Regional Renewable Energy Procurement
REQUEST FOR PROPOSALS

Exhibit D.2: Solar Thermal Specifications and Requirements

September 18, 2013

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THROUGHOUT THIS DOCUMENT THE TERMS DESIGN-BUILDER SHALL MEAN SELLER UNDER A PPA FINANCING, AND PURCHASER-OWNER SHALL MEAN BUYER.

1. SITE ACCESS

Design-Builder shall conform to all Purchaser-Owner rules and requirements for accessing sites. Road usage, road closures, number of vehicles, access points, etc., may be regulated by the Purchaser-Owner. Site visits shall be approved and proper check-in requirements must be followed. Design-Builder shall provide signage and/or electronic notification of possible operational impacts upon request by Purchaser-Owner. Unless otherwise determined by Purchaser-Owner, Design-Builder shall be responsible for providing bathroom and storage facilities for all workers on-site, and shall be responsible for procuring, installing, securing, and removing temporary security fencing and scaffolding.

2. PROJECT MANAGEMENT

2.1 PROJECT MANAGER

Design-Builder shall assign a Project Manager from their firm upon execution of any Agreement awarded as a result of this RFP and receipt of Notice to Proceed. The Project Manager shall manage all design, procurement, construction, and commissioning phases of the Project. The construction of solar thermal systems shall be accomplished by Design-Builder with an on-site construction management team. The Project Manager shall ensure that all contract, schedule, and reporting requirements of the Project are met and shall be the primary point of contact for the Purchaser-Owner.

2.2 PROJECT SCHEDULE

A Project Schedule is to be prepared and submitted to the Purchaser-Owner within 14 days of Agreement execution. The Purchaser-Owner will review and approve the Project Schedule prior to the initiation of work. Updates shall be submitted every other week, though the Purchaser-Owner may allow less frequent updates at their discretion. The submittal shall be a Critical Path Method (CPM) schedule describing all Project activities, dependencies, and sequencing of tasks. In particular, Design-Builder shall include Purchaser-Owner review of submittals on the Critical Path. The Project Schedule shall describe all elements of project design, equipment procurement, construction and commissioning, and shall be submitted in electronic format (MS Project, Primavera P6). Adobe Acrobat is not acceptable. The schedule shall also reflect the requirement that construction activities must be coordinated to minimize impacts on normal operations at each site, including ongoing construction activities.

Sufficient information shall be shown on the Project Schedule to enable proper control and monitoring of the Work. The Project Schedule shall show the intended time for starting and completing each activity; the duration of each activity; submittal and approval times; design; delivery of materials, equipment and software; all testing; and other significant items related to the progress of the Work. The Project Schedule shall include a CPM network diagram of sufficient detail to show how Mandatory Milestones are intended to be met. If a schedule submitted by Design-Builder includes changes affecting the achievement of Mandatory Milestones, Design-Builder should clearly identify and justify those changes.

Design-Builder is encouraged to phase the Work in a way that supports efficient and effective delivery of design and build services. The following Mandatory Milestones shall be reflected in the schedule and where applicable, represents the dates upon which each milestone is to be achieved for all sites in the Agreement.

Mandatory Milestones

Mandatory Milestone	Date
50% Schematic Design submittal	TBD
90% Design Development submittal	TBD
100% Construction Documents submittal for permitting	TBD
Approved Construction Documents – All Agency Sites	TBD
Notice to Proceed	TBD
Mobilization – All Agency Sites	TBD
Substantial Completion – All Agency Sites	TBD
Final Completion – All Agency Sites	TBD

2.3 SUBMITTALS

Design-Builder shall provide the following submittals as part of the performance of the Work. The cost of developing and providing submittals shall be included in the Project price.

Agreement Submittals

Submittal	Submittal Date	Exhibit D.1 Section
I. System Design		**TBD**
a. System Design Documentation	At each design milestone	TBD
b. Warranties	At Construction Documents milestone	TBD
c. Testing Plan	At Construction Documents milestone	TBD
d. Training Plan	At Construction Documents milestone	TBD
e. Energy production modeling	At Construction Documents milestone	TBD
II. Procurements and Construction		**TBD**
a. Quality Assurance / Quality Control (QA/QC) Plan	30 days before commencement of construction	TBD
b. Safety Plan	30 days before commencement of construction	TBD
c. As-built Documentation	After completion of Proving Period	TBD
III. Testing		**TBD**
a. Acceptance Test Results	After Acceptance Test	TBD
b. Startup Test Results	After Startup Test	TBD
c. Monitoring Data (Proving Period)	Continually throughout Proving Period	TBD
d. Proving Period Report	30 days after System Startup	TBD
IV. Training		**TBD**
a. Training Materials	30 days before Training Session	TBD
b. Monitoring Manual	30 days before Training Session	TBD
c. Operations & Maintenance Manual	30 days before Training Session	TBD

2.4 SOLAR INCENTIVES

Design-Builder shall submit applications for all available energy production incentives (e.g., CSI, etc.) or, should the Purchaser-Owner already have submitted such applications, assume responsibility for all future requirements (agreements, submittals, etc.) related to these programs. This includes

actions necessary to ensure compliance with the PG&E's net metering program and all interconnection agreements and related documents for Purchaser-Owner participation and utilization of the benefits of each applicable program. Design-Builder shall attend all site verification visits conducted by the applicable public utility or Governmental Authority and shall assist the Purchaser-Owner in satisfying the requirements of the incentive program. Design-Builder shall be responsible for providing updated documentation to incentive program administrators throughout the project, as required by rules of the relevant incentive programs. Incentives shall be paid to the Purchaser-Owner if the system is to be purchased and to the Design-Builder should the system be owned by a third-party.

