Pacific Gas and Electric Company®

PROGRAM MANUAL

Permanent Load Shift-Thermal Energy Storage (PLS-TES) Program

Version 11

June 30, 2017

Pacific Gas and Electric Company

Permanent Load Shift-Thermal Energy Storage

PROGRAM MANUAL

CONTENTS

I. Program Description

This Statewide Permanent Load Shift (PLS) Program is designed to help customers shift their cooling electricity use and lower their energy costs by offering one-time, upfront incentives to offset initial investments in mature (proven) Thermal Energy Storage (TES) technologies. TES systems accomplish load shifting by creating and storing ice or chilled water in off-peak hours and utilizing it for cooling in the typically hotter on-peak hours of the afternoon. The incentive is based on designed cooling load (tons) shift resulting in demand (kW) shift and, when coupled with bill savings from load shifts out of expensive peak hours, can improve the payback period on an investment in a TES system.

TES technologies are quite established in the marketplace. Several types are eligible for the program (these are listed in section III) and are available from a number of manufacturers.

TES technology helps utilities reduce the need for peak generation investments, reduce the likelihood of shortages during on-peak periods, and lower overall system costs by reducing the need for peaking units. The PLS-TES Program was developed under the auspices of the California Public Utilities Commission to advance the State's energy efficiency, energy grid reliability, and greenhouse gas emissions reductions.

Customers with high on-peak cooling loads are the best candidates for PLS. Qualified customers may receive an incentive of up to $875 per kilowatt (kW) of the designed and verified cooling load shift. Customers will be required to shift energy usage during the summer on-peak hours as defined by each utility. The other requirements of the program help ensure that TES customers experience the benefits of load shifting for years to come.

II. Eligibility

PLS-TES incentives are open to electric customers in PG&E's service territory.

To qualify for the PLS-TES Program, an applicant must:

- Be a Bundled Service, Direct Access, or Community Choice Aggregation customer, and
- Be billed on an PG&E Time-of-Use (TOU) rate schedule, and
- Have an installed interval or SmartMeter™, where interval data features and billing have been enabled.

III. Eligible TES Systems

The PLS-TES Program is focused on mature TES technologies. The most common thermal storage media are chilled water or ice. Qualifying equipment includes, but is not limited to:

- Chilled water or other fluid
- Ice-on-coil (external melt)
- Ice-on-coil (internal melt)
- Encapsulated Ice or Phase Change Material
- Ice Harvester/Chiller
- Ice Slurry.

An August 14, 2014, decision by the CPUC deemed Integrated Direct Expansion Packaged Units with Ice-on-Coil (referred to in the decision as refrigerant based air conditioning units less than or equal to 20 tons) to be an emerging technology and no longer eligible for this PLS-TES incentive program.

The TES systems must meet the following requirements to qualify for the Program's incentive:

- Commercially available and have a proven track record in the marketplace
- Control system must be fully automated providing integrated operation of the TES and site existing (or baseline) cooling system
- Installed within 18 months of PG&E Approval and reservation of incentive
- New, with the exception of refurbished TES tanks
- Existing TES systems in operation that increase cooling load shift capacity and existing TES systems inoperative for at least three years may be eligible for incentives
- Installed at the customer's premises
- Installed and functioning for a minimum of 5 years post-installation at the customer's premises
- Meet current building codes for existing and new construction
- Have a five-year warranty from the TES vendor/manufacturer. In general, the warranty should cover replacement of equipment for manufacturer defects or breakdown of the equipment with proper usage of the system.

All equipment must be installed by an appropriately licensed contractor, where applicable, and have obtained all required permits for the installation.

IV. Ineligible For Incentive

The PLS-TES Program will not provide incentives to a customer that has received additional TES incentives from other utility-funded programs. Incentives are not available for fuel switching, adjustment of controls, maintenance service fees, refurbished equipment with the exception of tanks, and shifting achieved by best practices commissioning.

V. Incentive Calculation

The cooling load shift calculation will be based on approved simulation software energy models used for the TES system design in the customer's Feasibility Study and the verified cooling load shift during the post-installation inspection. Energy models will be used to determine a customer's cooling load profile over a year (8,760 hours). From the cooling load profile, the day with the greatest total cooling load in the summer on-peak hours will be identified. The capacity of the TES system will be applied to the on-peak period for that maximum cooling load day. The incentive will be based on the cooling tonnage (ton) shifted from the peak hour on that day. See Appendix G for an incentive calculation example.

A conversion factor will be used to convert the cooling load shift (tons) to electricity load shift (kW) capacity. This calculation method is applied for both full and partial storage systems. A conversion factor of 0.7 kW/ton will be applied to water-cooled chillers and 1.2 kW/ton will be applied to air-cooled chillers.

The final, verified incentive amount for a TES system installation can vary from the amount estimated in the Application and/or the reserved incentive amount.

