Pumping Systems Custom Measure Package

CALIFORNIA
TECHNICAL FORUM

SPENCER LIPP, PE

Presentation Overview

- **Today, we are seeking TF affirmation of the Pumping Systems Custom Measure Package (CMP).**

- Overview of CMP Development
- CMP Scope: Measures and MAT
- CMP Content w/ Key Discussion/Decision Points
- TF Discussion
- **TF Affirmation**

Pumping Systems Measure Package

Materials

- Measure Package
  - Measure Characterization
  - Primary tool:
    - DOE MEASUR
  - Standard Practice Analysis
    - DOE Shipment Data Analyzed

Hyperlinks require access to the Custom Subcommittee SharePoint site; email spencer.lipp@futee.biz to request access.

Group Members

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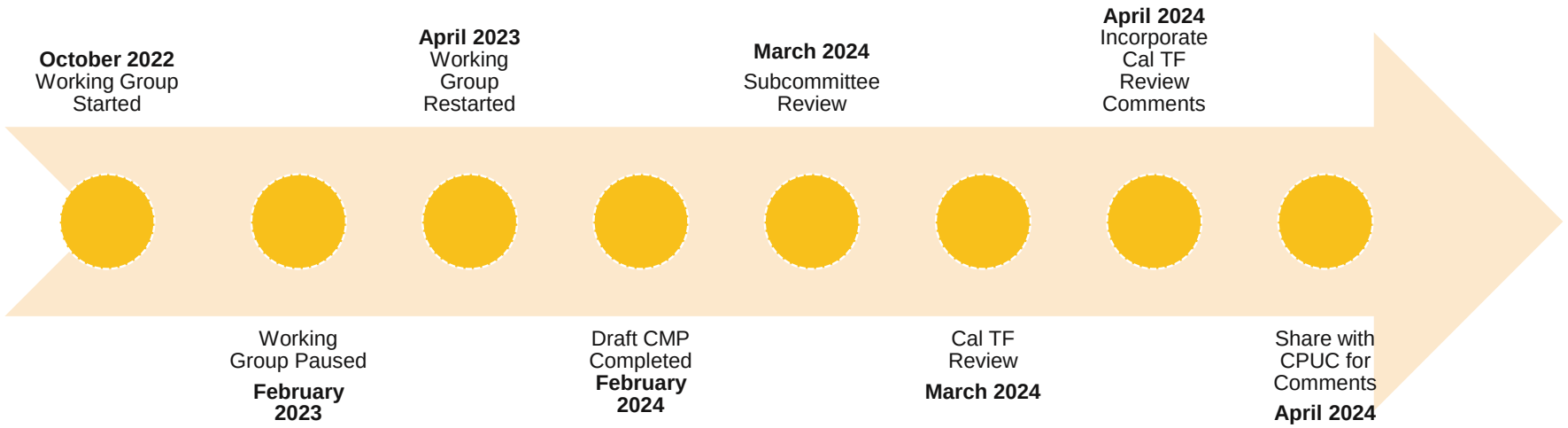
Pumping Systems CMP Timeline



CMP Measures

Custom Measures

- Pump replacement (including right sizing)
  - Clean water pump (AR)
  - Non-Clean water pumps (NR/AR)
- System operational adjustments
  - Sensors and controls (AOE)
  - Right size through stage removal (BRO)
  - Installation of valves (AOE)
  - Reconfigure VFD controls (BRO)
  - Setpoint optimization (BRO)
  - Piping system reconfigurations (AOE)
  - Trim Impeller (BRO)
- Installation of VSD
  - Industrial process pumps (AOE)
  - Agriculture pumps (AOE)

Related Deemed Measures

- SWWP004 – Water Pump Upgrade
  - Clean water pumps (≤250 hp)
  - NR and NC MATs
- SWHC008 – Variable Speed Drives for a Central Plant System
  - Commercial building chilled and condenser water pumps
- SWWP002 – VFD on Irrigation Pump
  - Well pumps (≤300 hp) and booster pumps (≤150 hp) with throttle valve
- SWWP005 – Enhanced VFD on Irrigation Pump
  - Well pumps (75-600 hp) and booster pumps (75-150 hp) with requirements
- SWPR002 – VFD for Glycol Pump Motor
  - Wine manufacturing system pumps (3-25 HP)
- SWWH015 – Demand Control for Centralized Water Heater Recirculation Pump
  - Multifamily and commercial domestic hot water pump control
- SWWH012 – Recirculation Pump Timer
  - Commercial building HVAC hot water pump controls

