Yemen Emergency Human Capital Project (YEHCP)

Environmental and Social Management Plan (ESMP)

Supply and Installation of Solar Power System into Water Pumping Station in Shibam Kawkaban City in Al Mahweet Governorate

Sub-Project EHC-AF-WS-MAW-012 and;

Supply and Installation of Solar Units into al Mahela Area Al Hamdi Park Wells Dhamar City

Sub-Project EHC-PR-WS-DHAM-002

August, 2024

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Abbreviations

ATS	Automatic Transfer Switch
C-ESMP	Contractor Environmental and Social Management Plan
Coc	Code of Conduct
CSO	Civil Society Organization
CT	Current Transformer
DC	Duration Curve
EHS	Environmental, Health and Safety
ESF	Environmental and Social Framework of the World Bank
ESHS	Environment, Social (including labor), Health, and Safety
ESIA	Environmental and Social Impact Assessment
ESMF	Environmental and Social Management Framework
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standard
GBV	Gender Based Violence
GM	Grievance Mechanism
HQ	Headquarter
HSSE	Health, Safety, Social and Environment
IDA	International Development Association
IDP	Internally Displaced Person
Km	Kilometer
kW	Kilowatt
LC	Local Corporation
LMP	Labor Management Procedures
MoWE	Ministry of Water and Environment
OHS	Occupational Health and Safety
PMU	Project Management Unit
PPE	Protective Personal Equipment
RF	Resettlement Framework
SWSLC	Sana'a Water and Sanitation Local Corporations
SCMCHA	Supreme Council For Management and Coordination of Humanitarian Affairs
SEA	Sexual Exploitation and Abuse
SEP	Stakeholder Engagement Plan
SH	Sexual Harassment
SMP	Security Management Plan
TPM	Third Party Monitoring
UNICEF	United Nations Children's Emergency Fund
UNOPS	United Nations Office for Project Services
UW-PMU	Urban Water Project Management Unit
UWSSP	Urban Water Supply and Sanitation project
VT	Voltage Transformer
WASH	Water, Sanitation and Hygiene
WWTP	Waste-Water Treatment Plant
YIUSEP I	First Yemen Integrated Urban Services Emergency Project
YIUSEP II AF	Second Yemen Integrated Urban Services Emergency Project Additional Financing

Summary Sheet:

Table 1: Summary Sheet

Subproject Name	Supply and Installation of Solar Power System to Water Pumping Station in Shibam Kawkaban City in Al Mahweet Governorate. Supply and installation of Solar Units to Al Mahela Area Al Hamdi Park Wells Dhamar City.
Subproject Location	Shibam Kawkaban City Al Mahweet Governorate. Al Mahela Area Al Hamdi Park Wells Dhamar City.
Implementing Partner	Urban Water Supply and Sanitation Project (UWSSP) Sana'a
Name of consultant preparing the ESMP	Nabil Shams Alden
Risk level (low or moderate)	Moderate
Date of the field visit	5 December, 2023
Implementation period	6 Months
Consultation dates and name of person conducting the consultations	were conducted 4-8 November and on 5-7 December 2023 by Abeer Rawiah UWSSP Social Specialist.
Observations/Comments	
Signature of responsible ESSO	
Date	

Chapter 1 Introduction:

This ESMP has been prepared to ensure that the proposed sub-projects incorporate sound environmental and social management principles and practices and comply with World Bank environmental and social safeguard policies, as well as with the applicable environmental and social policies and legal requirements of the Republic of Yemen (RoY).

This Environmental and Social Management Plan (ESMP) has been prepared to address the potential environmental and social risks and impacts of the subproject for Supply and Installation of a Solar Power System for Water Pumping Station in Shibam Kawkaban City in Mahweet Governorate and subproject for the Supply and installation of Solar Units to Al Mahela Area Al Hamdi Park Wells Dhamar City. This subproject is a part of Yemen Emergency Human Capital Project ,Parent Project, Additional Financing YEHCP PR and AF.

The sub-project is located in Al-Mahweet Governorate, Shibam Kawkaban City, 38km West-Northwest of Sana'a, it has a population of 39,163 inhabitant.

The sub-project EHC-PR-WS-DHAM-002 is located in al Mahela area Alhamdi park wells Dhamar-city look at Table 3 The Targeted Wells

The ESMP provides the key environmental and social baseline conditions within the sub-project's areas of influence and the risk assessment of the key potential environmental and social impacts of the proposed sub-projects activities. Mitigation measures designed to manage the identified limited and localized and residual impacts have also been summarized to ensure their effective implementation. A summary of the stakeholder identification, analysis, and engagement process, as well as the institutional and management implementation arrangements, has been included to ensure the effective implementation of the proposed mitigation measures and monitoring plans.

The risk level of this subproject is moderate which requires preparation of ESMP. It does not require the preparation of ESIA as detailed in the ESMF or RAP as detailed in the RF. However, site specific impacts that may be triggered are noise, dust emission, waste disposal and safety risks for workers and community including occupational health and safety. Minor localized short term noise from subproject rehabilitation is expected during implementation due to the use of heavy equipment. The project is expected to maximize the manual work which will minimize noise. The impact on air quality and noise is limited and they are seen as minor concerns. The corresponding mitigation measures for potential impacts are included in this ESMP and the environmental and social requirements for contractors will be included in the tender documents and contract. All environment, social, health and safety mitigation measures will be included in the contract. In addition, Bill of Quantities(BoQs) priced items for environmental and social safeguards including OHS will be included in the tender documents and contract.

Chapter 2. Sub-Project Description:

2.1 Description:

The conflict in Yemen has significantly worsened the already low electricity access level with severe impacts on urban public services as well as commercial and industrial activities, which all rely heavily on a functioning power supply. Fuel is scarce and many electricity generation facilities have been damaged. The national grid has disintegrated into several subnational systems because transmission links were damaged or ceased operations due to the conflict. Consequently, public electricity supply has been completely shut down in large areas of the country, only an estimated ten percent of the population has access to reliable electricity.

The impact on facilities dependent on reliable electricity has been devastating. Water pumping stations, water treatment stations, industry and commercial facilities have all had to cut back operations or find alternative power sources.

The aim of this project is to provide electricity for drinking water pumping project in Yemen (Shibam kawkaban city and Dhamar City) by utilizing a solar PV system.

Shibam kawkaban City Al Mahweet Governorate.**:**

Shibam kawkaban pumping station is located in Shibam city in Mahweet governorate. The station takes water from the nearby supply tank and lifts it to the elevated tank in Kawkaban area which serve around 5,000 residents. The current pump is surface horizontal multistage pump powered by a 250 kVA diesel generator. And the current water flow rate (45 m3/hr), and the abstracted water will be the same as before. The total requirement of water is around 150m3 of water each day.

At this project will be provide electricity for drinking water pumping project in one water well in Shibam kawkaban city by utilizing a solar PV system (The number of solar panels 144 and the Module capacity for each panel 650 W, and the total capacity 93.6 kilowatt) in total area in the Ground (390 sq meter).

Al Mahela Area Al Hamdi Park Wells **Dhamar City:**

In the city of Dhamar, three water wells will be targeted and the solar energy system will be provided.

And these three wells targeted as per the following:

Al-Gadad well: The main source of power to the pump by existing 127 KW diesel generator, to reduce Dhamar City LWSC's reliance on fuel, the project will be providing electricity for drinking water pumping project by utilizing a solar PV system (The number of solar panels 96 and the Module capacity for each panel 650 W, and the total capacity 62.4 kilowatt) in total area in the ground (252 sq meter). These panels will generate electricity to power the well, reducing the need for fuel. And the current water flow rate)(50.4m3/h and the abstracted water will be the same as before The total requirement of water is around 300 m3 of water each day.

Al-Mahlah well: The main source of power to the pump by existing 127 KW diesel generator, to reduce Dhamar City LWSC's reliance on fuel, the project will be providing electricity for drinking water pumping project by utilizing a solar PV system (The number of solar panels 96 and the Module capacity for each panel 650 W, and the total capacity 62.4 kilowatt) in total area in the ground (252 sq meter). These panels will generate electricity to power the well, reducing the need for fuel. And the current water flow rate (21.6m3/h) and the abstracted water will be the same as before. The total requirement of water is around 129 m3 of water each day

Al-Naser well: The main source of power to the pump by existing 127 KW diesel generator, to reduce Dhamar City LWSC's reliance on fuel, the project will be providing electricity for drinking water pumping project by utilizing a solar PV system (The number of solar panels 96 and the Module capacity for each panel 650 W, and the total capacity 62.4 kilowatt) in total area in the ground (252 sq meter). These panels will generate electricity to power the well, reducing the need for fuel. And the current water flow rate (25.2m3/h) and the abstracted water will be the same as before. The total requirement of water is around 150**m**3 of water each day

The general scope of work procures, supply, installing, testing, training and commissioning, operating, handing over of Solar PV Water Pumping System. Sub system is included in his offer to deliver a completed and functional system, includes but not limited the following components:

- Solar PV modules consisting of required number of Crystalline PV modules;
- Fixed Mounting structures suitable for number of PV panels in area;
- PV combiner box;
- Solar pump inverter (VFD with built in MPPT controller);
- System Cables (DC & AC);
- Earthing, short-circuit, surge and lightning protections;
- Chain Link Fences with two leaflets gate to protect the system;

2.2 Detailed Scope of Work

2.2.1 Civil Works Scope

A. Site cleaning, preparation and levelling of PV mounting structure area including excavating (60 x 60 Depth 40 cm) , cutting in all types of soils, removing/cut the existing asphalt/tiles and backfilling, compacting, removing obstacles and building side walls when required to hold the soil.

B. Installation of fixed mounting structures suitable for the provided PV panels with concrete foundations including all earthing works and manhole for cable trench such as excavation (70 x 70 Depth 60 cm), compacting and backfilling.

C. Installation of chain Link fences including earthing works such as excavation (70 x 70 Depth 60 cm), compacting and backfilling.

D. Site cleaning and finishing after work completion.

E. Installation of street sign board

2.2.2 Electrical and Solar Works Scope

A. Installation of solar PV modules, combiner boxes, solar pump inverter including electrical cables, control cables and accessories.

B. Installation of solar street lighting with galvanized terminal pole, It will be placed around the ground mounting structure for Solar PV.

C. Installation of lightning protection system to protect all electrical devices & equipment's, metal structure and solar system equipment & devices.

D. Installation of earthing grid (for AC & DC system separately) to grounding all electrical devices & equipment's, metal structure and solar system equipment & devices.

E. Installation of control components such as level sensors and pressure switch devices with control cable connection to the system for protection function.

F. Installation of electrical cables (DC & AC system) with all required accessories.

G. Installation of DC breaker boxes.

H. Set-up inverter parameters and system testing.

I. Installation of fire extinguishers.

6.2.3 Mechanical Works Scope only in Shibam kawkaban City Al Mahweet Governorate:

A. Taking out the submersible pump with existing raiser pipes to be re-installed with new level sensor with control cable inside the well to protect the submersible motor pump, the work includes all required fittings and accessories. Ana Supply, install and commissioning of horizontal multistage surface Pump Head: 370 m, Capacity: 36 m3/hr.

B. Installing pressure switch device on the pipeline with control cable.

C. Installation all solar street lights terminal pole.

D. Installation of piping fittings and accessories required to install the mechanical and piping components.

Civil Works

Mounting Structure

The structure that supports the PV modules, gateways for workers, and DC electrical components of the Plant (cabling, junction boxes, protections, sensors, etc.) must be made of permanent materials that can withstand all climatic conditions (wind, heat, water) without deflection or vibrations. It must be securely braced and fixed to the roof or the wall of a building or the ground. The frames, support structure, and other metal parts must be made of non- corroding materials or protected against corrosion by galvanizing, painting, etc. It is good practice to keep dissimilar metals separate, unless they are well sealed against water by paint or sealing compound. Calculations and supporting documentation may be required to demonstrate adequate design. Excavations work will be including foundations for the PV mounting structure, foundations for the fences and cables trench and the maxim depths it will be 60 centimeters, and the excavations work will by manual handling.

Table 2 Tabulation of structural Properties: -

Wind velocity withstanding capacity	>120 km / hour
Structure material	Structure material shall be hot or cold rolled galvanized steel S275 with a minimum galvanization thickness of (80-120) microns in accordance with ASTM A123, ASTM A153 and ASTM A385).
Bolts, nuts, fasteners, panel mounting clamps	Stainless Steel Grade SS 304, S275, High Strength Bolts Grade 8.8, all According to EC3.
Mounting arrangement for metal sheet roofs	Mounting directly on the sheet metal, ensuring stability and wind withstanding capacity, or penetrating the sheet metal and fixing to the sub- structure, ensuring that the roof remains waterproof and ensuring stability and wind withstanding capacity.
Mounting arrangement for elevated structures	The elevated structure has to be securely anchored to the supporting surface. Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; Bolted with anchor bolts of appropriate strength for elevated structures mounted on RCC surfaces.
Mounting arrangement for ground installations	Concrete foundations of appropriate weight and depth for elevated structures mounted directly on the ground; assuring enough ground clearance to prevent damage of the module through water, animals and other environmental factors.
Mounting arrangement for RCC-flat roofs Installation	The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of welding or complex machinery at the installation site.
Installation	The structures shall be designed for simple mechanical on-site installation. There shall be no requirement of welding or complex machinery at the installation site. Stainless steel bolts are required.
Access for panel cleaning and maintenance	All solar panels must be accessible from the top for cleaning and from the bottom for access to the module- junction box.

Panel tilt angle	18 degree

2.2 Location:

Shibam Kawkaban City:

The sub-project is located in Al-Mahweet Governorate, Shibam Kawkaban City, 38km West-Northwest of Sana'a.

Coordinates for the well (Longitude, Latitude, Elevation)	15.506493°, 43.901235°, 2644m
Coordinates for the Tank (Longitude, Latitude, Elevation)	15.501705°, 43.898643°, 2944m

Figure1 Google map for the subproject location

Figure 2 Well No.19 Aerial Image

Gov.	*District*	Well Name	Total dynamic head (m/hr)	Water Requi emen (m^3/hr	Daily Wate Requi emen (m^3/d
Al-Mahweet	Shibam Kawkaban City	A4	145	45	150

Dhamar City

The sub-project EHC-PR-WS-DHAM-002 is located in al Mahela area Alhamdi park wells Dhamar-city look at Table 3 The Targeted Wells:

Table 3 The Targeted Wells are as per the following table

Gov.	District	Well Name	Wall Coordinates		Total Dynam ic Head (m	Water Requi emen (m^3/hr	Daily Wate Requi emen (m^3/d
			N	E			
Dhamar	Dhamar City	Al-mahlah	14.521836°	44.397167°	110	21	129
		AL- jadad	14.513866°	44.405333°	85	50	300
		AL-naser	14.548739°	44.380742°	156	25	150

Figure 3 Drawings_Lot1_ AlGadad

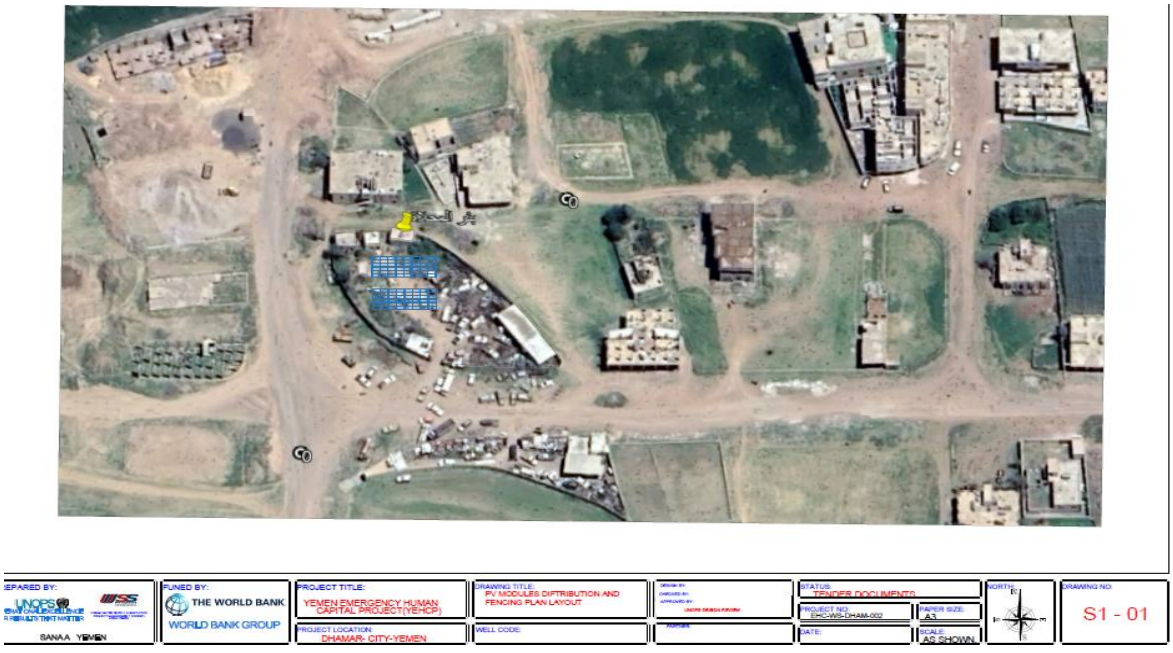


Figure 4 Drawings_Lot2_ AlMahlah

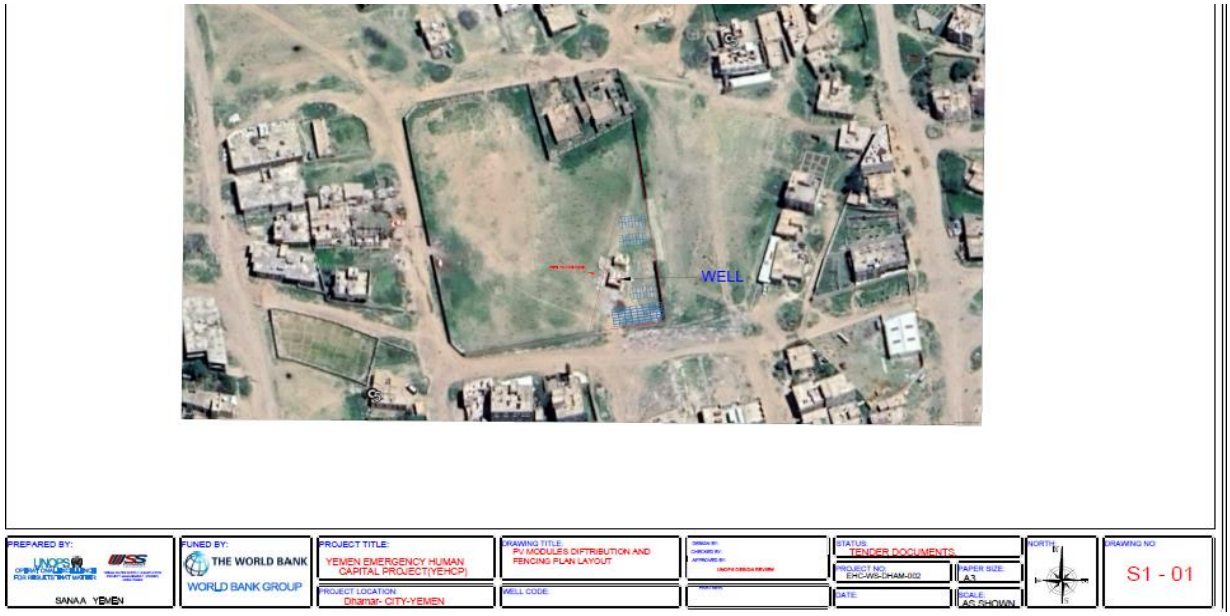


Figure 5 Drawings_Lot3_ Al Nasar

Chapter 3. Environmental and Social Baseline

Al-Mahweet governorate

Shibam is a small city in Al-Mahweet governorate located 38 km West-Northwest of Sana'a. According to the 2004 census it had a population of 39,163 . There is no available recent data to provide an updated population figure where the last census was conducted in 2004. However, the projection of 2021 were 770,920 persons in Al Mahweet and 2,194,159 in Dhamar Govenorates.

Al Mahwit Governorate is distinguished by the abundance of vegetation covering its surface, which remains evergreen throughout most seasons of the year. The vegetation includes many perennial trees such as acacia, sidr, salam, and dhaba, alongside numerous grasses, as well as small and annual plants, which flourish and thrive during rainy seasons.

In all directorates of the governorate, there are numerous wild animals, among which the most notable are wolves, hyenas, tigers, harriers, monkeys, foxes, otters, spiny hedgehogs, and rabbits. These animals primarily inhabit the mountainous and uninhabited regions. Additionally, various bird species can be found, including hawks, owls, wild pigeons, partridges, eagles, and a variety of small birds with diverse shapes, colors, and names. The majority of these birds reside in the valleys, particularly those with aquatic habitats. No threatened species of faunal and flora in the subproject site.

