

ENERGY INFRASTRUCTION Ltd

ASHKELON TANK FARM

**Standard Specification for
6.6KV Variable Speed Drive**

Revision No.	Date	Description	By	Approved

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APPENDIXES:

- **6.6KV VSD DATA SHEET**

1 General Conditions

1.1 Introduction

This standard specification covers the general requirements applicable to the design, manufacture, performance, supply transport to site, installation and connection between the parts, start up and training of 6.6KV variable speed drive, a.k.a., VSD, for use in P.E.I. plants.

In addition to this specification, each tender will contain data sheets for the required VSD.

This specification covers VSD's which are supplied either directly by the manufacturer or as an integral part of a system or equipment.

1.2 Packing , Protection and Transport to Site

Vendor shall be responsible for the supply of the VSD to one of P.E.I.'s warehouses, or to the relevant electrical room. Unless the vendor has advised the purchaser in writing to the contrary, the prices quoted by the Vendor shall include the packing and transportation and unloading of the goods.

Packing will be in containers/crates/boxes lined on the inside with water-repellent material, suitable for export and capable of withstanding rough handling during the shipping to Israel.

1.3 Language

All proposals, drawings, specifications, material control sheets, reports, test certificates and other documents shall be in English.

1.4 Marking

VSD and packing shall be suitably marked for identification by this Specification number and the purchase order number.

1.5 Service

The vendor has to prove in his offer the ability to provide service including maximum response time-up to 48 hours (maximum time from notification of problem till arrival of qualified technician to site).

1.6 Units

All drawings and dimension prints shall be metric.

2 Applicable Standards and Codes

2.1 The offered motors shall comply with the latest issues of the relevant IEC standards.

2.2 Standards

No.	Title
IEC 60076	Power Transformers: all parts
IEC 60146	Semiconductor converters– General requirements
IEC 60255	Measuring relays and protection equipment
IEC 60616	Terminal and Tapping Markings for Power Transformers
IEC 61378-1	Converter Transformers, Part 1: Transformers for Industrial Applications.
IEC 61800	Adjustable speed electrical power drive systems
IEC 61869-2	Instrument transformers – Part 2: Additional requirements
IEEE 519-1992	Guide for Harmonic Control and Reactive Compensation of Static Power Converters
IEC 62103	Electronic equipment for use in power installations
IEC 62271	High voltage switchgear and control gear

2.3 Deviations and exclusions:

The Supplier shall identify and list all deviations and exclusions to this specification.

Unless deviations / exclusions are specifically identified by the Vendor in the bid proposal and agreed by Purchaser, the Vendor shall be deemed to have confirmed full compliance with all documents listed.

3 Environmental and Grid Conditions

3.1 Environmental conditions

- 3.1.1 Temperature.....The VSD shall be installed in an air-conditioned room with controlled temperature.
- 3.1.2 Altitude.....Less than 10 m.
- 3.1.3 Hazardous Area:VSD shall be suitable to feed Zone 2 Ex proof motors
- 3.1.4 Location:.....Indoors corrosive, with industrial pollution, including H₂S and SO₂.
- 3.1.5 Operating conditionsVSD will be designed for continuous operation and/or long periods of inactivity in a corrosive atmosphere of a petrochemical processing facility's electrical room

3.2 Seismic Withstand

- 3.2.1 The vendor shall design the VSD system to withstand all forces acting on it during an earthquake.
- 3.2.2 The seismic level is defined as class AF3, which corresponds to 0.3g according to IEC 60068-3-3.
- 3.2.3 The vendor shall submit documents proving the above.
- 3.2.4 The vendor shall provide details for anchoring the VSD to the floor.

