

Appendix 1B

Technical specification

Project Name:
WAPA 2 - BESS

Customer:
USVI Water and Power Authority

TABLE OF CONTENTS

0.1	EXECUTIVE SUMMARY	5
0.2	TYPE OF PRODUCT	7
0.3	MAIN DATA AND CONDITIONS	8
0.4	CODES AND STANDARDS	9
A	POWER GENERATION EQUIPMENT	10
A1	ENERGY STORAGE EQUIPMENT	10
A1.1	BATTERY SYSTEM	10
A1.2	DC COLLECTION SYSTEM	13
A1.2.1	DC COLLECTION CABLES	13
A1.3	POWER CONVERSION SYSTEM	13
A2	ELECTRICAL SYSTEMS	14
A2.1	CONTROL SYSTEM	14
	CABLES AND ACCESSORIES	14
A2.1.1	ENERGY STORAGE CONTROL SYSTEM	14
A2.2	MEDIUM VOLTAGE SYSTEM	19
A2.2.1	MEDIUM VOLTAGE CABLES	20
A2.3	LOW VOLTAGE SYSTEM	21
A2.3.1	LOW VOLTAGE CABLES	21
A2.4	DC SYSTEM	21
A2.6	PLANT ELECTRIFICATION AND EARTHING	22
A2.6.1	CABLE RACEWAYS	22
A2.6.2	CCTV	22
A2.6.3	EARTHING ABOVE 0-LEVEL	22
A2.6.6	LIGHTING AND BUILDING ELECTRIFICATION	22
B	CIVIL	23
B0.1	PROJECT DATA	24
B0.2	DESIGN DATA	24
B0.2.1	DESIGN CRITERIA	24
B0.2.1.1	Explanation to abbreviations	24
B0.2.1.2	Codes and standards	24
B0.2.1.3	Loads	25
B0.2.1.4	Other design criteria	25
B0.3	ASSUMPTIONS AND GENERAL INFORMATION	26
B0.3.1	SITE, SOIL AND OTHER ASSUMPTIONS	26
B0.3.1.1	Demolition	26
B0.3.1.2	Contamination	26
B0.3.1.7	Soil properties	26
B0.3.1.9	Access to site	26
B0.3.1.10	Connection points	26
B0.3.1.11	Lay down area / logistic issues	27
B0.3.1.12	Construction obstacles	27
B0.4	Site preparation	27

B0.4.1	SITE CLEARING	27
B0.4.2	DEMOLITION AND RELOCATION	27
B0.4.3	CONTAMINATION	27
B0.4.6	BLASTING	27
B0.4.7	SOIL IMPROVEMENT	27
B0.4.7.1	Piling	27
B0.4.7.3	Other soil improvement	28
B0.5	UNDERGROUND NETWORK	28
B0.5.1	DRAINAGE SYSTEM	28
B0.5.3	UNDERGROUND CONDUITS, CABLE DITCHES AND LIGHTING POLES	28
B0.5.4	EARTHING (GROUNDING) NETWORK	28
B0.6	LANDSCAPING	28
B0.6.1	LAWNS	28
B0.6.2	TREES AND BUSHES	28
B0.7	ROADS, PAVING AND SURFACING	28
B0.7.1	ACCESS ROAD	29
B0.7.3	GRAVEL AREAS	29
B0.7.4	CURB STONES	29
B0.7.5	SITE ACCESSORIES	29
B0.7.5.1	Fence	29
B0.8	FOUNDATIONS	29
B0.8.1	EXCAVATION	29
B0.8.2	FILLING	29
B0.8.3	REINFORCED CONCRETE FOUNDATIONS	29
B0.8.3.1	Material used	29
B0.8.3.2	Surface treatment	30
B0.8.7.2	Foundations	30
B0.8.8	Power transmission	30
B0.8.8.1	Station transformer (Auxiliary transformer)	30
B0.8.9	Other foundations	30
B1	Civil structures and material	30
B1.1	Electrical equipment buildings	30
B1.1.3	Energy storage container	30
B1.1.4	Inverter for energy storage	30
B1.2	Station auxiliary transformer structures	30
B1.2.1	Station transformer for energy storage	31
C	ENGINEERING	32
C1	ENGINEERING MANAGEMENT	32
C2	ELECTRICAL AND AUTOMATION ENGINEERING OF ITEMS SUPPLIED BY WÄRTSILÄ	33
C3	CIVIL DETAILED ENGINEERING	34
C4	DOCUMENTATION	36
C4.1	INSTALLATION AND COMMISSIONING DOCUMENTS	36
C4.2	ENGINEERING APPROVAL DOCUMENTS	37
C4.3	MANUALS FOR COMMERCIAL OPERATION	37
D	TRANSPORTATION OF ITEMS SUPPLIED BY WÄRTSILÄ (DAP, ST. THOMAS SITE)	38
D1	MATERIAL AND SERVICES FOR LOGISTICS	39

D2	COLLECTION TRANSPORT AND LOADING PORT OPERATIONS	39
D3	MAIN TRANSPORT AND UNLOADING PORT OPERATIONS	41
D4	SITE TRANSPORT	43
E	TAXES, DUTIES, PERMITS AND INSURANCE	45
E1	TAXES AND DUTIES	45
E3	INSURANCE	45
F	PROJECT MANAGEMENT SERVICES	46
F1	PROJECT MANAGEMENT FOR ENERGY STORAGE	46
G	CONSTRUCTION MANAGEMENT	51
G1	SITE ORGANISING AND RESOURCING	51
G2	HEALTH, SAFETY, ENVIRONMENT (HSE) AND SECURITY MANAGEMENT	51
H	TEMPORARY INSTALLATION AND ARRANGEMENTS	53
H1	ROADS AND WORKING AREA	53
H2	UTILITIES	53
H3	SECURITY	53
H4	HEALTH SAFETY AND ENVIRONMENT	54
H5	DEMOBILIZATION	54
I	LOCAL SUPPLY AND INSTALLATION	55
I2	INSTALLATION OF ELECTRICAL EQUIPMENT	55
I3	INSTALLATION OF CIVIL EQUIPMENT	55
J	COMMISSIONING AND COMMISSIONING MANAGEMENT	56
J2	COMMISSIONING MANAGEMENT	56
K	TRAINING	58
K1	TRAINING AT SITE	58

0 GENERAL

0.1 EXECUTIVE SUMMARY

General

This technical specification provides the reader with the basic technical data required for an evaluation of the plant's technical features.

The proposed energy storage system is designed and engineered in accordance with this technical specification.

The technical data stated in this document is for guidance and evaluation purposes only. Performance data and related reference conditions are separately stated in the supply contract documents.

The governing law and the procedures of dispute resolution for this technical specification shall be as stipulated in the Agreement Supply Contract. If there is any discrepancy between the English version and a translated version of this technical specification, the English version shall prevail and have precedence over the translation.

Design and construction

The essence of the design is simplicity, safety and reliability.

The equipment is designed to prevent accidental contact with moving, hot or tensional parts and to minimise ingress of dust and dirt.

The structure and layout design of the power plant permits access to all parts for inspection, maintenance and repair.

Wärtsilä quality procedures and test & inspection procedures are applied to ensure product quality throughout the design and manufacturing process.

Wärtsilä's quality and environmental management systems fulfil, and are certified according to ISO 9001:2000 and ISO 14001:2004.

Main parts and devices are marked with engraved name plates indicating their item codes used in Wärtsilä documentation and manuals.

English is used in all documents, correspondence and nameplates.

SI units of measurement are used in all technical documents.

The design and manufacture of energy storage equipment supplied by Wärtsilä is subject to constant review, and due to improvements and optimisation of materials, design and tooling techniques, manufactured equipment may be improved from the specification given below.

Deviations to assumptions made in this specification

If the purchaser's requirements, local building codes, zoning requirements, Grid/Interconnection Study, Environmental Impact Assessment, Building Permit Application, Soil investigation,

Topographical survey, Contamination evaluation or site Demolition requirements or other conditions deviate from the assumptions made herein and have an impact on Wärtsilä's scope of supply, the scope of work shall be reviewed, and the price adjusted accordingly.

Project Management and Engineering

The delivery of the energy storage system will be managed by a dedicated project team, comprised of a project manager who has the overall responsibility for the delivery. The project manager is assisted by project engineers for the main technical disciplines.

The project team is the single point of contact with the purchaser's organisation, and has full authority to decide on technical and commercial issues related to the project on behalf of Wärtsilä.

Equipment Technical Data

Wärtsilä uses data gathered from equipment and software to improve and develop our products and services.

0.2 TYPE OF PRODUCT

The proposed energy storage system is designed for the following applications:

- Frequency regulation
- Spinning reserve
- Voltage regulation
- Black start capability

0.3 MAIN DATA AND CONDITIONS

Design ambient temperature

Altitude above sea level	100 m
Ambient air temperature	77 / 25 °F / °C

Maximum ambient temperature

Maximum ambient air temperature	104 / 40 °F / °C
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Minimum ambient temperature

Minimum ambient air temperature	50 / 10 °F / °C
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0.4 CODES AND STANDARDS

The design complies with the following standards:

Electrical systems

The electrical systems are designed, manufactured, constructed and installed to applicable parts according to the following standards:

Description	Code
- Transformer, oil-type	IEEE C57.12
- Transformer, dry-type	IEEE C57.12
- MV switchgear	IEEE C37.37.20.2
- LV switchgear	UL891
- Enclosure protection	IEC 60529
- Earthing network	IEEE 80
- Lighting installation	IEC 60598
- Fire detection	EN 54
- Protection against lightning	IEC 62305

Abbreviations

IEC:	International Electrotechnical Commission
IEEE:	Institute of Electrical and Electronics Engineers
EN:	European Standard
UL:	Underwriters Laboratory

A POWER GENERATION EQUIPMENT

A1 ENERGY STORAGE EQUIPMENT

A1.1 BATTERY SYSTEM

64 Battery racks with modules and battery management system

The lithium-ion battery rack sourced from an internationally recognized manufacturer include battery modules, rack frame, and Battery Management System (BMS). The BMS is the communication interphase between the battery modules and the facility Energy Management System in terms of individual battery voltage, current, temperature, State Of Charge and State Of Health. The battery modules are vertically wired.



Figure 1 Example of a battery rack

General rack characteristics:

Battery rack dimensions (W x D x H)	1200x1050x2300	mm
Number of modules per rack	17	
Working voltage range	952 - 1224	V
Nominal energy capacity	304.6	kWh
Continuous max C-rate	0.5	
Working temperature range	20-30	°C
Permissible ambient humidity (non-condensing)	0-95	%

4 GridSolv battery enclosure

The batteries and the necessary auxiliaries for the energy storage system are installed in a purpose-built enclosure called GridSolv. Every GridSolv include:

- HVAC for thermal management
- Fire detection and suppression systems for safety measures
- Auxiliary, control cabinet (ACC) which will provide AC load to auxiliary power circuits
- Disconnect Combiner Cabinet(s) (DCC) that can be fused or unfused
- All necessary internal cabling and accessories.

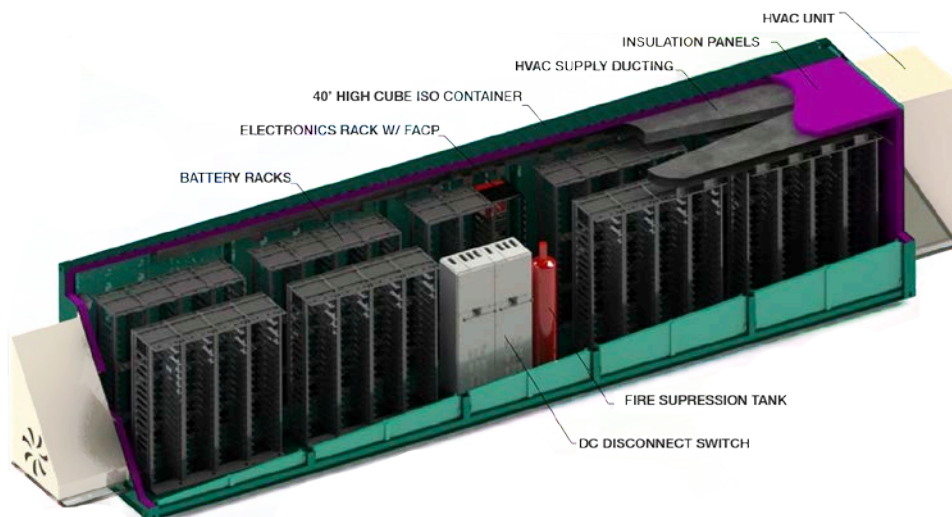


Figure 2 Example of a GridSolv enclosure

GridSolv technical characteristics:

Ingress protection	IP 54 / NEMA Type 3R equivalent
Shipping weight, approx.	25,000 kg (40 ft)
Installed weight	55,000-80,000 kg (40 ft)
Seismic withstand rating	See civil section B0.2.1.3 Loads
Wind rating	See civil section B0.2.1.3 Loads
Fire resistance rating	EI60 according to EN 1363-1
Paint specification	C-5
Design compliance	UL9540, IEC 61439, 62619, 60364, 61508, 62933, AS3000, AS3008, AS5000

Electrical

The electrical design (AC and DC) is based on international recognized standards, and industry best practices as it relates to conductor sizing, physical layout, device selection and implementation. All electrical equipment and control, wiring, and terminations used in GridSolv are suitable for their intended application. The enclosure is equipped with appropriate safety circuits such as external E-stop that properly shut the system down and lock it from operation until reset. The enclosure can be fully isolated from the inverter via the DC disconnect switch. The electrical circuit includes the following protection and monitoring:

1. Main DC fuses between batteries and inverter in addition to individually fused battery racks
2. Surge protection device (SPD) limiting transient voltages.
3. Surge protection device (SPD) on the Auxiliary supply voltage connection and communication connections external to the Gridsolv.

Workspace

Access for operation, Installation, inspection and maintenance for the equipment, batteries, fire suppression, disconnect switches etc. is from the outside of the enclosure and do not require a person entering the GridSolv.

Thermal management system

Every GridSolv includes a project specific engineered heating, ventilation, and air conditioning (HVAC) system for internal thermal management. The HVAC system maintains the internal temperature of GridSolv within a temperature range so that batteries can function efficiently which is configurable to satisfy different battery manufacturer's warranty terms. Every GridSolv also includes the necessary thermocouples and humidity sensors to monitor and control its thermal efficiency.

Fire detection and suppression system

GridSolv is equipped with an early aspiration smoke detection method along with several multizonal smoke/heat detectors in different locations inside the enclosure to detect any smoke or gasses indicative of a fault or overuse (Hydrogen and Carbon Monoxide). The aspiration smoke detection mechanism is sampling the air inside the enclosure through a pipe system continuously. In case of detection a designated central alarm panel executes alarm/annunciation, and initiates the BESS shutdown sequence, and will ultimately trigger the release of the fire suppression system. The fire suppression agent used is NOVEC 1230. Every GridSolv is individually tested for airtightness based on NFPA 2001 and ISO14520 to ensure that the clean agent will be held by the enclosure. The fire safety system of every GridSolv is tested and commissioned during FAT and SAT.



Figure 3 Example of a fire suppression control panel

Constant monitoring and emergency shutdown

The equipment and conditions inside the GridSolv enclosure are continuously monitored. The control system monitors alarms, temperature, humidity, enclosure door status, as well as the fire alarm panel. The control system executes a shutdown sequence of the system in order to safely stop the operation of the batteries in case faults or severe abnormal conditions. The control system acts on information both from the sensors and equipment in the GridSolv and the battery management system. In addition there are designated emergency stop buttons at each end of the GridSolv enclosure.

