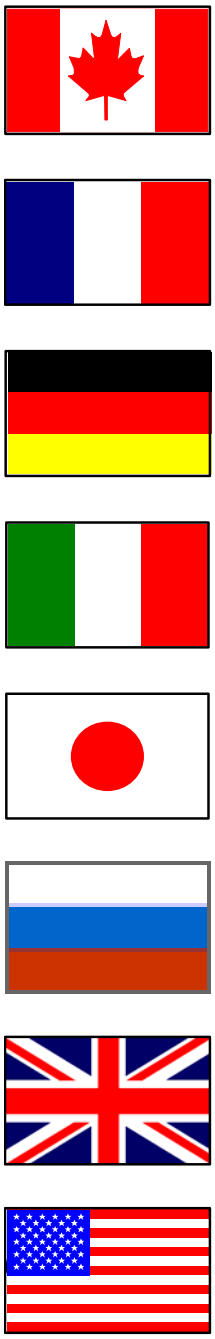

e8-153

FEASIBILITY STUDY REPORT FOR SOLAR POWER GENERATION PROJECT IN TUVALU

APRIL 2007

Kansai Electric Power
Tokyo Electric Power

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Abbreviations

A$	Australian dollar
CDM	Clean Development Mechanism
EPC	Engineering procurement and construction
INV	Inverter
IPCC	Intergovernmental Panel for Climate Change
JICA	Japan International Cooperation Agency
Kansai	Kansai Electric Power Co., Inc.
LOA	Letter of agreement
OJT	On-the-job-training
PICs	Pacific Island Countries
PPA	Pacific Power Association
PV	Photovoltaic
TEC	Tuvalu Electric Corporation

Funafuti atoll, capital city of Tuvalu

Summary

Consisting of nine coral islands in the south Pacific, Tuvalu is one of the smallest nations in the world. Many of Tuvalu's citizens lead self-sufficient lifestyles through fishing and agriculture. Although the tiny country emits almost no greenhouse gases, it has a low elevation and is said to be in the process of submerging under the rising sea level caused by global warming.

The primary source of power generation in Tuvalu is diesel power generation. Because the small-scale system is inefficient and relies on imported fuel, the electricity price is too expensive for the average citizen. Furthermore, the price of diesel oil has soared in recent years (has doubled from 2004 to 2006). Sustainable energy development therefore cannot be anticipated for Tuvalu with its system that relies upon diesel power generation.

Kansai (Kansai Electric Power) and Tepco (Tokyo Electric Power) have conducted a feasibility study for an e8 project in Tuvalu since August 2006. The primary findings of the study are as follows:

- The government of Tuvalu and the Tuvalu Electric Corporation (TEC) strongly desire a trigger to shift from full reliance on diesel generation to a hybrid system with a renewable energy source.
- Wind and biomass have some potential as a renewable source of energy to be harnessed for producing electric power, but sunlight is thought to have the greatest potential.
- The government owns a suitable location and sufficient space to set up a solar array and is able to offer it for that purpose.
- Considering the TEC power system size and the provided area size, an appropriate capacity for this solar project would be around 40kW.
- The estimated construction cost is about US$ 412,000. In terms of the unit cost per kWh, solar power generation in Tuvalu is almost equivalent to diesel power generation.
- While a dramatic reduction in the cost of diesel power generation is not anticipated, the cost of solar power generation has been more than halved in the past 10 years and is expected to continue to decrease. The project is expected to provide an opportunity to shift to solar power generation and has the potential to cut the current price of electricity in the long term.

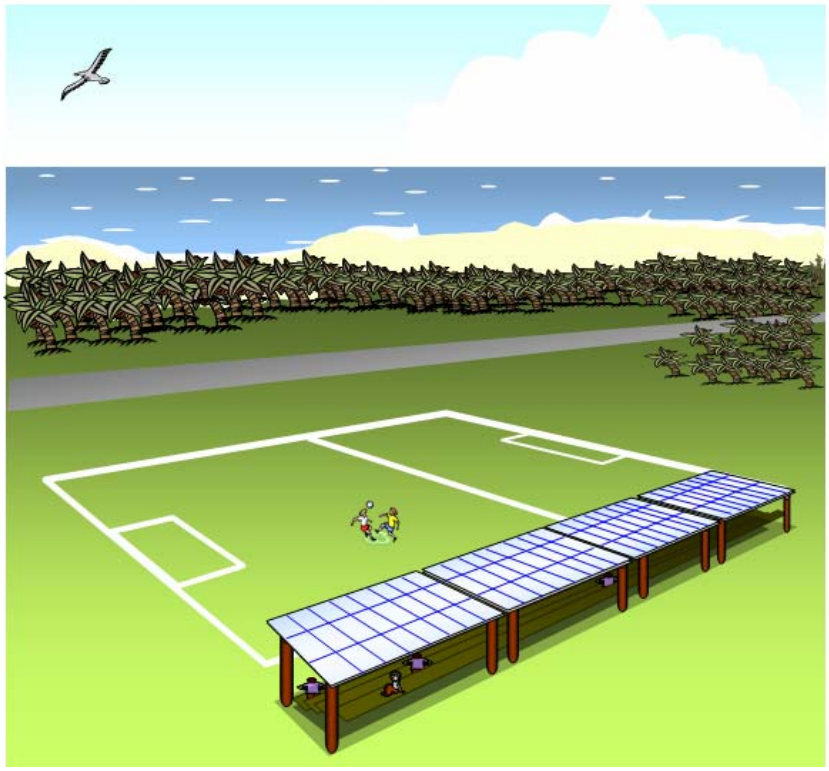
As a pilot model for a grid-connected solar power system, regardless of its size, the solar power generation project for Tuvalu could facilitate sustainable energy development in the Pacific region. In addition, the renewable energy utilization project can be expected to send a symbolic message to the world for a country that could become an unwitting victim of global warming.

Due to the high price of crude oil in recent years, the government of Tuvalu and TEC desire to realize an electric power generation project that uses renewable energy as soon as possible. Kansai and Tepco plan to complete construction in early 2008.

1. Significance of the Project

It is said Tuvalu would be the first in the world to be swallowed up by the ocean due to rise of the sea level, which may caused by the global warming. In addition to the long-time issue of submergence in the order of some ten years to some hundred years, Tuvalu is facing the short or medium-term problem in the order of several years to some ten years of rapidly rising diesel power generation cost (about US$0.5/kWh at present) due to international upsurge of the crude oil price.

Currently, the power source in Tuvalu totally consists of diesel power generation. Since the technology for diesel power generation is no longer capable of further improvement of efficiency and the fuel price is expected to remain at high rate in the future, if power supply remains relying totally upon existing diesel power system, drop of the electricity fees to the level, which allows people to use electricity freely, can not surely be expected. Therefore, the Government of Tuvalu and Tuvalu Electric Company are desirous of shifting from total reliance upon the diesel power generation to the best combination of power source including renewable energy. Considering these situation, Kansai and Tepco planned the project for solar power system with generation capacity of 40 kW.



A Conceptual Drawing of the Proposed Project

To Tuvalu, of which peak demand is about 900 kW, solar power equipment with generation capacity of 40 kW is by no means small. Rather, it is sufficient capacity to provide momentum to employ renewable energy. When comparing with the world total power demand, capacity of the world power generation by renewable energy (except hydraulic power generation) is about 2%, and that of solar power equipment is just 0.1%. On the other hand, Tuvalu will have the capacity of solar power equipment, which is about 5% as against peak demand, making Tuvalu one of the world leading countries employing solar power generation in terms of the ratio.

Since the amount of solar radiation and daylight hours in Pacific islands are considerable, a large volume of generation capacity can be expected with the solar generation panels. If it can be verified that the hybrid system with solar and diesel generation is more economical against the system only with diesel generation in the Pacific island nations, further spread of the solar power generation in this area can be expected. Kansai and Tepco found e8's role in moving towards a bright energy future here.

On the other hand, how do you cope with the long-term problem of submergence due to rise in the sea level? This project will somewhat decrease CO_2 emission, however, it does not in the least stem the tide of the global warming. Tuvalu people know about that. However, although this project is just small-scaled, it has such impact that it hopefully attracts considerable attention in the world and thus symbolic message urging approach to prevention of global warming can be transmitted to the world. To Tuvalu people who love their homeland, offering something they can do other than just standing by and watching submergence: this may be e8's role too.

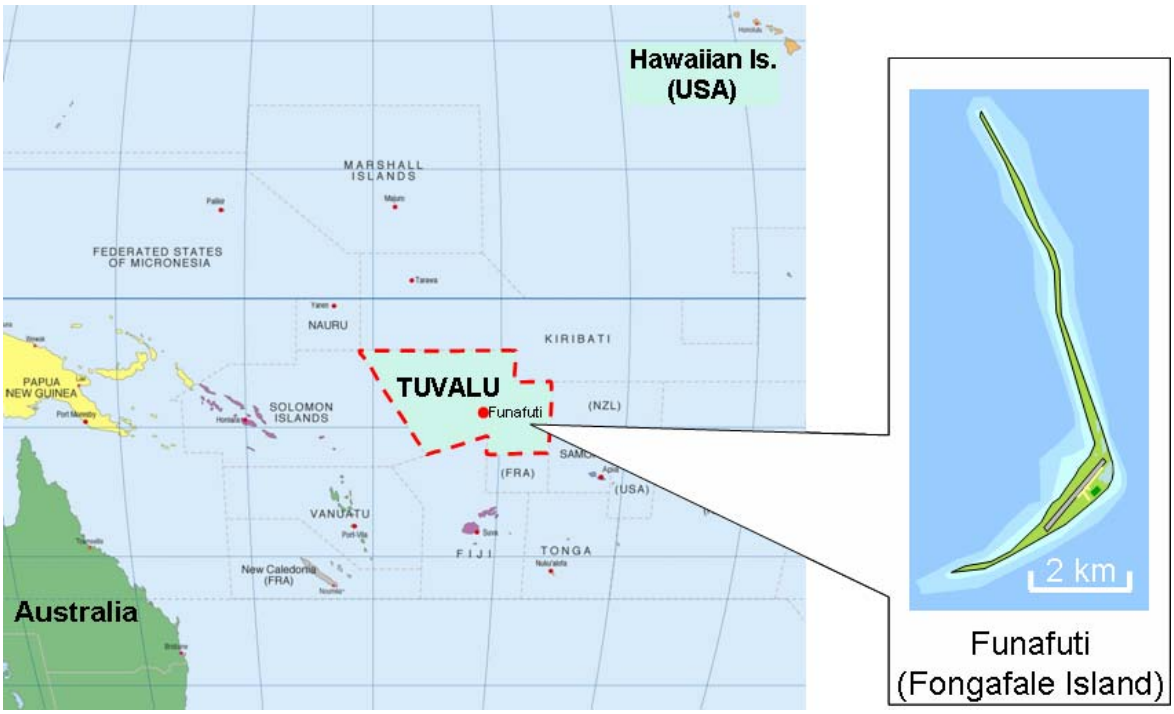
This project is contribution based. Kansai and Tepco expects no financial return. However, it is expected that rise in e8's visibility in the Pacific island nations and publicity and advertising effect at home and abroad for e8 could be greater than the total amount of contribution. Kansai and Tepco hope such win-win relationship will be informative as one example of e8's capital project.

Children of Tuvalu

2. General Description of Tuvalu

2.1 Geography

Located in the southwest Pacific Ocean between Australia and Hawaii (5 - 11 degrees south latitude, 176 - 180 degrees east longitude), Tuvalu consists of nine atolls formerly known as the Ellice Islands. The total area of the country is only 26 km^2. It has a tropical ocean climate. The capital of Tuvalu, Funafuti, is located on the island of Fongafale (8 degrees south latitude) in the Funafuti atoll. Fongafale is a small coral island of 3 km^2 in area. It is equipped with a single air strip, schools and a hospital. It is the location of the Tuvalu government office and is home to approximately half of the general population of Tuvalu.