Incentive Amount Caps:

- A customer will be entitled to the lesser of the project's calculated load shift incentive, or 50% of the project's verified total project cost.
- There is also a PLS-TES Program incentive cap of $1.5 million per customer.

VI. Incentive Process

Customer is eligible for incentive payment after meeting all of the program's requirements and completing the following incentive process in the order listed below. Some process steps may be completed concurrently.

1. Customer submits complete PLS-TES Program Application Agreement.

2. PG&E reviews application, sends acknowledgement of receipt of application, and issues Feasibility Study due date.

3. Customer's engineering firm begins Feasibility Study (See Appendix A).

4. For retrofit projects, Customer installs measurement & verification monitoring instrumentation, and begins data capture (See Appendix B). Although pre-installation monitoring data can be collected and submitted to PG&E after Project Approval and incentive reservation, the timing of monitoring instrument installation should facilitate the capture of three months of shoulder month data prior to the installation of TES.

5. Customer submits Feasibility Study by its due date.

6. PG&E approves (or declines) Feasibility Study.

7. PG&E conducts Pre-Installation Site Inspection. TES equipment must not be installed before the Pre-Installation Site Inspection.

8. PG&E sends PLS-TES Project Approval to customer and reserves estimated incentive amount.

9. Customer submits a Commitment Letter indicating commitment to going forward with the project and a Target Installation Date. Customer can opt, here, for first installment of incentive payment by indicating preference in Commitment Letter.

10. For retrofit projects, Customer submits three months of pre-installation monitoring data to PG&E. Three shoulder months of pre-installation data must be submitted to PG&E before TES tanks are installed.

11. Customer starts TES project and provides periodic project status updates.

12. Customer provides design drawings and proposed sequence of operation for PG&E review.

13. Within 18 months of the incentive reservation, customer installs and commissions TES system and notifies PG&E.

14. Customer submits Commissioning Report to PG&E (See Appendix C).

15. Customer submits all remaining documentation, including certification documentation and project invoices, to PG&E for verification and approval.

16. PG&E conducts post-installation inspections, tests, and verifications (See Appendix D).

17. PG&E determines final incentive amount, gives final approvals, and issues final incentive payment.

18. Customer submits monitoring data monthly to PG&E for five continuous years.

See Appendix F for a process flow diagram.

VII. Incentive Payment Options

Customer has two incentive payment options:

1. Single Installment:

   Customer will be paid for 100% of the Feasibility Study cost and other TES project cost after post-installation inspection approval.

2. Two Installments:

   Payment 1: Twenty-five percent (25%) of the Feasibility Study cost (up to a maximum of $10,000), upon review and approval of the Feasibility Study and Pre-install Inspection approval. To receive Payment 1, customer must indicate Payment 1 preference in submitted Commitment Letter.

   To receive Payment 1, Customer must provide PG&E a copy of the Feasibility Study author's invoice and contracted scope of work description for PG&E to verify the Feasibility Study cost.

   Payment 2: Remainder of the Feasibility Study cost and other approved and verified TES project Costs, after post-installation inspection and verification, commissioning verification and approval, and any other final project verifications and approvals.

The customer's final, verified incentive amount can vary from the amount estimated in the Application and the reserved incentive amount.

VIII. Key Requirements

Customer's failure to submit a Feasibility Study by its Due Date could result in automatic withdrawal of the Application.

During the approved reservation period, PG&E may request that the customer provide proof of progress toward completing its project. Failure to demonstrate adequate performance towards completion of a project for which a reservation was approved may result in forfeiture of the reservation. PG&E also reserves the right to modify or reject any reservation request that, in PG&E's sole judgment, fails to meet the requirements of the program. Upon written request, reservation of customer's incentive may be extended, at the sole discretion of PG&E.

Final incentive payment is subject to a post-installation inspection where a verification of the cooling load shift capability and functionality of the system is performed.

PG&E will include reasonable in-house labor costs and related expenses associated with installation of qualifying equipment. Reimbursable in-house costs shall be limited to labor and other expenses directly incurred for design, engineering, and installation activities, and shall not include indirect labor or overhead costs.

Proof of TES system purchase and installation is required, including, if applicable, proof of payment of third-party installation, receipts, invoices, credit card statements or other documentary proof. If applicable, for proof of payment of third-party installation, PG&E requires an itemized invoice from the third-party installation contractor that clearly details each item of labor and material (if any) that was invoiced by the third-party contractor for the installation of the qualifying TES technology, and proof of payment of the invoiced costs.

PG&E reserves the right to consult with one or more qualified third parties of its own choosing to determine the reasonableness of any in-house related expenses.

IX. Program Participation

Customer is required to operate the TES system on all non-holiday weekdays in the summer months (May 1 until October 31), to shift load from on-peak periods of the day to off-peak periods. PG&E's Summer On-peak hours start at 12:00 pm and end at 6:00 pm. It is expected that some customers will benefit from running the TES system outside the summer months and will be encouraged to do so to maximize energy cost savings.