Measure Application Types – TF Input

Category	Measure	Description	MAT
Pump Replacement	Clean water	Replacement of the pump with a more efficient clean water pump	AR
	Non-clean water	Replacement of the pump with a more efficient non-clean water pump	AR/NR
System Operational Adjustments	Sensors and controls	Additional sensors and controls to optimize the run time, pump head, and/or pump flow including on/off controls	AOE
	Right size pump (stage removal)	Removal of a pump stage to meet the current service demands of less flow and/or pressure requirements	BRO
	Installation of valves	Additional valves and control strategies to optimize run time, pump head and/or pump flow	AOE
	Reconfigure VFD controls	Adjust existing VFD controls with lower minimum speeds or activities to return to modulating VFD operation	BRO
	Setpoint optimization	Adjust setpoints in control sequences to optimize the run time, pump head, and/or pump flow	BRO
	Piping system reconfigurations	Redesigned piping system to minimize pressure drop with larger diameter, decrease pipe length, and/or replacement of fittings and bends.	AOE
	Impeller trimming	Trimmed impeller to reduce pressure losses and match the flow profile	BRO
VSD	Installation of VSDs	Installation of VSDs on a pump system to vary and match pump flow to demand.	AOE

Combustion Controls AOE MAT – TF Input

- Review of CPUC language and definition for piping reconfigurations
  - E-4818 AOE definition
    - New equipment onto existing host that improves host efficiency or energy burden ***(piping reconfiguration reduces pressure/energy burden)***
    - Host system operational without AOE ***(system is able to provide required flow with existing configuration)***
    - Energy reduction occurs at the host equipment ***(savings occur at the pump)***
  - E-4818 Page 26 "…allowing reconfiguration and modifications to systems to optimize performance…as add-on equipment, which is a reasonable classification for them."

Combustion Controls AOE MAT – TF Input

- Track 1 Working Group Report
  - T1WG AOE Example #1 (emphasis added)

    A VFD replaced a throttling valve in modulating the flow in a pumping system. In the course of installing the VFD, ***minor repair and replacement*** of a portion of the controls and/or inverter duty motor was necessary to implement the VFD/VSD primary function. This measure ***qualifies as an AOE*** because it is a ***component that was added on to existing equipment that still serves the load***.
  - T1WG AOE Example #7 (emphasis added)

    An existing agricultural pump performance has degraded over time. The pump impeller, seals, and bearings can be replaced, restoring the pump to its former operating condition, although ***not exceeding its previous operation***. This measure is restorative and ***does not qualify as an AOE measure***.

- Any TF Concerns with AOE or BRO categorizations?

Baseline Considerations – TF Input

- Existing conditions
  - 8 of the 10 measures are AOE or BRO
  - Clean and non-clean water pump replacement have AR MATs
- Standard practice baseline
  - Pump replacement
    - SWWP004 standard practice
      - CPUC approved values do not appear to have any documentation supporting the decision
      - Binned pumps by hp based on Hydraulic Institute (HI) product list
      - Constant speed SP is 42-74 and variable is 39-50 percentile based on product availability
    - CMP based on shipment data from the DOE regulation effort for clean water pumps
    - Non-clean water assumed to be the same as clean water pumps
    - Non-submersible vertical turbine (not in DOE) assumed to be the same as vertical turbine (in DOE)

Baseline Considerations – TF Input

- Clean water end suction closed couple, end suction frame mounted, inline, radially split vertical, vertical turbine submersible (VT-S)
  - DOE obtained **2014 shipment data** by pump type/speed and efficiency from the Hydraulic Institute (HI) but **did not differentiate constant and variable speed**.
  - Working group could not obtain more recent data from HI
  - DOE included an estimate of pump sales by pump type and efficiency after the regulation would go into effect
  - Working group calculated a **weighted average based on efficiency and projected 2024 sales by pump type**.
  - Results in SP PEI ranging from 0.976 to 0.994

- TF Input – Is this a reasonable assessment of ISP baseline?

Baseline Considerations – TF Input

- Vertical turbine non-submersible (VT-NS) represented by VT-S
  - PG&E pump test data from 1,472 pumps was analyzed
  - Average Overall Plant Efficiency ranges 58-62% with 4% standard deviation for all pump types

Row Labels	Average of Ideal OPE	StdDevp of Ideal OPE	Count of Pump Type
	0.61	-	1.00
Centrifugal	0.61	0.02	203.00
Mix Flow	0.61	-	3.00
Other	0.58	0.04	11.00
Propeller	0.60	0.02	16.00
Submersible	0.58	0.05	217.00
Turbine	0.61	0.03	704.00
Vertical Turbine Booster	0.62	0.05	192.00
Well	0.61	0.06	125.00
Grand Total	**0.61**	**0.04**	**1,472**

  - TF Input – Is the VT-NS = VT-S reasonable?

