KEPCOPC

JAFURAH COGENERATION POWER PLANT, SAUDI ARABIA

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

Project No.: 55003680
Date: 25 January 2023

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INTRODUCTION

WSP has been appointed by The Korea Electric Power Corporation (KEPCO) as the Environmental Consultant to undertake an Environmental and Social Impact Assessment (ESIA) for the Project in accordance with the National Centre for Environmental Compliance (NCEC) (previously known as General Authority of Meteorology and Environmental Protection (GAMEP) and prior to that as Presidency of Meteorology and Environment (PME)) requirements for projects in the third category, and due consideration of potential international lenders' requirements.

The Environmental and Social Impact Assessment (ESIA) required for this development will cover the construction, pre-commissioning, commissioning, start-up, and operation of the plant, in order to obtain approvals from the National Center for Environmental Compliance (NCEC).

PROJECT DESCRIPTION

The Jafurah Cogeneration Power Plant (herein referred to as the 'Project') is a proposed gas turbine facility that will have a capacity of 317 Megawatt (MW) to provide steam and electricity to the Jafurah Gas Plant (JFGP) under a 20-year Energy Conversion Agreement. The proposed location for the plant is in the Eastern Region of the Kingdom of Saudi Arabia (KSA) in Jafurah, which is 100 kilometers (km) south of Dammam, and 40 km east of Al Hofuf.

LIMITATIONS

This assessment was prepared based on the designs and information at the time of the preparation of this report. Where gaps in data or information were identified, WSP has made assumptions based on professional judgement and experience with similar projects in the region.

SUMMARY OF ESIA ASSESSMENT

Air Quality

Based on the Project scope, air quality impacts have been assessed for the construction and operational stages of the Project.

An assessment of construction dust was undertaken based on the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction. Taking into consideration the meteorological condition, topographic condition, severity of dust emissions and sensitivity of area, the overall impact significance of dust emissions from construction activities is assessed to vary from low to high.

Construction impacts will be mitigated through implementation of good working practices incorporated into the Construction Environmental and Social Management Plan (CESMP). In order to mitigate impacts from construction dust, good practice as per the IAQM standard will be implemented. A Dust Management Plan (DMP) will be developed and implemented to control dust emissions, as well as employment of effective construction management. Construction emissions from vehicles will be mitigated in accordance with best practice. Daily site inspections will include observations of black smoke and dust emissions, in addition to an appropriately scheduled maintenance programme for vehicles and equipment. Following the application of the mitigation measures described above, the impacts on air quality are considered to be low.

An air dispersion modelling assessment has been undertaken to evaluate the impacts on ambient air quality of Project operation.

The model evaluates the baseline monitored air quality data surrounding the Project site and the meteorological conditions for the duration of 5 years (2015-2020). The meteorological data is sourced from the nearest airport, which is King Fahd International Airport located 120 km north of the Project site.

Development of the dispersion model was undertaken using AERMOD software. AERMOD is a steady-state Gaussian dispersion model that represents the current state-of-the-science and the preferred dispersion model of the US EPA.

The scenarios that have been modelled are:

- **Scenario 1:** Emissions associated with the continuous normal operation of COGEN facility i.e HRSG and two auxiliary boilers
- **Scenario 2:** Cumulative Emissions associated with the continuous normal operation of COGEN facility (Scenario 1) plus emission from the adjacent JFD facility like thermal oxidizer, burn pit etc. It is noted that the emission rate and other parameters used for adjacent JFD facility was considered from the previous modelling report[1] based on the KEPCO approval.

The pollutants that are modelled are NOx, PM2.5 and PM10 and CO.

The outcomes of the air quality modelling assessment have indicated that the 1^{ST} highest maximum concentrations for CO, NO_2, $PM_{2.5}$, PM_{10} and SO_2 are well within GAMEP air quality standard for all six different receptor's locations for both Scenarios 1 and 2.

In addition to the above tabular data for Scenario 1 and 2, isopleths for each species are presented in Appendix 1 and 2 of the Air Quality Dispersion Modelling Report (WSP, 2022), Appendix J.