With the highest place in Tuvalu a mere five meters above sea level and the majority less than a meter high, Tuvalu could eventually be swallowed up by the ocean if global warming continues on its present course. The islands sit upon a coral shelf that is porous like a sponge, so submerging cannot be prevented by building levees.

The damage inflicted upon Tuvalu by global warming may not be a phenomenon of the distant future. The tide has risen in recent years, and seawater gushes forth from the ground during high tide season, invading fields and damaging crops. The beaches have been whittled away and coastal erosion has progressed to the point where plants along the seacoast have fallen down.

13:00pm 16 Feb 2007

17:00pm 16 Feb 2007

2.2 People

Almost the entire population (96%) is of Polynesian descent. There are also some of Micronesian descent. The languages used are English and Tuvalian (Polynesian). The main religion is Christian (Protestant) and most of the citizens belong to the Church of Tuvalu.

Population structure data is as follows.

Population	11,810 (2006)
Population at the project location	4,000
Age structure	0-14 years: 30.2% (male 1,819/female 1,752) 15-64 years: 64.7% (male 3,715/female 3,923) 65 years and over: 5.1% (male 228/female 373) (2006)
Median age	total: 24.6 years male: 23.6 years female: 26 years (2006)
Population growth rate	1.51% (2006)
Birth rate	22.18 births/1,000 population (2006)
Death rate	7.11 deaths/1,000 population (2006)
Sex ratio	total population: 0.95 male(s)/female at birth: 1.05 male(s)/female under 15 years: 1.04 male(s)/female 15-64 years: 0.95 male(s)/female 65 years and over: 0.61 male(s)/female (2006)
Infant mortality rate	total: 19.47 deaths/1,000 live births male: 22.27 deaths/1,000 live births female: 16.52 deaths/1,000 live births (2006)
Total fertility rate	2.98 children born/woman (2006)

Source: CIA the World Facts Book Website

2.3 Socioeconomic Conditions

Poor in resources, the national government's principal source of income is fishing fees and money sent home by sailors who go off to work on foreign fishing vessels. The country began receiving contract fees for leasing the right to use the domain code "tv" to a U.S. Internet related firm in 1999, but because income from usage fees varies greatly from year to year, how to get by with limited income in the future is an important theme. With such constraints on principal national financial resources, the government is striving to improve fiscal responsibility by dramatically reducing government expenditures such as government subsidies and special development costs.

Concerning the way the average citizen of Tuvalu makes a living, with the exception of government employees, most of the people do not work for a salary, but rather still engage in subsistence fishing or farming and bartering among themselves. The per capita GDP is approximately US$1,000 (2000), but with its miniscule population, this statistical index is not suitable for expressing the local standard of living. The actual figure is considered to be less than US$800.

2.4 Political Status

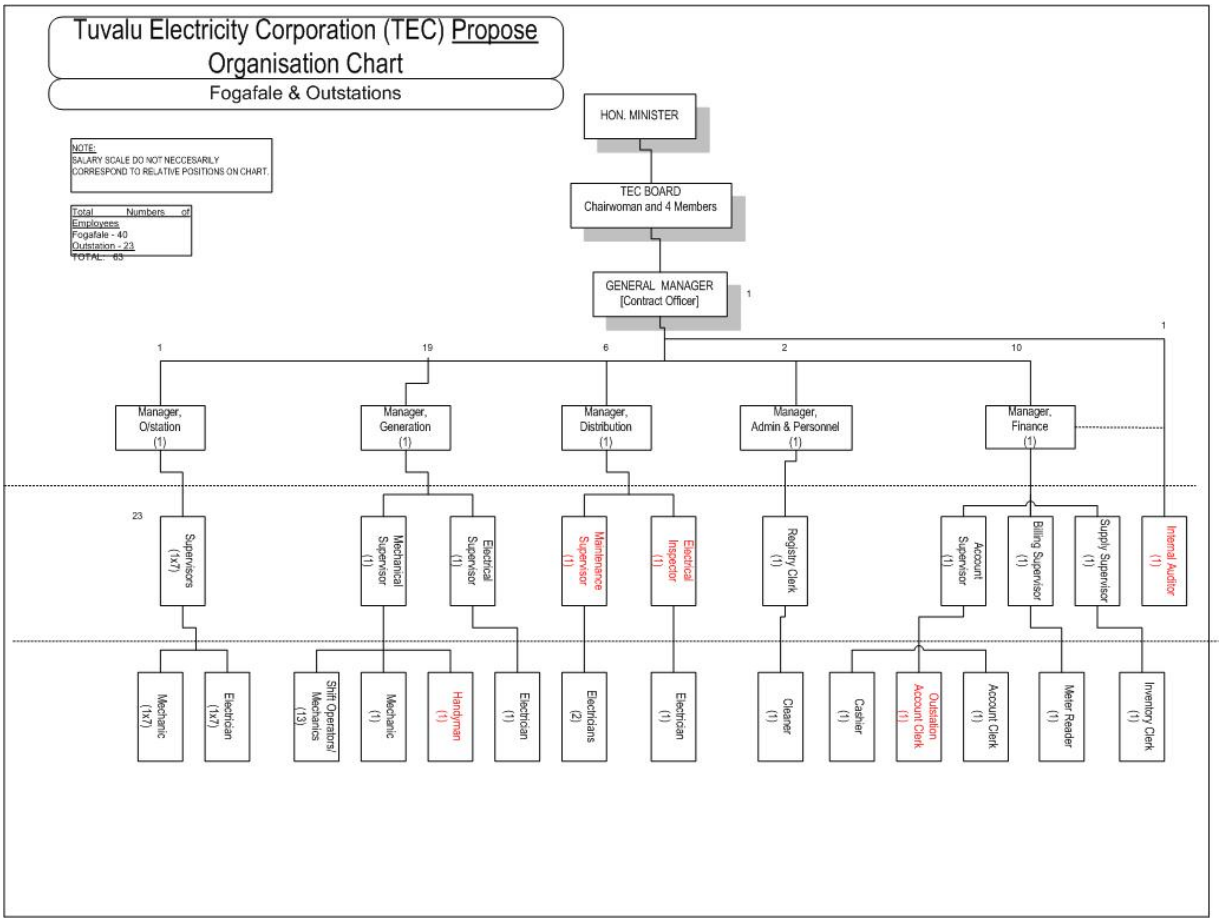
Tuvalu is a limited monarchy in the British Commonwealth; Queen Elizabeth II is the head of state. A governor appointed with counsel of the prime minister serves as the agent of the Queen. The current governor as of January 2007 is Reverend Filoimea Telito (installed April 15, 2005; 4-year term).

The one-house parliament consists of 15 seats. The term of office is 4 years. The prime minister who heads the government is chosen from among the members of the assembly. The current prime minister cum foreign minister as of January 2007 is Apisai Ielemia. There are no political parties in Tuvalu. Factions are formed by supporting certain candidates for prime minister. Almost all of the 9 administrations since the one that came to power as a result of the general election in 1993 have been evenly matched with the opposing faction. In the general election held in August 2006, 4 ministers were unseated, Apisai Ielemia assumed the office of prime minister and the cabinet was replaced.

Concerning foreign relations and national defense, the basic foreign policy has been to "have diplomatic relations with only peace-loving nations." The country recently has actively participated in the international community with Australia, New Zealand and the neighboring island states with whom it already has a deep relationship. The country does not have a military.

2.5 Regulatory Framework in Electricity Sector

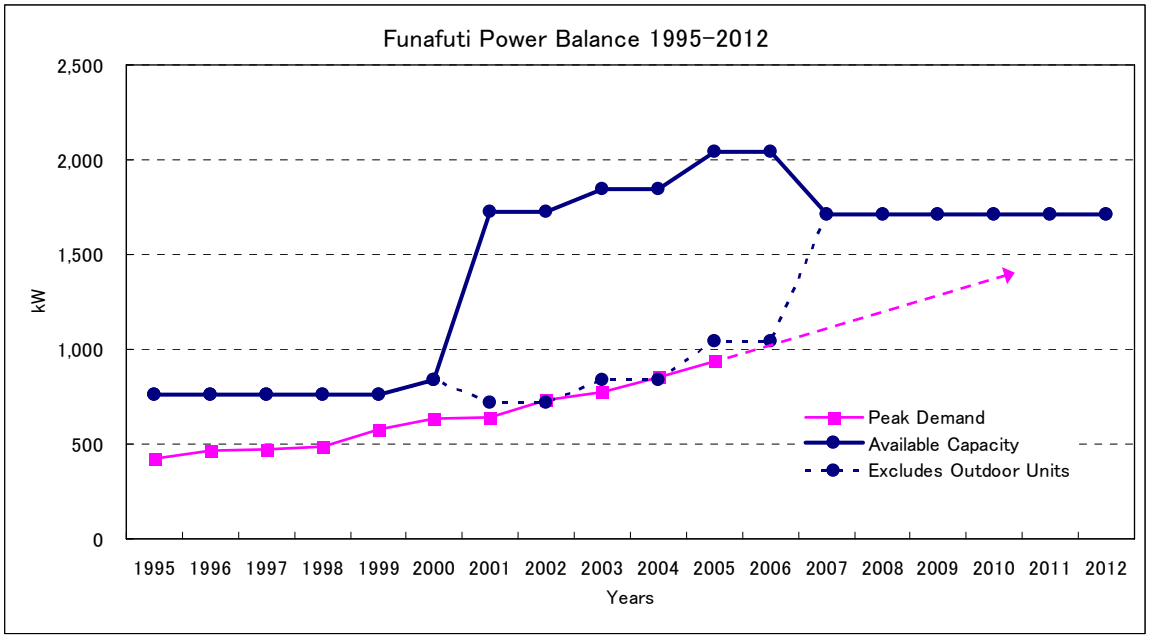
The electric power industry of Tuvalu is under the supervision of the Ministry of Works and Energy. TEC plans, operates and maintains generation, distribution and sale of electric power. The Organization Chart as of January 2007 is as follows. Forty people are positioned on the island of Fogafale of the Funafuti Atoll, and 23 on regional coral islands. The electric industry is regulated by the Laws of Tuvalu and Tuvalu Electricity Corporation Act enacted in 1990.



Source: TEC

2.6 Electricity Demand and Existing Power System

Because power demand on Tuvalu is quite small (4,285 MWh in 2005, peak demand is 936 kW at generators), peak demand tends to increase largely when large-scale public or commercial facilities start their usage. Increase in peak demand is particularly notable on Fongafale Island where the population and capital functions are concentrated. The factors behind this according to TEC analysis are the opening of a large store and harbor illumination (1999), street lights (2002) and government offices and a general hospital (2004).



Power Balance of the Funafuti Power System (source: TEC)

Power availability on the other hand is covered by the Fongafale Power Plant (diesel power generators), the only power plant in the Funafuti power system. Outdoor diesel power generators (total of 1,005 kW) had been set up on a temporary basis to meet the necessary demand during the new diesel power plant construction.