3. SYSTEM DESIGN

3.1 DESIGN REVIEW PROCESS/ PHASES

The Purchaser-Owner will review and approve design documentation based on the requirements in this RFP and as detailed in Section 3.3 of this document. Additional documents may be requested by the Purchaser-Owner as needed. The precise organization and format of the design submittals shall be agreed upon by Design-Builder and the Purchaser-Owner prior to the first design submission. The Purchaser-Owner will review all submittals, provide written comments, and conduct Design Review Meetings for each stage of the process. Design-Builder shall provide additional detail, as required, at each successive stage of the Design Review. Design-Builder shall not order equipment and materials until Schematic Design submittals have been approved. Design-Builder shall not begin construction until Construction Documents have been approved and all required permits have been obtained. The Purchaser-Owner will formally approve, in writing, each phase of the design and is the sole arbiter of whether each phase of the design has been completed. The Design-Builder shall not enter a subsequent design phase without the approval of the Purchaser-Owner.

Design-Builder shall be held solely responsible for obtaining approvals from the Purchaser-Owner, including revising designs as necessary until they are given approval by the Purchaser-Owner and all other required entities and organizations. A description of requirements for each design phase is provided below. System design shall comply with all applicable laws, statutes, ordinances, codes, rules, and regulations for construction projects of jurisdictions with authority over the Purchaser-Owner. Design-Builder is responsible for providing designs approved by the appropriate professional engineers registered in the State of California. Costs for engineering reviews and approvals shall be borne by the Design-Builder. System designs must take into account Purchaser-Owner aesthetic issues and not conflict with any current Purchaser-Owner operations.

3.1.1 Schematic Design

Design-Builder shall prepare Schematic Design documents consisting of drawings and other documents illustrating the scale and relationship of Project components, including but not limited to, schematic design studies, site utilization plans, solar thermal array layouts and design information, a shading analysis, equipment lists and bills of material, and equipment cut sheets or specifications.

3.1.2 Design Development

Design Development documents shall consist of elevations, cross sections, and other drawings and documents necessary to depict the design of the Project. This submittal shall include architectural, structural, geotechnical, mechanical and electrical design documents and equipment specifications to illustrate the size, character, and quality of the Project and demonstrate that it meets the performance specifications defined in this RFP. The Design Development documents shall represent 100% of the intended scope for the Project.

3.1.3 Construction Documents

Design-Builder shall prepare Construction Documents (CDs) depicting the detailed construction requirements of the Project. CDs shall conform to all applicable governmental, regulatory, and code requirements, and all pertinent federal, state, and local permitting agencies. The CDs shall show the work to be done, as well as the materials, workmanship, finishes, and equipment required for the Project. CDs shall comply with and illustrate methods to achieve the performance specifications of this RFP. CDs shall be stamped by the engineer of record and any other required engineering disciplines.

3.2 DESIGN-BUILDERS' LICENSE CLASSIFICATION

In accordance with the provisions of California Public Contract Code §3300, the Purchaser-Owner requires that Respondents possess, at the time of submission of a Proposal, at the time of award of the Agreement and at all time during construction activities, a Contractor's License as in one of the following classifications: General Engineering (A); General Building (B); Boiler, Hot Water Heating and Steam Fitting (C-4); Plumbing (C-36); or Solar (C-46). It shall be acceptable for a Respondent that does not possess a C-4, C-36 or C-46 License to list a Subcontractor with a C-4, C-36 or C-46 License.

3.3 DESIGN SUBMITTALS

Design-Builder shall prepare a comprehensive submittal package for each phase of the Work that will be reviewed and approved by the Purchaser-Owner. At a minimum, each submittal package shall include the elements required to convey in sufficient detail the following for each phase of the design:

- Site Layout Drawings, with distances from roof edges and existing equipment, as applicable
- Construction Specifications (trenching, mounting, etc.)
- Equipment Layout Drawings
- Detailed Drawings
- Piping and Mechanical Diagrams and Details
- Electrical Single-Line and Three-Line Diagrams
- Electric Wire and Conduit Schedule
- Network Connection Diagrams
- Architectural Drawings
- Structural Drawings including roof penetration
- Geotechnical Drawings
- Manufacturer's Cut Sheets with Equipment Specifications
- Data Acquisition System (DAS) Specifications, Cut Sheets, and Data Specifications

Design-Builder shall include adequate time for Purchaser-Owner review and approval of submittals, as well as re-submittals and re-reviews. Minimum Purchaser-Owner review time shall be ten (10) days from the date of receipt of each submittal package during each phase of the Design Review.

3.4 PERFORMANCE MODELING

Performance modeling of the solar thermal system shall be performed using Polysun or equivalent modeling software using weather data for the location closest to the site. The simulations shall

accurately utilize proposed system layouts, sizes, and orientation to demonstrate projected production. It is critical that solar thermal performance models accurately encompass proposed system specifications, with all methodology and assumptions described. The Purchaser-Owner will independently verify performance models are accurate to the designed systems and utilize simulations for economic evaluations. Design-Builder shall be responsible for updating the performance models each time sufficient changes are made to the proposed system designs that will impact system performance.

Design-Builder shall avoid excessive shading on collectors to the extent possible. Where shading losses are encountered, Design-Builder shall perform a shading analysis justifying the basis for their design, including any proposed tree removal, and explaining why shading does not create an adverse performance and/or economic impact.

