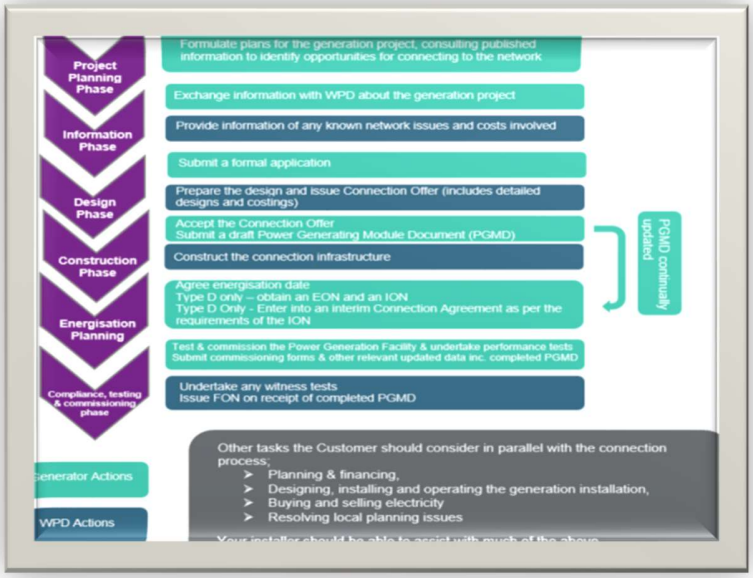
Grid Connection Process Management - UK

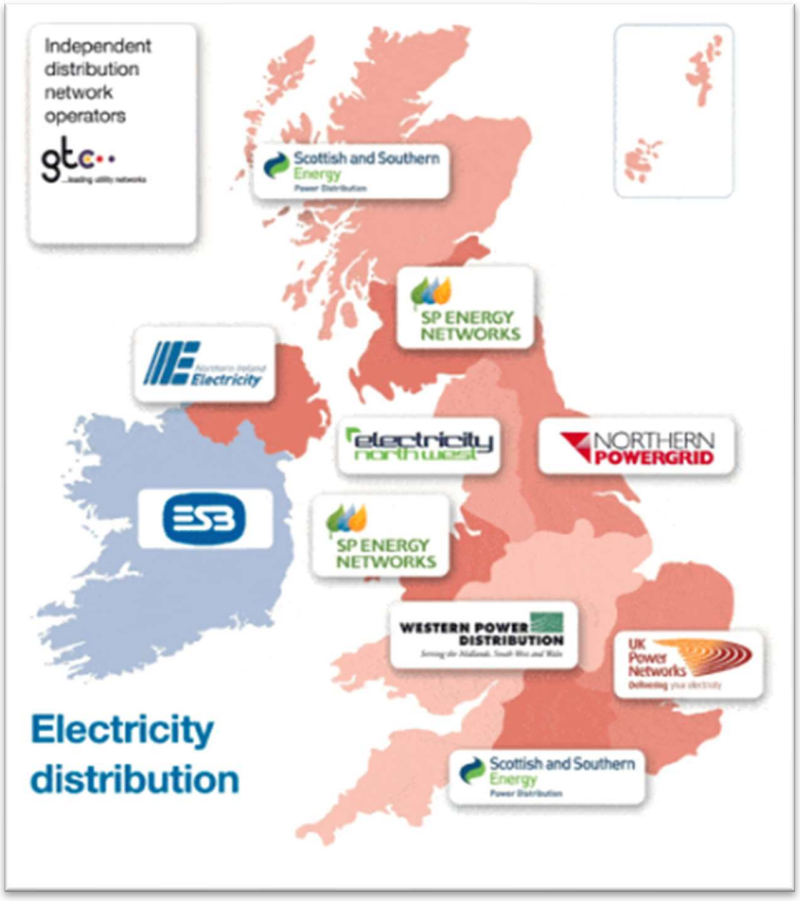


NDA International Limited has been engaged by multiple renewable energy and battery storage developers and Independent Power Producers (Lightsource BP, TagEnergy, Q Energy, etc) to facilitate the end-to-end grid connection process in the UK, which is governed by ENA regulations and the G99 standard.

