

Hyundai Engineering Corporation

Anma-do 540MW Offshore Wind Farm FEED Project

Proposal/TBD

Issue | 01



ARUP

Hyundai Engineering Corporation

Anma-do 540MW Offshore Wind Farm FEED Project

Proposal/TBD

Issue |

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number F2106

Ove Arup & Partners Hong Kong Ltd

Level 5 Festival Walk

80 Tat Chee Avenue

Kowloon Tong

Kowloon

Hong Kong

www.arup.com

Document verification

ARUP

Job title		Anma-do 540MW Offshore Wind Farm FEED Project		Job number		F2106	
Document title						File reference	
Document ref		Proposal/TBD					
Revision	Date	Filename	Technical Proposal_Issue_01.docx				
Issue	30 Decemb er 2021	Description	1 st Issue				
			Prepared by	Checked by	Approved by		
		Name	Steve Yoon, Honest Tang & Boya Yin	Jack Yiu	Peter Thompson		
		Signature					
		Filename					
		Description					
			Prepared by	Checked by	Approved by		
		Name					
		Signature					
		Filename					
		Description					
			Prepared by	Checked by	Approved by		
		Name					
		Signature					
		Filename					
		Description					
			Prepared by	Checked by	Approved by		
		Name					
		Signature					
<div>Issue Document verification with document</div> <div> <input checked="" type="checkbox"/> </div>							

Contents

	Page
1 Introduction	1
1.1 Background	1
1.2 Purpose of this proposal	1
1.3 Project Description	1
1.4 Structure of this Proposal	2
1.5 Basic Requirements	3
1.6 Basic Information	3
1.7 Purpose of the FEED Design	4
1.8 Assumptions, Exclusions and Limitations	5
1.9 Validity of Proposal	6
2 Project Organization	7
3 Scope of Works	8
3.1 Proposed Methodology	8
3.2 Work Package 1A - Project Management	9
3.3 Work Package 2 - Site Conditions	11
3.4 Work Package 3B - Design Basis	14
3.5 Work Package 5B - WTG Supporting Structure (Low Voltage System)	15
3.6 Work Package 6 - Grid connection plan	17
3.7 Work Package 7 - Electrical Cables	19
3.8 Work Package 9 – Installation and O&M Ports	23
3.9 Work Package 10 - Substation (Onshore / Island)	25
3.10 Work Package 12 - Monitoring Houses	28
3.11 Work Package 13B - Bill of Material	29
3.12 Work Package 14B - Tender Packages (ITT) Support	30
3.13 Work Package 15 - CAPEX and OPEX Estimates	31
3.14 Work Package 16B - Support to Certifications	32
4 Deliverables and Timescales	33
4.1 Proposed Deliverables	33
4.2 Proposed Programme of Deliverables	35
5 Fee	37
5.1 Remuneration	37
5.2 Payment Schedule	39
5.3 Additional Scope of Works	43
5.4 Expenses	44
6 Terms & Conditions	45

6.1	General	45
6.2	Payment	46
6.3	Way Forward	46

Appendices

Appendix A . Soil Investigation Plan of Wind Farm

1 Introduction

1.1 Background

Korea Wind Energy Co., Ltd. (“KWC”), Hyundai Engineering Co (“HEC”), Korea Hydro & Nuclear Power Co. Ltd., (“KHNP”) and Jeonnam Development Corp.(“JNDC”) in the Republic of Korea (Korea) entered into the Memorandum of Understanding in May 2019 which sets forth that the parties agreed to develop Phase 1 of the Anma-do 230MW offshore wind power plant (the ”Project”) in Korea on a ‘build-own-operate (BOO)’ basis. Equis Wind (Korea) Holdings Pte.Ltd (“EQUIS”) has since joined the Project in 2021 which has enabled the consideration to develop Phase 1 and Phase 2 of the proposed wind farm which will comprise 540MW of combined gross power generation capacity.

The Consortium of KWC, EQUIS, HEC, KHNP and JNDC (“the consortium” “SPC”) will therefore develop the Project together which involves the design, construction, operation, maintenance, finance and ownership of the Plant including all ancillary facilities. HEC (“the Client”) engaged Arup (consortium leader) and International Consultant (“IC”), to participate in the Project to provide Engineering services as their Technical Advisors for the project.

1.2 Purpose of this Proposal

This proposal is in response to the Request for a Proposal (RFQ), submitted in an email from the Client, received on 20th December 2021. In response to this request, Arup herein submits a single proposal including the technical and financial offering for this FEED design service for the Anma-do offshore wind farm project (Phase 1 and Phase 2, 540MW gross capacity) for the Client’s consideration.

1.3 Project Description

The project site is located approximately 5km from the northern side of Anma Island, which is about 30km from the northern side of Yeonggwang county, South Korea. General project data are given in below:

The project is expected to comprise offshore wind turbine generators linked by inter array cables to an intermidate substation on the nearby Juk-Do Island. Water depths at the site range from between 10m and 27m and the project covers an area of approximately 125km². The intermediate substation is linked via subsea export cables to an onshore substation from where the electrical energy is exported to the grid.

Table 1 Project Summary

Item	Description
Project Name	Anma-do 540MW Offshore Wind Farm Project
Capacity	540MW (230MW for Phase 1 and 310MW for Phase 2)
Location	5km from Anma Island, Yeonggwang-gun, Jeollanam-do
Partners	KWC-EQUIS-HEC-KHNP-JNDC Consortium -KWC : Korea Wind Energy Company -EQUIS: Equis Wind (Korea) Holdings Pte.Ltd -HEC : Hyundai Engineering Co., Ltd -KHNP : Korea Hydro&Nuclear Power Co., Ltd -JNDC : Jeonnam Development Corporation
Offshore Wind Measurement Device (Ridar location)	Latitude: 35° 19' 45.94" N Longitude: 125° 53' 16.86" E
Environment	90km from Mokpo Port, Low possibility of earthquake

**Figure 1 Location of Anma-do Offshore Wind Farm Site**

1.4 Structure of this Proposal

This proposal follow the format below format:

- Section 3: Scope of Works – The design packages are to be covered.
- Section 4: Deliverables and Timescale – We provide our proposed project programme and list of deliverables in this section.

- Section 5: Fee – Arup’s fee for the service is proposed. The fee is also broken down for each work packages.
- Section 6: Terms and Condition – Arup’s standard terms and condition is explained. We understand that this is subject to discussion with client and we welcome to apply the same or similar terms and condition in Concept Design agreement.

1.5 Basic Requirements

A list of requirements from the Client, as stated in their email of 20th December 2021, for Arup to base the preparation of this FEED proposal are listed below and forms the basis of the offer made.

- One type of Wind Turbine Generator (WTG): The information on type and technical data of one WTG would be available at the start of FEED and will be given to Arup.
- One type of WTG substructure (Jacket).
- One type of substation (Onshore at Juk-do Island).
- The island monitoring house will be located on Juk-do Island which forms part of the Anma Island group (To be discussed).
- One export cable route via the Transmission Tower on Songi-do to a landing point (preferably LP 5) in Younggwang.
- A switch station located at the landing point and electrical cable runs under the roadside in between switch station and the West Younggwang No. 2 Substation.
- Minimization of the program through intensive resource input and application of automation tools to shorten the analysis time.

1.6 Basic Information

The following basic information, which are necessary to generate the design basis for the FEED, will be provided by the client. The below timeline is tentative and if there is significant change in dates, the FEED schedule presented in section 4.2 has to be changed accordingly.

Table 2 Tentative Schedule for Basic Information Receipt

Items	Timeline		Remark	
	Draft	Final	Draft	Final
Soil Investigation (wind farm area) See Appendix A.	End of March	End of May	The interim SI report including the results of laboratory test for six boreholes (2 boreholes for Phase 1, 4 boreholes for Phase 2)	The final SI report including the remaining six boreholes.
Metoccean Study (by DHI)	End of March	End of May	Interim report	Final report

Items	Timeline		Remark	
	Draft	Final	Draft	Final
Geophysical Survey (wind farm area)	End of February	End of March	Including Bathymetric Survey work	Final engineering report
Geophysical Survey (cable route area)	End of February	End of March	Including below items -. Bathymetric Survey work -. Side Scan Sonar -. Marine Seismic Reflection Survey -. Marine Magnetic Survey	Final engineering report
WTG specification and Tower geometry	-	To be updated	-	To be updated

The tentative schedule of soil investigation for FEED can be referred to **Appendix A. Soil Investigation Plan of Wind Farm.**

The Metocean study currently being conducted by DHI will include below information ;

- Basic data collection and analysis referring to meteorological data, marine physical environmental data and seabed topography.
- Numerical modelling work such as hydrodynamic modelling and wave modelling.
- Local scour assessment for up to 3 WTGs
- Engineering analysis and report.

