MINISTRY OF ENERGY

Environmental and Social Impact Assessment

Al-Kahfah Solar PV Park



Document No Rev 1: 413011-00907-EN-REP-103
29 Aug 2021

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PROJECT 413011-00907-EN-REP-103 - Environmental and Social Impact Assessment - Al-Kahfah Solar PV Park

Rev	Description	Originator	Reviewer	Worley Approver	Revision Date	Customer Approver	Approval Date
Rev 1	Issued for client use	M.Megahed O. Abdelbary D. Zamfriescu F. Peno Y. Zakaria	I El-Sersy	J. O'Toole	29.08.21		
Rev 0	Issued for client use	M.Megahed O. Abdelbary D. Zamfriescu F. Peno Y. Zakaria	I El-Sersy	J. O'Toole	09 Aug 2021		
Rev A	Issued for client review	M.Megahed O. Abdelbary D. Zamfriescu F. Peno Y. Zakaria	I El-Sersy	J. O'Toole	27 June 21		

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Acronym List

A	a
AC	Alternating Current
AH	Anno Hegirae (Hijri year)
C	**c**
CSP	Concentrated Solar Power
D	**d**
DC	Direct Current
DEFRA	Department for Environment, Food and Rural Affairs
DNI	Direct Normal Irradiance
E	**e**
EERP	Environmental Emergency Response Plan
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMEA	Europe, Middle East, and Africa
EN	Endangered
EP	Equator Principles
EPFI	Equator Principles Financial Institutions
ESIA	Environmental and Social Impact Assessment
ESS	Environmental and Social Standards
G	**g**
GAMEP	General Authority of Meteorology and Environmental Protection
GAStat	General Authority of Statistics
GEF	Global Environment Facility
GHI	Global Horizontal Irradiance
GIIP	Good International Industry Practice
GIS	Geographic Information System
GOSI	General Organization for Social Insurance
GW	Gigawatt
H	**h**
HAP	hazardous air pollutant
I	**i**
IBA	Important Bird Area
IBAT	Integrated Biodiversity Assessment Tool
IFC	International Finance Corporation
ILO	International Labor Organization

	IPCC	Intergovernmental Panel on Climate Change
	ISCC	Integrated Solar Combined Cycle
	IUCN	International Union for Conservation of Nature
K		**k**
	KSA	Kingdom of Saudi Arabia
	kV	Kilovolt
L		**l**
	LC	Least Concern
M		**m**
	Ma	Megaannum (one million years)
	MEWA	Ministry of Environment, Water and Agriculture
	MLSD	Ministry of Labour and Social Development
	MoE	Ministry of Energy
N		**n**
	NCEC	National Center for Environmental Compliance
	NREP	National Renewable Energy Program
	NT	Near Threatened
O		**o**
	OECD	Organisation for Economic Co-operation and Development
	OHL	Overhead line
P		**p**
	PV	Photovoltaic
T		**t**
	TMY	Typical Meteorological Year
U		**u**
	UNDP	United Nations Development Programme
	UNEP	United Nations Environment Programme
	UNESCO	United Nations Educational, Scientific and Cultural Organization
V		**v**
	VOC	Volatile Organic Compound
	VU	Vulnerable
W		**w**
	WWF	World-Wide Fund for Nature

Executive Summary

Al-Kahfah Solar PV Park project (hereinafter "the Project") is located 6 km south of the town of Al-Kahfah, in the Hail province, between the cities of Hail and Buraydah. The location is mostly undeveloped with an area of approximately 83 km^2. The final overall capacity of the site is expected to be close to 3,000 MW, to be divided into Six (6) Solar Generating Units (SGU). This generating capacity will be equivalent to approximately 8,500 GWh per year and equivalent to supplying energy to 380,000 households and will significantly reduce the emission of greenhouse gases by 5.2 million tons of CO_2 equivalent.

Chapter 1 of this report presents an overview of the Project and the study objectives. Chapter 2 presents the legal and regulatory framework. It covers both national and international requirements, IFC, World Bank, and Equator Principles.

Chapter 3 of this report presents a description of the Project lifecycle, namely construction, operation and decommissioning. The chapter presents main activities, components, schedule and anticipated wastes and emissions.

Chapter 4 presents the different alternatives of the Project including not but not limited to the "no-project" alternative.

Chapter 5 presents the baseline data. It covers natural environment and human environment. Environmental components such as climate, groundwater, soil and terrestrial ecology are presented in this chapter. In addition, the current population status (e.g. employment) are presented in this chapter.

Penitential positive and negative impacts are assessed in Chapter 6. The assessment covers the construction phase, operation phase as well as potential impacts resulting from non-routine (accidental) events.

Chapter 7 presents the proposed different management plans and mitigation measures during each phase of the Project as well as impact significance evaluation after implementing the proposed mitigation measures.

The ESIA study conclusion is presented in Chapter 8 of this report.

Chapter 9 provides a summary of the stakeholder mapping report and stakeholder engagement activities.

The following is a summary of the Project features:

Regulatory Framework:

Environmental quality standards, in the Kingdom of Saudi Arabia, such as emission standards, are established by the Ministry of Environment, Water, and Agriculture. The study is prepared in compliance with the requirement established by the executive regulation for the environmental permits for construction and operation of activities issued by the Ministry of Environment, Water and Agriculture in 2021. The study also adopts and complies with the most stringent environmental standards, both nationally and internationally.

Ecological and Environmental Sensitivity:

There are no designated/proposed protected areas or sensitive areas located within 10 km of the Project area. Nearest protected area is At-Taysiyah Natural Reserve located about 145 km north-east of the project area. Vegetation in the Project area is limited in density. The identified species are not evaluated by the IUCN Red List except for one species that is classified as Least Concern (LC). Camels were noted onsite grazing on the vegetation. Two common bird species were recorded in the Project area and both species are classified as LC on the IUCN Red List.

Environmental Assessment:

An ESIA should assist in ensuring environmentally and socially sound management of the Project during its entire lifetime (construction, operation, decommissioning); also, non-routine events during Project phases. The methodology followed in this ESIA for the impact assessment is presented in the "European Union, EIA - Guidance on scoping, 2017". This methodology applies a multi-criteria analysis to evaluate impacts significance. It worth notice that the majority of impact significance are "Negligible "or "Minor".

Mitigation Measures:

Specific mitigation recommendations for those impacts of Moderate significance are provided. Proposed technical, social and/or institutional mitigation measures for the expected impacts/change during construction and operation of the proposed Project. Additional mitigation measures are presented as part of the Environmental Management Plan Framework and Monitoring Plan.

Stakeholder Engagement

A summary of the most important stakeholder groups identified and a summary of the analysis of stakeholder significance are presented in this report. Furthermore, a summary of the Stakeholder Engagement activities is documented in this report.

Finally, based on the findings and recommendations of the environmental and social impact assessment for the proposed Project, the assessment team concludes that if mitigation measures are followed properly; the Project shall be meeting all regulatory requirements without any tangible impact to the environment. In addition, Positive impacts upon the local community through renewable energy generation and local employment created by the Project during construction and operation are expected.

1. Introduction

1.1 General Information

This Environmental and Social Impact Assessment (ESIA) Report has been prepared for the proposed Al-Kahfah Solar PV Park project (hereinafter "the Project"), 6 km south of the town of Al-Kahfah in Ha'il Province (Figure 1). The total area of the Project is about 83 km^2. A copy of the project land allocation official approval is presented in Appendix C.

The proposed Project will entail the installation and operation of six (6) solar generating units (SGUs). The estimated power generation capacity will be approximately 3 GW. The total power generation capacity is expected to be equivalent to 8,534 GWh per year[1]. This yearly production will be equivalent to supplying energy to 406,400 households[2] and will significantly reduce the emission of greenhouse gases by 7.7 million tons of $CO_{2\ equivalent}$[3] (Master Plan, Al-Kahfah Solar Energy Park, Worley, April 2021).



Figure 1 Project location

The scope of work for the Project requires the preparation of an ESIA report based on Saudi national legal requirements, Equator Principles, International Finance Corporation (IFC) Performance Standards and World Bank Environmental, Health, and Safety (EHS) Guidelines.

[1] It should be noted that this capacity is the initially estimated capacity and should be confirmed or updated, as necessary as part of the detailed design of the Project.

[2] Based on average consumption of 21 MWh/household/year. Household Energy Survey 2017, General Authority for Statistics.

[3] Based on 0.97 T CO_2/MWh, Dynamics of energy sector and GHG emissions in Saudi Arabia, 2014, Climate Policy.

This ESIA provides the legal framework, the proposed project description, description of the receiving environment, the identification and analysis of impacts during the project phases and frameworks for various management plans.

More details on the objectives of the present study are presented in Section 1.2; whereas, detailed report structure is presented in Section 1.3.

1.2 The Justification, Scope and Objectives

The present ESIA study report is prepared to meet the national requirements for permitting new activities as stipulated in the executive regulations for activities construction and operation environmental permitting. The study is also prepared to meet international guidelines, namely IFC. Details on the legal framework and permitting requirements can be found in Section 2. The main objectives of the ESIA are:

- Identify and analyse sensitive components of the existing environment. Review the existing literature and document the regional and site-specific environmental baseline status, as far as practical in order to describe the pre-project environment. All media potentially affected shall be considered;
- Determine the type, nature and significance of the potential environmental and/or social impacts during construction and operation phases;
- Identify and recommend practical/ feasible mitigation measures early in the design process to eliminate, minimise, mitigate or avoid any negative environmental and/or social impacts resulting from the Project; and
- Recommend environmental and social management/monitoring plans for the Project in order to eliminate and/or minimise the potential negative environmental and/or social impacts as identified above.

The scope of the present study is limited to Al-Kahfah PV proposed project different components within the site boundaries indicated in section 3.4.

1.3 Study Structure

The report structure is presented below:

- Chapter 1: Introduces the background of the Project. It also states the objectives of this report
- Chapter 2: Identifies and presents the applicable national regulatory requirements related to the environmental aspects for the proposed development. It also presents relevant international guidelines
- Chapter 3: Provides an overview of the Project components and a description of the activities during the different phases of the Project
- Chapter 4: Provides analysis of the alternatives considered for the Project
- Chapter 5: Presents a description of the surrounding environment
- Chapter 6: Presents the assessment of the potential environmental and social impacts
- Chapter 7: Provides an overview of the different management plans to be implemented for the proposed Project
- Chapter 8: Provides conclusions on the preferred alternatives, a summary of the gains and losses associated with the Project implementation, roles of different relevant authorities
- Chapter 9: Presents an overview of the stakeholders' engagement process and a summary of the public consultation meeting held for the proposed Project
- Chapter 10: Appendices

1.4 Information about the Permit Applicant

The Ministry of Energy is primarily responsible for overseeing and issuing regulations in relation to the oil and gas industry in KSA. Furthermore, it delivers on the goals of the National Renewable Energy Program (NREP) introduced under Vision 2030 to maximise the potential of the renewable energy industry in KSA. In addition, it sets out a specific road map to diversify local energy sources as well as establishing the renewable energy industry.

1.5 Information about the Service Provider who Prepared the Study

Jacobs DCSA is an approved National Center for Environmental Compliance (NCEC), replacing the General Authority for Meteorology and Environmental Protection (GAMEP), supplier of environmental consultancy services (accreditation certificate is attached in Appendix B). Jacobs DCSA is an affiliate of Worley and has been working collaboratively with the Worley team to develop and submit this document.

Jacobs DCSA is one of the leading providers of environmental consultancy services in the Kingdom of Saudi Arabia and provides fully integrated environment expertise across the full spectrum of the project lifecycle. Our In-Kingdom team has completed over 70 environmental assessments on behalf of clients in the renewable energy, oil and gas, petrochemical, buildings and infrastructure sectors.

Worley is an engineering company providing high quality diverse services including environmental consulting services to various sectors including energy. We support our customers in solve some of the complex and critical energy challenges. We have over 3,000 consultants in 49 countries, backed by Worley's engineering and project delivery experts. The present study was conducted by the following team:

- Jonathan O'Toole – Project Manager
- Ihab El-Sersy – Environment & Society Practice Lead
- Eddie Bradbrook – Director of Environment and Sustainability Services
- Daniela Zamfirescu – Environmental Consultant
- Yousra Zakaria – Environmental Consultant
- Mahmoud Hashish–Environmental Consultant
- Hussain Al Baqshi–Environmental Consultant
- Menna Megahed – Ecologist
- Omar Abdelbary – Environmental Specialist
- Francisco Peño – Senior GIS Cartographer

The curriculum vitae of the Project team is available in Appendix B.

2. Policy, Legal and Administrative Framework

2.1 Administrative Framework

2.1.1 Ministry of Environment, Water, and Agriculture (MEWA)

The Ministry of Environment, Water, and Agriculture (MEWA) is responsible for the regulation and implementation of all aspects of the country's policies for environmental, water and agricultural sectors. The Ministry implements environmental plans and programs across the Kingdom, with a focus on sustainability and value creation. It has widened its contribution to the national economy through numerous programs especially in the areas of food security, water preservation and environmental protection. There are various departments within the ministry including:

- Directorate of Environment
- Directorate of Water
- Directorate of Agriculture
- Directorate of Lands and Survey

2.1.2 The National Center for Environmental Compliance (NCEC)

The National Center for Environmental Compliance (NCEC) is replacing the General Authority for Meteorology and Environmental Protection (GAMEP) in terms of issuing environmental permits. Beside preparing environmental standards, NCEC is expected to impose environmental commitment on the development sectors, issuing environmental licenses and permits, as well as to monitor and control pollution levels and sources. These tasks will be fulfilled by providing high-quality services that contribute to raising the level of compliance with environmental regulations and standards.

The National Center for Environmental Compliance is tasked with the following:

- Issuing standards and technical guidelines related to environmental impact assessment reports
- Receiving and reviewing environmental classifications forms and environmental impact assessment reports
- Issuing the guiding classifications of projects
- Monitoring the implementation of the plans of any project in any of its phases
- Issuing and renewing environmental permits
- Auditing and monitoring and issuing penalties in relation to the implementation of the executive regulation

2.1.3 Ministry of Energy (MoE)

The Ministry of Energy is primarily responsible for overseeing and issuing regulations in relation to the oil and gas industry in KSA.

Additionally, it delivers on the goals of the National Renewable Energy Program introduced under Vision 2030 to maximise the potential of the renewable energy industry in KSA and sets out a specific road map in order to diversify local energy sources as well as establishing the renewable energy industry.

2.2 Regulatory Framework

2.2.1 National Legislation

2.2.1.1 Environment Regulation

The first comprehensive Saudi Arabian national environmental legislation was enacted on 24 September 2001 in the form of the General Environmental Regulation, Council of Ministers Resolution No 193. It entered into force on 31 October 2002, and its Implementing Rules were published on 30 September 2003. In 2020 Saudi Arabia enacted a new law to protect the environment. It provides a comprehensive legal framework governing all aspects related to the preservation and protection of the environment. The Environment Regulation, Royal Decree No M/165 of 19 Dhul Qada 1441 Hejra (corresponding to 10 July 2020) entered into force on 13 January 2021, superseding the previous Regulation.

The new law aims to regulate the environmental sector and related activities. Some of its executive regulations including but not limited to environmental auditing, ozone depleting substances and hydrofluoric compounds, environmental rehabilitation, environmental permits for construction and operation and soil pollution prevention and treatment have been already issued by the time of preparing this report (May 2021). The rest of the executive regulations are expected shortly.

Chapter 2 article 7 stipulates that it is prohibited to exploit, transfer, store, sell or promote without a permit or license any of the natural resources and their products in the Kingdom's territory. This includes islands, airspace, inland waters, the territorial sea and all other areas in which the Kingdom exercises sovereign rights in accordance with international law. The law also bans the improper disposal of wastewater or any other residual liquid through chapter 2 article 11. Chapter 5 of the new environmental law regulates the aspects related to wildlife in Saudi Arabia. Article 26 states that It is prohibited to kill or injure live fauna. As an exception to this, it is permissible in specific cases in accordance with the executive regulations. Article 28 prohibits bringing any of the biological control methods into the Kingdom, or the use of any; without obtaining a license, as indicated by the executive regulations.

Royal Decree No. (M/165) dated 11/19/1441 AH states that those engaged in the environmental sector directly or in activities that have a direct or indirect impact on the environment are required to comply with the law. They should assess their activities and their impact on the environment and take corrective measures in line with the new law, if required, and submit their plans to relevant authorities with a clear timeline during a period not exceeding 9 months demonstrating the implementation of measures. The minister of environment, water and agriculture may grant a grace period(s) based on the recommendations of a public interest investigator. According to chapter 8 article 38, anyone who violates any of the provisions of the law and regulations shall be punished with one or more penalties, including a fine not exceeding SR20 million riyals ($5.3 million), suspension of a license or permit for a period not exceeding six months and cancellation of a license or permit.

The financial fine and the suspension period will be doubled if the violation is repeated within a year.

2.2.1.2 Environmental Standards

The main objective of the Project is to meet the relevant environmental legislative requirements and guidelines. Until the NCEC issues new environmental standards superseding the GAMEP standards currently in force, the GAMEP standards and their most recent updates will continue to apply. It should be noted that soil, noise and air quality new executive regulations were issue in 2021. A summary of the applicable standards is listed in Table 1.

Table 1 Saudi Environmental Standards

Standard	Effective date
Air Quality and Emissions	
Ambient Air Quality	25/05/2021
Control of Emissions to Air from Stationary Sources	25/05/2021
Standards on Emissions from Mobile Sources	24/03/2014
Ozone depleting substances and hydrofluoric compounds	29/03/2021
Water Environment	
Ambient Water Quality	02/03/2014
Soil	
Soil pollution prevention and treatment	7/04/2021
Wastewater Discharges	
Industrial and Municipal Wastewater Discharges	02/03/2014
Waste and Material Management and Transport (Hazardous and Non-hazardous)	
Prevention of Major Accidents	24/03/2012
Waste Classification	24/03/2012
Waste Acceptance Criteria	24/03/2012
Material Recovery and Recycling of Waste	24/03/2012
Waste Regulatory Control and Compliance	24/03/2012
Waste Handling and Storage	24/03/2012
Waste Transportation	24/03/2012
Best Practice Environmental Options for Waste Disposal	24/03/2012
Noise	
Environmental Noise	02/06/2021

2.2.1.2.1 Air

Ambient Air Quality

The Standards for ambient air quality as detailed in the executive regulations for ambient air quality issued in 2021 are detailed in Table 2.

Table 2 Ambient Air quality Standards

Parameter	Unit (µg/Nm3) [4]			Number of allowable exceedances
	1-hour	24-hour	Annual	
PM_{10}	-	340	50	24-hour: 12 times per annum5 Annual: N/A
$PM_{2.5}$	-	35	15	24-hour: 12 times per annum[5] Annual: N/A
Nitrogen Dioxide	200	-	100	1-hour: 24 times per annum 24-hour: N/A
Sulphur Dioxide	441	217	65	1-hour: 24 times per annum 24-hour: 3 time per annum Annual: N/A
Ozone 6	-	157 (8hours)	-	24-hour: 25 days per annum, an average is calculated over three years

The executive regulations for ambient air quality set standard limits for ambient concentrations of hazardous pollutants in annex 2 of the executive regulations. It also sets generic point source emission limit values for industry in annex 3 and specific point source emission limit values for each industry type in annex 4. The proposed Project is not identified within these industries and thus only the ambient air quality limits apply.

The GAMEP 2012 Environmental Standard, Standard Number 2 sets generic parameters and limit values for all mobile sources of air emissions such as non-road petrol engines, and non-road diesel engines such as generators, and forklifts. These limits are presented in Table 3 and Table 4.

[4]The limits are taken at a standard temperature of 25°C and 1 atmosphere.

[5]Exceedance calculation: The natural sources contribution can be quantified through measurements, modelling and remote sensing, and they can be deducted from the monitoring results to calculate the exceedances

[6]To calculate the Ozone levels for 8 hours and attribute it to the correct day the following is done: determining the maximum concentration per day for 8 hours through examining the average for operation over 8 hours and updating it hourly. The first calculation period starts from 5 pm the previous day to 1 am of the present day. The last period should be from 4 pm to 12 am.

Table 3 Air Emission Standards of Non-Road Petrol Engines (includes construction, agricultural, and industrial equipment)

Rated Power	CO (g/kW-hr)	HC (g/kW-hr)	NO_x (g/kW-hr)	PM (g/kW-hr)	Smoke (%)
50 ≤ hp < 100	N/A	N/A	9.25 (ABT)	N/A	20/15/50
100 ≤ hp <175	N/A	N/A	9.25 (ABT)	N/A	20/15/50
175 ≤ hp < 750	11.4	1.34	9.25 (ABT)	0.54	20/15/50
Hp = 750 +	11.4	1.34	9.25 (ABT)	0.54	20/15/50

Table 4 Air Emission Standards of Non-Road Diesel Engines (Spark-Ignition Engines)

Rated Power	CO (g/kW-hr)	HC (g/kW-hr)	NO_x (g/kW-hr)	HC + NO_x (g/kW-hr)
< 225cc (non-handheld)	518.97	N/A	N/A	N/A
≥ 225cc (non-handheld)	518.97	N/A	N/A	N/A
< 20cc (handheld)	804.6	295.02	5.36	0.54
≥ 20cc > 50 cc (handheld)	804.6	241.38	5.36	N/A

2.2.1.2.2 Water

Drinking Water

The GAMEP limits for drinking water quality applies. This standard regulates the quality of drinking water regardless of origin; however, does not apply to bottled mineral water. The list of parameters and guidelines is attached in Appendix E.

Sourcing Water

Water will be used in the construction and operation phases of the proposed Project. More details on the water use can be found in Section 3.4.2.1. The exact source of water is not yet determined at this early stage; however, it is expected that the Project will be provided from a low salinity water source such as water trucks by local suppliers. GAMEP 2014 provides relevant standards for water quality for surface water and ground water. The Ministry of Environment, Water, and Agriculture licenses the abstraction of groundwater and regulates the establishment of any wastewater treatment plant with regard to public health and environmental aspects. The Wastewater Treatment & Re-use Policy provides regulation and standards for the disposal and reuse of wastewater with a view to maximizing water efficiency while providing adequate protection of public health and the environment from pollution and infectious diseases.

Permits from the Ministry of Environment, Water, and Agriculture should be issued if recycled and treated wastewater is to be utilized. Licenses are also needed to use groundwater that lay within the range of urban cities and rural communities or groundwater that is of the same quality of wastewater conditioned that the beneficiary shall conduct analysis of groundwater in laboratories accredited by the Ministry of Environment, Water, and Agriculture. GAMEP Standards for groundwater are detailed on Table 5.

Table 5 GAMEP 2014 Standards for Groundwater Quality

Parameter	Unit	Max. Value
Chemical Indicators and nutrients		
Oil & Grease	mg/l	0
Phosphorus (total)	mg/l	0.03
Ammonia (free, as NH_3)	mg/l	0.3
Chloride (as Cl)	mg/l	Above Background Data (ABD)
Calcium ($CaCO_3$)	mg/l	ABD
Inorganic nitrogen (as Nitrite and Nitrate)	mg/l	30
Sodium	mg/l	150/250 (guide)
Sulfide	mg/l	0.002
Total Petroleum Hydrocarbons	mg/l	0.2
Heavy Metals		
Aluminium	mg/l	0.2
Arsenic	mg/l	0.005
Barium	mg/l	1
Cadmium	mg/l	0.005
Chromium (total)	mg/l	0.1
Chromium (Hexavalent)	mg/l	0.005
Cobalt	mg/l	0.05
Copper	mg/l	0.05
Iron	mg/l	0.2
Lead	mg/l	0.005
Manganese	mg/l	0.1
Mercury	mg/l	0.001
Nickel	mg/l	0.02
Silver	mg/l	0.1
Zinc	mg/l	0.02
Organic and inorganic compounds		
Aldrin*	mg/l	2.2×10^{-6}
Benzene	mg/l	0.005

Parameter	Unit	Max. Value
Carbon Tetrachloride*	mg/l	0.005
Chlordane*	mg/l	0.002
Hydrocarbons (Total)	mg/l	0.001
Cyanide (free)	mg/l	0.001
DDT (and metabolites)*	mg/l	1.7×10^{-5}
Dieldrin*	mg/l	4×10^{-6}
TCDD - Dioxin*	mg/l	3×10^{-8}
Endrin	mg/l	0.001
Fluoride	mg/l	0.2
Furans*	mg/l	1×10^{-6}
Helptachlor*	mg/l	0.0004
Hexachlorobenzene	mg/l	0.007
Lindane	mg/l	0.0002
Mirex*	mg/l	1×10^{-6}
MtBE	mg/l	0.02
Pentachlorophenol	mg/l	0.0005
PAH	mg/l	0.0002
PCBs (total)	mg/l	1.9×10^{-6}
Phenols (total)	mg/l	0.005
Toxaphene*	mg/l	0.002
1,1,1 Trichloroethane*	mg/l	0.001
Toluene	mg/l	0.002
Vinyl chloride	mg/l	0.001
Xylenes	mg/l	0.005
Microbial		
Cyanobacteria	mg/l	5,000
E. Coli	Count/100 ml	<10
Intestinal enterococci	Count/100 ml	<5

*The concentrations of these chemical compounds are determined on a monthly average basis.

2.2.1.2.3 Noise

Table 6 shows the permitted noise limits as per the newly released executive regulation for noise issued in June 2021. These limits should not be exceeded unless a permit is issued by the NCEC.

Table 6 Maximum permissible limit for noise levels

Area	LAeq T(dB)	
	Daytime (7 AM – 8 PM)	Night-time (8 PM – 7 AM)
Industrial (1)	70	65
Residential areas – Class A (2)	50	40

Notes:

(1): The limits for noise levels will apply for industrial areas (at the boundaries of the site)

(2): Residential areas with low population density

The standards also list noise limits corrections for construction activities and are found in Table 7.

Table 7 Maximum Correction Values for Construction Activities

Construction Duration	LAeq T(dB)
Up to 2.5 hours	10
From 2.5 hours to 8 hours	5
Over 8 hours	0

Notes:

a) Exceeding the specified limit for noise level is accepted during construction in the period from 7 am to 6 pm.

b) These limits should not be exceeded unless a permit is issued by the NCEC

2.2.1.2.4 Soil

The executive regulation for soil pollution prevention and treatment issued in 2021 provides the basic framework for soil pollution prevention, soil quality standards and soil quality management. Annex 1 to the executive regulations provide the standard soil quality in the KSA (unless baseline soil quality was found exceeding the limits). The list of parameters and limits is attached in Appendix E.

2.2.1.2.5 Waste

The Royal Decree No M/165 of 19 Dhul Qada 1441 Hejra (corresponding to 10 July 2020) indicates that waste cannot be disposed of in areas of vegetative cover (article 19) nor in protected areas (article 32) and that hazardous waste cannot be disposed of in the environment (article 35). The executive regulations for waste management is not yet released. However, the Royal Decree No M/165 states that provisions relating to waste contained in the General Environmental Regulation - issued by Royal Decree No. (M / 34) dated 7/28/1422 AH - continue until the relevant provisions are issued and enforced.

The Saudi GAMEP environmental standards of 2012 and 2014 provide a framework for developing integrated waste management systems in KSA which should provide improved control of environmental pollution, protect public health and welfare and minimise the impact of economic development. The Project should comply with GAMEP requirements relevant for those generating, storing and handling wastes as outlined in the following standards:

Waste Acceptance Criteria (2012G) (PME Env. Std. 8):	The objective of this standard is to set a framework for the development of waste acceptance criteria for waste generators, and treatment, storage, and or disposal facilities (TSD facility) with the aim of reducing the environmental impact of landfills. Acceptance criteria determine the waste to be diverted from landfill, or categories of landfill, by establishing contaminant thresholds for hazardous and inert landfills to determine which wastes are acceptable for landfilling. The standard applies to all types of waste such including hazardous, non-hazardous, and inert waste.
Waste Classification (2012G) (PME Env. Std. 9):	This standard guide those generating, storing, and handling wastes in assessing their classification in terms of: • The origin of the waste • The physical form of the waste: liquid or solid • The character of the waste: Hazardous or non-hazardous • The type of hazardous waste This Standard defines and classifies waste to be managed in KSA with respect to the form of the waste material and its associated impact on human health or the environment.
Waste Regulatory Control and Compliance (2012G) (PME Env. Std. 12)	This standard offers a framework that includes a waste licensing regime for storage, treatment, and disposal facilities. This standard applies to all generators, transporters and TSD Facility (refers to a treatment, storage and/or disposal facility, including recycling facilities) operators in KSA, and extends to all waste types including hazardous, non-hazardous and inert waste.
Waste Handling and Storage (2012G) (PME Env. Std. 13)	This standard guide those handling and storing waste in good operating practices, in managing effective waste storage and segregation systems, and in detecting, containing and cleaning up any leaks that may occur. This standard applies to Waste Handlers who handle and store waste from the point of generation through to the storage of waste where it is held at a facility prior to its onward transfer for recycling, treatment or disposal. This Standard must therefore be read in conjunction with the specific requirements for dedicated storage facilities which are detailed further in the Waste Storage and Material Recycling Facilities – Design and Operation Standard.
Waste Training and Assessment of Technical Competence of Operators (2012G) (PME Env. Std. 14)	The objective of this standards is to establish the framework to ensure that efficient, nuisance-free and environmentally acceptable waste management procedures are practiced in KSA by outlining the minimum requirements for training, certification and assessment of persons participating in or responsible for the operation of treatment, storage and disposal facilities. This standard is to be applied by PME or other PME approved body with responsibility for assessing the technical competence of designated facility operators.

Waste Transportation (2012G) (PME Env. Std. 15)	This Standard utilizes the waste classification and definitions as stated in the provisions of the Waste Classification Standard and does not extend to provisions covering radioactive waste or explosives. This Standard does not apply to the on-site transportation of waste within a facility's property boundary.
Best Practicable Environmental Option (BPEO) for Waste Disposal (2012G) (PME Env. Std. 18)	The BPEO is the waste management system which achieves effective and affordable waste management with minimum cost and maximum benefit to the environment, society and the economy and is therefore one of the key principles to guide progress towards more sustainable waste management practice. The BPEO concept is thus clearly consistent with the objectives of sustainable development.
Industrial and Municipal Wastewater Discharges (PME 2014).	This environmental standard has been developed for quality control of direct discharge from installations and operators. The scope of this standard applies to drainage including any treated liquids or industrial water that cannot be classified as clean water or non-contaminated surface water discharge, including rainwater. This includes but not limited to: • Detergents • Cooling water • Cleaning water

Liquid Waste

Article 11 of the environmental law issued by Royal Decree No M/165 prohibits dumping, draining or injecting treated wastewater or any of the liquid components in underground wells or any environmental medium, without obtaining a permit, as indicated by the regulations.

The executive regulations for waste management is not yet released, as such the GAMEP requirements shall apply. According to GAMEP Environmental Standard number 9 on Waste Classification, waste in liquid form is regarded as:

- Any waste that near instantaneously flows into an indentation void made in the surface of the waste; or
- Any waste load containing free draining liquid substance in excess of 250 litres or 10% of the load volume, whichever represents the lesser amount. "Free draining" means a liquid is defined irrespective of whether that liquid is in a container
- Another interpretation should be used where liquids are known to be present in small amounts in a generally solid waste

Liquid waste is classified into five groups:

- Water containing larger quantities of filterable or non-filterable solids
- Water containing larger quantities of dissolved chemical substances
- Water containing larger quantities of dissolved nutrients
- Non-aqueous liquids
- Combinations of two or more of the above groups

Environmental standards for industrial and municipal wastewater should also be taken into consideration when considering discharged water. Table 8 lists limits for treated water before being discharged to a source of surface water. No limits are available for groundwater.

Table 8 Drainage Limits for Effluents Before Discharging to Surface Water (and Municipal Collection Systems)

Parameter*	Unit	Max. Value
Physio-chemical Properties		
Rough/Coarse Material		Not Permissible
Temperature	Δ Temperature from surrounding environment	5
pH		6.5-8.5
Turbidity	NTU	5
Total Suspended Solids	mg/l	10
Parameters		
Biological Oxygen Demand (BOD)	mg/l	10
Chemical Oxygen Demand (COD)	mg/l	50
Oil and Grease	mg/l	5
Total Organic Nitrogen	mg/l	5
Total Organic Carbon	mg/l	100
Total Phosphorus	mg/l	5
Phosphate (PO_4)	mg/l	1
Ammonia (NH_3)	mg/l	0.5
Chloride (Cl)	mg/l	1500
Inorganic nitrogen (as Nitrite NO_2 and Nitrate NO_3)	mg/l	15
Sodium	mg/l	800
Sulphates	mg/l	600
Sulphide	mg/l	0.2
Heavy Metals		
Aluminium	mg/l	5
Arsenic	mg/l	0.1
Barium	mg/l	1
Cadmium	mg/l	0.001
Chromium (total)	mg/l	0.01
Chromium (Hexavalent)	mg/l	0.05
Cobalt	mg/l	0.05
Copper	mg/l	0.2
Iron	mg/l	2
Lead	mg/l	0.1
Manganese	mg/l	0.2
Mercury	mg/l	0.001
Nickel	mg/l	0.2
Silver	mg/l	0.3

Parameter*	Unit	Max. Value
Zinc	mg/l	2
Organic and Inorganic Compounds		
Aldrin	mg/l	0.01
Benzene	mg/l	0.05
Carbon Tetrachloride	mg/l	0.02
Chlordane	mg/l	0.01
Chlorine (residual)	mg/l	0.3
Chlorinated Hydrocarbons (Total)	mg/l	0.1
Cyanide (free)	mg/l	0.05
DDT (and metabolites)	mg/l	0.01
Dieldrin	mg/l	0.01
TCDD - Dioxin	mg/l	0.01
Endrin	mg/l	0.002
Fluoride	mg/l	15
Furans	mg/l	0.01
Helptachlor	mg/l	0.01
Hexachlorobenzene	mg/l	0.01
Lindane	mg/l	0.01
Mirex	mg/l	0.01
MtBE	mg/l	0.01
Pentachlorophenol	mg/l	-
PAH	mg/l	0.01
PCBs (total)	mg/l	0.01
TPH		5
Toxaphene	mg/l	0.01
Vinyl chloride	mg/l	0.02
Xylenes	mg/l	0.05
Microbial		
Total Coliform	Count/100ml	2000

*Important note: substances not listed above may not be discharged at concentrations greater than 0.001mg/l unless agreed in advance with the competent authority or treatment plants.

Solid Waste

According to the environmental law issued by Royal Decree No M/165, solid waste cannot be disposed of in areas of vegetative cover (article 19) nor in protected areas (article 32). The executive regulations for waste management is not yet released, as such the GAMEP requirements shall apply. For waste to be considered solid, according to the GAMEP Environmental Standard number 9 on Waste Classification, the following criteria are met:

- Has an angle of repose of greater than five degrees (5°)
- Has no free liquids in excess of 10% of the load volume, when tested in accordance with the US EPA Paint Filter Liquids Test – Method 9095 (US EPA 1986)
- It emits no free liquids when transported
- It does not become free flowing at or below 60°C or when transported
- It is spadable

Hazardous Waste

According to the environmental law issued by Royal Decree No M/165, hazardous waste cannot be disposed of in the environment (article 35). Similar to the case of liquid and solid wastes, the executive regulations for waste management is not yet released, as such the GAMEP requirements shall apply. GAMEP has defined hazardous waste, Environmental Standard number 9 on waste classification lists criteria for wastes to be considered hazardous. The waste is considered hazardous if:

- It is included in the Hazardous Waste List;
- It contains one of the hazardous constituents listed;
- It displays one of the hazardous properties listed;
- The waste is a mix of hazardous and non-hazardous materials; or
- If the competent agency decides to consider them specifically hazardous

Some properties of hazardous waste considered are ignitability, reactivity, toxicity, and corrosivity. A list of hazardous waste is found in Appendix E.

2.2.1.2.6 Labour

The labour law was issued by Decree M/51, dated 23/8/1426H. Article 5 lists the provisions this law will apply to, including but not limited to:

- Each contract whereby a person undertakes to work for the account of the employer and under his management and supervision in consideration for a wage
- The apprenticeship and training contracts with workmen other than those of the employer within the limits of the provisions set forth in this law.
- Part time workmen within the limits related to occupational safety and health and workmen injuries and the other categories designated by the Minister.

Articles 50 to 60 of this law describe the requirements of a binding work contract. Articles 61 to 64 describe the duties of the employer, whereas article 65 describe worker's duties. Articles 66 to 73 lists the different penalties and disciplinary actions as per the law, while articles 74 to 83 describe contract termination. Work conditions are managed by articles 89 to 118. The Labour law also manages occupational health and safety through articles 121 to 178.

2.2.1.2.7 EIA Requirements

The Environment Regulation issued by Royal Decree No M/165 of 19 Dhul Qada 1441 Hejra (corresponding to 10 July 2020) stipulates in chapter 1 article 3 that no person may engage in any environmental activities or activities which may have an environmental impact; unless after obtaining a permit or license.

After obtaining a permit or license, a licensee is prohibited from engaging in activities that may emit emissions or pollutants or that may affect the environment in any way as stated in article 8 of chapter 2 of the law. They should comply with Saudi Arabia's laws and standards determined through regulations by monitoring the impact of their projects on the environment. They are also required to submit periodic reports containing data on emissions and other information detailing the environmental impacts of their projects to the relevant Saudi authorities. The requirement for Environmental Impact Assessments (EIAs), are established by the executive regulation for the environmental permits for construction and operation of activities issued by the Ministry of Environment Water and Agriculture in 2021. The executive regulations are applicable to all owners/operators of projects that has an environmental impact (new or existing) inside the Kingdom of Saudi Arabia including construction, operation, modification, addition, expansion and decommissioning. In accordance with the executive regulation, the proposed Project has been classified as Category 3 as per NCEC response to the Project Environmental Classification Form (Annex 1 – Environmental Permits for Activities Construction and Operation Executive Regulations). Figure 2 illustrates the EIA approval process for Category 3 projects.

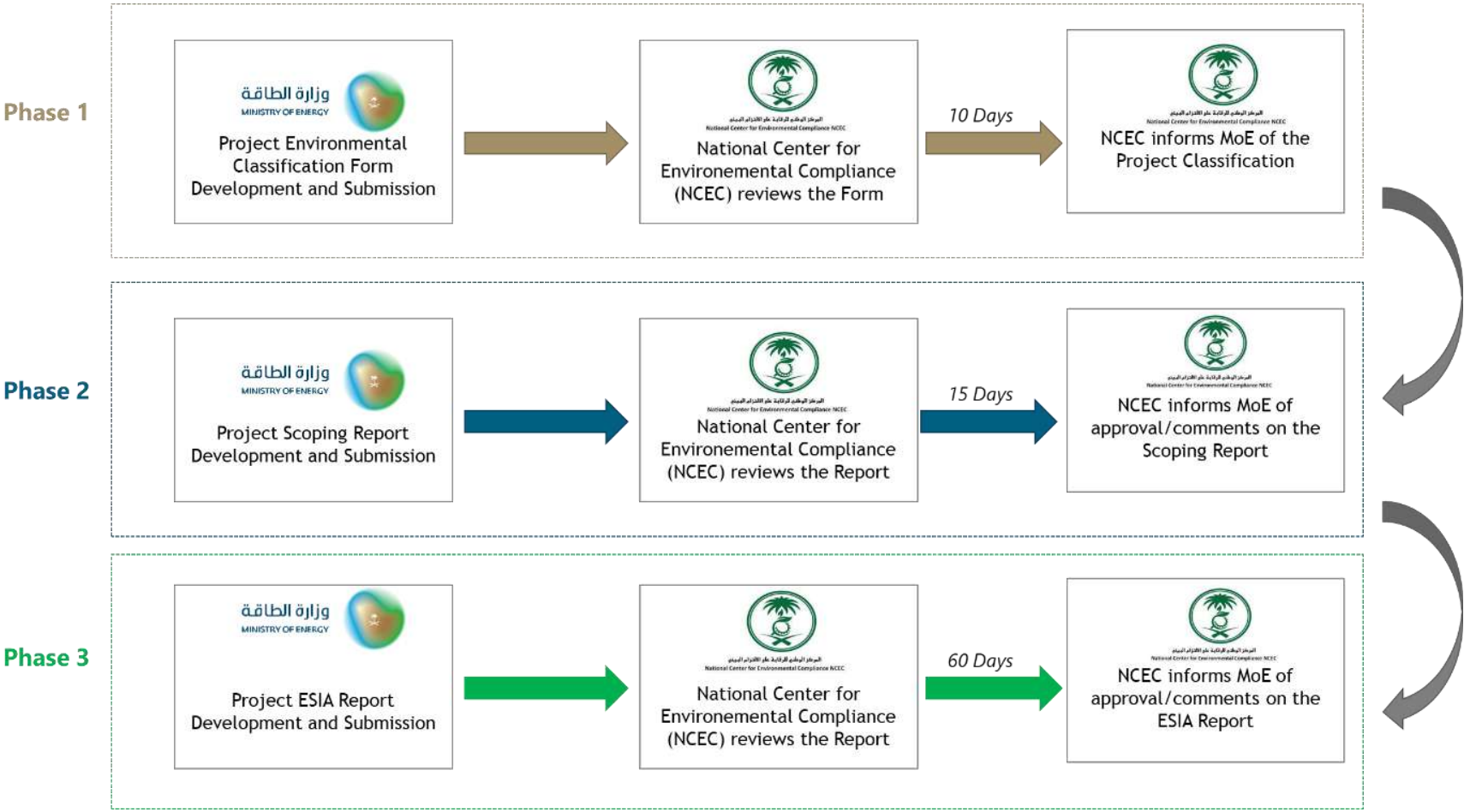


Figure 2 EIA approval process

The following structure should be accounted for within EIAs (Appendix 4 of the executive regulation for the environmental permits for construction and operation of activities, 2021):

- 1 Introduction
  - 1.1 General information on the study
  - 1.2 The justifications for preparing the study, its objectives, and the scope of work
  - 1.3 Study Structure
  - 1.4 Information about the permit applicant
  - 1.5 Information about the service provider who prepared the study
- 2 Policy, Legal and Administrative Framework
  - 2.1 Administrative Framework
  - 2.2 Regulatory Framework
  - 2.2.1 National Legislation
  - 2.2.2 Regional Legislation/Standards
  - 2.2.3 International Legislation/Standards
  - 2.2.4 International Conventions
  - 2.2.5 Results of the strategic environmental assessment study, if available
- 3 Description of the Project
  - 3.1 Identifying project purpose and justification
  - 3.2 Project Location
  - 3.3 Project Activities (during all project phases)
  - 3.4 Project footprint
    - 3.4.1 Required area for the project
    - 3.4.2 Project resources (types and source)
    - 3.4.3 Waste (type and disposal methods)
  - 3.5 Activity Schedule
- 4 Project Alternatives
  - 4.1 Methodology
  - 4.2 No-project Alternative
  - 4.3 Location Alternatives
  - 4.4 Technology Alternatives
  - 4.5 Alternatives Comparison
- 5 Description of the Surrounding Environment
  - 5.1 Information on project area
  - 5.2 Physical Environment
  - 5.3 Biological Environment
  - 5.4 Archaeological and Cultural Environment
  - 5.5 Social and Economic environment
  - 5.6 Sensitive Receptors
- 6 Identification, Analysis and Evaluation of Impacts
  - 6.1 Impact identification, Analysis and Evaluation methodology

- 6.2 Analysis and evaluation of the potential impacts
- 6.3 Summary of the assessment of expected impacts before mitigation

- 7 Management Plans
  - 7.1 Proposed plan to mitigate environmental impacts (for each environmental component) including the cumulative effects and the remaining effects
  - 7.2 Proposed environmental monitoring plan
  - 7.3 Summary of the assessment of expected impacts after mitigation
  - 7.4 Emergency response plan
  - 7.5 Environmental rehabilitation and treatment plan
  - 7.6 Environmental management framework
    - 7.6.1 Roles and responsibilities
    - 7.6.2 Capacity building
    - 7.6.3 Communication
    - 7.6.4 Review and reporting
    - 7.6.5 Data management
    - 7.6.6 Audit and Inspection
- 8 Conclusion
  - 8.1 The preferred alternative from an environmental, social and economic point of view
  - 8.2 A summary of the environmental, social and economic losses and gains that justify the establishment of the proposed project
  - 8.3 A summary of how negative impacts are addressed and to what extent they will be mitigated, improved, or controlled
  - 8.4 Summary of the Environmental Management Plan
  - 8.5 The roles of the various relevant authorities
- 9 Appendices
  - 9.1 List of References
  - 9.2 CVs of EIA consultants
  - 9.3 Technical documents of the Project
  - 9.4 Maps of the Project
  - 9.5 MSDS
  - 9.6 Table indicating how NCEC comments on the scoping report are addressed in the EIA report

2.2.2 International Legislation/Standards

2.2.2.1 International Standards

2.2.2.1.1 Equator Principles

The Equator Principles have been adopted by the Equator Principles Financial Institutions (EPFIs) to provide a financial industry benchmark for determining, assessing and managing environmental and social risk in project financing. They are created to ensure that the financed project is developed in a manner that is socially responsible and reflect sound environmental management practices. Accordingly, negative impacts on project-affected ecosystems and communities should be avoided where possible, and if these impacts are unavoidable, they should be reduced, mitigated and/or compensated for appropriately[7]. Loans are provided to projects complying with the social and environmental policies and procedures and conforming to the Equator Principles (EP) IV, will be effective from 1 July 2020, as follows:

- Principle 1: Review and categorisation
- Principle 2: Environmental and Social Assessment
- Principle 3: Applicable Environmental and Social Standards
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan
- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent Review
- Principle 8: Covenants
- Principle 9: Independent Monitoring and Reporting
- Principle 10: Reporting and Transparency

According to the Equator Principles, Saudi Arabia is a Non - Designated Country. Consequently, Equator Principles require the environmental assessment screening process to be carried out using the host country and the environmental standards and assessment criteria derived in compliance with the IFC Performance Standards and the World Bank Group EHS Guidelines. The most stringent of all the appropriate regulations is to be applied during the assessment.

2.2.2.1.2 IFC Performance Standards on Social and Environmental Sustainability

The IFC Sustainability Framework promotes sound environmental and social practices, encourages transparency and accountability, and contributes to positive development impacts.

[7] For detailed potential impacts assessment of the proposed Project and mitigation measures, please refer to Section 6 and Section 7, respectively.

The Sustainability Framework includes the Performance Standards, which define clients' responsibilities for managing their environmental and social risks. The IFC Performance Standards have become globally recognized as a benchmark for environmental and social risk management in the private sector; they are as follows:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous People
- Performance Standard 8: Cultural Heritage

In addition, IFC has prepared a set of Guidance Notes, corresponding to the Performance Standards on Environmental and Social Sustainability. These Guidance Notes offer helpful guidance on the requirements contained in the Performance Standards, including reference materials, and on good sustainability practices to improve project performance. These Guidance Notes are not intended to explain the requirements in the Performance Standards.

In 2007, IFC Environmental, Health, and Safety (EHS) Guidelines were released, which replace World Bank Guidelines previously published in Part III of the Pollution Prevention and Abatement Handbook. The IFC EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards.

The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines, which provide guidance to users on EHS issues in specific industry sectors. For complex projects, use of multiple industry-sector guidelines may be necessary. *It should be noted that there are no industry specific guidelines for the solar energy projects.*

2.2.2.1.3 World Bank Environmental and Social Framework

In August 2016, the World Bank released the “Environmental and Social Framework-Setting Environmental and Social Standards for Investment Project Financing” (The Framework). This Framework sets out the World Bank’s commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards with the aim of promoting shared prosperity.

The framework comprises:

- A Vision for Sustainable Development.
- The World Bank Environmental and Social Policy for Investment Project Financing.
- The Environmental and Social Standards.

Projects supported by the Bank through Investment Project Financing are required to meet the following Environmental and Social Standards (ESS), as applicable:

- ESS 1: Assessment and Management of Environmental and Social Risks and Impacts
- ESS 2: Labour and Working Conditions
- ESS 3: Resource Efficiency and Pollution Prevention and Management
- ESS 4: Community Health and Safety
- ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement
- ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
- ESS 8: Cultural Heritage
- ESS 9: Financial Intermediaries
- ESS 10: Stakeholder Engagement and Information Disclosure

2.2.2.2 International Guidelines

According to section 2.2.2.1, the international guidelines described in the following sections are the IFC standards for air, water, noise, wastewater and social. Whereas for the soil, the section will describe the Netherlands standards as it represents the most conservative methodology for assessing land contamination.

2.2.2.2.1 Air

Given that KSA is a non-OECD country and Principle 3 of the EP states that the assessment for projects located in non-OECD countries will refer to the applicable IFC Performance Standards and the applicable Industry Specific EHS Guidelines, the assessment in this chapter will take into account the following guidelines: IFC Environmental, Health, and Safety General Guidelines (April 30, 2007), specifically Air Emissions and Ambient Air Quality section and the Construction and Decommissioning section.

The IFC EHS guidelines require implementation of the WHO Ambient air quality guidelines or the host country regulations, whichever is more stringent. Table 9 shows the ambient air quality guidelines.

Table 9 IFC/WHO Ambient Air Quality Guidelines

Parameter	IFC/WB EHS /WHO	
	Averaging Period	Guideline value in µg/m3
Sulphur Dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10-minute	500 (guideline)
Nitrogen Dioxide (NO_2)	1-year	40 (guideline)
	1-hour	200 (guideline)
Particulate Matter PM_{10}	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline)
	24-hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily	160 (Interim target-1)
	maximum	100 (guideline)

Furthermore, section 4 of the guidelines (Construction and Decommissioning) some air emissions reduction and control options that should be considered include:

- Minimizing dust from material handling sources, such as conveyors and bins, by using covers and/or control equipment (water suppression, bag house, or cyclone)
- Minimizing dust from open area sources, including storage piles, by using control measures such as installing enclosures and covers, and increasing the moisture content
- Dust suppression techniques should be implemented, such as applying water or non-toxic chemicals to minimize dust from vehicle movements
- Avoiding any open burning

2.2.2.2.2 Water

The IFC provides general standards for water conservation in the General EHS guidelines. The IFC guidelines present recommendations that could be implemented to reduce, reuse and recycle the different water flows in the project.

2.2.2.2.3 Noise

To ensure compliance with both the National and IFC requirements, the identification of sensitive receptors and modelling of potential noise impacts should be undertaken and mitigation measures should be defined as part of the impact assessment.

The General EHS Guidelines address impacts of noise beyond the boundary of the facilities. As stipulated in the Guidelines, noise emissions for industrial areas should not exceed 70 dBA (one-hour LAeq) during daytime (07:00-22:00) and night-time (22:00-07:00) or result in a maximum increase in background levels more than 3 dB at the nearest receptor location off-site.

Furthermore, the Guideline provides some noise reduction options that should be considered. These options include:

- Selecting equipment with lower sound power levels
- Installing silencers for fans
- Installing suitable mufflers on engine exhausts and compressor components
- Installing acoustic enclosures for equipment casing radiating noise
- Improving the acoustic performance of constructed buildings, apply sound insulation

The Guidelines state that noise monitoring may be carried out for the purposes of establishing the baseline ambient noise levels in the area of a proposed or existing facility, or for verifying operational noise levels. Noise monitoring programs should be designed and conducted by trained specialists. Typical monitoring periods should be sufficient for statistical analysis.

Further details on noise impacts are detailed in the IFC's General EHS Guidelines: Occupational Health and Safety and includes the following:

- No employee should be exposed to a noise level greater than 85 dB (A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB (A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB (A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB (A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.
- Periodic medical hearing checks should be performed on workers exposed to high noise levels.
- The guideline also details different noise limits for a number of working environments detailed in Table 10.

Table 10 IFC Noise Limits for Working Environments

Location/Activity	Equivalent Level LA_{eq},8h	Maximum LAmax,fast
Heavy industry (no demand for oral communication)	85	110
Light industry (decreasing demand for oral communication)	50 - 65	110
Open offices, control rooms, service counters and similar	45 - 50	-
Individual offices (no disturbing noise)	40 - 45	-
Classrooms, lecture halls	35 - 40	-
Hospitals	30 - 35	40

2.2.2.2.4 Wastewater

The Guidelines apply to projects that have either direct or indirect discharge of process wastewater, wastewater from utility operations or stormwater to the environment. As stipulated in the IFC General EHS Guidelines, discharges of process wastewater, sanitary wastewater, wastewater from utility operations or stormwater to surface water should not result in contaminant concentrations in excess of local ambient water quality criteria. Furthermore, the Guidelines indicate that the quality of treated process wastewater, wastewater from utility operations or stormwater discharged on land, should be established based on local regulatory requirements.

2.2.2.2.5 Soil and Groundwater

Two of the most important laws that serve as the foundation for Dutch soil policy are the Soil Protection Act and the Environmental Protection Act. The Soil Remediation Circular 2013 (July 2013) serves as a supplement to the Soil Protection Act. This circular contains guidelines for the use of remediation criteria and the determination of remediation goals in the case of soil and groundwater pollution. The Netherlands Soil Protection Guideline for Industrial Activities (NRB) has been developed to support the implementation of soil protection policy in business and industrial activities. The NRB is a tool for the competent authority and for entrepreneurs to help them determine the risk of soil threatening activities, select adequate soil protection measures and facilities and support the drawing up (and enforcement) of permit conditions. The list of parameters and limits is attached in Appendix E.

2.2.2.2.6 Social

Two IFC Performance Standards are related to the social aspects of the proposed project, namely 2 (Labour and Working Conditions) and 4 (Community Health, Safety, and Security).

IFC Performance Standard 2 (Labour and Working Conditions): recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. The main objectives of this performance standard are to include promoting compliance with national employment and labour laws, protecting workers, including vulnerable categories of workers such as children and promoting safe and healthy working conditions.

IFC Performance Standard 4 (Community Health, Safety, and Security): addresses the project owner's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups. One of the main objectives of this performance standard is to ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the affected communities.

In addition, IFC and the European Bank for Reconstruction and Development (EBRD) issued a guidance note regarding workers' accommodation. This guidance note addresses the processes and standards that should be applied to the provision of workers' accommodation in relation to projects funded by the IFC or EBRD.

During the COVID-19 pandemic, the IFC issued an Interim Advice on Supporting Workers in the Context of COVID-19, that sets out useful information to support decision making in response to the impacts of COVID-19 on workers and employment. It focuses on the following areas: Health and safety, Job protection and Responsible retrenchment. Additionally, IFC released a number of guidance documents related to community development and stakeholders' engagement. In 2010, IFC (Environment Division) released Community Development Resource Guide for Companies, which aimed to serve as a resource guide to help IFC clients and other companies establish effective community development programs for communities located near or affected by their operations. It lays out general principles and methods and disseminates good practice to help develop an appropriate community development program.

The guideline included the key principles for community development that included building trust and managing expectations by clearly defining roles and responsibilities. Furthermore, IFC published "A Good Practice Handbook for Companies Doing Business in Emerging Markets" in May 2007 that presented the key concepts of Stakeholder Engagement such as identification and analysis and specific practices and approaches in implementing a successful stakeholder engagement process at each phase of the project cycle.

In May 2020, an interim advice on Safe Stakeholder Engagement in the Context of COVID-19 was issued to assist in identifying alternative approaches and mechanisms for engaging stakeholders, for continuing to deliver project-related information to the communities within their areas of operations and for receiving feedback, while taking all feasible steps to protect the health and safety of those involved.

2.2.3 International Conventions

Saudi Arabia has used the signing of international agreements and treaties as an extension to its regulations. Saudi Arabia is party to various international environmental conventions or agreements; some of which include the following:

- Montreal Protocol on the Substances that Deplete the Ozone Layer (1987)
- Vienna Convention (and its protocol) on Protection of Ozone Layer (1988)
- Basel Convention on Trans-boundary Movement of Hazardous Waste and their disposal (1989)
- UNEP Convention on the Conservation of Migratory Species of Wild Animals (1991)
- Convention on Biological Diversity (1992)
- Convention on the Conservation of Wildlife and their Natural Habitats in the Countries of the Gulf Cooperation Council (2004)
- Paris Agreement (2015) on climate change

In addition to these guiding principles, Saudi Arabia contributes to many regional and international organizations that are concerned with the protection of environment and conservation of natural resources, such as the United Nations Environment Program, World Health Organisation, United Nations Food and Agriculture Organization, World Meteorological Organization, UNESCO, the relevant organizations working under the Arab League and the Gulf Cooperation Council as well as the Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO).

Saudi Arabia is a member of the International Labour Organisation (ILO). The ILO is devoted to advancing opportunities for women and men to obtain decent and productive work in conditions of freedom, equity, security and human dignity.

Its main aims are to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue in handling work-related issues. Saudi Arabia is a signatory to the Kyoto protocol since January 2005, but as a developing country it would not be subject to emissions cuts under Kyoto, a requirement only binding 30 industrialised nations. Nonetheless, Saudi Arabia agreed that emissions reduction is needed whenever possible by signing the protocol.

2.2.4 Results of the Strategic Environmental Assessment Study, if applicable

Not applicable

3. Description of the Project

3.1 Project Purpose and Justification

The Kingdom of Saudi Arabia is aiming to significantly increase electricity generation from renewable sources, in order to curb emissions from conventional power plants which are using fossil fuels. The MoE is developing Al-Kahfah Solar Energy Park as part of the National Renewable Energy Program, which is a strategic initiative under Vision 2030 and the King Salman Renewable Energy Initiative. The program aims to maximize the potential of renewable energy in Saudi Arabia. The total power generation capacity is expected to be equivalent to 8,534 GWh per year[8]. This yearly production will be equivalent to supplying energy to 406,400 households[9] and will significantly reduce the emission of greenhouse gases by 7.7 million tons of $CO_{2\ equivalent}$.

3.2 Project Location

The proposed Project is located in the Ha'il Province, adjacent to Road 65 Ha'il – Buraydah, ca 140 km south-east of Ha'il city and ca. 110 km north-west of Buraydah city (Figure 1). The closest city to the Project is city of Al-Kahfah at about 6 km (Figure 3). The location is an undeveloped and unfenced area on almost flat terrain. Table 11 presents the angular coordinates of the site polygon. Official approval relevant documentation can be found in Appendix C, and the typical drawings of key equipment and the plant layout are provided in Appendix C.



Figure 3 Project location with respect to Al-Kahfah city

[8] It should be noted that this capacity is the initially estimated capacity and should be confirmed or updated, as necessary as part of the detailed design of the Project.

[9] Based on average consumption of 21 MWh/household/year. Household Energy Survey 2017, General Authority for Statistics.

Table 11 Project coordinates

	WGS84	
	NORTHING	**EASTING**
C#01	26° 58.376'	43° 4.868'
C#02	26° 57.394'	43° 3.935'
C#03	26° 55.322'	42° 59.929'
C#04	26° 57.152'	42° 56.819'
C#05	27° 0.270'	42° 58.977'
C#06	27° 0.895'	42° 57.806'
C#07	27° 1.993'	42° 58.558'
C#08	27° 1.388'	42° 59.760'

3.3 Project Activities

3.3.1 Construction Phase

Due to the extremely large scale of the proposed site, the Project will most likely be constructed in several phases. Depending on the intensity of the construction (timeline, parallel projects) there could be up to 600 people at the peak. Accommodation will be provided in Al-Kahfah and the workers will be bussed in each day. No built structures are currently encountered on the site. Installation of the Project will require moving informal camps and any installations related to grazing activities to alternative locations outside the site boundaries, if still present by the time of the construction activities commencement.

3.3.1.1 Description of Activities

3.3.1.1.1 Civil Works

The main civil works are as follows:

- Rerouting existing underground services, such as piping, cabling and ducts, if necessary
- Civil works for discharging rainwater, if necessary,
- General site filling, levelling and grading to the necessary lines and levels, and all other earthworks, where required, including access areas,
- Construction of new roads, pavements and parking areas as part of the required infrastructure,
- Security fence, lighting system and surveillance in accordance with the relevant requirements,
- Security gate,
- Solar array foundations/piling,
- All civil works for the solar array of each SGU, which typically include the following works and systems:
    - Complete civil works for the solar field
    - Trenches
    - Service roads
    - Local infrastructure

- Foundations for power blocks
- All civil works for water and wastewater treatment plants, if needed
- Any other outdoor civil works required inside the Project or as needed for interconnection to the grid, including the overhead line,
- Civil works required for the administration and workshop building, the control building, the substations buildings, and the security gate house and support building

Earthworks will be required during construction to remove loose sand and to reinforce unstable areas. Construction of the proposed Project and the associated infrastructure will require above ground buildings, installation of racks and panels, and construction of roads. Construction works will require temporary labour force, as well as vehicle movements and construction machinery.

3.3.2 Operation Phase

The expected lifetime of the proposed Project is 25 years. The number of workers required to operate the Project is approximately 150. More details on the Project components and activities during the operation phase are presented below.

3.3.2.1 Components

The main components of the system are as follows:

- PV modules
- Inverter stations, including all MV components (transformers, MV switchgear, inverters, communications, control units and auxiliary services)
- Cabling (DC, AC, LV, MV and HV)
- Racking system, single-axis tracking
- Fencing
- Roads
- Buildings: Substation buildings, storage and maintenance, and control access.
- Internal 132kV high voltage evacuation lines from the SGU to the SEC Substation
- 6 x 33/132kV SGU substations (SGUSs)
- A 132/380kV high voltage SEC Substation
- Interconnection with the Saudi Arabian Transmission System
- 380 kV transmission line from the SEC Substation to the existing 380 kV lines or to other interconnection points

The proposed Project configuration is summarised in Table 12.

Table 12 Selected PV Plant Configuration

Component	Specification/Value
PV Module	540 W Monocrystalline Bifacial Panel (LRS-72H BD 540M 1500V)
Inverter	3.125 MW Central Inverter (SG 3125HV)
Mounting System	Single-Axis Tracking
GCR (%)	0.30
DC/AC Ratio	1.25

Drawings of key equipment are provided in Appendix C.

The PV blocks comprise 517 strings (7,817 kWp DC total) connected to two (2) central inverters with a nominal power of 3,125 kW AC each inverter. Each string has 28 PV panels connected in series (15.1 kW DC) to raise the voltage. The 800, 600, 520 300 and 275 MW SGUs collects the energy from 128, 96, 83, 48 and 44 PV block inverter stations, respectively.

The Project will incorporate a complete SCADA and Communication system to operate the Project. The main equipment in each SGU PV field (inverters, trackers and weather stations) will be connected to the SCADA system of the SGU to enable monitoring and control of the PV field equipment. Each SGU substation will have a separate SCADA system, and both SCADA systems will be interconnected so that the inverters are connected to the SGU substation and provide all relevant signals and controls to operate the inverter blocks, including status of each string, voltages, currents, temperatures, and tracking status, among others.

The SEC Substation will also have a SCADA system, which will be connected to the National Control Centre (NCC). Each SGU will have a Power Plant Controller (PPC) in the Switching Substation (SS), which will receive signals from the NCC and send signals to the SGU and SGU substation. SCADA systems to comply with NCC requirements. The individual SGUs will be monitored from the central administration building located adjacent to the switching substation. Control and operation can also be executed from the SGU substation building; however, this will depend on the final arrangement of O&M contract.

Communication will be through a fibre optic network with sufficient redundancy to ensure uninterrupted signals to the switching substation. SEC will have access to all necessary signals to ensure that the PV plants are fully captured in their operation and that grid stability can be guaranteed.

More details on the key components are presented below.

3.3.2.1.1 Polycrystalline PV Modules

The PV module LONGI Hi-MO5 LRS-72H BD 540M 1500V, manufactured by Longi Solar, was selected as the basis for the design and yield estimates. This type of PV panel, combines both half-cell and bifacial technologies together (Figure 4), among other properties that ensure a considerable increase in the module efficiency. The model chosen is from a leading company in the PV modules industry with one of the most updated technologies, knowledge and experience in PV projects around the world. However, a variety of PV panels provided by different manufactures would be suitable for the site and could offer competitive LCOE. The key specifications of the PV modules are presented in Table 13.

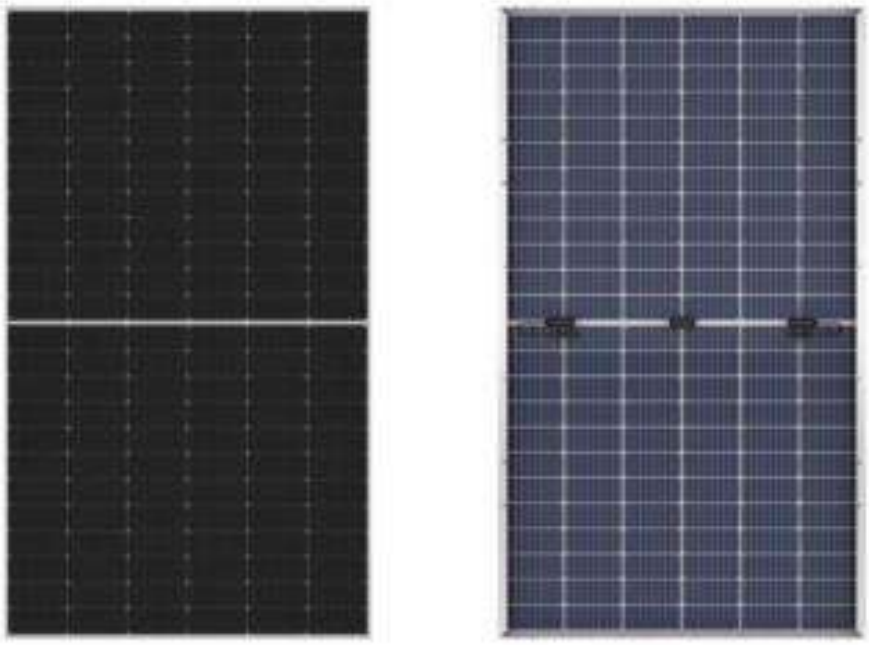


Figure 4 Half-cell bifacial module

Table 13 PV module specifications

Parameter	Value
Maximum Power (Pmax)	540 Wp
Power Tolerance	0-5 W
Maximum Power Voltage (Vmp)	41.65 V
Maximum Power Current (Imp)	12.97 A
Open-circuit Voltage (Voc)	49.5 V
Short-circuit Current (Isc)	13.85 A
Module Efficiency STC (%)	21.1
Maximum System Voltage (Vdc)	1,500 Vdc
Operating Temperature (ºC)	-40ºC~+85ºC
Temperature Coefficients of Voc	-0.284 %/ºC
Module Dimensions (mm)	2256X1133

3.3.2.1.2 Inverters

Central inverter types can be either indoor or outdoor. Both are available on the market and can be installed in the proposed Project. Irrespective of the type of inverter ultimately installed, they shall be designed to withstand all local conditions, e.g. high temperature, sand and dust atmosphere. The inverters shall provide for controls of temperature and moisture content. The SG 3125HV manufactured by Sungrow was selected as the basis for these design and yield estimates.

This inverter, shown in Figure 5, is representative of the industry standard and is extremely common with a long and proven track record. However, several inverter types, sizes and manufacturers would be suitable for this site.



Figure 5 Inverter, central inverter type

3.3.2.2 Activities Description

Generally, the operation of the proposed Project entails the production of power by conversion of solar energy to electricity. The PV power generation process is primarily self-sufficient and is not in need of constant supervision. The resources required for operation include:

- Solar radiation
- Water
- Consumables, including but not limited to spare parts and equipment, detergents and fuel

The outputs from the Project during routine operation include:

- Power
- Solid waste (hazardous and non-hazardous) and liquid effluents (non-hazardous)
- Wastewater from washing of PV panels

The two main activities during this phase are operation and maintenance as well as panel cleaning as further detailed below.

3.3.2.2.1 Operation and Maintenance

In general, the Project will be operated and maintained with the objective to maximise energy production at minimum costs, following SEC and Control Centre requirements.

The main Operation and Maintenance (O&M) activities will include the following, as a minimum:

- Periodic supervision of equipment with the aim to reduce the number of failures and the need of corrective maintenance activities, thus maximizing energy generation
- Inspection and maintenance of equipment and installations according to the O&M manual, the manufacturers' recommendations, and good utility practice
- Repair breakdowns and failures of equipment under normal operating conditions according to the O&M manual, the manufacturers' recommendations, and good utility practice
- Cleaning PV modules (more details are presented in Section 3.3.2.2.2)
- Managing spare parts
- Monitoring and reporting
- Site Security

Furthermore, the operation of each SGU is based on the following:

- The PV modules are connected in series up to the rated voltage of the inverter, referred to as a string
- Strings are connected to electrical panels known as Combiner Boxes, which are in turn connected to the inverters
- The inverters transform the DC current into AC current, and the Low Voltage (LV)/ Medium Voltage (MV) transformers connected to the inverters step-up the voltage to a 33kV. Transformers are protected by 33kV protection switchgears. The 33kV switchgears of the SGUs are connected by underground lines (feeders) to the 33kV switchgear in the step-up substation
- The step-up substation collects all feeders from the PV field and steps up the voltage from 33kV to 132 kV. Each 33kV feeder collects approximately 20 MW
- A supervisory control and data acquisition (SCADA) system is installed for the control, operation and monitoring of the SGU PV field and step-up substation
- The SGU Substations are connected by 132kV feeders to the SEC Substation, where the voltage is stepped up to 380 kV for interconnection to the grid
- The Project will be connected to existing 380kV OHLs through which all of the energy generated by the Project will be evacuated to the existing electrical grid

3.3.2.2.2 Panels Cleaning

As expected for a desert environment, dust particles carried by wind are deposed back to the ground surface and will inherently cover to some degree the solar panels, impeding on the conversion efficiency of solar to electrical energy. During operation, active cleaning of the panels at regular intervals will therefore be required. The panels cleaning system has not been specified yet at this stage. Cleaning activities should weigh water availability limitations in the area with losses in energy generation due to soiling (Master Plan, Al-Kahfah Solar Energy Park, Worley, May 2021). The two alternatives that are considered at this stage of the Project development for panels cleaning are water-based cleaning or waterless cleaning systems. The final selection of the panels cleaning will be largely depending on the availability/cost of water in the area. The optimum alternative will be selected prior to the start of the proposed activities.

3.3.3 Decommissioning Phase

Decommissioning phase is associated with activities related to the demolition of infrastructure and the rehabilitation of disturbed areas. All construction material, equipment, temporary facilities, and waste will be removed from the site.

Topsoil will be backfilled where required, including landscaping to achieve proper drainage. The majority of the semiconductor material and of the glass can be recovered and recycled. The remaining materials (e.g. glass fines, dust) are collected and properly disposed of according to local regulations. Rehabilitation works will ensure that the total area will be free draining, covered with topsoil.

No decommissioning plan is yet available; however, the following activities can be anticipated in association with the decommissioning phase:

- Existing buildings and structures demolished, rubble removed, and the area levelled;
- Remaining exposed excavated areas filled and levelled using overburden recovered from stockpiles;
- Stockpiles and tailings impoundments to be smoothed and contoured;
- Topsoil replaced using topsoil recovered from stockpiles

The following dust-generating activities may be expected during decommissioning:

- Smoothing of stockpiles by bulldozer
- Grading of sites
- Transport and dumping of overburden for filling
- Infrastructure demolition and piling of Infrastructure rubble
- Transport and dumping of building rubble
- Transport and dumping of topsoil
- Preparation of soil for re-vegetation

Of particular importance is the disposal of the PV panels at the end of the decommissioning phase because of their extremely large number (approximately seven million pieces). These are considered hazardous waste and, if not recycled, they will need to be disposed of at an appropriate waste facility able to receive such quantities.

3.4 Project Footprint

3.4.1 Required Area for the Project

The planned area for the Project is 83 km^2. All Project activities are expected to be within the boundaries of this area therefore, the physical footprint of the Project is expected to be confined to these boundaries. The coordinates of the proposed Project boundaries are presented in Section 3.2. It should be noted that the details on the associated infrastructure outside the Project boundaries are not available at this point of Project development.

The Project is expected to have a final total capacity of close to 3 GW and will be divided into the following to individual Solar Generator Units (SGU) as follows:

- 600 MW (SGU 1)
- 800 MW (SGU 2)
- 600 MW (SGU 3)
- 520 MW (SGU 4)
- 300 MW (SGU 5)
- 275 MW (SGU 6)

The general layout of the Project configuration is presented in Figure 6. A higher resolution figure is shown in Appendix D.

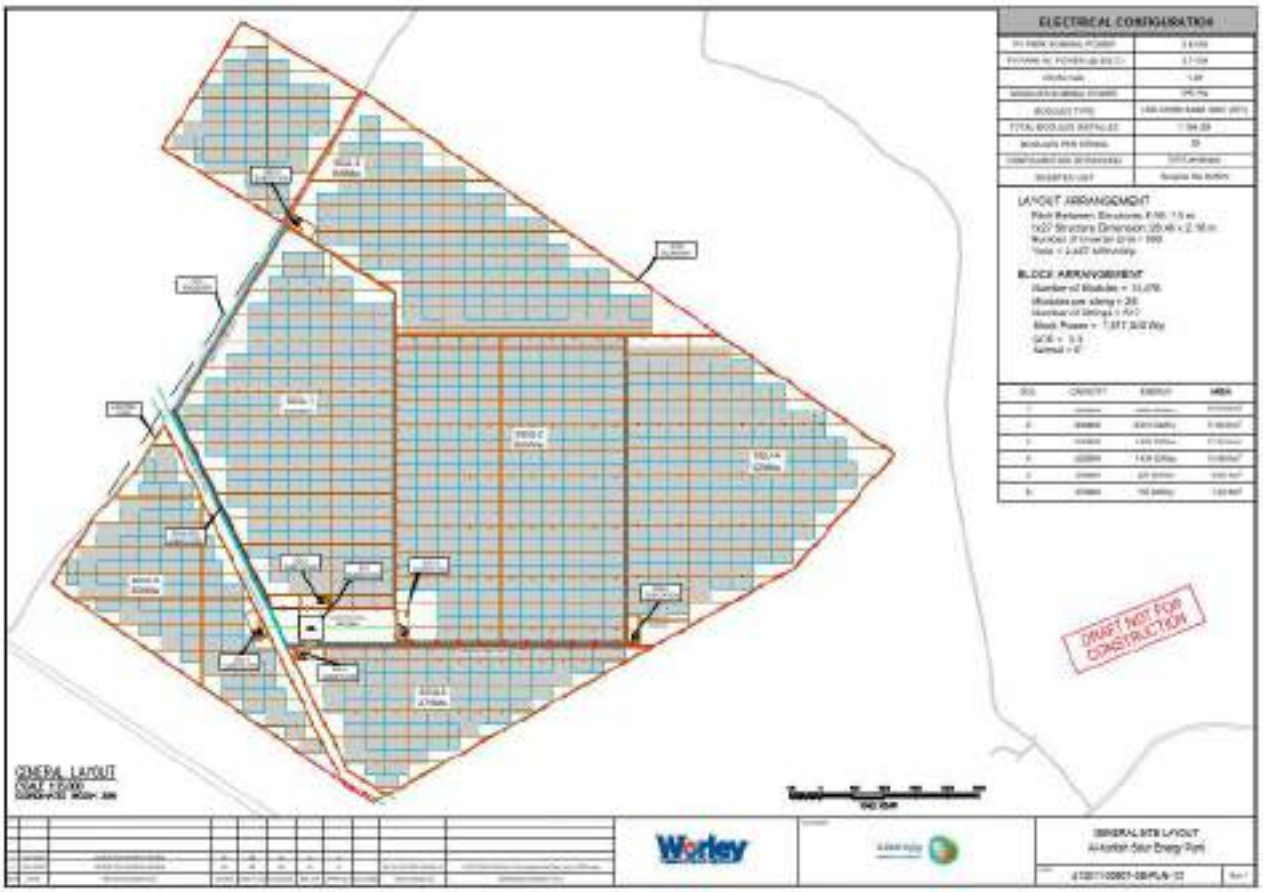


Figure 6 General layout of the Project

3.4.2 Project Resources

3.4.2.1 Water

The daily drinking water consumption for the construction workers is estimated to be approximately 136.8 m^3/d. This number is based on the total number of workers required at each stage of the construction activities (i.e. 600)[10]. There is no available estimate for the construction activities water consumption at this early stage of the project; however, it should be determined prior to commencement of works.

During the operation phase, potable water will be required for the onsite workers. The potable water daily consumption for the operations workers is estimated to be approximately 34.2 m^3/d. This number is based on the total number of workers (i.e. 150 workers). During the operation phase, water will be supplied using trucks and stored onsite in large tanks, similar to the approach followed in the construction phase. Other water supply alternatives might be investigated at a later stage of the Project such as the utilization of a dedicated pipeline.

[10] Based on average daily consumption of 228 l/c/d in Ha'il Province(Source: Argaam, accessed in June 2021)

There might be a need for additional water volumes in case water-based cleaning is considered for panels cleaning (Section 3.3.2.2.2). If selected, the Project is expected to consume around 126,000 m^3 of water per year to ensure the performance of the panels is maintained. This preliminary figure for water consumption has yet to be refined in the detailed design. Depending on the quality of the selected water source, it may be necessary to construct a water treatment plant to obtain the required water quality for panels cleaning. The need for a water treatment plant, and consequently its specifications, will be determined at a later stage of the Project development.

3.4.2.2 Construction Materials

Materials required (aggregates, etc.) will be acquired from the local market. There is no available estimate of the quantities of these materials at this early stage of the project; however, they should be determined prior to construction commencement.

3.4.2.3 Hazardous Chemicals

There is no available estimate of the quantities of these materials at this early stage of the project; however, they should be determined prior to construction commencement. In general, it is anticipated that there will be a variety of chemicals stored and used during construction and operation of the Solar Power Plant, as listed in Table 14 below.

Table 14 Hazardous materials

Project Phase	Hazardous Materials
Construction	▪ Liquid fuels including diesel, petrol and gas (LPG) and lubricating and hydraulic oils will be used extensively by vehicles, pumps and generators; ▪ Cement and concrete admixture chemical will be used for the provision of concrete for substations, building bases and platforms; cement and concrete; ▪ Gases: oxygen, acetylene and nitrogen; ▪ Paints, coatings, grease and chemical cleaners for general use.
Operation	▪ Hydraulic and lubricating oils and greases contained within the synchronous condensers; ▪ Insulating oil contained in the solar farm inverter/transformers and substations; ▪ Gelled sulphuric acid electrolyte contained in batteries associated with the control room emergency power supply system; ▪ Small quantities of hydraulic and lubricating oils and greases, fuels (gas, petrol and diesel) ▪ Epoxy resins and hardeners (contained in fibreglass repair kits) ▪ Coolants, thread glues, paints, degreasers, ▪ Pesticides and herbicides associated with hygiene and maintenance activities; ▪ Gases such as oxygen, acetylene nitrogen; ▪ Sulphur hexafluoride (SF_6) gas contained within high voltage equipment.

3.4.3 Wastes and Emissions

In general, all the wastes (solid, liquid) will be appropriately collected and disposed of following the applicable national requirements.

3.4.3.1 Domestic Wastewater and Sewage

During construction, sanitary waste streams will be generated from the domestic uses and portable toilets. The wastewater will be appropriately collected in dedicated septic tanks and they will be emptied and serviced on a regular basis by an approved contractor. The estimated daily wastewater generation during the construction phase is approximately 109 m^3/d. This assumes that wastewater represents approximately 80% of the domestic water demand indicated in Section 3.4.2.1[11]. Following the same approach, the expected domestic wastewater during operation phase is estimated to be approximately 27 m^3/d.

3.4.3.2 Solid Waste

Solid waste is expected to be generated during construction and operation. This will likely include construction waste (debris, discarded concrete, empty drums) and municipal solid waste (paper, cardboard, plastic and other packages, food waste). Municipal waste will be collected in dedicated places onsite and disposed of by a specialized contractor at the local municipal landfill site. Construction waste will be reused as much as possible in construction activities, or alternatively it will be disposed of at a landfill site.

Another potential source of solid wastes is the damaged PV panels, if any during the installation. There are different management alternatives for the damaged panels, including return to supplier, offsite disposal at licensed facility and recycling at licensed facility, as far as practical. The final selection of the management approach shall be determined at the early start of the construction phase.

There will be limited production of wastes during the proposed Project operation; these will most probably include oil, oily rags, scrap metal, replaced machine components etc. which will be disposed offsite according to relevant national legislation. Another potential source of solid wastes during this phase is the damaged solar panels, if any. The management approach for the damaged panels, if any will be similar to those followed during the construction phase (e.g. return to supplier, etc.). The final selection of the management approach shall be determined at the early start of the operation phase.

3.4.3.3 Air Emissions

Dust and particulate generation are expected to occur during the construction phase. Furthermore, heavy equipment will produce exhaust emissions from diesel engines leading to temporary increase in SO_2, NO_x, and CO_2 concentrations. The release of carbon monoxide (CO) occurs as a result of incomplete combustion of fuel in engines. No air emissions are expected during the operation phase. Furthermore, the proposed Project is expected to significantly reduce the emission of greenhouse gases by about 7.7 million tons of $CO_{2equivalent}$.

3.4.3.4 Noise

The possible source of noise levels is the construction phase is equipment and machinery. Table 15shows the maximum typical sound pressure levels for some of the construction equipment to be used in the proposed construction activities as per Defra[12] noise database for prediction of noise on construction and open sites.

[11] Saudi Gazette report, accessed in May 2021

[12] Defra, Update of Noise Database for Prediction of noise on Construction and Open Sites, 2005

Table 15 Typical sound pressure levels for construction equipment

Equipment	A-weighted Sound Pressure Level, LAeq dB
Tracked excavator (loading dump truck)	85
Grader	86
Dump truck (tipping fill)	79

During operation, a potential noise sources are the substations, inverter stations and transformers. The noise levels vary depending on the specifications of the equipment. For example, the average noise level of the operating substation is 80 to 100 dBA (Chen et al., 2014). The noise generating from the inverters is expected to be limited and below 60 dBA. Furthermore, the Project will also include transmission lines which may produce sizzles sounds that occur during periods of high humidity. Though this noise is audible to those very close to the transmission lines, it quickly dissipates with distance and is easily drowned out by typical background noises and thus not considered as a significant noise source. Another potential noise source is the water treatment plant that might be utilized for panels cleaning water treatment if the wet cleaning option is selected. However, the need for the water treatment plant is yet to be determined at a later stage of the Project and thus the specifications of the treatment plant is not available at this stage and consequently not further assessed in this study.

3.5 Activity Schedule

The Project is scheduled to be constructed in phases, where each phase is expected to be around 18 months. The start of the construction and operation will be dependent on obtaining the required permits to commence the activities. The operational lifetime of the proposed Project is expected to be 25 years.

3.6 Workers Accommodation

No onsite accommodation is expected during both the construction and operation phase. Due to its close proximity, the workers can be accommodated at Al-Kahfah city and workers will be bussed in each day.

4. Project Alternatives

4.1 Methodology

The analysis of alternatives is an approach in environmental policy to minimize environmental harm by comparing multiple potential solutions in the context of specific problems or design goals. In general, the assessment of alternatives includes the consideration of a number of possible options to achieve a specific objective, in this case minimizing the impact of the proposed Project on the environment, lowering cost, and maximizing energy yield. During the evaluation of alternatives, careful consideration is given to social, economic, and ecological factors that influence the predicted outcome. The most important aspect of analysing alternatives is to understand the consequences of each available option as it helps avoid decisions that substitute one problem with another possibly unknown problem.

The following alternatives are considered for the proposed Project:

- No-project
- Location
- Technology (e.g. mounting system)

More details on each of the above-mentioned alternatives is presented in the following sections.

4.2 No-project Alternative

The proposed Project is part of the National Renewable Energy Program (NREP), which aims to maximize the potential of renewable energy in Saudi Arabia. The Project capacity is approximately 3 GW. The total power generation capacity is expected to be equivalent to 8,500 GWh per year. This yearly production will be equivalent to supplying energy to 380,000 households and will significantly reduce the emission of greenhouse gases by 5.2 million tons of $CO_{2\ equivalent}$. As such, the “No-project” alternative would lead to loss of potential energy production. Furthermore, the “no-project” alternative would lead to loss of investment and new jobs that would otherwise be created during both the construction and operation of the proposed Project. It is expected that approximately 600 workers will be required for each stage of the construction. Furthermore, around 150 workers will be required during the operation phase. Hence, carrying out the proposed Project can have positive impacts on the country.

4.3 Location Alternatives

In general, the key selection criteria for renewable energy projects location include (Joseph et al., 2016):

- The availability of land
- The area has few important environmental receptors and is sufficiently distant from residential areas to minimize social impacts
- The site is easily accessible and will easily connect with the local electricity grid

Furthermore, the level of irradiation at the Project site should be strong. The location selected should not be a culturally significant site. More information on the location and its surrounding environment is presented in section 5.

4.4 Technology Alternatives

The basic PV Plant arrangement was chosen to minimize the cost per energy generated, while using proven PV technology that is industry standard. The design of the proposed Project is based on standard PV plant configurations and industry best practice and were combined with the results of optimization studies to determine several key parameters of the Project. Considerations such as mounting system and panels cleaning were studied as further detailed below.

4.4.1 Mounting System

The structure upon which the PV modules are mounted is a critical component in the proposed Project as it impacts the generation output and profile, as well as the capital and operational costs.

There are two alternatives for the mounting system:

- Fixed tilt
- Single-axis tracking

For a fixed-tilt mounting system, the PV modules remain in a fixed position, typically tilted at an optimal angle, with the rows oriented in a West-East direction. For single-axis tracking systems, the PV modules are aligned in a north-south orientation and turn on a single axis (+60°/-60°) to follow the sun from east-to-west. Figure 7 shows mounting systems examples.



Fixed tilt mounting system



Single-axis tracking system

Figure 7 Examples of mounting systems

4.4.2 Panels Cleaning Systems

In desert areas having a high concentration of atmospheric dust with very scarce rain, soiling of the panels surface is inevitable. For maximum efficiency of electricity generation from solar cells, cleaning of these panels is a must. Different manual and automatic cleaning technologies are available. Cleaning expenses in a solar plant accounts for almost half of the O&M cost (Khadka et al., 2020). There are two alternatives for PV panels cleaning:

- Water-based cleaning systems: best suited in an area where water is abundantly available. Routine cleaning shall be required to perform cleaning from time to time, such that no soiling particles or bird excreta are allowed to stay for a long time. These systems virtually create a rain-like environment in the solar plant as hoses spray the water directly on the panels; the panels due to their inclination washes the dirt along with water to earth due to gravity
- Waterless cleaning systems: best suited in dry places like deserts where water is not available and the soiling in the surface of the panel is only due to dust accumulation. In waterless cleaning technology, a brush, typically dust repellent, is rotated or moves along the surface of the panel to swipe the dust away. These systems are less complicated as no water storage and high-velocity pumping of water onto the panel are required

At this early stage of the Project, the final panels cleaning system has not yet been selected yet. As such, these alternatives will not be further assessed at this stage of the Project development. However, the final selection will be made prior to activities commencement and will take into consideration the technical and environmental aspects. It should be noted that the current study covered the impacts associated with the water-based cleaning alternative following a conservative approach.

4.4.3 PV Modules

The alternatives considered for the PV modules are:

- Mono facial
- Bifacial

Unlike the mono facial PV modules, bifacial modules absorb solar power from both the front and rear sides of the panel, allowing the PV cell to capture more solar irradiation, and therefore produce more energy (Figure 8).

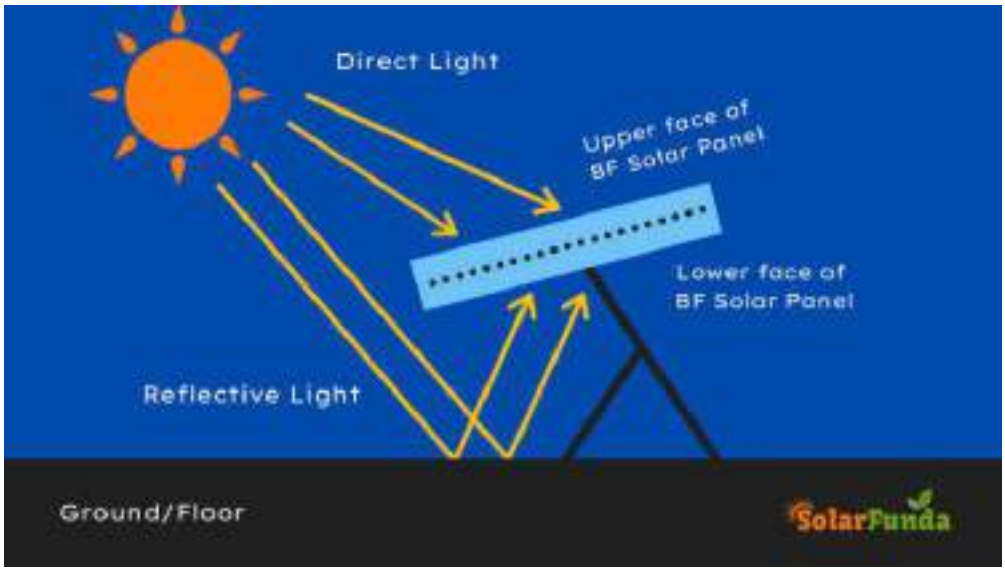


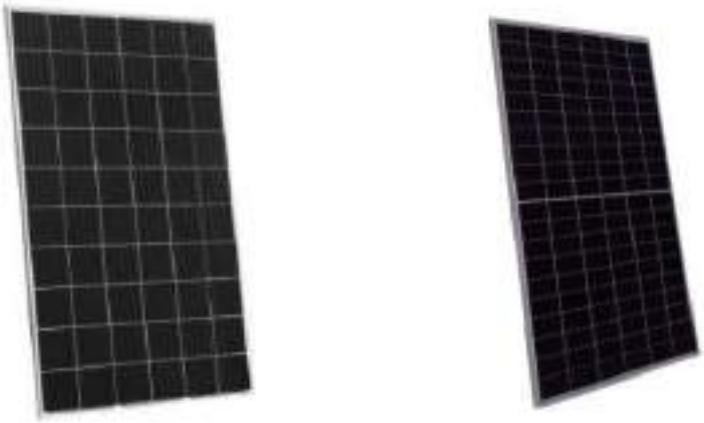
Figure 8 Bifacial PV Module

Source: Solar Funda, Link

The benefits of bifacial modules are highly variable to the site conditions of installation, specifically the surface where they are installed. When bifacial modules are installed with enough spacing and on a highly reflective surface (e.g., a white roof or on the ground with light-coloured stones), production can be increased by up to 25% due to the extra irradiance captured from the rear. Conversely, tight spacing and dark ground can negate such gains.

Another alternative considered for the PV module are (Figure 9):

- Full cell
- Half- cell



Full cell *Half-cell*

Figure 9 Cells Alternatives

Half-cell modules are solar cells cut in half to improve performance and durability. When solar cells are halved, their current is halved, thus lowering resistive losses (i.e., higher productivity). Smaller cells also experience reduced mechanical stresses, which decreases cracking. The modules assembled with half cells also perform better during daily operation due to lower temperature coefficient of power, along with reduced shading effects on energy generation, lower risk of hot spots, and enhanced tolerance for mechanical loading. Some manufacturers use third-cut cells, but this is not standard in the market yet. There is a trend in the market toward half-cell technology due to the higher output and reduced losses in case of shadowing.

4.4.4 Ground Coverage Ratio (GCR)

The PV module spacing and tilt angles determine the GCR, as shown in Figure 10, which is calculated by dividing the length of the module (A) by the distance from the front edge of a module to the front edge of a neighbouring module (B): GCR =A/B .

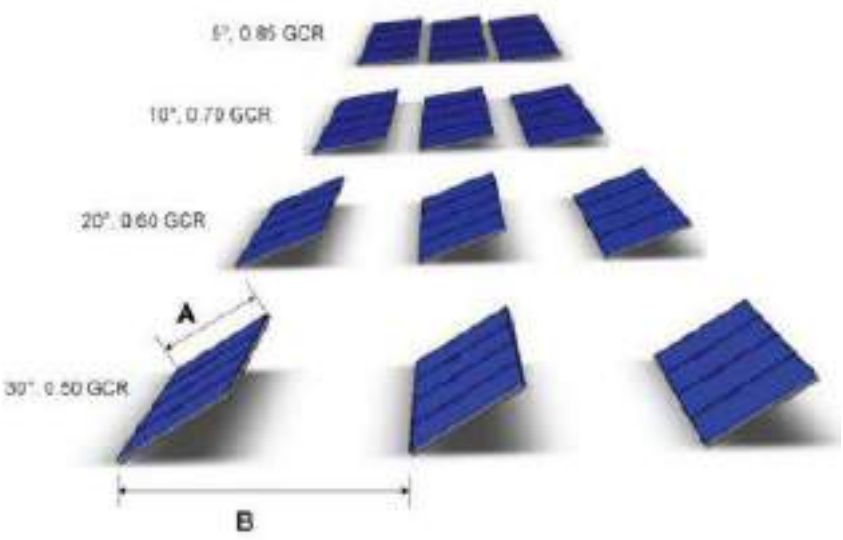


Figure 10 GCR variations based on array configuration

In general, decreasing the space between rows of PV arrays reduces the net energy due to increases in near shadows. The selection of the GCR is dependent on the required energy production and land availability. Different GCR values were considered for the proposed Project ranging between 0.25 to 0.75.

4.4.5 DC/AC Power Ratio

The DC/AC ratio is the ratio between the power of modules installed and the power of inverters. When this ratio is 1 (one) the PV modules power and inverter power are the same. Because the solar radiation increases and decreases along the day, there are moments when the inverters are generating much less energy than they could. By increasing the DC/AC ratio the energy generation is maximized during the day even if there are moments when the PV field generates more energy than inverters can export. This excess of DC energy from the PV field is lost (due to the "clipping" effect), but the gain in energy compensates those losses. The use of the inverter and transformers can be maximised while running close to the maximum efficient range (between 85-95% of the nominal load) by compensating for losses by increasing the peak DC power above the nominal AC power of the inverter. Other losses, such as those due to temperature and degradation, can be compensated for by increasing the DC/AC ratio. However, increasing the DC/AC ratio above 1 will cause the PV generation to exceed the inverter nominal power, requiring a power limitation imposed by the inverter called "clipping" (Figure 11).

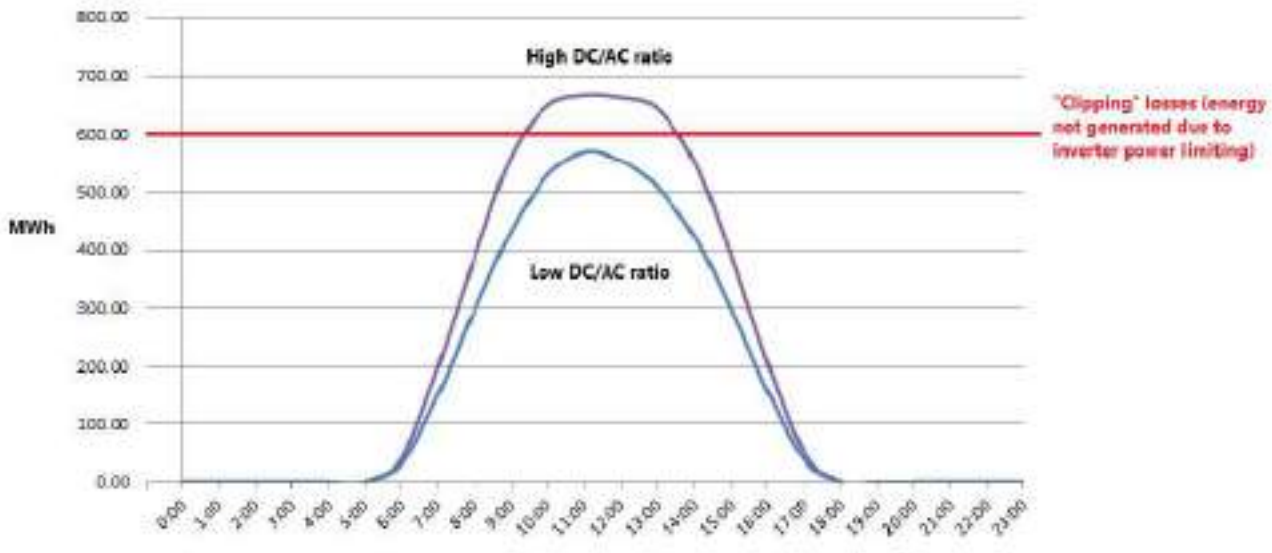


Figure 11 Clipping effect on inverters

The effect of the DC/AC ratio on net energy generated by the PV Plant was simulated and a detailed LCOE analysis was conducted. The ratios considered ranged between 1.0 to 1.35.

4.5 Alternatives Comparison

Table 16 shows a summary of the above-mentioned alternatives comparison.

Table 16 Alternatives Comparison Summary

Alternative	Pros	Cons	Selected alternative	Justification
No-project	• No environmental impacts as no construction or operation activities will take place	• No power generation • Loss of job opportunities • Loss of investment		
Project establishment	• Power generation • Reduction of GHGs emissions by 7.7 million tons of CO_2 equivalent • Job opportunities provision • Investment and local economy enhancement	Limited environmental impacts during the different phases especially during construction. However, largely mitigated as illustrated in Section 7.3	✓	The overall positive impact resulting from the proposed Project are notably more significant than the limited negative impacts, if any. As such, the "no-project" alternative (not constructing the proposed Project) is not a feasible alternative, as it would lead to loss of investment and expected employment as well as less clean power generation, contrary to the Saudi National Renewable Energy Program.

Alternative	Pros	Cons	Selected alternative	Justification
Location of the Project	• The area is designated for PV projects (Appendix C) • The availability of land for the planned development • The area is sufficiently distant from residential areas to minimize social impacts. Nearest city is Al-Kahfah at a distance of approximately 6 km • The site is easily accessible and will easily connect with the local electricity grid. • the level of irradiation at the Project site is strong, with a Global Horizontal Irradiation (GHI) of 2,264 kWh/m² • Is not a culturally significant site	Some herders were noted on the site during the site visit; however, grazing is generally a seasonal activity	The location of the Project with the boundaries indicated in Section 3.2 is selected for the proposed development	The Project area is officially designated for similar developments (PV Energy Park) as part of Vision 2030 to maximise the potential of the renewable energy industry in KSA and its characteristics is suitable for establishing the proposed Project
Technology Alternatives				
Mounting System				
Fixed tilt	Lower O& M cost compared with the single-axis tracking	Lower annual generation of energy		

Alternative	Pros	Cons	Selected alternative	Justification
Single-axis tracking	For the same rated capacity, the annual generation is 16.5% higher on average with a single-axis tracking system compared to fixed-tilt mounting	Higher O&M cost compared with the fixed tilt	✓	Higher annual generation of energy
PV module				
Mono facial	Common technology	Lower energy production compared with bifacial		
Bifacial	Energy production can be increased by up to 25%	The benefits of bifacial modules are highly variable to the site conditions of installation	✓	Higher energy production
Full cell	Common technology	Lower performance and less durable when compared with half-cell		
Half- cell	Improved performance and durability compared with full cell		✓	Improved performance and durability
Ground Coverage Ratio (GCR)	NA	NA	0.3	The results of the simulation indicated that for Al-Kahfah Solar Energy Park, a GCR of 0.3 is the optimal compromise between land usage and energy production. In consequence the distance from pier to pier of different rows is 7.5 meters. Considering the length of the PV modules, the distance between modules when they are in horizontal position is 5.25 meters.
DC/AC Power Ratio	• NA	• NA	1.25	The results of the data analysis indicated that for Al-Kahfah Solar Energy Park, a DC/AC Power ration of 1.25 is the optimal value

5. Description of the Surrounding Environment

5.1 Information on Project Area

The present chapter provides a general overview of the existing conditions at the Project site and wider area, as far as relevant. Data utilized in the receiving environment description was obtained by desktop research, site walkover and specific site studies (topographical, hydrological and geotechnical).

