Project technology and Operation, Procurement

1. Technology

The hybrid solar thermal/fossil fuel power station will be comprised of:

(i) Solar collector field (solar trough) with a collection area of approximately 220,000 m^2 to support a 35MW_e to 40MW_e solar thermal plant.

(ii) High Temperature Fluid (HTF) system for absorption of the solar heat, including pipe system, HTF-storage, pumps.

(iii) Solar steam generator with capacity of 200 $Mw_{thermal}$.

(iv) Power block based on mature fossil fuel technology, i.e. a gas turbine with a capacity of 70 MW; a waste heat boiler for recovery and superheating of the waste heat and the solar steam; and a steam turbine of 70 MW including a condensor and a fresh water system.

(v) Thermal heat storage device

(vi) Cooling Tower (wet or dry).

(vii) Control system to monitor and control plant operations, and control building.

(viii) Fuel handling and storage system.

(ix) Water carriage system for raw water supply.

(x) Data acquisition and storage system for monitoring and assessing the performance of the solar field and the integration with the fossil fuel power block.

(xi) Ancillary facilities and plant services such as fire protection, grid interconnection system, emergency electricity system, water supply and treatment systems, water reservoir, etc.

The choice of the fossil fuel power block will be left open in the bidding documents. Other details of the configuration which are still not decided or are subject to the bidding process would be the following:

- wet or dry cooling
- thermal energy storage (slabs or molten salt)
- specification of the gas turbine; there is a chance that (a) one larger or two smaller turbines may be installed, (b) the turbine capacity might vary slightly from 70 MW.

As the Mathania plant will be the first of its kind, there are bound to be technical risks in construction and operation. These will be mitigated by the implementation consultant and the private operator.

2. Operation

The plant shall be operated as a base-load plant, i.e. the plant load factor may vary between 69% and 80% and above, depending on the mode of operation. The following options are being considered:

(i) CC-plant operation without additional firing, PLF around 69%. The solar share will be 8.1%.

(ii) CC-plant operation without additional firing, solar thermal storage of 300 MWh capacity, PLF around 80%. The solar share will be 8.1% but with lower levelised unit cost.

The plant will initially be operated by a private operator for five years, who will be part of the EPC-consortium responsible for erecting the plant. The private operator will be paid on a performance basis which will include, inter alia, the electricity generated, the solar share, the efficiency of the plant and the availability. After expiry of the operation contract, the owner will have a number of options for future operation: continuation with the same operator, selection of a new private operator, or a takeover of operations by the owner. The choice will be made well in advance of expiry of the initial operating contract in order to allow for a smooth transfer of plant operation.

3. Procurement

The project will be tendered internationally as an engineering, procurement and construction (EPC) contract, part of which will also include a five-year contract for operation of the plant. Neither the raw water carriage system from the source nor the spur pipeline for the supply of LNG will be included in the EPC contract. The EPC/O&M contract will be awarded based on open competitive bidding. The water carriage system will be tendered locally; the construction of the spur pipeline will be conducted by the LNG supplier under the Gas Supply Agreement.

The tender documents for the EPC/O&M contract are being prepared by an international consultant selected by international competitive bidding.

Project Costs by Procurement Arrangements

(in USD million equivalent)

Expenditure Category	Procurement Method				Total Cost (including contingencies)
	ICB	NCB	Other	N.B.F	
1. Works					
EPC contract	X				190.0 (45)
Township		X		X	2.1
2. Goods					
3. Services					
Implementation Consultant	X			X	2.86
Replication Activities (incl. Consultancies)	X				4.00 (4.0)
Project preparation studies (PDF)		X			0.75 (0.75)
4. Miscellaneous					
Total					

Notes:
- N.B.F. = Not Bank-financed
- Figures in parenthesis are the amounts to be financed by the GEF grant
- Township: separate contract, subject to local competitive bidding

4. Definition of Indicators for project objective

The justification for the indicators measuring the achievement of the project objective are as follows:

1. With a solar field of 219,090 m^2 and a long-term average solar irradiation of 2,285 kwh/m^2/a, the achievable energy generation attributable to the solar field is 65 Gwh/a if no additional firing is applied. If this energy was targeted, the calculated net efficiency of the solar field would be 13%.
2. The availability of the solar field inclusive of the steam generator is targeted at 97% during usable solar irradiation, i.e. at least 200 watt/m^2. Such an availability factor is regularly achieved or surpassed in existing solar trough plants in California. Repairs normally affect only one element of the solar troughs; the rest remains fully functional. Maintenance and cleaning can take place during non-solar hours on a daily basis. The solar steam generator is a simple construction and will be extremely reliable.
3. Availability of 86% for the combined cycle (CC) is a rather common figure. It will be achieved if the entire plant runs at a plant load factor of 80% as the solar field contributes steam only during the day (or for a few additional hours if a heat storage device is applied).
4. The heat efficiency of the CC is calculated on the basis of a night-time net-efficiency of 45.5%, converted into 8040 kj/kwh. This is a conservative net-efficiency estimate for a CC.
5. The total energy (about 815 Gwh/a) is calculated for a gas turbine of 65 MW gross output (6FA) which is operated 7500h/a. No additional firing is applied; the solar field contributes 207 Gwh_{th}/a. As these technical data may be modified as a result of the tender, the indicator will be specified only after award of contract.