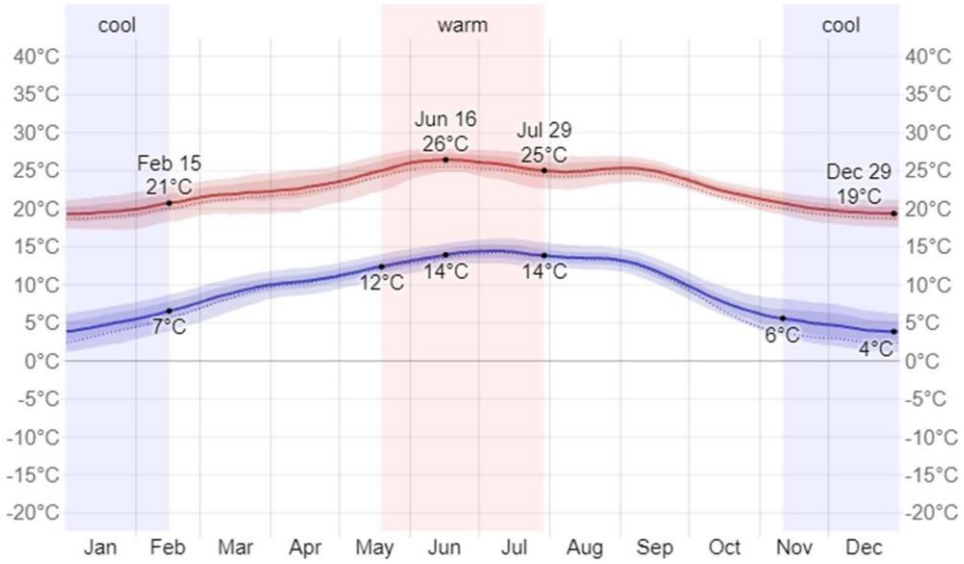
CLIMATE – METEOROLOGICAL CONDITIONS

In Shibām, the summers are short, warm, arid, and mostly cloudy and the winters are cold, dry, and mostly clear. Over the course of the year, the temperature typically varies from 4°C to 26°C and is rarely below 1°C or above 28°C.

Average Temperature in Shibam

The warm season lasts for 2.3 months, from May 19 to July 29, with an average daily high temperature above 25°C. The hottest month of the year in Shibām is June, with an average high of 26°C and low of 14°C.

The cool season lasts for 3.1 months, from November 10 to February 15, with an average daily high temperature below 21°C. The coldest month of the year in Shibām is December, with an average low of 4°C and high of 20°C.



The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures.

Average	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
High	20°C	21°C	22°C	23°C	25°C	26°C	26°C	25°C	25°C	22°C	20°C	20°C
Temp.	12°C	14°C	15°C	17°C	19°C	20°C	20°C	19°C	19°C	15°C	13°C	12°C
Low	5°C	7°C	9°C	11°C	12°C	14°C	14°C	14°C	12°C	8°C	5°C	4°C

Clouds

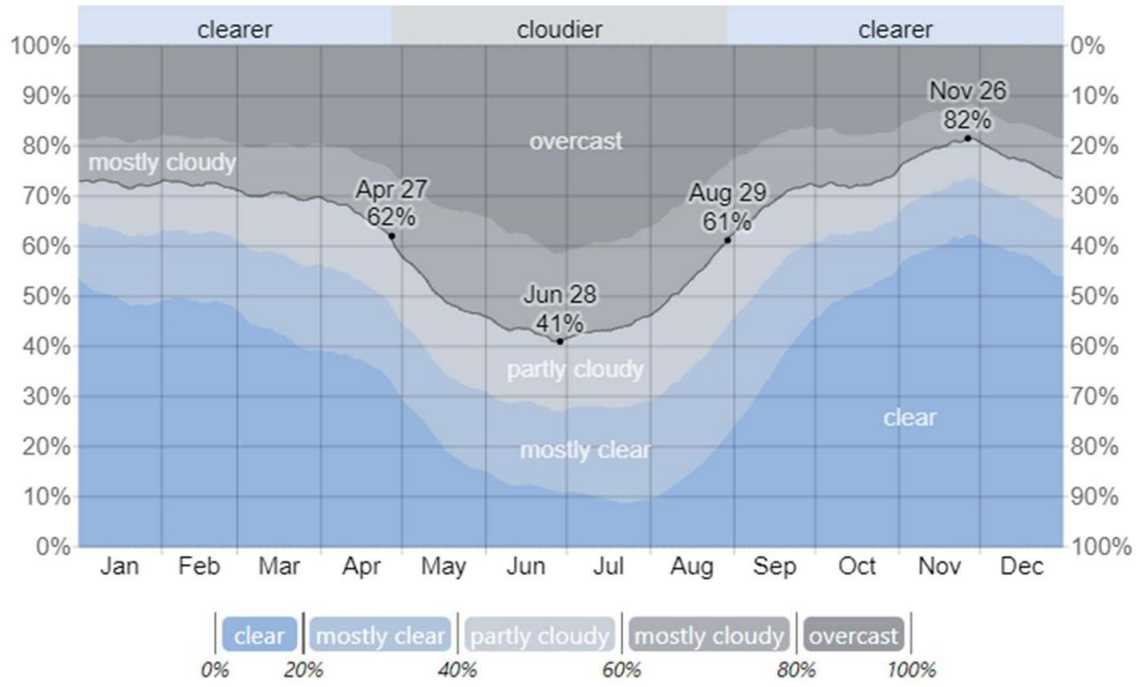
In Shibām, the average percentage of the sky covered by clouds experiences significant seasonal variation over the course of the year.

The clearer part of the year in Shibām begins around August 29 and lasts for 7.9 months, ending around April 27.

The clearest month of the year in Shibām is November, during which on average the sky is clear, mostly clear, or partly cloudy 80% of the time.

The cloudier part of the year begins around April 27 and lasts for 4.1 months, ending around August 29.

The cloudiest month of the year in Shibām is June, during which on average the sky is overcast or mostly cloudy 57% of the time



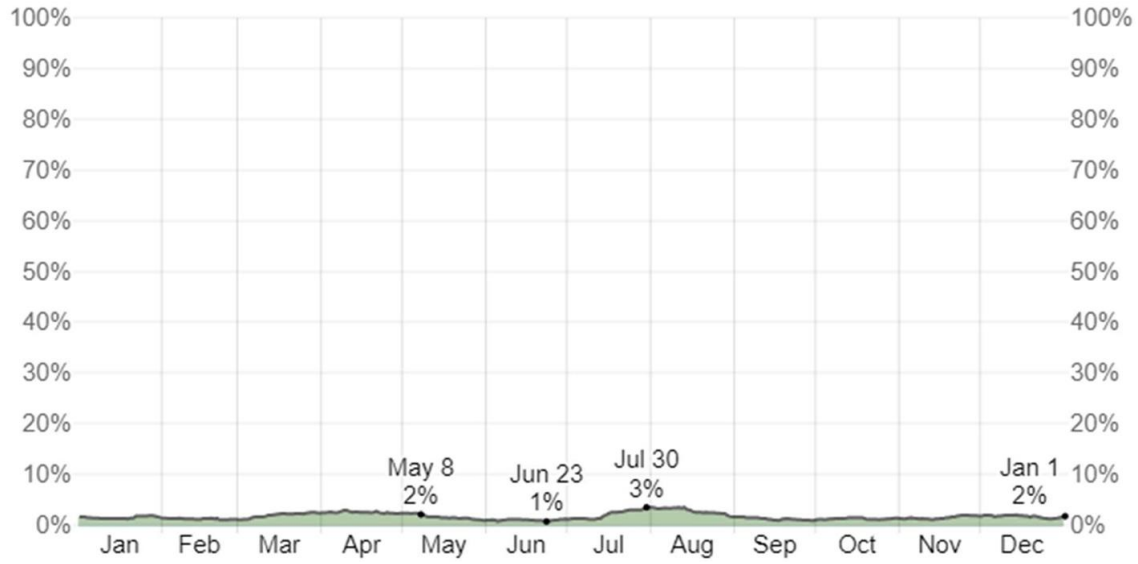
The percentage of time spent in each cloud cover band, categorized by the percentage of the sky covered by clouds.

Fraction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cloudier	27%	28%	30%	35%	50%	57%	56%	46%	31%	27%	20%	23%
Clearer	73%	72%	70%	65%	50%	43%	44%	54%	69%	73%	80%	77%

Precipitation

Shibām does not experience significant seasonal variation in the frequency of wet days (i.e., those with greater than 1.00 millimeters of liquid or liquid-equivalent precipitation). The frequency ranges from 1% to 3%, with an average value of 2%.

Among wet days, we distinguish between those that experience rain alone, snow alone, or a mixture of the two. The month with the most days of rain alone in Shibām is August, with an average of 0.8 days. Based on this categorization, the most common form of precipitation throughout the year is rain alone, with a peak probability of 3% on July 30.

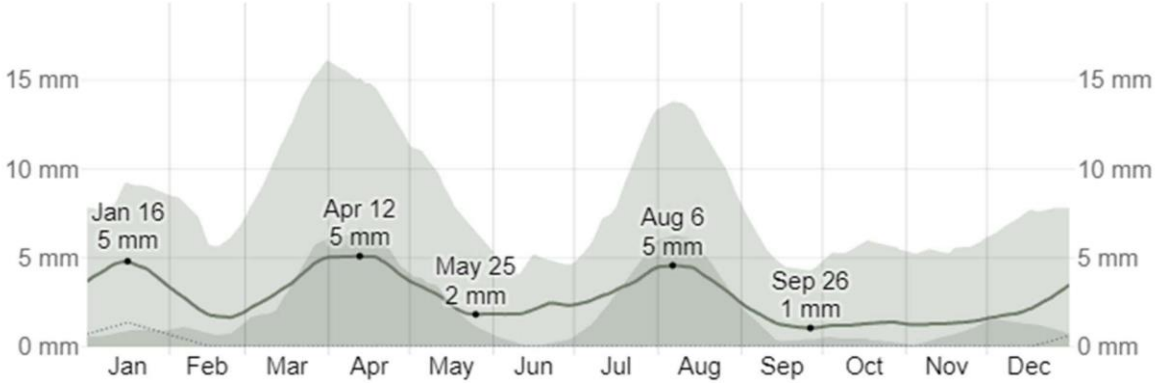


The percentage of days in which various types of precipitation are observed, excluding trace quantities: rain alone, snow alone, and mixed (both rain and snow fell in the same day).

Days of	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rain	0.4d	0.3d	0.6d	0.8d	0.5d	0.3d	0.7d	0.8d	0.4d	0.4d	0.4d	0.5d

Rainfall

The sliding 31-day quantity of rainfall in Shibām does not vary significantly over the course of the year, staying within 2 millimeters of 3 millimeters throughout the year

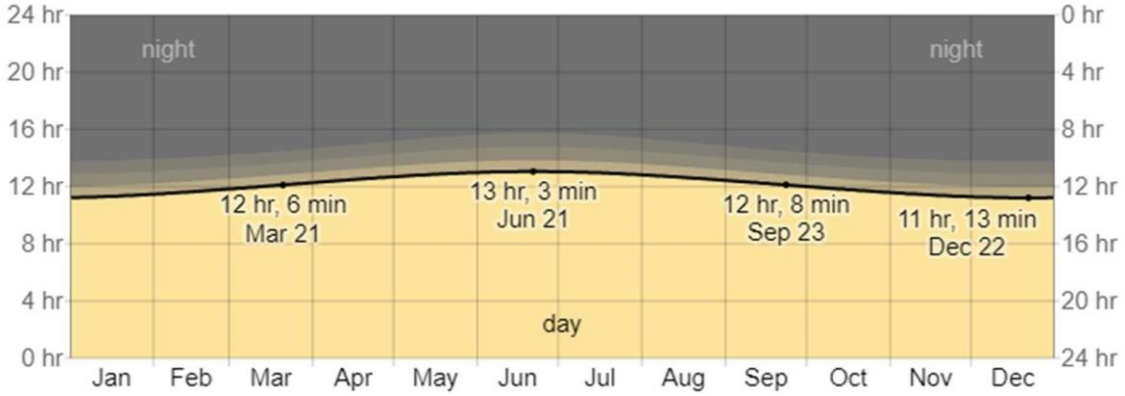


The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands. The thin dotted line is the corresponding average snowfall.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall	4.8mm	1.9mm	3.4mm	5.1mm	2.3mm	2.1mm	3.2mm	4.2mm	1.2mm	1.3mm	1.3mm	2.1mm

Sun

The length of the day in Shibām varies over the course of the year. In 2023, the shortest day is December 22, with 11 hours, 13 minutes of daylight; the longest day is June 21, with 13 hours, 3 minutes of daylight



The number of hours during which the Sun is visible (black line). From bottom (most yellow) to top (most gray), the color bands indicate: full daylight, twilight (civil, nautical, and astronomical), and full night.

Hours of	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daylight	11.3h	11.6h	12.1h	12.5h	12.9h	13.0h	12.9h	12.6h	12.2h	11.8h	11.4h	11.2h

The earliest sunrise is at 5:32 AM on June 3, and the latest sunrise is 1 hour, 2 minutes later at 6:34 AM on January 21. The earliest sunset is at 5:30 PM on November 21, and the latest sunset is 1 hour, 9 minutes later at 6:39 PM on July 8.

Daylight saving time (DST) is not observed in Shibām during 2023.

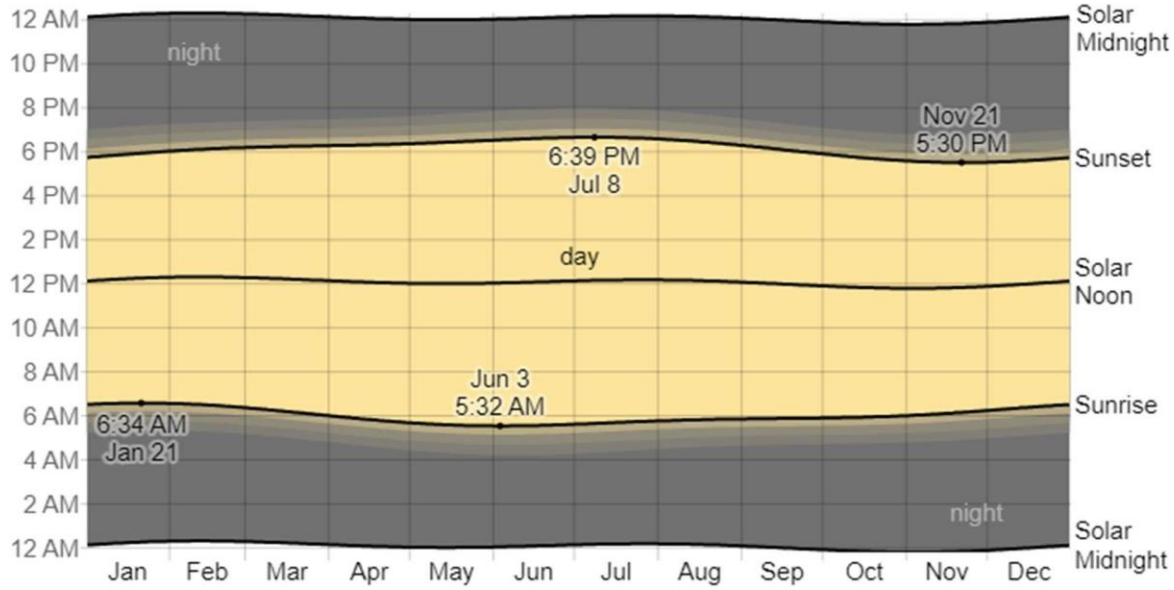
Hydrology:

The Amran Group limestone's outcrop only to the north of the area near Hababah and form much of the catchment drained by the Shebam wadi, the Wadi ad Dabyani. Younger, Tawilah Sandstones overlay the Amran rocks and themselves form a major scarp which trends NW-SE and have considerable outcrop around Shebam town; locally, the sandstones are cut by lava dykes. Along the Wadi ad Dabyani east of Shebam, alluvium covers the Tawilah Sandstones. The Tawilah Sandstone is the regionally important aquifer and around Shebam, it is over 60m thick and appears to have good aquifer characteristics in terms of saturation thickness and permeability. It occurs in outcrop and beneath wadi alluvium, both situations which should allow effective aquifer recharge, directly from rainfall or indirectly via the mantling wadi alluvia.

Depths of Ground water and distances from surface water areas between 80 to 175 meter

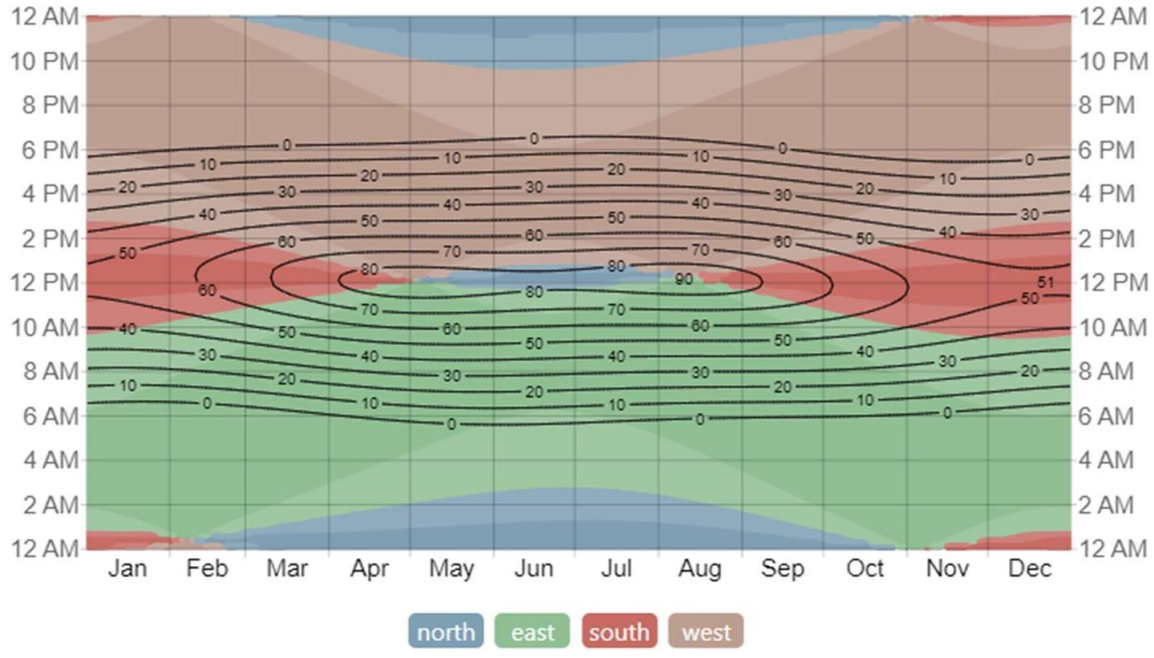
The intervention will not have a role in increasing the water abstraction and will not decrease the surface and groundwater levels in the sub-project area. There are no surface water near the subproject area.

Sunrise & Sunset with Twilight in Shibām



The solar day over the course of the year 2023. From bottom to top, the black lines are the previous solar midnight, sunrise, solar noon, sunset, and the next solar midnight. The day, twilights (civil, nautical, and astronomical), and night are indicated by the color bands from yellow to gray.

The figure below presents a compact representation of the sun's elevation (the angle of the sun above the horizon) and azimuth (its compass bearing) for every hour of every day in the reporting period. The horizontal axis is the day of the year and the vertical axis is the hour of the day. For a given day and hour of that day, the background color indicates the azimuth of the sun at that moment. The black isolines are contours of constant solar elevation.

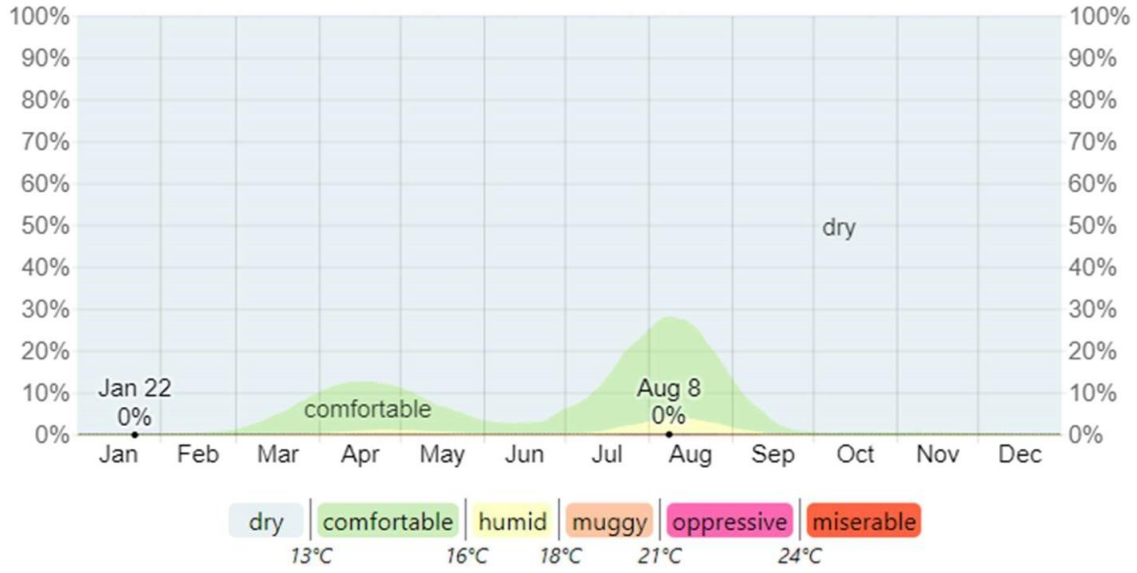


Solar elevation and azimuth over the course of the year 2023. The black lines are lines of constant solar elevation (the angle of the sun above the horizon, in degrees). The background color fills indicate the azimuth (the compass bearing) of the sun. The lightly tinted areas at the boundaries of the cardinal compass points indicate the implied intermediate directions (northeast, southeast, southwest, and northwest).