Habitat map and land use map of the proposed Project can be found in Appendix D of this report.

5.2 Physical Environment

5.2.1 Topography and Landscape

A detailed topographic survey (1:500 scale) of ground profile and features at 50-meter intervals was conducted by Scopus Engineering in March 2021 (Worley Doc. No. 413011-00907-CI-REP-102_Rev 1). A high-resolution topographic map of the site is available in Appendix D. The survey concluded that, mainly in the south-west and north areas, the terrain is mostly uneven, rocky and with irregular slopes, as shown in Figure 12; the surface is dominated by fine flat gravel. Otherwise, the terrain is almost flat over extended areas, with a mild slope towards Kahfah (ca 40 m altitude difference over a distance of ca. 4 km). Boarding the northern site border there is a cliff running in northwest to southeast direction, at which the terrain descends with a somewhat steeper slope than within the site borders (Figure 13). The topographic survey shows that the site elevation varies from 741 m in the north-east to 823 m in the south-west (Figure 14).



Figure 12 Photos from the site area



Figure 13 Cliff with respect to the Project site

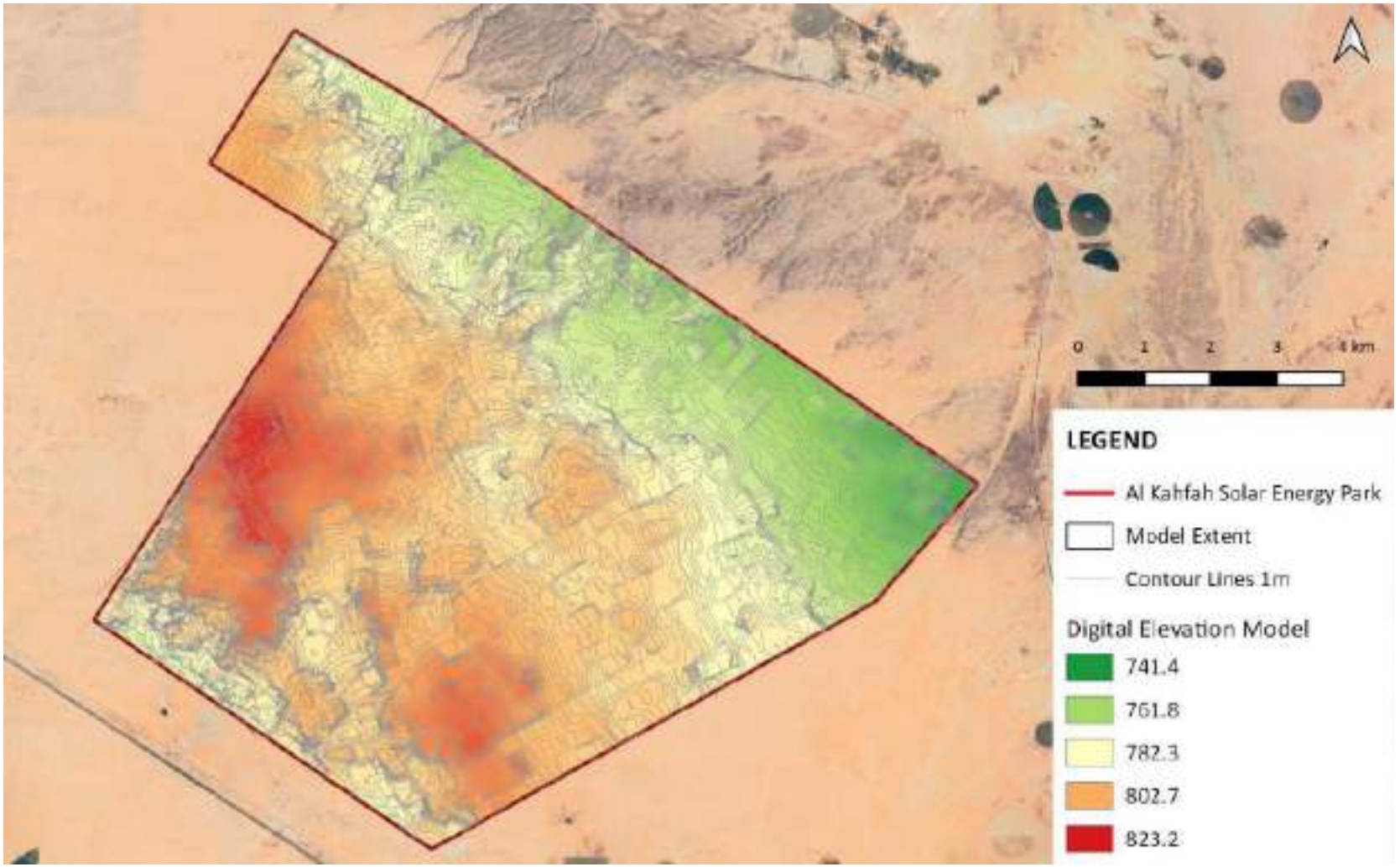


Figure 14 Topographical map for the Project area

5.2.2 Climate and Meteorology

5.2.2.1 Climate

The climate in Ha'il Province can be characterised as a hot dry climate which is a classification in the Köppen Climate Classification system (Köppen, 1884) and translated in (Volken & Bronnimann, 2011) as BWh. It has a somewhat milder climate than other Saudi cities due to its higher altitude.

5.2.2.2 Meteorology

Meteorological conditions in Buraydah, which is located at a distance of about 110 km from the Project site, are expected to be more similar to the Project site since they share relatively similar topography, as opposed to Ha'il city which is surrounded by mountains and at a distance of approximately 120 km from the project.

5.2.2.2.1 Temperature

As the region is a desert climate, it is expected that the temperature varies diurnally and seasonally as well. In addition, as Ha'il is one of the northern provinces in Saudi Arabia, it is expected to be colder during the winter. Table 17 shows details on the temperatures in Buraydah recorded over a period of 21 years.

Table 17 Temperature records in Buraydah

Parameter	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Temperature (°C)	24.5	12.2	14.4	18.3	23.9	31.1	33.3	33.9	34.4	32.2	27.2	18.9	13.9
Average High Temperature (°C)	32.2	17.8	21.1	25	31.1	38.9	42.8	42.8	43.9	41.1	36.1	26.1	20
Average Low Temperature (°C)	16.7	6.1	7.8	12.2	17.2	22.8	23.9	25	25	22.8	17.8	12.2	7.8

Source: Weatherbase website accessed August 2021.

5.2.2.2.2 Precipitation

Table 18 shows number of days with precipitation recorded at Buraydah; whereas, Table 19 presents the average relative humidity measured in Buraydah for a period of more than 10 years.

Table 18 Average Number of Days with Precipitation at Buraydah

Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22	4	2	4	4	2	-	-	-	-	1	3	2

Source: Weatherbase website accessed August 2021.

Table 19 Relative humidity in Buarydah

Parameters	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average Relative Humidity (%)	31.3	55	45	40	30	20	15	15	15	15	25	45	55

Source: Weatherbase website accessed August 2021.

5.2.2.2.3 Wind

Table 20 shows monthly averages of wind speed and direction at Buraydah, from data observed between 2015 and 2021 at Prince Nayef Bin Abdulaziz International Airport. The average annual wind direction is predominantly from the east- northeast in winter and spring and from the north during the summer months.

Table 20 Wind statistics for Buraydah

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dominant wind direction	NE	ENE	ENE	ENE	NW	N	N	N	ENE	SSE	E	ENE
Average Wind speed (knots)	7	8	9	9	8	8	8	9	7	6	8	7

Source: Windfinder.com, accessed March 2021

5.2.2.2.4 Other Weather Phenomena

The following information was extracted from the Statistical Yearbook of 2019, (issued by the Ministry of Environment, Water, and Agriculture) for Ha'il Province, and is not site specific.

Pressure

Atmospheric pressure in Ha'il Province ranged from 930.1 hPa in July to 940.6 hPa in December.

Fog

Ha'il Province does not experience many foggy days, recording zero instances of fog all year.

Thunderstorms

Thunderstorms were frequently recorded in Ha'il Province. Table 21 shows more information.

Table 21 Frequency of thunderstorms in Ha'il Province

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Thunderstorms	0	1	3	3	8	1	0	0	0	2	9	0

Dust and dust storms

According to the Statistical Yearbook, suspended dust was recurrent most of the year with the highest frequency during March. Table 22 shows more information.

On the other hand, the frequency of dust storms was low, compared to other Provinces, with only three storms recorded during March (two storms) and May (one storm).

Table 22 Frequency of dust and dust storms in Ha'il Province

Parameters	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Suspended dust	9	5	10	8	8	1	1	0	0	3	6	2
Dust storm	0	0	2	0	1	0	0	0	0	0	0	0

5.2.2.2.5 Onsite Meteorological Station

In April 2018, a meteorological station was placed on site at the location indicated in Figure 15, to collect data and to conduct a solar resource assessment and a soiling rates assessment for the Project site; it was decommissioned in May of 2019. The station collected ground measurements such as temperature, wind speed, precipitation, global horizontal irradiance (GHI), and direct normal irradiance (DNI).

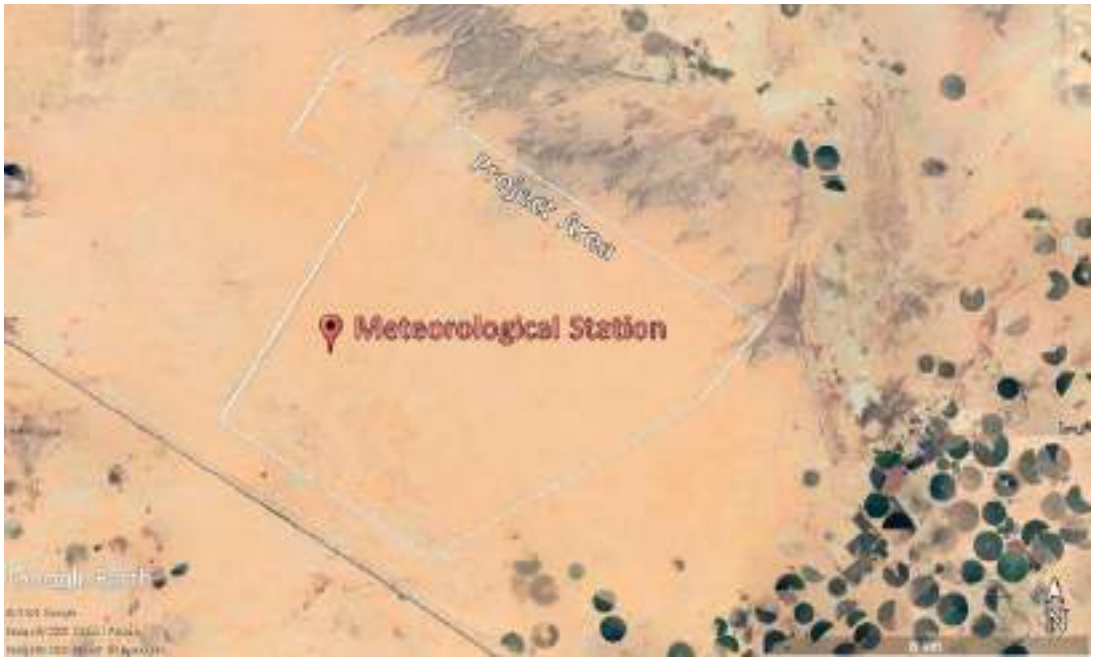


Figure 15 Location of meteorological station

Table 23 shows some meteorological data collected by the meteorological station on site, according to the Site Assessment of Solar Resource Report (CSP Services, 2019). This data was collected over a year, from 2018 to 2019.

Table 23 Monthly meteorological data from meteorological station at the Project site

Parameters	Annual	May '18	Jun '18	Jul '18	Aug '18	Sep '18	Oct '18	Nov '18	Dec '18	Jan '19	Feb '19	Mar '19	Apr '19
Average Temperature (°C)	23.8	29.1	33.3	34.2	33.5	33.9	25.9	16.0	14.3	13.6	13.5	16.6	21.4

Parameters	Annual	May '18	Jun '18	Jul '18	Aug '18	Sep '18	Oct '18	Nov '18	Dec '18	Jan '19	Feb '19	Mar '19	Apr '19
Average wind speed (m/s)	4.6	5.2	4.8	4.8	4.5	3.8	4.3	4.2	4.6	4.2	4.6	5.0	5.0
Sum of precipitation (mm)	145	5	0	0	0	0	8	84	23	2	18	0	6

CSP Services., 2019

5.2.3 Air Quality

The National Center for Meteorology issues air quality reports summarizing results of monitoring the air quality from various stations located around the Kingdom. The available air quality reports for the city of Ha'il are available for the first and second quarter of 2020. Table 24 shows the highest average hourly concentrations of different parameters from this report. The approximate location of the Project is indicated on the map in black dot, while the station is indicated in green (Figure 16). The green colour indicates good air quality, with low concentrations of air pollutants.

Table 24 Average hourly concentrations of different air quality parameters in Ha'il

Parameter	Carbon monoxide (CO)		Sulphur Dioxide (SO_2)		Nitrogen dioxide (NO_2)		Ozone (O_3)		Particulate matter (PM_{10})	
Quarter	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2	Q1	Q2
Concentration	1.57 ppm	0.94 ppm	8.28 ppb	4.5 ppb	8.78 ppb	9.35 ppb	59.54 ppb	39.34 ppb	65.38 µg/m³	115.21 µg/m³

Air quality report for Ha'il, first and second quarter 2020

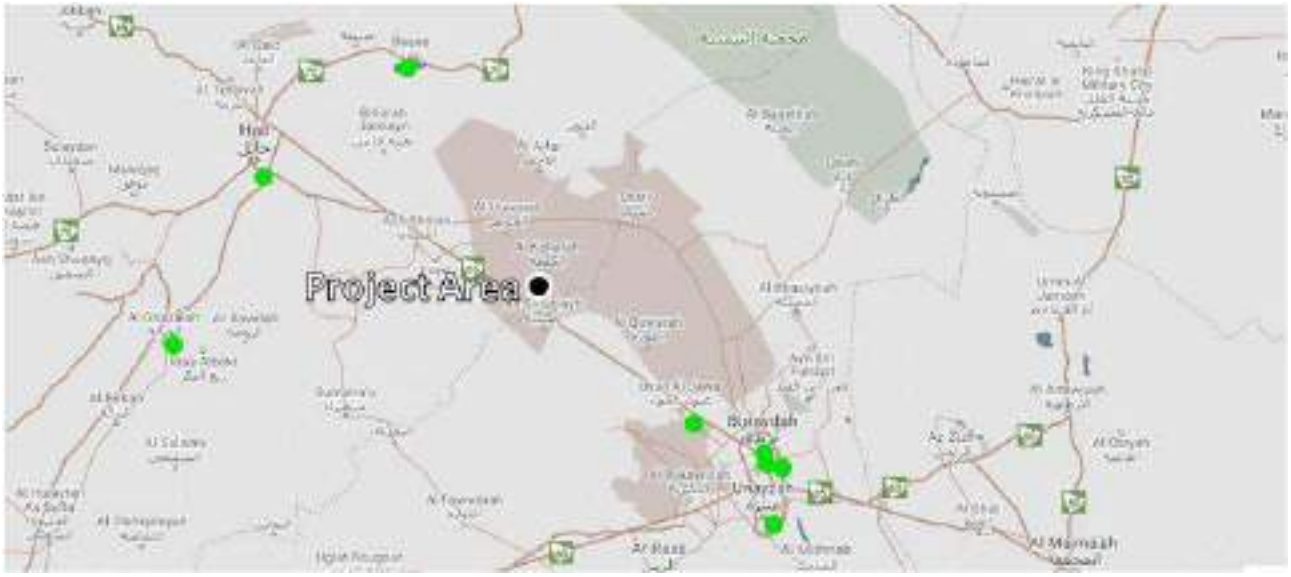


Figure 16 Air quality stations

Existing sources of air pollutants in vicinity of the Project site are limited (e.g. traffic on the highway #65 and dust particles resuspended by wind from sandy areas). Dust storms are expected to occur in Hail Province (Albugami et al., 2019).

5.2.4 Solar Radiation

Data on solar radiation is crucial information for programs of deployment of solar energy technologies. Solargis has developed a collection of solar resource maps to help the solar industry with development of solar projects. Maps were developed for over 200 countries including Saudi Arabia; these maps show information for various indicators such as Global Horizontal Irradiance (GHI) and Direct Normal Irradiance (DNI).

GHI is the most important parameter for energy yield calculation and performance assessment of photovoltaic (PV) technologies. This solar resource map (Figure 17) provides a summary of the estimated solar energy available for power generation and other energy applications. It represents the long-term average of yearly/daily sum of GHI.

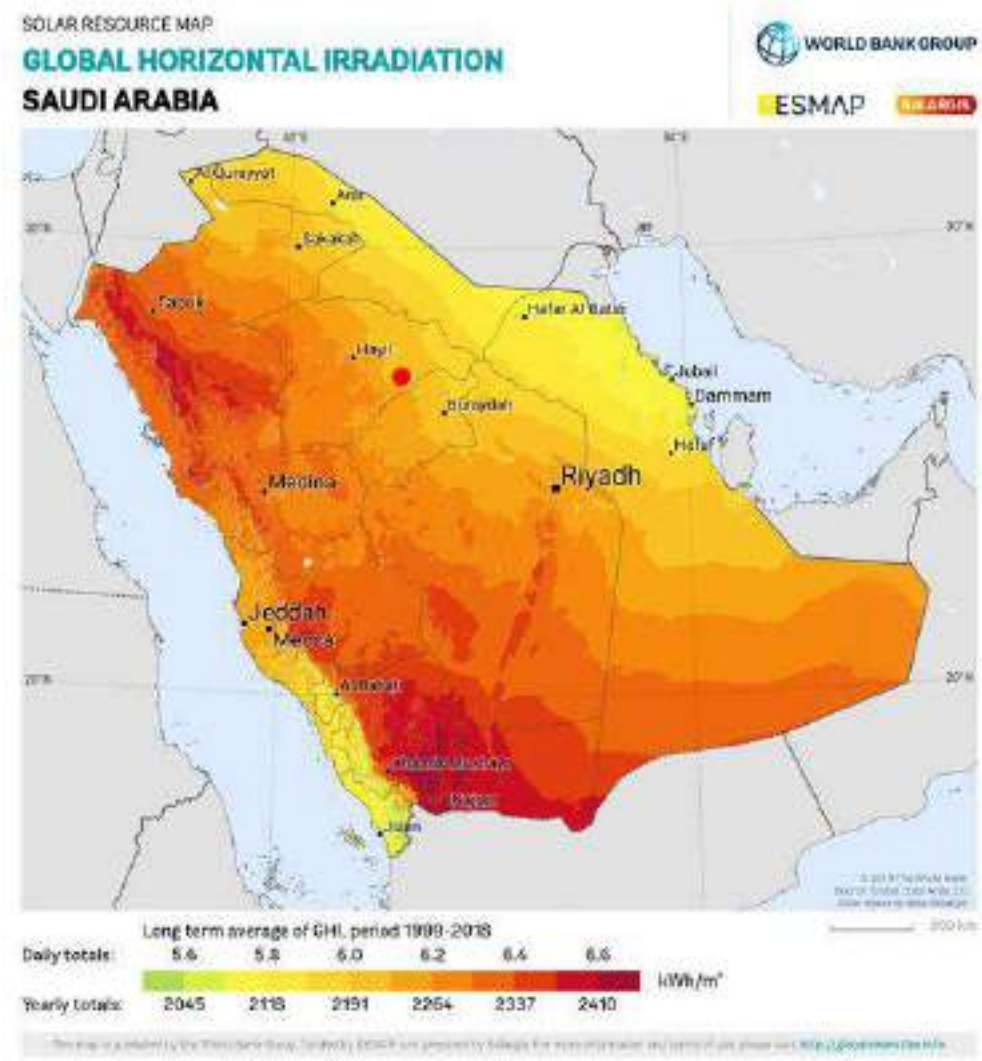


Figure 17 GHI for the Project area (© 2019 The World Bank, Source: Global Solar Atlas 2.0, Solar resource data: Solargis)

Data obtained from the meteorological station in April 2018 – May 2019 was used to conduct the solar resource assessment for the proposed project (CSP Services, June 2019).

The assessment shows that the solar resources at this site are strong, with a total annual Global Horizontal Irradiation (GHI) of 2,264 kWh/m², which compares favourably to other regions with strong solar resources around the world.

5.2.5 Geology and Soils

The Arabian Peninsula is a huge crustal plate composed of ancient sedimentary and volcanic rocks, deformed, metamorphosed and injected by plutonic intrusions. The Arabian Peninsula consists of two major regions: Arabian Shield in the west and the Arabian Platform in the east.

The Project site is located on the Arabian Shield. Figure 18 shows the simplified geologic map of the Arabian Peninsula, the distribution of the main rock sequences and the main tectonic elements (Al Ajmi, et.al, 2014). The white circle indicates approximately the planned Project location on the Arabian Shield.

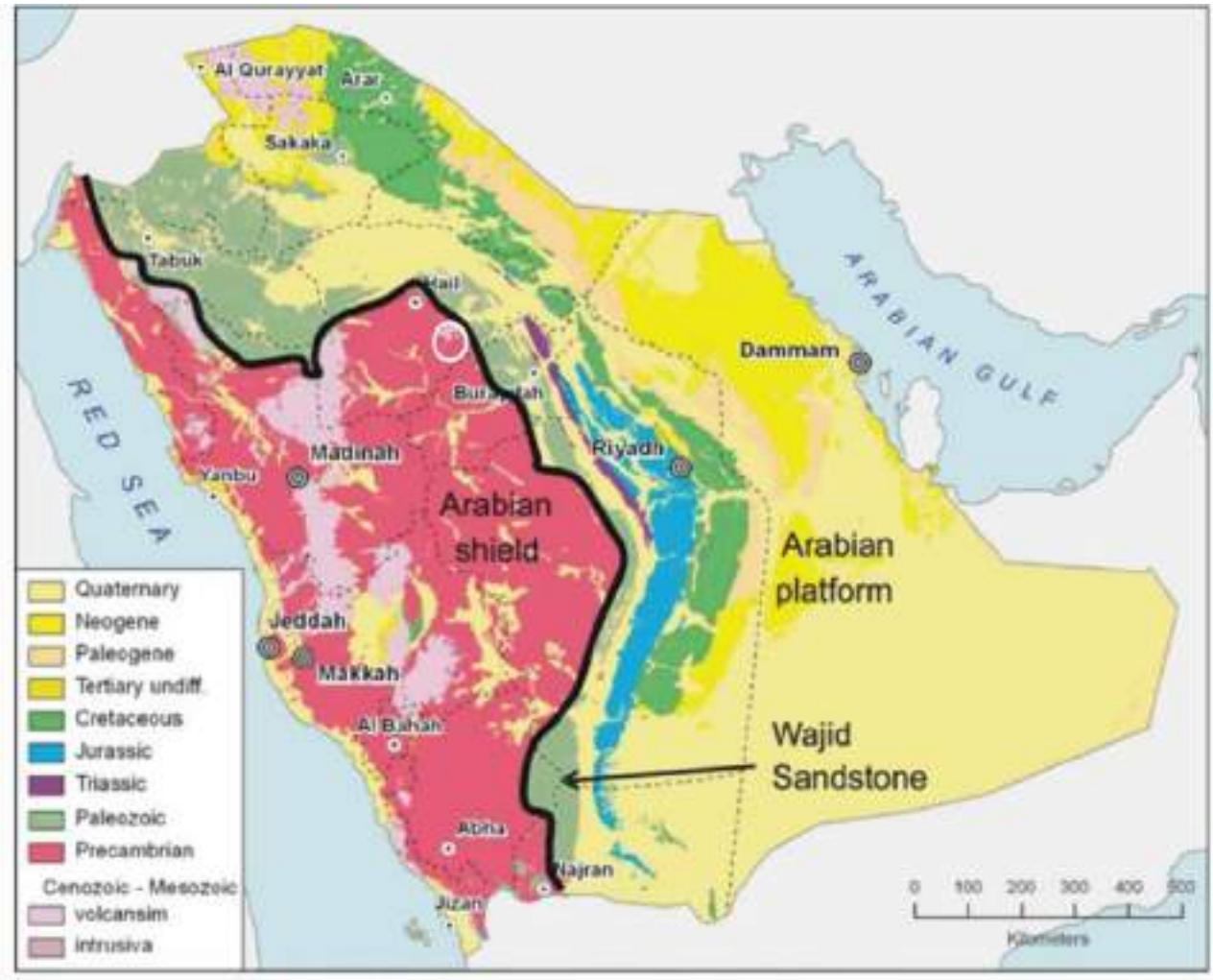


Figure 18 Simplified Geologic Map of the Arabian Peninsula

According to regional geological mapping, the site is located in the Interior Homocline – Central Arch geological province (USGS, 1997). The geologic period to which the site belongs is the Cambro-Ordovician, characterised by continuous sandstone rocks (Khalifa, 2015).

According to the site-specific geotechnical study findings, the Project area comprises 'Saq Sandstone (OCs)" consisting of unconsolidated surficial deposits of silt, sand and gravel, which may include unrecognized equivalents of other units of Quaternary age. The underlying rock is generally weak to moderately strong, light yellowish white to light greyish white SANDSTONE, highly to moderately weathered, completely to moderately fractured (ACES, 2021).

5.2.6 Hydrology and Water Resources

5.2.6.1 Groundwater

Groundwater resources in Saudi Arabia have been categorised into renewable and non-renewable water resources. Renewable groundwater is stored in shallow or alluvial aquifers and depends upon rainfall-runoff for recharge, whereas, non-renewable groundwater is found in deep sandstone formations, also known as fossil aquifers, where water was accumulated nearly 10 to 32 thousand years ago[13].

These, fossil aquifers have been classified as either primary or secondary, based on their volume, quality, development potential, and areal extent. Primary aquifers found in Saudi Arabia are Saq, Tabuk, Wajid, Minjur, Dhruma, Wasia, Biyadh, Umm Er Radhuma, Dammam, and Neogene.

Ḥail is an agricultural Province and is dependent on groundwater reserves of the deep Saq sandstone formation (Hereher, 2016). These reserves have been significantly depleted and the groundwater table is currently several tens of meters deep due to decades long exploitation. As anticipated, this also applies for the Project site. During the geotechnical survey conducted at the proposed Project site, a total of one hundred and forty one (141) boreholes were drilled to depths ranged between 10 to 30 m. Groundwater was not encountered in the drilled boreholes at the time of this geotechnical site investigation (ACES, 2021).

5.2.6.2 Surface water

There are no permanent surface water bodies in the Project area and its surroundings. Numerous culverts can be observed every few hundreds of meters along the rail line parallel to the site border. Also, there is a culvert under the road from Al-Kahfah along the western site boundary. The presence of these structures indicates that larger amounts of rainwater probably run off during rain events, and these flood defence structures are needed to facilitate drainage.

Parallel and dry, wadi-like structures are crossing the rocky formations between the site area and Al-Kahfah from south-west to north-east, indicating the general drainage direction in that area from the west towards east – northeast during the rainy season. More details on the flood risks are presented in Section 5.2.7.1.

5.2.7 Natural Hazards

5.2.7.1 Flash Flood

There are several factors controlling the severity of the flooding problem including:

1. the climate in terms of intensity, frequency and duration of rainy storms

[13]Ministry of Agriculture and Water, 1984, Water Atlas of Saudi Arabia. Department of Water Resource Development, Riyadh, Saudi Arabia

1. the topography of the region and the slope steepness of the landscape
2. the geology in terms of the rock type and structure
3. the geomorphology of the terrain and drainage pattern
4. the land use structures

In Saudi Arabia, flash floods are considered one of the top ten disasters. Although the climate is generally arid, there are two peaks of rainfall storms occurring during spring and fall (Hereher, 2016). According to the Preliminary Site Assessment Report (February 2021), some areas of the Project site might be subject to flooding (Figure 19).



Figure 19 Floodable areas

The hydrology study conducted for the proposed Project concluded that the site area is subject to shallow flood waters as well as discrete regions of deeper flow depths. The hydraulic modelling has confirmed that rainfall run-off follows one main drainage pathway within the site, however, there is also discrete shallow flow across other areas of site reflecting the topography.

The flood hazard map for the Project area indicates the majority of the site has a low hazard rating, with the flows shallow and slow, especially after implementing some mitigation measures such as grading the site (Figure 20).

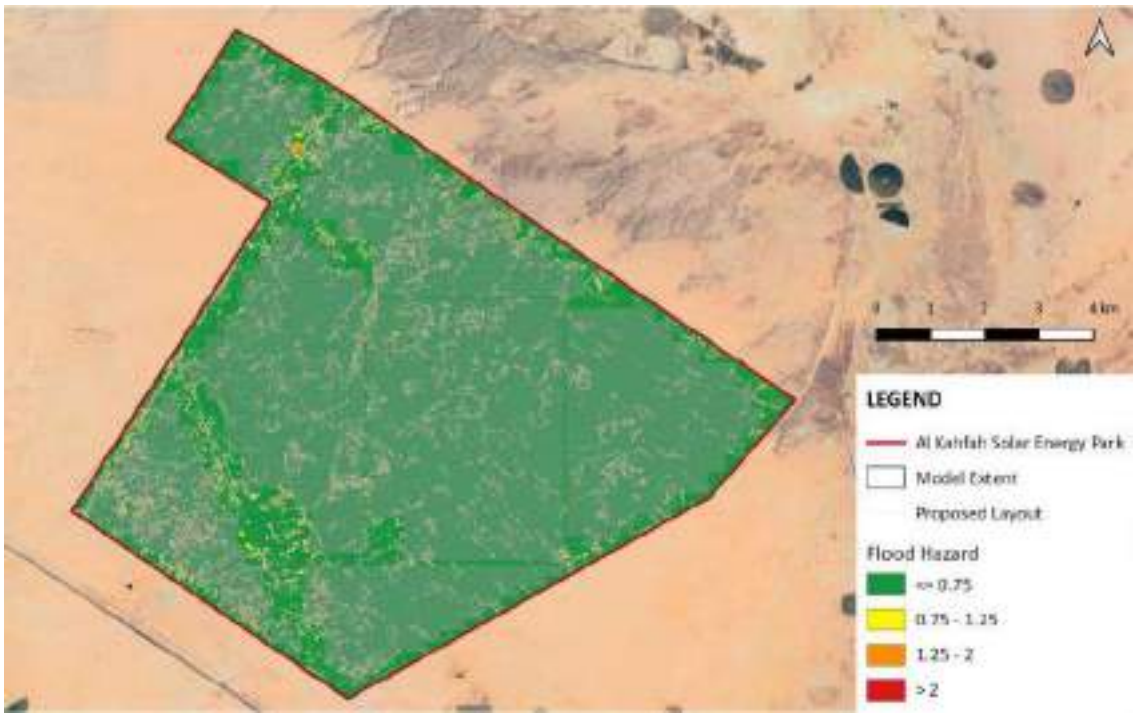


Figure 20 Flood hazard map

5.2.7.2 Seismicity

Saudi Arabia has experienced considerable earthquakes in the past. The tectonic setting around Saudi Arabia suggests that large earthquakes can occur along the Red Sea rift zones, Arabian Gulf and Zagros belt (Zahran et al., 2015). Figure 21 shows the instrumental recorded earthquakes of the Arabian Plate from 1900 to 2015 (Deif et al., 2017) and the approximate project location. The proposed Project is in an area of relatively low seismic risk of the Arabian Shelf.

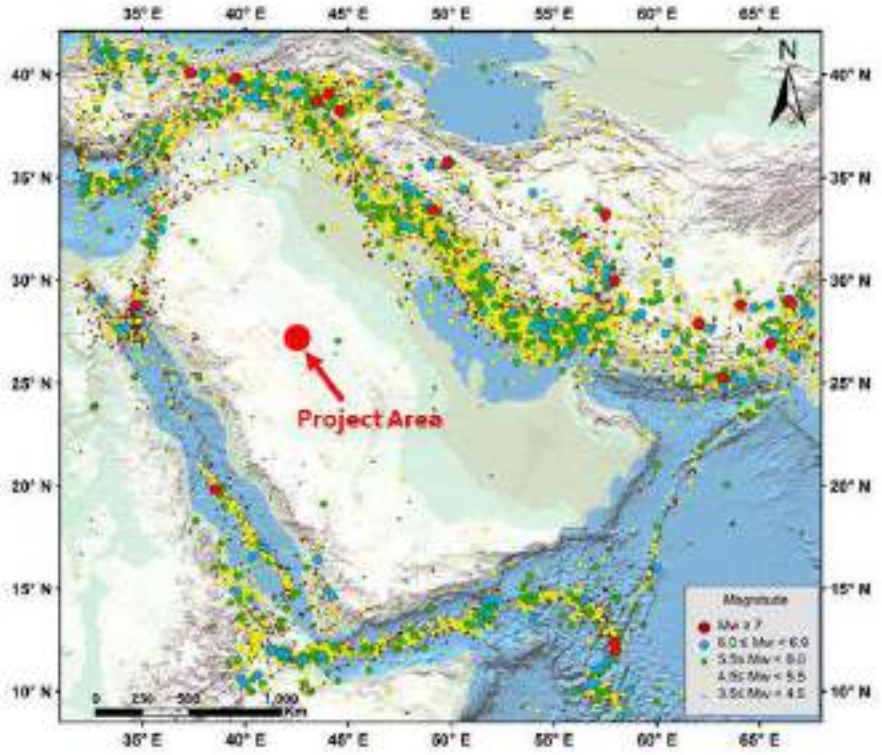


Figure 21 Instrumental recorded earthquakes of the Arabian Plate from 1900 to 2015 (Source: Deif et al., 2017)

The seismicity parameters for the Project site were determined according to SAES A-112, June ,2018 and Chapter 20 of ASCE-7-10. Cross-hole tests were completed and based on the results of those tests the site class was determined to be Class B (i.e. site characterized by rock) based on the classification provided in ASCE-7-10, 2013, Table 20.3-1. The main characteristics of the Project site area also include:

- Short period acceleration (Ss) in g%: 13.4
- Second period acceleration (S1) in g%: 4.3
- Peak ground acceleration (PGA) in g%: 3.0
- Site Coefficient: 1.0

5.2.7.3 Sand Drift

Sand drift denotes the phenomenon pertaining to moving sand either as loose sediments or as a mass. Drift and dune movement are the most conspicuous natural geohazards prevailing across the Arabian Peninsula due to the occurrence of vast expanses of aeolian sand deposits within four major sand seas one of which is An Nufud Desert (Edgell, 2006). The presence of Aja mountain modified the trend of sand drift at the north of Hail by deflecting the westerly winds toward a northern direction.

The city of Hail is, therefore, protected from the sand encroachment flowing from the west. However, the northern and north-western urban communities of Hail are under the influence of sand encroachment. Most vulnerable locations are El-Khitta, El-Hufayr and Jubbah as well as the main roads connecting the city of Hail with the northern regions of Saudi Arabia, such as Hail-Sakaka and Hail-Rafha roads (Hereher, 2016). It should be noted that these vulnerable locations (e.g. El-Hufayr, Jubbah) are more than 200 km away from the proposed Project location and as such sand drift risk is not likely.

5.2.7.4 Dust Storms

In dry deserts, such as Saudi Arabia there is a wide diurnal temperature variation that causes turbulence in the atmosphere, which favours formation of dust storms during daytime (Edgell, 2006). Hail region is among the most regions in the country that is frequently exposed to dust storms as it occurs close to the main sources of dust in northern and eastern Arabia. Dust storms normally occur during the spring season and they are associated with strong winds and severe darkness (Hereher, 2016) (Figure 22).



Figure 22 Dust storm recorded in Ha'il (Source: Hereher, 2016)

Site-specific soiling rates are therefore an important parameter for the proposed Project efficiency and have been measured at the site between May 2018 and December 2019 (Figure 23). The measurement data was analysed and used for the calculation of the daily, monthly and yearly average soiling rates. It was concluded that soiling is highly dependent on weather events, like rain and dust storms, and can remain constant for several days; conversely, a single dust storm could significantly increase soiling over a short period. The average daily recorded soiling loss rate was 0.20% only.



Figure 23 Soiling rate measurements onsite

5.3 Biological Environment

5.3.1 Biome and Habitat

The area can be classified within the World-Wide Fund for Nature (WWF) eco-region called “Arabian Desert and East - Sahero- Arabian xeric shrub lands”. This is a desert eco-region characterized by very little biodiversity. According to the habitat classification scheme of the International Union for Conservation of Nature (IUCN), the Project area can be classified as a Subtropical/Tropical Dry Shrubland. Flora and fauna found in this eco-region are well adapted to its extreme weather conditions.

This ecoregion is highly sensitive to grazing, soil disturbance and other cover alteration. Restoration potential can be very low, and regeneration is very slow. The introduction of non-native species may pose serious risk.

5.3.2 Flora

The Peninsula as a whole has about 3,400 species of flowering plants, of which about 2,100 occur in Saudi Arabia. Of these only 34 or about 2 % are endemic. Endemic species are particularly located in the south-west of the Peninsula in the well-watered highlands of the southern Hijaz, Asir and Yemen (Vincent, 2008). According to the Preliminary Site Assessment Report, vegetation in the Project area is limited in density and the floristic community at the site is composed of annual and perennial plants and shrubs.

Five different plant species were recorded:

- Qatad (*Astragalus spinosus*)
- Jahaq (*Diplotaxis acris*)
- Hanzal (*Citrullus colocynthis*)
- Alanda (*Ephedra alata*)
- Rimth (*Haloxylon salicornicum*)

With the exception of one plant species Alanda (*Ephedra alata*), the identified species are not evaluated by the IUCN Red List. The assessed species is classified as Least Concern (LC). Figure 24 shows examples of the flora recorded on site.



Astragalus spinosus

Photographed by: Abdelhalim Mahmoud



Citrullus colocynthis

Photographed by: Abdelhalim Mahmoud

Figure 24 Examples of flora recorded on site

5.3.3 Fauna

The information in the following section is based on the following sources:

- National Centre for Wildlife (Link);
- National Strategy for Conservation of Biodiversity in the Kingdom of Saudi Arabia prepared by the National Commission for Wildlife Conservation and Development (Link);
- IUCN Red List of Threatened Species (Link);
- "Birds of the Middle East" and other scientific publications.

5.3.3.1 Mammals

During the preliminary site assessment visit in February 2021, wild mammals such as foxes or small rodents such as gerbils, were not observed. However, small burrows were noted on the site. Therefore, the possibility of their existence in the wider area of the Project is not eliminated.

Domesticated mammals, mainly camels, were observed grazing on local vegetation on site in addition to temporary camps probably used for grazing (Figure 25). It should be noted that grazing is generally a seasonal activity and is typically limited to the spring season. Consequently, these camps are of seasonal nature.



Burrows

Photographed by: Abdelhalim Mahmoud



Camels grazing on site

Photographed by: Abdelhalim Mahmoud

Figure 25 Mammalian presence in the Project area

5.3.3.2 Birds

Common bird species were observed at the Project site which were House Sparrow (*Passer domesticus*), and Finsch's Wheatear (*Oenanthe finschii*) (Figure 26). Both species are classified as LC on the IUCN Red List. The Project area is also a potential habitat for various desert bird species, including Desert Lark (*Ammomanes deserti*), and Desert Wheater (*Oenanthe deserti*), it is also expected that some species associated with the surrounding agricultural areas be observed in the wider area, such as shrikes, ravens, and bulbuls. The floodable areas observed in the Project area may be attractive to other common desert species such as the Sand Partridge (*Ammoperdix heyi*).



House Sparrows (*Passer domesticus*)

Adamo, CC BY 2.0 de



Finsch's Wheatear (*Oenanthe finschii*)

Dûrzan cîrano – Own work, CC BY-SA 3.0

Figure 26 Common birds found in the Project area

5.3.3.2.1 Migration

Twice a year, birds migrate vast distances across the globe. Typically, these journeys follow a predominantly north-south axis, linking breeding grounds in arctic and temperate regions with non-breeding sites in temperate and tropical areas. Many species migrate along broadly similar, well-established routes known as flyways. Figure 27 shows East Asia / East Africa birds flyway according to BirdLife International where the proposed Project site, indicated in a red dot, is located in the vicinity of this flight route.

Migratory birds within the Province of Ha'il include various species of waterfowl such as Ferruginous Duck (*Aythya nyroca*). Other migrants are soaring birds such as White Stork (*Ciconia ciconia*), the Endangered (EN) Egyptian Vulture (*Neophron percnopterus*), and the Vulnerable (VU) Eastern Imperial Eagle (*Aquila heliaca*). The agricultural areas may also attract smaller migratory passerines such as the Green Bee-eater (*Merops orientalis*) and European Roller (*Coracias garrulus*). The floodable areas observed during the site visit may also attract migratory birds to stop and rest for a short time during their migration.

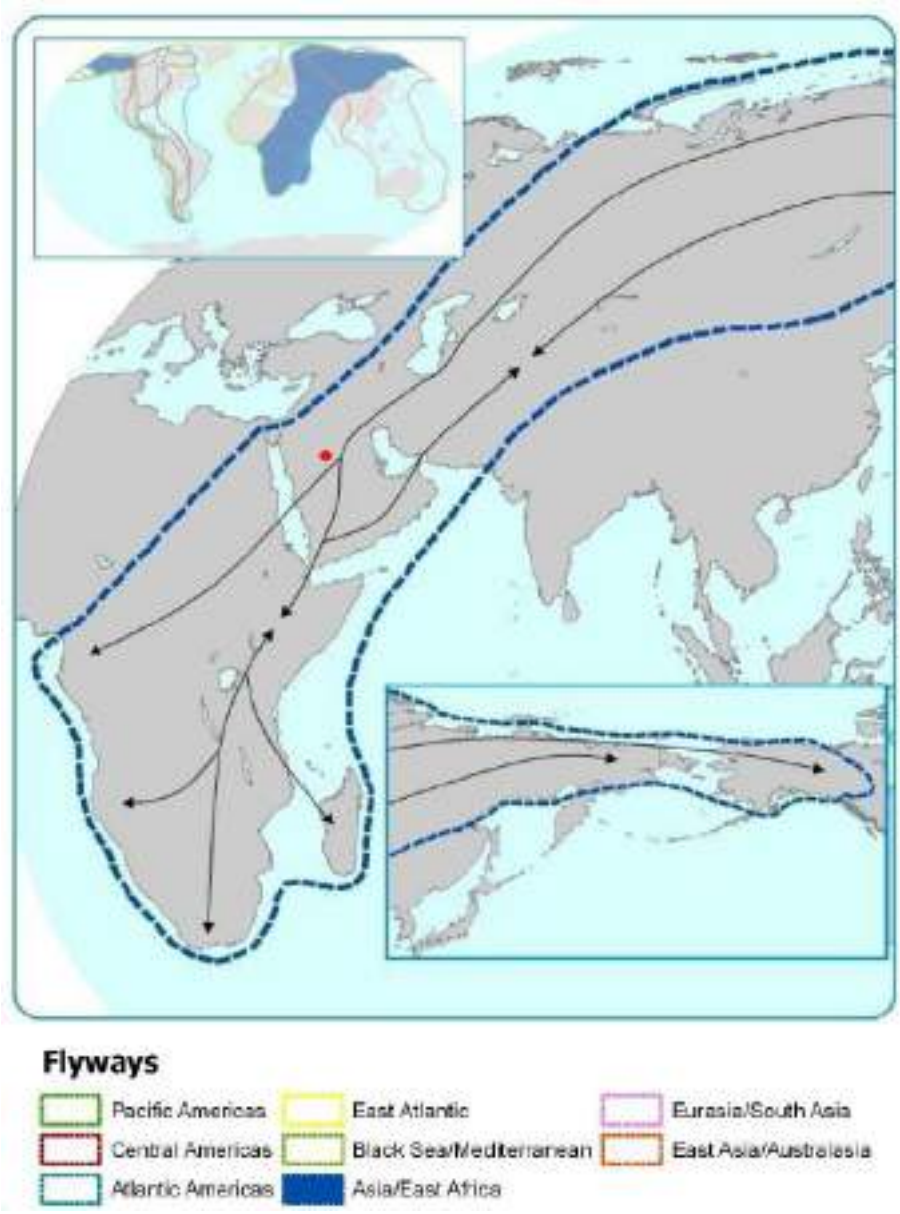


Figure 27 East Asia/Easy Africa Flyway

5.3.4 Reptiles and Amphibians

All of Saudi Arabia's seven native amphibian species are restricted to freshwater seeps and ephemeral pools.

There are 45 species of terrestrial snakes in Saudi Arabia, of which 23 species are poisonous, and 10 species of sea snakes that are all poisonous. There are 67 species of lizards known from Saudi Arabia, the most notable species is the Vulnerable Egyptian Spiny–tailed Lizard (*Uromastyx aegyptia*), which is hunted for its meat in Saudi Arabia. The Preliminary Site Assessment Report did not record any reptilian species in the Project area.

5.3.5 Ecosystem Services

The Project area is part of a wider ecosystem which provides provisioning services to its inhabitants. Provisioning services are described as the material or energy outputs from ecosystems such as food (crops, meat, and dairy products, fish and honey); water (from rivers and groundwater); fibre (timber and wool); and fuel (wood and biofuels).

Plants are an integral part of the lives of people throughout the world. Plants satisfy basic human needs such as food, shelter, and health care. As such, plants found in Saudi Arabia have played an integral role in the culture of Bedouins and animals (Mandaville, 2011).

An important plant for herders, especially camel herders, is *Haloxylon salicornicum*, for this plant provides salt, which is a crucial supplement in camel diet, in addition the plant Alanda (*Ephedra alata*) is used to treat sarcoptic mange[14] in camels (Mandaville, 2011). The economic uses of plants identified in the project area are listed in Table 25 (Al-Sodany et al., 2013).

Table 25 Economic uses of plants (Al-Sodany et al., 2013)

Species	Economic Uses				
	Medical	Grazing	Edible	Fuel	Other
Astragalus spinosus	+	+		+	
Haloxylon salicornicum	+	+		+	
Citrullus colocynthis	+	+			

According to site visits to the Project site, various camps with livestock such as camels were observed (as detailed in Section 5.3.3), which indicates that the Project site is of some importance to these seasonal herders. More information on animal husbandry in the Province is available in Section 5.5.6.

5.3.6 Sensitive Areas

According to the Integrated Biodiversity Assessment Tool (IBAT), there is a designated protected area and an Important Bird Area (IBA) close to the Project site.

[14] Mange is a type of skin disease caused by parasitic mites.

The protected area and the IBA are both located approximately 145 km from the planned Al-Kahfah PV Project site, in the north-east and north-west directions respectively (Figure 28).



Figure 28 Sensitive areas near the Project site

5.3.6.1 Protected Areas: At-Taysiyah Natural Reserve

At-Taysiyah Natural Reserve is a protected area in Saudi Arabia managed by the Saudi Wildlife Authority. The natural reserve is situated to the north-eastern of Saudi Arabia with an area of 4272.2 km². It was designated as a natural reserve in 1995. The geographic patterns of the reserve include dune areas, shallow valleys and steppe desert. Vegetation cover is characterized by the presence of more than 50 species, the most important of which are *Acacia* sp., *Ziziphus spina-christi*, *Lycium shawii*, *Rhanterium epapposum*, *Haloxylon* sp.

Due to its nature, the reserve becomes a destination for migrant Houbara Bustards (*Chlamydotis undulata*) during the winter. The reserve is also home to Arabian Sand Gazelle (*Gazella marica*), and Arabian Oryx (*Oryx leucoryx*) (National Center for Wildlife, accessed February 2021).

5.3.6.2 Important Bird Areas (IBAs): Jebel Aja and Northern Ha'il

According to BirdLife International (2021), the Jebel Aja IBA lies west and south-west of Ha'il city and is an extensive outcrop of granite mountains with deep valleys. The site is extended to north of Ha'il and towards north-east to the edge of An Nufud Desert to include an area used for surveys of migrant Demoiselle Crane (*Anthropoides virgo)*. Flocks of this species have been observed using both desert and agricultural habitats.

Reports include breeding species as well such as Dunn's Lark (*Eremalauda dunni*), Temminck's Lark (*Eremophila bilopha*), Spanish Sparrow (*Passer hispaniolensis*), Desert Finch (*Rhodospiza obsoleta*), and Trumpeter Finch (*Bucanetes githagineus*).Table 26 shows IBA trigger species for this IBA.

Table 26 IBA trigger species of Jebel Aja and Northern Ha'il

Common name	Scientific name	Current IUCN Red List Category	Season
Sand Partridge	*Ammoperdix heyi*	LC	resident
Demoiselle Crane	*Anthropoides virgo*	LC	passage
Desert Tawny Owl	*Strix hadorami*	LC	resident
Egyptian Vulture	*Neophron percnopterus*	EN	resident
Griffon Vulture	*Gyps fulvus*	LC	resident
Menetries's Warbler	*Sylvia mystacea*	LC	passage and winter
White-throated Robin	*Irania gutturalis*	LC	passage
Finsch's Wheatear	*Oenanthe finschii*	LC	passage and winter
Pale Sparrow	*Carpospiza brachydactyla*	LC	breeding
Cinereous Bunting	*Emberiza cineracea*	NT	passage



Egyptian Vulture (*Neophron percnopterus*)
Kousik Nandy - Own work, CC BY-SA 3.0



Demoiselle Crane (*Anthropoides virgo*)
Sumeet Moghe - Own work, CC BY-SA 3.0

Figure 29 Examples of IBA trigger species

5.4 Archaeological and Cultural Environment

No historical or archaeological sites are known to be found at the project area.

There are many cultural and archaeological sites within Ha'il Province such as Barzan Palace, Airif Fort, Qishlah Fortress, Jubbah Rock Art (Figure 30), among others. Furthermore, the Rock Art in Jubbah comprises one part of Rock Art in Ha'il denoted as a World Heritage Site.

The other part is a site in Jabal al-Manjor (located about 310 km west of the Project Area). Ancestors of present-day Arabs left marks in numerous petroglyph panels and inscriptions at these two sites (World Heritage List website, accessed March 2021). Other attraction sites in the Province include the subranges Aja and Salma and the home of Arabian Legend Hatim Al Tai.

According to reports, the subranges Aja and Salma are famous landmarks in Ha'il Province and attractive touristic spots. The mountains are covered with *Acacia* trees and a popular destination for taking walks, capturing photos, camping activities, learning about different plants, stargazing and telescope viewing, and visiting archaeological sites (Arab News, accessed February 2021).

A further touristic attraction is the home of Arabian Legend Hatim Al Tai, a sixth-century Arab poet of the Tai tribe whose altruism and generosity made him a revered icon. His legend even made it into the famed stories of "One Thousand and One Nights" (also known as "Arabian Nights") and many poems, films and TV shows. On the northwest slope of the Aja peak, visitors can explore the preserved ruins of his palace and the small nearby cemetery where Hatim is believed to be buried.

In general, all these sites are located at distances more than 100 km away from the Project site.



Figure 30 Location of archaeological sites

5.5 Social and Economic Environment

5.5.1 Population

The Project is in Ash-Shinan Governorate in Ha'il Province. The 2019 Statistical Yearbook published by the General Authority for Statistics (GAStat) indicates the population of the province to be 731,147 (2.13% of the entire kingdom).

Table 27 provides details on the population of Ha'il Province according to gender and nationality, according to the statistical yearbook for 2018. The total population of Ash-Shinan governorate is 30,441, Table 28 shows the details of the population distribution, based on the data of the general census of the population and housing 2010.

Table 27 Population for Ha'il Province

Province	Saudi		Non-Saudi		Total	
	Male	Female	Male	Female	Male	Female
Ha'il	270875	276679	125133	43334	396008	320013

Source: Statistical Yearbook of 2018 – GAStat

Table 28 Population for Ash-Shinan governorate

Governorate	Saudi		Non-Saudi		Total	
	Male	Female	Male	Female	Male	Female
Ash-Shinan	11,657	11,228	6,753	803	18,410	12,031

Source: The sixteenth services guide 2017_Region Ha'il

According to the Preliminary Site Assessment report, some small temporary camps were observed during the site visit. The camps appeared to be used for grazing activities by the local herders (Figure 31). Grazing is generally a seasonal activity and typically limited to the Spring season. Consequently, these camps are of seasonal nature.



Photographed by: Abdelhalim Mahmoud

Figure 31 Temporary camps

5.5.2 Employment

According to the statistical year book (2018), there are a total of 146,360 employees in Ha'il Province. Table 29 shows how this number is broken down by gender and nationality. These numbers exclude employees in the military, security sectors, and outside enterprises.

Table 29 Total number of employees by gender and nationality in Ha'il Province

Nationality	Gender	Employees No.	Total
Saudi	Male	28,440	49,121
	Female	20,681	
Non-Saudi	Male	94,290	97,239
	Female	2,949	
Total	Male	122,730	146,360
	Female	23,630	

Source: Statistical Yearbook of 2018 - GAStat

Ḥail is a largely agricultural province, with significant grain (produces a large percentage of Saudi Arabia's wheat), date, and fruit production (Al Eqtisadiah, accessed February 2021). According to statistics released by GAStat, the total area cultivated in the province is 3,368,509 donum[15].

[15] Area: Donum = 1000 m^2

5.5.3 Residential Areas

The Project is located in Ha'il Province in a low populated agricultural area, with vast farmed areas north, east and south east from the site. The closest city is Al-Kahfah, ca. 6 km of the Project site (Figure 32). The main city of Ha'il Province is Ha'il and is located at a distance of about 140 km from the proposed Project site. Furthermore, Buraydah is located at a distance of approximately 110 km from the proposed Project.



Figure 32 Urban residential areas around the Project site

5.5.4 Social Services

5.5.4.1 Educational Services

Table 30 presents the number of schools divided according to level, as well as details on the number of students and teachers. These numbers include general education, Quran memorization, and secondary schools.

Table 30 Educational services at the governorate level in the public sector in Ash-Shinan

Gender	Primary			Intermediate			Secondary		
	School	Student	Teacher	School	Student	Teacher	School	Student	Teacher
Male	27	1,231	162	9	566	83	7	615	88
Female	18	1,180	187	10	537	96	7	528	119

Source: The sixteenth services guide 2017_Region Ha'il

For higher educational services, Ha'il Province does not have any private universities, only one public university in Ha'il with its branches in the other governorates. More information is presented in Table 31.

Table 31 Higher educational services in Ha'il

Item		Number
Universities		1
Branches		3
Students	Male	13009
	Female	26172
Teaching staff	Male	1046
	Female	943

Source: The sixteenth services guide 2017_Region Ha'il

5.5.4.2 Health Services

According to the statistics released by GAStat, there are a total of 14 public hospitals in Ha'il Province, and 2 private hospitals. These hospitals have a total number of 1,960 beds with a team of 2,865 doctors and nurses distributed among these hospitals. There are additional 111 public primary care centres in the Province, and an additional 44 private clinics. Also, there are 13 red crescent centres and 26 ambulances with 136 paramedics.

In Ash-Shinan, there is only one public hospital, with 50 hospital beds with a team of 75 doctors and nurses. Additionally, there are 11 public primary care centres. The red crescent centres available are 2 and 4 ambulances. Table 32 presents information on the medical teams distributed among the hospitals and clinics in Ash-Shinan.

Table 32 Distribution of medical teams

Hospital/Clinic Type	Doctors		Nurses	
	Male	Female	Male	Female
Public hospitals	13	9	17	36
Public primary care centres	19	8	20	42

Source: The sixteenth services guide 2017_Region Ha'il

5.5.4.3 Water Usage and Supply

According to the Statistical Yearbook of 2019, issued by the Ministry of Environment, Water, and Agriculture, the main sources of water for domestic use in Ha'il is groundwater and water collected from dams. The total volume of drinking water distributed for domestic use in 2019 reached approximately 65 million m^3. Table 33 shows more information on the volume of water used according to sector in Ha'il. The report also states that the Province has 6 groundwater wells, 46 dams, and 34 desalination plants for the treatment of groundwater. The dams have a total storage capacity of 27,800,246 m^3, while the desalination plants have a production capacity of 156,730 m^3/day.

Table 33 Volume of water used in Ha'il

Province	Domestic Use (million m^3/year)	Commercial Use (million m^3/year)	Annual Total (million m^3/year)
Ha'il	59.6	5.5	65.2

The report states that the total length of the water network pipes in Ha'il is 4,570 km, with 101,378 connected houses in the Province. As for sanitation networks, the Province has about 1.731 km of pipelines, with 37,687 connected houses. There are two wastewater treatment plants, the volume of wastewater treated by these two plants in 2019 was 24,445,371 m^3. It should be noted that only 6.73 % of the treated water was reused according to the Statistical Yearbook of 2019.

5.5.5 Agriculture

Ha'il is an agricultural province being one of the most fertile of the provinces in the Kingdom. The Statistical Yearbook of 2019, issued by the Ministry of Environment, Water, and Agriculture, gives the area dedicated for each type of crop and the total production from these areas. Table 34 shows more details on the area planted and production according to crop category. The Province produces a variety of crops including dates, fruits (most notably citrus fruits), vegetables, olives and its derivatives, and medicinal plants (Al Eqtisadiah, accessed June 2021).

Table 34 Statistics on agriculture in Ha'il

	Date Palm	Fruits	Vegetables	Grains	Medicinal and aromatic plants
Area (hectare)	34.8	15.7	6.7	29	3.8
Production (ton)	183.14	55.5	4	117	1.7

5.5.6 Animal Husbandry

Ha'il is rich with a stock of livestock. Cattle in Ha'il include goats, sheep, and poultry. According to the Statistical Yearbook of 2019, issued by the Ministry of Environment, Water, and Agriculture, there were about 445 heads of cattle accounted for in Ha'il.

5.5.7 Transport and Infrastructure

Figure 33 shows the roads (yellow), rail (green) and HV power lines (red) infrastructure identified around the site.



Figure 33 Roads, rail and power infrastructure in the Project area

The proposed Project is accessible by highway route #65 (also known as Riyadh–Qassim Expressway) which runs at approximately 1 km parallel to the southern site border. Between road 65 and the project site boundary, at ca. 150 m distance from the road, is the rail line connecting Ha'il and Buraydah (green line). A paved road coming from Al-Kahafah town is crossing the site from northeast to southwest and almost coincides with the western site border. This road is mostly paved and in good condition, except for the last 1.5 km approaching the highway, which is unpaved. This unpaved portion ends almost perpendicular to the rail line, in a culvert (Figure 34).

The culvert does not seem to be specifically designed for use by vehicles; due to its dimensions, it will only be possible for passenger vehicles to pass though, and all large vehicles will need to pass through Al-Kahfah town to access the site. At the time of the visit, this access was blocked by mud deposits and flooding (Preliminary Site Assessment Report, 2021).



Figure 34 Railway underpass

Almost parallel to it, ca. 7 km to the east is a wider road (#6287) which appears to be recently paved until ca 1 km before its existing junction with road # 65 (Figure 35). Other local roads east and north from the Project site are serving the agricultural lands in the area. A 380 kV line is passing the site as shown on the figure (red line); twenty power HV line posts are within the site boundaries. Driving tracks can be noticed following almost the same route as the HV overhead line that crosses the site. A second overhead power line runs parallel to road 65, between the road and the rail line, connecting the substations located at Ha'il. Additional three transmission lines are planned to be built in parallel to the existing line (Preliminary Site Assessment Report, 2021).

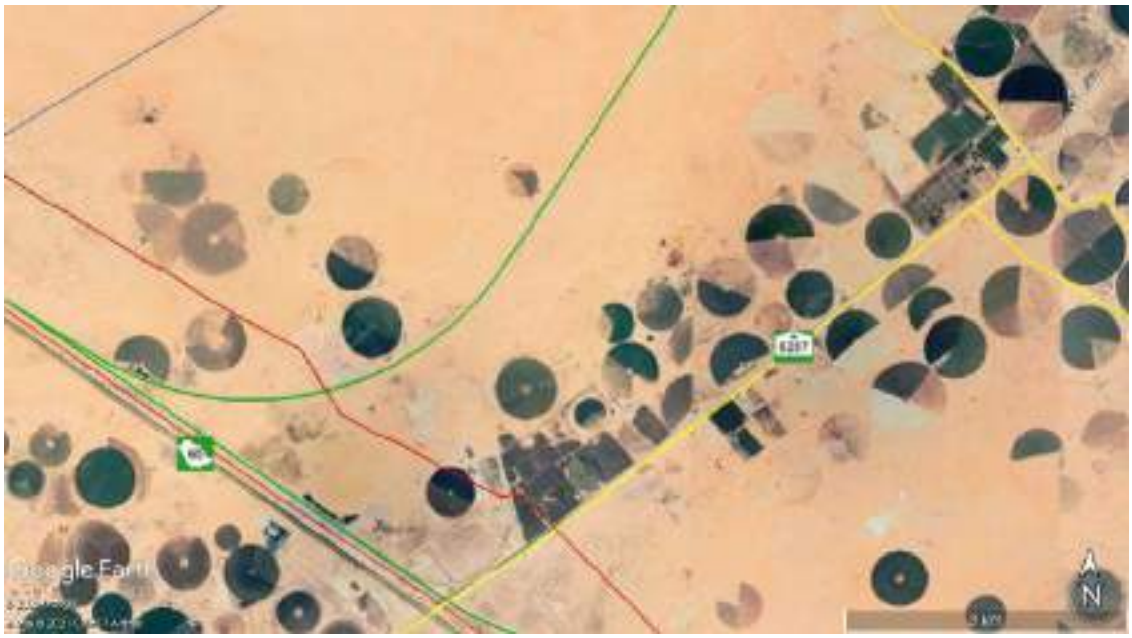


Figure 35 Junction area of roads 65 and 6287

Two airports are located in the wider area (Figure 36):

- Ha'il International/Regional Airport, serving both domestic and international flights, located to the southeast of Ha'il city and ca. 140 km form Project site;
- Prince Nayef Bin Abdulaziz International Airport at Buraydah at ca. 100 km south - east from Project site.



Figure 36 Locations of Ha'il and Buraydah Airports relative to Al-Kahfah PV Project site

The car drive journey from the Hail airport to the Project site takes about 1.5 hours.

5.6 Sensitive Receptors

Sensitive receptors are defined herein as any component of the receiving environment or society that is considered important by the developer, operator, the public, or any non-governmental or governmental organisation involved in the assessment process. Importance is determined based on cultural values and/or scientific and public concern. The sensitive receptors are selected depending on the identification of pathways linking important environmental components with the totality of the project's activities.

Each receptor is categorised in terms of its perceived environmental and social value, taking into account local, national or international designations and legal protection status, if appropriate. Based on these considerations, the receptors sensitivity is categorised as "Low", "Medium" or "High". The definition of these three categories is detailed in Section 6.1.

Based on the assessment of the environmental and social conditions in the study area, the sensitive receptors identified for this project, along with their sensitivities, are listed by category in Table 35.

Table 35 Preliminary list of valued receptors

Environmental Receptor	Importance	Sensitivity
Physical Environment		
Air quality	The closest residential areas (Al-Kahfah) is at a distance of about 6 km away. Air quality in areas close to road #65 is expected to be impacted to some extent by emissions from traffic. Naturally elevated background concentrations of suspended particles are typical for a desert environment. In general, good air quality is required for the health of the population.	Low
Global climate	Contribution to global warming by greenhouse gas emissions is an area of focus that has attracted more attention at the national and international levels in the recent years.	Medium
Soil	Generally, soil quality is an important aspect for specific activities such as farming. It should be noted that the proposed Project area is undeveloped and dedicated for industrial activities. Soil supporting spontaneous flora in the site area, if polluted, may on a very limited scale affect the health of fauna feeding on this vegetation. Furthermore, deterioration in soil quality might indicate potential deterioration in groundwater quality in the area, if any.	Low
Groundwater	Groundwater is used as a main source of water for agriculture in the wider area of the Project. However, the groundwater table was not encountered at depths ranged between 10 to 30 m during the geotechnical survey in the Project area, and therefore not vulnerable to infiltration of contaminants from the surface.	Low
Acoustic environment	Increasing the ambient noise levels may cause nuisance to population and have effects on fauna. There are no major population centres around the proposed Project.	Low
Electromagnetic emissions	Increase in electromagnetic emissions during the operation phase is expected which may impact nearby radio receivers. This can also include any blocking or attenuation of nearby radar or communications by the PV system	Low
Biological Environment		
Flora	The area is characterised by a dry desert plain with scattered vegetation. It is expected that seasonal rains help flourish ephemeral species. Species of flora identified in the Project site are medicinal, grazed upon by livestock and occasionally used as fuel. With the exception of one plant species, the identified species are not evaluated by the IUCN Red List. The assessed species is classified as Least Concern (LC).	Low
Avifauna	Two common bird species were observed at the Project site. Both species are classified as LC on the IUCN Red List. However, the site is in the vicinity of East Asia / East Africa birds flyway.	Medium
Reptiles and Mammals	The Project area is used for seasonal grazing by livestock. No other notable fauna has been observed on site.	Low

Environmental Receptor	Importance	Sensitivity
Socioeconomic Environment		
Population (local community)	The Project area is an unfenced undeveloped area far from populated areas (Al-Kahfah town which about 6 km away). However, it is important to maintain the well-being of the local community.	Medium
Population (onsite workers)	Onsite workers will be temporarily present during the construction and operation of the Project and may be affected by project activities. It is important to maintain the well-being of the onsite workers.	Medium
Visual receptors (Traffic and aviation)	Commuters on the roads/highway and aviation may be affected by glint and glare from the site during the proposed Project operation. The nearest commercial airport, Prince Nayef Bin Abdulaziz International Airport at Buraydah, is located at a distance of more than 100 km. The Project site is accessible via highway # 65 and through roads branching from this highway (Section 5.5.7).	Low
Local economy	Enhanced economic conditions can help improve living standards and positively impact the society welfare.	High

6. Identification, Analysis and Evaluation of Impacts

6.1 Impact identification, Analysis and Evaluation Methodology

The impact assessment procedure is as follows:

- Identification of the Receptors/Valued Receptors (VRs) (Section 5.6)
- Identification of the key activities of the project (Section 3)
- Impact evaluation
- Significance ranking

Figure 37 shows an overview of the impact assessment process.

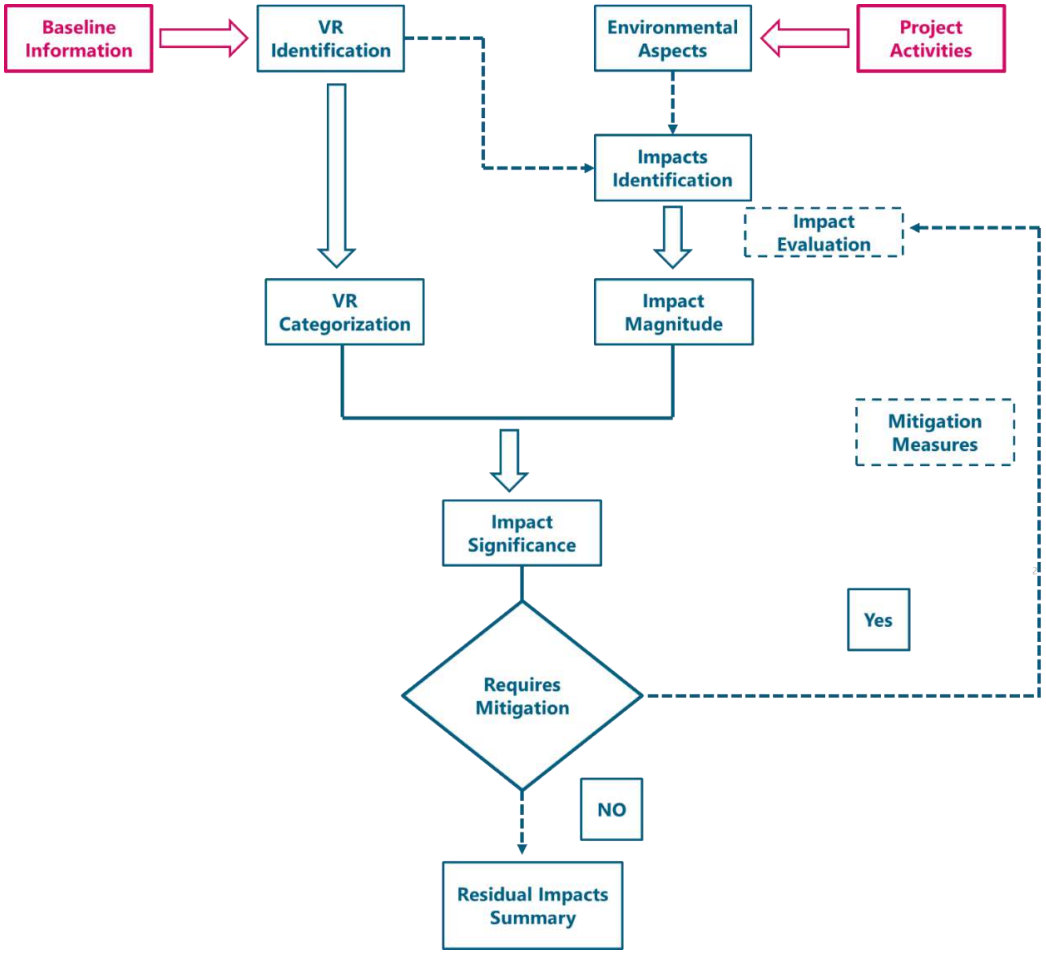


Figure 37 Summary of impact assessment methodology

The methodology followed for assessing impacts in this report is presented in the "European Union, EIA - Guidance on scoping, 2017". This methodology applies a multi-criteria analysis to evaluate impacts significance based on:

5. Magnitude of the predicted effect
6. Sensitivity of the receiving environment

The impacts magnitude considers the following characteristics which could affect the target receptor as a result of the proposed project:

- Intensity and direction: Intensity describes the physical dimension of a development and direction specifies whether the impact is negative or positive. Depending on the type of impact, intensity can often be measured with various physical units and compared to reference values.
- Spatial extent (geographical area): Spatial extent describes the geographical reach of an impact area or the range within which an effect is observable.
- Duration (reversibility, timing, periodicity and regularity): Duration describes the length of time during which an impact is observable, and it also takes into account timing and periodicity.

Sensitivity of the receiving environment and impacts magnitude are scaled according to the categories listed in Table 36 and Table 37 and are then weighted in the matrix of shown in Table 38 to determine impacts significance category “High”, “Moderate” or “Minor”.

Table 36 Scale of sensitivity of the receiving environment

High	High importance and rarity, national scale, limited potential for substitution and low capacity to accommodate proposed form of change
Medium	Medium importance and rarity, national scale and limited potential for substitution. The receiving environment has some tolerance of the proposed change subject to design and mitigation
Low	Low or medium importance and rarity, local scale. The receiving environment is tolerant of the proposed change subject to design and mitigation

Table 37 Scale of magnitude of the impact

Major	Loss of resource and/or quality and integrity of resource over a significant area; Severe change/damage to key characteristics, features or elements for more than 2 years
Moderate	Loss of resource, but not adversely affecting the integrity over a significant area; Partial loss of/damage to key characteristics, features or elements, for more than 6 months but less than 2 years
Minor	Some measurable change in attributes, quality or vulnerability; Minor loss of, or alteration to, one (maybe more) key characteristics, features or elements

Table 38 Impacts significance

Impact Magnitude	**Environmental Sensitivity**		
	High	***High***	***High***
Major	High	High	Moderate
Moderate	High	Moderate	Minor
Minor	Moderate	Minor	Negligible

Technical, social, and/or institutional measures are proposed to mitigate anticipated changes and consequential impacts during project implementation and operation.

6.1.1 Identification of Significant Impacts

The matrix below (Table 39) gives an overview of the potential impacts resulting from the routine activities of the proposed Project. Sensitive receptors are listed in columns and the impact-generating project activities (environmental aspects) are shown in rows. Activities likely to generate an impact on the environment are identified and classified as negative (blue) or positive (green). The detailed impact assessment during the different phases is presented in the following sections.

Table 39Impacts Identification Matrix – Normal Operations

		Physical environment					Biological environment			Socioeconomic Environment			
PROJECT PHASES	**Actions/Activities**	Air quality	Global Climate	Soil	Acoustic environment	Electromagnetic emissions	Flora	Avifauna	Reptiles and Mammals	Population (local community)	Population (onsite workers)	Visual receptors (road traffic and aviation)	Local economy
Construction	Purchase of supplies, services and job opportunities									√	√		√
	Clearing and earthworks	√		√	√		√	√	√				
	Mobilization/demobilization (trucks, busses, construction vehicles, etc.)				√			√	√				
	Construction activities: foundations, trenching, civil construction, electrical, etc.				√			√	√				
Operation	Project presence		√					√				√	
	Equipment operations	√	√			√					√		
	Purchase of supplies, services and job opportunities									√	√		√
	Power generation									√			√

Key:

Positive Impact √
Negative Impact √

6.2 Impacts Assessment

6.2.1 Impacts Assessment during Construction

6.2.1.1 Physical Environment

6.2.1.1.1 Air Quality

Construction activities would involve a number of separate operations, including mobilization, land clearing (grubbing and vegetation removal), topsoil stripping, cut-and-fill operations (i.e., earthmoving), access road(s) construction, ground excavation, foundation treatment, buildings and structures erection, electrical and mechanical installation, pipeline(s) laying and landscaping. Construction activities would involve two phases: a shorter site preparation phase, followed by actual construction.

Major heavy equipment used in the site preparation phase would include chainsaws, chippers, backhoes, dozers, scrapers, end loaders, trucks, cranes. A temporary concrete batch plant may be needed if premixed concrete is unavailable from nearby vendors. Fugitive dust from soil disturbances and engine exhaust from heavy equipment and vehicles for workers commuting, materials delivery and support within and around the facility would contribute to air emissions of pollutants, volatile organic compounds (VOCs), greenhouse gases (GHGs; e.g., CO_2), and small amounts of hazardous air pollutants (HAPs) (e.g., benzene). Typically, potential impacts of fugitive dust emissions on ambient air quality would be higher than those of engine exhaust emissions.

Soil disturbance during the site preparation phase, which involves the intense use of heavy equipment over a short time period, has the greatest potential for air emissions and adverse air quality impacts (through the release of large amounts of fugitive dust). In addition, soil disturbance from heavy equipment used for access road construction and/or re-contouring of land results in a greater potential for emissions and adverse air quality impacts. Under unfavourable dispersion conditions, infrequent high concentrations of PM10 or PM2.5 could exceed the standards at the site boundaries. However, given the long distances to inhabited areas, construction activities would probably contribute minimally to concentrations of air pollutants at the nearest human receptors.

Fugitive dust emissions would be caused by site preparation, construction activities, and wind erosion and would cause unavoidable localized impacts. Construction activities would probably be limited to a portion of the site at any time which would reduce impacts. However, the large total area disturbed during construction could be exposed to wind erosion and dust resuspension. Stabilizing soils in an area at the completion of construction would reduce these emissions. However, given that stabilization is never fully effective and disturbed soils sometimes cannot be stabilized, wind erosion from disturbed areas could continue throughout the remainder of the construction period and beyond into the operation phase. Impacts on air quality during construction are Moderate. Given the Low sensitivity of air quality as receptor, impacts on air quality during construction are **Minor**.

6.2.1.1.2 Soil

Construction of the proposed Project could result in significant impacts on soil resources over an area equivalent to the sum of the footprints of all structures and related infrastructure, which, beside the PV panels will include buildings, on-site roads, access roads, parking areas, and fencing).

Soil-related impacts during the construction phase may extend beyond the site boundary as a result of increased erosion by wind or water. Ground-disturbing activities would include vegetation clearing and grubbing; excavating for foundations, footings, and trenches for buried electrical connections; stockpiling excavated material for backfilling; grading for roads and staging and laydown areas. The construction of other facilities, such as the central control building, electrical substations, concrete batching plant, sanitary facilities and temporary offices, and an area for minor maintenance and storage of equipment and parts also would have the potential to result in adverse impacts on soil resources, because they involve some degree of ground disturbance.

Direct adverse impacts of construction activities relate mainly to the increased potential for soil compaction, soil horizon mixing, soil erosion and deposition by wind, soil erosion by water and surface runoff. Soil contamination could also result from the release of contaminants related to the use of trucks and mechanical equipment machinery, from improper storage and handling, and from the application of chemical stabilizers to control fugitive dust emissions.

During construction works, transfer of contaminated soils from one location to another (cross-contamination) may occur, thereby extending the area of any contamination that may have occurred due to poor management. In addition, if contaminated soil is dispersed through dust generation as a result of construction activities like ground excavation, then further spreading of contaminants will also occur.

Removal of the grazing camps in the site area, if still present at the site by the time of the construction commencement, has the potential to create some soil disturbance in limited areas.

Construction impacts on soil, a receptor of Low sensitivity, are considered of Moderate magnitude; hence the impact significance is assessed as **Minor.**

6.2.1.1.3 Acoustic Environment

The key noise generating construction activities at the site will likely include the following:

- Site preparation - Site preparation may involve back-filling, levelling and grading. It is assumed that these activities will require the use of dozers, excavators and lorries.
- Construction and Installation - This phase of works is assumed to involve the casting of reinforced concrete slabs 'in-situ', block work, steel/scaffold erection and the installation of plant etc. It is assumed that these works will require the use of concrete truck mixers, compressors, generators, heavy lifting equipment (including cranes) and hand tools.
- Drainage and road paving - This stage of the works will comprise of several operations that will likely include excavation for and laying of drainage pipes and road surfacing.

The noise level during construction phase of a project is affected by:

- The type of works (excavation etc)
- The size and number of machinery and equipment
- The moving speed of the machinery
- The local conditions, as the topography, the distance from access roads, etc.

At the present stage, the composition of the worksite of the project is not yet known. Thus, an accurate calculation of the noise level during construction cannot be provided. During construction, standard construction equipment will be used. Additionally, the construction activities are temporary.

According to the national standards, the combined noise effect at the facility fence from noise sources during construction may not at any time exceed the limits set for industrial areas by more than 10 db(A) (i.e. 80 dB(A) during the day). However, in case of possible exceedance, a construction noise permit is required.

Since noise is attenuated by distance and no human settlements are present within several km from the site perimeter, the construction activities on site are unlikely to affect the offsite ambient noise levels significantly. Based on the Low sensitivity of the acoustic environment and the assumed Moderate impact magnitude, significance of noise impacts during construction is **Minor**.

6.2.1.2 Biological Environment

Dust deposition during construction would increase due to movement of trucks, site excavation and all other construction works. Land will be utilized for temporary lay-down areas and for the storage of construction waste and debris. It is highly likely that most bird species will vacate the area for the duration of these activities. Scarce vegetation will be removed.

Light during the night and presence of organic waste (e.g. food, water) will attract species of the desert. Insects will be attracted by light and birds/bats attracted by insects. Foxes, lizards, reptiles and mammals could be found near the construction sites.

Vegetation is almost absent and terrestrial biodiversity (reptiles and mammals) is typically low at the site. The impact magnitude on flora is classified as Major as the vegetation will be completely removed from the site and the effect of construction activities is of **Moderate** significance. The fauna in general can be disturbed the construction noise and emissions. However, the impacts on air quality and noise are assessed to be of Minor significance as previously illustrated in Section 6.2.1.1. The impact magnitude on reptiles and mammals can be classified as Moderate as it will be basically limited to avoidance and as such, the potential impact is of **Minor** significance. Similarly, the impacts on avifauna will be of minor magnitude; however, due to the medium sensitivity of the potentially affected receptor, the significance of construction impacts on avifauna is **Moderate**.

6.2.1.3 Socioeconomic Environment

6.2.1.3.1 Population

This sensitive receptor includes both the local community and onsite workers. In general, the closest city is located at a distance of few kilometres and as such the main concern are the onsite workers. The population of local residents is very minimal, and none is located within the project footprint, which is a designated area of industrial purposes. During this phase, there will be a number of machinery and heavy equipment operating at the site which will increase the noise level in the project area and impact onsite workers. Another source of increased noise is delivery of construction material and equipment to the construction sites as well as the daily transport of the onsite workers from the offsite accommodation.

Air quality might be reduced during this phase of the Project due to dust and gaseous emissions generation. However, the impacts on air quality and noise are assessed to be of Minor significance as previously illustrated in Section 6.2.1.1. As such, the impacts on the onsite workers can be classified of Minor magnitude. Given the Medium sensitivity of the population, the significance is estimated to be **Minor**.

6.2.1.3.2 Visual Receptors

Construction activities will cause noise and disruptions from vehicles and machinery. These activities will alter the existing land use patterns on the site from currently vacant to construction related activities which have a visual impact. The construction phase will result in a total transformation from the current setting and landscape of the Project site.

Potential visual impacts caused by construction activities will include the visual changes caused by clearance of vegetation, ancillary buildings and laydown areas; visual disturbance caused by construction of roads, buildings, energy collectors, power lines, increased traffic (and number of large vehicles), worker presence, and dust emissions.

No permanent residents are present within several kilometres from the site. Impacts during construction are therefore considered of Minor magnitude. Given the Low sensitivity of the visual receptors the impact is expected to be of **Negligible** significance.

6.2.1.3.3 Local Economy

The primary economic impact during construction is likely to result from local employment creation and the use of local businesses/services during this phase. In general, any creation of jobs is likely to be welcomed and is a net **Positive** social impact. Money paid to local workers will also stimulate the local economy via the multiplier effect, whereby money earned on the project expended locally will re-circulate within the local economy.

Experience at new industrial project sites within the Kingdom suggests that a lack of necessary skills within the immediate local population will be identified, and as such it is probable that a significant proportion of work on the site will be undertaken by internal migrants. This will particularly be the case at due to the remote location in a largely unpopulated area. To the extent that the development proves an enabler for further regional development, any skills acquired are likely to prove readily marketable in the aftermath of the project construction. On a local scale, this impact is considered to be of **Positive** significance. Supplies of goods, food and some materials from local suppliers could be a benefit for local communities and should be maximized. A further secondary impact is likely to arise from spending on local goods during the construction process. This will result in a **Positive** impact upon the local economy.

6.2.2 Assessment of impacts during Operation

6.2.2.1 Physical Environment

6.2.2.1.1 Climate and Air Quality

There are no air emissions expected during this phase. As such, it can be concluded that there is **no impact** on the air quality due to the proposed Project operations. However, potential impact on climate is expected during the operation phase. More details are presented below.

CO_2 offset

As previously mentioned in Section 3.1, the Project yearly production will be equivalent to supplying energy to 406,400 households and will significantly reduce the emission of greenhouse gases by 7.7 million tons of CO_2 equivalent.

Being a renewable energy generation project, the planned solar park has a **Positive** effect on the environment as it contributes to reduce climate change compared to the case in which the same amount of electricity would be produced through conventional power generation methods based on combustion of fossil fuels.

SF_6

The substations at the proposed Project can be SF_6 - insulated. In 1997, the Kyoto Protocol (Global Warming Treaty) listed SF_6 as one of the six greenhouse gases that should be controlled by reducing emission or eliminating use. For high voltage switchgear (circuit breakers and gas insulated substations) there are no practical substitutes, so continued use is necessary for the near future. SF_6 gas has the highest global warming potential, 23,900 times that of CO_2; in other words, 1kg of SF_6 vented into the atmosphere corresponds to roughly 24 tonnes of CO_2. It is also very persistent in the atmosphere, with a lifetime of 3,200 years.

In case used, the SF_6 gas systems at the proposed Project will comprise several sealed gas compartments and are designed to avoid in as much as possible SF_6 leaks during normal operation. The SF_6 amount contained in these pieces of equipment is not specified but is assumed to be less than 50 kg per piece, which is typical for modern circuit breakers.

Even during normal operation, SF_6 emissions can't be completely ruled out. Studies on SF_6 from circuit breakers in the U.S. report SF_6 losses in the range of 0.5 – 2 % per year; given the operating conditions at Al-Kahfah (hot, desert climate), routine SF_6 losses are expected rather at the higher limit of this range, amounting to about 1 kg SF_6 routinely emitted per year per piece (equiv. 24 t CO_2/year). SF_6 losses during routine operation must be compensated by refilling from pressure containers.

Potential sources of SF_6 emissions occur from: 1) losses through poor gas handling practices during equipment installation and maintenance; and 2) leakage from SF_6-containing equipment.

The operation and maintenance of SF_6 gas carts which are used to remove, store, clean, and re-fill SF_6 gas to high-voltage equipment are a major source of handling-related losses. Equipment leakage, on the other hand, is the result of the deterioration of SF_6-containing equipment fittings and materials with time and use through chemical, hardening, and corrosion effects.

In general, the SF_6 gas carts operation and maintenance activities will be carefully planned and executed; furthermore, leak detection devices will be installed as needed and immediately handle the source of leakage in an appropriate manner. As a result, the impact magnitude of SF_6 releases during operation is considered Minor. Given the Medium sensitivity of climate as a receptor, the impact significance of routine SF_6 releases is **Minor**.

Heat-island Effect

A growing concern that remains understudied is whether or not PV installations cause a "heat island". Large PV power plants induce a landscape change that reduces albedo so that the modified landscape is darker and, therefore, less reflective. Lowering the terrestrial albedo from ~20% in natural deserts to ~5% over PV panels alters the energy balance of absorption, storage, and release of short- and longwave radiation. A PV heat island effect would be the result of a detectable increase in sensible heat flux (atmospheric warming) resulting from an alteration in the balance of incoming and outgoing energy fluxes due to landscape transformation. Due to modified albedo, the solar arrays influence local and regional wind patterns.

The magnitude of these effects is hard to predict and could only be assessed trough monitoring once the solar park becomes operational, combined with a fully coupled regional climate model to investigate feedbacks between surface albedo changes, surface temperature, precipitation and average cloud cover.

6.2.2.1.2 Soil

Similar as during construction, direct adverse impacts on soils during operation may include soil erosion and deposition by wind, soil erosion by water and surface runoff. Potential impacts on soil, a receptor of *Low* sensitivity, during the operation phase are considered of Minor magnitude; hence the impact significance is assessed as **Negligible**.

6.2.2.1.3 Groundwater

During operation, the PV panels will have to be routinely cleaned. The cleaning system has not yet been selected. An alternative that is might be considered is using wet cleaning. From typical consumption data from similar plants, it seems that, if the spraying system is operating correctly, most water sprayed on the mirrors would probably evaporate quickly before reaching the ground. A well designed and optimally functioning panels cleaning system which consumes minimum water quantities is essential. Given the deep groundwater table in the area, it is assumed that no significant amounts of panels wash water will infiltrate and reach the groundwater. In case of utilizing wet cleaning, the significance of the potential impact of panels wash water on groundwater is considered **Negligible**.

6.2.2.1.4 Acoustic Environment

There are a number of noise sources during the operation phase. These sources include the transformers and inverters. The Project will also include transmission lines which may produce sizzles sounds that occur during periods of high humidity. Though the sizzles sounds are audible to those very close to the transmission lines, it quickly dissipates with distance and is easily drowned out by typical background noises and thus not considered as a significant noise source. In general, the noise emissions from the other Project components (transformers and inverters) are expected to be very limited. For example, at a distance of 10 m, at typical central inverters have a sound pressure level of about 60 dB(A). This is approximately equivalent to the amount of noise generated by large air conditioner and as distance increases it will become less audible. A noisier equipment can be the transformers. Maximum noise levels of the HV transformers according to E.ON Elnät Sverige AB[16] are equal to 84 dB(A) for 33/132 kV 175 MVA. However, the noise impacts are still expected to be limited.

In the case of the proposed Project, the closest SGU units to Al-Kahfah town are SGU4 and SGU3. Each of these SGU units have four (4) transformers The estimated noise levels generating from the transformers is maximum of approximately 46.5 dB(A) as presented in Table 40. Given the distance between Al-Kahfah and the nearest fence of the Project (few kilometers), the noise levels resulting from the Project will be negligible (approximately zero) and thus compliant with the applicable limits for residential areas (Table 6).

[16] E.ON Elnät Sverige AB: Technical Requirements for Power Transformers. Standard Operating Procedures. NUT-091103-027/ D10-0015669/11.0 valid from 2017-06-07. Table 13, page 21.

Table 40 Noise Levels Estimation from Noise Emitting Equipment during Operation

Equipment	Location	Approx. distance from the façade to the nearest fence to the receptor	Estimated combined sound pressure at the source (dB(A))[17]	Estimated combined sound pressure at the nearest fence (dB(A))
Four (4) transformers 132/33 kV	SGU3	1,500 (to the east)	90	46.5
Four (4) transformers 132/33 kV	SGU4	3,000 (to the east)	90	40.5

Similarly, the closest SGU unit to the fence is SGU4 with a distance of approximately 500 m. When calculating the noise level at the closest fence (eastern fence), the noise level is estimated to be approximately 56 dB(A)[18], which is significantly less than the applicable limits for industrial areas (70 dB(A) during the day and 65 dB(A) during the night).

Given the Low sensitivity of the acoustic environment, negligible resulting noise levels, especially at distance from the sources as well as absence of potential noise receptors in the site proximity (absence of settlements in the site proximity and no permanent personnel on site during operation), with the above assumptions, the significance of noise impacts without mitigation is considered to be **Negligible.**

6.2.2.1.5 Electromagnetic Emissions

An often neglected aspect of PV plants impacts is electromagnetic interference (EMI). Typically, this refers to mean radiofrequency (RF) emissions, emanating from PV systems, which can impact nearby radio receivers. This can also include any blocking or attenuation of nearby radar or communications by the PV system.

Although the risk of EMI from PV systems is typically very low, it does merit evaluation, if only to improve the confidence of site owners and other stakeholders. This particularly is the case for a solar park of the size of the proposed Project which will cover a very large area.

Grid-connected or grid-tied systems must meet utility power quality requirements. Large PV plants are generally exempt from Electromagnetic Compatibility (EMC) standards, but their internal control systems and inverters must meet industrial EMC standards in order to provide adequate operating reliability. Inverters employ high-power switching circuitry, which can generate radiated and conducted interference unless adequately shielded and filtered. Other pieces of PV systems equipment, such as step-up transformers, are not a source of electromagnetic interference because of their low-frequency (60 Hz) operation.

The International Electrotechnical Commission's (IEC) Technical Committee 82 prepares International Standards for systems of PV conversion of solar energy into electrical energy and for all the elements in the entire PV energy system. In this context, the concept "PV energy system" includes the entire field from light input to a solar cell to, and including, the interface with the electrical system(s) to which energy is supplied. CISPR 22 is a widely used standard for electromagnetic compatibility within Europe for Information Technology Equipment, ITE. CISPR 22 is maintained by CISPR, International Special Committee on Radio Interference.

[17] Source: Combined Noise Source & Distance Calculator (Link), accessed in June 2021

[18] Source: Decibel calculator for sound (Link), accessed in June 2021

The Federal Communications Commission (FCC) CFR Title 47, Part 15 regulates RF emissions from commercial products. Compliance with Part 15 is not a requirement for large-scale power generation equipment, but many PV inverter manufacturers do qualify their residential or utility scale equipment to this standard and it is easily validated when procuring equipment.

A review conducted by the US National Renewable Energy laboratory (NREL) on behalf of NFEC showed that several case studies have indicated that EMI from PV installations are low risk. Research and field investigations of electromagnetic emission (EME) from Solar PV arrays concluded that they produce extremely low frequency EME similar to electrical appliances and wiring. At a distance of 150 feet from the inverters, EM fields dropped back to very low levels of 0.5 mG or less, and in many cases to much less than background levels (<0.2 mG).

To illustrate the relative emissions for FCC-compliant equipment, the following plot shows field strength vs. distance for a transmitting cell phone, and the maximum output of a FCC-compliant inverter (Figure 38). Comparing the field strength of both devices, the maximum expected field strength for a compliant inverter at a distance of 100 feet is comparable to the field strength of a cell phone a mile away. This is likely to be indistinguishable from background noise.

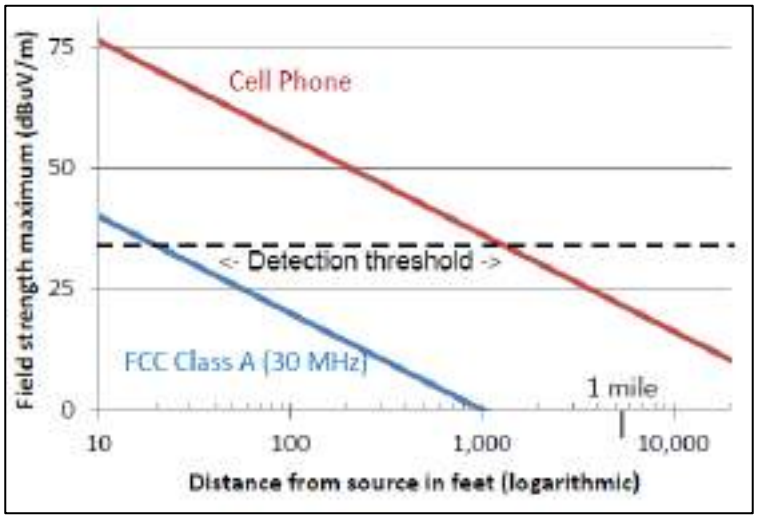


Figure 38 Measured transmit signal power (logarithmic dBuV/m) for a typical cell phone (red) and maximum allowed FCC class 'A' emission at 30 MHz (Source:NREL)

In some cases where PV systems were deployed near existing radar equipment, a setback distance of 250–500 feet was implemented to minimize the physical blocking or reflection of the radar signals by the PV system. A similar 250-foot setback near any other critical communication equipment could be considered in order to attenuate any low-frequency emitted radiation that may be produced by the PV system. With diligent procurement and siting of PV systems, including specifications for FCC Part 15 Class A compliant equipment and a 250-foot setback from communication equipment, NREL anticipates little to no EMI impact on nearby communications or telemetry equipment.

The site is at a remote location with nearest human receptors at several km distance. The closest airport is located at a distance more than 100 km. No radar communication facilities are known to be present. Following these considerations**,** as long as the solar plant is using best industrial practices (e.g. FCC Part 15 Class A equipment (or equivalent)), the resulting impact significance is **Negligible**.

6.2.2.2 Biological Environment

Generally, solar parks are associated with some impacts related to disruption to wildlife and habitat. Very few measurements of ecological impacts, or mitigation efforts, from large-scale solar projects are published. The impact to wildlife will be correlated to the biodiversity (species density) of the land on which the power plant is built; loss of habitat and habitat fragmentation will be one of the negative direct impacts.

The light at the solar power plant may attract multiple insect species. The increased presence of insects may lead to the attraction of insectivorous birds and bats and land-based predators that feed on them if they were fatally injured.

In this way, solar plants may behave like ecological traps especially for insects and birds. However, this effect is less significant at facilities employing PV panels, such as the proposed Project, compared to solar thermal facilities.

The full spectrum of impacts of solar facilities on birds is starting to emerge from compliance reports at solar facilities. These can be summarized as follows:

- Permanent displacement due to habitat transformation
- Collisions with the PV panels
- Collisions with the associated power lines resulting in mortality

It is hard to tell how significant the impact on birds' moving along the relevant migration route will be. Collision with PV panels is a relatively low risk as long as these are absorbing light and are not mistaken by birds for a water body. It is hard to tell whether this will actually happen until post-construction monitoring reveals actual birds' mortality at the site. Some species of birds may collide with panels because they are attracted to shaded areas, particularly if panels are located in previously undisturbed areas as is the case of the proposed Project.

Small birds will maybe attempt to nest underneath the panels to take advantage of the shade, but this behaviour is not very probable due to the changing position of the panels during the day and it should not adversely affect the operation of the equipment.

The most affected candidates by collision mortality on the power lines are medium to large terrestrial species (birds).

The impacts of the solar plant operation will be low compared to other anthropogenic sources of bird and insect fatality, unless the PV design would significantly attract flying animals (birds and insects) due to specific visual effects.

In addition, the use of non-organic herbicides and pesticides for landscaping may be toxic to birds and also impact on the local vegetation if present, thereby increasing the secondary poisoning of non-targeted species.

The impacts on biodiversity during PV plant operation will be persistent for two and a half decades; however, since it is expected that, as time will pass, some adaptation of species to the presence of the solar park and operational noise would occur, so that the initial impacts magnitude would decrease with increasing operation time. Impacts significance will depend on receptors sensitivity: it will be **Minor** for avifauna and **Negligible** for species of lower sensitivity such as reptiles and mammals.

6.2.2.3 Socioeconomic Environment

6.2.2.3.1 Population

This sensitive receptor includes both the local community and onsite workers. In general, the closest city is located at a distance of few kilometres and as such it is not expected that the local community will be negatively impacted by the proposed Project operations. Furthermore, the local community can be **positively** impacted by the power generation.

During this phase, no air emissions are expected; furthermore, the potential impacts resulting from noise emissions are classified as negligible (for more details, please refer to section 6.2.2.1). As such, and given the medium sensitivity of the onsite workers, the significance of the potential impacts resulting from the proposed Project operations is expected to be **Minor**.

6.2.2.3.2 Visual Receptors

The large size, strong regular geometry of solar facilities, and the use of glass panels with metal supporting structures, may result in high visual contrast that is visible for long distances in many instances. The appearance varies substantially, depending on the horizontal and vertical viewing angle and distance as well as on the time of the day, and it may change dramatically as the observer moves or as even short time elapsed. The potential visual receptors can be:

- Any observers located east of the site, looking to the west when the solar panels are tilted eastwards
- Observers west of the site, looking to the east when the solar panels are tilted westwards
- Aircraft that may be flying at low altitude, sufficiently close to the site

In favourable conditions, the large facilities observed in other studies at sites with similar geomorphology were easily visible at distances of tens of km. This impact persists for the entire lifetime of the project (i.e. 25 years). When viewed from long distances, the facility may not be recognizable as solar facility. Depending on the projects' layouts and contrast, in some cases it may appear to be natural features (e.g. large bodies of water). In absence of human settlements and busy nearby roads, the human receptors with respect to visual impacts from the proposed Project are limited to civil and military aviation.

Since the closest commercial airport is very far from the proposed Project (in the range of almost 200 km), no regular low altitude flights (as e.g. during take-off and landing) are taking place over the site area so the visual impact on aviation is considered low. Impacts may be more significant for low altitude occasional flights such as those for entertainment, emergency air transport (e.g. airborne traffic monitoring, rescue flights, etc.) when reflexion on the panels in form of glare may be observed from the cockpit. However, the panels are expected to have very low reflection and this impact is considered of **Minor** significance.

The visual impacts of the facility including eventual glint and glare should be re-assessed and mitigation measures be refined by the EPC based on final design as well as after start of operation.

6.2.2.3.3 Local Economy

At a strategic level, the operation of the plant offers potential to support the continued growth of the local and national economy, through the ability to provide an important source of electrical energy to the Saudi Arabian grid.

Similar to the construction phase, a **Positive** economic impact during operation will result from any local employment created by the project. Whilst the likely nature of these impacts is largely unchanged from the construction phase, they are likely to be less significant due to a minimum number of personnel required for plant operation; this effect is to some extent compensated by the greater time scales involved in the operation of the site compared to construction.

6.2.3 Impacts during Decommissioning

The lifetime of this facility is planned to be 25 years, at the end of which it will have to be decommissioned and the site restored at or close to its initial conditions.

No decommissioning plan is yet available; this section highlights decommissioning aspects considered to be most relevant for a PV power plant.

6.2.3.1 Closure Plan

Following the operational life of the project, the project owner shall perform site closure activities to meet federal, state and local requirements for the rehabilitation and revegetation of the project site after decommissioning. The project owner shall prepare a Closure, Revegetation, and Rehabilitation Plan and submit it to obtain the necessary permits.

Under this plan, all aboveground structures and facilities are removed and taken offsite for recycling or disposal. Areas that had been graded will be restored and plant species native to the area will be replanted.

6.2.3.2 PV Panels End-of-Life Management

This section is based on information provided in IRENA and IEA-PVPS (2016): "End-of-Life Management: Solar Photovoltaic Panels," International Renewable Energy Agency and International Energy Agency Photovoltaic Power Systems.

