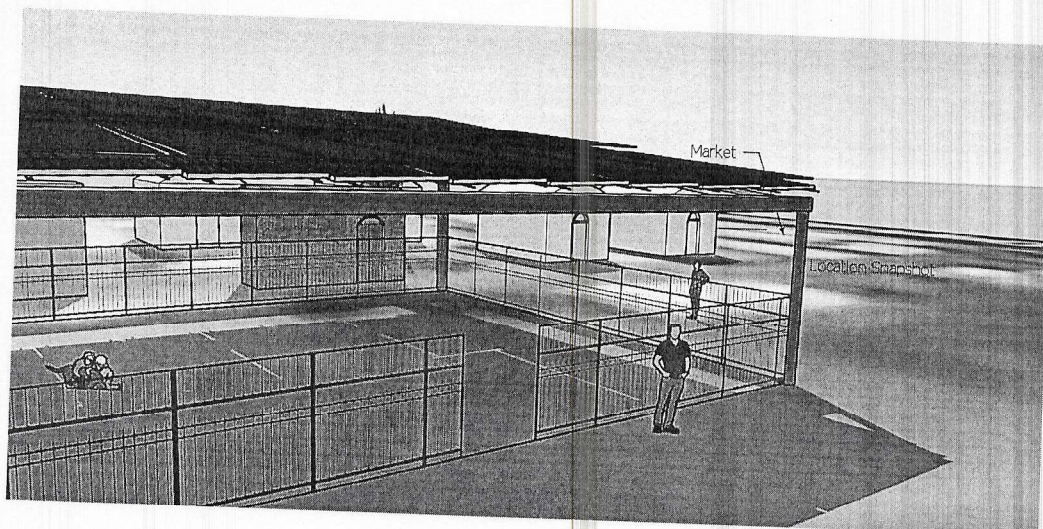


5.5.3 cables and junction boxes Design requirements

Requirement	Item
DC cables requirements	Conductor: Soft annealed tin-coated flexible stranded copper per ASTM B-33 and EN 60228, TUV certified.
	Insulation: Halogen-free, thermoset polyolefin specifically designed for maximum flexibility, and Jacket, low smoke non-halogenated, flame retardant, oil, abrasion, chemical and sunlight resistant cross-linked compound meeting UL 44, UL 854.
	All DC cables should be sized for maximum 1% voltage drop at rated power.
DC junction box requirements	Metal ,67 IP rating, with suitable protection (string fuses, SPD, main dc breaker, over and under voltage protection), Internal connection should be through bus bars.
	Solar VFD junction box diminution should be suitable to hold the inverter and all needed protection and should be fitted with filters and fans if needed.
AC cables requirements	AC Cabling Stranded type, TUV certified, double insulation material 1kV PVC insulated cables with copper conductor.
	All cables and wires should be correctly sized and marked properly according to approved design so that cable can be easily traced and identified.
	All AC cables should be sized for maximum 2% voltage drop at rated power.
AC Main Distribution Board requirements	should be installed and connected the deep freezers room and the other designated locations. The description of the distribution panel is: Metal Enclosure (galvanized steel sheets), Indoor, Internal connection should be through bus bars. use high quality breakers. Fix on Rail Enclosure. Protection Degree IP 55, Adjustable DIN-rails complete with earth bar.
Conduits and cable tray	All cables should be installed through suitable conduits and cable trays, or buried under ground no Arial cables allowed
	Cable trays perforated type Galvanized steel cable trays, cable tray covers, clamping bolts and other cable tray accessories such as coupler plates, bends, tees, reducers, vertical elbows in manufactured accordance with ASTM A653 SS, Grade 33, coating designation G90.

