

# Wild Horse Solar Project Request For Proposals and Technical Specification



December 4<sup>th</sup>, 2006

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## **1 INTRODUCTION**

### **1.1 Instructions to Respondents**

#### 1.1.1 Preparation and Submission of Proposal

1. All proposals must be in strict conformity with the proposal documents and any addenda.
2. Each Respondent shall submit an electronic copy on CD and two (2) hard copy proposals [one (1) original and one (1) copy]. The upper left-hand corner on the face of the envelope shall specify the following:
  - (a) the name of the Respondent; and
  - (b) the name of the Work: "Wild Horse Solar Proposal"
3. Each proposal must be addressed to and submitted so as to be received by PSE **no later than 2:00 P.M. on Thursday, February 1<sup>st</sup>, 2007**, at the following address:

Puget Sound Energy, Inc.  
Contract Services  
10885 NE 4th Street  
P.O. Box 97034  
Bellevue WA 98009-9734

4. Proposals will be evaluated promptly after submission and Contractor selection is expected by **Monday, March 5<sup>th</sup>, 2007**.
5. Proposal security will **not** be required.
6. The preparation and submission of a proposal will be by and at the expense of the Respondent.

#### 1.1.2 Examination of Proposal Documents.

Each Respondent must carefully examine the proposal documents and all addenda. If any Respondent (a) finds any discrepancies, omissions, or ambiguities in the proposal documents, (b) is uncertain as to the intent or meaning of any provision of the proposal documents, or (c) has any question regarding the proposal documents, the Respondent must promptly notify PSE's RFP manager. Replies to such notices may be made in the form of addenda which will be issued simultaneously to all persons who have obtained the proposal documents from PSE.

### 1.1.3 Modifications or Withdrawal of Proposals.

1. A Respondent may modify or withdraw their proposal by written request, provided that the request is received by PSE prior to the time specified for contract award. Following withdrawal of its proposal, a Respondent may submit a new proposal, provided that such new proposal is received by PSE prior to the submittal deadline.
2. PSE may modify any provision of the proposal documents at any time prior to the time specified for the submission of proposals. Such modifications may be made in the form of addenda which will be issued simultaneously to all persons who have obtained the proposal documents from PSE.

### 1.1.4 Award or Rejection of Proposals.

1. All proposals will be opened privately and kept confidential.
2. Formal interviews may be scheduled with selected Respondents to further review and discuss the proposal.
3. All proposals are subject to further negotiation.
4. The contract, if awarded, will be awarded on the basis and after consideration of price and any other factors deemed pertinent by PSE.
5. PSE reserves the right to reject any or all proposals or to waive any informality in the proposals or bidding.

### 1.1.5 Contract Execution

1. Prior to execution of the contract, the Respondent to whom the contract is awarded (the “successful Respondent” or “Contractor”) must deliver to PSE certificates of insurance and any other documents required by the RFP.
2. If requested by PSE, the successful Respondent must assist and cooperate with PSE in preparing the formal contract. Within three (3) days after presentation of the formal contract, the successful Respondent must duly execute the same and return it for execution by PSE. The failure of the successful Respondent to duly execute and return the contract, together with certificates of insurance and any other required documents, will entitle PSE, in addition to all other rights and remedies of PSE, to award the contract to any other Respondent.
3. All proposal documents shall remain the property of PSE. If requested by PSE, the unsuccessful Respondents shall return all RFP documents to PSE at the address specified above.

## **1.2 Project Synopsis**

### **1.2.1 General**

Puget Sound Energy (“PSE” or “Owner”) is seeking qualified proposals for the design, engineering, procurement, supply, installation, commissioning, and testing of a fully integrated and operational 500 kW STC rated<sup>1</sup> grid-paralleled solar electric renewable energy system (the “Work”) to be located at PSE’s Wild Horse wind power project located in Ellensburg, Washington. The base proposal shall be for a nominal 500 kW STC rated system, but Respondents may also include an optional proposal for an additional 500 kW STC (for a total electrical capacity of 1,000 kW STC rated).

This RFP document provides instructions and proposal requirements for Respondents. In preparing a proposal, the Respondents shall rely fully upon their own experience and physical inspection of the Wild Horse wind power project.

The Owner has identified three sites at the Wild Horse project which would be suitable for the installation of a solar energy conversion project. Each provides ready access to the existing underground electrical collection system, is already disturbed due to construction activities for the wind project, and is easily accessed by road for solar project construction and O&M purposes.

The base 500 kW rated project will be split to include approximately 50 kW installed in site 1 at the site of Owner’s Operations Center building, with the remaining approximate 450 kW to be installed in site 2, the Old Quarry Site. If selected by Owner, an optional 500 kW shall be installed in site 3. See Appendix 3.3.1 for the relative proximity of the three sites.

Qualified proposals shall be from Respondents with a proven track-record of success on large solar projects, be in good financial health and have been in business for a minimum of five years. Qualified proposals shall also use proven technology with more than 5 MW of field experience, common manufacturing and construction techniques, and best installation practices as well as adhere to this RFP’s specifications. Owner reserves the right to select more than one firm to provide these services. Joint venture proposals are acceptable, but not required.

### **1.2.2 Site Features**

The Wild Horse wind power generation project is located on approximately 9,200 acres near a topographic feature called Whiskey Dick Mountain in Kittitas County about eleven miles east of Ellensburg, Washington. The project is on the eastern rim of the Kittitas Valley and lies within an area comprised of “shrub steppe” habitat spanning several ridges and canyons.

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<sup>1</sup> STC or “Standard Test Conditions” assumes the nameplate DC power rating at conditions of 1000 W/m<sup>2</sup> solar irradiance and 25° C PV module temperature.

The elevation ranges over the site from approximately 2,600 ft. to 3,600 ft. and winds blow from the west-northwest over the site. To the west of the site is the Kittitas Valley at an elevation of under 2,000 ft. To the east of the site the land slopes down to the Columbia River at an elevation of about 500 ft. Shrub steppe is used part of the year for cattle grazing, and is also considered sensitive habitat for plants and animals.

The wind power project consists of 127 wind turbines with a maximum aggregate electrical capacity of 229 mW, an underground power collection system operating at 34.5 kV, a 34.5 kV/230 kV onsite electrical substation, an approximately eight mile transmission line to the point of interconnection with Owner, a Supervisory Control And Data Acquisition system (“SCADA”), a network of gravel roads sufficient for access and long-term maintenance, a set of temporary and permanent meteorological towers, and an onsite operation and maintenance center and staff.

For site photos see Appendix 3.3.1.

### **1.3 Meteorological conditions**

#### 1.3.1 Solar Resource

Proposals for this project will use the solar resource as estimated for Yakima, Washington as part of the 30 year NREL “Redbook” study. This has been attached as Appendix 3.2.2. A flat plate collector fixed at a latitude tilt angle receives an average of 4.8 kWh/m<sup>2</sup>/day of solar irradiation annually.

#### 1.3.2 Wind description

The project site has prolonged gust speeds in excess of 120 mph and average wind speeds of 22.50 mph (33 ft/s).

#### 1.3.3 Temperatures and Precipitation

Temperature and precipitation for Ellensburg, Washington as recorded by the Western Regional Climate Center are presented in Appendix 3.2.1. In historical extremes, the site experienced temperatures from -31° to 110° F, rain fall up to 1.78” in 24 hours and snowfall of up to 19” in 24 hours.