Humidity

We base the humidity comfort level on the dew point, as it determines whether perspiration will evaporate from the skin, thereby cooling the body. Lower dew points feel drier and higher dew points feel more humid. Unlike temperature, which typically varies significantly between night and day, dew point tends to change more slowly, so while the temperature may drop at night, a muggy day is typically followed by a muggy night.

The perceived humidity level in Shibām, as measured by the percentage of time in which the humidity comfort level is muggy, or worse, does not vary significantly over the course of the year, remaining a virtually constant 0% throughout September to March.



The percentage of time spent at various humidity comfort levels, categorized by dew point.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Muggy days	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d	0.0d

Topography

For the purposes of this report, the geographical coordinates of Shibām are 15.509 deg latitude, 43.904 deg longitude, and 2,587 m elevation.

The topography within 3 kilometers of Shibām contains very significant variations in elevation, with a maximum elevation change of 462 meters and an average elevation above sea level of 2,663 meters. Within 16 kilometers contains very significant variations in elevation (1,854 meters). Within 80 kilometers also contains extreme variations in elevation (3,556 meters).

The area within 3 kilometers of Shibām is covered by bare soil (60%) and sparse vegetation (40%), within 16 kilometers by bare soil (60%) and sparse vegetation (39%), and within 80 kilometers by bare soil (58%) and sparse vegetation (27%).

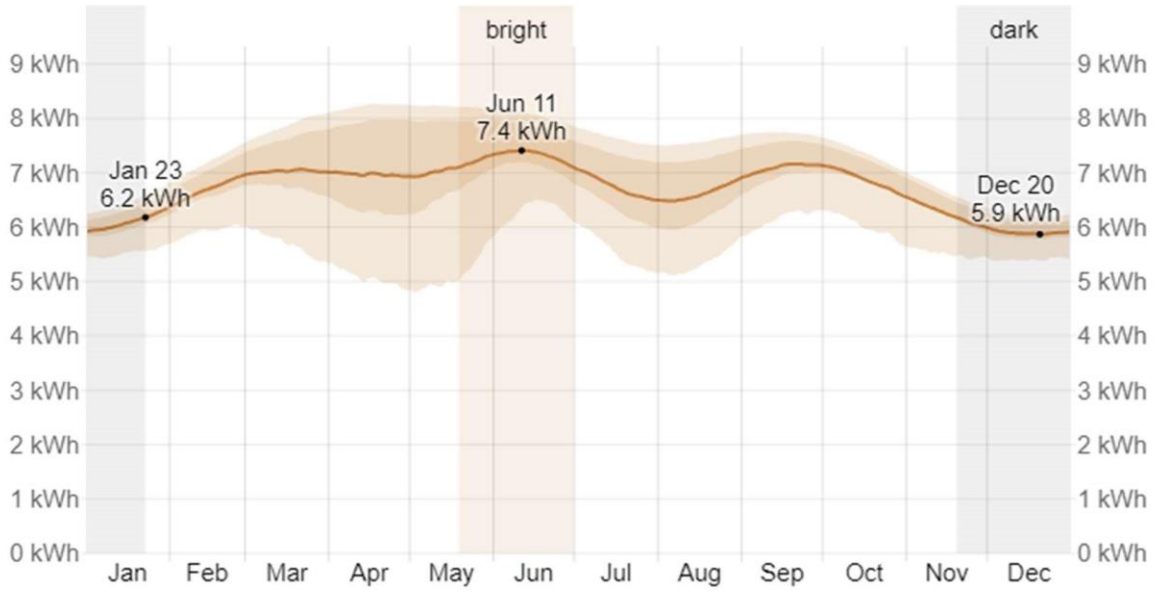
Solar Energy

This section discusses the total daily incident shortwave solar energy reaching the surface of the ground over a wide area, taking full account of seasonal variations in the length of the day, the elevation of the Sun above the horizon, and absorption by clouds and other atmospheric constituents. Shortwave radiation includes visible light and ultraviolet radiation.

The average daily incident shortwave solar energy experiences some seasonal variation over the course of the year.

The brighter period of the year lasts for 1.4 months, from May 19 to June 30, with an average daily incident shortwave energy per square meter above 7.1 kWh. The brightest month of the year in Shibām is June, with an average of 7.3 kWh.

The darker period of the year lasts for 2.1 months, from November 19 to January 23, with an average daily incident shortwave energy per square meter below 6.2 kWh. The darkest month of the year in Shibām is December, with an average of 5.9 kWh.



The average daily shortwave solar energy reaching the ground per square meter (orange line), with 25th to 75th and 10th to 90th percentile bands.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Solar Energy (kWh)	6.1	6.7	7.0	7.0	7.1	7.3	6.7	6.6	7.1	6.9	6.2	5.9

* The climate data has been taken from (weatherspark.com)

Dhamar governorate

Dhamar governorate is located 100 kilometers to the south of the capital Sana'a and shares borders with Sana'a and Raymah governorates in its north, Al-Hodeidah in its west, and Ibb and Al-Dhalea in its south. The governorate is divided into 12 administrative districts, with Dhamar City as the capital of the governorate. According to the 2014 Household Budget Survey, the poverty rate in Dhamar was 31.1%. With the decline of economic conditions in Yemen, this number has likely increased.(source: National Information Center)

Population

Estimated Dhamar City district population is about 322,730 persons in 2022. Women represent 0.48% of Dhamar City district population, and the total IDPs is 52,120

Temperature [1]

The summers are short, warm, arid, and mostly cloudy and the winters are cool, dry, and mostly clear. Over the course of the year, the temperature typically varies from 4°C to 27°C and is rarely below 1°C or above 29°C.

The warm season lasts for 1.8 months, from May 20 to July 14, with an average daily high temperature above 26°C. The hottest month of the year is June, with an average high of 27°C and low of 12°C. The cool season lasts for 3.3 months, from October 28 to February 9, with an average daily high temperature below 22°C. The coldest month of the year is December, with an average low of 4°C and high of 21°C.

Rainfall

Rain falls throughout the year in Dhamar. The month with the most rain is August, with an average rainfall of 10 millimeters. The month with the least rain is November, with an average rainfall of 2 millimeters.

Wind

The windier part of the year lasts for 5.6 months, from May 20 to November 6, with average wind speeds of more than 2.9 meters per second. The windiest month of the year is July, with an average hourly wind speed of 3.2 meters per second. The calmer time of year lasts for 6.4 months, from November 6 to May 20. The calmest month of the year is December, with an average hourly wind speed of 2.6 meters per second.

Air Quality and Noises

There is a severe lack of information on the state of the air in Yemen in general and in the sub-project area in particular. There was no air quality monitoring data for the sub-project area found.

During the field visit, numerous sources of air pollution have been observed. Emissions from diesel generators and vehicles, additionally dust generation as result of vehicles passing on un-asphalted roads.

[1] Temperature, rainfall, wind from: https://weatherspark.com/y/103142/Average-Weather-in-Dham%C4%81r-Yemen-Year-Round

Diesel generators and traffic movement are a source of noise in the sub-project location. It is noted that activities will not include decommissioning for any diesel power generators, as they might be needed during emergencies at night and during cloudy days.

Biodiversity

Endemic, near-endemic and threatened species of plants and animals are not existing in the sub-project area which is urban area and there is no impact on Biodiversity in the sub-project area during the implementation.

Hydrology

The average depth of the groundwater in the subproject area is 250meters and there is no surface water in the subproject area, and contractors responsible to return the ground level/ the runoff as the same level as before (before implementation of the subprojects), The sub-projects will include some civil work as mentioned above to install the PV solar mounting structures and the contractor is responsible for the ground leveling work after finishing these civil works.

Economy

Agriculture is the main economic activity in Dhamar governorate, which is the fifth largest agricultural producer in Yemen, accounting for 5.3% of total production. The most important crops are vegetables, cereals, and fodder. Dhamar is one of the main sources for construction stones and minerals in Yemen, and quarrying and mining of a scoria, zeolite, and agate make it a center of Yemen's small and largely artisanal mining sector.

The poverty rate in Dhamar was 31.1%. With the decline of economic conditions in Yemen, this number has likely increased.

All sub-projects are in Dhamar city (urban region) and are easily accessible through asphalted roads. The areas targeted in the sub-projects are residential areas. The overall number of households in the targeted locations is 1693.

The majority of families are working in the government sector, with some working in the private sector. in this area there are four health care facilities and seven educational facilities These are public general hospitals, health centers and schools.

Chapter 4. Environmental and Social Risks and Impacts

4.1 Applicability:

The World Bank Environmental and Social Framework ESF has been applied because these subprojects may trigger some environmental and social impacts such as residual wastes and occupational health and safety (OHS).

4.2 Eligibility (Exclusion List)

The subproject is eligible for support because it does not have any of the attributes in the following exclusion list.

#	Statement	Yes	No
1	Production or activities involving harmful or exploitative forms of forced labor/harmful child labor;		X
2	Production or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements;		X
3	Production or trade in weapons and munitions;		X
4	Gambling, casinos and equivalent enterprises;		X
5	Trade in wildlife or wildlife products regulated under CITES;		X
6	Production or trade in radioactive materials;		X
7	Production or trade in or use of un-bonded asbestos fibers;		X
8	Production or trade in wood or other forestry products from unmanaged forests;		X
9	Production or trade in products containing PCBs;		X
10	Production, trade, storage, or transport of significant volumes of hazardous chemicals, or commercial scale usage of hazardous chemicals;		X
11	Production or trade in pharmaceuticals subject to international phase outs or bans;		X

12	Production or trade in pesticides / herbicides subject to international phase outs or bans;		X
13	Production or trade in ozone depleting substances subject to international phase out;		X
14	Production or activities that impinge on the lands owned, or claimed under adjudication, by indigenous peoples, without full documented consent of such people;		X
15	Power plants;		X
16	Large-scale transport infrastructure such as highways, expressways, urban metro-systems, railways, and ports;		X
17	Investments in extractive industries; commercial logging;		X
18	Dams, or projects involving allocation or conveyance of water, including inter-basin water transfers or activities resulting in significant changes to water quality or availability;		X
19	Activities that would significantly convert natural habitats or significantly alter potentially important biodiversity and/or cultural resource areas;		X
20	Activities that would require the relocation of residential households and/or significant involuntary land acquisition; or		X
21	Activities in disputed areas.		X

Table 4: Exclusion list

4.3 Environmental and Social Screening:

UNOPS used the following form to screen for the potential environmental and social risks and impacts for the selected subproject under ESMF of the YIUSP II. The risk level of this subproject is moderate which requires preparation of ESMP. It does not require the preparation of ESIA as detailed in the ESMF or RAP as detailed in the RF. However, site specific impacts that may be triggered are noise, dust emission, waste disposal and safety risks for workers and community including occupational health and safety. The project is expected to maximize the manual works which will minimize noise. The impact on air quality and noise is limited and they are seen as minor concerns. The corresponding mitigation measures for potential impacts are included in this ESMP and the environmental and social requirements for contractor will be included in the

tender documents and contract. All environment, social, health and safety mitigation measures will be included in the contract. In addition, BoQs priced items for environmental and social safeguards including OHS will be included in the tender documents and contract.

Question Actions	Answer		ESS relevance	Due diligence/
	Yes	No		ESMP, SEP
Does the sub-project involve civil works including new construction, expansion, upgrading, or rehabilitation of existing infrastructure?	X		ESS1	SEP
Does the sub-project involve the land acquisition and/or restrictions on land use?		X		ESMP, SEP
Is the sub-project associated with any external waste management facility such as a sanitary ?landfill, incinerator, or wastewater treatment plant		X		ESMP
Does the sub-project have an adequate system in place (capacity, processes, and management) to address waste?	X		ESS1, ESS3	LMP, SEP
Does the sub-project involve the recruitment of workers including direct, contracted, primary supply, and/or community workers?	X		ESS2	LMP
Does the sub-project have appropriate OHS procedures in place and an adequate supply of PPE (where necessary)?	X		ESS2	LMP, SEP
Does the sub-project have a GM in place, to which all workers have access, designed to respond quickly and effectively?	X		ESS10, ESS2	ESMP, SEP
Does the sub-project involve the use of security or military personnel during the construction and/or operation of the facility/well field?		X		ESMP, LMP
Does the Sub-project establish and implement an appropriate quality management system to anticipate and minimize risks and impact that services may have on community health and safety?	X		ESS4	ESMP, SEP
Does the sub-project apply the concept of universal access were technically and financially feasible?	X		ESS4	ESMP, SEP

Is the sub-project located within or in the vicinity of any ecologically sensitive areas?		X		ESMP, SEP
Is the sub-project located within or in the vicinity of any known cultural heritage sites?		X		ESMP, SEP

Table 5: Environmental and Social Screening Form

4.4 Environmental and Social Impacts

The sub-projects assigned risk is moderate, thus, it requires the preparation of an Environmental and Social Management Plan (ESMP) as detailed in the Environmental and Social Management Framework ESMF for YEHCP AF. Some environmental, social and OHS impacts may be triggered. Therefore, UNOPS will include environmental and social requirements for contractor including all OHS requirements in the contract and tender documents.

Environmental Risk and Impacts:

- Solid waste produced by work accumulated and pollutes the environment including E-wastes
- Air and noise pollution due to emissions from equipment/transportation trucks.
- Soil and potential groundwater contamination from accidental oil and fuel spills from machineries used in excavation and lifting of the panels. Other sources of spills include chemicals such as bituminous paint. And soil contamination from improper battery storage and disposal during end of life.
- Removal of vegetation

Social Risk and Impacts:

- Lack of worker's awareness and knowledge on risks relating to gender, SEA/SH and GBV.
- Child Labor
- Community Health and Safety
- Social exclusion of vulnerable groups from the consultative process and project benefits
- Conflicts with community because of discriminatory recruitment procedures

OHS Risk and Impacts:

- Falling and slipping in a high space, with high 2m, (ladder and scaffold) when working to install PV panels and connect cables
- Lifting Operations Impacts:

The following impacts may occur during lifting the solar panels:

Failure of lifting equipment;

Potential failure of lifting equipment: Although the panels will primarily be installed on the ground, there remains a possibility of requiring lifting operations and the use of cranes for equipment installation

Falling loads;

- Electricity Shock Impacts:

Thermal burns

Muscle, nerve and tissues damage due to electrical shock

Fall from height (2 M) due to sudden electric shock

Fatalities or injuries.

- Manual Handling Impacts and tripping:

Manual Handling Injuries that include

Fractures

Damage to muscles, ligaments and tendons

Spinal disc injuries

Trapped nerves

Abrasions and cuts

Burns

Hernias

Tripping from cables and excavated areas

- Dealing with chemicals and Hazardous Substances such as cement and oil, paint and hot bituminous paint and Wastes Impacts that may cause skin and eye irritation
- Injuries or fatalities that result from:

Fire

Flash burns

- Air pollution due to emissions from equipment/transportation trucks, and excavation works that might result in breathing difficulty
- Falling in excavated trenches (60cm)Noise pollution from machineries and equipment
- Environmental pressures on workers from bad weather conditions such as heat wave, rainy periods, dust storms etc.
- Road accidents while transporting materials and equipment and waste to and from the site
- Dealing with hazardous chemicals

Operational and maintenance phase:

Operation and Maintenance, risk of potential electric shock to the maintenance staff, falling from height, electrocution etc. and other OHS such as and dealing with diesel, chemical and emissions from diesel generator such as PM, VOCs and Nox which may cause respiratory problems to workers.

Soil contamination from diesel leaks from the generator or chemical storage area

Lack of maintenance and disfunction of PV system and impacting the community (i.e., water cuts)

E-waste from solar panels after reaching its lifespan (estimated 25 years on average) and batteries.

Water risks (high abstraction and quality deterioration)

Furthermore, UNOPS will take the following measures to ensure that groundwater extraction does not exceed the rate of recharge, preventing overexploitation and the depletion of the aquifers:

- **Groundwater Monitoring**: UNOPS to ensure that institutions on charge Implement a robust groundwater monitoring system (quantity and quality) to continuously track water levels of groundwater and its quality. This data is essential for understanding the dynamics of the aquifer and ensuring that abstraction rates do not exceed recharge rates.
- **Pumping Regulations** (Ensure safe yield of the aquifer): UNOPS to ensure that institutions on charge limit the maximum abstraction rate to a sustainable level which is usually below the recharge rate to prevent over-pumping.

Chapter 5. Consultations

Public consultation process takes the form of direct interviews with local communities and other stakeholders in the selected Sub-project area i.e Shibam Kawkaban City. The consultations were conducted in the subproject areas with 17 persons.

The consultations with the stakeholders: WSSLC Shibam Branch, Local Authority as well as beneficiaries, that utilize water, such as housewives, old and young, educated and illiterate, the interviews have been conducted from 5-7 of December 2023 by UWSSP social specialist with 17 persons: 13 males, and 4 females.

Dhamar governorate. The consultations were conducted in the subproject areas with 17 persons.

The consultations with the stakeholders: WSSLC Dhamar, as well as beneficiaries, that utilize water, such as housewives, old and young, educated and illiterate, was conducted from 4-8 of November 2023 by UWSSP social specialist with 17 persons: 14 males, and 3 females. Consultation questionnaire was distributed to the interviewees.

5-1 Consultation topics

The consultations with men and women covered several issues and topics including:

- Ensure communities' needs and confirm the selection priority;
- Inform local communities about the subproject and its activities to be undertaken, its timetable;
- Inform them about their rights to have a job opportunity during implementation.
- Raise their awareness about subprojects' potential risks such as safety, health, environmental, and social risks and required control measures.
- Document and address the local communities' concerns, expectations, and feedback.
- Ensure the participation of subproject beneficiaries both females and males.
- Discuss the positive impacts that the subprojects will have such as improved sanitation services and accessibility to cleaner water.
- Discuss subprojects' possible negative impacts such as odors and safety of workers and proposed mitigation measures and how to avoid and mitigate them.
- Raise awareness regarding social risks such as SEA/ SH, that may occur during the implementation and the required measures that should be taken in case of occurrence.
- Inform them about how to use the GM to give their opinions regarding social safeguard,
- OHS, and any complaints and concerns without fear.

5-2 Gender and related issues:

The sub-project is a priority to all community's groups, men and women, with non-discrimination based on gender, and it will serve all families living in the targeted area without exclusion. It will contribute to ensure the improvement of the water services to the beneficiaries and improving the health and environment in the area. Samples of beneficiaries, including women and men, were taken during the design of the project. The project will also help in improving the living conditions of the community in a positive way.

5-3 Child Labor:

All workers should be more than 18 years old. Verifying age of workers by checking IDs and official documents. Ensure a worker log is available, and all workers are registered giving their name and date of birth.

5-4 Recruitment of workers:

The contractor must not discriminate in recruitment of workers during implementation on the basis of gender.

5-5 Gender Based Violence- SEA/SH:

UWSSP contributed to raising community awareness during consultation regarding gender-based violence and sexual exploitation and abuse and sexual harassment, in addition to raising community awareness regarding the GM and how to use it to report complaints of SEA/SH with the highest levels of confidentiality and anonymity. To ensure effectiveness, the water and sanitation project will implement mandatory awareness sessions on refraining from unacceptable behavior towards community members through resident engineers for all workers, and also inform workers of national laws that make gender-based violence, sexual abuse and exploitation and sexual harassment a punishable crime.

5-6 Subproject sustainability:

Some of the issues that contribute to the subproject sustainability

1. The use of solar energy will reduce the cost of diesel fuel used for water pumping.
2. The use of solar energy helps in the continuity of water pumping during the interruption supply of diesel fuel and its high price.
3. The use of solar energy helps preserve the environment and reduces pollution.
4. The project will contribute to alleviating the suffering of displaced persons, the poor, and the population.
5. The project is an economic and social priority for the population.