5.5.2 PV array Design requirements

Design requirements for PV array		
Requirement	Item	Reference
PV array mounting requirements	Roof mounted: Overall structure is based on 16cm steel beams, 8mm sheet flanges, 2 inches' heavy duty angel. Based on reinforced concrete great beam(4 bolts size 36 to install steel beams on reinforced concrete)	A protected area under the solar PV generator, will be created through a fence who will delimitate the space under the PV mounting structure (pergola). This space, will be prepared, and used as training center and/or show room.so: A steel fence should cover around the area with height of 2.5 m according to children's safety policies. The fence should be made of meshed wire as used in the poultry houses with thickness of 5 mm, fixed on iron props with thickness of 2 inch and 3 meters' distance between each one and another.
	Easy to handle and install.	
	PV panels mounting structure should be fitted to the proper angle determined by initial design.	
	Steel structure should be mounted with the height of 3m from the ground surface (at the lowest side),as in the warehouse steel structure	
	*The steel structure should be a shelter according to the bill of quantity.	
	The materials should be anti-corrosive against harsh environment.	
	Withstand minimum wind speeds of 140 km/Hr.	
PV module requirements	half-cut, monocrystalline, grade A solar panel. (from one of top 10 manufactures).	Minimum 550W or higher
	Working temperature -20c to +80c	Common in local market in cases of replacement or addition
	efficiency should not be less than 21 % under STC.	The PV module warranty should be at least 20 years.
System requirements	Minimum PV array oversize factor	Not less than 30%
	Minimum reacquired days of autonomy	Not less than 1 day
PV array efficiency	Efficiency loss from shading	Not more than 5%
	Efficiency loss from soiling	Not more than 3%



5.5. Design requirements for one MSP solution:

The technical solution chosen for this project is a Micro-grid solar system, so a PV generator with a LV mini-grid supplying electricity to the various production units.

- the flour mill motor is to be powered by a solar motor drive (table 3)
- all other IGAs is to be powered by one hybrid pro (work directly from panels) string PV inverter (table 4)

Tables below describes minimum requirements for each system

5.5.1 Solar VSD system

Design requirements for flour mill motor	
Facility type	Flour mill (15HP) motor
Energy requirements	Value/description
Daily energy requirements	81.408KW/day
Average power draw	11.2 KW-AC power at 400V, 21.2A, 50HZ at 0.8 PF
Battery bank	Not applicable
System design specification	
Load type	AC load
System configuration	Solar VSD inverter system
	high efficiency, high reliability, grade A, MPPT based, 5 years warranty. recommended INVT or equivalent.
System Voltage	Output voltage: 0 – 450 V