The following comprehensive services have been provided to our clients:

- Preparation of Single Line Diagrams (SLDs), site plans, and layout drawings.
- Technical data collection for the generation plant and substation equipment.
- Compilation and preparation of grid connection applications along with relevant appendices (G99, NGESO, BELLA, and BEGA).
- Submission of grid connection applications to the Distribution Network Operator (DNO) / Transmission Network Operator (TNO) followed by diligent follow-up.
- Addressing technical queries raised by the DNO during the application assessment process.
- Reviewing grid connection offers and facilitating their acceptance.
- Managing and overseeing communication with DNOs/TNOs for the Statement of Works (SoW) process.
- Supervising the Mod-App process subsequent to the SoW outcome.
- Coordination with the TNO/DNO on the variation offers and challenging their proposals
- Conducting and/or reviewing G99 studies, G5/5, and P28 studies.
- Preparation of scope of works for contestable (Independent Connection Provider - ICP) works and assistance with the selection of ICPs.
- Preparation and/or review of the G99 technical submission for the following stages:
    - Pre-Energisation (EON - Energisation Operational Notification)
    - Pre-Export (ION - Interim Operational Notification)
    - Completion (FON - Final Operational Notification)

UK Grid Capacity Investigation



NDA International Limited has been engaged by multiple renewable energy and battery storage developers and IPPs (Lightsource BP, TagEnergy, and Q Energy, etc), to assist in assessing available grid capacity on the UK's electric Transmission and Distribution system for early-stage greenfield solar project development.

The renewable and battery developers provided NDA with geographic areas suitable for solar project development and expected installed plant capacity. Grid capacity investigations by the Distribution Network Operators (DNOs) involved utilizing publicly available grid capacity data from network operator websites, reviewing network development plans, attending connection surgeries, and confirming the status of existing connection applications/offers.

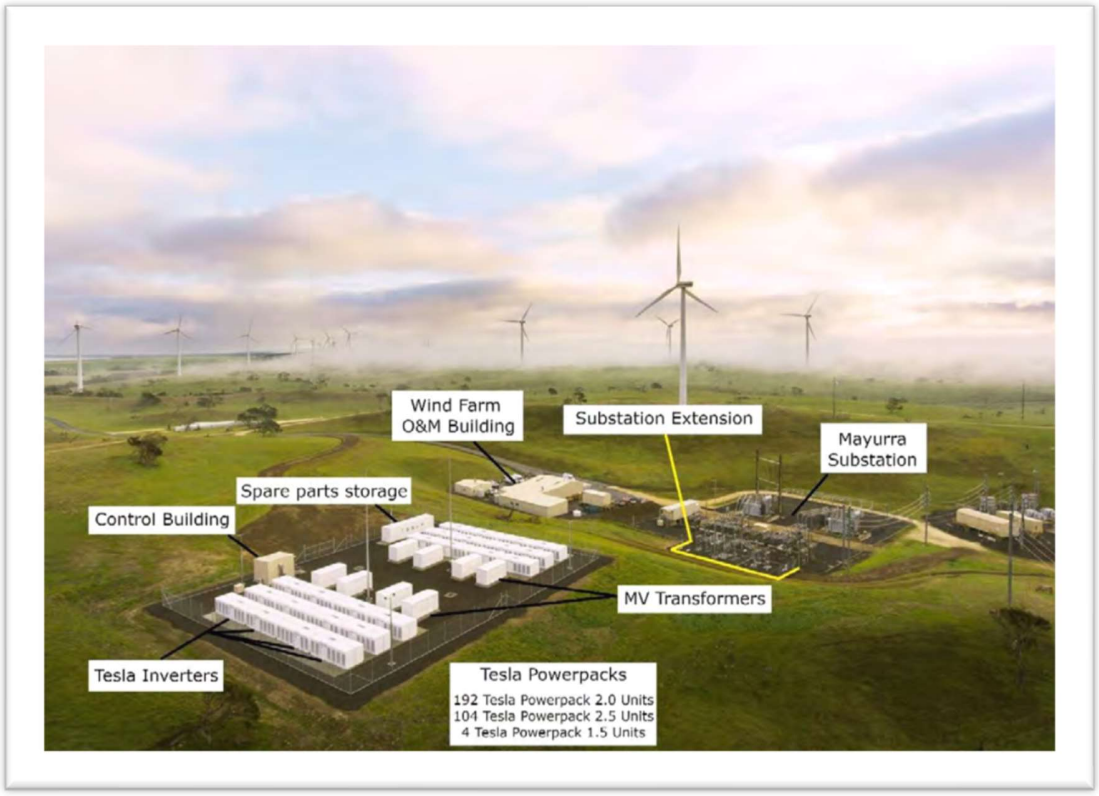
Transmission Network Operator (TNO) grid capacity investigations included utilizing publicly available grid capacity data, EYTS statements, examining network development plans, and arranging pre-application meetings for specific sites of interest.