1.7 Purpose of the FEED Design

The definition of Front End Engineering Design (FEED) varies across different countries and different engineering sectors. For clarity and to ensure mutual understanding on the extent and level of details of our proposed FEED service, we would like to define the purpose of the FEED work for Anma-Do Offshore Wind Farm Project as follows:

- Identify and mitigate major project risk items. Where information and time is limited to enable complete close-out of certain risk items, they should be properly documented, and mitigate through clear definition and requirements given in the FEED and EPC tendering package
- Review the design work conducted in the concept design stage, and provide necessary development and refinement to bring the design to the level ready for EPC tendering. It should be noted that the design product produced in the FEED stage will have to be further developed in the detailed design stage by the EPC contract designer based on particular choice of construction methods, equipment and detailed coordination among different interfaces (e.g. client, operators, contractors, etc.), prior to the actual commencement of construction works.

- Resolve construction logistics, land issues, interfaces, relevant government procedures (if any) necessary for EPC tendering. It should be noted that the FEED designer will not be able to handle all the above alone. Nonetheless we will provide the required technical support to HEC that are within our capability and capacity.
- Develop and confirm arrangement for operation and maintenance with the input from HEC, WTG supplier, the operator and other relevant parties.
- Support on project programme and EPC tender process

1.8 Assumptions, Exclusions and Limitations

Our assumptions, exclusions and limitations for this proposal are as listed below:-

- We will conduct general engineering inspection and site visits as appropriate as necessary to ensure we have good appreciation of the site conditions to facilitate our FEED work. However, physical fieldworks of any kind, including site investigation (e.g. borehole drilling, field and laboratory tests, geophysics tests) and surveys (e.g. topographical survey and utilities survey), are beyond the scope of this Contract. We shall identify the need for those works as soon as practicable in the beginning of the FEED stage and provide technical support to HEC for procurement of those works. We assume the contractual work and supervision work (if any) will be handled by the SPC.
- All technical documents required for the FEED is expected to be available at the commencement of our engineering services. We will review and interpret the available reports / received data and provide our recommendation on the use of data and derivation of design parameters. When we spot errors in those reports such that we cannot further proceed with our work, we expect the Client will assist in requesting and obtaining the rectification / explanation from the report originator.
- All survey and experiment including geotechnical survey and interpretation, numerical analysis experiment, will be performed and provided by SPC and Arup will review the HEC's result and complete the review report.
- At the end of FEED, we will produce relevant drawings (general layouts and arrangement, interpreted geological plans and sections, foundation general arrangement and schematic secondary structure layout) with details sufficient for subsequent EPC costing exercise and auction preparation.
- The FEED will be based on IEC standards and local (Korea) design codes, and the international codes if necessary.
- Local permit and authority approvals are not included in Arup's scope unless otherwise specified.
- Any international certification support other than specified in section 3.14 Support to Certifications. However, if it is required, we are happy to offer support as an additional service.
- Any environmental impact assessment (EIA) service is excluded.

- Translation and interpretation of any other languages other than English are excluded.
- All deliverables provided by Arup shall be revised as per HEC's comments. extra fee and time shall be provided for involving scope / requirements or details that are beyond what FEED stage may reasonably entail. In addition, the list of drawings will be submitted at the beginning.
- Any update and revision of the design in FEED stage is due to late provision of the updated or additional information. When necessary, extra fee and time shall be decided through mutual consultation according to the relevant content.

1.9 Validity of Proposal

Our proposal remains valid for 6 months from the issue of this proposal, after which time we reserve the right to adjust the fees and expenses, should this be necessary.

2 Project Organization

Arup and IC propose to use many of their key personnel to deliver this project. The proposed organisation combines the strength and depth of both Arup and IC's design capability and experience with its local project management team in Korea.

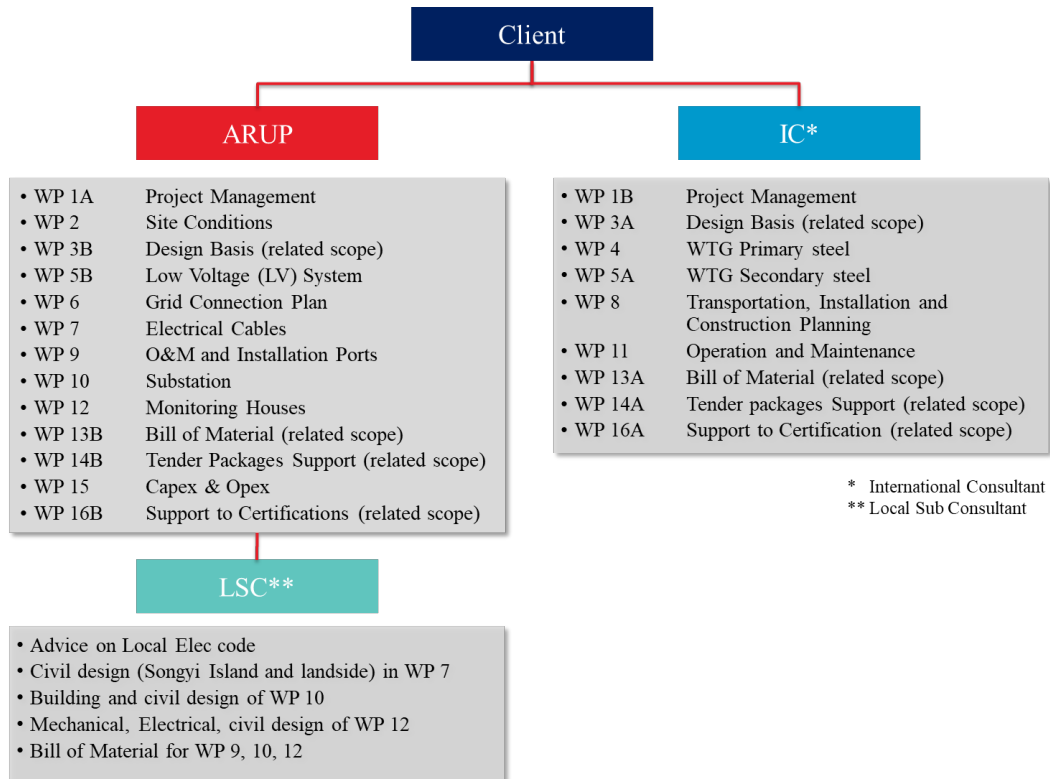


Figure 2 Proposed Project Organization

Arup and IC's respective responsibilities are shown in the **Figure 2**.

A local sub consultant will join the team under Arup to provide support in local electrical code and practice as well as civil design of electrical cable layering in Songyi Island and Landside between cable landing point #5 and West Younggwang #2 substation.

Arup and IC will form an un-incorporated consortium where each party has separated scope and several but not joint responsibility.

3 Scope of Works

3.1 Proposed Methodology

The methodology that will be adopted to execute the scope of works, is presented in this section. We also briefly present our approach and understanding of the design process.

The latest revisions of codes and standards, including amendments, will be adopted unless otherwise noted. Best practice and standards in the industry will be used during the design process.

Table 3 Example of Codes, Rules & Standards to be adopted

No.	Document Title
1	IEC-61400-3-1, Design Requirements for Fixed Offshore Wind Turbines, 2019
2	DNVGL-ST-0126, Support Structures for Wind Turbines, July 2018
3	DNVGL-ST-0437, Loads and Site Conditions for Wind Turbines, November 2016
4	NORSOK N-004, Design of Steel Structures, revision 3, 2013
5	DNVGL-RP-0416, Corrosion Protection for Wind Turbines, March 2016
6	DNVGL-RP-C203, Fatigue Design of Offshore Steel Structures, April 2016

3.2 Work Package 1A - Project Management

3.2.1 Project management Team

The proposal includes project management and coordination in Seoul provided by Arup, and supported by the technical design teams from Arup and IC to manage all design works. Where necessary, Arup will engage sub-consultants in Korea to undertake tasks that require significant local inputs and/or interfacing.

All interface with client will take place in English and in Korean if necessary.

3.2.2 Procedures and Documentation

Project management procedures and documentation will be adopted as established early in FEED design stage to ensure efficient and timely delivery.

Please refer to **Section 4.1** for the documents to be delivered.

