

# Solar Powered Cold Storage

## Solution of Cold Chain

DRE/Tech/01/Jan-23

Rev -0

### 1. Introduction

The solar cold storage enables effective use of solar energy for cooling of fruits /vegetables /other perishable items so as to store and preserve them for a longer duration. Today solar cold storage is treated as a most versatile product in cold chain industries.



This product is changing the cold chain infrastructure landscape in most effective manner. This product is targeted poorly electrified area or place using diesel as power sources.

### 2. Technology

The cold storage unit in off-grid operation, primarily runs on power generated from Solar Photovoltaic and can be switched to grid during cloudy days. During sunshine hours the electricity generated from solar photovoltaic is used to provide cooling through a vapor compression refrigeration cycle to cool a cold room and store the excess energy in Thermal Energy Storage (TES) System.

In Thermal Energy Storage (TES) system the energy is stored in

phase change material such as water or water salt eutectic mixture and transferred to the cold storage unit depending on the usage needs.

During non-solar hours, the cooling needs of cold storage unit are met from the thermal energy storage system. Use of solar photovoltaic and thermal energy storage backup eliminates dependency on grid and need of diesel generator as a backup device.



### 3. Technical Specification

#### 3.1 Major Components

The system comprised mainly of the following components and equipment:

1. Cold Room,
2. Solar PV System,
3. Solar Controller,
4. Refrigeration System,
5. Thermal Energy Storage (TES) System,
6. Maintenance free Battery for meeting Auxiliary Load.



Combination of all these components is unique. Any change in combination will be treated as different model of Solar Cold Storage System.

### 3.2 Block of the complete system



1. Solar Panel
2. Cold Room
3. Condensing unit (including compressor)
4. Evaporating System
5. Thermal Storage System

### 3.3 Cold Room

The cold room is a PUF insulated room that maintains desired temperature and humidity for storage of commodities. The cold room is equipped with refrigeration unit which provides necessary cooling by circulating cold air to the commodities for preservation.

### 3.4 Solar Photovoltaic System

The SPV system generates electrical powers during sunshine hours which are used to operate the cold storage system. It provided electricity for running refrigeration system and auxiliary load.

The SPV system shall have following specifications:

- Crystalline silicon cell PV modules of 330 Wp or higher capacity.
- The PV module has IEC 61215 qualification certification for solar PV modules.

- The PV module conforms to IEC 61730 Part-1 requirements for construction & Part-2 requirements for testing for safety qualification.
- The PV modules qualifies relevant IEC standard.
- The PV modules used in solar power plants/ systems are warranted for their output.
- peak watt capacity, which is not less than 90% at the end of 10 years and 80% at the end of 25 years.
- All PV modules should have STC testing certificate from an NABL accredited test laboratory



### 3.5 Solar Controller

The controller converts the DC power (DC voltage & Current) of the PV array into a controlled high or low DC voltage power, or converts this DC power into single-phase or three-phase alternating-current power (voltage or alternating current) suitably for driving the refrigeration system.

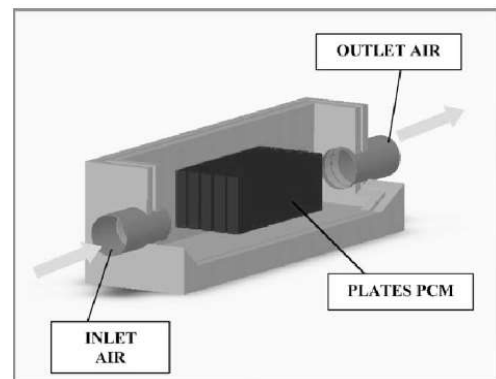
NOTE —The Controller may also include equipment for MPPT, monitoring, metering and sine wave filters.

### 3.6 Refrigeration System

Refrigeration system consisting of condensing unit and evaporating unit is working on vapor compression cycle. The condensing unit generates cooling energy which can be used for charging the thermal energy storage system and to provide cooling to the cold storage depending upon the design of Solar Cold Storage system.

### 3.7 Thermal Energy Storage (TES) System

In Thermal Energy Storage (TES) system the energy is stored in phase change material such as water or water salt eutectic mixture and transferred to the cold storage unit depending on the usage needs. During non-solar hours, the cooling needs of cold storage unit are met through the stored cooling in the Thermal Energy Storage (TES) system.



### 3.8 Electric Battery System for Auxiliary Components

The auxiliary power system consists of MPPT based inverter/MPPT charge controller and battery. These are meant to provide electricity for auxiliary electrical loads such as fans of evaporator unit, thermal energy storage control panel, temperature controller unit, lighting, and data monitoring system.