### **1.4 Geological Conditions**

An abridged geological report is provided in Appendix 3.6. Respondents should be aware that PSE’s experience to date on digging trenches for electrical cables in the area has demonstrated this process to be difficult.

### **1.5 Scope of Services**

#### 1.5.1 Design and Engineering

The Contractor shall design a solar electric generating system appropriate for the Wild Horse wind power project taking into consideration the facility's electrical demand and load patterns, contribution to system harmonics, the currently operating wind farm project, permissible and accessible installation sites, the available solar resource, applicable permits and codes, and other relevant factors. The Contractor shall provide design documents to fully communicate and obtain approval for the design and its basis, plans for manufacturing and supply, installation, startup, commissioning, testing, and monitoring including but not limited to the following:

- Overall system description
- Governing design standards, codes, and compliance
- Installation guidelines, notes and procedures
- Bill of materials
- Key equipment specifications
- Design calculations
- Geotechnical, electrical, structural (including wind loads) and mechanical design
- Corrosion control
- Detailed drawings, equipment layout and construction plans
- Crane and/or heavy equipment plans
- Electrical interconnection
- Controls, lightning protection plans, and instrumentation plans
- Site security plans and measures
- Quality assurance plans and inspection records
- Energy production estimates; 24 hour average for each month.
- Performance monitoring details, guidelines and procedures
- Installation, startup, commissioning, and monitoring plan
- The data from any audits and/or surveys

The Contractor, along with Owner's personnel, shall evaluate and work together on selecting a suitable site location for all equipment, including but not limited to, the solar collection system, the DC to AC inverter (if so equipped) and its related components, environmental control equipment, and other miscellaneous equipment.

#### 1.5.2 Solar collection, inverters, balance of plant components

The Contractor shall provide a complete and operational solar electric generating system. All equipment and systems must meet the minimum

technical specifications described by this RFP in section 2. Photovoltaic (PV), solar concentrating, direct thermal, sterling cycle, or other solar conversion technology may be proposed for this project.

### 1.5.3 Owner Design Approval

No portion of the Work including shop drawings, product data, samples, work descriptions, subcontractor qualifications, field stamps, or government agency approval shall be finalized until the design has been reviewed and accepted as appropriate by Owner.

There will be four (4) sets of shop drawings submitted to PSE prior to beginning fabrication, construction or implementing any project changes. The shop drawings shall be reviewed by PSE technical representatives with the following responses:

**ACCEPTED** - Accepted subject to its compatibility with future submittals. Acceptance does not constitute approval of deletion for items not shown on the submittal.

**ACCEPTED WITH REVISIONS** - Same as above, except that minor corrections as noted shall be made by Contractor. Resubmission is not required by the Contractor.

**RESUBMIT** – Returned because of inconsistencies or errors which shall be resolved or corrected by Contractor. Resubmission is subject to additional reviews.

**REJECTED** - Submitted drawings, plans or specifications do not conform to the project's intentions in a major respect, i.e.: wrong size, model, capacity, or material. Rejected plans shall be resubmitted for additional reviews.

The project design will be deemed completed once the shop drawings are accepted and approved for construction.

### 1.5.4 Electrical and interconnection

The Contractor shall supply and install all required materials and equipment and perform all work as necessary to design, engineer, procure, construct, and commission the interconnection of the solar conversion system to the existing underground electrical collection system. The Contractor's scope shall include, but not be limited to, providing all applications, studies, engineering, submittals, equipment, labor, materials, commissioning, and testing necessary to complete the interconnection. All costs, associated with designing, building, and testing an interconnection, including modification to existing facilities, will be the sole responsibility of the Contractor.

### 1.5.5 Startup and acceptance testing

The Contractor shall provide all services related to start up and transfer of the Work to the Owner. During startup, the Owner's staff or its independent

engineer shall observe the system's performance. The Contractor shall perform the following minimum required services:

- Startup and operate the solar conversion system until it achieves its performance requirements. The system power production shall be recorded at the inverter output between 10am and 2pm during an irradiance period which exceeds 750 W/m<sup>2</sup> at the plane of the array. The power production shall be normalized to Standard Test Conditions (STC) with respect to the irradiance and temperature conditions and reported to PSE prior to final system acceptance. The performance requirements shall be tested with an IV curve tracer to illustrate an aggregate peak power production at STC which conforms to these specifications.
- Perform all required performance testing to certify system and component performance. Document  $V_{oc}$  (open circuit voltage) and  $I_{sc}$  (short circuit current) of each solar array "string". The irradiance, time of day and date shall be recorded for each string of modules. This documentation shall be included in the operations and maintenance manual. All  $V_{oc}$  and  $I_{sc}$  values shall be within the stated manufacturer's tolerance. All faulty or suspected faulty modules or other components shall be replaced immediately upon system startup.
- Meggar each length of wire to ensure it meets the minimum acceptable resistance of 5 Meg-Ohms to ground. Results for these tests shall be recorded in the operations and maintenance manual.
- Conduct successful acceptance tests, finalize all punchlist items, and perform a customer walk-through to reach Substantial and Final Completion.

#### 1.5.6 Operation and maintenance (O&M) manual, and as-built drawings

The Contractor shall provide six (6) sets of site specific operation, maintenance, and parts manuals for the solar conversion system and for modifications to any existing facility, structures, or features therein. The manual shall cover all components, options, and accessories supplied. They shall include maintenance, troubleshooting, test records, energy production expectations and safety precautions specific to the supplied equipment. Maintenance schedules shall also be provided. The Contractor shall also provide six (6) sets of as-built drawings which shall be stamped by a licensed professional engineer in the state of Washington. These documents are to be delivered before Final Completion of the Work.

#### 1.5.7 Operation and Monitoring

The Contractor shall provide an operation and monitoring system that will allow Owner to operate the facility and monitor its performance in historical and real time, for the life of the equipment. See section 2.4 for more detail.

#### 1.5.8 On-site training for operations and maintenance

Within ten (10) days of completion of the startup and acceptance testing, the Contractor shall conduct a one to two day training program for the Owner's engineering, operation and maintenance, and plant supervisory personnel. This training shall cover all equipment and systems furnished under these Specifications, and shall include written material, and on-site instruction. At a minimum, training topics shall include the following:

- PV module maintenance and troubleshooting
- Structural elements maintenance and repair guidelines
- Calibration and adjustment procedures for the inverter
- Operations and testing the PV modules
- Software orientation and training
- Solar panel replacement
- Inverter overview

The Contractor shall submit the scope and detail of the training program to the Owner for approval at least 30 days prior to performing the training. The on-site portion of the training program shall be scheduled to take place at the jobsite at a time agreeable to both the Owner and the Contractor, but not to exceed 60 days following Substantial Completion.

#### 1.5.9 Annual maintenance

During the system performance warranty period, the Contractor shall provide all necessary repair and replacement excluding routine maintenance and adjustments. The Owner will provide inspection of the system, routine maintenance services per the Contractor's training and manuals, and Owner will promptly notify Contractor should the system fail or shows signs of failure in any way during the first warranty period. Any premature product failures or workmanship issues are not considered routine maintenance. Premature product failures may include but are not limited to: PV module, structural or electrical failures.