The following activities were undertaken as part of this project:

- Investigation of publicly available grid capacity data using heat maps and capacity statements.
- Analysis of network operators' development plans

- Examination of substation and circuit ratings, loadings, and queues for generation connection applications/offers
- Analysis of the most recent Statement of Works (SoW) outcomes to investigate constraints at the GSP points.
- Ranking of substations with available grid capacity based on predetermined criteria, considering factors such as:
- Estimation of available grid capacity for renewable generation connection.
- Commenting on proximity of suitable land for solar PV development from the TNO/DNO substations.
- Presence of major planning constraints such as residential areas, airports, and areas of natural beauty (AONB).
- Preliminary assessment of potential cable route e.g. length of route, private land ownership, road, railway or river crossings, etc..
- Comments on availability of DANM and TANM schemes and constraint connection

FEED Design for 100MW/100MWh BESS and 220kV Interconnection Substation



NDA International Limited were engaged by Juru Energy and Synergy Consulting to perform the FEED design of the 100MW 100MWh Battery Energy Storage System (BESS) and the HV Interconnection substation in the Republic of Uzbekistan. The BESS system was collocated with two onshore wind power plants: 100MW and 200MW respectively.

The BESS system was rated 100MW for 1-hour duration (energy rating 100MWh). The proposed technology for the BESS was Lithium-Ion Phosphate (LFP) technology. The BESS was supposed to address three main issues on grid: (1) smoothing out the power output from the two onshore windfarms, (2) energy arbitrage, and (3) contribution to grid frequency stability.

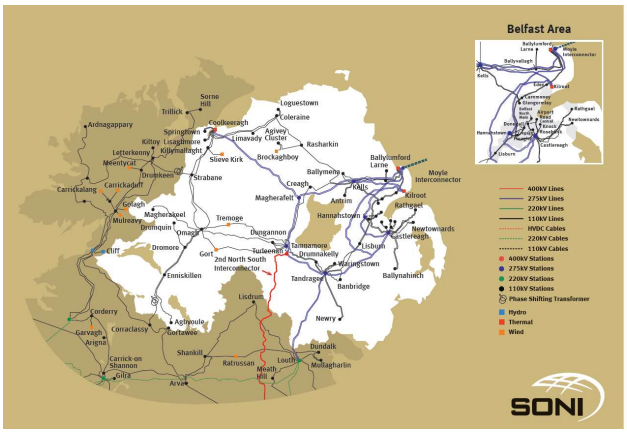
The BESS was directly to the electrical transmission grid system of the Republic of Uzbekistan at 220kV voltage level. The proposed point of connection (PoC) for the BESS was the 220kV busbars of the newly proposed 220kV switching substation to be constructed for interconnection of the wind power plants.

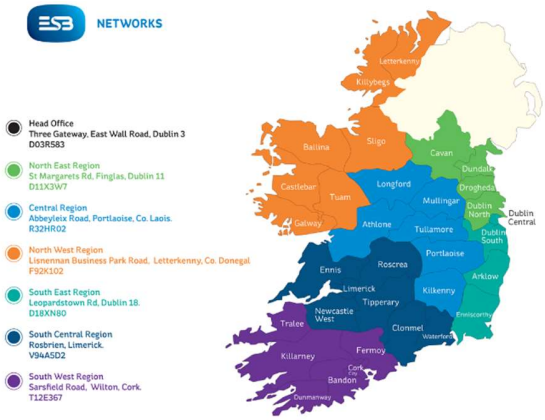
The following services were provided to the clients:

- Preparation of SLDs of the BESS facility and the interconnection substation
- Performed design calculations for sizing of the BESS plant:
    - Power transformer
    - LV, MV and HV cables
    - BESS inverters

    - Battery modules
    - Reactor and Capacitors
    - CTs and VTs
    - Recommendation on reactive compensation
- Performed load flow analysis, short circuit analysis and cable rating analysis
- Performed calculations of the design of the protection system
- Produced protection SLDs and protection functional diagrams.
- Produced scheme for the tariff metering
- Produced control logic for the three modes of BESS operation
- Produced SLDs for the overall control system of BESS
- Produced the site plans and layout drawings for the BESS and Switching substation.
- Produced technical specifications for the electrical BoP plant including battery modules, inverters, transformers, circuit breakers, protection system, and cables.