Table (3) Design requirements for flour mill motor

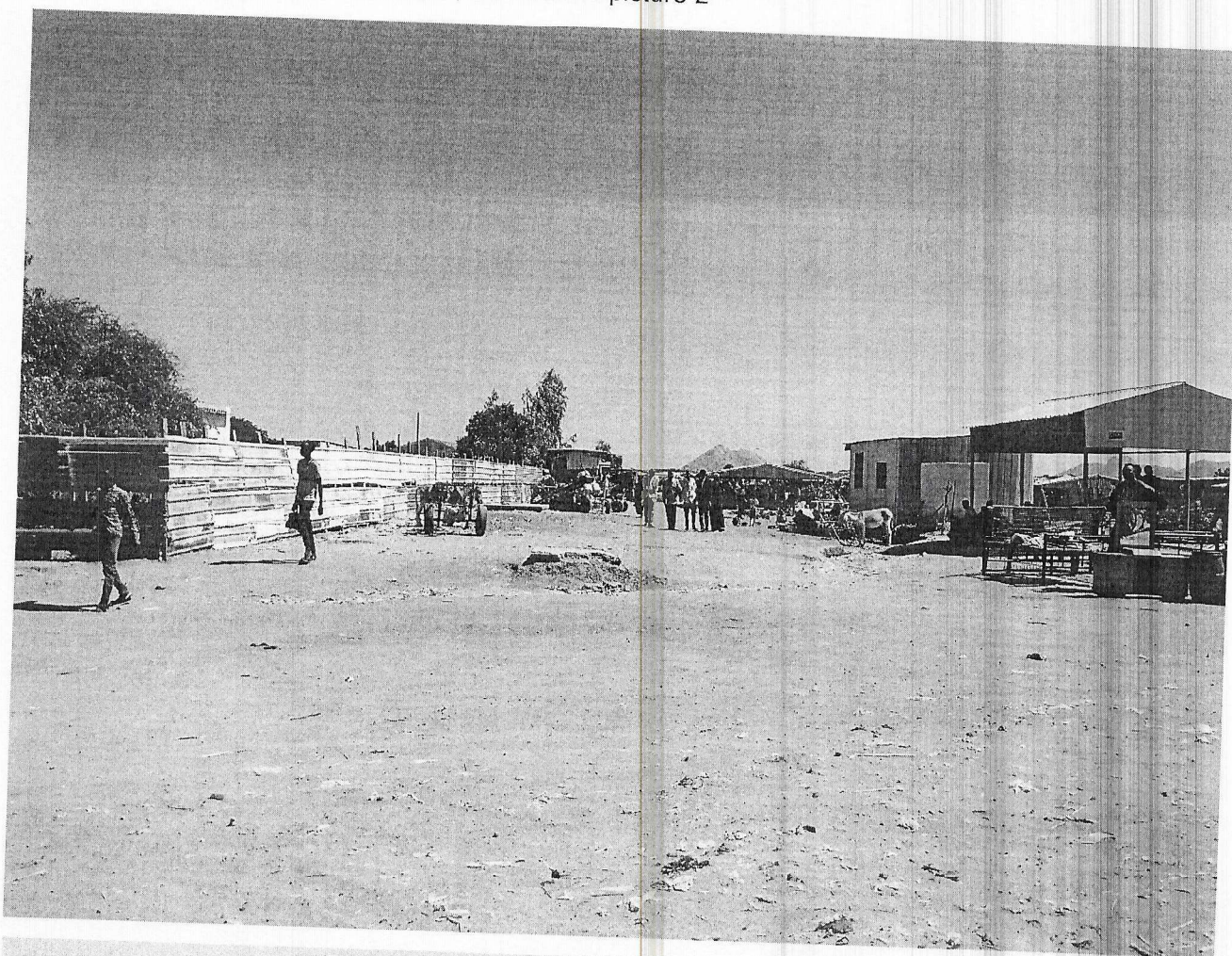
5.3.2 hybrid pro inverter system

Design requirements for IGAs	
Facility type	Other IGAs (shops-lighting)
Energy requirements	Value/description
Daily energy requirements	50KW/day
Average power draw	5KW, battery bank not included
Battery bank	Enough for 1 days of autonomy
System design specification	
Load type	AC load
System configuration	hybrid pro all in one PV string inverter
	high efficiency (95=<)), high reliability MPPT based, pure sine wave, able to work directly from solar panels, LCD display. 200% maximum surge rating or higher.-Integrated Ac Output Overload protection-Integrated Overheating protection-low battery voltage shutdown-Integrated PV string input reverse polarity protection-Integrated surge protection, IP 54 or higher.5 years warranty.
System Voltage	48V system
Battery bank	Deep cycle, grade A, (LI.FE.BO4), 51v, 5 years' warranty. (85% or higher depth of discharge). batteries to be from the same maker of inverter. Battery should be installed according to manufacturer recommendation regarding humidity protection, cooling methods, space needed etc.

Table (4) Design requirements for IGAs

5.4.1.2 ALredais 2 project location

- Regarding Alredais 2, the camp. The selected location for the MSP installation is between camp management office and the camp market with overall area of 520 square meter (15 meter in width and 35 meter in length). Reference picture 2



Picture 2 (MSP location in Alredais 2 camp)

- Both sites are on natural water drainage course so Contractor should take this into regard while designing the infrastructure.