#### 1.5.10 Warranties and guarantees

The Contractor shall provide a warranty against defective design, materials, workmanship, and latent defects for the first five (5) year period following Final Completion. In the proposal, Respondents shall fully define the offered warranty according to proposal submittal requirements. The following lists the minimum warranty requirements:

- Five (5) year performance, design, workmanship, repair and replacement warranty
- Twenty five (25) year PV panel manufacturer's warranty, for PV projects
- Ten (10) year inverter manufacturer's warranty, for PV projects

Contractor shall provide copies of all manufacturers' warranties.

#### 1.5.11 Five (5) Year Performance Warranty

The Work shall be warranted for power output and annual energy. The guarantee parameters shall be those submitted in Bid Form 3.1.6. Should the Work fail to meet any of the guarantee parameters, the Contractor shall have the opportunity to correct the deficiency to the Owner's satisfaction within a period of 90 days. At that time, all guarantee parameters shall be tested and/or reviewed again. All costs to correct the deficiency, including engineering, fabrication, materials, labor, and retesting shall be to the Contractor's account. Should the Work still be deficient in meeting the guarantee parameters, the Owner may impose monetary penalties commensurate with the magnitude of the deficiency when projected over the remaining lifetime of the Work.

##### 1.5.11.1 Electrical Capacity

The Contractor shall guarantee the electrical capacity of the Work to be not less than the capacity submitted by the Contractor in Bid Form 3.1.6. The power output shall be measured at the AC side of the inverter.

##### 1.5.11.2 Annual Energy

Contractor shall guarantee the annual energy (kWh) performance as presented in Bid Form 3.1.6.

#### 1.5.12 Five (5) Year Design, Workmanship, Repair and Replacement Warranty

##### 1.5.12.1 Warranty

All components provided by the Contractor shall be warranted against deficiencies or defects in design, workmanship, and materials.

##### 1.5.12.2 Inspections

The Contractor shall inspect the Work annually until expiration of the warranty period. Such inspections will be assisted and supported by the Owner's personnel. For each inspection performed, the Contractor will issue a report to the Owner.

##### 1.5.12.3 Repairs

All repairs are subject to the Owner's prior review and acceptance of the repair procedure. The repairs shall be made at no cost to the Owner, and will be considered successful if they permit operation for a minimum of 1 year without the appearance of new deficiencies or other defects.

#### 1.5.12.4 Rejection of Defective Parts

If, after repeated repair or at the expiration of the warranty period, new deficiencies or defects should continue to appear, the Owner reserves the right to reject the defective parts.

### **1.6 Permits**

Owner will lead and coordinate the state and local permitting process and the Contractor shall support the process by providing equipment details, drawings and other documentation as will be required. The only permit Owner anticipates needing is an amendment to its existing Energy Facility Site Evaluation Council (EFSEC) permit.

### **1.7 Interconnection**

The Contractor will perform integration services in coordination with PSE to eliminate or minimize disruption to the existing electrical infrastructure.

The 50 kW STC system shall be integrated into a 480 VAC panelboard located at Owner's Operations Center. The 450 kW STC system will be fully integrated into the existing underground 34.5 kV electrical collection system. If selected by Owner, the optional 500 kW STC system at site 3 shall be fully integrated into the existing underground 34.5 kV collection system.

PSE will file an interconnection request for the project with the appropriate authorities if required.

### **1.8 Pricing**

#### 1.8.1 Lump-Sum Cost Basis for 100% PSE Ownership

PSE requires all proposals to provide a 100% PSE owned and operated, ownership structure, and pricing on a lump-sum cost basis. All materials, equipment, labor, and other expenses necessary to complete the Work in a safe and lawful manner shall be included in the contract amount.

#### 1.8.2 PPA or Hybrid Ownership Structure

In addition to a 100% PSE Ownership structure, Respondents may offer alternative structures such as a PPA or a hybrid ownership option. In all cases PSE desires to have the environmental attributes. If such an alternative ownership structure is offered, please describe this structure in full in the pricing section of the Bid Forms.

## **1.9 Additional Scope of Supply**

If directed to do so in writing by the Owner, the Contractor shall perform additional work beyond the Scope of Supply included in the original Lump-Sum Cost. Charges for such additional work shall be submitted in writing by the Contractor to the Owner for approval prior to beginning such additional work.

Any services performed by the Contractor beyond the scope of the original contract, if directed to do so in writing by the Owner, shall be compensated according to Contractor's standard Fee Schedule, included in this Contract, or other mutually agreeable fee standard. Fees quoted shall include all costs of services including overheads and/or multipliers.

### **1.9.1 Spares**

Contractor shall supply a list of proposed spare parts for the Work. This list shall include at a minimum 0.5% spare PV panels, and MC cable connectors, hardware, fuses, diodes, controller cars, combiner boxes, disconnects, nuts & bolts, mounting rails and other commonly replaced components as applicable.

### **1.9.2 Environmental Monitoring**

The Contractor shall provide an independent Environmental Monitor to ensure compliance with all environmental permits and commitments and with this RFP, and to report its findings to the Contractor, Owner, and appropriate regulatory agency.

The Environmental Monitor must be the on-site environmental manager and problem solver, and shall be charged with three broad responsibilities:

- To review design and construction activities with emphasis on avoidance and minimization of land disturbing activities and to ensure environmental commitments, requirements, and Best Management Practices are incorporated into the construction of the project.
- To function as an unbiased independent source of environmental expertise, including making recommendations of measures and actions to reduce project impacts and to rectify non-compliance issues.
- To function as a liaison between the Contractor, Owner, and the regulatory agencies specifically in relation to environmental commitments and coordination with the Owner for problems/issues that may arise regarding construction in the sensitive Shrub Steppe habitat.

The environmental monitoring effort shall begin with involvement in the initial design phase and extend throughout the life of the construction project. To fulfill its assigned responsibilities, the Environmental Monitor shall perform daily inspections of the entire project site, maintain a physical presence during the full length of construction activities within

environmentally sensitive areas, obtain periodic water quality data (if necessary) from streams and/or storm water management facilities, and reviews all regulatory submittals for project design and permitting.

1.9.3 Environmental Restoration

Upon completion of the work, the Contractor shall remove all excess materials, construction debris, contamination, pollutants, tooling, machinery, or other items that have accumulated in or around work areas. Under the supervision and direction of the Environmental Monitor (see 1.9.2), the area disturbed by construction shall be restored as much as practicable to its condition prior to beginning the Work. This shall include, but not be limited to, backfilling, grading, placement of topsoil, and seeding the disturbed areas.

Site restoration and cleanup actions shall be performed in a manner that reduces or prevents the generation of new wastes and pollutants.

1.9.4 Payment Terms and Invoicing

The Owner will compensate the Contractor during its performance of the Work in accordance with the following progress payment schedule. Suitable documentation and certification by the Contractor of the completion of each compensation step is required, in writing, by the Owner. All invoices shall be subject to retention, as described in the General Terms and Conditions.

1.9.4.1 Milestone Payment Schedule

On Contract Signing	10% of Lump Sum
Completion of Project Design	10% of Lump Sum
Deliver Solar Modules to Site	15% of Lump Sum
Delivery of Balance of System to Site	15% of Lump Sum
Substantial Completion	40% of Lump Sum
Final Completion	10% of Lump Sum

1.9.4.2 Invoicing

Invoices shall be sent to the Owner’s Project Manager. Invoices shall be paid in accordance with the Milestone Payment Schedule, and/or actual labor & expenses, and/or quoted unit-prices for approved extra work and shall be itemized. Any invoice discrepancies shall be resolved prior to payment being issued. Payments will not exceed the original contract amount, unless an authorized change order is obtained in writing from the Owner prior to the Contractor initiating any additional work.

