

Government of Tokelau

Grid Connected Photovoltaic Electricity Supply on Tokelau

INVITATION TO TENDER

29 January 2004

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1 Background

There is significant solar energy potential available in Tokelau. Tokelau has already had positive experiences with Photovoltaics (PV) dating back to 1984. Existing environment and energy strategies, action plans and projects in the Government of Tokelau also support the utilisation of solar power. In general, most Pacific Island Countries have strong potential for the utilisation of grid-connected PV for electricity generation, but to date this has been used in few locations. On-site demonstrations of the viability of small-scale grid connected PV in Tokelau will assist in regional replication and set standards for future sustainable energy developments in the Pacific region. On a global level the context for the project among others is the Millennium Development Goals, in particular with regard to ensuring environmental sustainability.

With a view towards a sustainable future the Government of Tokelau, in cooperation with the Government of New Zealand, UNESCO and UNDP, has decided to start making use of their renewable energy resource as part of a long-term energy supply strategy. Funding for this project has been allocated from these parties. In the short-term, solar energy will supplement the diesel-generated power, but in the medium run, solar power could provide a significant part of the country's energy mix. In the long-term, solar energy could possibly make Tokelau energy self-sufficient through the sustainable utilization of local energy resources - i.e. make Tokelau a Renewable Energy Island Nation.

Detailed background information on the project is provided in Annex 1 "Feasibility Study" to this document.¹

2 Scope of Supplies and Services

2.1 The subject of the tender is the supply and installation of equipment. The general requirements and technical specifications for the supplies and services are contained in the present document.

2.2 Tenders shall be for the supply of equipment, transport, installation and final commissioning comprising one single lot, described as follows:

Supply, transport and installation of one grid connected PV generation unit including battery storage and needed training.

2.2.1 The Contractor shall pay all shipping, insurance and handling charges to the final transportation destination described.

2.2.2 The Contractor shall specify the time required for supply and transport. The completion of transportation and installation should not take longer than five months from the date of receipt of the endorsed contract by the successful bidder.

2.2.3 The Contractor shall notify the Government of Tokelau at least thirty (30) days in advance of the date the materials are scheduled to be shipped.

2.2.4 The Contractor shall be responsible for making good any defect or damage to any portion of the supplies arising from defective design, materials or workmanship for a period of one year following the installation or for the manufacturer's warranty period for specific components whichever is longer.

2.2.5 The Contractor shall include in his tender details of local or regional agents or representatives to whom any requests for advice or service may be addressed, together with details of any other warranties, maintenance or training services which may be offered, which shall form a part of the tender evaluation.

2.2.6 The Contractor shall guarantee the availability of the supply of spare parts for a period of 10 years, from the date of final commissioning.

2.2.7 The Contractor shall state how he intends to meet this spare parts obligation, and shall indicate the nearest agent in the area where spare parts are available.

¹ In case there are any differences between the information contained in this Invitation to Tender document and the information contained in Annex A, this Invitation to Tender document supersedes.

3 Information for Contractors

3.1 General

- 3.1.1 The Contractor shall bear all costs associated with the preparation and submission of the Tender, and the Government of Tokelau will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the solicitation.
- 3.1.2 Eligible Contractors. Contractors should not be associated, or have been associated in the past, directly or indirectly, with a firm or any of its affiliates which have been engaged by the Government of Tokelau to provide consulting services for the preparation of the design specifications, and other documents to be used for the procurement of goods to be purchased under this Invitation to Tender.
- 3.1.3 Prospective Contractors should state their experience and track record with hybrid solar systems.
- 3.1.4 Clarification of Solicitation Documents: A prospective Contractor requiring any clarification of the Solicitation Documents may notify the Government of Tokelau via the Director, Tokelau Office of the Council of Faipule and Cc the Project Manager by e-mail on the e-mail addresses mentioned in section 3.4.3. The response will be made in writing to any request for clarification of the Solicitation Documents that it receives earlier than two weeks prior to the deadline for the submission of Tenders. Written copies of the response (including an explanation of the query but without identifying the source of inquiry) will be sent via e-mail to all prospective Contractors that received the Solicitation Documents.
- 3.1.5 Contractors are expected to examine all corresponding instructions, forms, terms and specifications contained in the Solicitation Documents. Failure to comply with these documents will be at the Contractor's risk and may affect the evaluation of the Tender.
- 3.1.6 All experiences and results from this project will be widely disseminated throughout the Pacific region.
- 3.1.7 In case references have been made to products manufactured by specific companies the intention is to highlight the required technical specifications. The Contractor can propose any device from different manufacturers having the same technical characteristics.
- 3.1.8 English is the official language for all projects related documents including the tenders themselves.

