

Steam Boiler Plant Add-On Custom Measure Package

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SPENCER LIPP, PE

Presentation Overview

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- **Today, we are seeking TF affirmation of the Steam Boiler Plant Add-On Custom Measure Package (CMP).**
- Overview of CMP Development
- CMP Scope: Measures and MAT
- CMP Content w/ Key Discussion/Decision Points
- TF Discussion
- **TF Affirmation**

Steam Boiler Plant Measure Package

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Materials

- Measure Package
 - [Measure Characterization](#)
 - Primary tool:
 - ✦ [DOE MEASUR](#)
 - Secondary support tools
 - ✦ [Steam Boiler Economizer Auxiliary Calculation Procedure](#)

Group Members

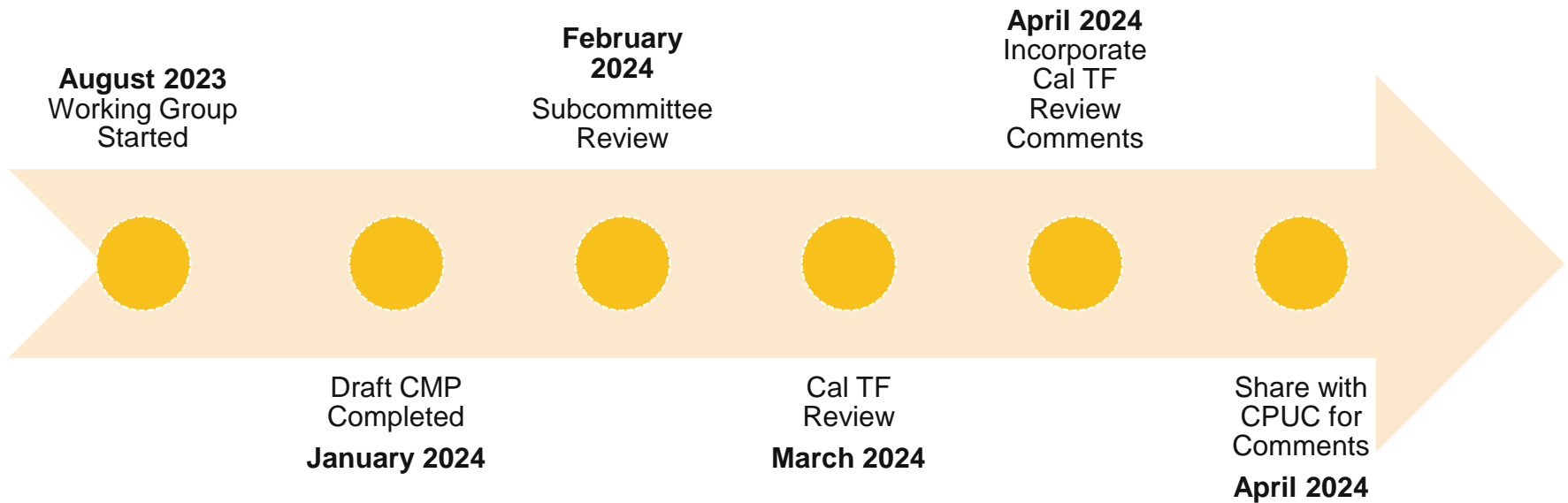
- Steven Long* (ICF)
- Roger Baker* (Independent)
- Myrna Dayan* (Cascade)
- Wayne Chi (SCG)
- Afshan Hasan (SCG)
- Wilfredo Garcia (SCG)
- Anthony Zavala (SCG)
- James Gingras (PG&E)
- Jessie Wang (SDG&E)
- Glen LaPalme (TRC)
- Novi Leigh (ICF)
- Ryan Rodriguez (Willdan)
- Shafi Armoni (Cascade)

* TF member

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

Steam Boiler Plant CMP Timeline

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CMP Measures

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Custom Measures

- Stack economizer
 - Feedwater (AOE) – SWPR007 limited
 - Condensing (AOE) – SWPR007 limited
 - RCx existing system (BRO)
- Blowdown system
 - Automated control (AOE)
 - Heat recovery (AOE)
- Combustion system
 - Combustion controls (AOE)
 - Burner retrofit (NR/AR)
- Deaerator (DA)/make-up water system
 - Deaerator optimization (BRO)
 - Water treatment system (AOE)
 - Water treatment system controls (AOE)