- 1 Impact of the new building code (IBC 2018 USVI) requirements (container structure, fastening & anchoring to foundations, etc.)**

A1.2 DC COLLECTION SYSTEM

1 DC combiner system - including disconnect switch, over current protection, busbars

The DC combiner system collects the DC outputs of the individual racks and may provide fuse protection for the DC circuit and a means of disconnecting the inverter(s) from the battery racks. The DC combiner consists of the following main parts: DC-switch, DC fuses (if required) and enclosure. The DC combiner system is integrated into the battery enclosure(s).

A1.2.1 DC collection cables

1 DC collection cables - battery racks to combiner box(es)

1 DC collection cables - DC combiner box(es) to inverters

A1.3 POWER CONVERSION SYSTEM

4 Medium voltage block - inverter and transformer

The medium voltage block is a close coupled inverter and transformer solution, with a high level of system integration.

The MV block contains the following integrated components:

- 1 Inverter
- 1 Inverter transformer
- 1 AC busway

Inverter

The bi-directional, 4-quadrant, high power density, high efficient AC/DC inverter is suited for outdoor installation. The inverter is housed in a rugged steel sheet enclosure with an efficient cooling and is protected from harmful ingress of moisture, sand and dust.

General inveter characteristics:

Working DC voltage range	880 - 1500	V
Nominal AC voltage	600	V
AC voltage range	480-720	V
Nominal AC power	3450	kVA
Nominal frequency	60	Hz
Frequency range	57-63	Hz

Inverter transformer

The inverter transformer is a 3-phase power transformers suitable for outdoor installation. The transformer is of 2-winding type.

The transformer is sized with the following ratings:

Rated power	3500	kVA
Nominal voltage, high-voltage side	34500	V

Nominal voltage, low-voltage side	600	V
Cooling	ONAF	
Voltage adjustment range	±2x2,5	%
Tap changer	DETC	

2 Black Start capability software in inverters

Black start and energising of the provided BESS system.

A2 ELECTRICAL SYSTEMS

A2.1 CONTROL SYSTEM

Cables and accessories

Control and instrumentation cables for the equipment delivered. Necessary joints and fittings are included.

1 Control cables - energy storage system

A2.1.1 Energy storage control system

1 GEMS software

GEMS stands for Greensmith Energy Management System. It is a suite of software products built upon a common software platform developed for intelligently managing large power plants and energy sites. GEMS is built upon a foundation of “connectors” to physical assets. These connectors enable GEMS to control and acquire data from batteries, inverters, and numerous other sources such as building load, solar output, and SCADA signals from an independent system operator. On top of these connectors sits a computational platform, which enables the control of physical assets with a rules-based engine and provide additional functionality such as fleet control. GEMS includes the following components.



Figure 4 GEMS OS architecture

GEMS Power Plant Controller

GEMS Power Plant Controller (PPC) conducts comprehensive monitoring, intelligent control and optimized operations at large power plants. GEMS PPC is part of Wärtsilä’s distributed energy resource (DER) management system (EMS) platform for solar, wind, energy storage, engine and hybrid power plants that combines multiple types of energy resources.

For large power plant, GEMS PPC controllers are installed within a 19" rack that comes with L3 network switch for cyber security, UPS, touch-screen HMI and dual-controller failover configuration for high availability.

GEMS software design is highly modular with plugin architecture. Based on customer / project requirements, GEMS PPC can be flexibly configured in the following ways:

- **Device Support** – GEMS PPC supports a wide range of devices from major manufactures of renewables, energy storage and thermal generation equipment. Over the years, we have qualified, tested and integrated large number of energy generation, power measurement and grid protection devices from major manufacturers. Drivers for new devices required by customers can be quickly developed and validated using GEMS software development toolkit (SDK).
- **Control Algorithms** – GEMS comes with a rich library of algorithms that operate plants in ISO markets or islanded microgrids. Control algorithms are deployed to a power plant controller using a software as a service (SaaS) model, and new project specific algorithm can be developed by Wärtsilä engineers based on customer / project specific requirements.
- **Operation Intelligence** – **GEMS Machine Learning** derives knowledge from historical data and conducts optimized operation planning to maximize control goals and stay within constraints. **GEMS Rule Engine** turns knowledge into machine rules and directs plant operations according preconfigured rules and detections such as market pricing and equipment status. GEMS combines these two technologies to enable fully automated, adaptive and optimized plant operations.
- **Communication Interfaces** – GEMS PPC supports both traditional SCADA protocols (DNP3, Modbus, OPC, etc.) and modern RESTful Web APIs that enables our customers systems to interface with GEMS in any ways they choose to. Wärtsilä engineers can create customized SCADA data points per customer / project requirements using GEMS SDK.
- **User Interface** – GEMS PPC has rich Web-based, UI features that support plant configuration, equipment monitoring, operation and trouble-shooting. Most of the UI views are fully customizable by users to meet their individual needs.

GEMS Fleet Director

GEMS Fleet Director (FD) provides centralized, real-time visibility into a global fleet of power plants. The Fleet Director is hosted in the cloud and allows for secure monitoring of real-time status, operation history and alarms at aggregated fleet, power plant and individual device levels.

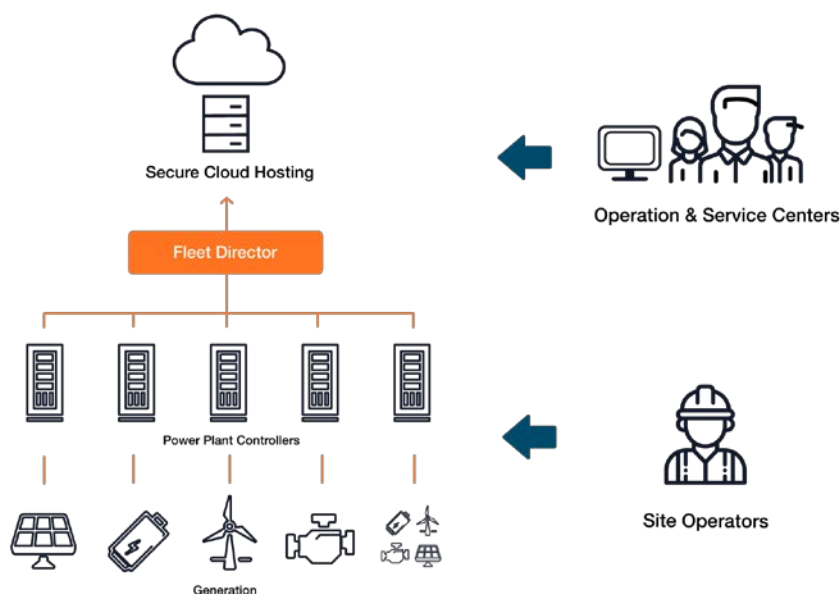


Figure 5 GEMS Fleet Director deployment

Wärtsilä has developed advanced data streaming technologies to aggregate over 100,000 data points per second from PPC to FD at minimum network bandwidth consumption and is capable of riding through temporary Internet connection outage without data lose.

The aggregation of power plants formed virtual power plant (VPP) at Fleet Director. Combined with third party data such as market pricing and weather forecast, GEMS Fleet Director works closely with GEMS power plant controller installed on site to conduct intelligent operation of renewable, thermal, energy storage and hybrid power plants.

GEMS User Interface

GEMS user interphase provides overall single line diagram (SLD) of entire plant for operator to monitor and operate critical electrical equipment and their connections in real time. Each SLD segment is color-coded and marked with power flow direction to reflect its energization status.

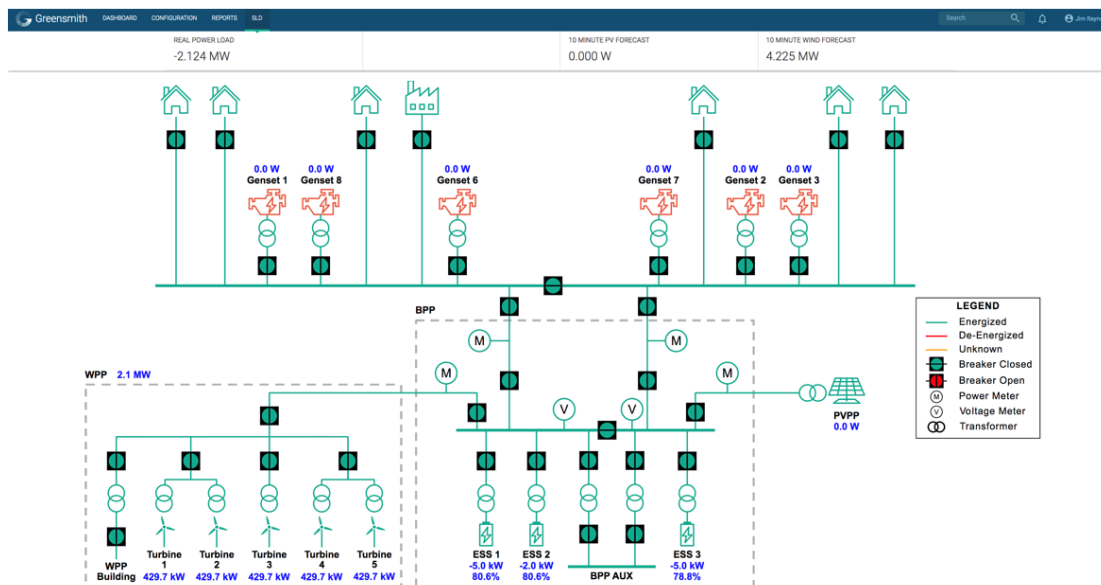


Figure 6 Plant SLD view

The user interphase provides also details of battery rack layout throughout the power plant that reflects their physical location, unit groupings and real-time status. Using this feature, operator can quickly locate faulty battery using color code and conduct trouble-shooting remotely.

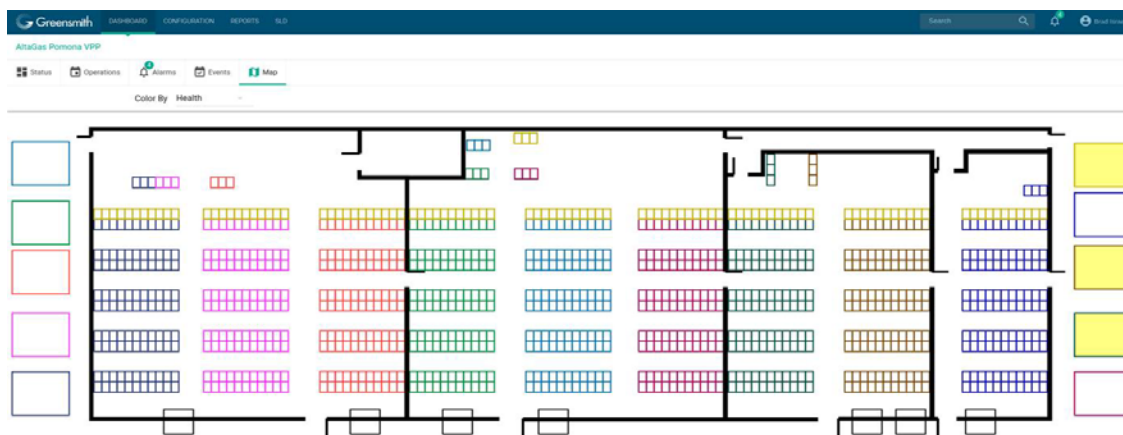


Figure 7 Plant equipment layout view

Users can compose highly customized reports combining plant performances, equipment status and market data into charts and data tables.

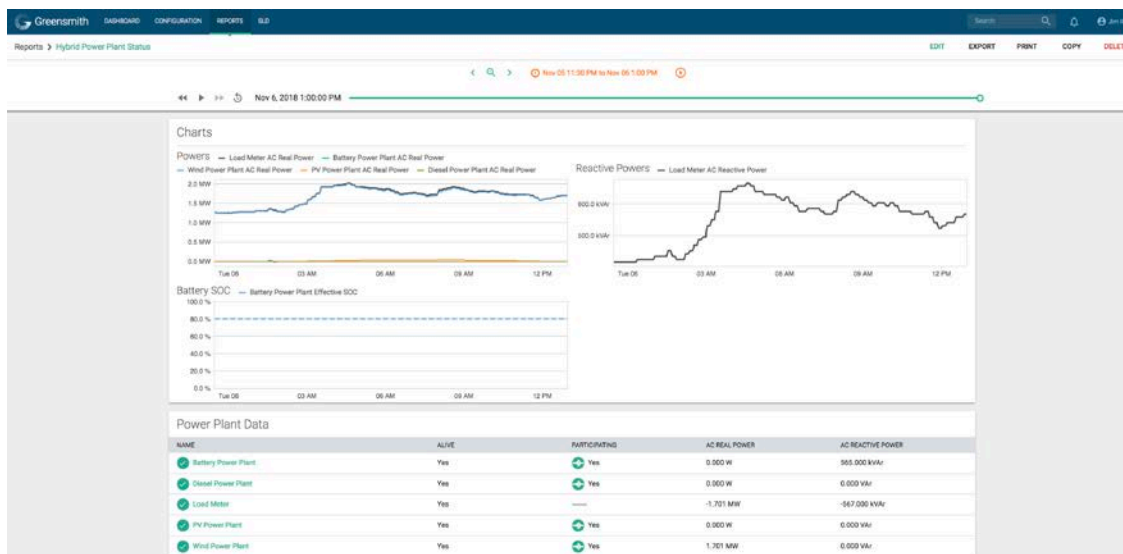


Figure 8 Sample data report

1 GEMS hardware

The GEMS power plant controller is deployed on site to conduct concurrent monitoring, control and operation coordination of all on-site devices using GEMS software.

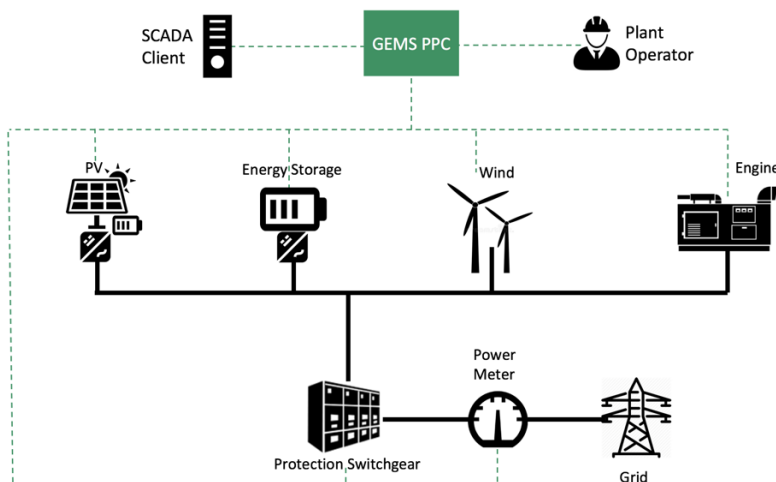


Figure 9 GEMS power plant controller deployment

The controller includes a 19" rack, L3 network switch for cyber security, UPS, touch-screen HMI and dual-controller failover configuration for high availability.