3.2 Amendments of Solicitation Documents

- 3.2.1 Amendments of Solicitation Documents: No later than two weeks prior to the deadline for submission of Tenders, the Government of Tokelau may, for any reason, whether at its own initiative or in response to a clarification requested by prospective Contractors, amend the Solicitation Documents.
- 3.2.2 All prospective Contractors that have received the Solicitation Documents will be notified in writing of any amendments. In order to afford prospective Contractors reasonable time in which to take the amendments into account in preparing their offers, the Government of Tokelau may, at its discretion, extend the deadline for the submission of Tenders.

3.3 Tender Evaluation

- 3.3.1 The tenders will be evaluated by a Tender Committee under the chairmanship of the Director, Tokelau Office of the Council of Faipule, Government of Tokelau.
- 3.3.2 Tenders will be ranked according to their combined technical (*St*) and financial (*Sf*) scores using the weights (*T* = 0.6 the weight given to the Technical Proposal; and *P* = 0.4 the weight given to the Financial Proposal; (*T* + *P* = 1).
- 3.3.3 The lowest price (*Fm*) will be given a financial score (*Sf*) of 100 points. The financial scores (*Sf*) of the other tenders will be computed according to the formula:

$$Sf = 100 \times Fm/F,$$

in which *Sf* is the financial score, *Fm* is the lowest price and *F* the price of the proposal under consideration.

The total score will thus be determined by:

$$S \text{ (Total score)} = St \times 0.6 + Sf \times 0.4$$

The firm achieving the highest combined technical and financial score will be invited for negotiations.

The following table displays the technical evaluation criteria and their respective weights:

Technical Tender Evaluation Criteria

| | |
|--|------------|
| Qualification of Company (weight) | 20% |
| (i) On Site Project Manager (adequacy for Project) | 30 |
| (ii) Track record with hybrid PV/diesel systems | 35 |
| (iii) Experience in the Pacific region | 35 |
| Total Points: | 100 |
| | |
| Quality of Product (weight) | 50% |
| (i) Conformity with Specifications | 40 |
| (ii) Ability to be operated and maintained in Tokelau | 30 |
| (iii) Redundancy | 30 |
| Total Points: | 100 |
| | |
| After Sales Service (weight) | 20% |
| (i) Proximity of Agent | 20 |
| (ii) Spare parts access (dispatch and delivery modality) | 40 |
| (iii) Operator training | 40 |
| Total Points: | 100 |
| | |
| Delivery Time ² | 10% |
| Delivery Time Fastest | 100 |
| Total Points: | 100 |

² Sdt = $100 \times \frac{Dtf}{Dt}$ where Sdt is the score for delivery time, Dtf the shortest proposed number of weeks required for completion after signing of Contract and Dt is the completion time of the slower Competitor.

3.4 Tender Delivery

- 3.4.1 All tenders must be send or delivered in sealed envelopes by registered mail with three (3) original copies to:

**Mr. Falani Aukuso
Director
Tokelau Office of the Council of Faipule
Nia Mall, 1st Floor
Vaea Street
Apia
Samoa**

In addition one (1) electronic copy of the tender must be included on CD-ROM.

- 3.4.2 All tenders will be opened at the presence of the Director, Tokelau Office of the Council of Faipule and the Project Manager, Tokelau PV Project.
- 3.4.3 Inquiries by prospective Contractors concerning the tender should be sent by e-mail to the Director, Tokelau Office of the Council of Faipule on the following e-mail address:

falani.aukuso@clear.net.nz

In addition the Project Manager, Tokelau PV Project must be Cc on the following e-mail address:

thomas.jensen@undp.org

- 3.4.4 Printed and electronic copies of tenders shall reach no later than Monday 1 March 2004, 14.00 local time Apia, Samoa.
- 3.4.5 Award of contract: The Tender Committee's decision on the winning Contractor shall be final.

4 Model form of Tender

The model form of Tender should be written on company letter head and addressed to:

Mr. Falani Aukuso
Director
Tokelau Office of the Council of Faipule
Nia Mall, 1st Floor
Vaea Street
Apia
Samoa

We the undersigned.....(name, forename, position, company name) after having examined all documents in the Invitation to Tender Dossier for the Grid-connected Photovoltaic Electricity Supply on Tokelau project and having understood the nature of the goods and services to be provided and the nature and difficulties of the services to be provided, offer and undertake to supply, deliver and install the whole of the equipment and services in conformity with the Articles, Conditions and Specifications of the Invitation to Tender.

Our tender will be valid for 90 (ninety) days after the deadline for tender submissions.

Unless and until a formal Agreement is prepared and executed, this Tender, together with your written acceptance thereof, shall constitute a binding contract between us.

We understand that you are not bound to accept the lowest bid price or any Tender you may receive.