1.9.5 Project Schedule

1.9.5.1 Engineering, Procurement and Construction Schedule

PSE anticipates issuing a Notice to Proceed on April 4th, 2007. In the attached Bid Forms the Respondents shall provide the milestone

completion dates to support Substantial Completion by the end of September, 2007 and Final Completion in 2007. PSE's experience to date indicates that the effective construction period at the Wild Horse Site is from the beginning of May to the end of September.

In addition to these target dates, the Contractor shall maintain a detailed schedule for the purpose of job tracking and project review.

#### 1.9.5.2 Substantial Completion

The Contractor shall achieve Substantial Completion when the following milestones are achieved.

- The entire solar installation(s) has passed all acceptance tests and can be operated as a fully integrated generation asset.
- All regulatory permit conditions have been satisfied and Best Management Practices are in place for sediment control and storm water management.
- All cleanup and restoration of the project site have been completed.
- All punch list items have been identified and mutually agreed with Owner identified and the list submitted to Owner.
- PSE has received a waiver from the Contractor for any contractual liens

#### 1.9.5.3 Final Completion

The Contractor shall achieve Final Completion when the following milestones are achieved.

- Substantial Completion
- All punch-list items have been cleared and signed-off by PSE.
- The test-run period was completed successfully.
- Successful completion of the test-run period
  - On site training has been conducted such that PSE personnel can perform regular operation and maintenance for the solar installation.
  - All final drawings and documentation described in 1.12 have been submitted and accepted by PSE.
  - The Contractor has removed all remaining personnel, equipment and waste materials from site.

#### 1.9.6 Liquidated Damages

If imposed by the Owner, liquidated damages will be deducted from the compensation due Contractor for each day the solar project is not available

for power generation past the “Substantial Completion” scheduled date. The daily liquidated damages will be calculated on the basis of current power cost and capacity value for the project period and the loss of investment tax credits. These deductions will be treated as liquidated damages and not as a penalty.

#### 1.9.7 Test Run Period

After Substantial Completion, the facility shall be subject to a Test Run Period of three (3) months. Owner and Contractor shall agree on what constitutes a successful completion of the Test Run Period.

#### 1.9.8 Test Waiver

In the event the Owner and the Contractor agree to postpone or waive one or more commissioning tests, the beginning of the Test Run Period will not be delayed. In particular, this refers to the tests which cannot be performed until necessary solar resources are available.

#### 1.9.9 Subcontracts

##### 1.9.9.1 Subcontractor Listing

The Contractor shall provide a comprehensive list of any and all subcontractors it intends to use to fulfill any part of the Work. Included on the listing shall be the subcontractor's name, address, and phone number; area of specialty; and percentage of the Work it is to receive. It shall be the responsibility of the Contractor to insure that all work performed or materials supplied by any subcontractor shall be in accordance with these Specifications.

##### 1.9.9.2 Owner Consent

The Contractor shall not subcontract any of the Work to be performed without the prior written Owner's consent. The Contractor shall be fully responsible to the Owner for all acts and omissions of its subcontractors and of the persons directly or indirectly employed by a subcontractor. Nothing contained in these Specifications will create a contractual relationship between any subcontractor and the Owner. The Owner retains the right to reject any and all subcontractors; however the Owner's refusal to allow a subcontractor to participate in or perform a portion of the Work shall not entitle Contractor to an increase in compensation due under this agreement or a time extension to complete the Work.

##### 1.9.9.3 Preference for Local Labor and Materials

PSE prefers Contractors to use local labor, materials and services where applicable and reasonable.

### 1.9.10 Conferences/Meetings

#### 1.9.10.1 Pre-Bid Conference

The pre-bid conference will be held at the Wild Horse wind power project to introduce the PSE project team and answer questions on the RFP. The conference is tentatively scheduled for Tuesday, January 11<sup>th</sup>, 2007. Attendance by the Respondents is optional, but the conference may assist the Respondents with submission of a timely and complete proposal.

#### 1.9.10.2 Coordination Conferences

The Contractor shall confer at least weekly with the Owner during performance of the Work to discuss progress, coordination, or other issues. These conferences may be held by telephone; in person at the Owner's offices in Bellevue, Washington; at the Jobsite; at the Contractor's offices; or at other mutually agreeable locations or means at date(s) and time(s) established by the Owner as necessary to properly coordinate the Work.

### 1.9.11 Exceptions and Deviations

Respondent shall conduct the necessary investigations to identify the actual as-built conditions. Respondents who discover discrepancies or lack of information during bidding period shall make a written request to PSE for a clarification. Existing facilities may differ from records on file, or may have been altered. Any deviation from these Specifications identified by the Contractor shall be brought to the attention of the Owner in writing and requires written authorization from the Owner for approval. Items pertaining to the commercial and/or technical terms of these Specifications shall be addressed by the individuals listed in 1.11.1.2. All exceptions or deviations submitted to the Owner will be reviewed for appropriate response by the Owner.

### 1.9.12 Corrections and Omissions

Any corrections to or omissions from these Specifications identified by the Contractor shall be brought to the attention of the Owner in writing. Items pertaining to the commercial and/or technical terms of these Specifications shall be addressed by the individuals listed in 1.11.1.2. All corrections or omissions submitted to the Owner will be reviewed for appropriate response by the Owner.

### 1.9.13 Publications

The Contractor or any of its subcontractors shall not disclose to third parties without the prior written consent of the Owner, any information obtained or developed in connection with the Work unless the information is in the public domain at the time of disclosure. Further, the Contractor or any of its

subcontractors shall not publish any report, research paper, data, information, advertisement, or other items relating to the Work, without the Owner's prior written approval, which approval will not be unreasonably withheld if the publication does not adversely affect the Owner's commercial, proprietary or other interests.

#### 1.9.14 Force Majeure

1.9.14.1 Neither Owner nor Contractor shall be deemed to be in default or responsible for delays or failures in performance resulting from acts of God, acts of war or civil disturbance, epidemics, governmental action or inaction, fires, earthquakes, unavailability of labor, materials, power or communication, or other similar or dissimilar causes beyond the reasonable control of the party whose performance is delayed or prevented.

1.9.14.2 Both Owner and Contractor acknowledge and understand that the site is subject to severe or extreme weather conditions that may impair or prevent work at the project site. Because of potential weather-related delays during the installation window, the Owner encourages early delivery of components to the project site and will provide secure storage for any components delivered in advance of installation.

1.9.14.3 In the event of a delay in the project schedule for any cause falling under this provision, the Contractor will develop a new project schedule that will not interfere with other contractual obligations of the Owner to supply power.

### **1.10 Health, Safety & Environmental**

#### 1.10.1 Access

The Contractor shall maintain unobstructed access to adjacent properties, roads, and the work area during performance of the Work.

#### 1.10.2 Work Site Protection

The shrub steppe environment is very fragile and easily disturbed. The Contractor shall protect the surrounding area of the work site where the Work is to be performed by setting up barriers, flagging, direct protection of the land surface, or other measures as appropriate to the activity being performed. Disturbed areas shall be restored to the satisfaction of the Owner and/or local regulatory authorities. All such repairs shall be to the Contractor's account.