For a period of no less than 60 months, customer is required to monitor and record five-minute trend data of its TES system to alert operators of equipment performance issues and submit the data to allow PG&E to perform a load impact evaluation for the CPUC. Data should be submitted to PG&E on a monthly basis.

X. Penalties

If customer fails to comply with any PLS-TES incentive program requirement, PG&E may seek a refund of a portion or all of the PLS-TES incentive paid to the customer. The customer will be solely responsible for refunding PG&E, even if the incentive was released to an Authorized Third Party. PG&E has no right or obligation to seek refund from the customer's Authorized Third Party to whom the incentive payment may have been released. PG&E is not responsible for resolving disputes between the customer and the customer's Authorized Third Party.

XI. Program Duration

The PLS-TES Program is effective until program incentive funding is fully subscribed, but no later than December 31, 2017. PG&E will accept PLS-TES Applications no later than December 31, 2017. The Program may be modified without prior notice.

XII. Additional Resources

PLS-TES Helpdesk: **855.350.2040**

PG&E Website: **http://www.pge.com/en/mybusiness/save/energymanagement/pls/index.page**

Email: **PLS-TES@PG&E.com**

Appendix A - Feasibility Study Requirements

An engineering-quality Feasibility Study is required for any project applying for the PLS-TES program. This study is to provide an evaluation of the technical feasibility and economic viability of installing and operating a TES system at the customer site. The study is to be completed by a professional mechanical engineer, licensed and registered in the State of California.

The Feasibility Study must address the facility's overall cooling system with TES equipment.

For retrofits, the modeled baseline system is the existing system. For new construction, the modeled baseline system is a Title 24 baseline system.

The Feasibility Study must include the following:

1. Cover Page
    - Customer Name, Customer Address, Service Account Number
    - Feasibility Study Author Info (Name, Address)
    - Date

2. Table of Contents

3. Executive Summary
    - Project Background Summary
    - Project Scope Summary
    - Facility Load Summary
    - TES Load Summary
    - Energy Reduction/Shift and Savings Summary
    - Evaluation of customer's ability to maintain system
    - Engineers recommendation of the best course of action and feasibility of the customer investing in a TES system

4. Project Background
    - Project and Proposed Chiller Plant Scope of Work Description
    - Facility Overview
        - Space use type, hours of operation, process load description
        - Retrofit or new construction
        - Existing chiller plant equipment schedule (if retrofit)
    - Why is TES being considered? (chiller plant replacement, load expansion, etc.)
    - Existing PG&E meter electrical load summer week trend review

- HVAC or process cooling system description
    - If Retrofit, describe existing and proposed systems
    - If New Construction, describe proposed system

5. Energy Model Results: Cooling and Electric Loads, including future loads (include future load if it is included in scope of PLS-TES application)[1]:

- Annual Totals:
    - Baseline cooling plant input energy (kWh/yr)
    - Proposed cooling plant input energy (kWh/yr) and savings compared to baseline (kWh/yr)
    - New construction only: Baseline building cooling load (ton-hours/yr), if different than proposed cooling load
    - Proposed building cooling load (ton-hours/yr)
- Energy Efficiency Results:
    - TES Summer On-Peak totalized average efficiency (kWh per ton-hour) comparison vs. baseline cooling plant
    - TES Annual totalized average efficiency (kWh per ton-hour) comparison vs. baseline cooling plant
- Graphs:
    - Proposed Summer weekday peak day 24-hour cooling load profile (tons)
    - Baseline Summer weekday peak day 24-hour cooling plant input power (kW)
    - Proposed Summer weekday peak day 24-hour cooling plant input power (kW)
- Note which modeling software and version were used for energy model and economic analysis.

6. Thermal Energy Storage Discussion

- TES peak-day load shift strategy (full vs. partial)
- Proposed TES technology type (ice-on-coil, chilled water, etc.)
- Statement of why selected TES technology was chosen
- TES 24-hour operating schedule (24-hour charge and discharge schedule)
- TES system schematic
- TES location on site (map)
- For TES refurbishment projects, indicate length of time and provide evidence of TES inoperability, and evidence of year of original TES installation.

[1] Baseline = existing for retrofits, and Baseline = Title 24 for new construction.

7. Estimated Load Shift and Incentive
    - Maximum On-Peak TES load shift
    - PG&E incentive (based on maximum cooling on-peak cooling load from approved computer modeling programs compliant with ASHRAE Standard 140 and cooling plant efficiency conversion factor. If project involves an existing load, the model should be calibrated to existing electricity use.)