The following documents are annexed to the present tender:

- i. The Schedule of Quantities with Prices, duly completed, signed and dated as per section 8
- ii. The time schedule for the transportation and installation
- iii. All other documents, according to the stipulation of the Invitation to Tender

Done at.....the.....

The Tenderer's signature (s).....

Name
Position

Company Name:
Address:
Nationality:
Registered place of business:
Company Seal or Stamp:
Tel no:
Fax no:
Email address:

5 Model form for the supply, transportation, installation and commissioning contract

Between:

The Government of Tokelau
Tokelau Office of the Council of Faipule
Nia Mall, 1st Floor
Vaea Street
Apia
Samoa

on the one hand

and

the [Winning Contractor]

on the other

The following has been agreed:

The subject of the present Contract is the supply of equipment, spares and tools, transportation and installation of a photovoltaic power plant including, battery storage and connection to the existing electricity grid on Fanuafale Village, Fakaofu Island, Tokelau. Included are also needed training.

The following documents shall be considered and interpreted as being integral parts of the present Contract:

- i. this notification of Award of Contract,
- ii. the Tender with its Annexes,
- iii. the terms and conditions of the Invitation to Tender for the project.

The Contract Sum is fixed at (*figures*) (*words*).

A description of the goods and services to be provided is provided in the Annexes to this Contract.

The Government of Tokelau hereby undertakes to pay to the Contractor as remuneration for carrying out the Contract, the sums stated in this Contract according to the manner set out in the Contract and in accordance with the payment schedule and in the manner set out in the tender document.

In witness whereof, the contracting parties place their respective signatures on the present document, on the day and the year set out hereunder.

Director, Tokelau Office of the Council of Faipule,
Government of Tokelau

Supplier

Date:

Date:

6 Special conditions

6.1 Currency

- 6.1.1 The tender quotation should be in United States Dollars (US\$). The payment will be made in the currency of the tender (US\$).

6.2 Involvement of recipient agency staff

- 6.2.1 Members of the recipient agency staff or their assigned agents may visit or join the installation team(s) at any time during the implementation phase, at their own expenses.
- 6.2.2 As part of capacity building activities, Contractors are encouraged to temporarily employ and must as a minimum train two assistants provided by the Tokelau Power Systems (TPS) on Fakaofu Island during the installation.

6.3 Contractors Responsibility for Employees

- 6.3.1 The Contractor shall be responsible for the professional and technical competence of its employees and will select, for work under this Contract, reliable individuals who will perform effectively in the implementation of this Contract, respect the local customs, and conform to a high standard of moral and ethical conduct.

6.4 Responsibility and insurance

- 6.4.1 The Contractor assumes entire responsibility for the loss and deterioration of all supplied equipment and tools during transportation and erection and may contract all necessary insurance for this purpose.
- 6.4.2 The Contractor will be entirely liable for damages caused by all acts accomplished by his agents during the transportation and erection of the equipment.
- 6.4.3 The Contractor assumes entire responsibility for the risk of illness of his agents including all direct and indirect costs resulting from illness or accidents, such as the cost of health repatriation.

6.5 Implementation details

- 6.5.1 The Contractor should provide in his tender the CV and professional references of the leader of the installation technicians team who will assume the field responsibility for the installation.
- 6.5.2 A TPS representative representing the Government of Tokelau will supervise the installation of equipment on Fakaofu.

6.6 Variations

- 6.6.1 The Director, Tokelau Office of the Council of Faipule representing the Government of Tokelau reserves the right to increase or decrease the quantity of systems to be installed by up to twenty (20) percent. The unit price of installed systems mentioned in the offer shall be applicable to the quantities ordered within the limit of this variation.

6.7 Inspections

- 6.7.1 Inspections will be performed for quantitative and qualitative controls by a representative of the TPS. The provisional on site inspection will be carried out at the end of the installation by a representative of the TPS. The Contractor will bear the cost of its representative during this inspection as part of its contractual obligations.
- 6.7.2 The final on site inspection will take place six months after the provisional onsite inspection by an Engineer paid and appointed by the Government of Tokelau.
- 6.7.3 The Engineer will produce a final test and commissioning report that includes: test results, condition of all equipment, operational condition of solar plants and equipment and final recommendations. Based

heron the UNDP Samoa Resident Representative will decide if commissioning will be undertaken.

6.8 Schedule of payment

The schedule of payments will be as follows:

- 6.8.1 50% of the total contract amount at contract signature against an equivalent performance bond signed to Government of Tokelau.
- 6.8.2 30% of the total contract amount at installation completion (provisional commissioning). The 50 % performance bond requirement will be lifted upon signature of the provisional commissioning.
- 6.8.3 10% of the total contract amount at provisional commissioning.
- 6.8.4 The 10% shall be paid upon signature of provisional commissioning against provision of an equivalent performance bond.
- 6.8.5 The final 10 % will be paid after six month of satisfactory plant operation following provisional commissioning.