## 4. Codes and Standards

All equipment shall comply with requirements of the latest revisions of relevant standards of

NEC: National Electric Code

IEC: International Electro Technical Commission

BIS: Bureau of Indian Standards

## 5. Description of the Units

### Constructional

Model	5MT	10 MT
Product Dimension	20'X 8'X8'(LXBXH)	40' X 8'X8'(LXBXH)
Useful Volume	750 cft	1500 cft
Cold Room Insulation	Poly Urethane Foam (PUF), 100mm, 40kg/m <sup>3</sup>	
Cold Room body	Pre-painted Galvanized Iron	
Room Door	100 mm PUF, heavy-duty hinges & lock	
Curtains	PVC to reduce infiltration on door opening	

### Operational data

Model	5MT	10 MT
Refrigeration TR	~2.7 TR approx. @ - 5°C evaporating and 50°C Condensing	~5.4 TR approx. @ - 5°C evaporating and 50°C Condensing
Storage capacity	5 MT depending upon the commodity	10 MT depending upon the commodity
Temperature Range	2°C - 10°C or 10°C -20°C using set point control	
Humidity Range	80%-95% by using set point-controlled humidifier	
Backup type	Wall Mounted Plate Type Thermal Energy Storage	
Backup Duration	24 Hrs. (With Solar Only operation @ 5.5kWh/m <sup>2</sup> /day)	

Model	5MT	10 MT
Pre-Cooling Minimum Pre-cooling capacity only with thermal back-up	500 kg within 6 hours	1000 kg within 6 hours
Remote monitoring	GPRS based, Viewable on Desktop and Smart phone	

### Power Sources

Model	5MT	10 MT
Auxiliary Battery (Maintenance free)	24 V, 240 Ah	
Solar Power Capacity	5 kWp Minimum	10 kWp minimum
Alternative power	1-Ph or 3-ph Grid Supply/ Diesel Generator	

## 6. Estimated Cost

Model	5MT	10 MT
Indicative Cost*	₹ 16,00,000.00 to ₹ 17,00,000.00	₹ 27,00,000.00 to ₹ 30,00,000.00
Generator Synchronized model also available on extra cost		

\*Excluding GST and transportation

## 7. Schedule of Work

Sl. No.	ITEM	QTY.	PRICE
1	<b>Refrigeration System Including:</b> <ul style="list-style-type: none"> <li>• ~ 2.7 TR /~ 5.4 TR @ - 5 °C mean Evaporating and 50 °C mean Condensing Temperature</li> <li>• Condensing unit</li> <li>• Expansion valve</li> <li>• Vertical air distribution system</li> <li>• Refrigerant</li> </ul>	01	

Sl. No.	ITEM	QTY.	PRICE
2	<b>Power System and Control System Including:</b> <ul style="list-style-type: none"> <li>• 5 kWp /10 kWp Solar PV Polycrystalline modules</li> <li>• Panel Mounting</li> <li>• Drive Control</li> <li>• Power Convertors</li> <li>• Auxiliary Battery- 24 V 240 Ah</li> </ul>	01	
3	<b>Thermal storage:</b> <ul style="list-style-type: none"> <li>• Should be able to provide back-up of 24 to 30 hours with no door opening @ 5.5 kWh/m2/day Solar Irradiation</li> </ul>	01	
4	<b>Insulated Room Including:</b> <ul style="list-style-type: none"> <li>• PPGI lined sheets on the outside</li> <li>• PUF panels of minimum 100 mm thickness on the inside</li> <li>• Heavy duty door, hinges and lock</li> </ul>	01	
5	<b>Temperature Set Point Selection</b> <ul style="list-style-type: none"> <li>• Mobile App based crop selection set via Bluetooth or Internet</li> </ul> <b>Remote Monitoring</b> <ul style="list-style-type: none"> <li>• Per minute logging GPRS based with viewable front end in computer and smart phone</li> </ul>	01	
6	Transportation and Insurance	01	
7	Installation, Testing & Commissioning	01	
<b>Total (excluding GST)</b>			

## West Bengal Renewable Energy Development Agency

(An organization of Department of NRES, Government of West Bengal)

Plot No J-1/10, Bikalpa Shakti Bhavan, EP & GP Block, Sector-V,  
Salt lake, Kolkata 700091

Tel: 033-23575037 / 5038 / 5348

Email: [wbreda1993@gmail.com](mailto:wbreda1993@gmail.com) website: [www.wbreda.org](http://www.wbreda.org)