3.3 Electrical Supply

- 3.3.1 6600 ± 5%; 50Hz ± 2%; 3 phases, resistor-grounded.
- 3.3.2 Low voltage auxiliary and control voltage- 400± 10%; 50Hz, 3 ph. / 230± 10%; 50Hz, 1 ph. TN-S

4 VSD Performance Requirements

4.1 General

- 4.1.1 Unless otherwise stated in the data sheet, the VSD will include a multi winding, dry type minimum 18 pulses isolating transformer AoAk as an integral part.
- 4.1.2 Low voltage VSD with step-down step-up transformer will not be accepted.
- 4.1.3 The VSD shall be of modular design to provide for ease and speed of maintenance. Metal or plastic barriers shall be provided between each vertical section and between the low voltage compartment and the power cell. Personnel shall have access to the low voltage compartment, with the VSD energized, without being exposed to any medium voltage live parts.
- 4.1.4 The VSD shall produce a variable voltage and variable frequency output to provide continuous operation over the speed range. The VSD shall be capable of operating with the output short circuited at full current or with the output open circuited at rated voltage.
- 4.1.5 VSD shall operate standard AC squirrel cage induction motor over the frequency range of 25 ÷ 60 Hz.
- 4.1.6 The VSD system shall provide controlled speed over the range specified. Speed accuracy within this range, expressed as a percent of top speed, shall be within 0.5% without encoder or pulse tachometer feedback.
- 4.1.7 The VSD shall have a “normal duty” rating of 100% continuous current with a short-time duty rating of 150% overload for one minute.
- 4.1.8 The supply voltage harmonics produced by VSD shall not exceed the requirements stated in IEEE 519.

4.2 Motor Compatibility

- 4.2.1 The VSD shall provide near sinusoidal voltage and current waveforms to the motor at all speeds and loads.
- 4.2.2 Output current THD shall be according to IEEE519.
- 4.2.3 Standard induction motors shall not require de-rating or upgraded turn-to-turn insulation and shall not require additional service factor.
- 4.2.4 The VSD shall provide stable operation of the motor, without compromising the motor insulation system. Motor power cable shall be armored three-core.
- 4.2.5 Motor cable length will be stated in the data sheet. Vendor shall clearly state the limitations in motor cable distance with the proposal. If an output filter is required to mitigate reflected waves, or to meet any special requirements of the application, it must be integral to the VSD controller.
- 4.2.6 When output filters are used in the VSD, they must eliminate a potential harmonic resonance within the operating speed range.
- 4.2.7 VSD induced torque pulsations to the output shaft of the mechanical system shall be less than 1% to minimize the possibility of exciting a resonance.

4.3 Efficiency

- 4.3.1 VSD system efficiency shall be a minimum of 96% at 100% speed & 100% load.
- 4.3.2 System efficiency shall include VSD, input transformer, line reactor, harmonic filter (if applicable) power factor correction unit (if applicable), and output filter (if applicable), control power supplies, control circuits, cooling fans or pumps, shall be included in all loss calculations.

4.4 Audible Noise Level

- 4.4.1 Maximum audible noise from the VSD and its associated system shall be at a maximum of 80 dB (A) at a distance of one meter from the front of the equipment (with doors closed).
- 4.4.2 The above limit will prevail at any speed or load condition.

4.5 Power Factor

- 4.5.1 The VSD shall be capable of maintaining a minimum true power factor (displacement P.F. x Distortion P.F.) of 0.95 at load range of 30-100%.

5 Reliability

- 5.1 The availability of the VSD system shall be designed for a minimum of 99.9%.
- 5.2 The Mean Time between Failures (MTBF), of the VSD system shall be designed for 100,000 hours.
- 5.3 The Life Expectancy of the VSD system shall be designed for a minimum of 20 years.
- 5.4 The VSD shall be capable to "Ride Through" a loss of power of 5 cycles.
- 5.5 The VSD shall have "Auto-Restart Capability" to automatically restart in the event of a momentary loss of power. An automatic restart delay parameter shall be available in the VSD with an adjustment range of 0 -10 seconds with 1 sec. steps.
- 5.6 The VSD system shall be capable to "Power Sag Ride-Through" a 30% voltage sag on the input power line. (The motor shall not be allowed to reach pull out condition).
- 5.7 The VSD shall have "Flying Re-Start Capability" to restart and taking control of a motor attached to a spinning load.