Please refer to **Section 4.2** for the proposed project programme.

3.2.3 Execution Plan and Schedule

Upon the commencement of the project, the execution plan and project schedule will be prepared and submitted to client. The service execution plan should include but not limited to the following documents:

- Service schedule. (용역 예정 공정표)
- Service detailed implementation plan. (용역 세부 시행계획)
- Service performing organization and Engineer's personal information (list of participating engineers, duties, etc.).
(용역 수행조직 및 기술자 인적사항(참여기술자 명단, 담당업무 등))
- Engineer mobilization plan by field and grade.
(분야별, 등급별 기술자 동원계획)
- Participating Engineer Security Memorandum. (참여기술자 보안각서)
- Security maintenance measures and detailed implementation plan.
(보안유지 대책 및 세부 이행계획서)

3.2.4 Regular Meetings and Progress Update

Our proposal includes time and resource for the following activities:

- Monthly technical and progress meetings attended by PM, DPM and Lead Engineers
- Preparation of meeting minutes and necessary meeting information

- Ad-hoc telephone discussions between HEC and our Seoul office
- Preparation and submission of monthly progress report
- Regular review and update of the service schedule in biweekly intervals.

3.2.5 Project Presentations & Workshops

We understand that the ultimate client may require presentations and workshops for presenting the progress, findings and results of the FEED work. Our proposal includes the following provision for project presentations and workshops:

- Two presentations / workshops (events) conducted using Microsoft Teams or similar online communication tools
- Each event would last up to eight hours. We assume such event would not last for more than three days.
- Events will be attended by the management team (PD, PM or DPM), lead engineers and team members relevant to the topics to be discussed.
- Preparation of event materials such as powerpoint slides, pre-meeting materials and meeting minutes.

3.2.6 Note

- Invoicing and payment matter of IC is not part of our scope but should be dealt by IC.

3.3 Work Package 2 - Site Conditions

3.3.1 General

In the beginning of FEED service, Arup will conduct necessary studies and reviews to confirm the site conditions to enable the preparation of the design basis and subsequent FEED design work. The following deliverables will be produced:

3.3.2 Geotechnical Interpretative Report

We understand the current round ground investigation (GI), which consists of boreholes, CPT and laboratory testing, will be completed by early March 2022. We will conduct a comprehensive review and analysis of all available GI data.

Where possible and appropriate, three dimensional (3D) ground model of the WTG site area will be created by integrating all relevant geotechnical and geological information from the target area. Geotechnical parameters obtained from ground investigation such as drillholes, vibro-core and CPT could be incorporated in model by populating the attributes in the 3D space.

Derivation of lower bound, upper bound and best estimate values with appropriate Level of Confidence (LOC) across unlimited soil strata will be undertaken. The design line can be obtained in terms of equations and plots. Multiple sets of design lines may be developed if different parts of the project WTG site exhibits substantially different geological conditions.

The ground interpretative report (GIR) will be developed based on the abovementioned work for the subsequent FEED design work. It should be noted that at the time of preparing this proposal, we are not sure if GI information will be available in relevant areas outside the project WTG sites, including:

- Possible island substation site on Juk-Do Island
- The latest export cable route (both sub-sea and on land) suggested by HEC, including the intermediate landing on Songi Island
- Possible sites for onshore substation, monitoring houses and auxiliary facilities

In view of tight schedule, we suggest GIR be issued in a number of volumes as follows:

1. Project WTG site
2. Export Cable route (including Songi Island)
3. Island Substation
4. Onshore facilities

With the exception of Volume 1 – Project WTG site, the level of details and issue date for the remaining parts of GIR shall be jointly agreed by HEC and Arup based on the availability of the data and the service schedule.

3.3.3 Metocean Study Review Report

As state in **section 1.6** we understand DHI Group is conducting below service for client as moment.

- Basic data collection and analysis referring to meteorological data, marine physical environmental data and seabed topography.
- Numerical modelling work such as hydrodynamic modelling and wave modelling.

Once, the report is issued, Arup will review and produce review report.

3.3.4 Seabed Condition Survey Review Report

At the time of preparing this proposal, it is not certain when the bathymetric and geophysical survey of the project WTG site and the latest proposed subsea export cable route will be completed. Assuming those information will be available upon the commencement of the FEED service, Arup will conduct a comprehensive review of the available survey data.

Seabed profile and geological interfaces shall be modelled based on results of multi-beam bathymetric survey and seismic survey, which are then correlated against the results of detailed investigation, i.e. vibro-core and cone penetration test (CPT).

Any potential uncharted objects and obstruction that may impact the layout / alignment and the installation of the WTG foundation and cables will be identified. Findings and recommendations will be documented in the Seabed Condition Survey Review Report.

3.3.5 Seabed Mobility and Scour Study Review Report

We understand that Seabed Mobility study is being carried out by DHI as stated in section 1.6 where sediment transport modelling will be carried out by calibrating the sediment transport against the observed migration of seabed features. Together with assessed sandwave properties, the model will enable short-term and long-term predictions of the sea bed level at the wind turbine locations and along the export cable route.

Similarly, DHI is conducting the scour study to confirm the possible scouring depth that would be developed around the WTG foundation.

The abovementioned studies by DHI will be reviewed by Arup and findings and recommendations will be documented.

3.3.6 AEP and WTG Layout Report

AEP analysis and optimisation of WTG layout were conducted in the concept design stage. In the FEED stage, the layouts developed from the concept design will be further optimised, based on the latest survey results and site condition review. If necessary, the WTG layout will be further optimised to avoid any risky ground or site constraints.. After conducting WTG layout optimization considering various

site conditions and AEP, the best single layout will be prepared for the selected turbine. Additional scenarios or further sensitivity checks will be considered as additional works and subject to further agreement between HEC and Arup between those works are undertaken.

The optimisation rationale, the process, and the finalised layout will be documented and presented in AEP and WTG Layout Report.

3.3.7 Technical Note on Evaluation of Site Conditions

Preliminary review on site conditions was conducted in the concept design stage. A further review will be carried out on the available data of the follow items but not limited to :

- Environmentally sensitive areas
- Coral reefs
- Fishery activities
- Migratory birds and birds habitats
- Military affairs
- Nearby large infrastructure and construction projects
- Shipping routes
- Proximity to manufacturing bases, etc.
- Cultural Properities

3.3.8 Offshore and Onshore Ground Investigation Plans for Detailed Design

We shall prepare ground investigation plans and the associated RFQ for both island substation and onshore facilities for HEC's tendering purposes. We assume the tendering and contract work will be handled by HEC.

3.4 Work Package 3B - Design Basis

Arup has developed the following design criteria for the Anma-Do Offshore Wind Farm Project in the concept design phase:

- AWF-ARUP-V-13-001 Part 1a: Offshore Substructures and Foundations (Jacket)
- AWF-ARUP-V-13-001 Part 2: Design Criteria (Basis) Report -Part 2: Electrical System and Grid Connection

Based on the above, design basis will be prepared in the FEED stage for the following items:

1. Wind turbines (Part A only);
2. Substations;
3. Power cables;

The development of design basis shall follow the relevant DNVGL guidance:

- DNVGL-SE-0073 Project Certification of Wind Farms According to IEC 61400-22

For item 1 – wind turbines and their supporting structures, given the project will be procured under an EPC arrangement, the development of the design basis will be up to Part A as defined in DNVGL-SE-0073. Where appropriate, we will support and provide necessary input to the turbine supplier for their development of the Part B design basis.

3.5 Work Package 5B - WTG Supporting Structure (Low Voltage System)

The foundation structure LV electrical design will consider the following systems:

- Main Low Voltage (LV) Distribution Board
- LV/ELV Cables and containment
- Earthing and Bonding Connections
- Socket Outlets
- Lighting (General & Escape)
- HVAC
- Fire Detection System power system
- Power supplies to Davit Crane
- SCADA interfaces for Onshore Monitoring and Control
- Navigational Aids power supply as required
- Impressed Current Cathodic Protection (ICCP)
- Corrosion Monitoring Systems (CMS)
- Wave Radar (if required) power supply
- Closed Circuit Television (CCTV) and power supply to other security system as required
- Ornithology (Bird) Strike Monitoring power supply

For the FEED stage our team will produce the following information:

- Basis of Design Document
- FEED stage drawings comprising; equipment layouts, LV cable containment, lighting, small power, equipment layouts, earthing and bonding.
- Schematics and wiring diagrams for LV and ELV systems.
- Earthing and bonding studies
- Illumination study, calculations and report for general lighting
- Specifications and electrical equipment schedules for contractor procurement of specialist electrical and electronic (ELV) systems.
- Cable calculation for LV, ELV, networking and earthing & bonding.
- LV systems input into the O&M manual, including advice on spare parts.
- Input into the H&S Design Risk Register.