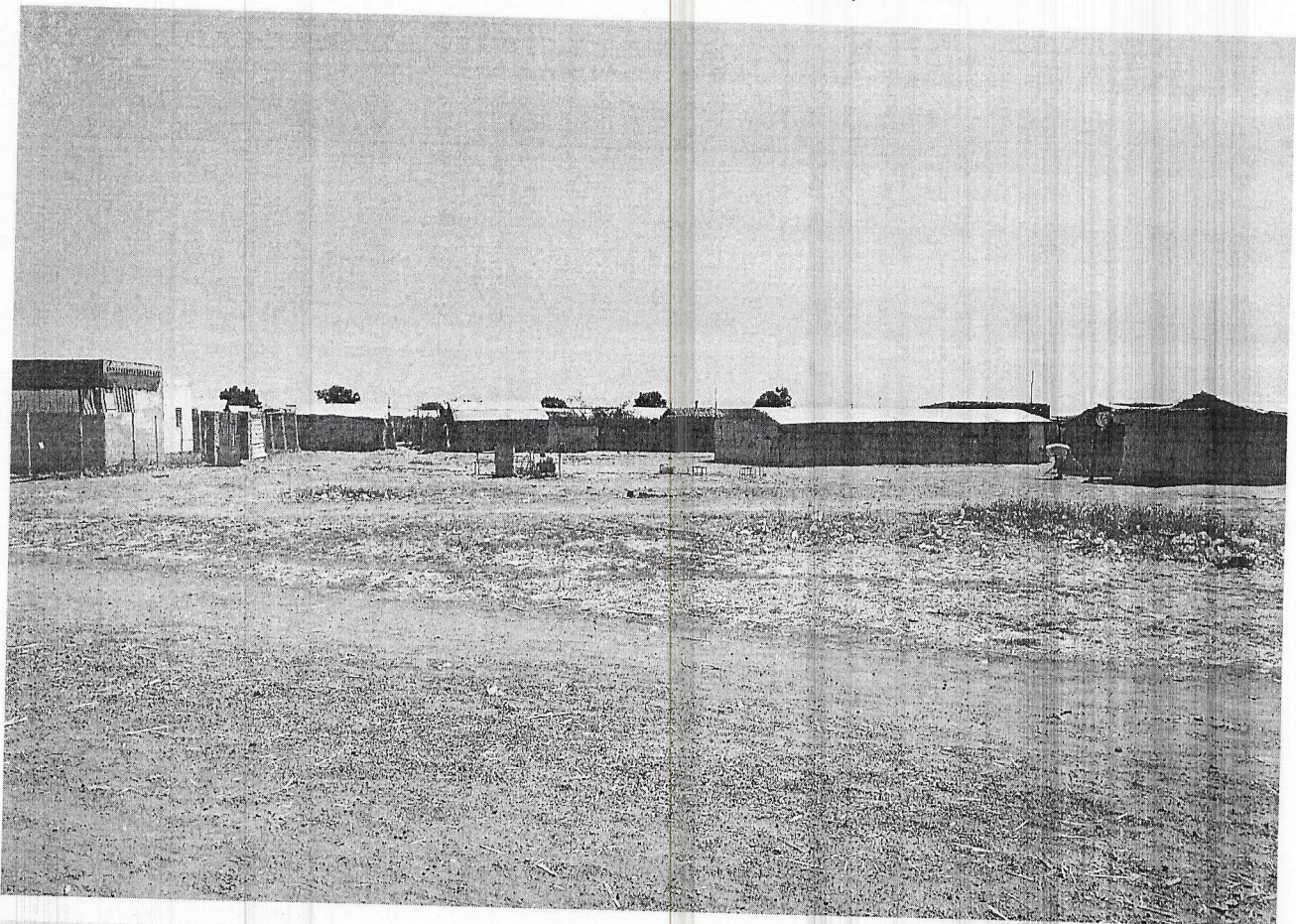
5.4.1 MSP location

The MSP location is already selected in both camps, the overall area must be divided wisely taking into regard that it will have to contain:

- **Solar oven and oven infrastructure:**
 - one room-bakery shop-
 - the oven structure (minimum circular area with 7-meter diameter around 50² meter) free from obstacles and shading)
 - Water supply system (water tank and all accessories and connection)
- **Control room**
- **Flour mill room**
- **The MSP solar panel array and show room/training center**
- **Other IGAs may or may be included in the overall area so contractor should take into regard enough area for (small barber shop, mobile charging table, refrigerator room) if not they will be near by 100-meter maximum.**

5.4.1.1 ALredais 1 project location

- Regarding Alredais 1 camp, the selected location for the MSP installation is in the beginning of the adjacent to camp market and women development center with overall area of 450 square meter (15 meter in width and 30 meter in length). reference picture 1.



Picture 1 (MSP location in Alredais 1 camp)



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The design will consider an installation in an isolated place with few qualified personnel in the mechanical and electrical fields. Resistant material is therefore required, both for the main components and for the mounting accessories, in order to require the lowest possible maintenance and to resist corrosion and long-term degradation.

- Climatic characteristics have to be considered for the sizing of the components.

The equipment designed will be sized to deliver the daily energy indicated for the site under the reference of climatic conditions taking into account days of autonomy, and shading effect.

- The MSP design (including all components) must comply with international electrical safety standards, laws and regulations. The MSP and its components must comply with the most stringent IEC standards for solar photovoltaic system equipment and design.