6.9 Conditions of payment

- 6.9.1 Invoices are payable within 30 days after receipt by Government of Tokelau.
- 6.9.2 For each payment, three copies of the invoice (one original and two copies) will have to be sent together with the required documents to the Project Manager, Tokelau PV Project on the following address:

Mr. Thomas Lynge Jensen
Project Manager, Tokelau PV Project
C/o UNDP
Private Mail Bag
Apia
Samoa

- 6.9.3 Payment shall only be made following the approval of Director, Tokelau Office of the Council of Faipule, Project Manager, Tokelau PV Project and TPS General Manager.

6.10 Delayed payments

- 6.10.1 The interest rate for delayed payment will be 4.5 % per annum.

6.11 Liquidated Damages

- 6.11.1 All supply, transport and installation works must be completed in five months. The time schedule begins on the date of receipt of the endorsed contract by the successful bidder and will be determined in the contract.
- 6.11.2 If the Contractor fails to supply and install the specified equipment within the time period, specified in the Contract the Government of Tokelau shall, without prejudice to its other remedies under the contract, deduct from the Contact price, as liquidated damages, a sum equivalent to 0.5 percent of the contract price for each week of delay until actual delivery, up to a maximum deduction of 10 percent of the Contract price.
- 6.11.3 Once the maximum is reached, the Government of Tokelau may consider termination of the Contract.

6.12 Bank Guarantee

- 6.12.1 All bonds and/or Bank Guarantees will be issued in the currency of the contract and in favor of Government of Tokelau.

6.13 Warranty

- 6.13.1 The Contractor shall warrant that all supplies shall have no defect arising from design, materials or

workmanship.

6.13.2 The warranty on complete installation shall remain valid for one year from the date of the provisional commissioning certificate. The minimum warranty period of components from that date will be:

- Photovoltaic modules 15 years
- PV array mounting structures 15 years
- Batteries 5 years
- Battery enclosures 10 years
- Inverter 5 years
- All other parts 5 years

6.13.3 Warranties applicable to solar modules will provide for replacement without cost should module output fall more than 10% below stated manufacturer specifications or should defect in manufacture result in corrosion or degradation of the sealed structure of the module. Modules defects are defined as those that are recognized as the failures listed in the CEC specifications N° 501/502.

6.13.4 The Contractor shall provide proof of manufacturers warranty for the solar modules, inverters and batteries. Where component manufacturer warranties are longer than those required herein, the manufacturer warranty will be used.

6.14 Settlement of Disputes

6.14.1 Amicable Settlement: The Parties shall use their best efforts to settle amicably any dispute, controversy or claim arising out of, or relating to this Purchase Order or the breach, termination or invalidity thereof. Where the Parties wish to seek such an amicable settlement through conciliation, the conciliation shall take place in accordance with the UNCITRAL Conciliation Rules then obtaining, or according to such other procedure as may be agreed between the Parties.

6.14.2 Arbitration: Unless, any such dispute, controversy or claim between the Parties arising out of or relating to this Contract or the breach, termination or invalidity thereof is settled amicably under the preceding paragraph of this Section within sixty (60) days after receipt by one Party of the other Party's request for such amicable settlement, such dispute, controversy or claim shall be referred by either Party to arbitration in accordance with the UNCITRAL Arbitration Rules then obtaining, including its provisions on applicable law. The arbitral tribunal shall have no authority to award punitive damages. The Parties shall be bound by any arbitration award rendered as a result of such arbitration as the final adjudication of any such controversy, claim or dispute.

6.15 Intellectual Property Infringement

6.15.1 The Contractor warrants that the use of the goods sold supplied under this Contract does not infringe any patent, design, trade-name or trade-mark.

6.15.2 In addition, the Contractor shall, pursuant to this warranty, indemnify, defend and hold the Government of Tokelau harmless from any actions or claims brought against the Government of Tokelau pertaining to the alleged infringement of a patent, design, trade-name or trade-mark arising in connection with the goods supplied under this Contract.

7 Technical specifications for photovoltaic systems components

7.1 General

- 7.1.1 The system will be connected to the electricity grid operated by TPS. The unit has to be capable of supplying balanced sine wave electricity to the three phases of TPS's 415 Volt system. Three generators having a combined capacity of approx 120 KW generally supply the system. The photovoltaic system will be mainly used to support peak-hour operation of one diesel generator set. I.e. the unit will operate in parallel with one or more generators. The unit should however also be able to supply the system without a diesel generator running. This mode has to be initiated by an operator overriding a feature that avoids system "islanding" in case of a generator failure in parallel operation mode.
- 7.1.2 The system will be connected at a connection point determined by TPS. This connection point will be not more then 100 meters from the site of the photovoltaic system.
- 7.1.3 The photovoltaic system will be installed in an environment of high ambient temperature, high humidity, and high levels of atmospheric salt.
- 7.1.4 The system shall be designed to operate under tropical coastal conditions. All system components are to be fully integrated and compatible.
- 7.1.5 Technical specifications will be included in the technical analysis of the tender evaluation.