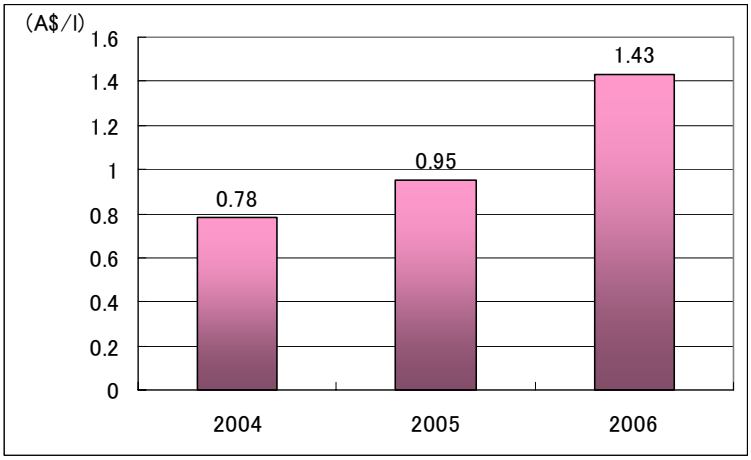
The Funafuti power system provides power to customers primarily through 11kV cables from the Fongafale Power Plant via substations with 11kV/415V-240V transformation equipment at 14 locations on the island. Years ago, the country received aid from England, but since 1982, power distribution installations have been fundamentally supported by the EU. However, the equipment had aged significantly and could affect the stable supply of electric power.

To address this problem, with the support of the government of Japan, a new Fongafale power plant was constructed (diesel power generators, 600 kW x 3 units) and the 11 kV power grid was refurbished in December 2006. By doing so, the required capacity is scheduled to be available until 2012. Along with establishing a reliable power supply system, the improvements are expected to promote the stability of central functions such as government and the economy and improve the standard of living for citizens in Funafuti.

2.7 Electricity Price

The TEC expects an annual average increase of 6.0% in peak demand in the future for projected enhancement of harbor equipment (80 kW) and stadium lighting (18 kW), etc. The TEC will need to carry out measures to avoid disruptions to power supply when load is at its peak demand from 2013 and on.

Even if the TEC has enough supply capacity, the electricity price is too expensive for the average citizen, at about US$0.35/kWh (2004). In fact, the cost of electric power was 1.5 times more than the price (as of 2004). In addition, the price of fuel has soared in recent years (has doubled from 2004 to 2006). The financial situation of the TEC has been seriously affected by the soaring cost of fuel, and the TEC is being compelled to consider the rise of the electricity price to about US$0.50/kWh.



Price of Fuel for Diesel Generators in Tuvalu (source: TEC)
(1 Australian Dollar = 0.83 US Dollar, April 24, 2007)

For above reason, the government of Tuvalu and the TEC strongly desire a trigger to shift from full reliance on diesel generation to a hybrid system with renewable energy resources. The TEC has begun to conduct studies concerning the adoption of solar and wind power generation, but no actual construction has been initiated due to lack of funds and experiences.

3. Background of the Project

3.1 Pacific Power Association

The Pacific Power Association (PPA) is an association of electricity utilities, organizations, and individuals who have an interest in the operations and development of the power industry in the Pacific Island Countries (PICs). It is a non-government regional organization founded by the electricity utilities operating in the PICs. The PPA was established in 1992 and has a Secretariat Office located in Suva, Fiji. Currently it has a membership of 25 electricity utilities operating in 20 Pacific Island Countries (Active Member) and 42 Allied Members world-wide with interest in the development of the power industry in the Pacific region.

The main objective of the PPA is to enhance the performance of power utilities in the region and through a cooperative effort maintain a partnership among the Active Members, Allied Members and regional and international aid donors. Through the PPA, the members pool their resources and expertise for their common benefit and gain international representation and improved access to international power sector assistance programmes. In addition, the direct links that the PPA provides between the private sector and utility members are designed to improve private sector services to member utilities and make the private sector members' presence in a geographically difficult marketing region more productive.

Srouce: PPA web site

3.2 e7 PPA Workshop

Pacific Island countries are facing the direct effects of global warming, as well as the rapid increase in the price of oil, both of which are urgent issues influencing all the people in the region. Power utilities from Pacific Island countries are interested in renewable energy resources to reduce both CO_2 emissions and costs associated with importing fossil fuel.

In response to a request from the PPA, which consists of the power utilities in the Pacific region, the e7 conducted workshops to train engineers and technicians of their member utilities in the area of renewable energies. Two workshops were successfully held in March and November, 2005, one in Majuro, Republic of the Marshall Islands, and the other in Nadi, Republic of the Fiji Islands. A total of 37 participants from 19 PPA member utilities attended.

3.3 Further Collaboration with PPA

Through three years of collaboration, a good relationship between the PPA and e8 was established. In order to enhance this good relationship and e8 visibility in the Pacific region, e8 started to explore the possibility of further collaboration with the PPA. Through discussions with the PPA secretariat and some experts in the region, it turned out that Tuvalu is the strongest candidate for a possible e8 project in terms of local needs and significance of the project.

4. Basic Concept of the Project

4.1 Overall Goal and Project Purpose

- ✓ To provide momentum in Tuvalu for the shift from full reliance on diesel generation to a hybrid system with a renewable energy source
- ✓ To reduce both CO_2 emissions and fossil fuel consumption
- ✓ To be a successful pilot model of grid-connected solar power generation in the Pacific region
- ✓ To enhance good relationships and e8 visibility in the Pacific region
- ✓ To disseminate a symbolic message about the prevention of global warming world wide

4.2 Renewable Energy Resources in Tuvalu

Wind power and biomass have some potential, but sunlight is thought to have the greatest potential as a renewable source of energy to be harnessed for producing electric power.

Resources	Comments
Micro Hydro	Hydro power resource is not available, because there are no rivers.
Biomass	There is limited land and soil. Although a small amount of coconut trees and husks are available, it is now used for cooking.
Wind	Appropriate wind blows only between November and March. In addition, there are no good wind synopsis points, since atolls are low lying.
Tidal	The island sits upon a coral shelf that is porous like a sponge; therefore it is quite difficult to store huge amounts of water.
Solar	The rainy season lasts from November to April, but it never rains continuously. Located at 8 degrees south latitude, good solar radiation (more than 5 kWh/m^2/day) can be expected through the year.

Source: TEC, Global Environment Center Foundation

4.3 Project Site

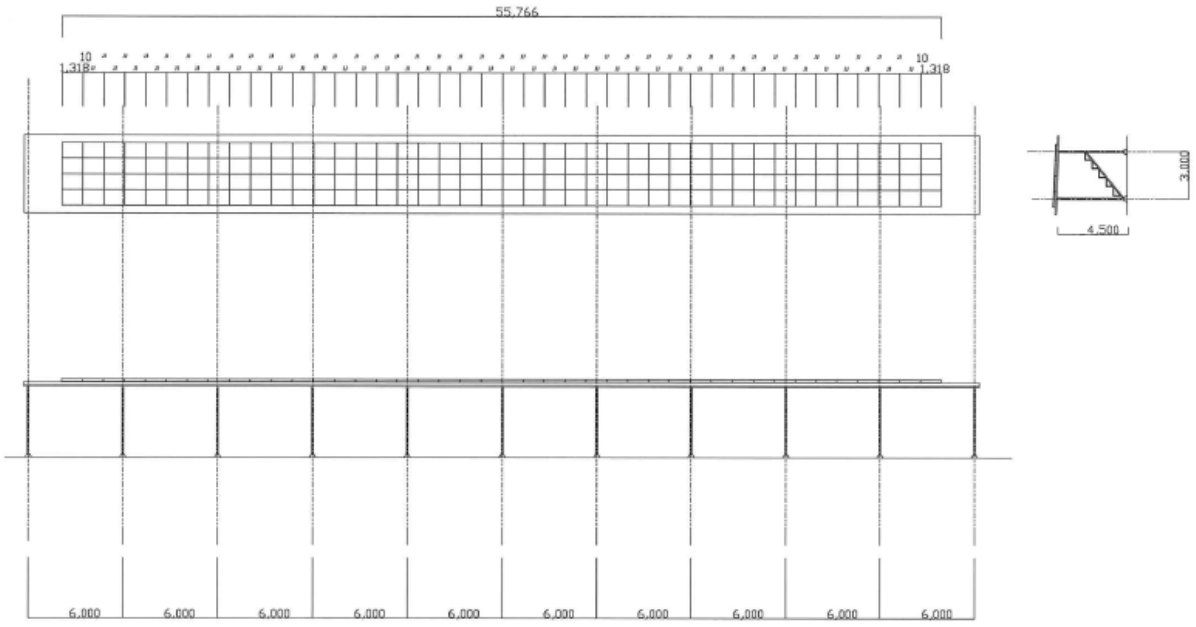
Installing solar panels requires space where there are no obstacles blocking the sunlight. The government of Tuvalu has been cooperative concerning the project, and the government has offered to have the solar panels located on government managed land.

In the pre-feasibility study, a plan to construct pillars and roof in the north of the soccer stadium and install solar power generation panels on the roof was proposed. Then, as a result of a survey during the feasibility study, it was found that the roof over the spectators seats on the south side of the soccer stadium is worn-out and should be replaced, and the master plan for the area surrounding the soccer stadium by the Government of Tuvalu includes construction of basket ball court to the north of the soccer stadium. Kansai and Tepco reviewed the original proposal and decided to refurbish the existing roof over the spectators' seats in the south of the stadium and on the roof replaced, to set the solar power generation panels.

Proposed Project Site

Situation as of Feb 2007

A technical drawing of a solar array set up on the south side of the soccer stadium is provided below.



A Solar Array set up on the spectators' seats

Watching soccer games of the local team is one of the national pastimes for the people of Tuvalu. The sunshine in Tuvalu is more than just hot, it can be excruciating, so many people watch from a tin-roofed shed or the shade of trees. For this reason, space can be optimally utilized and allow visitors to use the shade underneath.

4.4 Generation Capacity

In the pre-feasibility study, solar power generation panels of 50 kW-class was proposed. However, on the area as wide as the roof over the existing spectators' seats, panels collectively corresponding to only 30 kW can be set. Then, Kansai and Tepco proposed a plan to install additional 10kW panels on the top of two containers to contain inverter and transformer. This method allows effective use of the area and arrangement of 40 kW solar panels as a whole in consistent with the master plan of the Tuvalu Government.

The installation capacity of 40kW accounts for about 5% of the peak demand of TEC and therefore is enough to provide momentum for the shift from full reliance on diesel generation to a hybrid system with a renewable energy source.

There is another consideration regarding the generation capacity. The electricity output from solar panels easily fluctuates depending on the weather conditions. This fluctuation should be within the adjustment ability of the TEC power system, otherwise the quality of the electricity could be significantly deteriorated. However, considering the peak demand and the operation mode of the diesel generators, 40kW solar panels can be connected to the TEC power system with no such difficulties.

5. Design of Solar Power Generation System

5.1 Design Policy

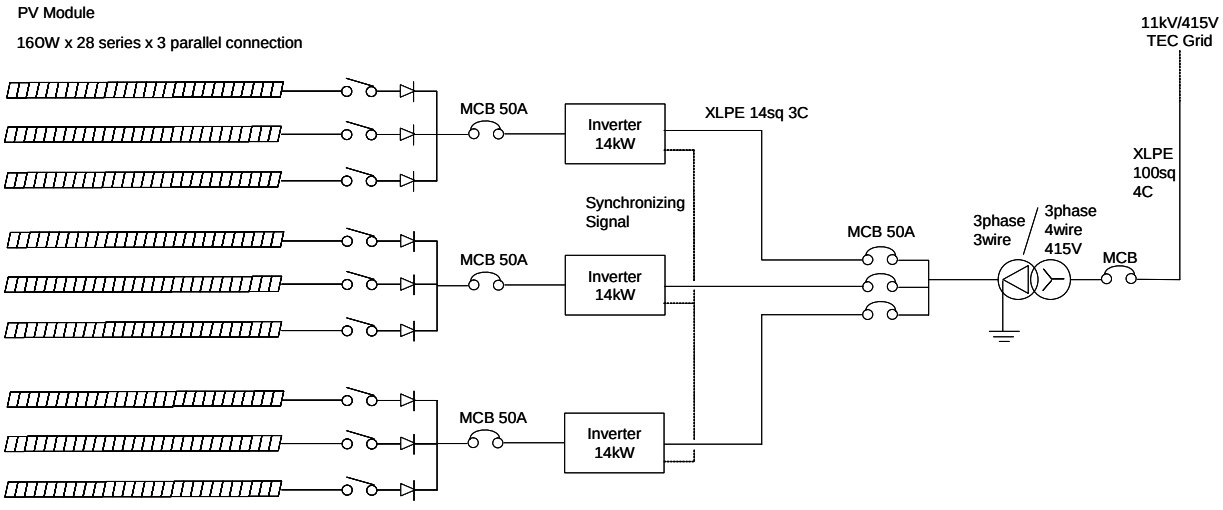
- ✓ **Replicability** : In order to reduce construction costs and to enhance the replicability of the project, equipment with special specifications will not be used. The system instead will be configured with commonly used general equipment.

