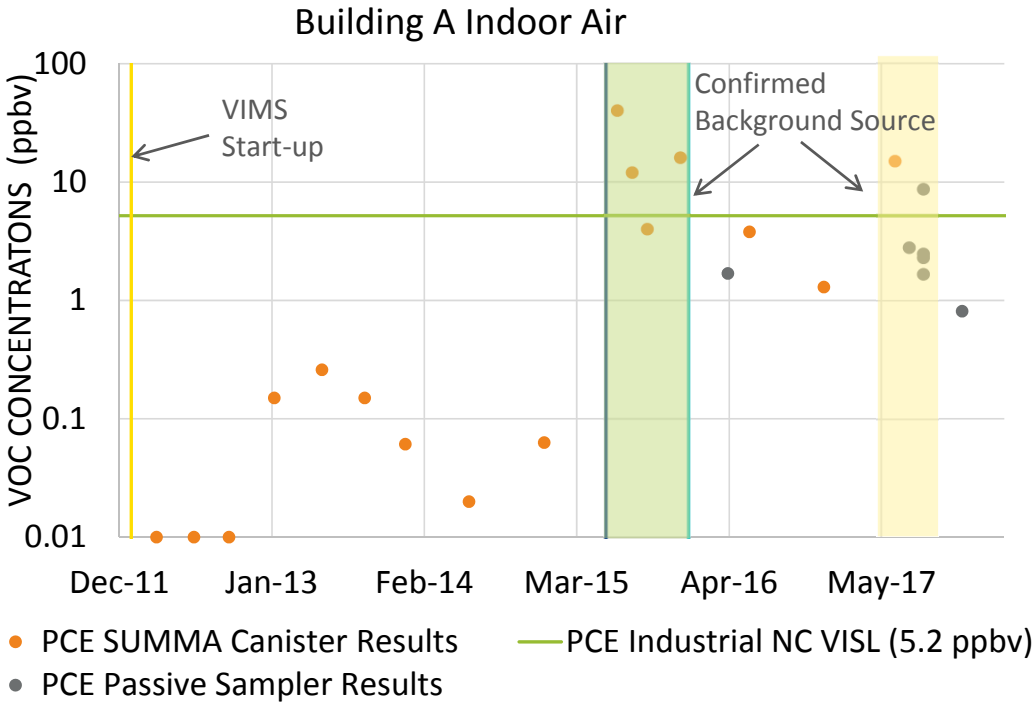
Smart Data During O&M

- Indoor air concentrations alone are not a predictor of system performance





NC VISL = North Carolina Vapor Intrusion Screening Level

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Why **Smart** VIMS Data Matter

Site specific design that holistically evaluates CSM and operational concerns prior to start-up

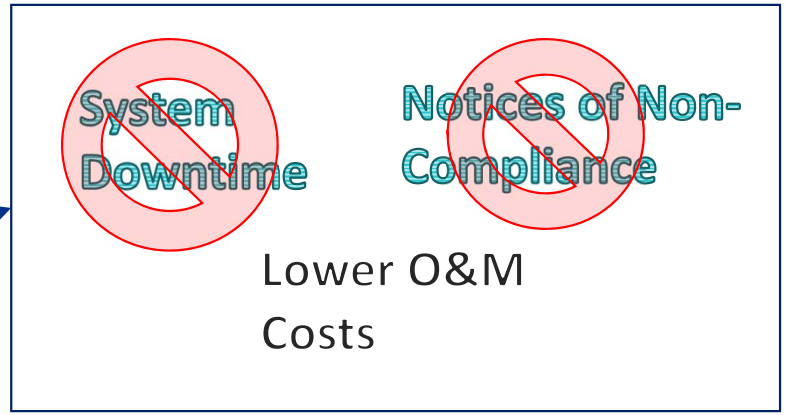
DESIGN

INSTALLATION

It's not too late to adjust design/installation or update performance monitoring plan

System operation is long-term and can always be optimized

O&M



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Thank you!

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