Based on installations existing in 2016 and future annual installations, IRENA provided an estimation of panel waste by country by 2050. Projections for Saudi Arabia without consideration of early losses are given in Table 41.

Table 41 Modelled results of cumulative waste volumes of end-of-life PV panels for KSA, in tonnes

Year	2020	2030	2040	2050
End-of-life waste PV panels in tonnes (no early losses)	300	3,500	70,000	450,000

PV panels create unique waste-management challenges along with this increasing waste streams forecast. By weight, typical PV panels today contain about 76% glass (panel surface), 10% polymer (encapsulant and backsheet foil), 8% aluminium (mostly the frame), 5% silicon (solar cells), 1% copper (interconnectors) and less than 0.1% silver (contact lines) and other metals (mostly tin and lead). It follows that typically, more than 90% of their mass is composed of glass, polymer and aluminium, which can be classified as non-hazardous waste. However, smaller constituents of PV panels can present recycling difficulties since they contain silicon, silver and traces of elements such as tin and lead (together accounting for around 4% of the mass).

From a regulatory point of view, end-of-life management requirements for PV panels still largely falls under the general waste classification rather than dedicated to PV. The EU is the only jurisdiction that has developed specific regulations and policies addressing the end-of-life management of PV.

The waste management and classification for PV panels in the EU is regulated by the WEEE Directive in addition to other related waste legislation (e.g. Waste Framework Directive 2008/98/EC). This comprehensive legal framework also ensures that potential environmental and human health risks associated with the management and treatment of waste are dealt with appropriately.

- The responsibility for end-of-life waste-management activities downstream (waste generation, collection, transport, treatment and disposal) are typically covered by the following three main stakeholders:
    - Society. End-of-life management is supported by society, with government organisations controlling and managing operations, financed by taxation which could create revenue for municipalities;
    - Consumers. The consumer that produces panel waste is responsible for end-of-life management, including the proper treatment and disposal of the panel;
    - Producers. End-of-life management is based on the extended-producer-responsibility (EPR) principle. This holds producers physically and financially responsible for the environmental impact of their products through to end-of-life and provides incentives for the development of greener products with lower environmental impacts.

The legislation currently in place in KSA requires that PV panels' disposal after decommissioning follows the national legislation for waste classification, waste management and disposal and waste transportation. Decommissioning the solar park which will affect a very large number of solar modules, will generate very large amounts of different types of waste and could be an important impact that should be thoroughly assessed at a later stage of the project. A detailed decommissioning plan will ensure that all legal guidelines are implemented, and all waste will be disposed safely, which will reduce the impacts significance below concern.

6.2.3.3 SF_6 end-of-life recycling for HV and MV equipment

Although not a PV plant specific issue, when MV and HV electrical equipment insulation or breaker component materials contain SF_6 and the equipment is near end-of-life, special care must be taken in the recycling process. SF_6, at the time of disposal, is recognized by numerous government organizations as hazardous waste. Owners of power equipment technologies that contain SF_6 should involve knowledgeable, legitimate partners when retiring obsolete electrical equipment. Electrical equipment manufacturers around the globe have put in place a detailed end-of-life program to help support customers who are confronted with SF_6 equipment end-of-life recycling issues. When electrical equipment reaches the end of its useful life, the equipment usually contains gaseous and solid SF_6 decomposition by-products which are toxic and corrosive.

The main potential gaseous decomposition by-products are HF, SO_2, SO_2F_2 and SOF_2. Their respective concentration can range from a very few parts per billion to a few percentage points of the volume of the SF_6. The existence of molecular sieves placed inside SF_6 equipment compartments help to absorb most of these gaseous decomposition by-products during the lifecycle of the electrical equipment.

The by-products result from partial discharges or the process of breaking load during the lifecycle of the electrical equipment. Sometimes, some solid powder by-product (a few grams) can also accumulate inside the enclosure containing the gas during the equipment's lifecycle. Special care must be taken by the operators extracting the gas in order to prevent the breathing-in or touching of this powder.

European Union Directive 305/2008 states that all personnel handling SF_6 gas must be trained and certified by authorized certification bodies.

The SF_6 technology imbedded in electrical equipment represents no threat as long as the SF_6 is properly handled, recovered, recycled and re-used in a closed cycle. The launching of a SF_6 disposal initiative begins with an audit of equipment that is near end-of-life. Once the quantity of equipment has been identified, a plan can then be developed with the appropriate partner to begin the formal disposal and recycling process.

SF_6 recycling is highly regulated at the national and international level. SF_6 is considered a hazardous waste at the moment of its end-of-life by a majority of countries. Therefore, only licensed or authorized hazardous waste managers are allowed to handle, transport, recycle, or destroy the gas according to national or regional regulations and standards. The hazardous waste will subcontract the end-of-life process to licensed waste managers.

SF_6 gas transported inside spent electrical equipment is subject to United Nations (UN) code 3164. SF_6 gas contained within a bottle is subject to UN code 3163 regulations. Labelling and packaging should therefore adhere to ADR regulation requirements. UN hazardous waste codes concerning the transportation of waste include UN code 16 05 04* [* = hazardous waste] when the SF_6 is contained inside a bottle and UN code 160213* [* = hazardous waste] when SF6 is contained inside electrical equipment.

When the electrical equipment begins to be dismantled, copper, aluminium, and iron components (which make up most of the spent electrical equipment) need to be segregated and stored in different, separate containers. The envelope / enclosure containing the SF_6 should also be carefully set aside. This separation of materials facilitates the processing work and improves the efficiency rate of the recycling. A recycling rate of up to 98% can be achieved under the best conditions.

The magnitude of SF_6 releases during decommissioning is hard to quantify. However, since climate is considered a medium sensitive receptor subjected to change, the impact significance of SF6 release on this receptor will be at least **Moderate** even for a **Minor** impact magnitude**.**

6.2.4 Impacts due to Accidental (Non-routine) Events

Non-routine events include a range of unintended activities and accidental events (e.g. spills). These non-routine events could negatively impact a number of receptors, mainly including air and soil quality. The non-routine events that could occur during the different project phases are listed below:

- Leaks and Spills
- Inappropriate waste disposal
- Explosion and fire
- Vehicles accidents

Assessment of significance of impacts for the accidental (non-routine) events throughout the project phases detailed below is based on the most conservative approach and does not take into consideration the probability of occurrence of the accident.

6.2.4.1 Air Quality

Air quality can be potentially affected as a result of explosion and fire. Considerable concentration of various air pollutants (e.g. SO_2, particulates) results from the fire and/or explosion. The type of the released air pollutants is dependent on the composition of the flammable material as well as the temperature.

The impact of fire and explosion on ambient air quality is highly dependent on different factors such as the type and volume of the flammable material and the duration of the fire. In case of large fire, given the Low sensitivity of the potentially affected receptor, the impact is expected to be **Moderate**.

6.2.4.2 Groundwater

Groundwater quality may be impacted by spillages during construction. This may occur due to inadequate management and leak of polluting construction materials (e.g. paints) and fuel that may reach the groundwater resulting in pollution. Hazardous and non-hazardous materials used in construction are likely to include fuel, engine oil, paints, solvents and other chemicals. Poor handling of those materials and their inappropriate storage may result in poor containment and ultimately potential leaks.

Impacts to groundwater quality during construction may also result from limited spills at maintenance locations/workshops for construction equipment or leaks from the wastewater collection system for the sanitation facilities available at the worker accommodation camp. Such limited leaks could result in introducing organic matter, hydrocarbons (oils), coliforms or heavy metals if reached the groundwater. Inappropriate waste disposal may have also impact on the groundwater quality.

In general, groundwater is not very vulnerable to direct contamination trough infiltration from the ground surface. This is due to the potential depth of the groundwater table of several tens of meters.

Additionally, some of contaminants may be trapped in the soil matrix and may act over decades as long-term contaminants source, causing extended dissolved plumes. The overall impact on groundwater quality due to the different non-routine events can be classified as **Minor**.

6.2.4.3 Soil

During construction, potentially contaminating materials including fuels, engine oil, paints, solvents, chemical additives are expected to be stored and handled at the construction sites. Accidental spills may reach the soil, resulting in contamination. Inappropriate waste management can have similar consequences. Inappropriate sanitation facilities during the construction phase may cause soil contamination.

Soil quality could be impacted due to the failure of containment systems for chemicals, raw materials, and wastewater, such as tanks, pipe work, etc. Accidental impacts on soils are **Minor**, due to the Low sensitivity of soil.

6.2.4.4 Biological Environment

The biological environment includes flora, reptiles, mammals and avifauna. Biological environment may be affected during any accidental events. Impacts could result from the following accidental (non-routine) events:

- Fire and explosion
- Leaks and spills
- Inappropriate waste disposal

As for fire and explosion and apart from animals present at the immediate accident location that could be killed when the fire starts, animals are expected to escape the area very shortly due to the heat radiation. The significance of the potential impact is classified as **Minor**.

Spill and leaks may negatively affect the terrestrial ecology and biodiversity. The extent and magnitude of the impact is highly dependent on the material/chemical released in terms of composition and quantity. Given that the sensitivity of the potentially affected environmental receptors the significance of the direct impact is classified as **Negligible**.

Accidental release of solid wastes from vehicles may occur during the transport of those wastes for disposal which may have impacts on the well-being of existing biodiversity if not immediately contained. The impact significance is expected to be also **Negligible**.

6.2.4.5 Population

Impacts population could result from the following accidental (non-routine) events:

- Fire and explosion
- Vehicle accidents

Fire and explosion may affect surrounding population, if present. In general, fire due to flammable material may occur which will cause disturbance to inhabitants in the area eventually present in the project surroundings, which may result in change of their behaviour; however, such changes are expected to be limited to a short period of time and the impact is expected to be of **Minor** significance. However, higher significance is expected on the onsite workers and as such, the impact is expected to be Moderate.

Vehicle collision and accidents during construction vehicle movement and workers transportation from and to their accommodation location may result in injuries or loss of lives. The impact of injuries may persist for a long duration while loss of lives is permanent consequently the impact is expected to be of **Moderate** significance.

6.3 Impact Assessment Summary – Before Implementing Mitigation Measures

Impacts from the project during construction, operation and accidental events before mitigation measures implementation are summarized in Table 42to Table 44.

Table 42 Impacts during project construction (before mitigation)

Sensitive Receptor	Sensitivity	Magnitude	Impact Significance
Physical Environment			
Air quality	Low	Moderate	**Minor**
Soil	Low	Moderate	**Minor**
Acoustic environment	Low	Moderate	**Minor**
Biological Environment			
Flora	Low	Major	**Moderate**
Avifauna	Medium	Minor	**Moderate**
Reptiles and Mammals	Low	Moderate	**Minor**
Socioeconomic Environment			
Population (local community)	Medium	Minor	**Minor**
Population (onsite workers)	Medium	Minor	**Minor**
Visual receptors (road traffic and aviation)	Low	Minor	**Negligible**
Local economy	**Positive**		

Table 43 Impacts during Operation (before Mitigation)

Sensitive Receptor	Sensitivity	Magnitude	Impact Significance
Physical Environment			
Global climate – CO_2 offset	**Positive**		
Global climate – SF_6	Medium	Minor	**Minor**
Soil	Low	Minor	**Negligible**
Groundwater	Low	Minor	**Negligible**
Acoustic environment	Low	Minor	**Negligible**
Electromagnetic emissions	Low	Minor	**Negligible**
Biological Environment			
Avifauna	Medium	Minor	**Minor**
Reptiles and Mammals	Low	Minor	**Negligible**
Socioeconomic Environment			
Population (local community)	**Positive**		
Population (onsite workers)	Medium	Minor	**Minor**
Visual receptors (road traffic and aviation)	Low	Moderate	**Minor**
Local economy	**Positive**		

Table 44 Impact Assessment – Accidental Events (Before Mitigation)

Sensitive Receptor	Sensitivity	Magnitude	Impact Significance
Leaks and spills			
Soil	Low	Moderate	**Minor**
Groundwater	Low	Moderate	**Minor**
Flora	Low	Minor	**Negligible**
Reptiles and Mammals	Low	Minor	**Negligible**
Population	Medium	Minor	**Moderate**
Inappropriate waste disposal			
Groundwater	Low	Moderate	**Minor**
Soil	Low	Moderate	**Minor**
Flora	Low	Minor	**Negligible**
Reptiles and Mammals	Low	Minor	**Negligible**
Fire and explosion			
Air	Low	Major	**Moderate**
Avifauna	Medium	Minor	**Minor**
Reptiles and Mammals	Low	Moderate	**Minor**
Population (local community)	Medium	Minor	**Minor**
Population (onsite workers)	Medium	Moderate	**Moderate**
Vehicles accidents			
Population (local community and onsite workers)	Medium	Moderate	**Moderate**

7. Management Plans

7.1 Proposed Plan to Mitigate Environmental Impacts

Recommended mitigation measures/procedures for the expected impacts are presented below. Additional mitigation measures are presented as part of the Environmental Management Plan Framework and Monitoring Plan presented in Appendix G of this report. The residual impacts after implementing the below proposed mitigation measures are summarized in Section 7.3.

7.1.1 Mitigation of Impacts during Construction

During construction, the contractor should ensure that no encroachment to the nearby land should occur and should follow the clearly defined transportation routes. Transport routes will be identified, and training will emphasize that employees should keep to the designated routes in order to protect the environment and reduce encroachment on adjacent land, reduce dust fall across the site due to the movement of trucks on undesignated sand tracks and also protect the visual aesthetics of the landscape. Construction activities should be limited to demarcated areas.

The following mitigation measures are also recommended:

- Transportation on and to/from the site will be minimized through efficient transport management in order to minimize noise and vehicle pollution. Machinery will be maintained on a regular basis to ensure smooth efficient running to control emissions and leakages
- Signage and diligent supervision of contractors should be implemented across the site
- Hazardous materials used during the construction stage should be adequately managed, in order to minimize the potential risk of spillage
- In addition, any labour facilities should promote fair labour practices in the construction industry. The provision of facilities should include dedicated areas for food preparation, personal hygiene, and healthcare and provide suitable waste management facilities, sewage collection and removal facilities and health, safety and security programs. Inspection schedules should also be included in the independent audits to ensure that standards are achieved and maintained
- Proper organic waste management practices should minimize temporary negative effects during construction
- Light generation during night periods should be minimized, to avoid attracting fauna and potential deviations from migrating routes

7.1.2 Mitigation of Impacts during Operation

An avifauna survey and monitoring should be undertaken by an ornithologist during the first year of operation of the Project, to assess the impacts from the project on the bird population in the area, assess behaviour and eventual mortality and, based on the outcome, to adapt mitigation measures as necessary.

Landscaping on the site should include indigenous/native plants that have minimum water and fertilizer requirements. An integrated pest management plan should be developed which uses organic pest management products in preference to large-scale pesticides.

Transport routes on site and training will emphasize that vehicles and employees should keep to the designated routes in order to prevent unnecessary land encroachment, thus protecting the natural resources and reducing dust emissions, limit speeds in areas eventually known to be occupied by special status species and minimize foot traffic in undisturbed areas. An efficient waste management plan will prevent inert waste from polluting the Project site and adjacent areas and will also provide options for sustainable management of waste. Recycling facilities should be provided for staff in order to maximize the re-use and recycling of materials and waste. Since human settlement generally attracts pests and has a large impact on birds, consideration should be given to developing a plan to manage pests. Further mitigation measures that can be implemented are:

- To the extent possible, minimize the number of areas where wildlife could hide or be trapped
- Use avian deterrence techniques, including prey control; anti-perching technology; nest-proofing or other enclosures
- Regularly monitor the solar field, access roads, and ancillary facilities for invasive non-native plant species establishment. Initiate control measures immediately upon evidence of invasive species introduction or spread
- Limit vegetation management and use mechanical controls in preference to herbicides/pesticides. Where required, limit herbicide/pesticide use to non-persistent, immobile herbicides/pesticides and apply only in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications
- Address spills immediately per the appropriate spill management plan, and initiate soil clean-up and soil removal if needed
- Turn off all unnecessary lighting at night to avoid disturbance of migratory birds
- Conduct seasonally appropriate inspections by a qualified biologist or team of biologists to ensure that important or sensitive species or habitats are not present in or near project areas. If birds' collisions are found to be frequent, the borders of the panels could be painted in white to increase mirrors visibility
- To protect large birds, it is recommended that transmission lines be separated by at least the wingspan of the birds to avoid short circuiting during perching and take-off from transmission line towers. Further, the project should consider mitigation by underground powerlines or birdlife diverters, if possible

7.1.3 Accidental (non-routine) Events

The different accidental (non-routine) events may affect different receptors. The following general management and control measures are recommended to minimise accidental impacts that may occur during the different phases of the project:

- Ensure regular inspection and maintenance of electrical equipment and fittings to avoid their damage and risk of fire
- Prohibit smoking in all storage areas and display prominent NO SMOKING notices.
- Material safety datasheets (MSDS) and safety instructions should be clearly displayed in the storage area
- Implement training systems to ensure that personnel onsite respond in a timely manner to incidents that could result in soil and groundwater contamination
- For all potential accidental events, an emergency response plan must be put in place
- Employees should be fully trained to implement the relevant emergency response plans in the event of emergency

- Different preventative concepts shall be applied (e.g. proper documentation of standard procedures, work permitting rules and procedures effective management of processes)
- Implement Environmental Emergency Plan (Appendix H)
- Vehicles and other equipment shall be subjected to regular maintenance to avoid spills and leakage of fuels and lubricants
- Environmental register should be used to register all waste management activities including quantities and types of waste handled
- All employees should be educated through trainings to deposit all wastes in the appropriate containers without throwing out carelessly
- Good housekeeping should always be maintained
- Operational controls, maintenance procedures and comprehensive response planning
- Train employees to promptly contain, report and/or clean up any hazardous material spills as well as emergency events
- An emergency notification system should be implemented to inform nearby industries and residential communities of an emergency
- Emergency alarm systems are both audible and visible
- Qualified first-aid shall be provided at all times for all the employees. Appropriately equipped first-aid stations will be easily accessible throughout the place of work
- Ensure driver safety training are provided and verify driver qualifications
- Driving safety –this will include compliance with local law, night driving procedures, incident procedures, acceptable journey times, mobile phone/radio usage, etc.
- Traffic plan should be appropriate to cover all transport arrangements
- Availability of first aid kit and safety equipment requirements for vehicles
- Portable fire extinguishers are intended as the first line of defence to fight fires of limited size
- Mobile fire-fighting equipment shall be available on site. For major fire, external support may be required as per the Emergency Response Plan
- Firefighting products shall be considered with the least hazard and lowest potential environmental and/or health impact
- Coordination with local fire services and providing specific information on the facility, as necessary, so that the most effective firefighting methods can be determined
- All employees are responsible to contribute to the prevention of fire and will be trained on fire-fighting techniques and the use of fire extinguishers regularly
- Grievance Mechanism shall be in place and appropriately implemented
- Addressing any compliant received from the local community and onsite workers promptly as far as practical

7.2 Environmental Monitoring Plan

In this section of the report an overview of the Environmental Monitoring Plan is presented. The detailed plan can be found as part of the Environmental Management Plan Framework and Monitoring Plan (Appendix G, Section 2 – Environmental Monitoring Plan). Different aspects will be monitored during the construction and operation phases of the Project. During construction phase, these aspects include but not limited to air emissions, noise levels, incoming chemicals, wastes and site access. During operation, the aspects to be monitored may include noise levels, solid and hazardous waste and workspace. The frequency, location and parameters to be monitored will be carefully selected, as applicable and will be subject to review and update as needed.

7.3 Summary of the Assessment of Expected Impacts after Mitigation

Table 45 to Table 47 show the impact assessment after implementing the proposed mitigation measures. It should be noted that some of the impact significance did not change after implementing the mitigation measures due to the sensitivity of the potentially affected sensitive receptor. In general, the majority of the potential impacts during the different phases of the Project are of negligible and minor significance.

Table 45 Impact Assessment during Construction Phase (after implementing mitigation measures)

Sensitive Receptor	Sensitivity	Impact Significance (before mitigation)	Impact Significance (after mitigation)
Physical Environment			
Air quality	Low	Minor	Negligible
Soil	Low	Minor	Minor
Acoustic environment	Low	Minor	Negligible
Biological Environment			
Flora	Low	Moderate	Minor
Avifauna	Medium	Moderate	Minor
Reptiles and Mammals	Low	Minor	Minor
Socioeconomic Environment			
Population (local community)	Medium	Minor	Minor
Population (onsite workers)	Medium	Minor	Minor
Visual receptors (road traffic and aviation)	Low	Negligible	Negligible

Table 46 Impact Assessment during Operation Phase (after implementing mitigation measures)

Sensitive Receptor	Sensitivity	Impact Significance (before mitigation)	Impact Significance (after mitigation)
Physical Environment			
Global climate – SF_6	Medium	Minor	Minor
Soil	Low	Negligible	Negligible
Groundwater	Low	Minor	Minor
Acoustic environment	Low	Negligible	Negligible
Electromagnetic emissions	Low	Negligible	Negligible
Biological Environment			
Avifauna	Medium	Minor	Minor
Reptiles and Mammals	Low	Negligible	Negligible

Sensitive Receptor	Sensitivity	Impact Significance (before mitigation)	Impact Significance (after mitigation)
Socioeconomic Environment			
Population (onsite workers)	Medium	Minor	Minor
Visual receptors (road traffic and aviation)	Low	Minor	Minor

Table 47 Impact Assessment during accidental events (after implementing mitigation measures)

Sensitive Receptor	Sensitivity	Impact Significance (before mitigation)	Impact Significance (after mitigation)
Leaks and spills			
Soil	Low	Minor	Negligible
Groundwater	Low	Minor	Minor
Flora	Low	Negligible	Negligible
Reptiles and Mammals	Low	Negligible	Negligible
Population	Medium	Moderate	Minor
Inappropriate waste disposal			
Groundwater	Low	Minor	Minor
Soil	Low	Minor	Negligible
Flora	Low	Negligible	Negligible
Reptiles and Mammals	Low	Negligible	Negligible
Fire and explosion			
Air	Low	Moderate	Minor
Avifauna	Medium	Minor	Minor
Reptiles and Mammals	Low	Minor	Negligible
Population (local community)	Medium	Minor	Minor
Population (onsite workers)	Medium	Moderate	Minor
Vehicles accidents			
Population (local community and onsite workers)	Medium	Moderate	Minor

7.4 Emergency Response Plan

In this section of the report an overview of the Emergency Response Plan is presented. The detailed plan can be found in Appendix H. The plan outlines procedures for emergency awareness, preparation, and response with the purpose of preventing, minimizing and/or mitigating environmental impacts. The plan covers different scenarios such as personnel injury, fire or explosion, floods and site evacuation. The structure of the plan is as follows:

- Introduction: it presents purpose, scope and definitions
- Emergency Response Team: it includes the notification procedure
- Prevention: It presents risk assessment
- Preparedness: this section presents the training objectives and programme, exercise and drill as well as resources
- Emergency Response Activities: these activities include alerts and notifications, assessing the situation, reporting to concerned authorities and response deactivation
- Environmental Emergency Response Plans: this section covers different scenarios such as site evacuation

7.5 Environmental Rehabilitation and Treatment Plan

Following the operational life of the Project, the project owner shall perform site closure activities to meet local requirements for the rehabilitation and revegetation of the project site after decommissioning. The project owner shall prepare a Closure, Revegetation, and Rehabilitation Plan and submit it to obtain the necessary permits. The objectives of an Environmental Rehabilitation and Treatment Plan are to describe the decommissioning plans for the proposed Project after its operations cease, and to establish a methodology by which environmental conditions may be returned to present conditions pre-development. In general, the plan will be complaint with the relevant local legal requirements (for example: the executive regulations for deteriorated sites environmental rehabilitation and treatment of contaminated sites). This section of the report presents a framework for the environmental rehabilitation and treatment plan that will be further developed prior to the initiation of the decommissioning phase of the proposed Project.

7.5.1 Plan Objectives

The aim of the plan is to:

- Restore the site to a condition which is as similar as possible to the natural environment or to the pre-determined end use
- Ensure that all the applicable environmental regulations and best-practices are followed and implemented
- Ensure that all areas are stable, and there is not risk of erosion

7.5.2 Procedures and Measures

The different procedures and measures to be followed during the rehabilitation of the Project site will be outlined in the plan. These procedures may cover aspects such soil stabilization, flora and fauna, chemicals and wastes management as well as public safety. These procedures may include the following:

- All infrastructure, equipment, plant, fencing, temporary services and foreign materials shall be removed from the site
- All disturbed areas should be stabilized

- Waste material will be removed entirely from the Project site and disposed of at a recognised landfill facility. It will not be permitted to be buried or burned on the site
- Any damage caused by erosion will be rehabilitated and the necessary erosion control measures will be maintained
- No construction equipment, vehicles or unauthorised personnel shall be allowed unto areas that have been rehabilitated

7.5.3 Monitoring Plan

Different aspects will be monitored during the decommissioning and rehabilitation activities. These aspects include but not limited to air emissions, noise levels, incoming and outgoing chemicals, wastes and site access. The frequency, location and parameters to be monitored will be carefully selected, as applicable and will be subject to review and update as needed.

7.5.4 Reporting

Reports on progress of the rehabilitation and treatment activities will be regularly developed. The reports will include the activities done during the reporting period, results of the monitoring activities, conclusions and recommendations.

7.5.5 Emergency Management Plan

An Emergency Management Plan will be prepared during the rehabilitation and treatment activities. Tentatively, it is expected that the Emergency Management Plan will outlines procedures for emergency response with the purpose of preventing, minimizing and/or mitigating environmental impacts. The plan will cover different scenarios such as personnel injury, fire or explosion, floods and site evacuation.

7.6 Environmental Management Framework

Appendix G of the present report presents the Environmental Management Plan Framework. This section provides an overview of the plan.

7.6.1 Roles and Responsibilities

The most important members of the construction team from an environmental perspective are the Project Manager (PM), the EPC Contractor (EPCC), the EPC Contractor's Environmental Control Officer (ECO), and the Project Owner.

The PM is responsible for the implementation of the EMP on the site during the pre-construction and construction phases of the project.

The ECO is responsible for monitoring the implementation of the EMP during the design, pre-construction and construction phases of the project.

The EPCC is responsible for abiding by the mitigation measures of the EMP which are to be implemented by the PM during the construction phase.

The Project Operator is responsible for the implementation of the EMP during the operational and decommissioning phases of the project.

7.6.2 Capacity Building

Project personnel, environmental team personnel and managers are all required to undertake recurrent environmental and social awareness training. A record of induction and other related environmental trainings shall be completed by all personnel. Training records shall be deposited in secured individual personnel files stored onsite and a copy sent to the HSE Manager. The training matrix shall be reviewed on a quarterly basis to ensure it accurately reflects the best practice environmental management. Employees at all levels are to be made aware of:

- The importance of conformance with the environmental policy and procedures and with the requirements of environmental and social regulations and standards
- The significant environmental impact, actual or potential of the Project and the environmental benefits of improved personnel behaviour
- The effect of the Project on the environment and the adequate management practices to mitigate and reduce impacts
- Their roles and responsibilities concerning the Environmental Management Plan implementation

7.6.3 Communication

Communications channels will remain open with employees, suppliers, government agencies, and communities, with regards to environmental and social matters. The main purpose of internal communication on the project is to ensure that employees and different departments are aware of current and/or controlled information pertaining to the environmental aspects of the project, suppliers are following the correct procedures. Topics for communication may include but not be limited to internal communication with the workers/employees to improve their motivation and raise environmental awareness and updates on potential procedures, technologies and data that would improve environmental performance. The main purpose of external communication on the project is to ensure that the Project is compliant with applicable regulations and requirements and that communities are updated with the current environmental and social performance of the Project. Topics for communication may include but not be limited to updated regulations/limits and their applicability on the project and community grievances and the measures taken.

7.6.4 Review and Reporting

The below procedures will be followed:

- Top Management periodically reviews all working activities on regular basis. At appropriate intervals, the management reviews the EMP to ensure its suitability, adequacy and effectiveness.
- Records about management reviews are maintained by HSE Manager
- EMP audit results, environmental performance and external communication are discussed in management review meetings
- Regular EMP, HSE policies, standards and procedures are updated to address the audit results

The following documentation must be kept on site in order to record compliance with the EMP:

- Record of Complaints
- Monitoring Results
- Notification of Emergencies and Incidents
- Environmental Register

7.6.5 Data Management

The plan will be distributed to Owner, consultant, government agencies, relevant Project subcontractor companies, the PM, the HSE manager and or the Environmental Control Officer (ECO), and will be freely available to all Project Team members and Subcontractors.

7.6.6 Audit and Inspection

Undertaking environmental audit and inspections will help assess potential environmental risk, environmental liabilities, and the degree of compliance with environmental standards and legislation. Periodic internal audits and reviews will be initiated to identify whether the EMP is being actively implemented. A report of findings will be compiled in a formal document.

8. Conclusion

8.1 The Preferred Alternative from an Environmental, Social and Economic Point of View

Different alternatives were analysed as part of the ESIA report as detailed in Section 4. Below in Table 48 is a brief summary of the preferred alternatives studied in this report.

Table 48 Preferred alternatives summary

Selected Alternative	Justification summary
Project establishment	The Project establishment will result in a number of positive impacts: • Power generation • Reduction of GHGs emissions by 7.7 million tons of CO_2 equivalent • Job opportunities provision • Investment and local economy enhancement The limited environmental impacts during the different phases especially during construction are largely mitigated as illustrated in Section 7.3. As such, the "no-project" alternative (not constructing the proposed Project) is not a feasible alternative and the preferred alternative is establishing the proposed Project
Location of the Project	The location selected for the Project has a number of advantages: • The area is designated for PV projects (Appendix C) • The availability of land for the planned development • The area is sufficiently distant from residential areas to minimize social impacts. Nearest city is Al-Kahfah at a distance of approximately 6 km • The site is easily accessible and will easily connect with the local electricity grid. • the level of irradiation at the Project site is strong • Is not a culturally significant site The Project area is officially designated for similar developments (PV Energy Park) and its characteristics is suitable for establishing the proposed Project
Mounting System: Single-axis tracking	For the same rated capacity, the annual generation is 16.5% higher on average with a single-axis tracking system compared to fixed-tilt mounting
PV module: Bifacial	Energy production can be increased by up to 25%
PV module: Half- cell	Improved performance and durability compared with full cell
Ground Coverage Ratio (GCR)	The results of the simulation indicated that for the proposed Project, a GCR of 0.3 is the optimal compromise between land usage and energy production. In consequence the distance from pier to pier of different rows is 7.5 meters. Considering the length of the PV modules, the distance between modules when they are in horizontal position is 5.25 meters.
DC/AC Power Ratio	The results of the data analysis indicated that for the proposed Project, a DC/AC Power ration of 1.25 is the optimal value

8.2 A summary of the Environmental, Social and Economic Losses and Gains

As earlier presented in Section 8.1, the proposed Project has a number of significant positive impacts. A summary of the potential gains and losses associated with the Project is presented below in Table 49.

Table 49 Gains and losses summary

Aspect	Gains	Losses
Environmental	• GHGs reduction (approximately 7.7 million tons of CO_2 equivalent) • Energy production from renewable resources	Limited negative impacts on the environment (e.g. increased noise levels) during construction and operation phases as detailed in Section 6.3. However, applying the proposed mitigation measures outlined in Section 7.1 will further minimize these impacts.
Social	• Energy production that is equivalent to supplying energy to 406,400 households • Job opportunities creation during the different phases of the Project • Purchasing of materials, especially during the construction phase will have indirect positive impacts on the local community due to the improved economic conditions	Limited nuisance to the local community and onsite workers especially during construction phase is expected. However, these impacts are limited in duration and magnitude as well. More details are presented in Section 6. However, applying the proposed mitigation measures outlined in Section 7 will further minimize these impacts
Economic	• Purchasing of materials, especially during the construction phase will have direct positive impacts on the local economy • Power generation (approximately 8,534 GWh per year)	Not applicable

8.3 A summary of How Negative Impacts are Addressed and to What Extent they will be Mitigated, Improved, or Controlled

During the different phases of the proposed Project, the following mitigation hierarchy shall be followed as applicable (Figure 39):

- Avoid the direct and indirect impacts
- Reduce these impacts
- Restore the environment
- Compensate the residual impacts

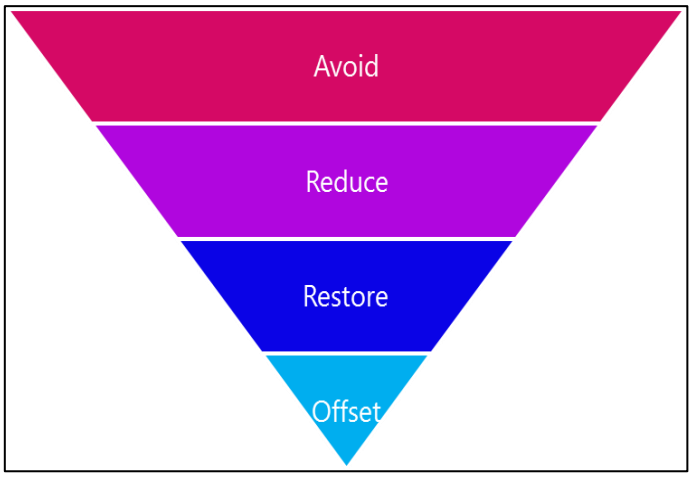


Figure 39 Mitigation Measures Implementation Hierarchy

In general, the mitigation measures and management plans and procedures presented in Section 7 of this report will be followed. Section 7.3 presents the significance of the potential impacts after implementing the proposed mitigation measures. In general, the impact significance ranged between negligible and moderate. Furthermore, the majority of the potential impacts were classified of minor and negligible significance after implementing the proposed mitigation measures.

8.4 Summary of the Environmental Management Plan

Section 7.6 and Appendix G present the Environmental Management Plan Framework. In general, the plan will include but is not limited to:

- Roles and responsibilities
- Non-Conformance and Corrective Action
- Capacity building
- Communication
- Measures to be followed during the different phases of the Project in order to minimize the potential negative impacts

8.5 The Roles of the Various relevant Authorities

Table 50 shows the role of the key relevant authorities. It should be noted that a comprehensive Stakeholder Mapping Report has been developed for the proposed Project. This report includes more details on the relevant authorities' roles and interests in the Project. It also includes a brief Stakeholder Engagement Action Plan. More details can be found in Section 9 and Appendix F. For more details on the permitting process, please refer to Section 2.2.2.

Table 50 Role of different authorities

No.	Name	Role in Construction	Role in Operation
1	Hail Province Municipality	Issuing land allocation and building permits	No direct role
2	Al-Kahfah Town Municipality	Issuing land allocation and building permits	No direct role
3	Ministry of Municipal, Rural Affairs and Housing (MOMRA)	Issuing land allocation and building permits	No direct role
4	National Center for Environmental Compliance (NCEC)	The NCEC has been assigned the responsibilities related to reviewing and approving EIAs for development projects, for the granting of permits and for the issuing of licenses (i.e. Environmental Permit to Construct and Environmental Permit to Operate).	NCEC functions as an enforcement institution for the application of environmental laws including environmental licensing and auditing.
5	Ministry of Environment, Water, and Agriculture (MEWA)	Issues permit to drill groundwater wells, if needed	General interest in the proposed Project environmental performance
6	Ministry of Energy	Monitoring performance. Lead in communication to interested governmental agencies/ministries as required	Monitoring performance. Lead in communication to interested governmental agencies/ministries as required
7	Saudi Electricity Company (SEC)	Respond directly on issues relating to project interaction with SEC assets	Ongoing role related to the operation of the Project and energy supply to the grid
8	National Center for Wildlife	Ensures that all measures included in the EIA for the protection of biological diversity are followed	General interest in the proposed Project environmental performance

9. Stakeholder Engagement and Public Consultation

9.1 Stakeholder Mapping

A Stakeholder Mapping Report was prepared for the proposed Project. This section gives a summary of the most important stakeholder groups identified and a summary of the analysis of stakeholder significance. This section will also provide a summary of the Stakeholder Engagement Action Plan. The detailed report is presented in Appendix F.

9.1.1 Stakeholder Identification

The report identified parties and/or individuals who might have an interest in the proposed Project and who might influence or be influenced by the proposed Project.

The identified stakeholder group included regulatory bodies and competent authorities, including but not limited to:

- Hail Province Municipality
- Ministry of Municipal, Rural Affairs and Housing (MOMRA)
- National Center for Environmental Compliance (NCEC)
- Ministry of Environment, Water, and Agriculture (MEWA)
- Ministry of Energy
- Saudi Electricity Company (SEC)

Other stakeholder groups identified include intergovernmental groups, specifically Project lenders who set environmental and social requirements that must be met for loans to be approved.
In addition, there are businesses and community representatives such as local residents of Al-Kahfah. Other groups include the media organizations such as local newspaper and radio media groups.

9.1.2 Stakeholder Analysis

This section provides a quick overview of the significance of stakeholder groups identified in the previous section according to the expected impact, interest, and influence of said stakeholder on the proposed Project. Table 51 details the criteria used to determine the significance of each stakeholder group previously identified.

The appropriate level of engagement of each stakeholder was also determined based on the criteria identified using the engagement matrix shown in Figure 40.

Table 51 Criteria Used to Determine the Significance of Each Stakeholder Group

Significance	Impact	Interest	Influence
Low	Stakeholder will experience very few impacts as a result of the project	The project has limited relevance to the stakeholder's field of interest and/or responsibilities	Stakeholder has very little control over the project
Moderate	Stakeholder will experience a moderate degree of impact as a result of the project. These impacts can be managed and mitigated	The project has some relevance to the stakeholder's field of interest and/or responsibilities	Stakeholder can influence the scope and schedule of the project
High	Stakeholder will experience a high degree of impact as a result of the project	The project is directly related to the stakeholder's field of interest and/or responsibilities	Stakeholder has decision making powers regarding the project

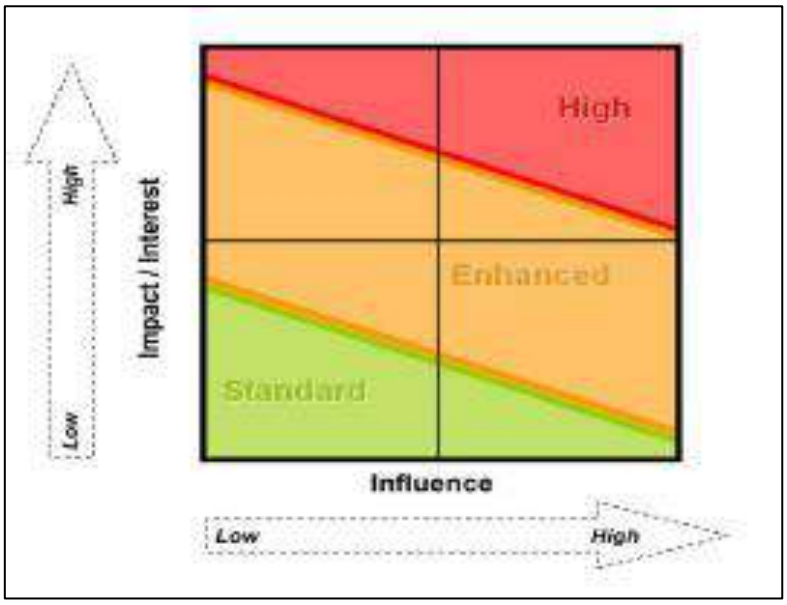


Figure 40 Levels of Engagement Matrix

As might be expected, regulatory bodies and competent authorities, as well as Project lenders have Moderate to High significance regarding the proposed Project and Enhanced to High levels of engagement. While local businesses and communities have Moderate to High significance and Enhanced to High levels of engagement regarding the proposed Project. While the media has Low significance and standard level of engagement.

9.1.3 Stakeholder Engagement Action Plan

This plan will provide all identified stakeholder groups and interested factions with a channel of communications between the stakeholder groups and the Project developer. The approach generally uses the different levels of engagement to provide more focused activities based on the level of significance of each stakeholder groups. For example, a Standard level of engagement can be achieved using disclosure, while a Moderate level can be achieved via consultation and engagement, and focused engagement can achieve a High level of engagement.

The action plan included various engagement methods for the different proposed activities. The action plan also details some proposed grievance mechanisms for the project developer in order to monitor grievances and identify any recurrent issues, or escalating conflicts. Including but not limited to the following:

- Implementing a grievance mechanism and ensure the responsiveness of this mechanisms to concerns and complaints
- Receiving and logging all comments and complaints associated with the project
- Responding to such complaints and comments wither verbally or in writing

Lastly, the report emphasizes the importance of monitoring stakeholder engagement activities in order to ensure that the consultation and disclosure efforts are sufficient and effective throughout the process.

9.2 Public Consultation

A public consultation session took place on 4 August 2021. Due to COVID-19 pandemic restrictions, the meeting was held through means of video conference. The meeting was attended by representatives from different stakeholders including but not limited to:

- National Centre for Environmental Compliance (NCEC)
- National Centre for Wildlife (NCW)
- Ministry of Environment, Water and Agriculture (MEWA)
- Ministry of Tourism
- The Public Authority for Transport
- Ministry of Transport and Logistic Services
- Ministry of Municipal, Rural Affairs and Housing
- Saudi Railway Company
- Ministry of Defence
- Ministry of Interior
- Ministry of Communication and Information Technology
- Communications and Information Technology Commission (CITC)
- The Saudi Authority for Industrial Cities and Technology Zones (MODON)
- General Authority of Civil Aviation (GACA)
- Heritage Commission
- Saudi Ports Authority
- Saudi Electricity Company (SEC)

During the session, the different Project aspects were discussed including but not limited to components as well as the potential positive and negative impacts of the Project. Attendees were supportive of the concept of the renewable energy program and the development of the proposed Project. The relevant documentations of the session are presented in Appendix F.

10. Appendices

10.1 List of References

Please refer to Appendix A.

10.2 Curriculum Vitae of Study Team

Please refer to Appendix B.

10.3 Technical Documents

Please refer to Appendix C.

10.4 Project Location Maps

Please refer to Appendix D.

10.5 MSDS

Not applicable

10.6 Summary of NCEC Comments on the Scoping Report and how they are addressed in the EIA Study

Not Applicable. NCEC approved the Scoping Report without comments.

10.7 List of Applicable Limits

Please refer to Appendix E.

10.8 Stakeholder Engagement Documentation

Please refer to Appendix F.

10.9 Environmental Management Plan Framework

Please refer to Appendix G.

10.10 Environmental Emergency Response Plan

Please refer to Appendix H.

Appendix A. List of References

Abuzinada, A. H., Al-Wetaid, Y. I., & Al-Basyouni, S. Z. M. (2005). The National Strategy for Conservation of Biodiversity in the Kingdom of Saudi Arabia. The National Commission for Wildlife Conservation and Development, Conservation of Biological Diversity, Riyadh, Saudi Arabia.

Affolter, R., & Krass, B. (June 2019b). Soiling Rate Measurement Report: Al Kahafah, Kingdom of Saudi Arabia (12-Month Summary for May 2018 - April 2019). CSP Services.

Albugami, S., Palmer, S., Cinnamon, J., & Meersmans, J. (2019). Spatial and Temporal Variations in the Incidence of Dust Storms in Saudi Arabia Revealed from In Situ Observations. Geosciences, 9(4), 162. https://doi.org/10.3390/geosciences9040162

Alghamdi, A., Mseddi, K., Abdelgadir, M., & Sharawy, S. (2020). Inaccessible Zones Of Jabal Salma, Ha'il Region In Saudi Arabia: A Reservoir For Native Seed Species. Journal of Experimental Biology and Agricultural Sciences, 6(3), 572-581.

Arab Company for Laboratories and Soil (2021): Preliminary Geotechnical Site Investigation for Al Kahfah Solar Energy Park. June 2021.

BirdLife Data Zone. http://datazone.birdlife.org/country/saudi-arabia

BirdLife International (2021) Important Bird Areas factsheet: Jabal Aja and Northern Ha'il. Downloaded from http://www.birdlife.org on 07/02/2021.

Chowdhury, S., & Al-Zahrani, M. (2015). Characterizing water resources and trends of sector wise water consumptions in Saudi Arabia. Journal of King Saud University-Engineering Sciences, 27(1), 68-82.

Cox, N.A., Mallon, D., Bowles, P., Els, J. and Tognelli, M.F. (compilers). (2012). the Conservation Status and Distribution of Reptiles of the Arabian Peninsula. Cambridge, UK and Gland, Switzerland: IUCN, and Sharjah, UAE: Environment and Protected Areas Authority.

Dabbagh, A. E., Al-Hinai, K. G., & Khan, M. A. (1997). Detection of sand-covered geologic features in the Arabian Peninsula using SIR-C/X-SAR data. Remote Sensing of Environment, 59(2), 375-382.

Deif, A., Al-Shijbi, Y., El-Hussain, I., Ezzelarab, M., & Mohamed, A. M. (2017). Compiling an earthquake catalogue for the Arabian Plate, Western Asia. Journal of Asian Earth Sciences, 147, 345-357.

Edgell, H. S. (2006). Arabian deserts: nature, origin and evolution. Springer Science & Business Media.

Hereher, M. E., Al-Shammari, A. M., & Abd Allah, S. E. (2012). Land cover classification of Ha'il—Saudi Arabia using remote sensing. International Journal of Geosciences, 3(02), 349.

Hereher, M. E. (2016). Synopsis of geo-environmental hazards in Ha'il region, Saudi Arabia using remote sensing. Environmental Earth Sciences, 75(3), 233.

IUCN 2021. The IUCN Red List of Threatened Species. Version 2020-3. <https://www.iucnredlist.org>

Joseph, J. I., Umoren, A. M., & Markson, I. (2016). Development of optimal site selection method for large scale solar photovoltaic power plant. *Mathematical and Software Engineering*, 2(2), 66-75.

Krass, B., & Affolter, R. (June 2019a). Site Assessment of Solar Resource: Al Kahfah, Kingdom of Saudi Arabia (12-Month Summary for May 2018 - April 2019). CSP Services.

Porter, R., & Aspinall, S. (2013): Birds of the Middle East. Bloomsbury Publishing. Print.

Vincent, P. (2008). Saudi Arabia: an environmental overview. CRC Press.

Worley (2021): Hydrological Assessment Al Kahfah Solar Energy Park. May 2021.

Worley (2021): Master Plan Al Kahfah Solar Energy Park. April 2021.

Worley (2021): Preliminary Site Assessment Report Al Kahfah Solar Energy Park. February 2021.

Worley (2021): Topographical Survey Al Kahfah Solar Energy Park. March 2021.

Zahran, H. M., Sokolov, V., Youssef, S. E. H., & Alraddadi, W. W. (2015). Preliminary probabilistic seismic hazard assessment for the Kingdom of Saudi Arabia based on combined areal source model: Monte Carlo approach and sensitivity analyses. *Soil Dynamics and Earthquake Engineering*, 77, 453-468.

Appendix B. Curriculum Vitae of Study Team



Jonathan O´Toole

Project Manager, Mechanical Engineer, Renewable Energy Specialist

Overview

Jonathan is a seasoned Mechanical Engineer specialising in renewable energy technologies. He has extensive and direct experience in Wind, PV, and Solar Thermal technologies; including project management and consulting, engineering review, construction supervision, Due Diligence, project development and feasibility studies. Jonathan also has experience in energy efficiency and off-grid projects and programs. He has specific on-site experience in construction, and has worked in Central America, Europe, United States and South Africa and extensively in the Middle East in various positions.

Areas of Expertise

- Wind; project management, performance modelling, O&M Supervision, site and resource assessments, construction, due diligence, feasibility studies.
- PV; sizing, design, site assessment, commercial viability installation, development and feasibility studies.
- Solar Thermal; basic engineering, modelling, financial and performance assessments, construction supervision, engineering review, feasibility studies.
- Co-generation and Energy Efficiency;
- Engineering and Design; basic, reviews, modelling, FEED
- Mechanical supervision, construction
- Project Management, HSE, Quality
- Energy Efficiency; studies and audits, government programs, commercial and industrial applications.
- Economic studies, financial assessments
- Off grid community power, small scale wind and PV systems

Relevant experience

Project Manager | Green Energy Study 200MW | Pertamina, Indonesia | 2021 |

Project Manager and technical lead for a Green Energy Study evaluating different technology options for a large refinery in the development stage with the objective to reduce operating costs and emissions intensity of the installation.

Project Manager | Pre-Development Studies for 9x PV Plants and 2x Wind Farms 10GW+ | Ministry of Energy, Saudi Arabia | 2017 - present |

Project Manager for the pre-development studies for 9 different PV parks and 2 wind farms in Saudi Arabia with proposed installation capacities between 30 MW and 4 GW. Services include site inspection, Master Planning, Environmental and Social Impact Assessment, permits and non-objection letters, Geotechnical, Topographical and Hydrological studies, and Basis of Design documents.

Project Manager | OE/PMC 10MW Wind Farm | KISR, Kuwait | 2015 - Current |

10 MW wind farm located at the Shagaya Renewable Energy Park in Kuwait. Project Manager for Owners Engineer contract with duties including engineering reviews, inspections, contractor coordination, HSE and quality compliance monitoring, general collusion between stakeholders, reporting, performance verification and O&M monitoring.

Project Manager | Medium Scale Rooftop PV Deployment and Market Study | QEWC, Qatar | 2019 |

Preliminary studies to identify various commercial and industrial locations for the deployment of Medium scale rooftop PV plants, 1MW+. Development of business case for preferred projects to determine feasibility of project and expected risks and returns. Final presentation.

Wind Lead | Bankable Feasibility Study 120 MW Wind Farm | Eleqtra, Mozambique | 2018 - Current |

Wind Lead for a large-scale wind farm feasibility study. This includes the responsibilities of initial site assessment, design and installation of 120 MW meteorological tower, data monitoring and assessment, as well as supporting the logistics, grid connection and ESIA studies.

Project Manager | Shagaya Phase III Feasibility Studies & RFP Package | KISR, Kuwait | 2017-Current |

Development of 3 Feasibility Studies for 100 MW Wind, 1,200 MW PV Plant, and a 200 MW CSP Plant Farm as part of Shagaya Renewable Energy Park in Kuwait. These projects will eventually be bid under and PPP program

Project Manager | Renewable Energy Options Study | Ergo Mining, South Africa | 2017

Development of a pre-feasibility study to assess different renewable energy options to replace the existing energy consumption from the grid. The study included the assessment of 30 MW PV plant, 30 MW wind farm, and the 50MW CSP plant.

Project Engineer | 70MW Molten Salt CSP, 70MW PV | Enerstar, Chile | 2015 - 2016 |

Multi-phase project involving the selection and development of a 70MW molten salt CSP plant with 70MW PV in the Atacama desert, Chile. Work responsibilities include:

- Pre-engineering for technology selection of 70MW CSP with salt HTF and 70 PV plant, including technology review, assessment and verification; financial and performance assessment for cost comparison between technologies;

- Front End Engineering and Design such as layout and heat and mass balances, to further develop the project and to contribute to environmental approvals;
- Heat supply studies; identifying and evaluating options to supply process heat to adjacent mine, including modelling and LCOE estimations.

Project Engineer | FEED and EIA Technical Study, 3 x 150MW CSP Tower & 100MW PV | SolarReserve, Chile | 2015 - 2016 |

Front end engineering technical study and EIA technical documentation, and preliminary works for a large three phase project in Chile each consisting of a 150MW Power Tower with salt storage and 100+MW of PV. Work responsibilities include:

- Preliminary engineering and drawings, site layout, heat and mass balance, water balance, process flow diagrams, technical descriptions, equipment lists
- EIA information including construction and operation emissions estimates, construction plan, traffic plan.

Mechanical Supervisor / Project Engineer | PMC 100MW CSP Trough, South Africa | Abengoa | 2012-2014

Owner Engineer 100MW Kaxu! Solar One (trough type).

Mechanical supervision of all site activities covering construction, commissioning, pressure testing, documentation and quality control, and safety aspects. Areas included water treatment plant, thermal energy storage, steam cycle, heat transfer fluid piping and equipment, steam turbine and auxiliary systems.

Engineering review and approvals of all project documentation related to mechanical systems.

Project Engineer, Mechanical | OE 100MW CSP Trough, 50 CSP Tower | Abengoa | 2013 - 2014

Owner Engineer Solar Thermal Power Plants (100MW trough and 50MW central receiver type).

Engineering review and approvals of all project documentation related to mechanical systems, such as power block and solar field. Review and approval of technical documentation and variation proposals. Project management support and team alignment.

Carbon & Energy Engineer | Energy Reduction Plan | Queensland Urban Utilities | 2012

Identification and analysis of the potential energy reduction opportunities with a focus to reduce energy expenditure. Development of recommendations to support and achieve savings. Over $1M of opportunities were identified and assessed, including optimising pumping performance and reducing the demand on the aeration blowers.

Technical Analyst | NSW Energy Saving Scheme, Australia | IPART | 2011

Review of applications of projects under the Energy Efficiency Scheme, development of the scheme's processes and documentation, providing technical expertise in the area of energy efficient lighting, providing advice to applicants and potential applicants of how best to create Energy Savings Certificate and how to meet the scheme's requirements

Project Researcher | Alaska Centre for Energy & Power, USA | 2010 - 2011

Ground Source Heat Pump Assessment – Conducting state funded research to analyse the viability of ground-source heat pumps in the state of Alaska as a high energy efficient heating system. Tasks included liaising with manufacturers, installers and designers, looking into the viability and differences of the technology as well as an in-depth literature review focusing on cold climate applications and financial analysis to determine economic feasibility.

Technical Manager | BlueEnergy, Nicaragua | 2008 - 2010

Hybrid Energy System, Cajunicuil – Completed all stages to install a hybrid wind and PV solar system for a small and remote community for the applications of water pumping and mini-grid. Tasks included wind studies, load planning and efficiency measures, material acquisition and construction, project planning, installation, reporting and maintenance.

Wind Turbine Development – Worked to develop 12' diameter turbine (prototype for a 14'). Tasks included CAD technical drawings, lab and onsite testing, data collection and analysis, material selection.

Junior Engineer | SnowyHydro, Australia | 2006 - 2007

Internship with SnowyHydro power scheme working on numerous projects.

Qualifications

- Bachelor of Mechanical Engineering, University of New South Wales, 2008, 1st Class Honours
- Graduate Diploma of Economics, University of New England, 2016

Work history

2015 to Current	Project Manager, Worley, Spain
2013 to 2014	Mechanical Engineer / Supervisor, WorleyParsons, South Africa
2011 to 2013	Carbon & Energy Engineer, WorleyParsons, Australia
2010 to 2011	Project Researcher, Alaska Centre for Energy & Power, USA
2008 to 2011	Technical Manager, BlueEnergy, Nicaragua
2006 to 2007	SnowyHydro, Australia



Ihab El-Sersy

Environmental Country Manager / Practice Lead, Environment and Society, SEMEA

Advisian Location Lead – Egypt, BSc, MSc, PMP

Overview

Eng. Ihab El-Sersy is an environmental management consultant with 25 years of experience managing environmental projects including ESHIA for oil & gas, petrochemicals, and industrial sectors; environmental and energy audits; cleaner production/pollution prevention assessments; solid and hazardous waste management; and environmental training. He has gained specific experience in interpreting large data sets and has designed and implemented environmental and social monitoring programs (construction, commissioning and start-up, performance testing, and operation) and management plans for onshore/offshore facilities in Africa and the Middle East. He has also managed several field activities in the region and supervised the implementation of Health, Safety, Security and Environment (HSSE) plans for these projects. As project manager, he provided environmental consultancy for major clients to assure compliance with national regulations and international lenders' (World Bank, IFC, Equator Principles, EIB, EBRD, US EX-IM, JBIC, and others) environmental and social requirements.

Ihab technical focus has been on environmental permitting for new sites in complex settings, e.g., Strategic Environmental Assessments (SEAs), ESHIAs, ESH management and monitoring, and due diligence for projects such as onshore upstream oil and gas, power plants and petrochemical industries. His experience also included environmental investigation (Phase I), as well as environmental risk assessment.

He has participated in the preparatory work for the Privatization of the Integrated Solid Waste Management (ISWM) Projects, and the evaluation of the privatization practices and activities in several governorates/donor agencies including waste Strategy and Policy, Waste Implementation Plans, Hazardous Waste Management, Waste Treatment Technology Assessment, and ESIA studies. He has designed, developed and delivered several environmental training courses, seminars and workshops for different organizations.

He has also gained overseas experience in several environmental projects within Africa (Algeria, Ethiopia, Libya, Sudan and Uganda), the Gulf Cooperation Council (GCC) states (Bahrain, Qatar, Saudi Arabia and the United Arab Emirates), and the Middle East (Iraq, and Yemen) and is well versed with the regulatory process and the importance of close liaison with key stakeholders. He is fluent in English, French and Arabic languages.

Areas of Expertise

- Environmental, Social and Health Impact Assessment (ESHIA)
- Environmental & Social Monitoring Program
- Environmental and Social Management Plan (ESMP)
- Environmental and Social Due Diligence (ESDD)
- Contaminated Sites Assessment
- Stakeholders Engagement Plan
- Public Consultation and Disclosure
- Environmental Regulatory Compliance
- Solid Waste Management
- Sustainability Reporting

Relevant experience

Environmental, Social and Health Impact Assessment (EIA, ESIA, ESHIA)

Duties included but were not limited to: Project Management, Impact Assessment, Alternatives Assessment, Environmental and Social Baseline Survey (ESBS), Public Consultation and Disclosure, and Management Plans. Key projects (partial list):

- Scoped EIA and Environmental Screening (Form B) studies (60+) for Onshore (Delta Region) and Offshore (Mediterranean Sea) activities, Egypt, BP Exploration (Delta) Ltd., 2007-2021
- ESHIA and Baseline Studies Service for ENI Offshore and Onshore Activities, Egypt, Ieoc Production B.V., 2020-2022
- ESHIA for EHC Plant Expansion Project – Ammonia Production Unit, Egypt, Egypt Hydrocarbons Cooperation (EHC), 2020
- Preliminary Environmental and Social Impact - Feasibility Study for Damietta Polyoxymethylene (POM) Petrochemicals Plant, USTDA Funded Project, Egypt, The Egyptian Petrochemicals Holding Company (ECHEM), 2020
- ESIA and Scoping reports for Al Henakiyah Concentrated Solar Power (CSP) / PV Solar Power Plant, KSA, Renewable Energy Project Development Office (REPDO), 2020
- ESIA and Scoping reports for Seven (7) Photovoltaic (PV) Park Projects in KSA, Ministry of Energy, Industry and Mineral Resources (MEIM) / Renewable Energy Project Development Office (REPDO), 2017-2020
- Expansion of Ammonia Plant, Addition of Wastewater Treatment Plant and Reuse of Effluent, Egypt Basic Industries Corporation (EBIC), 2020
- Environmental Screening (Form B), Ameeq-1X Exploratory Well – North Theka Offshore Concession, Egypt, Edison International S.P.A – Egypt Branch, 2019
- Health, Safety and Environmental Impact Assessment (HSEIA) for Updates for existing facilities, United Arab Emirates, ADOC, 2018-2019

- EIA and Scoping Reports for Compressed Natural Gas Station in Mesaieed Industrial City (MIC), Qatar, Qatar Petroleum (QP), 2019
- EIA and Scoping Reports for Compressed Natural Gas Station in Ras Laffan Industrial City (RLIC), Qatar, Qatar Petroleum (QP), 2019
- Community Health Impact Assessment Report – Phase 1 Scoping for Naphtha Cracker Complex, Egypt, Carbon Holdings Limited (CHL), 2018
- EIA for North Field Expansion - Drilling two data acquisition wells and six well head platforms (WHP)s off the coast of Qatar in the North Field region, QatarGas, 2018
- Scoped EIA for Production Optimization for Giza-Fayoum-Raven Onshore Gas Processing Facility, West Nile Delta (WND) Gas Development Project in Idku, Egypt, BP Exploration (Delta) Ltd., 2018
- EIA for Modifications of Co-Operating Petroleum Co. (CO-OP) Existing Jetty for ENPC/MOPCO Future Utilization in Damietta, Egypt, Egyptian Nitrogen Products Company (ENPC), 2016-2018
- Soil and Groundwater Baseline Assessment for El Matariya Onshore Concession, Egypt, BP Exploration (Delta) Ltd., 2017 – 2018
- EIA and Environmental Scoping Reports for Upgrade of Ethane Facilities - Ju'aymah NGL Fractionation (JNGLF) Plant, KSA, Jacobs Zate/Saudi Aramco, 2017
- EIA and Environmental Scoping Reports for Increase Pumping Capacity - Qatif, KSA, Jacobs Zate/Saudi Aramco, 2017
- ESIA and Environmental Baseline Survey (EBS) for Tarif Deep-1 Exploratory Drilling, North El Mahala Onshore Concession, NEMO Block 2, Egypt, TOTAL E&P Egypte, 2016-2017
- ESIA for Polypropylene Expansion Project in Sokhna, Egypt, Oriental Petrochemicals Company (OPC), 2016-2017
- Environmental and Social Impact Assessment and Offshore Environment Baseline Survey (EBS) for for Atoll Development Project, Egypt, Pharaonic Petroleum Company (PhPC), 2016-2017
- ESIA for the First Egyptian Nuclear Power Plant at El Dabaa, Egypt, Egyptian Nuclear Power Plant Authority (NPPA), 2017
- EIA Studies for Several Thermal Power Plants in Kingdom of Saudi Arabia, KSA, Saudi Electricity Company (SEC), 2014-2017
- As Built EIA Addendum for Ammonia Plant, Suez Industrial Zone, Egypt, Egyptian Basic Industries Corporation (EBIC), 2015-2016
- ESIA for Naphtha Cracker Complex in Ain Sokhna, Egypt, Tahrir Petrochemicals, 2012-2016
- Addendum EIA for Ammonium Nitrate Plant Project Expansion (Management of Surplus Nitric Acid) - Notification of Design Changes (As-Built Design) and Project Modifications, Egypt, Egypt Hydrocarbon Corporation (EHC), 2015
- Environment and Health Impact Assessment (EHIA) for Waste Management Sump Facility - South of Awali Field, Kingdom of Bahrain, Tatweer Petroleum (TP), 2014
- EIA study for Bahrain LNG Floating Terminal Project, Khalifa Bin Salman Port (KBSP), Kingdom of Bahrain, Nogaholding/Galway Group, 2014
- EIA studies for seven (7) offshore exploratory wells, Environmental and Socioeconomic Baseline Desktop study for North Red Sea Concession and Comprehensive Baseline Study and EIA for Safaga Shore Base, Egypt, HESS Egypt Exploration Limited (HEEL), 2009-2011

- EIA and Environmental Risk Assessment (ERA) for Offshore Exploratory Drilling well Kiwi-A1X, El Dabaa Offshore Concession, Egypt, Statoil Egypt El Dabaa Offshore AS, 2010
- Strategic Environmental and Social Impact Assessment study (SESIA) for Phosphatic Fertilizer Complex "Phase I" in Aswan, Egypt, Egyptian Company for Phosphatic and Compound Fertilizers (EgyPhos), 2009-2010
- Preliminary Environmental, Socio-Economic and Health Impact Assessment (ESHIA) and Bankable Feasibility Study (BFS) for Iron Ore deposits for Wadi Sawawin Project in Tabuk, KSA, London Mining Plc (LMP)/Saudi Arabian National Mining Company, 2009
- Preliminary Environmental Assessment (PEA) for a proposed Aromatics Complex Project in Sokhna, Egypt, Granherne/KBR, 2009
- ESIA for Hydrocracking Complex in Mostorod, Egypt, Egyptian Refining Company (ERC), 2008-2009
- Preliminary Environmental and Social Impact Assessment (PESIA) for Lead-Zinc Mine Development Project in Oued Amizour, Algeria, Terramin Australia Ltd / Western Mediterranean Zinc SpA (WMZ), 2007
- Environmental Baseline Study (EBS) for Warehouse and Storage Facility in Ras Laffan Industrial City, Qatar, Anadarko Qatar Energy Co. LLC, 2007
- Environmental Impact Statement (EIS) for Ammonia and Urea Facility in Industrial Zone of Arzew, Algeria, Orascom Construction Industries (OCI)/Sonatrach, 2006-2007
- EIA for Nitrogenous Project, Urea/Ammonia and Shipping Facilities in Damietta, Egypt, Egyptian Agrium Nitrogen Products Company (EAgrium), 2006-2007
- EIA for Methanol Facility in Damietta, Egypt, Egyptian Methanex Methanol Company S.A.E (EMethanex), 2006-2007
- Addendum EIA for a Bio-diesel production facility in Sokhna, Egypt, Sokhna Biodiesel Company, 2006
- Baseline Noise Assessment for LNG Facility in Idku, Egypt, Egyptian Liquefied Natural Gas (ELNG), 2006
- EIA for Underground Storage Facility of Liquefied Petroleum Gas (LPG) for LPG Filling Plant at Zeit Bay, Egypt, LIQUIGAZ, 1999

Environmental and Social Due Diligence

Key projects include but not limited to:

- Vendor Due Diligence (VDD) for Chemical Facility, Port Said, Egypt, Confidential Client, 2019
- Project Silver Ocean - Technical Due Diligence Reports for expanding client existing fertiliser business in Egypt and Algeria, ADNOC Group, 2018
- Environmental Due Diligence Phase I (Phase I Environmental Site Assessment), North El Mahala Onshore concession, NEMO Block 2, East Nile Delta, Egypt, Egypt, TOTAL, 2016
- Assessment of Produced Water Disposal Site for New Oil and Gas Development in West Nile Delta (WND) Project, Egypt, BP Exploration (Delta) Ltd., 2015-2016
- Environmental Assessment for BOOT Thermal Power Plants, Egypt, POWERTEK / Egyptian Operating Company, 2015

Environmental Regulatory Compliance

Duties comprised of identifying the applicable regulatory framework, environmental permitting process and planning. Key projects include but not limited to:

- Environmental and Infrastructure Permitting Roadmap, Oil and Gas Activities in the Egyptian Mediterranean Sea, Confidential Client, 2019-2020
- Environmental and Social Risks Identification, Oil and Gas Activities in the Egyptian Red Sea, Equinor, 2019
- Supplementary Environmental and Social Information Package (SESIP) for Naphtha Cracker Complex to satisfy compliance with IFC Performance Standards, Egypt, Tahrir Petrochemicals, 2018-2019
- Environmental Performance Standards: Gap Analysis, various asset locations/countries, CEPSA, 2018-2019
- EHS Legal Register for Benban Solar Photovoltaic (PV) Plant, Egypt, Alcazar Energy, 2019
- Update Permit and Government Regulations Requirements for Jubail 1 Cogeneration Project, KSA, Saudi Basic Industries Corporation (SABIC), 2017
- Environmental Impact Strategy and Early Environmental Permitting for New Gas Supply in Damietta LNG Plant, Egypt, Damietta, Confidential Client, 2015
- Review of Environmental Legislation compared with World Bank Group Standards, Algeria and Libya, RWE, 2007
- Environmental Legislation Review for Iran, Kazakhstan, KSA, Turkey, and United Arab Emirates, Global Environmental Forum (GEF), 2006
- Environmental, Health and Safety Compliance Assessment at Nile Kordsa Company, 10th of Ramadan Industrial City, Egypt, URS Cooperation Limited, 2005
- Environmental, Health and Safety Compliance Assessment at Alcoa Closure Systems International Factory in 6th of October Industrial City, Egypt, Alcoa International/EHS Group Europe, 2005
- Environmental, Health and Safety Compliance Assessment at Haarmann & Reimer Egypt S.A.E. (a Bayer Company), 6th of October City, Egypt, URS/Dames & Moore, 2002

Solid Waste Management Consultancy

Duties comprised of reviewing local legislation and client's requirements, identifying types and estimating quantities of the waste streams expected to be generated, presenting best practice for waste handling and management procedures, proposing waste minimization and reduction techniques, identifying available in-country waste facilities and assessing their suitability, and finally presenting a Best Practicable Environmental Option (BPEO). Key projects include but not limited to:

- Waste Management Plan (WMP) for Yamama Formation Development Project, West Qurna 2, Iraq, 2014 – 2015
- Waste Management Plan (WMP) for Site Preparation, Installation and Commissioning of Subsea Facilities and Pipelines, West Nile Delta (WND) Gas Development Project, Egypt, BP Exploration (Delta) Ltd., 2011
- Disposal Alternatives study for water-based mud and cuttings for North Shadwan Near Shoreline Project, North Shadwan Concession, Egypt, Gulf of Suez Petroleum Company (GUPCO), 2009

- National Solid Waste Management Consultant for the Integrated Solid Waste Management Project (ISWM) in the Governorate of Beni Suef, EMG Component, Egypt, EEAA-DANIDA Environmental Sector Program (ESP), 2005-2006
- Municipal Solid Waste Management Strategy, 10-year Implementation Plan and Demonstration Project for Damietta Governorate, Egypt, SEAM Programme, 2004
- Implementation work plan for the Infectious Solid Waste Management Services in the Southern Zone of Cairo Governorate, Egypt, 2004
- Technical, Environmental, Market and Economic Feasibility Study financed by EEIF/CIDA for the new textile waste recycling plant at new Damietta Industrial City, Egypt, El-Deeb Company, 2004
- Solid Waste Management Consultant for the preparation of National Report of Egypt, Five Case Studies for SWM in Egypt, and the ToR for the National Activity "Study for Solid Waste Recycling Sector in Egypt" for the Regional SWM Project, Egypt, Mediterranean Environmental Technical Assistance Program (METAP), 2003
- Technical and Economic Feasibility Study for Sustainable Management of Municipal, Agriculture and Health Care Solid Waste in Egypt, Arab Office for Youth and Environment (AOYE), 2003
- Operation Study and Work Plans for the Health Care Waste Management Services at the Western Zone of Cairo Governorate, Egypt, ENSER, 2003
- SWM Performance Indicators Study for the Monitoring, Verification and Evaluation Unit (MVE) of the Egyptian Environmental Policy Program (EEPP), USAID, Egypt, 2001
- Pre-Feasibility Study financed by KfW for the Hazardous Industrial Waste Management in 10th of Ramadan City, Egypt, 2001
- Technical & Commercial proposal for the "Alexandria General Cleanliness Project", Egypt, ONYX CGEA, 2000

Contaminated Sites Assessment

Key projects include but not limited to:

- Soil and Groundwater Assessment for Site A – Phase 1 Assessment, BP West Nile Delta Gas Development Project in Idku, Egypt, Bechtel Egypt S.A.E, 2019
- Soil and Groundwater Assessment - Phase 1 for Oriental Petrochemicals Company (OPC) Facility in Ain Sohkna, Egypt, Carbon Holdings Limited (CHL), 2018-2019
- Phase I and Phase II Environmental Site Assessment Studies (soil and groundwater baseline assessment) for Giza-Fayoum Plant in Idku, Egypt, BP Exploration (Delta) Ltd., 2016-2017
- Site Supervision for underground survey, geotechnical and soil contamination investigations, Project Management Consultant (PMC), Egypt, Egyptian Refining Company (ERC), 2012-2013
- Phase I Environmental Site Assessments of Halliburton Camps, Libya, Tetra Tech EM Inc., 2005

Environmental Monitoring Program (EMP)

Duties comprised of Project Management and Customer Interface Management including designing and managing monitoring activities, technical direction to the field activities and Peer Review of monitoring round and comprehensive reports. Key projects include but not limited to:

- Environmental Monitoring Services for BP West Nile Delta Gas Development Project in Idku, Egypt, Bechtel Egypt S.A.E, 2016 - 2019
- Environmental Monitoring Services for Tarif Deep-1 Environmental Monitoring Services Drilling and Testing Phase for North El Mahala Onshore concession, Egypt, TOTAL E&P Egypte (TEPE), 2017
- Environmental Monitoring Services for KIMA Project in Aswan, Egypt, Tecnimont S.P.A. Egypt Branch, 2016
- Environmental Construction Monitoring Program for Ammonium Nitrate Plant, Ain Sokhna, Suez, Egypt, Egypt Hydrocarbon Corporation (EHC), 2012-2014
- Environmental Monitoring Program for Operation of Methanol Facility, Damietta, Egypt, Egyptian Methanex Methanol Company S.A.E (EMethanex), 2011-2012
- Environmental Monitoring for Indoor Air Quality and Wastewater Quality at R&D Laboratory, Egypt, Henkel, 2012
- Environmental Monitoring Program for construction, commissioning and performance testing for Methanol Plant in Damietta, Egypt, TECHINT Engineering & Construction, 2008–2011
- Environmental Pre-commissioning Monitoring for Onshore facilities in Sokhna, Egypt, Egyptian Basic Industries Corporation (EBIC), 2008
- Environmental Operational Monitoring Program for onshore/offshore facilities for Liquefied Natural Gas (LNG) Facility in Damietta, Egypt, Spanish Egyptian Gas Company (SEGAS), 2006-2009

Environmental and Social Management Plan (ESMP)

Duties comprised of developing the environmental and social management plans / frameworks during construction and operation phases. Key projects include but not limited to:

- Construction Environmental Management Plan (CEMP): North Field Expansion, QatarGas, 2018
- Construction Environmental Management Plan (CEMP) including Waste Management Plan for Phase 1- of the Diversion of ONSAG from Dukhan to Mesaieed through existing Khuff Gas Pipeline Project, Qatar, Doha Petroleum Construction Co. W.L.L. (DOPET), 2017
- Environmental and Social Management Plan (ESMP) for Polypropylene Expansion Project in Sokhna, Egypt, Oriental Petrochemicals Company (OPC), 2016-2017
- Environmental and Social management Plan (ESMP) for Yamama Formation Development Project, West Qurna 2, Iraq, 2014 – 2015
- Construction Emergency Response Plan (CERP)/Construction Environmental Management Plan (CEMP)/EIA for the Expansion of the Fujairah Navy Base Project, Fujairah, United Arab Emirates, China Harbour Engineering Company Ltd. (CHEC), 2014
- Operational Plan for Waste Management Sump Facility - South of Awali Field, Kingdom of Bahrain, Tatweer Petroleum (TP), 2014
- Construction Environmental Management Plan (CEMP) for Nitrogenous Project, Urea/Ammonia and Shipping Facilities in Damietta, Egypt, EAgrium, 2007

Stakeholders Engagement Plan / Public Consultation and Disclosure

Duties include but are not limited to developing Stakeholders Engagement Plan/Framework, preparing and chairing Public Consultation Sessions, as well as stakeholder groups' identification and ranking. Key recent projects include:

- Updated Stakeholder Engagement Plan (SEP) for Tahrir Petrochemicals Complex (TPC), Egypt, Carbon Holdings Limited (CHL), 2018-2019
- Public Hearing Session for BP West Nile Delta Gas Development Project in Idku, Egypt, BP Exploration (Delta) Ltd., 2018
- Public Hearing Session for the First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, Egyptian Nuclear Power Plant Authority (NPPA), 2017
- Public Hearing Session for Atoll Development Project, Phase-1 (Offshore Scope), PhPC, Egypt, 2017

Sustainability Reporting

Duties comprised of managing sustainability reporting following GRI Guidelines and other applicable guidelines. Key projects include but not limited to:

- Annual Sustainability Reports (2015, 2017, 2018, 2019), UAE, Borouge
- Annual Sustainability Report (2013 and 2014), United Arab Emirates, Abu Dhabi Company for Onshore Petroleum Operations Ltd. (ADCO), 2014-2015
- Annual Sustainability Report (2013 and 2014), United Arab Emirates, Zakum Development Company (ZADCO), 2014-2015

Other Studies

- Kingfisher Field Detailed Oil Spill Risk Assessment (OSRA) and Oil Spill Contingency Plan (OSCP), Lake Albert, Western Uganda, CNOOC, 2017-2018
- Oil Spill Trajectory Modelling (OSTM) Review and OSCP, Mocha-1 Onshore Exploration Well, El Matariya Concession (Block 3), Nile Delta, Egypt, BP Egypt, 2016-2017
- Spill Response Philosophy, FEED, Yamama Formation Development West Qurna 2, Iraq, LMEL, 2014
- Desk Review for Environmental and Social Sensitivity Indicators, West El Manzala and West Qantara Onshore Concessions, Nile Delta, Egypt, BP Egypt, 2012
- E&S Sensitivity Mapping Data Acquisition/Presentation, Egyptian Mediterranean, BP Egypt, 2012

Qualifications / Affiliations

Education

- Professional Program in Project Management, Engineering and Science Services, The American University in Cairo (AUC), 2011
- MSc. in Chemical Engineering, Faculty of Engineering, Cairo University, 2009

- Thesis Title: "Maximize Methane Yield in Landfill Gas to Enhance Economic Feasibility for Energy Utilization in Egypt"
- Professional Program in Environmental Engineering, Engineering and Science Services, The American University in Cairo, Egypt, 1998
- BSc. in Chemical Engineering, Faculty of Engineering, Cairo University, 1994
- Secondary Certificate - Science Section, French Division, Collège De La Salle, El-Daher, Cairo, 1989

Affiliations

- Environmental Consultant (Registration No. 93/30/12/2015) at the Egyptian Environmental Affairs Agency (EEAA) for these consultancy areas:
- Environmental Impact Assessment development and review;
- Wastes and Chemicals Management; and
- Hazardous Material and Waste Management
- Certified Project Management Professional (PMP) at the Project Management Institute (PMI) - License No. 1413472, May 2011
- Egyptian Syndicate of Engineers (ESE) - 1994
- Egyptian Society for Water Environment Affairs (ESWEA)
- Egyptian Project Management Society (EPMS)

Specific Technical Expertise/Specialist Courses

Circular Economy and Climate Change Resilience

- Considering Greenhouse Gas Emissions in Environmental Impact Assessment, Institute of Environmental Management and Assessment (IEMA – UK), Webinar, August 2020
- Circular Economy in Practice: Designing out Waste – How to embed CE Principles at the outset of Building Construction Projects, IEMA – UK, Webinar, August 2020
- Circular Economy 101: An Introduction to Sustainable Resource and Waste Management, IEMA – UK, Webinar, August 2020
- Capacity Building on Monitoring Reporting and Verification (MRV) National Greenhouse Gas (GHG) Emissions and Actions in Developing Countries – MRV of Mitigation Actions in Egypt, May 2017
- Capacity Building on Monitoring Reporting and Verification (MRV) National Greenhouse Gas (GHG) Emissions and Actions in Developing Countries – GHG Inventory Workshop, NIRAS Denmark / Ministry of Environment, Egypt, February 2017

Special Professional Topics

- Training Sessions for Customer Success Platform (CSP) License Users powered by Worley Salesforce, Abu Dhabi, The United Arab Emirates (UAE), January 2020
- Site Health Considerations Workshop, International SOS, Egypt, 2018

- Building Lasting Company – Community Relations Workshop, International Finance Corporation (IFC) in collaboration with Egyptian Refining Company (ERC), Egypt, December 2013
- LEED 201: Core Concepts and Strategies, The U.S. Green Building Council and The American University in Cairo (AUC), Egypt, November 2011

Project Management Professional

- Risk Management: PRMG-095, Engineering and Science Services (ESS), The American University in Cairo (AUC), September – December 2013
- Project Delivery - The WorleyParsons Way, August 2013
- WorleyParsons Project Management Training Program (WPMP) – Risk Workshop Facilitator Refreshment Training, April 2013
- WPMP – Module 3: Project Risk Management, Refreshment Course, April 2013
- Certified Cost Consultant / Certified Cost Engineer "CCC/CCE" (Preparation Course): PRMG-090, ESS, AUC, February - May 2011
- The 36-hour Project Management Professional (PMP) Preparation Course: PM3002, Amideast, February – March 2011
- Project Budgeting and Financial Control: PRMG-030, ESS, AUC, September 2010 – January 2011
- Project Bids and Contracts: PRMG-080, ESS, AUC, September 2010 – January 2011
- Project Feasibility Studies: PRMG-050, ESS, AUC, February - May 2010
- Value Analysis for Engineering Project: PRMG-099, ESS, AUC, September 2009 – January 2010
- Management of Project Resources: PRMG-020, ESS, AUC, June - July 2009
- WPMP– Risk Workshop Facilitator Training, June 2009
- WPMP– Module 3: Project Risk Management, June 2009
- WPMP– Module 1: Project Initiation, Scope Management and Project Close-out, October 2008
- WPMP– Module 0: Introduction to Project Management, October 2008
- Project Planning and Control Techniques: PRMG-010, ESS, AUC, September 2007 – January 2008
- WorleyParsons' Enterprise Management System and WorleyParsons' Project Management Process –Introduction to EMS and WPMP V3, Abu Dhabi – UAE, March 2007

Environmental Engineering & Management Systems

- Introductory Seminar: Environmental & Social Risk Analysis (ESRA), UNEP Finance Initiative/Central Bank of Egypt – Egyptian Banking Institute in collaboration with GIZ/PAGE, Egypt, November 2017
- Capacity Building Workshop for Environmental & Social Advisors in Post Conflict Countries, International Finance Corporation (IFC) / Wardell Armstrong, Amman, Jordan, July 2017
- Capacity Building Workshop for Local Consultants on Environmental, Health & Safety and Social (EHSS) Policies, Procedures and Due Diligence Requirements, The European Bank for Reconstruction and Development (EBRD) and Environmental Resources Management (ERM), Cairo, December 2016
- Environmental Impact Assessment (EIA) Workshop, Bristol - UK, March 2006

- Effluent Management, Water Environment Federation (WEF) / Egyptian Society for Water Environment Affairs (ESWEA), March – April 1998
- Environmental Management: EVEN-003, AUC, February - May 1998
- Environmental Systems and Processes: EVEN-002, AUC, September 1997 – January 1998
- Pollution Prevention and Waste Minimization: EVEN-019, AUC, September 1997 – January 1998
- Design and Operation of Water Treatment Plant: EVEN-017, AUC, September 1997 – January 1998
- Environmental Management Systems (EMS) Implementation: Safety, Environment and Quality Management (SEQM) - UK, October 1997
- Introduction to Environmental Management Systems (EMS); Safety, Environment and Quality Management (SEQM) - UK, October 1997
- Advanced Environmental Management Systems (EMS) Auditor Course, Excel Partnership - UK, June-July 1997
- Introduction to Environmental Engineering: EVEN-001, AUC, January - May 1997
- Environmental Impact Assessment and Environmental Auditing: EVEN-014, Department of Engineering – Engineering Services, The American University in Cairo (AUC), January - May 1997

Languages

- ARABIC: Mother tongue
- ENGLISH: Fluent spoken and written
- FRENCH: Fluent spoken and written

Publications / Presentations

- Ihab El Sersy, Asmaa S Hamouda, Nabil Abdelmonem, Shadia Elshishini and Ibrahim Ismail (2018). Estimation of Landfill Gases in Egypt-1 – Evaluation and Validation of Different Models. The 4th International Conference on Advanced Applied Sciences. The IOP Conference Series: Materials Science and Engineering
- N. ABDELMONEM, I. EL SERSY, S. ELSHISHINI AND I. ISMAIL (2014). Estimation of Landfill Gases in Egypt-1 – Evaluation and Validation of Different Models. The Fifth International Symposium on Energy from Biomass and Waste, San Servolo, Venice, Italy; 17 - 20 November 2014

Work history

2015 - Present	Environmental Country Manager / Practice Lead – Advisian, WorleyParsons Group, Egypt
2006 - 2015	Project Manager & Location Proposals Coordinator – WorleyParsons, Egypt
1999 - 2006	Senior Environmental Specialist - EcoConServ Environmental Solutions, Egypt
1998 - 1998	Environmental Specialist, Auditing Team, Ministry of State for Environmental Affairs/ Minister Office / Policy Support Unit, Cairo, Egypt

1996 - 1998	Environmental Engineer and Textile Sector Coordinator, Hagler Bailly Consulting Inc., Environmental Pollution Prevention Project (EP3), USAID Cairo, Egypt
1996 - 1996	Technical Representative, Selim International, Cairo, Egypt
1994 - 1995	Process Engineer, Member of the R&D Department, Technopack, Modern Packaging Products Co., 6th of October City, Egypt

JACOBS
DCSA Saudi Arabia Co. Ltd



Eddie Bradbrook

Director of Environment and Sustainability Services

Eddie Bradbrook is a dynamic and adaptable discipline lead with over 20 years professional experience in environmental and social risk management; the last 8 years within the Kingdom of Saudi Arabia. Subject matter expert with reputation for driving environmental improvement, managing liabilities on behalf of clients and implementing sustainable solutions. He has a track record of maximizing the environmental and sustainability performance of projects during planning and execution and assisting clients to successfully attain their corporate environment and sustainability goals. Multi-sector experience in oil and gas, petrochemical, renewable energy, buildings and infrastructure markets.

Eddie has extensive experience of conducting and managing ESIA and environmental permitting for Type I facilities under the jurisdiction of the Royal Commission; including petrochemical facilities (e.g. SADARA, YANSAB, INEOS) and greenfield projects (e.g. InoChem). He has also delivered bankable ESIA projects in the Kingdom of Saudi Arabia to International Finance Corporation and World Bank standards; including liaison and consultation with lenders advisors.

Areas of Expertise

- Environmental and Social Impact Assessment
- Environmental Permitting
- Environmental Compliance Auditing and Environmental Due Diligence
- Project Management
- Construction Environmental Management

Relevant Project Experience - Royal Commission Environmental Regulations 2015, Environmental Permitting

Saudi Aramco, Yanbu Refinery Sulfur Recovery Project

Start Date: August 2020

End Date: Ongoing

Role: Environment Manager

The Yanbu Refinery SRU upgrade project is designed to meet GAMEP source emission standards limiting SO2 emissions to 400 mg/Nm3 for a degraded airshed. %. In order to achieve compliance with the GAMEP regulations, the two SRU trains will be upgraded with a Tail Gas Treatment Unit (TGTU) and associated degassing infrastructure to achieve 99.9+% sulfur recovery efficiency.

Eddie is the Environment Manager for this project, liaising with the engineering disciplines and coordinating a multi-disciplined environmental team to deliver the ESIA to Saudi Aramco and Royal Commission standards. The project scope includes the preparation of a

EDUCATION/QUALIFICATIONS

BSc Marine and Freshwater Biology, Queen Mary and Westfield College,

M.Sc. Aquatic Resource Management, Kings College, London.

Diploma Business Management, Aston Business School

ISO 14001:2015 Lead Auditor

Chartered Environmentalist (CEnv)

Full Member of Institute of Ecology and Environmental Management

OTHER

- Office location – Al Khobar, Saudi Arabia
- Nationality - British

Eddie Bradbrook

new Permit Application Package in accordance with RCER 2015. The Royal Commission has confirmed that this is a Type I Facility.

InoChem, Soda Ash and Calcium Chloride Plant, ESIA

Start Date: June 2019

End Date: Ongoing

Role: Project Manager

Eddie is the project manager responsible for the production of the Environmental and Social Impact Assessment for the Khair Inorganic Chemical Industries Co. (InoChem) soda ash and calcium chloride plant in the Royal Commission Industrial City of Ras Al-Khair. Following consultation with the Royal Commission, the new facility has been categorized as a Type I Facility.

The new plant occupies a total area of 800,000 square meters and once operational, will be capable of producing 300,000 tons of soda ash and 300,000 tons of calcium chloride per annum. The ESIA has been prepared in compliance with the Royal Commission Environmental Regulations 2015 and the lending requirements of Saudi investors.

InoChem, Soda Ash and Calcium Chloride Plant, Environmental PMC

Start Date: August 2019

End Date: Ongoing

Role: Environmental Consultant

Eddie is the environmental consultant for Jacobs DSCA, the Project Management Consultant working on behalf of the Project Proponent Khair Inorganic Chemical Industries Co. (InoChem). He is responsible for providing technical environmental support to the project proponent and the Detailed Design consultant based in China (i.e. Chenga) to ensure compliance with the Royal Commission's Environmental Regulations 2015 and the commitments and obligations specified in the project's Environmental and Social Impact Assessment.

The new facility has been categorized as a Type I Facility. Eddie is responsible for ensuring all engineering deliverables, including the Permit Application Package, meet the requirements of the Royal Commission for this Type of facility. This included the detailed review of PFDs and P&IDs to ensure all emission sources are identified and included within emission inventories for the project; and that all emissions and control equipment achieve emission limits set by the Royal Commission.

SADARA, Ethylene Oxide / Propylene Oxide Pipelines Air Dispersion Study

Start Date: August 2019

End Date: December 2019

Role: Project Manager

Eddie Bradbrook

Sadara Chemical Company (SADARA) located within the Jubail Industrial City 2 proposes to construct two pipelines (approximately seven kilometers in length) with associated facilities in order to transport ethylene oxide (EO) and propylene oxide (PO) from the SADARA plant to the proposed Royal Commission (RC) Value Park located to the north of the SADARA plant.

Eddie project managed an air dispersion modelling study on behalf of SADARA to assess the potential impact of fugitive emissions from the pipelines under normal conditions. Dispersion modelling was also carried out to assess the potential impact of a very unlikely abnormal scenario to represent a pipeline leak or rupture under abnormal conditions (Abnormal Scenario EO and Abnormal Scenario PO).

Marafiq, Solar Energy Park

Start Date: July 2019

End Date: October 2019

Role: Project Manager

The Royal Commission of Jubail & Yanbu (RC-Y), Saudi Basic Industries Corporation (SABIC) and the Power and Water Utility Companies of Jubail and Yanbu (MARAFIQ) intend to generate renewable energy by developing a solar energy power plant of 200 - 400MW installed capacity.

This power plant will be constructed within Yanbu Industrial City. The generated power will be utilized by SABIC, allowing the company to reduce its emissions of Greenhouse Gases (GHG). This is aligned with the National Transformation Program 2020 and the 2030 Vision within the Kingdom of Saudi Arabia.

Eddie project managed the development of a technical and feasibility study for the solar energy plant. This includes a Preliminary Environmental and Social Impact Assessment (PESIA). The PESIA is seen as a critically important activity and qualitatively evaluates the potential environmental and social impacts of the proposed development and identify if there are any significant constraints that may preclude the installation of a solar energy plant in this location.

SATORP, Environmental Impact Assessment Update

Start Date: March 2019

End Date: July 2019

Role: Project Manager

SATORP has an operational target to increase refining capacity from 400,000 BPSD (Barrel Per Stream Day) as-designed and currently permitted, to 460,000 BPSD. This represents an increase in production capacity of 115%. Capacity has incrementally increased up to 440,000 BPSD but the increase to 460,000 BPSD will be achieved and consolidated by the Plant Load Increase project.

The current operational facility has a valid Environmental Permit to Operate (EPO) (2/44-

Eddie Bradbrook

376) but it has been ascertained during consultation with the Royal Commission of Jubail that a revised permit is required to cover the increase in production capacity.

Eddie project managed the review and update of the existing ESIA prepared in 2009, confirmed as a Type I Facility.

The main objective of the ESIA Update was to demonstrate that the increase in production capacity will not generate any new environmental and / or social impacts of significance, over and above those previously assessed during the development of the engineering design; and confirm the current status of the Environmental Permit Application Package and details of the revised PAP forms prepared and submitted by SATORP. This required managing a complex air dispersion modelling assessment, including the development of emission inventories.

SADARA, Ethylene Oxide / Propylene Oxide Pipeline, Jubail, Saudi Arabia

Start Date: January 2016

End Date: July 2016

Role: Environmental Specialist

Sadara Chemical Company (SADARA) located within the Jubail Industrial City 2 proposes to construct two pipelines (approximately seven kilometers in length) with associated facilities in order to transport ethylene oxide (EO) and propylene oxide (PO) from the SADARA plant to the proposed Royal Commission (RC) Value Park located to the north of the SADARA plant.

Eddie provided technical environmental leadership during the development of the ESIA, including the design and execution of field surveys, the preparation of environmental deliverables and technical review of the Permit Application Package and Best Available Techniques (BAT) assessment.

This is a Type I facility and the ESIA required detailed site surveys and modelling to achieve compliance with the requirements of the Royal Commission Environmental Regulations 2015.

YANSAB Ethylene Glycol De-Bottlenecking Project, Yanbu, Saudi Arabia

Start Date: November 2015

End Date: May 2016

Role: Environmental Technical Lead

The objective of the Project was to increase the Ethylene Oxide reactor production capacity from 548,510 metric tons per year (mtpy) to 767,919 mtpy with an increase of 40 percent over the original production capacity.

The existing fiber grade mono-ethylene glycol (MEG) production capacity was also increased from 700,000 mtpy to a range from 919,500 – 974,000 mtpy based on different operational cases, which is equivalent to a 32-40% of production capacity increase.

Eddie Bradbrook

Eddie project managed the delivery of the environmental deliverables which included an ESIA for a Type I facility, Permit Application Package, Sustainability and Life Cycle Analysis calculations, preparing and managing an Environmental Risk Identification Register (ENVID), developing Emissions Inventories and planning all site investigations including noise sampling and air quality monitoring.

Relevant Project Experience – Bankable ESIA & Studies (i.e. IFC / World Bank Compliant) & Interface with Lenders Advisor

PetroRabigh, Bottom of the Barrel

Start Date: July 2019

End Date: September 2019

Role: Project Manager

Aramco Overseas Company B.V and Sumitomo Chemical Co. Ltd. acting as a joint venture will undertake the expansion of facilities at the PetroRabigh Refinery / Petrochemical complex in the Kingdom of Saudi Arabia. This includes the addition of a 'Bottom of the Barrel' (BOTB) complex with the aim of increasing higher value streams for further blending and processing.

Eddie project managed the preparation of the Environmental Basis of Design document for the project. This document provides an overview of the environmental legislation and guidance which govern the development of the Project, including international requirements such as the International Finance Corporation (IFC) and the World Bank.

Confidential Chemical Company, Feasibility Study

Start Date: April 2019

End Date: May 2019

Role: Environment Manager

Saudi Aramco and Total Refining & Petrochemical Company (SATORP) intend to build a mixed feed cracker as part of the Al Jubail Refinery expansion in the Industrial City of Jubail. This development will support the Saudi Vision 2030 initiative in the Kingdom to diversify its economy, specifically the integration of downstream derivatives. This facility is classified as a Type I Facility.

The Investor (i.e. Confidential) proposes to utilize the ethylene from the mixed-feed cracker. The ethylene will be valorized by constructing a 420 kTa Linear Alpha Olefin (LAO) Unit and an 85 kTa Poly-Alpha Olefin (PAO) Unit. The downstream derivatives produced will be exported through King Fahad Industrial Port in Jubail.

As a new investor in the Kingdom, and potentially sourcing funding from international lenders, understanding the environmental assessment and permitting requirements of the Royal Commission is a critical component in achieving project success.

Eddie led the development of a clear and transparent permitting strategy that will

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facilitate the timely and efficient issuance of the required environmental permits for Project Neptune from the regulator. This included the identification of the relevant emission standards for both the Royal Commission and international lenders (e.g. IFC / World Bank).

Ministry of Energy, National Renewable Energy Program, Dumat al Jandal Wind Energy Park

Start Date: September 2016

End Date: October 2017

Role: Project Manager

Eddie was the project manager for the Environmental Consultancy Services contract delivering a bankable Environmental and Social Impact Assessment (ESIA) and environmental permitting for the Kingdom of Saudi Arabia's Round 1 projects of the National Renewable Energy Program (NREP).

The Dumat Al Jandal Wind Energy Park will use wind technology on an area of approximately 71 km^2 and is expected to have a total installed capacity of approximately 400 Mega-Watt (MW). The Park consists of a wind power plant, including up to 130 wind turbine generators (WTGs) with a maximum height of up to 175 meters (m), and an associated grid interconnection, including a medium voltage/high voltage (MV/HV) sub-station and HV overhead lines connecting the sub-station to the electrical transmission system owned by the Saudi Electricity Company (SEC).

When fully implemented the Park is expected to generate approximately 1100 Giga-Watt hours (GWh) per annum, displacing 2,000 Thousand Barrels of Oil Equivalent (MBOE) of hydrocarbons per annum and 800 Thousand tons (Mt) of CO2 per annum.

The development of the ESIA required working with the Lender's Advisor to ensure legal compliance with national and international environmental obligations.

Ministry of Energy, National Renewable Energy Program, Midyan Wind Energy Park

Start Date: September 2016

End Date: October 2017

Role: Project Manager

Eddie was the project manager for the Environmental Consultancy Services contract delivering a bankable Environmental and Social Impact Assessment (ESIA) and environmental permitting for the Kingdom of Saudi Arabia's Round 1 projects of the National Renewable Energy Program (NREP).

The Midyan Wind Energy Park will utilize wind technology on an area of approximately 116 km^2 and is expected to have a total installed capacity of 500 Mega-Watt (MW). The Park consists of a Wind Power Plant, including up to 160 Wind Turbine Generators (WTGs) with a maximum height of up to 175 meters (m), and an associated grid interconnection, including 2 medium voltage / high voltage (MV/HV) sub-stations and

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HV overhead lines connecting the sub-stations to the electrical transmission system owned by the Saudi Electricity Company (SEC).

When fully implemented the Park is expected to generate approximately 2,000 Giga-Watt hours (GWh) per annum, displacing 3,300 Thousand Barrels of Oil Equivalent (MBOE) of hydrocarbons per annum and 1,500 Thousand tons (Mt) of CO2 per annum.

The development of the ESIA required working with the Lender's Advisor to ensure legal compliance with national and international environmental obligations.

Ministry of Energy, National Renewable Energy Program, Sakaka Solar Energy Park

Start Date: September 2016

End Date: July 2017

Role: Project Manager

Eddie was the project manager for the Environmental Consultancy Services contract delivering a bankable Environmental and Social Impact Assessment (ESIA) and environmental permitting for the Kingdom of Saudi Arabia's Round 1 projects of the National Renewable Energy Program (NREP).

The Sakaka Solar Energy Park will utilize photovoltaic (PV) technology on an area of approximately 16.38 km2 and is expected to have a total installed capacity of approximately 1 Giga-Watt (GW). The Park consists of a PV Power Plant, including solar PV modules installed on mounting structures connected to inverter stations, surrounded by a security fence, and an associated grid interconnection, including a medium voltage/high voltage (MV/HV) sub-station and HV overhead line connecting the sub-station to the electrical transmission system owned by the Saudi Electricity Company (SEC).

When fully implemented the Park is expected to generate approximately 2,500 Giga-Watt hours (GWh) per annum, displacing 4,600 Thousand Barrels of Oil Equivalent (MBOE) of hydrocarbons per annum and 2,000 Thousand tons (Mt) of CO2 per annum.

The development of the ESIA required working with the Lender's Advisor to ensure legal compliance with national and international environmental obligations.

Other Project Experience

Saudi Aramco, Berri Gas Plant Sulfur Recovery Project

Role: Environment Manager

The Berri Gas Plant SRU upgrade project is designed to meet GAMEP source emission standards limiting SO2 emissions to 600 mg/Nm3 for a normal air shed. Saudi Aramco's Berri Gas Plant currently operates five (5) Sulfur Recovery Unit (SRU) trains. To meet these emission standards, each SRU train will be upgraded with a Tail Gas Treatment Unit (TGTU) and associated degassing infrastructure to achieve 99.9+% sulfur recovery efficiency.

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Eddie is the Environment Manager for this project, liaising with the engineering disciplines and coordinating a multi-disciplined environmental team to deliver the ESIA to Saudi Aramco and national legislative standards. This includes managing the design and execution of baseline environmental surveys, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Wasit Gas Plant Sulfur Recovery Project

Role: Environment Manager

The primary objective of Wasit Gas Plant SRU project is to upgrade the four SRUs through the modification of existing facilities and installation of new equipment (i.e. Tail Gas Treatment Units) to ensure full compliance with the GAMEP regulations, which limit in-Kingdom point source emissions for SO2 to 600 mg/Nm3.