3.5 PERMITS AND APPROVALS

Construction Documents must be reviewed and approved by all authorities having jurisdiction (AHJs) over the work, which may include, but are not limited to: the Purchaser-Owner, the City or County in which the work is being done, the utility, the Office of Statewide Health Planning and Development (OSHPD), and the California Solar Initiative Program Administrator. Design-Builder shall be responsible for obtaining all approvals and shall account for permitting requirements in their system designs, project pricing, and schedule. Design-Builder shall produce required documentation in sufficient detail to obtain all regulatory approvals requested for design, construction and operation of the system, including but not limited to all federal, state, and local permits. Design-Builder shall attend all site verification visits conducted by the applicable public utility or Governmental Authority and shall assist the Purchaser-Owner in satisfying the requirements of the incentive program including any special inspections for piping, wiring, trenching and roof attachment work. The Purchaser-Owner will not grant Design-Builder relief based on Design-Builder's incomplete or incorrect understanding of permitting and approval requirements.

3.6 TECHNICAL REQUIREMENTS

3.6.1 General Considerations

This specification addresses the installation of solar thermal hot water systems for use in domestic hot water heating or in swimming pool heating. All systems must meet the qualifications for obtaining an incentive from PG&E's California Solar Initiative Thermal Program, whether or not incentives are available at the time of construction. Design-Builder must be on PG&E's Eligible Contractor List for the CSI Thermal Program.

Participation in the CSI Thermal Program requires an Energy Efficiency Audit/Survey. This is not the responsibility of the Design-Builder and the required work for the audit/survey is not included in this scope of work.

The Minimum Design Life for solar domestic hot water systems is twenty (20) years. The Minimum Design Life for solar swimming pool heaters is twelve (12) years.

All documentation and components furnished by Design-Builder shall be developed, designed, and/or fabricated using high quality design, materials, and workmanship meeting the requirements of the Purchaser-Owner and all applicable industry codes and standards. Reference is made in these specifications to various standards under which the Work is to be performed or tested. The installations shall comply with at least, but not limited to, the latest approved versions of the International Building Code (IBC), National Electrical Code (NEC), California Building Code (CBC), California Mechanical Code and all other federal, state, and local jurisdictions having authority.

Design-Builder shall conform to all specification and guidelines from equipment manufacturers.

3.6.2 Design Standards

The design, products, and installation shall comply with at least, but not limited to, the following electrical industry standards, wherever applicable:

- Institute of Electrical and Electronics Engineers (IEEE) Standards
- National Electrical Manufacturers Association (NEMA)
- National Electric Code (NEC)
- Solar Rating and Certification Corporation (SRCC)
- Underwriters Laboratories, Inc. (UL)
- National Fire Protection Association (NFPA)
- Pacific Gas and Electric Utility Requirements
- American National Standards Institute (ANSI)
- Occupational Health and Safety Administration (OSHA)
- American Disabilities Act (ADA)
- American Society for Testing and Materials (ASTM)
- National Electrical Contractors Association (NECA)
- National Electrical Testing Association (NETA)
- International Building Code (IBC)
- International Code Council (ICC)
- California Building Code (CBC)
- California Building Standards Commission Code (BSC)
- California Mechanical Code (CMC)
- California Plumbing Code (CPC)
- International Association of Plumbing and Mechanical Officials (IAPMO)
- IAPMO Backflow Prevention Reference Manual Second Edition
- All other Authorities Having Jurisdiction

3.6.3 Solar Collectors

In addition to the above, the solar collectors proposed by Design-Builder shall comply with at least, but not limited to, the following:

- Solar Rating & Certification Corporation Standard 100 Minimum Standards for Solar Thermal Collectors (SRCC OG-100)
- Solar Rating & Certification Corporation Standard 300 Minimum Standards for Solar Water Heating Systems (SRCC OG-300)
- All equipment shall be new, undamaged, fully warranted without defect.
- All equipment and installation shall qualify for CSI Thermal Incentive
- Acceptable mounting methods for panels shall be provided by the manufacturer. Bolted and similar connections shall be non-corrosive and include locking devices designed to prevent twisting.

- If collectors using hazardous materials are to be provided, then the environmental impact of the hazardous material usage must be disclosed, including any special maintenance requirements and proper disposal/recycling of the collectors are the end of their useful life.
- Glazed Closed Loop Flat Plate Collector: Provide minimum 65% optical efficiency, rugged high quality construction using impact-resistant, anti-reflective solar glass, copper meander/serpentine absorber tube, selective-surface absorber plate, non-degrading thermal insulation and optional rapid connections kits to interconnect collectors, ports for collector temperature sensors, air vents and electronic differential controls.
- The collector shall have no less than 95% transmission, eta conversion factor of no less than 0.75 by gross area.

3.6.4 Solar Collector Array

- Array Layout: Collector array shall be oriented so that all collectors face the same direction. Space collectors arranged in multiple rows so that no shading from other collectors is evident between 1000 hours and 1500 hours solar time on December 21. Indicate minimum spacing between rows. Collector array must have a minimum surface orientation factor (SOF) of 0.75.
- Piping: Connect interconnecting array piping between solar collectors, in a reverse-return configuration with approximately equal pipe length for any possible flow path. Indicate flow rate through the collector array. Provide each collector bank isolated by valves, with a pressure relief valve and with the capability of being drained. Locate manually operated air vents at system high points, and pitch array piping a minimum of 0.25 inch per foot so that piping can be drained by gravity. Supply calibrated balancing valves at the outlet of each collector bank as indicated.
- Supports for Solar Collector Array: Utilize the existing support structure and recertify that it will be covered under the Design-Builders warranty of ten (10) years with an optional twenty (20) warranty. If a new support is proposed, the Design-Builder must provide a support structure for the collector array of aluminum, stainless steel, or other corrosion-resistant approved material. Furnish a support structure which secures the collector array at the proper tilt angle with respect to horizontal and orientation with respect to true south. Provide a support structure that will withstand the static weight of filled collectors and piping, wind, seismic, and other anticipated loads without damage. Provide a support structure which allows access to all equipment for maintenance, repair, and replacement. Neoprene or EPDM washers shall separate all dissimilar metals. Depending on system type, supports for solar array could terminate in ballast blocks to avoid roof penetrations.