5.8 **VSD Protection**

The VSD shall have the following minimum protection features:

5.8.1 At Input Source Side:

- 5.8.1.1 Under voltage (adjustable)
- 5.8.1.2 Over voltage (adjustable)
- 5.8.1.3 Instantaneous over current (adjustable)
- 5.8.1.4 Ground fault (adjustable)
- 5.8.1.5 Overload (adjustable)

5.8.2 On System Level:

- 5.8.2.1 Gate driver power supply under voltage
- 5.8.2.2 Control power over / under voltage and signals
- 5.8.2.3 Over temperature protection

5.8.3 At Output Motor Load Side:

- 5.8.3.1 Short circuit protection (instantaneous over current)
- 5.8.3.2 Overcurrent
- 5.8.3.3 Over voltage (adjustable)
- 5.8.3.4 Motor over speed (adjustable)
- 5.8.3.5 Electronic motor overload protection.
- 5.8.3.6 Earth /Ground fault
- 5.8.3.7 Over temperature of stator windings and bearings.
- 5.8.3.8 Motor stall protection.

5.8.4 At transformer :

- 5.8.4.1 Winding temperature monitoring
- 5.8.4.2 Overload (delayed over current)

6 Operator Interface and Communication

- 6.1 The VSD shall be provided with an integral Monitoring and indications display panel.
- 6.2 All measurements, faults, events and status indicators shall be shown on this panel.
- 6.3 The manufacturer will offer his standard metering, indicators and alarms. However, the following is required as a minimum:
 - 6.3.1 Measurement of all major system voltages & currents
 - 6.3.2 Motor speed, current and active load
 - 6.3.3 Alarm and fault messages on Alpha-numeric display
 - 6.3.4 System history recording & display – at least 30 events with time and date stamp.
 - 6.3.5 The log file shall be stored in non-volatile memory.
- 6.4 The panel of the VSD shall indicate at least the following alarms accompanied by audible notifications:
 - 6.4.1 Fuse failure (if any)
 - 6.4.2 Overload
 - 6.4.3 System shutdown (due to overload or emergency)
 - 6.4.4 Internal module failure
 - 6.4.5 DC overvoltage
 - 6.4.6 High internal temperature
 - 6.4.7 Mains failure
 - 6.4.8 Fan failure, or water pump failure
 - 6.4.9 Cooling system failure
 - 6.4.10 Control power failure
 - 6.4.11 Motor protections
 - 6.4.12 Motor measurements
 - 6.4.13 A Windows based application software shall be quoted as part of the unit to monitor and edit VSD parameters, upload and save parameters to a file, download parameters to the VSD, print parameters, and view and clear faults/alarms in the VSD.
- 6.5 The VSD will be supplied with communication modem for remote control and monitoring, and local connection of a PC.
- 6.6 Communication protocols shall not be propriety one, but Modbus TCP or/and Modbus RTU.
- 6.7 Control and Operations**
 - 6.7.1 The panel of the unit shall be the manufacturer's standard and will include, at least, the following functions:
 - 6.7.1.1 ALARM/FAULT RESET;
 - 6.7.1.2 EMERGENCY POWER OFF: Shuts down the unit,

- 6.7.1.3 Local Start/stop
- 6.7.1.4 Settings of parameters
- 6.7.1.5 RAISE/LOWER speed

6.8 Inputs and Outputs

- 6.8.1 The VSD will be controlled either by communication link, input digital and analogue signals, or locally from the control panel, which will include an emergency stop push button, local/remote selector switch, direction of rotation, and speed reference.
- 6.8.2 Ten (14) programmable isolated digital inputs and ten (6) programmable isolated digital outputs shall be available as standard on the VSD, rated from 12V to 260V AC and 130V DC.
- 6.8.3 The VSD system will Isolated analog signals:
 - 6.8.3.1 Speed reference input (4-20 mA input signal).
 - 6.8.3.2 Speed reference input from a standard potentiometer.
 - 6.8.3.3 Speed output (4-20 mA output signal).
 - 6.8.3.4 Current output (4-20 mA output signal).
 - 6.8.3.5 Load (kW) output (4-20 mA output signal).