#### 1.10.3 Adjacent Equipment Protection

The Contractor shall protect any adjacent equipment or facilities during the performance of the Work from the effects construction activities, accumulations of dust and/or dirt, visual impacts, or nuisance conditions.

Dust, noise, erosion and pollution resulting from the Contractor's performance of Work, either inside or outside the construction areas, shall be controlled by the Contractor

#### 1.10.4 Safety Rules

The Contractor shall perform the Work in accordance with all applicable Federal, State, and local safety rules and in a manner which will create minimal disruption to the Owner's operations. Coordination of appropriate safety precautions necessary to perform the Work shall be the Contractor's responsibility. While on the Jobsite, the Contractor's personnel shall be equipped with and using hard-hats, hearing protection, safety glasses, and other personal safety items as may be required to perform the Work.

#### 1.10.5 Property Damage

The Contractor shall be responsible for any damage to roads, highways, underground facilities, or other property caused by the Work, whether the damage is at the site of the Work or caused by transporting to or from the Jobsite. The Contractor shall repair all such damage to the satisfaction of the Owner and/or the responsible party or public agency.

#### 1.10.6 Health & Safety Plan

The Contractor shall complete a Health & Safety Plan and instruct all of its personnel in flammable material handling, fire prevention and control, and emergency procedures as required for the work being performed. At least one (1) 20 LB class ABC fire extinguisher shall be located not more than thirty (30) feet from the location of activities associated with the Work. In the event of a fire, the Contractor shall provide assistance in controlling or containing it until professional assistance arrives. In addition, the Contractor shall provide a first aid kit and oil absorbent pads which shall be immediately available during the performance of the Work.

#### 1.10.7 General Housekeeping

1.10.7.1 Contractor shall be responsible for its on-site office space requirements and crew facilities as appropriate to maintain a safe working environment. All the Owner's facilities are designated as non-smoking areas.

1.10.7.2 The Owner's safe clearance procedures for safety of personnel and/or equipment shall be strictly adhered to by the Contractor at all times. An on-site pre construction/safety meeting will be conducted to review these procedures with all Contractor personnel.

- 1.10.7.3 If specific devices or equipment require clearances, the Contractor shall provide a list of the devices at least 24 hours prior to issuance of the clearance.
- 1.10.7.4 The Contractor and its support crews shall promptly and fully carry out all safety, sanitary, and medical requirements as prescribed by law, and/or as may be necessary or reasonable to ensure the safety and health of all persons directly or indirectly impacted by the Work.
- 1.10.7.5 Periodically throughout the progress of the Work, the Contractor shall cooperate with representatives of the different state or other agencies responsible for enforcement of regulations related to safety, sanitary, and medical requirements.

## **1.11 Project Management**

### **1.11.1 General Requirements**

It is intended that the Work shall be performed in a cooperative effort with the Owner, and is therefore, a condition of this Contract. All design information, calculations, etc., shall be made available for review by the Owner. Design assumptions and concepts shall be established in concert with the Owner.

#### **1.11.1.1 Correspondence**

All correspondence, drawings, literature, instruction books, data, and nameplates shall be in the English language, with English units as currently used in the United States. For questions of a commercial or technical nature, please contact PSE.

#### **1.11.1.2 Owner's Project Team**

Throughout the duration of the Contract, the Owner's Project team for the solar project will be as follows:

RFP Manager:	Stephen Emmert, PSE
Project Manager:	Steve St.Clair, PSE
Owner's Engineer:	Tobin Booth, Blue Oak Energy
Construction Manager:	TBD

All interface coordination by the Contractor with the Owner will be through and under the direction of the Owner's Project Manager.

#### **1.11.1.3 Contractor's Project Team**

The Contractor shall submit a list of its key people who will make up the project team and provide a brief resume for each, following award of the Contract. The Contractor shall make every effort to keep this project team intact throughout the duration of the project. Removal

and replacement of a member of the project team shall require prior approval of the Owner.

The Contractor shall name an individual as its contract Project Manager for the duration of the Work. The assigned Project Manager shall be subject to the Owner's approval and shall not be removed from the project without the Owner's prior consent. It shall be the responsibility of the Contractor's Project Manager to insure that the Work conforms to these Specifications and serve as the Owner's primary coordinating interface throughout the performance of the Work.

#### 1.11.1.4 Progress Updates

The Contractor shall be required to provide the Owner with project progress reports at weekly intervals. Schedule updates shall show all changes occurring since the previous update, major changes in project scope, modified activities, revised projections of progress or completion and other identifiable changes. Updates shall also identify anticipated delays and the corresponding corrective action recommended minimizing or eliminating the effect of the delay on the overall project completion schedule.

#### 1.11.1.5 Construction Logs

The Contractor shall prepare and maintain, at the job site, a daily log of construction related activities for review by the Owner's representative(s). The log shall include but not be limited to the following: subcontractors at the site; personnel at the site; equipment at the site, including a list of activities and hours of operation for each piece of equipment; times and quantities of material deliveries to the job site; records of all pre-disassembly and reassembly measurements and clearance readings; temperature and weather conditions; accidents and emergency procedures; field orders; meetings held and items discussed; change orders received and implemented; decisions by the Owner and representative; coordination activities, etc. If requested, duplicate copies of the daily log shall be furnished to the Owner.

### 1.11.2 Project Work Rules

#### 1.11.2.1 Work Rules

Without limiting the generality of the General Terms & Conditions, the Contractor shall enforce the following work rules with regard to the actions of the Contractor, its employees, labor force, suppliers, subcontractors, delivery personnel, and any others associated with the Work. These work rules shall apply to the site and other property adjacent to the site:

- No smoking, alcoholic beverages, or controlled substances.
- No overnight camping or lodging.
- No open fires.
- No loose domestic animals.
- No firearms or weapons of any type.
- No horseplay on-site.
- No illegal activities of any kind.

#### 1.11.2.2 Employee Removal

The Owner shall retain the right to request immediate removal from the Jobsite any employee found in violation of any of these work rules.

#### 1.11.3 Drawings

All preliminary and final design/fabrication drawings shall be submitted to the Owner for approval. The drawings shall be submitted on standard “D” size (24” x 36”) bond paper for the Owner's review and comment. All text shall be in the English language and all dimensional units shall be in English and SI formats. Final as-built drawings shall be submitted on computer disk for the Owner's information upon completion of the Work. The computer drawing files may be in AutoCAD®, Microstation®, DXF, or other standard drawing format, in that order of preference.

#### 1.11.4 Test Engineer

The Test Engineer shall inspect the Work for conformance to Contractor's design documentation, the specified installation standards, and these specifications; and coordinate and manage the Contractor's commissioning activities. The Test Engineer shall develop the commissioning plan and schedule, review controls documentation and interface with other systems, and prepare the final commissioning report for review by Owner. The Test Engineer will also ensure that necessary test instrumentation is available during functional performance testing and that all instruments meet quality and calibration requirements and are in good working order.

#### 1.11.5 Welding

The Contractor shall be capable of executing high quality shop and field welding and grinding workmanship with plain carbon, alloy, aluminum, and/or stainless steels, as required by the Work. Welding shall be performed only by welders qualified under AWS or ASME Code or other recognized standard. All welds shall have a low concentration of weld defects and all welds shall be finished to an acceptable profile and surface finish appropriate to their application. All welds shall be subject to non-destructive examination, at the option of the Owner.

#### 1.11.6 Lodging

Accommodations and/or per diem for Contractor's personnel shall be provided by the Contractor, and included in the base lump-sum proposal price. Accommodations and/or per diem related to optional work shall be included in the option price.