Arup acknowledges complexities of the LV and ELV system interfaces which we will proactively manage through the design stage. Interfaces will be discussed at regular workshops with key stakeholders, contractors and suppliers, for example;

Client, WTG Supplier, HV Sub-Sea Cabling Contractor, Controls and Networking, SCADA and any other specialists.

Based on our past work we bring a design approach that places a high priority on; functionality, safe access, space consciousness, cost, fabrication and installation sequencing with valuable insight into materials and equipment in a corrosive marine environment (where we make use of our inhouse specialist materials scientists).

Arup will design with safety in mind but also consider space constraints with focus on the need for a design response that considers efficient equipment layouts, ergonomics as well as emergency evacuation.

The LV design will account for various voltage levels (690V/400V (3-phase) and 230V/110V (1-phase)) to provide flexibility for fixed and portable equipment with adequate maintenance sockets.

Arup will also consider the temporary condition prior to installation of WTG tower when power is not available. A mobile generator hook-up point will be included to power the TP during construction, testing and commissioning phases and later during operations for planned or unplanned supply outages.

Our knowledge of specialist electronic (ELV) systems, for example; Navigation Aids, CMS, ICCP, CCTV, Bird Strike, Radio Comms and interfaces with shore-based SCADA systems puts us in a good place to ensure systems integration is considered in the early stage of the design process.

3.6 Work Package 6 - Grid Connection Plan

The FEED grid connection plan is very much driven by power system studies to ensure that suitable equipment and topology adhered to requirement specified by KEPCO through its grid code. Arup will develop a FEED level grid connection plan for the wind farm to be connected to the electricity grid and export power to the electricity grid. The grid connection plan will consider:

- Applicable standards for the grid interface – Arup will conduct a desktop review of publicly available information to collate relevant normative and regulatory design standards for the grid connection interface. This will include a review of any grid requirements required by KEPCO and applicable to the connection. In parallel, Arup will also prepare a list of applicable standards governing best practise benchmark to support the attainment of grid connection. Where Korean specific information and standards are not available, Arup will utilise internationally recognised standard such as IEC standard and add value to the project by leveraging our global experience in offshore wind projects.
- Review components of electric power system – Arup will review the main electrical components required for grid connection, such as main transformers, switchgear, auxiliary transformers and compensation equipment (e.g. harmonic filters, reactive power compensation) to ensure that they are in adherence to applicable standards. Arup will prepare the main equipment list for the windfarm to enable connection to the grid.
- Grid connection simulation and studies – Arup will develop a steady state model of the Anma-do offshore wind farm in a power system software and undertake preliminary load flow and fault level calculations to determine the preliminary ratings of the main electrical components. Arup will the subsequently undertake the design of the Jukdo substation and subsea cables in conjunction with close collaboration with OEM and equipment manufacturers based on the preliminary result of the power system study. This will include reactive power compensation and active harmonic filtering equipment. Subsequently, Arup will perform an iterative power system modelling to ensure grid connection requirement is still achieved based on the parameters of available equipment as confirmed by manufacturers or any enhancement strategy that is required to adhere to the grid connection requirement. It should be noted that some parameters will be required from KEPCO to model they grid. Assumptions will adopted should there is insufficient information provided. The model and calculation will be based on one design only (i.e. one specified export votage level, one substation configuration and one WTG type) that should be confirmed at the conclusion of the concept design phase. The output will include inter alia single line diagram, simulation result, component sizing and specification.
- Connection with Korea Power Exchange (KPX) – Arup will review and summarise the technical requirement for participation in electricity market through the KPX. This may include metering requirements, data communication and registration process. This requirement will be taken into account in the design of the electrical infrastructure
- Grid connection voltage and configuration of transformer – The grid entry point will influence the design of the wind farm export architecture including export

cable voltage and the need for dedicated onshore substation for voltage transformation. Arup will assess potential grid entry points and grid connection voltage and propose the outline power export and grid interface architecture.

3.7 Work Package 7 - Electrical Cables

3.7.1 General

It is expected that the wind farm will utilise HVAC technology with submarine inter-array cables (IAC) connecting wind turbine generators (WTGs) arrays and the substation (SS) in Anma-Island, and submarine export cables connecting the SS in Anma-Island to the yet undetermined onshore landing point. Once landfall has been made the onshore cable will travel a distance to an onshore KEPCO sub-station. We understand that the scope of this section includes the submarine cables (IAC and export cables) and inland cables upto the KEPCO Younggwang No2 sub-station.

3.7.2 Cable Type and Voltage

The type and voltage of the IAC and export cables is influenced by a range of technical, commercial and environmental factors. Arup will perform a survey/desktop review on the cable options available in the market and summarize the pros and cons of each of the different types of cable and voltages with a traffic light (RAG) system considering the parameters against the following aspects, whenever applicable:

- current carrying capacity
- export cable length,
- reliability, redundancy and maintenance requirements,
- current state of the art
- system design (charging current and inrush current as well as other effects).
- communications requirements,
- cable supply chain availability,
- vessel and installation tool availability,
- water depth,
- bathymetry,
- seabed conditions,
- environmental constraints,
- UXOs (Unexploded ordnances) on the sea bed,
- third party damage risk,
- jointing and termination technology,

From the survey Arup will set up a conversation with cable manufacturers that have procurement capability of the selected cables to the Korean market. Arup will then recommend suitable cable type from manufacturer and confirm the voltage level for the wind farm with reference to the work done in the concept design stage. Up to a maximum of two manufacturers will be recommended if available.

3.7.3 Study of Cable Sizing

High voltage submarine export cables are typically of 3-core design, with its cross-sectional area (csa) primarily driven by its voltage, conductor type (Cu or Al) and choice of insulation (XLPE, EPR, etc). Electrical parameters including current carrying capability, cable loss factor and capacitance are key parameters to consider in the design, as well as the number of circuits and redundancy levels. Arup will study and summarise the potential options of different cable sizes for the IAC and export cables through conversation with manufacturers and recommended up to two manufacturers to supply such cables.

3.7.4 Export Cable Routing Study

We understand the export cables will be routed via Songi-do as explained in **Section 1.4**. On Songi Island, cables will tranverse across the island above ground and supported by cable towers. On the other hand, as the switching station (mainland) will be located near the mainland landing point, the cables wil have to travel underground on land, presumably along existing road network, to reach the existing Younggwang No2 sub-station. The following tasks will be conducted for export cable routing study:

- Review the relevant ground investigation, bathymetric survey and geophysical survey on the offshore section of the proposed export cable route
- Conduct desktop study and site inspection to the possible routes and landing points for the onshore / island section of the proposed export cable route
- Recommend HEC on the topographic and other relevant surveys to be conducted on land prior to detailed design
- Confirm the recommended export cable route for the preparation of the EPC tender and subsequent detailed design

3.7.5 Inter Array Cable (IAC) Optimisation

Arup has the knowledge and experience to carry out IAC system optimisation study efficiently. Arup has completed studies on a number of offshore wind farms in the UK and Asia.

Arup proposes an optimisation study to determine the economically optimal inter-array cable layout. The fixed WTG coordinates will be modelled in a specialist optimisation software (CableArchitect), together with all relevant input parameters. The optimiser will search the solution space and return the most economical inter-array system configuration. Arup will make assumption of input parameters based on expert opinion should some data is not available for the model.

A sensitivity analysis will be carried out to determine the influence of the main input parameters to the IAC outcome. Variation in system layout configuration (i.e. string, tree and loop configuration), cable failure rates, MTTR and wind speeds will be considered.

The study will consider the lifecycle cost of the IAC system and will integrate the following element of costs:

- CAPEX for the supply and installation of inter-array cable system.
- OPEX due to routine operation and maintenance activities.
- OPEX incurred through cable energy losses due to Joule effect in normal operation.
- OPEX incurred through losses caused by lack of available capacity due to outages in the inter-array cable system. For inter-array cable failures, OPEX will be based on complete replacement of the inter-array cable.