Eddie is the Environment Manager for this project, liaising with the engineering disciplines and coordinating a multi-disciplined environmental team to deliver the ESIA to Saudi Aramco and national legislative standards. This includes managing the design and execution of baseline environmental surveys, impact assessment, recommendations for mitigation measures and development of environmental management plans

Saudi Aramco, Green Energy Initiatives

Role: Program Manager

Eddie is the program manager for Saudi Aramco's Green Energy Initiatives program. This program sits at the core of the Company's decarbonization strategy and supports the development and implementation of robust and independently verifiable carbon sequestration and storage projects. Through the development and implementation of nature-based solutions, Jacobs ZATE is supporting the Company's targets for decarbonization, and the restoration of healthy ecosystems that are resilient to climate change.

Saudi Aramco, Shaybah Security Project

Role: Environment Manager

The primary objective of this project was to enhance the level of security infrastructure at Shaybah operating facilities and to support the objectives of the Ministry of Defense (MOD). The MOD intends to install Patriot surface-to-air missile systems, Skyguard air defense systems, and a radar station in four locations within the dune systems around Shaybah operating facilities. The Project will also involve the construction of an accommodation building in proximity to existing structures to accommodate the MOD personnel.

Eddie led the development of a Category 1 EIA in accordance with SAEP-13, including the planning and execution of site surveys in a remote location, impact assessment, recommendations for mitigation measures and development of environmental management plans.

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Saudi Aramco, Sulfur Blocking Facility Hawiyah Gas Plant

Role: Environment Manager

Under normal operating conditions at Hawiyah Gas Plant (HGP), sulfur tanks are used to store molten sulfur from where it is transported to the end user. HGP does not currently have facilities to handle and store excess molten sulfur, for example when the sulfur storage tanks are filled to their maximum capacity, when transportation to the end user is interrupted and / or there is insufficient market demand for the product.

It is therefore proposed to construct a new Sulfur Blocking Facility at HGP for the long-term storage and handling of excess sulfur. Installation of the new facility is considered part of the emergency management of liquid sulfur. It is intended that sulfur blocks will be stored for a maximum of 90 days.

Eddie led the development of a Category 2 EIA in accordance with SAEP-13, including the planning and execution of site surveys in a remote location, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Environmental Monitoring Services

Role: Program Manager

Eddie was the program manager for Saudi Aramco's Environmental Compliance Auditing program for its mega-projects (i.e. >$1 billion CAPEX). The objective of the program is to evaluate the compliance of Saudi Aramco's mega-project program during the execution phase against environmental commitments and legal obligations, Saudi Aramco Policies, Standards and Procedures, as well as Saudi Government Environmental Regulations. In addition, Eddie is evaluating compliance with the Company's ISO 14001:2015 Environmental Management system.

Saudi Aramco, Refined Products Interface Handling Facility

Role: Project Manager

The project scope was to provide segregated facilities in North Riyadh Tank Farm & Bulk Plant (NRTF & NRBP) and Qassim Bulk Plant (QSBP) to store and dispose of any high sulfur hydrocarbon products transmix (interface) post the Clean Fuels implementation.

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Replace Halon System - East / West Pipeline

Role: Project Manager

The project scope was to support the corporate strategy to intensify the focus on safety and to protect the environment by phasing out Halon 1301 based fire suppression systems at eleven pump stations currently in operation located along the East/West

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Pipeline. Currently there are 44 installations at eleven pump stations which are utilizing Halon fire suppression systems. Under this project, environmentally friendly gaseous fire suppressions systems and new detection systems were installed.

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco Gas Distribution Pipeline - King Salman Energy Park (SPARK) and Dammam Third Industrial City (MODON)

Role: Project Manager

Saudi Aramco commissioned Jacobs ZATE to develop a Design Basis Scoping Paper (DBSP) for a new gas pipeline to service the King Salman Energy Park (SPARK) and Dammam Third Industrial City (MODON) in the Abqaiq area.

The purpose of the Project is to install a pipeline to transport 100 million standard cubic feet per day (MMSCFD) of sales gas to SPARK and Dammam Third Industrial City (hereafter referred to as Dammam-3). The new pipeline will take gas from the existing Master Gas System (MGS) at UBTG-3 KM 104. The Project will utilize the existing pipeline corridor within the Saudi Aramco reservation.

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Marjan Development Program - Package 18 Ras Tanura Area Pipelines

Role: Project Manager

The 300 MBCD Marjan Development Program (MDP) in is an integrated development for oil, associated gas, gas cap and non-associated gas production. Marjan development program includes new offshore oil and gas facilities, onshore crude oil stabilization facilities (GOSP), a gas processing plant at Tanajib (TGP), Cogeneration facility, and water desalination facility.

The project (BI-10-09004) under package 18 will provide 6 downstream pipelines. The 6 downstream pipelines will support to the Marjan Field Increment Program to maintain the Maximum Sustained Capability. In addition to pipelines, the project scope also includes ancillary components (i.e. isolation valves, scraper launcher/receivers, corrosion protection systems etc.).

Eddie project managed the preparation of a Construction Environmental Management Plan (CEMP) during the detailed design for this Project. The CEMP translates the findings and recommendations of Package 18, Marjan Development Program (MDP) EIA, into a set of procedures and plans for implementation on the ground and identifies those parties responsible for implementing them

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Saudi Aramco, Marjan Development Program - Package 17 Ras Tanura Area Pipelines

Role: Project Manager

The 300 MBCD Marjan Development Program (MDP) is an integrated development for oil, associated gas, gas cap and non-associated gas production. The Marjan development program includes new offshore oil and gas facilities, onshore crude oil stabilization facilities (GOSP), a gas processing plant at Tanajib (TGP), cogeneration facility, and water desalination facility.

Package 17 will provide 2 downstream pipelines under the program BI-10-09004. These pipelines will support Marjan Field Increment Program to maintain the Maximum Sustained Capability (MSC). In addition to pipelines, the project scope also includes ancillary components (i.e. isolation valves, scraper launcher/receivers, corrosion protection systems etc.)

Eddie project managed a technical review and EIA validation exercise to determine if the environmental assessments completed during the FEED remain valid for the Detailed Design.

Saudi Aramco, Marjan Development Program - Package 16 Tanajib Area Pipelines

Role: Project Manager

The 300 MBCD Marjan Development Program (MDP) is an integrated development for oil, associated gas, gas cap and non-associated gas production. The Marjan development program includes new offshore oil and gas facilities, onshore crude oil stabilization facilities (GOSP), a gas processing plant at Tanajib (TGP), cogeneration facility, and water desalination facility.

The Marjan offshore oil field currently produces the 500 thousand barrels per calendar day (MBCD). Saudi Aramco intends to increase the production from this field by 300 MBCD and has started two programs i.e. BI-10-12201 and BI-10-12222. Saudi Aramco also started program BI-10-09004 to provide support to Marjan Development Program (MDP).

The two programs (BI-10-12201 and BI-10-12222) will provide 6 onshore upstream pipelines which will connect the offshore structures to the new Tanajib Gas Plant under package 16. Program BI-10-09004 will provide 3 downstream pipelines under package 16. These pipelines will support Marjan Field Increment Program to maintain the Maximum Sustained Capability (MSC). In addition to pipelines, the project scope also includes ancillary components (i.e. isolation valves, scraper launcher/receivers, corrosion protection systems etc.)

Eddie project managed a technical review and EIA validation exercise to determine if the environmental assessments completed during the FEED remain valid for the Detailed Design.

Saudi Aramco, Relocate Khursaniyah – Ras Tanura Pipelines

Role: Project Manager

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Saudi Aramco commissioned Jacobs ZATE to develop a Design Basis Scoping Paper (DBSP) for Reroute Khursaniyah Ras Tanura Pipeline Project.

The Project plans to relocate sections of ten (10) pipelines in the Jubail area consisting of five (5) Company pipelines and five (5) third-party pipelines from the Khursaniyah Ras Tanura (KRT) corridor to the Qatif Berri Gas Gathering corridor (QGBB). In addition, a full replacement of one (1) pipeline BRT-1R from Berri Gas Plant to Ras Tanura Refinery through the QGBB corridor is included in the scope.

Eddie project managed the preparation of a Category 3 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

BAPCO, Modernization Program – Ornithological Surveys

Role: Project Manager

Bahrain Petroleum Company (Bapco) commissioned Environment Arabia Consultancy Services to prepare the Environmental and Social Impact Assessment (ESIA) for the Bapco Modernization Program (BMP).

As part of the capability expansion, pre-construction bird surveys are required along a stretch of the Ma'ameer Channel where new pipeline infrastructure crosses the channel. Eddie project managed the completion of specialist migratory and breeding bird surveys to evaluate the potential impacts on the project on important bird assemblages.

Saudi Aramco, Final Abqaiq Homeownership Development, EIA, Eastern Province, Saudi Arabia

Role: Project Manager

Saudi Aramco commissioned Jacobs ZATE to develop a Design Basis Scoping Paper (DBSP) and Project Proposal (PP) for the Final Home Ownership Lot Development, Increment VIII, Phase 3 Abqaiq Project.

The Project will provide final site development for 247 Home Ownership (HO) lots and 13 community support facilities (5 gardens, 1 girls college lot, 1 girls primary school lot, 3 Mosque lots, 1 shopping center lot and 2 government service lots). The Project scope includes establishment of permanent street paving, sidewalks and medians, curbs and gutters, street lighting, street naming and house numbering, and traffic signs and markings.

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Initial Abqaiq Homeownership Development, EIA, Eastern Province, Saudi Arabia

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Role: Project Manager

Saudi Aramco commissioned Jacobs ZATE to develop a Design Basis Scoping Paper (DBSP) and Project Proposal (PP) for the Initial Home Ownership Lot Development, Increment VIII, Phase 4 Abqaiq Project.

The Project will provide initial site and utility development to 156 Home Ownership (HO) lots and community support facilities. The Project scope includes; site preparation and grading, lot monuments, initial asphalt paving, stormwater drainage system, water supply system, sewage collection system, communication network system and power distribution system.

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Initial Abqaiq Homeownership Development, EIA, Eastern Province, Saudi Arabia

Role: Project Manager

Saudi Aramco commissioned Jacobs ZATE to develop a Design Basis Scoping Paper (DBSP) and Project Proposal (PP) for the Initial Home Ownership Lot Development, Increment IV, Phase 1 Al Hasa Project.

The Project will provide initial site and utility development to 319 Home Ownership (HO) lots, 2 schools, 3 local mosques, 1 grand mosque, 6 local gardens and community support facilities. The Project scope includes; site preparation and grading, lots monuments, initial asphalt paving, stormwater drainage system, water supply system, sewage collection system, communication network system and power distribution system.

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, modelling studies, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Saudi Aramco, Upgrade to Saudi Aramco Security Facilities

Role: Project Manager

The High Commission of Industrial Security (HCIS) directives for Industrial Faculties and the Industrial Security Operation Standards mandate that facilities are classified in accordance with the impact that they create to the Kingdom, where Class-1 is the highest classification, whose destruction could damage the Kingdom’s economy or cause serious fatalities.

Currently, 29 facilities which are categorized in seven packages in Dhahran and Northern areas do not comply with the High Commission for Industrial Security (HCIS) directives due to the lack of 360-degree visibility, ballistic resistance protection, auxiliary gates,

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visitor buildings, crash barriers, x-ray rooms, metal arches, under vehicle inspections and sunshades. In addition, some existing facilities require replacement of the gatehouse, support buildings, toilets and sub-standard perimeter fences.

Saudi Aramco has commissioned Jacobs ZATE to prepare the preliminary engineering deliverables for a series of upgrades to the security facilities at 29 facilities in Dhahran and the Northern areas, in line with the approved security master plan released in January 2017. The objective of the upgrades is to ensure compliance with the mandated HCIS directives

Eddie project managed the preparation of a Category 2 Environmental Impact Assessment in compliance with SAEP-13; including managing the design and execution of baseline environmental surveys, impact assessment, recommendations for mitigation measures and development of environmental management plans.

Confidential Client, Environmental Due Diligence for Data-Centers

Role: Environment Manager

Eddie managed the coordination and preparation of environmental due diligence documentation in support of an International Client's investment program for data-centers in the Kingdom of Saudi Arabia. The environmental due diligence documentation (i.e. natural resource evaluation, Phase 1 contaminated land assessments, and preliminary air quality and noise assessments) critically analyzed the potential environmental risks and hazards to the successful development of the data-centers and involved specialist teams from the UK, UAE and Saudi Arabia.

Ministry of Energy, Data Management and Drawing Services for the National Renewable Energy Program

Role: Project Manager

The Ministry of Energy, Industry and Mineral Resources (MEIM) has launched the National Renewable Energy Program (NREP) for the implementation of 9.5 GW of renewable power by 2023, with an initial target of 3.45 GW by 2020. This national program will implement the targets for renewable energy in Vision 2030 and support the national transformation program. Eddie is managing the development of a GIS web portal to support the National Renewable Energy Program with GIS specialists based in the UK. The web portal will serve as a centralized repository for NREP information and design data for all of its 28 renewable energy parks, and allow the client to view, interrogate and print project data from any location.

Saudi Aramco, Replace Hydrogen Induced Cracking Affected Vessels

Role: Environment Manager

The scope of this project is comprised of the replacement of Hydrogen Induced Cracking (HIC) Affected Vessels at South Ghawar Gas Oil Separation Plants (GOSPs). Eddie

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provided technical oversight and procurement support of the development of the Category 2 EIA for the replacement of vessels in a total of four GOSPs in compliance with Saudi Aramco SAEP-13.

Saudi Aramco, Pipeline Rehabilitation

Role: Environment Manager

Eddie was the environment manager responsible for planning and executing the ESIA for the rehabilitation of the Uthmaniyah pipeline. This included developing the scope and design of field surveys in accordance with Saudi Aramco standards to support the impact assessment. The primary objective of the Project is to support Saudi Aramco's corporate strategy to maintain a reliable maximum sustained capability of the sour Arabian Light (AL) crude supply. The engineering scope of the project comprised replacing Uthmaniyah to Abqaiq (UA-4) pipeline section-II, modifying UA-1 pipeline Section-I, and installing corrosion inhibition injection skids for the UA pipeline system in a total of 17 Gas Oil Separation Plants (GOSPs).

Saudi Aramco, Saudi Strategic Storage Program Facility 5 Refined Products Supply Pipeline

Role: Environment Manager

This project will provide a new 12" 24 kilometer (km) pipeline to transport 53 Thousand Barrels Per Day (MBD) of multi refined products to the SSSP-5 storage facility near Jeddah. The new pipeline is expected to deliver both grades of gasoline (Premium Grade 95 (PG95) and Premium Grade 91 (PG91)) from the YNJ-1 pipeline and Jet Fuel and Ultra-Low Sulfur Diesel (ULSD) from the YNJ-2 pipeline. Eddie was the project manager and oversaw the production of a Category 3 EIA for the project, in compliance with SAEP-13. Responsibilities included managing the design and execution of baseline environmental surveys and providing technical support during the assessment of impact and identification of mitigation measures.

Saudi Aramco, Yanbu Distribution Hub, EIA Validation Study

Role: Environment Manager

To meet the growing demand of refined products within the Makkah Province, Saudi Aramco intends to construct the Yanbu Distribution Hub YDH. The YDH will aggregate refined product (Premium Grade 95 (PG95), Premium Grade 91 (PG91), Diesel and Dual Purpose Kerosene (DPK)) from SAMREF, YASREF, and Yanbu refineries and act as an origin pump station for two connecting pipelines, the Yanbu to Jeddah pipelines (YNJ-1 and YNJ-2) and the Yanbu to the central region pipeline. Eddie was the environment manager, overseeing the technical review of the EIA submitted at FEL-2 and determining its adequacy and validity for the Detailed Design package, determining if there are any materially significant design changes which might give rise to new or significantly different environmental effects over and above those reported in the existing EIA.

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Saudi Aramco, North Jeddah Bulk Plant Expansion, EIA Validation Study

Role: Environment Manager

To meet the growing demand of refined products within the Makkah Province, Saudi Aramco intends to upgrade and expand the North Jiddah Bulk Plant (NJBP). NJBP will be upgraded to receive the new Yanbu to North Jiddah Products Pipeline (YNJ-1) as well as increased loading and offloading facilities. Eddie was the environment manager, overseeing the technical review of the EIA submitted at FEL-2 and determining its adequacy and validity for the Detailed Design package, determining if there are any materially significant design changes which might give rise to new or significantly different environmental effects over and above those reported in the existing EIA.

Saudi Aramco, Crude Oil to Chemicals Project, Saudi Arabia

Role: Environment Manager

Eddie was the Environment Manager for the feasibility study for the proposed Crude Oil to Chemicals (COTC) facility. This project is for development of a fully integrated crude oil-to-chemicals complex which will maximize chemicals production and higher profitability products with minimum fuel production and transforming and recycling by-products in the Kingdom of Saudi Arabia. Eddie established the environmental basis of design, preliminary environmental baseline information, and set out the environmental permitting procedures for such a facility under the jurisdiction of the Royal Commission. Eddie also identified strategically important national sustainability initiatives to be considered (i.e. Saudi Energy Efficiency Program).

Saudi Aramco, Berri Increment Program

Role: Project Manager

Eddie was the Project Manager of multidisciplinary environmental teams during the development of an ESIA and environmental permitting for Saudi Aramco's Berri Increment program. The project is for the development of two nearshore islands in the Arabian Gulf for upstream assets to enable the recovery of reserves from an existing reservoir. The work requires the integration of Ports and Marine Engineering, Marine Modelling, ESIA and Consultation activity across three continents (i.e. UK, Australia and Saudi) and securing environmental permits from the Royal Commission and the General Authority for Meteorology and Environmental Protection (GAMEP). Consultees include two operational ports, the coast Guard, local municipalities and Saudi Rail Authority who are also developing in the vicinity.

Saudi Aramco, Jubail to Ras Tanura Product Pipeline

Role: Project Manager

To meet the forecasted diesel demand in the Eastern and Central Regions of the Kingdom of Saudi Arabia, Saudi Aramco intends to install a 112 km refined products (Diesel) pipeline from SASREF and SATORP to the refined products system at Ras Tanura Refinery. Eddie was the project manager and oversaw the production of a Category 3 EIA for the project, in compliance with SAEP-13. Responsibilities included managing the design and execution of baseline environmental surveys and providing technical support during the

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assessment of impact and identification of mitigation measures.

Saudi Aramco, Abqaiq Field Water Injection System

Role: Environment Manager

Saudi Aramco intends to install a new seawater injection pump and new substation at Abqaiq Gas Oil Separator Plant (ABGOSP) ABGOSP-5, seawater injection trunk pipelines and upgrade the existing produced water system at both ABGOSP-2 and ABGOSP-5. Eddie was the environment manager and oversaw the production of a Category 2 EIA for the project, in compliance with SAEP-13. Responsibilities included managing the design and execution of baseline environmental surveys and providing technical support during the assessment of impact and identification of mitigation measures.

Saudi Aramco, Maritime Yard Residential Master Plan, Ras al Khair

Role: Environment and Sustainability Manager

Eddie was the environment and sustainability manager for the Ras al Khair Residential Masterplan. The masterplan will provide housing and all support services for approximately 16,000 shipyard workers. Responsibilities included providing the technical environmental inputs and facilitating the broader sustainability integration for the master plan, to meet Saudi Aramco's corporate sustainability ambitions such as the development of sustainability criteria and support to zoning and layouts in response to environmental sensitivities.

Saudi Aramco, Shaybah Runway Extension ESIA

Role: Environmental Manager

Eddie was the environment manager responsible for planning and executing the ESIA for the proposed runway extension in Shaybah. This included developing the scope and design of field surveys in accordance with Saudi Aramco standards to support the impact assessment.

Saudi Aramco, Wellcore Facility ESIA, Dhahran

Role: Environmental Manager

Eddie was the environment manager responsible for planning and executing the ESIA for a new storage building and research facilities within the Dhahran campus. This included developing the scope and design of field surveys in accordance with Saudi Aramco standards to support the impact assessment. The new facility will comprise of core-sample storage facilities and new research laboratories, offices, support and storage areas, and parking.

Saudi Aramco, Dhahran - Ras Tanura Pipeline Corridor ESIA, Dhahran

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Role: Environmental Manager

Eddie was the environment manager responsible for planning and executing the ESIA for new recreational facilities within the existing Dhahran – Ras Tanura pipeline corridor. This included developing the scope and design of field surveys in accordance with Saudi Aramco standards to support the impact assessment. Specifically, a land quality assessment was undertaken to determine the levels of contamination, including soil and groundwater sampling and testing; and the subsequent development of remediation measures.

Saudi Aramco, Downstream Pipelines Haradh Increment, Haradh, Saudi Arabia

Role: Environmental Technical Lead

The objective of this Project is to provide pipelines for the transmission of the gas coming on-stream under the Haradh Gas Increment Program to meet in-Kingdom gas demand and reduce liquid burning. A rich gas pipeline (HUG-2) is planned to take gas from Hawiyah Gas Plant (HGP) to Uthmaniyah Gas Plant (UGP) for Natural Gas Liquid (NGL) recovery. A sales gas pipeline (UBTG-5) is planned from UGP to Master Gas System (MGS) at Shedgum Area. Eddie provided a technical review of the ESIA undertaken by a third-party consultant to ensure compliance with Saudi Aramco Engineering Procedure 13 Project Environmental Impact Assessments (SAEP-13) and maximize opportunities for environmental enhancement.

Saudi Aramco, East – West Crude Pipeline Upgrade ESIA, Trans-Saudi Arabian Pipeline, Saudi Arabia

Role: Environmental Technical Lead

Saudi Aramco identified that the reliability of East-West crude oil pipeline is compromised by the low reliability of the existing Pratt & Whitney (FT-4) and Rolls Royce (RB-211) Combustion Gas Turbines (CGT) and their supporting facilities located within the eleven (11) intermediate pump stations. The primary objective of this project is to therefore increase the reliability of the East–West crude oil pipeline to 93% to support the normal and strategic delivery of crude oil to the west coast of the Kingdom. This will be achieved by replacing and refurbishing the CGT within the intermediate pump stations. Eddie managed the preparation of the ESIA Scope of Works and provided technical oversight and due diligence review of the third party contractor.

Saudi Aramco, Qatif GOSP, Salt Water Disposal Pumps ESIA, Saudi Arabia

Role: Environmental Technical Lead

The main objective of this project is to maintain production capacity from the Abu Safah and Qatif oil fields by installing additional salt-water disposal capacity to handle the increasing flow rates due to the incremental higher water cut. This objective will be met by installing a new water disposal pump and also to install a jump over between the disposal header (which goes to Sulaiy aquifer) and the injection header (which goes to the producing reservoirs). Although the main project scope is to install additional disposal pump, the jump-over will significantly reduce the disposal of wastewater from Sulaiy to Qatif oil reservoirs for pressure maintenance. Eddie managed the preparation of the ESIA Scope of Works and provided technical oversight and due diligence review of

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the third-party contractor.

Saudi Aramco, Qatif GOSP, Shipping Pumps ESIA, Saudi Arabia

Role: Environmental Technical Lead

The main objective of this project is to increase the Crude Transfer capacity from Qatif Gas Oil Separation Plant (QGOSP)-2 to QGOSP-1 to meet the Maximum Sustained Capability (MSC). QGOSP-2 is designed to deliver 200 thousand barrels per day (MBD) wet crude oil to QGOSP-1 through a 25.6 KM QT-2 pipeline. As per the production profile and to meet the MSC, a new 24 inch pipeline with associated Scraper Launcher and Receiver is proposed parallel to the existing 20 inch QT-2 pipeline to deliver up to 300 MBD of wet crude from QGOSP-2 to QGOSP-1. Eddie managed the preparation of the ESIA Scope of Works and provided technical oversight and due diligence review of the third party contractor.

Saudi Aramco Total Refinery Project (SATORP), Emergency Siren Noise Study, Jubail, Saudi Arabia

Role: Project Manager

Eddie was the Project Manager responsible for planning and executing a technical noise modelling assessment of the emergency sirens at SATORP to determine compliance with industry design standards. This included designing and executing comprehensive noise sampling within the refinery facility and coordinating the modelling activities of the acoustic consultants. The modelling outputs will be used to inform the design of the emergency siren system, including the number and location of the sirens in order to achieve a 15dB sound level above ambient background.

BP Khazzan Gas Field, BP, Oman

Role: Environmental Project Engineer

BP Exploration (Epsilon) Limited (BP) has signed an Exploration and Production Sharing Agreement (EPSA) with the Government of the Sultanate of Oman for development of the gas concession of Khazzan Block 61. As part of the development, BP will drill up to 300 wells, construct a Central Processing Facility (CPF) and a Gathering, Wells, Exploration System (GWES) to extract, treat and export gas and condensate to the national pipeline network for sale within Oman. Eddie was a project engineer providing technical support, project assurance and environmental due diligence services to the BP Khazzan Gas Field project during the construction phase. This included supporting the assessment of engineering design changes and the providing technical oversight to the permitting requirements of the project.

KFUPM Research Laboratory Building ESIA, Dhahran, Saudi Arabia

Role: Project Manager

Eddie was the Project Manager responsible for planning and executing the ESIA for a new research laboratory building within the campus of the King Fahd University of Petroleum

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and Minerals (KFUPM). This included developing the scope and design of field surveys in accordance with Saudi Aramco standards to support the impact assessment. The new facility will comprise of teaching and research laboratories, classrooms, offices, support and storage areas, and parking. The Project will support KFUPM's research and development strategy through provision of a consolidated state-of-the-art facility located at the center of its campus.

Dhahran Techno-Valley Science Park, Research Laboratory Building ESIA, Dhahran, Saudi Arabia

Role: Project Manager

Eddie was the Project Manager responsible for planning and executing the ESIA for a new research laboratory building within the Dhahran Techno-Valley Science Park. This included developing the scope and design of field surveys in accordance with Saudi Aramco standards to support the impact assessment. The new facility will comprise of teaching and research laboratories, classrooms, offices, support and storage areas, and parking. The building will provide research and development laboratory space as well as incubator laboratories to foster innovation and entrepreneurship across KFUPM.

Saudi Aramco, Jeddah Area Master Plan, Saudi Arabia

Role: Project Manager

The intent of the Jeddah Area Master Plan Update is to provide a sustainable development and implementation framework for streamlining Saudi Aramco's corporate functions in Jeddah, maximizing the utilization of its assets, optimizing future capital investment and enhancing the safety of its employees. The master plan includes a significant land quality assessment for the current Sough Jeddah Refinery and the development of a framework for the remediation of this site. Eddie was the project manager for the Jeddah Area Master Plan and his responsibilities included overseeing the technical inputs of all master planning, facility planning, process and environmental disciplines.

Saudi Aramco, South Ghawar Gas and Oil Separation Plant Upgrades, Saudi Arabia

Role: Project Manager

The overall objective of this project was to replace vessels which were identified as suffering hydrogen induced cracking in order to maintain crude oil production and maximum sustained capacity targets for Arab light crude from the South Ghawar fields. Responsibilities included technical environmental lead and management of the delivery of 9 environment and social impact assessments for the Front End Engineering Design for replacing sixteen pressure vessels within 9 gas oil separation plants.

Saudi Aramco, Abqaiq Master Plan, Saudi Arabia

Role: Environmental Technical Lead

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The project involved developing a sustainable master plan framework for Saudi Aramco's Abqaiq community and to provide planning guidance to enhance Abqaiq's urban core. The intention of the master plan was to enhance the economic, social and environmental performance of the urban environment and contribute to the improved well-being of Saudi Aramco's Abqaiq community. Eddie was the environmental technical lead and his responsibilities included providing technical inputs and facilitating the broader sustainability integration for the master plan, to meet Saudi Aramco's corporate sustainability ambitions such as the development of sustainability criteria and support to zoning and layouts in response to environmental sensitivities. The zoning included the identification and establishment of an eco-park to safeguard and protect existing valuable habitats, and to enhance the biodiversity and amenity value of this area.

Saudi Aramco, Replace Three Substations, Riyadh Refinery ESIA

Role: Project Manager

Eddie was the Project Manager and oversaw the delivery of a Category I EIA in accordance with Saudi Aramco engineering procedures. The EIA included an assessment of potential impacts on sensitive receptors during the different phases of the project (i.e. construction & demolition, operation, decommissioning). A Construction Environmental Management Plan (CEMP), Operational Environmental Management Plan (OEMP) and Environmental Mitigation Plan were developed as part of the EIA.

Saudi Aramco, Jeddah to Yanbu Refined Products Pipeline, Saudi Arabia

Role: Project Manager

The project supported Saudi Aramco's corporate strategy of meeting the growing demand for refined products in Jeddah and the wider Makkah Province. This included 331 kilometers refined products pipeline between the Yanbu Distribution Hub and the North Jeddah Bulk Plant, with a capacity of 576 million barrels a day. Eddie managed the production of the Category 2 EIA for the project. Responsibilities included management of the inputs from all technical specialists and conducting the baseline environmental fieldwork including ecology surveys, archaeology surveys and noise sampling.

Saudi Aramco, Dhahran to Ras Tanura Pipeline Corridor Masterplan, Dhahran, Saudi Arabia

Role: Environmental Technical Lead

Eddie led the environmental and sustainability design of the conceptual masterplan for the disused Dhahran to Ras Tanura pipeline corridor. This included safeguarding and enhancing the biodiversity value of features of ecological interest and developing options for the establishment of a Desert Eco Park and a coastal Mangrove Eco park.

King Abdullah University of Science and Technology, Research & Development Centre ESIA, Saudi Arabia

Role: Environmental Technical Lead

Eddie led the delivery of the environmental field investigations, which included developing the scope and design of site surveys in accordance with Saudi Aramco

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standards to support the impact assessment. The data from these studies fed into the environmental impact assessment for the new research and development center which is comprised of state of the art science laboratories.

Saudi Aramco, Abha to Najran and Sulayyil Pipeline Preliminary ESIA, Saudi Arabia

Role: Project Manager

Eddie managed the technical preparation of the Preliminary ESIA in support of a new refined fuel products pipeline in south-west Saudi Arabia. The preliminary assessment identifies the potential environmental impacts of the project, and the critical issues that have the potential to affect the viability of the preferred routing scenario. This high-level assessment contributed to the development of the scope for the ESIA which will be undertaken during the Project Proposal stage (i.e. Front End Engineering Design).

Saudi Aramco, Abha to Najran and Sulayyil Pipeline Environmental Feasibility Study, Saudi Arabia

Role: Project Manager

Eddie managed the development and application of project specific environmental screening and scoping criteria for the evaluation of pipeline routing scenarios from the Abha bulk plant to the Najran and Sulayyil bulk plants. The project supports Saudi Aramco's objective of reducing the transportation of refined fuel products by road in the south-west region of the Kingdom of Saudi Arabia. The application of the screening and scoping criteria and the development of environmental constraints mapping assisted with the development of the route options and the avoidance / minimization of associated environmental impacts.

MODON, Rumah Industrial City Master Plan ESIA and Waste Management Plan, Saudi Arabia

Role: Environment Manager

Eddie managed the production of the ESIA and all environmental inputs into the Rumah Industrial City master plan. His role included coordinating the inputs from all technical specialists and conducting the baseline environmental field work including ecology surveys, archaeology surveys, air quality and noise sampling, and production of the ESIA itself. In addition he drove the broader sustainability integration for the master plan to meet MODON’s corporate sustainability ambitions, e.g. development of sustainability criteria, support to zoning and layouts in response to environmental sensitivities and sustainable multi-modal transportation.

Saudi Aramco, Master Gas System Expansion ESIA, Saudi Arabia

Role: Project Manager

Eddie managed the production of the Category 3 ESIA for a 900km trans-Arabian high pressure gas transmission line and all associated infrastructure including valve stations, scraper launchers and receivers and utilities and communications. The project supports Saudi Aramco's corporate strategy of meeting the growing demand for sales gas in the

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central and western regions of Saudi Arabia. Eddie managed the inputs from all technical specialists, and conducted the baseline environmental field work including ecology surveys, archaeology surveys and noise sampling.

Saudi Aramco, Exploration and Petroleum Engineering Advanced Research Center Advanced Research Centre ESIA, Saudi Arabia

Role: Technical Environmental Specialist

Eddie led the delivery of the environmental field investigations, which included developing the scope and design of site surveys in accordance with Saudi Aramco standards to support the impact assessment. The development proposal concerned the site of existing engineering workshops which were to be demolished and redeveloped to provide a state of the art upstream Research and Development Facility, the EXPEC Advanced Research Centre. A precautionary approach was taken to the land quality baseline and so the EIA was supported by an environmental site investigation, laboratory analysis and interpretation was provided as well as developed sections on noise and air quality impacts. He authored the Category 2 ESIA for the proposed development.

Saudi Aramco, Shaybah Wildlife Sanctuary, Ecological Management Plan, Saudi Arabia

Role: Technical Biodiversity Specialist

Central to the successful establishment and operation of the Shaybah Wildlife Sanctuary is the implementation of the Ecological Management Plan. This document presents the required stages and key milestones to deliver the release of the first animals at the Sanctuary's opening and provides a strategic framework to enable the sanctuary to function thereafter. The Ecological Management Plan includes: the landscape restoration, rehabilitation and enhancement plan, the animal procurement and transportation plan; the bio-security plan; the visitor interpretation program and the staff structure, recruitment and training Plan. Eddie was the key author of this document, integrating the technical contributions from specialist sub-contractors and the broader project team.

Saudi Aramco, Shaybah Wildlife Sanctuary, Ecological Design Criteria, Saudi Arabia

Role: Technical Biodiversity Specialist

Saudi Aramco plans to establish a protected area of international importance in Shaybah which reflects the unique character of the Rub' al Khali, creating a biodiversity jewel for the Kingdom, its citizens and for future generations. The Ecological Design Criteria Report will ensure that the vision and the ecological design objectives for the Sanctuary are realized though alignment of the critical design elements. The purpose of this report is to inform front end engineering design (FEED). The ecological design criteria fall within the following categories: habitat augmentation strategy, spatial configuration of

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sanctuary, water supply and irrigation strategy, species re-introduction strategy, visitor interpretation concepts and scientific research. Eddie acted as the technical interface between the design team and International Conservation Services, and authored the Design Criteria Report.

Saudi Aramco, Shaybah Wildlife Sanctuary, Ecological Design Philosophy, Saudi Arabia

Role: Technical Biodiversity Specialist

Saudi Aramco is committed to protecting and enhancing the natural heritage and biodiversity of the Rub' al-Khali (Empty Quarter) and has commissioned Jacobs Zate to develop a concept design for the realization of a wildlife sanctuary (the Sanctuary) in Shaybah with a strong focus on conservation and the visitor experience. The Ecological Design Philosophy captures Saudi Aramco's aspirations for the Sanctuary within a focused vision, supported by a set of ecological design objectives. Eddie authored the Ecological Design Philosophy following extensive stakeholder consultation and design meetings with the client and design team.

Saudi Aramco, Shaybah Wildlife Sanctuary ESIA, Saudi Arabia

Role: Technical Environmental Specialist

Eddie undertook the ecological impact assessment and prepared the Biological Resources chapter for the Environmental and Social Impact Assessment (ESIA). This project is for the establishment of a 637km^2 wildlife sanctuary within the Empty Quarter of the Kingdom of Saudi Arabia, and includes the restoration / rehabilitation of desert habitats and the re-introduction of Arabian oryx and other native species.

Ma'aden, Umm Wu'al Phosphate Mine and Industrial Complex ESIA, Saudi Arabia

Role: Technical Environmental Specialist

Eddie prepared the ecological impact assessment and prepared the Biological Resources chapter for the Environmental and Social Impact Assessment (ESIA). This project is for the Umm Wu'al Mine, and the Waad Al Shamaal Phosphate Industrial Complex which includes an open cast mine, an industrial complex (i.e. a beneficiation plant, Sulphuric Acid Plant (SAP), Phosphoric Acid Plant (PAP), Purified Phosphoric Acid (PPA) plant, Sodium Tri Poly Phosphate (STPP) plant, Mono Calcium Phosphate (MCP) / Di Calcium Phosphate (DCP) plant) and all required utilities.

Ma'aden, Ras al Khair Industrial City and Port Expansion ESIA, Saudi Arabia

Role: Technical Environmental Specialist

Eddie prepared the ecological impact assessment and contributed to the preparation of the Biological Resources chapter for the Environmental and Social Impact Assessment (ESIA). The project is for the expansion of the Ras Al Khair Industrial City and port facility to include new chemical production plants for Ammonia, Di-Ammonium Phosphate and Nitro-Phosphate Potash. This includes all supporting infrastructure and connection to existing utilities within the Ras Al Khair Industrial City.



Dr. Daniela Zamfirescu

Lead Project Engineer

Overview

Dr. Daniela Zamfirescu brings 20+ years of academic and consulting experience, out of which 13 years with WorleyParsons/Advisian in the Middle East, in technical expert roles for thermal, solar and nuclear power generation, onshore and offshore oil and gas and various industrial projects.

Areas of Expertise

- environmental and social impact assessment
- environmental surveys, management and monitoring
- environmental legislation and permitting
- process engineering
- site selection, characterization and evaluation for nuclear power plants
- contaminant hydrogeology/soil and groundwater remediation
- environmental analytical chemistry

Relevant experience

Since joining WorleyParsons/Advisian, key expertise included Legislation Review and Permitting, Environmental Baseline Survey and Assessment, Environmental and Social Impact Assessment, Environmental Monitoring, Alternatives Assessment, Project and Proposals Management, Process Engineering. Key projects:

Environmental, Social and Health Impact Assessment (EIA, ESIA, ESHIA)

- Upgrade/Revamp Environmental Aspects and Impacts Assessment of Qatar Fuel Additives Company. QAFAC – ongoing.
- Operation Environmental Management Plans and HSEIA Updates for Various Offshore Facilities**.** Abu Dhabi Oil Company, 2018 – 2019.

- Compressed Gas Stations in Ras Laffan and Messaied Industrial Cities. Qatar Petroleum, 2019
- Al Faisaleiyah, Mahd Ad Dahab, Ar Rass, Sa'ad and Qurrayat Solar Power Plants, for Saudi Ministry of Energy, Industry and Mineral Resources, Renewable Energy Development & KA-CARE, 2017-2019;
- North Field Expansion Project: Drilling two data acquisition wells and six wellhead platforms off the coast of Qatar in the North Field Region. Qatar Gas, 2018;
- Soil and Groundwater Site Assessment at the OPC Facility. Carbon Holdings, Egypt, 2018;
- Increased Pumping Capacity – Qatif. Saudi Aramco, 2017;
- Upgrade of Ethane Facilities - Juaymah. Saudi Aramco, 2017;
- Atoll Offshore Project. PhPC Egypt, 2016 - 2017;
- Several Power Plants in KSA for Saudi Electricity Company (SEC), 2012 – 2016:
  - Jeddah South 2400-2800 MW Power Plant
  - Shuqaiq Steam Power Plant (Stage I)
  - Khafji South Power Plant
  - Rabigh V & VII SEC Power Plant Project Conversion of Single Cycle to Combined Cycle
  - Ras Al-Khair Power Plant
  - Qurayyat Power Plant Conversion and Expansion
  - Tihama Combined Cycle Power Plant
  - Farasan Power Plant
  - Riyadh PP9 Conversion
  - Wadi Dawaser Conversion
  - North Qassim Integrated Solar - Combined Cycle Power Plant
- Several proposed offshore exploratory wells in the Mediterranean Sea (Raven 3, Raven 4, Fayoum South, Libra North, West Nile Development Project). BP Egypt 2006 - 2009;
- Proposed Methanol Facility. EMethanex, 2006 – 2007.
- Proposed Ammonia/Urea Facility and Shipping Facilities. EAgrium, 2006 – 2007.
- Sokhna Biodiesel Company – Proposed Bio-Diesel Production Facility at the Sokhna Port Free Zone in Egypt. SBC, 2006 – 2007.

Permitting and Regulatory Requirements

- Permit and Government Regulations Requirements for Jubail 1 Cogeneration Project, KSA, Saudi Basic Industries Corporation (SABIC), 2017
- Environmental Legislation Review for Iran, Kazakhstan, Saudi Arabia, Turkey, and UAE for GEF, Japan, 2006.

Site Characterization, Site Selection and EIA for Nuclear Power Plants

- Consultancy for Nuclear Power Plant Siting in KSA – Site screening. KA-CARE, 2011 – 2012.
- First Egyptian Nuclear Power Plant (NPPA) – 2009 – 2019:
  - Regional analysis for alternative sites selection;
  - Characterization and ranking of alternative sites;

- Site evaluation report for site permit application;
- Legislation review: IAEA, USNRC, Egyptian AEA – NCNSRC;
- Technical tender documents for First Egyptian Power Plant;
- Environmental Impact Assessment for El Dabaa NPP.

Qualifications

Education

- PhD in Applied Geology / Hydrogeochemistry (Dr. Rer. nat.) (University of Tübingen) (2000)
- MSc in Hydrogeology and Water Resources Engineering (Technical University for Civil Engineering Bucharest & École des Mines de Paris) (1996)
- Chemical Engineer (Polytechnic University Bucharest) (1994)

Languages

- ROMANIAN: Mother tongue
- GERMAN: Fluent verbal and written
- ENGLISH: Fluent verbal and written
- FRENCH: Verbal and written comprehension
- ARABIC: Basic conversation

Selected Publications

Zamfirescu, D. (2000): Release and fate of specific organic contaminants at a former gasworks site. Tübinger Geowissenschaftliche Arbeiten (TGA), Reihe C, Nr. 53. 96 p.

Zamfirescu, D., Grathwohl, P. (2001): Attenuation rate of specific organic contaminants at a former gasworks site. Journal of Contaminant Hydrology, Special Issue 53(3-4). 407-427.

Teutsch, G., Rügner, H., Zamfirescu, D., Finkel, M., Bittens, M. (2001): Source remediation vs. Plume management: critical factors affecting the cost efficiency. CLARINET and NICOLE Special Edition of Land

Contamination & Reclamation: The Sustainable Management and Remediation of Contaminated Land. 9(1). 121-140.

Bockelmann, A., Zamfirescu, D., Ptak, Th., Grathwohl, P., Teutsch, G. (2003): Quantification of mass fluxes and natural attenuation rates at an industrial site with a limited monitoring network: a case study. Journal of Contaminant Hydrology, 60(1-2). 97-121.

Teutsch. G., Dietrich, P., Grathwohl, P., Liedl, R., Ptak, Th., Zamfirescu, D. Et al. (2000): REference Testfield Zeitz for the Implementation of Natural Attenuation Concept (RETZINA). Contaminated Soil 2000. Proceedings of the Seventh International FZK/TNO Conference on Contaminated Soil. Sept. 2000, Leipzig, Germany. Vol. 2 Thomas Telford. p. 1178 – 1180.

Zamfirescu, D.; Martac, E.; Teutsch G. (2004): Quantification of the potential for natural attenuation at the field scale in deep aquifers. Report 02WN0437 (in German)

Zamfirescu, D.; Martac, E.; Teutsch G. (2005): Natural attenuation of a complex contaminant mixture in a fractured aquifer – former mineral oil factory Epple, Stuttgart. Report 02WN0353 (in German)

Zamfirescu, D.; Grathwohl, P. (1998): Release of various organic pollutants by dissolution and desorption: long-term impact on groundwater quality. Groundwater Quality: Remediation and Protection (Proceedings of the GQ '98 Conference, Tübingen, Germany, Sept. 1998. IAHS Publ. No. 250, 1998.

Zamfirescu, D., Grathwohl, P. (1998): Schadstoffemission durch Desorption und Lösung standortspeziffischer organischer Verbindungen im Schadstoffzentrum, Testfeld Süd. Grundwasser, Heft 4, Band 3: 167-174.

Wallace, S.; Burgess, W.; Dottridge, J., Zamfirescu, D., Zamfirescu, F. (1998): Characterization of extensive hydrocarbon contamination of an alluvial aquifer, Ploiesti, Romania. Geological Society, London, Engineering Geology Special Publications 1998, v. 14, p. 189-194.

Work history

2007 - Present	Senior Hydrogeologist/ Lead Project Engineer WorleyParsons/Advisian, Egypt
2006 - 2007	Senior Hydrogeologist, Komex, Egypt
2003 - 2006	Scientific Assistant at Groundwater Research Institute Tübingen (TGF), Germany
2000 - 2003	Scientific Assist. and Lecturer at the Centre for Applied Geoscience Tübingen, Germany
1996- 2000	Scientific Assistant, Eberhard Karls University of Tübingen, Applied Geology Department, Germany



Yousra Zakaria

Study Manager, Environment and Society, SEMEA

BSc, MSc

Overview

Yousra is an environmental and sustainability consultant with a Master's degree in Environmental Engineering and more than ten (10) years practical experience. She has primarily worked on Environmental and Social Impact Assessments (ESIAs), Environmental and Social Management Plans (ESMPs), Environmental Regulatory Compliance, Stakeholder Engagement Plan, Environmental Baseline Surveys and Sustainability Reports in the Middle East (Egypt, KSA, UAE, Qatar, Bahrain and Iraq).

Yousra was Study Manager of and participant in ESIAs completed for several solar plants in KSA. She was a Senior Environmental Consultant of the ESIA for El Dabaa Project (Egypt's first nuclear power plant). She also has extensive experience with Sustainability Reporting and has worked on projects meeting international funding organisations requirements, such as the IFC and the World Bank, and companies in renewable and conventional energy, oil and gas exploration and petrochemicals sectors.

Yousra is a doctoral candidate in Environmental Engineering with a research focus on Sustainability Assessment. During the past decade, Yousra has managed interdisciplinary and multicultural teams on a variety of projects, and she is fluent in English and Arabic and conversant in Spanish.

Areas of Expertise

- Environmental and Social Impact Assessment (ESIA)
- Environmental, Social Management Plans (ESMP)
- Environmental Monitoring Plans (EMP)
- Environmental Regulatory Compliance
- Stakeholder Engagement Plans
- Sustainability Reporting
- Environmental and Social Baseline Assessment

Relevant experience

Environmental and Social Impact Assessment (ESIA)

Project Management, ESIA, EIA, ESHIA, Public Consultation and Disclosure, Alternatives Assessment, Environmental and Social Baseline Survey and Assessment. Key projects (partial list):

- EIA, ESIA and ESHIA:
  - Al Henakiyah CSP/PV Solar Power Plant, KSA, Renewable Energy Project Development Office (REPDO), 2020
  - EHC Expansion ESHIA – Ammonia Plant, Egypt, EHC, 2020
  - Saad Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Ar Rass Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Layla Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Wadi Ad Dawasir Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Qurayyat Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Tahrir Petrochemicals Supplementary Socio-Economic Impact Assessment, Egypt, Carbon Holdings Limited, 2019
  - Compressed Natural Gas Station in Mesaieed Industrial City (MIC), Qatar Petroleum, Qatar, 2019
  - AlFaisaliya Solar PV Park, KSA, Renewable Energy Project Development Office (REPDO), 2018
  - Mahad Al Dahab Solar PV Park, KSA, REPDO, 2018
  - ENPC Existing Facility, Modifications of Products Exporting Arrangements, Damietta, Egypt, ENPC/MOPCO, 2018
  - First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, Egyptian Nuclear Power Plant Authority (NPPA), 2017
  - Upgrade Ethane Facilities - Ju'aymah NGL Fractionation (JNGLF), KSA, Jacobs ZATE, 2017
  - Increase Pumping Capacity, Qatif, KSA, Jacobs ZATE, 2017
  - Atoll Development Project, Phase-1 (Offshore Scope), Pharaonic Petroleum Co. (PhPC), 2017
  - Tahrir Petrochemicals Complex, Ain Sokhna, Suez, Egypt, Tahrir Petrochemicals, 2016
  - Ammonia Plant (as built addendum), Suez Industrial Zone, Egypt, EBIC, 2015
  - Ammonium Nitrate Plant Expansion (addendum) (Management of Surplus Nitric Acid), Ain Sokhna, Egypt; Notification of Design Changes (As-Built Design) and Project Modifications, EHC, 2015
  - Bahrain LNG Floating Terminal, Galawy Group/Nogaholding, 2014

- Urea & Ammonia Facility (update/addendum), Damietta, Egypt, MOPCO, 2011
- Methanol & Ammonia Complex, Suez Industrial Zone, Ain Sokhna, Egypt, EJPC, 2011
- **45+** Screening and Scoped EIAs, Onshore and Offshore activities, BP, 2010-ongoing

- Screening and Scoping Reports
  - Waad Al Shammal Wind Project, KSA, Ministry of Energy, 2021
  - Tabarjal Solar PV Solar Park, KSA, Ministry of Energy, 2021
  - Al-Kahfah Solar PV Park, KSA, Ministry of Energy, 2021
  - Al Henakiyah CSP/PV Solar Power Plant, KSA, Renewable Energy Project Development Office (REPDO), 2020
  - Layla Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Wadi Ad Dawasir Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Saad Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Ar Rass Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Qurayyat Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
  - Compressed Natural Gas Station in Mesaieed Industrial City (MIC), Qatar Petroleum, Qatar, 2019
  - Compressed Natural Gas Station in Ras Laffan Industrial City (RLIC), Qatar Petroleum, Qatar, 2019
  - AlFaisaliya Solar PV Park, KSA, Renewable Energy Project Development Office (REPDO), 2018
  - Mahad Al Dahab Solar PV Park, KSA, REPDO, 2018
- Pre-ESHIA for West Sherbean Onshore Concession (Block 11) 3D Seismic Acquisition, IEOC Production B.V., 2021
- Biodiversity and Ecosystem Services Baseline Study for Sinai Fields - Desktop Study, IEOC Production B.V., 2020
- Environmental Baseline Assessment for West Sherbean Onshore Concession (Block 11), IEOC Production B.V., 2020
- Environmental Baseline Survey for Tarif Deep-1 Exploratory Drilling, North El Mahala Onshore Concession, NEMO Block 2, East Nile Delta, Egypt, TOTAL E&P Egypte, 2017
- Environmental Baseline Offshore Survey for Atoll Field, East Nile Delta, Egypt, PhPC, 2017

Environmental Regulatory Compliance and Due Diligence

Identification of applicable regulatory frameworks, environmental permitting processes and planning. Key project (partial list):

- Due Diligence, Solar assets in Egypt, Confidential Client, 2021
- Environmental and Social Risks Identification, Oil and Gas Activities in the Egyptian Red Sea, Confidential Client, 2019
- Environmental and Social Due Diligence, Chemicals Facility, Confidential Client, 2019
- Environmental Permitting Roadmap, Offshore and Onshore Egypt, Confidential Client, 2019
- Environmental and Social Audit, Oriental Petrochemicals Company (OPC) Expansion Project, OPC, 2016
- Environmental Impact Strategy and Early Environmental Permitting, Egypt, Confidential Client, 2015

Environmental and Social Management Plans (ESMP)

ESMPs for construction and operation phases. Key projects (partial list):

- EHC Expansion, Suez, Egypt, 2020
- Wadi Ad Dawasir Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
- Saad Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
- Ar Rass Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
- Layla Solar Energy Park, KSA, Renewable Energy Project Development Office (REPDO), 2019
- Oriental Petrochemicals Company (OPC) Expansion Project, Oriental Petrochemicals, 2016
- Construction Environmental Management Plan (CEMP)/EIA for Expansion of the Fujairah Navy Base Project, Fujairah, United Arab Emirates, China Harbour Engineering Company Ltd. (CHEC), 2014

Stakeholder Engagement

Stakeholder Engagement Plan frameworks, stakeholder groups identification and SWOT analysis.

- Stakeholder Management Plan Updates, First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, NPPA, 2019-2021
- Stakeholder Engagement Plan, Tahrir Petrochemicals Complex, Ain Sokhna, Suez, Egypt, Carbon Holdings Limited, 2019
- Stakeholder Management Plan, First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, NPPA, 2017-2019
- Annual Communication Plan, First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, NPPA, 2018
- Internal Communications Procedures, First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, NPPA, 2018
- External Communications Procedures, First Egyptian Nuclear Power Plant, El Dabaa, Marsa Matrouh, NPPA, 2018

Environmental Monitoring Plans (EMP)

Design and management of monitoring activities, including technical support to field activities and QA/QC of laboratory analysis reports. Key projects (partial list):

- Giza-Fayoum and Raven Operations Environmental Monitoring - Ambient Air Monitoring, , Idku, El-Beheira, Egypt, BP Exploration (Delta) Limited, 2021
- Giza-Fayoum and Raven Operations Environmental Monitoring, Idku, El-Beheira, Egypt, BP Exploration (Delta) Limited, 2020
- Environmental Monitoring, West Nile Delta Gas Development Project, Idku, El-Beheira, Egypt, 2016-2019, Bechtel, 2016 - 2019
- Environmental Monitoring, Tarif Deep-1 Drilling and Testing Phase, Nile Delta, Egypt, TOTAL, 2017
- Environmental Construction Monitoring Program, Ammonium Nitrate Plant, Ain Sokhna, Suez, Egypt, EHC, 2012-2014
- Environmental Monitoring Programme, Operation of Methanol Facility, Damietta, Egypt, EMethanex, 2011-2012
- Environmental Monitoring, Indoor Air and Wastewater Quality. R&D Lab, Cairo, Egypt, Henkel, 2012
- Environmental Construction and Commissioning Monitoring Program, Methanol Facility, Damietta, Egypt, TECHINT Engineering & Construction, 2010-2011

Sustainability Reporting

Technical support and management of sustainability reports following applicable guidelines (GRI and other). Key projects (partial list):

- Borouge Annual Sustainability Reports, 2015-2020, UAE
- Zakum Development Co. (ZADCO) Sustainability Report 2014, UAE
- Abu Dhabi Co. (ADCO), Onshore Petroleum Operations Ltd. Sustainability Report 2014, UAE
- Zakum Development Co. (ZADCO) Sustainability Report 2013, UAE.

Qualifications / Affiliations

Education

- GRI Standards Exam, Passed, 2018
- Professional Program Certificate in Occupational Health, Safety and Environmental Control (HSE) OSHA, The American University in Cairo (AUC), Engineering and Science Services, 2013
- MSc, Environmental Engineering, AUC, School of Science and Engineering, 2009
- BSc, Ain Shams University, Faculty of Engineering, Civil Department, 2005

Affiliations

- Environmental Specialist (Registration No. 40/9/10/2016), Egyptian Environmental Affairs Agency (EEAA), Environmental Impact Assessment development and review
- Member of Institute of Environmental Management & Assessment (IEMA), UK, Affiliate Member 2014-2018
- Member of International Association for Impact Assessment, Member 2015-2018
- Member of the Egyptian Engineers Syndicate since 2005

Specific Technical Expertise/Specialist Courses

- New Managers Success Camp, The American University in Cairo (AUC), School of Continuing Education, 2019
- E-learning Master Class on EIB - Environmental and Social Sustainability Management, Frankfurt School of Finance & Management, 2019
- Introduction to the World Bank Environmental and Social Framework, The Open Learning Campus, World Bank Group, 2019
- Sustainability Training and E-Learning Program (STEP), The Open Learning Campus, IFC, 2019
- Site Health Considerations Workshop, ISOS, 2018
- Statistical Package for the Social Sciences (SPSS) Workshop, AUC, 2018
- Progressing on SDGs through GRI Disclosures, GRI, 2018
- UNEP Finance Initiative Introductory Seminar on Environmental & Social Risk Analysis (ESRA), 2017
- Introduction to GRI and Sustainability Reporting Standards, GRI, 2017
- Orientation Day on the 2006 IPCC Introduction and Cross-Cutting issues, The Biennial Update Report Project (BUR), Egyptian Ministry of Environment, 2017
- Sustainability in Construction – A Middle East Perspective Webinar, Institute of Environmental Management & Assessment (IEMA), 2017
- Survey Design and Analysis Workshop, AUC, 2017
- Elements of Renewable Energy, The Open University (UK), 2017
- Effective Project Management Using Metrics, KPIs and Dashboards, AUC, 2017
- Capacity Building Workshop for Local Consultants on Environmental, Health & Safety and Social (EHSS) Policies, Procedures and Due Diligence Requirements, The European Bank for Reconstruction and Development (EBRD) and Environmental Resources Management (ERM), Cairo, 2016

Languages

- ARABIC: Mother tongue
- ENGLISH: Fluent verbal and written

- SPANISH: Basic Knowledge

Publications / Presentations

- Zakaria, Y., El Gendy, A. and El Haggar, S. (2021) Sustainability Assessment for Wastewater Treatment Systems—Case Studies in Egypt. *Journal of Environmental Protection*, **12**, 90-105. doi: 10.4236/jep.2021.122007.
- Ahmed, YZ and El-Gendy, A and El-Haggar, S (2017). Sustainability Assessment of Municipal Wastewater Treatment. International Journal of Environmental, Chemical, Ecological, Geological and Geophysical Engineering Vol:11, No:2. 19th ICEPSD, Amsterdam, The Netherlands (Best Paper Award)
- Zakaria, Y and Smith, E (2010). Pb (Π) Adsorption using Clayey Sediments Retained by the Aswan High Dam, paper presented at CESD 2010, Singapore
- Zakaria, Y and Smith, E (2010). Physical-Chemical Surface Characterization of Lake Nasser Sediments, World Academy of Science, Engineering and Technology. Issue 66:1600-1605

Work history

2020 - present	Study Manager, Advisian-Worley Group, Cairo, Egypt
2011 - 2019	Senior Environmental Consultant, Advisian-Worley Group, Cairo, Egypt
2010 - 2011	Environmental Engineer, WorleyParsons, Cairo, Egypt
2009 - 2019	Teaching Assistant, Construction and Architecture Department, The American University in Cairo (AUC), Egypt
2009 - 2010	Environmental Engineer, EcoConServ Environmental Solutions, Egypt
2008 - 2009	Research Assistant (Master programme), AUC, Egypt
2006 - 2008	Highways Engineer, General Authority of Roads, Bridges and Land Transportation, Egypt



Mahmoud Hashish

SUPERVISOR ENVIRONMENT AND SUSTAINABILITY CONSULTANT

Mahmoud is a **Supervisor Environment and Sustainability Consultant, IEMA Practitioner** and certified by the International Register of Certificated Auditors (IRCA) as a **Lead Auditor for ISO 14001/2015** with 16 years of experience in Environment, Sustainability and Waste Management. He has actively managed and participated in several environmental and social studies, including ESIA, EIA, environmental regulatory compliance review, ESMP, Stakeholder Engagement Plans and environmental monitoring programs that met national standards and international guidelines (e.g., GAMEP, World Bank, IFC, Equator Principles, etc.). He has provided technical leadership on a range of different Environmental and Waste Management projects for industrial, private sector and governmental clients. He has responsibilities for planning and coordinating the execution of consultancy services for multi-million dollar projects. He has experience of building and developing commercial relationships with business partners, universities and institutes and of delivering corporate environmental and sustainability objectives. Mahmoud has an extensive experience for Middle East projects (in Egypt, Saudi Arabia and Oman). Presently, he is leading the Environment and Sustainability team in Jacobs.

Relevant Project Experience

Supervisor Environmental and Sustainability Consultant, Jacobs, Saudi Arabia, June 2015 till present

Saudi Aramco, Green Energy Program

July 2019 – June 2020

Mahmoud acts as a senior project engineer on the program providing project management support in terms of scope, cost, schedule, resources and risk management. In addition to providing quality support for the project deliverables. Mahmoud also has the responsibility for liaison and interface management with the client; as well as the project execution offices. In this project, Saudi Aramco aims to launch several initiatives that have high public visibility which result in carbon emissions reduction and expand the company outreach. The Saudi Aramco Green Energy Program covers forestation, plastic recycling, vertical farming, biofuels, waste-to-energy, sustainability procurement and sustainability reporting.

Saudi Aramco, Environmental Compliance Monitoring Services Program

July 2018 – April 2019

Mahmoud performs the role of project manager in the program providing program overall management support in terms of scope, cost, schedule, resources and risk management. In addition to providing technical support for the project team on site as well as the project deliverables. The program is the first of this kind in Saudi Aramco to evaluate Saudi Aramco projects environmental performance against local and international legislations and in accordance with ISO14001/2015 standards. The program is developed to assess the project's environmental management system and evaluate implementation of the environmental commitments of the ESIA, CEMP and EMP and support the project team to identify opportunities for continual improvement in environmental performance of the project. In addition, working with the project team to recommend and implement corrective actions in the event of any significant audit findings.

EDUCATION/QUALIFICATIONS

PhD Student, Environmental Management, University of Mansoura, 2016

MSc Chemistry, University of Mansoura, 2009

BSc (Hons) Chemistry and Biochemistry, University of Mansoura, 2002

MEMBERSHIPS AND AFFILIATIONS

IEMA Practitioner

Certified ISO14001/2015 Lead Auditor – IRCA

PMI-member (*prepare for PMP exam*)

REGISTRATIONS/ CERTIFICATIONS

OSHA Construction Industry Safety & Health, OSHA General Industry Safety & Health, National Association of Safety Professionals, MOS Certificate (Microsoft Office Specialist)

LANGUAGES

Arabic – Native

English - Fluent

OTHER

- Year Joined JACOBS 2015
- Al Khobar Office, SA
- Egyptian
- Mob. +966542059678

mahmoud.hashish@jacobs.com

Saudi Aramco, Lubref Plant, Environmental Gap Analysis and Environmental Permitting Strategy, Jeddah, Saudi Arabia

July 2019 – September 2019

Mahmoud performed the role of lead environmental consultant in the project. Mahmoud established a permitting strategy roadmap to communicate the key steps for the plant to successfully obtain the required environmental permits from the regulator; and define the anticipated timelines for securing these permits. Also, Mahmoud conducted a gap analysis of the relevant environmental legislative requirements against the existing environmental performance at the plant.

Saudi Aramco, Final Abqaiq Homeownership Development, EIA, Eastern Province, Saudi Arabia

April 2019 – June 2019

Mahmoud performed the role of lead environmental consultant. Mahmoud managed the environmental impact assessment team and conducted technical review for the EIA report. He participated in environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. The Project will provide final site development for homeownership lots and community support facilities for Saudi Aramco employees.

Saudi Aramco, Initial Abqaiq Homeownership Development, EIA, Eastern Province, Saudi Arabia

April 2019 – June 2019,

Mahmoud performed the role of lead environmental consultant. Mahmoud managed the environmental impact assessment team and conducted technical review for the EIA report. He participated in environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. The Project will provide initial site and utilities development for homeownership lots and community support facilities for Saudi Aramco employees.

Saudi Aramco, Initial Al Hasa Homeownership Development, EIA, Eastern Province, Saudi Arabia

April 2019 – June 2019

Mahmoud performed the role of lead environmental consultant. Mahmoud managed the environmental impact assessment team and conducted technical review for the EIA report. He participated in environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. The Project will provide initial site and utilities development for homeownership lots and community support facilities for Saudi Aramco employees.

Saudi Aramco, Pipeline Rehabilitation, EIA, Eastern Province, Saudi Arabia

May 2018 – August 2018

Mahmoud performed the role of lead environmental consultant. Mahmoud managed the environmental impact assessment team and conducted technical review for the EIA report. He participated in environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. This project is for replacing pipeline sections at Uthmaniyah and Abqaiq and installation corrosion inhibition injection skids for pipeline systems.

InoChem Soda Ash and Calcium Chloride Plant, EIA, Ras Al Khair, Saudi Arabia

May 2018 – July 2018

Mahmoud provided senior environmental support to the project and undertook specialist environmental and social impact assessment for multi-disciplinary chapters of the EIA. This project is for a new Soda Ash and Calcium Chloride Plant in Ras Al Khair Industrial City and all related utilities.

Confidential Client, Confidential Project, Environmental Site Assessment, Western Province, Saudi Arabia

April 2018 – August 2018

Mahmoud performed the role of lead environmental consultant, providing project management support. Mahmoud undertook the

Phase 1 Environmental Site Assessment for multiple sites in the western province in Saudi Arabia for a confidential project in accordance with ASTM E1527-13 standards.

Saudi Aramco, Replace HIC Affected Vessels Project, Eastern Province, Saudi Arabia

February 2018 – March 2018

Mahmoud performed the role of lead environmental consultant. Mahmoud managed the environmental impact assessment team and conducted technical review for the EIA report. He participated in environmental and social impact assessment for multi-disciplinary chapters of the EIA. The project concerns the replacement of four existing non-Hydrogen Induced Cracking (HIC) resistance pressure vessels to meet the Crude Program objective of maintaining crude oil production and MSC targets from South Ghawar Fields.

Saudi Aramco, Yanbu Distribution Hub Facility Project, Yanbu, Saudi Arabia

January 2018

Mahmoud is performing the role of lead environmental consultant, providing project management support. Mahmoud complete a review of the EIA submitted at FEED phase and validate the adequacy of the assessment for the Detailed Design phase of the Project against Saudi Aramco Engineering Procedures (SAEP-13), Appendix C.

Senior Environmental Scientist, JACOB, Saudi Arabia, Jun 2015 till Dec 2017

Saudi Aramco, Sakaka Solar Farm, National Renewable Energy Program, Al Jouf, Saudi Arabia,

September 2016 - January 2018

Mahmoud is performing the role of lead environmental consultant, undertaking environmental and social impact assessment for multi-disciplinary chapters of Environmental and Social Impact Assessment (ESIA). Mahmoud also is responsible for undertaking the site survey including phase1 habitat mapping, noise survey and traffic survey and supporting bird survey. In addition, Mahmoud is identifying and engaging with key Government stakeholders and securing relevant permits and no-objection authorizations for the project. Sakaka Solar Farm project will utilize photovoltaic (PV) technology to produce 1 Giga-Watt (GW) of power. This EIA has been carried out in accordance with IFC performance standards, Equator Principles and GAMEP rules and regulations.

Saudi Aramco, Midyan Wind Farm, National Renewable Energy Program, Tabuk, Saudi Arabia
September 2016-June 2017

Mahmoud is performing the role of lead environmental consultant, undertaking environmental and social impact assessment for multi-disciplinary chapters of the Environmental and Social Impact Assessment (ESIA). Mahmoud is also responsible for undertaking the site survey including phase1 habitat mapping, noise survey and traffic survey and supporting bird survey. In addition, Mahmoud is identifying and engaging with key Government stakeholders and securing relevant permits and no-objection authorizations for the project. Midyan Wind Farm project will utilize wind technology to produce 500 Mega-Watt (MW) of power. This EIA has been carried out in accordance with IFC performance standards, Equator Principles and GAMEP rules and regulations.

Saudi Aramco, Dumat Al-Jandal Wind Farm, National Renewable Energy Program, Al Jouf, Saudi Arabia

September 2016 - August 2017

Mahmoud is performing the role of lead environmental consultant, undertaking environmental and social impact assessment for multi-disciplinary chapters of the Environmental and Social Impact Assessment (ESIA). Mahmoud is also responsible for undertaking the site survey phase1 habitat mapping, noise survey and traffic survey and supporting bird survey. In addition, Mahmoud is identifying and engaging with key Government stakeholders and securing relevant permits and no-objection authorizations for the project. Dumat Al-Jandal Wind Farm project will utilize wind technology to produce 400 Mega-Watt (MW) of power. This EIA has been carried out in accordance with IFC performance standards, Equator Principles and GAMEP rules and regulations.

Saudi Aramco, Jeddah Bulk Plant Project, Jeddah, Saudi Arabia

December 2017

Mahmoud is performing the role of lead environmental consultant, providing project management support. Mahmoud complete a review of the EIA submitted at FEED phase and validate the adequacy of the assessment for the Detailed Design phase of the Project against Saudi Aramco Engineering Procedures (SAEP-13), Appendix C.

Saudi Aramco, Berri Increment Program, EIA & PAP, Jubail, Saudi Arabia

October 2015 – March 2018

Mahmoud is performing the role of lead environmental consultant, providing support to Saudi Aramco's Berri Increment program and the development of off-shore drilling islands, including the delivery of a package of consents and approvals from Royal Commission, General Authority for Meteorology and Environment and the client. The project concerns the development of two nearshore islands in the Gulf of Arabia for the location of upstream assets to enable the recovery of reserves from an existing reservoir. The work requires the integration of Ports and Marine Engineering, Marine Modelling, ESIA and Consultation activity across three continents. Consultees include two operational ports, the coast Guard, local municipalities and Saudi Rail Authority who are also developing in the vicinity.

Saudi Aramco, Confidential Facility Refined Products Supply Pipeline, EIA, Jeddah, Saudi Arabia

November 2017

Mahmoud is performing the role of lead environmental consultant, providing project management support. Mahmoud undertook environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. This project is for installation of a new refined products pipeline to replace an existing pipeline for a confidential facility in Jeddah.

Saudi Aramco, Upgrade Airport Runway, Shaybah, Eastern Province, Saudi Arabia

August 2017

Mahmoud is performing the role of lead environmental consultant, undertaking environmental and social impact assessment for multi-disciplinary chapters of the EIA. The project involves an upgrade of the existing airport runway by rehabilitating the existing long concrete runway.

Saudi Aramco, Jubail – Ras Tanura Pipeline Project, Jubail, Saudi Arabia

May 2017

Mahmoud is performing the role of lead environmental consultant, providing project management support. Mahmoud undertook environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. This project is for installation of a new refined products pipeline from Jubail to Ras Tanura.

Saudi Aramco, Abqaiq Upgrading Water Reinjection System Project, Abqaiq, Saudi Arabia

April 2017

Mahmoud is performing the role of lead environmental consultant, providing project management support. Mahmoud undertook environmental and social impact assessment for multi-disciplinary chapters of the EIA. Mahmoud coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. This project is for upgrading water reinjection system for GOSP plants in Abqaiq.

Saudi Aramco, Wellcore Facility, EIA, Dhahran, Saudi Arabia

January 2017

Mahmoud performed the role of lead environmental consultant providing project management support. Mahmoud undertook environmental and social impact assessment for multi-disciplinary chapters for the project. The project is for installation of a new storage building and research facilities within the Dhahran campus. The new facility will comprise of core-sample storage facilities and new research laboratories, offices, support and storage areas, and parking.

British Petroleum, KHAZZAN Project, Oman

October 2015 – December 2017

Mahmoud is performing the role of lead environmental consultant, providing project management support and specialist technical advice and oversight of site activities. In this role Mahmoud has reviewed engineering design changes and authored environmental change assessment reports for the BP Khazzan project in accordance with BP environmental procedures. He has also taken the lead for the procurement of a permanent air quality monitoring station including the preparation of tender documentation, review vendor documents and support station engineering scope. Mahmoud is also supporting the permitting scope of the project including developing permit compliance plan and permit monthly reports in addition to review permit applications. Mahmoud is performing technical review and regular update of environmental management documents (e.g. Environmental Management Plan, Environmental and Social Monitoring and Management Plan, monthly Environmental and Social Reports).

Saudi Aramco, Fadhili Gas Plant, Eastern Province, Saudi Arabia

September 2017

Mahmoud is performing the role of lead environmental consultant, undertaking technical review of the Environmental Management System Action Plans and ensure the competency of these plans with the project design. Mahmoud also is responsible for confirming the compliance of the project design aspects with the Saudi Aramco environmental standards. The Fadhili Gas Plant will process gas from the Khursaniyah and Hasbah fields to produce sales gas, liquid sulfur, and fuel gas suitable.

Saudi Aramco, Dhahran-Ras Tanura Pipeline Corridor Public Parks Project, Dammam, Saudi Arabia

November 2016

Mahmoud is performing the role of lead environmental consultant, providing project management support. Mahmoud is also undertaking environmental and social impact assessment for multi-disciplinary chapters of the EIA. This project is for development of the inland portion of the Dhahran-Ras Tanura (DRT) Pipeline Corridor into Public Parks.

Saudi Aramco, Crude Oil To Chemicals Project, Saudi Arabia

October 2016

Mahmoud is performing the role of lead environmental consultant, developing the Environmental Screening Questionnaire templates for project operational cases. This project is for development of a fully integrated crude oil-to-chemicals complex in order to maximize chemicals production with high profitability out of crude oil with minimum fuel production and transforming and recycling by-products.

Saudi Aramco Total Refining and Petrochemicals, Emergency Siren Noise Study, Jubail, Saudi Arabia

May 2016 – June 2016

Mahmoud is the senior environmental consultant, responsible for undertaking the monitoring survey for ambient noise levels within SATORP. In addition to coordinating and gathering the required data for executing the technical noise modelling assessment of the emergency sirens at SATORP to determine compliance with industry design standards. This included designing and executing comprehensive noise sampling within the refinery facility and coordinating the modelling activities of the acoustic consultants. The modelling outputs will be used to inform the design of the emergency siren system, including the number and location of the sirens in order to achieve a 15dB sound level above ambient background.

YANSAB, Ethylene Glycol DBN Project, Yanbu, Saudi Arabia

January 2016 – February 2016

Mahmoud performed the role of senior environmental consultant and coordinated the environmental site surveys, including the design and execution of field investigations including noise monitoring, air quality sampling, traffic counts and ecological survey. The data from these surveys fed into the environmental impact assessment and permit application package for the Yansab Ethylene Glycol expansion project.

Arabian Amines Company, Best Practicable Environmental Option, Jubail, Saudi Arabia

October 2015 – December 2015

Mahmoud performed the role of senior environmental consultant and provided management support for the procurement of waste management contractors including the technical bid evaluation for proposals and conducting waste management assessment.

SADARA EO PO Pipeline, Permit Application Package and EIA, Jubail, Saudi Arabia

August 2015 – December 2015

Mahmoud performed the role of senior environmental consultant and provided management support, assisting with the preparation and on-going management of work plans, work schedules, task assignments, hours and rate structure and coordinating with project team members. In addition, he undertook environmental and social impact assessment for multi-disciplinary chapters of the EIA and prepared the Permit Application Package. This project is for the construction of new pipelines with associated facilities in order to transport ethylene oxide (EO) and propylene oxide (PO) from SADARA Plant to Royal Commission Value Park.

Saudi Aramco, Yanbu to Jeddah Pipeline, ESIA

July 2015

Mahmoud provided senior environmental support to the project and undertook specialist environmental and social impact assessment for archaeology and cultural heritage and environmental baseline condition chapters. This project is for a proposed pipeline to transport refined products from Yanbu Distribution Hub, to the North Jiddah Bulk Plant.

IDEA Soda Ash and Calcium Chloride Plant, EIA, Yanbu, Saudi Arabia

June 2015 – July 2015

Mahmoud provided senior environmental support to the project and undertook specialist environmental and social impact assessment for multi-disciplinary chapters of the EIA. This project is for a new Soda Ash and Calcium Chloride Plant in Yanbu Industrial City and all related utilities.

Senior Environmental Specialist, Environmental Horizons Co., Saudi Arabia, September 2010 to May 2015

EIA Projects

Mahmoud conducted the environmental and social impact assessment for multi-disciplinary chapters of the following projects in accordance with GAMEP, RC Jubail & Yanbu, Saudi Aramco, USEPA, EU Commission, IFC performance Standards, and Equatorial Principles:

- **WAAD ALSHAMAL Combined Cycle Power Plant, WAAD ALSHAMAL, Saudi Arabia**
- **Duba Solar Thermal Combined Cycle Power Plant, Tabuk Region, Saudi Arabia**
- **PP13 Combined Cycle Power Plant, Riyadh, Saudi Arabia**
- **PP14 Combined Cycle Power Plant, Riyadh, Saudi Arabia**
- **Arar Combined Cycle Power Plant, Arar, Saudi Arabia**
- **Rafha Combined Cycle Power Plant, Northern Board Region, Saudi Arabia**
- **Marafiq, Fuel Supply Facilities – Package 3, Yanbu, Saudi Arabia**
- **Air Liquide, Industrial Gases Project, Yanbu, Saudi Arabia**
- **AL MASANE AL KOBRA Mining Company, Mining Facility Project, Najran, Saudi Arabia**
- **Cristal Global Co., Titanium Dioxide Products Project, Yanbu, Saudi Arabia**

- **Lubrizol Trans-Arabian Co., Oil Additives Production Project, Yanbu, Saudi Arabia**
- **Safra Co. Ltd, Petrochemical Refinery Project, Yanbu, Saudi Arabia**
- **Bilfal, Heavy Industries Project, Yanbu, Saudi Arabia**
- **Integrated Industrial Waste Management & Recycling Complex, Yanbu, Saudi Arabia**
- **Nestle food industry plant, Jeddah, Saudi Arabia**
- **Nazir Chudary for Chemical Industries, Rabigh, Saudi Arabia**
- **TOYOTA Vehicle & Accessory Stock Yard, King Abdullah Economic City, Saudi Arabia**
- **Sanofi-Aventis, King Abdullah Economic City, Saudi Arabia**
- **BAWABT MAKKAH Project, Jeddah Makkah Highway, Saudi Arabia**
- **ALWAJEH Chalets, Madinah Region, Saudi Arabia**
- **Yanbu Steel Plant, Yanbu, Saudi Arabia**
- **United Mining Industries Plant, Yanbu, Saudi Arabia**
- **Medical Services Co., Rabigh, Saudi Arabia**
- **Environmental Horizons Hazardous Waste Landfill, Johfa, Rabigh, Saudi Arabia**
- **GAC for Ready Mix Concrete, Yanbu, Saudi Arabia**
- **RADWA for Feed Products, Jeddah, Saudi Arabia**
- **Bait Jameel Precast Factory Phase I & Phase II, King Abdullah Economic City, Saudi Arabia**
- **ALJ Oil Co., King Abdullah Economic City, Saudi Arabia**

Waste Management Projects

Fly Ash Management Project (Transportation, Treatment & Disposal), Saudi Electricity Company, Shoaibah & Rabigh Power Plants, Saudi Arabia

Mahmoud managed the process of hazardous waste collection, transportation, treatment and safe disposal.

Fly Ash Management Project (Transportation, Treatment & Disposal), Saline Water Conversion Corporation, Shoaibah & Rabigh Power Plants, Saudi Arabia

Mahmoud managed the process of hazardous waste collection, transportation, treatment and safe disposal.

Fly Ash Management Project (Transportation, Treatment & Disposal), SEPCO III Power Plant, Rabigh, Saudi Arabia

Mahmoud managed the process of hazardous waste collection, transportation, treatment and safe disposal.

Design, construct and operate hazardous waste landfill facility of Environmental Horizons Co. in Johfa - Rabigh – Saudi Arabia

Mahmoud has assessed and classify the received hazardous waste material according to hazardous waste environmental complying manual. He also has managed the process of hazardous waste collecting, transport, treatment and safe disposal.

Environmental Auditing Projects

Saudi Electricity Company, Shoaibah Power Plant, Shoaibah, Saudi Arabia

Mahmoud has performed the periodic environmental audits to assess the compliance of Shoaibah power plant with the environmental standards and regulations as outlined in the operational environmental management and monitoring plan in accordance with IFC and PME standards. The audit comprised site inspection, environmental management documentation review and environmental compliance documentation review. The audit also included undertaking noise monitoring, air quality monitoring and water and soil samples collection.

Saudi Electricity Company, Rabigh Power Plant, Rabigh, Saudi Arabia

Mahmoud has performed the periodic environmental audits to assess the compliance of Rabigh power plant with the environmental standards and regulations as outlined in the operational environmental management and monitoring plan in accordance with IFC and PME standards. The audit comprised site inspection, environmental management documentation review and environmental compliance documentation review. The audit also included undertaking noise monitoring, air quality monitoring and water and soil samples collection.

Saudi Electricity Company, Shuqaiq Power Plant, Shuqaiq, Saudi Arabia

Mahmoud has performed the periodic environmental audits to assess the compliance of Shuqaiq power plant with the environmental standards and regulations as outlined in the operational environmental management and monitoring plan in accordance with IFC and PME standards. The audit comprised site inspection, environmental management documentation review and environmental compliance documentation review. The audit also included undertaking noise monitoring, air quality monitoring and water and soil samples collection.

Survey Projects

Mahmoud has acted as a professional surveyor in Jeddah Master Plan Project (Terrestrial Ecology Survey – Jeddah - KSA). He has also participated in Green Kingdom Waste Project (Plastic Wastes in Western Region - KSA). In addition he has conducted coastal survey of ALWAJEH City Chalets Project – Saudi Arabia.

Strategic Projects

Installation and preparation of Excellency Center for Environmental Technologies, Researches & Studies in the Presidency of Meteorology & Environment

Participate in the Environmental Technology transfer on the national level in Saudi Arabia within the project of Installation and preparation of Excellency Center for Environmental Technologies, Researches & Studies in the Presidency of Meteorology & Environment in cooperation with Center for Environment and Development for the Arab Region and Europe (CEDARE).

Environmental Researcher – Egyptian Environmental Affairs Agency, Ministry of Environment, Egypt. October 2003 to September 2010

Environmental Inspection & Auditing Projects

Mahmoud has conducted Environmental Inspection and Auditing for more than 500 plants and facilities in different industrial sectors all over Egypt (e.g. Oil & Gas, Petrochemical, Infrastructure, Metal & Steel, Mining, Power Plants, Cement Plants, Ready Mix Concrete Plants, Water Treatment Facilities, Medical Facilities, Food Industries, Chemical Industries, Pharmaceutical Industries, Paintings, Hazardous Wastes Landfills, Fish and Shrimp Farms, Poultry Farms, Marina Anchors, Touristic Facilities) in accordance with Egyptian Environmental Law no. 4/1994.

Mahmoud has also participated in the Environmental Conditions Reconciling Project for Industrial facilities in 10th of Ramadan City – Egypt. In addition he has participated in the Environmental Conditions Reconciling Project for Medical Facilities in Eastern Delta – Egypt.

Legislation & Permitting

Mahmoud has conducted and reviewed EIAs in different industrial sectors (e.g. Oil & Gas, Petrochemical, Infrastructure, Metal & Steel, Mining, Power Plants, Cement Plants, Ready Mix Concrete Plants and Water Treatment Facilities) all over Egypt in order to issuing the required environmental permits. In addition he has participated in the preparation of the Waste Management Legal Framework in Egypt.

Quality Management System ISO 9001/2008

Mahmoud has conducted in the installation, initiation and implementation of Quality Management System ISO 9001/2008 in the Egyptian Environmental Affairs Agency – Egypt. He also has acted as a director of Quality Management Department in the Egyptian Environmental Affairs Agency.

Acute Air Pollution Control Program in Eastern Delta – Egypt

Mahmoud has participated in the Acute Air Pollution Control Program which is resulting from the burning of rice straw wastes in the Eastern Delta – Egypt.

Training and Awareness

Mahmoud has conducted HSE training courses in Industrial Modernization Center Projects (Egyptian Ministry of Trade and Industry) for the development of HSE & administrative capacity and management for projects with governmental & non-governmental authorities. He also has provided training sessions for municipalities on solid waste management concepts and techniques. In addition he has provided HSE training programs for the labors and technical staff in the industrial facilities.



Hussain Al Baqshi

ENVIRONMENTAL ENGINEER

Hussain Al Baqshi is an **Environmental Engineer** with over 6 years' felid experience in the environment, Water quality, Waste Management, occupational Safety and health discipline. Hussain received several Saudi Aramco approvals to perform the role of EPC Environmental Coordinator for several Saudi Aramco mega projects; and he acted as leader engineer of the Environmental Coordination team, Environmental Inspection team as well. Hussain has extensive site-based experience in environmental management and has previously performed and supervised environmental management / compliance surveys in the field, He provides specialist and technical environmental support to projects and managing the activities of environmental disciplines within the construction, infrastructure, oil/gas and refinery sectors. Using his technical experience, Hussain provides technical inputs and support to Environmental Impact Assessments (EIA) and construction environmental management programs (e.g. environmental management plans and programs, environmental policies, environmental resource conservation plans and environmental compliance action plans) in compliance with national standards and regulations (e.g. Saudi Aramco, GAMEP). Currently Hussain is lead auditor of environmental compliance, on behalf of Saudi Aramco Environmental Protection Department, for the mega projects in Kingdom.

Relevant Project Experience

Environmental Engineer, JACOBS, Saudi Arabia, March 2019 till Present

- **Saudi Aramco, Environmental Monitoring Services: Jazan City Infrastructure & Ports Division, Jazan IGCC Power Plant, Maritime Yard, Tanajib Gas Plant, Marjan & Zuluf Field Development Program, King Salman Energy Park (SPARK), Gas Compression Program and the South Dhahran Homeownership Project (Ajyal), Saudi Aramco**

Hussain performs the role of Lead Auditor for Saudi Aramco's Environmental Compliance Auditing program for its mega-projects. Hussain is undertaking regular environmental compliance inspections at these eight (8) Mega-Projects to assess compliance across a wide-range of environmental disciplines. This involves regular site visits to onshore and near-shore operations followed by technical report to the client, including calculation of KPIs for each project and providing comprehensive detailed databases of health and environmental findings in the projects sites. As part of the three (3) to five (5) year monitoring program he works closely with Saudi Aramco Project Management Team to assess compliance in accordance with EIA commitments, Saudi Aramco Standards and government regulations (i.e. GAMEP and Royal Commission) prior to providing recommendations and action items to improve environmental management approaches across the projects. The objective of the program is to evaluate Saudi Aramco projects environmental performance against local and international legislations and environmental management system and evaluate implementation of the environmental commitments of the ESIA.

EDUCATION/QUALIFICATIONS

BSc in Environmental Engineering,
University of Dammam
2009-2014
Saudi Arabia

REGISTRATIONS/ CERTIFICATIONS

- OSHA 30 hours
- IOSH Managing safely

TRAINING

- Working at height training.
- Slinging and rigging training.
- Power & hand tools training.
- Accident/incident reporting training.
- Job safety analysis (JSA) training.
- Permit to work system training.
- Job safety analysis training.
- Emergency First Aid at Work.
- Defense Driving.
- Site Risk Assessment.
- Auto-CAD Skill.

LANGUAGES

Arabic- Native
English – Fluent

OTHER

- Year Joined JACOBS 2019
- Al Khobar Office, SA
- Saudi
- Mob. +966 500 055 473

hussain.albaqshi1@jacobs.com

- **Marafiq Yanbu Solar Energy Power Plant**

Hussain undertook site visits, including noise surveys, and originated the entire Preliminary ESIA for PV solar park in Yanbu industrial city in western of Saudi Arabia. This included waste management, hydrology, soils and geology, air quality, noise, terrestrial biodiversity, utilities & infrastructure, transportation, socio economic aspects, health & safety, monitoring & management plan, and emergency plan.

- **Replace Abqaiq Community HVAC System**

Hussain undertook site visits, including noise surveys, and originated the entire ESIA for HVAC system replacement in Abqaiq community residential in the Eastern Province of Saudi Arabia. This included waste management, hydrology, soils and geology, air quality, noise, terrestrial biodiversity, utilities & infrastructure, transportation, socio economic aspects, health & safety, monitoring & management plan, and emergency plan.

- **Saudi Aramco, Pipeline Reroute, EIA, Eastern Province, Saudi Arabia May 2019**

Hussain performed the role of project environmental engineer, providing project inputs and support to Environmental Impact Assessments. Hussain undertook environmental and social impact assessment for multi-disciplinary chapters of the EIA. Hussain coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. This project is for reroute pipeline sections at Kharasanyah and Ras Tanura pipeline systems. **Saudi Aramco, Jubail Saudi Arabia**

- **Saudi Aramco, Development Home Ownership lets, EIA, Eastern Province, Saudi Arabia June 2019.**

Hussain performed the role of project environmental engineer, providing project inputs and support to Environmental Impact Assessments. Hussain undertook environmental and social impact assessment for multi-disciplinary chapters of the EIA. Hussain coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site. This project is for development homeownership lets at Abqaiq and Al Hassa. **Saudi Aramco, Eastern Province Saudi Arabia.**

- **Energy and Resources Consumption and Conservation, and Optimization Studies:**

Hussain performed comprehensive and integrated studies in the water and energy consumption and conservation; solid waste reduction as well, to be reference material for planning and development in terms of sustainability, conservation of resources and environmental action plan in the role of environmental engineer.

Hussain is member in sustainability committee in Jacobs ZATE and responsible for public relations, providing environmental service providers in relation to the management of the committee and communication

Environmental Engineer, KOLIN Construction, Saudi Arabia, December 2018 till March 2019

Projects: Saudi Aramco, Ajyal South Dharan Housing Ownership Increment 2, Initial Site Development (Package 1 & 2)

Developed the Environmental Protection & Waste Management Programs and Plans for the business line of KOLIN in Saudi Arabia. In addition, performed coordinated and implemented actions to achieve environmental compliance with applicable environmental regulations and standards. The following activities were conducted:

- Managing Solid, Sewage & Hazardous Waste, as originator and transporter of waste.
- Prepared waste tracker system and communication channels from generation point up to disposal facilities.
- Ensured waste and chemicals storing areas match GAMEP & client standards.

- Prepared and reviewed environmental reports & compliance monitoring.
- Implemented Resource Management initiatives, supported by resource conservation plans and implementation plans and implementation monitoring.
- Delivered Fuels & Chemicals Control and safe handling training, and monitored successful implementation and initiated corrective actions to enforce compliance where applicable.
- Developed Leak & Spill Management plans and correct response training
- Prepared Air Pollution mitigation plan
- Conducted Noise Control monitoring
- Managed Environmental Health hygiene program (monitoring, training, inspection lists and proper records)
- Conducted Training and toolbox talks for Environmental awareness topics
- Achieved compliance with GAMEP & SA ARAMCO standards.
- Provided technical oversight of the third party contractor to align with environmental standards. This included identifying service providers and contract preparation.
- Conducted periodic meetings with Project Management to work towards continuous improvement in environmental compliance, and coordinated environmental activities with the engineering disciplines and lead engineers to ensure full integration of multi-disciplines and support the delivery of projects to agreed programs and costs.
- Monitored the progress of environmental improvement program.
- Arranged monthly safety and Environment bulletin.

HSE Engineer, Azmeel Contracting, Saudi Arabia, September 2016 till December 2018

Projects: Saudi Aramco, Ajyal South Dharan Housing Ownership Increment 1, Initial Site Development (Package 1, Package 3 and Package 4)

Hussain was responsible for managing the development and implementation of construction environmental management activities to achieve compliance with Saudi Aramco's HSE standards. The following activities were conducted:

- Division leader of Environmental Coordination and compliance for all Azmeel Contracting projects in Ajyal South Dharan Housing Ownership projects
- Managed Solid, Sewage & Hazardous Waste, as originator and transporter of waste.
- Prepared waste tracker system and communication channels from generation point up to disposal facilities.
- Ensured waste and chemical storage areas aligned with GAMEP & client standards.
- Prepared and reviewed environmental reports & compliance monitoring.
- Implemented Resource Management initiatives, supported by resource conservation plans and implementation plans and implementation monitoring.
- Prepared Fuels & Chemicals Control and safe handling training, monitoring, and corrective action enforcement.
- Conducted Leak & Spill Management plans and correct response training
- Prepared Air Pollution mitigation plan
- Conducted Noise Control monitoring
- Managed Environmental Health hygiene program (monitoring, trainings, inspection lists and proper records)
- Conducted Training and toolbox talks for Environmental awareness topics

- Achieved compliance with GAMEP & SA ARAMCO standards.
- Provided technical oversight of the third-party contractor to align with environmental standards. This included identifying service providers and contract preparation.
- Conducted periodic meetings with Project Management to work towards continuous improvement in environmental compliance, and coordinated environmental activities with the engineering disciplines and lead engineers to ensure full integration of multi-disciplines and support the delivery of projects to agreed programs and costs.
- Arranged monthly safety and Environment bulletins
- Monitor the progress of environmental improvement program
- Provided Domestic and potable water analysis reports based in Client and GAMEP standards.
- Conducted Safety tool box talk.
- Completed Risk Assessment / Job Safety Analysis / Accident/ incident / near mess reports.
- Investigation of accident and incident.
- HSE site inspection (over flow septic tanks, working at height, permit to work, electrical safety, chemical storing and handling, tools handling, PPE, Inspection of fire extinguisher, scaffolding Inspection etc.).

Environmental Engineer, Nature for Environmental Studies and Services, Bahrain and Saudi Arabia, October 2014 till December 2016

- **Projects: GAS Leaking Detection & Repair (LDAR) project in Abqaiq and Yanbu Refinery, Saudi Aramco, Saudi Arabia**

  Hussain was Leading experts of environmental Technicians group for leak detection monitoring applications Projects. Hussain has been conducting custom LDAR inspections for Aramco in Abqaiq and Yanbu Refineries 2015. Hussain Ensured all environmental documentation provided as per project scope. And he presented Nature consultancy services to significant clients and coordinated communication and logistics planning with Nature partner in Belgium. including experience as an Environmental Clerk of Works

- **EIA Projects:**

  Hussain conducted the environmental and social impact assessment for multi-disciplinary chapters of the following projects Hussain coordinated and undertook the environmental site surveys, including the design and execution of field investigations, ecological survey and noise monitoring for the project site in Saudi Arabia & Bahrain:

  - Eastern Cement Company EPPCO in Khurasany, Saudi Arabia
  - Install Sales Gas and Ethane Custody Metering Facilities, Saudi Aramco, Jubail city, Saudi Arabia
  - Al Nakheel channel digging, Bahraini Public Sector, Setrah city, Bahrain.



Menatallah Megahed

Junior Environmental Consultant

Overview

Menatallah Megahed, a Junior Environmental Consultant with a bachelor's degree in Biology, has three (3) years of experience with Advisian. Since joining Advisian, Menna applies her knowledge of terrestrial and marine ecology gained through her studies to numerous onshore and offshore Environmental Impact Assessments (EIA, ESIA), Environmental Baseline Studies (EBS), and monitoring programs for oil and gas developments in Egypt and UAE, and Environmental Screening and Scoping studies for renewable energy projects in Saudi Arabia. Menna is fluent in English and Arabic.

Areas of Expertise

- Ecology: Marine and terrestrial flora and fauna
- Environmental Impact Assessment (EIA, ESIA)
- Groundwater and Nearshore Water Quality Monitoring
- Site Investigation and Evaluation
- Environmental Performance Standards
- Environmental Screening and Scoping
- Nature Conservation

Relevant Experience

Junior Environmental Consultant, 2017 – present

Participation in gap analyses for Environmental Performance Standards for biodiversity, Environmental Monitoring reports, Baseline Studies, Environmental and Social Impact Assessment (ESIA), Scoped EIAs, and Environmental Screening Studies for Oil and Gas facilities and exploration and production activities in Egypt, and Environmental Scoping and Screening studies for renewable energy projects in Saudi Arabia. Duties include international guidelines and national legislation review, reports development, including environmental sections, existing environmental baseline data collection and review, and translation into Arabic for official use.

- Environmental, Social, and Health Impact Assessment for Ammonium Nitrate Plant Expansion – Egypt Hydrocarbon Corporation SAE, 2020
- Scoped Environmental Impact Assessment (B) for the Addition of a Wastewater Treatment Plant and the reuse of wastewater – Egypt Basic Industries Corporation, 2020
- Environmental Baseline Study, West Sherbean Onshore Concession (Block 11) – IEOC Production B.V., 2020

- Environmental and Social Risk Identification, Oil and Gas Activities in the Egyptian Red Sea – Confidential Client, 2019
- Environmental Screening (Form B), Ameeq-1X Exploratory Well – North Theka Offshore Concession, Egypt, Edison International S.P.A – Egypt Branch, 2019
- Health Safety and Environmental Impact Assessment: Updates for existing facilities, ADOC, 2018-2019
- Environmental Performance Standards: Gap Analysis, various asset locations, CEPSA, 2018-2019
- Environmental Monitoring Services, BP West Nile Delta Gas Development Project, Idku, El-Beheira, Egypt, Bechtel, 2017-2019
- Environmental and Social Impact Assessment (ESIA) for PV Solar Energy Parks in Saudi Arabia, REPDO, 2018-ongoing
  - Al Faisaliya PV Solar Energy Park
  - Mahd Al Dahab PV Solar Energy Park
  - Al Qurayyat PV Solar Energy Park
  - Ar Rass PV Solar Energy Park
  - Saad PV Solar Energy Park
  - Layla PV Solar Energy Park
  - Wadi Ad Dawasir PV Solar Energy Park
  - Al Henakiyah Solar CSP/PV Park
- Screening and Scoping Reports, REPDO, Saudi Arabia, 2017-ongoing
  - Al Faisaliya PV Solar Energy Park
  - Mahd Al Dahab PV Solar Energy Park
  - Al Qurayyat PV Solar Energy Park
  - Ar Rass PV Solar Energy Park
  - Saad PV Solar Energy Park
  - Layla PV Solar Energy Park
  - Wadi Ad Dawasir PV Solar Energy Park
  - Al Henakiyah Solar CSP/PV Park
- Environmental and Social Impact Assessment (ESIA), Tie-in and Production of Development Wells Fayoum-North 3, North Alexandria Block B Concession, West Nile Delta, BP, 2018
- Environmental Screening (Form B), North El Tabya Concession, BP, 2019
  - Atoll North Exploratory Drilling
- Scoped EIAs (B), West Nile Delta, North Alexandria Block B Concession, BP, 2017-2018:
  - Optimization of Production of Giza-Fayoum and Raven Onshore Gas Processing Facilities
  - Tie-in and Production of Offshore Development Wells: Giza-North 4; Giza-East 1; and Fayoum-North 4
  - Drilling and Completion of Development Well Raven East-5

- Scoped EIA (B), North Damietta Concession, BP, 2018-2019:
  - Drilling and Completion of Development Well ATOLL-4
  - Qattameya Well Re-entry for Production Drilling and Completion
- Environmental Screening (Form B), East Nile Delta, El Matariya Onshore Concession, BP, 2017:
  - Khairat Upthrown-1 Exploration Well
  - Nafahat Exploration Well
- Environmental Baseline Study, El-Matariya Onshore Concession, East Nile Delta, Egypt, BP, 2017
- Addendum EIA, MOPCO Existing Facility, East Nile Delta, Damietta, Egypt, MOPCO, 2017

Qualification / Affiliations

Education

- BSc, Biology, The American University in Cairo (AUC), Egypt, 2015

Languages

- Arabic: Mother tongue
- English: Excellent proficiency spoken and written

Courses

- PADI certified Open Water Diver

Publications/Presentations

- Bos, A. R., Ogwang, J., Bariche, M., Horoiwa, M., Megahed, M., Ouf, A., & Yasuda, N. (2020). Anti-Lessepsian migration rectified: the Comber Serranus cabrilla (L. 1758) existed in the Red Sea prior to the Suez Canal opening. Marine Biology, 167(9), 1-10.
- Megahed M, AM Sanad, AR Bos (2017). Reproductive biology of the crown-of-thorns sea star Acanthaster sp. in the Red Sea, Diversity (submitted)
- Megahed, M. (2015), Birds on the Move, Egypt Today, September 2015, pp 24-25

Work History

2017 - present	Junior Environmental Consultant, Advisian-Worley Group, Cairo, Egypt
2016 - present	Teaching Assistant, Biology Department, American University of Cairo (AUC), Egypt
2015 - 2017	Educational Programs Coordinator, The IG Club, Cairo, Egypt



Omar El Farouk Abdelbary

Environmental Consultant, Environment and Society, SEMEA

BSc, Construction Management

Overview

Omar El Farouk Abdelbary is an Environmental Consultant with a BSc in Construction Management with a concentration in Environmental Engineering and three (3) years of experience as an Environmental Consultant in Egypt. He has participated multiple projects and tenders in Egypt, the Middle East and Africa for various industrial sectors. He has actively managed and participated in several environmental and social studies, including ESIA, EIA, ESMP and environmental monitoring programs that met national standards and international guidelines (e.g., World Bank, AFD), and has completed pre-assessment reports, audits and entry and exit environmental surveys. Omar is fluent in English, French and Arabic.