### **1.12 Equipment Documentation**

#### 1.12.1 Instruction Manuals

Contractor shall deliver to the Owner not more than 30 days after completion of acceptance tests, six (6) copies of manuals each covering in detail the erection, installation, operation, service, and maintenance of each component part furnished under this contract. These manuals shall include complete parts lists identifying each and every component in sufficient detail to facilitate the ordering of renewal parts. Each part listed shall be fully and completely described and shall be referenced to its appropriate drawing or drawings.

#### 1.12.2 Drawings

The manuals described above shall contain all as-built drawings and diagrams covering the solar panels, structures, interconnecting wiring, inverter, data system, and other appurtenances. All drawings and diagrams incorporated in these manuals shall be reduced in size and bound into the manuals and delivered to the Owner.

## **2 TECHNICAL SPECIFICATIONS**

### **2.1 Mature technology**

Use of commercially mature equipment and technologies offers significant opportunities for reduced design and engineering time; faster procurement, construction, and commissioning; and lower life cycle and training costs. Maximum use of commercially mature equipment and technologies also provides the greatest opportunity to maintain project cost, schedule, and performance requirements and is consistent with the Owner's core business as a regulated investor-owned utility providing electrical energy and natural gas to retail and commercial customers.

Regardless of how much of the system is composed of commercially mature equipment or technologies, the Contractor shall ultimately be responsible for integration of such equipment and technologies and providing an operational system conforming to the performance intent of these Specifications. Contractor shall review the intended usage environment of the commercial equipment and technologies and establish to what extent this differs from (or is

similar to) the commercial usage environment to ensure solar system performance, safety, reliability, and durability.

## 2.2 **Standards of performance**

It is not the intent of this Specification to reproduce the technical requirements covered by the applicable industry codes & standards. All components furnished by the Contractor shall be designed and fabricated using high-quality design, materials, and workmanship meeting the requirements of applicable industry codes & standards and these Specifications.

Reference is made in these Specifications to various standards under which the Work is to be performed or tested. If the Contractor proposes to deviate from any published standard in any way, a written statement as to the exact nature of the proposed deviation shall be submitted to the Owner for approval. Unless otherwise specified the following list of standards (at a minimum) shall apply:

<b>Standard #</b>	<b>Standard Title</b>
NFPA 70	National Electrical Code (Including article 690)
ANSI C2	National Electrical Safety Code
ICEA	Insulated Cable Engineers Association standards
ICC-IBC	International Building Code
IEEE 80	Guide for Safety in AC Substation Grounding
IEEE 519	Standard Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE 519A	Guide for Applying Harmonic Limits on Power Systems
IEEE P1262	Recommended practice for qualifications of photovoltaic modules
ANSI/IEEE 928	Recommended criteria for terrestrial PV power systems
UL 1703	Standard for Safety for Flat-Plate Photovoltaic Modules and Panels
SERI/TR213-3624	Qualification tests and procedures for terrestrial photovoltaic thin film flat plate modules
ANSI/ASCE 7-88	Building code requirements for minimum design loads in buildings and other structures
AISC	Manual of steel construction allowable stress design
AWS DL1	Structural welding code steel
AWS DL3	Structural welding code sheet steel

<b>Standard #</b>	<b>Standard Title</b>
AISI SG-673	Specification for design of cold formed steel structural members
AA ADM1	Aluminum Design Manual: Specifications and Guidelines for Aluminum Structures
SSPC-SP3	Surface Preparation Specification - Power Tool Cleaning
SSPC-SP6	Surface Preparation Specification - Commercial Blast Cleaning
SSPC- SP10	Surface Preparation Specification - Near White Metal Blast Cleaning
SSPC- SP11T	Surface Preparation Specification - Power Tool Cleaning to Bare Metal

### **2.3 Solar Module Mounting System**

#### 2.3.1 Preferred Mounting System

A fixed tilt solar module racking system is the preferred mounting system. The rack system shall be reliable, proven in similar projects and shall be designed for corrosion resistance over the expected 25 year lifetime.

#### 2.3.2 Solar Array Tracking Systems

The Respondents may include in the proposal a single or dual axis tracking system provided that the capital and operational economic considerations are clearly stated and detailed in the proposal. In addition, PSE’s load peaks seasonally in the winter and tracking systems that help provide winter energy generation are encouraged. PSE also encourages Respondents to consider a seasonal tracking system (e.g. manual adjustment of the angle of panels) given the latitude of the project. Preference will be given to the most robust, low-maintenance, cost effective solution.

#### 2.3.3 Structural Design

All structures, including array structures, shall be designed for withstanding local wind speeds, seismic loads and soil conditions for the area. Seismic, wind, and geotechnical calculations shall be provided to Owner for review. Systems must be able to withstand wind speeds of at least 120 mph. Also, thermal loads caused by expected fluctuations of component and ambient temperature must be combined with all of the above load combinations.

All structural components shall be designed in a manner commensurate with a minimum 25 year design life. Particular attention shall be given to the prevention of corrosion at the connections between dissimilar metals such as aluminum and steel.

#### 2.3.4 Footprint of Permanent Disturbance

The footprint of permanent disturbance shall be kept to a minimum. Owner will evaluate energy density per unit area in proposal evaluation. Projects that minimize the overall disturbance area are preferred.

Grading and leveling of terrain shall be kept to a minimum to preserve to the natural environment.

#### 2.3.5 Footings

Footings shall be designed for withstanding the lateral and uplift loads due to 120 mph wind speeds. Additionally, the footings shall be designed to withstand the temperature fluctuations, precipitation, and snow loads for the region, as expressed in Appendix 3.2.1, describing historical weather conditions. Because extreme heat and cold temperatures are common, the footings shall be carefully designed for the anticipated loads and to ensure a 25 year lifetime.

### **2.4 Monitoring / Metering / Interface**

Regularly collected data should include, but not be limited to, the following: Power (kW) produced, energy (kWh) produced, AC Voltage, DC Voltage, irradiance, windspeed, ambient temperature, system availability, averaged and accumulated output by string, capacity factor, percent degradation, and the reliability of the equipment installed. Proposals will include a robust, web-enabled interface with data recorded in a server that may be stored on site or remotely with unfettered access by PSE for the life of the project.

In addition, the Contractor shall supply an educational display for use within the Owner's operation center, providing electronic real-time data and an overview of how the solar system functions.

At site 1 fiber-optic networking services are readily available. At sites 2 and 3 there is no wired connectivity and a remote system (direct connected or wireless) may be required.

### **2.5 Photovoltaic Module Specifications**

#### 2.5.1 General description

Photovoltaic ("PV") modules provided for this RFP may include mono crystalline, polycrystalline, or thin film technologies.

The PV modules shall be designed to produce low cost energy, have minimum maintenance requirements and high reliability, have a minimum 25 year design life, and be designed for normal unattended operation.

#### 2.5.2 PV module structural design

Framed PV modules shall be anodized aluminum with pre-drilled holes or mounting channels as approved by Owner. Acceptable mounting methods for unframed modules shall be provided by the manufacturer.

Bolted and similar connections shall be non-corrosive and include locking devices designed to prevent twisting over the 25 year design life of the PV system.