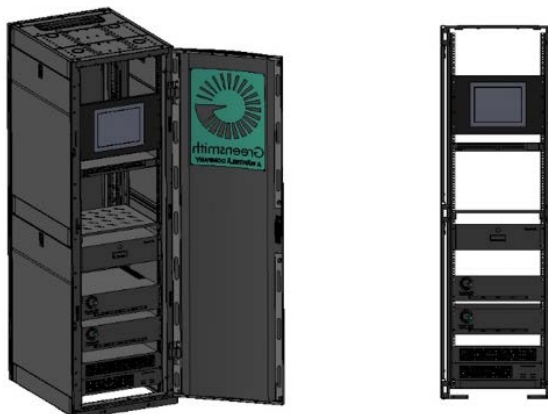


Figure 10 GEMS controller rack

1 Modification to existing automation system (WOIS)

A2.2 MEDIUM VOLTAGE SYSTEM

1 Main busbar

The main switchgear is of the three-phase, metal-enclosed and air-insulated type and is provided with withdrawable circuit breakers.

The switchgear is designed, manufactured and tested according to ANSI / IEEE standards.

The switchgear is designed with the following ratings:

Rated insulation voltage	34.5	kV
Rated voltage	34500	V
Rated current for bus bars	1200	A
Rated short circuit withstand current $I_{th}/1$ sec.	25	kA/s
Enclosure protection class	NEMA 3R	
Switchgear standards	IEEE C37.20.2	
Circuit breaker standards	ANSI/IEEE C37.04	
Circuit breaker type	Vacuum	
Installation	outdoor non-walk-in	

The current and voltage transformers have a rated burden to suit the connected measurement and protection devices and have the following accuracy classifications:

Current transformers:

Accuracy class for phase current protection transformers	5P10
Accuracy class for earth fault current transformers	10P10
Accuracy class for measuring transformers	Class 0.5

Voltage transformers:

Accuracy class for measuring transformers	Class 0.5
Accuracy class for earth fault voltage transformers	6P

The main switchgear consists of the following equipment:

1 Incoming feeder cubicle

The incoming feeder breaker cubicle includes the following main equipment:

- 1 Feeder breaker section consisting of
- 1 1200 Amp 38KV 25 KA Vacuum Breaker
- 125V DC Control
- 3 600:5 SR CT'S
- 1 MOC Switch (3A/3B)
- 1 TOC Switch (3A/3B)
- 1 Protective Relay
- 1 Breaker Control Switch with Indicating Lights

1 Outgoing feeder cubicle

The outgoing feeder breaker cubicle includes the following main equipment:

- 1 Feeder breaker section consisting of
- 1 1200 Amp 38KV 25 KA Vacuum Breaker
- 125V DC Control
- 3 600:5 SR CT'S
- 1 MOC Switch (3A/3B)
- 1 TOC Switch (3A/3B)
- 1 Protective Relay
- 1 Breaker Control Switch with Indicating Lights
- 3 Draw Out Mounted PT's with CLF
- 1 PT Rollout Drawer
- 3 Distribution Class Arresters

1 Station auxiliary transformer cubicle

The station auxiliary transformer breaker cubicle includes the following main equipment:

- 1 Feeder breaker section consisting of
- 1 1200 Amp 38KV 25 KA Vacuum Breaker
- 125V DC Control
- 3 600:5 SR CT'S
- 1 MOC Switch (3A/3B)
- 1 TOC Switch (3A/3B)
- 1 Protective Relay
- 1 Breaker Control Switch with Indicating Lights

1 Racking handle

1 Breaker lift truck

A2.2.1 Medium voltage cables

- 1 Medium voltage power cables - inverter transformer to switchgear**
- 1 Medium voltage power cables - switchgear to point of interconnection (Transformer BTT01, BTT02)**
- 1 Medium voltage power cables - station auxiliary transformer area**

A2.3 LOW VOLTAGE SYSTEM

The low-voltage system distributes low-voltage electricity to electrical consumers included in Wärtsilä's scope of supply.

The low-voltage system includes the following equipment:

1 Station auxiliary transformer

The station auxiliary transformer is a three-phase, two-winding, naturally cooled distribution transformer, and is designed according to ANSI, NEMA, IEEE and DOE (2016) energy conservation standards. The transformer is sized with the following ratings:

Rated power	300	kVA
Rated incoming voltage $\pm 2 \times 2.5\%$	34500	V
Rated outgoing voltage	480	V
Enclosure	NEMA 3R	
Type	Oil	

The transformer includes the following main equipment:

- Medium and low voltage bushings
- Thermometer with two alarm contacts
- Winding temperature indicator with alarm contacts
- Off-load tap changer, 5 positions, on MV side
- Ground pads in opposing corners
- Rollers
- Lifting and hauling lugs

- 1 Low voltage switchboard**
- 1 UPS and distribution of control voltage for inverter black start capability**

A2.3.1 Low voltage cables

The low-voltage cables are installed between the station low-voltage switchboard and the various motor control centres and electrical consumers included in the Wärtsilä scope of supply.

- 1 Low voltage power cables**

A2.4 DC SYSTEM

1 DC system - 125 V

The DC supply unit includes the following main equipment:

- 1 125V DC Battery Section - Consisting of:
- 1 (Lot) Battery Rack and Charger
- 1 DC Panel
- 1 AC Panel

A2.6 PLANT ELECTRIFICATION AND EARTHING**A2.6.1 Cable raceways**

- 1 Cable raceways - switchgear to point of interconnection (Transformer BTT01, BTT02)

A2.6.2 CCTV

- 1 CCTV fix cameras to BESS site area

A2.6.3 Earthing above 0-level

The safety earthing system is based on an earthing ring line. The ring line is connected to the main equipment of the plant.

- 1 Earthing above 0-level

A2.6.6 Lighting and building electrification

- 1 Lighting and building electrification - energy storage internal
- 1 Lighting and building electrification - energy storage external

B CIVIL

The civil works for this project will be engineered, procured and constructed (EPC-project) by the Contractor in accordance with this technical specification and corresponding scope of supply.

This technical specification provides the reader with the basic technical data and information required for evaluation of the plant's technical features.

All other obligations that are not mentioned or described in this specification, are either not actual or in Owner's scope.

B0.1 PROJECT DATA

Basic information

Project name **WAPA Phase II**

B0.2 DESIGN DATA

B0.2.1 Design criteria

B0.2.1.1 Explanation to abbreviations

ASHRAE: American Society of Heating, Refrigeration and Air-Conditioning Engineers
 ASTM: American Society for Testing and Materials
 AASHTO: American Association of State Highway Transportation Official
 ECCS: European Convention for Constructional Steelwork
 EN: European Standard
 FEM: European Federation of Materials Handling and Storage Equipment
 NFPA: National Fire Protection Association
 ISO: International Organization for Standardization
 SFS: Finnish Standards Association
 AISI: American Iron and Steel Institute
 UBC: Uniform Building Code
 ASCE: American Society Of Civil Engineers
 OSHA: Occupational Safety and Health Administration
 IBC: International Building Code

B0.2.1.2 Codes and standards

The civil works and structures are designed, manufactured, constructed and installed applicable and according to the following standards:

Description	Code	Note
- Wind load, seismic load	ASCE 7-16	
- Geotechnical design	EN 1997	Eurocode 7
- Reinforced concrete structures	ACI 318-14	IBC 2018
- Steel structures	AISC 341-16	IBC 2018
- Road dimensions (road structural design follows AASHTO Low Volume Road Design procedure)	AASHTO	Vehicle WB-15M
- Subsurface site works and substructures	Applicable ASTM standards	
- Installation of pre-manufactured buildings	European Norms and ISO standards	
- Water pipes	Polyethylene standard SFS-EN12201 or local equivalent	

B0.2.1.3 Loads

The design loads for the civil structures are the following:

Description	Value	Unit	Code	Note
Wind			ASCE 7-16	IBC 2018
Basic wind speed	175	mph		
Risk Category	III			
Exposure	D			
Earthquake			ASCE-7-16	IBC 2018
Spectral response	Ss=1.22 g S1=0.427 g			
Risk category	III			
Site class	D			
Importance factor	1.25			
Component importance factor	1.0			
Live load				
- Roof	0.96	kN/m ²		
- Floor, ground	10	kN/m ²		
	40	kN		Concentrated 200x200 mm ²
Working platforms	2.87	kN/m ²		5.0 kN/m ² for engine platforms
- Distributed load	2.0	kN/m ²		
- Concentrated load	1.5	kN		200 x 200 mm ²
Dead load				
- Material				According to material weights
- Equipment				According to Wärtsilä and other manufacturer specifications
Load combinations			ASCE 7-16	IBC 2018

Wärtsilä power plant design fulfils general international requirements for structural safety.

B0.2.1.4 Other design criteria

The works and structures are designed, manufactured and constructed as following:

Description	Value	Unit	Code	Note
Temperatures and relative humidity				
- Max. ambient air temperature	35	°C		
- Min. ambient air temperature	10	°C		
- Dimensioning relative humidity, RH	65	%		At 30 °C ambient
Rainfall				
- Maximum rainfall	150	mm/h		

Other				
- Altitude above sea level	4	m		Above sea level
- Dust level	Low			

*ISO 1996 Acoustics - Description, measurement and assessment of environmental noise, Parts 1-3

B0.3 ASSUMPTIONS AND GENERAL INFORMATION

All assumptions and specifications herein are based on the geotechnical report “**Technical letter on subsoil exploration for proposed Wärtsilä Power Plant, Harley Power Plan, St. Thomas, USVI. Project: PS-16010. December 15, 2016**”

It is noted that the investigations received are limited and do not cover the site.

B0.3.1 Site, soil and other assumptions

The contract price is based on the following site and soil assumptions, unless otherwise described:

B0.3.1.1 Demolition

It is assumed that on site existing buildings and structures, pipes, overhead lines or any other obstacle, above or below ground, interfering with the work, are identified, demolished, removed or relocated by Owner, prior to issuing site access to contractor.

B0.3.1.2 Contamination

It is assumed that possible soil and ground water contamination is taken care of by Owner. It is assumed that when starting the work the soil is environmentally clean.

B0.3.1.7 Soil properties

- Soil investigation indicate cobbles and boulders at the top layer, and loose sand with some silt below that layer
- Soil load bearing layer is assumed to be on average at 13 m depth measured from the BESS foundation level.
- Groundwater is assumed to be close to MSL (3 m below ground surface)
- No risk for swelling soil
- Liquefaction susceptible soils are estimated to be on site
- Pile supported solution are needed for the project due to possible large scale post seismic settlement of the ground

B0.3.1.9 Access to site

It is assumed that the access to the site is suitable for heavy transportation, and that no access road / access road improvement of any kind is needed.

B0.3.1.10 Connection points

It is assumed that connection points for rain water, water, sewage, fuel or other piping, power (for construction) and other utilities are available and of suitable size the site boundary. No work outside site boundary is included.

B0.3.1.11 Lay down area / logistic issues

It is assumed that a sufficient lay down and working area is available for the project.

B0.3.1.12 Construction obstacles

It is assumed that no limitations and restrictions of any kind are affecting the construction work (like working time restrictions, noise, traffic etc.).

If the site and soil properties deviates from above listed assumptions 1-12, it will entitle the Parties to issue a Variation Order, causing a change in the Contract price and time schedule. In case of scope increase, Contractor is also entitled to extension of time.

All Variation Orders shall be agreed upon in writing prior to start of actual variation work.

B0.4 Site preparation**B0.4.1 Site clearing**

Owner's obligation.

B0.4.2 Demolition and relocation

Owner's obligation.

B0.4.3 Contamination

Owner's obligation.

B0.4.6 Blasting

No blasting, rock chipping nor any rock excavation included.

B0.4.7 Soil improvement**B0.4.7.1 Piling**

NOTE! No actual quantities of piling can be estimated before a soil investigation of the Battery Storage site have been done. Soil investigation will give input to the piling design for the battery energy storage site.

It is assumed that the equipment for piling is on site, no mobilization costs considered.

Pile type and length is based on WAPA Phase I soil conditions.

Following pile types are used:

- piling, steel pipes 200 mm, max. assumed pile length = 15 m

The following structures are on piles:

- Energy storage container
- Inverter
- Station transformer
- Medium voltage switchgear

B0.4.7.3 Other soil improvement

No other soil improvement included.

B0.5 UNDERGROUND NETWORK

B0.5.1 Drainage system

The water from roads and other areas with hard paving is lead away, where needed, with either open trenches or with rain water piping and rain water sumps.

No rain water pond or rain water monitoring system is considered.

B0.5.3 Underground conduits, cable ditches and lighting poles

Underground cable conduits are made of plastic, Schedule 40, or equivalent.

The conduits for power cables are embedded in sand.

The cables for the area lighting are buried cables. The cables are installed at a min. depth of 700 mm, embedded in sand. A marking tape is placed 200 mm above the cables.

The lighting and other area cables are placed in cable conduits. The conduits are installed at a min. depth of 700 mm, embedded in sand. A marking tape is placed 200 mm above the cables.

B0.5.4 Earthing (grounding) network

The underground earthing system consists of copper wires installed at a depth of minimum 700 mm. The joints and crossings are Cadwelded® or C-clamped. To the system vertically installed earthing rods might be added. Necessary "control pits" will be installed.

B0.6 LANDSCAPING

B0.6.1 Lawns

No lawns included.

B0.6.2 Trees and bushes

No trees and bushes nor any other plantations are included.

B0.7 ROADS, PAVING AND SURFACING

B0.7.1 Access road

No access road is included.

No roads nor parking areas are included.

B0.7.3 Gravel areas

The areas around the outdoor equipment are covered with coarse non dusty granular material.

B0.7.4 Curb stones

No curb stones included.

B0.7.5 Site accessories
B0.7.5.1 Fence

The fence post and gate profiles are made of EN-AW 6063-T5 aluminium. Alternatively galvanized steel, diam. 1,9 inch (50 millimeter). The wire net mesh #50 mm / Ø 3,1 mm aluminium or Ø 2,0 mm galvanized steel.

The fence is 8 feet (2,5 meter) high and on the top of it are 3 strands of hot galvanized barbed steel wire. There's a 19 feet (6 meter) wide double swing vehicle gate in the entrance to the site.

B0.8 FOUNDATIONS
B0.8.1 Excavation

Excavation is made to actual foundation level taking into account possible structural filling thickness and necessary working space. The slope safety is according to the requirements for the actual soil and purpose.

B0.8.2 Filling

Structural filling is made with granular material compacted to the requirements stated for the respective structure.

Backfilling is made using excavated material or other granular material. Compaction according to design requirements.

B0.8.3 Reinforced concrete foundations
B0.8.3.1 Material used

Material characteristics are according to EC2 SFS-EN 1992-1-1.

Description	Grade	Note
- Concrete for buildings and structures (where water tightness not needed)	C20/25, max aggregate size 40 mm	Compressive strength = 20 N/mm ² , at 28 days age; test with cylinder Ø=150mm; h=300mm
- Watertight concrete	C25/30, max	Compressive strength min. 25 N/mm ² , at

	aggregate 20 mm	28 days age
- Reinforcement (minimum requirement)	F _y (min)=400 N/mm ²	High-yield deformed reinforcing bars

The material might be changed to equivalent according to other international (ACI 318, BS8110) standard.

B0.8.3.2 Surface treatment

The upper surface of engine foundation, slabs and other foundations for similar use is steel troweled (steel floated).

The vertical foundation surfaces are poured against either plywood or steel formwork. For non-visible foundations other material and methods may be used.

B0.8.7.2 Foundations

The foundations are slab foundations.