Noise

The Project is a greenfield Project devoid of any existing development. The occasional presence of local herders and their livestock has been noted in the area. However, during the construction phase only authorized personnel will be allowed on site. Based on the potential impacts to personnel working on site during the construction phase, mitigation measures will be recommended to achieve the suitable noise limits specified in the applicable noise standard/guideline so that the impact of noise on personnel is not significant.

Increased noise and vibration during the construction phase will likely result in the disturbance to local fauna species in the Study Area, in particular birds, which will result in their relocation or avoidance of the area. The Study Area is not a significant habitat for birds and their mobility negates any significant impact. The mammals (for example, foxes) and reptiles (for example, dhubs) in the study area will also be exposed to any increase in noise and vibration levels. However, foxes are mobile and will relocate and dhubs are noise tolerant.

Construction site and traffic noise and vibration levels will have a low spatial extent and will be largely contained within or in close proximity of the site (500 m). The duration of the impact will be temporary, with the construction phase being completed within 32 months.

Although noise will be generated during the operation phase, there are no noise sensitive receptors located within the Project site. The nearest encampment is located 3 km from the site. Moreover, during the operation phase a buffer zone will be implemented and access will be regulated to authorized personnel only. Based on the potential impacts to personnel working on site during the operation phase, mitigation measures are recommended to achieve the suitable noise limits specified in the applicable noise standard/guideline so that the impact of noise on personnel is not significant.

It is recommended that the best practicable means of construction noise mitigation to be included in the CESMP. It is also recommended that general noise control measures and best practicable means of construction noise mitigation are applied throughout the construction of the Project to further mitigate noise levels.

Odour

This aspect has been scoped out of the ESIA.

Water Quality

Geotechnical investigations were undertaken by Riyadh geotechnique & foundations LLC in 2019. Borehole investigations carried out at the site identified the presence of granular soil deposits underlain by silt/clay/claystone at all locations. The subsurface strata consists of medium dense to very dense sand deposits underlain by hard silt/clay/claystone layers up to the maximum investigated depth of 50m below the surface. The subsurface strata was considered sufficient to support the development footprint and proposed structures (Riyadh Geotechnique & Foundations LLC, 2019).

As evidenced from the survey, the groundwater across the JFGP sit ranges from 1.60 to 10.20 m below existing grade level. Specifically at the Cogeneration Power Plant site location, the

groundwater was 5.10 below existing grade level. The groundwater generally follows the topography and flows from southwest to northeast towards the sea.

Several sources of effluent streams will potentially be generated during construction phase. This will include wastewater and stormwater. Dewatering is not anticipated and therefore is not expected to cause contamination. If not appropriately collected or otherwise discharged to the surrounding environment, this could impact the quality of surface and groundwater by increasing the levels of nitrate, phosphate, ammonium, turbidity total suspended solids (TSS), biological oxygen demand (BOD), and chemical oxygen demand (COD). These could have an adverse impact on the surrounding habitat. The impact has been assessed and the impact significance determined as low.

No groundwater will be utilised during the construction phase. Water required for the construction phase will be sourced and delivered to the site by tanker. Based on initial estimates, a total of 296,000 m^3 will be required across the complete construction period; of which, 246,000 m^3 is required for potable water use and 50,000 m^3 for concrete curing, testing, commissioning and firefighting. This water is planned to be sourced by the EPC Contractor and its Subcontractor under the EPC contract, presumably from the nearest water production plant from the site, and it is estimated that up to seven 40-ton trucks would be required per day to transport water to the site via Highway 95.

The Project will handle operational phase wastewater in accordance with the IFC EHS Guidelines for Thermal Power Plants. The operational phase wastewater is expected to include GTG wash water, boiler blowdown, and sanitary wastewater from ablution facilities. Disposal of sanitary wastewater will be undertaken by approved carriers to the closest licensed facility is located in Hofuf, approximately 50 km to the west of the Project area. Operational phase process water will be treated at the Project wastewater treatment system.