The deliverable of the study will be an optimum inter-array cable layout that minimises the cost and at the same time fulfills the technical requirements. Examples of technical requirements include the following:

- Minimising total cable lengths, thereby minimising procurement and installation cost and power losses;
- Minimising installation complexity, thereby minimising installation cost;
- Limiting the number of cable types, thereby simplifying installation and procurement process;
- Minimising the cable factory joints;
- Minimising losses costs caused by energy losses and cable failure during operation;
- Avoiding forbidden areas (i.e. UXO exclusion zone, dry well, wreck contact, and potential sabellaria reef).

3.7.6 Cable Burial Risk Assessment (CBRA)

The Cable Burial Risk Assessment (CBRA) is qualitative method to improve risk management of subsea cables for offshore wind farms, improve conservative estimates of residual risk. The purpose of the study is to recommend the minimum depths of lowering to mitigate the risks identified to an appropriate level.

Based on the all available data including bathymetry, GI, seabed condition, etc, Arup will conduct the cable burial risk assessment and produce the report.

3.7.7 Cable Installation and Protection Methods

Arup will study available installation methods for the submarine IAC and export cables.

Arup will perform a desktop review on the options available in the market for installation methods for the submarine IAC and export cables. Arup will summarize the pros and cons of individual installation methods with a traffic light (RAG) system considering the technical, technology and local project delivery aspects. Installation schemes will be developed to the level sufficient for EPC tender and

facilitating the subsequent detailed design. Relevant cable protection methods will be also studied and recommended.

3.8 Work Package 9 – Installation and O&M Ports

3.8.1 Installation Port: Preparation of Hinterland Plan for Equipment & Substructure Assembly

We understand that the installation works for the project will involve the use of the Mokpo New Port facilities. The scope of works includes the FEED for the development of the Installation Port including the Foundation Marshalling Area and Wind Turbine Assembly yards. We assume information or requirements for the Turbine assembly will be provided by HEC from their proposed suppliers and manufacturers.

We will produce an outline port layout based on the available information at the time of production for the study.

This will consider the current form and layout of the proposed facility and associated modifications/additions to site infrastructure (e.g. haul routes, laydown areas and quays).

Key aspects that will be considered as part of our methodology will include size (principle dimensions and mass) of components relative to the site scale and critical infrastructure including berths and laydown area availability relative to the proposed production scale, capability for co-located assembly/marshalling functions, allowance or potential for future facility expansion or development of complimentary facilities.

In this proposal, we are assuming that our responsibility is limited to the layout of the installation port, warehouse and the FEED of the construction management office (WP12) but does not include any detailed level of design for any of the port infrastructure or buildings include dredging, breakwater, quay and warehouses, jetties, breakwaters, quays etc.

However, we will work closely with HEC to provide costing and cost estimates of port facilities at this stage, which shall be sufficient for EPC tendering purpose.

3.8.2 O&M Ports: Preparation of Available Port Plan for OWF Construction

We propose the scope of works will include the preparation of plans for both primary and secondary Operation and Maintenance Ports (O&M) to be located onshore near LP5 and offshore on Juk-Do Island respectively.

We will produce an outline port layout based on the available information at the time of production of the study.

This will consider the current form and layout of the proposed facility and associated modifications/additions to site infrastructure based mainly on the requirements for warehousing and typical OSW support vessels used in Korea.

In this proposal, we assume our responsibility is limited to preliminary sizing and layout of the port, warehouse and FEED of O&M offices (WP12). This does not

include any detailed level of design for any of the port infrastructure or buildings
include jetties, breakwaters, quays, warehouses etc

However, we will work closely with HEC to provide costing and cost estimates of
port facilities at this stage, which shall be sufficient for EPC tendering purposes.

3.9 Work Package 10 - Substation (Onshore / Island)

3.9.1 General

The substation for the Anma-do OWF has been previously decided to be located on Jukdo island and will be an onshore and referred to as an island substation. This substation will include transformers to step up the array voltage of 66kV to export voltage of 154kV. If this export voltage does not match the utility grid voltage, another transformation will need to take place in the mainland substation, whereas if the export voltage match the grid voltage the mainland station will not include transformers and will be referred to as mainland switching station. This work package will include both the island substation and the switching station.

Concept design of the island substation will be developed in the Phase 2 of the concept design stage, prior to the commencement of the FEED.

It was also decided the mainland substation/switchstation would be located near the mainland landing point of the export cables.

In the FEED stage, the design of the abovementioned onshore substations will be further developed to enable EPC tendering and facilitate the subsequent detailed design work.

3.9.2 Electrical

The design of the substation is site specific, dependent on the total offshore wind farm capacity, location of the connection point and local network conditions. Depending on grid code and developer appetite on risk as well as the result of RAM study, sometimes a minimum of two transformers are required to meet the necessary N-1 requirement as typically set by the network operator. Provision for compensation equipment is also most likely necessary to achieve both reactive power and voltage control. Harmonic filters could also be required to maintain power quality within limits with respect to harmonic distortion.

This work package should cover the following:

- Preparation of SS design standard
- Review grid connection method for SS
- Review external and internal cable connection method
- Adequacy review for location of the SS
- Review type and scale of SS
- Review configuration of SS and major protection method (protective relay)
- Durability review for SS and establish countermeasures for external environment (salt damage and moisture)
- Harmonic and counter measures review
- Electric equipment selection and layout plan.
- Review SS emergency power supply plan

- Proposal of basic direction for SS operation plan.
- Review of plans to establish power control system for SS
- Review scale and necessary facilities of SS
- Ground connection, lightning protection system and corrosion proof system plan for SS
- Fire protection and fire escape facilities plan for SS
- Review of load and structure of SS
- Route and connection method review for onshore substation cable
- Preliminary facility plan for operation of onshore substation (Water and wastewater treatment, heating and cooling, and etc)
- Info-communication plan for onshore substation

Arup understands that the general purpose of the island substation scope of work is to screen the main electrical architecture options and propose the optimal configuration to HEC, in terms of operability, reliability, losses, cost, planning and risks.

From the main equipment list, Arup will extract the information applicable to the SS and compile a separate list focusing on the main equipment, utilities and other functionalities that we deem necessary for the SS FEED design. Arup will issue a weight/size estimate of the equipment to determine footprint and structural loading. The Electrical team will work together with the structural teams, through weekly design meetings to identify gaps and opportunities on footprint optimisation and refine the overall design. Arup will add value to the project by searching ways to optimize the substation footprint for example by arranging the transformer compound, switchgear rooms, control room etc. in such a way to reduce space requirements whilst ensuring practical operation. Arup will also consider the outcome of the grid connection study and supply chain availability through communication with manufacturers to ensure appropriate equipment selection for the SS.

The outcome will include the following:-

- An overall equipment layout (in high-level blocks of drawing) at the SS
- The weight and size (length, width and height) of main equipment
- High level technical specification for SS

In estimating equipment size and weight, Arup will rely on publicly available information and our internal benchmarks. We may also engage main equipment OEMs as appropriate to understand the potential and limitations of a given technology and consider the technological developments and room for innovation for the project.

Separately, Arup will define the anticipated surface of the switching station, using the bottom-up approach similar to the SS approach. Arup will produce preliminary layout drawings for both the island substation and switching station.

Arup will produce a preliminary list of critical items to inform the Client's project planning regarding potential on project implementation.

3.9.3 Other Disciplines

In the FEED stage, we will develop the reference design for substations, to the level that is sufficient for EPC tendering and facilitate subsequent detailed design work. The following aspect will be covered:

- Architecture
- Civil
- Structure and geotechnics
- Building services (including HVAC)
- Control and Instrumentation

3.10 Work Package 12 - Monitoring Houses

3.10.1 General

In the concept design stage, preliminary designs of the monitoring house in terms of architectural, electrical and civil aspects have been developed and described in the below document. In FEED design stage, the following items will be further developed.

- AWF-ARUP-V-19-009 Concept Design for Monitoring House

3.10.2 Identification of Site Constraints

The monitoring houses ideally are located in the port area close to the vessel assess. Upon identification of potential locations with port owners, site constraints such as limited physical area, marine environment, flood considerations, existing quay wall capacity should be considered.

3.10.3 Refinement of Conceptual Facilities

The facilities provided in the report mentioned in **Section 1.1** shall be refined upon the receipt of WTG supplier requirements on O&M facilities. The capacities of each facilities shall be refined to cope with the supplier requirements.

3.10.4 Ground Investigation

Ground conditions shall be assessed on the preferred monitoring house location to decide suitable foundations. If no ground investigation records are available at the preferred location, ground investigation shall be proposed there for ground assessment.