ROI and NI Grid Connection Capacity Consultancy





NDA International Limited was commissioned by a confidential client to investigate available grid capacity on the electric Transmission and Distribution systems in the Republic of Ireland (ROI) and Northern Ireland (NI), supporting early-stage greenfield solar project development. Additionally, a workshop was conducted for the client on the grid connection process for renewable generation projects in the Republic of Ireland, focusing particularly on cluster connections in Northern Ireland.

The client provided NDA with geographic areas of interest and pre-identified plots of land suitable for solar project development, along with respective threshold solar power plant capacities.

NDA International investigated grid capacity on circuits and substations using publicly available information for the networks of ESB, EirGrid, NIE, and SONI. Distribution Network Operator (DNO) grid capacity investigations involved reviewing publicly available data from network operator websites, examining network development plans, arranging meetings with generation connection teams, and confirming the status of existing connection applications/offers. Cluster connection options available in NIE were also explored and recommended.

Transmission Network Operator (EirGrid and SONI) grid capacity investigations included analysis of publicly available data, network development plans, and arranging pre-application meetings for specific sites of interest.

The project included the following investigations/deliverables:

- Conducting a workshop on the grid connection process in Northern Ireland and the Republic, emphasizing cluster connections in Northern Ireland.
- Analysing publicly available grid capacity data using heat maps and capacity statements.
- Analysing network development plans.
- Analysing substation and circuit ratings, loadings, and queues for generation connection applications/offers.
- Analysing recent Statement of Works (SoW) outcomes to identify constraints at GSP points.

- Investigating existing and future cluster connection options and identifying available capacity at each cluster.
- Identifying suitable locations for new cluster options.
- Arranging meetings with generation connection teams.
- Preparing short grid capacity assessment reports for each site, discussing ratings, loading, available capacity for renewable generation connection, and plans for reinforcement in the area.
- Ranking ESB substations with available grid capacity based on predetermined criteria, considering factors such as available grid capacity level, distance to suitable land for solar PV development, major planning constraints (e.g., residential areas, airports, AONBs), and major grid cost constraints (e.g., length of cable route, river crossings, railway lines, or major highway crossings).

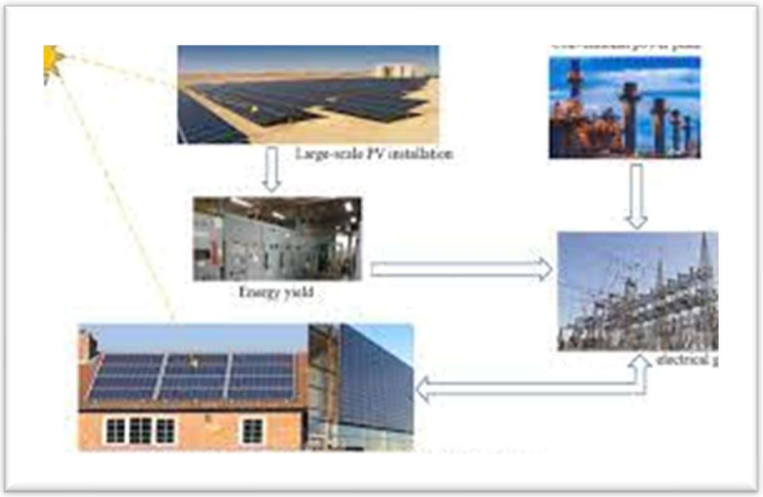
Late-Stage Development Support Until FID

NDA International Limited supported TotalEnergies Renewables during their M&A journey to acquire 5x RTB Solar PV projects in the UK totalling 500MW a.c. capacity. NDA International were responsible for all aspects of the interconnection works. NDA scope, following the signing of the exit agreement with the developer (Bluestone) was to lead the interconnection activities on the pipeline until FID and handover to the construction contractors.