- ✓ **Ease of maintenance** : The system will ve configured to enable economic replacement in the event of equipment failure. Measures will also be taken to protect against salt damage such as coating and sealed cases for the various devices.

- ✓ **Enviromental conservation** : The solar power generation will be utilized without lead storage batteries by connectiong to the exisiting power grid of the TEC.

5.2 Schematic Design

A schematic design drawings of the solar power generation system is provided below. Taking account of the fact that of all the parts of the system, the inverter is the one that tends to fail most often, the configuration will employ parallel 13.4 kW units to enable economic replacement even in the event of equipment failure.



5.3 Expected Total Power Generation

As a result of a simulation based on sunlight data at the site, annual power generation output would be about 56 MWh. The Operating rate is still 16% despite a conversion efficiency drop at high temperatures and loss due to inverters, transformers, cables, etc., being subtracted from the value. This indicates that the site is highly conducive to solar power generation.

Month	Daily Power Generation (kWh/day)	Days (day/month)	Monthly Power Generation (kWh/month)
January	158	31	4,884
February	153	28	4,271
March	160	31	4,960
April	157	30	4,717
May	146	31	4,539
June	138	30	4,133
July	141	31	4,375
August	150	31	4,653
September	159	30	4,757
October	169	31	5,241
November	155	30	4,653
December	153	31	4,737
Total		365	55,920 kWh/year

Source: SHARP Corporation

(Calculation Condition)

Installation angle:	5° to north
Dirt coefficient:	0.97
Transformer efficiency:	0.98
Inverter efficiency:	0.92
Cable loss factor:	0.98

6. Grid Connection

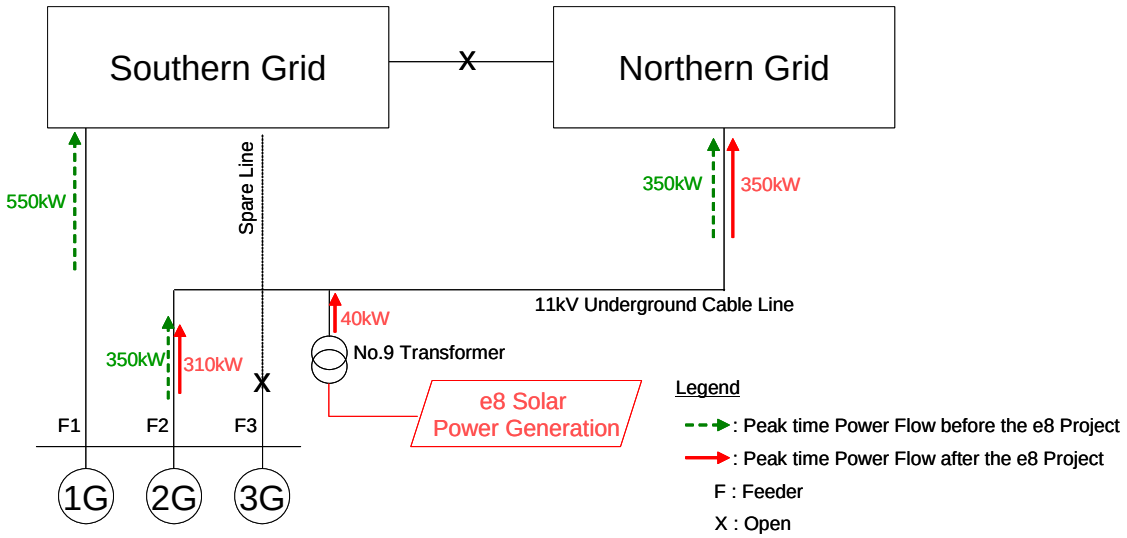
Sufficient consideration is required to ensure that the solar power generation system does not negatively affect the TEC power grid. TEC does not have a grid code, so the following grid interconnection requirements are recommended for the project.

On the other hand, in the small scale grids, great fluctuations in frequency and voltage are expected and the protection relay on the solar power generation equipment interconnected may be actuated and unnecessarily paralleled off. Thus, in order to maintain stable interconnection against parallel-off or load fluctuation in diesel power generators, the protection relay on the solar power generation needs to be properly provided.

6.1 TEC Power Grid

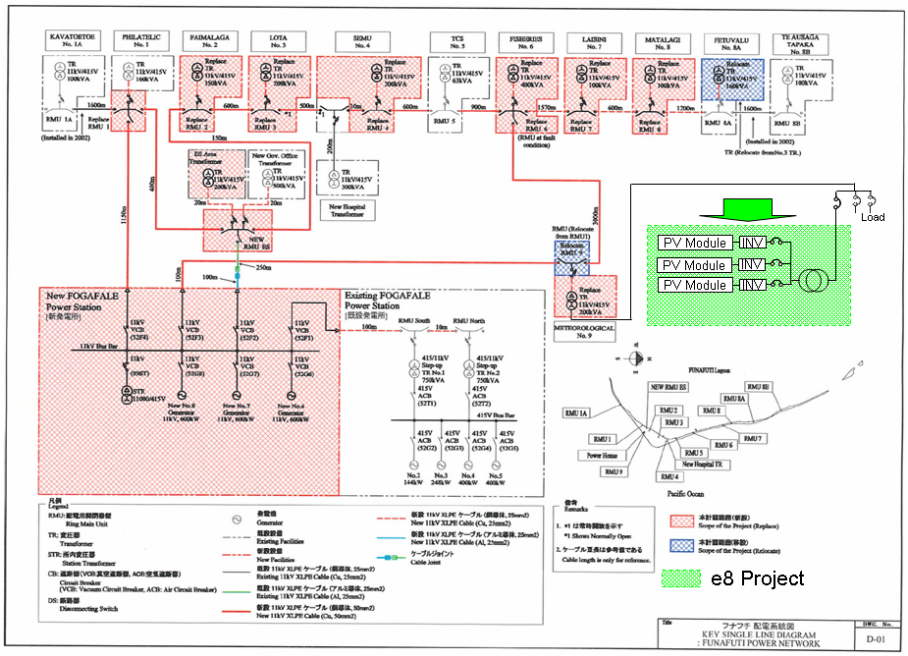
The power system in Funafuti is classified broadly into two grids: southern grid providing power to the government building and others; and northern grid providing power to private houses as the major load. The 11 kV underground cable is configured in a loop, however, it is radial in operation with a switch between the southern grid and the northern one to limit the effects of a failure. The system is close to wiring in a factory rather than power system in terms of scale.

The point (No.9 Transformer) to which the 40 kW solar power equipment is interconnected is near the 2nd feeder at the main bus bar of the diesel power station, at a distance of about 100 m, thus the direction of the power current is hardly affected within the grid.

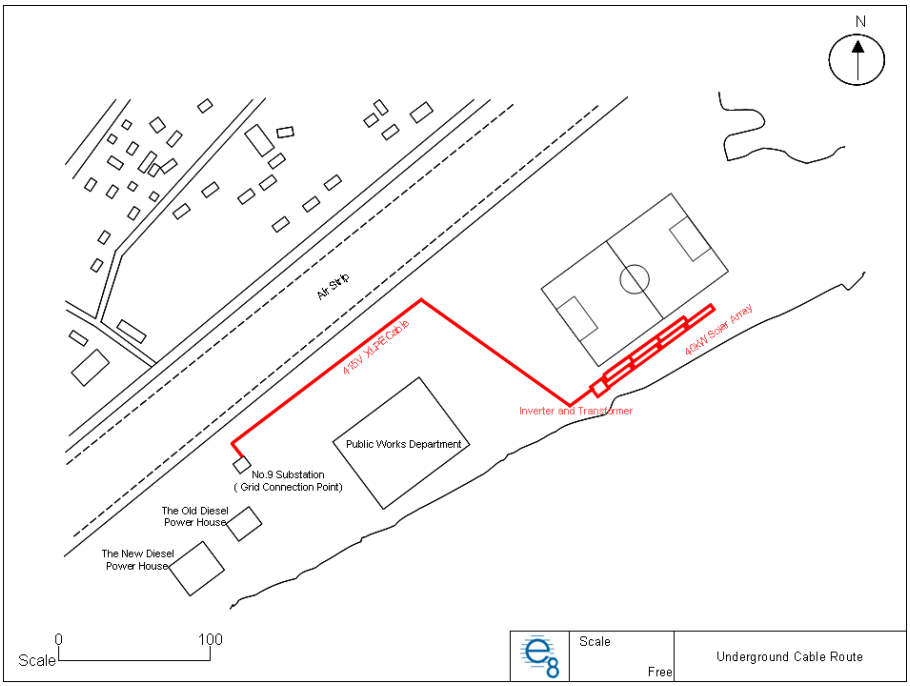


6.2 Grid Connection Point and Underground Cable Route

The site on the south side of the stadium is close to the TEC 11kV/415V power grid, so grid connection can be carried out economically. Considering the planned generation capacity, connecting on the 415V side would be one of the best options.



Source: Basic Design Study Report on the Project for Upgrading of Electric Power Supply in Funafuti Atoll, Tuvalu (JICA)

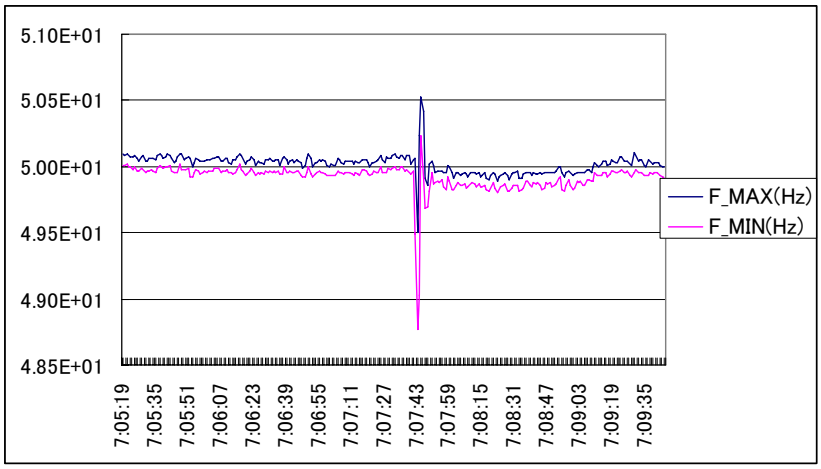


6.3 Frequency and Voltage Fluctuation

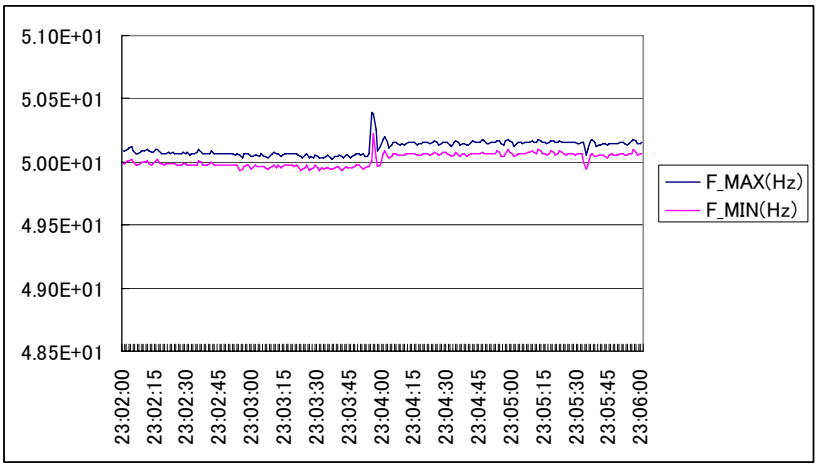
Fluctuation of frequency and voltage was measured during peak demand and off-peak demand on weekdays, peak demand and off-peak demand on weekends and holidays, on clear days and rainy days, and when used in combination with the second diesel grid. As a result of the field measurement, load fluctuation does not have much effect on both frequency and voltage. However, if, during operation of a diesel power generator, the second generator is set in parallel in the grid, both frequency and voltage tend to greatly decline, because angle of setting the diesel generator in parallel is of "lagging setting".