B0.8.8 Power transmission

B0.8.8.1 Station transformer (Auxiliary transformer)

The foundation for station transformer is made of reinforced concrete.

B0.8.9 Other foundations

Owner's obligation

B1 Civil structures and material

B1.1 Electrical equipment buildings

B1.1.3 Energy storage container

1 Substructures

1 Superstructures

B1.1.4 Inverter for energy storage

1 Substructures

B1.2 Station auxiliary transformer structures

B1.2.1 Station transformer for energy storage

1 Substructures

1 Superstructures

C ENGINEERING**C1 ENGINEERING MANAGEMENT****1 Engineering management of Wärtsilä engineering scope****General**

Engineering management is managing and coordinating the engineering work to fulfil the contractual requirements.

Engineering Planning

Engineering plan is made as part of the project plan and is based on the contract requirements and project time schedules. Included in the plan is the specific schedule for the design packages.

Engineering Execution

Wärtsilä have a well-defined engineering process with clear responsibilities and phases. The engineering for Wärtsilä scope is divided into disciplines: electrical and automation, and civil. Each discipline is led and managed by a chief project engineer. Additional to managing own discipline the chief project engineers are coordinating the cross-discipline engineering.

Engineering work is done by engineering experts. Detail engineering is done by reliable and long-term partners and suppliers.

Monitoring and Controlling

The engineering activities are monitored and controlled by regular internal review meetings with partners and suppliers. Review meetings with Customer are arranged based on project requirements.

Project team coordinate and control together with Customer the information needed at scope boundaries for the interfaces between Wärtsilä and Customer.

Reporting

Engineering status is reported as part of project reporting.

Basic Engineering

Basic engineering is development of a well-defined design package of Wärtsilä supplied equipment or solution. Basic design is the input for detailed engineering.

Customer to provide the engineering inputs at the interfaces of Wärtsilä supplied equipment and solutions to Customer's or other suppliers systems and existing structures. Engineering inputs are defined during project planning.

Detailed Engineering

Detailed engineering is further development of basic design, with more technical details that will enable finalising of procurement and proceeding with the construction, installation and

commissioning of the system or solution. Detailed design is input for quality assurance and manuals.

Sharing of engineering documents

Wärtsilä will set up an online web-based collaboration platform DCM365 which is used for submission and follow-up of engineering documents and other communication between project internal and external stakeholders.

Document format

- All documents are submitted as PDFs to avoid unintended modifications to the document content
- Editable file formats are not included in any document delivery
- Documents will be shared online from DCM365
- Documentation in paper only as final delivery for commercial operation

Manufacturing drawings of Wärtsilä supplied items are not included in any documentation deliverable.

Only written measurements in drawings can be used for reference.

Wärtsilä expect the Customer to share their engineering with Wärtsilä project team, for information purpose only. Wärtsilä do not take responsibility or have any approval process of any of the engineering made by the Customer.

1 Labor/union agreements and payments for energy storage

C2

ELECTRICAL AND AUTOMATION ENGINEERING OF ITEMS SUPPLIED BY WÄRTSILÄ

1 Electrical and automation engineering for energy storage

Basic Engineering

Activities when developing basic engineering for all electrical and automation systems in Wärtsilä scope include:

- Collecting and investigating data, such as voltages, currents, frequencies and short-circuit levels at scope limit
- Calculating and defining electrical system values
- Defining system main equipment
- Engineering of system layouts
- Creation of single-line diagram drawings

Deliverables of the basic design:

- General system layout
- Dimensional drawings the equipment
- Documentation providing information pertaining to the shape, dimensions, placing and fixing of equipment
- Single-line diagram

- A single-line diagram depicts (describes) interconnections and the configuration of the electrical system. The graphical symbols represent equipment or functionality
- Technical specifications of main equipment
 - Technical specification with project specific data

Detailed Engineering

Activities when developing detailed engineering for all electrical and automation systems in Wärtsilä scope include:

- Check process parameters and update single-line diagrams
- Monitoring and controlling of engineering activities of discipline and coordinating the cross-discipline engineering activities including technical reviews
- Creating circuit-diagrams and detailed drawings
- Review of the control, protection and monitoring of the system

Deliverables of the detailed design:

- General arrangement layout
- Dimensional drawings of the equipment
- Document providing information about shape, dimensions, placing and fixing of equipment or functionality
- Assembly drawings for equipment to be mounted on site
- Single-line diagram depicts (describes) interconnections and configuration of the electrical system. The graphical symbols represent equipment or functionality
- Technical specification with project specific data
- Circuit Diagram
 - Diagram providing information on the circuitry of an object
 - Graphical symbols representing the objects
 - Graphical symbols representing the connections among objects
 - Reference designations
 - Terminal designations
 - Signal level conventions (applicable to logic signals)
 - Information necessary to trace paths and circuits (signal designations, location references)
 - Supplementary information necessary for the understanding of functions
- Setting values
 - Protection relay settings
- Transport drawing
 - Transport drawing for step up transformer
- List of cables

C3 CIVIL DETAILED ENGINEERING

Needed Engineering Inputs from Customer

For Wärtsilä to be able to make the civil engineering, these engineering inputs are needed from Customer:

- Connection points (water, sewage, electricity, rain water and roads)
- Topographical map of site and surroundings
- Information of existing buildings and structures on site

1 Earthworks and siteworks engineering for energy storage

Activities when developing earthworks and siteworks engineering include:

- Drainage flow calculation
- Settlement calculations
- Structural calculations
- Excavation and filling plan engineering
- Seismic calculations (if applicable)
- Pile calculations (if applicable)

Deliverables are:

- Levelling design
 - Optimized levelling plan to fit site, road connections and drainage connections
- Drainage design and calculations
 - Gravity drainage
 - Flow capacity checks at all manholes/open drain connections
 - Total outflow calculation at outlets
- Geotechnical design report
 - Bearing capacity for ground- or pile-supported foundations
 - Settlement analysis/tolerances
 - Seismic analysis results
- Earthwork design drawings
 - Earthworks plan and sections
 - Site development transverse and longitudinal sections
- Surface material
 - Pavement design yards and green areas

1 Foundation engineering for energy storage

Activities when developing foundation engineering include:

- Determining foundation locations
- Structural calculations
- Dimensional drawing production
- Reinforcement drawing production, including bending schedules
- Piling structural design (if applicable)

Deliverables are:

- Foundation dimensional drawings
- Foundation reinforcement drawings
- Foundation location drawing
- Piling dimensional drawings (if applicable)
- Piling reinforcement drawings (if applicable)

1 Frames engineering for energy storage

Activities when developing frame engineering include:

- Raw modelling of steel structures
- Structural calculations
- Modelling of steel structures
- Manufacturing drawing production
- Assembly drawing production
- Specifying foundation bolt and welding plate types and sizes

Deliverables are:

- Material specification, MASP (including summary of total weights, painting system)
- Assembly drawings, including 3D views, line views, details and part lists

1 Heating, comfort ventilation and air conditioning engineering for energy storage

Activities when developing heating, comfort ventilation and air conditioning (HVAC) engineering include:

- System calculations
- Dimensioning of units / system
- Modelling of duct routing
- Electrical design and electrical panel design

Deliverables are:

- List of materials and units
- Duct design
- Assembly drawings
- Technical description
- Electrical scheme

1 Fire protection system for energy storage

C4 DOCUMENTATION

C4.1 INSTALLATION AND COMMISSIONING DOCUMENTS

1 Installation documentation

Installation and commissioning documentation contain original equipment manufacturers (OEM) manuals for the equipment supplied by Wärtsilä and detailed design, which is divided into engineering disciplines (civil, electrical & automation), and each discipline's documentation is divided into system and sections as applicable. The documents for installation and commissioning are issued prior to start of the concerned installation works.

1 Site Quality Assurance Documentation set

Site quality assurance documentation (SQAD) set is used for execution of site inspections and tests to validate plant installation quality and its performance. Contains test form templates,

instructions and performance test procedures. A set of site quality assurance documentation (SQAD) is provided in digital format.

1 Commissioning documents

C4.2 ENGINEERING APPROVAL DOCUMENTS

1 PE stamping of single line diagrams

1 PE stamping of detailed electrical engineering and interconnections

1 PE stamping of detailed structural engineering

1 PE stamping of detail civil engineering

C4.3 MANUALS FOR COMMERCIAL OPERATION

The manuals for commercial operation (O&M) are issued prior to handing over of the energy storage system. The manuals contain operating and maintenance instructions for the whole installation. Technical documents such as drawings and lists, datasheet and OEM manuals, which are needed for the correct understanding and handling of the power plant, are included. The consolidated manuals are tailor made for the project based on Wärtsilä scope.

1 Operation and maintenance manuals on digital media - energy storage

1 Operation and maintenance manuals as hard copy - energy storage

D TRANSPORTATION OF ITEMS SUPPLIED BY WÄRTSILÄ (DAP, ST. THOMAS SITE)**General**

Transport management shall ensure that the goods are delivered safely and in a timely fashion according to contractually agreed delivery terms between the Customer and Wärtsilä.

Transport management refers to the planning, leading and managing of all transport-related activities, within the Wärtsilä scope, which are necessary for ensuring that the correct amount of goods is safely delivered within the agreed time schedule and quality and safety requirements.

Dedicated resources shall be assigned to the project focusing on timely deliveries, mitigating risks and optimising the shipments for the project.

The material and equipment shall be of various sizes and may include heavy and out-of-gauge cargo.

Wärtsilä coordinate and manage all the activities mentioned in the scope of the supply list under the section "Transportation of items supplied by Wärtsilä" and marked as Wärtsilä's responsibility.

Wärtsilä Finland and have the status of Authorised Economic Operator (AEO) certified by Finnish Customs ensuring high standards for export and custom clearance procedure.

Shipment Planning

Shipments shall be planned in order to ensure that the goods are delivered in a safe, timely and effective manner according to contractually agreed delivery terms between the Customer and Wärtsilä.

This shall be created based on the project-specific requirements taking into account the following (but not limited to):

- Specifics of the scope of supply
- Contractual delivery time and/or installation schedule at the construction site
- Number of planned shipments and dates, information and duration
- Inland transportation, information and duration

Freight Forwarder / Carrier

Wärtsilä Energy Solutions have long-term relationships with our approved freight forwarders and carriers (third-party transportation service providers). By working in close cooperation with freight forwarders and carriers and having agreed upon common terms and conditions as well as a common way of working results in the efficient handling of the transportation chain activities, Customers are released from having to involve their own transportation service providers, management and follow-up of the same activities.

LogWis

LogWis is an online service tool used for transportation management exclusively in Wärtsilä Energy Solutions. LogWis has been developed to enhance and extend the visibility of the logistic chain all the way from production and sourcing to procurement and handing over. LogWis enables proactive and punctual control and visibility over deliveries and information sharing between involved parties.

D1 MATERIAL AND SERVICES FOR LOGISTICS**1 Packing and marking of equipment as per Wärtsilä requirements**

Seaworthy packages for Wärtsilä overseas transportation are designed to protect and withstand the whole transport and handling process to the final destination. Seaworthy packing is carried out based on HPE German packing standards and/or SEI French packing standard, and the packing material is according to ISPM standard number 15. For large pieces such as Wärtsilä engines, generators, transformers and exhaust gas boilers, the units are covered by tarpaulin or other material if the equipment so require.

1 Arranging of export license or other export authorisation (if needed)

An Export licence is a document prepared by an authority granting the right to export certain goods to a specified country. Wärtsilä shall arrange an export licence and other export documentation required for the export.

1 Export clearance of goods at the port of loading nominated by Wärtsilä

Export declaration is a document required for export of the goods. Export declaration is required by the customs authorities in the country of origin and country of export to control export and is a source for export statistics.

1 Notification to buyer of time and place of delivery of equipment

Customer will be notified about the estimated time and place of delivery according to the contractual agreement of the project.

D2 COLLECTION TRANSPORT AND LOADING PORT OPERATIONS**1 Loading of equipment at place of manufacturing**

Wärtsilä is coordinating and arranging that the equipment will be loaded on the transport equipment at place of manufacturing.

1 Transportation of equipment from place of manufacturing to port of loading nominated by Wärtsilä

Wärtsilä is coordinating and arranging that the equipment will be transported from the place of manufacturing to place of delivery (i.e. port of loading).

1 Transport insurance from place of manufacturing to port of loading nominated by Wärtsilä

The equipment are insured according to Incoterms 2010 from place of manufacturing to place of delivery (i.e. port of loading).

1 Unloading of equipment at port of loading nominated by Wärtsilä

The equipment shall be discharged from the transportation equipment at the place of delivery (i.e. port of loading).

1 Shifting of equipment to warehouse/open storage/container yard

The equipment is discharged and transferred from transport vehicle into temporary warehouse or other suitable area waiting for further delivery to final destination.

1 Warehousing at port of loading nominated by Wärtsilä (up to contractual delivery date)

Wärtsilä shall arrange storage of goods at the place of delivery up to the agreed contractual delivery date. In the event that no delivery has taken place due to the Customer's failure to fulfil its obligations or the delivery is postponed due to reasons attributable to the Customer, the equipment shall not be automatically insured nor storage paid for. The Customer must come to a separate written agreement with Wärtsilä and agree on an extension of the warehousing agreement and insurance cost.

1 Containerizing of loose non out of gauge cargo at port of loading nominated by Wärtsilä to the extent reasonable

Goods are to be containerised taking into account the conditions such as method of transportation, nature of the goods (weight and dimensions) and duration of the transportation, as well as agreed delivery terms (see ownership of shipper's own container).

1 Shifting of equipment from warehouse to alongside vessel

Wärtsilä will communicate, arrange and coordinate with the port operator the shifting of equipment from the warehouse at the port of loading to alongside vessel.

1 Onshore stevedoring cost at port of loading nominated by Wärtsilä

Wärtsilä will communicate, arrange and coordinate with the port operator all onshore stevedoring costs that arise at port of loading from activities such as but not limited to manpower during the loading operation.

1 Hooking on charges for equipment when delivered alongside vessel at port of loading nominated by Wärtsilä

Wärtsilä is responsible to arrange and coordinate with the port operator the activities related to securing the equipment to the hook of the crane when lifting the equipment into the vessel or other mean of transport.

1 Loading of equipment on board vessel or any other transport vehicle

Wärtsilä is responsible to arrange and coordinate that the port operator loads the equipment with certified lifting equipment in a safely manner into the vessel or any other mean of transport. Wärtsilä arranges its own surveyor for lashing and securing of heavy items i.e. engines and/or generator set and/or generators.

1 Unhooking charges for equipment loaded on board vessel or any other transport vehicle

Wärtsilä shall be responsible for arranging and coordinating with the port operator that the goods are safely loaded on board the vessel or any other means of transport when they are released from the crane's hook and lifting equipment.

1 Lashing, securing, dunnage and welding on board vessel or any other transport vehicle

Wärtsilä is responsible to arrange and coordinate its third party service provider that the cargo is lashed, secured, dunned and welded according to applicable standards intended for selected mode of transport.

D3**MAIN TRANSPORT AND UNLOADING PORT OPERATIONS****1 Nomination of vessel or other mean of transport**

Wärtsilä will book and arrange the vessel or other mean of transport according to contract between Wärtsilä and Customer.

1 Engaging and instructing freight forwarder

Wärtsilä is contracting a third party transport service provider to be engaged and instructed to handle the transport according to contractually agreed delivery terms between Customer and Wärtsilä. By this contract the service provider is informed about the details of the cargo, delivery term, origin of the goods and other relevant information needed to ensure a safe and timely transport of the goods.