The task will have to provide a full design with all the necessary documents (narrative, drawings, cables routing, technical specifications, list of materials CAD drawings and a simulation using PVsyst , PVsol etc. for the MSP and civil work) a full installation plan for one single solution for the Multi Solar Platform containing:

- Detailed design for the MSP infrastructure (the mounting structure for the panels serves as a training center) contain dimensions, layouts, material used, panels angle, mounting slope (single to south or double east-west)
- Technical specifications that will be required for all the components (panels, inverters, wiring, batteries, other required electrical components, buildings and other required infrastructure). It will have to consider the proper power and connection of all the systems detailed in the preliminary market and energy demand assessment, and include the most efficient and sustainable solutions. The design will have to include all the necessary detailed information for the procurement and installation of the MSP.

It's strongly recommended for the applicants to visit the site and its surroundings and to obtain by themselves and at his own risk all the information which may be necessary for the preparation of the design; the costs related to these visits are the responsibility of the applicants.

- Take note that there are two (2) sits in each an MSP will be implemented with all infrastructure.
- Take note that the solar panels will serve as roof for the show room-training center, so panels dimensions should be taken into regard as they affect training center area
- Location, altitude and dimensions of the mounting structure is flexible to minimize shading on the solar panels

5.4. Designing of the twin MSP systems

The main purpose is to detail design Photovoltaic system (called Multi-Functional Solar Platform - MSP) and a training centre/show room that will be installed in (ElRedais1) (ElRedais 2) and the host communities.

This Multi Solar Platform will be used to provide a sustainable energy supply for the Revenue and Income Generating Activities that will be developed around them.

The intention is to use the MSP mainly to produce flour through milling grains and. The flour produced will then be used for the production of bread.

In addition, the MSP will be a renewable energy generator for feeding other types of economic activities that may be developed by all community members and, consequently, to strengthen their families' economic security.

the training center-showroom will serve the purposes of demonstration model of Renewable Energy-based RGAs for mentoring and replication, showroom to sell/renting Renewable Energy kits for domestic or productive users. mentoring and replication, showroom to sell/renting Renewable Energy kits for domestic or productive users.

This way, all the community will always have the possibility to buy one solar kit (solar home systems (SHS), lantern, etc.) to run their own business and also the non-productive users can be covered.

The detail design will be based on the information produced from a preliminary study that will provide a market assessment which shall show market opportunities for the Income Generating Activities, as well as an energy demand assessment based on the market findings and the beneficiary's preferences. Initial estimation is of a 20KW power demand.

The system concepts will have to consider the following:

- Power capacity adapted to the demand of:
 - (I) The milling infrastructure.
 - (II) Other Income Generating Activities that will be defined in the previous assessment.

- Design should also consider:

Must be adapted to the location that will have already been selected in order to ensure the security of the infrastructure and its users, and easy access to the market.

- Must design space for:

A training centre and demonstration model of Renewable Energy-based RGAs for mentoring and replication.

Water supply system

Solar oven and bakery room(50² meter for the oven and a 4*4 room)

- The technical specifications will allow the supply and installation of MSP in order to deliver a continuous and reliable service in the locality targeted by the project, and will consider the following basic principles:

(I) reliability of equipment,

(ii) optimization of operating and maintenance

- conditions to take climatic conditions into account.

- transportation, storage, installation and performance period, covering damages, losses, theft, meteorological events, during transportation, storage, installation and O&M period.
- The tenderer participating in the work is required to take out a "Civil Liability Insurance" policy to cover the financial consequences of damage of any kind caused to third parties:
 - a. By its staff working on the site,
 - b. By the equipment used on the site for which they are responsible
 - c. Because of the work it carried out before final acceptance.
 - It is also the responsibility of the tenderer to be insured against the risk of theft, damage from any cause (e.g. transportation/logistic, meteorological events, etc.) whatsoever or misappropriation of materials or prefabricated elements supplied to the site on the site.
 - The tenderer shall dispose of the waste from the works undertaken, including waste and dirt resulting from the works, in accordance with the employer's recommendations for disposal. Sites shall be returned to their original state of cleanliness. If, during installation, there are old batteries that are not working, the tenderer shall, after approval by the owner, remove them and dispose of them through proper recycling channels approved by the employer.
 - The tenderer must carry out a verification test for the platform.
A list of commissioning tests will be proposed by the bidder:
The tenderer, at his own cost, shall immediately repair any malfunction resulting from the test and repeat the test.