Related Deemed Measures

- SWPR007 – Steam Boiler Economizer, Industrial
 - Non-condensing and condensing economizer
 - Boiler input rating \leq 20 million Btu/hr
 - Commercial, industrial, and agriculture sectors

Measure Application Types – TF Input

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Category	Measure	Description	MAT
Stack Economizer	Feedwater	Sensible heat recovery	AOE
	Condensing	Indirect or direct latent heat recovery	AOE
	Feedwater and condensing	Sensible and latent heat recovery	AOE
	RCx existing system	Operational adjustments	BRO
Blowdown	Automated control	Automates blowdown through measurement of water conductivity	AOE
	Heat recovery	System to use waste heat to preheat make up water or offset DA steam usage	AOE
Combustion System	Controls	O₂ trim control with a combustion blower VFD	AOE
	Burner retrofit	Retrofit to more efficient burner. Often coupled with a Selective Catalytic Reduction (SCR) system	NR/AR
DA/Make-up System	DA tank optimization	Adjust DA tank pressure set-point to reduce steam pressure	BRO
	Water treatment system	New system to use reverse osmosis process discharge water as make up water	AOE
	Water treatment system controls	Additional controls to optimize water use and efficiency through increased hot water reclamation or increased feedwater temperature	AOE

Combustion Controls AOE MAT – TF Input



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- Review of CPUC language and definition for combustion controls
 - E-4818 AOE definition
 - ✦ New equipment onto existing host that improves host efficiency (***new controls that improves boiler efficiency***)
 - ✦ Host system operational without AOE (***boiler operates with existing combustion controls, example parallel positioning***)
 - ✦ Energy reduction occurs at the host equipment (***savings occur at the boiler and blower***)
 - Replacement of AOE equipment
 - ✦ Broken or poorly performing AOE equipment returning to previous efficiency levels is BRO or NR with a like for like (***O₂ trim increases efficiency***)

- Track 1 Working Group Report

- T1WG AOE Example #5 (emphasis added)

An existing controls system with scheduling features only is replaced with a new system capable of multiple **additional functions** including optimized start/stop, local occupancy override, and other functions that are not present in the old system. The implementation plan includes the replacement of existing on/off actuators and temperature sensors.

This measure is largely an AOE since controls are an add-on measure and the proposed system is a **nominal improvement over the old system with additional energy functionality**. However, the replacement of like-with-like components (actuators and sensors) is restorative.

- Working group decision consideration

- ✦ O₂ trim systems decrease the excess O₂% to target 3% from ~5% for parallel positioning systems
- ✦ Nominal energy improvement at the host equipment over the old system

- Any TF Concerns with AOE categorization?

Baseline Considerations

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- Existing conditions
 - 10 of the 11 measures are AOE or BRO
 - Burner retrofit for AR requires existing system meets CARB/local AQMD requirements
- Standard practice baseline
 - Burner retrofit
 - ✦ Burner system that meets the requirements of current and/or known future CARB requirements
 - ✦ 35 Air Pollution Control Districts (APCD) and Air Quality Management Districts with varying requirements

Eligible Products and Program Exclusions

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Eligibility

- Steam boilers only
- All Residential and Non-Residential sectors of any vintage
- Any climate zone

Exclusions

- New feedwater and/or condensing economizer for systems ≤ 20 kBtu/hr
- New construction
- Steam without natural gas as a fuel source
- Boilers designed to be condensing boilers not eligible for stack heat recovery

Primary Calculation Tool

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● DOE MEASUR

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

SELECT POTENTIAL ADJUSTMENT PROJECTS

Select potential adjustment projects to explore opportunities to increase efficiency and the effectiveness of your system.

Add New Scenario

Modification Name	<input type="text" value="Efficiency"/>
Implementation Costs	<input type="text" value="0"/> \$
<input checked="" type="checkbox"/> Adjust General Operations	
<input type="checkbox"/> Modify Operating Hours	
<input type="checkbox"/> Modify Make-up Water Temperature	
<input type="checkbox"/> Adjust Unit Costs	
<input checked="" type="checkbox"/> Adjust Boiler Operations	
<input type="checkbox"/> Adjust Boiler Combustion Efficiency	
<input type="checkbox"/> Change Fuel Type	
<input type="checkbox"/> Adjust Blowdown Rate	
<input type="checkbox"/> Blowdown Flash to Low Pressure	
<input type="checkbox"/> Preheat Makeup Water with Blowdown	
<input type="checkbox"/> Change Steam Generation Conditions	
<input type="checkbox"/> Change Deaerator Operating Conditions	
<input type="checkbox"/> Adjust Condensate Handling	
<input type="checkbox"/> Adjust Heat Loss Percentages	
<input checked="" type="checkbox"/> Adjust Steam Demand/Usage	
<input type="checkbox"/> Adjust High Pressure Steam Usage	