7.2 Photovoltaic array

- 7.2.1 The solar array consists of strings of PV modules that together produce a nominal output of at least 10 Kilowatt under Standard Test Conditions. PV modules have to comply with IEC 61215 or have to be ESTI CEC 503 certified.
- 7.2.2 The array output has to be guaranteed within $\pm 10\%$ for a minimum of 15 years under tropical coastal conditions, which include exposure to high ambient temperature, high humidity, and high levels of atmospheric salt.
- 7.2.3 Tilt angle should be 10 – 15 degrees north facing.
- 7.2.4 Specifications:
- | | |
|--|-------------------------------------|
| Nominal output in line with IEC 61825/60904.1: | > 10 KW |
| Real array output: | approx 8-9 KW peak |
| Cell material: | mono or polycrystalline Si |
| By pass diodes: | integrated in modules |
| Blocking diodes minimum rating: | 1.25 x Isc of modules in the string |
| Module Frame: | anodised aluminium |
- 7.2.5 Full technical specifications shall be provided with the tender. These must specifically include:
- Voc,
 - Isc,
 - Wp at standard conditions,
 - the relationship between temperature and module output, IV (current/voltage) curves for 500, 800, and 1000 W/m² solar inputs,
 - physical size and weight,
 - details of the materials used in construction, particularly the backing material and the encapsulation material.
- 7.2.6 The results of tests carried out on the modules at ESTI (European Solar Testing Institutions) using the

CEC Specifications No. 503 or the results of any other international testing and certification facility.

7.2.7 A statement of manufacturers' warranties in effect on the proposed module type must be provided.

7.3 Photovoltaic modules support structures (Rack)

7.3.1 The material of the rack and the mounting of the solar arrays has to withstand a very corrosive maritime climate and hurricane force wind up to 200 Km/h. It must allow mounting of the panels at approx 10-15 degrees tilt angle facing north +/- 5 degrees.

7.3.2 The Foundation will be in concrete. TPS will provide the Contractor with labour for foundation and other installation work. Materials for the foundation have to be supplied by the Contractor. The Contractor shall also cover the cost of labour provided by TPS.

7.3.3 Material permitted for the rack are:

- hot-dipped galvanising steel of at least 400g/m² of zinc with additional white epoxy paint or
- anodised aluminium structure (standard to be specified by the supplier)

7.3.4 Brackets and fasteners:stainless steel or anodised aluminium.

7.3.5 All support structures components must be able to resist at least 15 years of outdoor exposure without any appreciable corrosion or fatigue.

7.3.6 Full technical specifications of the mounting structure shall be provided with the tender. These must specifically include physical size, and details of materials used in construction, complete drawings showing the construction and assembly of the mounting structures and the mounting of the modules thereon.

7.3.7 The Contractor shall provide calculations confirming the requested wind resistance.

7.4 Battery Bank

7.4.1 The battery bank shall be of the lead-acid, open cell construction type with positive tubular plates. The batteries must be of deep cycle heavy-duty design, with expected lifetime of 10 years. The container shall be of molded construction with bonded lid and polarity markings. Batteries shall be supplied with protection against acid leakage. The battery manufacturer must have received ISO 9001 certification.

7.4.2 The Contractor shall select the operating voltage of the battery bank in line with efficiency criteria. Alternative operating voltages can be proposed.

7.4.3 The battery bank will be installed on racks in a battery house of minimum 8-m2 surface area. TPS will provide the battery house.

7.4.4 In order to avoid explosion hazards form H₂ accumulation catalytic vent caps should be provided. Other H₂ management techniques are permitted. Technical details should be provided by the Contractor.

7.4.5 Batteries must have a proven capability under tropical, coastal conditions. Tenders must include details of prior qualifying service, a statement that the batteries offered are identical to those used in prior service and the names and contact details of at least two users not affiliated with the manufacturer or Contractor who are willing to corroborate the stated field experience.