Frequency fluctuation

- When the second diesel power generator is set in parallel in the grid, fluctuation from 48.5-50.5Hz occurs for about five seconds.

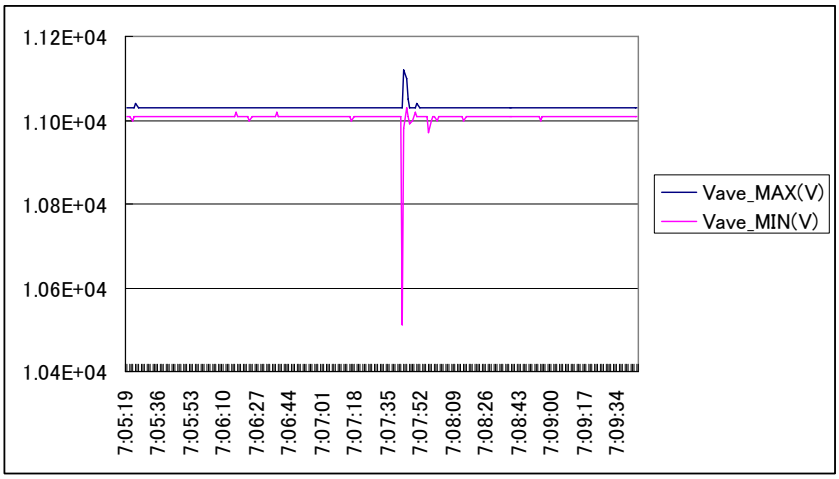


- On the other hand, in case of parallel off to decrease units of the diesel power generators, range of frequency fluctuation is about ±0.3Hz.

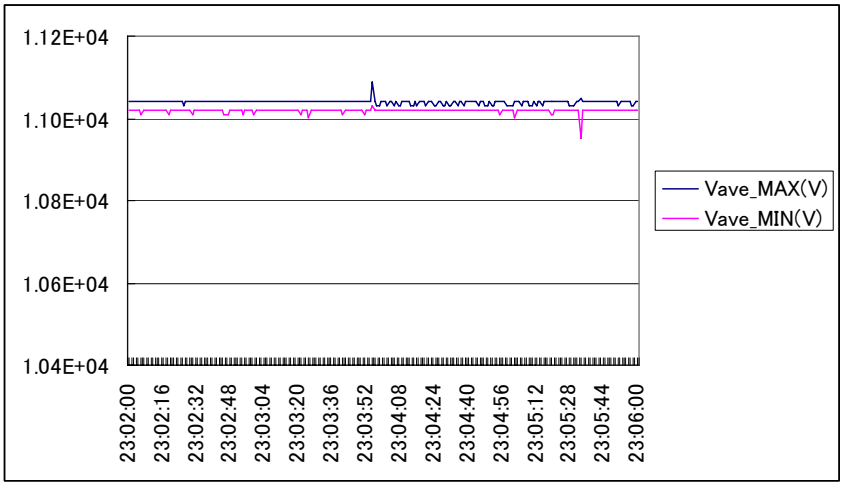


Voltage fluctuation

- When setting the second diesel power generator in parallel, decline in voltage by about 5% occurs for about 300 ms.



- Range of fluctuation at the time of parallel off of the diesel is around 0.2%.



Since parallel in or parallel off of diesel power generators is performed at around 7:00 in the morning or 23:00 midnight, it has small effect on the solar power generation, which generates power in the daytime. However, since islanding operation detection function (both passive and active mode) may malfunction, it shall be locked. Other protection relays (for overcurrent, overvoltage, frequency deviation, etc.) shall be set according to the settling of diesel power generators.

6.4 Applicable Standards

International standards (such as IEC and ISO) and Japanese standards will apply to the main functions of the equipment while taking into consideration compatibility with TEC's existing equipment.

Scope of application	Standard
Industrial products in general	International Organization for Standardization (ISO)
Electrical products in general	International Electrotechnical Commission (IEC)
Industrial products in general	Japanese Industrial Standards (JIS)
Electrical products in general	Japanese Electrical Standards (JEC)
Electrical products in general	Japan Electrical Manufacturers' Association Standards (JEM)
Electric power equipment design in general	Japanese technical standards for electrical equipment
Electric power equipment design in general	Grid-interconnection Code (JEAC)
Electric wire/cable and materials in general	Japanese Electric Wire & Cable Makers' Association (JCS)
Electrical products in general	Australian Standards (AS), etc.

6.5 Electric Mode and Power Factor

Electric mode is as follows in order to be compatible with the existing equipment.

Item	High-voltage distribution line	Low voltage	DC
Nominal voltage	11 kV	415-240V	110V
Wire connection	3 phases, 3 wires	3 phases, 4 wires	2 wires
Frequency	50 Hz	50 Hz	—
Grounding	Direct grounding	Direct grounding	(-) side grounding

The power factor at the interconnection point is at least 85%, and must not be the leading power factor from the perspective of the grid. According to the Grid-interconnection Code (JEAC9701-2006), this philosophy indicates the possible range whereby a general purpose synchronous electric power generator of standard specifications can function at all times. Because inverters have at least the same reactive power modulation function as conventional synchronous generators, it would probably be a good idea to use their power to contribute to stabilizing the voltage of the existing grid.

6.6 Protection Relay

The protection relays on the side of the solar power system are as follows. Reliable protection of devices (such as is provided by the gate block of an inverter) from fluctuation of frequencies and/or voltages due to variable load (such as is often seen with small capacity grids) is demanded.

Relay protection description	Abbreviation	Accidents, etc., to be protected from	No. of phases
Overcurrent *1	OCR-H	Short on premises	2
Ground fault overcurrent *1	OGCR	Ground fault on premises	1
Overvoltage	OVR	Power generation equipment abnormality	2
Undervoltage	UVR	Power generation equipment abnormality, Grid power loss, Grid short	3
Over frequency	OFR	Grid frequency rise	1
Under frequency	UFR	Grid frequency drop	1
Islanding operation condition *2	-	Islanding operation	Case by case study

*1. Can be omitted if ground leakage breaker with overcurrent element (ELCB w/OC) is provided.

*2. Islanding operation detection function of at least one passive and one active mode respectively is required.

6.7 Power Quality Measures

7.7.1 Voltage Fluctuation

If based on the grid-interconnection code (JEAC), constant voltage fluctuation for a 240V power grid where the load equipment is used must be kept within 240 ± 24V.

Measures should be taken to automatically adjust the power grid voltage by a phase reactive power control function or output control function if voltage in the 415V power grid rises due to current from the solar power station and there is danger of deviating from the proper values.

7.7.2 Instantaneous Voltage Drop

A lot of information equipment such as computers and OA equipment are widely used in Tuvalu, so instantaneous voltage drop should be limited to within 10% of the rated voltage. Self-exciting inverters are recommended. If separately-excited inverters are used, equipment that can control incoming current such as a current-limiting reactor is required.

7.7.3 Higher Harmonics

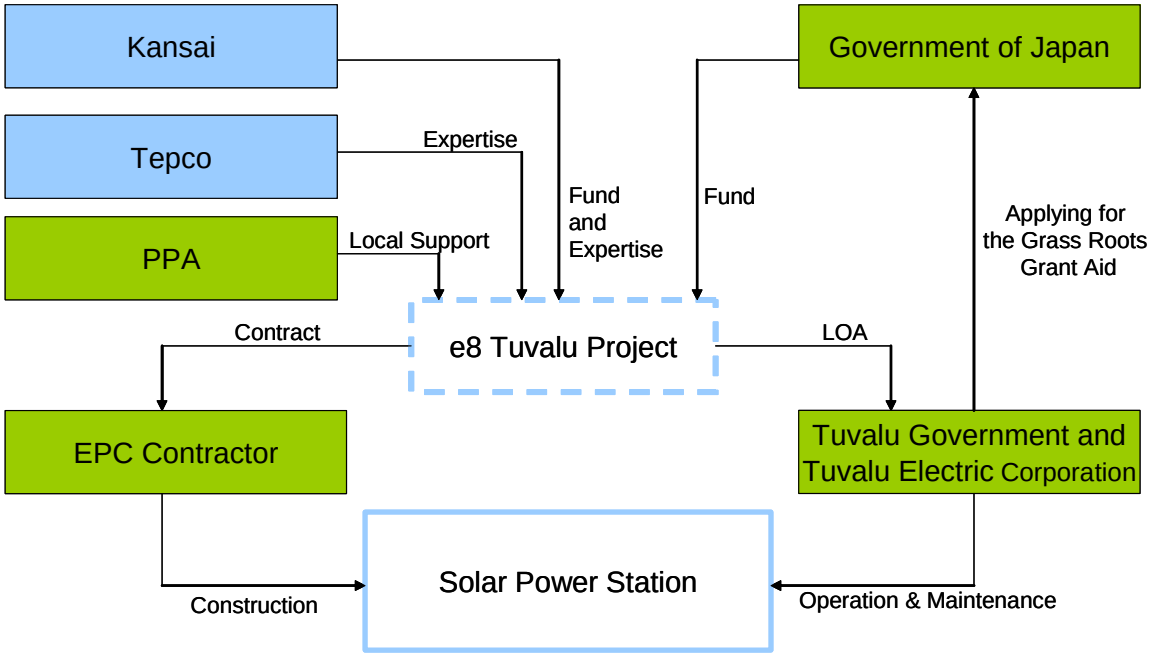
According to Japanese Industrial Standards, (JIS C 61000-3-2: Harmonic current generation limit value), the harmonic outflow current value of the inverter (including filter) should have no more than 5% total current distortion and no more than 3% individual current distortion. At the current point in time, the effect on electrical appliances in Tuvalu is uncertain, but those that comply with Industrial Standards should be used for interconnection.

7. Implementation Plan

7.1 Project Framework

A planned project framework is provided below. The project will be mainly funded by e8 companies. However, there is a possibility that the project may be funded by a grass roots grant aid scheme of the Japanese Government, which is called, “Grant Assistance for Grassroots Human Security Projects” (up to 10 million yen, approximately 83,000 US$). In addition, PPA has been supportive about the project.

The engineering procurement and construction (EPC) contractor will be in charge of construction. After completion of construction work, the TEC will take over the facilities for future operation and maintenance under the letter of agreement (LOA) between e8 and the Tuvalu government/TEC.