3.10.5 Reference Design for Monitoring Houses

In the FEED stage, we will develop the reference design for monitoring houses, to the level that is sufficient for EPC tendering and facilitate subsequent detailed design work. The following aspect will be covered:

- Architecture
- Civil
- Structure and geotechnics
- Building services

3.11 Work Package 13B - Bill of Material

In the concept design stage, below deliverable was developed.

- AWF-ARUP-V-21-001 Bill of Material

Arup will be further develop the Bill of Material in the FEED design which includes below items.

- Low Voltage Systems
- Subsea cables
- Island onshore substation
- Onshore switchstation and civil design of cable routing up to the West Younggwang No. 2 Substation
- Monitoring and warehouses (excluding O&M equipments inside the buildings)
- Two O&M Ports

3.11.1 Exclusion

- BoM of Primary and Secondary steel
- BoM of T&I and O&M related structures other than specified in section 3.11
- BoM of installation port

3.12 Work Package 14B - Tender Packages (ITT) Support

3.12.1 General

In concept design phase, Arup has developed below document to support client for tender process. Below documents will be further updated reflecting design development during FEED phase.

Arup will assist HEC in determining the best tendering and packaging strategy for the EPC contracts.

3.12.2 Project Programme

The project programme will be developed to facilitate the planning of EPC contracts and the relevant tendering work.

3.12.3 Technical Specifications

Technical specifications will be updated to reflect the further development of various design and works.

- AWF-ARUP-V-22-001 Technical Specifications

Please note that technical specification of primary & secondary steel, T&I and O&M related structure, equipments, etc are not part of our scope. We believe these will be provided by IC.

3.12.4 Request for Proposal

Assuming the same packaging, we will update the following documents for the request for proposal.

- AWF-ARUP-V-22-001 (Part 4) Request for Proposal – Offshore Electrical Cable and Substation
- AWF-ARUP-V-22-001 (Part 5) Request for Proposal – Onshore Land Based Civil and Building Works

Below document will be modified to focus on Onshore Substation to follow client's requirement as explained in **Section 1.5**.

- AWF-ARUP-V-22-001 (Part 3) Request for Proposal – Offshore Substation Foundation and Substructures

3.13 Work Package 15 - CAPEX and OPEX Estimates

- Responsible: Arup (Please see detail in Appendix A)

The project CAPEX and OPEX estimate was first carried out in the concept design stage and documented in the following:

- AWF-ARUP-V-25-002_Final Project CAPEX and OPEX Estimate Report

In the FEED stage, we will review and revise the CAPEX and OPEX estimate based on the latest scheme and design adopted. We will also collaborate with HEC to incorporate information that may have been collected over the course of FEED design.

3.14 Work Package 16B - Support to Certifications

We will provide the technical support to HEC to gain certifications from international certifier, who is an independent body or organisation that will check and certify the design to ensure that the final products meet the requirements and specifications for wind farm engineering and the processes followed meet industry standards.

Our proposed asset for certifications are as below.

- Wind Turbines Design Basis Part A
- Substation Design Basis
- Power Cable Design Basis

As defined in DNVGL-SE-0073.

The supporting activities include:

- Additional packaging of report for submission to certifier
- Response to certifier's comments
- Attend meetings with certifiers to explain design rationale and analysis methodologies to facilitate the certification process

Notwithstanding the above, we will not be responsible for provide any local professional engineer (or similar) signatory / endorsement for permit applications.

4 Deliverables and Timescales

4.1 Proposed Deliverables

The following table summarises our understanding of the project deliverables. This deliverables list is based on the scope of services specified in the RFQ. It is just for reference and subject to final agreement.

Primary format of our deliverable is PDF. All of the deliverables are available in modifiable format (e.g. .doc, .dwg). However, we are not responsible of any data modified or changed after the delivery.

We will print out deliverables as necessary. However, we will claim the printing and binding fee depends on the amount.

It is assumed that the Client will provide a definitive list of document numbers for each of these deliverables at the start of the project, if Client's document numbering system is to be adopted.

All the design reports shall include the corresponding drawings, calculation reports, bill of materials, etc.

Table 4 List of proposed deliverables

No.	Deliverable	Refers to Scope of Works Item	Tentative Milestone Date
	Work Package 1A - Project Management		TBD
1	Inception Report	3.2	
2	Monthly Progress Report	3.2	
	Work Package 2 – Site Conditions		TBD
3	Geotechnical Interpretative Report	3.3.2	
4	Metoccean Study Review Report	3.3.3	
5	Seabed Condition Survey Review Report	3.3.4	
6	Seabed Mobility and Scour Study Report	3.3.5	
7	AEP and WTG Layout Report	3.3.6	
8	Technical Note on Evaluation of Site Conditions	3.3.7	
	Work Package 3B - Design Basis		TBD
9	Design Criteria (Basis) Report	3.4	
	Work Package 5B - WTG Supporting Structure (Low Voltage System)		TBD
10	Low Voltage System Design Report	3.5	
	Work Package 6 - Grid connection plan		TBD
11	Grid Connection Plan Report	3.6	
	Work Package 7 - Electrical Cables		TBD
12	Cable Design Report	3.7.1, 3.7.2, 3.7.3, 3.7.4, 3.7.5	
13	Cable Burial Risk Assessment Report	3.7.6	
14	Cable Installation Report	3.7.7	

No.	Deliverable	Refers to Scope of Works Item	Tentative Milestone Date
	Work Package 9 – O&M and Installation Ports		TBD
15	Port Status Overview & Port Planning Report	3.8.1, 3.8.2	
	Work Package 10 - Substation (Onshore / Island)		TBD
16	Substation Design Report	3.9	
	Work Package 12- Monitoring Houses		TBD
17	Monitoring House Design Report	3.10	
	Work Package 13B - Bill of Material		TBD
18	Bill of Material Report	3.11	
	Work Package 14B - Tender packages (ITT) support		TBD
19	Technical Specifications	3.12.3	
20	Request for Proposal – Substation	3.12.4	
21	Request for Proposal – Offshore Electrical Cable	3.12.4	
22	Request for Proposal – Onshore Land Based Civil and Building Works	3.12.4	
	Work Package 15 - CAPEX and OPEX Estimates		TBD
23	CAPEX and OPEX Estimates Report	3.13	
	Work Package 16B – Support to Certification		TBD
24	Packaging for certification	3.14	

4.2 Deliverables Acceptance Criteria

All deliverables, unless otherwise specified, shall be deemed approved and will be regarded as the final revision after the 2nd issue (i.e. Rev.A). The progress procedure for all deliverables shall be as follows:

- 1st issue by Arup (Rev.-): 80%
- 1st comment by HEC, regardless of the status being “Reject” or “Approved with Comments”: 90%
- 2nd issue by Arup (Rev.A): 100%

If HEC withholds responses to any of the deliverables for more than two weeks, it will be deemed that the deliverables have been approved.

The comments from HEC are expected to be minor in nature. In the case of Arup receiving comments involving changes that lead to major revisions to the concerned deliverable or a series of deliverables, mutual agreement between HEC and Arup should be made to determine the revised acceptance criteria of the deliverables. Arup will not be responsible for the delay of completion of services caused by any such changes.

4.3 Proposed Programme of Deliverables

Based on the RFP and our understanding of the Project requirements, we have developed high-level draft programme as below for your reference. This programme will be further developed once contract is awarded.

Table 5 Proposed programme of deliverables

Item	Title	Duration (months)	Q1 / 2022			Q2 / 2022			Q3 / 2022			Q4 / 2022			Q1 / 2023		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
0	Project Milestones and Key Dates																
0.1	Contract Award																
0.2	COMPANY INPUT: WTG Selection																
0.3	COMPANY INPUT: Project Design Basis																
0.4	Stage Gate 1: Baseline Concept Established																
0.5	Stage Gate 2: Client Requirement Freeze																
0.6	Stage Gate 3: Final Definition																
0.7	FOU Tender Drawings (Primary & Secondary Steel)																
0.8	Design Basis Submitted																
0.9	Design Basis Expected Certification																
0.10	Primary Steelwork Design Submitted																
0.11	Primary Steelwork Design Expected Certification																
0.12	Secondary Steelwork Design Submitted																
0.13	Secondary Steelwork Design Expected Certification																
0.14	Entire Design Submitted																
0.15	FOU Final Design Drawings																
1A	Work Package 1A - Project Management	9															
2	Work Package 2 - Site Conditions	4															
3B	Work Package 3B - Design Basis	5															
5B	Work Package 5B - WTG Supporting Structure (Low Voltage System)	6															
6	Work Package 6 - Grid connection plan	8															
7	Work Package 7 - Electrical Cables	8															
9	Work Package 9 - O&M and Installation Ports	6															
10	Work Package 10 - Substation (Onshore / Island)	8															
12	Work Package 12 - Monitoring Houses	6															
13B	Work Package 13B - Bill of Material	3															
14B	Work Package 14B - Tender packages (ITT) support	3															
15	Work Package 15 - CAPEX and OPEX Estimates	3															
16B	Work Package 16B - Support to Certifications (Optional)																

5 Fee

5.1 Remuneration

5.1.1 General

The project will be contracted with Ove Arup & Partners Hong Kong Limited (Arup). Based on our understanding of the RFQ, we assume that the contract for the Design Services will be formed between the Hyundai Engineering Co. and Arup. Our Client will be Hyundai Engineering Co. during the whole course of the services.