8. Operations and Maintenance Recommendations

9. Economic Analysis
    - Total First Costs: Equipment, Installation, Design/Commissioning, Permits, etc. costs
    - Annual operating costs
    - Electricity cost savings due to shift to off-peak cooling (from energy model) Economic analysis results; show simple payback at a minimum

10. Recommendation

11. Appendices (Computer Models, Diagrams and Schematics, Photos, Illustrations, Tables/Charts)

Appendix B - Instrumentation and Monitoring Requirements

The purpose of this document is to describe the measurements and data collection required by the program in order to ensure that the customers and program administrators have access to useful and accurate data for the purpose of commissioning (Cx) and measurement and verification (M&V). Additionally, this document will describe the minimum accuracy requirements for the necessary data collection instrumentation.

Measurement Points

The pre-installation parameters must be measured and recorded over a time span of at least three (3) months in order to confirm the thermal cooling load of the building/plant and cooling equipment electrical demand and energy usage.

Built-up Chilled Water/Ice Systems

	Pre-Installation	Post Installation
Outside air temperature	✓	✓
Supply chilled water temperature (water entering building)	✓	✓
Return chilled water temperature (water returning from building)	✓	✓
Chilled water flow rate (total flow rate entering/leaving building)	✓	✓
Total chiller power*	✓	✓
Total primary and secondary chilled water pump power*	✓	✓
Total condenser water pump power*	✓	✓
Total cooling tower fan power*	✓	✓
Power of any other auxiliary loads required to operate chilled water plant*	✓	✓
TES supply chilled water temperature (water leaving storage)		✓
TES return chilled water temperature (water entering storage)		✓
TES chilled water flow rate (total flow rate through storage)		✓

*Electric loads for individual equipment may be combined as long as total chilled water plant power is trended. The total chilled water plant power trend may be achieved by using individual equipment or circuit power meters and summing their trends or by using a single power meter measuring circuits for all chilled water plant equipment.

Meters measuring cooling load, such as with a BTU meter, is acceptable to the PG&E PLS-TES Program in lieu of equivalent chilled water supply, chilled water return, and chilled water flow rate trends.

Instrument Accuracy Requirements

In order to ensure the quality of the data to be collected, the program will require that all measurement instrumentation meets the requirements described below. The instrument accuracy requirements are based on Section 6 of ASHRAE Standard 150-2000 (Method of Testing the Performance of Cool Storage Systems).

Temperature

The rated accuracy, precision, and resolution of the instruments and their associated readout devices shall be within the following limit:

Table 1: Temperature Instrument Requirements

	Temperature	**Temperature Difference**
Accuracy	±0.15°C (±0.3°F)	±0.10°C (±0.2°F)
Precision	±0.10°C (±0.2°F)	±0.075°C (±0.15°F)
Resolution	±0.05°C (±0.1°F)	±0.05°C (±0.1°F)

Temperature sensors used for measuring the temperature difference across a component should be calibrated as matched pairs by the manufacturer.

Liquid Flow Meters

The rated accuracy, precision, and resolution of the instruments and their associated readout devices shall be within the following limits over the entire range of expected flow.

Table 2: Flow Measurement Instrument Requirements

	Flow Measurement
Accuracy	± 5% of reading
Precision	± 2% of reading
Resolution	±0.1% of reading

For locations where flow changes direction depending on operation, flow sensors shall be capable of measuring the flow rates in both directions. All flow meters shall be installed according to the manufacturer's specifications.

Electric Power Measurements
Electrical power shall be measured in true rms power. Therefore instruments must measure voltage and current of each common leg concurrently. The accuracy of the electrical power measuring and associated readout devices shall be equal to or better than 2% of the measured value.

Data-Recording Instruments
Data shall be recorded by data-recording instruments meeting the following requirements:

- The PLS-TES program requires recording intervals of 5 minutes or less. The recorded value shall consist of the average of the values of at least 15 previous individual measurements observed at the scan rate.
- Scan Rate – Data-recording instruments shall sample individual measurements at a rate of not less than five samples per second.
- Scan Interval – Separate scans of the complete set of measurements shall be initiated at least every 20 seconds.
- Resolution – The minimum resolution of the recording instruments shall be 0.1% of the full-scale range and one second for time. This corresponds to the resolution of a 10-bit analog-to-digital converter.
- Accuracy - The accuracy of the recording instruments shall be within 0.25% of full scale.
- Precision – The precision of the recording instruments shall be within ±0.1% of full scale.

- Memory – The data-recording instruments shall have the ability to save up to three (3) months of data or the customer must propose a process for sending the data to the PG&E PLS program in sufficient intervals for the program to collect three (3) months of continuous data.

Calibration Verification Requirements

All measurement instrumentation shall be field calibrated no more than three months prior to the submittal of the data to the PG&E PLS program. The calibration and verification of the instruments shall be completed per section 6.8 of ASHRAE Std 150—2000. Documentation of calibration will not be a required submittal unless requested by the PLS-TES program.