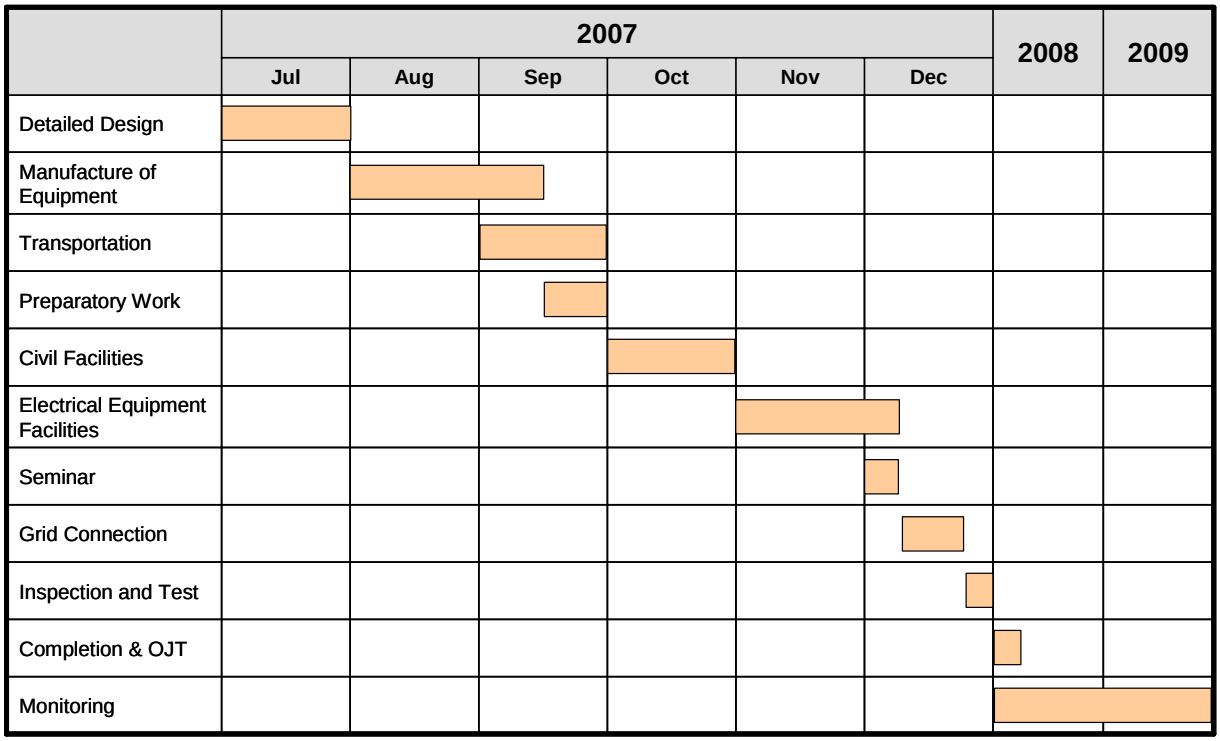


An Example of the Project Framework

7.2 Implementation Schedule

An implementation schedule is provided below.

The implementation of this project takes six months in total. Construction work on the site will be finished in four months including the preparatory work, inspection and testing. A seminar to give local people an opportunity to learn about solar power generation will be held during the final stage of construction work. After completion, on-the-job-training (OJT) will be given to the TEC engineers and technicians so that the solar power system will be operated and maintained properly.



Implementation Schedule

8. Estimated Project Cost

8.1 Construction Cost

The current estimated cost is 412,000 US$. The break down of the cost is provided below.

Item	Specifications	Amount(US$)
1. Equipment and Material		
PV module	**40kW**	**110,000**
Inverter	**14kW x 3 units**	**25,000**
Spec modification		**15,000**
PV fixing base	**Hot dip galvanizing**	**29,000**
Display unit		**10,000**
Cable and pipe		**40,000**
Wood and heat shield		**10,000**
Other equipment		**11,000**
Subtotal		**250,000**
2. Construction		
Preparatory works		**2,000**
PV fixing base setting		**4,000**
PV setting		**2,000**
Pipe work		**4,000**
Inverter setting		**2,000**
Travel expense		**20,000**
Accommodation		**7,000**
Field management		**34,000**
Labor work		**31,000**
Commissioning and test		**20,000**
Subtotal		**126,000**
3. Transportation		
Cargo shipment		**9,000**
Ocean shipping		**27,000**
Subtotal		**36,000**
Total		412,000

8.2 Generation Unit Cost per kWh

In many countries, current solar generation systems are economically inefficient in terms of the generation unit cost per kWh. However, solar generation systems can be competitive on the remote islands of the Pacific region. In this project, the estimated unit cost of solar generation is almost same as the cost of diesel generation as listed below.

Unit Cost of the Solar Generation

Annual Production of Electricity: 55920kWh (Calculation result)

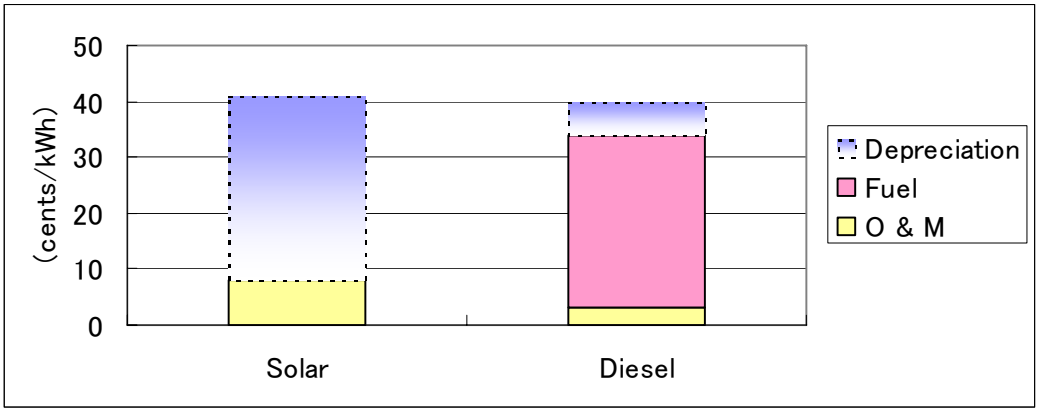
Item	Annual Cost (US$)	Unit Cost per kWh (US$)	Note
Fuel & Lubricating Oil	0	0.00	
Depreciation	18,540	0.33	economic life 20 year, salvage value 10%, straight line method
Operation & Maintenance	4,623	0.08	1% of the original facility cost and 720 person - hour
Total	**23,163**	**0.41**	

Unit Cost of the Diesel Generation

Annual Production of Electricity: 3,700GWh (total demand)

Item	Annual Cost (US$)	Unit Cost per kWh (US$)	Note
Fuel & Lubricating Oil	1,139,304	0.31	fuel 0.26 l/kWh x 1.15 $/l, lubricating oil 0.002 l/kWh x 4.46 $/l
Depreciation	215,220	0.06	economic life 15 year, salvage value 10%, straight line method
Operation & Maintenance	109,062	0.03	fuel 0.26 l/kWh x 1.15 $/l, lubricating oil 0.002 l/kWh x 4.46 $/l
Total	**1,463,586**	**0.40**	

Comparison between solar and diesel in generation unit cost per kWh



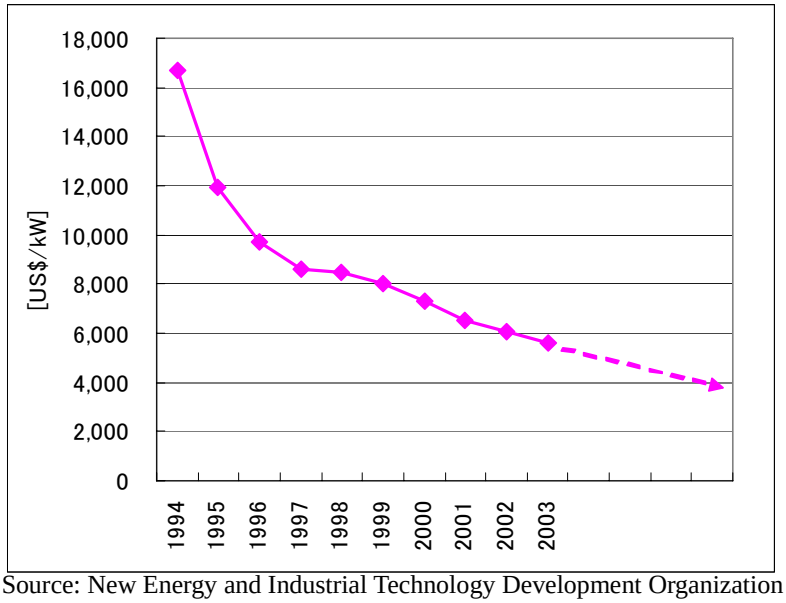
8.3 Future Tariff Scenario

Because solar power generation does not require fuel, the post-construction outlay is extremely low. Consequently, if power output is the same, solar power generation will have a large effect by significantly reducing the cash outlay for the TEC for equipment support as opposed to diesel power generation.

From the standpoint of electricity tariff, on the other hand, there is a need for accumulation of depreciation equivalent for replacing equipment when its service life is up. Because the unit price per kW is approximately the same as that of diesel power generation, for the time being solar power generation cannot be expected to significantly reduce the price of electricity.

Be that as it may, a dramatic reduction in the price of diesel power generators is not anticipated, and while the price of oil is expected to continue to rise if you consider the increase in energy demand from countries such as China and India, the cost of equipment per kW of solar power generation has been more than halved in the 10 years from fiscal 1994 to 2003. Due to a radical increase in demand for solar panels in recent years, there is an insufficient supply of raw silicon. The downslide in price temporarily ceased in 2005, but the earth still contains a generous supply of silicon, and price reduction is expected to continue due to increased production of dedicated raw silicon in the long term, expansion of production scale, reduction of the amount of silicon used and commercialization of new materials. If the tendency for lower cost of solar panels continues, this e8 project will provide the opportunity to replace existing diesel power generators in Tuvalu with solar power generation when their service life is up.

Unit Cost for Solar Power Generation System Construction



Source: New Energy and Industrial Technology Development Organization

9. Risk Assessment and Management Plan

The risks concerning the project and measures to avoid them are as follows.

9.1 Equipment Damage

Salt Damage and High Ambient Humidity:
Rust damage is expected due to high humidity and salt because of the proximity to the sea. Waterproofing such as applying grease will be applied for equipment. Air vents of the inverter will be fitted with a filter to protect corrosion caused by water and salt.

Typhoons and Heavy Rain:
Robust frames and panels will be used. The panels will be positioned to minimize wind-catching surface area and be arranged so as not to create “air holes” or “impasses.”
For heavy rains, the housing of inverters will be provided with sufficient waterproofing.

Lightning:
Because of the coral terrain, it may be impossible to reduce ground resistance sufficiently. A lightning arrester will be installed in the main and control circuits.

Strong Ultraviolet Radiation:
Intense ultraviolet radiation causes the semiconductor crystal of the cells to deteriorate and promotes deterioration of conversion efficiency with age. Therefore solar panels coated with a film to filter ultraviolet radiation will be used.

Mischief:
Solar panels will be positioned in a high place. Therefore they are not at a high risk of damage due to mischief such as throwing rocks.

Tsunami:
Tuvalu has no earthquake. Although some of the neighboring countries such as Tonga and Solomon have earthquake, there is little danger of tsunami.

9.2 Danger to Third Parties

Danger from Electricity such as Electric Shock:
Although the charging parts are not exposed, there is a danger of accidental shock occurring due to damaged wiring or mischief. Panels will be located out of human reach.

Danger of Equipment Collapse or Damage:
The equipment will be located in a sufficient distance from private residences. Therefore, there will be free of risk that equipment damaged or broken apart by lightning or the elements harm local people.

10. Environmental Influence

Solar power generation generally has little impact on the environment; it never has a major environmental impact such as may sometimes be posed by hydroelectric projects. This solar power generation project in particular does not use lead storage batteries, so the biggest risk of causing environmental problems is avoided. Albeit minor, the following environmental impact exists from construction. The following countermeasures are taken to reliably address such issues.