6. The implementation of the project will contribute to the overall satisfaction of the beneficiaries, and therefore the community will support it.
7. The project has positive implications for the community.
8. Project implementation will not cause any type of the social conflicts.
9. The extent to which the project has disturbed the population in general.
10. The extent to which project works have caused pollution or waste to the surrounding environment.
11. The need for periodic maintenance of the solar power system.
12. Society's awareness of the complaint mechanism.

5-7 Consultation during implementation:

The water and sanitation project will engage stakeholders during project implementation through holding meetings with beneficiaries and local authorities to discuss any issues raised, aspects of implementation, as well as listen to stakeholders' concerns and feedback. Monthly meetings will be held with the stakeholders about four to six times during implementation to coordinate with them on implementation and protection issues, and conduct awareness and training regarding protection requirements and their monitoring roles. The resident engineers will also be in continuous cooperation and coordination when needed. Moreover, various meetings can be held with the local authorities to cooperate and facilitate the implementation. In addition, at the end of the implementation, a meeting will be held with the beneficiaries and local authorities to prepare for the operation process and training beneficiaries on maintenance and operation to ensure the sustainability of projects.

5-8 Photos of Public Consultation

Figure ١ photo during the interview with Mr. Abdullah Al-Wali (Director General of the WSSLC Branch office- Shibam)

Figure2 photo during the interview with Engineer Taha al-Hindi (Director General of the Local Water Corporation - Dhamar

Figure ٣ A photo during the interview with Ali Abdullah Ali Al-Quhali (an employee in the WSS Local Corporation Branch Office- Shibam)

Figure ٤ A photo during the interview with Mr. Nasher Baki Hami Kabool (District Local Authority Director – Shibam)

Figure ٥ A photo during the interview with Mr. Abdulkareem Mohammed Sharafadeen (Governorate Local Authority Deputy),

Figure ٦ A photo during the interview with Mr. Saleh Mohammed Saleh Al-Hajj.

Figure 7 A photo during the interview with Mrs. Donia Mohammed Hussein (Citizen)

Figure ٨ A photo during the interview with Mrs. Takwa Mohammed Mohammed Sa'atar (housewife-Shibam)

5-9 Grievance Mechanism GM:

Bank procedures require that Grievance Mechanisms (GMs) be established and operational prior to commencement of the sub-projects, and that they continue to operate for one year following completion of the works for third party settlement of disputes arising from resettlement. This GM should take into account the availability of judicial recourse as well as traditional and community dispute resolution mechanisms.

UNOPS has established Grievance Redress Mechanism (GM) for Yemen Emergency Human Capital Project (YEHCP) to enable beneficiaries to communicate their concerns regarding the project activities. More specifically, the GRM details the procedures that communities and individuals, who believe they are adversely affected by the project or a specific sub-project, can use to submit their complaints, as well as the procedures used by UNOPS and its local partners to systematically register, track, investigate and promptly resolve complaints.

Accordingly, hard copies of the translated application of the GM (which is attached as Annex 1) was provided to interviewed people and they have been informed that the GM contact information will be posted at the sub-project site to ensure any grievance can be addressed in an amicable manner. Resolving complaints at community level is always encouraged to address the problem that a person may have during implementation and/or operation phase.

In any case, the project implementing partners must maintain records of grievances and complaints, including minutes of discussions, recommendations and resolutions made.

5-10 GM Procedures for Complaints:

Registering Complaints:

UNOPS is providing multiple access points to the UNOPS GM focal point for beneficiaries to voice their concerns. These access points will be advertised at sub-project level and put on the sign boards on each sub-project site, and include GM contact information including hotline, landline, mobile SMS, email and website:

Address:	Haddah Street, former European Union Office Building, Sana'a
Tel:	+967 1 504914 and +967 1 504915
SMS:	+967 739888388
Email	grm-yemen@unops.org
Website:	www.unops.org

The GM contact information will be posted in Arabic and be communicated through multiple channels to ensure all groups can easily access contact information and relevant mechanisms to provide feedback.

Grievances can be brought up by affected people in case of: (i) non-fulfillment of contracts or agreements; (ii) disputes related to destruction of assets or livelihoods; (iii) disturbances caused by rehabilitation activities; (iv) concerns around safety and protection related to project's activities.

Anonymous complaints will be admissible to their attention verbally or in writing by sub-projects affected communities or individuals, and will relay these concerns in writing to UNOPS on a next day basis. UNOPS will determine if these concerns rise to the level of a complaint.

UNOPS will register the complaint in a dedicated log by gender, age, and location, and include a copy of the complaint and supporting documents. A draft template for registering grievances is annexed.

UNOPS will record and document complaints received in the sub-project file and the sub-project progress reports, including the number and type of complaints and the results of their resolution.

Tracking, Investigating and Resolving Complaints

The GM log maintained by UNOPS will track the date the complaint was received, date responded to, the type of response, and if the complaint was resolved to the satisfaction of the plaintiff.

The Environmental and social safeguard officer(ESSO) will coordinate with local partners, local field staff and local government officials to ensure prompt follow up action in response to each complaint. More specifically, the GM focal point will address complaints :

Inform the plaintiff if the complaint is accepted or rejected within 3 days from receiving the complaint; any technical input from project engineers; if necessary the response will require input from project engineers.

If the complaint is accepted, send the plaintiff an officially stamped review card indicating:

plaintiff name or legal representative
plaintiff address
complaint title
review date
list of annexes submitted with the complaint

Work with engineers, local partners, and contractors to resolve the complaint within 28 days of its submission.

Grievance Categories

The grievance could be among but not limited to the following categories:

- Access to project benefits (e.g., no or insufficient jobs created for local communities);

- Non-equal distribution of project services among target beneficiaries;
- Disputes (e.g. matters raised by/related to beneficiaries.

Disturbance (e.g. noise, traffic road access and public safety etc.).

Steps to handle GM

- Publicizing: stakeholder's consultation, printed materials;
- Receiving and registering complaints: staff at local and central level who will be responsible for receiving registering and tracking complaints;
- Acknowledging: The GRM staff (team) acknowledges receipt of the complaint within 2-3 working days. Inform the complainant on the eligibility of his/her complaint;
- Anonymous complaints: To be studied as well;
- Reviewing and investigating, collect, review and analyze related documents;
- Conducting interviews of the involved persons, officers and staff;
- Analyzing the related national legislations & regulations, World Bank Policies & Guidelines and UNOPS standards;
- Summarizing the facts and findings;
- Developing resolution options: based on the collected evidence, the GRM staff (team) will draw conclusions, make recommendations for solutions, and present it to the complainant;
- If the solution is not accepted, complaint will be presented to the Program Manager as a second level to appeal who can make the resolution and/or can delegate an arbitrator to investigate on the complaint and propose recommendations for resolution;
- Implementing resolution: If the solution is accepted, then it will be implemented;
- Monitoring and closing: the complaint should be monitored for a reasonable period to make sure that the complainant does not express additional concerns, and then complaint could be closed.
- Reporting (recording): prepare concise summary reports of the complaints received, with the resolutions taken and status of resolutions implementation, and filled in the database with detailed record. Table 10 summarizes the complaints management review process.

Table (5) Summary of Complaints Management Review Process

Summary of Complaints Management Review Process			
#	**Action**	**Responsibility**	**Time frame**
1	Complaint is submitted	Complainant	Any time when there is a complaint
2	Complaint logged into the YEHCP /UNOPS registration system with index number	GRM assigned staff	1 day
3	Confirm a receipt of complaint and notify complainant whether complaint is eligible or not.	GRM Assigned staff	Within 3 days

4	Gather evidence on the complaint and conduct interviews as necessary, analyze information and develop resolution on grievance.	GRM appointed staff/team including ESSO (at central level and local focal points	Within 10 days
5	Send notification letter to the complainant in case the investigation of the case is going to take longer than two weeks.	GRM assigned staff and ESSO	Within 14 days from the process start
6	Review and approve resolutions	Project Manager	Within 18 days
7	Produce grievance summary report	GRM assigned staff	Within 21 days
8	Inform the complainant on the resolutions (correction actions)	GRM assigned staff and ESSO	Within 21 days
9	Implement resolutions and report on the progress (monitoring)	Implementing Partners with contractors	Agreement for implementation
10	Close the complaint file and fill it in the system for documentation.	GRM staff, ESSO and Project Manager	3 days after sending response
11	Provide record of complaints, requests or inquires per month to the WB showing number of resolved and pending issues, for review and comments.	GRM assigned staff, ESSO and Project Manager.	Quarterly basis

Chapter 6. Mitigation measures

Environmental and Social Mitigation Plan

Mitigation measures have been determined to reduce the impact of potential environmental and social risks during the sub-project's implementation, which are provided in Table 6.

Labor Management:

Six months will be needed to complete site work and supply time for the sub-projects. There will be 21 employees working on the project. Each worker will have a daily working hours of 8 hours, and they will be entitled to 2 days off every week. These workers are contracted and will be hired locally. Although there is no need for lodging because the workers will be hired locally, they will use the restrooms present in the intervention areas.

The contractor shall:

- Ensure all working conditions as per national law and the ESS2 requirements are met
- Ensure all workers are more than 18 Years old.
- Ensure gender equality as possible in the subproject's cycle as a core principle for success.
- Protect the workers from any risk that may be encountered during the implementation
- Maintain occupational health and safety system in the site to protect workers from hazards and risks and provide adequate health and safety training, required PPE, first aid box, and toilets and potable drinking water
- Avoid all forms of forced, involuntary, unpaid or compulsory labor
- Provide health and medical insurance for all employees involved in onsite activities
- Ensure the contractor meets the requirements of the LMP
- Mobile latrines for workers must be implemented and connected to the public sewage network through the inspection rooms on the site, and it must contain wash hand and soap. It must be removed after the completion of the sub-project work.

The mitigation measures shall include:

- Inspect existing facility where solar panels are to be installed and apply all safety measures to reduce the risk of any injury to the workers during installation or the users during operation before implementation of work.
- Conduct regular awareness sessions about gender, SEA/SH, GBV and GM for workers.
- Provide the required safety and health PPE and hygienic materials to workers to protect workers and ensure their safety.

- Prepare and install emergency response plan onsite
- Provide fully insulated PPE, isolated installation tools, instruments and equipment.
- Install security fence and danger signage in the electrical hazard areas and chemical storage areas if any
- Provide safety training to all workers including working at installation, lifting operations, electrical, coating safety before commencing any work
- Provide the necessary first aid equipment in site and train workers on using first aid equipment and performing first aid.
- Hiring a flag-man for site arrangement and movements and paramedic
- Work site arrangement entails organizing the layout, safety measures, waste management, facilities, and utilities to ensure an efficient and secure working environment for project execution.
- Maintain good housekeeping measures
- Ensure good management of cables and warning signs are added next to cables and trenches to prevent tripping
- A health and safety training should also be provided to workers to avoid electrocutions and potential electric hazards and wearing proper PPEs.
- The impacts on the community health and safety can be mitigated through:
- Working hours will be in day hours.
- Install barriers, danger warning signs and restriction signs to only authorized persons and signs showing the potential danger to the public.
- Establish barriers around the working site

Table 6 : Potential Environmental and Social Risks Impact and Mitigation Measures

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
OHS Impacts Mitigation			
Lifting Operations: Failure of lifting equipment	Inspect ladders and scaffolds prior usage Wear head helmets while standing on ladders or scaffolds Ensure ladders and scaffolds are properly maintained and properly fixed	Contractor, LWSC , ESSO and UNOPS	BoQ Items
Falling in excavated trenches (60cm)	• Install barricades and signs around excavated zones or manholes • Grade soil away from the excavation • Fence or barricade trenches left overnight • Provide and install protective barricades and other equivalent protection to protect employees • Prohibit employees from working on faces of sloped or benched excavations at levels above other employees unless employees at lower levels are adequately protected from the hazard of falling, rolling, or sliding material or equipment.	Contractor, LWSC , ESSO and UNOPS	BoQ Items
Work Injuries and Electricity Shock Thermal burns Muscle, nerve and tissues damage due to electrical shock Fatalities or injuries	Apply all safety measures to prevent the risk of any injury to the workers by electricity shock during installation or the users during operation, and apply Hot Work Permit and Electricity Isolation Certificate subject to written approval by the UNOPS engineer provided before implementation of work. Carefully design using appropriate technologies to minimize hazards.	Contractor, LWSC , ESSO and UNOPS	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	Build security fences around electricity areas and chemical storage areas. Contractor electricians should be well trained and provided with appropriate insolated PPE and work tools and should be aware of electricity shocks and avoidance techniques. Install danger signage in the electrical hazard areas and apply all safety measures to prevent exposures. Avoid working during rainy times.		
Other risk related to OHS	Ensure skilled workers are hired for each work. Conduct regular awareness sessions and daily Toolbox Talks on OHS requirements before commencing any work. Periodic inspection to ensure that mitigation measures are implemented and stop any unsafe act or unsafe situation. Emergency response plan to be in place with details and contact of the nearest hospital is shibam hospital the distance to the hospital is around 1km or medical center, responsibilities are understood for all works, first aid boxes are available and a list of trained first aiders is posted and known by all workers with available transportation. Immediately report all accidental occurrences with serious accident potential to UNOPS and within 48 hours to the WBG	Contractor , ESSO and UNOPS	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	Contractor shall monitor, keep records and report on the following environmental and social issues: *Safety:* hours worked, lost time injury (LTI), lost workdays, recordable incidents and corresponding Root Cause Analysis (lost time incidents, medical treatment cases), first aid cases, high potential near misses, and remedial and preventive activities required (for example, revised job safety analysis, new or different equipment, skills training, and so forth). *Environmental incidents and near misses:* environmental incidents and high potential near misses and how they have been addressed, what is outstanding, and lessons learned. *Major works:* those undertaken and completed, progress against project schedule, and key work fronts (work areas). *ESHS requirements:* noncompliance incidents with permits and national law (legal noncompliance), project commitments, or other ESHS requirements. *ESHS inspections and audits:* by Project Company, Independent Engineer, UNOPS and its implementing partners, or others—to include date, inspector or auditor name, sites visited and records reviewed, major findings, and actions taken. *Maintaining a record of injuries and accidents specifying cause and location*		

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	Provide a list of trained workers, whom will be checked for their training skills. Measures will be implemented onsite and followed by regular monitoring visits. *Ensuring the contractor is taking care of the safety of workers while working in the site and give all necessary vaccines to workers to prevent any infection with epidemic and pandemic diseases. , and fulfilling insurance requirements for workers* *Provide health and life insurance to workers*		
Life and Fire safety prevention measures	There are several fire prevention measures during the design preparation, design review, technical specification preparation, work implementation and operation. -Ensure batteries are stored in ventilated rooms to prevent the buildup of hydrogen gas Fire Prevention measures during design stage: -Selecting the proper size of cabling compatible with international standards to avoid overloading/overheating of the cables. -Include appropriate size of circuit breakers between the system components to prevent electrical surge. Fire Prevention measures of the system specifications: -Ensure high quality cables standard outdoor and indoor are applied.	Contractor, LWSC, ESSO and UNOPS	

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	-Ensure high quality circuit breakers are provided. Fire Prevention measures during implementation and operations stage: -Detection and fire alarm system - Presence of Foam fire-extinguishers - Presence of Powder fire-extinguishers --Emergency Response plan -Provide Fire Safety training and drill for the facility operation staff and technicians. The following fire extinguishers should be provided: Powder extinguisher, according to BS EN 3 Parts 7 to 9 and SS EN3 &UL listed. Wheeled Foam Extinguisher, Approved to EN1866, High Quality 3% Foam, Long throw foam nozzle with grip control, one-person operation and movement with Refillable stored pressure unit. Working Pressure to be not less than 12 Bar, Test Pressure not less than 22 Bar, Temperature Range (-5/+60), 2 Year Warranty and testing check list of the extinguishers to be provided. Training on fire safety and how to use fire extinguishers shall be provided to staff		
Manual Handling Manual Handling Injuries that includes Fractures	Provide required information and training on manual handling to the site workers. Ensure applying safe handling techniques.	Contractor, LWSC , ESSO and UNOPS	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
Damage to muscles, ligaments and tendons Spinal disc injuries Trapped nerves Abrasions and cuts Burns Hernias	Remove space constraints, ensure good housekeeping and providing improved layouts Ensure manual handling tasks are limited to a single level and focus on enhancing floor and environmental conditions. Maintain clean, obstacle-free floors that are open, well-protected, and conducive to safe operations. The floor must be clean from any obstacles and should be open, clean and well protected. Ensure use of appropriate PPE and safety materials. Addressing potential use of handling aids with matching safety measures. Provide awareness on healthy lifting techniques in case this activity is present -Inform workers on safe lifting techniques to prevent back injuries		
Infection by Covid-19	UNOPS will ensure that contractor will provide health, safety and hygiene awareness and materials to staff, workers and visitors and provide proper training on health and hygiene issues. Contractor to maintain routine cleaning and disinfecting of surfaces, equipment, and other elements of the work environment. When choosing cleaning chemicals, employers should follow the manufacturer's instructions for use of all cleaning and disinfection products (e.g., concentration, application method and contact time, PPE).	Contractor, LWSC , ESSO and UNOPS	

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	Workers should wear masks, gloves and goggles at all times in the sites. And social distancing will be applied		
Excavation, dust emission and tripping and poor onsite housekeeping	Excavation will be less than 60cm depth. Excavation area to be appropriately secured using barricades, fences and precaution tapes Reflective Safety signs to be placed. Continuously remove the waste and transfer it to the approved disposal site by the local district authorities -Ensure workers are wearing masks to protect them against dust emission - Use dust sweeping methods and limited water for dust suppression - use minimal water for dust suppression	Contractor, ESSO and UNOPS	BoQ Items
Dust and noise emissions during excavation and while using machineries and equipment (OHS)	● Provide dust masks to workers ● Provide ear mufflers to workers working with or near noisy equipment and machines ● Ensure proper maintenance of equipment and machineries ● Use dust sweeping methods and limited water for dust suppression	Contractor, ESSO and UNOPS	BoQ Items
Road accidents while transporting equipment and materials	● Ensure drivers received awareness sessions on good driving practices such as maintaining speed limits and wearing seat belts ● Conduct drug checkups on drivers.	Contractor, ESSO and UNOPS	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
'Environmental pressures on workers (heat strokes, dust storms)	Allow resting breaks in shaded areas and provide workers with enough water Raise awareness on the importance of drinking enough water Provide proper PPEs against heat and dust Do not allow working during bad weather, rain, dust storms	Contractor, ESSO and UNOPS	BoQ Items
Dealing with hazardous chemicals and waste	Engineering control systems (e.g., local/general ventilation) must be established to maintain exposure to hazardous materials, agents, and environments within acceptable limits. The Material Safety Data Sheet (MSDS) must be available at the job site. Only trained workers can deal with hazardous chemicals and wastes Store, handle and dispose hazardous chemicals and wastes according to MSDSs Properly label any chemicals All chemical must be stored in secondary containers on insulated ground and according to their MSDSs When hazardous materials that are irritating to the skin or clothing may come into contact, first aid	Contractor, LWSC , ESSO and UNOPS	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	facilities and protective equipment must be provided. Protective equipment may include suitable gloves, appropriate face/eye protection covers and chemical protective suits. The process of disposal of surplus or excess materials and containers must be carried out so that it does not result in pollution or corruption of any water sources, groundwater, or rivers, and this process must comply with all laws and regulations. Precautionary Statements Keep away from heat/sparks/open flames/hot surfaces. - No smoking. Do not eat, drink or smoke when using this product. Use only outdoors or in a well-ventilated area. Do not breathe vapour/spray. Wear PVC or Nitrile coated gloves and safety glasses. IF INHALED: Remove person to fresh air and keep comfortable for breathing. Store in a well-ventilated place. Keep container tightly closed. Dispose of contents/container to hazardous waste collection point. Keep container tightly closed.		
Environmental Impacts Mitigation			

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
Air quality impacts from Excavation Dust generated by excavation activities, transport trucks Waste generated from the excavation	Apply dust suppression methods such as using grey water to control dust Use sweeping methods to avoid wasting water in dust suppression. Cover any waste material including soil that will be transported to designated landfills	Contractor, LWSC , ESSO and UNOPS	BoQ Items
Ambient Noise impacts from machineries	The work will take place during day-time. Properly maintain equipment Noise should be minimum (Maz 84 dB) during installation,	Contractor, LWSC and UNOPS	BoQ Items
Solid waste and E waste produced	Ensure that work wastes are properly stored at designated areas and are segregated (solid waste, E-waste) and regularly collected and transported to authorized disposal site and arrange for safe path of last destination of E-waste. Ensure waste storage areas are properly fenced and insulated Ensure good housekeeping measures are kept Ensure workers dealing with waste are wearing proper PPEs. Ensure handling E-waste to certified contractor to deal with it.	Contractor , ESSO and UNOPS	BoQ Items
Soil, surface and ground water	Ensure that work wastes are properly stored and regularly collected and transported to authorized	Contractor , ESSO and UNOPS	BOQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	disposal site and arrange for safe path of last destination of E-waste. Ensure waste areas are properly fenced and insulated. Ensure waste is stored in secure areas away from runoff zones. Ensure the presence of spill prevention kits in case of accidental spills from machineries used. Inspect machineries before usage and perform regular maintenance of machineries at service centers and away from runoff areas and at zones that have soil insulation Ensure batteries are stored on insulated ground from the soil to avoid soil contamination Store chemicals on insulated ground according to MSDSs and away from runoff areas and groundwater areas and wells Batteries must be stored according to manufacturer's guidelines and should be on concrete base away from soil and water resources to avoid contamination		