During the operation phase, raw water will be utilised from the groundwater for the first 20 (twenty) months of operation, following which raw water will be provided by the desalination plant at the JFGP. The raw water will be abstracted at a rate of 86.31 m^3/hr for the initial 20 months. It is noted that the groundwater in the shallow primary aquifers is renewable, recharged through percolation of seasonal surface water runoff. Whilst no specific studies for the wider area were available from the landowner, it is noted that the cumulative impact of groundwater abstraction from any surrounding activities shall be part of the scope of the JFGP ESIA.

During the ICOD phase under the commissioning stages of the plant, well water will be used for the SWRO and demineralization plant. This water will be provided by the JFGP and initially stored in the raw water storage tank at the Cogeneration Power Plant. It is assumed that the impacts of water extraction on groundwater recharge and localized changes to hydraulic flow will be assessed under the wider JFGP ESIA based on the overall demand for the combined Projects. Potential impacts during this phase specific to the Cogeneration Power Plant are limited to water usage.

- Water usage for hydrotesting.
- Water usage for start-up of facilities.
- Contamination of groundwater due to oil and chemical spills.

During the operation phase, raw water will be provided by the desalination plant at the JFGP. No well water will be utilized. Potential impacts due to operation include:

- Contamination of groundwater due to oil and chemical spills.

- Contact/ near contact with perched aquifer.

The impact has been assessed and the impact significance determined as low.

Soil and Sediment Quality

The Project area lies within a zone rich in organically rich mud rock which has been targeted for unconventional oil and gas exploration and development. The formation below the Project site is known as the Jurassic Tuwaiq Mountain Formation (Hakami, Al-Mubarak, Al-Ramadan, Kurison, & Leyva, 2016).

Four soil samples were collected by the SGS field survey team on 10 August 2022. The samples were collected to be representative of the conditions of the area and composite samples taken in accordance with laboratory sampling procedure. The samples were analysed at the SGS laboratory in KSA and results indicate no evidence of contamination or exceedances when compared to the latest NCEC Implementing Regulation standard for natural areas.

During the all phases, the soil within the Project site may experience surface runoff, erosion, soil contamination due to vehicle and equipment maintenance and spill events due to improper handling of hazardous materials and other related activities which could bring about a change in its natural constitution.

Biodiversity and Natural Vegetation Cover (Terrestrial)

Multiple surveys were carried out to assess and document the site ecological characteristics to identify potential impacts, survey was undertaken at the site from 2nd to 10th October 2018 and on the 15th and 16th March 2019, including daytime and nighttime surveys. A third survey was carried out in October 2022

The main impacts on biodiversity and natural vegetation cover include:

- Habitat loss through site clearance and movement of earth/soils.
- Disturbance to existing fauna populations due to noise and vibration.
- Introduction of invasive species.

Site levelling and habitat clearing are the factors most likely to impact native fauna and flora during the construction phase. This is a result of direct alteration of the land surface, rendering it unsuitable habitat for most species during the construction phase. Relocation of fauna and flora prior to construction is expected. Excavations within the proposed development have the potential to trap small animals such as reptiles and small mammals. However, carrying out the clearing work during the summer will minimize the impact. There will be barriers around any ongoing construction activities. Noise and vibration pollution associated with construction of the facility is also a potential disturbance factor for fauna.

A Critical Habitat Assessment (CHA) has been conducted based on the ecological data collected in three surveys, concluding that the study area is not a Critical Habitat (CH) for any of the identified species, as the study area doesn't meet any of the IFC PS6 and its Guidance Note (2019) criteria of CH.

Biodiversity (Marine)

This aspect has been scoped out of the ESIA.

Health and Safety (Occupational and Public Health)

A number of activities expected to be undertaken during the construction period may adversely affect workers' health and safety either through misuse of equipment or machinery, ineffective training or carelessness. Similarly, at such a site there are general site hazards which vary in nature over the course of the construction period according to the activities being undertaken and include hazards such as:

1. Construction noise;
2. Falls from height;
3. Slips and trips;
4. Manual lifting;
5. Working at confined spaces;
6. Falling structures or loads;
7. Safety risks from land and marine traffic accidents;
8. Handling of fuels and chemicals;
9. Electric and machinery works (including working on live wires);
10. Respiratory effects from poor air quality; and

Construction workers are often at risk from exposure to infectious diseases on construction projects due to poor sanitary conditions associated with toilets and clean-up facilities. Poor sanitation is a major cause of disease and can be a serious occupational health risk. These infectious diseases can spread to operational staff.