10.1 Impact of Alien Organisms in the Ecosystem

Alien organisms adhering to containers, etc., when parts and materials are imported could possibly have an impact on Tuvalu's fragile ecosystem. Countermeasures such as extermination of harmful insects will be taken when importing parts and materials.

10.2 Disposal of Construction Waste

Tuvalu has no facilities for disposal of waste. Trash that does not decompose spontaneously is kept at the dump on the northern part of Funafuti Island. In order to minimize the amount of waste generated by construction of the project, cases for transporting equipment will be made of wood if possible and the quantity of the material such as the length of the cables required will be accurately estimated in advance to reduce the amount of leftover. The unavoidable waste concrete and empty wooden boxes will be used as materials for building houses in the area.

10.3 Danger of Flood from Drainage of Heavy Rain

Because the panel surface area is large, a large quantity of water may flow into the drainage ditches at times of heavy rainfall. Flooding will be taken into account when engineering drainage.

10.4 Noise and Light

The characteristic noise produced by inverters and light reflecting from the panels may directly strike private residences. The equipment will be located a sufficient distance from private residences or the consent of local inhabitants will be obtained in advance.

11. Positive Impact on the Community

The positive impacts of the project on the community are summarized and devided into short term and long term impacts as below.

11.1 Short-term Social Impact

The project is small in scale, and the short-term reduction of electricity fees is also small. The effect on improving the convenience of electricity that local people can actually perceive in the short term is slight. The amount of CO_2 emitted will be reduced only slightly. About 50 tons per year will be cut, but this will fall far short of preventing the global warming and saving Tuvalu from being submerged under water. Even if certified as a CDM, it cannot be expected to produce even enough carbon credit to cover the CDM application expense.

There are, however, national governments that place great diplomatic importance on Pacific island nations and many organizations that can potentially implement solar power generation projects such as manufacturers and research institutions performing verification tests on solar power generation systems with small scale power grids.

By succeeding, this project can pave the way for similar projects in Tuvalu and neighboring countries. The apparent impact of solar power generation facilities is immeasurable, and will provide the people of Tuvalu, who are in the process of becoming victims of climate change, with the opportunity to consider environmental issues. The project is furthermore expected to send a symbolic message to the world concerning preservation of the global environment.

11.2 Long-term Social Impact

Because Tuvalu is so tiny, the grid is located near the homes of the people, and they have good access to the power. The amount of electricity used by the average citizen is however extremely limited due to the high price of electricity. As is described in “9.3 Future Tariff Scenario,” the project is expected to provide an opportunity to shift from total dependence on diesel power generation to a renewable source of energy, and has the potential to cut the current price of electricity in the long term. If electricity fees are halved, electricity will come to be used by the local people and could improve income, the level of education, average lifespan, as well as promote the social evolution of women.

The effect will not be limited to just Tuvalu. The benefits could be laterally spread to the entire Pacific island nation area through activities of the PPA. Such initiatives by Pacific island nations will create a stir in the way energy is consumed throughout the world, including in advanced countries and emerging economies. It is also expected to help avoid the worst scenario in which Tuvalu would be submerged.

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- METEOTEST, METEONORM Version 5.1 Database
- PPA web site

Attachment 1: Design Condition

Precise Solar Radiation Data

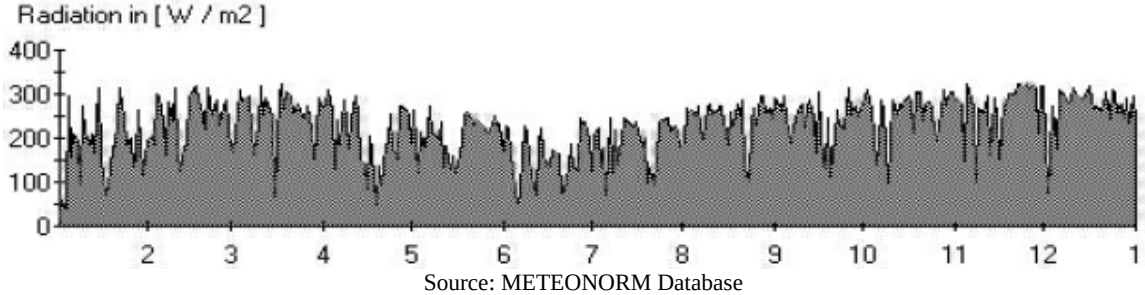
Solar radiation data is as follows. Although the amount of sunlight decreases somewhat during the rainy season in May, June and July, there is not that much variation. Sufficient sunlight for solar power generation can be obtained throughout the year.

Monthly Average of Solar Radiation

Month	Monthry Average of Solar Radiation (KWh/m2/day)
January	5.307
February	5.136
March	5.390
April	5.299
May	4.938
June	4.641
July	4.746
August	5.048
September	5.339
October	5.692
November	5.225
December	5.147

Source: METEONORM Database

Radiation Curve through the year



Source: METEONORM Database

Other Weather Conditions

Other weather conditions are provided below.

Item		Unit	Record (1933-2003)
Temperature			
	Maximum	℃	36.1
	Mean	℃	32.3
	Minimum	℃	28.3
Humidity			
	Maximum	%	99
	Mean	%	79
Rainfall			
	Maximum mean monthly	mm/month	400
	Mean	mm/month	280
Wind velocity			
	Maximum	m/sec	30
	Mean	m/sec	5
Annual days of thunderstorms		days/year	15

Source: Basic Design Study Report on the Project for Upgrading of Electric Power Supply in Funafuti Atoll, Tuvalu (JICA)

Installation Site

The condition of the installation site is as follows.

Ground
The site has extremely high soil bearing capacity and employs a concrete foundation for installation. During the high tide season in February when water gushes forth from the ground, however, the water level may rise up to about 60 cm, so the equipment needs to be installed at least 60 cm high to avoid being submerged.

Item	Unit	Record (1933-2003)
Elevation	m	+1.0
Bearing capacity	tons/m^2	More than 10
Groundwater table	m	-1.0
High tide water	m	Less than +0.6

Source: Basic Design Study Report on the Project for Upgrading of Electric Power Supply in Funafuti Atoll, Tuvalu (JICA)

Salt and Water Damage
Measures to prevent salt and water damage are needed for Tuvalu. No matter where the equipment is located on Fongafale, it is still extremely close to both seashores. Also the impact of high tide must be taken into account. Sufficient attention must be given to measures to prevent salt and water damage and must be reflected in equipment design.

Transportation
As Funafuti has a port and a 6m wide paved road between the port and the site, the preparatory work for the construction in Funafuti will be relatively simple.

Environmental Issues

Solar panels do not produce noise or toxic materials when generating electricity. The area where the sunlight will be blocked by the panels is saline and no crops are being cultivated there. Therefore, the project could be thought of as having no impact on the environment.

However, waste that is not biodegradable is currently dumped on the northern part of Funafuti, and if the panels are installed along with lead storage batteries, there is a danger of them becoming a source of environmental pollution if disposed of on the island without being reprocessed. Kansai and Tepco therefore plan to avoid the use of lead storage batteries in this project.

Attachment 2: The draft of Letter of Agreement

(This draft is prepared to be signed after the project is accepted for implementation.)

Letter of Agreement (LOA)

between the

Government of Tuvalu

and the

Tuvalu Electricity Corporation

and the

e8

for

Co-operation in the implementation of a solar power generation project

in Funafuti, Tuvalu (hereinafter 'the Project')

A. THE PARTIES TO THIS AGREEMENT ARE:

The Government of Tuvalu, as represented by the Secretary, Ministry of Works and Energy, whose office is located at Funafuti, Tuvalu, (hereinafter **"Government"**)

and

The Tuvalu Electricity Corporation, as represented by the General Manager, whose office is located at Funafuti, Tuvalu, (hereinafter **"Corporation"**)

and

The e8, as represented by the chair of the e8 Management Board, whose Secretariat is located at 1155 Metcalfe Street, Suite 1120, Montréal, Québec, Canada, H3B 2V6, (hereinafter "**e8**")

(hereinafter, individually, the **"Party"**, or collectively, the **"Parties"**)

Whereas the Government of Tuvalu:

- Is dedicated to promote sustainable energy development.
- Has expressed its interest in installing renewable energy supply systems in Funafuti to reduce green house gas emissions and fossil fuel consumption.
- In this capacity, welcomed the e8 to cooperate in the implementation of the Project in Funafuti.

Whereas the Tuvalu Electricity Corporation:

- Is dedicated to promote sustainable energy development.
- Has expressed its interest in installing renewable energy supply systems in Funafuti to reduce green house gas emissions and fossil fuel consumption.
- In this capacity, welcomed the e8 to cooperate in the implementation of the Project in Funafuti.

Whereas the e8:

- Is committed to the principles of sustainable energy development and its function is to coordinate non-commercial projects and act as an advisory group on electricity, energy and environmental issues to electric utilities, governments and related organizations.
- Is dedicated to the implementation of energy projects that promote sustainable development.
- Has agreed to implement the Project in Funafuti.

Whereas the Pacific Power Association:

- Is a regional non governmental organization of electricity utilities in the Pacific region;
- Has agreed to support the Project implementation.

Therefore the Parties, in consideration of the foregoing, hereby agree to cooperate on the Project, outlined in the following Terms of Reference, and mobilize resources appropriate to each of the Parties:

- to ensure the success of the Project implementation phases, including construction, O&M, and monitoring.
- to provide positive socio-economic and environmental benefits for the people of Tuvalu in general.
- to execute the Project that will provide valuable information and lessons for the promotion of sustainable energy development using renewable energy sources.
- to maximize the impacts of the Project in terms of efficient energy generation.
- to bear their own costs incurred in the performance of this LOA including, but not limited to, the Project.

The Parties hereby agree to respect and be submitted to the following Terms of Reference.

B. THE TERMS OF REFERENCE

I. Purpose of the Project

1. Context

Following the Renewable Energy Workshop conducted jointly by the e8 (former e7) and the Pacific Power Association (PPA) in 2005, the e8 considered a possible e8 project with the PPA. Upon discussion with the PPA, it was concluded that there is a great need for and significance in a solar power generation project in Tuvalu.

The primary source of power generation in Tuvalu is diesel power generation. Because the small-scale system relies on imported fuel, the electricity price is too expensive for the average citizen. Furthermore, the price of diesel oil has soared in recent years (has doubled from 2004 to 2006). Sustainable energy development therefore cannot be anticipated for Tuvalu with its system that relies upon diesel power generation.

After completion of the feasibility study, it was concluded that the Government, the Corporation and the e8 share a common desire of a trigger to shift from full reliance on diesel generation to a hybrid system with a renewable energy source and hope to cooperate in the development of a solar power generation project in Funafuti, Tuvalu.

As a pilot model for a grid-connected solar power system, regardless of its size, this Project could facilitate sustainable energy development in the Pacific region. In addition, the renewable energy utilization project can be expected to send a symbolic message to the world for a country that could become an unwitting victim of global warming.

2. Scope of the Project

The e8, with support of the Government and Corporation, will develop and finance a grid-connected solar power generation facilities in Funafuti with the principles of sustainable energy development. The Corporation, with supervision by the Government, will take full responsibility for operation and maintenance of the facilities when they are transferred by the e8.

II. Nature of this LOA

The Parties agree and acknowledge that this LOA constitutes a legally binding contract and give rise to enforceable rights or benefits on each Party.

III. Conditions for Cooperation

Specific activities under this LOA must be mutually agreed to by the Parties, documented and defined as below.

Therefore, the Parties specifically agree that the works for the Project shall include the activities mentioned hereafter.