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	Latrines must be located away from runoff areas and water resources and wells and should be regularly cleaned and inspected		
Vegetation removal	Preserve existing vegetation whenever feasible Perform appropriate landscaping on completion using native species in consultation with environment authority Ensure construct /destruct produced martial are transported properly and not affects the surrounding environment and public	• Contractor to implement • WSLC to follow-up • PMU to supervise	BOQ Items
Social impacts mitigation			
Lack of workers awareness and knowledge on social safeguard issues on gender, SEA/SH, GM .	Contractor and workers to sign the code of conduct, and ensure workers respected and adhere to the code of conduct. Conduct regular awareness sessions on site in SEA/SH prevention. GM system is in place to handle any issue on SEA/SH. GM system for all workers including providing a complaint box and complaint means.	Contractor, LWSC , ESSO and UNOPS	
Child Labor	All workers should be more than 18 years old. Verifying age of workers by checking IDs and official documents. Ensure a worker log is available, and all workers are registered.	Contractor, LWSC , ESSO and UNOPS	BoQ Items
Inadequate stakeholder engagement	Ensure according to the ESMP and SEP continuous stakeholder engagement during implementation.	Contractor, LWSC , ESSO and UNOPS	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
	Submit periodic reports on stakeholder engagement Adherence to the implementation of GM requirements and GM.		
GM not working as intended	Increase sensitization of the GM among the communities Review the functionality of access points. Ensure regular reports on the complaints submitted to see how they are resolved or otherwise and the period it takes to address these complaints	Contractor, ESSO and UNOPS	
Public Health: Access of public working site. Impacts: Public Exposure to high risk activities (Lifting, Excavation,) Water cuts	Install barriers, danger warning signs and restriction signs to only authorized persons and signs showing the potential danger to the public. And establish barriers around the working site, equipment area and excavation area. Do not allow public to access working sites in all cases Avoid construction work during academic seasons Ensure proper storage of construction material and fencing the storage area to prevent accessibility. Inform the public on work periods.	Contractor, LWSC , ESSO and UNOPS	BoQ Items
Operational Phase			
Operation and Maintenance (Staff Health and Safety)	Same mitigation measures for installation will apply for inspection and maintenance as well for relevant risks.	Contractor, LWSC , , ESSO , UNOPS and	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
Operation and Maintenance (cleaning using water)	The contractor to offer a training to the facility workers on OHS measures during maintenance of the PV hybrid system Proper and regular maintenance to the system shall be performed Ensure water is used efficiently while cleaning the panels in order to avoid wasting water. The solar panel cleaning will be wiper cleaning and water saving practice by using Rubber Blade water sprayers with very little amount of water. Ensure wearing masks and ear mufflers when maintaining back-up generators or working near them Properly maintain generators Inspect any leakage and monitor fuel used	Authority Administration	
Lack of maintenance and deterioration of the hybrid system	-Ensure regular maintenance of the PV system is conducted -Ensure continuous monitoring to detect any malfunction early	Facility Administration.	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
Operation and Maintenance; Staff Health and Safety (i.e for risk of potential electric shock to the maintenance staff and working at height risks that may be caused during cleaning/ inspection or general maintenance of the solar panels system) and community health and safety (i.e at maintenance areas).	Same mitigation measures for installation will apply for inspection and maintenance as well. Training by contractor on OHS, environment and social measures before handing over to the facility shall be carried out.	Contractor, LWSC , , ESSO , UNOPS and Facility Administration.	BoQ Items
The disposal process for solar panels and batteries presents several Occupational Health and Safety (OHS) risks that need to be addressed: Chemical Exposure: Solar panels and batteries contain hazardous materials such as lead, cadmium, and other chemicals. Improper handling or disposal can lead to exposure risks for workers, causing respiratory issues, skin irritation, or other health problems. Electrical Hazards: Solar panels and batteries may still retain electrical charge even after being removed from the system. Workers must be trained to safely handle these components to	- Providing comprehensive training to workers on safe handling and disposal procedures. - Ensuring the availability and use of personal protective equipment (PPE) such as gloves, goggles, and respiratory protection. - Implementing engineering controls to minimize exposure to hazardous materials, such as ventilation systems or containment measures. - Following regulatory guidelines and best practices for the disposal of electronic waste, including proper recycling or disposal methods. - Conducting regular risk assessments and audits to identify and address potential hazards in the disposal process. -Arrange for proper disposal of batteries and panels at end of life in coordination with local authority and according to manufacturer's guidelines	LWSC , , ESSO , UNOPS and Facility Administration	BoQ Items

Potential Impact Factor	Mitigation Measure	Implementation Responsibility	Estimated cost (USD)
prevent electric shock or electrocution. Physical Strain: Solar panels and batteries can be heavy and awkward to handle, increasing the risk of musculoskeletal injuries for workers involved in their disposal. Improper lifting techniques or lack of mechanical aids can exacerbate these risks. Fire and Thermal Hazards: Improper disposal methods, such as incineration or exposure to high temperatures, can lead to fires or thermal hazards due to the flammable components within batteries or panels. Environmental Contamination: Incorrect disposal practices can lead to environmental pollution, such as soil or water contamination from leaching hazardous materials. Workers must follow proper disposal procedures to minimize these risks.	-Ensure batteries, generator and fuel are stored on insulated ground away from soil and water resources		

Chapter 7. Monitoring Plan

The Environmental and Social Monitoring Plan (Table 6) aims at ensuring effective and timely implementation of environmental and social mitigation measures. The monitoring plan include all sensitive environmental and social parameters; should be performed by well trained personnel; within a pre-defined timeline; and by utilizing available management resources and systems.

The site supervision engineer, PMU resident engineer, and WSSLC site supervisors' engineer must be at the site at all times. In addition, UNOPS/WASH Environmental and Social (ES) Consultant and PMU ES consultant visits the site during subproject implementation, if any environmental and social issues are identified, the visit should be carried out in bi weekly manner.

The site resident engineer should report on the environmental and social aspects. Hence the subproject lifetime period is short, so the environmental and social status report is expected to be submitted at start, middle and the end of the subproject implementation time period. However, if there any topical issues resident engineer should report immediately to the UNOPS ES consultant and the PMU management. The environmental and social reports should be supported with photos and any other supportive documents and records.

In case any environmental and social issues raised by the resident engineer, site monitoring visit should be conducted immediately by UNOPS/WASH ES safeguard consultant PMU ES engineer, the WSSLC engineer and contractor supervisions. Report should be submitted after monitoring is performed. In the event of non-compliance with environmental protection measures, a statement specifying the remedial period for contractor should be drawn up.

UNOPS also will receive information via GRM communication channels, if there are any deviation on the activities and if any harm to environment and people occurs. So, actions will be taken according to process set for handling and resolving complaints.

«Environmental protection» section will be included in regular progress reports prepared by technical supervision engineers. The section should contain compressed information and briefly describe monitoring activities as well as any arising issues and the ways to address them.

The final responsibility for the implementation of the ESMP remains with the Project Implementation Unit (PMU), and supervision of UNOPS team mainly the ES safeguard consultant. The mentioned above measures should be to be transferred in proper documentation to the contractor from the PMU.

Table 6: Monitoring Plan

Risks and monitored aspects	Measurements (incl. methods & equipment) and indicators	Frequency	Implementation responsibility
Community/Social- Health and Safety			
Public safety during the rehabilitation work.	Method: Visual observation and photographic documentation of safety measures. Visual observation for installing of warning signs, barricading of working area with safety tapes and fencing/barricades to prevent unauthorized access of public to the working site including workers entrance. Indicator: Number of grievances, number of recorded complaints. Number of incidents related to public safety.	Continuous/Daily	Contractor, LWSC , ESSO , and UNOPS
The risk of employing children for work activities.	Method: Site inspection, checking and documentation of contractor employee records and checking/verifying age documents. Indicator: Number of cases of employing workers under 18 years old during the regular inspection.	Weekly during site inspection and regularly by TPM	UNOPS , ESSO and TPM

External stakeholder engagement:	Highlights, including formal and informal meetings, and information disclosure and dissemination—to include a breakdown of women and men consulted and themes coming from various stakeholder groups, including vulnerable groups (e.g., disabled elderly, children, etc.). Indicators: Number of engagement sessions Number of persons per session (gender disaggregated)	Continuous/ Monthly	Contractor, LWSC , ESSO and UNOPS
External stakeholder grievances	Number of grievances and date submitted, action(s) taken and date(s), resolution (if any) and date, and follow-up yet to be taken grievances listed should include those received since the preceding report and those that were unresolved at the time of that report. Grievance data should be gender disaggregated. Indicators: Number of Grievance / Complaint received	Continuous/ Monthly	Contractor, LWSC, , ESSO, UNOPS and TPM
Low aesthetic value of landscape such as accumulation of waste and debris in the site.	Site inspection and documentation of general landscape. Indicators: Number of reported complaints related to landscape Presence of waste at undesignated zones	Continuous/Monthly	Contractor, LWSC , ESSO and UNOPS
GBV and SEA issues	Number of reported and registered cases of SEA/SH through project GM	Continuous/ Monthly	Contractor, LWSC, , ESSO , UNOPS and TPM

	Number of reported cases of contractor noncompliance to PSEA/SH obligations in work sites Number training/sensitization sessions held with workers and the community		
Poor coordination, planning and sequencing of work could lead to breakage of underground pipes (electric power cables,)	Inspection and photographic documentation. The contractor and UNOPS engineers should ensure that the site supervisor shall submit daily report on the movement of workers, approved and trained workers in place and conduct monitoring to ensure Permit to Work PTW and TBT applied and workers to be well informed about risks, mitigation measures and OHS requirements before commencing any work. Indicators: Number of grievances Number of electric power cables,	Continuous/Daily	Contractor, LWSC, , ESSO and UNOPS
General Environmental Impacts			
Air emissions and noise generation during work implementation from equipment/transportation trucks, excavation work etc	Method: Visual observation and photographic documentation of equipment induced dust clouds during work activities. Indicator: visible dust emissions Indicator: Number of complaints regarding noise and air emissions	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
Soil and groundwater contamination	Method: Visual inspection on soil, / spill inspection Indicator: - Presence of spills - Change in soil color	Continuous/Daily	Contractor, LWSC, , ESSO UNOPS and facilities Administration.

	- Presence of chemicals and batteries stored directly on the ground		
Waste generation, proper disposal and disposal of work's debris and waste materials.	Method: Inspection and photographic documentation. Indicators: Presence of waste at undesignated zones Presence of pests and flies Presence of waste receipts	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS
Environmental incidents and near misses	Records of environmental incidents and high potential near misses and how they have been addressed, how they have been reported, incidents review, and lessons learned. Monitoring working in good weather conditions.	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
Vegetation removal	Significant decrease in vegetation %cover Presence of dead vegetation	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
Occupational Health and Safety			
Lifting Operations and falling loads	Method: Visual inspection to ensure that all lifting activities in the work site are executed safely and as per the standard lifting safety rules. Indicator: Number of injured workers, cause of injury and the specific activity required PPE worker adherence. Indicator: number of times falling loads occurred and number of injuries from falling loads if any and number of near misses	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS

Electricity Work	Method: Visual inspection to ensure that all electricity safety rules are implemented, followed and communicated. Ensure that only skilled workers are authorized to perform any electrical operations. Indicator: Number of injured workers and the specific activity required PPE worker adherence.	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS
Fire	Method: Visual inspection to ensure that all fire safety rules and practices are implemented by providing the following extinguisher: Powder extinguisher, according to BS EN 3 Parts 7 to 9 and SS EN3 &UL listed. Indicator: Number of injured workers and the specific activity required PPE worker adherence. Number of fire events and causes Presence of fire extinguishers on site	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS
Manual Handling	Method: Visual inspection to ensure that all manual handling activities are performed according to the OSH manual handling safety rules and instructions. Ensure that the implementation of the safety techniques to control the manual handling risk is monitored continuously. Indicator: Number of injured workers and the specific activity required PPE and proper manual handling techniques worker adherence.	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS

Excavation	Visual inspection to ensure that all excavation activities are executed safely and all safety rules are implemented. Indicators: Presence of barriers and warning signs at excavation or cable zones to avoid tripping	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS
Hazardous substances and wastes	Method: visual inspection, complaints received/records Indicators: Zero complaint related to working site arrangement and safety, Proper first aid boxes are present Zero incident report related to site waste mismanagement Zero complaint on illegal offsite waste dumping Licenses for educate waste dumping site Designated permitted waste dumping site Zero incidents related to occupational health and safety equipment use Proper PPE and Occupational Health facilities Number of training sessions on occupational Health equipment and working site safety measures Records of environmental incidents and high potential near misses and how they have been addressed, how they have been reported, incidents Presence of waste receipt	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS

Proper housekeeping and health risks	Visual inspection to ensure that health, safety and hygiene awareness are followed and communicated. Visual inspection to ensure that all health, safety and hygiene materials are provided. Indicators: number of sick workers Presence of suitable PPEs and soap and water in toilets	Continuous/Daily	Contractor, LWSC , ESSO and UNOPS
Work related accidents and injuries.	Method: inspections and documentations Indicator in the records: number of injured worker and activity leading to injury	Continuous daily	Contractor, LWSC, , ESSO , UNOPS and TPM
Poor onsite housekeeping, toilet and water supply, leading to illness and disease.	Method: Site inspection. Indicators: presence of pests, domestic waste located outside designated bins, use of soap and sanitizer not observed	Weekly during site inspection and regularly by TPM	UNOPS, ESSO and TPM
Safety	Hours worked, recordable incidents and corresponding Root Cause Analysis (lost time incidents, medical treatment cases, first aid cases, high potential near misses, remedial and preventive measures required (for example, revised job safety analysis, new or different equipment, manual handling and skills training etc.	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
Complaints.	Method: GM reports Indicators: Number of GM Reports and number of solved issues.	Continuous/weekly	Contractor, LWSC , ESSO and UNOPS
Major works:	Work undertaken and completed, progress against project schedule, and key work fronts (work areas).	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS

E&S and OHS requirements:	Non-compliance with OHS requirements, national law (legal noncompliance), project commitments and E&S requirements.	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
E&S/OHS inspections and audits:	By contractor, engineer, or others, including authorities to include date, inspector or auditor name, sites visited and records reviewed, major findings, and actions taken. Indicators: Presence of suitable PPEs (dust masks, and ear mufflers) Number of workers adhering to proper PPEs Presence of first aid kits on site and trained workers to perform first aid Details of nearest hospital is present on site.	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
Workers:	Method: Labor log Indicators: Number of workers, indication of origin (expatriate, local, nonlocal nationals), gender, age with evidence that no child labor is involved, and skill level (unskilled, skilled, supervisory, professional, management).	Continuous/ Daily	Contractor, LWSC , ESSO and UNOPS
Training on E&S issues	Method: training reports including dates, number of trainees, and topics. Indicators: number and type of trainings and details provided	Continuous / Weekly	Contractor, LWSC , ESSO and UNOPS

Footprint management:	Details of any work outside boundaries or major off-site impacts caused by ongoing work—to include date, location, impact, and actions taken.	Continuous/ Monthly	Contractor, LWSC , ESSO and UNOPS
Worker grievances:	Method: worker's GM reports Indicator: Number of workers grievances and solved grievances and details including occurrence date, grievance, and date submitted; actions taken and dates; resolution (if any) and date; and follow-up yet to be taken grievances listed should include those received since the preceding report and those that were unresolved at the time of that report.	Continuous/Monthly	Contractor, LWSC, , ESSO, UNOPS and TPM
Major changes to contractor's environmental and social practices.	Monitor and record contractor's environmental and social practices and noncompliance through visual inspections. Indicator: Presence of activities out of scope Non compliances with safety measures such as presence of PPEs, designated waste zones, no temporary latrines, GM channels are missing etc.	Continuous/ Monthly	Contractor, LWSC, , ESSO, UNOPS and TPM

Deficiency and performance management	Actions taken in response to previous notices of deficiency or observations regarding E&S performance and/or plans for actions to be taken—these should continue to be reported until UNOPS determines the issue is resolved satisfactorily.	Continuous/ Monthly	Contractor, LWSC, , ESSO, UNOPS and TPM
Complaints Handling	Method: Complaint register Indicator: Presence of an updated complaints register be kept on site and this will feed into the GM. Details of complaints received will be incorporated into the audits as part of the monitoring process.	Continuous/ Monthly	Contractor, LWSC , ESSO and UNOPS
Operation and Maintenance			
Training to facility staff on PV hybrid system and OHS	Method: visual inspection on training records Indicator: Number of trainings received by facility workers and type of training.	Prior to handing the operation of the generators	Contractor, LWSC, , ESSO ,UNOPS and TPM

Operation and Maintenance (Staff Health and Safety and community health and safety) and maintenance of hybrid system	Follow same monitoring measures related to OHS, Env, and Soc during construction for relevant works - Number of complaints regarding waste - Visible detection of waste stored at undesignated zones - Change in soil color from fuel spills - Number of maintenance work performed - Number of complaints regarding water cuts - Number of times the hybrid system stopped working. - Number of fire events and major events - Water quality's parameters above legal limit - Significant decrease in water levels.	Follow same frequency for related OHS, Env and Soc during construction of relevant works For maintenance (monthly). For monitoring water levels and quality (monthly)	Facility operator
All costs will be under the responsibility of each party including the contractor and will be included in the contract BoQ.			

Annex 1: GM Complaint and Suggestion Form

مشروع رأس االمال البشري الطارى

نموذج لألية التظلمات والشكاوى

Yemen Emergency Human Capital Project
YEHCP

Sample of GRM

"Documenting and Monitoring Complaints Form of Beneficiaries

الاسم الثلاثي للمستفيد: Beneficiary Name			
رقم البطاقة الشخصية: ID No.		رقم الهاتف للمتابعة .Tel No for follow up	
العنوان الدائم: Permanent Address			
اسم النشاط المنفذ (مركز/وحدة) Name of activity under implementation			
مكان تنفيذ النشاط: Place of activity under implementation	القرية: Village	المديرية: District	المحافظة: Governorate

نوع الشكوى Complaint Type	إدارية Administrative	فنية Technical	مالية Financial	أخرى Other

موضوع الشكوى:

الوضع الحالي: Current Situation			
أسباب المشكلة: Reason of the problem			
التاريخ: Date		توقيع صاحب الشكوى: Complainant Signature	

- الجهة التي يجب أن يقدم لها الشكوى:.. **UNOPS/Sana'a – Tel: 01 504914/915 - SMS:739888388 Email:**
..... **GRM.yemen@unops.org**
The entity which the complaint should be forwarded to:
-الرأي في جدية الشكوى:.....
Opinion on the seriousness of the complaint
-الجهة المحول لها الشكوى :.....
The complaint transferred to
- المدة الزمنية اللازمة للبت في الشكوى:.....
Time required for response
-مدى رضى المستفيد عن الاستجابة لحل شكواه:.....
Satisfaction of beneficiary in responding to his/her complaint

الإجراءات المتخذة : Action taken			
ما ترتب عليها من نتائج: The results of the action taken		التاريخ: Date	

اسم مستلم الشكوى ووظيفته: .....
Name of person received the complaint and his/her position
التاريخ Date : ..... توقيع الموظف المختص/ Signature

Annex 2: List of Stakeholder Consulted (available upon request)

Annex 3: List of Stakeholder Consulted (available upon request)

Annex 3: Technical specification

Electrical Works

PART A (PV and Electrical Systems)

PV Module

- The capacity of the solar modules should be at least 40 % greater than AC motor pump.
- Module capacity should not be less than 650 W @STC
- The solar modules should be designed to run near the MPPT
- Type of cell: Poly or Mono Crystalline, 5 busbar technology
- The PV manufacturer should be approved as tier-1.
- Module efficiency: should not be less than 17.5%
- Positive Tolerance of maximum power rating
- The PV modules junction box must be IP67
- Should be supplied from approved tier 1 manufactures only.
- Module Voltage: Not less than 1500 VDC;
- Operating temperature: -40°C to 85°C
- Temperature Characteristics: P max: -0.42% /C° or less
- VOC: -0.31% /C° or less;
- Nominal operating cell temperature (NOCT) : 45 ±2°C.;
- Weather proof DC rated MC4 connector. Fully Secured, not allowing for any loose connections.
- High transmittance tempered glass: Minimum thickness of 4.0 mm;
- Must conform to IEC 61215, 61730, 61701, and UL 1703.TUV, UL certificates or equivalent;
- Certificates and Data sheet of PV module that contains the P-V & I-V Curves, all electrical and mechanical Data, Dimensions, Module area should provide by bidder;
- Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years;
- Product warranty shall be at least 12 years.