1 Arranging of bill of lading

Wärtsilä shall have the transportation document issued for the carriage of goods from the place/port of loading until the place/port of unloading in the form and method agreed in the contract.

1 Preparation of origin country documents required for destination customs clearance

The country of origin documents refer to such documents, which state the origin of the delivered equipment. The country of origin documents are to be issued according to origin country authority regulations.

1 Transportation of equipment from port of loading to port of destination (offloading quay nominated by Wärtsilä)

Wärtsilä shall be responsible for arranging a contract of carriage for the transportation of the goods. Unless otherwise separately agreed in the contract between the Customer and Wärtsilä, it shall be understood that the sea freight is booked on a part charter basis for the out of gauge cargo.

1 Transport insurance from port of loading to port of destination (offloading quay nominated by Wärtsilä)

Wärtsilä has insured the goods during transport according to Incoterms 2010 and contract between Wärtsilä and Customer.

1 Discharging of equipment from vessel or any other transport vehicle at port of destination (offloading quay nominated by Wärtsilä)

Wärtsilä is responsible to discharge the equipment. Discharging of the goods is to be done with certified lifting equipment in a safely manner from the vessel or any other mean of transport.

1 Unhooking charges for equipment discharged from vessel or any other transport vehicle

Wärtsilä shall be responsible for arranging and coordinating with its appointed third party transportation service provider that the equipment is safely discharged from the vessel or any other means of transport when they are released from the crane's hook and lifting equipment.

1 Onshore stevedoring cost at port of destination (offloading quay nominated by Wärtsilä)

Wärtsilä is responsible to arrange and coordinate with its appointed third party transport service provider activities such as but not limited to manpower during the unloading operation.

1 Shifting of equipment from alongside vessel to warehouse/open storage/container yard inside the port of destination (offloading quay nominated by Wärtsilä)

Wärtsilä is responsible to arrange and coordinate with its appointed third party transport service provider that when the goods is safely discharged from the vessel that it is shifted to a temporary storage area.

1 Shifting of containers delivered by liner vessels to container yard at port of destination

Containers are transferred from vessel to container yard at port of destination as standard procedure by the container liner.

1 Unloading of equipment at warehouse/open storage/container yard at port of destination

Wärtsilä shall be responsible for arranging and coordinating with its appointed third party transportation service provider that the goods are safely unloaded when they are shifted to a temporary storage area.

1 Wharfage (Customer responsibility)

A charge asserted by the port, terminal, pier or dock owner for handling incoming or outgoing cargo. The charge made for docking a vessel at a wharf. A user will be subject to a charge, even for limited periods of time.

In the event that the port of destination applies a wharfage, the Customer shall be responsible for these charges.

The Customer shall indemnify Wärtsilä against any claims any delay not attributable to Wärtsilä.

1 Arrange import license or import permit (if required) (Customer responsibility)

An import licence may be required by an authority of the destination country to grant the right to import certain goods to the destination country. The Customer shall be responsible for arranging, coordinating and paying for all required activities and costs with authorities in order to obtain any such import license(s).

The Customer is to indemnify Wärtsilä against claims arising from any delay not attributable to Wärtsilä.

1 Import of goods (Customer responsibility)

Customer arrange and coordinate all related activities and documents related to the import of the goods in the destination country.

Customer to indemnify and hold Wärtsilä harmless for any delay not attributable to Wärtsilä.

1 Import taxes and duties (if required) (Customer responsibility)

Customer is responsible for arranging payment for the import taxes and duties declared by the authorities during the custom clearance process. Customer is responsible for presenting all required documents enabling the import custom clearance.

Customer to indemnify and hold Wärtsilä harmless for any delay not attributable to Wärtsilä.

D4

SITE TRANSPORT

1 Transport route preparation (if required) (Customer responsibility)

Customer to ensure safe delivery of the goods, such as but not limited to strengthening of the bridges structures and pavement, removal of tree branches, traffic signs, lifting of cables, survey to ensure safe berthing of vessel (bathymetry survey), and construction of temporary structures such as jetty and overall control over safety during transport.

1 Transport permit assistance (Customer responsibility)

The Customer is responsible for arranging all required permit(s) for transportation specifically related but not limited to heavy and out-of-gauge cargo. If transport permit assistance is required from Wärtsilä to enable a better and clearer understanding between local authorities and Customer, Wärtsilä will provide such supporting documentation to the Customer in order to facilitate the transport permit(s) process.

The Customer is to indemnify and hold Wärtsilä harmless for any delay not attributable to Wärtsilä.

1 Loading of equipment on truck at warehouse

Wärtsilä arranges and coordinates with the third party transport service provider that the equipment is safely loaded with certified lifting equipment onto the transport vehicle.

1 Transportation of equipment from port of destination to Named Place of Destination

Wärtsilä shall arrange and coordinate with the third party service provider that the equipment is lashed and secured to the certified transport vehicle according to standards applicable to the selected mode of transport and that it is transported to the project site. For destination country to project site, Wärtsilä shall demand a method statement from the third party transportation service provider before the actual transportation takes place as to how the heavy goods (e.g. engines and/or generator set and or generator) transport will be performed during different transport modes and shifting to the final position. During transportation, Wärtsilä shall demand status reports from our third party transport service providers on a regular basis.

1 Transport insurance from port of destination to Named Place of Destination

Wärtsilä has insured the goods during transport according to Incoterms 2010 and contract between Wärtsilä and Customer.

1 Equipment at Named Place of Destination for discharging cargo

Wärtsilä arranges equipment, such as crane and forklift truck and any other to discharge cargo from transport vehicles.

1 Unloading of equipment at Named Place of Destination

Wärtsilä shall discharge the goods from the transportation vehicle into the nominated area at the project site according to the instructions of the site personnel.

1 Temporary warehousing in country of destination

Wärtsilä arranges that goods are placed into temporary warehouse if required for duration of customs clearance, lack of space at site or any other reason.

E TAXES, DUTIES, PERMITS AND INSURANCE

E1 TAXES AND DUTIES

1 Construction labour tax (BESS)

E3 INSURANCE

1 General liability and product liability insurance

1 Construction and erection all risk insurance

1 Workers' compensation and employer's liability insurance for Wärtsilä personnel

F PROJECT MANAGEMENT SERVICES**F1 PROJECT MANAGEMENT FOR ENERGY STORAGE****General**

Project management is service utilizing knowledge, skills, tools and techniques to project activities in order to meet project requirement. This enables to manage the scope of work required to deliver agreed deliverables specified in contract.

The project management process at Wärtsilä Energy Business is based on the Project Management Institute's (PMI) standards, the PMBOK® Guide, ISO 21500, and Wärtsilä best practise and experience.

Wärtsilä uses CA PPM as portfolio and project management tool. For scheduling Wärtsilä uses Microsoft Project.

The project will be managed by a dedicated project team, led by a competent project manager. The project manager is fully responsible for achieving the targets set by the contract, empowered to organize and lead the project team, and authorized to make decisions on the supplier's behalf. The project team administers, manages and controls the project in accordance with the contract requirements. The project manager is the interface towards the Customer.

The project management service will cover the time period based on contract delivery schedule (including commissioning).

Project management process

The project team plans the project based on the contract requirements. The team executes the plan by directing and managing the works throughout the engineering, procurement, logistics, construction and commissioning phases of the project. The project phases are planned and executed in accordance with Wärtsilä's project management process as shown in figure below.

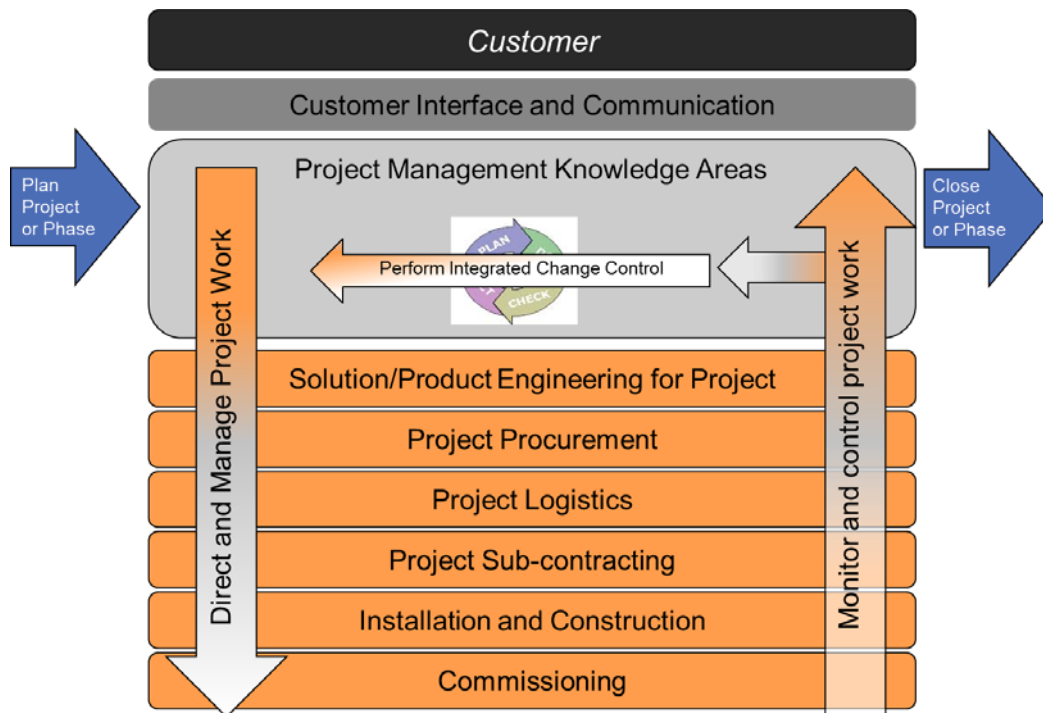


Figure 11 Wärtsilä's project management process

The project phases are managed by means of the project management knowledge areas as described below.

Project Management Deliverables

Project management integrates the project management areas throughout the project management phases. The project management phases are listed below and comprise the deliverables and methods of the project management service:

- Planning
 - Task: In the planning phase all parts of the project are planned in an integrated manner and compiled into a project execution plan. The project execution plan will cover the resource -, schedule -, financial -, engineering -, risk -, communication -, quality -, HSSE -, procurement -, permit -, subcontracting -, scope, change and documentation management. A first version of the project execution plan will be given to the customer during the kick-off meeting and after that as progressive elaborations when new information is obtained.
- Execution: Directing and managing project work
 - Task: Directing and managing refers to the daily coordination of the scope of supply and other work tasks across the other project related services (engineering, procurement, logistics and construction management). Problems are proactively addressed and issues related to the scope of supply and its interfaces to other systems are coordinated with the customer (or other assigned parties).
- Reporting: Monitoring and controlling project work
 - Task: The project is continuously monitored as part of the daily coordination. Formal control and monitoring strives to communicate the status of the project in a systematic manner and to identify deviations from the plan or scope.
- Change Control

- If a change to the materials or works specified in the contract or project execution plan occurs during the project, the project team will follow a change procedure specified in the contract or according to general, prevailing contracting practices.
- **Project Closure**
 - **Task:** When the delivery is completed, the project team requests formal acceptance of the project.
 - **Deliverable:** Handing-over certificates as per contract.

Project Organization

The delivery of the energy storage system will be managed by a project team dedicated to the project. The team is led by a competent project manager.

The project team is resourced with necessary competencies so that the project work can be executed. The project team is formed based on the contract scope and involves resources for engineering, procurement, logistics, installation, civil works, project controls as well as resources from necessary support functions.

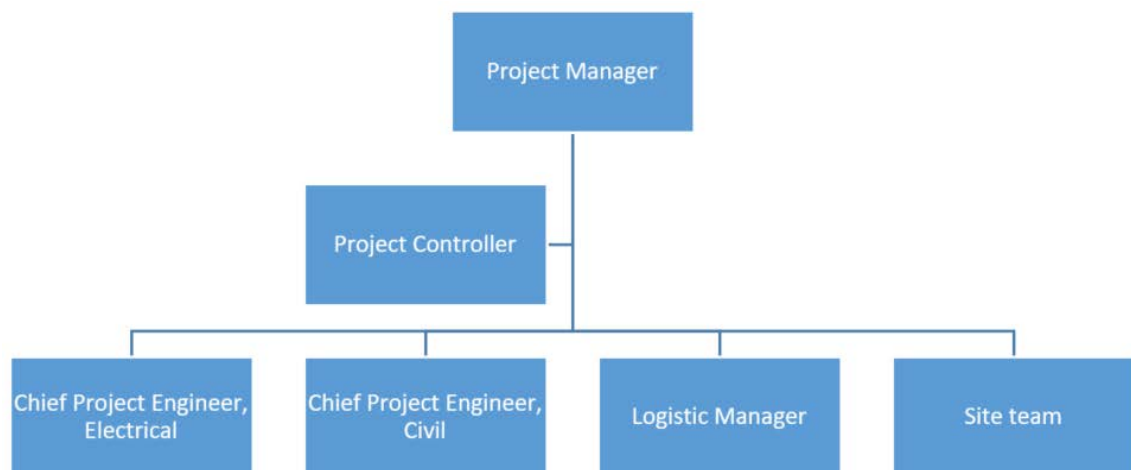


Figure 12 Typical Wärtsilä core project team

Project Risk Management

The project team identifies the risks of the project work for energy storage system delivery and creates a response plan to mitigate them.

Project Financial Management

The project financial management is done by planning and following the contractual invoices, payments, performance bonds and payment securities.

Taxation and work permits - Customer shall support in obtaining the work permits and other licences required for the employees of Supplier to perform the service in the project site.

Project Handing Over

The project will be handed over as set forth in this contract. Handing over will be done when commissioning activities are completed and requirements set forth in the contract are fulfilled. Warranty period set forth in contract will be handled by dedicated warranty team, led by lead warranty manager.

Project Document Control

The objective of project document control is to:

- Ensure that the all stakeholders, both internal and external, have access to the valid revisions of documents in real time
- Provide means to identify which purpose each document is good for
- Remove the risk of having duplicates in use with different revision and content by applying single source technology
- Reduce unnecessary email communication, and consequently improve project communication and transparency

Wärtsilä Energy Solution use DCM365 as the tool for document control.

Project Collaboration Platform DCM365

DCM365 is the document control platform used in Wärtsilä for online collaboration and document sharing with project stakeholders. The main purpose of the system is to have a comprehensive document control and transmittal management environment which is accessible for both internal and external project stakeholders. It also provides a possibility to keep track of comments and approvals received for every transmitted document.

DCM365 is independent of operating system and accessible from any device anywhere in the world. DCM365 is built on Office 365 SharePoint Online (SPO).