1. Undertakings by the Government

In order to facilitate a smooth and efficient conduct of all Project activities, the Government, at its expense (if any mainly in the form of in-kind) shall take necessary measures for the following:

1.1 to provide all authorizations related to the exemption from customs duties and consumer tax and royalties for all items procured for direct input to the Project;

1.2 to pay or reimburse, to the external financing agency, all custom duties, consumer tax and royalties if items procured as direct inputs to the Project are not exempted at the source;

1.3 to provide all authorizations for exemption of payment of Tuvalu income tax by expatriate employees of the external financing agency;

1.4 to assist in obtaining the necessary approval, permits, and concessions required for the Project such as issuing work visa;

1.5 to provide any land needed for the construction of the solar power generation facilities;

1.6 to assist in building consensus with local residents in the areas surrounding the Project site;

1.7 to facilitate cooperation from local residents and other authorities, and coordinate the use of any necessary land for the facility yards and disposal areas;

1.8 to take care of the disposal wastes as necessary;

1.9 to coordinate for provision of local workers, to be hired and paid by the e8 to provide on-site coordination with the contractor and other concerned agencies based on Government pay rates;

1.10 to provide direction to the contractor for provision of proper sanitation facilities to the workforce employed at the Project site;

1.11 to facilitate all necessary arrangements with the Ministries and Agencies as well as all stakeholders concerned to obtain the necessary concessions and permits, as necessary, to build and operate the Project;

1.12 to provide the machines and facilities for construction as necessary if e8 pays for the use.

2. Undertakings by the Corporation and Energy Department

In order to facilitate a smooth and efficient conduct of all Project activities, the Corporation, at its expense (if any mainly in the form of in-kind) shall take necessary measures for the following:

2.1 to provide all necessary institutional, legal, economical, environmental, socio-economic, financial, fiscal, and technical data for the implementation of the Project;

2.2 to provide a well-skilled key person of the Corporation for on-site training for the period of construction;

2.3 to assume the full responsibility for operation and maintenance for the long-term sustainability of the solar power generation facilities, in accordance with national standards, on and after the date when the e8 sends a notice of completion of construction and commissioning, and for the duration of the lifetime of the facilities;

2.4 to make sure that the solar power generation facilities should not be removed for at least five (5) years after the date when the e8 sends a notice of completion of construction and commissioning;

2.5 to assume the responsibility for the monitoring of the solar power generation facilities after commissioning and provide any information that e8 or PPA requests and will help the e8 gain experience from, and evaluate the effects of, such projects. This information will include electricity production and consumption, tariff collection, and operation and maintenance information, environmental and social impact and other relevant information;

2.6 to assume all liability for the solar power generation facilities such as replacement of inverters on and after the date when the e8 sends a notice of completion of construction, and for the duration of the lifetime of the system;

2.7 to restore to their original state the temporary facility yards after completion of the Project works.

In accordance with the provision of **III. Conditions for Cooperation,** Government and Corporation shall jointly and severally bear any liabilities and obligations.

3. Undertakings by the e8

For the implementation of all Project tasks, the e8 shall take the following measures at its own expense:

3.1 to provide and oversee the design, procurement and construction of the solar power generation facilities;

3.2 to decide the specifications and capacity of the solar power generation facilities;

3.3 to provide technical assistance, training and capacity building for the operation and maintenance of the solar power generation facilities on and before the date when the e8 sends a notice of completion of construction;

3.4 to transfer all of the solar power generation facilities on an "AS IS" basis to the Corporation after they are constructed;

3.5 to offer warranty for one year after the date when the e8 sends a notice of completion of construction on the condition that the solar power generation facilities be kept as they are during the period of warranty.

IV. Transfer of Title and Risk of Loss

Title and risk of loss shall pass from the e8 to the Government once construction and transfer have been completed.

V. Main Representatives

The main representatives responsible for the implementation of the Project are:

for the Ministry of Works and Energy:	for the Tuvalu Electricity Corporation:	for the e8:
Ms. Misalaima Nelesone Secretary Ministry of Works and Energy Private Mail Bag Funafuti, TUVALU Tel: +688 20060 Fax: +688 20207 mailto : fataoto@yahoo.com	Mr. Mafalu Lotolua General Manager Tuvalu Electricity Corporation P. O. Box 32, Vaiaku Funafuti, TUVALU Tel: +688 20352 Fax: +688 20351 mailto : Mlotolua@yahoo.com.au	Mr. Makoto Suto General Manager International Network The Kansai Electric Power Co., Inc. (e8 member) 3-6-16 Nakanoshima, Kita-Ku, 530-8270, OSAKA, JAPAN Tel: +81 (6) 6441-8821 Fax: +81 (6) 6441-4277 mailto:suto@kepco.co.jp

The name and contact information of the main representatives may be changed by informing the other Parties beforehand.

VI. Quality Assurance and Satisfaction

Undertakings by any Party shall be executed and completed in a reasonable manner that is acceptable and satisfactory to all Parties.

VII. Force Majeure

Each Party hereto shall use all due diligence to perform its obligations under this LOA. Conditions may arise which prevent or delay performance by one of the Parties because of causes beyond said Party's reasonable control, including, without limiting the generality of the foregoing, failure of facilities, flood, earthquake, storm, lightning, fire, explosion, epidemic, war, riot, civil disturbance, labor trouble, sabotage, and restraint by court (hereinafter "Force Majeure"), which by exercise of due diligence and foresight neither Party could be expected to avoid. If the affected Party is rendered unable to fulfill any obligations by reason of such causes, it shall immediately notify the non-affected Parties of this Force Majeure and be excused from performing to the extent it is prevented or delayed from doing so and shall not be liable for injury, damage, or loss resulting from such inability. Provided however that the affected Party shall exercise due diligence to correct such inability with all reasonable means and shall resume any obligations after Force Majeure has been resolved. However, settlement of labor work conditions shall be wholly within the discretion of the Party having difficulty.

VIII. Liability

The Parties to this agreement shall be liable for any direct losses or damages related to the other Parties, or any other person or relevant organizations, arising out of or in connection with their respective services rendered and activities undertaken within the Project. A Party to this LOA shall not make any claim against the other Parties for any liability it has incurred as a result of any damages sustained by third parties from any cause whatsoever.
For the avoidance of doubt no Party shall be liable to the other for any indirect, consequential, punitive or any other damages other than actual direct and foreseeable costs, losses and damages incurred by such Party as a result of a breach of this LOA.
Provided however that the Government and Corporation shall jointly and severally indemnify and hold harmless the e8 from any claims, costs, liabilities, obligations, and damages they incur (including, without limitation, for the fee of repair of and the damage to a third party by the malfunctioned solar power generation facilities) after the construction, commissioning and transfer have been completed.

IX. Applicable Law

This LOA shall be governed by and construed in accordance with the laws of Japan.

X. Consultation and Settlement of Disputes

The Parties shall consult with each other with respect to any matter that may arise from or in connection with Project tasks. Any dispute will be settled based on mutual and amicable agreement. If no such mutual and amicable agreement is attainable, the matter shall be referred to, and settled in the court of Japan.

XI. Withdrawal and Modification

Any Party can withdraw from this LOA without any liabilities and costs by providing written notice to the other Parties at least sixty (60) days without prejudice. For the purpose of clarification, any Party who withdraws from this LOA pursuant to this Article shall be liable for any costs and liabilities incurred by the Project before such withdrawal and shall not be liable after such withdrawal. The Parties agree that the terms of this LOA may be modified upon mutual agreement. Each such modification shall be contained in an addendum, which shall form an integral part of this LOA. Any variation or modification shall only be valid if produced in writing and signed by the Parties hereto.

XII. Financial Commitments

Each Party shall provide financial and/or in-kind support in accordance with this LOA for the implementation and execution of its respective tasks. Any

additional or external financial and/or in-kind support for the Project shall be approved by all Parties.

XIII. Working Language

The working language of the Project is English. If translation into English of any language is necessary (verbal or written), each Party will bear its own costs. In event of a difference in meaning, English shall prevail.

XIV. Results and Publications

For the public interest and the mutual benefit of the Parties, the Parties agree to promote and give full credits to each Party's contributions for the Project and all outcomes resulting from the activities under this LOA in any type of communication, written and oral, such as company annual report, conferences, papers or news media.

XV. Intellectual Property Rights

It is understood and agreed that:

- Notwithstanding the foregoing, any intellectual property rights, including copyright, trademark, patent or industrial design rights, resulting solely from joint activities under this LOA shall be jointly owned by the Parties and each of the Parties shall be allowed to use such property for their own purposes with mutual agreement upon prior to use;
- any intellectual property rights contributed by one of the Parties shall remain the property of that Party.

Termination of this LOA for any reason shall not affect the rights and obligations of any Parties under this article.

XVI. Confidentiality

Any document data, plan, design, drawing or information exchanged or received from or between the Parties in connection with this LOA (hereinafter "Information") shall be treated as confidential and shall not be disclosed to any person/body not a Party to this LOA.
With written permissions by the e8, the Government and Corporation can disclose the Information to regional organizations based in the Pacific region.
Notwithstanding the above, a receiving Party may disclose the Information to consultants or advisors who need to know such Information for the purpose of implementation of this LOA and who are legally bound to maintain the confidentiality of the Information.
The confidentiality obligations set forth in this LOA shall terminate 2 years after the termination of this LOA as set out in Article XVII or on the earlier date by mutual written agreement hereto.
The foregoing restriction shall not apply to:

a) information which at the time of disclosure is generally available to the public;
b) information which after disclosure becomes generally available to the public through no fault of the receiving Party;
c) information which the receiving Party can show was in its possession prior to the disclosure and which was not acquired directly or indirectly from the other Party;
d) information which the receiving Party can show was received by it after the time of disclosure from the third party without any obligation of confidentiality and which was not acquired directly or indirectly from the other Party;
e) information which is required to be disclosed pursuant to any applicable law, regulation, judicial or administrative order or decree, or request by the other regulatory organization having authority pursuant to the law.

Notwithstanding the foregoing, the parties hereto shall not request from each other any fee, cost or consideration with regard to the disclosure of Information.

XVII. Effective Date and Term

This LOA shall come into force immediately upon signing by the Government, the Corporation and the e8, and shall continue to be in full force and

effect for a period of five (5) years from the date of signatures of the LOA or on an earlier date by mutual written agreement hereto.

In case any Party breaches or defaults the performance of any of the provisions of this LOA and such breach or default is not cured within sixty (60) days after the breaching Party receives the notification by the non-breaching Party, the non-breaching Party shall have the right to terminate this LOA.

XVIII. Assignment

No Party may assign or otherwise transfer any of its rights or obligations under this LOA without the prior written consent of the other Parties.

XIX. No Partnership

Nothing hereto contained in this LOA shall be construed to create between the Parties partnership, joint venture, agency relationship, or other business entity.

XX. Waiver of Immunity

The Parties hereby agree that, to the extent that it or any of its property may have or hereafter acquire (or may be attributed, whether or not claimed) any right of immunity (including, but not limited to, sovereign immunity) from suit, court, jurisdiction, execution, attachment prior to judgment, attachment in aid of execution of a judgment, set-off or other legal process, it hereby irrevocably waives and agrees not to claim, to the fullest extent permitted by law, such right of immunity (other than its immunity from bankruptcy and insolvency laws to which it is otherwise entitled) with respect to (a) its obligations under this LOA, (b) any legal proceedings to enforce such obligations and (c) any legal proceedings to enforce any judgment rendered in any proceedings to enforce such obligations.

Notwithstanding to the contrary herein, any provisions of this LOA shall not be construed that the e8 guarantees some certain level of power production or any other performances for the Government or Corporation.

SIGNATURES

Signed:

Ms. Misalaima Nelesone Secretary Ministry of Works and Energy	Mr. Mafalu Lotolua General Manager Tuvalu Electricity Corporation	Mr. Masao Ikoma Chair of the e8 Management Board Executive Officer of the Kansai Electric Power Company (e8 member)
Place and Date	Place and Date	Place and Date