Solar Pumping Inverter Controller

The solar pumping drive is required, the drive should have a long lifetime, low maintenance

cost, inbuild MPPT + VFD (Variable Frequency drive). The drive rating should be 1.25 X

AC pump rating and it shall follow below features:

- Three phase output, voltage range 380-420 V;
- Efficiency: Not less than 95%;
- Output Frequency: 50H±3%;
- Enclosure class should be not less than IP55.
- Maximum input voltage Voc): not less than 850 VDC;
- The system should be designed to run near its MPPT range;
- Operating temperature: up to 45 °C;
- Such device should have built in data loggers
- The device shall allow hybrid operation with external power source, where solar power should be configured as the primary power source;
- Soft start, V/F stable speed control during solar radiation changes, adjustable auto/ manual start in early morning, auto wakeup after adjustable hibernation time in cloudy days, and inputs for pressure switch and water level sensor to protect the pump against dry running and tank full water or closed pipeline (high pressure)
- Display: LCD Screen display with Cover + LED status indicator
- Protection: Over-Voltage, pump Over-Current, pump Over-Load, Over-Temperature, pump Phase Loss, pump Short-Circuit, ground fault, solar low power, DC Input Antireverse, AC output unbalance (3Phase);
- Display content: PV status (Current, Voltage, Power, Energy), AC input voltage, AC output voltage, Load, Running Status, RPM, and Frequency.
- Product warranty should be at least 2 years

PV Combiner Box

The PV combiner box shall be used to combine the multiple DC input to one output, and it

shall comply with the following specifications as minimum.

- Enclosure materials: Coated metal with lockable door.
- Enclosure protection: IP65.
- Number of input circuit: total number of strings in addition to 2 spare inputs.

- DC fuse rating for each string:1500V, 25 A.
- DC output circuit: In accordance with the maximum current X 1.25, 1500 VDC
- breaker;
- Built in surge protection device;
- Anti-backflow diodes.
- Operational Environment Temperature: -30 °C ~+70 °C;
- Product warranty shall be at least 2 years.

System Cables:

Cables should be sized in accordance with IEC 60364-5-52 standard, bidders should submit cable sizing, cable sizing, and voltage drop calculations taking into account that the maximum voltage drop should be drop should be no more than 3% for each side (AC and DC);

3phase, AC Submersible Pump Cable

Voltage rating: 450/750VAC, Type of Conductor: copper, flexible, finely multi stranded, Insulation: AD8 rated black poly chloroprene, HO7RN -F or equivalent material.

- DC Cable (From array to Combiner Box)

Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colours: black, red, Type of Conductor: tinned copper, flexible, finely multi stranded

- DC Cable (From Combiner Box to inverter)

Made of double insulation material and jacket, TUV certified, 1000VDC, Sheath colours: black, red, type of Conductor: tinned copper, flexible, finely multi stranded

- Water level Cable with Sensor

- Submersible cable, 1 ×1.5 mm2 mm, double sheath.
- Dry running electrodes**.**

Cable Laying

- All above ground cables shall be installed in perforated galvanized cable tray with cover. Cable tray shall be supported with concrete blocks in appropriate intervals or on the mountings structure.
- Under-ground cables shall be installed in cable trench 60 cm depth with PVC Sch#40pipes as per drawings.
- 50% spare for future expansion

Earthing and Lightning Systems

AC and DC Earthing

- All PV modules shall be grounded in accordance to the manufacturer instruction
- Each array structure of the PV modules should be grounded properly.
- All metal casing/shielding of the system and its components should be thoroughly grounded.
- Earthing System shall be complied with IEC/BS EN 62305-3.
- Earthing installation in accordance with the IEE Wirin1g regulations BS 7671.
- Earthing clamps shall be used.
- Grounding and lightening protection equipment shall include SPD, earth pits and Rods
- Grounding resistance should be not more than 5 ohm.

Lightning System

- Lighting arrestor should be provided.
- Lightning arrester shall be installed with height to protect all PV arrays.
- Lightning System shall comply with IEC/BS EN 62305-3.
- Minimum height of lightning arrester is 1.5 m.
- System resistance should be no more than 1 ohm.

Moulded Case Circuit Breaker (MCCB)

- 400V, 3P & 25KA
- NEMA 3R enclosure and powder-coated steel construction
- Lockable front door, wall mounted type, direct handles, Locking devices, Auxiliary contacts and Protective plates.
- 3 ways at least, shock and vibration proof contacts.
- Conform to BS EN 60947-3 and UL 1008 Listed.

PART B (Safety and Security)

Solar Outdoor Lighting

- Minimum capacity 60 Wp lamp compact type (All in one) or separated module (
- battery shall be built-in with the lamp)
- Lamp luminous efficacy: not less than 100 Im/w.
- Working lifetime: not less than 30,000.
- The color temperature range: 3000K – 5000K.
- The LED lamps are outdoor designed with IP 65 protection.
- Operating Temperature range: up to 60°C.
- Certification: All related certificates shall be provided such as CE, RoHS.

- PV module and Battery capacities shall cover all energy consumption by lamp for 12
- Hr at least.
- Provided with mounting support and all required accessories.
- Fence supports cannot be facilitated for the installation of lighting
- Shall be distributed to light all areas of PV modules and well-head rooms.
- Warranty: at least two years.

Fire Extinguishers

- A portable fire extinguisher shall be provided, 2 extinguishers for each facility should
- be supplied near the solar inverter unit.
- Powder / CO2 extinguishers.
- Approved to EN1866.
- 5- 6 kg capacity.
- Made of high strength steel cylinders with a red epoxy polyester paint finish.
- Warranty: at least two years.

Smoke and Heat Detector

- Smoke and heat detector, including button for false alert. Battery for three years long
- life, warning sound delivers sounds of >85 dB

PART C (Mechanical)

Submersible Pump and Motor:

Surface Pump and Motor

- Pump Efficiency at Duty Point: Not less than 60%,
- Skid mounting Horizontal multi-stage centrifugal pump
- Material : Cast or Ductile Iron
- Stainless steel Shaft
- Tungsten carbide bearing or equivalent
- Mechanical Seal: Carbon/Sci
- Motor Speed:1850rpm – 2950rpm
- Product warranty should be at least 2 years.

Motor

- The motors shall be Rewindable, insulation rating is compatible with AC VFD operation
- Rated Voltage:380/400 VAC
- Insulation Material and Class, PE2+PA
- Ambient water temp:40 C°
- Motor Efficiency: Not less than 80%
- Motor Speed:1850rpm – 2950 rpm
- Product warranty should be at least 2 years.

Piping Equipment Martial :

Piping equipment shall include any required fittings and materials for proper installation or existing system modification such as elbows, tees, sockets, flanges, piece of pipes, ..etc with high quality and high rating, piping equipment shall be installed inside the valve chamber.

Mechanical Water Flow Meter

- Inline, Flanged, Magnetic type, Dray dial, turbine flow meter with all needed accessories such as
- such as threaded flanges, gaskets and bolts.
- Nominal Diameter (DN): Shall be selected according to output pumping line diameter.
- Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of the pumping line.

the pumping line.

- Body: Cast Iron
- Standard: EN14154, ISO4064
- Transient Flow Qt : Shall be less than 50% of Pump flow rate.
- Accuracy: ±2% of Nominal flow
- Maximum dial indication: 999999
- Measuring Units: cubic meter m3

Horizontal Pumping line Non-return Valve.

- Nominal Diameter (DN): Shall be selected according to pumping line diameter.
- Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of
- the pumping line.
- Connection Type: Flanged.
- Type: Swing
- Standard: BS5153 or Equivalent
- Body Material: Cast Iron (Gg25)
- Spindle: Stainless steel
- Complete with flanges, gaskets, bolts and nuts

Gate Valve

- Nominal Diameter (DN): Shall be selected according to pumping line diameter.
- Nominal Pressure (PN): Shall be selected according to output pressure on the beginning of
- the pumping line.
- Connection Type: Flanged.
- Standard: BS BS6163 or Equivalent.
- Operator: Hand Wheel
- Resilient Seated.
- Body Material: Cast Iron(Gg25)
- Stem: Stainless Steel
- Complete with flanges, gaskets, bolts and nuts

Pressure Switch

- High pressure Low pressure function
- Regulating range: Shall be selected according to output pressure on the beginning of the
- pumping line
- NO/NC electric connection
- NPT thread connection to pipe
- Manual trip function
- IP44 to EN 60529 / IEC 60529
- Shall be equipped with isolation Stainless steel 1/2 inch Ball valve of the same pressure
- rating.

Analogue Pressure Gauge.

- Reading range: Shall be specified according to the pressure on the installation point.
- Process connection: NPT connection 1/2" or 1/4".
- Pressure gauge should be equipped with isolation Stainless steel 1/2 inch Ball valve of the
- same pressure rating.
- Casing: Stainless steel, 4 inch

Well Cap / Cover

- Material: made from A36 or equivalent CS plate
- Min. thickness: 18 mm for borehole wells caps
- Painted by Anti-corrosion Paint
- Diameter: Shall be more than well diameter
- Fabricated with stiffeners and holes for pump and sensor cables
- Stiffeners shall be holed for lifting purposes

2.3 Scope of Work

BOQ - Equiping Solar PV System for Shibam Kawkaban Pumping Station

BOQ - Equiping Solar PV System for Shibam Kawkaban Pumping Station						
Item #	Description	Unit	Qty	Unit Price (USD)		Total Price (USD)
				Figures	Words	
A	Electrical Works					
	PV System	-	-	-	-	-
1	Solar PV Module Supply, install, test, and commission a solar PV module with the following specifications: Wattage: 650Wp Efficiency: 21% Operating temperature range: -40 to +85 degrees Celsius Warranty: 10 years product, 25 years performance	No.	144			
2	Mobile, unheated high pressure cleaner Supply, delivery, test and commission of a mobile, cold water high-pressure cleaner such as Kärcher HD 10/23-4 S with the following specifications: • Working pressure = min 200 Bar • Motor = 4-pole, three-phase motor with air and water cooling Price shall include providing all required solar panel cleaning equipment, include brushes such as Kärcher iSolar 800 water-driven brush head or equivalent, sprayers, chemical cleaners such as RM 99 Solar Cleaner or equivalent and extender poles as well. A-shaped Ladder Supply A-shaped Ladder Telescopic lifting household folding double-side, 2.5 meter high, metal.	No.	1			

3	Solar PV Pump Inverters Supply, install, test, and commission three-phase Solar Pump Inverters (Controllers) with the following specifications: • Voltage: 380-420 V • Frequency: 50 Hz • Built-in MPPT • Soft start • V/F speed control with solar radiation auto and manual start and stop • Monitoring system • All required accessories such as controls, wires, etc. • Capacity: Not less than 70 kW	No.	1			
4	<u>PV Combiner Boxes</u> Supply, install, test, and commission PV Combiner Boxes with the following specifications: * 9 string imputs + 2 spare inputs • Enclosure materials: Coated metal with lockable door • Enclosure protection: IP65 • DC fuse rating for each string: 1500V, 25 A • DC output circuit breaker: In accordance with the maximum current × 1.25, 1500 VDC • Built-in surge protection device (SPD) 40KV, 1500V • Anti-backflow diodes • The work and installation should be achieved as per technical specifications and drawings	No.	1			
6	DC Solar Cable	Notes	-	-	-	-

6.1	Solar PV Cable Supply, install, test, and commission of Solar PV Cable from array to combiner boxes as per technical specifications and drawings. • Cable type: Solar PV cable • Size: 1×6 mm² • Insulation: Polyethylene • Jacket: PVC • UV resistant • Flame retardant • The cable must be installed in accordance with the technical specifications and drawings. • The cable must be tested for continuity and insulation resistance. • The cable must be commissioned by a qualified electrician.	m	350			
6.2	Couple of Solar Connectors Supply, install, test, and commission of a couple of solar connectors of the same type and manufacturer of the PV panel as per technical specifications and drawings. • Connector type: MC4 connector • Size: 6 mm² • Quantity: 2 (Pair male and female) • The connectors must be of the same type and manufacturer as the PV panel. • The connectors must be installed in accordance with the technical specifications and drawings. • The connectors must be tested for continuity and insulation resistance. • The connectors must be commissioned by a qualified electrician.	No.	9			

6.3	Solar PV Cable Supply, install, test, and commission of Solar PV Cable from PV combiner boxes to Inverter as per technical specifications and drawings. • Cable type: Solar PV cable • Size: 1×150 mm² • Length: As per drawings • Insulation: Polyethylene • Jacket: PVC • UV resistant • Flame retardant • The cable must be installed in accordance with the technical specifications and drawings. • The cable must be tested for continuity and insulation resistance. • The cable must be commissioned by a qualified electrician.	m	140			
7	AC Power Cable:	No	-	-	-	-
7.1	AC Power Cable Supply, install, test, and commission of AC submersible power cable CU/XLPE/PVC with the following specifications: • Cable type: CU/XLPE/PVC • Size:(4× 95 mm²) • Number of cores: 3 • Conductor per phase: 1 • Insulation: Cross-linked polyethylene (XLPE) • Jacket: PVC • UV resistant • Flame retardant • Voltage rating: 450/750 VAC • Type of conductor: Copper, flexible, finely multi stranded • Insulation: Black polychloroprene, HO7RN-F or equivalent material	m	20			

7.2	Level Sensor Cable Supply, install, test, and commission of Level Sensor Cable with probes with the following specifications: • Cable type: Level Sensor Cable • Size: 3 x 1.5 mm² • Number of probes: 3 • Probe material: Stainless steel • Probe insulation: Polyurethane • Cable jacket: PVC • UV resistant • Flame retardant	m	50			
8	Cable Tray	No	-	-	-	
8.1	Cable Tray Supply, install, test, and commission of covered cable tray for AC with all required accessories with the following specifications: • Material: Hot dipped galvanized steel (120 micron) • Thickness: 1.2 mm • Width: 20 cm • Depth: 10 cm • Length: As per Quantities • Tray coating: Powder coated • Tray finish: Black • Tray accessories: Cable tray brackets, cable tray supports, cable tray covers, cable tray labels • The cable tray must be installed in accordance with the technical specifications and drawings. • The cable tray must be tested for strength and durability. • The cable tray must be commissioned by a qualified electrician.	m	50			

9	<u>Earthing System</u> Supply, install, test, and commission of Earthing System with the following specifications: • 2 x Copper rods, tap-clamps, earthing pits (Y/G earthing cable, earthing pits and all system accessories). • 3 x Earth bus bars. • Main earth cables (Bare cables between earth rods, earthing bars and its interconnections) should not be less than 70mm2 bare copper. • The sizing of earthing conductor and earthing installation shall be according to IEE Wiring regulations & BS 7671. • Earth resistance should be tested in presence of the UNOPS representative by calibrated earth tester, the earth resistance should not be more than 5 Ohm. • All conductive materials shall be copper.	System	2			
10	<u>Lightning System</u> Supply, install, test, and commission of Lightning System with the following specifications: • Lightning arrester: Copper • Lightning arrester height: As per drawings • Lightning arrester compliance: IEC/BS EN 62305-3 • System resistance: Not more than 1 ohm • Earthing installation: In accordance with the IEE Wiring regulations, BS 7671 • All conductive materials: Copper • Conductor size: According to table 54.7 of IEE – BS 7671 – IEC 60365-5-54	System	1			

11	Cable Trench Supply, install, test, and commission of Cable Trench with the following specifications: • Depth: 60 cm • Width: 60 cm • Filling material: Sand or gravel • Conduits: PVC or steel • Marker tape: Yellow or orange • Civil work: Excavation, backfilling, compaction • Pipe fittings: Elbows, tees, couplings • Connection to manholes: Flexible conduit or sleeve • 12 mm nylon rope: For pulling cables • Required sleeves: For protecting cables from sharp objects All necessary accessories: As per drawings, specifications, and related codes and standards	m	40			
12	Manhole Supply, construct, and install a Manhole with the following specifications: • Size: 70 x 70 cm • Material: Solid concrete blocks 15 x 20 x 40 cm • Watertight and airtight • Base: At least 15 cm thick of cast in situ concrete • Plastering: Yes • Painting: Two coats of hot bituminous paint • PVC cover: Yes, can withstand 200 kg/m² • All work to be completed in accordance with the technical specifications and drawings • To the complete satisfaction of the supervisor engineer	No	3			
13	Fire alarm System Supply, install, test and commission of a fire alarm system including all necessary accessories such as fire-resistant cable, trunkeys, metal conduit pipes, and proper labeling with complete drawings and documentation.	No	1			

13.1	Smoke and Heat Detectors Supply, install, test, and commission of standalone smoke and heat detectors. Smoke detectors: • Must be photoelectric or ionization type • Must have a sensitivity level of at least 5% obscuration • Must have a battery backup • Must be labeled in a clear and concise manner Heat detectors: • Must have a heat detection range of at least 50°F to 150°F • Must have a battery backup • Must be labeled in a clear and concise manner	No.	2			
13.2	Fire CO2 Extinguishers Supply, install, test, and commission of fire CO2 extinguishers, according to specifications including: • Must be 5KG CO2 type • Must be approved to BS EN 3 Parts 7 to 9 and SS EN3 &UL standards • Must have a discharge time of at least 10 seconds • Must be labeled in a clear and concise manner Accessories: • Must include a carrying case • Must include a hose • Must include a nozzle	Pcs	1.0			
13.3	Powder Extinguishers Supply, install, test, and commission of powder extinguishers, according to specifications including: • Must be 6 kg powder type • Must be approved to BS EN 3 Parts 7 to 9 and SS EN3 &UL standards • Must have a discharge time of at least 10 seconds • Must be labeled in a clear and concise manner Accessories:	Pcs	2.0			

	• Must include a carrying case • Must include a hose • Must include a nozzle					
13.4	Wheeled Foam Extinguisher Supply, install, and commissioning of a Wheeled Foam Extinguisher, according to specifications including: • Size: 50 liters • Material: Steel • Type: Wheeled foam extinguisher • Approvals: EN1866 • Foam concentration: 3% • Foam nozzle: Long throw with grip control • Operation: One-person • Movement: Removable wheels • Pressure: Working pressure not less than 12 Bar, test pressure not less than 22 Bar • Temperature range: -5/+60 • Warranty: 2 years • Testing: Testing checklist to be provided as per drawing	Pcs	1.0			
14	LED Lighting Supply, install, test, and commission of LED lighting with all required accessories as per technical specifications including:• Must be LED type• Must be dimmable• Must have a lifespan of at least 50,000 hours• Must be labeled in a clear and concise manner Accessories:• Must include a power supply• Must include a mounting bracket• Must include a controller	No				

14.1	Solar LED Street Light Supply, install, and commissioning of a solar LED street light as per technical specifications including: LED: • Maximum output: 40W • Efficacy: At least 120lm PV module: • At least 60Wp Battery: • Type: LiFePO4 • Voltage: 12.8V • Capacity: At least 27 AH Mounting system: • For fence poles	Set	4			
15	<u>Project sign boards</u> Supply, install, and maintenance of a project sign board with the following specifications: • Size: 1.6m x 1.4m • Height from ground: 1.2m • Material: Similar to specified large sign support • Information: Written in Arabic and English Languages as shown in attached drawings, and any other information instructed by the Employer/Engineer	pcs	1			
16	System Maintenance: System maintenance for a period of 1 year, including preventive maintenance visits as per scope of work. Preventive maintenance visits: • The contractor will visit the system on a 3-month basis to perform preventive maintenance tasks. The preventive maintenance tasks will include: • Cleaning and inspecting the system components. • Lubricating the system components. • Replacing any worn or damaged components. Corrective maintenance:	Lump Sum	1			

	• The contractor will repair any system components that fail during the warranty period. • The contractor will also repair any system components that are damaged due to negligence or misuse.					
17	System Training: Comprehensive training on how to operate and maintain the system. The training will cover the following topics: • System overview • System operation • System maintenance • System troubleshooting • The training will be conducted by a qualified instructor. • The training will be tailored to the specific needs of the owner's staff. Training materials: The contractor will provide the following training materials: • Training manual • Training exercises • Training videos	LS	1			
	Total Carried to Summary Page 1					
	Sub Total (1)					
B	Mechanical Works	-	-	-	-	-
2	<u>PIPING MATERIAL VALVE CHAMBER:</u> Supply, install, and commissioning of piping materials with all required required fittings, as per drawings and technical specifications including: Pipe: 4 inch, PN40, carbon steel	LS	1.0			
2.1	Mechanical flow meter: 4 inch, with a flow rate of up to 1000 liters per minute	No.	1.0			
2.2	Gate valve: 4 inch, PN40, with a pressure rating of 40 bar	No.	1.0			