The following functions are included:

- Manage the flow of documents between stakeholders securely and efficiently
- Control the design review and approval processes in different phases of the project
- Maintain comprehensive master document register (MDR) to ensure identification, revision, and status of documents
- Send automated notifications on document activities (status changes, comments etc.)
- Keep track record of formal document transmittals and project correspondence
- Shared e-mail account for the project, which is used for capturing all official e-mail correspondence
- Control the user access to project information based on the users' role in the project

Information security

The platform, Office 365, complies with the ISO 27001 - Information security management and the EU data protection directive 95/46/EC. Furthermore the following security requirements are be met:

- Users authenticated by username and password
- All project stakeholders have access to accurate and correct information based on their role in the project

- Use only European data centres
- Encryption at rest to protect the data on servers
- Traffic between browser and server is encrypted using 128-bit secure sockets layer (SSL) encryption

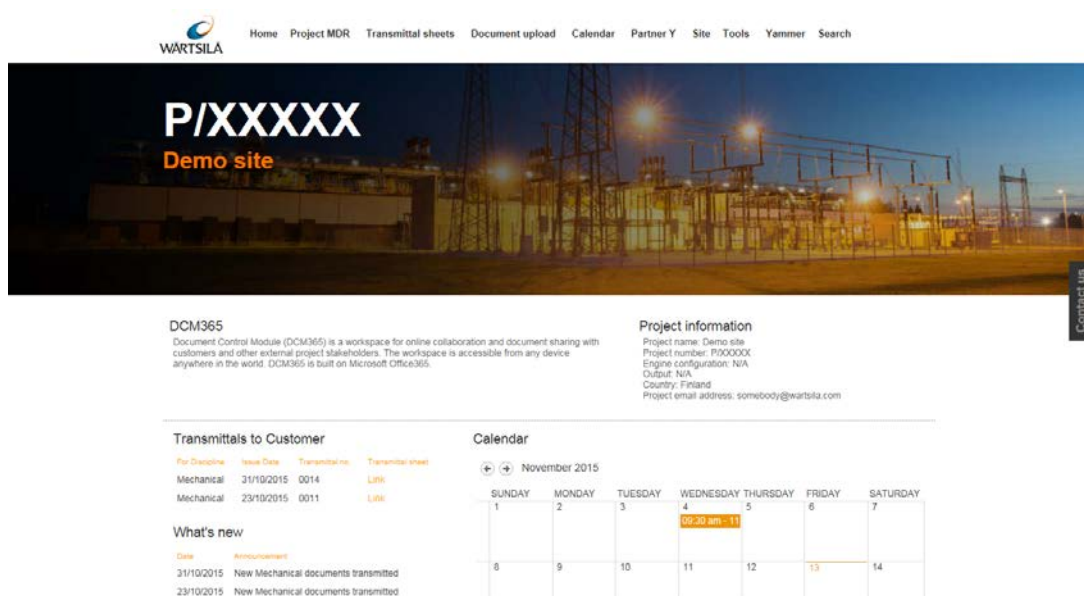


Figure 13 The main page of DCM365

1 Project management for work under Wärtsilä's responsibility

G CONSTRUCTION MANAGEMENT

General

Construction management refers to the planning, leading and managing all activities related to the construction site, which are necessary for ensuring that site activities are performed within the set time schedule and according to the contract and quality and safety requirements of the project.

G1 SITE ORGANISING AND RESOURCING

A Wärtsilä site organisation is set up based on the project needs. The site activities are led by a site manager reporting to a project manager. Needed resources are added on a timely basis to fulfil project requirements. A commissioning team is assigned to the site when commissioning activities begin (ref Commissioning service).

Site manager is Customer's main point of contact at the site during construction. Customer assigns authorised site representative to be main point of contact towards Wärtsilä.

A construction management team is set up in such a way that it ensures legality, timeliness and good working conditions. Wärtsilä and its subcontractors take care of work permits, travelling, and on-site requirements of their personnel. On-site requirements include office space, housing, transportation and medical care. The customer assists and sponsors work permitting for a smooth and timely process.

Lodging and office facilities for Customer's and other parties' personnel are not included in Wärtsilä's scope (if not otherwise specifically stated in the contract).

Site personnel working times are according to laws and regulations, and planned to maintain personnel health and safe working conditions.

1 Site management [items and work under the responsibility of Wärtsilä]

G2 HEALTH, SAFETY, ENVIRONMENT (HSE) AND SECURITY MANAGEMENT

Wärtsilä is certified for environmental management system ISO 14001 and occupational safety management system OHSAS 18001. Health, safety and environmental (HSE) management is one of the key elements in construction activities. HSE documentation, including plans, procedures and other HSE documentation, is prepared per project and implemented at the worksite. HSE procedures follow Wärtsilä's internal HSE instructions, contractual requirements, and local legislation. The main purpose of HSE documentation is to identify the occupational health and safety management methods applied to the contractual scope of work by Wärtsilä, the customer and subcontractors. The documentation also provides rules for co-operation between the customer, Wärtsilä, subcontractors and others working in a shared workplace with regard to health, safety and environmental matters. All personnel to perform their activities in strict compliance with Wärtsilä's and contractual safety requirements. The construction management team is responsible for implementing the HSE management system and for monitoring its efficiency.

Worksite personnel are inducted for HSE management system. All incidents are reported, investigated and corrective actions are taken to improve safety. Wärtsilä monitors HSE performance in delivery projects continuously, and sets HSE targets and objectives for continuous improvement.

A site security plan is prepared and implemented, when site security is part of Wärtsilä's scope. If security arrangements are Customer's responsibility, Wärtsilä to review the plans before site activities are started up.

- 1 Health, safety and environment plan**
- 1 Site safety management and HSE plan implementation**
- 1 HSE reporting and corrective actions**
- 1 Emergency action plan**
- 1 Worksite personnel induction and training for site HSE management system**
- 1 Site security plan**
- 1 Site security plan implementation/security arrangements**

H TEMPORARY INSTALLATION AND ARRANGEMENTS

Temporary facilities consist of items that are needed during construction. A temporary facilities plan is made, which includes locations and dimensions of temporary facilities, utility connections, laydown areas, access and temporary roads.

The temporary facilities will be removed and areas cleaned when demobilization of construction work is completed.

Materials, installation and maintenance of temporary facilities and controls to be in compliance with applicable regulatory requirements.

Contract /scope of work defines what site temporary utilities are included for Wärtsilä's and what to Customer's scope.

H1 ROADS AND WORKING AREA

- 1 Temporary access road to site for energy storage**
- 1 Temporary roads at site for energy storage**
- 1 Preparing of working areas for energy storage**
- 1 Lay down area - preparation for energy storage**

H2 UTILITIES

- 1 Site office including furniture for Wärtsilä personnel for energy storage**
- 1 Internet consumption during construction**
- 1 Electricity consumption during construction**
- 1 Water consumption during construction**
- 1 Sewage during construction for energy storage**
- 1 Illumination during construction for energy storage**
- 1 Parking places during construction for energy storage**
- 1 Workers social facility**
- 1 Workshop areas**
- 1 Construction equipment and tools**
- 1 Fuel supply for construction equipment usage**

H3 SECURITY

- 1 Security of Wärtsilä supplied equipment
- 1 Temporary fencing during construction for energy storage
- 1 Security for personnel transport between site and accommodation

H4 HEALTH SAFETY AND ENVIRONMENT

- 1 Fire protection during construction and commissioning work on the site
- 1 Medical evacuation plans of seriously injured persons
- 1 Chemical storage
- 1 Hygiene and safe canteen and food preparation (when on-site canteen)
- 1 Work permitting at site
- 1 Locking and tagging procedures
- 1 Dust control
- 1 Waste material handling

H5 DEMOBILIZATION

- 1 Removal of temporary facilities
- 1 Cleaning of areas used by Wärtsilä
- 1 Excess imported material

- I LOCAL SUPPLY AND INSTALLATION**
- I2 INSTALLATION OF ELECTRICAL EQUIPMENT**
 - 1 Installation of electrical equipment supplied by Wärtsilä**
- I3 INSTALLATION OF CIVIL EQUIPMENT**
 - 1 Installation of civil equipment supplied by Wärtsilä**

J COMMISSIONING AND COMMISSIONING MANAGEMENT**J2 COMMISSIONING MANAGEMENT**

Commissioning management refers to the planning, leading and managing all activities related to the commissioning work for Wärtsilä supplied systems and solutions, which are necessary for performance of the commissioning service within the set time schedule, and according to the quality and safety requirements of the project.

1 Commissioning planning

General planning of the commissioning works is to start at an early stages of the project as part of project planning. The commissioning plan is to be based on the project requirements.

Commissioning planning is a continuous process, activities are planned in more detail closer to commencement of the work.

1 Commissioning organization and resourcing

The Wärtsilä commissioning organisation is part of the construction management team and is built based on the project needs. The commissioning activities are to be led by the commissioning manager.

1 Health, Safety and Environment during commissioning

Health, safety and environmental (HSE) management is one of the key elements at commissioning activities. During commissioning same HSE management system as during construction (see construction management) will be used in strict compliance with Wärtsilä and contractual safety requirements.

1 Commissioning coordination and meetings

Coordination and steering is to be executed by means of establishing and maintaining clear communication with the Customer (or the Customer's representative on site) and other stakeholders in order to minimise risks during commissioning.

The most important steering system at the site is the active meeting procedure. The meetings are to be organised in advance, short, well defined and targeted on clear decisions, and are typically chaired and minuted by Wärtsilä. Minutes of meetings are to be signed by all parties. The weekly commissioning meetings schedule is to be planned and communicated to all parties involved, and consist typically of short daily morning briefs, weekly commissioning meetings and coordination meetings with stakeholders as needed.

Wärtsilä uses its own online collaboration platform DCM365 (described in document control) for site information and document handling. The Customer, subcontractors and stakeholders have access to information via DCM365.

1 Commissioning time management, controls and progress reporting

The commissioning schedule, control and reporting is to follow the methods described under construction management and the project schedule management system.

1 Commissioning and performance test documentation

The site quality plan (SQP), site quality assurance documentation (SQAD), performance test documentation and other contractually required documentation are to be prepared and provided to Customer. The SQP and SQAD are described under the construction management section.

K TRAINING

This energy storage system supply includes the following training programme for the personnel of USVI Water and Power Authority. The programme is intended to give the operation personnel the necessary basic knowledge of how to operate and maintain the supplied equipment.

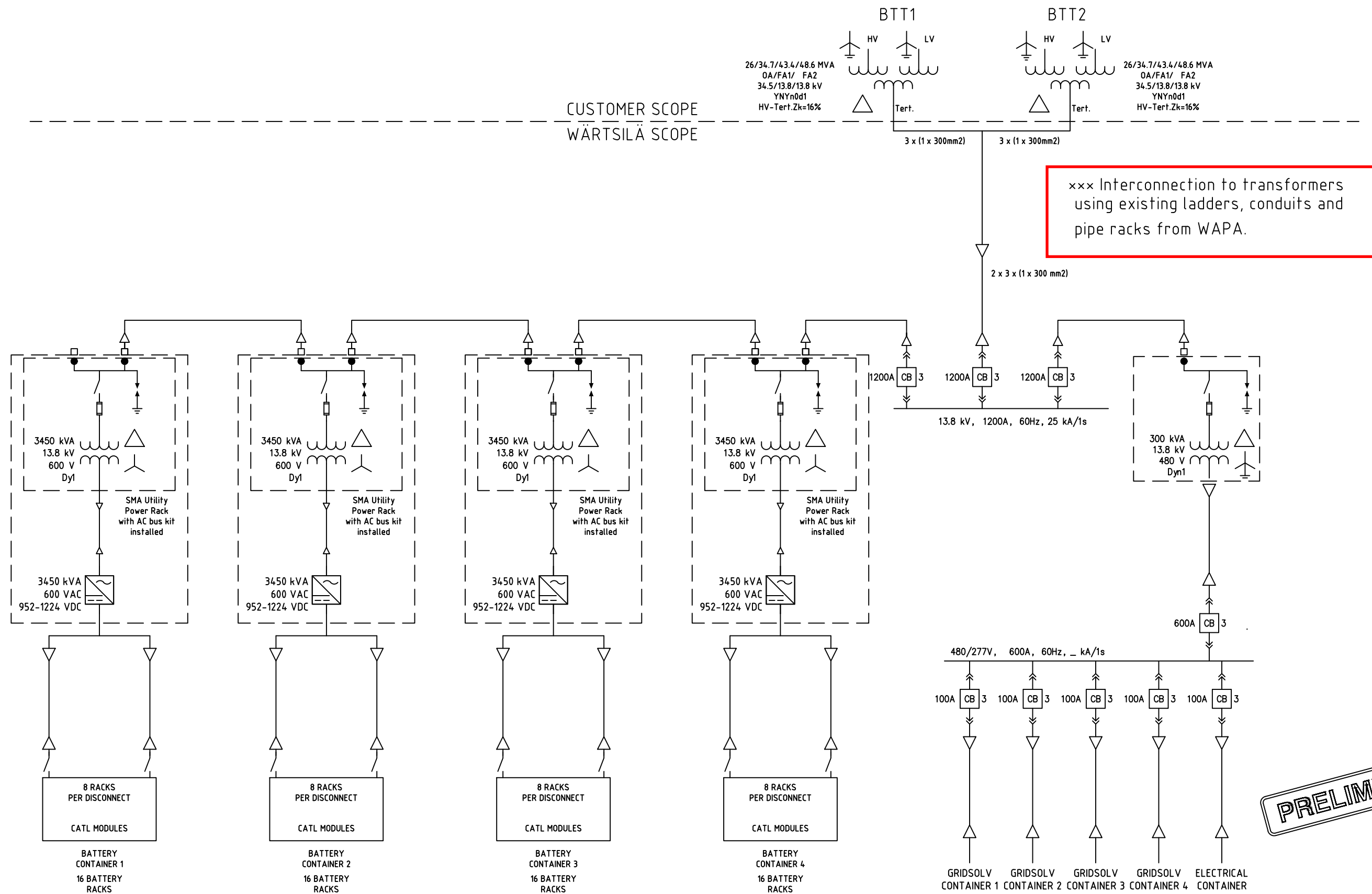
K1 TRAINING AT SITE**1 Energy storage operation course**

Wärtsilä will conduct a training during commissioning of the project. The training will be provided either on site or via the remote training once the system is fully commissioned. Wärtsilä will provide safety documents to local operators with instructions on PCS and battery/module safety during maintenance and replacement.


Training will also include review of manual disconnects that will be installed on the auxiliary power, PCS, and battery strings, enabling manual shutdown of all electrical equipment during maintenance and service.