7.4.6 The general specifications of the battery include:

| | |
|--|----------------------------------|
| Battery type: | lead acid positive tubular plate |
| H ₂ Management: | Catalytic vent cap |
| Operating Temperature Range: | 20 – 50 degree C |
| Containers: | Impact resistant plastic |
| Nominal Bank Voltage: | to be determined by supplier |
| Effective capacity | 30 KWh |
| Design Depth of Discharge: | < 40% |
| Nominal charge at C 20 approx: | 90 KWh |
| Surge load capability: | 20 KVA |
| Self-Discharge % per month at 20 degree C: | < 4% |
| Energy conversion efficiency: | >75% |
| Coulombic efficiency: | >85% |

| | |
|---------------------------|---------------------|
| Cycles at 40 % discharge: | > 2500 |
| Battery Racks: | Corrosion protected |
| Transport/delivery: | dry charged |
| Supplier warranty: | minimum 5 years |

- 7.4.7 Full technical specifications shall be provided with the tender. These must specifically include: curves showing rated Ah capacity at discharge rates from C10 – C100, cycle life versus depth of discharge, self-discharge characteristics, a table of hydrometer readings from discharge to full charge, battery performance and life curves at temperatures from 25-50C and the relationship between temperature and water replacement requirements, physical size and weight, and details of the materials used in construction of the battery.
- 7.4.8 The Contractor must provide a statement of manufacturer warranties in effect and a copy of ISO 9001 certification of the battery manufacturer. The electrolyte supplied shall be of a specific gravity intended to provide minimum internal corrosion under tropical conditions. The Contractor must precisely provide this.

7.5 Inverters/ Battery Controllers

- 7.5.1 Inverter/battery charger units are to be located in the battery house.
- 7.5.2 The Contractor shall propose the detailed configuration of the battery chargers and inverter units and switches bearing in mind that simplicity and reliability of operation are considered important features for these components.
- 7.5.3 The inverters/charger units must not produce radio frequency interference in any operating conditions beyond a range of 20 meters from the units.
- 7.5.4 Inverter and battery chargers can be either integrated or separate units. The preferred number of inverter units is three. For both battery charger and inverters one each spare unit has to be supplied by the Contractor. The following specifications are required:

| | |
|--|---|
| Inverter/controller Type: | Sine Wave |
| Preferred number of units for redundancy: | 3 |
| Combined max continuous inverter output: | >15 KVA, supplying 3 phases, 415 V |
| Combined half hour rating: | >20 KVA |
| Combined surge rating: | >24 KVA |
| Full load conversion efficiency: | >90% |
| Demand start response time: | <1 sec |
| Battery charge time from DoD to full by mains: | <5 hours |
| Inverter operation: | manually and/or automatic switching |
| Safety feature: | automatic disconnection of inverter in case of generator stoppage with manual overriding facility |

Operation modes (minimum requirements):

The following operating modes of the inverter unit must be possible through automatic and/or manual switching:

1. Charging (controlled by voltage, high amperage charging)
 - a. From mains – limited to a set Amax
 - b. From solar array
 - c. From both sources

2. Utility Interactive Mode
 - a. Peak load shaving at peak hours (approx 6 KVA) manual and/or automatic switching
 - b. Support for grid to cope with short time peaks up to 15 KVA up to 2 hours (manual and/or automatic switching)
 - c. Power from solar array fed directly into grid (automatic when generator is working)

- d. Power from battery (limited by voltage setting) fed into grid (automatic when generator is working)
3. Stand Alone Off-peak Mode (in case of 24 hours supply only)
 - a. Stand alone supply only after manual overriding of safety feature
 - b. Off-peak supply up to 15 KVA to battery DoD.
- 7.5.5 Full technical specifications shall be provided with the tender. These must specifically include: voltage range of adjustments for settings, type of switching circuits used, switching and continuous carrying capacity, required protections, tolerated temperature/humidity range, physical size, and details of the materials used in construction.
- 7.5.6 A statement of manufacturer warranties in effect must be provided.

7.6 **Other Components/Balance of System**

- 7.6.1 **DC Junction Box.** The DC junction box containing a control board shall be located in the battery house. It will contain fuses, circuit breakers/switches in IP 65:
 - DC circuit breaker to isolate the Battery Bank
 - Isolating circuit breakers/fuses for DC inputs from any string of the solar array
 - Isolating circuit breaker from Inverters/chargers
 - Positive and negative buses for the termination of all DC loads
 - 7.6.2 **Control board.** The Contractor shall provide and install a control board containing a main switch for connection and disconnection of the solar unit at the TPS powerhouse.
 - 7.6.3 **Cabling/Wiring:** In general heavy-duty copper wiring of the UF type shall be used for all DC wiring with all connections in watertight junction boxes and strain relief connectors. Resistive losses Voltage Drop between array and battery less than 3% at I_{sc} . Resistive losses between array and inverter less than 3% I_{sc} .
 - 7.6.4 All AC wiring and termination inverter – main grid including terminals/connectors shall be provide by the Contractor.
 - 7.6.5 **Earthing;** adequate earthing shall be provided for both DC and AC sides of the unit. The array earthing (against lightning) shall consist of a 50 meters of heavy gauge bare copper wire in a 5 meter trench connected via 16 mm² cable. DC side earthing shall be a one side earthing with battery fuse for the other rail. AC side earthing shall be of multiple earth neutral type. All metal structures must bonded and connected to the main earth.
 - 7.6.6 **Data Logger with Solarimeter:** The system shall be equipped with a data logger. Data logging capability of an interactive inverter is acceptable. Data logging shall have the following minimum capabilities:
 - Minimum Variables:
 - Solar irradiation
 - PV array current
 - Battery current charging and discharging
 - Currents to grid
 - Battery voltage
 - System frequency
 - System Voltage
 - Power Factor
 - Ambient temperature outside
 - Ambient temperature in Battery enclosure/house
-