Appendix C - Functional Testing Requirements

The purpose of functional performance testing is to verify that the installed equipment and control sequences are operating as expected. Functional testing also facilitates optimization of setpoints and control logic in order to improve efficiency. Functional performance tests are normally conducted as part of the commissioning process. The purpose of this document is to provide program participants with an outline of the required functional performance tests (FPT) that need to be completed and documented in the Commissioning Report for the project to be considered operating properly.

The main goals of the FPTs will be to confirm the following functionality:

- The instrumentation and monitoring equipment is working properly.
- The cooling plant or compressors are shutting off, or are operating at reduced loads (partial shift system), during the summer peak hours.
- The TES is discharging during the summer peak hours.
- The TES is discharging at the correct temperature and flow during summer peak hours.
- The chilled water returning from the load is sufficiently high to maintain the capacity of the TES.
- The total on-peak cooling load of the building is being met by either the TES alone or the TES and cooling plant/ACs.
- The TES is recharging during off-peak hours.
- The TES is charging sufficiently to meet the next day's load.

Procedure

Functional performance shall be verified and documented in the following ways:

1) General system description and operating set points shall be documented for reference to trend data and onsite observations.
2) Trend logs of normal operation shall be collected for a minimum of seven days at a sample rate of 5 minutes. See Instrumentation and Monitoring Requirements for sampling requirement details.
3) Create plots of the data versus time with all points described in the Trend Points section below and major operating modes identified, including their start and end points. Include no more than 4 parameters per plot.

4) From these plots verify the following:
   a) TES Chiller starts charging at scheduled time.
   b) TES Chiller shuts down when TES entering temperature reaches full charge setpoint or is scheduled off.
   c) If system type is partial – chiller priority, during on-peak period mixing valve is closed until chilled water supply temperature setpoint cannot be met without storage.
   d) If system type is partial – storage priority, during on-peak period mixing valve provides correct chilled water supply temperature setpoint. If load exceeds the rated storage output, TES Chiller then operates to make up the difference w/o removing load from storage.
   e) If system type is partial – demand limited, during on-peak period TES Chiller operates below its demand limit and the mixing valve is closed until chilled water supply temperature setpoint cannot be met without storage.
   f) If system type is full shift, during the on-peak period the TES Chiller is off and the mixing valve provides the correct chilled water supply temperature.
   g) All other control sequences are operating properly.
   h) Control loops are appropriately tuned and setpoints are maintained without hunting or cycling.
   i) Test the capacity of the chillers and tank to ensure they are within reasonable range of design. This can be based on the temperature differential across chiller(s) and tank(s).
5) The expected outcome for each test shall be listed with a pass/fail indication beside each.

General System Documentation

Document the following system parameters if not already included in the commissioning report:

1) Identify the system type:
   - partial – chiller priority
   - partial – storage priority
   - partial – demand limited
   - full storage
2) TES chiller size (tons).
3) TES chiller charge rate (tons).
4) TES system rated output from storage (tons).

5) TES system rated output met by TES chiller and storage (tons).
6) TES nominal storage capacity (ton-hrs).
7) TES entering (from chiller) temperature at which it reaches full charge.
8) TES design supply (to load) temperature.
9) TES design return (from load) temperature.
10) The piping layout indicating the names and location of equipment and measurement points.
11) If there is a material change from Feasibility Study information (e.g. TES system capacity, cooling load connected to the chiller plant, or anther change that affects the incentive calculation parameters), provide both 24-hour design day and off-season load profiles, with the percent of load being met by direct chilling and storage identified.
12) Actual sequence of operations.
13) Modes of operation - control sequences such as charge, charge and chill, discharge, discharge and chill, off, and any seasonal changes.
14) Verify that the physical installation is installed per approved construction documents. Pay particular attention to equipment sizing and installation location.

Verification of Instrumentation & Monitoring

Verify the accuracy of sensor values by comparing them with spot measurements taken with instrumentation that meets the accuracy requirements described in the Instrumentation and Monitoring Requirements (Appendix B).

Additionally, verify that the sensor readings, actuator positions, and VFD speeds monitored and displayed by the control system are consistent with spot measurements described above, field observations, and local VFD screen readings.

Trend Data

Trend data shall be collected per the Instrumentation and Monitoring Requirements and include the following measurement points and calculations at a minimum in order to accomplish the tests described in the Procedures section above:

1) OAT – outdoor ambient temperature (°F)
2) FM1 – fluid flow through the TES system (gpm)
3) T1 - fluid temperature leaving the TES system (°F)
4) T2 - fluid temperature entering the TES system (°F)