Areas of Expertise

- Environmental and Social Impact Assessment (ESIA)
- Environmental Monitoring Plans (EMP)
- Environmental and Social Management Plans (ESMP)
- Environmental and Social Baseline Assessment

Relevant experience

Environmental and Social Impact Assessment (ESIA)

- Environmental, Social, and Health Impact Assessment for Ammonium Nitrate Plant Expansion – Egypt Hydrocarbon Corporation SAE, 2020
- Scoped Environmental Impact Assessment (B) for the Addition of a Wastewater Treatment Plant and the reuse of wastewater – Egypt Basic Industries Corporation, 2020
- Environmental Baseline Study, West Sherbean Onshore Concession (Block 11) – IEOC Production B.V., 2020

- Environmental and Social Impact Assessment (ESIA) for PV Solar Energy Parks in Saudi Arabia, REPDO, 2020
  - o Al Henakiyah Solar CSP/PV Park
- Screening and Scoping Reports, REPDO, Saudi Arabia, 2020
  - o Al Henakiyah Solar CSP/PV Park
- 500 MW Wind Farm, North of Ras Ghareb, Egypt, RCREEE, 2019
- Zohr 15 Development Well, Scoped EIA, Egypt, Petrobel, 2019
- Zohr 16 Development Well, Scoped EIA, Egypt, Petrobel, 2019
- Upgrade of Western Desert Road Qena - Luxor EIA (Form B), Egypt, Housing and Development Authority, 2019
- Hamrawein Coal-Fired Power Plant, ESIA, Egypt, Shanghai Electric and Dongfang, 2019
- E-waste recycling facilities, ESIAs (5), Egypt, MEWM Project, 2018-2019
- Egypt International Airport Terminal 2, Hydrant Land Environmental Pre-assessment, Egypt, Total, 2018
- Samanud and Abu el Matameer OHTL, EIA (Form B), Egypt, Egypt Electricity Transmission Company, 2018
- Ataqah Hydropower Plant, ESIA update, Egypt, SinoHydro, 2018

Environmental Regulatory Compliance and Due Diligence

- Schlumberger Egypt Facilities, Environmental Exit Assessment, Schlumberger Egypt, 2018-2019
- Chemical Storage Yard in AbuQir Port, Environmental Exit Assessment, MISWACO Egypt, 2019

Environmental and Social Management Plans (ESMP)

- AlDhuluiya Irrigation Project, World Bank, Iraq, 2019
- Cairo Metro Line 3 Phase 3, Environmental and Social Construction Management Plan, Egypt, EFJV, 2019
- Cairo Metro Line 3 Phase 3, Environmental and Social Construction Management Plan, Egypt, 2018
- Cairo Metro Line 3 Phase 3, Waste Management Plan, Egypt, EFJV, 2018
- Cairo Metro Line 3 Phase 3, Dust Management Plan, Egypt, EFJV 2018
- New National Cancer Institute, Waste Management Plan, Egypt, 2018

Environmental Monitoring

- WND Project, Periodic Environmental Monitoring, Egypt, BP, 2020
- Cairo Metro Line 3, Phase 3, Environmental Monitoring Plan, Egypt, EFJV, 2018
- Cairo Metro Line 3, Phase 3, Monthly Environmental Monitoring, Egypt, EFJV, 2017-2019
- Schlumberger Egypt Facilities, Periodic Environmental Monitoring, Egypt, Schlumberger, 2018-2019

Sustainability Reporting

- Borouge 2020 Sustainability Report, UAE, Borouge, 2020-ongoing
- Borouge 2019 Sustainability Report, UAE, Borouge, 2020

Qualifications / Affiliations

Education

- BSc, American University in Cairo, School of Sciences and Engineering, Construction Management Department, 2017

Languages

- ARABIC: Mother tongue
- ENGLISH: Fluent verbal and written
- FRENCH: Fluent verbal and written

Work history

2020 - present	Environmental Consultant, Advisian-Worley Group, Cairo, Egypt
2017 - 2019	Environmental Specialist, EcoConServ Environmental Solutions, Egypt
2017	Proposals Engineer, K&A Egypt



Francisco José Peño

Geographer/GIS Technician and IT

Overview

Mr. Peño Álvarez has twelve (12) years of experience in Computer-Aided Design (CAD) projects and eight (8) years in Geographic Information System (GIS) projects. He has taken part in various projects, including mapping, telecommunications and Civil Engineering projects and more recently in Remote Sensing and Environmental projects. Francisco's capabilities include the preparation of drawings, CAD details and maps, and GIS and digital terrain models, and the performance of multivariate analysis, impact assessments and noise models.

Areas of Expertise

- GIS Technician for Environment, Power and Hydrocarbons
- CAD Draftsman
- Design and drawing with Corel Draw
- Environmental Studies
- Support and Map creation

Relevant Experience

GIS Technician, Infrastructure & Environment, Madrid | WorleyParsons España, S.L. | 2012 - Present

- Figures for Modelling Studies of Air Dispersion Model for the Environmental Screening of the Offshore Development Well Taurus North 3 (TN-3), in the North Alexandria concession, Egypt. British Petroleum (BP).
- Figures for Noise Assessments and Modelling Studies (Sound Plant) for the Central Production Facility (CPF) at Block 95 in Peru, for Bretaña Development FEED Services. Gran Tierra Energy Peru.
- Figures for Modelling Studies of Air Dispersion Model for an Open Waste Sump in Bahrain. Tatweer Petroleum.
- Maps supports for Detail Characterization of Torres, C.B. site in Aranjuez, Spain. Phase I (detail characterization) and Phase II (identification and quantification of risks) in contaminated soils management.
- Figures for Modelling Studies of Air Dispersion Model for the Extension II Project of the Farasan Power Plant in Saudi Arabia. Saudi Electricity Company (SEC).
- Figures for Noise Assessments and Modelling Studies (Sound Plant) and Modelling Studies of Air Dispersion Model for the Conversion of "Block C&D" and "Block E" Gas Turbine in the Riyadh PP9 Power Plant, in Saudi Arabia. Saudi Electricity Company (SEC).

- Figures for Modelling Studies of Dispersion Model for the Environmental Screening of the Offshore Development Well Libra South 1 (LS-1), in the North Alexandria concession, Egypt. British Petroleum (BP).
- Figures for Modelling Studies of Air Dispersion Model for the Conversion of the Tihama Power Plant from Simple Cycle to Combined Cycle in Saudi Arabia. Saudi Electricity Company (SEC).
- Figures support to Quantitative Damage Assessment to soil and groundwater environmental compartments in Duqm Bunker Terminal, Omán. Impact Assessment of potential accidental hydrocarbon spills and uncontrolled releases of liquid wastes to the environment (soil and groundwater).
- Figures for Modelling Studies of Air Dispersion Model for the Tahrir Petrochemicals Complex in Ain Sukhna, Egypt. Tahrir Petrochemicals Corporation (TPC).
- Maps, figures and GIS support for Phase I HSE Due Diligence of offshore Oil&Gas Assets in the North Sea (Confidential Customer).
- Figures for Noise modelling for Rumaitha North CO2 Injection Project, Rumaitha Field, Abu Dhabi. Abu Dhabi Company for Onshore Oil Operations (ADCO).
- Figures for Modelling Studies of Air Dispersion and for Marine Modelling of Oil Spill for the Environmental Baseline Survey & Environment Impact Assessment for Bahr Essalam Phase 2 Development Project, Mellitah Oil & Gas.
- Figures and support for CEPSA E.P., Appraisal Development Study, Peru Block 130, Decision Support Package, Peru.
- Figures for Noise Assessments and Modelling Studies of Air Dispersion Model for the Bahrain Liquefied Natural Gas (LNG) Import Terminal Project, Nogaholding – Galway Group.
- Figures for Noise Assessments and Modelling Studies (Sound Plant) and Modelling Studies of Air Dispersion Model for the JO's Central Gas Utilisation Plant (CGUP) at Wafra, Kuwait, Saudi Arabian Chevron Inc.- Kuwait Gulf Oil Company.
- Maps, figures and GIS support for HSE PIDD for Acquisition of Offshore Assets in Norway and United Kingdom. (Confidential Customer).
- Figures for Noise Assessments and Modelling Studies (Sound Plant) and for Modelling Studies of Air Dispersion Model of the Vladivostok Liquefied Natural Gas (LNG) plant for VNIPIgazdobycha.
- Maps and figures for Environmental Impact Assessment (EIA) and Air Dispersion Modelling (Screen) for Bricia-1 Well in Alfoz de Bricia (Burgos), Spain. Petroleum Oil&Gas España,S.A.
- Map and GIS for Environmental, Social and Health and Safety Review of mine activities compliance with IFC Standards and Guidelines for Zangezur Copper-Molybdenum Combine (ZCMC). Armenia. ZCMC.
- Figures and GIS support for Thailand Offshore Field Development Study, Confidential client.
- Figures for Marine Modelling of effluent modelling for the Teak-Samaan-Poui (TSP) offshore platforms in Trinidad and Tobago, Repsol.
- CAD support for Owners Enfgineers Projects Assistant: 100MWac CSP Power Tower,Redstone, South Africa.
- Figures for Modelling Studies of Air Dispersion Model for the Pollution Control Study Multipurpose Reactor FEL2/FEL3. Singapore. Stepan Asia Pte. Ltd.

- Figures and GIS support for the Design and Development of an Integrated System of Indicators for Environmental Risk Assessment (GEMIt). Spain, Repsol, S.A.
- GIS, figures and Maps for Environmental Quantitative Risk Assessment (EQRA) in Refinery Facilities, Spain, Repsol, S.A.
- Figures and Maps for Phase I HSE Due Diligence for O&G Operator in two oilfields, Venezuela, Confidential Customer.
- Maps, figures and GIS support for Social and Environmental Baseline, Impact Assessment and Biodiversity Action Plan development for gas operations in Area Caipipendi, Bolivia, Repsol, WorleyParsons.
- Figures for Modelling Studies of Smoke, gas and exhaust plume dispersion study with CALPUFF for the Eskene West Rail Project (EWRP) in Kazahstan, AgipKCO
- Figures for Modelling Studies of Air Dispersion Model Update for the Ammonium Nitrate Project of the Egyptian Hydrocarbon Corporation (EHC) in Ain Sukhna, Egypt.
- Figures and maps with GIS in support of Environmental Studies of a Water Treatment Plant on Poseidon, Repsol, Huelva, Spain
- Figures and representations of examples in support of for Modelling Studies of Air Dispersion Model for the Qatar Economic Zone 3 (QEZ3) Strategic Environmental Assessment, Qatar. Manateq.
- Maps and GIS support for a Phase I Due Diligence in Nicaragua for Repsol, Nicaragua
- GIS and Map support for Air Modelling in Turkmenistan, China Petroleum Engineering South West Company, Turkmenistan
- GIS Geodatabase for CILC Mendoza and model maps of pollutant flake isoconcentrations, YPF, Mendoza, Argentina
- ArcGIS environmental maps, queries and maps of the pipeline and the project with Autocad, CO2 geological storage, Duero, Spain
- Profiling and surface contaminants with Autocad and Corel Draw, hydrogeological model calibration, Modflow maps, and representation of emission points for the refinery with GIS, Confidential Customer, Argentina
- Conceptual models with Autocad, CEPSA, Spain
- Illustrative conceptual models for a variety of Environmental Impact Studies and associated mitigation measures., and maps and GPS files for fieldwork for ESHIA Drilling, Libya
- Design and update of a GIS and associated database as a tool for the analysis of a Refinery for Environmental Risk Control, Petronor, Risk Tool, Basque Country, Spain
- Maps for employment support, schematic drawing and help files in KML for an ESHIA of offshore 2D Seismic Operations, Repsol, Aruba
- Model dispersion of pollutants to the atmosphere and PDO Air Dispersion ADMS, Petroleum Development Oman, Sultanate of Oman
- Technical support for WorleyParsons Canada for the Project Harbor extension in La Guajira, Colombia
- Map of survey blocks locations for exploration HSE PIDD, Repsol, Romania

- Maps and illustrations for several proposals: EBS in Bolivia for Repsol, ESHIA of the DUQM Refinery in Oman, EIA Pipeline in Qatar, ESHIA Offshore Drilling Operations in Namibia, SK Booster Compression Feed and Pre-feed, and RCF PAI Air Modelling in Kuwait

GIS Technician & CAD Draftsman, │ Prointec (Environment) INDRA, Madrid │ 2007-2012

- GIS support for the Environmental Impact Study of changes to the General Plan of Madrid at the Santiago Bernabeu Stadium field
- Service Coordinator for study of the connection between the Valdebebas Forest Park and the winning design of the international ideas competition, Hortaleza City Council, Madrid
- Service Coordinator for the study of alternatives for a future cattle route through the Valdebebas Forest Park, Hortaleza City Council, Madrid.
- Strategic noise map for the City of Ceuta
- Advisory and Monitoring Program on Environment Facility project, works and actions of the Government Department of Works and Public Spaces, City of Madrid
- Evaluation Study of Environmental Impact of the Ermua revision of the General Plans of Iruña de Oca and Ermua, Basque Government
- Environmental studies of the revision and adaptation of the General Urban Plan of the City of Ceuta
- Project Path from Virgen del Mar to Liencres Natural Park, Santander, Santa Cruz de Bezana and Piélagos, Cantabria Coast, Ministry of Environmental and Rural and Marine Affairs
- Environmental studies of the Partial Reform Plan area interior APR 21.2 "Mahou Vicente Calderón", Madrid City Council
- Project sealing and construction of a new vessel in the landfill of La Chureca, Managua, Nicaragua
- Restoration of vegetation in the hills and banks of Torremocha del Jarama, Madrid
- Environmental Assessment of Provincial Highway Plan Salamanca 2006-2015, Province of Salamanca, Junta de Castilla y León
- Consulting and support for "Management of construction projects expropriations Demarcation of State Highways in Madrid", Province of Madrid, Ministry of Development and Highways
- Consulting and technical assistance for inventory supply protection areas of Extremadura and Andalusia, Guadina River Basin
- Framework agreement for consultancy and support file processing for the waterworks expropriation of Andalucia Water Agency., NET469118 EGMASA – Ministry of Environment, Junta de Andalucia
- Consulting and advisory assistance and environmental management projects and road works transportation, MINTRA public entity, Madrid Transport Infrastructure
- Study of technical and economic feasibility and preliminary works for the construction of a waste transfer and waste composting plant for pruning and gardening, Laguardia Gang – Rioja Alavesa
- Noise impact study for Sector 1 of the Expansion of El Escorial, Madrid
- CAD support for the Valdebebas Forest Park "Phase IX: Labyrinth, Gazebo and Gatesways"
- Restoration Project and Environmental Integration, Villaviciosa de Odon, Madrid

- Rehabilitation of parkland on Avenida de Cantabria, Barajas District, Madrid
- CAD support for the remodelling project for the Alcobendas Navarre Park, Thaler, City of Alcobendas
- Flora and landscape studies for environmental assessment of the General Plan of Urban Planning Municipal Township of Don Benito, Badajoz, Extremadura
- Environmental Assessment Studies and General Plan Municipal Urban Planning, Municipality of Villanueva de la Serena, Badajoz, Extremadura
- Environmental Assessment of Regional Roads Sector Plan for Castilla y León (2008-2020), Department of Development of the Government of Castilla y Leon
- Project activities in the Iznajar Reservoir Environment, Guadalquivir River Basin (several provinces)
- Technical Assistance to draft environmental impact studies, Canal de Isabel II
- Environmental Assessment Studies and General Urban Plan of the City of Ceuta
- Environmental Impact Assessment System Blueprint supply from the reservoir to the Commonwealth Cenajo – Taibilla Channel in Murcia, ACUASEGURA
- Feasibility study for the construction of the Duero Natural Path, Ministry of Environment
- Coordination support for project preparation and implementation for the Valdebebas Forest Park, Madrid City Council
- Environmental Assessment of proposed defence work in the riverbeds of Molina de Segura, Segura River Basin
- Drafting projects related to compensatory measures for the Madrid – Barajas Airport expansion, AENA
- Consulting and Technical Assistance for drafting projects for implementation of corrective environmental impact measures for the rail line "Valencia-Taragona, Section: Las Palmas – Oropesa" Castellón de la Plana, Directorate General of Railways, Ministry of Development
- Support for case management and presentation of GIS of integrated environmental authorisation procedures, Community of Madrid
- Consultancy and support for the expropriation process of property and rights affected by the "construction project of the High Speed Line to Asturias, Section: La Robla – Pajares Tunnels" Ministry of Development
- Consulting and technical support for the expropriation process of property and rights affected by the "Expansion and improvement of supply to populations of Sagra-East" Toledo, Disaggregated 01.02 and 03, Tajo River Basin Water, Inc.
- Regional Plan of the Territorial Scope of the Roadway de la Plata, Provinces of León, Zamora and Salamanca, Castilla y León
- Partial Territorial Management Plan of the District of the Metropolitan Area, Tenerife

GIS Technician & CAD Draftsman (Civil Engineering & Environment) | Proyectos de Ingenieria 63, S.L. Madrid | 2006-2007

- Construction Project environmental impact statement, National road N-232, Oña- Valdenoveda, Burgos, Ministry of Development
- Project for General Systems for the Council of Villarejo de Salvanes, Madrid

CAD Draftsman | GPO Ingeniería (Civil Engineering), Madrid | 2004-2006

- Head Draftsmen, Highway Junction Project M-50 with N-511, Madrid
- Railway renewal from Puigcerda – French border, Ministry of Development
- Light Rail from Majadahonda – Las Rozas – Pozuelo de Alarcón, MINTRA, Madrid
- Fieldwork, impact assessment, and cartography, Madrid

CAD Draftsman | Geocart Ingeniería del Territorio (Cartography), Madrid | 2004

- Mapping operator with Microstation, draft maps, Portugal Government
- Mapping operator with Microstation for Geomadrid Project, Madrid Regional Government
- Orthophotography Department, Correction of Portugal orthophotos with Photoshop, Madrid

CAD Draftsman | CH2 MHILL, Spain (Infrastructure & Environment), Madrid | 2003

- Delineation of antennas and telephone networks with Autocad, Microstation and Smallworld GIS, Project for Vodafone, Madrid

CAD Draftsman & GIS Technician | Cadmax Systems (Autodesk Resellers), Madrid | 2003

- GIS Projects with Autocad Map, Autodesk MapGuide and Autodesk Land Desktop, Presentations for AENA, Madrid

Qualification

- **Expert in GIS applied to Environmental Management** (300 hours) Forestry Engineering School, Universidad Politécnica de Madrid, Technician GIS in vectorial and raster with ArcGIS 9.2, and Remote Sensing with Erdas Imagine.3.1, Madrid, Spain, 2009
- **Master's Degree in GIS** (800 hours) Cibernos Institute, Madrid, Spain, 2003
- Autocad Map, Autodesk Map Guide, Geomedia, Microstation Geographics, Smallworld GIS, Data Base relations, SQL and Visual Basic 6.0, Madrid, Spain, 2003
- **Degree in Geography**, Geography and History Dept., Universidad Complutense, Madrid, Spain, 1995-2001
- **Erasmus Scholarship**:, Stockholm Universitet, Stockholm, Sweden, 2001Affiliations & Certifications

Specific Technical Expertise/Specialist Courses

- **ArcGIS 10.x – Advanced** course (50h), TYC GIS, Madrid, Spain, 2016
- **Construction of Geodatabases** (15h), ESRI Spain, Madrid, Spain, 2015
- Course **First aid** (5h), FREMAP, Madrid, Spain, 2014
- Course **Intermediate Excel** (14h), ADAMS, Madrid, Spain, 2013
- Course Suite **Corel Draw X4**, La Mirada Digital Academy, Madrid, Spain, 2010
- **Advanced Access**, Masercisa, Maldonado Training Center, Madrid, Spain, 2009

- **GIS for Environmental Management Specialist**, Forestry Engineering School, Universidad Politécnica de Madrid, Spain, 2009
- **Photoshop CS3**, Masercisa, Maldonado Training Center, Madrid, Spain, 2009
- **VisuaL Net**, Masercisa, Teachers Training, Madrid, Spain, 2008
- **ArcGIS 9.1**, Tecniberia / Asince, Cas Training, Madrid, Spain, 2008
- **Photointerpretation Technical Assessment and Natural Habitat**, ETECA, Madrid, Spain, 2003
- **Environmental Management**, AG Technology S.L., Madrid, Spain, 2001
- **Cartography and Map Production**, Stockholm University, Stockholm, Sweden, 2001
- **Seminar Land and Landscape** Stockholm University, Stockholm, Sweden, 2001

Languages

- **Spanish**: Native Language
- **English**: English Advanced level, Several courses, Madrid and Stockholm, 2001
- **Swedish** Beginner Level Course, Stockholm University, Sweden, 2001
- **French**: Basic Level
- **German**: Basic Level

Work History

2015-Act	**Advisian. WorleyParsons España** | Expert GIS & CAD
2012-2015	**WorleyParsons España** | Expert GIS & CAD
2007-2012	**Prointec (INDRA)** | Expert GIS & CAD
2006-2007	**Proyectos de Ingeniería 63 S.L.** | Expert GIS & CAD
2004-2006	**GPO Ingeniería** | Expert CAD
2004	**Geocart Ingeniería del Territorio** | CAD Operator
2003	**CH2 MHILL** | CAD Operator
2003	**Cadmax Systems (Distribuidor Autodesk)** | Assistant CAD & GIS

Appendix C. Technical Documents

المملكة العربية السعودية
وزارة الشئون البلدية والقروية
أمانة منطقة حائل
بلدية مدينة الكهفة

الرقم / .....
التاريخ / .....
المرفقات / .....
الموضوع / .....

(٦٠٦)

محضر تنسيقي لموقع استثماري لصالح
الشركة السعودية للكهرباء

بتاريخ ٠٦/٠٥/١٤٣٩هـ

إنه في يوم الثلاثاء الموافق ٠٦/٠٥/١٤٣٩هـ

وبناء على خطاب سعادة أمين منطقة حائل ٤٦٥٤ وتاريخ ٠٧/٠٤/١٤٣٩هـ المبني على خطاب سعادة وكيل الوزارة المساعد لتخطيط المدن رقم ٦٧١٤ وتاريخ ١٢/٠٢/١٤٣٩هـ بشأن طلب وزارة الطاقة والصناعة والثروة المعدنية استثمار قطعة أرض لتنفيذ مبادرات رؤية المملكة (٢٠٣٠) المتعلقة بقطاع الطاقة ومن ذلك الطاقة المتجددة، وبالتنسيق مع الجهة المستفيدة تم خروج كل من:-

١- فهد عوده الشمري — مندوب بلدية الكهفة
٢- محمد إبراهيم الشاعر — ممثل أملاك كهرباء حائل
٣- م/ طارق جار الله الجنفاوي — ممثل وزارة الطاقة والثروة المعدنية

حيث تم اختيار موقع مقترح (بمساحة ٨٣كم٢) تحت اجراءات الاعتماد كموقع استثماري يؤجر من البلدية لشركة الكهرباء حسب ما تحدده لجنة تقدير الأسعار، والوقوف عليه والتأكد من مناسبته للغرض المطلوب وذلك بعد مخاطبة رئيس مركز إمارة الكهفة والإفادة بحكومية الموقع وخلوه من الشوائب والمنازعات، وفقاً للإحداثيات التالية: -

	N	E		N	E
١	٢٦ ٥٨,٣٧٦	٤٣ ٠٤,٨٦٨	٥	٢٧ ٠٠,٣٧٠	٤٢ ٥٨,٩٧٧
٢	٢٦ ٥٧,٣٩٤	٤٣ ٠٣,٩٢٥	٦	٢٧ ٠٠,٨٩٥	٤٢ ٥٧,٨٠٦
٣	٢٦ ٥٥,٣٢٢	٤٢ ٥٩,٩٢٩	٧	٢٧ ٠١,٩٢٣	٤٢ ٥٨,٥٥٨
٤	٢٦ ٥٧,١٥٢	٤٢ ٥٦,٨١٩	٨	٢٧ ٠١,٣٨٨	٤٢ ٥٩,٧٦٠

وعليه جرى التوقيع ...

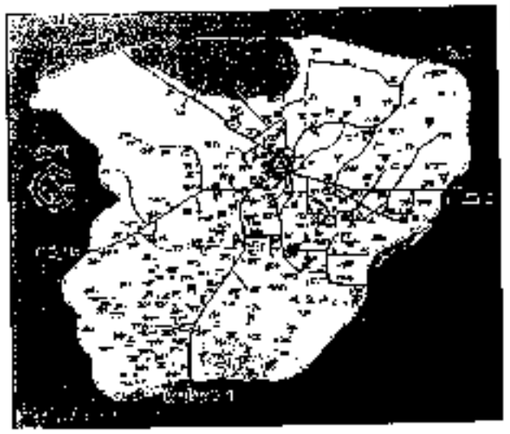
مندوب بلدية الكهفة
فهد عوده الشمري

ممثل أملاك كهرباء حائل
محمد إبراهيم الشاعر

ممثل وزارة الطاقة والثروة المعدنية
م/ طارق جار الله الجنفاوي

منطقة حائل / مدينة الكهفة / ت / ٠١٦٥٦٧١٥٥٢ ف / ٠١٦٥٦٧١٥٥٢
Hail Area Al kahfa City - Tel 0165671563 Fax 0165671552
Email : Mayor.alkahfa@amanathail.gov.sa

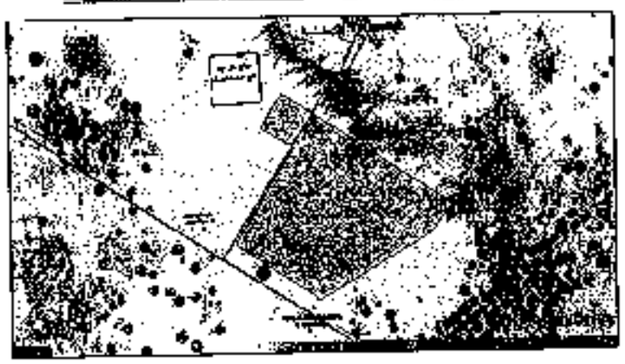
الموقع بالنسبة لمنطقة حـــائل

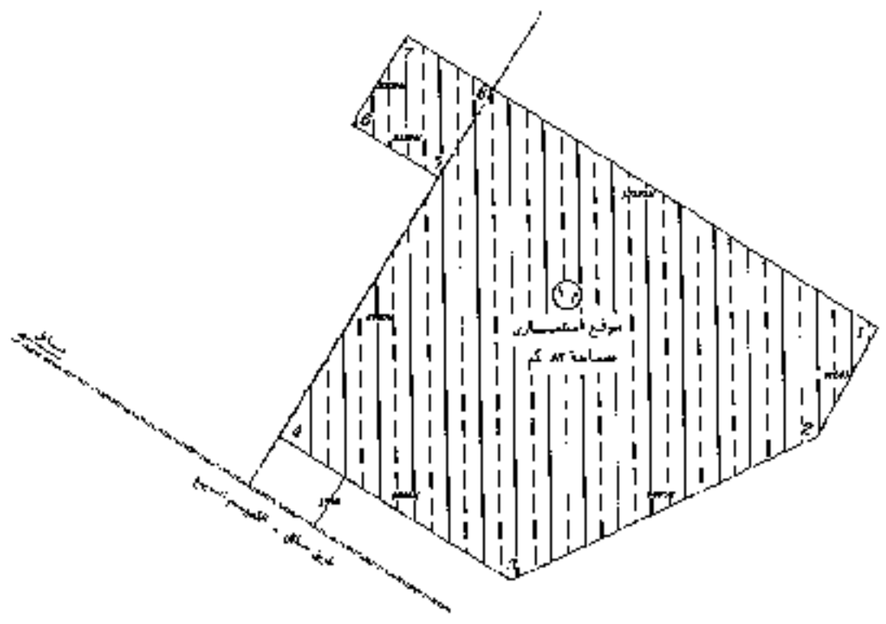


علاقة الموقع بالنسبة لمدينة الكهفة



الموقع بالنسبة للشوارع المحيطة والاستعمالات المجاورة





الاحداثيات

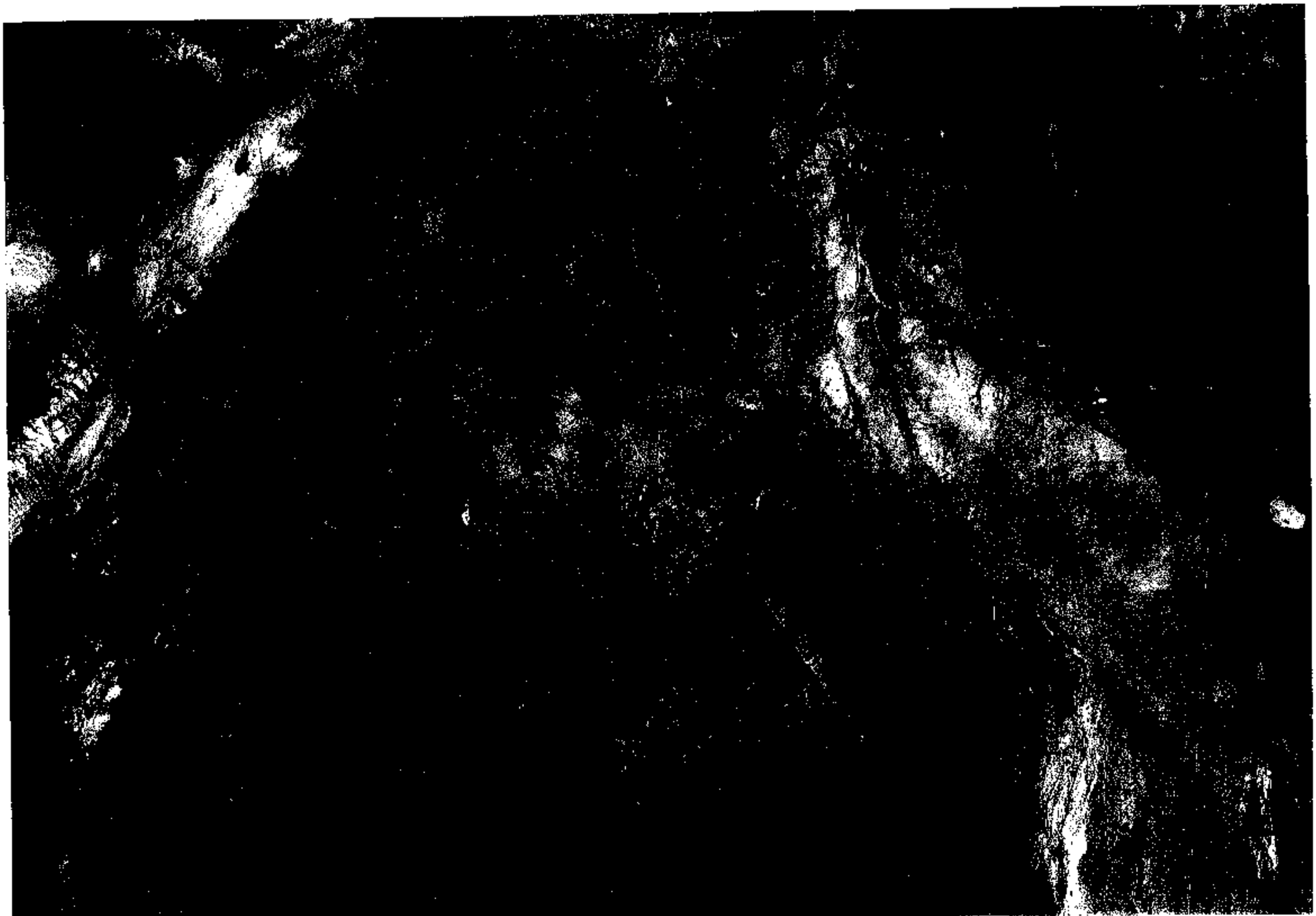
	N	E
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2	26 57.091	042 03 935
3	26 55.012	042 03 859
4	26 53.112	042 04 819
5	27 00.970	042 56 977
6	27 00.885	042 57 806
7	27 01 993	042 58 858
8	27 01 869	042 59 760

وزارة الشئون البلدية والقروية
أمانة منطقة حائل
بلدية مدينة الكهفة

منطط تقليبي الموقع استشاري
للشركة السعودية للكهرباء
بمدينة الكهفة

المصمم	محمد أنور شكك	
المشرف	جميل محمد الشدي	

مقياس الرسم ١/٥٠٠٠
رقم المخطط
التاريخ





GENERAL LAYOUT
ESCALE 1:25.000
COORDINATES WGS84 38N

500 0 500 1000 1500 2000 2500
SCALE 1:25.000

ELECTRICAL CONFIGURATION

PV PARK NOMINAL POWER	3.8 GW
PV PARK AC POWER (@ 825°C)	3.1 GW
DC/AC ratio	1.25
MODULES NOMINAL POWER	540 Wp
MODULES TYPE	LRS-72H BD 540M 1500V (STC)
TOTAL MODULES INSTALLED	7,164,304
MODULES PER STRING	28
CONFIGURATION OF RACKING	2x14 Landscape
INVERTER UNIT	Sungrow SG 3125HV

LAYOUT ARRANGEMENT

Pitch Between Structures E-W: 7.5 m
1x27 Structure Dimension: 28.48 x 2.16 m
Number of Inverter Unit = 990
Yield = 2,457 kWh/kWp

BLOCK ARRANGEMENT

Number of Modules = 14,476
Modules per string = 28
Number of Strings = 517
Block Power = 7,817,040 Wp
GCR = 0.3
Azimut = 0°

SGU	CAPACITY	ENERGY	AREA
1	600MW	1,655 GWh/y	15.03 Km^2
2	800MW	2,210 GWh/y	17.64 Km^2
3	600MW	1,655 GWh/y	17.43 Km^2
4	520MW	1,434 GWh/y	13.49 Km^2
5	300MW	824 GWh/y	8.65 Km^2
6	275MW	755 GWh/y	7.22 Km^2

DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

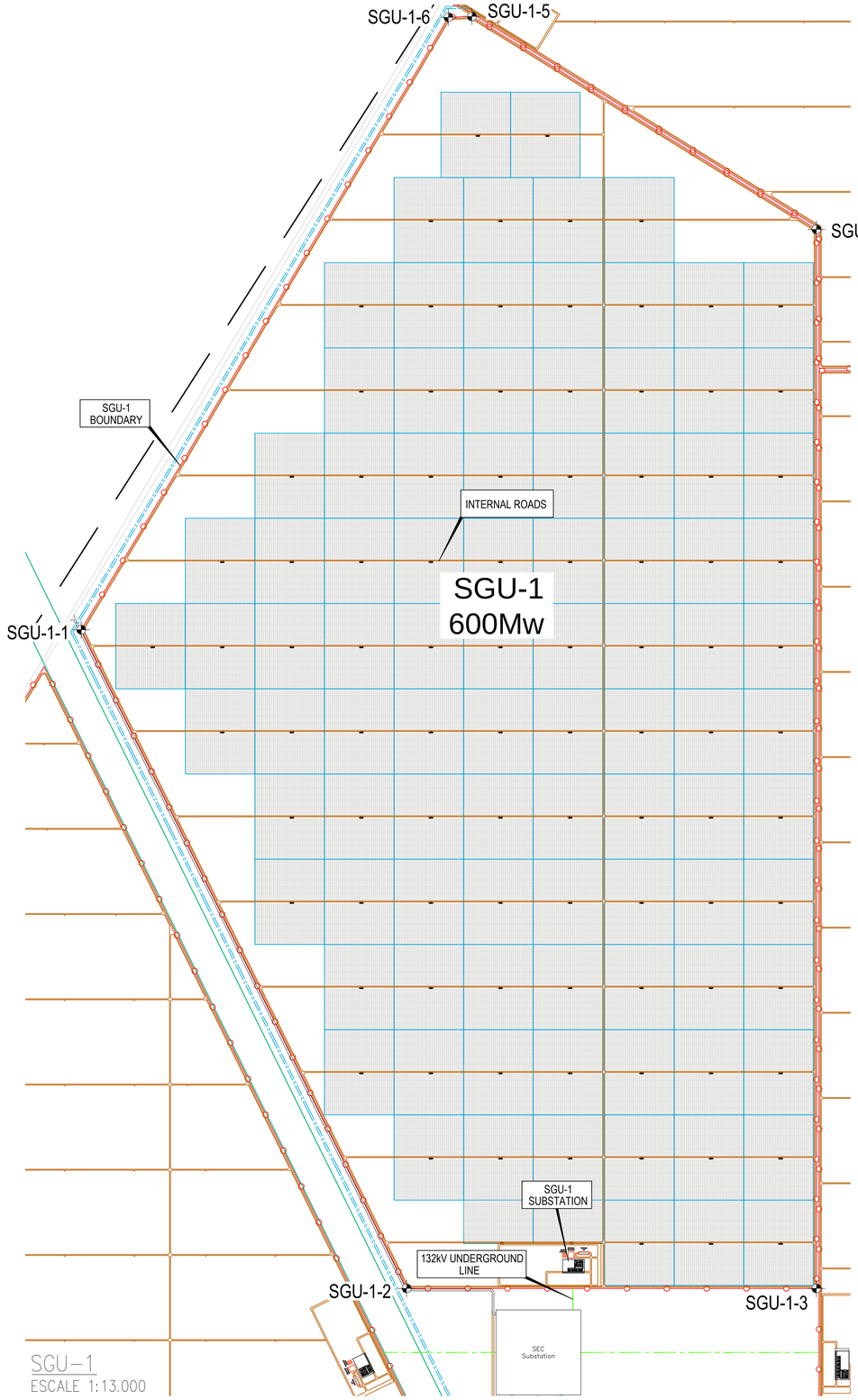
Worley
energy | chemicals | resources

CUSTOMER

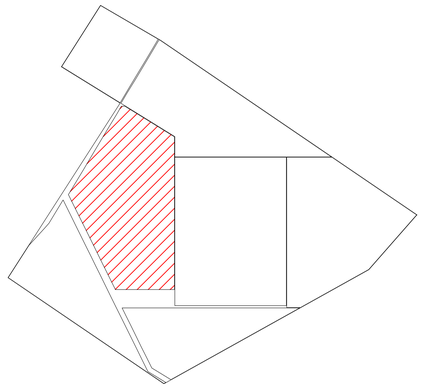
وزارة الطاقة
MINISTRY OF ENERGY

GENERAL SITE LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-GE-PLN-101 | Rev. 1



SGU-1
ESCALE 1:13.000



DRAWING KEY

- INTERNAL ROAD
- SITE BOUNDARY
- SGU FENCE
- BONDED ZONE
- BLOCK CONSTRUCTION PERIMETER
- UNDERGROUND LINE
- OVERHEAD LINE
- SGU-X-X — POINTS
- BUILDINGS
- SGU — SOLAR GENERATING UNIT

POINT	X	Y
SGU-1-1	298172.550	2985546.373
SGU-1-2	299705.135	2982445.896
SGU-1-3	301634.930	2982445.896
SGU-1-4	301634.930	2987430.873
SGU-1-5	300012.601	2988433.269
SGU-1-6	299901.802	2988429.081

DRAFT NOT FOR CONSTRUCTION

260 0 260 520 780 1040 1300
SCALE 1:13.000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

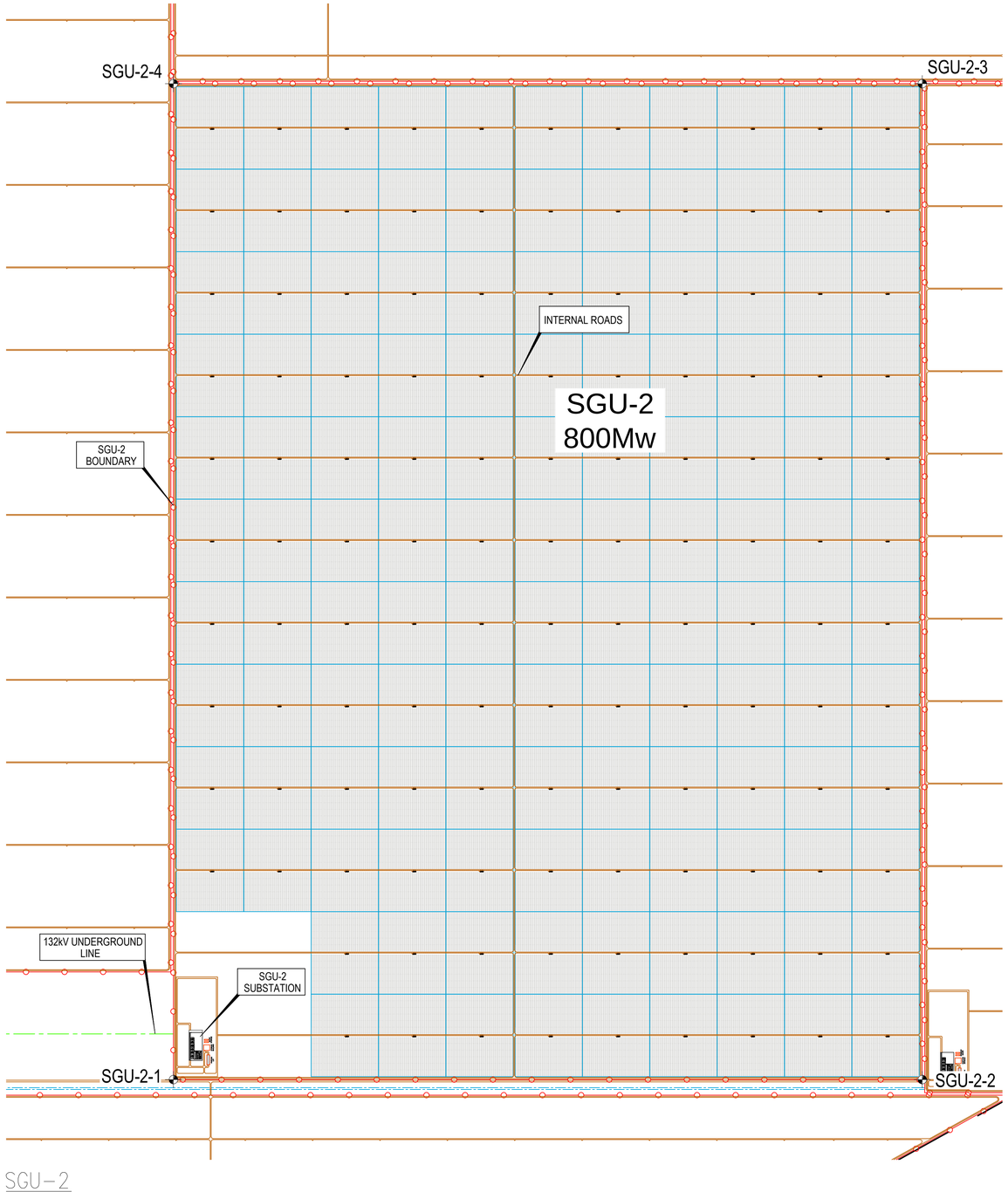
Worley
energy | chemicals | resources

CUSTOMER

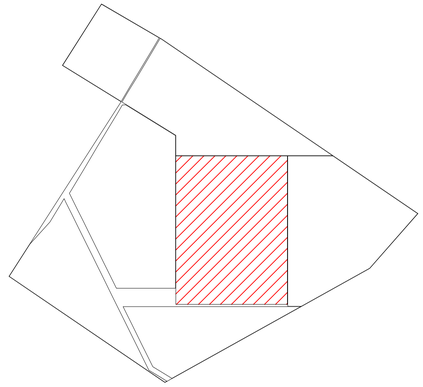
وزارة الطاقة
MINISTRY OF ENERGY

SGU-1 LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-101 SH01 | Rev. 1



SGU-2
ESCALE 1:13.000



DRAWING KEY

- INTERNAL ROAD
- SITE BOUNDARY
- SGU FENCE
- BONDED ZONE
- BLOCK CONSTRUCTION PERIMETER
- UNDERGROUND LINE
- OVERHEAD LINE
- SGU-X-X — POINTS
- BUILDINGS
- SGU — SOLAR GENERATING UNIT

POINT	X	Y
SGU-2-1	301646.930	2981922.164
SGU-2-2	305288.990	2981922.164
SGU-2-3	305288.990	2986764.900
SGU-2-4	301646.930	2986764.900

DRAFT NOT FOR CONSTRUCTION

260 0 260 520 780 1040 1300
SCALE 1:13.000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

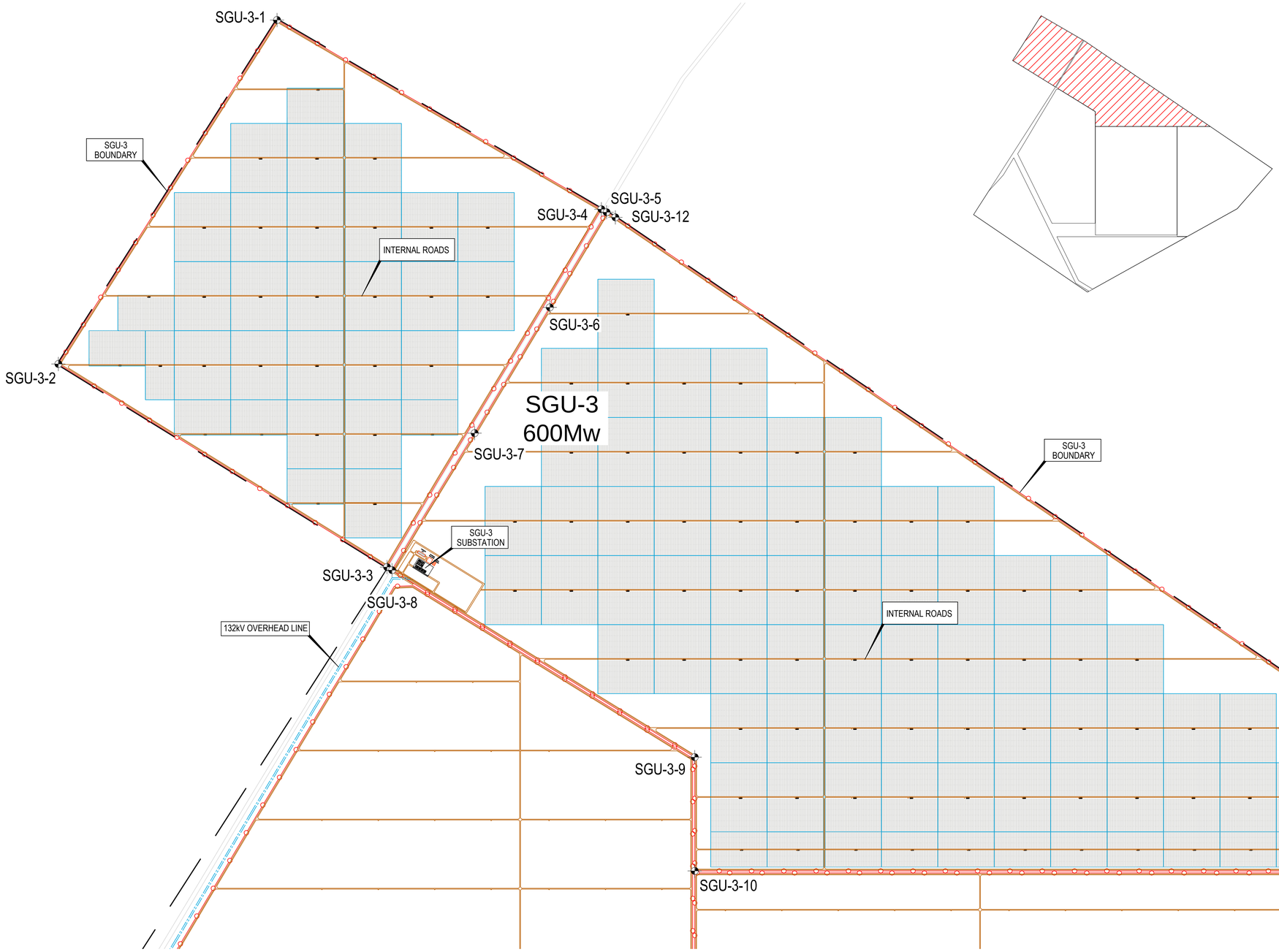
Worley
energy | chemicals | resources

CUSTOMER

وزارة الطاقة
MINISTRY OF ENERGY

SGU-2 LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-101 SH02 | Rev. 1



DRAWING KEY

- INTERNAL ROAD
- SITE BOUNDARY
- SGU FENCE
- BONDED ZONE
- BLOCK CONSTRUCTION PERIMETER
- UNDERGROUND LINE
- OVERHEAD LINE
- SGU-X-X — POINTS
- BUILDINGS
- SGU — SOLAR GENERATING UNIT

POINT	X	Y
SGU-3-1	299221.473	2991718.508
SGU-3-2	297951.477	2989720.890
SGU-3-3	299860.488	2988541.361
SGU-3-4	301105.109	2990619.872
SGU-3-5	301135.087	2990602.387
SGU-3-6	300368.961	2989319.320
SGU-3-7	300081.631	2988849.433
SGU-3-8	299889.290	2988523.565
SGU-3-9	301646.930	2987437.564
SGU-3-10	301646.930	2986776.900
SGU-3-11	306761.737	2986776.900
SGU-3-12	301186.291	2990572.522

DRAFT NOT FOR CONSTRUCTION

SGU-3
ESCALE 1:13.000

260 0 260 520 780 1040 1300
SCALE 1:13.000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

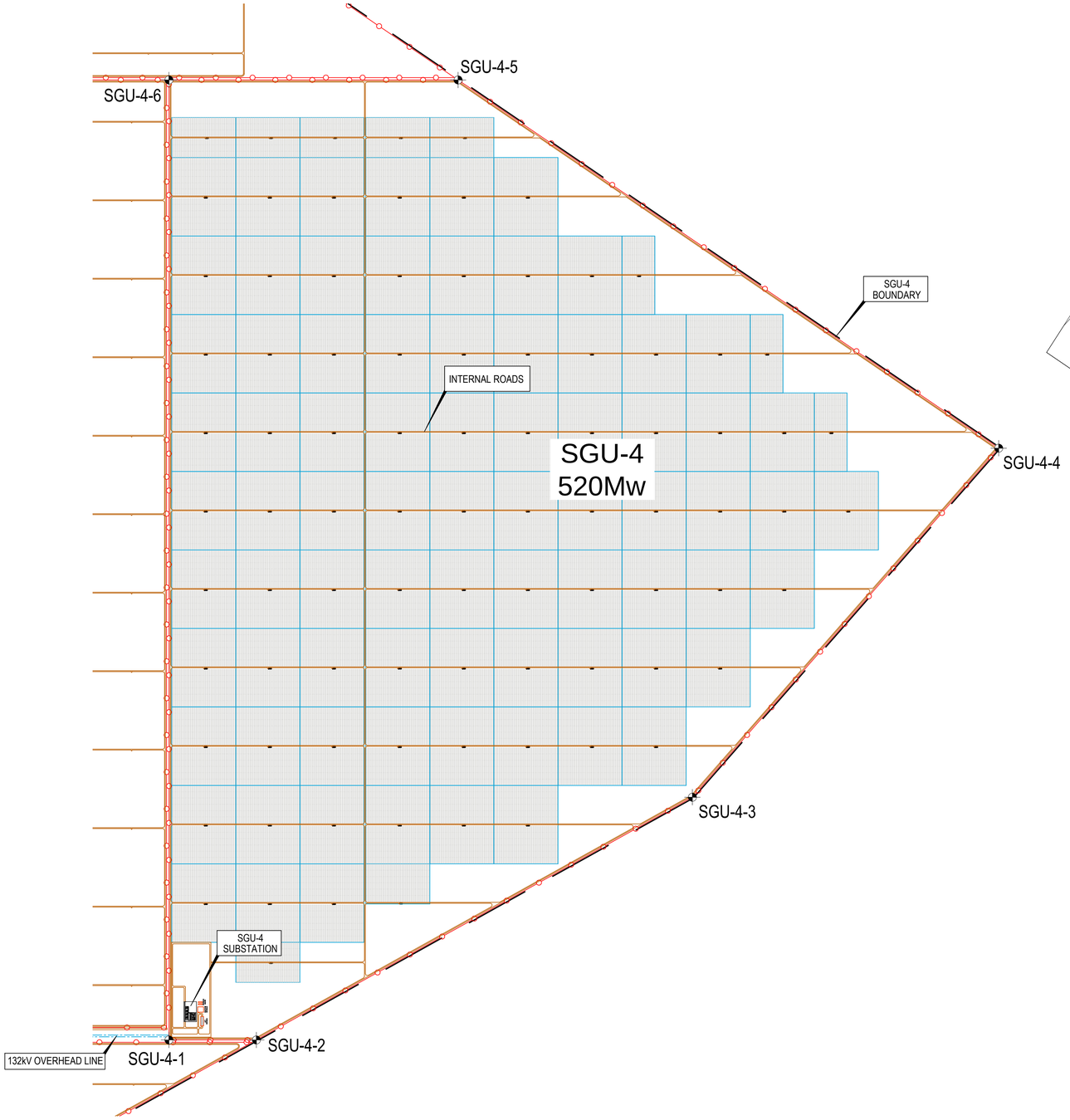
Worley energy | chemicals | resources

CUSTOMER

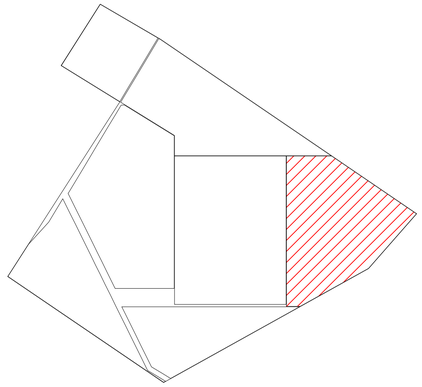
وزارة الطاقة MINISTRY OF ENERGY

SGU-3 LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-101 SH03 | Rev. 1



SGU-4
ESCALE 1:13.000



DRAWING KEY

- INTERNAL ROAD
- SITE BOUNDARY
- SGU FENCE
- BONDED ZONE
- BLOCK CONSTRUCTION PERIMETER
- UNDERGROUND LINE
- OVERHEAD LINE
- SGU-X-X — POINTS
- BUILDINGS
- SGU — SOLAR GENERATING UNIT

POINT	X	Y
SGU-4-1	305300.990	2981858.362
SGU-4-2	305747.861	2981858.362
SGU-4-3	307977.341	2983099.124
SGU-4-4	309543.634	2984883.055
SGU-4-5	306779.363	2986764.900
SGU-4-6	305300.990	2986764.900

DRAFT NOT FOR CONSTRUCTION

260 0 260 520 780 1040 1300
SCALE 1:13.000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

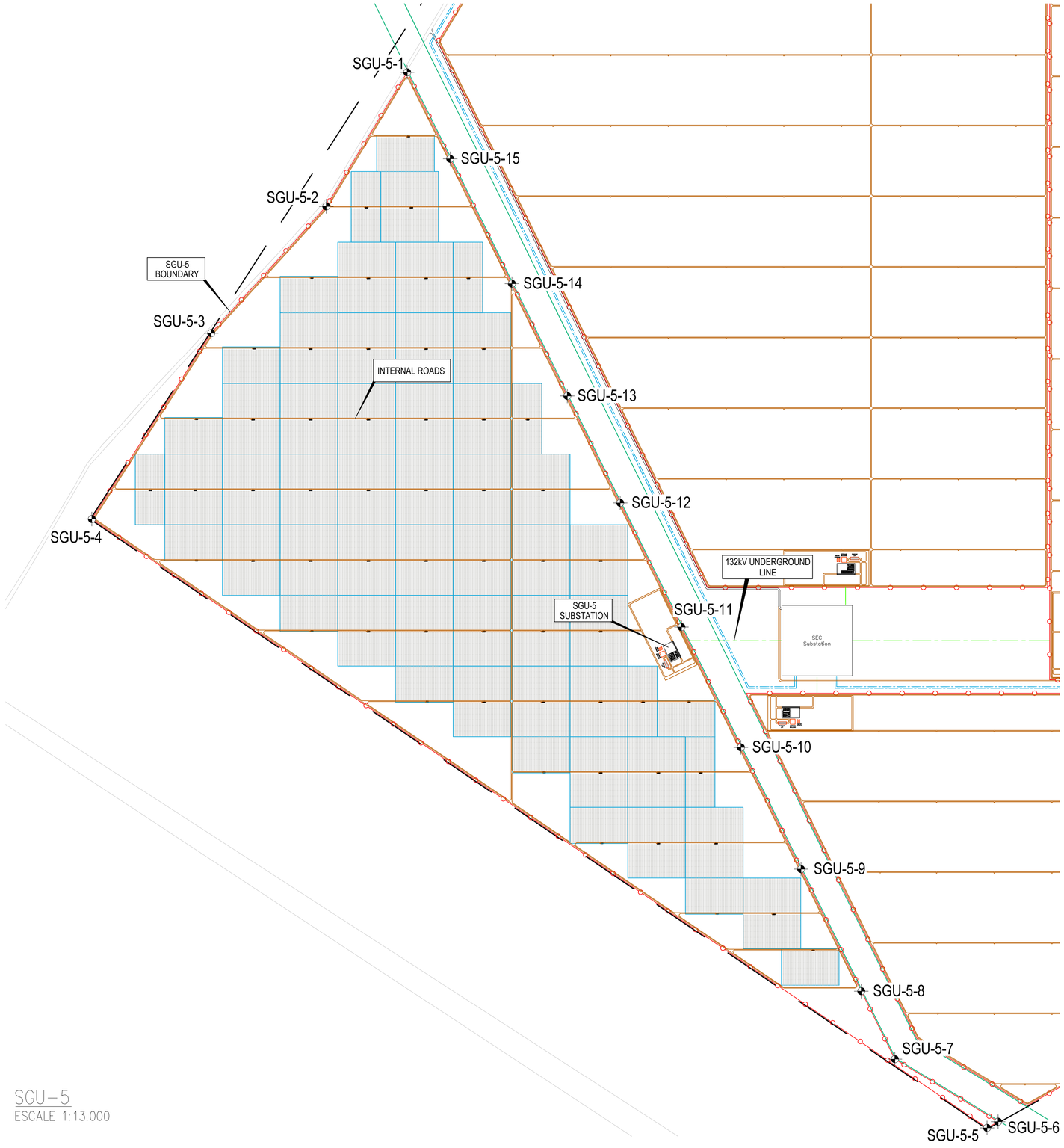
Worley energy | chemicals | resources

CUSTOMER

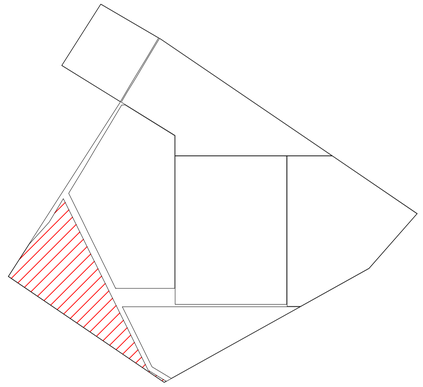
وزارة الطاقة MINISTRY OF ENERGY

SGU-4 LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-101 SH04 Rev. 1



SGU-5
ESCALE 1:13.000



DRAWING KEY

- INTERNAL ROAD
- SITE BOUNDARY
- SGU FENCE
- BONDED ZONE
- BLOCK CONSTRUCTION PERIMETER
- UNDERGROUND LINE
- OVERHEAD LINE
- SGU-X-X — POINTS
- BUILDINGS
- SGU — SOLAR GENERATING UNIT

POINT	X	Y
SGU-5-1	297998.065	2985371.337
SGU-5-2	297538.151	2984610.303
SGU-5-3	296884.646	2983890.331
SGU-5-4	296206.445	2982834.990
SGU-5-5	301291.780	2979378.440
SGU-5-6	301354.948	2979413.594
SGU-5-7	300768.041	2979768.924
SGU-5-8	300577.445	2980154.463
SGU-5-9	300235.150	2980847.459
SGU-5-10	299893.545	2981538.706
SGU-5-11	299556.017	2982221.734
SGU-5-12	299208.097	2982926.813
SGU-5-13	298907.613	2983534.045
SGU-5-14	298592.806	2984171.285
SGU-5-15	298242.163	2984880.060

DRAFT NOT FOR CONSTRUCTION

260 0 260 520 780 1040 1300
SCALE 1:13.000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley
energy | chemicals | resources

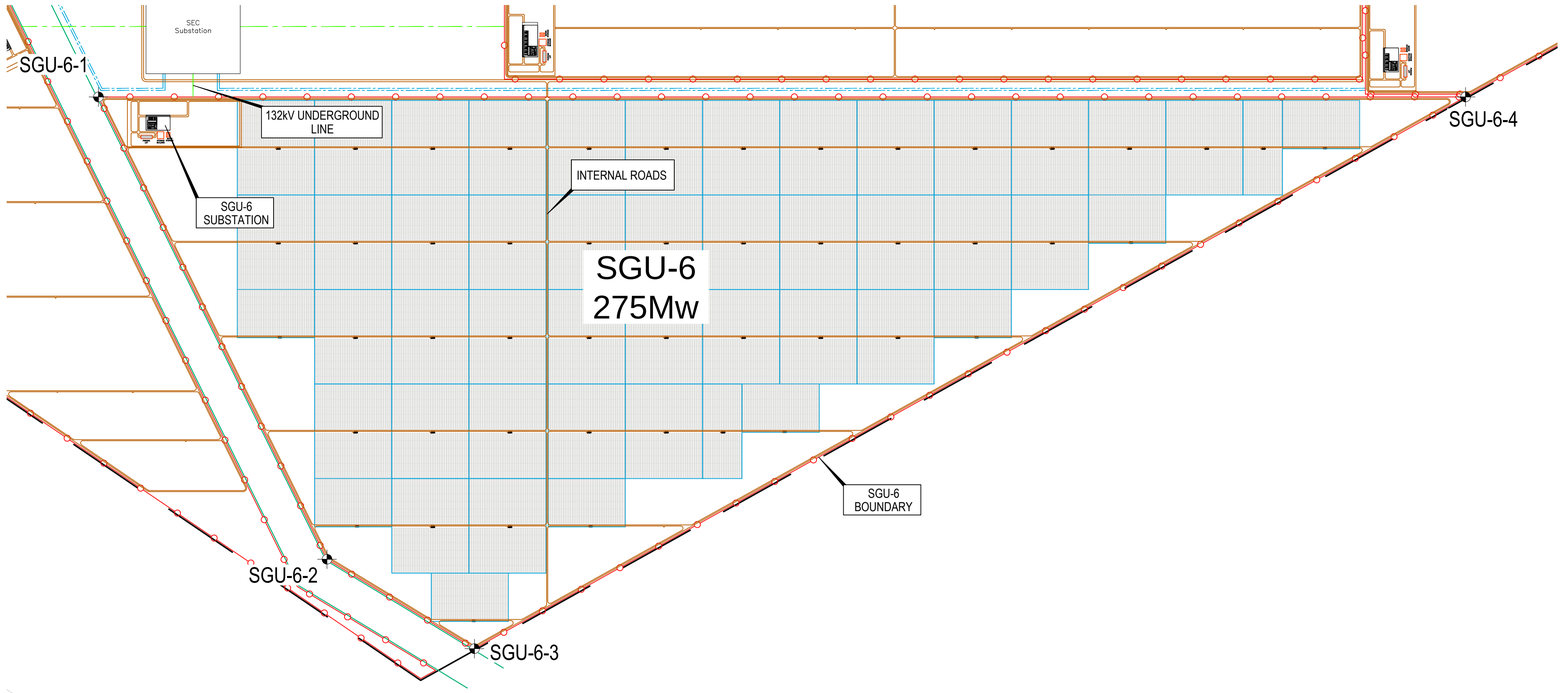
CUSTOMER

وزارة الطاقة
MINISTRY OF ENERGY

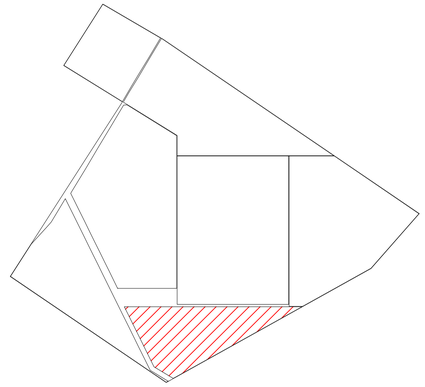
SGU-5 LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-101 SH05

Rev. 1



SGU-6
ESCALE 1:13.000



DRAWING KEY

- INTERNAL ROAD
- SITE BOUNDARY
- SGU FENCE
- BONDED ZONE
- BLOCK CONSTRUCTION PERIMETER
- UNDERGROUND LINE
- OVERHEAD LINE
- SGU-X-X — POINTS
- BUILDINGS
- SGU — SOLAR GENERATING UNIT

POINT	X	Y
SGU-6-1	299923.925	2981846.362
SGU-6-2	300893.794	2979884.614
SGU-6-3	301519.638	2979505.248
SGU-6-4	305726.299	2981846.362

DRAFT NOT FOR CONSTRUCTION

260 0 260 520 780 1040 1300
SCALE 1:13.000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
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Worley
energy | chemicals | resources

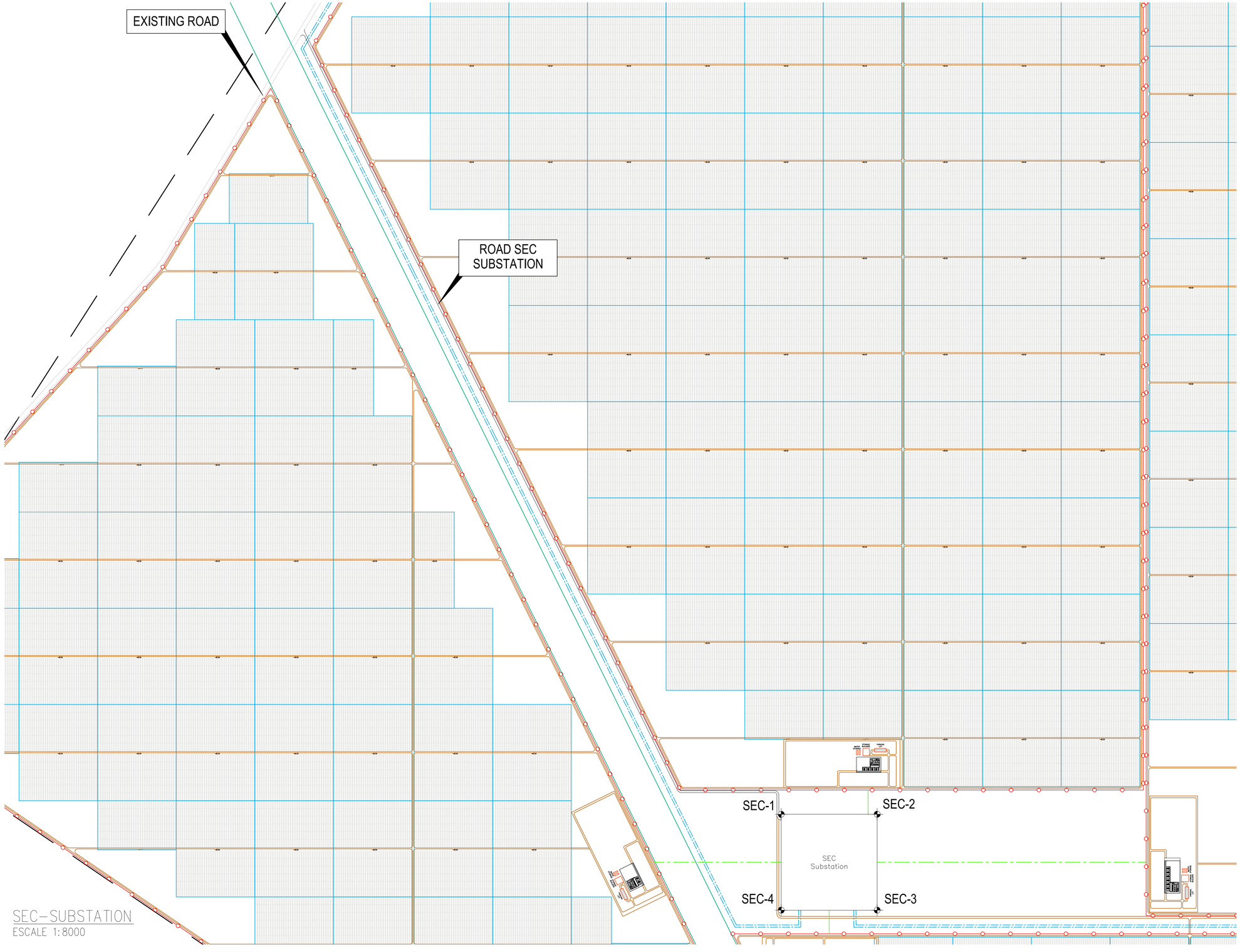
CUSTOMER

وزارة الطاقة
MINISTRY OF ENERGY

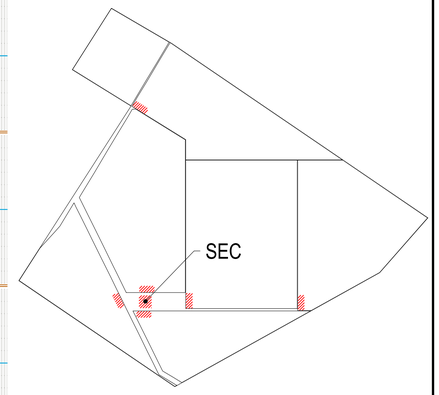
SGU-6 LAYOUT
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-101 SH06

Rev. 1



SEC-SUBSTATION
ESCALE 1:8000



SEC SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SEC-1	300125.759	2982344.768
SEC-2	300525.759	2982344.768
SEC-3	300525.759	2981944.768
SEC-4	300125.759	2981944.768

DRAFT NOT FOR CONSTRUCTION

160 0 160 320 480 640 800
SCALE 1:8000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley
energy | chemicals | resources

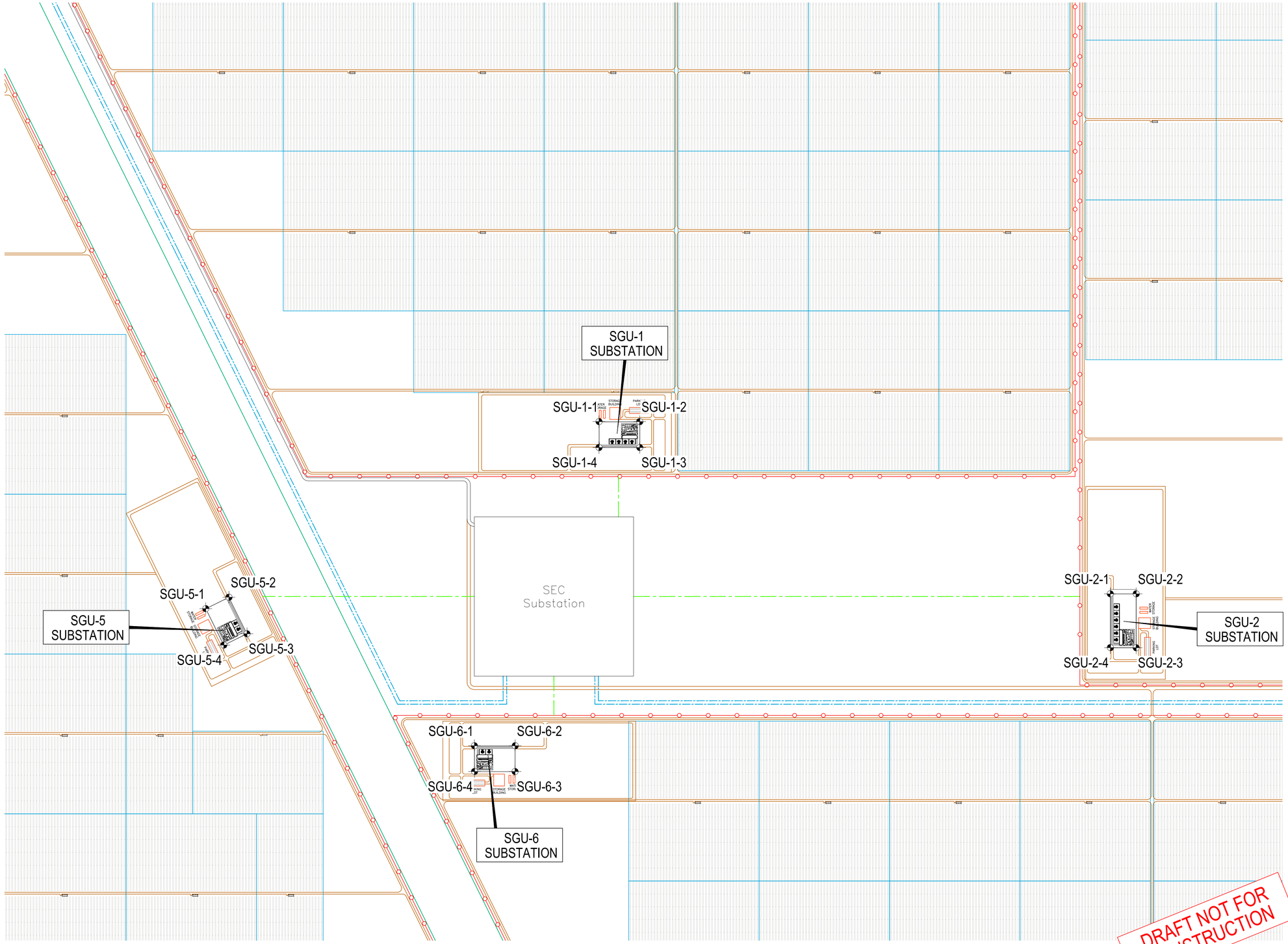
CUSTOMER

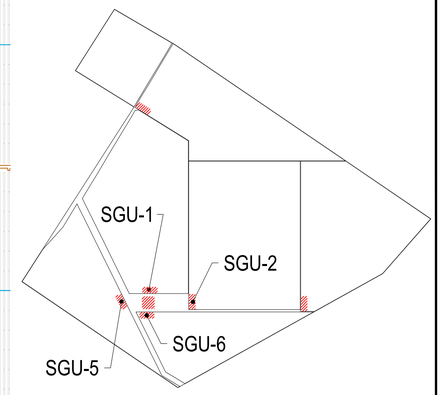
وزارة الطاقة
MINISTRY OF ENERGY

SGU & SEC SUBSTATIONS
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-102 SH1

Rev. 1





SGU-1 SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SGU-1-1	300439.217	2982583.342
SGU-1-2	300541.567	2982583.342
SGU-1-3	300541.567	2982518.338
SGU-1-4	300439.217	2982518.338

SGU-2 SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SGU-2-1	301723.372	2982151.363
SGU-2-2	301788.376	2982151.363
SGU-2-3	301788.376	2982015.947
SGU-2-4	301723.373	2982015.946

SGU-5 SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SGU-5-1	299451.046	2982114.096
SGU-5-2	299509.338	2982142.863
SGU-5-3	299554.633	2982051.081
SGU-5-4	299496.341	2982022.314

SGU-6 SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SGU-6-1	300125.954	2981769.919
SGU-6-2	300228.304	2981769.919
SGU-6-3	300228.304	2981704.916
SGU-6-4	300125.954	2981704.916

SGU – SUBSTATION
ESCALE 1:5000

100 0 100 200 300 400 500
SCALE 1:5000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley
energy | chemicals | resources

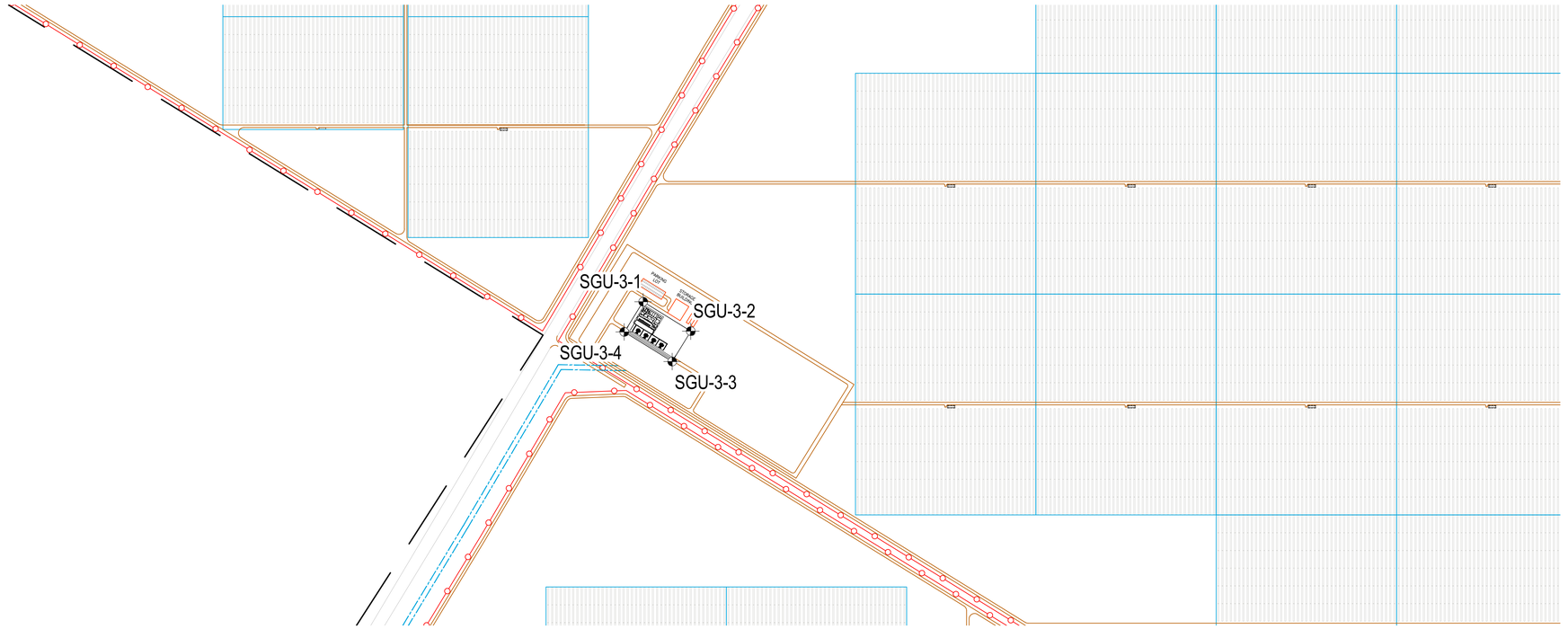
CUSTOMER

وزارة الطاقة
MINISTRY OF ENERGY

SGU & SEC SUBSTATIONS
Al-Kahfah Solar Energy Park

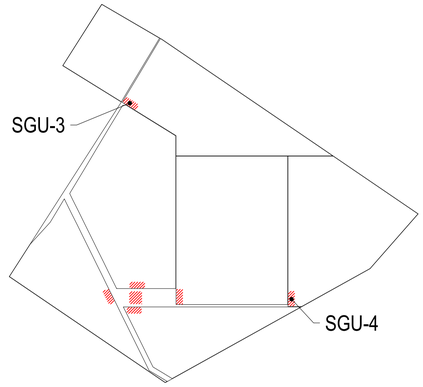
CODE 413011-00907-CI-PLN-102 SH2

Rev. 1

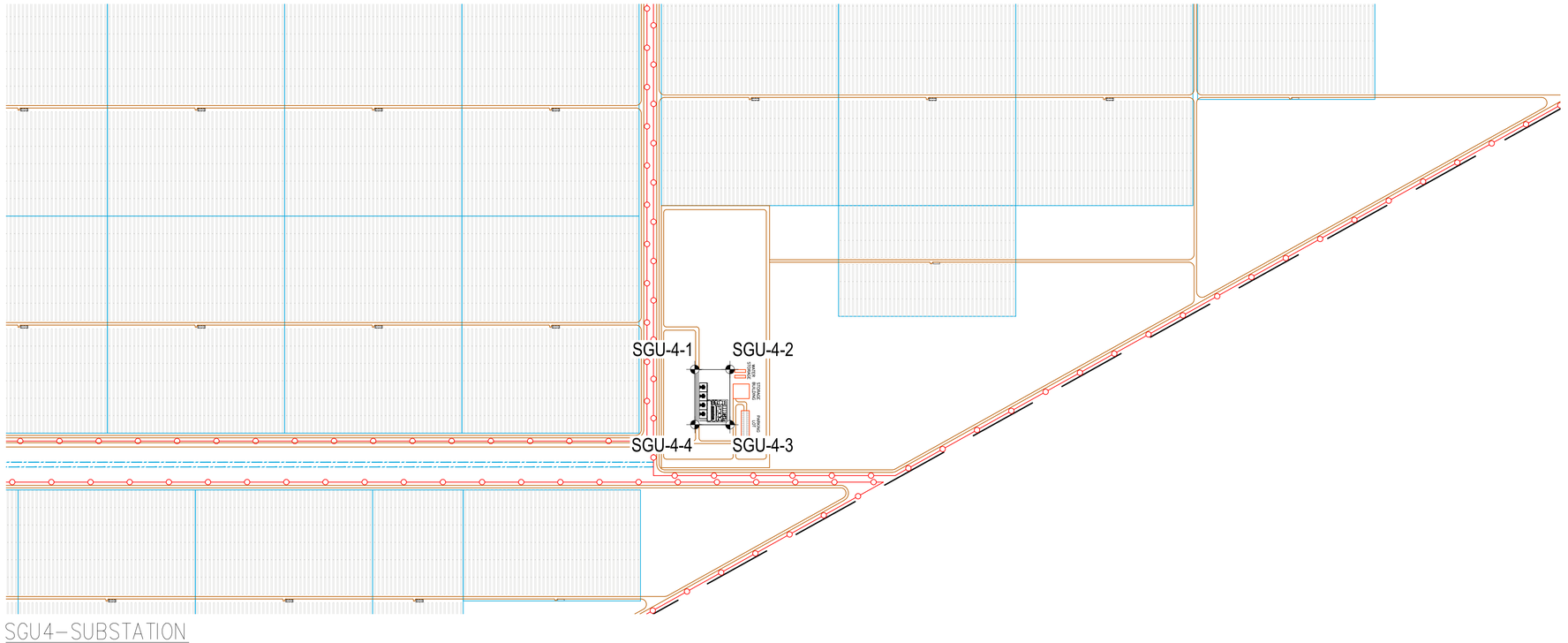


SGU3–SUBSTATION

ESCALE 1:5000



SGU-3 SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SGU-3-1	300043.172	2988594.754
SGU-3-2	300130.242	2988540.955
SGU-3-3	300096.074	2988485.656
SGU-3-4	300009.004	2988539.454



SGU-4 SUBSTATION COORDINATES (WGS84 38NORTH)		
POINT	X	Y
SGU-4-1	305377.433	2982054.495
SGU-4-2	305442.436	2982054.495
SGU-4-3	305442.436	2981952.145
SGU-4-4	305377.433	2981952.145

DRAFT NOT FOR CONSTRUCTION

SGU4–SUBSTATION

ESCALE 1:5000

100 0 100 200 300 400 500

SCALE 1:5000

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
1	2021/06/02	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO			
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley energy | chemicals | resources

CUSTOMER

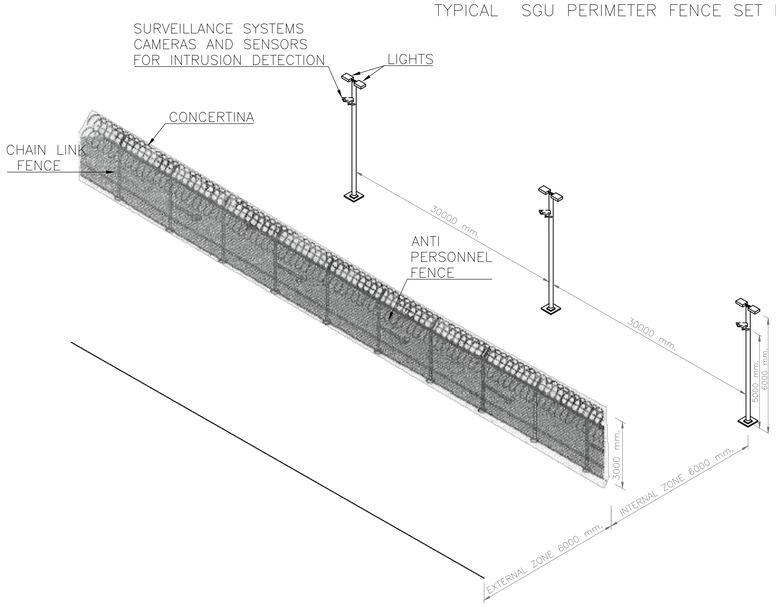
وزارة الطاقة MINISTRY OF ENERGY

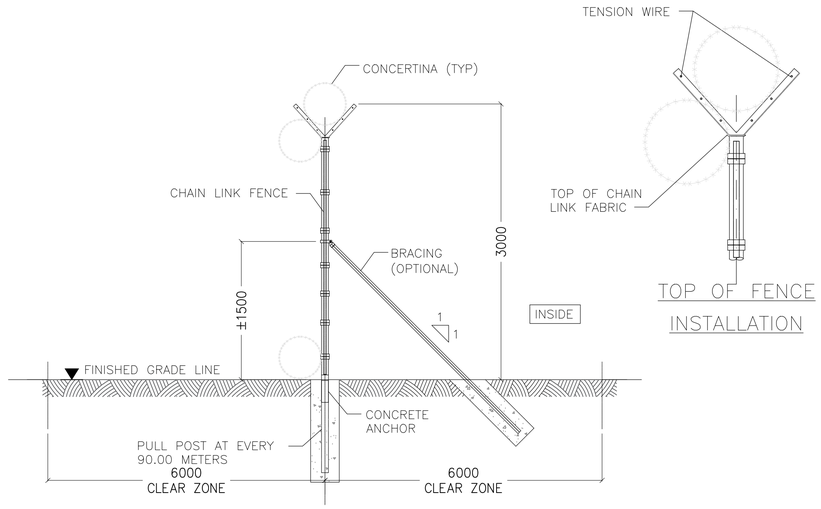
SGU & SEC SUBSTATIONS
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-102 SH3

Rev. 1

TYPICAL SGU PERIMETER FENCE SET BACK





SECTION A-A'

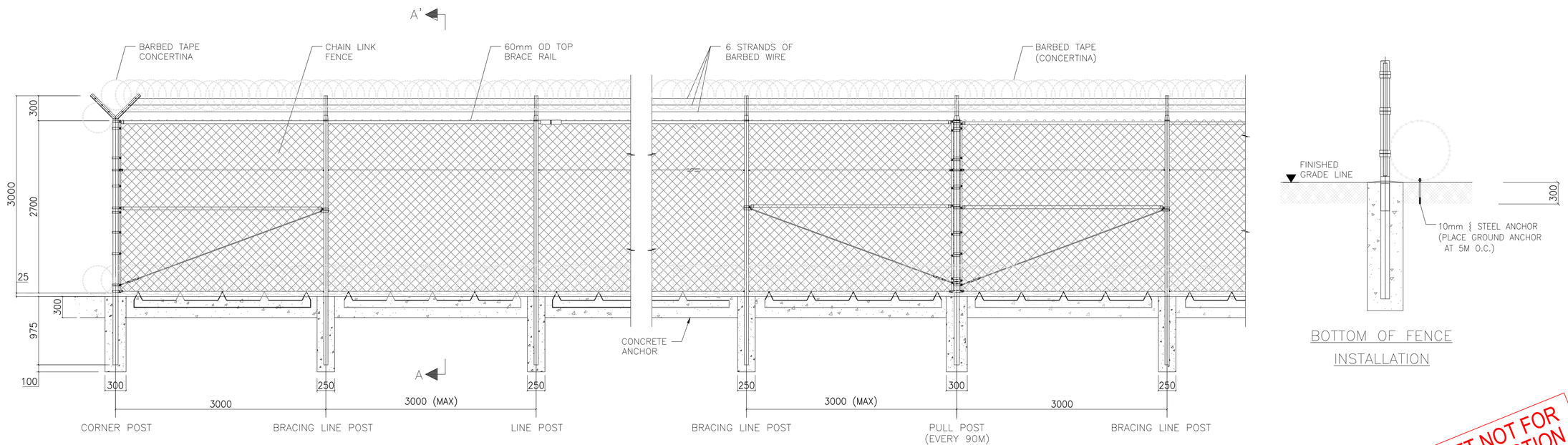
TOP OF FENCE
INSTALLATION

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. TOP OF THE FENCE SHALL FOLLOW THE PROFILE OF THE GROUND.
3. FOUNDATION WORK SHALL BE IN ACCORDANCE WITH APPLICABLE INDUSTRY CODES, STANDARD AND PROCEDURE.
4. FOUNDATION CONCRETE SHALL BE IN ACCORDANCE WITH APPLICABLE INDUSTRY CODES, STANDARD, SPECIFICATION AND PROCEDURE.
5. ALL BOLT THREADS SHALL BE BURRED AFTER FASTENING TO PREVENT REMOVAL.
6. BRACING POSTS SHALL BE PROVIDED AT ALL ENDS, CORNERS AND ACUTE VARIATIONS IN LEVELS. THE DISTANCE BETWEEN STRAINING POSTS SHALL NOT EXCEED 90 METERS. LINE POSTS SHALL BE AT 3000mm MAXIMUM SPACING.
7. FENCE POSTS AND BRACES SHALL BE IN ACCORDANCE WITH ASTM F1083 GROUP 1A SCHEDULE 80 PVC COATED.
8. FABRIC SHALL BE VINYL COATED CHAIN LINK AND FUSION BONDED AS PER ASTM F668, CLASS 2B, WITH A 50mm DIAMOND MESH AND A HEIGHT OF 2700mm.
9. REFERENCES HCIS, SECURITY DIRECTIVE FOR INDUSTRIAL FACILITIES (2017), SEC-02 SECURITY FENCING, SECTION 5.5 CATEGORY 3 FENCING SYSTEM.

LEGEND:

℄	–	CENTERLINE
MAX	–	MAXIMUM
M	–	METER
mm	–	MILLIMETERS
OC	–	ON CENTER
OD	–	OUTER DIAMETER
TYP	–	TYPICAL



GENERAL LAYOUT - CLASS 3 CHAIN LINK SECURITY FENCE

BOTTOM OF FENCE
INSTALLATION

DRAFT NOT FOR CONSTRUCTION

FENCE
SCALE N/S

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley
energy | chemicals | resources

CUSTOMER

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MINISTRY OF ENERGY

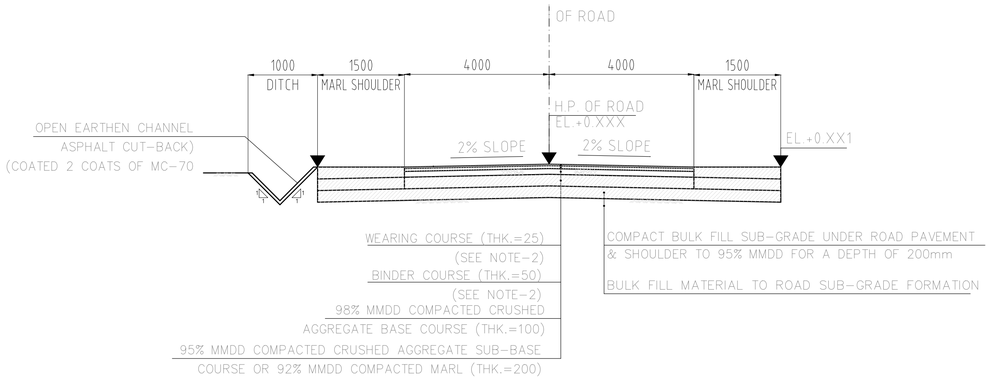
HCIS FENCING DETAILS
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-103

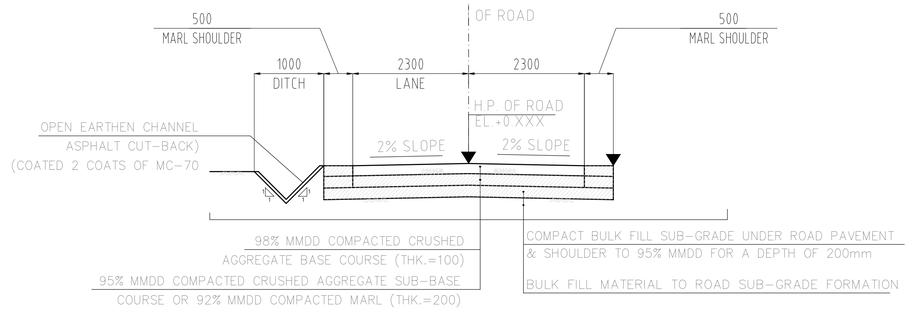
Rev. 0

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS AND ELEVATIONS ARE IN METERS UNLESS OTHERWISE NOTED.
2. ASPHALT PAVING FOR BINDER AND WEARING COURSES SHALL BE A MIXTURE OF ASPHALT CEMENT, COARSE AGGREGATES, FINE AGGREGATES AND IF REQUIRED, MINERAL FILLER.
3. REFERENCE SAUDI ARAMCO PLANT LAYOUT REQUIREMENTS SAES-B-055 FOR PRIMARY AND SECONDARY ROADS. REFERENCE SEC-02 SECURITY FENCING, SECTION 4.5 CATEGORY 3 FENCING SYSTEM FOR PATROL ROADS.