Baseline Considerations – TF Input

- Efficiency of clean water pumps equal to non-clean water pumps (e.g., sludge, digester)
  - CMP excludes viscous fluids such as crude oil
  - Pump design factors impacting efficiency from HI Guideline 20.3-2020 Rotodynamic Pump Efficiency Prediction
    - Specific speed
    - Surface roughness
    - Internal clearances
  - Working group concluded that pump design factors impacting design are not materially different for clean versus non-clean water pumps.
  - TF Input – Is assumption of similar efficiencies for clean and non-clean reasonable?

Eligible Products and Program Exclusions

Eligibility

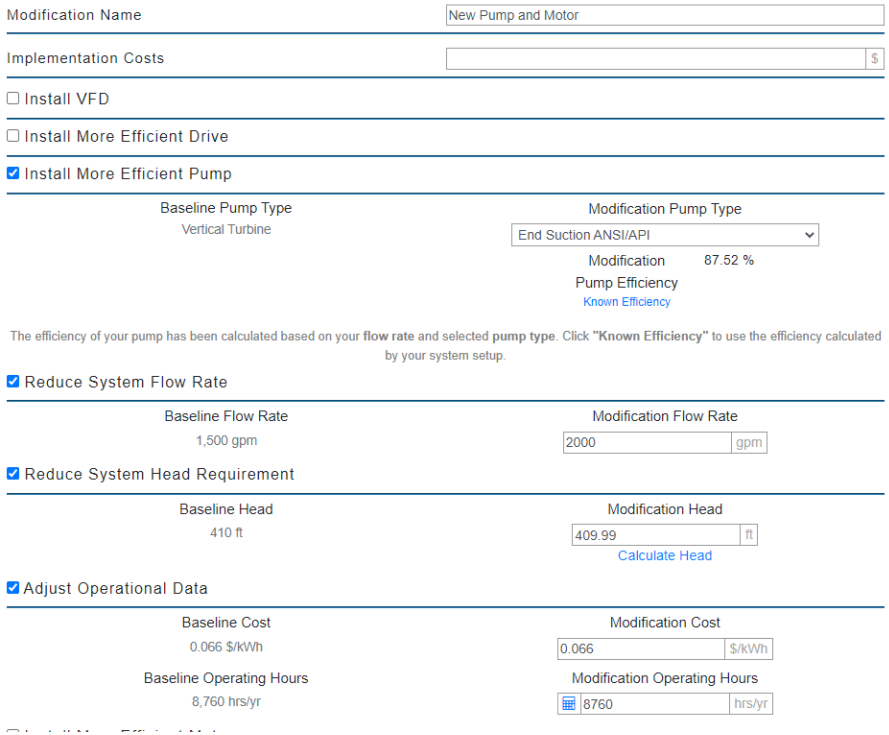
- All Residential and Non-Residential sectors of any vintage
- Any climate zone
- Limited to pump types analyzed for Standard Practice

Exclusions

- Transport of crude oil or other similarly viscous fluid
- System operational adjustments
  - Current system not meeting the needs as perceived by the customer
- VSD/Controls
  - New wastewater treatment pumps at municipal facilities
  - Existing and inoperable VSDs

Primary Calculation Tool

- **DOE MEASUR**
  - Updated and maintained version of the DOE Pump System Assessment Tool
  - Submodules and calculators incorporated into MEASUR assessment to calculate savings for most measures