Following activities were performed:

- Review of the TDD (Grid) reports and advise management on the risks and mitigation
- Risk identification, investigation and selection of the most optimal solution
- Liaison with the developer and DNO during the handover period
- Review the interconnection solution for the pipeline and propose modification considering risks, land availability, constraints and economy
- Seek DNO and NGESO approval for the recommended interconnection solution
- Provide inputs for the financial models
- Review scope of contestable design works and prepare tender documents
- Manage the ICP tender process and actively support selection of ICP
- Prepare scope for the grid design and compliance studies
- <Manage the grid design and compliance studies tender and actively support selection of the studies consultant
- Present the interconnection scope and price (non-contestable, contestable and others) at technical, tender and investment committees of the client
- Manage the division of responsibilities and scope split between EPC, ICP and DNO
- Actively participate in technical and commercial meetings
- Attend site meetings where necessary

Project Specific Grid Connection Option Reports



NDA International Limited was commissioned by various renewable energy developers and asset management clients to conduct detailed assessments of grid connection options for specific project sites across the UK. The primary objective of this consultancy work was to furnish clients with detailed information on available grid connection options, potential risks, and indicative costs of connection. This information proved invaluable for clients making early-stage investment decisions regarding greenfield project development at potential locations.

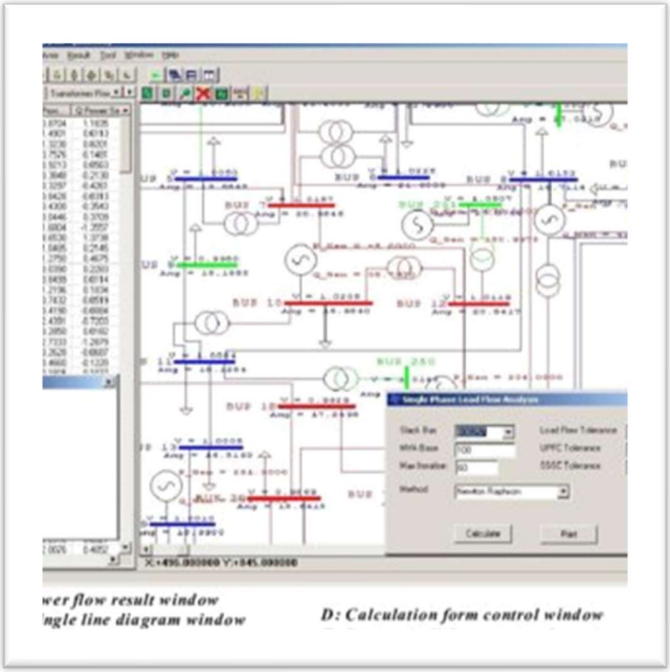
Clients provided the location and potential minimum/maximum capacity (size) of the renewable project. The reports were prepared for Solar PV, Battery storage, onshore wind, or Hybrid projects across the UK.

The following investigations and deliverables were included in the reports:

- Site visits were conducted as necessary, though in most cases, work was completed through desktop/online investigations.
- All possible grid connection options were identified within a pre-agreed radial distance range (typically 1km to 10km radius depending on the project size).
- High-level investigation of available grid capacity was conducted at each option to identify potential options with adequate available capacity for further investigation.
- Thorough analysis was performed for available grid capacity, grid constraints, existing offers or other known projects in the area, upstream grid capacity, and Statement of Works information at the GSP.
- Options were narrowed down based on publicly available grid capacity data, network development plans, substation and circuit ratings, loadings, queues for generation connection applications/offers, and recent Statement of Works (SoW) outcomes.
- Investigation of existing and future cluster connection options and identification of available capacity at each cluster, along with identification of suitable locations for new cluster options.
- Arrangement of meetings with generation connection teams.

- Preparation of short grid capacity assessment reports for each site, discussing ratings, loading, available capacity for connection of renewable generation, plans for reinforcement in the area, and more.
- ESB substations with available grid capacity were ranked according to predetermined criteria, considering factors such as available grid capacity level for connection of renewable generation, distance to suitable land for solar PV development from the substation, presence of major planning constraints (e.g., residential areas, airports, AONBs), and major grid cost constraints (e.g., length of cable route, river crossings, railway lines, or major highways crossings).

Generator Grid Code Compliance Studies



NDA International Limited were engaged by several renewable energy and battery storage developers and IPPs to perform grid code compliance studies and produce reports for the network operators. It is responsibility of the party seeking connection of a new generator (conventional, renewable or storage) to the electricity transmission and distribution system to prove compliance to the electricity grid code with help of simulations. Additionally, the party seeking connection is also responsible for provision of a simulation model for the new generator (storage system) within acceptable accuracy limits.