2.3	Non-return valve: 4 inch, PN40, with a pressure rating of 40 bar	No.	1.0			
2.4	Air vent valve (Air releaser), 1 inch, PN40	No.	1.0			
2.5	Valves Chamber	No.	1.0			
3	Pumps Interconnection Piping Materials Supply, install and commissioning Piping Materials with all required picespieces of pipes , fittings, gaskets and accessories	No				
3.1	Gate Valve, 4" , PN 40 , Flanged , Cast Iron	PCS	1.0			
3.2	Universal Flexible joint, 4", PN 40 , Flanged with tie rods , Stainless steel	PCS	1.0			
3.3	Y- Strainer, 4", PN 40 , Flanged, Cast Iron	PCS	1.0			
3.4	Gate Valve, 4" , PN 40 , Flanged, Cast Iron	PCS	1.0			
3.5	Air vent valve (Air releaser), 1" , PN 40 , cast Iron .	PCS	1.0			
3.6	Universal Flexible joint, 4", PN 40 , Flanged, Stainless steel for the inlet of the pump.	PCS	1.0			
3.7	Non-return Valves, 4", Flanged , PN40	PCS	1.0			
3	Analog Pressure Gauge: Supply, install, and commissioning of an analog pressure gauge, as per drawings and technical specifications including: • Range: 0-50 bar • Accuracy: ±1% of reading • Resolution: 0.1 bar • Connection: G1/4 NPT • Housing: Stainless steel • Dial: Black • Needle: Red • Mounting: Back mount	No.	1.0			

4	<u>Pressure Switches:</u> Supply, install, and commissioning of pressure switches, as per drawings and technical specifications including: • Setting pressure: 35-36 bar • Accuracy: ±1% of reading • Response time: <1 second • Connection: G1/4 NPT • Housing: Stainless steel • Terminals: Screw terminal block	No.	1.0			
7	<u>Electrical Surface Horizontal MultiStage Pump</u> Supply, install and commissioning of horizontal multistage surface Pump Head: 370 m , Capacity : 36 m3/hr <u>Pump</u> • Pump Efficiency at Duty Point: Not less than 60%, • Skid mounting Horizontal multi-stage centrifugal pump • Material : Cast or Ductile Iron • Stainless steel Shaft • Tungsten carbide bearing or equivalent • Mechanical Seal: Carbon/Sci • Motor Speed:1850rpm – 2950rpm • Product warranty should be at least 2 years. <u>Motor</u> • The motors shall be Rewindable, insulation rating is compatible with AC VFD operation • Rated Voltage:380/400VAC • Insulation Material and Class, PE2+PA • Ambient water temp:40 C° • Motor Efficiency: Not less than 80% • Motor Speed:1850rpm – 2950rpm • Product warranty should be at least 2 years.	No.	1.0			
	Total Carried to Summary Page 2					
	Sub Total (2)					
C	Civil Works	-	-	-	-	-

1	Ground Mounting Structure:	-	-	-	-	-
1.2	Steel Mounting Structure: Supplying, delivering, fabricating, installing, hoisting, and fixing in place, and making all structural steel work in accordance with shop drawings for columns, beams, purlins, bracing, brackets, etc., with minimum yield strength as specified in the technical specifications. The contractor will be responsible for the following: * Supplying all materials required for the steel mounting structure. * Fabricating the steel mounting structure in accordance with the shop drawings. * Delivering the steel mounting structure to the project site. * Installing the steel mounting structure in accordance with the technical specifications. * Hoisting and fixing the steel mounting structure in place. * Providing all temporary staging and supporting work required for the installation of the steel mounting structure. * Making all connections using plates, channels, angles, gusset plate, anchor bolt, cleats, fasteners, etc. * Hot galvanizing the steel mounting structure (min galvanized 120mic)). * Providing all necessary bolts and washers for fastening, including bolt grouting. * Completing the work to the complete satisfaction of the supervisor engineer. * Works shall be in accordance with EC3 std., and all bolts shall be Anti-thief high strength bolts (Grade 8.8), as per the technical specifications and drawings.	No				

1.3	SITE GRADING AND LEVELING Clearing, grubbing, removing and disposing of all, brush, stumps, fences, debris, and miscellaneous structures not covered under other contract items within the construction area and such other areas as specified in drawings. The Contractor shall clear such additional areas within the limits of the right-of-way as specified or directed by the Engineer. Materials generated by the work, including construction and demolition debris, shall be disposed of at an approved dumping site. The Contractor shall grade the new site by cut and backfill in any type of soil, construct necessary driveways and sidewalks, topsoil and/or seed the area and perform other incidentally required items of work to prepare the site in accordance with the contract documents.	Lump Sum	1.00			
1.4	GROUND LEVEL MOUNTING STRUCTURES TYPE S1 (48) The item shall include the following: • Surveying and conducting all site leveling. • Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work as per in the shop drawings and technical specifications of mounting structures. • Supply and implementation of reinforced concrete C25 (Cylinder 25 MPa) for all mountings foundations, including anchor bolts, the excavation works and all necessary related works according to the shop drawings, technical specifications and the instructions of the supervising Engineer. • Fabrication and erection in position structural steel sections for base plates, columns, rafters, eaves, bracing, galvanized purlins and others made out of plates, IPE Sections, L and UPE sections and other structural steel sections complete as per drawing and as per the direction	m^2	255.00			

	of supervising engineer in Charge including grouting, cutting, welding, grinding, drilling, hoisting, fixing in position at all heights and levels. The rate includes all connections, nuts, bolts, washer plates, welds required for fabrication and erection and all necessary related work according to the shop drawings and the technical specifications. • Providing and applying a coat of approved zinc chromite primer and two coats of synthetic enamel paint over all as specified and directed.					
1.5	GROUND LEVEL MOUNTING STRUCTURES TYPE S2 (16)The item shall include the following: • Surveying and conducting all site leveling.• Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work as per in the shop drawings and technical specifications of mounting structures.• Supply and implementation of reinforced concrete C25 (Cylinder 25 MPa) for all mountings foundations, including anchor bolts, the excavation works and all necessary related works according to the shop drawings, technical specifications and the instructions of the supervising Engineer.• Fabrication and erection in position structural steel sections for base plates, columns, rafters, eaves, bracing, galvanized purlins and others made out of plates, IPE Sections, L and UPE sections and other structural steel sections complete as per drawing and as per the direction of supervising engineer in Charge including grouting, cutting, welding, grinding, drilling, hoisting, fixing in position at all heights and levels. The rate includes all connections nuts, bolts, washer plates, welds required for fabrication and erection and all necessary related work according to the shop drawings and the technical specifications.• Providing and applying a coat of approved zinc chromite primer and two	m^2	45.00			

	coats of synthetic enamel paint over all as specified and directed.					
3	Security Fence					
3.1	Supply and install Chain Link Metal Fence with Barbed wires as per in the drawings and the technical specifications, the work includes the following:• Survey and conduct all site settlement and leveling such as cut and backfill in any type of soil, and clear all planned areas for the work from materials, debris, chairs and disposal of debris to authorized area prior to the commencing of work.• Provide materials and construction of 2.50-meter-high chain Link Fence made from hot dip galvanized coated with pvc coated Post that shall be embedded in concrete footings and pressed at end. The panel's width is 3 meters. The chain link comprises 50mmx50mm openings. The work includes installing three lines of Barbed Wires above.• Provide materials and construction of 3m wide double leaf gate as shown on the drawings and according to the technical specifications and instructions of the supervising Engineer.	m	180.00			
	Sub Total (3)					
	Total Sum					

Location						E	44.405333 °		
						N	14.513866 °		
Location Address							Aljadeed Well/ Dhamar - Yemen		
Bill of Quantitiy - Lot-1									
No.	**Item**					**Unit**	**QTY**	**Unit Price (USD)**	**Total Price (USD)**
1.0	**PV MODULES.** The capacity of the solar modules should be at least 40 % greater than AC motor pumps,Module capacity should not be less than 600 W @STC;Must conform to IEC 61215, 61730, 61701,62716 (Ammonia Corrosion) , UL 1703.TUV, UL certificates or equivalent;The solar modules should be designed to run near the MPPT;Type of cell: Mono /Poly Crystalline, Multi busbar technology;The PV manufacturer should be approved as tier-1;Module efficiency: should not be less than 21.87%;No of cells in each panel: 144 per panel;Tolerance of maximum power rating: 0-5 W;The PV modules junction box not less than IP68; Should be supplied from approved tier 1 manufactures only; Maximum module voltage: 1000/1500 VDC(IEC);Operating temperature: -40°C to 85°C;Temperature Characteristics: P max: -0.30% /C° or less VOC: -0.25% /C° or less;Nominal operating cell temperature (NOCT) : 45 ±2°C.;Weather proof DC rated MC4 connector. Fully Secured, not allowing for any loose connections.High transmittance tempered glass: Minimum thickness of 4.0 mm;Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years;As per technical specification and drawing.					**Pcs**	**96**		**0**

2.0	**PV Combiner boxes**Enclosure materials: Coated metal with lockable door;Enclosure protection: IP65;Number of input circuit:10 inputs.DC fuse rating for each string:1500V, 25 A;DC output circuit breaker MCCB: 150A 1000/1500 VDC ;Built in surge protection device (SPD) 40KV, 1500VSuitable Rating Anti-backflow diodes ; All wires/cables must be terminated through cable lugs;Operational Environment Temperature: -30 °C ~+70 °C;As per technical specification and drawing.	**Pcs**	**1**		**0**
3.0	Solar Pump Inverter (Controller) Three phase ,380-415 V, 50Hz , with built-in MPPT .Capacity (KW): (55)Kw , soft start ,VFD (Variable Frequency drive) with based on solar radiation auto and manual start and stop,98% efficiency ,not less than IP65,up to 50 °C operation temperature, Voc not less than 850 VDC. The system should be designed to run near its MPPT range. The device shall allow hybrid operation with external power source, where solar power should be configured as the primary power source, and should have built in data loggers. Protection: Over-Voltage, pump Over-Current, pump Overload, Over-Temperature, pump Phase Loss, pump Short-Circuit, ground fault, solar low power, DC Input Anti-reverse, AC output unbalance (3 Phase); Display content: PV status (Current, Voltage, Power, Energy), AC input voltage, AC output voltage, Load, Running Status, RPM, and Frequency. monitoring and Controlling the solar pumping inverter remotely. As per technical specification and drawing.	**Nots**			
3.1	Solar pump Inverter 55 Kw	**Pcs**	**1**		**0**
4.0	**AC circuit breaker :** Supply, install, testing, and commissioning AC circuit breaker panel / Box: Including AC 3PH MCCB Circuit Breaker 3Pole Voltage: 400V,Capacity: 100/150Amp.;wall mounted type, with metal box IP54 .	**pcs**	**1**		**0**

5.0	**DC and AC Cabling** DC Cables: Flexible stranded tinned copper per EN 60228, TUV certified. made of double insulation material, Halogen-free, thermoset polyolefin, the jacket is low smoke non-halogenated, flame retardant, oil, abrasion, chemical and sunlight resistant meeting UL 44, UL 854. AC Cables: Stranded type, TUV certified, double insulation material 1kV XPLE/PVC/CU -XLPE insulated and PVC sheathed single or multi core flexible copper cables meeting IEC 60227 and IEC 60502. - All outdoor exposed wiring to be protected from UV radiation and physical damage, all cabling above ground should be suitably mounted inside cable trays with proper covers; Cable ends connections are to be made through suitable lugs or terminals, crimped properly & with use of cable glands; • All above ground cables shall be installed in a perforated galvanized cable tray with cover. Cable tray shall be supported with concrete blocks in appropriate intervals or on the mounting structure. **Wiring Pipes/trenches;** PVC pipe minimum 50mm dia. and above depending on No. of wires to be drawn, HMS grade (1-2mm thick),accessories for PVC pipes of the same make of pipes; such as spacers & saddles ,couplers ,bends ,inspection or non-inspection type ,elbows ,tees ,junction boxes of required ways and resin/adhesive to make all joints rigid .Black pipe shall not be used for surface type wiring. this item with excavation to depth 50cm, pipe installation and backfilling , and all necessary related work according to the technical specifications, shop drawings and the instructions of the supervising Engineer.	**Nots**	**Nots**		**0**
5.1	**DC Cable from array to Combiner Box** Made of double insulation material and jacket, TUV certified, 1500VDC, Sheath colors: black, red, Type of Conductor: tinned copper, flexible, finely multi stranded, Sheath colors: black, red, Size 1×6 sq. mm²	**m**	**200**		**0**
5.2	**DC Cable from Combiner Box to inverters** Made of double insulation material and jacket, TUV certified, 1500VDC, Sheath colors: black, red, type of Conductor: tinned copper, flexible, finely multi stranded; Sheath colors: black, red,Size:1×50 sq. mm²	**m**	**200**		**0**

5.3	**AC cable form Generator supply to inverters** 3 phase, AC form Generator supply, New MDB, IEC 60502-1 standard , Voltage rating 0.6/1kv AC, Type of Conductor: copper CU/PVC/SWA/PVC, Size:4×35sq. mm2.	**m**	**10**		**0**
6.0	**Grounding & Lightning System** Supply, install, testing, and commissioning Lightning arrester with copper plate and Earthing & Grounding all System: For all system components as indicted in grounding schematic: **DC Grounding :** pits in ground ; 14x(1x6 mm2) earthing cable to each group of PV modules, (1x16mm2) earthing cable to DC combiner box . (1x25mm2) earthing bit cable, **AC grounding :** pits in ground ;2× (1x16mm2) . earthing cable to solar Inverter, generator set. (1x16mm2) earthing bit cable . - Earthing installation in accordance with the IEE Wiring regulations, BS 7671 - All conductive materials shall be copper. - The size of conductor shall be according to table 54.7 of IEE – BS 7671 – IEC 60365-5-54. As per technical specification and drawing.	**system**	**4**		**0**
7.0	**Solar Street Lighting Systems** Supply, install ,test and commissioning lighting System 60W with galvanized terminal pole as per technical specifications:-It shall be All in One Solar Street Light.- 3 lighting modes with PIR motion sensor.- Lumens not less than 100 Im/w.- Protection not less than IP65.- Discharging temperature -20 ˚C ~60 ˚C- Charging temperature 0~55 ˚C- Switch light sensor ≥50 Lux, OFF.≤10 Lux, ON.- Power Li-ion battery ,support 1500 cycles	**Pcs**	**4**		**0**
8	**Fire alarm System** Supply, install, test and commission of a fire alarm system including all necessary accessories such as fire-resistant cable, trunkeys, metal conduit pipes, and proper labeling with complete drawings and documentation.	**Note**			
8.1	**Smoke and Heat Detectors** **Supply, install, test, and commission of standalone smoke and**	**Pcs**	**2**		**0**

	heat detectors. **Smoke detectors:** • Must be photoelectric or ionization type • Must have a sensitivity level of at least 5% obscuration • Must have a battery backup • Must be labeled in a clear and concise manner **Heat detectors:** • Must have a heat detection range of at least 50°F to 150°F • Must have a battery backup • Must be labeled in a clear and concise manner							
8.2	**Flame Detectors** **Supply, install, test and commission of Flame Detector including all required fire resistant cable** **Technical Specifications:** - Operating voltage: 24 VDC nominal (18-32 VDC) - regulated - Detects hydrocarbon and non-hydrocarbon fuel fires in all environmental conditions - Alarm Current ≤ 32 mA				**Pcs**	**2**		**0**
9.0	Fire Fighting System:				**Note**			
9.1	**Fire Extinguisher Carbon Dioxide** 5kg Carbon Dioxide (CO2) Extinguisher As per technical specification .				**Pcs**	**1**		**0**
9.2	**Fire Extinguisher Powder extinguisher** 6kg Powder extinguisher,As per technical specification .				**Pcs**	**2**		**0**
10.0	**Project Sign board :** Supply, install and commissioning of project metallic signboard as shown in attached drawing, and any other information instructed by site engineer.				**Pcs**	**1**		**0**
11.0	Training for the system				**LS**	**1**		**0**
Total – US$								**0**
B	**CIVIL WORKS**							

B1	**Steel Mounting Structure:** Supplying, delivering, fabricating and installing, hoisting and fixing in place, including all temporary staging and supporting work, and making all structural steel work in accordance with shop drawings for columns, beams, purlins, bracing, brackets, etc. with connections using plates, channels, angles, gusset plate, anchor bolt, cleats, fasteners, etc., hot galvanized steel (min galvanized 120mic)) with minimum yield strength as specified in the technical specifications The cost of steel work must include assembling, jointing, and fasteners (nuts, bolts, and washers), among other required accessories. The price shall also include all necessary bolts and washers for fastening, including bolt grouting, and all other requirements to complete the work including materials and labor, at all heights and locations, all in accordance with the technical specifications, drawings and to the complete satisfaction of supervisor engineer. Note: Works shall be in accordance with EC3 std., and all bolts shall be Anti-thief high strength bolts (Grade 8.8), as per the technical specifications and drawings.	Note			
B1.1	**Site Grading and Leveling:** Conduct all site settlement and leveling such as clear from all areas planned for the work, materials, debris, ...etc, prior to the commencing of work, cut and backfill in any type of soil, removing/cut the existing asphalt/tiles, laying 15 cm sand above conduit, safety electrical wires with minimum depth from existing ground level 1 meter and disposal of debris to authorized area and all related civil works.	L.S	1.0		0.0

B1.2	**GROUND LEVEL MOUNTING STRUCTURES** The item shall include the following: • Surveying and conducting all site leveling. • Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work as per in the shop drawings and technical specifications of mounting structures. • Supply and implementation of reinforced concrete C25 (Cylinder 25 MPa) for all mountings foundations, including anchor bolts, the excavation works and all necessary related works according to the shop drawings, technical specifications and the instructions of the supervising Engineer. • Fabrication and erection in position structural steel sections for base plates, columns, rafters, eaves, bracing, galvanized purlins and others made out of plates, IPE Sections, L and UPE sections and other structural steel sections complete as per drawing and as per the direction of supervising engineer in Charge including grouting, cutting, welding, grinding, drilling, hoisting, fixing in position at all heights and levels. The rate includes all connections, nuts, bolts, washer plates, welds required for fabrication and erection and all necessary related work according to the shop drawings and the technical specifications. • Providing and applying a coat of approved zinc chromite primer and two coats of synthetic enamel paint over all as specified and directed.	M.S	252.0		0.0
SUBTOTAL CIVIL WORKS					--
TOTAL PRICE Lot-1					--

Al Mahlah Well/ Dhamar -Yemen

Location	E	44.397167°			
	N	14.521836°			
Location Address		Al Mahlah Well/ Dhamar - Yemen			
Bill of Quantity - Lot-2					
No.	Item	Unit	QTY	Unit Price (USD)	Total Price (USD)
1.0	PV MODULES The capacity of the solar modules should be at least 40 % greater than AC motor pumps, Module capacity should not be less than 600 W @STC; Must conform to IEC 61215, 61730, 61701,62716 (Ammonia Corrosion) , UL 1703.TUV, UL certificates or equivalent; The solar modules should be designed to run near the MPPT; Type of cell: Mono /Poly Crystalline, Multi busbar technology; The PV manufacturer should be approved as tier-1; Module efficiency: should not be less than 21.87%; No of cells in each panel: 144 per panel; Tolerance of maximum power rating: 0-5 W; The PV modules junction box not less than IP68; Should be supplied from	Pcs	96		0

	approved tier 1 manufactures only; Maximum module voltage: 1000/1500 VDC(IEC); Operating temperature: -40°C to 85°C; Temperature Characteristics: P max: -0.30% /C° or less VOC: -0.25% /C° or less; Nominal operating cell temperature (NOCT) : 45 ±2°C.; Weather proof DC rated MC4 connector. Fully Secured, not allowing for any loose connections. High transmittance tempered glass: Minimum thickness of 4.0 mm; Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years; As per technical specification and drawing.				
2.0	PV Combiner boxes Enclosure materials: Coated metal with lockable door; Enclosure protection: IP65;Number of input circuit:10 inputs. DC fuse rating for each string:1500V, 25 A;DC output circuit breaker MCCB: 150A 1000/1500 VDC ;Built in surge protection device (SPD) 40KV, 1500VSuitable Rating Anti-backflow diodes ; All wires/cables must be terminated through cable lugs; Operational	Pcs	1		0