5.3.1 grounding and lightning protection

specification system as follow

- Earthing System as per technical specifications including cabling, cable lugs, earthing rods and all required accessories.
 - Each array structure of the PV modules should be grounded properly. And protected against lightning strikes
 - All metal casing/shielding of the system and its components should be thoroughly grounded.
- Earthing pit.**

- The earth resistance should not be more than 5 Ohm.
- Earthing installation in accordance with the IEEE Wiring regulations, BS 7671.
- All conductive materials should be copper.
- The size of conductor should be according to table 54.7 of IEEE # BS 7671 # IEC 60365-5-54.

5.3.2 LV GRID and user's connections

- Low voltage power cable.
- An Ac distribution
- The distribution board should be mounted on a well secured position away from the reach of humans, to prevent from electrical shock or danger (2 meters from the ground)
- Consumers' connections to the load should be supplied according to the individual needs with copper wires with double isolation.
- All the wires should be laid underground in PPR pipes at 50 cm depth and must be well backfilled.
- Power and energy meters must be included in the offer with attention to the meter itself consumption.

1.5 ltr blender	1	500	8:00am-4:00pm	
Water supply				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
0.5HP 1PH water pump	1	180w=<	8:00 am- 4:00 pm	
Bakery shop				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
lights	2	10	8:00am-8:00pm	
Ac socket	2	-----	-----	

Table (2) Electrical equipment and out lets requirement

5.3. GENERAL INSTALLATION SPECIFICATIONS

The installation of materials and equipment must be carried out according to the rules of the trade, in accordance with the standards in force:

- Materials and equipment against possible deterioration due to external causes such as storms (wind, rain), water damage, lightning etc.;
- Against any possible wrong operation by the user or against any unexpected malfunction that could lead to premature and/or irreversible deterioration;
- Users against the risk of electric shock or other accidental hazards, in particular from the battery or the inverter;
- Buildings against any risk of accidental fire due to malfunctions or protection of the installation.

In addition:

The tenderer should indicate the manufacturer's warranty as specified in this document, on the various main components as well as the local or regional representation available for service and support.

- The tenderer must ensure a team of qualified technicians and workers to carry out the required tasks successfully.
- Plan International- Sudan will not allow any replacement of personnel whose qualifications have been reviewed and accepted during the bid evaluation. If replacement of such personnel is unavoidable, their replacement shall be subject to the approval of Plan International- Sudan.
- The tenderer must visit the selected sites to inspect them before installation and prepare an installation plan.
- As soon as the bidder receives the instructions to undertake the work, he must obtain written and signed approval from Plan International- Sudan on all purchased materials (PV modules, inverters, accessories and others) to be used during the installation and must obtain prior approval from the employer on the installation plan.
- The components delivered to the selected site will be taken care of by the tenderer until the final platforms are handed over to the employer. It should be noted that road conditions may be unfavourable and therefore the packaging must protect the equipment from moisture and vibration. In addition, the bidder will be responsible for the components and equipment until the end of the first year of operation and maintenance. This means that the tenderer is responsible for all components during transportation, storage, transport to sites, installation and operation during the first year (performance period). It is required to present an insurance covering the 110% of the value of the materials to be installed for the

Water supply	plastic water tank with capacity 500 liters, 60cm height base for the tank, with loads including: 0.5 HP water pump.	construction + supply and install
General lighting	20 lamps distributed around the MSP location (nearby houses)	supply and install

table (1) Facility type definition

5.2. Loads and outlets for one MSP solution:

Table below describes in details power demand, loads and outlets needed for one MSP in one camp and they are to be replicated on the other camp.

contractor is responsible of designing, supplying and installing, testing of all listed items on sit

Power demand for equipment and out lets				
Facility type				
Flour mill room				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
15HP motor	1	11,200	8:00am-4:00pm	
lights	2	10	10	
Ac socket	2	-----	-----	
Power room				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
Ceiling fan	1	90	24H	
lights	2	10	8	
Ac socket	2	-----	-----	
Barber shop				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
lights	2	10	8:00am-8:00pm	
Ac socket	4	-----	-----	
Shaving machine	4	20	8:00am-6:00pm	
Mobile charging shop				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
lights	2	10	8:00am-8:00pm	
Ac socket	25	-----	-----	
TV club				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
fan	2	90	8:00am-8:00pm	
lights	2	10	8:00am-8:00pm	
Ac socket	2	-----	-----	
TV and receiver	4	=<100	12	
Cold storage room				
Equipment type	No. of units	Rated power(W)	Work hours	Notes
lights	2	10	8:00am-8:00pm	
Ceiling fan	1	90	24H	
Ac socket	2	-----	-----	
Inverter type refrigerator	1	=<200	24H	