- Generator start/stop events
- KWh supplied to grid

Minimum Features:

- Power supply by DC/DC converter from Battery plus Lithium Battery back up
- All variables 30 minute average recording
- Min/Max values for 24 hour cycles
- Storage capability 90 days
- Communications Cable and software to download to PC and transfer via phone line

7.7 Spare Parts, Tools and Documentation

7.7.1 Spare Parts

In order to respond to failures of essential components quickly, the following items shall be supplied as spares:

- Battery cells worth 5 % of the battery capacity installed (dry with acid in containers)
- 100 litres of deionised water
- 5 kg of Vaseline
- Solar modules worth 5 % of the installed solar array capacity
- 1 inverter unit
- 1 battery charger unit (if separated from inverter)
- 1 Control board terminal
- 1 each of any circuit breaker/switch used
- 5 each of any fuse used
- Assorted set of fixations, colson rings, sealing leads and wire

7.7.2 Tools

Tools shall be provided to perform all supervision, maintenance work and replacements of spare parts provided. As a minimum the following items will be required:

- 1 heavy duty plastic toolbox
- 1 professional clamp type multimeter (Fluke or Avo)
- 1 simple multimeter (Fluke or Avo)
- 1 DC Voltmeter
- 2 Hygrometer syringe type
- 2 Immersion thermometers
- 2 pairs of safety glasses
- 2 acid-resistant protective aprons
- 2 pairs of rubber gloves
- 2 pairs of safety boots
- 1 set of appropriate spanners
- 1 torque wrench with insulated handles
- 1 complete set of sockets and wrenches
- 1 set of professional screw drivers
- 1 wire stripper
- 1 wire cutter
- 1 electrician knife

7.7.3 Documentation and Manuals

The documentation and manuals provided have to enable local staff to perform supervision and maintenance, find faults and replace faulty items. All items shall be provided in 5 copies. As a minimum the following will be required:

- Training Manual
- Fault Finding Guideline

- Operators poster laminated with essential features, functions and maintenance procedures
- Circuit diagram for entire system
- Overall design document showing interconnection with system, design power flows in each section and wiring diagrams for assemblies of components
- Block or Connection diagram (AS 4509)
- Operations manual for data logger

7.8 Technical specifications for solar system installations

- 7.8.1 Installation of all system components shall be the responsibility of the Contractor.
- 7.8.2 TPS will clear a 200 m2 site for the installation of the solar array and provide a ventilated battery house which will accommodate the battery bank and power electronics.
- 7.8.3 All installations should be performed using professional mounting techniques.
- 7.8.4 There should be no shade on the PV array from 9 am to 3 PM, solar time, at any period of the year. Installation technicians would benefit of using site control devices such as the solar pathfinder.

7.9 Training

- 7.9.1 The Contractor shall train at least two plant operators during installation (these will be nominated by TPS). Training has to ensure that the responsible plant operator is able to consistently perform:
- Regular supervision and maintenance of the facility
 - Dispatch/Switching in case manual switching is selected
 - Fault-finding
 - Repair/replacement of faulty equipment
 - Reporting of faults and unusual conditions
- 7.9.2 The capabilities have to cover all components of the system, i.e. solar array, inverter/battery charger, battery and balance of system components such as wiring, switches, connections etc. It is not assumed that complex repairs of power electronics will take place on site in Tokelau. An operator is not expected to open an inverter unit that is diagnosed faulty. The operators shall however be able to diagnose faults and replace the unit from a spare part stock.
- 7.9.3 The Contractor shall supply a plant specific maintenance and fault-finding manual. Training of operators shall establish the following skills in relation to the system components:

Solar Array

- Regular cutting vegetation that shades the array
- Regular cleaning of modules
- Regular check for module damage, cracks peeling, delamination etc
- Regular checking of rack structure for mechanical faults and treatment of corrosion
- Regular check of wiring for loose connections and damage
- Regular electrical performance check by voltage measuring of array strings
- Identification of faulty modules/diodes
- Replacement of faulty modules