3.6.5 Transport Subsystem

- Heat Exchanger (if required by system design): For system designs requiring a heat exchanger, provide a minimum design pressure rating of 150 psi. Construct heat exchanger of 316 stainless steel, titanium, copper-nickel, or brass. Furnish heat exchanger with a capability of withstanding temperatures of at least 240 °F. Tube-in-tube copper side-arm heat exchangers are acceptable for appropriate system types.
- Pumps (for active systems): For active solar system designs requiring a pump, provide electrically-driven, single-stage, centrifugal type circulating pumps. Support pumps on a concrete foundation or mounting intended for the purpose, or by the piping on which installed if appropriate to the size. Construct the pump shaft of corrosion resistant alloy steel with a mechanical seal. Provide stainless steel impellers and casings of bronze. Pump motor start stop shall be controlled by the solar thermal temperature control system that is compatible with open communication protocol and meets CSI thermal incentive program requirements

complete with manual override (Hand-Off-Automatic). Pumps shall be installed with isolation valves so the pump can be serviced without draining the system.

- Heat Transfer Fluid Heat transfer fluid shall be compatible with all materials in the system. The nature and amount of heat transfer fluid will depend on the type of system proposed and the freeze conditions encountered at the site. Any anti-freeze, conditioners or corrosion inhibitors added to the heat transfer fluid must be non-toxic and intended for use in potable water systems when used with single wall heat exchangers.

3.6.6 Piping System

Provide a piping system complete with pipe, pipe fittings, valves, strainers, expansion loops, pipe hangers, inserts, supports, anchors, guides, sleeves, and accessories with this specification and the drawings. Pipe shall be designed to observe limits on flow velocity, pressure drop and gauge pressure associated with the pipe type and characteristics.

Provide piping flow rates below five (5) feet per second. Piping shall be Type L or Type M copper tubing, ASTM B-88, with 95-5 tin-antimony soldered joints. If cold water piping supplying the SWH system is of another type, such as PVC, it shall be replaced within ten (10) feet of the SWH system with copper to avoid bulging and rupture due to proximity to the higher temperatures of the solar system.

All work performed as described herein including but not limited to piping, fixtures, fitting, solder, flux and panels shall meet California Code requirements for Lead Free products and the installation of these products as set forth in California Health and Safety Code, Sections 116875-116880.

- Provide outside array piping insulation with a capability of withstanding 250 °F, except that piping insulation within 1.5 feet of collector connections shall be capable of withstanding 400°F. Protect outside piping insulation from water damage and ultraviolet degradation with a suitable outer coating manufactured for this purpose (aluminum, sunlight resistant PVC or approved equal).
- If systems are proposed with multiple collector banks, provide calibrated balancing valves suitable for 125 psig and 250 °F service. Furnish calibrated balancing valves with bronze body/brass ball construction with seat rings compatible with system fluid and differential readout ports across valve seat area. Provide readout ports fitted with internal insert of compatible material and check valve. Provide calibrated balancing valves with a memory stop feature to allow valve to be closed for service and reopened to set point without disturbing balance position, and with a calibrated nameplate to assure specific valve settings. Provide calibrated balancing valves and ball valves at the outlet of each collector bank. The balancing valves are specified to allow the array to be flow balanced. The ball valves are required to enable the array to be disconnected for maintenance or repair.
- Provide pressure gauges with throttling type needle valve or a pulsation dampener and shutoff valve. Furnish a 3-1/2 inch minimum dial size.
- Supply thermometers with wells and separable bronze sockets.
- Support and hang piping so that the weight of the piping is not supported by drywall, siding, or other building members not designed to bear load. Support piping so that thermal expansion and contraction of pipe lengths is accommodated. Supports shall be replaced to ensure piping does not sag.
- Provide valves compatible with the piping. Ball valves shall be used for shutoff, with full port, bronze body, bronze ball and Teflon seat. Bronze hose-end gate valves shall be used for draining low points of piping.

- All exposed and accessible hot water piping must be insulated with material which has a minimum of R2.6 value.

3.6.7 Electrical Components

- Provide electrical equipment and wiring in accordance with NFPA 70, the NEC, and UL. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified. Provide each motor of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be high efficiency motors.

3.6.8 Mounting Systems

The mounting systems shall be designed and installed such that the panels may be fixed with reliable components proven in similar projects, and shall be designed to resist dead load, live load, corrosion, UV degradation, wind loads, and seismic loads appropriate to the geographic area over the expected twenty-five (25) year lifetime. The Design-Builder's design shall sufficiently respond to the design requirements imposed by Federal, State, and local jurisdictions in effect at the time of Agreement execution and any pending code decisions affecting the design shall be identified during Schematic Design. Design-Builder shall conduct an analysis, and submit evidence thereof, including calculations, of each structure affected by the performance of the scope described herein, and all attachments and amendments. The analysis shall demonstrate that existing structures are not compromised or adversely impacted by the installation of panels, equipment, or other activity related to this scope. Mounting systems must also meet the following requirements at a minimum:

- All structural components, including array structures, shall be designed in a manner commensurate with attaining a minimum twenty-five (25) year design life. Particular attention shall be given to the prevention of corrosion at the connections between dissimilar metals.
- Thermal loads caused by fluctuations of component and ambient temperatures shall be accounted for in the design and selection of mounting systems such that neither the mounting system nor the surface on which it is mounted shall degrade or be damaged over time.
- Each collector mounting system must be certified by the collector manufacturer as (1) an acceptable mounting system that shall not void the module warranty, and (2) that it conforms to the module manufacturer's mounting parameters.
- Final coating and paint colors shall be reviewed and approved by the Purchaser-Owner during Design Review.
- Painting or other coatings must not interfere with the grounding and bonding of the array.