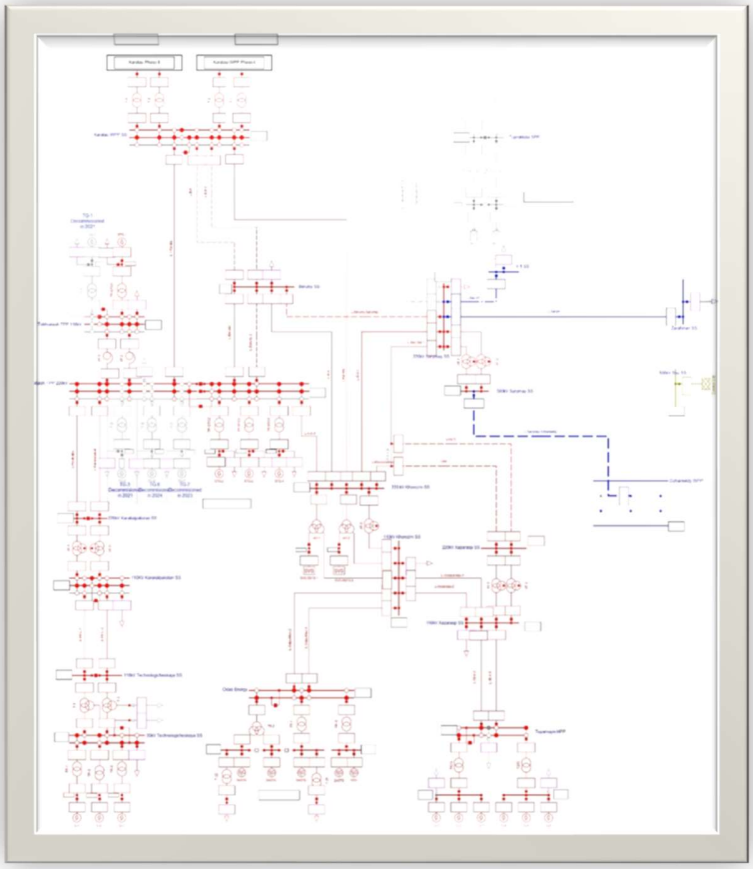
Power Simulation and Analysis software Experience: ***DigSILENT PowerFactory, PSS/E, PSCAD, MATLAB, NEPLAN, ETAP***

The following services were provided to the clients:

- Liaison with the DNO/TNO, OEMs and contractors in gathering technical data for the analysis.
- Preparation of the power system model of the generation and/or battery facility in the desired power system software
- Mimicking the power system model of the electricity transmission and distribution grid at the Point of Connection of generator/battery system
- Validation of the generator/BESS inverter models provided by the OEMs.
- Validation of the DNO/TNO power system model at the point of connection
- Performing the load flow and short circuit analysis
- Performing the full set of G99 studies and producing reports
- Performing the G5/5 analysis and producing reports
- Performing the P28 and P29 analysis and producing reports

- Provision of the generator simulation model with accuracy to the DNO/TNO
- Review of the DNO/TNO comments on the studies results
- Follow up with the DNO/TNO on the remedial actions
- Supporting the client in implementation of the remedial actions

Static/Dynamic Studies for 100MW/100MWh BESS



NDA International Limited were engaged by Juru Energy and Synergy Consulting to perform the static and dynamic studies for 100MW 100MWh Battery Energy Storage System (BESS) in the Republic of Uzbekistan. The BESS system was collocated with two wind power plants 100MW and 200MW respectively.

The BESS system was rated 100MW for 1-hour duration (energy rating 100MWh). The proposed technology for the BESS was Lithium-Ion Phosphate (LFP) technology. The BESS was connected directly to the electrical transmission grid system of the Republic of Uzbekistan at 220kV voltage level. The proposed point of connection (PoC) for the BESS were the 220kV busbars of the newly proposed 220kV switching substation to be constructed for interconnection of the wind power plants.

The following services were provided to the client:

- Coordination with the Republic of Uzbekistan transmission grid operator, OEMs and third parties in gathering technical information for the studies
- Produced a detailed simulation model of the BESS and the its connection with the transmission grid in DigSILENT powerfactory software

- Produced an equivalent model of the Republic of Uzbekistan transmission grid at the point of connection of the BESS
- Produced detailed dynamic simulation model of the battery modules and battery inverters
- Prepared control logic for operation of BESS to provide three different services:
    - Service 1. Forecast error smoothing of the combined output of Wind Power Plants
    - Service 2. Large ramps levelling of the combined output of Wind Power Plants
    - Service 3. A standby reserve
- Prepared Performed following studies:
    - Load flow analysis
    - Shor circuit analysis
    - Dyanamic studies
- Reviewed results of the studies and provided recommendations to the client on the sizing of battery and plant ratings
- Produced a detailed study report