5) Q1 – calculated storage heat flow rate (tons) = (FM1* (T2-T1)*C1). For chilled water at 45°F C1 = 0.0419; for 25% ethylene glycol and water at 34°F C1 = 0.0385.
6) TES Chiller kW – electric input to the TES chiller (kW) (all that apply)
7) Chiller kW – electric input to conventional chiller to be shifted if other than TES chiller (kW) (all that apply)
8) FM2 – fluid flow rate to the load (gpm)
9) T3 - fluid temperature to the load (°F)
10) T4 - fluid temperature returning from the load (°F)
11) Q2 – calculated facility thermal cooling load (tons) (FM2* (T4-T3)*C1).
12) Mx1 PID – TES mixing valve command (0-100)
13) Pump speeds (Hz)
14) Pump input power (kW)
15) Condenser water temperature (°F)
16) Cooling tower fan speeds (Hz)
17) Cooling tower fan input power (kW)

Appendix D - Commissioning Report

Minimum Requirements

1. Documentation of all installed TES system equipment (can include pictures of chillers, cooling towers, TES tanks, valves and actuators, and any other equipment relevant to in the TES system)

2. Documentation of installed TES system sequence of operations

3. Documentation that storage thermal capacity (ton-hrs) meets design requirements

4. Documentation that chilled water plant controls and Measure and Verification instrumentation (temperature sensors, flow meters and watt-hour meters) are installed and working properly and data is being gathered at the proper intervals. This could include pictures of the instruments and screen captures of graphics where this data is displayed once the sensors were made fully operational

5. Demonstration that the system is shifting load as per design using at least 5-15 minute trend data of plant power and building load and supply and return temperatures during tank discharge

6. Copy of sensor calibration report (if available)

7. Verification that the system is shifting load (kW) using trend data, building load, and supply and return temperatures during tank discharge

8. Documentation that as-built system control drawings and complete Operation and Maintenance manuals are provided to the owner

9. Verification that maintenance personnel are properly trained and understand the functionality of the system

10. Copy of TES System Acceptance Form (as specified in Title 24 Standards)**

11. Copy of the signed Certification Statement (as specified in Title 24)

12. One week of trends showing typical system operation, after Functional Performance Tests are completed. Refer to Appendix B - Instrumentation and Monitoring Requirements for trend list and requirements.

** It is recommended to follow ANSI/ASHRAE 150 Standard for testing the performance of cool storage systems in addition to verifying Title 24 Standards.

Appendix E - Design Review Requirements

Purpose

Provide Program Implementer and Administrator (PI/A) with opportunity to review design, make recommendations for improvements, and Engineer-of-Record incorporate recommendations into the design.

When

Submit design documents listed below at a stage that fully communicates the design intent and detail. This is expected to occur before submitting design for permit (typically, 2-3 months before permit submission). Design documents should be far enough along that the complete design is conveyed but with sufficient time that design changes can be made and the PG&E PI/A has time to influence the design.

Documents to be Submitted

- Design Intent
- Fully developed Sequence of Operation
- Controls Drawings
- Mechanical Drawings, Plans, and Construction Details
- Overall Cooling System Schematic Diagram
- Detailed Load Calculations
- Specifications
- Submittals (as available)

Format

PDF or Microsoft Word

Appendix F - Process Flow Diagram

Figure 1a - PLS-TES Process Flow Diagram (continued on next page)