3.6.9 Corrosion Control

In addition to the above, Corrosion Control proposed by Design-Builder must comply with at least, but not limited to the following requirements:

- Fasteners and hardware throughout system shall be stainless steel or material of equivalent corrosion resistance
- Racking components shall be anodized aluminum, hot-dipped galvanized steel, or material of equivalent corrosion resistance
- Unprotected steel not to be used in any components

- Each system and associated components must be designed and selected to withstand the environmental conditions of the site (e.g., temperatures, winds, rain, flooding, etc.) to which they will be exposed.

3.6.10 Roofing Requirements

The installation of collectors and other equipment shall provide adequate room for access and maintenance of existing equipment on the building roofs. A minimum of three (3) feet of clearance will be provided between equipment and existing mechanical equipment and other equipment mounted on the roof. A minimum of four (4) feet of clearance shall be provided between equipment and the edge of the roof. Clearance guidelines of the local fire marshal shall be followed. The installation of solar or thermal systems will be reviewed for code compliance and adherence to the *State Fire Marshal Solar Photovoltaic Installation Guideline*. The equipment shall not be installed in a way that obstructs air flow into or out of building systems or equipment.

Proposed roof top mounted systems may be ballasted, standing seam attachment, or penetrating systems and must meet or exceed the following requirements:

- Systems shall not exceed the ability of the existing structure to support the entire solar thermal system and withstand increased wind uplift and seismic loads. The capability of the existing structure to support proposed solar systems shall be verified by Design-Builder prior to design approval.
- Roof penetrations, if part of the mounting solution, shall be kept to a minimum.
- Design-Builder shall perform all work so that existing roof warranties shall not be voided, reduced, or otherwise negatively impacted.
- No work shall compromise roof drainage, cause damming or standing water or cause excessive soil build-up.
- All materials and/or sealants must be chemically compatible.
- Thermal movement that causes scuffing to the roof must be mitigated as part of the mounting solution.
- All penetrations shall be waterproofed.
- Detail(s) for the sealing of any roof penetrations shall be approved in writing to the Purchaser-Owner, as well as the manufacturer of the existing roofing system, as part of system design review and approval – prior to Design-Builder proceeding with work. The Purchaser-Owner will make available the roofing manufacturer for each building for consultation with Design-Builder as part of the design process.
- All roofing penetrations and waterproofing shall be performed or overseen by a licensed roofing contractor who is certified by the roofing materials manufacturer for the specific materials or systems comprising each roof upon which a solar system will be installed. The roofing contractor shall also be safety prequalified by the Purchaser-Owner.
- As part of the design submittals, Design-Builder shall include signed certificates from the roofing manufacturer stating:
    - The roofing contractor is certified installer of Complete Roofing System.
    - The manufacturer's Technical Representative is qualified and authorized to approve project.
    - Project Plans and specs meet the requirements of the warranty of the Complete Roofing System for the specified period.
    - Existing warranty incorporates the new roofing work and flashing work.

- Any damage to roofing material during installation of solar systems must be remedied by Design-Builder.
- The installation of panels and other equipment on building roofs will be designed to minimize visibility of the equipment from the ground.

3.6.11 Ancillary Equipment Enclosures

Design-Builder will be responsible for incorporating the following elements in the design and construction of the System:

- Fencing: all ancillary equipment be grouped to a single location per site and shall be surrounded by a fence to prevent access by unauthorized personnel. The fence shall be a six (6) foot high chain link fence with vinyl privacy slats. This requirement may be waived at the Purchaser-Owner's sole discretion.
- Location: all ancillary equipment shall be located in a manner that minimizes its impact to normal Purchaser-Owner operations and minimizes the visual impacts to the site.

3.6.12 Lightning and Surge Protection

- Design-Builder shall utilize lightning arrestors to protect appropriate equipment from lightning strikes.
- Design-Builder shall utilize surge suppressors to protect the appropriate equipment from electrical surges.

3.6.13 Monitoring System, DAS, and Reporting

Design-Builder will at least meet the requirements of the CSI Thermal Program for monitoring system performance. No metering process is required by CSI for systems under 30 kW thermal output. For this contract the same level of metering is required for systems under 30 kW as is required for systems between 30 and 250 kW. Between 30 and 250 kW thermal output a monitoring system is required that will be monitored by the site and provide an accuracy of ±15%. Above 250 kW thermal output a monitoring system (or other triggers) a performance based incentive (PBI) will require a third party Performance Data Provider (PDP) for an accuracy of ±5%.

Design-Builder shall design, build, activate and ensure proper functioning of the necessary Data Acquisition Systems (DAS) that enable the Purchaser-Owner to track the performance of the Solar Systems as well as environmental.

A Monitoring Manual shall be provided to the Purchaser-Owner in printed or on-line form that describes how to use the monitoring system, including the export of data and the creation of custom reports.

3.6.14 FAA Requirements

Design-Builder shall be responsible to submit the appropriate FAA Form 7460-1, along with any other required forms and documentation, for all proposed solar systems within the approach or takeoff paths or on the property of airports as defined by the Code of Federal Regulations Title 14 Part 77.9.

3.6.15 Freeze Protection

Design-Builder is responsible for designing and installing a solar system that meets freeze protection requirements set forth by SRCC and IAMPO for the appropriate climate zone of the site.