Our understanding of the working relationship among the Client and the Design Consultant is described in the Technical Proposal.

We propose a lump sum fee in US\$, which is net of any disbursement, local taxes and levies and will be paid to our Hong Kong bank account. Our fees shall not be subject to any retention.

5.1.2 Lump Sum Fee

The fees stated in the **6** below are Lump Sums for the proposed scope of services as defined in the Technical Proposal and based on the terms and conditions in **Section 6** below. A detailed cost breakdown of the contract fee is tabulated as in the **Table 7**. Should one or more of the above criteria change materially the fee shall be adjusted. Arup reserves the right to adjust the fees if partial services are required.

Commencement of the work shall be upon receipt of written confirmation to proceed from the client and receipt of the mobilisation fee.

Table 6 Professional Service Fees for FEED

Description of Services	Basis of Fee	Total Fee (US\$)
Technical Engineering Services	Lump Sum	2,813,000
Total (excluding expenses)	(\$\$)	2,813,000

The fee quoted above is based on the following assumptions:

- The fee is quoted exclusive of any Hong Kong taxes, duties, fees, levies and other impositions including withholding and similar taxes. In the event that any such items apply to Arup, its employees or agents, the fee shall be increased to take into account such items and Client undertakes to pay such increased fee.
- The fees are inclusive of expenses except for those noted in Section 5.4
- The fees are to be paid in US\$ to our designated bank account.

- Our proposal has been submitted on the basis that the Client will be responsible for remitting all fees to our bank account and will be responsible for all associated charges and taxes for remission of fees.
- The Table 8 also details our proposed invoicing schedule for fees.
- The lump sum fee is quoted based on the programme presented in the RFQ only.
- We will carry out other general progress meetings by teleconference or videoconference
- Our reports will be prepared in English.
- No International personnel from outside South Korea shall be required to be stationed in South Korea for the different stages of the Project.

Table 7 Proposed Price Breakdown

Work Package	Item	Price(US\$)			Remark
		ARUP	LSC	SUM	
WP 1A	Project Management	155,000		155,000	
WP 2	Site Conditions	93,000		93,000	
WP 3B	Design Basis (related scope)	46,500		46,500	
WP 5B	Low Voltage (LV) System	77,500		77,500	
WP 6	Grid Connection Plan	217,000	150,000	367,000	Consulting service for electrical design works
WP 7	Electrical Cables	310,000	270,000	580,000	Including civil design works for cable overpassing (Songi-do) and laying (inland)
WP 9	O&M and Installation Ports	155,000	80,000	235,000	Taking-off bill of materials only
WP 10	Substation	155,000	365,000	520,000	Including all of design onshore substation (juk-do) and switch station (inland)
WP 12	Monitoring Houses	93,000	220,000	313,000	Including civil, MEP+COMM+FF design
WP 13B	Bill of Material (related scope)	62,000	178,000	240,000	Taking-off bill of materials except for WP 9
WP 14B	Tender Packages Support (related scope)	93,000		93,000	
WP 15	CAPEX and OPEX	46,500		46,500	
WP 16B	Support to Certifications (related scope)	46,500		46,500	
Total	(exclusive of any VAT)	1,550,000	1,263,000	2,813,000	

In calculating the fee, we have assumed that the programme given in section **4.2 of the Proposal** shall be followed.

If there is any significant change to these assumptions which results in additional work, we would wish to discuss an appropriate adjustment to the fee.

5.1.3 Exclusions

The following services are excluded from our scope of services: -

- Physical fieldworks of any kind
- Site supervision works of any kind
- Site safety supervision or management of the site works
- Environmental management of the site works
- Quality management of the site works
- Permit management of the site works
- Translation and interpretation of any kind other languages other than English

5.2 Payment Schedule

We understand the detailed payment schedule for the Design Consultant service fee shall be decided jointly with the Client through negotiation after submitting the proposal.

Our proposed payment schedule and price breakdown are provided in **and** below, based on the proposed fee without optional item. The payment schedule for optional items shall be discussed when required.

Table 8 Proposed Payment Schedule

Deliverable Stage	Percentage of Total Fee
Upon Instruction to proceed	12.0
Regular Payments	
Month 1	1.5
Month 2	1.5
Month 3	1.5
Month 4	1.5
Month 5	1.5
Month 6	1.5

Deliverable Stage	Percentage of Total Fee
Month 7	1.5
Month 8	1.5
Month 9	1.5
Work Package 1A - Project Management	1.0
Issue of Inception Report	1.0
Approval of Inception Report	1.8
Issue of Monthly Progress Report (9 Reports x 0.2%)	
Work Package 2 – Site Conditions	1.0
Issue of Geotechnical Interpretative Report	0.2
Approval of Geotechnical Interpretative Report	0.5
Issue of Metocean Study Review Report	0.2
Approval of Metocean Study Review Report	0.5
Issue of Seabed Condition Survey Review Report	0.2
Approval of Seabed Condition Survey Review Report	0.5
Issue of Seabed Mobility and Scour Study Report	0.2
Approval of Seabed Mobility and Scour Study Report	0.5
Issue of AEP and WTG Layout Report	0.2
Approval of AEP and WTG Layout Report	0.5
Issue of Technical Note on Evaluation of Site Conditions	0.2
Approval of Technical Note on Evaluation of Site Conditions	
Work Package 3B - Design Basis	1.25
Issue of Design Criteria (Basis) Report	1.5

Deliverable Stage	Percentage of Total Fee
Approval of Design Criteria (Basis) Report	0.5
Work Package 5B - WTG Supporting Structure (Low Voltage System)	
Issue of Low Voltage System Design Report	2.0
Approval of Low Voltage System Design Report	0.75
Work Package 6 - Grid connection plan	
Issue of Grid Connection Plan Report	7.0
Approval of Grid Connection Plan Report	2.0
Work Package 7 - Electrical Cables	
Issue of Cable Design Report	8.0
Approval of Cable Design Report	1.25
Issue of Cable Burial Risk Assessment Report	2.5
Approval of Cable Burial Risk Assessment Report	0.25
Issue of Cable Installation Report	3.0
Approval of Cable Installation Report	0.5
Work Package 9 – O&M and Installation Ports	
Issue of Port Status Overview & Port Planning Report	6.0
Approval of Port Status Overview & Port Planning Report	1.5
Work Package 10 - Substation (Onshore / Island)	
Issue of Substation Design Report	10.0
Approval of Substation Design Report	3.0
Work Package 12- Monitoring Houses	
Issue of Monitoring House Design Report	4.0

Deliverable Stage	Percentage of Total Fee
Approval of Monitoring House Design Report	1.0
Work Package 13B - Bill of Material	
Issue of Bill of Material Report	3.0
Approval of Bill of Material Report	1.0
Work Package 14B - Tender packages (ITT) support	
Issue of Technical Specifications	0.8
Approval of Technical Specifications	0.2
Issue of Request for Proposal – Substation	0.8
Approval of Request for Proposal – Substation	0.2
Issue of Request for Proposal – Offshore Electrical Cable	0.8
Approval of Request for Proposal – Offshore Electrical Cable	0.2
Issue of Request for Proposal – Onshore Land Based Civil and Building Works	0.8
Approval of Request for Proposal – Onshore Land Based Civil and Building Works	0.2
Work Package 15 - CAPEX and OPEX Estimates	
Issue of CAPEX and OPEX Estimates Report	1.5
Approval of CAPEX and OPEX Estimates Report	0.5
Work Package 16B – Support to Certification	
Issue of Packaging for certification	1.25
Approval of Packaging for certification	0.25
Total	100

5.3 Additional Scope of Works

Any additional scope of services beyond those noted above will be scoped and charged through Scope Change process, utilizing the individual rates agreed in Additional Service Rates.