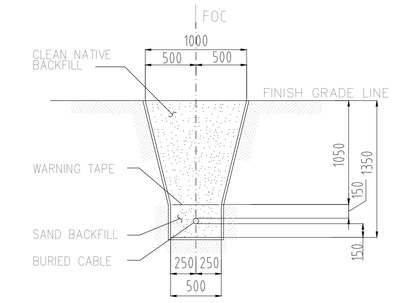


1 / - PRIMARY ROAD



2 / - PATROL ROAD

DRAFT NOT FOR CONSTRUCTION



3 / - CABLE TRENCH DETAIL

SECTIONS & DETAILS

SCALE N/S

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley energy | chemicals | resources

CUSTOMER

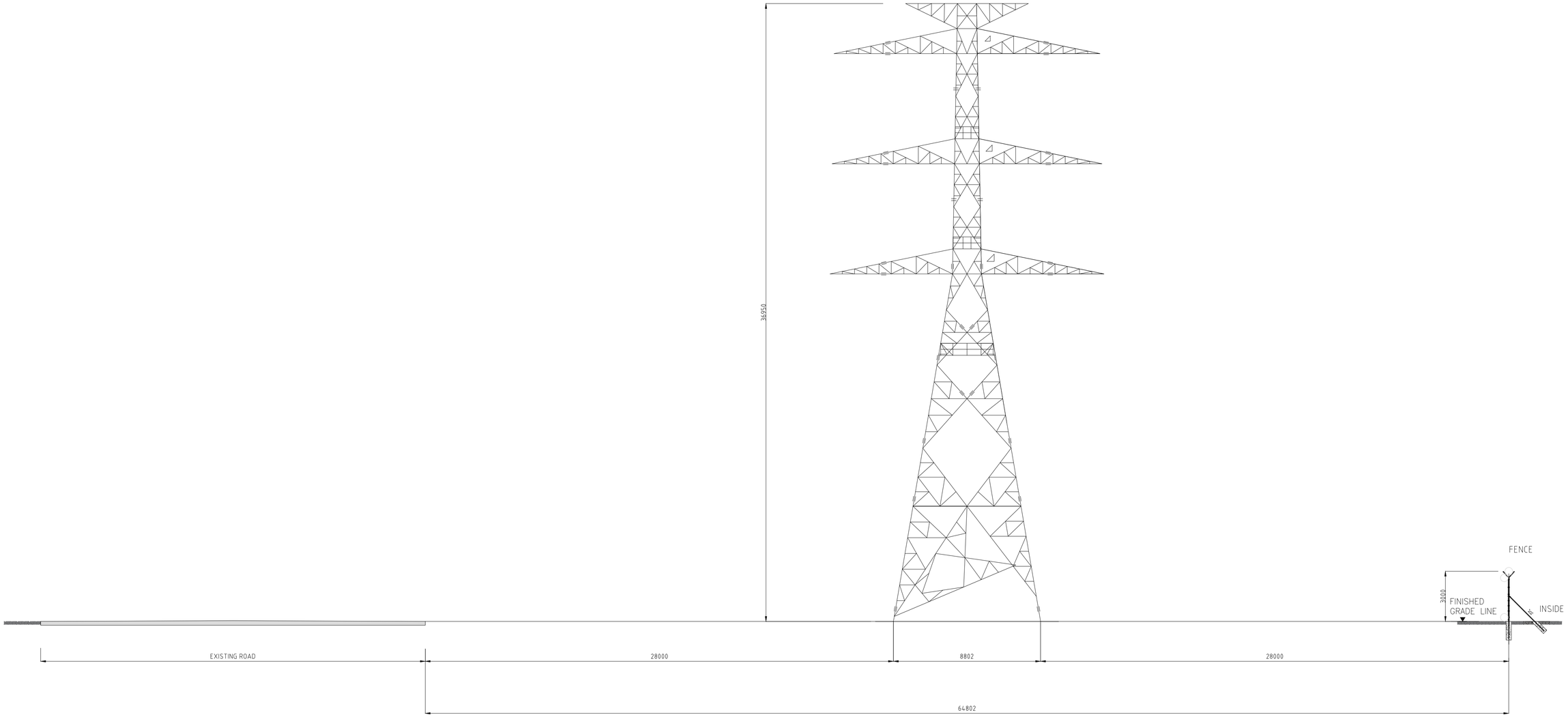
وزارة الطاقة MINISTRY OF ENERGY

ROADS, DRAINAGE & CABLE TRENCH TYPICAL DETAILS
Al-Kahfah Solar Energy Park

CODE 413011-00907-CI-PLN-104 | Rev. 0

NOTES:

1. REFERENCE TO TRANSMISSION ENGINEERING STANDARD, TES-P-122.09 REV.0, TABLE 09.16



DRAFT NOT FOR CONSTRUCTION

SECTION 1
SCALE N/S

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley energy | chemicals | resources

CUSTOMER

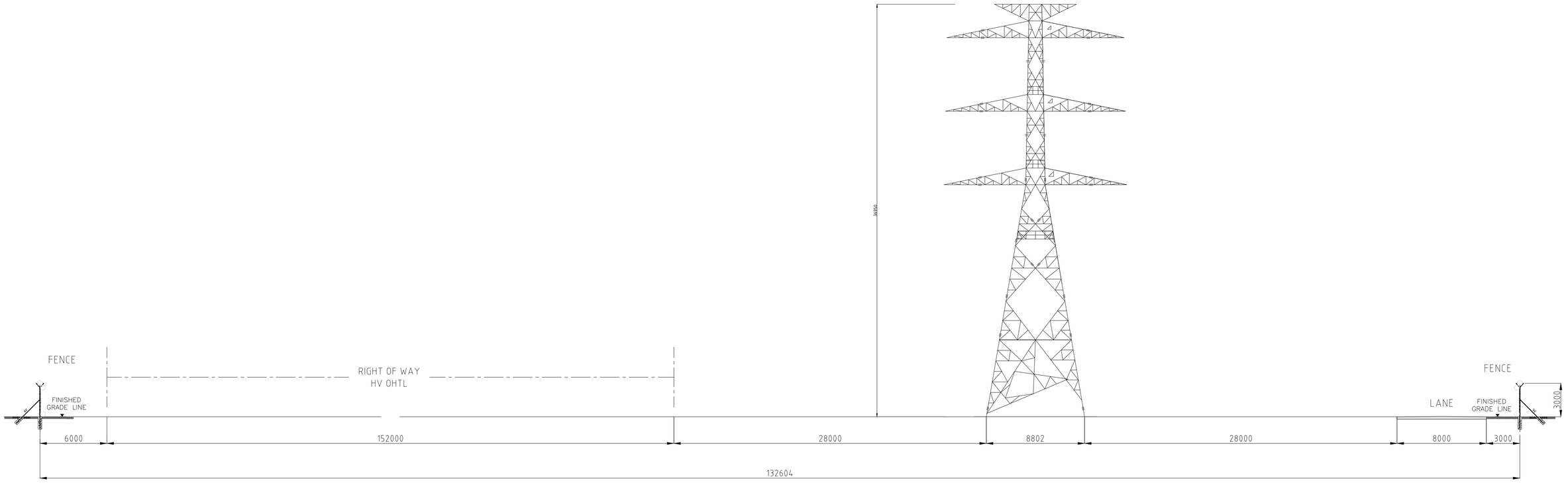
وزارة الطاقة MINISTRY OF ENERGY

SECTION 01 HV-LINE 132kV
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-101 SH1 | Rev. 0

NOTES:

1. REFERENCE TO TRANSMISSION ENGINEERING STANDARD, TES-P-122.09 REV.0, TABLE 09.16



DRAFT NOT FOR CONSTRUCTION

SECTION 2
SCALE N/S

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley energy | chemicals | resources

CUSTOMER

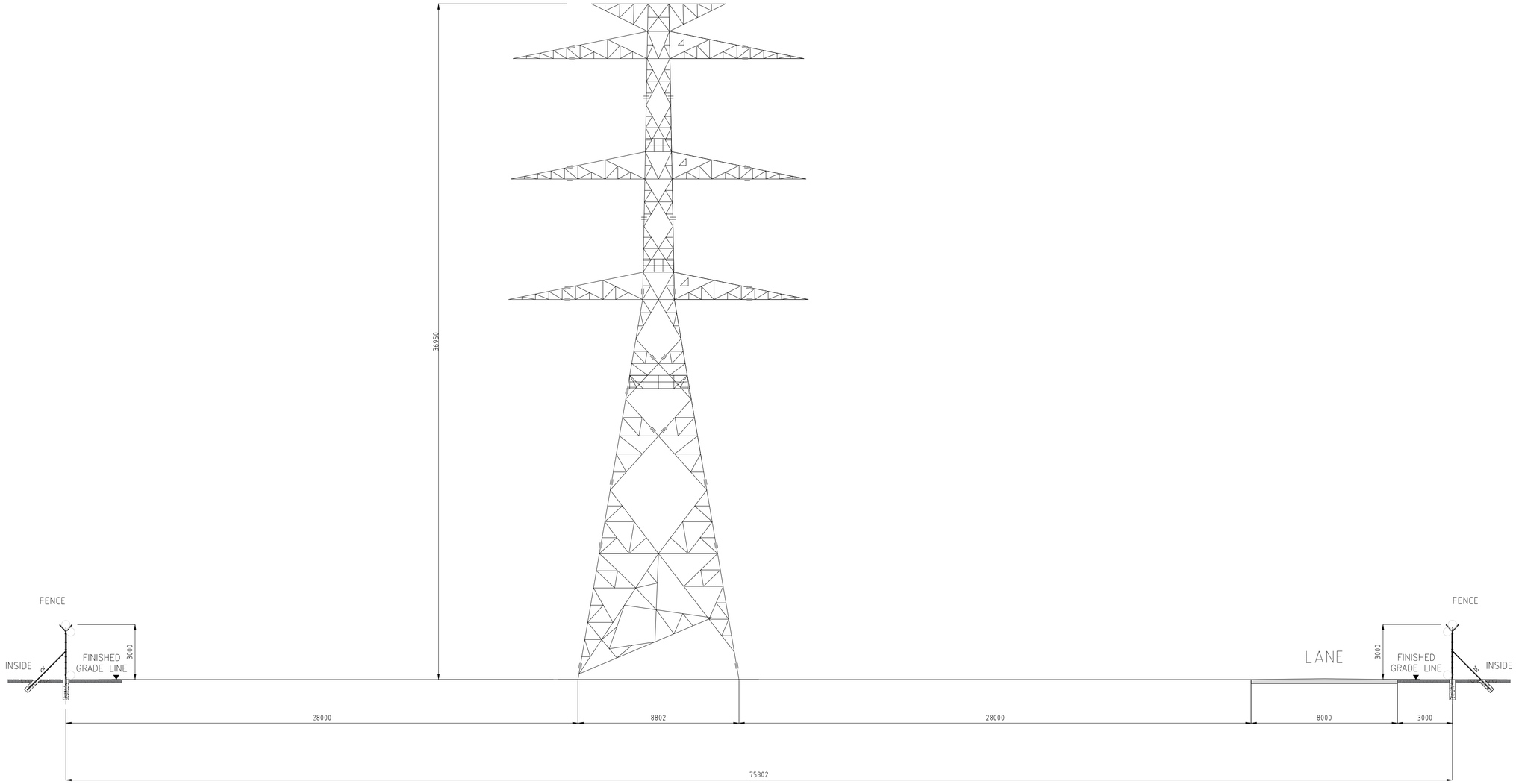
وزارة الطاقة MINISTRY OF ENERGY

SECTION 02 HV-LINE 132kV
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-101 SH2 | Rev. 0

NOTES:

1. REFERENCE TO TRANSMISSION ENGINEERING STANDARD, TES-P-122.09 REV.0, TABLE 09.16



DRAFT NOT FOR CONSTRUCTION

SECTION 3
SCALE N/S

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

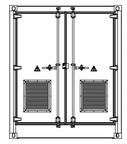
Worley energy | chemicals | resources

CUSTOMER

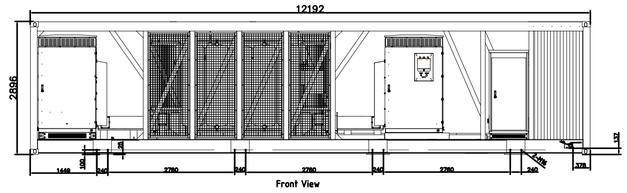
وزارة الطاقة MINISTRY OF ENERGY

SECTION 03 HV-LINE 132kV
Al-Kahfah Solar Energy Park

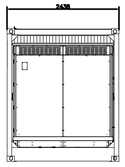
CODE 413011-00907-EL-PLN-101 SH3 | Rev. 0



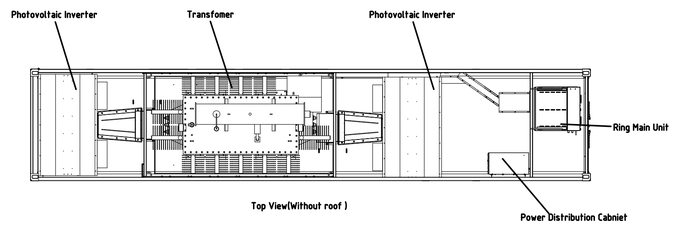
Left View



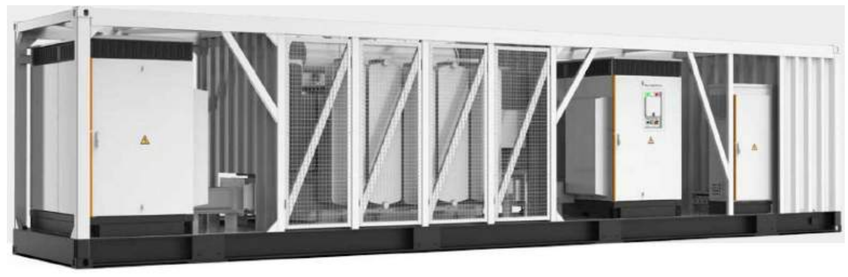
Front View



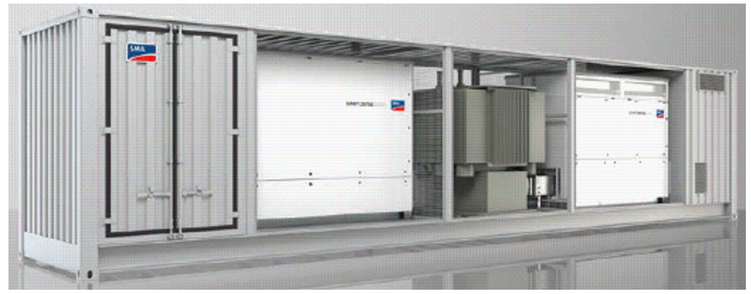
Right View

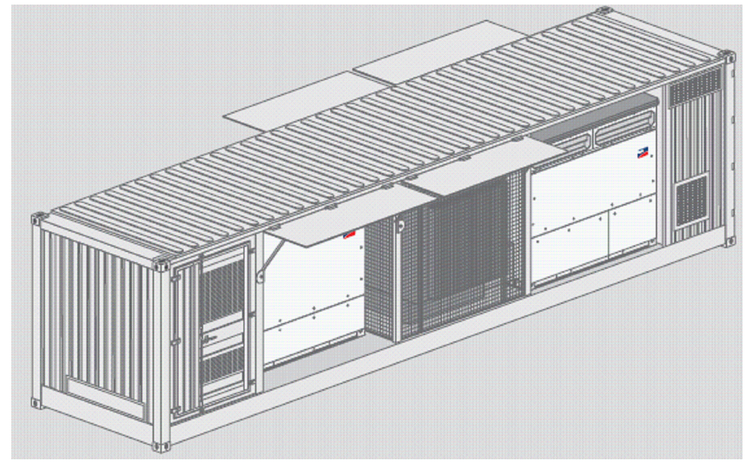


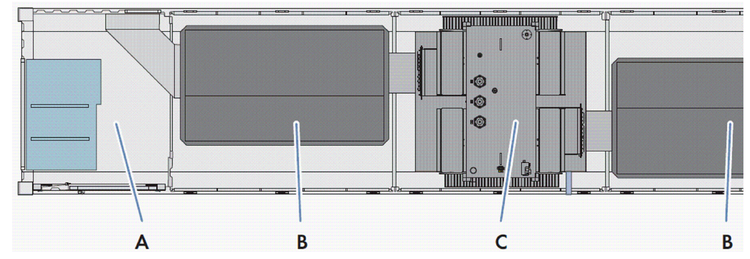
Top View(Without roof)



SUNGROW INVERTER SKID
EXAMPLE 1







A—MV Switchgear
B—Inverters
C—MV Transformer
D—LV Room

SMA
INVERTER STATION
EXAMPLE 2

DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

Worley
energy | chemicals | resources

CUSTOMER

وزارة الطاقة
MINISTRY OF ENERGY

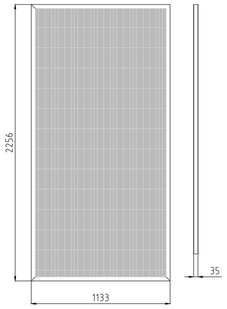
TYPICAL INVERTER STATION
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-102

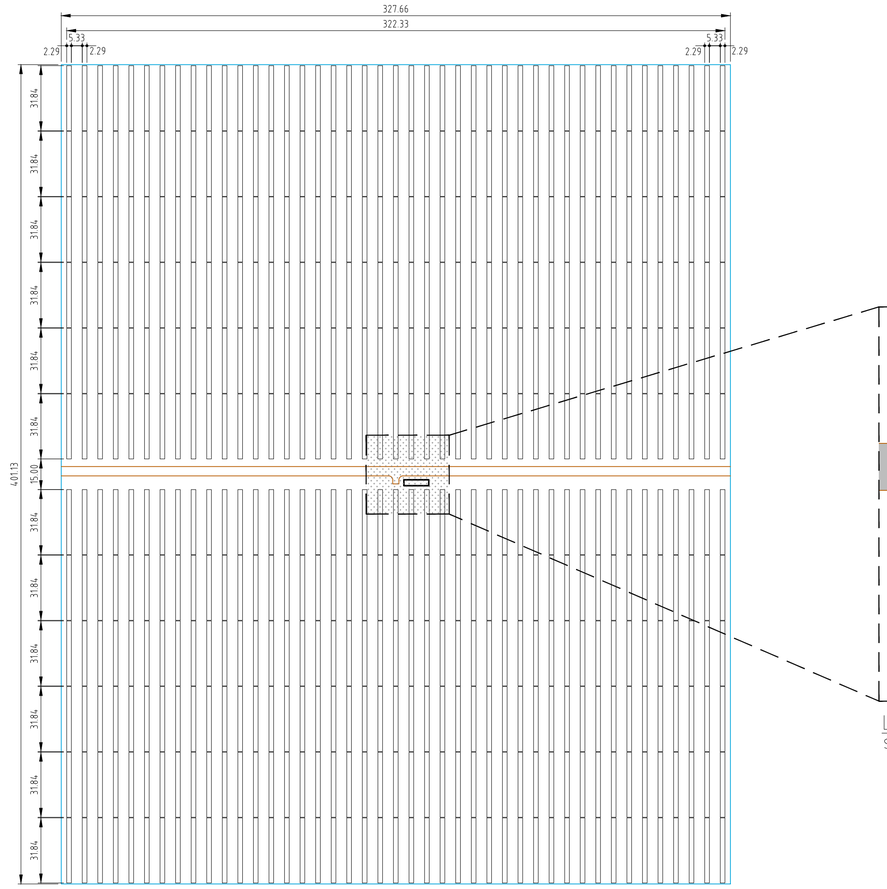
Rev. 0

BLOCK ARRANGEMENT

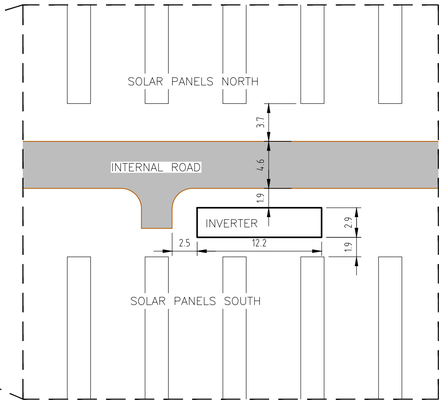
- Number of Modules = 14,476
- Modules per string = 28
- Number of Strings = 517
- Block Power = 7,817,040 kWp
- Inverter Power = 3,125 kWp
- DC/AC ratio = 1.25
- GCR = 0.3
- Azimut = 0°
- Pitch Between Structures E-W: 7.5 m
- 1x28 Structure Dimension: 31.84 x 2.29 m
- Number of tracking structures = 517
- Module Power = 540Wp



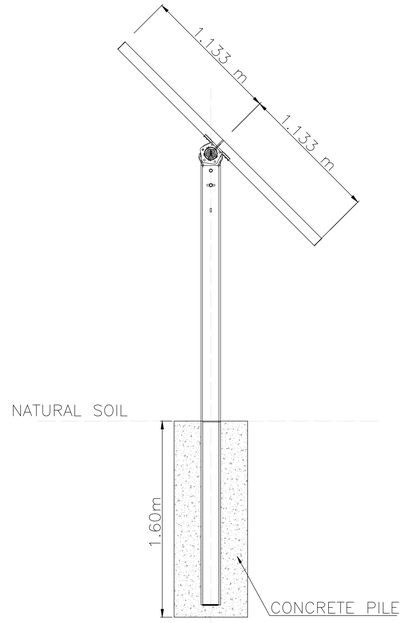
SOLAR PANEL
SCALE 1:25



TYPICAL SOLAR MODULE
SCALE 1:1500



LOCATION INVERTER DETAIL (TYP)
SCALE 1:300



SOLAR SINGLE AXIS TRACKER
SCALE 1:25

DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

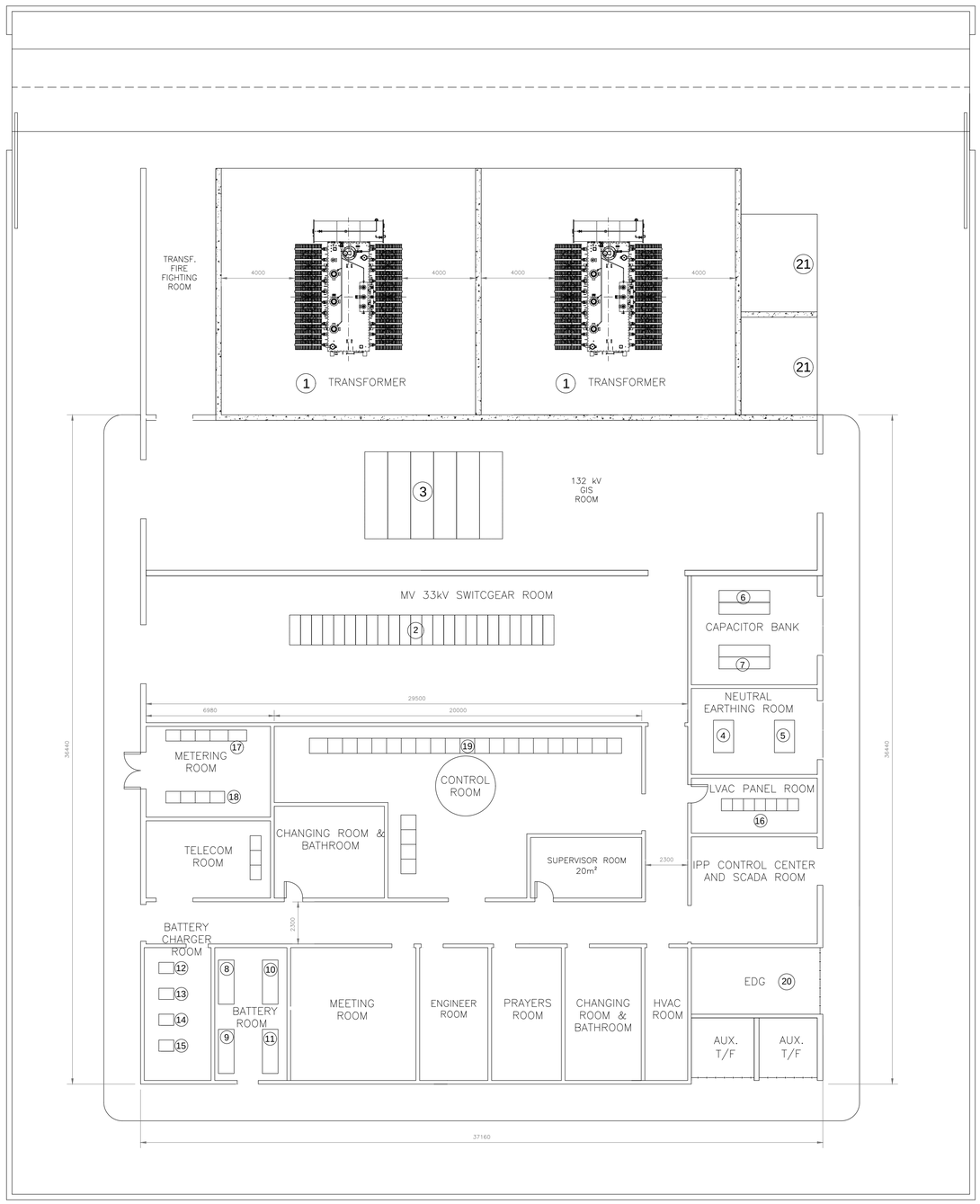
Worley energy | chemicals | resources

CUSTOMER

وزارة الطاقة MINISTRY OF ENERGY

TYPICAL ARRAY LAYOUT & SUPPORT STRUCTURE
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-103 Rev. 0



IPP SUBESTATION

ESCALE 1:150

EQUIPMENT LIST	
TAG Nº	DESCRIPTION
1	Step up transformer 33kV/132kV
2	33kV Medium Voltage Switchgear
3	132kV High Voltage Switchgear
4	Neutral resistor - 1
5	Neutral resistor - 2
6	Capacitor bank - 1
7	Capacitor bank - 2
8	Battery bank for control 220 V
9	Battery bank for tripping 220 V
10	Battery bank for emer. lighting 110 V
11	Battery charger for control 220 V
12	Battery charger for tripping 220 V
13	Battery charger for light 110 V
14	Battery charger 48 V
15	Battery bank 48 V
16	LVAC panel
17	Main and check metering panel busbar
18	Main and check metering panel busbar
19	33 kV Control and relay panel
20	Emergency Diesel Generator
21	Neutral grounding transformer

NOTE:

THIS TYPICAL SUBSTATION LAYOUT APPLIES TO A 300MW SGU, THE NUMBER OF EQUIPMENT WILL DEPEND ON THE POWER OF THE SGU.

DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

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CUSTOMER

وزارة الطاقة MINISTRY OF ENERGY

TYPICAL SGU SUBSTATION LAYOUT
Al-Kahfah Solar Energy Park

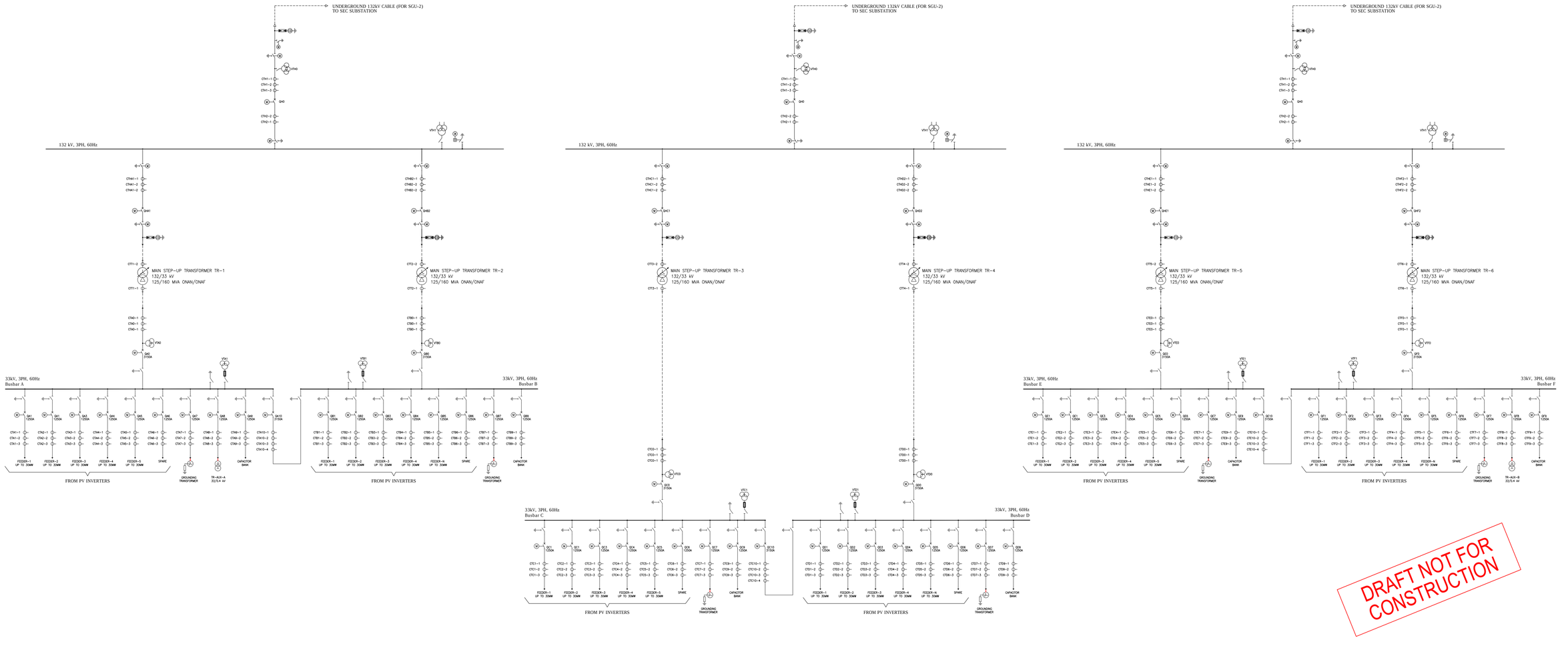
CODE 413011-00907-EL-PLN-104 Rev. 0

NOTES:

1. THE RATING SHOWN OF ALL THE EQUIPMENT IS PRELIMINARY. IT SHALL BE CONFIRMED DURING BASIC DESIGN.
2. REVENUE METERING SHALL BE INSTALLED IN SEC SUBSTATION. CHECK METERING SHALL BE INSTALLED ON THE 132kV SUBSTATION (BEFORE THE EVACUATION LINE).
3. THE NUMBER AND LOCATION OF CURRENT TRANSFORMER IS INDICATIVE ONLY. IT SHALL BE CONFIRMED DURING BASIC DESIGN.

LEGEND:

NUMBER	SYMBOL	DESCRIPTION	NUMBER	SYMBOL	DESCRIPTION
Q0		CIRCUIT BREAKER WITH MOTOR OPERATED SPRING MECHANISM	CT		CURRENT TRANSFORMER
Q1		3 POSITION SWITCH WITH MOTOR OPERATED (ISOLATOR + WORK IN PROGRESS EARTH SWITCH)	-		SURGE ARRESTER
Q2		ISOLATOR / DISCONNECTOR INCORPORATED WITH VT (MANUAL OPERATION)	-		COUNTER DISCHARGE
Q3		HIGH SPEED EARTHING SWITCH WITH MOTOR OPERATING	-		EARTHING POINT
Q4		SWITCH WITH MOTOR OPERATED	-		132/33 kV BUS BAR
FU		FUSE	-		132/33 kV CABLE
VT1		VOLTAGE TRANSFORMER WITH TWO OR THREE SECONDARY WINDINGS	-		CABLE SEALING END
VT		VOLTAGE TRANSFORMER WITH ONE SECONDARY WINDING	-		MAIN STEP UP TRANSFORMER



DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

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وزارة الطاقة MINISTRY OF ENERGY

GENERAL SLD 800MW
SGU-2
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-105 SH1

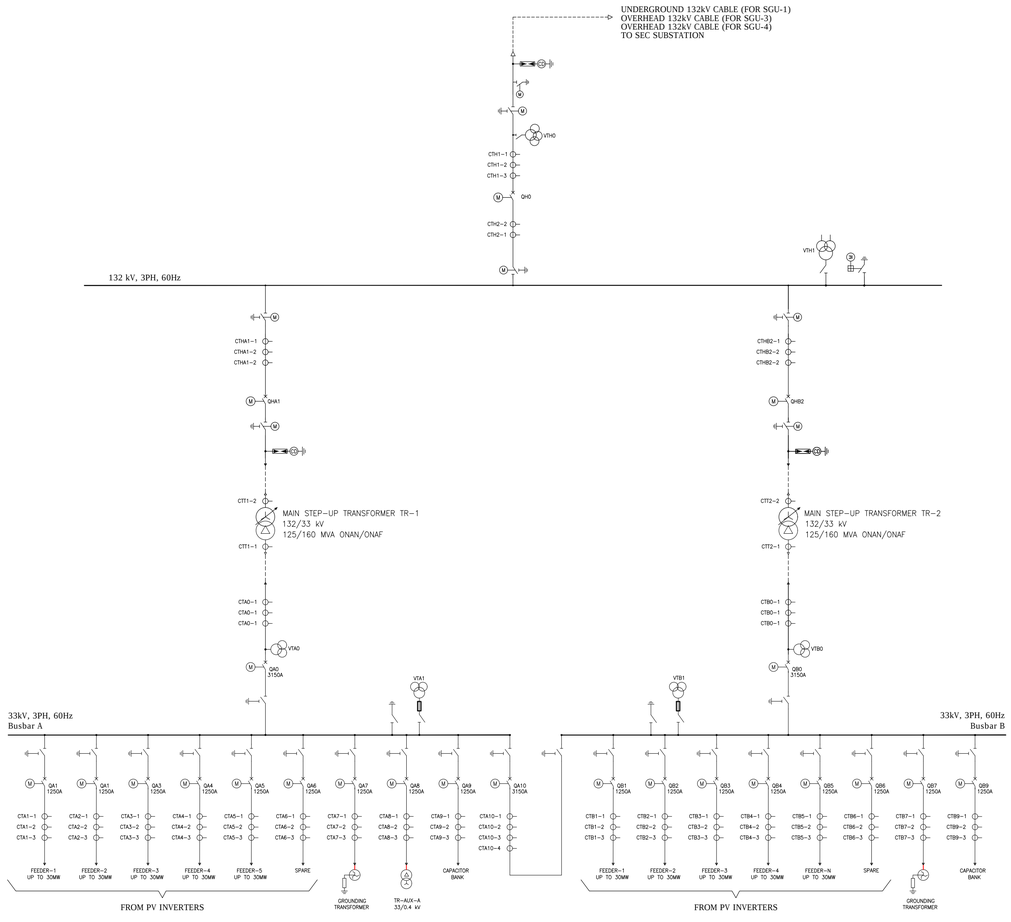
Rev. 0

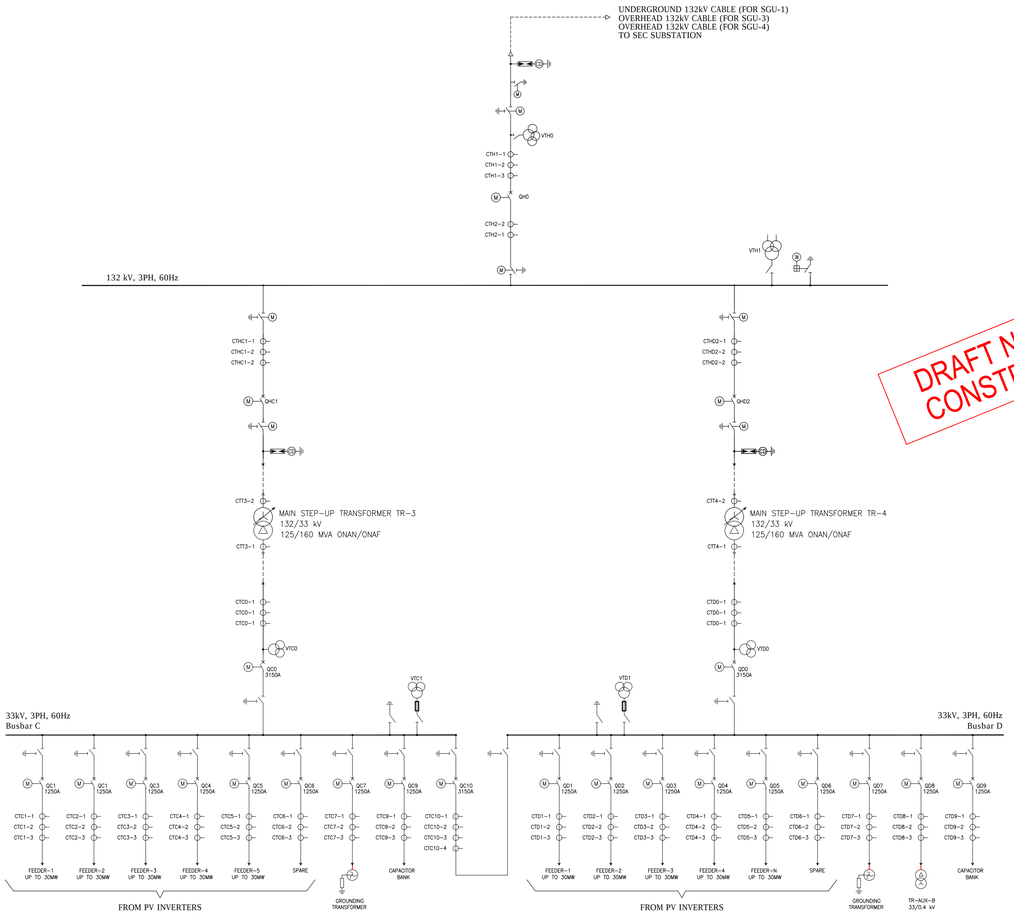
NOTES:

1. THE RATING SHOWN OF ALL THE EQUIPMENT IS PRELIMINARY. IT SHALL BE CONFIRMED DURING BASIC DESIGN.
2. REVENUE METERING SHALL BE INSTALLED IN SEC SUBSTATION. CHECK METERING SHALL BE INSTALLED ON THE 132kV SUBSTATION (BEFORE THE EVACUATION LINE).
3. THE NUMBER AND LOCATION OF CURRENT TRANSFORMER IS INDICATIVE ONLY. IT SHALL BE CONFIRMED DURING BASIC DESIGN.

LEGEND:

NUMBER	SYMBOL	DESCRIPTION	NUMBER	SYMBOL	DESCRIPTION
Q0		CIRCUIT BREAKER WITH MOTOR OPERATED SPRING MECHANISM	CT		CURRENT TRANSFORMER
Q1		3 POSITION SWITCH WITH MOTOR OPERATED (ISOLATOR + WORK IN PROGRESS EARTH SWITCH)	-		SURGE ARRESTER
Q2		ISOLATOR / DISCONNECTOR INCORPORATED WITH VT (MANUAL OPERATION)	-		COUNTER DISCHARGE
Q3		HIGH SPEED EARTHING SWITCH WITH MOTOR OPERATING	-		EARTHING POINT
Q4		SWITCH WITH MOTOR OPERATED	-		132/33 kV BUS BAR
FU		FUSE	-		132/33 kV CABLE
VT1		VOLTAGE TRANSFORMER WITH TWO OR THREE SECONDARY WINDINGS	-		CABLE SEALING END
VT		VOLTAGE TRANSFORMER WITH ONE SECONDARY WINDING	-		MAIN STEP UP TRANSFORMER





DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

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CUSTOMER

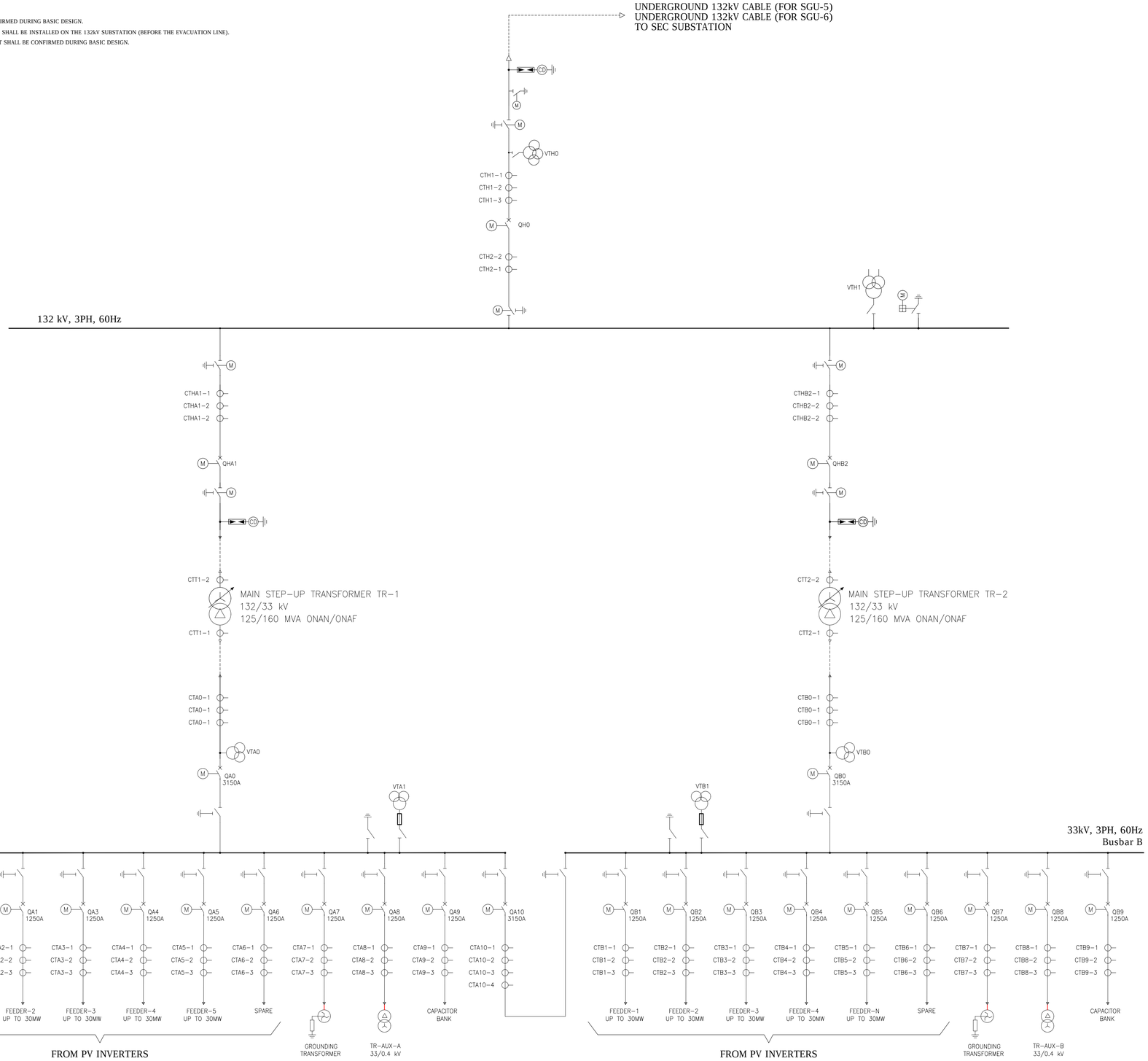
وزارة الطاقة MINISTRY OF ENERGY

GENERAL SLD 600MW
SGU-1، SGU-3 & SGU-4
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-105 SH2 | Rev. 0

NOTES:

1. THE RATING SHOWN OF ALL THE EQUIPMENT IS PRELIMINARY. IT SHALL BE CONFIRMED DURING BASIC DESIGN.
2. REVENUE METERING SHALL BE INSTALLED IN SEC SUBSTATION. CHECK METERING SHALL BE INSTALLED ON THE 132kV SUBSTATION (BEFORE THE EVACUATION LINE).
3. THE NUMBER AND LOCATION OF CURRENT TRANSFORMER IS INDICATIVE ONLY. IT SHALL BE CONFIRMED DURING BASIC DESIGN.



LEGEND:

NUMBER	SYMBOL	DESCRIPTION
Q0		CIRCUIT BREAKER WITH MOTOR OPERATED SPRING MECHANISM
Q1		3 POSITION SWITCH WITH MOTOR OPERATED (ISOLATOR + WORK IN PROGRESS EARTH SWITCH)
Q2		ISOLATOR / DISCONNECTOR INCORPORATED WITH VT (MANUAL OPERATION)
Q3		HIGH SPEED EARTHING SWITCH WITH MOTOR OPERATING
Q4		SWITCH WITH MOTOR OPERATED
FU		FUSE
VT1		VOLTAGE TRANSFORMER WITH TWO OR THREE SECONDARY WINDINGS
VT		VOLTAGE TRANSFORMER WITH ONE SECONDARY WINDING
CT		CURRENT TRANSFORMER
-		SURGE ARRESTER
-		COUNTER DISCHARGE
-		EARTHING POINT
-		132/33 kV BUS BAR
-		132/33 kV CABLE
-		CABLE SEALING END
-		MAIN STEP UP TRANSFORMER

DRAFT NOT FOR CONSTRUCTION

REV	DATE	REVISION DESCRIPTION	DRAWN	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/04/30	ISSUED FOR INTERNAL REVIEW	FP	BR	BR	JO	JO		WP1-413011-00907-GE-DAL-101	413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

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وزارة الطاقة MINISTRY OF ENERGY

GENERAL SLD 300MW
SGU-5 & SGU-6
Al-Kahfah Solar Energy Park

CODE 413011-00907-EL-PLN-105 SH3

Rev. 0

Appendix D. Project Location Maps

284000 288000 292000 296000 300000 304000 308000 312000 316000 320000 324000

2996000 2992000 2988000 2984000 2980000 2976000 2972000

N



Legend

- Al-Kahfah Solar Energy Park
- Corner Points

Overhead Transmission Line

- 380 KV

WGS 84 -UTM 38 North		
Al-Kahfah Solar Energy Park		
Name	**X**	**Y**
C#1	309552.62	2984884.20
C#2	307981.17	2983094.39
C#3	301291.47	2979371.40
C#4	296198.24	2982833.31
C#5	299861.50	2988533.68
C#6	297943.15	2989718.98
C#7	299219.51	2991726.60
C#8	301189.49	2990577.60

1:110.000

0 2,5 5 Km.

WGS 84 UTM Zone 38N
Source:
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Service Agreement. See http://www.esri.com/legal/licensing/third-party-data.html

NOTA: EL DISEÑO DE ESTE DIBUJO ES PROPIEDAD DE WORLEYPARSONS Y NO DEBE SER COPIADO O REPRODUCIDO SIN SU CONSENTIMIENTO POR ESCRITO.

Pathname: G:\TG\413011-00907_Al Kahfah and Tabrjal\Solar PV\Al Kahfah\MXD\413011-00907-GE-DAL-101-Al-Kahfah-Site Plant_rev0_210203.mxd

REV	DATE	REVISION DESCRIPTION	DRAW	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
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وزارة الطاقة MINISTRY OF ENERGY

SITE PLANT
Al-Kahfah Solar Energy Park

CODE **413011-00907-GE-DAL-101** Rev.0

292000 296000 300000 304000 308000 312000 316000

2992000 2988000 2984000 2980000 2976000

N

NOTA: EL DISEÑO DE ESTE DIBUJO ES PROPIEDAD DE WORLEYPARSONS Y NO DEBE SER COPIADO O REPRODUCIDO SIN SU CONSENTIMIENTO POR ESCRITO.

Pathname: C:\TG\413011-00907_Al-Kahfah and Tabjal (Sdar PV)\Al-Kahfah\MXD\413011-00907-GE-DAL-107-Al-Kahfah-Habitats_rev0_210310.mxd

Legend

- Al-Kahfah Solar Energy Park

Habitat

- Plantations
- Subtropical/Tropical Dry Shrubland

1:75.000

0 2,25 4,5 Km.

WGS 84 UTM Zone 38N
Source:
Basemap licensed by ESRI- Bing Maps for ArcGIS Desktop Users
Service Agreement. See http://www.esri.com/legal/licensing/third-party-data.html

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

REV	DATE	REVISION DESCRIPTION	DRAW	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
0	2021/03/10	ISSUED FOR INTERNAL REVIEW	FP	AM	AM	YZ	JO		WP1-413011-00907-GE-DAL-106	413011-00907-GE-DAL-107-Al-Kahfah-Habitats_rev0_210310.mxd

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وزارة الطاقة
MINISTRY OF ENERGY

HABITATS
Al-Kahfah Solar Energy Park

CODE **413011-00907-GE-DAL-107** Rev.0

292000 296000 300000 304000 308000 312000 316000

2992000 2988000 2984000 2980000 2976000

N

Legend

Al-Kahfah Solar Energy Park

Land Use

Open Land
Agricultural activities
Industrial activities
Urban Area
Railway
Road

1:75.000

0 2,25 4,5 Km.

WGS 84 UTM Zone 38N
Source:
Basemap licensed by ESRI- Bing Maps for ArcGIS Desktop Users
Service Agreement. See http://www.esri.com/legal/licensing/third-party-data.html

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

NOTA:EL DISEÑO DE ESTE DIBUJO ES PROPIEDAD DE WORLEYPARSONS Y NO DEBE SER COPIADO O REPRODUCIDO SIN SU CONSENTIMIENTO POR ESCRITO.

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REV	DATE	REVISION DESCRIPTION	DRAW	DRAFT CHK	DESIGNED	ENG CHK	APPROVED	CUSTOMER	REF DRAWING No	REFERENCE DRAWING TITLE
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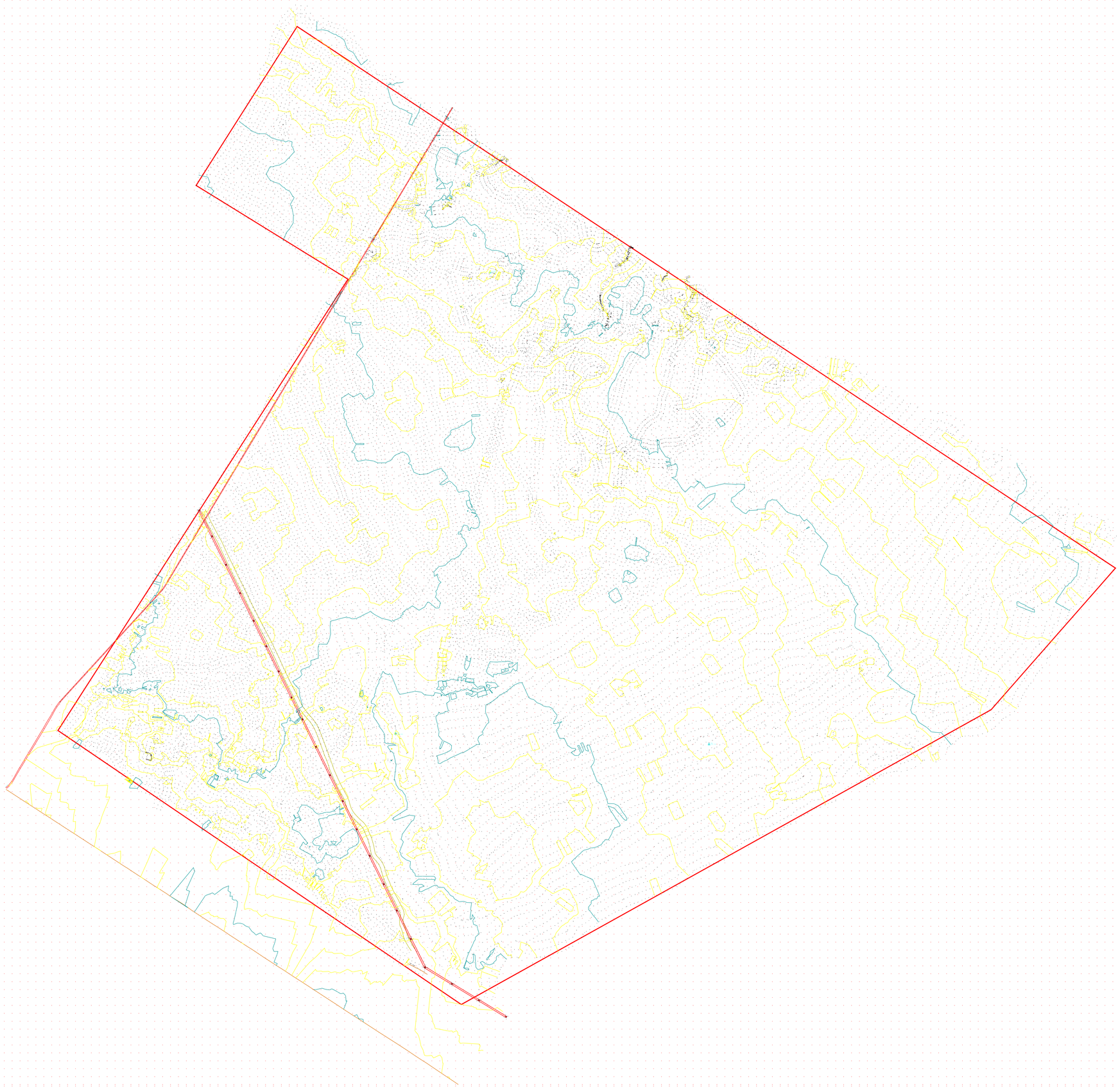
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وزارة الطاقة
MINISTRY OF ENERGY

LAND USE
Al-Kahfah Solar Energy Park

CODE **413011-00907-GE-DAL-106** Rev.0



ANNOTATIONS:

BH	Borehole	NB	Notice Board
Bl	Illum.Bollard	OHC	Overhead Cable
BL	Bed Level	P	Post
BM	Bench Mark	Pbox	Post Box
Bol	Bollard	Pl	Pipe
BPS	Brick Paving	PM	Parking Meter
BRC	Bracing Wire	PY	Electric Pylon
BRK	Brick	RE	Rodding Eye
BS	Bus Stop	RGY	Road Gully
Cbx	Control Box	RNP	Road Name Plate
CC	CCTV Camera	RP	Reflector Post
CL	Cover Level	RS	Road sign
CONC	Concrete	SAP	Sapling
CPS	Conc.Paving	Scam	Speed Camera
CTV	Cable TV	Slt	Salt Box
Culv	Culvert	SL	Soffit Level
DP	Down Pipe	SMP	Sheet Metal Piling
Ebx	Electric Box	ST	Stop Tap
EP	Electric Pole	SV	Stop Valve
ER	Earth Rod	SW	Stay Wire
FB	Flower Bed	TCB	Telephone Call Box
FH	Fire Hydrant	Thl	Threshold Level
FL	Flood Light	TL	Traffic Light
FS	Flag Staff	TP	Telegraph Pole
Gas	Gas Valve	TPS	Tactile Paving
IC	Inspection Cover	TS	Traffic Signal
IDL	Induction Loop	VP	Vent Pipe
IL	Invert Level	WL	Water Level
Jbx	Junction Box	WM	Water Meter
KI	Kerb Inlet	WO	Wash Out
KO	Kerb Outlet		
LB	Litter Bin	FENCE TYPES:	
LP	Lamp Post	BWF	Barbed Wire Fence
MAV	Air Valve	CBF	Close Boarded Fence
MC	Manhole Cable	CLF	Post & Chain Link Fence
ME	Manhole Electric	IRF	Iron Railings Fence
MF	Manhole Foul	MRF	Metal Railing Fence
MG	Manhole Gas	PWF	Post & Wire Fence
MH	Manhole	PRF	Post & Rail Fence
Mkr	Marker Post	SF	Security Fence
MP	Mile Post		
MS	Mile Stone	WALL TYPES:	
MT	Manhole Telecom	AB	Abutment Wall
MW	Manhole Water	BW	Brick Wall
		CW	Concrete Wall
		DSW	Dry Stone Wall
		RTW	Retaining Wall
		SW	Stone wall

Bench Mark

Temporary Control Point

Survey Stations

Name	Easting (m)	Northing (m)	Level (m)
GMN-151	302809.0940	2964308.2730	809.2230
UH1	304420.2870	2982657.9958	798.7823
UH2	300460.6769	2982792.7759	810.9923
SCO-08	301653.1281	2988619.4365	788.9596

Sheet Layout

NOTES

1. The survey has been accurately positioned to the UTM zone 38N projected coordinate system using GNSS observations.

2. True scale is shown and indicated by grid marks at 100m intervals.

3. All coordinates and elevations are in meters unless specified otherwise. Topography survey by RTK GNSS and conventional EDM methods planimetric information updated by field survey.

4. All levels relate to the World Geodetic System 1984 (WGS-84). Vertical control has been established using GNSS observations.

5. Digital drawing is 3D AutoCAD .dwg file

6. Contours are approximate and preference should be given to spot heights as shown where critical.

Rev	Rev. Date	Purpose of revision	Drawn	Checked	Rev'd	Appr'd
1	MAR 2021	Ground Level Values Amended	UH	HZ	TF	
0	MAR 2021	FINAL	UH	HZ	TF	

scopus
Al-Yaum Tower, King Fahad Road Dammam 31421, Saudi Arabia
Tel: +966 (0) 138074106 Email: info@scopuseng.com

Client

MOE
Ministry of Energy
Kingdom of Saudi Arabia

Project

Al Kahafah
Concentrated Solar Power (CSP) Plant

Drawing title

3D Topographical Survey

Drawing status

FINAL

Scale	NTS @ A0	DO NOT SCALE
Worley Project No.		
Client no.		

Drawing number: SAU0008-01-TOPO-001 Rev: 1

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C:\JOBS PROJECTS\2_Saudi Arabia\#13011-00019 - REPOS\REPOS - Renewable Energy Project Development Office\SAU0008 - SOLAR Al Kahafah - Tabarjal\Deliverables\Kahafah\SAU0008-01-TOPO-001 REV1.dwg 3/29/2021 10:56:27 AM - SAU0008-01-TOPO-001 - Howard Zibell

Appendix E. List of Applicable Limits

MINISTRY OF ENERGY

Applicable Limits

Al Kahfah Solar PV Park

Document No 413011-00907

Al-Yaum Tower
Dammam-Al-Khobar Highway Near Chamber of Commerce
Al Khobar 31952
Saudi Arabia
T: +966 13 807 8500
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Contents

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   - Hazardous Waste List 1
   - Hazardous Waste Constituents 2
   - Hazardous Property List 3
   - Toxicity Property Leaching Procedure Regulatory Levels 4
2. Drinking Water
   - Prescribed concentrations and values 6
3. Soil Quality
   - National Soil Quality Limits 1
   - Dutch Soil and Groundwater Intervention Values 1

1. Waste Classification

Hazardous Waste List

Y1	Clinical wastes from medical care in hospitals, medical centres and clinics
Y2	Wastes from the production and preparation of pharmaceutical products, drugs and medications
Y3	Wastes from the production, formulation and use of biocides and phyto-pharmaceuticals
Y4	Wastes from the manufacture, formulation and use of wood preserving chemicals
Y5	Wastes from the production, formulation and use of organic solvents
Y6	Wastes from heat treatment and steel tempering operations containing cyanides
Y7	Waste mineral oils unfit for their originally intended use
Y8	Waste oils/water, hydrocarbons/water mixtures, emulsions
Y9	Waste substances and articles containing (greater than 50 ppm) polychlorinated biphenyls (PCBs) and/or polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)
Y10	Waste tarry residues arising from refining, distillation and any pyrolysis treatment
Y11	Wastes from production, formulation and use of inks, dyes, pigments, paints, lacquers, varnish
Y12	Wastes from production, formulation and use of resins, latex, plasticizers, glues and adhesives
Y13	Waste chemical substances arising from research and development or teaching activities which are not known and are new and whose effects on human health and the environment are not yet known
Y14	Wastes of an explosive nature not subject to other regulations or standards
Y15	Wastes from production, formulation and use of photographic chemicals and processing materials
Y16	Wastes resulting from surface treatment of metals and plastics
Y17	Residues arising from industrial waste disposal operations
Y18	Petroleum refinery wastewater treatment sludges

Hazardous Waste Constituents

Y19	Metal carbonyls
Y20	Beryllium and beryllium compounds
Y21	Hexavalent chromium compounds
Y22	Copper compounds
Y23	Zinc compounds
Y24	Arsenic and arsenic compounds
Y25	Selenium and selenium compounds
Y26	Cadmium and cadmium compounds
Y27	Antimony and antimony compounds
Y28	Tellurium and tellurium compounds
Y29	Mercury and mercury compounds
Y30	Lead and lead compounds
Y31	Inorganic fluorine compounds excluding calcium fluoride
Y32	Inorganic cyanides
Y33	Acidic solutions or acids in solid form
Y34	Basic solutions or bases in solid form
Y35	Asbestos (dust and fibres)
Y36	Organic phosphorus compounds
Y37	Organic cyanide compounds
Y38	Phenols and phenol compounds, including chlorophenol compounds
Y39	Ether compounds
Y40	Halogenated organic solvents
Y41	Organic solvents other than halogenated solvents
Y42	Any congener of polychlorinated dibenzo-furan
Y43	Any congener of polychlorinated dibenzo-p-dioxin
Y44	Organic halogen compounds other than substances referred to in this Table

Hazardous Property List

H1 Explosive	Substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene
H2 Oxidising	Substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances
H3 Highly Flammable	(a) liquid substances and preparations having a flashpoint below 21°C (b) substances and preparations which may become hot and finally catch fire in contact with air at ambient temperatures without any application of energy (c) solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition (d) gaseous substances and preparations which are flammable in air at normal pressure (e) substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities
H3B Flammable	Liquid substances and preparations having a flashpoint >=21°C and <=55°C
H4 Irritant	Non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation
H5 Harmful	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks
H6 Toxic	Substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death
H7 Carcinogenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence
H8 Corrosive	Substances and preparations which can readily corrode or dissolve flesh, metal or other materials
H9 Infectious	Substances containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or living organisms
H10 Toxic for Reproduction	Substances or preparations which, if they are inhaled or ingested or if they penetrate the skin, may produce or increase the incidence of non-heritable adverse effects in the progeny and/or of male or female reproductive functions or capacity
H11 Mutagenic	Substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects or increase their incidence
H12 Toxic Gas Release	Substances or preparations which release toxic or very toxic gases in contact with water, air or an acid
H13 Ecotoxic	Substances or preparations which present or may present immediate or delayed risks for one or more sectors of the environment
H14	Substances and preparations capable by any means, after disposal, of yielding another substance, for example leachate, which possesses any of the characteristics H1 to H13

Toxicity Property Leaching Procedure Regulatory Levels

Contaminant	Concentration (mg/l)
Arsenic	5.0
Barium	100.0
Benzene	0.5
Cadmium	1.0
Carbon Tetrachloride	0.5
Chlordane	0.03
Chlorobenzene	100.0
Chloroform	6.0
Chromium	5.0
o-Cresol*	200.0
m-Cresol*	200.0
p-Cresol*	200.0
Total Cresols	200.0
2,4-D	10.0
1,4-Dichlorobenzene	7.5
1,2-Dichlorobenzene	0.5
1,1-Dichlorobenzene	0.7
2,4-Dichlorobenzene	0.13
Endrin	0.02
Heptachlor (and its epoxide)	0.0008
Hexachlorobenzene	0.13
Hexachlorobutadiene	0.5
Hexachloroethane	3.0
Lead	5.0
Lidane	0.4
Mercury	0.2
Methoxychlor	10.0

Contaminant	Concentration (mg/l)
Methyl ethyl ketone	200.0
Nitrobenzene	2.0
Pentachlorophenol	100.0
Pyridine	5.0
Selenium	1.0
Silver	5.0
Tetrachloroethylene	0.7
Toxaphene	0.5
Trichloroethylene	0.5
2,4,5-Trichlorophenol	400.0
2,4,6-Trichlorophenol	2.0
2,4,5-TP (Silvex)	1.0
Vinyl Chloride	0.2

* If o-, m- and p- cresols cannot be individually measured, the level for total cresols is used.

2. Drinking Water

Prescribed concentrations and values

Parameter	Units	Value (Health)	Value (Acceptability)	Indicator
Physical chemistry				
pH	pH units	No health criteria specified	6.5 -8	
Colour	Hazen units	No health criteria specified	15	Yes
Conductivity	µS/cm at 20 ^{0}C	2,500		Yes
Taste and Odour	n/a	No health criteria specified	Unobjectionable	Yes
TDS	mg/l		1500	
Turbidity	NTU	5	1	Yes
Gross Alpha activity	Bq/l	0.1		
Gross Beta activity	Bq/l	1		
Radioactivity (excl. potassium -40)[4]	mSv/(annual RDL[5])	0.1		
$CaCO_3$	mg/l	300		
DO	%	No health criteria specified	>85	
Nitrate (as NO_3)	mg/l	50		Yes
Nitrite (as NO_2)	mg/l	1		Yes
Organic and Inorganic chemical pollutants				
Acrylimade	µg/l	0.5		
Alachlor	µg/l	20		
Aldicarb	µg/l	10		
Aldrin and Dieldrin	µg/l	0.03		
Aluminium	µg/l		200	
Antimony	µg/l	20		
Asbestos	Million fibres/L	7		
Arsenic	µg/l	10		
Atrizine	µg/l	2		
Barium	µg/l	700		

Parameter	Units	Value (Health)	Value (Acceptability)	Indicator
Beryllium	µg/l	200		
Benzene	µg/l	10		
Benzo(a)pyrene	µg/l	0.01		
Boron	µg/l	1000		
Bromate	µg/l	10		
Bromodichloromethane (BDCM)	µg/l	60		
Bromoform	µg/l	100		
Cadmium	µg/l	3		
Carbofurans	µg/l	7		
Carbon Tetrachloride	µg/l	2		
Chloral Hydrate	µg/l	10		
Chlordane	µg/l	0.2		
Chlorate	µg/l	700		
Chlorine residual	µg/l	500		
Chloride	µg/l	No health criteria specified	250,000	
Chlorite	µg/l	700		
Chlorophenol (2,4,6,T)	µg/l	200		
Chloroform	µg/l	200		
Chromium	µg/l	50		
Copper	µg/l	2		
Cyanide	µg/l	70		
Cynazine	µg/l	6		
2,4 -D (2,4-dichlorophenoxyacetic acid)[6]	µg/l	30		
DDT and Metabolites	µg/l	1		
Dibromoacetonitrile	µg/l	70		
Dibromochloromethane (DBCM)	µg/l	100		
Dibromo-3-chloropropane 1,2 (DBCP)	µg/l	1		
Dibromoethane 1,2	µg/l	0.4		
Dichloroacetonitrile	µg/l	20		

Parameter	Units	Value (Health)	Value (Acceptability)	Indicator
Dichlorobenzene, 1,2-	µg/l	1000		
Dichlorobenzene, 1,4-	µg/l	300		
Dichloroethane, 1,2-	µg/l	30		
Dichloroethene, 1,1-	µg/l	30		
Dichloroethene, 1,2-	µg/l	50		
Dichloromethane	µg/l	20		
Dichloropropane 1,2 (1,2-DCP)	µg/l	40		
Dichloropropene 1,3	µg/l	20		
Dichlorprop (2,4 DP)	µg/l	100		
Edetic acid (EDTA)	µg/l	600		
Endrin	µg/l	0.6		
Ethylbenzene	µg/l	300		
Fenoprop (2,4,5 T)	µg/l	9		
Fluoride	µg/l	1500		
Formaldehyde	µg/l	60		
Haloacetic acids (HAA5)	µg/l		900	
Hexachlorobutadiene (HCBD)	µg/l	0.6		
Isoproturon	µg/l	9		
Iron	µg/l		300	
Lead	µg/l	10		
Lindane	µg/l	2		
Manganese	µg/l		400	
Mercury (inorganic)	µg/l	1		
Methoxychlor	µg/l	200		
Metolachlor	µg/l	10		
Microcystin-LR	µg/l	1		
Molybdenum	µg/l	70		
Monochloramine	µg/l	3000		
MTBE	µg/l	No health criteria specified	15	

Parameter	Units	Value (Health)	Value (Acceptability)	Indicator
Nickel	µg/l	20		
PAH (sum total)	µg/l	0.1		
Pentachlorophenol (PCP)	µg/l	9		
Pesticides (total)	µg/l	0.5		
Selenium	µg/l	10		
Sodium	µg/l	No health criteria specified	200,000	
Styrene	µg/l	20		
Sulphate	µg/l	500,00	250,000	
Tetrachloroethene	µg/l	40		
Toluene	µg/l	700		
TCBs (Total)	µg/l	No health criteria specified	5	
Trihalomethanes (THM total)	µg/l	100		
Trichloroethene, 1,1,1	µg/l	70		
Uranium	µg/l	15		
Vinyl chloride	µg/l	0.3		
Xylenes	µg/l	500		
Zinc	µg/l	No health criteria specified	3000	
Microbial				
Cryptosporidium	Count/100ml		-	
E. coli	Count/100ml	0		Yes
Total Coliform Bacteria	Count/100ml	0		Yes

3. Soil Quality

National Soil Quality Limits

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
pH		8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Cyanide (free)	mg/kg	0.9	0.9	0.9	8	8	0.9	0.9	0.9	8	8
Fluoride	mg/kg	200	200	200	2,000	2,000	200	200	200	2,000	2,000
Sulphur (elemental)	mg/kg	500	500	500	500	500	500	500	500	500	500

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Metals											
Antimony (Sb)	mg/kg	20	20	20	40	40	20	20	20	40	40
Arsenic (inorganic) (AS)	mg/kg	17	17	17	26	26	17	17	17	26	26
Barium (non-barite) (Ba)	mg/kg	750	750	500	2,000	2,000	750	750	500	2,000	2,000
Barite-barium	mg/kg	10,000	10,000	10,000	15,000	14,000	10,000	10,000	10,000	15,000	14,000
Beryllium (Be)	mg/kg	5	5	5	8	8	5	5	5	8	8
Boron (B)	mg/kg	3.3	3.3	3.3	5	5	3.3	3.3	3.3	5	5
Cadmium (Cd)	mg/kg	3.8	1.4	10	22	22	3.8	1.4	10	22	22

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Chromium (Hexavalent) (Cr)	mg/kg	0.4	0.4	0.4	1.4	1.4	0.4	0.4	0.4	1.4	1.4
Chromium (total)	mg/kg	64	64	64	87	87	64	64	64	87	87
Cobalt	mg/kg	20	20	20	300	300	20	20	20	300	300
Copper (Cu)	mg/kg	63	63	63	91	91	63	63	63	91	91
Lead (Pb)	mg/kg	70	70	100	260	600	70	70	100	260	600
Mercury (inorganic)	mg/kg	12	6.6	6.6	24	50	12	6.6	6.6	24	50
Molybdenum (Mo)	mg/kg	4	4	4	40	40	4	4	4	40	40
Nickel (Ni)	mg/kg	45	45	45	89	89	45	45	45	89	89

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Selenium (Se)	mg/kg	1	1	1	1	1	1	1	1	1	1
Silver	mg/kg	20	20	20	40	40	20	20	20	40	40
Thallium (TI)	mg/kg	1	1	1	1	1	1	1	1	1	1
Tin (Sn)	mg/kg	5	5	5	300	300	5	5	5	300	300
Uranium (U)	mg/kg	33	33	33	33	300	33	33	33	33	300
Vanadium (V)	mg/kg	130	130	130	130	130	130	130	130	130	130
Zinc (Zn)	mg/kg	200	200	200	360	360	200	200	200	360	360

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Hydrocarbon compounds											
Benzene (C_6H_6) (Surface Soil)	mg/kg	0.078	0.073	0.073	0.078	0.078	0.046	0.046	0.046	0.046	0.046
Benzene (C_6H_6) (Below Surface Soil)	mg/kg	0.078	0.078	0.078	0.078	0.078	0.046	0.046	0.046	0.046	0.046
Toluene (C_7H_8) (Surface Soil)	mg/kg	0.12	0.12	0.12	0.12	0.12	0.52	0.52	0.52	0.52	0.52
Toluene (C_7H_8) (Below Surface Soil)	mg/kg	0.12	0.12	0.12	0.12	0.12	0.52	0.52	0.52	0.52	0.52
Ethylbenzene (C_8H_{10}) (Surface Soil)	mg/kg	0.14	0.018	0.14	0.14	0.14	0. 073	0. 073	0. 073	0. 073	0. 073

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Ethylbenzene (C_8H_{10}) (Below Surface Soil)	mg/kg	0.14	0.14	0.14	0.14	0.14	0.073	0.073	0.073	0.073	0.073
Xylenes (C_8H_{10}) (Surface Soil)	mg/kg	1.9	0.003	1.9	1.9	1.9	0.99	0.99	0.99	0.99	0.99
Xylenes (C_8H_{10}) (Below Surface Soil)	mg/kg	1.9	1.9	1.9	1.9	1.9	0.99	0.99	0.99	0.99	0.99
Styrene (C_8H_8)	mg/kg	0.8	0.8	0.8	0.8	0.8	0.68	0.68	0.68	0.68	0.68
F1: C^6 to C^{10} (Surface Soil)	mg/kg	210	24	24	270	270	210	210	210	320	320
F2: C^6 to C^{10} (Surface Soil)	mg/kg	150	130	130	260	260	150	150	150	260	260
F3: C^6 to C^{10} (Surface Soil)	mg/kg	300	300	300	1,700	1,700	1,300	1,300	1,300	2,500	2,500

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
F4: C^{6} to C^{10} (Surface Soil)	mg/kg	2,800	2,800	2,800	3,300	3,300	5,600	5,600	5,600	6,600	6,600
F1: C^{6} to C^{10} (Below Surface Soil)	mg/kg	420	30	30	440	440	420	420	420	640	640
F2: C^{6} to C^{10} (Below Surface Soil)	mg/kg	300	160	160	520	520	300	300	300	520	520
F3: C^{6} to C^{10} (Below Surface Soil)	mg/kg	600	600	600	3,400	2,400	2,600	2,600	2,600	4,300	4,300
F4: C^{6} to C^{10} (Below Surface Soil)	mg/kg	5,600	5,600	5600	6,600	6,600	10,000	10,000	10,000	10,000	10,000
Acenaphthene ($C_{12}H_{10}$)	mg/kg	0.38	0.38	0.38	0.38	0.38	0.32	0.32	0.32	0.32	0.32
Anthracene ($C_{14}H_{10}$)	mg/kg	0.0056	0.0056	0.0056	0.0056	0.0056	0.0046	0.0046	0.0046	0.0046	0.0046
Fluoranthene ($C_{16}H_{10}$)	mg/kg	0.039	0.039	0.039	0.039	0.039	0.032	0.032	0.032	0.032	0.022

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Fluorene ($C_{13}H_{10}$)	mg/kg	0.34	0.34	0.34	0.34	0.34	0.29	0.29	0.29	0.29	0.29
Naphthalene ($C_{10}H_8$)	mg/kg	0.017	0.017	0.017	0.017	0.017	0.014	0.014	0.014	0.014	0.014
Phenanthrene ($C_{14}H_{10}$)	mg/kg	0.061	0.061	0.061	0.061	0.061	0.051	0.051	0.051	0.051	0.051
Pyrene ($C_{16}H_{10}$)	mg/kg	0.04	0.04	0.04	0.04	0.04	0.034	0.034	0.034	0.034	0.034
Carcinogenic PAHs	mg/kg	1	1	1	1	1	1	IACR<1	1	1	1
Benz[a]anthracene ($C_{18}H_{12}$)	mg/kg	0.083	0.083	0.083	0.083	0.083	0.07	0.07	0.07	0.07	0.07
Benzo[b+j]fluoranthene ($C_{20}H_{12}$)	mg/kg	6.2	-	-	-	6.2	6.2	-	-	-	-
Benzo[k]fluoranthene ($C_{20}H_{12}$)	mg/kg	6.2	-	-	-	6.2	6.2	-	-	-	-

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Benzo[a]pyrene ($C_{20}H_{12}$)	mg/kg	0.6	0.6	0.77	0.77	0.77	0.6	0.6	0.7	0.7	0.7
Chrysene ($C_{18}H_{12}$)	mg/kg	6.2	-	-	-	6.2	6.2	-	-	-	-
Halogen aliphatic compounds											
Vinyl Chloride (C_2H_3Cl)	mg/kg	0.02	0.00034	0.00034	0.0043	0.0046	0.014	0.0083	0.0083	0.014	0.014
Dichloroethene 1.1 ($C_2H_2Cl_2$)	mg/kg	0.24	0.21	0.21	0.24	0.24	0.15	0.15	0.15	0.15	0.15
Trichloroethene, TCE	mg/kg	0.081	0.012	0.012	0.081	0.081	0.054	0.054	0.054	0.054	0.054
Tetrachloroethene (C_2Cl_4)	mg/kg	0. 46	0.018	0.018	0.22	0.22	0.26	0.26	0.26	0.26	0.26
Dichloroethene 1.2 ($C_2H_4Cl_2$)	mg/kg	0.041	0.0027	0.0027	0.032	0.032	0.025	0.0062	0.025	0.025	0.15

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Dichloromethane (CH_2Cl_2)	mg/kg	0.095	0.048	0.095	0.095	0.095	0.1	0.052	0.1	0.1	0.1
Trichloromethane ($CHCl_3$)	mg/kg	0.003	0.003	0.003	0.002	0.002	0.0029	0.0029	0.0029	0.0029	0.0029
Tetrachloromethane (CCl_4)	mg/kg	0.062	0.00056	0.00057	0.0069	0.0069	0.037	0.013	0.013	0.037	0.027
Dibromochloromethane ($CHBr_2Cl$)	mg/kg	1.5	0.12	0.27	1.5	1.5	0.91	0.12	0.91	0.91	0.91
Chlorobenzene (C_6H_5Cl)	mg/kg	1.1	0.018	0.018	0.22	0.22	0.61	0.39	0.39	0.61	0.61
Dichlorobenzene 1.2 ($C_6H_4Cl_2$)	mg/kg	0.18	0.18	0.18	0.18	0.18	0.097	0.097	0.097	0.097	0.097
Dichlorobenzene 1.4 ($C_6H_4Cl_2$)	mg/kg	0.098	0.098	0.098	0.098	0.098	0.051	0.051	0.051	0.051	0.051

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Trichlorobenzene 1.2.3 ($C_6H_3Cl_3$)	mg/kg	0.31	0.26	0.26	0.31	0.31	0.26	0.26	0.26	0.26	0.26
Trichlorobenzene 1.2.4 ($C_6H_3Cl_3$)	mg/kg	0.93	0.23	0.23	0.93	0.78	0.78	0.78	0.78	0.78	0.78
Trichlorobenzene 1.2.5 ($C_6H_3Cl_3$)	mg/kg	3.6	0.13	0.13	1.3	1.3	1.9	1.9	1.9	1.9	1.9
Tetrachlorobenzene 1.2.3.4 ($C_6H_2Cl_4$)	mg/kg	0.05	0.05	0.05	0.05	0.05	0.042	0.042	0.042	0.042	0.042
Tetrachlorobenzene 1.2.3.5 ($C_6H_2Cl_4$)	mg/kg	0.7	0.1	0.1	0.7	0.7	0.37	0.37	0.37	0.37	0.37
Tetrachlorobenzene 1.2.4.5 ($C_6H_2Cl_4$)	mg/kg	0.37	0.052	0.052	0.37	0.37	0.19	0.19	0.19	0.19	0.19

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Pentachlorobenzene (C_6HCl_5)	mg/kg	4.5	4.5	4.5	4.5	4.5	3.7	3.7	3.7	3.7	3.7
Hexachlorobenzene (C_6Cl_6)	mg/kg	2	0.5	0.5	6	6	3.6	0.8	3.6	3.6	3.6
Dichlorophenol 2.4 ($C_6H_4Cl_2O$)	mg/kg	0.0034	0.0034	0.0034	0.0034	0.0034	0.0029	0.0029	0.0029	0.0029	0.0029
Trichlorophenol 2.4.6 ($C_6H_2Cl_3OH$)	mg/kg	0.37	0.37	0.37	0.37	0.37	0.19	0.19	0.19	0.19	0.19
Trichlorophenol 2.3.4.6 ($C_6H_2Cl_4O$)	mg/kg	0.047	0.047	0.047	0.047	0.047	0.039	0.039	0.039	0.039	0.039
Pentachlorophenol (C_6HCl_5O)	mg/kg	0.029	0.029	0.029	0.029	0.029	0.024	0.024	0.024	0.024	0.024
Dioxins and Furans	mg/kg	0.00025	0.000004	0.000004	0.000004	0.000004	0.00025	0.000004	0.000004	0.000004	0.000004

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Polychlorinated biphenyl	mg/kg	1.3	13	22	33	33	1.3	1.3	22	33	33
Pesticides											
Aldicarb ($C_7H_{14}N_2O_2S$)	mg/kg	0.065	0.012	0.065	0.065	0.065	0.041	0.012	0.041	0.041	0.041
Aldrin ($C_{12}H_8Cl_6$)	mg/kg	11	3.4	3.4	5.1	11	5.9	3.4	3.4	5.1	5.9
Altrazine and metabolites	mg/kg	0.01	0.01	0.01	0.01	0.01	0.0088	0.0088	0.0088	0.0088	0.0088
Aznipos-methyl ($C_{10}PN_3H_{12}S^2O_3$)	mg/kg	0.75	0.75	0.75	0.75	0.75	0.41	0.41	0.41	0.41	0.41
Bendiocarb ($C_{11}H_{13}NO_4$)	mg/kg	0.21	0.21	0.21	0.21	0.21	0.14	0.14	0.14	0.14	0.14
Bromacil ($C_9H_{13}BrN_2O_2$)	mg/kg	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Bromoxynil ($C_7H_3Br_3NO$)	mg/kg	0.052	0.052	0.052	0.052	0.052	0.044	0.044	0.044	0.044	0.044
Carbaryl ($C_{12}H_{11}NO_2$)	mg/kg	3.6	3.6	3.6	3.6	3.6	1.9	1.9	1.9	1.9	1.9
Carbofuran ($C_{12}H_{15}NO_3$)	mg/kg	1.2	0.089	1.2	1.2	1.2	0.68	0.082	0.68	0.68	0.68
Chlorothalonil ($C_8Cl_4N_3$)	mg/kg	0.01	0.01	0.01	0.01	0.01	0.0084	0.0084	0.0084	0.0084	0.0084
Chlorpyrifos ($C_9H_{11}Cl_3NO_3PS$)	mg/kg	95	3.8	95	95	95	49	3.2	49	49	49
Cyanazine ($C_9H_{13}ClN_6$)	mg/kg	0.21	0.032	0.21	0.21	0.21	0.12	0.028	0.12	0.12	0.12
Dichlorophenoxyacetic acid 2.4 ($C_8H_6CL_6O_3$)	mg/kg	0.68	0.1	0.68	0.68	0.68	0.43	0.1	0.43	0.43	0.43

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Dichlorodiphenyltrichloroethane ($C_{14}H_9Cl_5$)	mg/kg	0.7	0.7	12	12	12	0.7	0.7	12	12	12
Diazinon ($C_{10}H_{21}N_2O_3PS$)	mg/kg	4.2	4.2	4.2	4.2	4.2	2.2	2.2	2.2	2.2	2.2
Dicamba ($C_8H_6Cl_2O_3$)	mg/kg	0.79	0.12	0.79	0.79	0.79	0.5	0.2	0.5	0.5	0.5
Dichlofop-methyl ($C_{16}H_{14}Cl_2O_4$)	mg/kg	2.4	0.095	2.4	2.4	2.4	2	0.079	2	2	2
Dieldrin ($C_{12}H_8Cl_6C$)	mg/kg	1.1	1.1	1.1	1.1	1.1	0.59	0.59	0.59	0.59	0.59
Dimethoate	mg/kg	0.0055	0.0027	0.0055	0.0055	0.0055	0.0058	0.0028	0.0058	0.0058	0.0058
Dinoseb	mg/kg	5.5	1.7	5.5	5.5	5.5	2.8	1.4	2.8	2.8	2.8

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Diquat	mg/kg	21	21	21	21	21	11	11	11	11	11
Diuron	mg/kg	3.5	3.5	3.5	3.5	3.5	1.9	1.9	1.9	1.9	1.9
Endosulfan	mg/kg	0.0015	0.0015	0.0015	0.0015	0.0015	0.0013	0.0013	0.0013	0.0013	0.0013
Endrin	mg/kg	4.7	4.7	4.7	4.7	4.7	2.4	2.4	2.4	2.4	2.4
Glyphosate	mg/kg	0.049	0.049	0.049	0.049	0.049	0.054	0.054	0.054	0.054	0.054
Heptachlor epoxide	mg/kg	0.076	0.01	0.01	0.076	0.076	0.039	0.039	0.039	0.039	0.039
Lindane	mg/kg	0.6	0.13	0.6	0.6	0.6	0.31	0.11	0.31	0.31	0.31
Linurin	mg/kg	0.059	0.059	0.059	0.059	0.059	0.051	0.051	0.051	0.051	0.051

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Malathion	mg/kg	1.3	1.3	1.3	1.3	1.3	0.72	0.72	0.72	0.72	0.72
MCPA	mg/kg	0.66	0.025	0.66	0.66	0.66	0.42	0.026	0.42	0.42	0.42
Methoxychlor	mg/kg	0.056	0.056	0.056	0.056	0.056	0.046	0.046	0.046	0.046	0.046
Metolachlor	mg/kg	0.055	0.055	0.055	0.055	0.055	0.048	0.048	0.048	0.048	0.048
Metribuzin	mg/kg	0.028	0.014	0.028	0.028	0.028	0.024	0.012	0.024	0.024	0.024
Paraquat (as dichloride)	mg/kg	2.2	2.2	2.2	2.2	2.2	1.1	1.1	1.1	1.1	1.1
Parathion	mg/kg	14	14	14	14	14	7.2	7.2	7.2	7.2	7.2
Phorate	mg/kg	0.14	0.14	0.14	0.14	0.14	0.075	0.075	0.075	0.075	0.075

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Picloram	mg/kg	0.022	0.022	0.022	0.022	0.022	0.024	0.024	0.024	0.024	0.024
Simazine	mg/kg	0.038	0.038	0.038	0.038	0.038	0.033	0.033	0.033	0.033	0.033
Tebuthiuron	mg/kg	0.046	0.046	0.046	0.6	0.6	0.046	0.046	0.046	0.6	0.6
Terbufos	mg/kg	0.15	0.15	0.15	0.15	0.15	0.08	0.08	0.08	0.08	0.08
Toxaphene	mg/kg	6.3	4.8	4.8	6.3	6.3	3.3	3.3	3.3	3.3	3.3
Triallate	mg/kg	0.0092	0.0092	0.0092	0.0092	0.0092	0.0077	0.0077	0.0077	0.0077	0.0077
Trifluarin	mg/kg	0.045	0.045	0.045	0.045	0.045	0.038	0.038	0.038	0.038	0.038

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Other Organic Compounds											
Aniline	mg/kg	0.6	0.6	0.6	0.6	0.6	0.36	0.36	0.36	0.36	0.36
Bis(2-ethyl-hexyl) phthalate	mg/kg	41	41	41	41	41	34	34	34	34	34
Dibutyl phthalate	mg/kg	0.65	0.65	0.65	0.65	0.65	0.54	0.54	0.54	0.54	0.54
Dichlorobenzidine	mg/kg	8.1	8.1	8.1	8.1	8.1	4.2	4.2	4.2	4.2	4.2
Diethanolamine	mg/kg	3.5	3.5	3.5	3.5	3.5	2	2	2	2	2
Diethylene glycol	mg/kg	15	15	15	15	15	10	10	10	10	10
Disopropanolamine	mg/kg	17	17	17	17	17	14	14	14	14	14

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Ethylene glycol	mg/kg	62	62	62	62	62	60	60	60	60	60
Hexachlorobutadiene	mg/kg	0.031	0.0068	0.0068	0.031	0.031	0.026	0.026	0.026	0.026	0.026
Methanol	mg/kg	11	11	11	11	11	37	37	37	37	37
Methylmethracrylate	mg/kg	1.8	0.1	0.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Monoethanolamine	mg/kg	10	10	10	10	10	20	20	20	20	20
Methyl tert-butyl ether (MTBE)	mg/kg	0.062	0.046	0.046	0.044	0.044	0.044	0.044	0.044	0.044	0.044
Nonylphenol + ethoxylates	mg/kg	5.7	5.7	5.7	14	14	5.7	5.7	5.7	14	14
Phenol	mg/kg	0.0024	0.0012	0.0024	0.0024	0.0024	0.0028	0.0014	0.0028	0.0028	0.0028

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Sulfolane	mg/kg	0.21	0.21	0.21	0.21	0.21	0.18	0.18	0.18	0.18	0.18
Triethylene glycol	mg/kg	150	150	150	150	150	100	100	100	100	100
Radioactive substances											
Uranium – 238 Series (all progeny)	Bq/g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Uranium 238 (^{238}U, ^{235Th},^{235}mPa, ^{234}U)	Bq/g	10	10	10	10	10	10	10	10	10	10
Thorium 230	Bq/g	10	10	10	10	10	10	10	10	10	10

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Radium 226 (in equilibrium with its progeny)	Bq/g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Lead 210 (in equilibrium with 210 Bi and 210 Po)	Bq/g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Thorium 232 Series (all progeny)	Bq/g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Thorium 232	Bq/g	10	10	10	10	10	10	10	10	10	10
Radium 228 (in equilibrium with 228 Ac)	Bq/g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Thorium 228 (in equilibrium with its progeny)	Bq/g	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Parameter	Unit	Soil Classification									
		Coarse Soil					Fine Soil				
		Land Use									
		Natural Area	Agriculture	Residential/parks	Commercial	Industrial	Natural Area	Agriculture	Residential/parks	Commercial	Industrial
Potassium 40	Bq/g	17	17	17	17	17	17	17	17	17	17

Dutch Soil and Groundwater Intervention Values

Substance	Intervention Values	
	Soil (mg/kg DM)	Groundwater (µg/l)
Metals		
Antimony	22	20
Arsenic	76	60
Barium	-[G]	625
Cadmium	13	6
Chromium	-	30
Chromium III	180	-
Chromium VI	78	-
Cobalt	190	100
Copper	190	75
Mercury	-	0.3
Mercury (inorganic)	36	-
Mercury (organic)	4	-
Lead	530	75
Molybdenum	190	300
Nickel	100	75
Zinc	720	800
Other inorganic substances		
Chloride (mg Cl/l)	-	-
Cyanide (free)	20	1,500
Cyanide (complex)	50	1,500
Thiocyanate	20	1,500
Aromatic compounds		

Substance	Intervention Values	
	Soil (mg/kg DM)	Groundwater (µg/l)
Benzene	1.1	30
Ethylbenzene	110	150
Toluene	32	1,000
Xylenes (aggr.)[A]	17	70
Styrene (vinylbenzene)	86	300
Phenol	14	2,000
Cresols (aggr.)[A]	13	200
Polycyclic Aromatic Hydrocarbons (PAHs)[E]		
Naphthalene	-	70
Phenanthrene	-	5
Anthracene	-	5
Fluoranthene	-	1
Chrysene	-	0.2
Benzo(a)anthracene	-	0.5
Benzo(a)pyrene	-	0.05
Benzo(k)fluoranthene	-	0.05
Indeno(1,2,3cd) pyrene	-	0.05
Benzo(ghi)perylene	-	0.05
PAHs (total) (aggr.10)[A]	40	-
Chlorinated hydrocarbons		
(Volatile) hydrocarbons		
Monochloroethene (vinylchloride)[B]	0.1	5
Dichloromethane	3.9	1,000
1,1-dichloroethane	15	900
1,2-dichloroethane	6.4	400

Substance	Intervention Values	
	Soil (mg/kg DM)	Groundwater (µg/l)
1,1-dichloroethene	0.3	10
1,2-dichloroethene (aggr.)[A]	1	20
Dichloropropanes (aggr.)[A]	2	80
Trichloromethane (chloroform)	5.6	400
1,1,1-trichloroethane	15	300
1,1,2-trichloroethane	10	130
Trichloroethene (Tri)	2.5	500
Tetrachloromethane (Tetra)	0.7	10
Tetrachloroethene (Per)	8.8	40
Chlorobenzenes[E]		
Monochlorobenzene	15	180
Dichlorobenzenes (aggr.)[A]	19	50
Trichlorobenzenes (aggr.)[A]	11	10
Tetrachlorobenzenes (aggr.)[A]	2.2	2.5
Pentachlorobenzenes	6.7	1
Hexachlorobenzene	2.0	0.5
Chlorophenols		
Monochlorophenols (aggr.)[A]	5.4	100
Dichlorophenols (aggr.)[A]	22	30
Trichlorophenols (aggr.)[A]	22	10
Tetrachlorophenols (aggr.)[A]	21	10
Pentachlorophenol	12	3
Polychlorobiphenyls (PCBs)		
PCBs (aggr. 7)[A]	1	0.01

Substance	Intervention Values	
	Soil (mg/kg DM)	Groundwater (µg/l)
Other chlorinated hydrocarbons		
Monochloroanilines (aggr.)[A]	50	30
Dioxin (aggr. TEQ)[A]	0.00018	N/A[F]
Chloronaphthalene (aggr.)[A]	23	6
Pesticides		
Organochloride pesticides		
Chlordane (aggr.)[A]	4	0.2
DDT (aggr.)[A]	1.7	-
DDE (aggr.)[A]	2.3	-
DDD (aggr.)[A]	34	-
DDT/DDE/DDD (aggr.)[A]	-	0.01
Aldrin	0.32	-
Dieldrin	-	-
Endrin	-	-
Drins (aggr.)[A]	4	0.1
α-endosulphan	4	5
α-HCH	17	-
β-HCH	1.6	-
γ-HCH (lindane)	1.2	-
HCH compounds (aggr.)[A]	-	1
Heptachlor	4	0.3
Heptachloroepoxide (aggr.)[A]	4	3
Organotin pesticides		
Organotin compounds (aggr.)[A]	2.5	0.7

Substance	Intervention Values	
	Soil (mg/kg DM)	Groundwater (µg/l)
Chlorophenoxy-acetic acid herbicides		
MCPA	4	50
Other pesticides		
Atrazine	0.71	150
Carbaryl	0.45	50
Carbofuran[B]	0.017	100
Other substances		
Asbestos[C]	100	-
Cyclohexanone	150	150,000
Dimethyl phthalate	82	-
Diethyl phthalate	53	-
Di-isobutyl phthalate	17	-
Dibutyl phthalate	36	-
Butyl benzyl phthalate	48	-
Dihexyl phthalate	220	-
Di(2-ethylhexyl)phthalate	60	-
Phthalates (aggr.)[A]	-	5
Mineral oil[D]	5,000	600
Pyridine	11	30
Tetrahydrofuran	7	300
Tetrahydrothiophene	8.8	5,000
Tribromomethane (bromoform)	75	630

Notes:

A For the composition of the aggregate parameters, see Annex N of the Soil Quality Regulation. For the calculation of the aggregate TEQ for dioxin, see Annex B of the Soil Quality Regulation. Please refer to Annex G,

item IV of the Soil Quality Regulation for information on adding up measured values below the Limit of Quantification.

B The soil Intervention Value in respect of these substances equals or is lower than the Limit of Quantification (intralaboratory reproducibility). If the substance is detected, the risks must be examined in greater detail. If vinyl chloride or 1,1-dichloroethene is detected in the soil, the groundwater must also be assessed.

C Weighted standard (concentration of serpentine asbestos + 10 x concentration of amphibole asbestos).

D 'Mineral oil' is defined in the analysis standard. Where the contamination is composed of mixtures (e.g. petrol or domestic heating oil), the concentration of aromatic and/or polycyclic aromatic hydrocarbons must be determined in addition to the alkane concentration. This aggregate parameter has been adopted for practical reasons. Further toxicological and chemical disaggregation is under study.

E In the case of groundwater, effects of PAHs, chlorobenzenes, and chlorophenols are indirectly additive and are expressed as a fraction of the individual Intervention Value (i.e. 0.5 of the Intervention Value of Substance A has the same effect as 0.5 of the Intervention Value of Substance B). This means that an aggregate formula must be used to determine whether an Intervention Value has been exceeded. The Intervention Value for the aggregate of a group of substances is exceeded if $\Sigma(Ci/Ii) > 1$, where Ci = measured concentration of a substance in the group of substances in question, and Ii = Intervention Value for the substance concerned in that group.

F There is an Indicative Level for severe contamination for groundwater.

G The standard for barium has been temporarily repealed. It turned out the Intervention Value for barium was lower than the natural concentration in soil. In case of increased concentrations of barium vis-à-vis the natural background due to an anthropogenic source , this concentration can be assessed on the basis of the former Intervention Value for barium of 920 mg/kg DM. This former Intervention Value is substantiated in the same way as the Intervention Values for most of the other metals and includes a natural Background Concentration of 190 mg/kg DM for barium.

Appendix F. Stakeholder Engagement Documentation

MINISTRY OF ENERGY

Stakeholder Mapping Report

Al-Kahfah Solar PV Park



Document No 413011-00907

29 Aug 2021

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PROJECT 413011-00907-EN-REP-001-Revision 0– Stakeholder Mapping Report – Al-Kahfah Solar PV Park

Rev	Description	Original	Review	Worley Approval	Date	Customer Approval	Date
1	Issued for Client Use	O. Abdelbary	Y. Zakaria I. El Sersy	J. O'Toole			29.08.21
0	Issued for Client Use	A. Mahmoud	Y. Zakaria I. El Sersy	J. O'Toole			08.08.21

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Abbreviation List

CITC	Communications and Information Technology Commission
ECRA	Electricity and Cogeneration Regulatory Authority
EHS	Environmental, Health, and Safety
EIA	Environmental Impact Assessment
EP	Equator Principles
EPFI	Equator Principles Financial Institution
ESIA	Environmental and Social Impact Assessment
GACA	General Authority of Civil Aviation
GAMEP	General Authority of Meteorology and Environmental Protection
GER	General Environmental Regulations
IBRD	International Bank for Reconstruction and Development
ICSID	International Centre for Settlement of Investment Disputes
IDA	International Development Association
IFC	International Finance Corporation
KSA	Kingdom of Saudi Arabia
MEWA	Ministry of Environment, Water, and Agriculture
MIGA	Multilateral Investment Guarantee Agency
MISA	Ministry of Investment in Saudi Arabia
MOE	Ministry of Energy
MOMRA	Ministry of Municipal, Rural Affairs and Housing
NCEC	National Center for Environmental Compliance
NREP	National Renewable Energy Program
NTP	National Transformation Program
OP	Operational Policy

PIF	Public Investment Fund
PV	Photovoltaic
SAR	Saudi Railway Company
SEC	Saudi Electricity Company

1. Introduction

1.1 Background

The Ministry of Energy is developing Al-Kahfah Solar PV Park as part of the National Renewable Energy Program (NREP). The site is located 6 km south of Al-Kahfah and has been assigned an area of 83 km². The proposed project will comprise the installation of solar photovoltaic (PV) technology at the project location. As part of the project, an Environmental and Social Impact Assessment (ESIA) will be conducted in accordance with applicable national and international requirements.

1.2 Project Location

The site proposed for Al-Kahfah Solar PV Park is located 6 km south of the town of Al-Kahfah, in the centre of Saudi Arabia in the Ha'il province, as shown in Figure 1. It is located at a distance of approximately 140 km south-east of Ha'il city and about 110 km north-west of Buraydah city (Figure 2).



Figure 1 Project Location with respect to Al-Kahfah city



Figure 2 Project Location

2. Policy, Legal, and Administrative Framework

This section describes the policy, legal, and administrative framework within which the ESIA will be prepared. The main objective of the ESIA will be to meet or surpass the relevant environmental legislative requirements and guidelines, including but not limited to:

- National KSA Legislation – General Environmental Law (2020); and
- International Legislation - World Bank/IFC Guidelines

The recently published national Executive Regulations on environmental permitting indicate that relevant stakeholder engagement activities documentation (e.g. list of attendees, presentations) should be included for Category 3 projects. In general, both the national and international (i.e. the Equator Principles Financial Institutions "EPFIs") legislations requirements show a level of overlap. The proposed ESIA process is expected to adopt, where relevant, best practice and implement the requirements of the EPFIs. In this sense, it is considered that the national legislation will also be fully met.

2.1 Policy on Renewable Energy Development and Process

National Renewable Energy Program (NREP)

Saudi Arabia's National Renewable Energy Program (NREP) is a strategic initiative under Vision 2030 and the King Salman Renewable Energy Initiative. The program aims to maximize the potential of renewable energy in Saudi Arabia. The program sets out an organized and specific road map to diversify local energy sources, stimulate economic development and provide sustainable economic stability to the Kingdom in light of the goals set for Vision 2030, which include establishing the renewable energy industry and supporting the advancement of this promising sector while working to fulfill the Kingdom's commitments to reducing carbon dioxide emissions. The NREP is overseen by the Ministry of Energy.

2.2 National Legal and Administrative Framework

Article 32 of Saudi Arabia's Basic Law of Governance, issued by royal order No. A/91 on 1/3/1992, sets forth the requirement for the country to preserve, protect, and improve the environment. Article 32 establishes that "The state works for the preservation, protection, and improvement of the environment, and for the prevention of pollution." The first comprehensive Saudi Arabia national environmental legislation was enacted on September 24th, 2001 in the form of the General Environmental Regulation, Council of Ministers Resolution No. 193. It entered the force on October 31, 2002, and its Implementing Rules were published on September 30, 2003. The main objectives of this law included preservation, protection, development of the environment, safeguarding the environment from pollution; protection of public health from activities and acts that harm the environment; conservation and development of natural resources and rationalizing their use and raising awareness of environmental issues. The General Environmental Law entrusted the General Authority of Meteorology and Environmental Protection (GAMEP) with preserving and preventing the deterioration of the environment. In 2012, the GAMEP developed a number of draft supplementary Environmental Standards revising in part the General Standards for the environment issued in Appendix 1 to the General Environmental Law and Rules for Implementation.

In 2019, GAMEP's functions and responsibilities were transferred to four centers for environment sector development: The National Center for Environmental Compliance, the National Center for Vegetation Cover and Combating Desertification, the National Center for Wildlife and the National Center for Meteorology. The Ministry of Agriculture was renamed to the Ministry of Environment, Water and Agriculture (MEWA) in 2016, and now handles responsibilities related to environmental sustainability as well. The Environment Regulation, Royal Decree No M/165 of 19 Dhul Qada 1441 Hejra (corresponding to 10 July 2020) entered into force on 13 January 2021, superseding the 2001 Regulation. Moreover, the Environmental Regulation (2020) superseded the following regulations:

- The Law of the Saudi Wildlife Authority issued by Royal Decree No. (M / 22) dated 9/12/1406 AH
- The Law on Hunting Wildlife and Birds issued by Royal Decree No. (M / 8) dated 4/16/1420 AH
- The System for Trading in Endangered Wildlife Species and their Products issued by Royal Decree No. (M / 9) dated 3/6/1421 AH
- The Pastures and Forests System issued by Royal Decree No. (M / 55) dated 10/29/1425 AH
- The Law of Protected Areas for Wildlife issued by Royal Decree No. (M / 66) dated 10/19/1436 AH

The Environmental Regulation (2020) aims to protect, develop and sustain the environment, adhere to environmental principles, and regulate the environment sector and its related activities and services. Per Article 3 of the Regulation "No person may engage in any activities that have an environmental impact; Except after obtaining a permit or license; And according to what is specified by the regulations". Other relevant articles from the Environmental Regulation (2020) include the following:

- Article 6: "It is prohibited to do anything that would pollute, harm, or negatively affect the use of the environmental media and water resources".
- Article 8: "the licensee who engage in activities that may emit emissions or pollutants, or that may affect the environmental media shall comply with the following:
  - Environmental requirements, controls, procedures, and standards as determined by the regulations.
  - Taking necessary actions and measures before exceeding environmental standards, as specified by the regulations.
  - Establish programs and devices for monitoring, measuring and controlling the quality of the environmental media, as determined by the regulations.
  - Provide the competent authority, on a periodic basis, with data and reports related to emissions or pollutants issued by its activities. To review and comply with them, and to determine the violations of standards, standards and requirements, in accordance with what is specified by the regulations.
  - Provide the competent authority with the environmental audit study, as specified by the regulations.
  - Rehabilitation of the deteriorating environment as a result of practicing its activities, as determined by the regulations".

- Article 11: “It is prohibited to discharge, drain, or inject wastewater or any of the treated liquid components in ground wells or any environmental medium, without obtaining a permit, as indicated by the regulations”.
- Article 16: “It is prohibited to carry out any activity or work within lands of vegetation without obtaining a permit or license, as indicated by the regulations. It is prohibited to carry out any activity or work on lands that fall within the urban boundary and which contain vegetation cover under the supervision of the competent authority without obtaining a permit or license, as indicated by the regulations”.

2.2.1 National Environmental Impact Assessment (EIA) Requirements

The requirement for Environmental Impact Assessments (EIAs), are established by the executive regulation for the environmental permits for construction and operation of activities issued by the Ministry of Environment Water and Agriculture in 2021. The executive regulations are applicable to all owners/operators of projects that has an environmental impact (new or existing) inside the Kingdom of Saudi Arabia including construction, operation, modification, addition, expansion and decommissioning. In accordance with the executive regulation, the proposed Project has been classified as Category 3 as per NCEC response to the Project Environmental Classification Form (Annex 1 – Environmental Permits for Activities Construction and Operation Executive Regulations). Figure 3 illustrates the EIA approval process for Category 3 projects.