Submodules Used

- ❑ Modify Make-up Water Temperature
- ❑ Adjust Boiler Combustion Efficiency
- ❑ Adjust Blowdown Rate
- ❑ Blowdown Flash to Low Pressure
- ❑ Preheat Make-up Water with Blowdown
- ❑ Change Deaerator Operating Conditions
- ❑ Adjust Steam Usage

Secondary Calculation Tool

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- **Steam Boiler Economizer Auxiliary Calculation Procedure (Option)**
 - Guidance on incorporating MEASUR economizer calculator
 - Identifies input data location from MEASUR
 - Alternative to modifying combustion efficiency in MEASUR

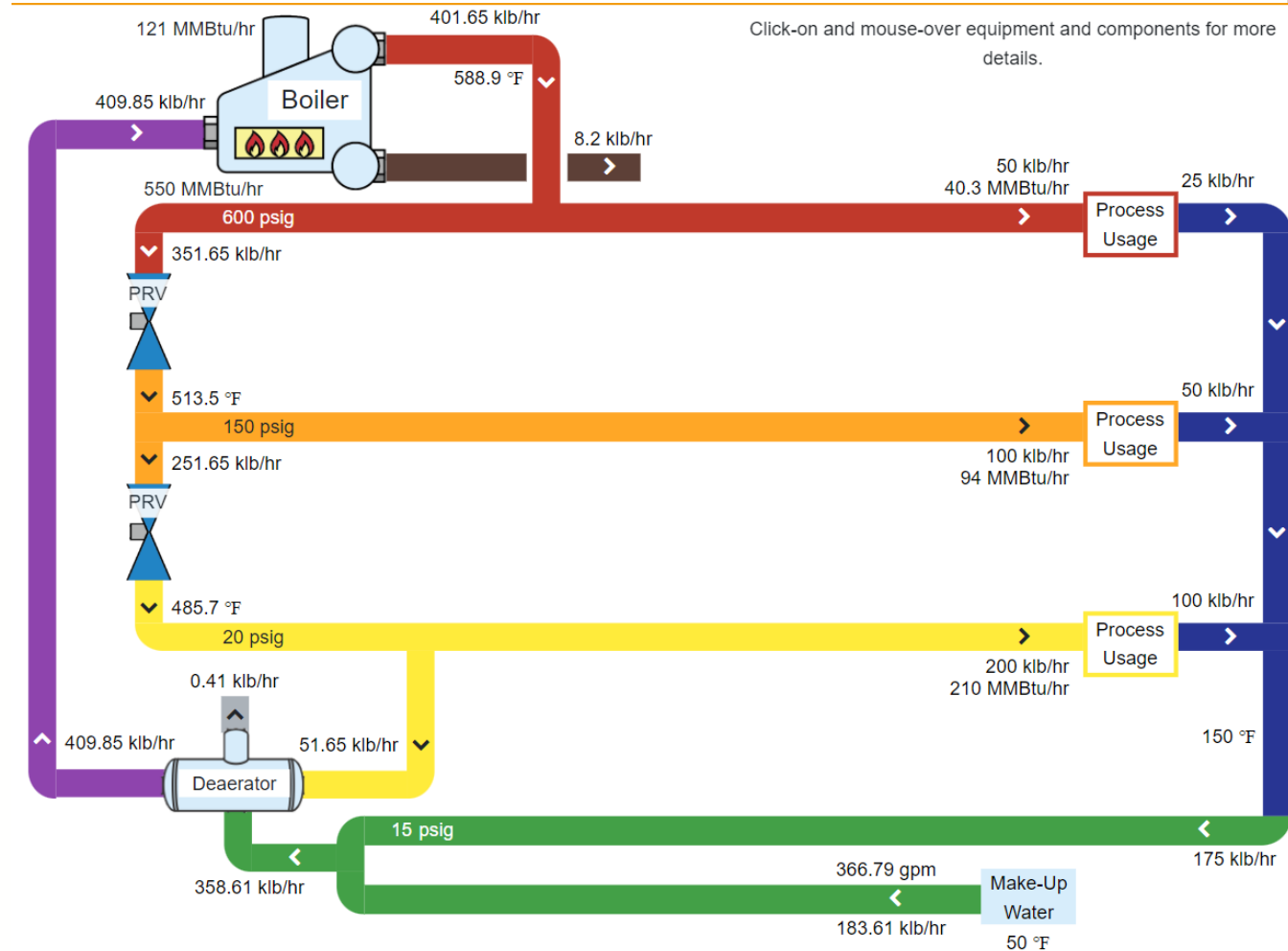
	A	B	C	D	E	F	G	H
1	DOE MEASUR Version Number			Source				
2	Operating Hours	8760	hr/yr	[from System Setup Operations Operating Hours]				
3	Fuel	Natural Gas	Choose	[from System Setup Operations Fuel Type]				
4	Higher Heating Value		Btu/SCF	[default from Feedwater Economizer]				
5	Fuel Cost	5.78	\$/MMBtu	[from System Setup Operations Fuel Cost]				
6	Fuel Temperature	60	°F	INPUT SOURCE				
7	Flue Gas Temperature	400	°F	[from Boiler Efficiency/Stack Loss Calculator]				
8	Percent O2 or Excess Air	O2	Choose	[from Boiler Efficiency/Stack Loss Calculator]				
9	O2 in Flue Gas/Excess Air	3	%	[from Boiler Efficiency/Stack Loss Calculator]				
10	Combustion Air Temperature	80	°F	INPUT SOURCE				
11	Moisture in Combustion Air	0.0077	%	[default from Boiler Efficiency Calculator]				
12	Boiler Energy Rate Input	125512.8	MMBtu/hr	[from Diagram Boiler Energy Input]				
13								
14	Steam Quality	Saturated	Choose					
15	Steam Pressure	150	psig	[from System Setup Header Pressure]				
16	Steam Temperature	370	°F	Only if Superheated Steam				
17	Feedwater Temperature	227.1	°F	[from Diagram Feedwater (purple)]				
18	Boiler Blowdown % of Feedwater	3	%	[from System Setup Boiler Blowdown Rate]				
19	Heat Exchanger Effectiveness		%	INPUT SOURCE [value between 40 and 65 allowed]				