Inverter/Controller Unit

- Regular inspection and cleaning
- Regular check for insect invasion
- Regular check for loose connections
- Regular check of performance (Voltages and Currents)
- Resetting of tripped circuit breaker (caused by surge current or excessive load)
- Disconnection of unit and replacement from spare stock

Battery Bank

- Regular inspection and cleaning of battery units and tray
- Regular check for loose connections
- Regular applications of Vaseline at connectors
- Regular check of cell and bank voltages
- Regular check for abnormalities (discoloration of electrolyte, leakage, sediment ect)
- Regular check of specific gravity of electrolyte and temperature (n/a for gel type)
- Regular topping of water

Overall System

- Regular check of grounding
- Regular check of all switches (battery, load and array disconnect etc)
- Regular check of all fuses
- Determination why fuses or circuit breakers have tripped
- Regular check of all connections
- Regular measurements of voltages and currents and comparison with specs

Recording and Reporting

- Maintaining a log book
- Follow checklists and trouble shooting guides
- Fill in maintenance charts
- Consistently report abnormalities to supervisor

8 Solar System Price Schedule

8.1 General

- 8.1.1 The Price Schedule must provide a detailed cost breakdown for each item.
- 8.1.2 Technical descriptions for each proposed item must provide sufficient detail to allow the Tender Committee to determine compliance of tender with specifications as per Schedule of Requirements and Technical Specifications.
- 8.1.3 Estimated weight/volume of the consignment must be part of the documentation submitted.
- 8.1.4 All prices/rates quoted must be exclusive of all taxes, since the United Nations, including its subsidiary organs, is exempt from taxes.
- 8.1.5 The format shown on the following pages should be used in preparing the Price Schedule. The format uses a specific structure which may or may not be applicable but are indicated to serve as examples.

8.2 Price Schedule Main System

| Name of Tenderer:..... | | | | | |
|------------------------|-------------|------|--------------|-------------------|----------------------|
| Item | Description | Unit | Unit Price * | Quantity Required | Total Price per item |
| Solar Array | | | | 1 | |
| Solar Modules | | | | | |
| Rack | | | | 1 | |
| Rack Foundation | | | | 1 | |
| Inverter | | | | | |
| Battery Charger | | | | | |
| Control Board | | | | | |
| Junction Box | | | | | |
| Wiring | | | | 1 | |
| Datalogger | | | | 1 | |
| Transport CIF | | | | 1 | |
| Installation | | | | 1 | |
| Operator Training | | | | 2 | |
| | | | | | |
| Total | | | | | |

8.3 Price Schedule Spare Parts

| | | | | | |
|---|---|--------|--|-----|--|
| Name of Tenderer:..... | | | | | |
| Battery cells (dry with acid in containers) | 5 % of the battery capacity installed | | | | |
| Deionised water | | liters | | 100 | |
| Vaseline | | Kg | | 5 | |
| Solar modules | 5 % of the installed solar array capacity | Wp | | | |
| Inverter unit | | | | 1 | |
| Battery charger unit (if separated from inverter) | | | | 1 | |
| 1 Control board terminal | | | | 1 | |

| | | | | | |
|---|--|--|--|--|--|
| 1 each of any circuit breaker/switch used | | | | | |
| Total | | | | | |

8.4 Price Schedule Tools

| | | | | | |
|--------------------------------------|--|--|--|---|--|
| Name of Tenderer:..... | | | | | |
| Heavy duty plastic toolbox | | | | 1 | |
| Professional clamp type multimeter | | | | 1 | |
| Simple multimeter | | | | 1 | |
| DC Voltmeter | | | | 1 | |
| Hygrometer syringe type | | | | 2 | |
| Immersion thermometers | | | | 2 | |
| Pairs of safety glasses | | | | 2 | |
| Acid-resistant protective aprons | | | | 2 | |
| Pairs of rubber gloves | | | | 2 | |
| Pairs of safety boots | | | | 2 | |
| Set of appropriate spanners | | | | 1 | |
| Torque wrench with insulated handles | | | | 1 | |
| Set of professional screw drivers | | | | 1 | |
| Wire stripper | | | | 1 | |
| Wire cutter | | | | 1 | |
| Electrician knife | | | | 1 | |
| Total | | | | | |

8.5 Price Schedule Documentation

| | | | | | |
|--|--|--|--|---|--|
| Name of Tenderer:..... | | | | | |
| Training Manual | | | | 5 | |
| Fault Finding Guideline | | | | 5 | |
| Operators poster laminated | | | | 5 | |
| Circuit diagram for entire system | | | | 5 | |
| Wiring diagrams for assemblies of components | | | | 5 | |
| Block or Connection diagram (AS 4509) | | | | 5 | |
| Operations manual for data logger | | | | 5 | |
| Total | | | | | |

Date/ Signature