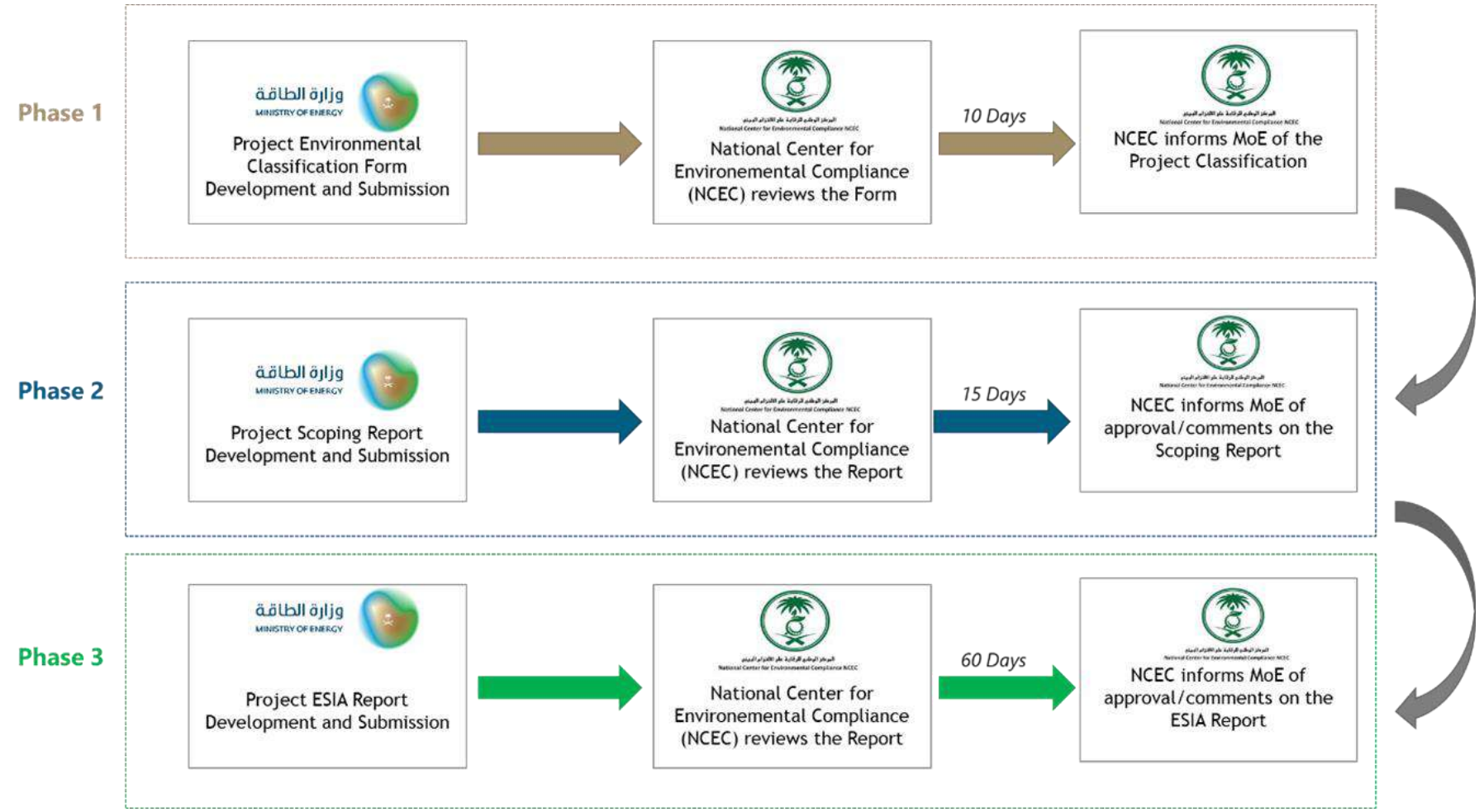


Figure 3 EIA approval process

2.2.2 Relevant National Ministries and Regulatory Bodies

Presented below the national ministries and regulatory bodies of relevance. It should be noted that some of these authorities have attended the public consultation held to disclose the ESIA study findings such as: NCEC, Ministry of Environment, Water, and Agriculture (MEWA), General Authority of Civil Aviation (GACA) and Ministry of Energy (MOE).

2.2.2.1 National Center for Environmental Compliance (NCEC)

The National Center for Environmental Compliance (NCEC) was set up in Saudi Arabia, as one of the four new national environmental centers replacing the General Authority of Meteorology and Environmental Protection (GAMEP). The NCEC has been assigned the responsibilities related to reviewing and approving EIAs for development projects, for the granting of permits and for the issuing of licenses. The NCEC is furthermore concerned with monitoring the environmental compliance of all establishments that have an impact on the environment in all development sectors, supervising programs for monitoring sources of environmental pollution and inspecting installations.

2.2.2.2 Ministry of Environment, Water, and Agriculture (MEWA)

The Ministry of Environment, Water, and Agriculture (MEWA) is responsible for the regulation and implementation of all aspects of the country's policies for the environmental, water, and agricultural sectors. The ministry implements environmental, water production, and agricultural plans and programs across the Kingdom with a focus on sustainability and value creation.

MEWA was established by virtue of the Royal Decree no. (A/133), dated 30/07/1437 H, upon which the name of the Ministry of Agriculture (MOA) was changed to the Ministry of Environment, Water and Agriculture (MEWA), and assigned the environment-related tasks to it. The establishment of the Undersecretariat of Environment was approved by the Ministerial Resolution no. 115/1/1438, dated 16/02/1438 H. Some of the tasks and responsibilities of the Directorate of Environment include mapping out national strategies and environmental and meteorological objectives and goals and coordinating and cooperating with the local, regional and international entities, and following up developments and updates in the fields of environment and meteorology.

2.2.2.3 Ministry of Energy (MOE)

The Ministry of Energy (MOE) is the central energy authority in Saudi Arabia. The ministry was formerly known as the Ministry of Energy, Industry, and Mineral Resources. However, in August 2019 a Royal Decree divided the Ministry into two; The Ministry of Energy, and the Ministry of Industry and Mineral Resources. The MOE manages and executes Saudi Arabia's National Renewable Energy Program (NREP), which is a long-term, multi-faceted renewable energy program designed to balance the domestic power mix, whilst working towards carbon reduction commitments. The Ministry of Energy directly supports the National Transformation Program (NTP) and Saudi Arabia's Vision 2030.

2.2.2.4 Ministry of Municipal, Rural Affairs and Housing (MOMRA)

The Ministry of Municipal, Rural Affairs and Housing (MOMRA) is the primary governmental organization in charge of the supervision and regulations of municipalities across cities, towns, and villages of the Kingdom of Saudi Arabia. MOMRA is currently leading the development of the municipal sector through the 4-year Municipal Transformation Program (MTP), which is a sector-wide, across-the-board overhauling and upgrading of municipal performance nationwide. The MTP ultimately aims for sustainable cities and communities that ensure developmental equilibrium between the economy, communities, and the environment, and which form the essential urban foundation and platform to enable the implementation of the whole-of-government National Transformation Program (NTP) toward the realization of Saudi Arabia's Vision 2030. The Ministry now also regulates all functions related to housing, with many initiatives, programs, and projects for individuals and business-related matters.

2.2.2.5 Emirate of Hail Province

The Law of Regions, promulgated by Royal Decree No. A/92 and amended by Royal Decree No. A/21, administratively divides Saudi Arabia into 13 provinces. Each province consists of a number of governorates (of "Class A" or "Class B"), districts and centers (of "Class A" or "Class B"). Each province is headed by an Emir, with the rank of a minister. The Emir of the province shall be answerable to the Interior Minister.

Every emir shall assume the administration of the region according to the general policy of the State in compliance with provisions of the Law of Regions and other laws and regulations. Some of the duties of the Emir include:

- Maintaining security, order, and stability, and take necessary measures in accordance with the Law of Regions and other laws and regulations;
- Working for social and economic development and public works of the province;
- Administering governorates, districts and centers, and supervising governors, directors and districts and heads of centers, and ascertaining their capabilities to perform assigned duties; and
- Protecting state property and assets and prevent their usurpation.

Hail Province is one of the thirteen (13) provinces of the Kingdom of Saudi Arabia, which has an area of approximately 103,887 km2 and a total population of approximately 731,147 (2019 Census). Hail Province is ranked eighth in terms of the overall area and ninth in terms of the population size. The capital of the province is the city of Hail.

2.2.2.6 Hail Province Municipality (Amanah)

The Municipalities and Village Law, promulgated by Royal Decree No. M/5, provides a framework for the function of municipalities in Saudi Arabia. Each municipality comprises a municipal council, which practices the authority of monitoring and reporting. Each municipality is headed by a mayor "Amin" who holds the executive authority, and is supported by various administrations. The head of the municipality shall be answerable to the Urban and Rural Affairs Minister.

Some of the functions of the municipality include the following:

- Regulation, and maintenance of the municipality in accordance with an official masterplan;
- Issuance of permits with respect to construction and buildings as well as public and private works extensions and their monitoring;
- Maintaining the cleanliness of the municipality, and creation of public parks and swimming pools and their regulation;
- Protecting public health and preventing the risks of floods;
- Establishing markets and retail outlets; and
- Establishing the locations for hawkers and regulating their activities.

A number of governorate municipalities and local branch municipalities are linked to Hail Province Municipality (Amanah), which supervises and coordinates with the local municipalities within Hail Region. These include Al-Kahfah Town Municipality, which is the local municipality of the project site.

2.2.2.7 Shanan Governorate

Governorates are the second level of regional administration in Saudi Arabia. Each of the thirteen provinces of Saudi Arabia is sub-divided into governorates. Governorates, in turn, are further subdivided into sub-governorates (or centers "Marakiz"). However, some sub-governorates may report directly to the provincial capital rather than to one of the governorates. Regional capitals are not included within any governorate but are governed by municipalities "Amanah" instead. Governorates in Saudi Arabia can be either "Category A" or "Category B", depending on population size. Each governorate is headed by a governor, appointed by an order from the council of ministers, and holds the highest executive authority in the governorate. Some of the duties of governors include:

- Maintaining order and security in the governorate in accordance with applicable laws and regulations;
- Working for the urban, social, and economic development of the governorate and its centers; and
- Developing the public services in the government and its centers and improving their efficiency.

Hail Province is administratively divided into eight (8) governorates. The proposed Al-Kahfah PV Energy Park will be located in Shanan Governorate, which is classified as a Class B Governorate. Shanan Governorate has a total population of 41,641 (2010 Census).

2.2.2.8 Ministry of the Interior

The Ministry of the Interior is the national authority responsible for national security, naturalization, immigration, and customs in Saudi Arabia. The Ministry was founded in 1951 after the combined ministerial body covering financial and interior affairs was separated.

2.2.2.9 Ministry of Defence

The Ministry of Defence is responsible for the protection of national security, interests, and sovereignty of the country from external threats as well as working with all ministries of the state to achieve national security and stability. The Ministry includes five armed forces; The Royal Saudi Land Forces, The Royal Saudi Air Forces, The Royal Saudi Naval Forces, The Royal Saudi Air Defence Forces, and The Royal Saudi Strategic Missiles Force.

2.2.2.10 General Authority of Civil Aviation (GACA)

The General Authority of Civil Aviation (GACA) is the national authority which administers all aviation industry matters in the Kingdom of Saudi Arabia. GACA owns and several domestic and international airports in Saudi Arabia and is responsible for all air traffic control, safety, operations and development matters in the country.

2.2.2.11 National Center for Wildlife

The National Center for Wildlife is one of the four new national environmental centers that have been established upon several resolutions issued in 2020 by the Council of Minister. The Center aims to preserve the wildlife on land, sea, and its natural habitats as well as improve and prosper the damaged ones.

2.2.2.12 Ministry of Tourism

The Ministry of Tourism is the government authority concerned with tourism of the Kingdom of Saudi Arabia. One of the Ministry's objectives is to activate tourism's contribution to cultural and economic development.

2.2.2.13 Heritage Commission

The Heritage Commission is a Saudi governmental body that was established in February 2020 under the Ministry of Culture. The Commission aims to support efforts to develop the national heritage and protect it.

2.2.2.14 Saudi Ports Authority

Saudi Ports Authority is a government agency that supervises the ports of Saudi Arabia. It was founded in 1976 as an independent agency of the Prime Minister's office, to bring together the governance and operations of the multiple ports of the country to one office.

2.2.2.15 Ministry of Transport and Logistic Services

The Ministry of Transport and Logistic Services plays the role of the legislator for the daily land, maritime, and air transport services planning and implementation. The Ministry has a mission of achieving integration between all transport sectors, land, maritime, and air, in order to meet the needs of the Kingdom by raising the levels of safety, energy rationalization, and to enhance the operation and performance efficiency to provide efficient services to all beneficiaries.

2.2.2.16 Communications and Information Technology Commission (CITC)

The Communications and Information Technology Commission (CITC) is the national communications authority. It was first established under the name "Saudi Communications Commission" in accordance with the decision of the Council of Ministers. The name was later changed after the commission was assigned new tasks related to information technology. CITC is responsible for regulating the information and communications technology sector in the Kingdom of Saudi Arabia. The Telecommunications Act, issued by Royal Decree No. M/12, dated 5/3/1422H and its Bylaws, issued in 1423 H, provides the legal framework for organizing this sector. This Act involves a number of objectives such as: Providing advanced and adequate telecommunication services with affordable prices, creating an appropriate atmosphere to encourage fair competition, using frequencies effectively, localization of telecommunication technology and managing recent advancements, clarity and transparency in procedures, equality and neutrality, protection of the public interest as well as the interest of users and investors.

2.2.2.17 The Saudi Railway Company (SAR)

The Saudi Railway Company (SAR) is a fully funded company owned by the Public Investment Fund (PIF) and is in charge of operating Saudi Arabia's rail network. SAR was established in 2006 in order to implement a railway project linking the northern region with both the eastern and central regions of the Kingdom.

2.2.2.18 The Public Transport Authority

The Public Transport Authority aims to organize public transport activity, supervise it and ensure the safety of the operation of its facilities. The Public Transport Authority is in charge of preparing the public transport network plans in each of the main cities of the Kingdom, in coordination with the relevant authorities (e.g. provinces).

2.2.2.19 The Saudi Authority for Industrial Cities and Technology Zones

The Saudi Authority for Industrial Cities and Technology Zones, known as MODON, is a government agency created in 2001 and is responsible for the regulation and promotion of industrial properties and technology zones. MODON currently oversees 35 existing and under development industrial cities in various regions of the Kingdom, in addition to supervising private industrial cities.

Some of MODON's objectives include the following:

- Deliver National Industrial Strategy targets
- Improve the standards for existing industrial cities
- Increase the number of industrial cities.

2.2.2.20 Saudi Electricity Company (SEC)

Saudi Electricity Company (SEC) is a Saudi electric utility company, which enjoys a monopoly on the generation, transmission, and distribution of electric power in Saudi Arabia through a number of power generation plants in the country. The company was formed in 2000 by Order of the Council of Ministers through a merger of existing

regional electricity companies around the country into a single joint stock company. The company, in coordination with governmental organizations, takes part in various activities aimed at the preservation of the environment in the Kingdom through the following:

- Participating in the development of national indicators for the environment and sustainable development;
- Participating in formulating and updating national plans for responding to radiological and nuclear emergencies;
- Continuously coordinating with the environmental competent agency with respect to the protection of the environment;
- Preparing quarterly environmental reports and forwarding them to the environmental competent agency;
- Participating and sponsoring environmental conferences and events locally and internationally; and
- Participating and sponsoring national campaigns for cleaning up cities and provinces of the Kingdom.

2.2.3 Permits

A number of permits are typically required to construct and operate the proposed project. Table 1 indicates the type of permits required for the construction and operation of the proposed project and associated facilities (e.g. utilities connections). Such permits set out and regulate the standards to which the proposed project must be in compliance with.

Table 1 Permitting Requirements for Al-Kahfah PV Energy Park

Permit Type	Permitting Authority	Law	Project Phase	
			Construction	Operation
Land Allocation Permit	Hail Province Municipality/Al-Kahfah Town Municipality/MOMRA	Municipalities and Villages Law	Yes	-
Building Construction Permit	Hail Province Municipality/Al-Kahfah Town Municipality/MOMRA	Municipalities and Villages Law	Yes	-

Permit Type	Permitting Authority	Law	Project Phase	
			Construction	Operation
Industrial License/Investment License	Ministry of Commerce/Ministry of Investment	Laws of the Legal Guide for Investors such as: • Basic Law of Governance • Implementing Regulations of the Foreign Investment Act • Labor Law • Income Tax Law • Social Insurance Law • Company Laws • Capital Market Law • Code of Law Practice • Copyright Law • Law of Patents • Law of Arbitration	Yes	Yes
Environmental Permit to Construct/Operate	NCEC	General Environmental Law	Yes	Yes

Permit Type	Permitting Authority	Law	Project Phase	
			Construction	Operation
Permit to Drill Groundwater Wells (if applicable)	Ministry of Environment, Water and Agriculture	Water Law	Yes	Yes
Permit to Connect to Saudi Electricity Company Utilities	Saudi Electricity Company	Public Utilities Protection Regulation, Electricity Law and Its Executive Regulations	Yes	Yes
Generation License, Transmission License, Distribution and Retail License	Electricity and Cogeneration Regulatory Authority	Electricity Law and Its Executive Regulations	Yes	Yes

2.2.4 International Conventions

Saudi Arabia has used the signing of international agreements and treaties as an extension to its regulations. Saudi Arabia is party to various international environmental conventions or agreements; some of which include the following:

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
- Vienna Convention of 1985 for the Protection of the Ozone Layer;
- Montreal Protocol of 1989 on Substances that deplete the Ozone Layer;
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal;
- Rio Declaration on Environment and Development;
- United Nations Framework Convention on Climate Change;
- Convention on Biological Diversity, Rio De Janeiro;
- United Nations Convention to Combat Desertification;
- Convention on International Trade in Endangered Species of Wild Fauna and Flora;
- The Kyoto Protocol to the UN Framework Convention on Climate Change; and
- The Paris Convention on Climate Change.

2.3 International Legal and Administrative Framework

It is required to conduct consultation with relevant stakeholders during the Environmental Assessment (EA) process. The project sponsor is required to conduct meaningful consultations with relevant stakeholders included affected groups and other interested parties about the project's environmental and social aspects and to take their views into account. According to IFC requirements, the stakeholders' consultation methods may vary and include but not limited to surveys, questionnaires, interviews or public hearings.

IFC released a number of guidance documents related to community development and stakeholders' engagement. In 2010, IFC (Environment Division) released Community Development Resource Guide for Companies, which aimed to serve as a resource guide to help IFC clients and other companies establish effective community development programs for communities located near or affected by their operations. It lays out general principles and methods and disseminates good practice to help develop an appropriate community development program.

2.3.1 World Bank Group

In October 2018, the World Bank launched the "Environmental and Social Framework" (ESF). This Framework sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards with the aim of promoting shared prosperity. The framework comprises:

- A Vision for Sustainable Development.

- The World Bank Environmental and Social Policy for Investment Project Financing.
- The Environmental and Social Standards.
- Bank Directive: Environmental and Social Directive for Investment Project Financing
- Bank Directive on Addressing Risks and Impacts on Disadvantaged or Vulnerable Individuals or Groups

Projects supported by the Bank through Investment Project Financing are required to meet the following Environmental and Social Standards (ESS), as applicable:

- ESS 1: Assessment and Management of Environmental and Social Risks and Impacts
- ESS 2: Labour and Working Conditions
- ESS 3: Resource Efficiency and Pollution Prevention and Management
- ESS 4: Community Health and Safety
- ESS 5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement
- ESS 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- ESS 7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities
- ESS 8: Cultural Heritage
- ESS 9: Financial Intermediaries
- ESS 10: Stakeholder Engagement and Information Disclosure

2.3.2 International Finance Corporation

The IFC Sustainability Framework promotes sound environmental and social practices, encourages transparency and accountability, and contributes to positive development impacts. The Sustainability Framework includes the Performance Standards, which define clients' responsibilities for managing their environmental and social risks. The IFC Performance Standards have become globally recognized as a benchmark for environmental and social risk management in the private sector; they are as follows:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labour and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention

- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous People
- Performance Standard 8: Cultural Heritage

In addition, IFC has prepared a set of Guidance Notes, corresponding to the Performance Standards on Environmental and Social Sustainability. These Guidance Notes offer helpful guidance on the requirements contained in the Performance Standards, including reference materials, and on good sustainability practices to improve project performance. These Guidance Notes are not intended to explain the requirements in the Performance Standards.

In 2007, IFC Environmental, Health, and Safety (EHS) Guidelines were released, which replace World Bank Guidelines previously published in Part III of the Pollution Prevention and Abatement Handbook. The IFC EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as required by their respective policies and standards.

2.3.3 Equator Principles (EPs)

The Equator Principles have been adopted by the Equator Principles Financial Institutions (EPFIs) to provide a financial industry benchmark for determining, assessing and managing environmental and social risk in project financing. They are created to ensure that the financed project is developed in a manner that is socially responsible and reflect sound environmental management practices. Accordingly, negative impacts on project-affected ecosystems and communities should be avoided where possible, and if these impacts are unavoidable, they should be reduced, mitigated and/or compensated for appropriately. Loans are provided to projects complying with the social and environmental policies and procedures and conforming to the Equator Principles (EP) IV, effective from 1 July 2020, as follows:

- Principle 1: Review and categorisation
- Principle 2: Environmental and Social Assessment
- Principle 3: Applicable Environmental and Social Standards
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan

- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent Review
- Principle 8: Covenants
- Principle 9: Independent Monitoring and Reporting
- Principle 10: Reporting and Transparency

According to the Equator Principles, Saudi Arabia is a Non - Designated Country. Consequently, Equator Principles require the environmental assessment screening process to be carried out using the host country and the environmental standards and assessment criteria derived in compliance with the IFC Performance Standards and the World Bank Group EHS Guidelines. However, following a conservative approach, the most stringent of all the appropriate regulations is to be applied during the assessment.

With respect to stakeholder engagement, Equator Principle 5 (Stakeholder Engagement) and Equator Principle 6 (Grievance Mechanism) are of most relevance. Per EP5, an effective stakeholder engagement should be demonstrated on an ongoing basis in a structured and culturally appropriate manner with affected communities and other stakeholders. Per EP6, a requirement exists for the client to establish a grievance mechanism designed to facilitate the communication and resolution of concerns and grievances about the environmental and social performance of the project.

2.3.4 ESIA Requirements

Equator Principles Financial Institutions (EPFIs) require burrowers to comply with the Equator Principles, to ensure that the project has been developed in a manner that is socially responsible and reflects sound environmental management practices. The first principle deals with the categorization of the project on the basis of its potential risks and impacts. The screening is undertaken using the following categorization scheme of the IFC:

- Category A: Projects with potential significant adverse environmental social risks and/or impacts which are diverse, irreversible or unprecedented.
- Category B: Projects with potential limited adverse environmental social risks and/or impacts that are few in number, generally site-specific, largely reversible, and readily addressed through mitigation measures
- Category C: Projects with minimal or no adverse environmental and social impacts/risks.

The proposed project is expected to be classified as a Category B Project: Projects with potential limited adverse social or environmental impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures.

3. Project Stakeholders

3.1 Identification and Analysis

Stakeholders refer to parties or individuals who have an interest in the project and who can potentially influence, or be influenced by the construction, operation, and/or decommissioning of the project. Stakeholders of consideration may include public and private bodies, groups and individuals, including local authorities, utilities/power companies, and public stakeholders. A proposed stakeholder group relevant to the project are included in the Table 2.

Table 2 Proposed Stakeholder Group

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
Regulatory Bodies/Competent Authorities	Hail Province Municipality	Regional municipality of project site	To be consulted as appropriate during the assessment stage; may be invited to attend consultation meeting	Issuing land allocation and building permits, general interest in the progress of the project	No direct role, general interest in the operation of the facility
	Al-Kahfah Town Municipality	Local municipality of project site	To be consulted as appropriate during the assessment stage; may be invited to attend consultation meeting	Issuing land allocation and building permits, general interest in the progress of the project	No direct role, general interest in the operation of the facility
	Shanan Governorate	Governorate of the project location including the governor or his representatives	To be consulted as appropriate during the assessment stage; may be invited to attend consultation meeting	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Emirate of Hail Province	Provincial area of the project site	To be consulted as appropriate during the assessment stage; may be invited to attend consultation meeting	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
	Ministry of Municipal, Rural Affairs and Housing (MOMRA)	Competent authority responsible for the supervision and regulation of municipalities across Saudi Arabia, Competent authority related to housing	Provision of advice and concerns regarding project development; Need to confirm if the Ministry does not have any planned development in the project area; Attend consultation meeting	Issuing land allocation and building permits, general interest in the progress of the project	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	National Center for Environmental Compliance (NCEC)	Competent agency responsible for environmental regulation permitting	Competent Authority tasked with the approval of EIA Studies and issuance of relevant environmental licenses (i.e. Environmental Permit to Construct and Environmental Permit to Operate). Attend consultation meeting	The NCEC has been assigned the responsibilities related to reviewing and approving EIAs for development projects, for the granting of permits and for the issuing of licenses (i.e. Environmental Permit to Construct and Environmental Permit to Operate).	NCEC functions as an enforcement institution for the application of environmental laws including environmental licensing and auditing.
	Ministry of Environment, Water, and Agriculture (MEWA)	Governmental authority responsible for the regulation and implementation of all aspects of the country's policies for the environmental, water, and agricultural sectors	To be consulted as appropriate during the assessment stage; may be invited to attend consultation meeting	Issues permit to drill groundwater wells, if needed	General interest in the facility. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Ministry of Energy	Project proponent. Central authority for energy projects in Saudi Arabia. Key stakeholder in the National Renewable Energy Program.	Lead in communication to interested governmental agencies/ministries as required	Monitoring performance. Lead in communication to interested governmental agencies/ministries as required	Monitoring performance. Lead in communication to interested governmental agencies/ministries as required
	Saudi Electricity Company (SEC)	Responsible for the transmission of produced electricity through an overhead transmission line/management, and operation, and maintenance of the grid. Key stakeholder in the National Renewable Energy Program	Provision of advice and concerns regarding project development. Attend consultation meeting	Respond directly on issues relating to project interaction with SEC assets	Ongoing role related to the operation of the facility and energy supply to the grid

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	National Center for Wildlife	Regulating authority whose objective is to conserve biological diversity in Saudi Arabia	Stakeholder for the EIA interested in ensuring the protection of biological diversity in the Kingdom; Need to confirm if there are any relevant requirements related to the project area; may be invited to consultation meeting.	Ensures that all measures included in the EIA for the protection of biological diversity are followed	General interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
	Ministry of Tourism	Governmental authority concerned with tourism	Stakeholder for the EIA, maybe invited to consultation meeting, may provide information related to potential touristic development in the vicinity of the project area, if any	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Heritage Commission	Governmental authority concerned with conservation of the country's national heritage	Stakeholder for the EIA as the sole body authorized to provide licensing and perform intrusive archaeological investigations, maybe invited to consultation meeting, may provide information related to potential archaeological recourses in the project area, if any	Potential supervision during the construction process to ensure archaeological findings are not overlooked.	General interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
	Saudi Ports Authority	Governmental authority concerned with supervising the ports of Saudi Arabia	Need to confirm if there are any ports to be affected by the project. To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Ministry of Interior	The national authority responsible for national security, naturalization, immigration, and customs in Saudi Arabia	To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role, general interest in the progress of the project. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
	Ministry of Defence	National authority responsible for the protection of national security, interests, and sovereignty of the country	Need to confirm if the Ministry does not have any associated facilities/activities or future plans in the area; To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Ministry of Transport	National legislator for the daily land, maritime, and air transport services planning and implementation	Need to confirm if the Ministry has any future plans in the area that could be affected by the project; To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
	General Authority of Civil Aviation	National authority which administers all aviation industry matters in the Kingdom of Saudi Arabia.	Need to confirm if there are any air corridors to be affected by the project. To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Saudi Railway Company	Company responsible for the management of freight rail network linking the northern region of the Kingdom of Saudi Arabia (KSA) with both the eastern and central regions	Need to confirm if there are any infrastructure to be affected by the project. To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
	Communications and Information Technology Commission	National communications authority	Need to confirm if there is any associated infrastructure to be affected by the project. To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	MODON	Authority in charge of the regulation and promotion of industrial properties and technology zones	Need to confirm if there are any plans to be affected by the project. To be consulted as appropriate during the assessment stage; may be invited to consultation meeting	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed	No direct role. Maintain open channel of communication with the stakeholder for receipt of updates in relation to the project activities, if needed
Intergovernmental	Project Lenders	An entity or group of entities providing project loan facility. Loan conditions include environmental and social requirements that the loan recipient must abide by	Imposing ESIA requirements	Monitoring environmental and social performance of the project / delivery of project environmental statement commitments	Monitoring environmental and social performance of the project / delivery of project environmental statement commitments

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
Project-Related	Workforce	May include expatriate employees, international contractors, national contractors, Saudi national employees	To be included as sensitive receptors in the ESIA. Potential impacts to workforce to be addressed in the ESIA	Health, safety, and general wellbeing; Implementation of the project related Construction Environmental Management Plan	Health, safety, and general wellbeing; Implementation of the project related Operation Environmental Management Plan
Businesses and Community Representatives	Local residents of Al-Kahfah	May include persons with general interest in local development	To be included as sensitive receptors in the ESIA. Any potential impacts to be addressed in the ESIA	No role. Potential to form part of project affected persons group and/or have general local interest in construction phase activities	No role. Potential to form part of project affected persons group and/or have general local interest in operation activities
	Agricultural farms near the project site	Local activities close to the project site	To be included as sensitive receptors in the ESIA. Any potential impacts to be addressed in the ESIA	Maintain communication of project developments, including any potentially disruptive activities (i.e. road closures and/or road transport disruptions)	Maintain communication of project developments

Type	Name	Description	Role in EIA Stage	Role in Construction	Role in Operation
	Local Herders	Temporary users of the wider area	Their temporary presence to be documented in the ESIA baseline	No role. Potential to form part of project affected persons group and/or have general local interest in construction phase activities, if present	No role. Potential to form part of project affected persons group and/or have general local interest in operation activities, if present
Media	Various	Local newspaper and radio media groups	Nonspecific – may be involved in the dissemination of information in relation to the project, including consultation meeting	Nonspecific – may be involved in the dissemination of information in relation to the project, including construction progress	Nonspecific – may be involved in the dissemination of information in relation to the project including facility completion / start of operations.

3.2 Mapping

The Power and Interest criteria were selected for SH mapping. This selection is based on one of the most commonly used and well-established mapping techniques– the Mendelow's Power - Interest Matrix, originally developed by Aubrey L. Mendelow. The Power/Interest Stakeholder Map has two axes. The vertical axis "Interest" represents the level of interest a SH group has in the Project. The horizontal axis "Power" represents the level of power a SH has in shaping the Project, its direction and parameters. The matrix prioritizes the SHs by the means of their Power and Interest, and thus helps to define the level of engagement required for different SH (Figure 4).

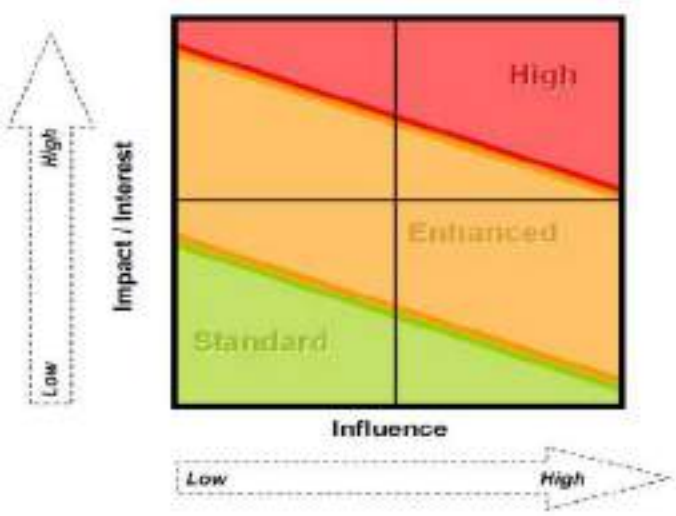


Figure 4 Levels of Engagement Matrix Example

A preliminary analysis has been undertaken to determine the potential level of influence and interest/impact of a stakeholder group as it relates to the group's relationship with the project. The significance of the group's relationship with the project may be classified as Low, Moderate, or High.

Table 3 provides the criteria used to determine the significance of each stakeholder group:

Table 3 Criteria Used to Determine the Significance of Each Stakeholder Group

Significance	Impact /Interest	Influence
Low	Stakeholder will experience very few impacts as a result of the project The project has limited relevance to the stakeholder's field of interest and/or responsibilities	Stakeholder has very little control over the project

Significance	Impact /Interest	Influence
Moderate	Stakeholder will experience a moderate degree of impact as a result of the project. These impacts can be managed and mitigated The project has some relevance to the stakeholder's field of interest and/or responsibilities	Stakeholder can influence the scope and schedule of the project
High	Stakeholder will experience a high degree of impact as a result of the project The project is directly related to the stakeholder's field of interest and/or responsibilities	Stakeholder has decision making powers regarding the project

On the basis of the criteria in Table 3, appropriate level of engagement for each stakeholder group is determined. Three levels of engagement have been defined as Standard, Enhanced, and High. The level of engagement for each stakeholder group will be used to design targeted group-specific engagement activities. More details are presented in section 4.

Table 4 provides the preliminary level of significance and engagement identified for each stakeholder group identified in Table 2. Stakeholders can move from one level of engagement to another throughout the project. The mapping and analysis of stakeholder groups is an ongoing process and will be revisited throughout the project.

Table 4 Stakeholder Levels of Significance and Engagement

Stakeholder Group	Stakeholder	Overall Significance	Level of Engagement
Regulatory Bodies/Competent Authorities	Hail Province Municipality	Moderate	Enhanced
	Al-Kahfah Town Municipality	Moderate	Enhanced
	Shanan Governorate	Moderate	Enhanced
	Emirate of Hail Province	Moderate	Enhanced
	National Center for Environmental Compliance (NCEC)	High	High
	Ministry of Environment, Water, and Agriculture (MEWA)	Moderate	Enhanced
	Ministry of Energy	High	High
	Ministry of Municipal, Rural Affairs and Housing (MOMRA)	Moderate	Enhanced
	Saudi Electricity Company (SEC)	High	High
	National Center for Wildlife	Moderate	Enhanced
	Ministry of Tourism	Moderate	Enhanced
	Heritage Commission	Moderate	Enhanced

Stakeholder Group	Stakeholder	Overall Significance	Level of Engagement
	Saudi Ports Authority	Moderate	Enhanced
	Ministry of Interior	Moderate	Enhanced
	Ministry of Defence	Moderate	Enhanced
	Ministry of Transport	Moderate	Enhanced
	General Authority of Civil Aviation	Moderate	Enhanced
	Public Investment Fund	Moderate	Enhanced
	Saudi Railway Company	Moderate	Enhanced
	Communications and Information Technology Commission	Moderate	Enhanced
	MODON	Moderate	Enhanced
Intergovernmental	Project Lenders	High	High
Project-Related	Workforce	Low-Moderate	Enhanced
	Local residents of Al-Kahfah	Low-Moderate	Enhanced

Stakeholder Group	Stakeholder	Overall Significance	Level of Engagement
Businesses and Community Representatives	Agricultural farms near the project site	Low-Moderate	Enhanced
	Local herders (if present)	Low-Moderate	Enhanced
Media	Various Media Outlets	Low	Standard

4. Stakeholder Engagement Action Plan

4.1 Approach

The Stakeholder Engagement Plan will allow a range of stakeholders and interested parties to be identified and engaged. This will include regulatory stakeholders who are of high importance/influence and stakeholders of lesser importance who require to be kept informed through less intensive engagement processes. As shown in Figure 4, three levels of engagement are proposed (Standard, Enhanced, and High). These levels of engagement will be used to focus stakeholder activities based on the level of impact/interest or influence identified for each stakeholder group. A Standard level of engagement can be achieved using disclosure/information dissemination. The objectives of this approach include:

- To ensure the timely communication of relevant project information; and
- To relay information in a manner that is both understandable and accessible to the groups being consulted.

Disclosure/information dissemination mechanisms can include the following:

- Email updates;
- Website content;
- Newsletters; and
- Status updates and reporting;

An Enhanced level of engagement can be achieved via consultation and engagement. The objectives of this approach include:

- To provide the platform to stakeholders to present their interests, views, and concerns; and
- To disclose information prior to consultations in a manner that is both understandable and accessible to the groups being consulted.

Consultation and engagement mechanisms can include the following:

- E-mail request for information;
- No objection letters from ministries/policy makers;
- Formal/informal Meetings; and
- Feedback and grievance mechanisms

A High level of engagement can be achieved using focused engagement. The objectives of this approach include:

- To achieve effective participation and engagement, in turn, influencing the project process; and
- To help manage and mitigate impacts to enable stakeholders, where possible, to maximize the benefits proposed by the project.

Focused engagement mechanisms can include the following:

- Workshops/Consultation Meeting; and
- Participatory monitoring and evaluation.

4.2 Stakeholder Engagement Action Plan

Table 5 provides a Stakeholder Engagement Action Plan. The plan must be continuously reviewed and updated to maintain a record of all communication and engagement activities.

Table 5 Stakeholder Engagement Action Plan

Activity	Stakeholders	Objectives	Communication Method	Responsibility	Timing
Environmental and Social Impact Assessment	Government authorities and policy makers	Disclose information on study methods and findings	**Focused Engagement, Consultation, Disclosure** Consultation meeting, presentation, Request for Information (if needed) and no-objection letters	MOE/Worley	During the finalization of the ESIA report
	Lender	ESIA report officially submitted to lender	**Disclosure** The report is made accessible online	MOE	Following the finalization of the ESIA report
Implement Environmental Management Plan	Local communities of the project area	Inform communities/industries of any potentially disruptive work/activities	**Disclosure**	MOE	During the construction phase of the project
	All	Disclose results of environmental monitoring	**Disclosure**	MOE	During the construction phase of the project

Activity	Stakeholders	Objectives	Communication Method	Responsibility	Timing
Grievance Mechanism	All	Set up a mechanism for stakeholders to raise concerns and grievances about the project	Stakeholder database and grievance log	MOE	Throughout the project, early in the project cycle
Project Implementation	Lender	To demonstrate: • Compliance with measures agreed on the basis of the findings and results of the EA, including the implementation of any Environmental management plan; • Status of mitigation measures; and the findings of the monitoring program	**Disclosure** Report to the lender	MOE	During the operation phase of the project

4.3 Grievance Mechanism

The management of grievances is a vital component of stakeholder engagement and an important aspect of risk management for a project. Grievances can be an indication of growing stakeholder concerns (real and perceived) and can escalate if not identified and resolved. Identifying and responding to grievances supports the development of positive relationships between projects, communities and other stakeholders. Monitoring of grievances will signal any recurrent issues, or escalating conflicts and disputes.

The project developer should implement a Grievance Mechanism to ensure that it is responsive to any concerns and complaints particularly from affected stakeholders and communities. The Developer will accept all comments and complaints associated with the Project and individuals who submit their comments or grievances have the right to request that their name be kept confidential.

Grievances can be an indication of growing stakeholder concerns (real and perceived) and can escalate if not identified and resolved. Identifying and responding to grievances supports the development of positive relationships between projects, communities and other stakeholders. Monitoring of grievances will signal any recurrent issues, or escalating conflicts and disputes. The following are proposed:

- The project developer should implement a Grievance Mechanism to ensure that it is responsive to any concerns and complaints particularly from affected stakeholders and communities. The Developer should investigate all comments and complaints associated with the Project and individuals who submit their comments or grievances have the right to request that their name be kept confidential.
- The project developer should receive, log and consider all comments and complaints associated with the Project. Any person or organization may send comments and/or complaints in person, by phone or via post or email.
- All comments and complaints should be responded to either verbally or in writing, in accordance with the preferred method of communication specified by the complainant, if contact details of the complainant are provided.
- All grievances should be registered and acknowledged within 5 working days and responded to within 20 working days of receiving the grievance. Individuals who submit their comments or grievances have the right to request that their name be kept confidential.
- The project developer should monitor the way in which grievances are being handled by the Contractor(s) and ensure they are properly addressed within deadlines specified above.
- The project developer should keep a grievance log, based on which grievance management reports will be produced.

- In cases when the complainant is not satisfied with the way the grievance has been responded to or handled and re-submits it, the project developer should invite representatives of the relevant local community to participate in the process so that a mutually agreed solution is identified and implemented. At all times, complainants are also able to seek legal remedies in accordance with the laws and regulations of the Kingdom of Saudi Arabia.

4.4 Monitoring

Monitoring of stakeholder engagement activities will ensure that consultation and disclosure efforts are effective and that stakeholders have been meaningfully consulted throughout the process. The Stakeholder Engagement Plan is a live and iterative document that will be updated periodically throughout the life of the Project. Stakeholder engagement activities will be monitored through:

- Updates to the stakeholder register and stakeholder action plan
- Records of all activities held
- Grievance logging and tracking.



وزارة الطاقة
MINISTRY OF ENERGY

كتاب الإحصائيات

٧٥ عجلة ٧٥ هدف

2021 | 7 | 8

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الإحداثيات الفعلية لحدود الأرض المخصصة لمشروع ٧٥ ميجاوات من برنامج NREP في منطقة الكهفة

حيث تقع الأرض المخصصة لمشروع ٧٥ ميجاوات من برنامج NREP في منطقة الكهفة على بعد ٣٦ كيلومتر جنوب-غرب مدينة الكهفة، وتبعد ٤٣ كيلومتر عن الطريق السريع الذي يربط مدينة الكهفة بمدينة سكاكا، وتبعد ٤٣ كيلومتر عن مدينة سكاكا، وتبعد ٤٣ كيلومتر عن مدينة الكهفة

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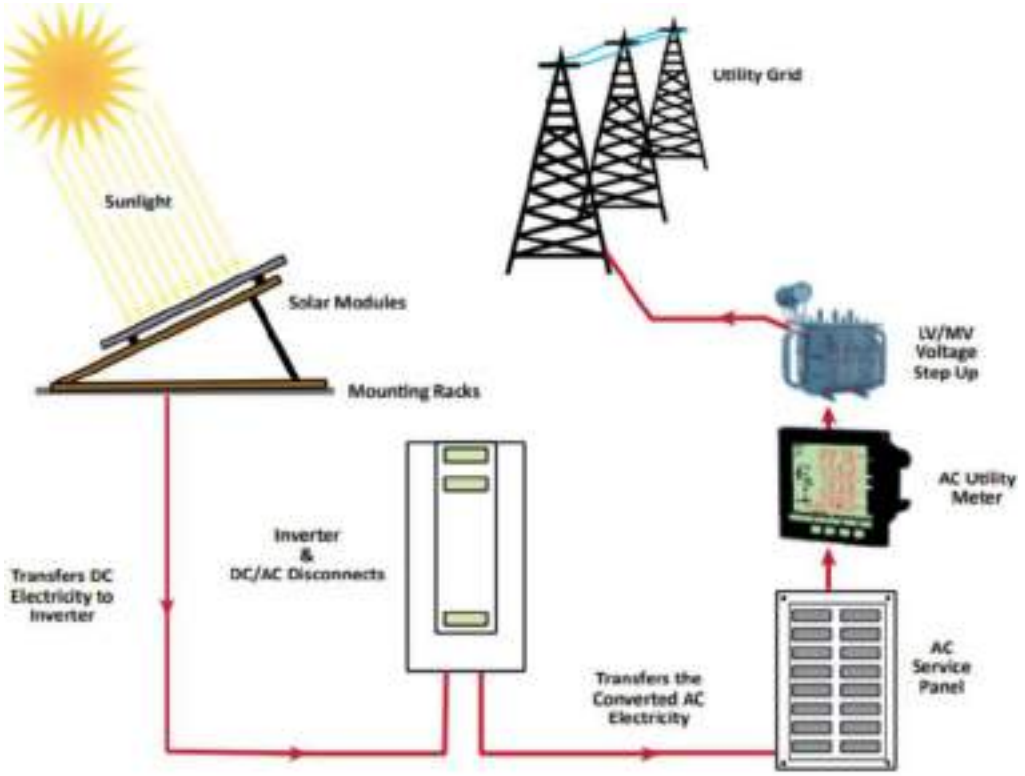
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ظ(لفضح يـ((٣ اخض ا اثـ(+) ا٦ نجـ٤لم) ESIA ح يـ((٤ا عاه ا اجفُضل اج ا٤ثاض٤ اتهل ا٤ثاض٤ ك٧-.٥ ٦ يـ ضل٤ ا٤عثه : ا.٤عض ٦لم.# ا اثـ(+٥ ا ا قؤ(م(٥ ا٦ اثض-٥ لاضدا تج يشدا ٥لا٦ اجفُضل اج قبل لا٤(٥ زط ثا يـ فاء ا٤٢/٤ ا د(٥ ا ا٤عجثم٥ اجـ يـ((٣ اخض هض٦ ق٥ ه) ح يـ((٣ اخض ا اثـ(+) ط٤ عل اج ٧ز لأخ يشنش ا٨ قاي ا٦ غلصد٤م ٧ ا ح ربل ا هدج)

غأ سلاشو يشه ا٤وار ا قدأ ESIA

ظهل اضه٩ قايح يـ((٣ اخض ا اثـ(+) ا٦ نجـ٤لم) م.# ا اد٩٧ ثا اثـ(+٥ ا٦ نجـ٤لم(٥ ا.٤عض ٦ ٦ خد٢ إض اح يـ((٣ ف ر) ا٦ ا٤عض ٦ ا ا(ط ا اجفُضل اج ف ر(٥ ٥ ر٤.٥مشاج ف.٥ لا٤ا ظ(ح يـ((٣ ٥ حدا ج اقبل اهد ا اجا ا(ج ٤علا لأ أقض لا اهدء ٧٥ اخيضح يـ((٣ اخض ا اثـ(+) ا٦ نجـ٤لم) اجفُضل ا ج ا ا٤ ر٤.٤مم.# ا اثـ(+٥ اصدق(٥ ا٦ اجفُضل اج ا اثض-٥ ا٦ نجـ٤لم(٥ ا٦ يـ غلس-٥

شهاز ولشم

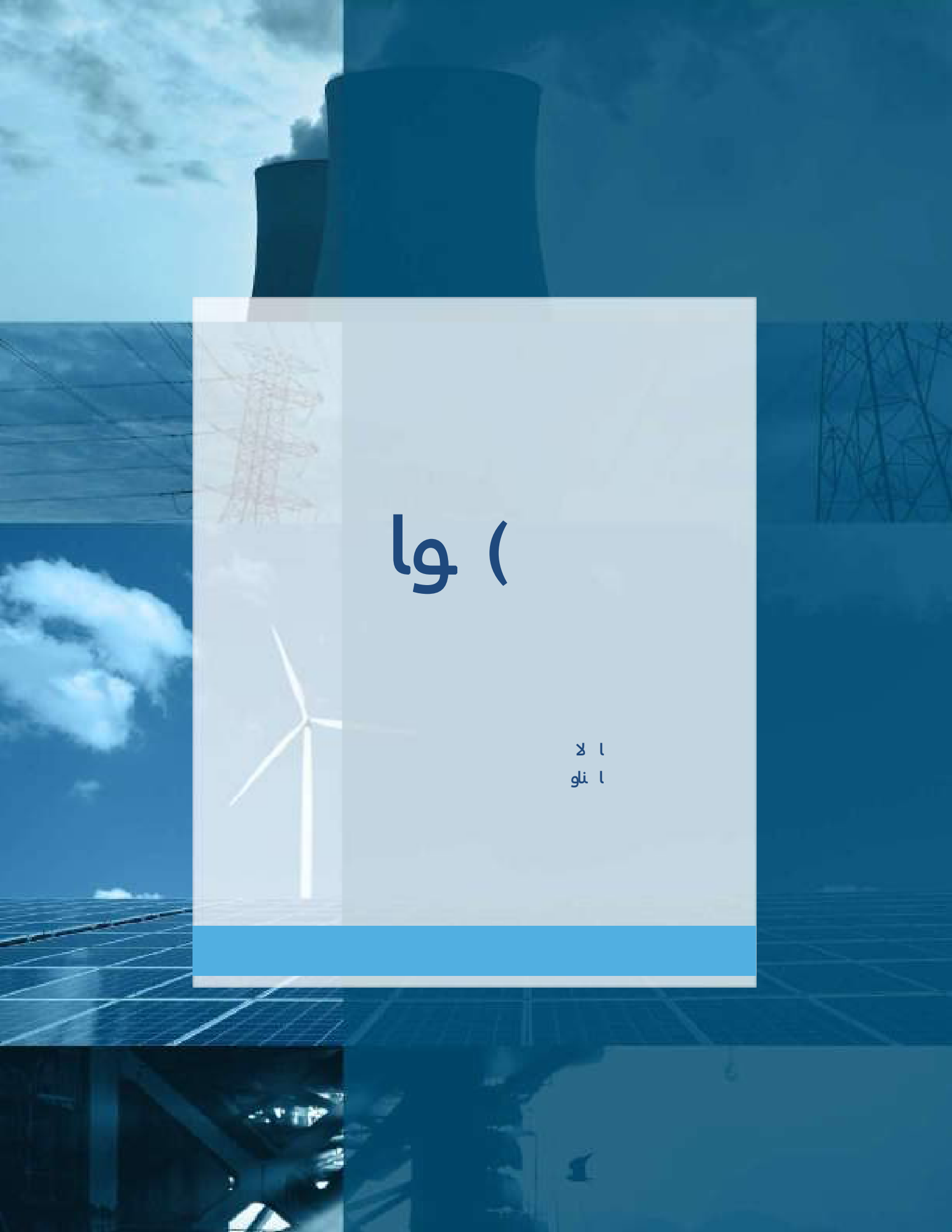
ظ(ح٣ يشنش ا٦ اجـ٧ ف(٥ ج جشفضل يص٥(نم٤.(٥ ا٦ه٥ ٧٥ ٥ ا زحـ اجلا.٥٥ اجفُضل اج ا ا ط.ث(٥ ج/ا٤عم.# ح يـ((٣ اجفُضل اج ا اثـ(+٥ ا٦ نجـ٤لم(٥ ا.٤عض ٦ ا ا٤ فيص ذس لأض ا ز لإ ا٤عض ٦ ا ا قرح.٥٥

م ا جوار ا نلو ار

ظ(ح٣ إشلس س قه ا سطع ا اثـ(+٥ ا.٤عض ٦ ظ جـ ع٤لإس قه ا سطع ا٣ه. أ- فاس قه ض ا يثه ٥ غ٤ ٥ ٤ اجـ ربلا٣ ٦ ق ع٤ ا٦ مجالأ اجشفضل ا جس٥(ز ا٤عض زه س لأض ا ز لإ ا٤عض ٦ ا ا قرح.٥٥

ع ا ن ا/
ك ة ش ن ا ، ئ ن ا/ ا ك ق
ا ٩ ن ل و ا ح ا ا ح ا ع ل ح ط ا ح ا ل

ا ع/ ا ز ا و	ا ج ا ل ح ا ن ج
ع ل ا ٩ ا ض ط ا ح ا ز ق خ	ا)ط ن م ش ا أ ق خ ج ق ، (ش ط ط ن ع ٧ خ ق ة ش /ة ا ك ع ة
ا ا و ا ن ع ا ا ط	ا ق ع ا ح ش ع ا ن ع ا ا ن ط ح /ة ا ك ع ة
ا خ ل ا ح خ ٩ ا و ا ح	ا) ك ل ع ة ق خ ج خ ل و ش /ة ا ك ع ة
ع ل ط ئ ا ة	خ ن ظ أ / ط أ ل ش خ ا ن ا ح أ ز ج ا ط ي ح ا ش /ة ا ك ع ة
ع ل ط ط	خ ن ظ أ / ط أ ل ش خ ا ن ا ح أ ز ج ا ط ي ح ا ش /ة ا ك ع ة
ع ل ا ج ا ا ق ع ل و	خ ن ظ / ط ج ا ا ق ع ل و ز ج ا ط ي ح ا ئ ا ك ع ة
ا ع ف ا ن ع ل خ و ا خ ا ا ج	ا ا ش خ ا ن ا ح ا ج ل خ ز ج ا ط ي ح ا ل خ ل ي ع س ا ج
ا ع ف ا ن خ ا ش ا ا ئ ن ع	ا ا ش ا ح ط ا ح ا ل ح /ة ا ك ع ق ن ظ ح
ع ل ا ق ل ش	ا ا و ا ا خ ا ذ ٩ ا ئ ش /ة ا ك ع ة ا ن ظ ح
ا ا و ا ٩	ا ك ل ع ة ا ٩ ا ق خ ج و ق ج ا ن ا ق ، (ا ش ط ط ش /ة ا ك ع ة
ع ل ا ك ا ج ط ا ه ا ق ا	ا ا ض ن م ا ش ا أ ق خ ج خ ق ة ا ش ا ء ا ق ، ل خ ز ل ع ش /ة ا ك ع ة
ع ل ا خ ل ا ح خ ٩ ا و ا ح	خ ن ظ ل ك ج ا ح ا خ ل ا ح ل ع ج ا ر ل خ ٩ ش ن ا ح ا ج د ط ن م ا خ ي ا ع م ح /ة ا ك ع ة
ا ا ق و ط ط ا ل و ا ن ٨ ل خ ٩	خ ن ظ ك ل ع ة ل ل و ئ ش م ن ٩ ا ك ع ة
ا ك ع ا ق و ط ض ن م ا ش ط ط	ا ا ض ن م ا ش ا أ ق خ ج ض ن م ا ق ، ا ش ط ط ش /ة ا ك ع ة
ل خ ع ا د	ا ا و ا ل خ ع ل خ ع ض ش /ة ا ك ع ة ا ن ظ ح
ا ا و ا	ا ع ل ئ ا ا ا ج ش ع ح ش م ن ٩ ا ك ع ق ب ن ظ ح



) وا

ا لا
ا نلو

Hudaithi, Abdulaziz R

From: Yousif, Noor A
Sent: Thursday, August 26, 2021 11:58 AM
To: Moamar, Mohamad A; Hudaithi, Abdulaziz R
Cc: Alkadi, Asem O
Subject: FW: RE: دعوة لاجتماع محطات الطاقة المتجددة

السلام عليكم ورحمة الله وبركاته
الرجاء الاطلاع على بريد مدن والذي يفيد بعدم وجود تعارض مع مشاريع الطاقة المتجددة.

Noor Alyousif
Project Manager
Renewable Energy, Ministry of Energy
Noor.Yousif@moenergy.gov.sa
Mobile: +966503805533
Tele: +966118270658

10th Floor, MU01, Digital City, Prince Turki Ibn
Abdulaziz Al Awwal Rd, Riyadh, SA

وزارة الطاقة
MINISTRY OF ENERGY

From: Adel S. Alsarhan / عادل السرحان<asarhan@modon.gov.sa>
Sent: Tuesday, August 10, 2021 3:19 PM
To: Yousif, Noor A <Noor.Yousif@moenergy.gov.sa>
Cc: Abdulrahman A. Al-Romaizan / عبدالرحمن الرميزان<adujayn@modon.gov.sa>; Ali S. Alkhashan / علي الخشان <akhashan@modon.gov.sa>; Faisal F. Al-Shalan / فيصل الشعلان<fshalan@modon.gov.sa>; Mansour A. Al-Turbak / منصور الطرباق<mturbak@modon.gov.sa>; Saeed A. Al-Shahrani (Contractor) <sshahrani@modon.gov.sa>
Subject: RE: RE: دعوة لاجتماع محطات الطاقة المتجددة

External email, report to SOC if suspicious

سعادة المشرف العام على الإدارة العامة للطاقة المتجددة المحترم،
الأستاذة نور اليوسف المحترمة،

أرجو ان تكونوا جميعاً بصحة وخير، نفيدكم بعدم وجود تقاطعات أو تعارض مع هيئة المدن الصناعية ومناطق التقنية "مدن"، وذلك للمواقع التي أشرتم إليها سلفاً خلال اجتماع العرض والمرفقات المرسلة من قِبلكم.

أطيب التحايا،،

-----Original Appointment-----
From: Yousif, Noor A <Noor.Yousif@moenergy.gov.sa>
Sent: Wednesday, August 4, 2021 3:53 PM
To: Adel S. Alsarhan / عادل السرحان; Mansour A. Al-Turbak / منصور الطرباق; Saeed A. Al-Shahrani (Contractor); alfarraja@mt.gov.sa; YahyaY@mt.gov.sa; ao.alanazi@moda.gov.sa; oalshaikh@moda.gov.sa; f.souyan@mawani.gov.sa; M.Aldosari@mawani.gov.sa; mkurbi@citc.gov.sa; fmudlaj@citc.gov.sa; Hhazzaa@citc.gov.sa; yazeed.alsaif@mot.gov.sa; abdulmged.alfhede@mot.gov.sa;

mohammed.alshammari@mot.gov.sa; Meshari.Altaleb@mot.gov.sa; fahad.al-enezi@mot.gov.sa; malmahmoud@sans.com.sa; Faalzahrani@gaca.gov.sa; asalahmadi@gaca.gov.sa; saqatlan@sans.com.sa; Satam Nada Hazmi; kalmutary@momra.gov.sa; aalothaimen@momra.gov.sa; yalghamdi@mewa.gov.sa; IAlbarrak@swcc.gov.sa; OOmira@swcc.gov.sa; al-al-nahdi@ncec.gov.sa; t.al-balawi@ncec.gov.sa; fbasalem@tga.gov.sa; ssalman@sar.com.sa; dr.almutairi@ncw.gov.sa; AalHayti@moc.gov.sa; NAlqanoor@moc.gov.sa; Ualessa@moc.gov.sa; Alkadi, Asem O; Hudaithi, Abdulaziz R; Moamar, Mohamad A; Shehri, Fahad A; Faisal A. Alyemni; al-al-nahdi@ncec.gov.sa; t.al-balawi@ncec.gov.sa; fbasalem@tga.gov.sa; ssalman@sar.com.sa; dr.almutairi@ncw.gov.sa; AalHayti@moc.gov.sa; NAlqanoor@moc.gov.sa; Ualessa@moc.gov.sa
Subject: FW: دعوة لاجتماع محطات الطاقة المتجددة
When: Wednesday, August 4, 2021 11:00 AM-12:30 PM (UTC+03:00) Kuwait, Riyadh.
Where: online

السلام عليكم ورحمة الله وبركاته
تحية طيبة،،،
نود شكركم على حضوركم للاجتماع وتعاونكم الدائم مع فريق وزارة الطاقة.

تجدون في المرفقات الملفات الخاصة بإحداثيات مشاريع طاقة الرياح والطاقة الشمسية التي تم مناقشتها خلال الاجتماع، كما أود أن انوه على أهمية ارسال خطاب عدم الممانعة خلال المدة المحددة وفي حال وجود أي تقاطعات الرجاء التواصل معنا للعمل عليها، و بما يخص توجيه الخطاب فلا مانع من ارسال الخطاب بالطريقة التي تجدونها مناسبة اما لسمو وزير الطاقة او لوكيل الوزارة لشؤون الكهرباء أو للمشرف العام على الإدارة العامة للطاقة المتجددة.

دمتم بحفظ الله ورعايته،

نور اليوسف

-----Original Appointment-----
From: Yousif, Noor A
Sent: Monday, August 2, 2021 4:04 PM
To: OOmira@swcc.gov.sa; asarhan@modon.gov.sa; mturbak@modon.gov.sa; sshahrani@modon.gov.sa; alfarraja@mt.gov.sa; YahyaY@mt.gov.sa; f.souyan@mawani.gov.sa; mkurbi@citc.gov.sa; Khowaiter, Malek T; Moamar, Mohamad A; malmahmoud@sans.com.sa; Alkadi, Asem O; Hhazzaa@citc.gov.sa; Meshari.Altaleb@mot.gov.sa; JONATHAN.OTOOLE@advisian.com; Shehri, Fahad A; Satam.Hazmi@mot.gov.sa; fbasalem@tga.gov.sa; ssalman@sar.com.sa; a-al-nahdi@ncec.gov.sa; t.al-balawi@ncec.gov.sa; Abdulrahman.Sorour@worley.com; Hudaithi, Abdulaziz R; Faisal A. Alyemni; Khanen, Ahmed K; oalshaikh@moda.gov.sa; Yousif, Noor A
Subject: دعوة لاجتماع محطات الطاقة المتجددة
When: Wednesday, August 4, 2021 11:00 AM-12:30 PM (UTC+03:00) Kuwait, Riyadh.
Where: online

السلام عليكم و رحمة الله و بركاته

تحية طيبة و بعد،،،

هذه دعوة للاجتماع مع أصحاب المصلحة من وزارات وهيئات وشركات لتقدم عرض شامل عن مشروعي الطاقة الشمسية المزمع تنفيذها في مدينة الكهفة ومحافظة طبرجل وكذلك عن مشروعي طاقة الرياح المزمع تنفيذها في محافظة الغاط ومدينة وعد الشمال والتقنيات التي ستستخدم فيها، وسيتم مناقشة نتائج دراسات تحديد الأثار البيئية الخاصة لها، وتحديد التسهيلات المُمكنة لمنح التصاريح والتراخيص اللازمة للمشاريع (مرفق نبذة عن المشاريع)

دمتم بحفظ الله ورعايته،،،

نور اليوسف

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مـدن
MODON

Adel S. Alsarhan / عادل السرحان
Business Development Manager
Tel: +966118745757
Fax: +966-11-874-9142
asarhan@modon.gov.sa

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رقم الصادر: ١/٤٣/٤٣٣
التاريخ الهجري: ١٤٤٣/٠١/١٦
التاريخ الميلادي: ٢٠٢١/٠٨/٢٤
المرفقات: بدون

٢١٧

وزارة الطاقة
Ministry of Energy
رقم الوارد ١٤٤٣/٠٠٤/١٢٩
تاريخ ١٤٤٣/٠١/١٧ هـ
الموافق ٢٠٢١/٠٨/٢٥ م
المرفقات ٠

الموضوع: بشأن/ دراسات وتحديد الاثار البيئية وتحديد التسهيلات الممكنة لمنح التصاريح والتراخيص اللازمة للمشاريع

سعادة وكيل الوزارة لشؤون الكهرباء **المحترم**

السلام عليكم ورحمة الله وبركاته

إشارة إلى خطاب صاحب السمو الملكي وزير الطاقة رقم (٠١-٧٩٤٨-١٤٤٢) وتاريخ ١٤٤٢/١٢/٠٦هـ، بإلاحاطة بأن وزارة الطاقة ستقدم عرض شامل عن مشروعي الطاقة الشمسية المزمع تنفيذها في مدينة الكهفة ومحافظة طبرجل وكذلك عن مشروعي طاقة الرياح المزمع تنفيذها في محافظة الغاط ومدينة وعد الشمال والتقنيات التي ستستخدم فيها. وطلب سموه توجيه المختصين للمشاركة في الأجتماع المنعقد بتاريخ ١٤٤٢/١٢/٢٥هـ الموافق ٢٠٢١/٠٨/٠٤م، وكذلك الرد بشأن أي تعارض مع المشاريع أعلاه خلال ستة أسابيع من تاريخ الإجتماع.

أفيدكم بقيام الهيئة العامة للنقل بالإطلاع على مواقع المشاريع آنفة الذكر والمرفقة بخطاب صاحب السمو الملكي وزير الطاقة المشار إليه أعلاه، وكذلك التنسيق مع شركة الخطوط الحديدية السعودية " سار" ، حيث تمت إفادتنا بعدم تقاطع المشروع مع ممتلكات الشركة.

وبناءآ عليه، فإن الهيئة العامة للنقل تفيدكم بعدم وجود أي تعارض مع مشاريع الخطوط الحديدية القائمة حالياً أو المشاريع المستقبلية التي تم حجز المسار لها.

كما نأمل إفادتنا بشأن إمكانية إستفادة شركة الخطوط الحديدية السعودية "سار" من المشروع بايصال الطاقة الكهربائية لبعض مواقع مباني الشركة والقريبة من المواقع لهذه المشاريع.

آمل التفضل بالاطلاع ، وفي حال وجود استفسار حيال الموضوع يمكن لمن ترون التنسيق في ذلك مع المهندس/ فهد باسليم على الهاتف المحمول رقم (٠٥٤٣٥٥١٨٨٦) أو البريد الإلكتروني (fbasalem@tga.gov.sa).

رقم الصادر: ١/٤٣/٤٣٣
التاريخ الهجري: ١٤٤٣/٠١/١٦
التاريخ الميلادي: ٢٠٢١/٠٨/٢٤
المرفقات: بدون

وتقبلوا أطيب تحياتي...

نائب الرئيس لقطاع النقل السككي

تم اعتماد الخطاب إلكترونياً

خالد بن ابراهيم السلطان

Hudaithi, Abdulaziz R

From: Yousif, Noor A
Sent: Thursday, August 26, 2021 11:52 AM
To: Hudaithi, Abdulaziz R; Moamar, Mohamad A
Cc: Alkadi, Asem O
Subject: FW: دعوة لاجتماع محطات الطاقة المتجددة

السلام عليكم ورحمة الله وبركاته
الرجاء الاطلاع على بريد وزارة السياحة والذي يفيد بعدم وجود تعارض مع مشاريع الطاقة المتجددة.

Noor Alyousif
Project Manager
Renewable Energy, Ministry of Energy
Noor.Yousif@moenergy.gov.sa
Mobile: +966503805533
Tele: +966118270658

10th Floor, MU01, Digital City, Prince Turki Ibn
Abdulaziz Al Awwal Rd, Riyadh, SA

وزارة الطاقة
MINISTRY OF ENERGY

From: Yousif, Noor A <Noor.Yousif@moenergy.gov.sa>
Sent: Monday, August 9, 2021 10:40 AM
To: Abdulaziz A. Al Farraj (SD) عبدالعزيز الفراج<alfarraja@mt.gov.sa>
Cc: Osama S. Khlawee (SD) أسامه الخلاوي<khlaweeo@mt.gov.sa>; Abdullah M. Alqahtani (SD) عبدالله القحطاني <am@mt.gov.sa>; Yahya H. Alyahya (SD) يحيى اليحيى<YahyaY@mt.gov.sa>; Alkadi, Asem O <Asem.Alkadi@moenergy.gov.sa>
Subject: RE: دعوة لاجتماع محطات الطاقة المتجددة

سعادة المهندس/ عبدالعزيز الفراج سلمه الله
السلام عليكم ورحمة الله و بركاته
أود أن أشكر لكم تعاونكم وحرصكم الدائم، كما أن ملاحظاتكم قد أخذت بعين الاعتبار وتم التواصل مع هيئة التراث لتأكد من عدم وجود التداخلات.

دمتم بحفظ الله ورعايته

نور اليوسف

Noor Alyousif
Project Manager
Renewable Energy, Ministry of Energy
Noor.Yousif@moenergy.gov.sa
Mobile: +966503805533
Tele: +966118270658

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دمتم بحفظ الله ورعايته،

نور اليوسف

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Appendix G. Environmental Management Plan Framework

MINISTRY OF ENERGY

Environmental Management Plan Framework and Monitoring Plan

Al-Kahfah Solar PV Park



Document No Rev 0: 413011-00907- EN-REP-000X
09.08.21

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PROJECT 413011-00907- - Environmental Management Plan Framework and Monitoring Plan - Al-Kahfah Solar PV Park

Rev	Description	Original	Review	Worley Approval	Revision Date	Approval Date
Rev 0	Issued for Client Use	YZ	IES	JO	09.08.21	

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1. Environment Management Plan Framework

1.1 Introduction

The environmental management plan (EMP) consists of the set of mitigation, monitoring, and institutional measures to be taken during project construction, operation and decommissioning to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures.

The purpose of this section is to provide a framework that gathers the recommended mitigation measures, to enable the preparation of a comprehensive environmental management plan that can be used during the construction and operation activities to ensure impacts to the environment are kept to an absolute minimum.

The EPC Contractor will provide with the bid a complete EMP and will update it after award. The project environmental management plan will be based on the ISO 14001 standard. The EMP will be a central document for identifying and controlling all environmental management system (EMS) related information and material based on the ISO 14001 standard, and will provide reference to all supporting documents. The following outline is based on the general requirements of an environmental management plan that would satisfy ISO 14001 requirements and would address:

1. Environmental policy
2. Planning

2.1 Environmental aspects

2.2 Legal and other requirements

2.3 Objectives and targets

2.4 Environmental management programs

3. Implementation and operation

3.1 Structure and responsibility

3.2 Training, awareness and competence

3.3 Communication

3.4 Environment management system documentation

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3.7 Emergency preparedness and response

4. Checking and corrective action

4.1 Monitoring and measurement

4.2 Non-conformance and corrective and preventative action

4.3 Records

4.4 Environmental management system audit

5. Management review

Once an approval for the proposed development has been granted, a detailed environmental management plan will be prepared, including all legal and regulatory requirements, specific performance targets, measurement systems and reporting requirements.

1.2 Key Principles

Environmental excellence is a primary management objective and the responsibility of every team member. The project team should commit to achieving environmental excellence in all of its business practices and operations through the key principles outlined below:

- Commitment - Management at all levels will be actively committed to the achievement of environmental excellence in the conduct of our business. Through communication with the project team members, the commitment to environmental excellence should be reflected in the day to day work.
- Organization - A project team wide organizational structure and culture will be established that recognizes and encourages the full and active participation of all employees in the systematic identification, assessment and management of environmental issues.
- Accountability - Responsibility for the protection of the environment is a matter of corporate policy and is a matter of law, with potentially severe consequences for failure to comply. Management at all levels is responsible for ensuring that operations are conducted in accordance with this policy and that appropriate environmental programs, procedures and systems of work have been developed and implemented for the project.
- Management Systems and Standards – The project team should develop, implement and continuously improve the project environmental management systems and develop environmental management standards using company documented standards where available, ensuring that they reflect best industry practices.
- Risk Management – The project team will ensure that potential environmental risks associated with all our designs and activities are assessed as early as is practicable in order to minimize and manage adverse effects and to identify opportunities for improvement.
- Legislative Compliance – The project team should operate to standards that will comply with the requirements of applicable local and appropriate national and international legislation and codes of practice and will strive beyond compliance and recognize these principles as a valued way of life.

- Training - Health, safety, and environmental managers and staff should be qualified by reason of education or experience to discharge their responsibilities and should participate in a program of continuing professional development. In addition, the project team is committed to provide training and development on environmental matters that is appropriate to each employee's job duties and responsibilities. The project team should be proactive in the management of third-party contractors to ensure they are fully aware of the environmental issues and to ensure that their actions are aligned with project environmental standards.
- Environmental Aspects – The project team should continuously evaluate the environmental aspects of the project activities through all of its phases. The goal will be to develop and provide products and services, as applicable that have minimal environmental impact and are safe in their intended use, efficient in their consumption of energy and natural resources and can be recycled, reused or disposed of safely.
- Continuous Improvement – The project team should be committed to continuous improvement of environmental management practices.
- Monitor, Audit and Review - Effective management requires on-going assessment and review, accordingly, an on-going assessment, self-evaluation and audit program will be implemented and maintained for the project activities.

1.3 EMP Objectives

This EMP seeks to manage and keep to a minimum the negative impacts of the project and at the same time, enhance the positive and beneficial impacts.

The objectives of the EMP are to:

- Identify the legislative and regulatory requirements governing environmental matters
- Summarise the project environmental management structure and processes to be implemented by the EPC Contractor
- Identify a range of mitigation measures which could reduce and mitigate the potential impacts
- Identify measures that could optimize beneficial impacts
- Establish a method of monitoring and auditing environmental management practices during all phases of development
- Ensure compliance with the safety recommendations
- Propose mechanisms for monitoring compliance with the EMP and reporting thereon
- Specify time periods within which the measures must be implemented, where appropriate
- Rectify impacts through rehabilitation, restoration, etc. of the affected environment
- Minimise impacts by optimising design features

The EMP is a legally binding document that all parties involved in the project must be made aware of.

1.4 Project Responsibilities

The most important members of the construction team from an environmental perspective are the Project Manager (PM), the EPC Contractor (EPCC), the EPC Contractor's Environmental Control Officer (ECO), and the Project Owner.

The PM is responsible for the implementation of the EMP on the site during the pre-construction and construction phases of the project.

The ECO is responsible for monitoring the implementation of the EMP during the design, pre-construction and construction phases of the project.

The EPCC is responsible for abiding by the mitigation measures of the EMP which are to be implemented by the PM during the construction phase.

The Project Owner is responsible for the implementation of the EMP during the operational and decommissioning phases of the project. Decommissioning will however entail the appointment of a new professional team and responsibilities will be similar to those during the design, pre-construction and construction phases.

An independent auditor will conduct an environmental audit quarterly during the construction phase of the project (quarterly audits are needed for the duration of the construction phase) according to the provisions of the EMP.

1.5 Environmental Management Plan

The EPC Contractor will develop an environmental management plan to, (a) identify the set of responses to potentially adverse impacts; (b) determine requirements for ensuring that those responses are made effectively and in a timely manner; and (c) describe the means for meeting those requirements.

More specifically, the EMP should address the following:

1.5.1 Description of the Proposed Activity(s)

This section will describe the technical detail pertaining to the project. Details on the location of the project and a description of the proposed works during all project phases will be provided.

1.5.2 Description of the Existing Environment

A summary of the existing environment of the Development footprint will be provided which generally covers the following areas:

- physical environment
- biological environment
- socio-economic environment
- particular values and sensitivities

1.5.3 Identification and Assessment of Environmental Effects and Risks

The environmental assessments will include:

- Air emissions
- Waste characterization and inventory
- Consumption of chemicals, and other raw materials
- Labour and social issues

The aspect, source, potential and predicted impact, management measures and residual risk will be detailed covering the following activities:

- Environmental Objectives, Standards and Criteria
- Environmental Management Techniques

1.5.4 Compliance with Laws/Regulations

Approvals / permits / consents / licenses relating to the environment will be in place prior to construction and operational phases and will be stored in a location which is easily accessible to the appropriate staff. The approvals / permits / licenses will include – but not limited to – the following:

- Planning permission
- Construction noise permit (as applicable)
- Environmental approvals (discharge to air, transport of waste, etc.)
- Contract with special and approved contractor for transport of hazardous material

Should any other approvals or permits be required for new activities, these will be obtained prior to the commencement of the activities. The project will comply with relevant legislation.

1.5.5 Setting Environmental Objectives and Targets

One of the most important components of the environmental management systems is the Environmental Performance Review.

This creates a number of specific environmental objectives that relate to the construction and operation of the project. As such, in terms of key environmental objectives, the Owner and its contractors in compliance to the KSA environmental laws. Owner's health and safety regulations will strictly apply the following measures:

- Design, construct and operate activities in a manner that protects human health and minimizes the impact of its operations on the environment
- Strive for an injury-free work force and minimize environmental impact through implementation of programmes in its project area that reduce risks to employees and the environment
- Encourage and promote waste minimization, the sustainable use of natural resources, recycling, energy efficiency, resource conservation and resource recovery

- Actively participate with the governmental agencies and other appropriate groups to ensure that the development and implementation of environmental policies, laws, regulations and practices serving the public interest based on sound scientific judgment
- Direct all employees to work in a safe manner, comply with the company's environmental policies and procedures and be environmentally responsible
- Comply with all applicable environmental laws and regulations of KSA. Where existing laws and regulations are deemed inadequate, the contractors and/ or the Owner will adopt its own Environmental Standards
- Each component will develop and maintain written safety policies and programmes to address known hazards in the project workplace
- Safe behaviour and judgment to be considered as essential measures of performance at all levels;
- Determine frequency of audits based on the complexity of the activities and the potential environmental risk
- When an audit is completed, report the findings to the site environmental management team and in case of any deficiencies found, develop corrective action plans
- Facilitate for the Saudi government and local environmental agencies to perform inspections of the project area to determine compliance with environmental regulations and permits
- The project team will recognize and respond to the community's questions about its operations
- Follow the waste disposal management plan to ensure that all kinds of wastes are properly managed and recycled
- In case of hazardous solid wastes\ specialized waste streams following the same type of waste management, wastes are sent to third-party leading to proper treatment before final disposal.
- Environmental performance at the site will be monitored regularly by the Owner and regulatory agencies (NCEC).

1.5.6 Roles and Responsibilities

Key roles and responsibilities of personnel with respect to meeting environmental management and performance objectives during the works will be identified.

1.5.7 Environmental Monitoring Program

- A monitoring program should be implemented for the duration of all phases of the project.
- Monthly audits will be conducted by the Environmental Control Officer for the duration of the construction phase. These audits can be conducted randomly and do not require prior arrangement with the Project Manager.
- An audit report will be prepared to address the rating of the compliance with the EMP. This report will be submitted to the Owner and to the relevant environmental authorities.

- The Contractor will be held liable for all unnecessary damage to the environment. A register will be kept of all complaints from the authorities and / or the local community. All complaints / claims will be handled immediately to ensure timely rectification by the responsible party.
- Environmental monitoring during project implementation provides information about key environmental aspects of the project, particularly the environmental impacts and the effectiveness of mitigation measures. Such information enables evaluating the success of mitigation as part of project supervision and allows corrective action to be taken when needed. Therefore, the EMP identifies monitoring objectives and specifies the type of monitoring. Specifically, the monitoring section of the EMP provides:
    - a specific description, and technical details, of monitoring measures, including the parameters to be measured, methods to be used, sampling locations, frequency of measurements, detection limits (where appropriate), and definition of thresholds that will signal the need for corrective actions
    - monitoring and reporting procedures to:
        - ensure early detection of conditions that necessitate particular mitigation measures
        - provide information on the progress and results of mitigation

A formal monitoring protocol will be included within the revised EMP once the detailed design is available and once recommendations and conditions from the decision-making authority have been received.

More details on the monitoring requirements are presented in Section 1.7.

1.5.8 Compliance with the EMP

A copy of the EMP must always be kept on site during the construction period. The EMP will be made binding on all contractors operating on the site and must be included as contractual clauses in any contractual agreement between the Owner and the EPC Contractor.

All persons employed by the Contractor or his sub-contractors will abide by the requirements of the EMP.

Contract conditions will include measures to be taken in the event of a construction workforce found to be in breach of any of the specifications contained within the EMP.

The Contractor will not direct a person to undertake any activity which would place them in contravention of the specifications contained within the EMP.

Should the Contractor be in breach of any of the specifications contained in the EMP, the Project Manager will, in writing, instruct the Contractor responsible for the incident of non-compliance regarding corrective and/or remedial action required, specify a timeframe for implementation of these actions and/or indicate that work could be suspended should non-compliance continue.

Should non-compliance continue, further written notification will be forwarded to the Contractor responsible for the incident of non-compliance outlining the required corrective and/or remedial action, the timeframe for implementation, penalties and/or work could be suspended as specified previously.

An appropriate reporting schedule for frequent reporting (of compliance with the EIA/EMP) to the Owner and the relevant Authorities will be developed.

Departmental officials will be given access to the property referred to in the EIA for the purpose of assessing and/or monitoring compliance with the conditions contained in the EMP at all reasonable times.

1.5.9 Non-Conformance and Corrective Action

The Contractor is deemed not to have complied with the EMP if:

- Within the boundaries of the site, site extensions and haul/ access roads there is evidence of contravention of clauses
- Environmental damage ensues due to negligence
- Failure to comply with corrective or other instructions within a specified time
- Failure to respond adequately to complaints from the public

The Owner is deemed not to have complied with the EMP if:

- Within the boundaries of the site there is evidence of contravention of clauses
- If environmental damage ensues due to negligence
- Failure to respond adequately to complaints from the public

1.5.10 Environmental Management Programs

Specific environmental management programs and procedures will be in place prior to the commencement of construction or operation activities. Procedures may include:

- Safety Management for operations
- Solid Waste Management Programme (disposal and reuse procedures)
- Emergency Response Procedures
- Oil/Hazardous substance spill/leak Response Plan
- Environmental and Security Management
- Effluents and Emissions Monitoring Procedures
- Air Emission Monitoring Procedures

The programmes are reviewed according to the frequency specified in the document control system, or on an as-required basis following an incident, or non-compliance.

1.5.11 Mitigation

To meet the requirements of government agencies and regulatory authorities, the management of environmental issues will be carried out in such a way that all stakeholders will be left with no doubt that hazards to the environment have been identified and appropriately managed.

The EMP should provide detailed prevention, minimisation and mitigation strategies or action programs (including design standards) for controlling environmental impacts at the site. The EMP will identify feasible and cost-effective measures that may reduce potentially significant adverse environmental impacts to acceptable levels. The plan will include cost-effective and sufficient compensatory measures whenever mitigation measures are not feasible.

1.5.12 Capacity Development and Training

Project personnel, environmental team personnel and managers are all required to undertake recurrent environmental and social awareness training. A record of induction and other related environmental trainings shall be completed by all personnel. Training records shall be deposited in secured individual personnel files stored onsite and a copy sent to the HSE Manager. The training matrix shall be reviewed on a quarterly basis to ensure it accurately reflects the best practice environmental management. Employees at all levels are to be made aware of:

- The importance of conformance with the environmental policy and procedures and with the requirements of environmental and social regulations and standards
- The significant environmental impact, actual or potential of the Project and the environmental benefits of improved personnel behaviour
- The effect of the Project on the environment and the adequate management practices to mitigate and reduce impacts
- Their roles and responsibilities concerning the Environmental Management Plan implementation

1.5.13 Emergency Events and Contingency Planning:

The implementation strategy will establish and provide for maintenance of an up-to-date emergency response manual with detailed response arrangements. It will be recommended that contingency plans must be approved before work can commence.

1.5.14 Implementation Schedule

For all three aspects (mitigation, monitoring, and capacity development), the EMP should provide (a) an implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans; and (b) the capital and recurrent cost estimates for implementing the EMP.

1.5.15 Integration of EMP with Project

The EMP should be specific in its description of the individual mitigation and monitoring measures and its assignment of institutional responsibilities, and it must be integrated into the project's overall planning, design, budget, and implementation. Such integration is achieved by establishing the EMP within the project so that the plan will receive funding and supervision along with the other components.

1.5.16 Documentation and Reporting

The following documentation must be kept on site in order to record compliance with the EMP:

- Record of Complaints
- Monitoring Results
- Notification of Emergencies and Incidents
- Environmental Register

1.5.16.1 Environmental Register

The Contractor will:

- Report incidents involving contractor employees and/or the public that could potentially cause negative sentiment and perception towards the project
- Report environmental complaints and correspondence
- Record and report incidents that cause harm or may cause harm to the environment
- Record all hazardous materials used on site
- Maintain a record of all waste disposal manifests detailing the nature of the waste disposed of, the waste classification and the location of the site to which such waste was sent

1.5.17 Public Communication and Liaison with Interested and Affected Parties

Clear and effective communications are maintained between contractors, consultants, regulators and Owner. The adjacent land/business owners should be kept informed and updated throughout the construction and operational phases. Sufficient signage should be erected around the site (including at the entrance), informing the public of the construction activities taking place.

1.5.18 Distribution of the EMP

The plan will be distributed to Owner, consultant, government agencies, relevant Project subcontractor companies, the PM, the HSE manager and or the Environmental Control Officer (ECO), and will be freely available to all Project Team members and Subcontractors.

1.6 Layout of the EMP

The EMP framework is separated into four phases. Each phase has specific issues unique to that period of the development and operation of the proposed project. The impact is identified and given a brief description. The four phases of the development are identified as below:

- Pre-Construction Phase
- Construction Phase and associated rehabilitation of affected environment
- Operational Phase (Post-Construction)
- Closure and Decommissioning

1.6.1 EMP for Pre-construction

Important requirements for the pre-construction phase are:

- Proper timely communication and continuous liaison to ensure all parties are always appropriately informed
- The Contractor must adhere to all conditions of contract including the Environmental Management Programme and landowner special conditions
- Adequate planning of the construction program to allow for disruptions due to rain and wet conditions
- Where existing roads are in a bad state of repair, such roads' condition will be documented before they are used for construction purposes
- All manmade as well as natural (vegetation) structures outside the boundary of the servitude will be protected against damage and any damage will be rectified immediately
- Proper documentation and record keeping of all complaints and actions taken
- Regular site inspections by the ECO and good control over the construction preparation process
- Appointment of an ECO on behalf of the Contractor to implement the EMP
- A formal communications protocol should be set up during this phase. The aim of the protocol should be to ensure that effective communication on key issues that may arise during construction be maintained between key parties. The protocol should also ensure that concerns / issues raised are formally recorded and considered and where necessary acted upon. The communications protocol should be maintained throughout the construction phase

Table 1-1 Pre-construction Phase

	PRE-CONSTRUCTION PHASE (This section deals with the preparation of the site and actions that need to be implemented before construction commences)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**PRE – CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• Appoint an Environmental Control Officer (ECO) • Before construction begins, all areas to be developed must be clearly demarcated with fencing • The Contractor must ensure compliance with conditions described in the PME • Records of compliance / non-compliance with the conditions of the authorization must be kept and be available on request • Records of all environmental incidents must be maintained, and a copy of these records be made available on request throughout the project execution • Confirm with Owner suitable sites for the storage areas for materials, if applicable • All construction equipment must be stored within the site and all associated oil changes etc. (no servicing) must take place within the site, if applicable • Skilled laborers should be drawn from the local market • Training of site staff • Environmental awareness training for construction staff, concerning the prevention of accidental spillage of hazardous chemicals and oil; pollution of water resources (e.g. groundwater), air pollution and litter control		

	PRE-CONSTRUCTION PHASE (This section deals with the preparation of the site and actions that need to be implemented before construction commences)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**PRE – CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Project Manager will ensure that the training and capabilities of the Contractor's site staff are adequate to carry out the designated tasks • Staff operating equipment (such as excavators, loaders, etc.) will be adequately trained and to any potential hazards associated with their tasks • No operator will be permitted to operate critical items of mechanical equipment without having been trained by the Contractor and certified competent by the Project Manager • Staff should be educated as to the need to refrain from indiscriminate waste disposal and/or pollution of local soil and water resources and receive the necessary safety training		

1.6.2 EMP for Construction

The boundaries of the construction site will be clearly identified on site during the construction process. The method of identification will be permanent fencing, temporary fencing or construction / safety barricades or high visibility tape. Where existing or new permanent fencing is used to identify construction boundaries high visibility warning tape will be interwoven in the fence. All works and storage of materials and equipment will be restricted to this area during the construction phase.

1.6.2.1 Site Clearing

Site clearing must take place in phased matter, as and when required. Areas which are not to be constructed on within two months of time must not be cleared to reduce erosion risks. The area to be cleared must be clearly demarcated and this footprint strictly maintained. Spoil that is removed from the site must be removed to an approved spoil site / licensed landfill site.

The necessary silt fences and erosion control measures must be implemented in areas where these risks are more prevalent (e.g. steep areas).

1.6.2.2 Site Establishment

Site establishment will take place in an orderly manner and all required amenities will be installed at site, if applicable before the main workforce move onto site. The site will have the necessary ablution facilities with chemical toilets at commencement of construction. The Contractor will inform all site staff to make use of supplied ablution facilities and under no circumstances will indiscriminate sanitary activities be allowed other than in supplied facilities.

The Contractor will supply waste collection bins where such is not available, and all solid waste collected will be disposed of at a registered landfill. A certificate of disposal will be obtained by the Contractor and kept on file. Where a registered waste site is not available close to the construction site, the Contractor will provide a method statement regarding waste management. The disposal of waste will be in accordance with all relevant legislation. Under no circumstances should solid waste be burnt on site.

Table 1-2 Construction traffic and access

	CONSTRUCTION TRAFFIC AND ACCESS (This section deals with the impact that construction traffic and access has on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Construction traffic*** • Construction routes must be clearly defined • Delivery of equipment must be undertaken with the minimum amount of trips • Access of all construction and material delivery vehicles should be strictly controlled, especially during wet weather to avoid compaction and damage to the topsoil structure • Planning of site delivery hours must be scheduled to avoid peak hour traffic, weekends and evenings • Wheel washing and damping down of un-surfaced roads must be implemented to reduce dust • Vehicles and equipment will be serviced regularly to avoid the contamination of soil from oil and hydraulic fluid leaks etc. • Servicing must be done off-site • Oil changes must take place on a concrete platform or on a drip tray • Soils compacted by construction will be deep ripped to loosen compacted layers and re-graded to even running levels		

	CONSTRUCTION TRAFFIC AND ACCESS (This section deals with the impact that construction traffic and access has on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Access • Temporary access roads that might be required must be rehabilitated prior to the contractor leaving the site • Strategic positioning of entry and exit points to ensure as little effect as possible on the traffic • The main routes to the site must be clearly signposted and printed delivery maps must be issued to all suppliers and Sub-Contractors • Planning of temporary access routes to the site for construction purposes, if needed will be done in conjunction between the Contractor, Owner and the Landowner. All agreements reached should be documented and no verbal agreements should be made. The Contractor will properly mark all access roads. Roads not to be used will be marked with a "NO ENTRY" sign • Where new access roads are constructed, this must be done according to design and contract specifications. Drainage channels will be suitably designed to ensure erosion does not occur, especially at the outflow points. The new access road will be designed to allow for the natural flow of water where required. Crossing of eroded areas on access routes to new sites will be thoroughly planned and installed according to design and contract specifications. All areas susceptible to erosion will be protected with suitable erosion control measures from the onset of the project. Prevention is the ultimate aim, as restoration is normally very difficult and costly.		

	CONSTRUCTION TRAFFIC AND ACCESS (This section deals with the impact that construction traffic and access has on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Road maintenance • Where necessary suitable measures will be taken to rehabilitate damaged areas. In the event of rehabilitation work being required on private roads, such work will be done to the original specifications of the private road • Contractors should ensure that access roads are maintained in good condition by attending to potholes, corrugations and stormwater damage as soon as these develop • The Contractor will meet the safety requirements under all circumstances. All equipment transported will be clearly labelled as to their potential hazards according to specifications. All the required safety labelling on the containers and trucks used will be in place ***General*** • The Contractor will ensure that all the necessary precautions against damage to the environment and injury to persons are taken in the event of an accident • Due precautions, including the monitoring of traffic speeds by all suppliers and sub-contractors where required, should be undertaken to prevent accidents leading to injury to persons on access roads and to minimise the likelihood of injury to wildlife		

Table 1-3 Storage Areas

	STORAGE AREAS (This section deals with the impacts relating to the storage areas i.e. storage of materials)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Storage of materials (including hazardous materials)*** • Choice of location for storage areas must take into account prevailing winds, distances to water bodies, general onsite topography and water erosion potential of the soil. Impervious surfaces must be provided where necessary • Storage areas must be designated, demarcated and fenced • Storage areas should be secure to minimize the risk of crime. They should also be safe from access by animals etc. • The storage areas must be kept clear of litter at all times • No open fires are allowed within the storage areas and no wood from surrounding vegetation may be used to create a fire • Fire prevention facilities must be present at all storage facilities • Proper storage facilities for the storage of oils, paints, grease, fuels, chemicals and any hazardous materials to be used must be provided to prevent the migration of spillage into the ground and groundwater regime around the temporary storage area(s). These pollution prevention measures for storage should include a bund wall high enough to contain at least 110% of any stored volume and an impermeable surface, and this should be sited away from drainage lines in a site with the approval of the Owner • Spillages within the storage areas need to be cleaned up correct disposal		

	STORAGE AREAS (This section deals with the impacts relating to the storage areas i.e. storage of materials)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Any water that collects in the bund must not be allowed to stand and must be removed immediately and the hydrocarbon digestion agent within must be replenished • All legal compliance requirements with respect to Fuel storage and dispensing must be met • All fuel storage tanks (temporary or permanent) and associated facilities must be designed and installed in accordance with the relevant oil industry standards, codes and other relevant requirements • Areas for storage of fuels and other flammable materials must comply with standard fire safety regulations and may require the approval of the Municipal Fire Prevention Officer • Flammable fuel and gas must be well separated from all welding workshops, assembly plants and loading bays where ignition of gas by an accidental spark may cause an explosion or fire • The tank must be erected at a safe distance from buildings, boundaries, welding sites and workshops and any other combustible or flammable materials • Symbolic safety signs depicting “No Smoking”, “No Naked Flames” and “Danger” are to be prominently displayed in and around the fuel storage area • The capacity of the tank must be clearly displayed, and the product contained within the tank clearly identified • There must be adequate fire-fighting equipment at the fuel storage and dispensing area or areas • The storage tank must be removed on completion of the construction phase of the project		

	STORAGE AREAS (This section deals with the impacts relating to the storage areas i.e. storage of materials)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• All such tanks to be designed and constructed in accordance with a recognised code (international standard) • The rated capacity of tanks must provide sufficient capacity to permit expansion of the product contained therein by the rise in temperature during storage • Only empty and externally clean tanks may be stored on bare ground. All empty and externally contaminated tanks must be sealed and stored in an area where the ground has been protected • Any electrical or petrol-driven pump must be equipped and positioned so as not to cause any danger of ignition • If fuel is dispensed from 200 litre drums, the proper dispensing equipment must be used • The drum must not be tipped in order to dispense fuel. The dispensing mechanism of the fuel storage tank must be stored in a waterproof container when not in use • All waste fuel and chemical impregnated rags must be stored in leak-proof containers and disposed of at an approved hazardous waste site • The amounts of fuel and chemicals stored on site will be minimised • Clear signage must be placed at all storage areas containing hazardous substances / materials • Material Safety Data Sheets (MSDSs) will be readily available on site for all chemicals and hazardous substances to be used on site. Where possible the available MSDSs should additionally include information on ecological impacts and measures to minimise negative environmental impacts during accidental releases or escapes		

	STORAGE AREAS (This section deals with the impacts relating to the storage areas i.e. storage of materials)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Staff dealing with hazardous materials / substances must be aware of their potential impacts and follow the appropriate safety measures • A suitable Waste Disposal Contractor must be employed to remove waste oil. These wastes should only be disposed of at licensed landfill sites designed to handle hazardous wastes • The contractor must ensure that its staff is made aware of the health risks associated with any hazardous substances used and has been provided with the appropriate protective clothing/equipment in case of spillages or accidents and have received the necessary training • All excess cement and concrete mixes are to be contained on the construction site prior to disposal off site • Any spillage, which may occur, will be investigated and immediate action must be taken. This occurrence must also be reported to the Owner, as well as local authorities if so required ***End of construction*** • Once construction has been completed on site and all excess material has been removed, the storage area will be rehabilitated. If the area was badly damaged, re-seeding will be done and fencing in of the area will be considered if livestock/faunal species specific to the area may subsequently have access to such an area • Such areas will be rehabilitated to their natural state. Any spilled concrete will be removed, and soil compacted during construction will be ripped, levelled and re-vegetated		

Table 1-4 Repair, Maintenance and Cleaning

	REPAIR, MAINTENANCE AND CLEANING (This section deals with the repair, maintenance and cleaning that may be required during construction)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• No vehicle maintenance and repairs will be undertaken within a 30m radius of any drainage lines. Any facilities susceptible to oil, petrol and diesel spillage will be located at a minimum of 30m and preferably 50m from the drainage line • Repair yards, batching plants and stationary machines will be provided with sumps, and spilled fluids and runoff will be kept in a conservancy tank until removed from the site in terms of the relevant legislative requirements • Adequate collection facilities such as diversion mounds, ditches, drains, oil separation sumps and sedimentation ponds will be constructed at each location with a pollution potential • All emergency repair work away from bunded areas will make use of drip trays • Regular inspections will be carried out to detect leaks and spillages. These facilities will be maintained as regularly as is necessary to ensure they meet the original specification		

Table 1-5 Environmental Education and Training

	ENVIRONMENTAL EDUCATION AND TRAINING (This section deals with the environmental training of construction employees)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Environmental training*** • Ensure that all site personnel have a basic level of environmental awareness training. The Contractor must submit a proposal for this training to the Owner for approval. • It is the Contractor's responsibility to provide the site foreman with environmental training and to ensure that the foreman has sufficient understanding to pass this information onto the construction staff • Training should be provided to the staff members in the use of the appropriate fire-fighting equipment. Translators are to be used where necessary • Use should be made of environmental awareness posters on site • The need for a "clean site" policy also needs to be explained to the workers • Staff operating equipment (such as excavators, loaders, etc.) will be adequately trained to deal with any potential hazards associated with their tasks ***Monitoring of environmental training*** • The Contractor must monitor the performance of construction workers to ensure that the aspects have been properly understood and are being followed. If necessary, the ECO and / or a translator should further explain aspects of environmental or social behaviour that are unclear. Toolbox talks are recommended		

Table 1-6 Borrow Pits

	BORROW PITS (This section deals with the impact that construction traffic and access has on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			

MITIGATION	***Location of borrow pits***
	• Borrow pit localities must be negotiated with the relevant municipality to ensure consensus of their location
	• The Contractor is required to comply with the requirements of the relevant regulation
	Management of borrow pits
	• The Contractor must also compile an information document which states the methods which will be utilised when creating borrow pits. This document must include, but not be limited to the following:
	  • Plans which detail the expected quantity of excavation that will be required
	  • Temporary and permanent stormwater control
	  • The final contouring of the borrow pit and the proposed method of rehabilitation
	  • The current status and land use of the borrow pit
	  • Topsoil management strategy (preservation of topsoil for reinstatement)
	  • Proposed management of dangerous conditions (e.g. Steep slopes, loose and unstable material, holes)		

Table 1-7 Soils

	SOILS (This section deals with the impact that the proposed development will have on soils)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION / METHOD STATEMENT	***Topsoil*** • The Contractor should, prior to the commencement of earthworks determine the average depth of topsoil, and agree on this with the Owner. The full depth of topsoil should be stripped from areas affected by construction and related activities prior to the commencement of major earthworks. This should include the building footprints, working areas and storage areas. Topsoil must be reused where possible to rehabilitate disturbed areas • Care must be taken not to mix topsoil and subsoil during stripping • Should any topsoil become polluted the Contractor must remove the polluted soil to the full depth of pollution and replace it at his own expense with approved topsoil which should be at least equal to approved topsoil specifications • Removed topsoil should be transported to a licensed landfill site or used onsite for landscaping as required ***Soil Stripping*** • No soil stripping must take place on areas within the site that the contractor does not require for construction works or areas of retained vegetation • Subsoil and overburden should, in all construction and lay down areas, be stockpiled separately to be returned for backfilling in the correct soil horizon order • Construction vehicles must only be allowed to utilise existing tracks or pre-planned access routes		

	SOILS (This section deals with the impact that the proposed development will have on soils)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Stockpiles • Stockpiles should not be situated such that they obstruct natural water pathways • Stockpiles should not exceed 2m in height unless otherwise permitted by the Owner • If stockpiles are exposed to windy conditions or heavy rain, they should be covered either by vegetation or cloth, depending on the duration of the project. Stockpiles may further be protected by the construction of berms or low brick walls around their bases • Stockpiles should be kept clear of weeds and alien vegetation growth by regular weeding • Where contamination of soil is expected, analysis must be done prior to disposal of excess soil to determine the appropriate disposal route. Proof from an applicable waste disposal site where contaminated soils are dumped if and when a spillage/leakage occurs should be forwarded to the Owner. ***Fuel storage*** • Topsoil and subsoil to be protected from contamination • Fuel and material storage must be away from stockpiles • Cement, concrete and chemicals must be mixed on an impermeable surface and provisions should be made to contain spillages or overflows into the soil • Any storage tanks containing hazardous materials must be placed in bunded containment areas with sealed surfaces. The bund walls must be high enough to contain 110% of the total volume of the stored hazardous material • Contaminated soil must be contained and disposed of off-site at an approved landfill site		

	SOILS (This section deals with the impact that the proposed development will have on soils)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Cement mixing • Concrete mixing must be contained within a bunded area • Cement mixing must only take place within designated areas • Ready mixed concrete must be utilised where and when possible • No vehicles transporting concrete to the site may be washed on site • If a batching plant is necessary, run-off should be managed effectively to avoid contamination of other areas of the site. Run- off from the batch plant must not be allowed to get into the storm water system or any streams, wetlands or existing erosion channels / dongas ***Earthworks*** • All earthworks and borrow pits must be adequately controlled and managed • Soils compacted during construction should be deeply ripped to loose compacted layers and re-graded to even running levels. Topsoil should be re-spread over landscaped areas. According to specifications by the Owner's Landscape Architect / Ecologist the area should be re-vegetated upon completion of construction activities • It is very important that the foundation excavations for the proposed structures be inspected by an engineering geologist or geotechnical engineer prior to the placing of steel reinforcement or concrete in order to determine that the structure is being founded upon the correct material, and also to detect whether any active layers have been exposed by the foundation excavation • Contaminated soil must be contained and disposed of off-site at an approved landfill site		

	SOILS (This section deals with the impact that the proposed development will have on soils)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Herbicides / pesticides • Fertilisers should not be used excessively, and slow release fertilizers and organic products should be used in preference to highly soluble and inorganic fertilizers • The use of herbicides and pesticides and other horticultural chemicals should be carefully controlled wherever these are used. Where feasible, 'environmentally friendly' products should be utilised		

Table 1-8 Erosion control

	EROSION CONTROL (This section deals with the impact that the proposed development will have with regards to potential erosion)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Bi-Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• Wind screening and stormwater control should be undertaken to prevent soil loss from the site • The use of silt fences and sand bags must be implemented in areas that are susceptible to erosion • Sensitive areas, if any need to be identified prior to construction so that the necessary precautions can be implemented • All erosion control mechanisms need to be regularly maintained • Retention of vegetation where possible to avoid soil erosion • Vegetation clearance should be phased to ensure that the minimum area of soil is exposed to potential erosion at any one time • Where possible re-vegetation of disturbed surfaces should occur immediately after construction activities are completed • Stockpiles not used in three (3) months after stripping must be seeded to prevent dust and erosion		

Table 1-9 Groundwater pollution

	GROUNDWATER POLLUTION (This section deals with the impact that the construction and operation of the development could have on groundwater pollution)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION / METHOD STATEMENT	***Sanitation*** • Sanitary facilities must be regularly emptied and serviced to reduce the risk of groundwater pollution ***Hazardous materials*** • Controlled use and or storage of materials, fuels and chemicals which could potentially leak into the ground • All storage tanks containing hazardous materials must be placed in bunded containment areas with sealed surfaces. The bund walls must be high enough to contain 110% of the total volume of the stored hazardous material • Contaminated wastewater must be managed by the Site Manager to ensure existing water resources on the site are not contaminated. All wastewater from general activities in the site will be collected and removed from the site for appropriate disposal at a licensed commercial facility ***Cement mixing*** • Cement contaminated water must not enter the ground as this disturbs the natural acidity of the soil and affects plant growth		

	GROUNDWATER POLLUTION (This section deals with the impact that the construction and operation of the development could have on groundwater pollution)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Public areas • Food preparation areas, if any should be provided with adequate washing facilities and food refuse should be stored in sealed refuse bins which should be removed from site on a regular basis • The Contractor should take steps to ensure that littering by construction workers does not occur and persons should be employed on site to collect litter from the site and immediate surroundings, including litter accumulating at fence lines • No washing or servicing of vehicles on site, except in assigned areas, prepared with adequate collection facilities such as diversion mounds, ditches, drains, oil separation sumps and sedimentation ponds or using drip trays (for emergency vehicle servicing) ***Water resources*** • Water sources/taps available for drinking water etc. must be pointed out by the ECO. It is not advisable that a contractor makes use of or collects water from any other source other than those pointed out to them as being suitable for use • Treated raw water should be used for all activities such as washing of equipment or disposal of any type of waste, dust suppression, concrete mixing, compacting, etc • The Owner as well as other emergency contact numbers provided by the Municipality should be contacted in order to deal with spillages and contamination of environments • Ensure that surface/storm water is diverted away from excavations • Ensure that contaminants are safely stored and away from construction site		

	GROUNDWATER POLLUTION (This section deals with the impact that the construction and operation of the development could have on groundwater pollution)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Water Flows Across Construction Sites • The quantity of uncontaminated stormwater entering cleared areas will be minimised by appropriate site design and by installation of control structures and drains which direct such flows away from cleared areas and slopes to stable (vegetated) areas or effective treatment installations • Site drainage lines will be identified and control measures installed to handle predicted stormwater		

Table 1-10 Air Quality

	AIR POLLUTION (This section deals with the impact from air pollution)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• All activities on-site must comply with the requirements of the NCEC's Air Quality Standard		
	Dust control • Retention of vegetation where possible will reduce dust travel • Excavations and other clearing activities must only be done during agreed working times and permitting weather conditions to avoid drifting of sand and dust into neighbouring areas • Damping down of all exposed soil surfaces with a water bowser or sprinklers when necessary to reduce dust • The Contractor will be responsible for dust control on site to ensure no nuisance is caused to the land owners in the surrounding areas, if any • A speed limit of 30km/h must not be exceeded • Any complaints or claims emanating from the lack of dust control will be attended to immediately by the Contractor • Spoil dumps will be positioned such that they are not vulnerable to wind erosion ***Odour control*** • Regular servicing vehicles in order to limit gaseous emissions (To be done off-site).		