5. Project overview and purpose

The main purpose of this assignment is to design supply and install of twin Multi-Functional Solar Platform (MSP) one on each site at (AlRedis 1), (AlRedis 2) refugee camps in White Nile State at Alsalam locality. This 2 Multi Solar Platform will be used to provide a sustainable energy supply for the Revenue and Income Generating Activities that will be developed around them.

In addition, the 2MSP will be a renewable energy generator for feeding other types of economic activities that may be developed by all community members and, consequently, to strengthen their families' economic security. The 2 MSP location will also serve for other purposes:

- as a training center and demonstration model of Renewable Energy-based RGAs for mentoring and replication
- showroom to sell/renting Renewable Energy kits for domestic or productive users.

This way, all the community will always have the possibility to buy one solar kit (solar home systems (SHS), lantern, etc.) to run their own business and also the non-productive users can be covered.

The design should be based on the information produced from previous a preliminary study that provided a market assessment which shows market opportunities for the Income Generating Activities, as well as an energy demand assessment based on the market findings and the beneficiary's preferences.

5.1. facility definition for one location:

Table below lists the different facility types. Regarding MSP activities on each camp, each facility will require a detailed design, some facilities are to be constructed.

Facility type definition		
Name	General description	Notes
Flour mill room	One room contains flour mill, flour mill motor and connections. With loads including general lighting, 15HP motor, one fan one user multi-purpose socket	construction + supply and install
Dedicated area	A protected area under the solar PV generator, will be created through a fence which will delimitate the space under the PV mounting structure (pergola). This space, will be prepared and used as training center and/or show room. No loads included	construction
Power room	One room, contain inverters, distribution and battery bank. With loads including general lighting, one fan and one user multi-purpose socket.	construction + supply and install
Barber shop	Two Barber table and mirror, With loads including general lighting, rechargeable shaving 4 machines and 2 user multi-purpose socket	supply and install
Mobile charging	One table, with loads including 20 mobile phone charging, general lighting	supply and install
TV club	One room contain chairs. with loads including general lighting, 4 TVs and 4 receivers, 2 user multi-purpose socket	supply and install
Bakery shop	With loads containing one ceiling fan	Supply and install
Cold storage room	One room contains one general purpose refrigerator. With loads including one refrigerator, one high efficiency heavy duty blender, general lighting and one user multi-purpose socket	wiring and connections

- Outcome 3: The set-up of Renewable Energy IGAs are supported and accompanied by providing more economic resources to vulnerable households to ensure greater food security.

Beneficiaries: 80 youth (60% women and 20% host communities) will benefit from training opportunities, direct employment opportunities and livelihood opportunities for self-employment and micro-businesses, breakdown of beneficiaries as follow,

In particular, 20 refugees and members of the host communities with at least 60 per cent female representation and including 20 per cent host community representation will be selected as members of the management committees: 10 persons for the two committees for the management of the two solar ovens and another 10 persons for the management committees of the two multifunctional solar platforms.

Another 40 people, again selected from the same group composition, will be considered as operators of at least 10 small Renewable Energy based Income Generating Activities (RGAs).

Finally, at least four young men and women from the host community, already operating mills, will be selected as mill operators connected to Multifunctional Solar Platforms (MSPs) within the camp.

2 Multi-Functional Solar Platforms (MSP) is a project that presents findings and recommendations based on a labor market and energy needs assessment conducted in **(AIRedis 1)**, **(AIRedis 2)** refugee camp and host community, in **AISalam** Locality, White Nile State.

The scope of the project is to cover all the existing small-scale businesses in **(AIRedis 1)**, **(AIRedis 2)** markets. The most dominant kinds of business activity in the two targeted markets are vegetables selling, fresh fish selling, small mobile charging, dried food making, tea making, food making and small shops.