	Environment Temperature: -30 °C ~+70 °C;As per technical specification and drawing.				
3.0	Solar Pump Inverter (Controller) Three phase ,380-415 V, 50Hz , with built-in MPPT .Capacity (KW): (55)Kw , soft start ,VFD (Variable Frequency drive) with based on solar radiation auto and manual start and stop,98% efficiency ,not less than IP65,up to 50 °C operation temperature, Voc not less than 850 VDC. The system should be designed to run near its MPPT range. The device shall allow hybrid operation with external power source, where solar power should be configured as the primary power source, and should have built in data loggers. Protection: Over-Voltage, pump Over-Current, pump Overload, Over-Temperature, pump Phase Loss, pump Short-Circuit, ground fault, solar low power, DC Input Anti-reverse, AC output unbalance (3 Phase); Display content: PV status (Current, Voltage, Power, Energy), AC input voltage, AC output voltage, Load, Running Status, RPM, and Frequency. Monitoring and Controlling the solar pumping inverter remotely.	Nots			

	As per technical specification and drawing.				
3.1	Solar pump Inverter 55 Kw	Pcs	1		0
4.0	AC circuit breaker: Supply, install, testing, and commissioning AC circuit breaker panel / Box: Including AC 3PH MCCB Circuit Breaker 3 Pole Voltage: 400V, Capacity: 100/150 Amp.; wall mounted type, with metal box IP54 .	pcs	1		0
5.0	DC and AC Cabling DC Cables: Flexible stranded tinned copper per EN 60228, TUV certified. made of double insulation material, Halogen-free, thermoset polyolefin, the jacket is low smoke non-halogenated, flame retardant, oil, abrasion, chemical and sunlight resistant meeting UL 44, UL 854. AC Cables: Stranded type, TUV certified, double insulation material 1kV XPLE/PVC/CU -XLPE insulated and PVC sheathed single or multi core flexible copper cables meeting IEC 60227 and IEC 60502. - All outdoor exposed wiring to be protected from UV radiation and physical damage, all cabling above ground should be suitably mounted inside cable trays with proper covers; Cable ends connections are	Nots	Nots		0

	to be made through suitable lugs or terminals, crimped properly & with use of cable glands; • All above ground cables shall be installed in a perforated galvanized cable tray with cover. Cable tray shall be supported with concrete blocks in appropriate intervals or on the mounting structure. Wiring Pipes/trenches; PVC pipe minimum 50mm dia. and above depending on No. of wires to be drawn, HMS grade (1-2mm thick),accessories for PVC pipes of the same make of pipes; such as spacers & saddles ,couplers ,bends ,inspection or non-inspection type ,elbows ,tees ,junction boxes of required ways and resin/adhesive to make all joints rigid .Black pipe shall not be used for surface type wiring. this item with excavation to depth 50cm, pipe installation and backfilling , and all necessary related work according to the technical specifications, shop drawings and the instructions of the supervising Engineer.				
5.1	DC Cable from array to Combiner BoxMade of double insulation material and jacket, TUV certified, 1500VDC, Sheath colors: black, red, Type of Conductor: tinned copper, flexible, finely multi stranded,	m	200		0

	Sheath colors: black, red, Size 1×6 sq. mm²				
5.2	DC Cable from Combiner Box to inverters Made of double insulation material and jacket, TUV certified, 1500 VDC, Sheath colors: black, red, type of Conductor: tinned copper, flexible, finely multi stranded; Sheath colors: black, red,Size:1×50 sq. mm²	m	120		0
5.3	AC cable form Generator supply to inverters 3 phase, AC form Generator supply, New MDB, IEC 60502-1 standard, Voltage rating 0.6/1kv AC, Type of Conductor: copper CU/PVC/SWA/PVC, Size:4×35sq. mm2.	m	10		0
6.0	Grounding & Lightning System Supply, install, testing, and commissioning Lightning arrester with copper plate and Earthing & Grounding all System: For all system components as indicted in grounding schematic: DC Grounding : pits in ground ; 14x(1x6 mm2) earthing cable to each group of PV modules, (1x16mm2) earthing cable to DC combiner box . (1x25mm2) earthing bit cable, AC grounding : pits in ground ;2× (1x16mm2) . earthing cable to solar Inverter, generator set.	system	4		0

	(1x16mm2) earthing bit cable - Earthing installation in accordance with the IEE Wiring regulations, BS 7671 - All conductive materials shall be copper. - The size of conductor shall be according to table 54.7 of IEE – BS 7671 – IEC 60365-5-54. As per technical specification and drawing.				
7.0	Solar Street Lighting Systems Supply, install ,test and commissioning lighting System 60W with galvanized terminal pole as per technical specifications:-It shall be All in One Solar Street Light.- 3 lighting modes with PIR motion sensor.- Lumens not less than 100 Im/w.- Protection not less than IP65.- Discharging temperature -20 ˚C ~60 ˚C- Charging temperature 0~55 ˚C- Switch light sensor ≥50 Lux, OFF.≤10 Lux, ON.- Power Li-ion battery ,support 1500 cycles	Pcs	4		0
8	Fire alarm System Supply, install, test and commission of a fire alarm system including all necessary accessories such as fire-resistant cable, trunkeys, metal conduit pipes, and proper labeling with complete drawings and documentation.	Note			

8.1	Smoke and Heat Detectors Supply, install, test, and commission of standalone smoke and heat detectors. Smoke detectors: • Must be photoelectric or ionization type • Must have a sensitivity level of at least 5% obscuration • Must have a battery backup • Must be labeled in a clear and concise manner Heat detectors: • Must have a heat detection range of at least 50°F to 150°F • Must have a battery backup • Must be labeled in a clear and concise manner	Pcs	2		0
8.2	Flame Detectors Supply, install, test and commission of Flame Detector including all required fire resistant cable Technical Specifications:- Operating voltage: 24 VDC nominal (18-32 VDC) - regulated- Detects hydrocarbon and non-hydrocarbon fuel fires in all environmental conditions- Alarm Current ≤ 32 mA	Pcs	2		0
9.0	Fire Fighting System:	Note			
9.1	Fire Extinguisher Carbon Dioxide 5kg Carbon Dioxide (CO2) Extinguisher As per technical specification.	Pcs	1		0
9.2	Fire Extinguisher Powder extinguisher 6kg Powder extinguisher, As per technical specification.	Pcs	2		0

10.0	Project Sign board: Supply, install and commissioning of project metallic signboard as shown in attached drawing, and any other information instructed by site engineer.		Pcs	1		0
11.0	Training for the system		LS	1		0
Total – US$						0
B	CIVIL WORKS					
B1	<u>Steel Mounting Structure:</u> Supplying, delivering, fabricating and installing, hoisting and fixing in place, including all temporary staging and supporting work, and making all structural steel work in accordance with shop drawings for columns, beams, purlins, bracing, brackets, etc. with connections using plates, channels, angles, gusset plate, anchor bolt, cleats, fasteners, etc., hot galvanized steel (min galvanized 120mic)) with minimum yield strength as specified in the technical specifications The cost of steel work must include assembling, jointing, and fasteners (nuts, bolts, and washers), among other required accessories. The price shall also include all necessary bolts and washers for fastening, including bolt grouting, and all other requirements to complete		Note			

	the work including materials and labor, at all heights and locations, all in accordance with the technical specifications, drawings and to the complete satisfaction of supervisor engineer. Note: Works shall be in accordance with EC3 std., and all bolts shall be Anti-thief high strength bolts (Grade 8.8), as per the technical specifications and drawings.				
B1.1	Site Grading and Leveling: Conduct all site settlement and leveling such as clear from all areas planned for the work, materials, debris,...etc, prior to the commencing of work, cut and backfill in any type of soil, removing/cut the existing asphalt/tiles	L.S	1.0		0.0
B1.2	Ground Level Mounting Structure the item shall include the following: • Surveying and conducting all site leveling• Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work as per in the shop drawings and technical specifications of mounting structures• Supply and implementation of reinforced concrete C25 (Cylinder 25 MPa) for all mountings foundations, including anchor bolts, the excavation works and all necessary related works according to the shop	M.S	252.0		0.0

	drawings, technical specifications and the instructions of the supervising Engineer. • Fabrication and erection in position structural steel sections for base plates, columns, rafters, eaves, bracing, galvanized purlins and others made out of plates, IPE Sections, L and UPE sections and other structural steel sections complete as per drawing and as per the direction of supervising engineer in Charge including grouting, cutting, welding, grinding, drilling, hoisting, fixing in position at all heights and levels. The rate includes all connections, nuts, bolts, washer plates, welds required for fabrication and erection and all necessary related work according to the shop drawings and the technical specifications. • Providing and applying a coat of approved zinc chromite primer and two coats of synthetic enamel paint over all as specified and directed.				
SUBTOTAL CIVIL WORKS					--
TOTAL PRICE Lot-2					--

Well Alnaser/ Dhamar -Yemen

Location	E	44.380742°				
	N	14.548739°				
Location Address		Well Alnaser/ Dhamar –Yemen				
Bill of Quantity - Lot-3						
No.	Item		Unit	QTY	Unit Price (USD)	Total Price (USD)
1.0	PV MODULES The capacity of the solar modules should be at least 40 % greater than AC motor pumps, Module capacity should not be less than 600 W @STC; Must conform to IEC 61215, 61730, 61701,62716 (Ammonia Corrosion) , UL 1703.TUV, UL certificates or equivalent; The solar modules should be designed to run near the MPPT; Type of cell: Mono /Poly Crystalline, Multi busbar technology; The PV manufacturer should be approved as tier-1; Module efficiency: should not be less than 21.87%; No of cells in each panel: 144 per panel; Tolerance of maximum power rating: 0-5 W; The PV modules junction box not less than IP68; Should be supplied from approved tier 1 manufactures only; Maximum module voltage: 1000/1500 VDC(IEC); Operating temperature: -40°C to 85°C; Temperature Characteristics: P max: -0.30% /C° or less VOC: -0.25% /C° or less; Nominal operating cell temperature (NOCT) : 45 ±2°C.; Weather proof DC rated MC4 connector. Fully Secured, not allowing for any loose connections.		Pcs	96		0

	High transmittance tempered glass: Minimum thickness of 4.0 mm; Performance warranty: Nominal power output 90% for 10 years, 80% for 25 years; As per technical specification and drawing.				
2.0	PV Combiner boxes Enclosure materials: Coated metal with lockable door; Enclosure protection: IP65;Number of input circuit:10 inputs. DC fuse rating for each string:1500V, 25 A;DC output circuit breaker MCCB: 150A 1000/1500 VDC ;Built in surge protection device (SPD) 40KV, 1500VSuitable Rating Anti-backflow diodes ; All wires/cables must be terminated through cable lugs; Operational Environment Temperature: -30 °C ~+70 °C;As per technical specification and drawing.	Pcs	1		0
3.0	Solar Pump Inverter (Controller) Three phase ,380-415 V, 50Hz , with built-in MPPT .Capacity (KW): (55)Kw , soft start ,VFD (Variable Frequency drive) with based on solar radiation auto and manual start and stop,98% efficiency ,not less than IP65,up to 50 °C operation temperature, Voc not less than 850 VDC. The system should be designed to run near its MPPT range. The device shall allow hybrid operation with external power source, where solar power should be configured as the primary power source, and should have built in data loggers. Protection: Over-Voltage, pump Over-Current, pump Overload, Over-Temperature, pump Phase Loss, pump Short-Circuit, ground fault, solar low power, DC Input Anti-reverse, AC output unbalance (3 Phase); Display content: PV status (Current, Voltage, Power, Energy), AC input voltage, AC output voltage, Load, Running Status, RPM, and Frequency. monitoring and Controlling the solar pumping inverter remotely. As per technical specification and drawing.	Notes			

3.1	Solar pump Inverter 55 Kw	Pcs	1		0
4.0	AC circuit breaker : Supply, install, testing, and commissioning AC circuit breaker panel / Box: Including AC 3PH MCCB Circuit Breaker 3 Pole Voltage: 400V,Capacity: 100/150 Amp.; wall mounted type, with metal box IP54 .	pcs	1		0
5.0	DC and AC Cabling DC Cables: Flexible stranded tinned copper per EN 60228, TUV certified. made of double insulation material, Halogen-free, thermoset polyolefin, the jacket is low smoke non-halogenated, flame retardant, oil, abrasion, chemical and sunlight resistant meeting UL 44, UL 854. AC Cables: Stranded type, TUV certified, double insulation material 1kV XPLE/PVC/CU -XLPE insulated and PVC sheathed single or multi core flexible copper cables meeting IEC 60227 and IEC 60502. - All outdoor exposed wiring to be protected from UV radiation and physical damage, all cabling above ground should be suitably mounted inside cable trays with proper covers; Cable ends connections are to be made through suitable lugs or terminals, crimped properly & with use of cable glands; • All above ground cables shall be installed in a perforated galvanized cable tray with cover. Cable tray shall be supported with concrete blocks in appropriate intervals or on the mounting structure. Wiring Pipes/trenches; PVC pipe minimum 50mm dia. and above depending on No. of wires to be drawn, HMS grade (1-2mm thick),accessories for PVC pipes of the same make of pipes; such as spacers & saddles ,couplers ,bends ,inspection or non-inspection type ,elbows ,tees ,junction boxes of required ways and resin/adhesive to make all joints rigid .Black pipe shall not be used for surface type wiring. this item with excavation to depth 50cm, pipe installation and backfilling , and all	Nots	Nots	Nots	0

	necessary related work according to the technical specifications, shop drawings and the instructions of the supervising Engineer.				
5.1	DC Cable from array to Combiner BoxMade of double insulation material and jacket, TUV certified, 1500VDC, Sheath colors: black, red, Type of Conductor: tinned copper, flexible, finely multi stranded, Sheath colors: black, red,Size 1×6 sq. mm²	m	330		0
5.2	DC Cable from Combiner Box to inverters Made of double insulation material and jacket, TUV certified, 1500VDC, Sheath colors: black, red, type of Conductor: tinned copper, flexible, finely multi stranded; Sheath colors: black, red,Size:1×50 sq. mm²	m	40		0
5.3	AC cable form Generator supply to inverters 3 phase, AC form Generator supply, New MDB, IEC 60502-1 standard, Voltage rating 0.6/1kv AC, Type of Conductor: copper CU/PVC/SWA/PVC, Size:4×35sq. mm2.	m	10		0
6.0	Grounding & Lightning System Supply, install, testing, and commissioning Lightning arrester with copper plate and Earthing & Grounding all System: For all system components as indicted in grounding schematic: DC Grounding : pits in ground ; 14x(1x6 mm2) earthing cable to each group of PV modules, (1x16mm2) earthing cable to DC combiner box . (1x25mm2) earthing bit cable, AC grounding : pits in ground ;2× (1x16mm2) . earthing cable to solar Inverter, generator set. (1x16mm2) earthing bit cable . - Earthing installation in accordance with the IEE Wiring regulations, BS 7671 - All conductive materials shall be copper. - The size of conductor shall be according to table 54.7 of IEE – BS 7671 – IEC 60365-5-54. As per technical specification and drawing.	syste m	4		0

7.0	Solar Street Lighting Systems Supply, install ,test and commissioning lighting System 60W with galvanized terminal pole as per technical specifications:-It shall be All in One Solar Street Light.- 3 lighting modes with PIR motion sensor.- Lumens not less than 100 Im/w.- Protection not less than IP65.- Discharging temperature -20 ˚C ~60 ˚C- Charging temperature 0~55 ˚C- Switch light sensor ≥50 Lux, OFF.≤10 Lux, ON.- Power Li-ion battery ,support 1500 cycles	Pcs	4		0
8	Fire alarm System Supply, install, test and commission of a fire alarm system including all necessary accessories such as fire-resistant cable, trunkeys, metal conduit pipes, and proper labeling with complete drawings and documentation.	Note			
8.1	Smoke and Heat Detectors Supply, install, test, and commission of standalone smoke and heat detectors. Smoke detectors: • Must be photoelectric or ionization type • Must have a sensitivity level of at least 5% obscuration • Must have a battery backup • Must be labeled in a clear and concise manner Heat detectors: • Must have a heat detection range of at least 50°F to 150°F • Must have a battery backup • Must be labeled in a clear and concise manner	Pcs	2		0
8.2	Flame Detectors Supply, install, test and commission of Flame Detector including all required fire resistant cable Technical Specifications: - Operating voltage: 24 VDC nominal (18-32 VDC) - regulated - Detects hydrocarbon and non-hydrocarbon fuel fires in all environmental conditions - Alarm Current ≤ 32 mA	Pcs	2		0
9.0	Fire Fighting System:	Note			

9.1	Fire Extinguisher Carbon Dioxide 5kg Carbon Dioxide (CO2) Extinguisher As per technical specification.	Pcs	1		0
9.2	Fire Extinguisher Powder extinguisher 6kg Powder extinguisher, As per technical specification.	Pcs	2		0
10.0	Project Sign board: Supply, install and commissioning of project metallic signboard as shown in attached drawing, and any other information instructed by site engineer.	Pcs	1		0
11.0	Training for the system	LS	1		0
Total – US$					0
B	CIVIL WORKS				
B1	<u>Steel Mounting Structure:</u> supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work in accordance with the design, drawing prepared by the consultant for columns, beams, purlins, bracing, brackets, etc. with connections using plates, channels and angles, gusset plate, anchor bolt, cleats, fasteners etc., galvanized steel (min galvanized 80~120mic)) with minimum yield strength of 240Mpa and up to 350Mpa.The rate of steel work shall include assembly, jointing, cost of fasteners (nuts, bolts and washers) etc. The rate shall also include necessary bolts & washers for fixing including grouting of bolts for fixed members on the R.C slab with 1:3 non shrink cement grout (min Fc'= 25Mpa for 28 days as ASTM Standers) etc., complete all as per design, details, drawings, specifications etc. with all lead & lift for all materials & labour and as directed, at all heights & locations.As AISC all bolts is Anti-thief A325 or A490 high strength bolts (8.8).as per drawing S1-01 To S1-07 AND S2-01 To S2-07	Note			

B1.1	Site Grading and Leveling: Conduct all site settlement and leveling such as clear from all areas planned for the work, materials, debris,..etc, prior to the commencing of work, cut and backfill in any type of soil, removing/cut the existing asphalt/tiles	L.S	1.0		0.0
B1.2	Ground Level Mounting Structures Type S1(48 PV) The item shall include the following: • Surveying and conducting all site leveling. • Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work as per in the shop drawings and technical specifications of mounting structures. • Supply and implementation of reinforced concrete C25 (Cylinder 25 MPa) for all mountings foundations, including anchor bolts, the excavation works and all necessary related works according to the shop drawings, technical specifications and the instructions of the supervising Engineer. • Fabrication and erection in position structural steel sections for base plates, columns, rafters, eaves, bracing, galvanized purlins and others made out of plates, IPE Sections, L and UPE sections and other structural steel sections complete as per drawing and as per the direction of supervising engineer in Charge including grouting, cutting, welding, grinding, drilling, hoisting, fixing in position at all heights and levels. The rate includes all connections, nuts, bolts, washer plates, welds required for fabrication and erection and all necessary related work according to the shop drawings and the technical specifications. • Providing and applying a coat of approved zinc chromite primer and two coats of synthetic enamel paint over all as specified and directed.	M.S	126.0		0.0

B2	Ground Level Mounting Structures Type S2(16 PV) The item shall include the following: • Surveying and conducting all site leveling.• Supplying, fabricating, delivering at site, hoisting and fixing in position, including all temporary staging and supporting work and making all structural steel work as per in the shop drawings and technical specifications of mounting structures.• Supply and implementation of reinforced concrete C25 (Cylinder 25 MPa) for all mountings foundations, including anchor bolts, the excavation works and all necessary related works according to the shop drawings, technical specifications and the instructions of the supervising Engineer.• Fabrication and erection in position structural steel sections for base plates, columns, rafters, eaves, bracing, galvanized purlins and others made out of plates, IPE Sections, L and UPE sections and other structural steel sections complete as per drawing and as per the direction of supervising engineer in Charge including grouting, cutting, welding, grinding, drilling, hoisting, fixing in position at all heights and levels. The rate includes all connections, nuts, bolts, washer plates, welds required for fabrication and erection and all necessary related work according to the shop drawings and the technical specifications.• Providing and applying a coat of approved zinc chromite primer and two coats of synthetic enamel paint over all as specified and directed.	M.S	128.3		0.0
B3	SECURITY FENCE (METAL CHAIN LINK FABRIC). Supply and install Chain Link Metal Fence with Barbed wires as per in the drawings and the technical specifications, the work includes the following: • Survey and conduct all site settlement and leveling such as cut and backfill in any type of soil, and clear all planned areas for the work from materials, debris, chairs and disposal of debris to authorized area prior to the commencing of work. • Provide materials and construction of 2.50-meter-high chain Link Fence made from hot dip	L.M	90.0		0.0

	galvanized coated with pvc coated Post that shall be embedded in concrete footings and pressed at end. The panel's width is 3 meters. The chain link comprises 50mmx50mm openings. The work includes installing three lines of Barbed Wires above. • Provide materials and construction of 3m wide double leaf gate as shown on the drawings and according to the technical specifications and instructions of the supervising Engineer.				
SUBTOTAL CIVIL WORKS					--
TOTAL PRICE Lot-3					--