Calculator Output/Results	
Flow Rate of Flue Gases	110,149,167 MMBtu/yr
Flow Rate of Steam	100,088,158 MMBtu/yr
Flow Rate of Feedwater	103,090,803 MMBtu/yr
Enthalpy of Steam	1,196 MMBtu/yr
Enthalpy of Feedwater	196 MMBtu/yr
Flue Gas Outlet Temperature	296 °F
Feedwater Outlet Temperature	256 °F
Annual Results	
Energy Savings	33,559,153 MMBtu
Cost Savings	\$133,901,022

Data Collection

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- Customer/Site information
- System operational data and specifications for MEASUR System Setup
- Specifications (e.g., manufacturer spec sheet, engineering lab data, etc.) of measure case equipment (if applicable)



M&V – TF Input

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Small Measures (<\$25k)

- Data input verification of key MEASUR inputs
 - Nameplate pictures
 - BAS/SCADA screenshots
 - LCD display pictures

Large Measures (>25k)

- Utilizes Steam Boiler M&V
- Data input verification of key MEASUR inputs
 - Nameplate pictures
 - Trend data as applicable
 - ✦ Steam flow and pressure or temperature
 - ✦ Measure specific parameters such as stack temperature, working fluid temperatures, blower speed

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

AOE Measure EULs – TF Input

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- 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 stack economizer, blowdown system, combustion controls, and water treatment
- Justification
 - Steam boiler activity to reset of the EUL is often due to a retube and measures remain
 - Measures are related to systems outside of the boiler replacement activity

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: <ul style="list-style-type: none"> · 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 <u>not</u> 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: <ul style="list-style-type: none"> · EUL of AOE · RUL of Host Proxy 	AOE: Aerator Host: Water Heater Host proxy: Faucet
	AOE is <u>not</u> 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?

Discussion and Affirmation

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- Any other TF comments or suggestions?
- ***Affirmation: Cal TF affirms the Steam Boiler Plant Add-On Custom Measure Package.***

Next Steps

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