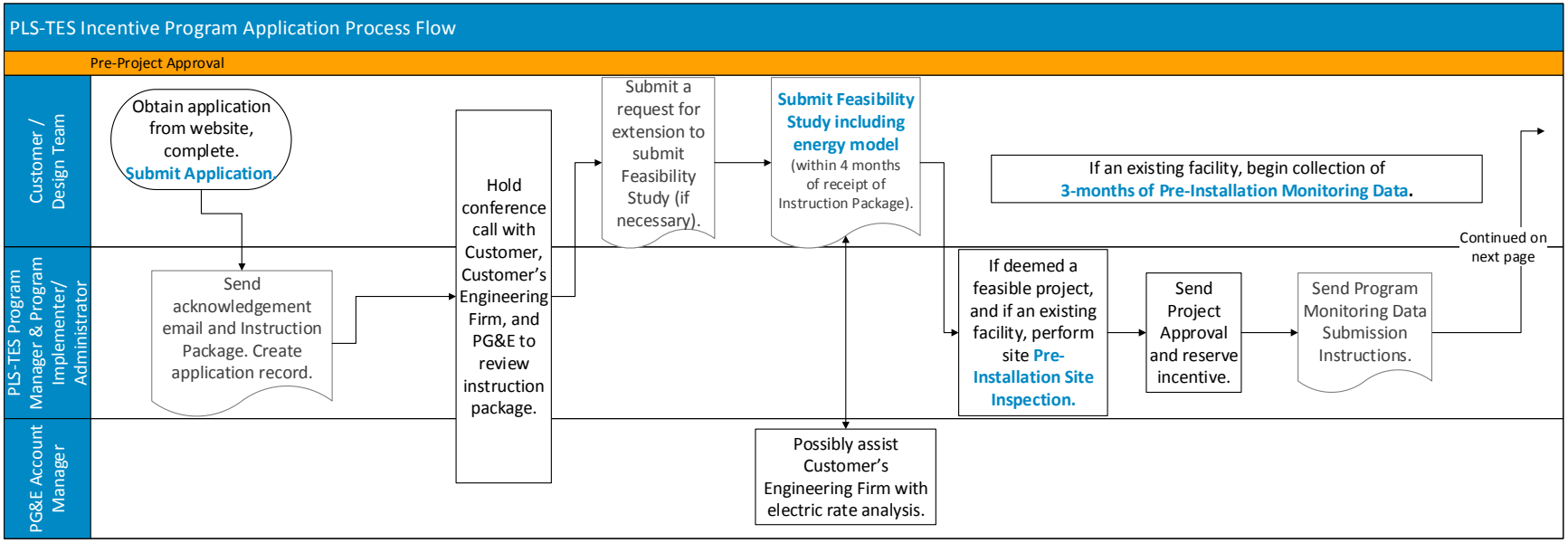
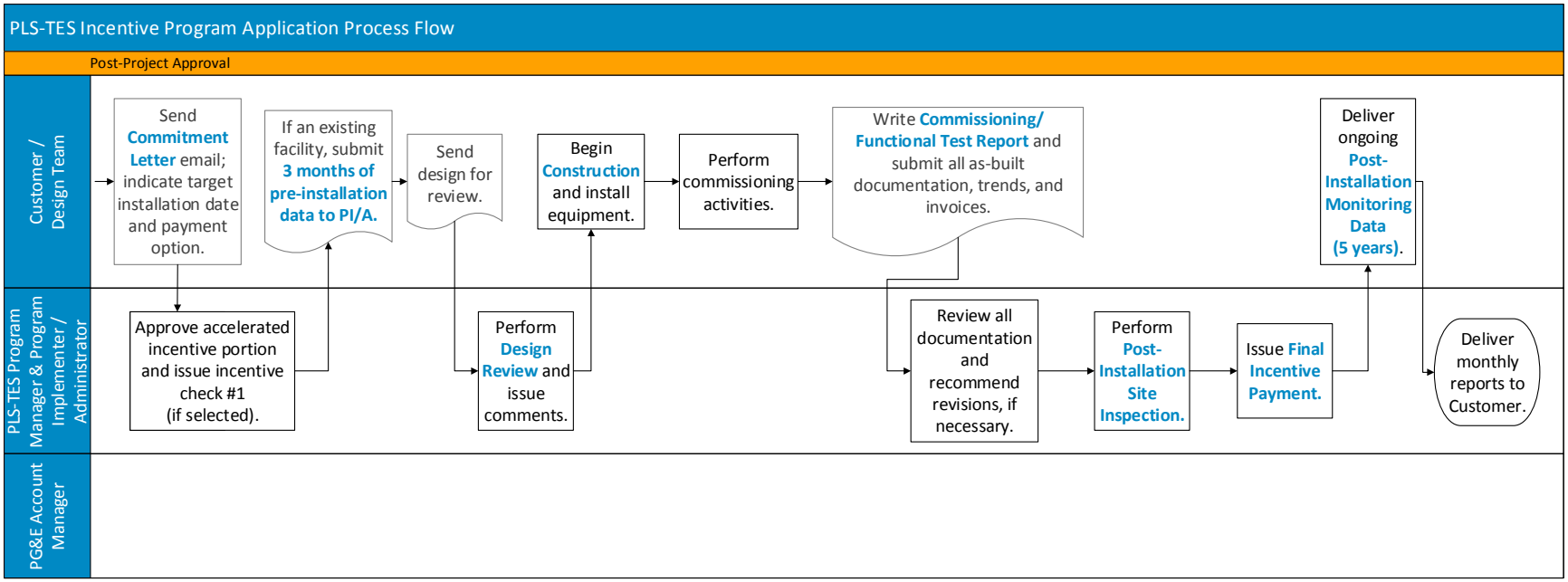


Figure 2b - PLS-TES Process Flow Diagram (continued from previous page)