Direct forced circulation systems, where potable water is pumped and heated directly in the collector, are not eligible for CSI Thermal rebates, so are not allowed on this contract.

3.6.16 Stagnation/Overheat Protection for Collectors

Stagnation protection must be provided to at least meet the requirements of the CSI Thermal Program.

3.6.17 Shading

Design-Builder shall adhere to the following requirements in order to avoid excessive shading on panels. For any object near an array that is higher than the lowest point of that array by height H, Design-Builder shall locate the array farther from the object than:

- 2H to the North of the object
- 2H to the East or West of the object
- 2H to any non-cardinal direction of the object

Any Design-Builder whose system design does not adhere to these rules shall perform a shading analysis justifying the basis for their design, including any proposed tree removal, and explaining why shading does not create an adverse performance and/or economic impact.

Any trees that are in the footprint of systems to be installed by the Design-Builder shall be removed by the Design-Builder at their expense, subject to the approval of the Purchaser-Owner. A tree shall be considered to be in the footprint of a system if its canopy would extend over any part of the system, including structural components or modules. The Purchaser-Owner will remove or prune, at its discretion, trees planted outside of the work area that shade PV systems (at present time or in the foreseeable future), provided the Design-Builder identifies these trees during the design process. The Design-Builder shall be responsible for any required tree remediation efforts resulting from tree removal that is deemed the Design-Builder's responsibility.

3.7 WARRANTIES

Design-Builder shall provide for the following warranties:

All solar collectors must have a minimum of a ten (10) year manufacturer's performance warranty to protect against defects and a 15% performance degradation. Additionally, the Design-Builder shall provide a twenty (20) year warranty option if commercially available.

All systems must have a minimum ten (10) year performance warranty to protect the host against more than a 15% degradation of system performance over the ten (10) year period that may occur as a result of faulty installation.

All systems must have a minimum one (1) year warranty on installation labor and workmanship not otherwise covered by the manufacturer's performance warranty.

The mounting system shall have a twenty (20) year warranty covering at least structural integrity and corrosion.

Design-Builder shall provide a comprehensive ten (10) year warranty on all system components against defects in materials and workmanship under normal application, installation, and use and service conditions.

All warranties must be documented in advance and be fully transferable to Purchaser-Owner.

All work performed by Design-Builder must not render void, violate, or otherwise jeopardize any preexisting Purchaser-Owner facility or building warranties or the warranties of system components.

4. PROCUREMENT/CONSTRUCTION

4.1 SCOPE OF SUPPLY

Design-Builder shall provide all necessary labor, materials, equipment, and services required to install complete integrated turnkey solar thermal systems. Design-Builder shall supply all solar collectors, mounting equipment, piping, pumps, controls, metering, related wiring, monitoring equipment, and all ancillary equipment necessary to install the solar system and interconnect it to the Purchaser-Owner hot water system. The solar system installations shall comply with all contract requirements, technical specifications, approved design documents, and applicable regulatory codes and requirements. Design-Builder shall submit As-Built Construction Drawings in hard copy with two (2) sets and an electronic copy in DWG format on compact disc to the Purchaser-Owner after completion of the Proving Period for each system at each site.

4.2 MATERIALS AND EQUIPMENT

Materials and equipment incorporated in the Work shall be new and suitable for the use intended. No material or equipment shall be used for any purpose other than that for which it is designed, specified or indicated.

Design-Builder shall use means necessary to protect the materials and equipment before, during and after installation. Design-Builder shall promptly replace lost or damaged materials and equipment with equal, or Purchaser-Owner-approved, replacements, or repair them, at no additional cost to the Purchaser-Owner.

4.3 LINE LOCATION

Design-Builder will be responsible for locating, identifying and protecting existing underground utilities conduits, piping, substructures, etc. and ensuring that no damage is inflicted upon existing infrastructure. In addition to USA Dig and utility line-locating, a private line-locator must be used for any project requiring underground work.

4.4 TREE REMOVAL

Any trees that are in the footprint of systems to be installed by the Design-Builder shall be removed by the Design-Builder at their expense, subject to the approval of the Purchaser-Owner. A tree shall be considered to be in the footprint of a system if its canopy would extend over any part of the system, including structural components or collectors. The Purchaser-Owner will remove or prune, at its discretion, trees planted outside of the work area that shade collectors (at present time or in the foreseeable future), provided the Design-Builder identifies these trees during the design process. The Design-Builder shall be responsible for any required tree remediation efforts resulting from tree removal that is deemed the Design-Builder's responsibility.

4.5 CLEANING

Clean and disinfect potable-water distribution piping as follows:

- Purge new piping and parts of existing water piping that have been altered, extended, or repaired before using. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed, procedure described in either AWWA C651 or AWWA C652. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows contamination.

Clean the non-potable solar thermal side of the system including the solar thermal collectors and heat exchanger according to manufacturer's recommendations. Clean all piping by flushing the piping system with clean, potable water until dirty water does not appear at outlets.

4.6 QUALITY ASSURANCE AND QUALITY CONTROL

Design-Builder shall implement a Quality Assurance / Quality Control (QA/QC) plan for construction activities on Purchaser-Owner sites. At least 30 days prior to the planned commencement of construction, Design-Builder shall submit a copy of the QA/QC Plan for review and approval by the Purchaser-Owner.