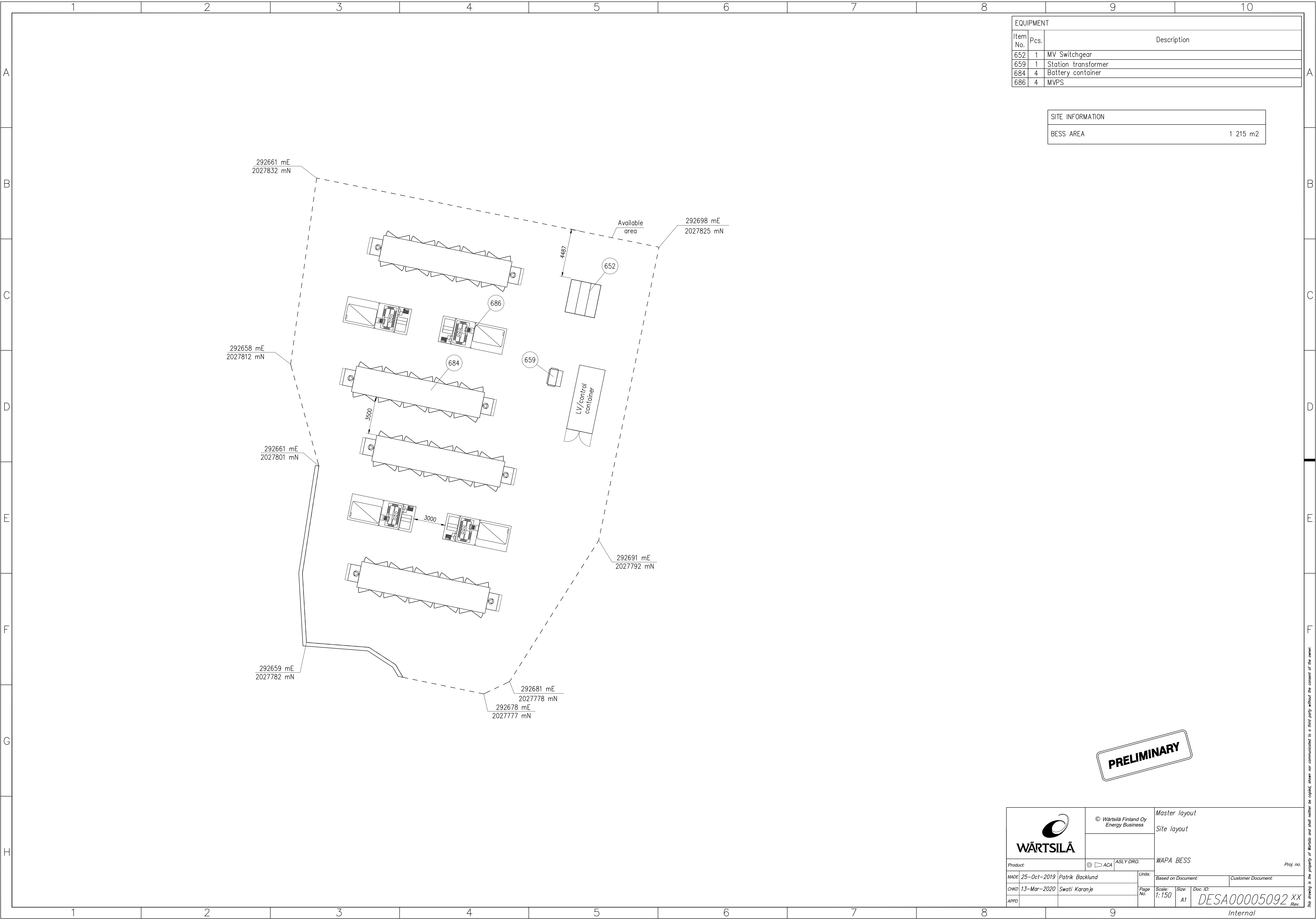
Training documentation will include an Operations & Maintenance Manual. The Operations & Maintenance Manual will provide detailed information about all major components of the energy storage system.

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PRELIMINARY

				Project name		MEDIUM VOLTAGE SYSTEM	Created by	Create date	Language	Object designation
c	17.3.2019	OHE010	OHE010	Added second outgoing feeder		SCHEMATIC SINGLE LINE	FRA019	25 Oct 2019	EN	
b	19.2.2020	OHE010	NBA026	Changed aux transformers connection	Product id		Reviewed by	Review date	Sheet size	Page
a	14.2.2020	OHE010	NBA026	Changed voltage levels and added BTT1/2	Customer document id		Approved by	Approval date	Document id:	Rev.
Rev.	Date	Created by	Appr. by	Revision text			NBA026	25 Oct 2019	-	



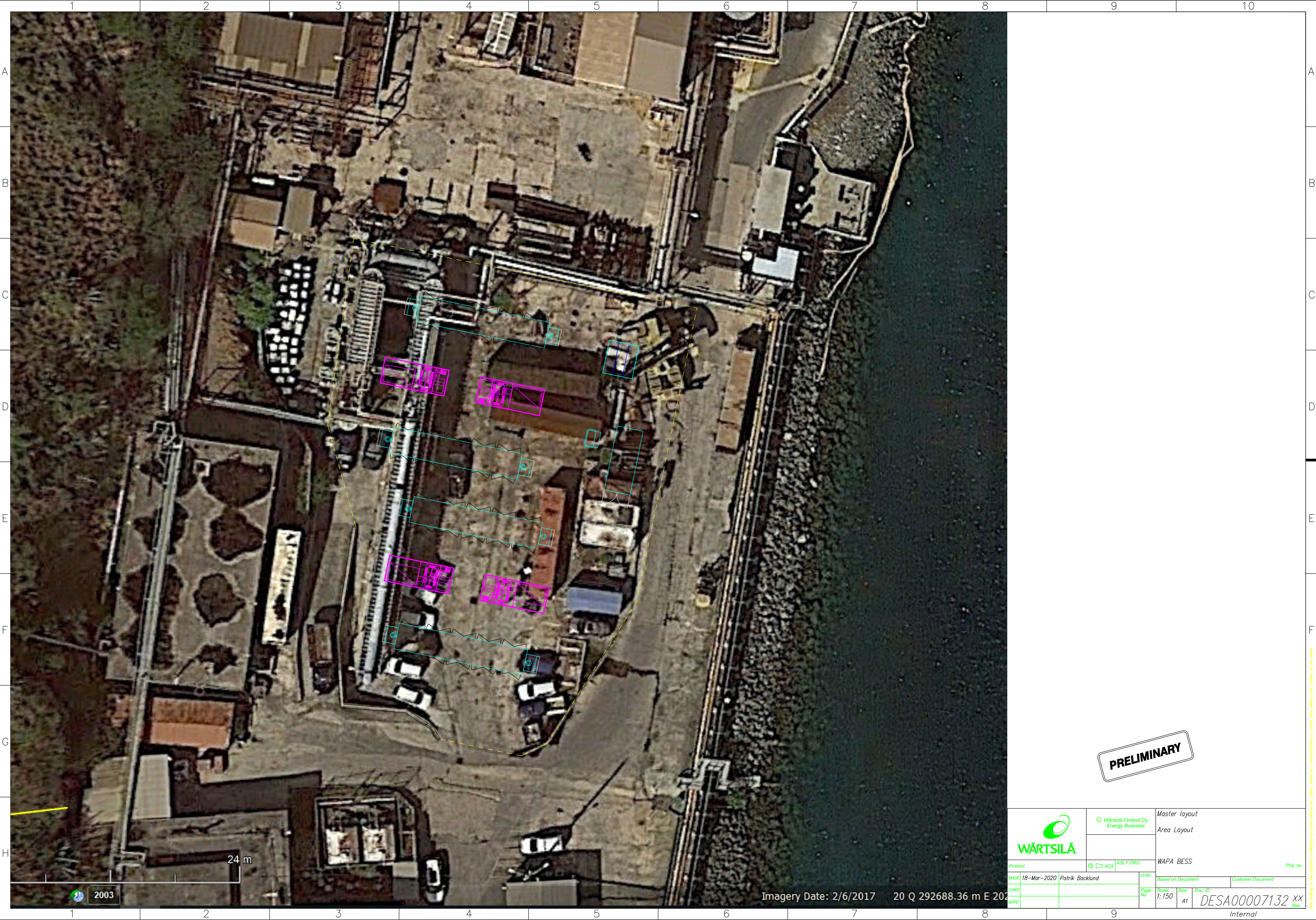
EQUIPMENT		
Item No.	Pcs.	Description
652	1	MV Switchgear
659	1	Station transformer
684	4	Battery container
686	4	MVPS

SITE INFORMATION	
BESS AREA	1 215 m2


PRELIMINARY

		© Wärtsilä Finland Oy Energy Business		Master layout Site layout	
		ASLY DRG:		WAPA BESS	
Product:		© ACA		Proj. no.	
MADE	25-Oct-2019	Patrik Backlund		Units:	
CHKD	13-Mar-2020	Swati Karanje		Based on Document:	
APPD				Customer Document:	
		Page No.	Scale: 1:150	Size: A1	Doc ID: DESA00005092 xx
				Rev.	
				Internal	

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PRELIMINARY

		© Wärtsilä Finland Oy Energy Business	Master layout	
			Area Layout	
Product:		© ACA ASLY DRG:	WAPA BESS	
MADE	18-Mar-2020	Patrik Backlund	Units:	Proj. no
CHKD			Page No.	Based on Document:
APPD			Scale:	Customer Document:
			1:150	
			A1	DESA00007132 XX
				Rev
				Internal

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INTERNAL Specification			
Title:	Project Design Basis (PDB)	DocID:	DESA00004422
		Revision:	-.2
Author:	Petteri Mäkinen	Status:	Draft
Draft by:	Petteri Mäkinen / 30 April 2020	Pages:	1 (14)
Organisation:	Wärtsilä Finland Oy Energy Solutions		
Project:	P/17402 WAPA 2		

Project Design Basis - WAPA II St. Thomas

Table of Contents

1	Project information	3
1.1	General.....	3
1.2	Engineering documentation	4
1.3	Technical documentation	4
1.4	Master layouts	4
1.5	Road dimensioning	4
1.6	Wind load.....	4
1.7	Seismic load	4
2	Safety design and Fire protection.....	5
2.1	Safety design.....	5
2.2	Fire Protection	5
3	Process and mechanical design.....	6
3.1	EG-set and module specifications.....	6
3.2	Piping and ducting specification	6
3.3	Piping and ducting insulation	6
3.4	Platforms and over walks.....	6
3.5	Piping trace heating and freezing protection	6
3.6	System and dimensioning requirements	6
3.7	Standards	6
4	Electrical design.....	8
4.1	Earthing system.....	8
4.2	Cable conduits.....	8

4.3	Lightning protection system	8
4.4	Cable ladders	9
4.5	Lighting system.....	9
4.6	Fire detection system.....	9
4.7	Cables	10
4.8	Calculations and system studies.....	10
4.9	Others.....	10
5	Civil design.....	11
5.1	Standards	11
5.2	Live Loads	12
5.3	Soil	12
5.4	Concrete.....	12
5.5	Buildings materials.....	12
5.6	Process ventilation.....	13
5.7	AC and heating.....	13
5.8	Rain water drainage system.....	13
5.9	Sewage system	13
5.10	Oily water system	14

1 Project information

This design basis presents a summary of initial data and standards to be considered in the engineering of the below mentioned project.

1.1 General

Project Main Data		
Project name	WAPA II St. Thomas	
Project number		
Wärtsilä project delivery system	EPC	
Wärtsilä project class	A	
Project location, country and city	St Thomas, US Virgin Island, USA	
Global coordinates for A/0 point and a second point, coordinate system (WGS 84 / UTM)	UTM	
Plant Data		
Engine type	W20V32LG	
Number of engines	4	
Engine numbering	SQA041 starting from 0 axis	
Identification system for the power plant	Wärtsilä standard	
Plant type	Standby Island mode & Connected to grid	
Plant output	36 MW	
Voltage/Frequency	69 kV/34.5 kV/13.8 kV / 480 V / 60 Hz	
Fuel	LPG/LFO	
Site Conditions		
Altitude, height above sea level (m)	10 meters above sea level	
Ambient min and max temperature (°C)	Min 10°C (50°F) – Max +35°C (95°F)	
Design ambient temperature (°C) and relative humidity (RH)	30 °C (86°F), 65 %	
Noise limitations	Below 75 dB(A) outside site boundary	
Noise simulation document ID	Yes, available in doc DESA00004609 rev c	
Site air quality	Clean, close to sea	
Atmospheric corrosivity category, INSIDE ISO 12944-2	<input type="checkbox"/> C1 Very low	<input type="checkbox"/> C4 High
	<input type="checkbox"/> C2 Low	<input type="checkbox"/> C5-I Very high (industrial)
	<input checked="" type="checkbox"/> C3 Medium	<input type="checkbox"/> C5-M Very high (marine)
Atmospheric corrosivity category, OUTSIDE ISO 12944-	<input type="checkbox"/> C1 Very low	<input type="checkbox"/> C4 High
	<input type="checkbox"/> C3 Medium	<input type="checkbox"/> C5-I Very high (industrial)
	<input type="checkbox"/> C3 Medium	x C5-M Very high (marine)

1.2 Engineering documentation

Specific Information	
Language in drawings and documents	English
Drawing frame and title block	Wärtsilä standard
Document numbering	Wärtsilä standard

1.3 Technical documentation

Description	Available	Document ID	Imp.order
Technical specification	<input type="checkbox"/>		
Tender documentation	<input type="checkbox"/>		
Wärtsilä standard solutions	x	Wärtsilä design handbooks	1

The importance order of the technical documentation follows an ascending order, with the highest importance being equivalent to the smallest number.

1.4 Master layouts

Description	Available	Document ID / Remarks
Site layout	<input checked="" type="checkbox"/>	
Site area layout	<input checked="" type="checkbox"/>	
Engine hall, plan	<input checked="" type="checkbox"/>	
Engine hall, section	<input checked="" type="checkbox"/>	
North direction	<input checked="" type="checkbox"/>	
Wind rose and wind prevailing direction	<input checked="" type="checkbox"/>	Prevailing wind direction NE
Master layouts documents IDs:	<input type="checkbox"/>	Continue with same document ID as in sales:
	<input checked="" type="checkbox"/>	New document IDs to be taken

1.5 Road dimensioning

Description	Vehicle type
Truck type to be considered according to AASHTO	WB-50

1.6 Wind load

According to IBC 2018/ ASCE 7-16

Description	Value	Remarks
Basic wind speed	175 mph	ASCE 7-16 or VIBEC VIBEC adopts latest version of IBC
Risk category	III	
Exposure category	D	To be confirmed based on site locations

1.7 Seismic load

According to IBC and ASCE 7-16

Description	Value	Remarks
Earthquake spectral response acceleration	Ss= 1.22 g S1= 0.43 g	IBC 2018/ASCE 7-16
Site class	D	Unless otherwise provided in Geotech report
Risk category	III	
Importance factor	1.25	Standby plant
Component Importance factor	1.0	Depends on system

2 Safety design and Fire protection

2.1 Safety design

Description		Design Standard / Notes
Explosive atmosphere	<input checked="" type="checkbox"/>	NFPA 70
Working platforms, stairs and ladders	<input checked="" type="checkbox"/>	OSHA
Escape routes	<input checked="" type="checkbox"/>	National legislations/ IBC 2018/OSHA
Safety markings/signs	<input checked="" type="checkbox"/>	ISO 3864-1:2011 & ISO 7010:2011
Emergency showers	<input checked="" type="checkbox"/>	ANSI Z358

2.2 Fire Protection

Description		Design Standard / Notes
Sprinkler	<input checked="" type="checkbox"/>	NFPA 13
Hose reels	<input checked="" type="checkbox"/>	NFPA 14
Main fire line	<input checked="" type="checkbox"/>	NFPA 24
Fire extinguishers	<input checked="" type="checkbox"/>	Portable fire extinguishers layout according to NFPA 10

3 Process and mechanical design

3.1 EG-set and module specifications

Description	Available	Document ID
Engine performance data (PERF).	<input type="checkbox"/>	
Engine IOS specification.	<input type="checkbox"/>	
Pipe Module Specification (MS)	<input type="checkbox"/>	
Small Unit Specification (SUS)	<input type="checkbox"/>	

3.2 Piping and ducting specification

Description		Remarks
Description The piping and ducting will be designed based on the pressure and temperature ranges defined for each system, based on (DBAD535614)		Based on Wärtsilä standard, ASME design. LFO and LPG: non-standard design with higher design pressure
	x	Wärtsilä design directives, Piping according to ASME standards

3.3 Piping and ducting insulation

Description		Remarks
Insulation	x	Wärtsilä standard
	<input type="checkbox"/>	Non standard