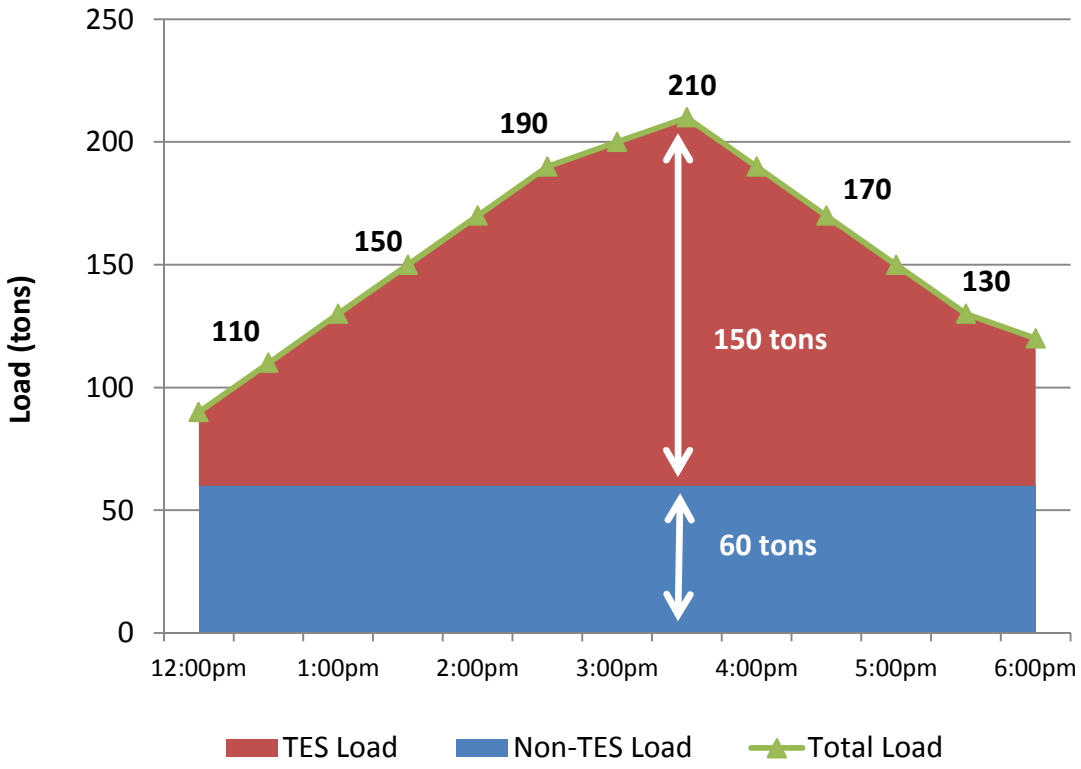
Appendix G - Example Incentive Calculation

Calculation Steps

Step 1: Determine day with largest 6-hour on-peak cooling load from energy model.
Step 2: Determine total 6-hour on-peak cooling load in ton-hours on day from Step 1.
Step 3: Determine TES tank capacity in ton-hours during the day with largest 6-hour on-peak cooling load.
Step 4: Calculate total non-shifted on-peak load by subtracting Step 3 result from Step 2 result.
Step 5: Calculate average non-shifted on-peak load (Step 4 ÷ 6).
Step 6: Determine hour with largest cooling load (tons) during day with largest 6-hour on-peak cooling load.
Step 7: Subtract Step 5 result from Step 6 result to determine on-peak cooling load shift for incentive (tons).
Step 8: Multiply Step 7 result by cooling plant Conversion Factor to determine on-peak electric load shift for incentive (kW).
Step 9: Multiply Step 8 result by $875/kW to calculate maximum potential financial incentive.
Step 10: Calculate incentive implementation cost cap by multiplying total eligible project implementation costs by 50%.
Step 11: Determine final incentive by using lesser of Step 9 result and Step 10 result.

Example

Assumptions
On-peak TES cooling capacity = 600 ton-hrs
Water-cooled chilled water plant: Conversion Factor = 1.2 kW/ton
Total eligible project implementation costs = $300,000



Step 1: See chart above.
Step 2: Total on-peak cooling load: 110 tons + 150 tons + 190 tons + 210 tons + 170 tons + 130 tons = 960 ton-hrs.
Step 3: Assumed TES tank capacity in example: 600 ton-hrs.
Step 4: Total non-shifted on-peak load: 960 ton-hrs – 600 ton-hrs = 360 ton-hrs.
Step 5: Average non-shifted on-peak load: 360 ton-hrs ÷ 6 hrs = 60 tons.
Step 6: Peak on-peak cooling load from chart above: 210 tons.
Step 7: On-peak cooling load shift: 210 tons – 60 tons = 150 tons.
Step 8: On-peak electric load shift: 150 tons * 1.2 kW/ton = 180 kW.
Step 9: Max potential financial incentive: 180 kW * $875/kW = $157,500.
Step 10: Incentive implementation cost cap: $300,000 * 50% = $150,000.
Step 11: Final incentive: minimum of $157,500 and $150,000 = **$150,000**.

Appendix H - Customer Project Verification Checklist

	Commissioning Report
	Sensor Calibration Report (if available)
	Title 24 TES System Acceptance Forms
	Title 24 Certification Statement
	Functional Testing Report (may be part of Commissioning Report)
	Seven days of 5-minute trend data – during functional tests
	Seven days of 5-minute trend data – after functional tests (showing typical operation)
	As-Built Sequence of Operation
	As-Built Mechanical Drawings, Plans, and Construction Details
	As-Built Controls Drawings
	Signed Incentive Recipient PG&E Form
	Signed Contractor PG&E Form
	Itemized Invoices
	Evidence of 5-year system warranty