As this will be a high profile, publicly visited installation, the aesthetics of the overall installation are extremely important to the Owner. To create a uniform appearance of the array, spacing between individual modules and panels should be kept uniform and to a minimum. As much as possible, all mechanical hardware, conduit, junction boxes, and other equipment should be concealed beneath and/or behind the array.

### 2.5.3 PV module electrical design

All PV modules and electrical components shall be required to be listed or recognized by an appropriate safety laboratory (e.g., Underwriters Laboratories (“UL”)).

The electrical design and installation for the PV system shall conform to the National Electric Code. Article 690 of the NEC applies specifically to photovoltaic systems safety, protection, control, and interface with other sources. The PV system electrical design shall also comply with the IEEE standard 1374, “Guide for terrestrial photovoltaic power system safety.”

All electrical components, including over current protection, disconnect, surge suppression devices, conduit, wiring, and terminals must have UL or equivalent listing and have appropriate voltage, current, and temperature ratings for this application.

Voltage drop in the PV array DC circuits should be limited to no more than 2%, including losses in conductors and through all fuses, blocking diodes, and termination points.

All series-connected PV modules must include a series fuse as required by UL and NEC to protect wiring and/or other system components. Parallel collections of modules and individual PV circuits are not permitted. Parallel connected cells within the individual modules are allowable as long as the module listing allows for a series fuse as required for this configuration.

All series-connected strings of modules must also include a blocking diode to prevent reverse currents. These diodes should have low voltage drop to meet the requirements above, and have a voltage and current rating at least twice the open circuit voltage and short circuit ratings of the PV module DC circuit.

PV module operating voltage shall be compatible with the DC to AC inverter provided under the specifications.

Compression type connectors at the PV module output terminals shall be provided in a watertight connection terminal box with knockouts for

watertight conduit mountings. Bypass diodes shall be supplied, mounted, and connected on each PV module in the watertight connection terminal box. If bypass diodes are not required, evidence of this must be supplied with the proposal for approval by Owner. Twist-on wire splices, crimped, soldered, or taped connections are not permitted for required field-installed wiring.

Outdoor enclosures shall be NEMA 3 waterproof and capable of surviving intact under the site environmental conditions specified. Outdoor enclosures shall be equipped to prevent condensation.

#### 2.5.4 Module qualification testing

Qualification tests shall be performed to establish the acceptability of the design, materials, and manufacturing process of the modules to be furnished. PV modules shall pass the tests described for the following: IEEE P1262 “Recommended practice for qualifications of photovoltaic modules”.

#### 2.5.5 Field wet resistance test

The installed modules and DC system shall be subjected to a wet resistance current leakage test by the Contractor. The test will be witnessed by the Owner and shall be conducted during installation of the PV system after all modules and DC wiring are installed, but prior to connecting the voltage sensitive components, such as surge protectors, and parallel connection of the source circuits.

The test shall consist of measuring the leakage resistance between the test section and ground while the modules are wet. A 1,000 volt high-impedance ohm meter (“Megger”) shall be used. The megger shall be inserted between the test section connection point and ground (i.e., module or array structure). The tests section shall be floating and open circuited for this test. The test shall be performed one at a time on all test sections. A minimum resistance to ground of 5 Meg ohms shall be demonstrated for all wire runs.

The Contractor shall provide a test procedure for the field wet resistance test and pass/fail criteria for the allowable leakage current.

## **2.6 Dish / Engine Solar System Specifications**

### 2.6.1 General Description

Concentrating dish engine solar systems shall include the solar concentrator or mirror, a two-axis tracking system, heat transfer medium, structural support truss or frame, energy receiver, and the engine/generator or power conversion unit, and control system.

The concentrator shall be fabricated from a metallized glass or polymer substrate in a paraboloid shape. The concentrator may be a single large reflector or multiple small reflectors concentrating to a single point of focus.

The concentrator shall have a solar reflectance greater than 95% when new and clean.

Tracking for the concentrator shall be provided in two axes and may be either an azimuth-elevation or polar rotational system. Each concentrator in the solar array shall have independent tracking drive mechanisms, but may be controlled centrally via a single solar position sensor and programmable controller.

The receiver shall be placed at or near the focal point of the concentrator and shall be of the direct or indirect type. Direct receivers shall use a gaseous heat transfer medium such as helium or hydrogen and shall be designed for full radiant intensity of the available solar resource. Should the heat conversion system be unavailable, the receiver shall be designed to operate without cooling until the tracking system can stow and secure the concentrator away from the sun. In an indirect receiver, the heat transfer medium may be gaseous or liquid as required by the power conversion unit. Energy conversion efficiency for the receiver shall be greater than 85% when new and clean.

The engine (or power conversion unit) shall be a Stirling or Rankine cycle device and shall be mounted on or adjacent to the concentrator frame. The engine and electrical generator shall be close-coupled to reduce maintenance expense and reduce leakage of the working fluid. The generator may be an AC or DC device and shall be designed for connection to an electrical grid with appropriate conditioning and control equipment.

Waste heat from the heat engine system shall be rejected to an air-cooled radiator. The radiator may be fan-forced and shall have a very low profile with respect to the concentrator array. Its materials of construction and structural design shall be appropriate to the site location and ambient weather extremes. The ambient noise contribution of the fan shall not exceed local nighttime noise standards of 50 dB.

Fully automated and unattended operation shall be achieved by use of a programmable control system located centrally or on the concentrator to monitor and command tracking and engine operation. A centralized supervisory control mode shall be provided for monitoring and data acquisition.

Passive spill containment shall be provided for any hazardous or problem liquids or materials which may escape the system in the event of an equipment failure. Accumulation of any such substance in the passive containment system shall trigger an alarm to the supervisory control system.

If water use (such as for cleaning or cooling) is required, details of the expected water usage should be included in the proposal.

## **2.7 Parabolic Trough System Specifications**

### 2.7.1 General Description

Parabolic trough solar collection and conversion systems shall include the linear trough, receiver pipe, single axis tracking system, heat transfer medium, structural support frame, heat exchangers, pumps and controls, engine/generator, and optional thermal storage reservoir.

The parabolic solar collection trough shall be fabricated from polished metal, a metallized glass, or polymer substrate attached to a tracking frame. The reflective surface shall have a solar reflectance greater than 95% when new and clean.

The linear receiver pipe shall be fabricated from a smooth steel tube with a selective absorption surface protected by a high quality evacuated glass tube. The outer glass tube shall have an anti-reflective coating on both its inside and outside surfaces to reduce reflective losses. Each glass tube shall have a simple vacuum indicator for quick verification of tube and seal integrity.

Tracking for the trough shall be provided in a single axis and shall be electric motor driven. Each trough string in the solar array shall have independent tracking drive mechanisms, but may be controlled centrally via a single solar position sensor and programmable controller.

Heat transfer shall be through a liquid medium pumped through the receiver pipe to an external heat exchanger or may be through direct phase change in the receiver pipe. Phase change systems may use water or organic liquids as the working fluid.

The engine shall be mounted on or adjacent to the trough array. The engine and electrical generator shall be close-coupled or mounted to a common base to facilitate maintenance. The generator shall be an AC device capable of operating within a power factor range of 0.9 to 1.0. The generator shall be designed for connection to an electrical grid with appropriate conditioning and control equipment.

Waste heat from the solar trough system shall be rejected to an air-cooled radiator. The radiator may be fan-forced and shall have a very low profile with respect to the solar conversion system. Its materials of construction and structural design shall be appropriate to the site location and ambient weather extremes. The ambient noise contribution of the fan shall not exceed local nighttime noise standards of 50 dB.