3.4 Platforms and over walks

Description		Remarks
Engine/Auxiliary platforms and over walks	<input type="checkbox"/>	EN-Standard
	x	OSHA

3.5 Piping trace heating and freezing protection

Description		Remarks
Trace heating	<input type="checkbox"/>	Steam heated.
	<input type="checkbox"/>	Electrically heated.
Freezing protection		

3.6 System and dimensioning requirements

Description		Remarks
Equipment sizing, redundancy	x	To be specified, redundancy requested in order to start the engine even if the black-start unit is not in operation. Redundancy to be ensured by means of UPS switchboard.
	<input type="checkbox"/>	Non standard

3.7 Standards

Pressure Piping	ASME B31.1
-----------------	------------

Pressure Vessels	ASME BPVC, Section VIII
Pipe Flanges and Flanged Fittings	ASME B16.5
Factory-Made Wrought Buttwelding Fittings	ASME B16.9
Forged Fittings, Socket-Welding and Threaded	ASME B16.11
Metallic Gaskets for Pipe Flanges	ASME B16.20
Studs	ASME B1.1, Class 2A
Nuts	ASME B18.2.2 and B1.1 Class 2B
Plain washers. Normal series.	ASTM F436/436M
Weld Procedure and Inspection	ASME BPVC, Section IX
Hot rolled structural steels	EN 10025
Seamless Carbon Steel Pipe	ASTM A106 Gr. B ASTM A53 Gr B, or ASTM A333 Gr.6
Welded Carbon Steel Pipe	API 5L, API A53 Gr. B
Wrought Carbon Steel Fittings	ASTM A234 Gr. WPB-S/W
Forged Carbon Steel Fittings	ASTM A105N
Carbon Steel Studs	ASTM A193 B7
Carbon Steel Nuts	ASTM A194 Gr. 2H
Seamless and Welded Stainless Steel Pipe	ASTM A312/A312M Grade TP304L
Wrought Stainless Steel Fittings	ASTM A403/A403M Grade TP304L
Forged Stainless Steel Fittings	ASTM A182/A182M Grade TP304L
Stainless Steel Studs	ASTM A193 Gr. B8, Class 2
Stainless Steel Nuts	ASTM A194 Gr 8
Piping in modules	EN
Fiberglass Tanks (Reagent)	API 12P
Vertical tanks	EN 14015, API 650 or API 12F
Horizontal tanks	EN 12285, API 620
Exhaust gas ducts, technical delivery conditions	material: Corten

4 Electrical design

4.1 Earthing system

Description	Details			
Earthing / Grounding grid below Zero	Bare Copper	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Earthing / Grounding grid joints	C-Clamps	<input type="checkbox"/>	Cad weld	<input checked="" type="checkbox"/>
Equipment grounding	Insulated YG copper wire	<input checked="" type="checkbox"/>	Bare Copper	<input type="checkbox"/>
Design Standards	IEEE 80 & 81	<input type="checkbox"/>	IEEE80,81,665 & NFPA 70	<input checked="" type="checkbox"/>
Design/ installation Basis	(DBAD300903)	<input type="checkbox"/>	<u>Underground Electrical Installation Specification</u> (DBAE782501)	<input checked="" type="checkbox"/>
Local Requirements (to be specified)		<input type="checkbox"/>		<input type="checkbox"/>

4.2 Cable conduits

Description	Details			
Cable conduits	Schedule 40, PVC, Diameters used 6", 4" and 2"	<input checked="" type="checkbox"/>	Any Other	<input type="checkbox"/>
Conduit bends	Schedule 40, PVC, Minimum bending radius 800mm	<input checked="" type="checkbox"/>	Any Other	<input type="checkbox"/>
Conduit Material list based on	<u>Cable</u> DAAB508823 rev:h <u>Conduits</u>	<input checked="" type="checkbox"/>	Any Other	<input type="checkbox"/>
Design/ installation Basis		<input type="checkbox"/>	<u>Underground Electrical Installation Specification</u> (DBAE782501) WAPA Cable and underground installation specification to be reviewed	<input checked="" type="checkbox"/>
Local Requirements (to be specified)		<input type="checkbox"/>		<input type="checkbox"/>

4.3 Lightning protection system

Description	Details			
Conductor material	Steel	<input checked="" type="checkbox"/>	Copper	<input type="checkbox"/>
Class of LPS	Level IV less than 80 thunderstorm/Level II More than 80 Thunderstorm	<input checked="" type="checkbox"/>	Verified by Wäertsilä	<input type="checkbox"/>
Design Standards	IEC62305-3	<input type="checkbox"/>	NFPA 780-2018	<input checked="" type="checkbox"/>
Design/ installation Basis	DBAB725968	<input type="checkbox"/>	<u>Underground Electrical</u>	<input checked="" type="checkbox"/>

	rev: <u>d</u>		<u>Installation Specification</u> (DBAE782501)	
Local Requirements (to be specified)		<input type="checkbox"/>		<input type="checkbox"/>

4.4 Cable ladders

Description	Details			
Design Standards	NEMA VE 2	<input checked="" type="checkbox"/>		<input type="checkbox"/>
Cable ladder type	Meka KS-80	<input type="checkbox"/>	BLINE	<input checked="" type="checkbox"/>
Material	Stainless Steel/ similar for outdoor (C5-M), hot dip galvanized for indoor	<input checked="" type="checkbox"/>	Anything else, Specify	<input type="checkbox"/>

4.5 Lighting system

Description	Details			
Standards Lighting of indoor work places	ISO 8995-1:2002/Cor 1:2005	<input type="checkbox"/>	NFPA 780-2018	<input checked="" type="checkbox"/>
Emergency escape lighting system	EN 50172	<input type="checkbox"/>		<input type="checkbox"/>
Local standard is any specify	IRAM-AADL J 20-06	<input type="checkbox"/>		<input type="checkbox"/>
Lighting materials	European materials	<input type="checkbox"/>	USA materials	<input checked="" type="checkbox"/>
Outlet sockets	European	<input type="checkbox"/>	Local	<input checked="" type="checkbox"/>
Emergency and Exit lights	Built-in batteries	<input type="checkbox"/>	Central system	<input type="checkbox"/>
Lighting panels	Wiring diagram drawings	<input type="checkbox"/>	Excel lists	<input type="checkbox"/>
Lux Levels	IEC	<input type="checkbox"/>	Local	<input checked="" type="checkbox"/>
Design basics			Project Specific Specification DBAF346717	<input checked="" type="checkbox"/>

4.6 Fire detection system

Description	Details	Details USA/Project Specific		
Standards to follow	EN54 NFPA 72 IEC 60331-21 IEC 60332-1-2 IEC 60332-3-22	<input type="checkbox"/>	- NFPA 70 - NFPA 72 - NFPA 101 - NFPA 59A	<input checked="" type="checkbox"/>
Connected to firefighting system	Yes	<input checked="" type="checkbox"/>	No	<input type="checkbox"/>
Material type/brand	Acc. To Wärtsilä standard supply, (to be same model as RH Phase 1) - Smoke detectors - Heat detectors - Flame detectors	<input checked="" type="checkbox"/>	Project specific	<input type="checkbox"/>
Design basis		<input type="checkbox"/>	Project Specific Specification	<input checked="" type="checkbox"/>

4.7 Cables

Description	Details		Details USA	
Design Standards	IEC 60305	<input type="checkbox"/>	NEC	<input checked="" type="checkbox"/>
MV Cables <ul style="list-style-type: none"> - Conductor - Insulation - Metallic shield - Outer sheath - Rated voltage - Dimensions 	Wartsila preferred cable types		Medium Voltage, Single Conductor Cable to 15kV DBAE782490 rev:- and Multi-Conductor	
LV Cables <ul style="list-style-type: none"> - Conductor - Insulation - Outer sheath 	Wartsila preferred cable types		Low Voltage, Single and Multi-Conductor Cables DBAE782498 rev:-	
Control Cables <ul style="list-style-type: none"> - Conductor - Insulation - Outer sheath 	Wartsila preferred cable types & Spec		Low Voltage, Single and Multi-Conductor Cables DBAE782498 rev:-	
Instrumentation cables <ul style="list-style-type: none"> - Conductor - Insulation - Outer sheath - Construction 			Low Voltage, Single and Multi-Conductor Cables DBAE782498 rev:-	

4.8 Calculations and system studies

Description	Details	Details USA		
Design Standards	IEC	<input type="checkbox"/>	NEC/IEEE	<input checked="" type="checkbox"/>
Grid code Requirements	To be Followed	<input type="checkbox"/>	Not To be Followed	<input checked="" type="checkbox"/>
Grid code Requirements specific	Project specific	<input type="checkbox"/>	PRC 25/26	<input type="checkbox"/>
Local Requirements (to be specified)		<input type="checkbox"/>		<input type="checkbox"/>

4.9 Others

Description	Details	Details USA		
IT system <ul style="list-style-type: none"> - Phone & Data - CCTV - Clock system 	IEC 60364	<input type="checkbox"/>	CCTV: Exacq vision system Building access: S2 security system	<input checked="" type="checkbox"/>

- PA system				
HVAC		<input type="checkbox"/>	USA design	<input checked="" type="checkbox"/>

5 Civil design

5.1 Standards

Description	Design	Manufacturing
Geotechnical design	As provided by USVI Licensed Geotechnical Engineer	
R/C foundations Load combinations Structural (Strength) design	ASCE 7-16 ACI 318-14	
Steel frame Load combinations Strength design	ASCE 7-16 AISC 360-16 AISC 341-16	
Vehicular surcharge loads	AISC 7-16, Ch.4 Live loads. Section 4.10.1. Notes a : (2) for mechanical parking structures without slab or deck that are used for storing passenger car only, 2,250 lb (10 kN) per wheel.	
Structural steel	Yield strength 355 N/mm ² (~51 ksi) S355JR for steel inside buildings S355J2 for steel outdoors S355J2H for hollow-sections	In general EN 10025-2 hot-rolled EN 10025-2 hot-rolled EN 10219-1 cold-formed
Steel shapes	Hollow sections, cold-formed I-profiles Channel profiles Plates	EN 10219-2 EN 10365 EN 10365 -
Structural bolting assemblies		EN 15048-1
Bolts		EN-ISO 4014, 8.8 A, B or EN-ISO 4017, 8.8 A, B BS EN-14399-3 (pretensioned assemblies), 8.8/8, 8.8/10 or 10.9/10
Nuts		EN-ISO 4032, A, B, C BS EN 14399-3 (pretensioned assemblies)
Washers		EN-ISO 7091, A, C, 100 or 300 HV BS EN 14399-5 or 14399-6 (pretensioned assemblies)
Water and sewage	International Plumbing code -2018	
HVAC	ASHRAE 55-2004 ASHRAE 62.1-2004 Wärtsilä Design Directives	

5.2 Live Loads

Description	Value	Unit	Remarks
Ground floor, qk	12	kN/m ²	ASCE 7-16 value 250psf (11.97kN/m ²) CIRSOC value 12kN/m ²
Ground floor, Qk	40	kN	Wärtsilä standard
Roof, qk	0.75	kN/m ²	ASCE 7-16 value 20psf (0.96kN) Not simultaneously with snow
Working platforms, qk	5.0	kN/m ²	ASCE 7-16 value 100psf (4.79kN)
Working platforms, Qk	2.82	kN	ASCE 7-16 4.79kN/m ² applied on 762x762 mm ² , equals to 2.78kN
Stairways, qk	5.0	kN/m ²	ASCE 7-16 value 100psf (4.79kN)
Stairways, Qk	1.35	kN	ASCE 7-16 value 300lb (1.33kN)
Engine platforms, qk	5.0	kN/m ²	ASCE 7-16 value 100psf (4.79kN) Wärtsilä standard value 5kN

5.3 Soil

Description	Available	Document ID
Soil investigation report	<input type="checkbox"/>	
Foundation type	<input type="checkbox"/>	Shallow foundations
	<input type="checkbox"/>	Deep foundations

5.4 Concrete

Description	Data	Remarks
Concrete grade	C20/25 (4000 psi)	According to Exposure Class for the structure To be checked by CPE Civil
Reinforcement grade	ASTM A615, Grade 60	According to Exposure Class for the structure To be checked by CPE Civil

5.5 Buildings materials

Buildings	Load bearing structure	Roof	Walls
Power House / Engine hall	<input checked="" type="checkbox"/> Steel	<input checked="" type="checkbox"/> Load bearing steel sheets, insulation and corrugated steel sheets	<input checked="" type="checkbox"/> Sandwich panels
	<input type="checkbox"/> Concrete pre-cast elements	<input type="checkbox"/> Roof elements and liquid roofing	<input type="checkbox"/> Concrete pre-cast walls
	<input checked="" type="checkbox"/> Concrete cast-in situ	<input type="checkbox"/> Roof elements and steel corrugated sheets	<input checked="" type="checkbox"/> Blocks/bricks
		<input type="checkbox"/> Concrete pre-cast slabs	
Other buildings	<input checked="" type="checkbox"/> Steel	<input checked="" type="checkbox"/> Load bearing steel sheets, insulation and corrugated steel	<input checked="" type="checkbox"/> Sandwich panels

		sheets	
	<input type="checkbox"/> Concrete pre-cast elements	<input type="checkbox"/> Concrete pre-cast slabs	<input type="checkbox"/> Concrete pre-cast walls
	<input type="checkbox"/> Concrete cast-in situ		<input type="checkbox"/> Blocks/bricks

5.6 Process ventilation

Rooms/buildings		System preference
Engine hall	<input checked="" type="checkbox"/>	Air inlet units and roof monitors
	<input type="checkbox"/>	Air inlet units and roof fans
	<input type="checkbox"/>	Extract wall fans and intake air louvers
	<input type="checkbox"/>	Air inlet and outlet ventilation units
Heating	<input type="checkbox"/>	Applicable

5.7 AC and heating

Rooms/buildings		System preference
Electrical rooms UB & Control room	<input type="checkbox"/>	Split units
	<input type="checkbox"/>	Wall mounted units
	<input type="checkbox"/>	Roof top units
Administration building	<input type="checkbox"/>	Split units
	<input type="checkbox"/>	Roof top units
Gas Compressor building	<input type="checkbox"/>	Split units
Heating	<input type="checkbox"/>	Applicable for continuously manned rooms
	<input type="checkbox"/>	Applicable for all rooms where HVAC is needed

5.8 Rain water drainage system

Rainfall Intensity	<input checked="" type="checkbox"/>	50 mm/hour
Rain Water System	<input checked="" type="checkbox"/>	Pipe system
	<input checked="" type="checkbox"/>	Open drains and ditches
Rain water from containment areas, roads and parking areas to be treated	<input type="checkbox"/>	Oily water separating system

5.9 Sewage system

Septic sewage system	<input type="checkbox"/>	Septic tanks, emptied by trucks,
	<input type="checkbox"/>	Connection to the sewage treatment plant
Septic sewage treatment	<input type="checkbox"/>	Septic separating system
	<input type="checkbox"/>	Sewage treatment plant connected to the rain water system

	<input type="checkbox"/>	Infiltration field
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5.10 Oily water system

Oily water treatment system	<input checked="" type="checkbox"/>	Oily water underground collecting sumps, emptied by truck
Chemical waste water system Chemical waste water comes from the Workshop and Warehouse washing area.	<input type="checkbox"/>	Oily water underground collecting pits, emptied by trucks
	<input type="checkbox"/>	Underground collecting sump, emptied by trucks