To ensure the highest quality of the installation, Design-Builder shall:

- Implement policies and procedures to ensure proper oversight of construction work, verification of adherence to construction documents and contractual requirements, and rapid identification and mitigation of issues and risks.
- Utilize best practice methods for communicating progress, performing work according to the approved Project schedule, and completing the Project on-time.
- Keep the Site clean and orderly throughout the duration of construction. All trash and rubbish shall be disposed of off-site by licensed waste disposal companies and in accordance with applicable Law.
- Provide equipment marking, as well as labeling and signage for the Project that shall be removed after Project completion.
- Fully comply with all applicable notification, safety and Work rules (including Purchaser-Owner safety standards) when working on or near Purchaser-Owner facilities.
- Provide Special Inspection for trenching, rebar, concrete, welding, and roof attachment work, according to AHJ requirements.
- Route all electrical collection system wiring and conduits in a neat and orderly fashion and in accordance with all applicable code requirements. All cable terminations, excluding module-to-module and module-to-cable harness connections, shall be permanently labeled.
- Torque all mechanical and electrical connections and terminations according to manufacturer specifications, with marking/sealing of all electrical terminations at appropriate torque point.
- Provide all temporary road and warning signs, flagmen or equipment as required to safely execute the Work. Street sweeping services shall also be provided as required to keep any dirt, soil, mud, etc. off of roads. Comply with all state and local storm water pollution prevention (SWPP) ordinances.

4.7 REMOVAL AND REMEDIATION

Design-Builder shall remove all construction spoils, abandoned footings, utilities, construction equipment and other byproducts of construction. All disturbed areas including landscaping, asphalt, and concrete shall be remediated to be in equal or better condition than found. Parking lots shall be re-striped if affected by construction operations.

The site shall be left clean and free of debris or dirt that has accumulated as a result of construction operations.

5. TESTING AND COMMISSIONING

Following completion of construction, Design-Builder shall provide the following services related to startup and performance testing of the systems:

- Acceptance Testing
- System Startup
- Proving Period

A detailed Testing Plan covering each of the phases above shall be submitted and approved by the Purchaser-Owner prior to substantial completion of construction. A detailed description of each phase is provided below.

5.1 ACCEPTANCE TESTING

Design-Builder shall perform a complete acceptance test for each System. The acceptance test procedures include component tests as well as other standard tests, inspections, safety and quality checks. All testing and commissioning shall be conducted in accordance with the manufacturer's specifications.

The section of the Testing Plan that covers Acceptance Testing cover at least the following:

- Detailed test methods, including sample calculations and reference to standards as required or applicable, and list of tested equipment.
- Pre-test checklist to ensure readiness and any safety measures are in-place.
- Detailed list of all items to be inspected and tests to be conducted.
- Acceptance Criteria: For each test phase, specifically indicate what is considered an acceptable test result.

The Acceptance Testing section of the Testing Plan shall include (but not be limited to) the following tests:

- Testing performance of the collectors relative to insolation, ambient temperature and inlet temperature
- Testing of all sensors of the DAS
- Temperature sensor diagnostics
- Testing of the Data Presentation interface of the DAS
- Piping hydraulic pressure test
- Water portability test

After Design-Builder conducts all Acceptance Testing based on the Testing Plan approved by the Purchaser-Owner prior to substantial completion, Design-Builder shall submit a detailed Acceptance Test Report to the Purchaser-Owner for review.

The Acceptance Test Report shall document the results of the tests conducted following the Testing Plan, and include additional information such as the date and time each test was performed. It shall also make reference to any problem and deficiencies found during testing. If there was troubleshooting done, the Report shall describe the troubleshooting methods and strategy. Design-Builder shall be responsible for providing the labor and equipment necessary to troubleshoot the System.

5.2 SYSTEM STARTUP

Following Purchaser-Owner approval of the Acceptance Test Report, Design-Builder shall conduct tests over twenty-four (24) hours and at a time resolution of fifteen (15) minutes, recording the following data:

- Thermal output (Btu)
- In-plane irradiance
- Ambient temperature
- Collector inlet temperature
- Thermal energy storage temperatures

These data points shall be presented in a manner that best depicts the actual performance of the system for Purchaser-Owner review and approval and shall be submitted as part of the Startup Test Report.

5.3 PROVING PERIOD (30 DAYS)

Upon completion of Acceptance Testing and System Startup, and approval by the Purchaser-Owner, Design-Builder shall monitor the system during a thirty (30) day Proving Period and submit a report for Purchaser-Owner review and approval prior to final acceptance by the Purchaser-Owner. This includes monitoring system output and ensuring the correct functioning of system components over this time. The values for the following data shall be acquired every fifteen (15) minutes over thirty (30) days:

- Date and Time of data points
- Thermal output (Btu)
- Total Btu's delivered (per tank if system has multiple tanks)
- In-plane irradiance
- Ambient temperature
- Collector inlet temperature
- Thermal energy storage temperatures
- Quantity of back-up fuel consumption
- System availability

Design-Builder shall utilize calibrated test instruments and DAS and monitoring system to collect the test data described above, which shall be made available to the Purchaser-Owner for access throughout the Proving Period. Design-Builder shall determine through analysis of data from the

Proving Period whether the solar thermal system delivers the expected production as determined by the final approved design (i.e., Construction Documents). Actual production shall be compared against expected production using actual weather data and other system inputs for calculating expected production.

All data and reports required in system testing shall be fully functional and available to the Purchaser-Owner at the commencement of the Proving Period. Data and reporting requirements are included in the testing scope of the Proving Period and deficiencies in these areas (including missing data, inaccurate reports, and other issues that make validation of system performance inconclusive) shall be grounds for denying approval of the Proving Period Report.