Fully automated and unattended operation shall be achieved by use of a programmable control system located centrally or on the concentrator to monitor and command tracking and engine operation. A centralized supervisory control mode shall be provided for monitoring and data acquisition.

Passive spill containment shall be provided for any hazardous or problem liquids or materials which may escape the system in the event of an

equipment failure. Accumulation of any such substance in the passive containment system shall trigger an alarm to the supervisory control system.

If water use (such as for cleaning or cooling) is required, details of the expected water usage should be included in the proposal.

## **2.8 Inverter Specifications**

### **2.8.1 General description**

The inverter shall be UL listed and designed for a fully functional utility interactive system installed to meet the requirements set forth in this specification. The inverter shall be designed to produce high-efficiency low-cost energy, have minimum maintenance requirements and high reliability and be designed for normal unattended operation. The inverter must be of a proven design successfully operated in solar power systems for a minimum period of at the least one year.

The inverter rating shall be 10% above the expected in-service loads of the solar system and be capable of limiting power output to prevent exceeding the current rating of any component as per NEC 690. The inverter must automatically reset and resume normal operation after a power limiting operation.

The inverter-generated harmonics including switching frequency at the system's AC interface and rated power shall not exceed a total harmonic current distortion of 5%, a single frequency current distortion of 3%, a total harmonic voltage distortion of 5%, and single frequency voltage distortion of 1%.

The inverter shall be housed in an appropriately waterproof and dust proof enclosure, and shall have provisions to prevent moisture condensation and entrance of rodents into air intake or exhaust ports. Snow loading, direct sunlight and extreme weather shall be considered for the inverter location. The inverter location shall be appropriately housed or shielded from the elements.

The inverter shall be designed to limit run-on and islanding to no longer than one second upon the loss of collection system voltage. The inverter shall restart not later than five minutes following restoration of collection system voltage and frequency.

### **2.8.2 DC electrical**

The inverter shall accept input voltage between 250 and 600 VDC. The open circuit voltage of the DC system shall be limited to 600 VDC. The inverters shall include a positive load breaking means of disconnect (e.g., switch, circuit breaker, removable link, etc.). The disconnect means shall be provided to disconnect both poll conductors and the neutral conductor. The

poll and neutral disconnect shall be located together and ganged. Disconnect switches shall be grouped together.

The inverters shall include a DC voltage limiting surge protection device. This component shall be installed in a manner to allow convenient and safe replacement. The design basis shall address thermal aging, and maximum voltage and current characteristics of such devices.

### 2.8.3 AC electrical

The inverters shall be capable of completely automatic unattended operation, including wake up, synchronization, and disconnect. The inverters shall also be capable of operation by local (front panel) controls.

The inverters shall be capable of operating in parallel with other inverters meeting the specifications delineated herein, the electrical collection system, and connected loads. The Contractor's system shall be capable of interrupting line-to-line fault currents and line-to-ground fault currents. It is preferred that the inverter design include turning off the inverter before AC or DC contactors are opened, as applicable.

The inverters output shall be 480 volts AC, 60 hertz, three phase. The inverter shall be capable of continuous operation into a system with voltage variation of plus or minus 10% of nominal. The inverter shall operate in an ambient temperature range of -20°C to +50°C, maintain frequency within ½ cycle and operate at a power factor of 1.0. Operating efficiency shall be greater than 95%.

The inverter shall include all necessary self-protective features and self-diagnostic features to protect the inverter from damage (in the event of component failure or from parameters beyond normal operating range due to internal or external causes). The self protective features shall not allow the inverters to be operated in a manner which may be unsafe or damaging. Faults due to malfunctions within the inverter or solar conversion system equipment shall be cleared by the inverter over-current protection device and not by Owner's protection devices.

### 2.8.4 Step-up transformer

A step-up transformer shall be supplied by the Contractor to match the voltage of the underground collection system, as required. This transformer shall be housed in the dust-tight and rain-tight enclosure. It may be dry type or liquid filled type. For oil filled transformers, the Contractor shall provide an adequate oil containment system subject to Owner's acceptance. No PCBs shall be allowed.

The step-up transformer shall include a positive load breaking means of disconnect (e.g., switch, circuit breaker, etc.) on the high side. The disconnect means shall be provided to disconnect all phases simultaneously. This disconnect means shall be capable of remote operation.

### 2.8.5 Grounding

An inverter grounding system shall be designed and installed for the solar conversion system. The grounding system shall provide personnel protection for step and touch potential in accordance with IEEE standard 80. The system shall also be adequate for the detection and clearing of ground faults.

The solar conversion system's ground shall be connected to the inverter at one point with provisions on the outside of the enclosure for a bare copper wire connection to the Owners grounding system.

All of the exposed non-current carrying metal parts shall be solidly grounded. Particular attention shall be given to prevention of corrosion at the connection of dissimilar metals such as aluminum and steel.

### 2.8.6 Testing

Prior to shipping the inverter or any of its component parts to the jobsite, the Contractor shall demonstrate its operability. As a minimum, the inverter shall be tested to demonstrate that all controls, protective functions, and instrumentation are performing as designed and that the inverter has the functional capability to be automatically synchronized to and connected in parallel with the Owner's electrical collection system.

### 2.8.7 Operations and maintenance manuals

The six (6) operations and maintenance manuals shall include the following sections:

- Operating instructions.
- Preventive maintenance instructions.
- Cleaning instructions.
- Safety precautions.
- Trouble shooting procedures.
- Theory of operation to discrete component level.
- Schematic diagrams, flow diagrams, wiring diagrams, logic diagrams, etc. to discrete component level.
- Parts lists showing all discrete components with part number, current prices and availability.
- List of replaceable supplies; with part numbers, current prices and availability.
- Recommended levels of spare parts and supplies to keep on hand.
- Manufacturers' service and maintenance technical manuals.

- Names, addresses and telephone numbers of service and repair firms for the equipment.

All product manuals shall be the same as are used by manufacturers' authorized technicians to completely service and repair the equipment.

### **3 APPENDICES ATTACHED**

#### **3.1 Bid Forms**

- 3.1.1 PSE Contact Information (XLS)
- 3.1.2 General Respondent Information (XLS)
- 3.1.3 Technology Summary (XLS)
- 3.1.4 O&M Routine and Spares (XLS)
- 3.1.5 Pricing (XLS)
- 3.1.6 Generation (XLS)
- 3.1.7 Schedule (XLS)
- 3.1.8 Subcontractor Listing (XLS)
- 3.1.9 O&M Routine and Spares (XLS)
- 3.1.10 Signature Page (XLS)

#### **3.2 Meteorological Data**

- 3.2.1 Western Regional Climate Center Data on Temperature and Precipitation (XLS)
- 3.2.2 NREL Solar Radiation Summary Data for Yakima (PDF)
- 3.2.3 NREL Solar Radiation Detailed Data for Yakima (XLS)

#### **3.3 Site Photos**

- 3.3.1 Site Photos and Descriptions (PDF)
- 3.3.2 Higher Resolution Photos and Video Clips (ZIP w/ JPG and MPG)
- 3.3.3 Site Map for Informational Purposes Only (DWF and PDF)

#### **3.4 PSE General Terms & Conditions (DOC)**

#### **3.5 Form of Construction Contract (DOC)**

#### **3.6 Geological Investigation Report (PDF)**