Landscape and Visual Comfort

This aspect has been scoped out of the ESIA.

Land Use

Potential impacts to land use during construction that are relevant to the Project include:

- Limitations in access for encampment/ stock owners and herders in the area as a result of land take.

Individuals involved in stock management and recreational users of the area will lose access to Project site. The Cogeneration Power Plant is being developed in conjunction with the JFGP, which will also restrict land use in the area. Therefore, impacts relating to access restrictions are cumulative. Additionally, loss of livelihood does not result from the Project as there are no encampment or groundwater wells located in the Project area and alternative grazing locations are available.

Following the completion of construction works, no further land take or displacement of individuals will be required, so impact on land use from operations is considered negligible. This aspect is therefore scoped out for the operational phase.

Waste Generation

No demolition works are required at the site as there is no infrastructure at present, however site clearance, site levelling, grading, and compacting will be done to prepare for the planned infrastructure as per design.

A detailed construction waste analysis for quantifying the volumes is not yet available for review. However, the following waste is likely to be produced on site:

- Packaging material (wooden pallets and cardboard packaging);
- Food waste from workers;
- Organic waste (e.g., removed vegetation);
- Reusable and recyclable construction waste (e.g., earth fill);
- Non-reusable construction waste (e.g., contaminated excavated material);
- Sanitary waste from worker welfare facilities; and
- Hazardous waste (e.g., lubricant and solvents containers).

Municipal waste is anticipated to be generated during the construction phase from the staff, engineers, offices, and staff deployed. However, the majority of waste generated during construction will require off-site shipmen and disposal to landfill. Increased on-site waste minimisation during construction will reduce the load on the regional and national waste management resources. Hazardous waste will be temporary stored in dedicated bunded area and transported off site on an as-required basis by a licensed operator to the nearest appropriately licensed hazardous waste facility.

The operational phase of the Project will result in the generation of waste streams associated with the plant operations, maintenance works and administration functions. The types of waste materials during the operational phase may include:

- Waste associated with operation and maintenance works of the plant equipment;
- General waste streams generated from the offices, worker accommodation, etc.;
- Hazardous waste such as hydrocarbons, oils, solvents, contaminated rags, steel, plastic drums, filters, paints, and greases; and
- Non-hazardous waste such as paper, organic food waste, and plastic packaging associated with the operational administration area and any worker's accommodation.

Socioeconomics

Potential impacts to socioeconomics during construction that are relevant to the Project include:

- Adverse impact: Limitations in access for encampment/ stock owners and herders in the area as a result of land take.

- Beneficial impact: Employment and increased opportunities for local and regional residents and businesses, which may be contracted to supply goods and services, as well as for the KSA economy.

Individuals involved in stock management and recreational users of the area will lose access to Project site. The cogeneration facility is being developed in conjunction with the JFGP, which will also restrict land use in the area. Therefore, impacts relating to access restrictions are cumulative.

Some of the workforce requirements for the Project may be met by existing residents of local communities thereby reducing the requirement for labor from other KSA communities or overseas. The project therefore provides increased opportunity for employment, either directly on the Project or indirectly through local businesses providing goods and services to the workforce and associated accommodation camps. The opportunity for increased employment and business in the local area represents a beneficial impact during construction.

Archaeology and Cultural Heritage

The movement of heavy vehicles may cause structural damage if occurred regularly over a long period of time. Additionally, construction vehicles may result in permanent loss or destruction, sterilization, relocation, or loss of the setting of an archaeological artifact or cultural feature. However, with the implementation of Best Practice working techniques, the significance of the potential impact of construction activities is considered minor adverse.

Additionally, a chance find procedure will be developed and implemented as part of the mitigation measures on-site through visual inspection of invasive site work practices to determine if consideration is being given to the possibility of chance finds.

No further earthworks will occur during operation and the level of activity on undisturbed areas on the Project site will be minimal. As such, the impact of operation on archaeology and cultural heritage is not applicable. Hence, it is scoped out of the ESIA assessment.