If the solar thermal system does not perform to design specifications, diagnostic testing shall be performed by Design-Builder, deficiencies shall be identified with proposed corrective actions submitted to the Purchaser-Owner, and the Proving Period test repeated. Design-Builder shall be responsible for providing the labor and equipment necessary to troubleshoot the system. The Proving Period Report shall be submitted after the successful completion of this phase and submitted to the Purchaser-Owner for review and approval. The report shall contain, but not be limited to, the following information; calculations shall be provided in Excel format with formulas visible to allow for peer review:

- System description
- Test period
- Test results
- Anomalies identified during test
- Corrective action performed
- Actual measured performance
- Calculations detailing expected performance under TMY conditions

5.4 CLOSE-OUT DOCUMENTATION REQUIREMENTS

Close-Out documents prepared by Design-Builder must include at minimum, but not limited to, the following items:

- Final As-Built Drawing Set, provided in two (2) hard copy sets and an electronic copy in DWG format (or as desired by Purchaser-Owner)
- Component warranties
- Signed inspections cards from AHJ and required Special Inspections
- Owner's Manual

6. OPERATIONS AND MAINTENANCE

Design-Builder shall offer Operations and Maintenance services for ten (10) years with their Proposal, with an option to extend the Contract for up to an additional ten (10) years. The Purchaser-Owner reserves the right to not execute the Operations and Maintenance services agreement. In offering such services, Design-Builder shall perform all necessary preventive and corrective maintenance, which includes routine maintenance adjustments, replacements, and repairs with supporting documentation delivered to the Purchaser-Owner after the Work has been performed. Maintenance by Design-Builder shall ensure that all warranties are preserved. The frequency and timing of collector wash-downs shall be determined by Design-Builder based on system monitoring data.

Environmental sensors such as pyranometers shall be tested and recalibrated at least once every three (3) years.

Design-Builder shall perform the following maintenance services, at a minimum, as described in the following sections:

6.1 PREVENTIVE MAINTENANCE

Preventive Maintenance shall be performed at least annually and include:

- Test system performance vs. insolation and ambient temperature to verify continued performance at or near design levels
- System level testing including tests of individual major components
- System visual inspection to include but not be limited to the list below. All discovered issues shall be resolved as needed.
    - Inspect for stolen, broken or damaged collectors, record damage and location. Report to the Purchaser-Owner and wait for the Purchaser-Owner to authorize a course of action.
    - Check mechanical attachments of the collectors and racking system.
    - Inspect all metallic parts for corrosion.
    - Survey entire jobsite for debris or obstructions.
    - Inspect fasteners for proper torque and corrosion.
    - Check for proper operation and reporting of monitoring hardware.
    - Inspect pipe connections for leaks
    - Inspect piping and other hardware for signs of damage from vandalism or animal damage.
    - Inspect storage tank(s) for signs of damage
- Routine system maintenance to include correction of loose water pipe connections, replacement if defective collectors found during testing, other minor maintenance repair work.
- Collector cleaning, at a frequency to be determined by the ongoing monitoring of the system such that effect on production is no more than 5%, but not less often than twice a year.
- Routine DAS maintenance to include sensor calibration and data integrity check

6.2 Troubleshooting, Inspection and Additional Repairs

- Dispatch of field service resources within two business days of notification (via automated or manual means) for repairs as necessary to maintain system performance.
- Any corrective action required to restore the system to fully operational status shall be completed within 24 hours of the service resources arriving on-site.
- Major system repairs.

6.3 CUSTOMER SERVICE SUPPORT

- Support telephone line made available to Purchaser-Owner staff to answer questions or report issues.

- Support line shall be staffed during operational hours from 8 am – 6 pm California Standard Time. During times outside of this operational period, an urgent call shall be able to be routed to a supervisor for immediate action.

6.4 MAJOR COMPONENT MAINTENANCE AND REPAIR

- Pump repair and component replacement and refurbishment as required in the event of pump failure.
- Pump inspection and regular servicing as required under pump manufacturer's warranty specifications. Those include but are not limited to the following annually:
  - Check for corrosion on all .fittings
  - Check all connections.
  - Perform a complete visual inspection of all connected systems including expansion tank and back-up water heater.
  - Record all inspections completed.
  - Inform pump manufacturer of all deficiencies identified.
  - Oversee pump manufacturer performance of In-Warranty replacement of failed pump components.
- Customer advocacy with vendors.

6.5 OTHER SYSTEM SERVICES

- O&M Manuals – Design-Builder shall provide three (3) copies of O&M Manuals. Updated editions of O&M Manuals shall be sent electronically to the Purchaser-Owner as they become available.
- Management of long term service and warranty agreements, ongoing.
- Design-Builder shall log all maintenance calls and document all maintenance activities. These activities shall be presented in a report, which is to be submitted to the Purchaser-Owner on a minimum monthly basis.

O&M services shall be priced separately from the design and construction of the system. Design-Builder shall submit a detailed description of their O&M services, detailing the activities and the intervals at which they will be performed, with their Proposal.

7. PRODUCTION GUARANTEE

Design-Builder shall offer a Production Guarantee as part of their Proposal. The Production Guarantee shall comply with the PPA Terms and Conditions and Design-Build Terms and Conditions included as Exhibits E.1 and E.2 of the RFP.

8. TRAINING

The Respondent shall provide four (4) hours of on-site training for Purchaser-Owner personnel in all aspects of operation, routine maintenance, and safety of the systems, DAS, and monitoring solution.

At a minimum, training topics shall include the following:

- System safety, including shut-down procedures
- Solar thermal collector maintenance and troubleshooting
- Calibration and adjustment procedures for flow meter, temperature sensors, pressure gauges
- DAS and monitoring solution, including standard and custom reporting
- Heat transfer fluid changing guide and schedule

Design-Builder shall submit a proposed Training Plan during the design process for approval and provide all training materials and manuals to support on-site training in advance of scheduled training sessions (see schedule of submittals in Section 2.3, “Submittals”). The on-site portion of the training program shall be scheduled to take place at the jobsite at a time agreeable to both the Purchaser-Owner and Design-Builder.