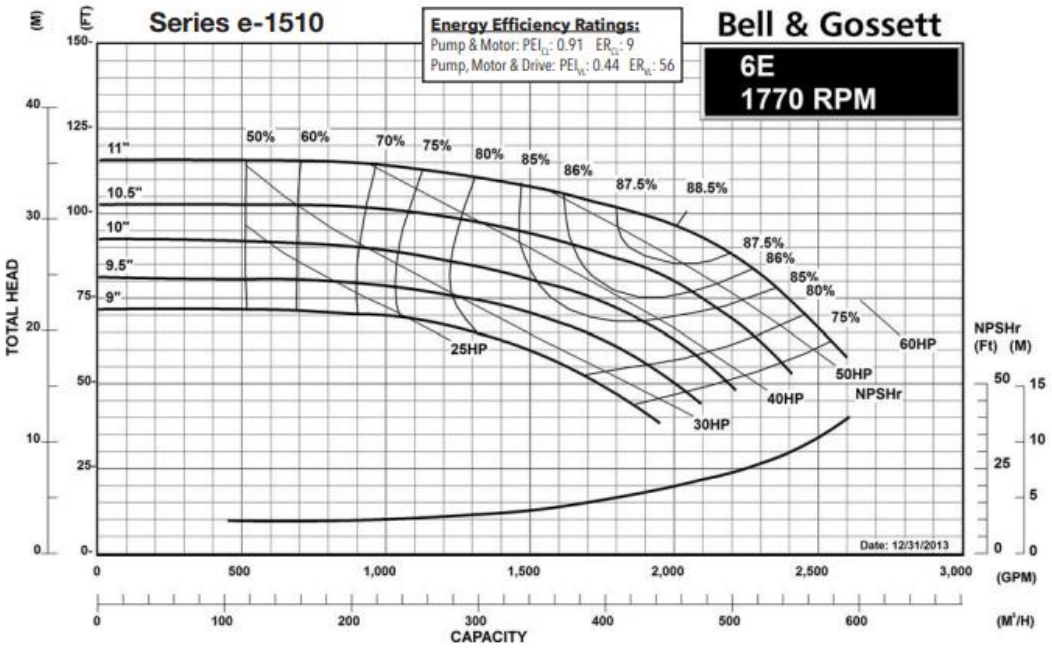


Submodules Used

- Install more efficient pump
  - Input or default
- Reduce system flow rate
  - Input
- Reduce system head
  - Input or pump head calculator
- Adjust operational data
  - Input
- Install VFD
  - Input with calculator options

Data Collection

- Customer/Site information
- Pump and motor specifications
- System operational data examples to set up MEASUR
  - Head
  - Suction pressure
  - Discharge pressure
  - Flow
- Pump curve



M&V – TF Input

Small Measures (<$25k or 250,000 kWh)

- Data input verification of key MEASUR inputs
  - Nameplate pictures
  - Operating hours from utility meter, customer data system, or customer estimate
  - Pump flow rate from customer data system, or customer estimate

Large Measures (>25k or 250,000 kWh)

- Data input verification of key MEASUR inputs
  - Nameplate pictures
  - Trend data as applicable
    - True RMS power or flow and pressure
    - Flow (when impacted)
    - Discharge/Inlet pressure (when impacted)

TF Input – Does the M&V strategy provide the right balance between M&V cost and value?

AOE Measure EULs – TF Input

- E-5152 allows exceptions to AOE EUL limited by host RUL to AOE equipment life as the EUL
  - AOE measure "remain(s) in place even if the host equipment is replaced"
- Impacts piping system reconfigurations
- Justification
  - Host equipment is pump and motor combination
  - Piping system configurations are typically not modified for pump replacements

E-5221 Examples

Table 1-3. Measure Life for Add-On Equipment by Host and Host Proxy

AOE Host	AOE Host Proxy*	Measure Life	Example
AOE is typically replaced or removed from service at same time as host equipment	None	Lesser of: · EUL of AOE · RUL of Host	AOE: Anti-Sweat Heater Controls Host: Refrigerated Case
	None	EUL of AOE	AOE: Pool Cover Host: Pool Heater
AOE is not typically replaced or removed from service at same time as host equipment	AOE is typically replaced or removed from service at same time as host proxy	Lesser of: · EUL of AOE · RUL of Host Proxy	AOE: Aerator Host: Water Heater Host proxy: Faucet
	AOE is not typically replaced or removed from service at same time as host proxy	EUL of AOE	AOE: Ozone Laundry Host: Water Heater Host proxy: Building System (Piping)

TF Input – Has the working group applied acceptable exceptions to standard AOE EUL related to the host equipment?

Standard Practice Cost – TF Input

- Working group worked with Hydraulic Institute on costs
- Hydraulic Institute advised best data was DOE Regulation

$$SPCost_i = (DOECost_i)(IR) + Labor + Other$$

- Standard Practice Cost
- DOE 2014 Material Cost for SP Pump Type i
- Inflation Rate
- Labor, Shipping, Concrete Pads, etc. = to EE pump

- Is the scaled SP cost appropriate?

Discussion and Affirmation

- Any other TF comments or suggestions?

- ***Affirmation: Cal TF affirms the Pumping Systems Custom Measure Package.***

Next Steps

- Post TF-Affirmed CMP in Cal TF Custom Measure Library
- Solicit CPUC Staff and CPR Consultant Team Review