Expenses will be charged separately. Time charge rates for additional services will be based on the rates set out in **Table 9** below:

Table 9 Additional Service Rates for Arup staffs

Classification of Professionals	Description of Professional Classification	Rate (\$\$/ Hour)
Director	Management	225
Associate Director / Group Leader	Management	190
Associate	Management	160
Senior Engineer	Corporate member of professional institution with a minimum of four years of relevant post-qualification experience	145
Chartered Engineer	Corporate member of an appropriate professional institution or equivalent with post-qualification experience up to three years	128
Assistant Engineer	University degree or equivalent with a minimum of one year of work experience	95
Graduate Engineer	University degree or equivalent in related discipline	74
CAD Draughtsman	Diploma or Higher Certificate or equivalent in appropriate discipline	68

Time charge assumptions / exclusions:

- The above time charge rates are for additional services reimbursed on a time basis.
- The above rates include for all normal overhead costs (payroll, general administration, etc.).
- The rates apply until end of December 2022, when they will be subject to review.
- Payment for the supervision staff will be considered as additional fees paid on time-charge basis, based on the actual hours spent on site.

- The rates do not include for costs of travel, subsistence, document reproduction, photocopying or international communications network usage such as IDD telephone / fax calls.

5.4 Expenses

The fees stated in **Section 5.1.2** of this proposal are inclusive of all disbursements and expenses associated with the project's scope of service and deliverables, except for those listed below.

- All International travel, accommodation, subsistence and disbursements other than that stated in Scope of Works in our proposal. All flights will use economy class international airlines and hotel accommodation shall be of equivalent standard to that provided by Ove Arup & Partners Hong Kong Ltd.
- Fees associated with site investigation or topographical surveys of the sites and verification of the utilities available at the sites.
- Fees associated with local approvals and submissions to authorities.
- Fees for any local consultants other than scope under this proposal
- 3D images/color renderings unless agreed otherwise.
- Non-typical expenses such as the purchase of relevant data, photographic expenses, model construction and other items requested by the client and shall be reimbursed at cost.
- Fees associated with statutory submissions or gaining of information/data to complete the service.
- Fees associated with the purchase of data, maps and satellite images etc. as required. The client will be invoiced at cost for the purchase of this data.

6 Terms & Conditions

6.1 General

1. These terms and conditions form part of our formal proposal, which is set out in the proposal. In the event of any conflict between these terms and any other terms proposed these terms shall apply.
2. We will use reasonable skill, care and diligence in the performance of the services and will be liable only to the extent that we have breached this obligation. Our liability shall be limited to such proportion of your losses as is fair and reasonable having regard to the extent of our responsibility for the same.
3. When the fee is a lump sum this is based on the assumptions/criteria set out in the proposal. Should one or more of these assumptions/criteria change materially the fee shall be increased by such sum as is fair and reasonable. If we are required to modify and/or revise any completed designs, specifications or reports and/or are delayed or disrupted (in either case for reasons other than our default) then you will pay us such sum as is fair and reasonable. Unless otherwise agreed, the sum will be calculated in accordance with the schedule of rates set out in the proposal (or, if none stated, in accordance our standard schedule of rates) to cover the additional resources employed by us in respect of such additional work.
4. Notwithstanding any other term of this agreement our total liability under or in connection with this agreement whether in contract, tort (including negligence), for breach of statutory duty or otherwise shall be limited to one times the total fee in aggregate for all phase of works instructed. We shall have no liability under or in connection with this commission after the expiry of six years from the date of our proposal.
5. Copyright and all intellectual property rights arising out of our services shall vest in us. Subject to payment of all fees properly due we shall grant you a royalty free, non-exclusive licence to use intellectual property in the deliverables we provide for the sole purpose of completing the project. We shall not be liable for the use by any person of any deliverable, information or documents for any purpose other than that for which it was provided. Our prior written consent is required in each instance for use of our name or logo in any publication or media communication. We shall be entitled to retain and use any data or information acquired during the course of our services (excluding personal data as defined under applicable data privacy legislation) for the provision of the services, and for modifying or improving the services we provide to our clients. Where any data or information generated during the course of our services is held within an externally hosted data storage system, project extranet or similar you shall on request provide to us (or procure from a third party) access to all such data and information.

6. The detailed content of our proposal is the copyright of Arup, is confidential, and may be used by you only for the purposes of considering the proposal. It remains valid for 90 days from the date of the proposal.
7. If you fail to make payment in accordance with the terms of our proposal we may, upon seven days' write a notice to you, suspend performance of services until such outstanding amounts are paid in full. We shall have no liability for delay or damage caused by such suspension. If the amounts remain unpaid after 14 days of such suspension, we may terminate this agreement.
8. Neither we nor you may assign our rights under this commission and no term of this agreement confers on any third party any benefit or right to enforce any term of this agreement. Unless otherwise agreed, any report is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party for it.
9. Our agreement with you shall be subject to the law in Korea and in the event of a dispute we shall both use all reasonable endeavours to resolve such dispute in good faith. If our efforts fail then the dispute shall be referred to mediation, arbitration and, if necessary, the Korea Courts.

6.2 Payment

Time basis rates will be fixed rate. Save for any items which are included in the fee (as stated in the covering letter) disbursements and expenses will be charged separately at cost. Our fees are net of all taxes, levies, imposts or other duties. Invoices for any lump sum will be submitted in accordance with the schedule referred to in the covering letter. Invoices for time basis services will be submitted for payment on a monthly basis. Payment is due on presentation of our invoices and final date for payment shall be thirty days thereafter. Interest at the statutory rate will be charged on any overdue amounts.

6.3 Way Forward

Arup is looking forward to having further collaboration with HEC on the upcoming offshore windfarm opportunities.

Appendix A. Soil Investigation Plan of Wind Farm

Section	Division	Mar						Apr						May															
		5	10	15	20	25	31	5	10	15	20	25	31	5	10	15	20	25	31										
1. Mobilization & Demobilization																													
(1) SEP Barge 1(45)																				3월 31일 현장조사 완료예정	보고서 수정본제출 ·현장조사+실내시험	5월 20일 최종보고서 제출 예정	Leg=45m						
(1) SEP Barge 2(48)																										Leg=48m			
2. Field investigation	Wind Farm Area																												
(1) NSPT/CPT1	2차조사 (수심 26m)																												S-PS
(2) NSPT/CPT2	2차조사 (수심 17m)																												S-PS
(3) NSPT/CPT3	2차조사 (수심 20m)																												
(4) NSPT/CPT4	1차조사, 종료85.0m 조사중32.6m, 2차 추가수행																											S-PS, DMT	
(5) NSPT/CPT5	1차조사, 종료90m 종료62.6m																												
(6) NSPT/CPT6	2차조사 (수심 20m)																											DMT	
(7) NSPT/CPT7	(수심 17m, 실측 20m), 종료92.5m 종료77.8m																											S-PS	
(8) NSPT/CPT8	(수심 16m, 실측 20m), 종료91.3m 종료80.1m																												
(9) NSPT/CPT9	(수심 18m, 실측 19m), 종료93.0m 조사중54.7m, 2차 추가수행																											S-PS	
(10) BNSPT/CPT10	(수심 14m, 실측 17m), 종료91.5m 종료73.5m																												
(11) BNSPT/CPT11	2차조사 (수심 21m)																												
(12) BNSPT/CPT12	2차조사 (수심 16m)																											S-PS, DMT	
3. Laboratory Test																													
1) Basic test -Moisture Content, Atterberge Limit, Specific Gravity, Particle size distribution																												1No. @ UD Sample, every 3.0m @ Borehole	
2) Maximum and Minimum Void ratio of sand																												6 No. @ Sand layers and 6 No. @ Weathered Soil	
3) Triaxial compression test -UU, CU with Bender element, CD with Bender element																												UU: Undisturbed Sample CU: Undisturbed Sample, 21ea	
4) Consolidation Test																												Undisturbed Sample, 20ea	
5) Resonant column test																												10 No. @ Sandy soil 10 No. @ Clayey soil	
6) Cyclic triaxial test																												Sandy soil, 10ea	
7) DSS Test, Cyclic DSS test																												DSS: Sandy soil, Sea, UD Sea CDSS: Sandy soil, Sea, UD 10ea	
8) TRT tests																												10ea	
9) Chemical Test -Organic Matter, Sulphate, Chloride, pH Value, Salinity																												10 No. for Phase 1 10 No. for Phase 2	
10) Rock test																												24ea	
11) Point Load test																												24ea	