Protection Plans

Detailed mitigation measures have been compiled based on the impact assessment undertaken for the Project and are provided in the Plans (Section 7) of this ESIA.

Monitoring and Reporting

Prior to the start of construction, the Contractor is required to undertake a pre-construction survey in accordance with the approach outlined in the ecology sections and as detailed within the Biodiversity Commitment.

During construction and operational phases, the following monitoring shall be undertaken by the Contractor:

- Weekly environmental inspections as per the checklist provided in F-CESMP and F-DESMP;
- Visual dust monitoring;
- Visual inspection for black smoke emissions;
- Excavated material monitoring;
- Noise monitoring at all sensitive receptors;

- Waste Monitoring;
- Labour- compliance with labour policies/laws including wages, contracts, welfare facilities and accommodation (IFC PS2); and
- Grievance mechanism.

FRAMEWORK MANAGEMENT PLANS

An F-CESMP has been developed as part of this ESIA. The Contractor is expected to prepare a detailed site-specific CESMP, incorporating the ESIA findings. An F-DESMP has also been developed as part of this ESIA. The Contractors are required to develop a Project DESMP that includes the recommendations of this ESIA.

CLIMATE CHANGE RISK ASSESSMENT

After extensive evaluation of relevant developing climate change transition risks on the project, it is concluded that most of the identified risks will have direct and indirect impacts on the Project within its operating years. As some of the main drivers of climate change policies are accelerating at the national and global level, plus further advancement on operational efficiency of clean technologies, the impact can vary at different stage of the project, extending beyond the jurisdiction where it is operating.

It is recommended that resiliency measures be considered for the Project, specifically for design infrastructure to withstand chronic and acute climate impacts through improved resiliency (such measures can include using high reflective paving around the site to reduce heat island effect, and ensuring piping and wiring is underground in conduits to protect against flooding and weather damage). Prioritize avoiding technology lock-in by designing the infrastructure to support flexible systems based on multiple, small, and decentralised solutions. Traditional infrastructure design relies on predicting demand at the end of an asset's life cycle. This predicted demand is used to establish the system's fixed capacity at the time of delivery. Flexible designs, on the other hand, define a lower capacity that matches current demand, such that rather than equipping the system with a set capacity throughout its lifetime, the capacity may be expanded accordingly based on changes in demand.

HUMAN RIGHTS IMPACT ASSESSMENT

A Human Rights Impact Assessment (HRIA) was undertaken for the Project, and includes a detailed description of the baseline conditions, specifically outlining the applicable legislation.

The impact assessment includes consideration of impacts of the project on human rights throughout the project life cycle and includes the supply chain. Based on the assessment, all impacts are considered as being of low impact, across the construction and operational phases.

Mitigation measures and monitoring measures are indicated and expected to be integrated into the ESMP's to be developed by the Proponent.

BIODIVERSITY COMMITMENT

In all cases, prior to mobilisation of equipment or construction commencing, Contractors are required to:

- Prior to commencement of works, all areas to be cleared or used for vehicle movements shall be checked by a competent ecologist for presence of fauna including mammal/reptile burrows, bird nests, etc. as part of a pre-construction survey.
- All workers will receive appropriate environmental awareness training prior to commencing work on site. This will include awareness of need for absolute protection of wildlife and local vegetation.
- No killing of fauna (incl. snakes, lizards and scorpions) on site is permitted unless human life is endangered. No collection of plant material is permitted.
- The Best Available Technology (BAT) shall be used to assess options for implementation onsite during the construction and operational phases, this includes wastewater, water, waste, air quality and other treatment or processing activities.

The above information should be provided to KEPCO no later than one week prior to the Contractor commencing works.

KEPCO, upon receipt of the information, will confirm the required biodiversity approach to be taken for the site, which may take the form of tree translocation or seeding/propagation of suitable species. It is highlighted that the Project and Contractor may be required to compensate for an increased number of trees/seedlings than are removed from a site.

CONCLUSION AND SUMMARY

Overall, the Project is considered to have a relatively low impact on the environment, provided that the Framework CESMP and OESMP are implemented correctly. Particular care should be given with regards to the mitigation measures specified.