The project intends to create employment and self-employment opportunities for the refugees affected by the Conflict in South Sudan and other nearby countries, by providing with capacity building trainings and the development of Income Generating Activities based on renewable Energy solutions such as a Multifunctional Platform, object of this tender, and a solar oven.

Selection mechanism of MSP management committee is a key factor to prevent solar system in the two targeted markets from theft and damage as well as becoming a source of inter-communal conflicts. It is therefore essential to make sure that all security procedures should be taken before the installation of solar systems as follows:

- 10 members of management committee should be selected autonomously and equally from blocks committees and community-based committees such as women, youth and market committees.
- This selection mechanism should be more sensitive to/ consistent with inter-communal arrangements as well as ethnic and tribal imbalances between Nuer and Shilluk in the refugee camp, form one hand, and between community leaders (Sultans) and other influential actors (youth) inside these committees, form the other hand.
- This management committee should include a representative member from the police station in the camp to enhance the committee members' sensitivity to security issues related to solar energy platforms that will be installed in the camp.



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3. Organization Background

Plan International is an independent child rights and humanitarian organization committed to children living a life free of poverty, violence and injustice. We actively unite children, communities and other people who share our mission to make positive lasting changes in children's and young people's lives. We support children to gain the skills, knowledge and confidence they need to claim their rights to a fulfilling life, today and in the future. We place a specific focus on girls and women, who are most often left behind. We have been building powerful partnerships for children for more than 75 years, and are now active in more than 70 countries. In Sudan, Plan operates in four states which are White Nile, North Kordofan, Kassalla and North Darfur. The assessment is to be conducted in White Nile South Sudanese Refugees camps and host communities in Al Salam locality, with focus on Al Redis 2 camp.

4. Project Background:

Based UNHCR Sudan - South Sudanese Refugees in Sudan Dashboard as of 30 September 2024, Sudan is home to 632,179 population of South Sudanese refugees (SSRs) officially registered were 418,159 registered by government and UN sources, They latter lived in Sudan before the conflict and are considered refugees as they cannot safely return to their country. The political, security, socio-economic and operational context in Sudan dramatically change with the start of the conflict in April 2023, this affects the South Sudanese population. The project focus on refugees displaced to White Nile state in Sudan particularly refugees in Al Redis1 &AL Redis2 and the host communities, the direct beneficiaries including adolescents, youth and young refugee women and members of host communities aged 15-35 years who will directly benefit from food production through solar ovens, MSPs and mills. .

The project intends to create employment and self-employment opportunities for the refugees , by providing with capacity building training and the development of Income Generating Activities based on renewable Energy solutions such as a Multifunctional Platform, object of this tender, and a solar oven which will be installed by the project.

The project is designed around three Expected Results - each representing a thematic component, which complements the following:

- Component 1: A.1: The women and young beneficiaries acquired the technical, financial and management skills needed to manage and maintain the renewable energy systems for food production, namely the multifunctional solar platform and the community solar oven.
 - Component 2: Strengthening food security for women and youth through the development of renewable energy-based food production/distribution in the refugee camp and host communities
 - Component 3: The set-up of Renewable Energy IGAs are supported and accompanied by providing more economic resources to vulnerable households
- Objective:** Strengthening food production and access to food resources through renewable energy solutions for vulnerable populations living in host communities and refugee camps in Sudan
- Outcome 1: The women and young beneficiaries acquired the technical, financial and management skills needed to manage and maintain the renewable energy systems for food production, namely the multifunctional solar platform and the community solar oven
 - Outcome 2: Strengthening food security for women and youth through the development of renewable energy-based food production/distribution in the refugee camp and host communities



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2. List of Abbreviations

A	Amp
V	Volt
VA	Volt-Ampere
AC	Alternating current
Ah	Amp-hour
DC	Direct current
PV	photovoltaic
MSP	Multifunctional Solar platform
O&M	Operating and maintenance
IEC	The International Electro technical Commission
NEC	national electrical code
IGAs	Income generating Activities
RGAs	Renewable energy based Income generating Activities

A handwritten signature in blue ink, consisting of a stylized 'S' followed by a horizontal line and a small flourish.



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Term of Reference for designing, supplying and installation of 2 Multi-Functional Solar Platform – under " Strengthening food production and access to food resources through renewable energy solutions for vulnerable populations living in host communities and refugee camps in Sudan, project funded by the Italian Government

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