	AIR POLLUTION (This section deals with the impact from air pollution)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Regular servicing of on-site toilets to avoid potential odours • Allocated cooking areas must be provided • The Contractor must make alternative arrangements (other than fires) for cooking. Liquid Petroleum Gas cookers may be used provided that all safety regulations are followed • Waste must be disposed, as soon as possible at a municipal transfer station, skip or at a permitted landfill site. Waste must not be allowed to stand on site to decay, resulting in malodours and attracting vermin ***Rehabilitation*** • The Contractor should commence rehabilitation of exposed soil surfaces as soon as practical after completion of earthworks ***Fire prevention*** • Burning of materials including wood, grass and refuse which emit visible smoke will not be permitted on construction sites • The Contractor must ensure that any grass left in a natural state during construction should be cut in order to prevent veld fires, especially during the dry months • No open fires will be allowed on site under any circumstance. All cooking will be done in demarcated areas that are safe and cannot cause runaway fires • The Contractor will have operational fire-fighting equipment available on site		

Table 1-11 Noise

	NOISE (This section deals with the impact of increased noise)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• Construction site yards and any noisy fixed facilities should be located well away from noise sensitive areas adjacent to the development site. Once the final layout, and power line alignments are made available by the Contractor, the sites must be evaluated in detail and specific measures designed into the system • Noise suppression measures must be applied to all construction equipment (where applicable). Construction equipment must be kept in good working order and where appropriate fitted with silencers which are kept in good working order. Should the vehicles or equipment not be in good working order, the contractor may be instructed to remove the offending vehicle or machinery from the site • Where possible, stationary noisy equipment (for example compressors, pumps, pneumatic breakers,) should be encapsulated in acoustic covers, screens or sheds. Proper sound insulation can reduce noise by up to 20 dBA. Portable acoustic shields should be used in the case where noisy equipment is not stationary (for example drills, angle grinders, chipping hammers, poker vibrators) • Machines in intermittent use should be shut down in the intervening periods between works or throttled down to a minimum • In general, operations should meet the noise standard requirements of the Health and Safety requirements • Construction staff working in areas where the 8-hrs ambient noise levels exceed 75 dBA should wear ear protection equipment. • Noise levels must be kept within acceptable limits. All noise and sounds generated must adhere to limits for maximum allowable noise levels for construction • Noisy operations should be combined so that they occur where possible at the same time		

	NOISE (This section deals with the impact of increased noise)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Noise from labourers must be controlled • The contractor must take measures to discourage labourers from loitering in the area and causing noise disturbance. Where possible labour will be transported to and from the site by the contractor or his Sub-Contractors' own transport		

Table 1-12 Fauna

	FAUNA (This section deals with the impact that the development will have on fauna in the area)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION / METHOD STATEMENT	• No disturbing, injuring or killing of any fauna (including snakes) for any purposes • No feeding of wildlife • Hunting of local fauna is to be prohibited • No domestic animals are to be brought onto the site • The construction site, if applicable will be kept clean and tidy and free from rubbish which would attract animal pest species • The contractor must ensure that no faunal species are disturbed, trapped, hunted or killed during the construction phase and allowed free movement away from the area. • Safety precaution measure must be implemented especially during the vegetation clearance phase • Construction activities must be planned carefully so as not to interfere with the calving and lambing season for most animal species, as far as practical • Wild animals and arachnids and scorpions may exist around the site and thus safety measures must be implemented to ensure the safety of the contractors and sub-contractors		

	FAUNA (This section deals with the impact that the development will have on fauna in the area)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Care should be taken when removing stumps, logs or rock material. Any scorpions encountered on the site should be left alone and allowed free access away from the activity or safely removed from the area by a suitable animal handler. No scorpions should be intentionally killed • All necessary mitigation measures must be implemented to minimise impacts • The Contractor will, as soon as reasonably possible, but within 24 hours of becoming aware of a complaint relating to wildlife interaction, respond to the complaint and register the complaint in the Environmental Register. In addition, the complaint must be reported to the Owner as soon as possible such that the incident can be investigated by the Owner or Contractor		
SITE SPECIFIC MITIGATION			
	• Ensure proper substrate anchorage, provide 'dummy pole' for power lines in order to prevent damage/ injury of mammals as a result of direct contact with pole structures (this requirement specifically refers to snakes and scorpions).		

Table 1-13 Waste Management

	WASTE MANAGEMENT (This section deals with the impact from waste produced by the development)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Construction rubble*** • All rubble from demolition activities must either be used on site as part of the existing development, or must be taken off and disposed of at an approved site • Rubble must not be dumped on site but must be placed within a skip bin for regular removal • Construction rubble will be disposed of in pre–agreed, demarcated spoil dumps that have been approved by the relevant Municipality ***Litter management*** • Refuse bins must be placed at strategic positions to ensure that litter does not accumulate within the construction site • A housekeeping team should be appointed to regularly maintain the litter and rubble situation on the construction site • Waste disposal will need to take place following the requirements of NCEC • If possible and feasible, all waste generated on site must be separated into glass, plastic, paper, metal and wood and recycled. An independent contractor can be appointed to conduct this recycling		

	WASTE MANAGEMENT (This section deals with the impact from waste produced by the development)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Littering by the employees of the Contractor will not be allowed under any circumstances. The ECO will monitor the neatness of the work sites, if applicable • Waste containers should be maintained on site. These should be kept covered and collected regularly form the site by the local council or a private waste contractor • All waste must be removed from the site and transported to a landfill site as approved by the relevant Municipality • Waybills providing disposal at each site will be provided to the Owner's inspection ***Hazardous waste*** • All waste hazardous materials must be carefully stored as advised by the Owner, and then disposed of off-site at a licensed landfill site • Contaminants to be stored safely to avoid spillage • Machinery must be properly maintained to keep oil leaks in check ***Sanitation*** • The Contractor will install mobile chemical toilets on the site • Adequate sanitary facilities and ablutions must be provided for construction workers (1 toilet per every 15 workers) • The exact location of the toilets must be approved by the SHE Officer/ECO prior to establishment		

	WASTE MANAGEMENT (This section deals with the impact from waste produced by the development)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	• All temporary/portable toilets must be secured to the ground to prevent them from toppling due to wind or any other cause • The Contractor will ensure that the entrances to toilets are adequately screened from public view • The Contractor will ensure that no spillage occurs when the toilets are cleaned or emptied • Suitable toilets will be provided for the staff at all points at which workmen are carrying out duties under the contract • All ablution activities must take place in these facilities, and the waste material must be stored and disposed of at the registered waste disposal site or collected by a suitable waste contractor on a regular basis • Ablution facilities will be within 100m from workplaces but not closer than 150m from any watercourses or boreholes. There should be enough toilets available to accommodate the workforce • Toilets should be no closer than 150m or above the 1:100 year flood line from any watercourse or alternatively located in a place approved of by the Owner • Toilets will be serviced regularly and the ECO will inspect toilets regularly • Water for sanitation purposes must be provided for all workers • Staff will be sensitised to the fact that they should always use these facilities. No indiscriminate sanitary activities on site will be allowed • The construction of “Long Drop” toilets is not allowed		

	WASTE MANAGEMENT (This section deals with the impact from waste produced by the development)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Remedial actions • Depending on the nature and extent of the spill, contaminated soil must be either excavated or treated on-site • Excavation of contaminated soil must involve careful removal of soil using appropriate tools/machinery to storage containers until treated or disposed of at a licensed hazardous landfill site • The ECO must determine the precise method of treatment of polluted soil. This could involve the application of soil absorbent materials as well as oil-digestive powders to the contaminated soil • If a spill occurs on an impermeable surface such as cement or concrete, the surface spill must be contained using oil absorbent pads • If necessary, oil absorbent sheets or pads must be attached to leaky machinery or infrastructure. • Materials used for the remediation of petrochemical spills must be used according to product specifications and guidance for use • Contaminated remediation materials must be carefully removed from the area of the spill to prevent further release of petrochemicals to the environment, and stored in adequate containers until appropriate disposal		

1.6.3 EMP for Operation

Table 1-14 Construction site restore

	CONSTRUCTION SITE DECOMMISSIONING	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**EPC Contractor/ Owner**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Removal of equipment*** • All structures comprising the storage areas, if applicable are to be removed from site • The area that previously housed the storage areas, if applicable is to be checked for spills of substances such as oil, paint, etc., and these should be cleaned up • All hardened surfaces within the storage areas area should be ripped, all imported materials removed, and the area will be top soiled and regressed ***Temporary services*** • The Contractor must arrange the cancellation of all temporary services • Copies of all certificates from waste disposed are to be presented to the Owner • Temporary roads must be closed and access across these blocked • All areas where temporary services were installed are to be rehabilitated to the satisfaction of the Owner		

	CONSTRUCTION SITE DECOMMISSIONING	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**EPC Contractor/ Owner**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Associated infrastructure • Surfaces are to be checked for waste products from activities such as concreting or asphalting and cleared in a manner approved by the Owner • All surfaces hardened due to construction activities are to be ripped and imported material thereon removed • All rubble is to be removed from the site to an approved disposal site as approved by the Owner. Burying of rubble on site is prohibited • The site is to be cleared of all litter • The Contractor is to check that all watercourses are free from building rubble, spoil materials and waste materials • Fences, barriers and demarcations associated with the construction phase are to be removed from the site unless stipulated otherwise by the Owner • All residual stockpiles must be removed to spoil or spread on site as directed by the Owner • All leftover building materials must be returned to the depot or removed from the site • The Contractor must repair any damage that the construction works have caused to neighbouring properties, specifically, but not limited to, damage caused by poor storm water management ***Borrow pits*** • Borrow pits are to be closed and rehabilitated.		

Table 1-15 Water & Wastewater Management

	WATER & WASTEWATER MANAGEMENT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Bi-Annually**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION / METHOD STATEMENT	***Management*** • Water Usage should be kept to the minimum needed for the operation of the plant and as much as possible recycle used water • Management must ensure that solid waste collection and sanitation is managed effectively in order to avoid any chances of ground and surface water pollution • All runoff water from fuel deposits, workshops, vehicles washing areas and other equipment must be collected and disposed of adequately • All water discharged from the works including effluent from wash water and stormwater from workshops and refuelling areas, as well as all runoff from areas with pollution potential will comply with national effluent standards • All chemical/hydrocarbon storage areas must be bunded. This bund water must be removed from site by a licensed contractor • All chemical usage areas, if any must be paved and if possible bunded • Any run-off that is discharged from the site must be uncontaminated • All vehicle transfers of materials must be conducted within a bunded area to minimise the potential for spills to enter the stormwater • Spills of potential contaminants must be immediately cleaned up and neutralised. Such spills must be handled with consideration to health and safety considerations • The use of water to clean up spills must be avoided except where necessary		

	WATER & WASTEWATER MANAGEMENT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Bi-Annually**
ENVIRONMENTAL MANAGEMENT PLAN			

	• Movement of vehicles on and off site is to be through approved access points only
	• Spill kits must be made available on site for the clean-up of spills and leaks of contaminants
	• Spill response procedures to include removal/disposal of potentially contaminated water and any used absorbent materials
	• In the event of a major spill or leak of contaminants, the administering authority must be contacted immediately as per incident reporting procedures
	• No groundwater must be polluted by any activities on site
	• Ensure that care is taken that spillage of oils and other hazardous substances are limited during maintenance. Should any accidental spillage take place, it must be cleaned up according to specified standards
	• Potentially contaminated water must be directed to an oil/water separator.
	• Water from bunds and oily water from oil/water separator must be removed by a licensed contractor or discharged to the evaporation pond
	• Waste – Leaked oil and chemicals:
	  • Appropriate disposal must be arranged with a licensed facility
	  • Waste must be stored and handled according to the relevant legislation and regulations
	• Water treatment reject must be removed by a licensed contractor or discharged to the evaporation pond		

	WATER & WASTEWATER MANAGEMENT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Bi-Annually**
ENVIRONMENTAL MANAGEMENT PLAN			

	• The evaporation ponds should be built taking in consideration not to be in a flood line and secured from runoff
	• The evaporation ponds should be lined to ensure no seepage of wastewater through the soil
	Monitoring and Reporting
	• A formal monitoring and reporting strategy/protocol should be developed for monitoring the integrity of the different water resources likely to be affected by the plant. This should include any ongoing rehabilitation measures initiated in the construction phase
	• Monitoring should include fixed-point photographs at specific intervals and after large flood events
	• Specific activities that should be monitored include:
	  • Erosion potential (specifically in and around roads and storm-water discharge points)
	  • Stormwater management and design
	  • Identified problem areas		

Table 1-16 Air Quality

	AIR QUALITY	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Annually**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Dust management*** • Dust control mechanisms must be utilised to reduce the amount of dust being released • Any dirt roads that are utilised by the contractor to access the site must be regularly maintained to ensure that dust levels are controlled • The plant's equipment must be performance tested during the commissioning phase to ensure that the manufacturer's standard has been delivered in respect of air emissions ***Emissions management*** • Ensure that the plant is fitted with appropriate air treatment units • Conduct regular monitoring and maintenance on the HTF piping system and Molten Salt piping and storage systems • Ensure all stack and exhaust emissions are regularly monitored • Regular ambient air quality monitoring around the project site • The Safety, Health and Environment Officer will maintain an incident reporting system to record non-conformances		

Table 1-17 Noise

	NOISE	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Annually**
ENVIRONMENTAL MANAGEMENT PLAN			

MITIGATION	***Noise from the plant***
	• The design of the plant is to incorporate all the necessary acoustic design aspects required in order that the overall generated noise level from the new installation does not exceed a maximum equivalent continuous daytime rating level, namely a noise level of 70 dBA (just inside the property projection plane, namely the property boundary). At the property fence and at potential receptors outside the facility, noise levels should comply with NCEC standards
	• The latest technology incorporating maximum noise mitigating measures for the plant components should be designed into the system
	• The design process is to consider, inter alia, the following aspects:
	  ◦ The position and orientation of buildings on the site
	  ◦ The enclosure of noisy plant in buildings where possible and practical
	  ◦ The design of the buildings to minimise the transmission of noise from the inside to the outdoors
	  ◦ The insulation of particularly noisy plant and equipment
	• All plant and equipment, including vehicles, must be properly maintained in order to minimise noise generation
	• Observation of on-site noise levels by Safety, Health and Environment Officer		

	NOISE	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Annually**
ENVIRONMENTAL MANAGEMENT PLAN			
	• A complaints register must be held, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, acted upon • Corrective action is required to be undertaken immediately after a complaint is made or non-conformance is identified • Any complaints regarding noise must be investigated, sources identified and mitigation measures implemented. Feedback on resolution of the issue must be provided to the complainant • The Safety, Health and Environment Officer will maintain an incident reporting system to record non-conformances		

Table 1-18 Biodiversity

	BIODIVERSITY (FAUNA AND FLORA)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Quarterly**
ENVIRONMENTAL MANAGEMENT PLAN			

MITIGATION / METHOD STATEMENT	***Flora management***
	• Indigenous vegetation, if any must be maintained.
	• The active control of all alien invasive species, if any by means of manual removal, ring-barking, chemical control or a combination of these methods
	• The use of herbicides will be in compliance with the NCEC regulations
	• The Operator will:
	  • Ensure that a registered pest control operator applies or supervises the application of all herbicides
	  • Ensure that all herbicides are stored in a well-ventilated demarcated storage area
	  • Ensure that a register of all contents of the storage area is kept and updated on a regular basis
	  • Ensure that a daily register of all relevant details of herbicide usage is kept, and that such a register is maintained by the Owner
	  • All emergent seedlings must be removed by hand and re- sprouting from existing rootstock must be chemically treated in a continual monitoring and follow-up programme
	  • Implementation of a rehabilitation and landscaping program for the site
	  • Where possible re-vegetation of the disturbed site is aimed at approximating as near as possible the natural vegetative conditions prevailing prior to construction		

	BIODIVERSITY (FAUNA AND FLORA)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Quarterly**
ENVIRONMENTAL MANAGEMENT PLAN			
	Fauna management • A monitoring programme must be developed to monitor the impacts of the plant on Avifauna. This monitoring programme should be set up in conjunction with NCEC and should include carcass count • Appropriate mitigation of bird collisions with PV panels needs to be determined on an ad hoc basis through regular monitoring once the plant is operational • Ensure that sub-sonic noises are played on a regular basis to repel avifaunal species • Install netting over the surface of the water to prevent birds/bats from accessing the surface. • Install a chain link fence topped by barbed wire around the perimeter of the sit/evaporation ponds. The fence should include a fine mesh from below the ground and above the ground to prevent burrowing animals and small ground-dwelling wildlife from entering the area. The fence should be inspected periodically and repaired as necessary. • Monitor the movement of small and medium size mammals through fences. In the event that an animal becomes trapped within the facility, procedures need to be developed in order to facilitate their removal • No faunal species must be harmed by maintenance staff during any routine maintenance at the site • Marking the relevant sections of the power line with appropriate marking devices.		

Table 1-19 Solid Waste Management

	Solid WASTE MANAGEMENT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Monthly when conduction / and or maintenance is required**
ENVIRONMENTAL MANAGEMENT PLAN			

MITIGATION	***Management***
	• Solid waste separation and recycling should take place for the entire duration of the operational phase for the project
	• All structures and/or components replaced during maintenance activities are appropriately disposed of at an appropriate licensed waste disposal site or sold to a recycling merchant for recycling
	• General Waste:
	  • Recycled where possible or disposed of properly to an appropriate landfill facility
	• Hazardous Waste:
	  • Separate hazardous and general waste and dispose hazardous waste to an appropriate hazardous waste disposal site
	• Waste handling, collection and disposal operations are managed and controlled by a waste management contractor
	• Uncontaminated waste must be removed at least monthly for disposal
	• Contaminated or regular wastes must be disposed of as necessary and in accordance with legislation
	• An incident/complaint register must be established and maintained		

	Solid WASTE MANAGEMENT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Monthly when conduction / and or maintenance is required**
ENVIRONMENTAL MANAGEMENT PLAN			
	Monitoring and Reporting • Visual inspection of the site must be carried out daily for evidence of litter or waste material that has been inappropriately disposed of by site personnel • Waste collection must be monitored on a regular basis • Waste documentation must be completed and available for inspection on request • A complaints register must be maintained, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, resolved • Weekly and monthly reports on exact quantities of all waste streams exiting the site must be compiled by the waste management contractor and monitored by the Safety, Health and Environment Officer. All appropriate waste disposal certificates accompany the monthly reports		

Table 1-20 Visual Impact

	VISUAL IMPACT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Annually**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• The exterior design in terms of buildings, fences and landscaping is planned in such a way to reduce the visual impact • All lighting where practical, must be "down" to minimise the visual impact of the facility at night. Lighting must be directed towards the areas they are supposed to illuminate • Use of light fixtures and the fitment of covers and shields designed to contain rather than spread light where practical. The minimum amount of lighting must be used • If a visually intrusive component of the site is identified, the procedures must be altered or updated to ensure effective management • An incident reporting system will record and manage follow up of resolution of non-conformances		

1.7 Layout of the SMP

This section is divided into three main parts. The first part and the second part address the Social Management Plan (SMP) for the construction and operations, respectively, and the third presents the grievance mechanism to be applied throughout the construction and operation phase of the Project.

This section is based on IFC Performance Standard 2, which recognises that the pursuit of economic growth through employment creation and income generation should be accompanied by due recognition of the rights of workers. Its objectives include the promotion of fair treatment, non-discrimination and equal opportunity, and the maintenance and improvement of worker-management relationships.

Requirements in terms of Performance Standard 2 include the following:

- Human Resource Policies and Procedures:
  - Adopt and implement the appropriate human resource policies
  - Provide workers with clear understandable documentation explaining worker's rights
- Working Conditions and Terms of Employment:
  - Respect collective bargaining agreements with workers organisations
  - Identify and ensure substantially equivalent terms and conditions for migrant workers
  - Develop and implement policies on the quality and management of accommodation and provision of basic services
- Workers Organisations: Not to restrict or prevent workers from forming and / join workers organisations
- Non-Discrimination and Equal Opportunity:
  - Employment decision will not be made on the basis of personal characteristics unrelated to inherent job requirements
  - Promote equal opportunity, fair treatment and non-discrimination.
  - Take measures to prevent and address harassment, intimidation and / or exploitation
- Retrenchment: Develop a Retrenchment Plan to address issues as it relates to legal and contractual requirements
- Grievance Mechanism: Provide grievance mechanism for workers to raise workplace concerns
- Protecting the Work Force:
  - Persons under the age of 18 will not be employed
  - Forced labour will not be employed
- Occupational Health and Safety:
  - Provide safe and healthy work environment
  - Take steps to prevent accidents, injury and disease
  - Apply good international industry practice to assess risk and potential hazards to workers, provide preventative and protective measures, training, monitoring and reporting, emergency preparedness and response procedures

- Workers engaged by Third Parties: Take reasonable action to ascertain compliance with the Performance Standard
- Supply Chain: Take reasonable action to ascertain compliance with the Performance Standard

The value of compliance with these requirements includes:

- Improved well-being and welfare of workers
- Improving the efficiency and effectiveness of the Project operations
- Maintenance of a positive corporate image

The site earmarked for the proposed facility is in a designated industrial area that is currently unoccupied. Thus, the project will not necessitate any relocation or resettlement. The project will, however, have some negative impacts of the surrounding social environment; these mainly relate to nuisance impacts, increased noise levels, and reduced air quality due to emissions. However, the project will also have various positive socio-economic impacts, including benefits for the local economy, the creation of indirect business opportunities, etc.

Effective management of relations with neighbouring communities and other local stakeholders is important, not only to inform them of likely negative impacts, but also to manage expectations concerning the magnitude and extent of positive impacts. The IFC Performance Standard 1 confirms the importance of effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them. According to PS1, Stakeholder engagement is an ongoing process that may involve consultation and participation. The process of consultation should be undertaken in a manner that provides the stakeholders with opportunities to express their views on project impacts and mitigation measures and allows the project owner to consider and respond to them.

Additionally, Principle 5 of the Equator Principles is focused on stakeholder engagement. According to this principle, an informed consultation and participation process should be conducted and should be free from external manipulation and intimidation. The results of the stakeholder engagement process should be documented, any actions agreed resulting from such process should be taken into consideration by the project owner.

1.7.1 SMP for Construction

Table 1-21 Social Environment

	SOCIAL ENVIRONMENT (This section deals with the social impacts that the new development will have on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor/Owner**	**Bi-Monthly**
MITIGATION	• All contact with the affected parties will be courteous at all times. The rights of the affected parties will be respected at all times • A complaints register should be kept on site. Details of complaints should be incorporated into the audits as part of the monitoring process. This should be in carbon copy format, with numbered pages. Any missing pages must be accounted for by the Contractor. This register is to be tabled during monthly site meetings • During the setup phase of the project the Contractor needs to make contact with those people that are interested in or affected by the development. The contractor will notify adjacent neighbours and inform them of the intended development. He will also inform neighbours that a complaints register will be available on site • No interruptions other than those negotiated will be allowed to any essential services. Damage to infrastructure will not be tolerated and any damage will be rectified immediately by the Contractor. A record of any damage and remedial actions will be kept on site • Speed limits will be enforced and all drivers will be sensitised to this effect • Any possible disruptions to essential services must be kept to a minimum and should be well advertised and communicated		

	SOCIAL ENVIRONMENT (This section deals with the social impacts that the new development will have on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
SITE SPECIFIC MITIGATION			
Roads	• Road rehabilitation should take place during and once construction is completed • Construction traffic should only make use of an approved route • Traffic signs should warn construction vehicles of the presence of pedestrians along the road • General road rules should be enforced		
Influx of construction workers	• Raise awareness amongst construction workers about local traditions and practices		
Influx of job seekers	• Ensure that employment procedures/policies are communicated to local stakeholders • Have clear rules and regulations for access to the site office to control loitering • Construction workers should be clearly identifiable by wearing proper construction uniforms displaying the logo of the construction company. Construction workers could also be issued with identification tags		
Direct formal employment opportunities for local individuals	• Unskilled job opportunities should be afforded to local community members • Equal opportunities for employment should be created • Payment should comply with applicable Labour Law legislation in terms of minimum wages		
Indirect formal and/or informal employment opportunities for local individuals	• Develop a procurement policy that is easy to understand and ensure that local subcontractors also comply with the procurement policy and any other applicable policies • Ensure that local subcontractors receive the necessary support in terms of resources • Encourage construction workers to use local services		

	SOCIAL ENVIRONMENT (This section deals with the social impacts that the new development will have on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
Disaster Management Plan	• Develop and implement a disaster management plan for implementation during the construction phase • Maintain risk-specific safety infrastructure and plans – such as major accidents involving roads		
Sanitation	• Adequate water facilities should be provided • Sufficient portable chemical toilets on site		
Sense of place	• Sufficient and transparent information should be supplied to neighbouring properties		
Physical splintering	• Fence off the construction site to prohibit unauthorised access • Community awareness on the safety mechanisms of the plant and related infrastructure, and the potential dangers • A clear emergency evacuation plan should be developed in close co-operation with the affected local municipalities		

Table 1-22 Workers Accommodation

	Workers Accommodation	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
SOCIAL MANAGEMENT PLAN			
MITIGATION	• Ensure design and construction of the accommodation camp complies with all the applicable national laws, standards and building code and the requirements of IFC/EBRD Guidance on Workers' Accommodation (2009), including but not limited to the following: • The camp is located to avoid flood risk and other natural hazards • Living facilities must be situated within reasonable distance from the worksite • The camp is adequately drained to avoid the accumulation of stagnant water • Air-conditioning and ventilation is appropriate for the local climatic conditions. It is recommended that the window area represents not less than 5% to 10% of the floor area • Both natural and artificial lighting are provided and maintained in living facilities. Emergency lighting must be provided • Wastewater, food and any other waste materials are adequately discharged in compliance with local or World Bank standards, whichever is more stringent. Containers for solid waste collection must be provided and emptied on a regular basis • Ensure adequate space is provided for workers' rooms and dormitory facilities range from 10 to 12.5 cubic meters minimal volume per resident or 4 to 5.5 square meters of minimal floor space per resident, with a minimum celling height of 2.10 m		

	Workers Accommodation	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
SOCIAL MANAGEMENT PLAN			
	• Pest and vector control as well as disinfection must be carried out in compliance with the applicable legal requirements and / or good practice • Adequate sanitary and washing facilities as well as cooking and storage facilities must be provided • Rest and recreation facilities must be provided • Basic healthcare and emergency health response must be provided • Living facilities must allow for sufficient privacy • Ensure administration and maintenance of accommodation facilities comply with all applicable standards in terms of: • Fire-fighting equipment must be provided at appropriate locations, and must be regularly maintained as per manufacturer's instructions • Access to an adequate and convenient supply of free potable water is always available for workers. Depending on climate, weather conditions and accommodation standards, 80 to 180 litres per person per day must be made available. Drinking water must meet local or WHO drinking water standard, whichever is more stringent and water quality must be monitored regularly • Living facilities must be kept in good repair and must be kept clean		

Table 1-23 Health and Safety

	HEALTH AND SAFETY (This section deals with the safety of workers and the public exposed to construction hazards)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor/ Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Worker safety*** • Implementation of safety measures, work procedures and first aid must be implemented on site • A health and safety plan must be drawn up to ensure worker safety • Workers should be thoroughly trained in using potentially dangerous equipment • Contractors must ensure that all equipment is maintained in a safe operating condition • A safety officer must be appointed • A record of health and safety incidents must be kept on site • Any health and safety incidents must be reported to the project manager immediately • First aid facilities must be available on site • Workers have the right to refuse work in unsafe conditions • The Contractor will take all the necessary precautions against the spreading of disease • A record will be kept of drugs administered or precautions taken and the time and dates when this was done. This can then be used as evidence in court should any claims be instituted against the Owner or the Contractor • Material stockpiles or stacks, such as, pipes must be stable and well secured to avoid collapse and possible injury to site workers/local residents		

	HEALTH AND SAFETY (This section deals with the safety of workers and the public exposed to construction hazards)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor/ Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	Worker facilities • Adequate sanitary facilities and ablutions must be provided for construction workers (1 toilet per every 15 workers) • Toilets will be serviced regularly and the ECO will inspect toilets regularly • Potable and drinking water must be provided for all construction staff • Eating areas should be regularly serviced and cleaned to ensure the highest possible standards of hygiene and cleanliness Fires are not to be allowed ***Protective gear*** • Personal Protective Equipment (PPE) must be made available to all construction staff and their usage must be compulsory. Hard hats and safety shoes must be worn at all times and other PPE worn were necessary i.e. dust masks, ear plugs etc. • No person is to enter the site without the necessary PPE • Standards and specifications governing dangerous processes such as welding and radiographic testing of welds must be strictly applied, with a view to proper protection of the public and workers ***Site safety*** • Potentially hazardous areas such as trenches, if any are to be demarcated and clearly marked • Adequate warning signs of hazardous working areas • Uncovered manholes and excavations must be clearly demarcated		

	HEALTH AND SAFETY (This section deals with the safety of workers and the public exposed to construction hazards)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor/ Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Emergency numbers for local police and fire department etc. must be placed in a prominent area • Firefighting equipment must be placed in prominent positions across the site where it is easily accessible. This includes fire extinguishers, a fire blanket as well as a water tank • Suitable conspicuous warning signs in Arabic, English and all other applicable languages must be placed at all entrances to the site • An adequate speed limits must be set and adhered to on site at all times and if necessary include physical speed restrictions such as speed bumps. • Avoid the need for vehicles reversing by: better design of the workplace; using safe systems of work for reversing. • Where possible segregate pedestrian and vehicle traffic routes. If not, adequate warnings must be in place. Ensure there are suitable pedestrian crossing points on vehicle routes. • Ensure that vehicle traffic routes are suitable for the types and quantity of vehicles that use them. Ensure they are wide enough and that floor and road surfaces are kept in good condition. • Ensure that vehicles are maintained appropriately, preventive maintenance programmes are required. Drivers should carry out basic safety checks before using vehicles, e.g pre-shift check of brakes and light ***Construction equipment safety*** • All equipment used for construction, including drills, TLB's must be in good working order with up to date maintenance records • Ensure that equipment are maintained appropriately, preventive maintenance programmes are required. Drivers should carry out basic safety checks before using equipment		

	HEALTH AND SAFETY (This section deals with the safety of workers and the public exposed to construction hazards)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor/ Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	Hazardous Material Storage • Staff that will be handling hazardous materials must be trained to do so • Any hazardous materials (apart from fuel) must be stored within a lockable store with a sealed floor • All storage tanks containing hazardous materials must be placed in bunted containment areas with sealed surfaces. The bund walls must be high enough to contain 110% of the total volume of the stored hazardous material • Material Safety Data Sheets (MSDS) which contain the necessary information pertaining to a specific hazardous substance must be present for all hazardous materials stored on the site • The bund walls for the transformer oil containers must be in place before the installation of these containers ***Procedure in the event of a petrochemical spill*** • The individual responsible for or who discovers the petrochemical spill must report the incident to the Owner • The problem must be assessed, and the necessary actions required will be undertaken • The immediate response must be to contain the spill • The source of the spill must be identified, controlled, treated or removed wherever possible ***Fire management*** • A Fire Management Strategy must be compiled and implemented • All construction personnel will receive training on fire hazards and techniques to extinguish any fire that may be initiated on the site		

	HEALTH AND SAFETY (This section deals with the safety of workers and the public exposed to construction hazards)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor/ Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	• They must also be made aware of the added risks during the dry summer months, as well as of the Fire Management Strategy to be implemented during construction • Firefighting equipment should be present on site at all times as per OHSA • All construction staff must be trained in fire hazard control and firefighting techniques • All flammable substances must be stored in dry areas which do not pose an ignition risk to the said substances		

Table 1-24 Security

	SECURITY (This section deals with issues of security during construction for workers and surrounding land users)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• Access to the construction site should be strictly controlled by a security company • 24-hour security on-site • Labour should be transported to and from the site to discourage loitering in adjacent areas and possible increase in crime or disturbance • Unsocial activities on site should be banned. Any persons found to be engaged in such activities should receive disciplinary or criminal action taken against them • The site will be fenced to prevent any loss or injury to persons or livestock during the construction phase • If any fencing interferes with the construction process, such fencing will be deviated until construction is completed. The deviation of fences will be negotiated and agreed with the landowner in writing • No alcohol / drugs to be present on site • No firearms allowed on site or in vehicles transporting staff to /from site (unless used by security personnel) • Construction staff is to make use of the facilities provided for them, as opposed to ad-hoc alternatives (e.g. fires for cooking, the use of surroundings as a toilet facility are forbidden) • Driving under the influence of alcohol is prohibited • All employees must undergo the necessary safety training and wear the necessary protective clothing • Secure the site in order to reduce the opportunity for criminal activity in the locality of the construction site		

Table 1-25 Labour and Working Conditions

	Labour and Working Conditions	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
SOCIAL MANAGEMENT PLAN			

MITIGATION	• Assess/ review HR policies to ensure that obligations under national and international labour and human rights laws are adequately addressed, including:
	  ◦ Non-discrimination & equal opportunity
	  ◦ Prohibition of child labour and forced labour
	  ◦ Remuneration and benefits
	  ◦ Deductions, hours of work, breaks and rest days
	  ◦ Overtime arrangements and compensation
	  ◦ Medical insurance and pension
	  ◦ Leave for illness, vacation, maternity or holiday
	  ◦ Implement measures to enforce and monitor compliance with HR policies
	• Provide awareness training to all project workers prior to commencing work on the project's HR policies and their rights under national and international labour and human rights laws (including the right to join workers' organisations and enter into collective bargaining agreements)		

	Labour and Working Conditions	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
SOCIAL MANAGEMENT PLAN			
	• Give preference to local workers in hiring process, wherever feasible and provided that candidates have the right skills and background • Working Conditions and Terms of Employment • Issue all workers with a contract which describes the employment relationship. The contract must be provided as part of the hiring process and shall describe all policies and procedures related to working conditions. • Assess the employment relationship with vulnerable groups, including women workers, young workers, migrant workers and workers with disabilities to mitigate discrimination. • Ensure that HR policies and procedures (discussed above) cover all workers, including direct, contracted and supply chain workers. • Where collective bargaining agreements are in place, verify that these meet the requirements of the applicable legislation. • In the event that some employees are covered by collective bargaining agreements and others are not, ensure that the terms and conditions of employment as well as benefits of all employees in similar positions are equivalent.		

Table 1-26 Employment

	EMPLOYMENT (This section deals with the impact that increased employment from the development will have on the area)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Weekly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• Training of labour to benefit individuals beyond completion of the project • Labour to be sourced from the local community where possible • Local suppliers to be used where possible • The Project Manager must ensure that all staff working on the proposed project must be in possession of a KSA work permit		

Table 1-27 Visual Impact

	VISUAL IMPACT (This section deals with the visual impact that the new development will have on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• Fencing of the site will also aid in reducing the visual impact of construction • Cluster construction activities on site. Storage facilities, elevated tanks and other temporary structures on site should be located such that they have as little visual impact as possible • Material chosen to blend in with the surrounding environment • Unwanted material and litter should be removed on a frequent basis • Cordon off construction site with shade-cloth if necessary • Lighting must be subtle and not disturb passing motorists and surrounding residents • Lighting should be inward and downward facing • The site will be kept visually and aesthetically pleasing. The ECO will regularly inspect the site to ensure that it is neat and clean • The exterior design in terms of buildings, fences and landscaping be planned in such a way that it will not distract travellers from visiting the site • An information centre is advisable which could explain the technology		

	VISUAL IMPACT (This section deals with the visual impact that the new development will have on the site and surrounds)	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**CONSTRUCTION**	**EPC Contractor**	**Monthly**
ENVIRONMENTAL MANAGEMENT PLAN			
SITE SPECIFIC MITIGATION			
	• Reduce the construction period through careful planning and productive implementation of resources • Restrict the activities and movement of construction workers and vehicles to the immediate construction site • Ensure that the general appearance of construction activities and lay-down areas are maintained by means of the timely removal of rubble and disused construction materials		

1.7.2 SMP for Operation

Table 1-28 Social Environment

	Social Environment	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**Operation**	**Owner**	**Annual**
SOCIAL MANAGEMENT PLAN			
MITIGATION	• Update the stakeholders database developed during the construction phase as needed • Provide appropriate training on cultural aspects for any foreign worker • Monitor implementation and effectiveness of SEP implementation • Minimising Negative Impacts on Host Communities • Restricting working hours for particularly loud or intrusive activities • Minimising machinery operation and vehicle movements • Minimising night time vehicle movement • Regular monitoring of the ambient air quality and noise levels at the boundaries of the facility as well as the nearest receptor(s) • Audit the grievance mechanisms utilised to ensure their adequacy. • Monitor local community attitude towards the project • Coordinate with nearby facilities and communities in case of non-routine events that might affect them • Identify and utilise opportunities to improve environmental conditions which affects the surrounding communities		

	Social Environment	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**Operation**	**Owner**	**Annual**
SOCIAL MANAGEMENT PLAN			
	• Surveillance programmes to screen the health of workers and minimise risk of introducing of new or highly resistant diseases into host communities • Education and training programmes for contractors to prevent the transmission of communicable diseases • Collaboration with local authorities to enhance access of workers' families and the community to public health services, immunisation facilities, etc. • Ensure communities and other stakeholders have access to information necessary to understand the nature of possible effects of an accident • Ensure communities and other stakeholders have adequate opportunity to contribute effectively, as appropriate, to decisions concerning the development of community emergency preparedness and response plans • Prohibit trespassing of workers onto neighbouring properties • Establish appropriate disciplinary action must be taken in the event of transgression • Implement public awareness programmes to identify areas of particular risk and approaches to reduce risk		

Table 1-29 Labour and Working Conditions

	Labour and Working Conditions	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**Operation**	**Owner**	**Quarterly**
SOCIAL MANAGEMENT PLAN			
MITIGATION	• Assess/ review HR policies to ensure that obligations under national and international labour and human rights laws are adequately addressed • Provide awareness training to all project workers on the project's HR policies and their rights under national and international labour and human rights laws (including the right to join workers' organisations and enter into collective bargaining agreements) • Give preference to local workers in hiring process, wherever feasible and provided that candidates have the right skills and background • Issue all new operational workers with a contract which describes the employment relationship. The contract must be provided as part of the hiring process and shall describe all policies and procedures related to working conditions. • Assess the employment relationship with vulnerable groups, including women workers, young workers, migrant workers and workers with disabilities to mitigate discrimination. • Ensure that HR policies and procedures (discussed above) cover all workers, including direct, contracted and supply chain workers. • Where collective bargaining agreements are in place, verify that these meet the requirements of the applicable legislation. • In the event that some employees are covered by collective bargaining agreements and others are not, ensure that the terms and conditions of employment as well as benefits of all employees in similar positions are equivalent. • Areas in plant whereas sound pressure levels exceed 85dBA need to be designated as "Restricted area", and personnel hearing protection is mandatory • Areas where hazardous materials are utilized will be designated as "Restricted area", and the appropriate PPE is mandatory		

	Labour and Working Conditions	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**Operation**	**Owner**	**Quarterly**
SOCIAL MANAGEMENT PLAN			
	• Ways of lowering noise levels from the different noise sources such as generators and pumps should be examined and implemented. • Design and implement a hearing conservation program for all project personnel. • Provision of the appropriate safety clothes to all workers. • Provide employees operating noisy equipment with appropriate noise protection (e.g. ear defenders, ear plugs) to protect them from hearing damage • Conduct medical check to all employees • Regular monitoring of noise levels will be conducted at the facility during operations phase. Should noise emissions exceed acceptable limits, additional mitigation measures shall be investigated; • Routine maintenance of equipment and vehicles based on manufacturer's recommendation will ensure that equipment are operating efficiently and not generating excessive noise or emissions. • Throttle down or switch off noise generating equipment when not in use. • In case of any near-miss or accident, prompt thorough investigation should be conducted and corrective measures should be taken as necessary		

Table 1-30 Health and Safety

	HEALTH AND SAFETY	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	***Emergency evacuation plan*** • Upon completion of the construction phase, an emergency evacuation plan must be drawn up to ensure the safety of the staff and surrounding land users in the case of an emergency • All permanent staff must undergo safety training ***Maintenance*** • The power lines are to be regularly maintained. A maintenance schedule must be drawn up and records of all maintenance kept ***Fire safety*** • Firefighting equipment in the form of fire hydrants or fire extinguishers must be available on the site. These must be regularly maintained by an appropriate company ***Storage and handling and management of hazardous materials*** • Management strategies/operational procedures for the routine monitoring and inspection of fuel tanks, and other fuel related equipment will be compiled and implemented • The storage of flammable and combustible liquids such as oils will comply with the relevant legislation • The storage and handling of corrosive substances must be in accordance with the relevant legislation		

	HEALTH AND SAFETY	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	• The minimum amount of fuel required for efficient operation of the facility must be stored on site • Any spills will be rendered harmless and arrangements made for appropriate collection and disposal, including cleaning materials, absorbents and contaminated solid • Ensure that spill kits are available on site to clean up spills and leaks • Obtain any permits and approvals necessary and comply with the conditions attached to such permits and approvals • Transport of all hazardous substances must be in accordance with the relevant legislation • Identify and maintain a register of all activities that involve the handling of potentially hazardous substances, as well as devise and supervise the implementation of protocols for the handling of these substances. This will include all fuels, oils, lubricants and grease • Ensure that all hazardous substances are handled in accordance with the manufacturer's specifications and relevant legal requirements • Arrange and supervise the implementation of clean-up operations and proper disposal of contaminated materials at a licensed hazardous waste disposal site • Keep written records detailing the type of spill, the corrective and remedial measures implemented in the stopping or reduction of the spill, and the clean-up. Such progress reporting is important for monitoring and auditing purposes and the written reports may afterwards be used for training purposes in an effort to prevent similar future occurrences • Tanks to be designed and constructed in accordance with a recognised code (international standard)		

	HEALTH AND SAFETY	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	OPERATION	Owner	Daily
ENVIRONMENTAL MANAGEMENT PLAN			
	• The rated capacity of tanks must provide sufficient capacity to permit expansion of the product contained therein by the rise in temperature during storage • Tanks must be situated in a bunded area the volume of which must be at least 110% of the proposed volume of the tank • The floor of the bunded area must be smooth and impermeable constructed of concrete or plastic sheeting with impermeable joints with a layer of sand over to prevent perishing. The floor of the bunted area will be sloped towards an oil trap or sump to enable any spilled fuel and/or fuel–soaked water to be removed • The fuel delivery area, if any must be bunded and an interceptor system or similar structure must be installed, with all drainage directed to an oil water separator. This approach will allow for the removal of free product from any surface run-off or spillages. The interceptor system must contain a holding tank that is used to contain any free product recovered. Free product must be removed from this separator, stored in a holding tank, and recycled or disposed of in an appropriate manner • Internationally approved non-corrosive pipework systems must be installed (approved codes) • Ant flash nozzles must be installed at the end of the vent pipes and provisions must be made for overfill protection devices in the tank filling pipes to prevent tank overfills during filling operations • Fuel must be dispensed via a system that has suitable leak detectors linked to the fuel lines if and where required. These leak detectors must form an integral part of the pumping system and allow for automatic cut-off the fuel supply must a leak be detected • Any water that collects in the bund must not be allowed to stand and must be removed and the hydrocarbon digestion agent within must be replenished		

	HEALTH AND SAFETY	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Daily**
ENVIRONMENTAL MANAGEMENT PLAN			
	• Spill and emergency response equipment must be accessible at chemical transfer/unloading points and refuelling locations • Bunds and storage facilities must be maintained to ensure design capacity is available • Water which ponds within the bunded areas must be pumped to the oil/water separator as soon as possible after rain events cease • Observation and supervision of chemical storage and handling practices and vehicle maintenance by the Safety, Health and Environment Officer throughout the plant's operational phase • Inspection of bunding integrity, stability and function ***Hazard and Risk*** • All monitoring will occur according to the risk management and emergency response plan, guidelines and license conditions • A complaints register must be maintained, in which any complaints from the community must be logged. Complaints must be investigated and, if appropriate, acted upon		

Table 1-31 Visual Impact

	VISUAL IMPACT	RESPONSIBILITY	FREQUENCY / MONITORING REQUIREMENTS
PHASE	**OPERATION**	**Owner**	**Annually**
ENVIRONMENTAL MANAGEMENT PLAN			
MITIGATION	• The exterior design in terms of buildings, fences and landscaping is planned in such a way to reduce the visual impact • All lighting where practical, must be "down" to minimise the visual impact of the facility at night. Lighting must be directed towards the areas they are supposed to illuminate • Use of light fixtures and the fitment of covers and shields designed to contain rather than spread light where practical. The minimum amount of lighting must be used • If a visually intrusive component of the site is identified, the procedures must be altered or updated to ensure effective management • An incident reporting system will record and manage follow up of resolution of non-conformances		

1.7.3 Grievance Mechanism Framework

According to Equator Principle 6, a grievance mechanism should be established that is designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. Furthermore, the grievance mechanism should be accessible both to the public and on-site workers. IFC Performance Standard 1 also provides for the establishment of a mechanism to address community grievances. In addition, IFC PS 2 on Labour and Working Conditions mentions that it is good practice to establish a grievance mechanism to deal with workers' claims.

The grievance mechanism should be scaled to the risks and impacts of the Project. It provides a formal and ongoing avenue for stakeholders (including on-site workers) to engage with the project proponent, whilst the monitoring of grievances provides signals of any escalating conflicts or disputes. In general, identifying and responding to grievances supports the development of positive relationships between the project proponent and the communities, and other stakeholders.

An effective and equitable grievance mechanism, whether it is intended for us by workers or the public, has the following positive attributes:

- Accessibility: All intended users are aware of the grievance mechanism, and are informed about how it operates. Moreover, the relevant grievance mechanism (be it intended for workers or the public) is accessible to all potentially-affected persons, individual workers (including employees of Sub-contractors) and the organisations representing those workers. The mechanism should be clear and understandable, and available to all intended users at no cost.
- Transparency of the process: Workers and community members are aware of whom they can turn to in the event of a grievance, and of the support and sources of advice that are available to them. All relevant personnel within the organisation (including line and senior managers and the community relations team) must be familiar with their organization's grievance procedure.
- Cultural appropriateness: The mechanism is designed to take into account culturally appropriate ways of handling community and worker concerns.
- Confidentiality and non-retribution: The process will ensure that, where required, a complaint is dealt with confidentially. Moreover, the worker or community member making the complaint will not be subject to reprisal or retribution, and will not be prevented access to other remedies.
- Reasonable timescales: While sufficient time is allowed to investigate grievances fully, the process aims for swift resolutions. Time limits are set for each stage of the process, for example, a maximum time between a grievance being raised and the setting up of a meeting to investigate it.

In the context of this Project, a Grievance Mechanism must be developed in accordance with national law and IFC Performance Standards. The Grievance Mechanism will have two aspects: one dealing with Project workers, and the other dealing with community/ stakeholder complaints. A framework for developing each of these two components is provided in the following sub-sections.

1.7.3.1 On-Site Workers

The worker's grievance mechanism must have the following characteristics:

- Workers will be made aware to whom they can turn in the event of a grievance and the support and sources of advice that are available to them. All line and senior managers must be familiar with their organization's grievance procedure.
- Complaints can be filed through the following means, including mail, email, or in person by meeting the relevant line manager or HR manager.
- The Grievance Mechanisms shall be accessible to individual workers as well as to the organisations employing/ representing them.
- Anonymous complaints are allowed. The process will ensure that a complaint is dealt with confidentially. While procedures may specify that complaints should first be made to the workers' line manager, there should also be the option of raising a grievance first with an alternative manager, for example, a human resource (personnel) manager.
- Any worker raising a complaint will not be subject to any reprisal.
- Sufficient time will be allowed to investigate grievances fully, but the process will aim for swift resolutions. Time limits should be set for each stage of the process, for example, a maximum time between a grievance being raised and the setting up of a meeting to investigate it.
- A worker will have the right to appeal to a higher level of management if he or she is not happy with the initial finding.
- In any meetings or hearings, the worker will have the right to be accompanied by a colleague, friend or union representative.
- Written records will be kept at all stages. The initial complaint should be in writing if possible, along with the response, notes of any meetings and the findings and the reasons for the findings.
- As per IFC PS2, the mechanism should not impede access to other judicial or administrative remedies that might be available under the law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.

1.7.3.2 Public

To ensure that the grievance mechanism is accepted within the affected communities, it shall conform to the following principles (Figure 1-1):[1]

- Principle 1. Proportionality: Scaled to risk and adverse impact on affected communities
- Principle 2. Cultural Appropriateness: Designed to take into account culturally appropriate ways of handling community concerns
- Principle 3. Accessibility: A clear and understandable mechanism that is accessible to all segments of the affected communities at no cost
- Principle 4. Transparency and Accountability to All Stakeholders: The affected community:
    - Know who in the organization is responsible for handling complaints and communicating outcomes, and who is in charge of the mechanism oversight;
    - Have input into its development;
    - Possess sufficient information on how to access it; and
    - Have power to ensure that the process is adhered to by those directly responsible for managing it.
- Principle 5. Appropriate Protection: A mechanism that prevents retribution and does not impede access to other remedies

[1] Source: IFC Good Practice Note Addressing Grievances from Project-Affected Communities, 2009

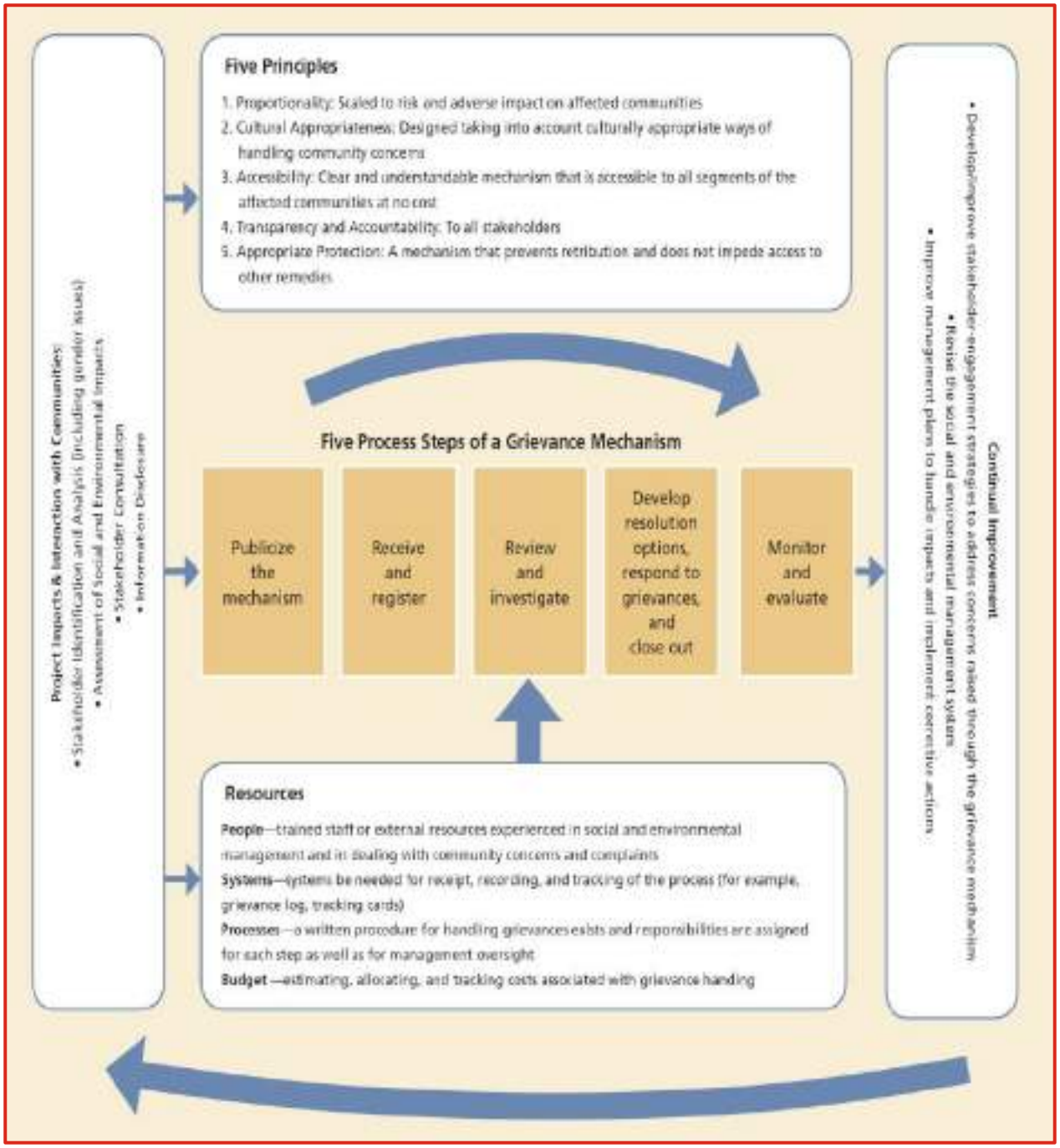


Figure 1-1 Grievance Mechanism Basic Design Elements

2. Environmental Monitoring Plan

This section provides a monitoring plan which is designed to control and ensure compliance with the proposed mitigation measures. It is recommended to assign an Environmental Fieldwork Supervisor (EFS) to ensure that the monitoring program/requirements are fulfilled and properly implemented. The EFS should understand the Monitoring Plan, and will be provided all necessary assistance from personnel in the field to fulfil it. He/she will have a sufficient and appropriate environmental, sampling/analyses and environmental management background.

2.1 Monitoring Categories

The proposed monitoring program is composed of three separate monitoring categories. These are:

- Environmental monitoring
- Socio-economic monitoring
- Operational and management performance monitoring.

Corrective actions will be implemented in cases of non-conformance.

It should be noted that given that the groundwater table is at depth of more than 10 m and the nature of the proposed Project activities, groundwater quality it is not likely to be impacted due to the Project implementation and thus not considered in this monitoring plan at this stage of the Project.

2.1.1 Environmental Monitoring during Construction

During the construction phase of the solar park, an environmental monitoring program will be implemented, and will include:

- Visual inspection
- Water resources
    - Groundwater
    - Potable water
- Air emissions
- Noise levels
- Solid and hazardous waste
- Incoming and outgoing chemicals
- Trucking and machinery use
- Workspace monitoring
- Site access and internal roads

In the early phases (construction and operation start-up), the environmental monitoring program will include all regulated parameters. Subsequently the list of parameters can be re-examined according to their significance for the project and to the specific site conditions.

2.1.1.1 VISUAL INSPECTION OF SPECIFIC LOCATIONS

Certain locations will require weekly visual inspection to ensure that construction work proceeds in an environmentally sound manner.

These may include:

- Storage areas sites and workshops, if applicable
- Waste collection locations and wastewater storage tank locations
- Construction material storage locations

2.1.1.2 Groundwater

During the construction phase, ongoing visual inspection will be conducted at all storage areas, workshops, waste collection and wastewater storage tank locations, etc., to ensure that mitigation measures are in place and that no leaks occur that may reach the groundwater. During this phase, groundwater will be sampled at two locations and analysed twice annually for the parameters regulated by the PME groundwater standard (2012). During each monitoring round, the groundwater level will be measured in each well prior to sampling.

An additional monitoring round will be conducted at an early stage of the construction phase and the analysis results of this round will be considered as baseline values. Analysis results of all monitoring rounds will be compared to baseline values and the limits set by relevant legislation.

2.1.1.3 Potable Water

Potable water will be regularly monitored prior to the point of supply to ensure compliance with health standards. Results will comply with the local standards for drinking water quality.

2.1.1.4 Air Emissions

During the construction phase, ambient air quality will be monitored quarterly by active sampling for $PM_{2.5}$, PM_{10}, SO_2, and NOx at predetermined locations. The measured concentrations should comply with relevant legislation.

2.1.1.5 Noise Monitoring

Noise levels at the project site during construction must comply with the NCEC standard for construction noise. In areas with direct equipment usage, noise levels are to be checked at least quarterly. Ambient noise will be monitored twice a year at the site boundaries and also at two locations closest to the nearest residential area, if any. At these locations the noise level will be recorded by 24-hour noise measurement divided into two intervals (day and night) using a Type 1 sound level meter (precision grade) at least once a year to ensure compliance with relevant legislation.

2.1.1.6 SOLID AND HAZARDOUS WASTE MONITORING

A logbook will be kept and maintained to record the amounts of produced wastes and excavated material, transportation routes and reuse or final disposal. During construction, wastes will be handled according to a waste management plan. Monitoring is required to ensure proper implementation of the management plan. Records of the frequency of solid waste collection at site will be documented and the documents kept along with records of waste transportation to disposal sites.

Hazardous waste types and quantities, including paint and oil containers, aerosol cans, and batteries, will be recorded along with documentation to support proper handling (by specialized contractors) and disposal.

2.1.1.7 INCOMING AND OUTGOING CHEMICALS

A logbook will be kept and maintained to record the types and amounts of all incoming and outgoing hazardous chemicals. This book will be reviewed regularly to check the chemicals consumption. An inventory of material safety data sheets for all chemicals on the site will also be kept. Moreover, any new chemical proposed for purchase for the first time must be approved by the site's Environmental Officer prior to purchase.

2.1.1.8 TRUCKING AND MACHINERY USE

Trucking and machinery use will be continuously monitored, machinery operational conditions recorded, and regular or necessary maintenance performed to avoid increases in exhaust emission and fuel consumption levels. This will ensure that air mitigation measures to avoid dust and emissions have been applied during the construction phase. Road and truck related accidents will be recorded.

2.1.1.9 WORKSPACE MONITORING

During the construction phase occupational noise levels in the vicinity of operational heavy machinery and inside closed workplaces will be monitored weekly using Type 2 noise equipment. Dust levels should be visually monitored during construction to ensure that the visibility on the adjacent highway is not affected.

Air quality monitoring will be conducted twice weekly to measure concentrations of CO and PM10.

2.1.2 Environmental Monitoring during Operation

During the operation phase, an environmental monitoring program will be implemented that will include:

- Water resources
  - Groundwater
  - Potable water
- Air emissions
- Noise levels
- Solid and hazardous waste
- Incoming and outgoing chemicals
- Trucking and machinery use
- Workspace monitoring

2.1.2.1 Groundwater

During the operation phase, groundwater will be sampled at the two monitoring locations used during the construction phase. Monitoring will be conducted twice annually for selected parameters. During each monitoring round, the groundwater level will be measured in each well prior to sampling. All analysis results will be compared to the limits set by relevant legislation.

2.1.2.2 Potable Water

Potable water will be regularly monitored prior to the point of supply to the plant's potable water supply network to ensure compliance with health standards. Quarterly monitoring will take place during construction. The results will comply with the relevant local standards.

2.1.2.3 Ambient Air Quality

During the operation phase, both ambient air and ambient air quality should be quarterly monitored. The ambient air quality will be monitored at the same locations used during the construction phase. The ambient air quality parameters to be monitored will be the same as those monitored during the construction phase. As for the air emissions, the parameters will include as a minimum NOx/NO_2. It should be noted that during the commissioning activities, more frequent monitoring will be required (e.g. monthly). In all cases, the measured concentrations should comply with relevant legislation.

2.1.2.4 Noise Monitoring

During the operation phase, ambient noise will be monitored twice annually at the site boundaries in addition to two locations on the public road closest to the nearest residential area if any. At these locations, the noise levels will be recorded on a 24-hour noise measurement basis divided into two intervals (day and night) using Type 1 sound level meter (precision grade) at least once a year to ensure compliance with relevant legislation.

2.1.2.5 Solid and Hazardous Waste Monitoring

The volume, collection frequency, means of transportation and locations of disposal of generated municipal solid waste during the operation phase will be recorded in a logbook and addressed in the waste management plan. This information will be kept in the power plant's environmental records for inspection.

2.1.2.6 Incoming and Outgoing Chemicals

A logbook will be kept and maintained to record the types, amounts and transportation routes of all incoming and outgoing hazardous chemicals. This book will be reviewed regularly to check the chemicals consumption. An inventory of material safety data sheets for all chemicals on the site will also be kept. In addition, any new chemical proposed for purchase for the first time must be approved by the site's Environmental Officer prior to purchase.

2.1.2.7 Trucking and Machinery Use

Trucking and machinery use will be continuously monitored and machinery operational conditions recorded. Regular maintenance will be performed to avoid increases in exhaust emission and fuel consumption levels. Road and truck related accidents will be recorded.

2.1.2.8 Workspace Monitoring

Noise levels in the vicinity of operational machinery and inside closed workplaces will be continuously using Type 2 noise equipment. Temperatures inside all workplaces will be recorded during the operation phase. Air quality monitoring will be monitored continuously in the work place for concentrations of CO, VOCs, and PM_{10}.

2.1.3 Socio-economic Monitoring

A survey will be undertaken annually starting the first year of construction and continuing for the first two years of operation, then undertaken every 2-4 years thereafter. Key elements to be monitored may include numbers of temporary and long-term jobs created during the project construction and operation, change of income, job availability, internal transportation costs, etc.

2.1.4 Operational and Management Performance Monitoring

Operational and management performance monitoring will involve checking that all data are documented and interpreted and that corrective actions are followed up and implemented.

2.1.4.1 Documentation

The documentation system (including logbooks, internal/external communication documentation, etc.) and environmental register will be quarterly checked and daily updated. Monitoring results will be available to be presented to responsible authorities as required. Upon the identification of any data gaps, correction actions will be made and documented.

2.1.4.2 Corrective/Preventive Action Results and Follow-up

Forms will be available for corrective action requirements. Similarly, other forms will be made for corrective action follow-ups. Corrective action will be followed up regularly until they are finalised. Any such documentation system will be structured so as to be ISO 9000: 2000 certification-capable. Wherever possible, the documentation will be electronic.

2.2 Monitoring Work Plan

This section describes the tasks required to fulfil the monitoring requirements.

2.2.1 List of Tasks

- Review the monitoring plan
- Set a start date; adjust all following dates to fit the monitoring schedule
- Keep copies of the monitoring plan in areas relevant to sampling locations
- Review locations, lists of monitoring parameters and activities (sampling, analysis, etc.)
- Clearly mark the monitoring locations onsite plans
- Conduct or supervise the required sampling and analysis
- Record any site remarks observed while sampling and analysing
- Based onsite remarks and data interpretation, determine non-conformances and requirements for corrective actions, if any
- In case non-conformances are detected, propose, document, and follow up on corrective actions (weekly)
- For each monitoring round, prepare a report including:
    - findings of the monitoring program and data interpretation
    - status of corrective and preventative actions
    - remarks and recommendations
    - Monitoring activities and dates for the coming round
- During each monitoring round, examine previous monitoring results and decide on any future additions or reductions in the monitoring parameters and the frequencies of sampling accordingly

2.2.2 General Recommendations

It is advised that qualified individuals implement the monitoring program and train local representatives. It is recommended that analysis of samples be conducted by third-party accredited laboratories to ensure that impartial objective data are produced. It is also recommended that all locations be accurately geo-referenced.

Appendix H. Environmental Emergency Response Plan

MINISTRY OF ENERGY

Environmental Emergency Response Plan

Al-Kahfah Solar PV Park



Document No Rev 0: 413011-00907- EN-REP-000X
09 August 2021

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PROJECT 413011-00907- - Environmental Emergency Response Plan - Al-Kahfah Solar PV Park

Rev	Description	Original	Review	Worley Approval	Revision Date	Approval Date
Rev 0	Issued for Client Use	YZ	IES	JO	09.08.21	

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Abbreviation List

C	**c**
CEO	Chief Executive Officer
E	**e**
EMP	Environmental Management Plan
EERP	Environmental Emergency Response Plan
ERP	Emergency Response Plan
ERT	Emergency Response Team
H	**h**
HSE	Health, Safety and Environment
I	**i**
ICS	Incident Commander System
M	**m**
MSDS	Material Safety Data Sheet
P	**p**
PPE	Personal Protective Equipment
PV	Photovoltaic

Document Control Procedures

The Environmental Emergency Response Plan (EERP) is a controlled document. All EERP Recipients, detailed within the distribution list, will receive a copy of EERP. This document will be subject to review on a three-monthly basis and updated as necessary by HSE Department to comply with current and best industry practice, to reflect audit recommendations and incorporate current contact details.

It is the responsibility of the EERP copy holder; Chief Executive Officer (CEO), to maintain the accuracy of this document. All updates should be promptly inserted and acknowledged according to Ministry of Energy Management Procedures. The amendments to EERP will be maintained and approved by the CEO. The following table will be used to record detail amendments (reviews).

Revision Number	Page(s)/Section(s) Amended or Added	Amended by	Date

1. Introduction

1.1 Purpose

This plan outlines procedures for emergency awareness, preparation, and response with the purpose of preventing, minimizing and/or mitigating environmental impacts. The procedures listed provide a framework for proper response to emergency situations that occur and may have environmental impacts.

1.2 Scope

This procedure applies to Al-Kahfah PV Project of Ministry of Energy for which potential accidents and emergency situations may arise. The procedures for preventing and mitigating the following emergency situations are described:

- Personnel injury;
- Site evacuation;
- Fire or explosion;
- Floods;
- Chemical spills; and
- High winds and dust.

1.3 Objectives

The EERP core objectives are to:

- Preserve life and ensure the safety of people;
- Minimise the impact on the environment;
- Minimise damage to property;
- Minimise the impact on business continuity and reputation; and
- Minimise the impact on neighbouring industries and communities, if any.

1.4 Project Overview

the proposed Al-Kahfah Solar PV Park project (hereinafter "the Project"), 6 km south of the town of Al-Kahfah in Ha'il Province (Figure 1). The total area of the Project is about 83 km^2. The proposed Project will entail the installation and operation of six (6) solar generating units (SGUs). The estimated power generation capacity will be approximately 3 GW. The total power generation capacity is expected to be equivalent to 8,534 GWh per year[1]. This yearly production will be equivalent to supplying energy to 406,400 households[2] and will significantly reduce the emission of greenhouse gases by 7.7 million tons of $CO_{2\ equivalent}$[3] (Master Plan, Al-Kahfah Solar Energy Park, Worley, April 2021).

[1] It should be noted that this capacity is the initially estimated capacity and should be confirmed or updated, as necessary as part of the detailed design of the Project.

[2] Based on average consumption of 21 MWh/household/year. Household Energy Survey 2017, General Authority for Statistics.

[3] Based on 0.97 T CO2/MWh, Dynamics of energy sector and GHG emissions in Saudi Arabia, 2014, Climate Policy.



Figure 1 Project location

Generally, the operation of the PV plant entails the production of power by conversion of solar energy to electricity. The PV power generation process is primarily self-sufficient and is not in need of constant supervision. The resources required for PV plant operation include:

- Solar radiation
- Water
- Consumables, including but not limited to: spare parts, equipment, detergents and fuel

The outputs from the PV plant during routine operation include:

- Power
- Solid waste (hazardous and non-hazardous)
- Liquid effluents (hazardous and non-hazardous) such as wastewater from washing PV panels and heliostats

1.5 Definitions

Term	Definition
Accident	An incident which has resulted in actual injury or illness and/or damage (loss) to assets, the environment or third party(ies).
Causal factor	An event or condition that results in an effect. Anything that shapes or influences the outcome.
Fatality	A death results from a work-related injury or occupational illness.
First Aid case	Any one-time treatment and any follow-up visit for the purpose of observation of minor scratches, cuts, burns, splinters and so forth, which do not ordinarily require medical care. Such a one-time treatment and the follow-up visit for the purpose of observation are considered first aid even though it is provided by a physician or registered medical professional.

Term	Definition
Hours of exposure	The total number of hours worked by all employees and contractors during the reporting period.
Incident	An unplanned, undesired event that can result in physical harm and/or property damage.
Medical Treatment Case	It is an occupational injury/illness which is not classified as a lost time injury but results in loss of consciousness or medical treatment other than first aid. For example, loss of consciousness due to lack of oxygen/ high temperatures /electrocution /head injury, penetrating eye injury, chemical or hot burns, fracture not resulting from lost time injury, etc.
Near Miss	Incidents with no injury, property or environmental damage, but having the potential to cause it. This could include an unsafe act.
Occupational Illness	Any work-related abnormal condition or disorder, other than an injury, which is mainly caused by exposure to environmental factors associated with employment. It includes acute and chronic illness or diseases which may be caused by inhalation, absorption, ingestion or direct contact. Whether a case involves a work-related injury or occupational illness is determined by the nature of the original event or exposure which caused the case, not by the resulting condition of the affected employee. An injury results from a single event. Cases resulting from anything other than a single event are considered occupational illnesses.
Property damage	Damage to any assets including buildings, equipment, and/or vehicles.
Root Causes	One of multiple factors (events, conditions or organizational factors) that contributed to or created the direct cause and subsequent undesired outcome and, if eliminated, or modified would have prevented the undesired outcome. Typically, multiple root causes contribute to an undesired outcome.
Work-related injury	An injury to a person arising out of or in the course of work being done for or on behalf of the Company. It includes injury to Company employees whilst on company duties and injury to an employee of a company approved contractor whilst engaged in work for or on behalf of the Company.

2. Emergency Response Team

The Emergency Response Team (ERT) will report through the normal, internal management chain-of-command. The response teams are organized in a manner consistent with the principles of the Incident Commander System (ICS). The ICS is a management system designed to enable effective and efficient domestic incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to enable effective and efficient domestic incident management.

2.1 Emergency Response Team

2.1.1 Emergency Response Team during Construction

Prior to construction, Ministry of Energy will establish the ERT that may include some or all of the positions outlined below:

- Emergency Response Room – Duty Manager – 24 hours
- Construction Manager (Incident Commander)
- Engineering Project Manager (Deputy Incident Commander)
- HSE Manager (Planning Lead)
- Contractor Safety Manager (Operations Lead)
- Contractor Safety Coordinator (ERT Lead)
- Contractor Logistics Coordinator (Logistics Lead)
- Contractor Finance and Administration Manager (Financial Lead)

2.1.2 Emergency Response Team during Operation

Ministry of Energy will update the EERP with the names and phone numbers of the ERT which may include some or all of the positions outline below. These names and contact information shall be made available throughout the site and to all site personnel, in addition to emergency numbers such as police, ambulance, and firefighting.

Position	Name	Phone Number	Email Address
Emergency Response Room – Duty Manager – 24 hours			
Incident Commander			
Deputy Incident Commander			
Environment and Planning Lead			
Logistics Lead			
Finance and Administration Lead			
Health and Safety Advisor			
Safety Coordinator			

Position	Name	Phone Number	Email Address
Legal Manager			
Security Manager			
Media Relations Manager			

2.2 Notification Procedure

The following 7-step Emergency Notification Procedure should be used during construction and operations:

2.2.1 Notify the Duty Manager (Emergency Response Room)

All emergency situations should immediately be reported to the Duty Manager (Emergency Response Room). The Duty Manager shall immediately notify the Incident Commander to decide upon appropriate course of actions.

2.2.2 Describe

Describe the emergency situation. Typically, the categories below can be used:

- Fatality;
- Major illness (heart attack, not breathing, unconscious, etc.);
- Major injury (broken bone, loss of limb, severe cuts/bleeding, etc.);
- Minor injury (twisted ankle, foreign body in eyes, minor cuts, etc.);
- Bite/sting (snake, scorpion, etc.);
- Weather effect (effects of heat, sun, cold, wind chill, lightning strike, etc.); and/or
- Incident type (fall, crush, vehicle crash, fire, electric shock, etc.).

2.2.3 Location

Give the Duty Manager (Emergency Response Room) the location of the emergency by referring to the nearest structure or road junction.

2.2.4 Call Emergency Services/Statuary Bodies

The Incident Commander will arrange for the required emergency service/statuary bodies to respond. For non-urgent medical attention, the Incident Commander should arrange for site transport to take the injured to the nearest hospital and notify the hospital that they are on their way.

2.2.5 Notify ERT Leaders

The Incident Commander will contact the ERT Leaders, who will assist at the location of the emergency. Jointly, the ERT Leaders will arrange for trained emergency responders to attend the scene of the emergency, if required. The names of all emergency responders (e.g. first aiders) should be made available to all the site personnel – first aiders should be identified by a badge on their hard hats.

2.2.6 Coordinate

The ERT Leaders will send an employee to the nearest site access point to meet the emergency services, and escort them to the location of the emergency.

2.2.7 Accompany

The ERT Leaders will continue to assist with the situation on site, and the Safety Coordinator will accompany any injured personnel to the hospital. The employer can later require the injured to make an appointment to see the Ministry of Energy Doctor if confirmation of the extent or nature of injuries, treatment, or disability is required.

3. Prevention

The key method employed to prevent the occurrence of incidents is the planned and controlled execution of work processes. In summary, preventative measures include:

- Ensuring that adequate planning is undertaken including appropriate risk assessment;
- Ensuring that appropriate control measures are implemented and maintained;
- Complying with all legislative and industry requirements;
- Complying with all applicable internal system procedures;
- Complying with the requirements of the Environmental Management Plan (EMP) and its related sub-plans and procedures;
- Complying with the requirements of the Health and Safety Plan; and
- Complying with the requirements of this EERP

3.1 Risk Assessment

3.1.1 Hazard Identification

There are a number of ways of identifying potential sources of injury or disease. Selection of the appropriate procedure will depend on the type of work processes and hazards involved. Procedures may range from a simple checklist for a specific piece of equipment or substance, to a more open-ended appraisal for a group of related work processes.

Methods of identifying workplace hazards may include:

- Reviewing information from designers or manufacturers (work method statement);
- Analysing incident and injury data;
- Analysing work processes;
- Consulting with employees;
- Developing a hazard checklist;
- Conducting walk-through audit/surveys;
- Examining and considering material safety data sheets or product labels; and
- Seeking advice from specialist practitioner or representatives.

When determining hazards associated with the task, the hazard types below should be considered:

- Physical hazards, e.g.: objects falling from heights, noise, etc.
- Electrical hazards, e.g.: direct electrocution, contact with overhead or underground cables etc.
- Chemical hazards, e.g.: inhalation, chemical contact with skin or eyes, ingestion of chemicals etc.
- Radiation hazards, e.g.: UV light, lasers
- Biological hazards, e.g.: infection, handling of waste etc.

3.1.2 Risk Assessment

The purpose of risk assessment is to identify potential hazards associated with site activities, evaluate the degree of risk by quantitative assessment of the “likelihood” and “consequence” and then to determine corresponding control measures required. For ongoing identification of hazardous tasks that require risk assessment, the HSE Department shall review the major site progress of the upcoming three months to identify the need for a risk assessment update.

3.1.2.1 Purpose of Risk Assessment

The purpose and function of a risk assessment can be expressed as follows:

1. To identify operations, tasks and processes which may foreseeably cause harm to employees and/or others on the site (hazards);
2. To identify the potential for the hazard to be realized, and the potential consequences which might then occur (risks); and
3. To enable a risk assessment to be developed which will assist in eliminating or reducing the exposure of the workers and others to the risk.

Risk evaluation is considered based on the principles of prevention and protection of all workers, client, consultants, and all visitors. The principles, in summary are to:

1. Avoid risk;
2. Combat risk at the source;
3. Change the method of work to suit the individual;
4. Make use of technological developments;
5. Incorporate control measures into procedures within an overall planned structure to reduce risks;
6. Give precedence to controls, which cover the whole workforce or activity; and
7. Provide information and training to all workers involved.

3.1.2.2 Definition of Hazard and Risk

Hazard: The potential to cause harm, including ill-health, physical injury, damage to plant, equipment, property or the environment.

Risk: The likelihood that a specified undesired event will occur due to the realization of a hazard by or during work activities, or by products and services created by work activities.

3.1.2.3 Risk Evaluation

Figure 2 shows an example of a risk evaluation matrix. Where the probability of occurrence is categorized as follows:

5	Frequent	Likely to occur frequently
4	Occasional	May occur occasionally
3	Probable	Unlikely but possible to occur
2	Remote	So unlikely that occurrence may not be experienced
1	Improbable	Occurrence is rare

		Hazard Severity				
		Negligible **A**	**Slight/low** **B**	**Medium** **C**	**High** **D**	**Very High** **E**
Probability of Occurrence	**Improbable** **1**	Low	Low	Low	Low	Low
	Remote **2**	Low	Low	Low	Medium	Medium
	Probable **3**	Low	Low	Medium	Medium	High
	Occasional **4**	Low	Medium	Medium	High	High
	Frequent **5**	Medium	Medium	High	High	High

Figure 2 Example of a risk evaluation matrix

Risk Rating and Action criteria:

Low (L)	Acceptable, however review to see if risk can be reduced further.
Medium (M)	Task should only proceed with appropriate management authorization after consultation with specialist teams. Efforts must be made to reduce the risk; the cost of prevention should be measured. Risk reduction measures should be implemented within a defined time period. Where a medium risk is linked with extremely harmful consequences, further assessment may be necessary to establish more precisely the likelihood of harm to determine the need for improved control measures
High (H)	Task must not proceed. It should be redefined, or further control measures put in place to reduce risks. Work should not be started until the risk has been reduced. Considerable resources may be required to reduce the risk. Where work is in progress, urgent action should be taken. If it's not possible to reduce the risk, work has to remain prohibited.

3.1.2.4 Risk Control

The following criteria shall be put into consideration while establishing control measures to mitigate the risks. Preferred orders of control are as follows:

- **Elimination** – removing the hazard or hazardous work practice from the workplace;
- **Substitution** – substituting or replacing a hazard or hazardous work practice with a less hazardous one;
- **Isolation** – isolating or separating the hazard or hazardous work practice from people not involved in the work or the general work areas from the hazard. This can be done by installing screens or barriers, or marking of hazardous areas with conspicuous colours;
- **Engineering Control** – if the hazard cannot be eliminated, substituted or isolated, an engineering control is the next preferred measure. This may include modifications to tools or equipment, providing guarding to machinery or equipment;
- **Administrative Control** – includes introducing work practices that reduce the risk. This could include limiting the amount of time a person is exposed to a particular hazard, control access into hazardous area by implementing a "permit to work" system; and
- **Personal Protective Equipment (PPE)** – should be considered only when other control measures are not practicable or to increase protection of personnel.

3.1.2.5 Procedure

1. Break down the identified job into individual processes;
2. Identify potential hazards associated with each process;
3. Evaluate the risk level arising from each hazard based on the likelihood of occurrence and consequences of the harm using the risk matrix;
4. Determine control measures to eliminate the hazards or to further reduce the risk level;
5. Identify risk controllers;
6. Complete the risk assessment report and pass it to the HSE manager for approval and endorsement. Communicate the risk assessment report to the identified risk controllers, relevant subcontractors and concerned parties;
7. Implement the control measures mentioned in the risk assessment reports;
8. The Safety Coordinator is to carry out periodical inspections to ensure the risk control measures are being implemented properly; and
9. The Safety Coordinator to review the risk assessments wherever required.

3.1.2.6 Record and Review

Records of the risk assessments should be properly maintained. A register of risk assessment shall be prepared for ease of reference. The risk assessments shall be reviewed when:

- Significant change to the working method;
- New technology, plant, equipment or material applied;
- Major accident or high potential incident has occurred;
- Change in applicable legislation;
- An industrial summons, suspension notice, or improvement notice has been received; and
- Any other reason exists to suspect that the original assessment is no longer valid or could be improved.

4. Preparedness

The site must be prepared for potential incidents or emergencies by:

- Developing and implementing HSE and emergency procedures;
- Providing adequate and ongoing training for site personnel;
- Conducting drills and exercises;
- Regular auditing of site activities;
- Ongoing and effective communication;
- Ongoing liaison with emergency service agencies;
- Identifying resources and equipment required for effective emergency response;
- Identifying roles and responsibilities of individuals;
- Identifying key personnel and reliable means of contacting them; and
- Maintaining documentation so potential incidents or emergencies can be properly managed.

4.1 Training

4.1.1 Objective

In order to enhance employees' safety and environmental protection awareness and knowledge in accident prevention, adequate training will be provided to all employees including subcontractors' employees.

4.1.2 Orientation Training

All new or transferred employees, including subcontractor's employees, shall attend an orientation training provided by HSE Department, within seven days of their arrival on site. The content of the orientation training shall include an introduction to this EERP and special arrangements for emergency situations in place.

4.1.3 Training Programme

An example of typical training schedule of in-house training is presented in Table 1.

Table 1 Schedule of in-house training

Training Details	Conducted by	Participants	Frequency
Emergency procedure and application of EERP	HSE In-Charge	All staff	Quarterly
Fire Evacuation Drill	HSE In-Charge	Concerned staff	Once every 6 months

4.2 Exercise and Drill

Only a structured drill and exercise programme can ensure the effectiveness and readiness of the emergency resources (responders and equipment). Drill and exercise will be tailored to suit the nature of site activities and will include, but not limited to, the following emergency situations:

- Fire and evacuation;
- First Aid; and
- Spill response drills.

There are various methods employed to periodically test the response capability, including:

4.2.1 Table-top Exercise (Every 3 months)

A table-top exercise is a facilitated discussion or activity conducted in a conference room setting involving the discussion of a scenario by the response team. The primary characteristic of a table-top exercise is that it involves a verbal "walk-through" of a response to an incident. Table-top exercises are also:

- Used for establishing policies, providing input to planning, developing procedures, clarifying roles, and confirming knowledge;
- Conducted in a non-threatening learning environment; and
- Conducted by trained personnel to facilitate discussions and evaluate performance.

The purpose of a table-top exercise is to have participants practice problem solving skills, resolve questions of coordination, and assign responsibilities in a non-threatening environment, under minimum stress. A table-top exercise can be used in preparation for a functional or full-scale exercise.

4.2.2 Functional Exercise (Every 6 Months)

A functional exercise is more extensive than a table-top exercise in that the activities are conducted beyond a conference room atmosphere. This type of exercise is often referred to as a "drill" and focuses on a single response function. Functional exercises (drills) are characterized by:

- Scenario-driven response activities;
- Simulation of non-participating parties;
- Limited mobilization of personnel and resources;
- Limited scope;
- Trained personnel to serve as controllers, evaluators, and simulators; and
- Hands-on experiential learning.

The purpose of a functional exercise (drill) is to exercise a specific function or a limited range of functions of a response plan. Functional exercises (drills) enable those involved to validate key functions/objectives and demonstrate individual team knowledge, skills and capabilities.

4.2.3 Functional Exercise (Annually)

A full-scale exercise is used to evaluate a response of the total, integrated, operational capabilities involving all levels of management and could involve all aspects of a response operation (e.g., notification, assessment, initial response, recovery, disposal, etc.). Full-scale exercises are designed to mirror real-life incidents as closely as possible. This type of activity enables the validation of a multitude of functions and teams, as well as to evaluate the interaction and coordination among participants. Exercises involve:

- Scenario-driven response activities;
- Variation in the number or type of participants;
- Simulation of non-participating parties;
- Arrangement of personnel and resource mobilization;
- Participation of multiple teams/management levels in integrated response;
- Extensive realism; and
- Trained personnel to serve as controllers and evaluators.

The purpose of a full-scale exercise is to practice the range of response functions in the EERP to the maximum extent practical. A full-scale exercise will incorporate a high degree of realism, extensive involvement of personnel and resources, and an increased level of stress on player participants.

4.2.4 Lessons Learned

Ministry of Energy will develop a comprehensive management system to address all lessons learned from drills and real-life incidents together with near misses. The lessons learned should be incorporated into an action plan for measurment and focus on key issues.

4.3 Resources

Resources and equipment are readily located on-site to enable prompt response and effective management of incidents or emergencies. Such resources and equipment include:

4.3.1 Adequately Trained Emergency Teams

Ministry of Energy will assgin the following trained and qualified Emergency Teams to be available and ready onsite in the event of any emergencies:

- Rescue Team;
- Fire Fighting Team;
- Security Team;
- Administration Team;
- First Aid Team; and
- Engineering Team.

4.3.2 Equipment

4.3.2.1 Fire Extinguishers

Enough number of fire extinguishers will be made available in appropriate places with the following specifications:

- A fire extinguisher rated not less than 2A shall be provided for each 3,000 square foot of building area and in each yard storage area. Travel distance to any fire extinguisher shall not exceed 100 feet from any protected area.
- One or more extinguishers rated not less than 2A shall be located on each floor of a multi-storied building. At least one 2A-rated extinguisher shall be located adjacent to each stairway in a multi-storied building. Extinguishers rated not less than 10B will be provided between 25 feet and 75 feet of any area in which more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas are used or stored.
- Extinguishers shall be conspicuously located where they will be readily accessible and immediately available in case of a fire. Their locations shall be conspicuously marked. Extinguishers shall be installed on hangers or in brackets provided and its height shall not be more than 5 feet from the floor. Extinguishers weighing more than 40 pounds shall be installed so that the top is not more than 3 ½ feet from the floor.

4.3.2.2 First Aid Box

Enough number of First Aid Boxes will be made available in appropriate places. The contents of a first aid box typically include:

- 6 Triangular Bandages
- 2 Crepe Roller Bandages 2”
- 2 Crepe Roller Bandages 3”
- 24 Adhesive Dressing – Band-aid Style
- 1 Roll Surgical Adhesive Tape ½” – 1”
- 1 Packet individually wrapped Sterile Wound dressing (50 Nos)
- 2 Packet cotton Balls
- 20 Swab Sticks (in plastic container)
- 1 Bottle Antiseptic Liquid (250ml)
- 1 Tube Antiseptic Cream (30 gm)
- 2 Bottle Eye Pads
- Sterile Eye Pads
- 2 Small Towels
- 12 Safety Pins
- 1 Pair Scissors
- 1 Pair Forceps
- 1 Pair Tweezers
- 1 Kidney Dish Plastic (small)
- 1 Pair of pocket disposable Gloves

4.3.2.3 First Aid Room

Apart from enough number of First Aid Boxes, a suitable and adequately equipped First Aid room shall be provided on site and it will be maintained as follows:

- A Stretcher
- Wheel Chair
- A sink with cold and hot running water
- Drinking water
- Paper Towels, soap and nail brushers
- Clean garments for use by First Aiders
- Clinical Thermometer
- A cough with pillow and blankets frequently cleaned
- Dressing trolley
- Kidney tray;
- Splints of different size
- Oxygen Tank
- Sphygmomanometer
- Stethoscope
- Other necessary surgical items

4.3.2.4 Material Safety Data Sheets (MSDS)

MSDSs on all substances and chemicals used on site shall be maintained in folders and placed in easily and readily accessible locations and should be regularly updated.

4.3.2.5 Oil and Chemical Spill Containment Equipment

Oil spill containment equipment and spill kits shall be placed in easily accessible and pertinent locations throughout the site.

5. Emergency Response Activities

5.1 Emergency Response Procedures

In the event of an emergency, the following procedures will be implemented to ensure an effective response:

- Immediate reactions (Initial response);
- Alerts and notifications;
- Assess situations;
- Initiate appropriate Environmental Emergency Response Plans (EERPs);
- Report to concerned/relevant authorities/parties; and
- Response to deactivation and debriefing.

5.1.1 Immediate Reactions (Initial Response)

Any person involved in or witnessing an incident must initiate appropriate action to ensure the safety and immediate treatment of injured personnel and to prevent consequential injury or loss at the incident site. In addition, Safety Coordinator must be notified to command and continue the initial response activities. The priorities of initial response are to:

1. Ensure human health and safety;
2. In the event of an injury to any person;
    - Stabilize injured person(s). If the person is able to move or there is the ability to move the injured person, they shall be moved to the First Aid Room as early as possible, irrespective of whether they have received First Aid treatment. If there is no capacity to move the injured person, the First Aid Team shall be summoned to the site of injury. First Aid should be administered by trained and approved first aiders or medical staff;
    - HSE Manager/Incident Commander should be immediately notified.
3. In the event of a fire, immediate actions shall be taken to:
    - Stop all hot work activities;
    - Shut down all electoral and fuel sources, if necessary;
    - Assess the size of the fire and the resources available to suppress it;
        - If the fire is small enough, extinguish it;
    - Notify others in the area;
    - Notify immediate Supervisor/Foreman and the site designated Fire Marshal;
    - Notify local fire department if necessary;
    - Conduct a head count; and
    - Evacuate the area, if necessary.
4. Preserve the environment;
5. In the event of a spill, immediate actions shall be taken to contain/clean up the spill using sand, or other suitable absorbent material;

6. Minimize or prevent property damage;
7. Minimize or prevent equipment damage;
8. Secure the area/scene;
9. Immediate notification:

- The type of accidents (indicative) that require immediate notification to the relevant local authorities and the ambulance service are as follows:
  - Fatality
  - Any fracture other than finger, thumbs or toes
  - Any amputations and dislocations of shoulder, hip, knee, or spine
  - Loss of sight (temporary or permanent)
  - A chemical or hot metal burn to the eye
  - Penetrating eye injury
  - Any injury resulting from an electric shock which causes unconsciousness
  - Any injury resulting from an electric shock which requires resuscitation
  - An injury resulting from an electric shock which requires hospital admittance for more than 24 hours
  - An injury that result in unconsciousness or the casualty needing resuscitation
  - An injury resulting in the casualty being admitted to hospital for more than 24 hours

5.1.2 Alerts and Notifications

Safety Coordinator shall broadcast an alarm requiring all onsite personnel to gather at the predetermined gathering place/assembly point/muster point to receive further instructions.

An alarm or an emergency notification system will be established as part of the Emergency Preparedness to alert all employees at the site in the event of an emergency. According to site practical conditions, the alarm or notification system could include lights, horns, sirens, or other appropriate devices or operational forms to ensure that all employees are aware of site emergencies.

5.1.3 Assess the Situation

Safety Coordinator shall assess the situation and establish contact with Incident Commander to decide upon course of action and appropriate emergency response stagey/method.

5.1.4 Initiate appropriate EERPs

The Incident Commander shall decide to initiate one of the following ERPs:

- Personnel Injury
- Site Evacuation
- Fire or Explosion
- Floods
- Chemical or oil spillage
- High Winds and Dust

5.1.5 Report to Concerned/Relevant Authorities/Parties

The degree of reporting required in the event of an accident is determined by both the outcome and the severity of the accident. Reporting of low potential incidents, including First Aid cases and Medical treatment cases of low severity is limited within the Site Safety Department through the Site First Aid Room. Any accidents resulting in fatality, fire, or preventing personnel from duty more than 3 days will be reported to concerned authorities by telephonic message or by fax immediately following the accident and a more comprehensive report shall be prepared and submitted to the authorities within 24 hours.

The procedure to be followed in accident reporting is as follows:

1. Injured persons shall be moved to the site's First Aid Room as early as possible, irrespective of whether they have received First Aid treatment;
2. Inform the Supervisor, Safety Department, and Incident Commander;
3. Inform the authorities if required;
4. A detailed investigative report will be prepared by the Safety Department and submitted to the Incident Commander;
5. The Incident Commander will submit the report to the authorities concerned;
6. It is the responsibility of the supervisor to submit the preliminary report to the Safety Department. The Safety Coordinator shall in turn investigate the incident and furnish the detailed report to be submitted to the Incident Commander

During the accident investigation time, witness statements, the contributing causes, and root causes are to be analysed. In addition, a compiled report with all the Learning Points arising from the incident are to be passed on to all employees to raise awareness on the incident.

A Safety Summary Report will be prepared on a monthly basis incorporating all data related to any type of accidents. The initial accident report will be issued within 48 hours and the final close out report within 7 to 14 days.

5.1.6 Response Deactivation and Debriefing

Once the incident has been declared over, the Incident Commander chair the debriefing activities and notify appropriate organisations of de-brief meeting time and location.

5.2 Environmental Emergency Response Plans (EERPs)

5.2.1 Personnel Injury

The following actions will be taken for personnel injuries:

- The Site Safety Coordinator or site designee, will be notified of the injury(ies) by the employee(s) at the scene;
- A qualified First Aid Attendant will be summoned immediately to administer first aid until medical assistance arrives;
- The Incident Commander or designee will notify local emergency services for Ambulance and other relevant emergency services, if required;
- All key supervisors will be paged or called and informed of the injury;

- For off-site assistance, the HSE Manager or designee will meet the emergency responders at a prearranged gate and direct them to the location of the emergency;
- Should an employee require off-site medical transportation, they will be accompanied by a site representative such as First Aid Attendant/Nurse to give pertinent information needed;
- As soon as possible, the HSE Department will carry out an accident investigation to identify the root cause(s) and implement corrective measures;
- Once the root cause(s) have been identified, an incident briefing to all concerned employees should be conducted by Management Team; and
- All necessary documentations regarding the incident should be filled out and sent the HSE Department.

5.2.2 Site Evacuation

In the case of severe weather events, a potential threat to the site property or workers such as a bomb threat, the site area may have to be evacuated. Once a decision is taken by the Incident Commander to evacuate, the following procedures/actions must be taken:

- All employees will evacuate to predetermined area(s) unless the evacuation area is in danger;
- The Site Safety Coordinator or designee will broadcast via all means available, such as two-way short band radio and over cell phones, a predetermined alarm and convey the specific egress and gathering area instructions and the nature of the emergency. Acknowledgement from each on-site team leader and their crews will be required;
- The Site Incident Commander or designee will notify the concerned authorities;
- All visitors and vendors/subcontractors will be guided by their key on-site contact;
- Site ERT will proceed to the assembly area, perform a head count and provide further instructions to evacuated personnel; and
- After all employees are accounted for, the employees must await instructions prior to leaving the site or going back to work.

5.2.3 Fire or Explosion

- All on-site employees are responsible for fire prevention and will be trained on firefighting techniques and the use of fire extinguishers regularly in addition to the orientation training they receive upon arriving to the site;
- There is potential for an accidental fire to be caused by construction materials/waste or by sparks thrown from cigarette smoking, welding or cutting torch;
- There is also a risk associated with the use and storage of small quantities of flammable liquids and compressed gases, including equipment fuels, paints, and cleaning solvents. Hazards associated with these materials will be mitigated by following safety requirements found in MSDSs or Health and Safety Specific Plan; and
- Ministry of Energy will have fire extinguishers onsite to address any small fire which can be extinguished in its infancy stages. For larger fires, firefighting services will be notified and mobilized to the site of the fire.

Upon discovering the fire, the following actions will be taken;

- Safety Coordinator to assess the size of the fire and the areas affected by it;
- Determine the cause of the fire and apply corrective measures;
- Prepare documentation in accordance with incident reporting requirements; and
- Notify the Incident Commander.

5.2.4 Floods

The following list of actions shall be performed in the event of flooding:

- Site Safety Coordinator or designee will consult with concerned authorities to determine the severity of local flooding;
- Construction material which can be damaged by water or pollute the water if submerged will be moved to either enclosed areas or elevated areas above the short-term local sheet flooding to remain dry; and
- If the flooding is severe, the site will be shut down and evacuated, if required.

5.2.5 Chemical Spillage

General emergency response procedures in the event of spills:

- Identify the drum/can which is the source of the leak/spill;
- Cordon off the area of spillage;
- Use appropriate PPE (gloves, goggles, boots, etc.);
- If the chemical spill is in the form of a jet, immediately move the material from the affected area. The workmen should wear the necessary PPE while doing so;
- Drain off the punctured drum/can into an appropriate container;
- After the drum is drained off completely, dispose of the drum appropriately. Wash off the floor with water (use saw dust if required);
    - If chemical has been spilt directly on soil, decontaminate saturated soil by removing the top 2 to 3 inches of soil. This contaminated soil must be disposed of at a proper disposal site. The decontaminated area should be covered with at least 2 inches of lime and then topped with fresh topsoil.
- Contaminated spill material shall be collected in a separate bin and disposed of by an approved waste disposal contractor; and
- All concerned staff shall be trained in the procedures for handling spills and shall be made aware of Federal and local regulations.

5.2.6 High Winds and Dust

- When high wind creates a hazard to craftsmen or work being performed i.e. instability in elevated areas, limited visibility due to dust or particles in the air, unmanageable materials etc., supervisors will stop work activities, reassign work and area, properly store and secure material which might be blown away, injure someone or damage equipment, lower/tie down crane booms and obtain further instruction from Site Management;
- Appropriate material should be available and stored on the site to facilitate the securing of site property, materials, and equipment, i.e. rope, wire, boards / plywood; and
- Although the storm might have passed, hazards may still exist because of unstable structures or other hazardous conditions. Therefore, a safety and property damage loss assessment inspection shall be conducted on the site by supervisors and reported to the Safety Team for planned clean-up prior to start-up or normal site activities.