7 Cooling System

- 7.1 The VSD system shall be air cooled.
- 7.2 The VSD shall be provided with mixed flow cooling fan, mounted integral to the VSD enclosure. The VSD shall include air flow pressure switches and temperature detectors to monitor proper operation of the air cooling system. If a fan fails, the system must generate alarm indication of the fan failure.

8 Enclosure and Cabling

- 8.1 VSD enclosures shall be IP21. Door vents shall consist of louver-panel assemblies that can be removed from the front in order to replace air filters. Safety screens shall be located behind each louver panel. Cabinets and doors shall be fabricated using minimum 2 mm steel for sturdy construction. All doors shall be gasketed to provide environmental protection and secure fit.
- 8.2 Door latches shall be heavy-duty units which are operated with a standard key. The converter cabinet door and cabling cabinet door shall be interlocked with up-stream isolators or breakers with a key lock. Interlocking shall be fully coordinated to prevent access to all medium voltage compartments.
- 8.3 The VSD shall be designed for front access only to allow for installation with no rear access.
- 8.4 The VSD shall contain a power cable termination cabinet designed for easy termination and access to line and load cables. The termination assembly cabinet shall allow for bottom entry and exit of line and load cables.
- 8.5 All power and control terminations and termination strips shall be identified in accordance with all schematics and wiring diagrams.
- 8.6 Low voltage control wire shall be 600 volt rated, and fire retardant.

9 Testing, Commissioning and Training

9.1 Standard Testing

- 9.1.1 The following tests shall be carried out in accordance with applicable requirements and/or specifications of IEC.
- 9.1.1.1 Functional checks, inspection and continuity checks shall be made.
 - 9.1.1.2 "HI-POT" dielectric withstand test shall be performed on all bus work and cables from phase-to-phase and phase-to-ground (except solid-state components, low voltage controls and instrument transformers). The voltage level used for this test depends on the product's nominal AC voltage.
 - 9.1.1.3 Components and devices shall be functionally operated in circuits as shown on electrical diagrams or as called for by specific test instructions.
 - 9.1.1.4 All inputs and outputs simulated and tested.
 - 9.1.1.5 Communication test.
 - 9.1.1.6 Instruments, meters, protective devices and associated controls shall be functionally tested by applying the specified control signals, current and/or voltages.
 - 9.1.1.7 Load Tests

9.2 Field Start-Up Commissioning Services

- 9.2.1 Start-up will be performed at the User's site.
- 9.2.2 The Supplier shall provide the professional man-power to carry out the pre-startup inspection and testing and the startup itself

9.3 On-Site Training

- 9.3.1 The Supplier shall provide a qualified instructor to provide user's personnel with training that is specific to the system installed at the facility.
- 9.3.2 The Supplier shall outline the training session duration and content.
- 9.3.3 Manuals and documentation shall be provided for each participant, (maximum of five participants per training course).
- 9.3.4 The training shall cover the following topics as a minimum:
- 9.3.4.1 Theory of operation
 - 9.3.4.2 VSD hardware
 - 9.3.4.3 VSD firmware
 - 9.3.4.4 VSD software
 - 9.3.4.5 Cooling system operation
 - 9.3.4.6 Operator interface

- 9.3.4.7 Board replacement procedures
- 9.3.4.8 Power device replacement procedures
- 9.3.4.9 Fault analysis and troubleshooting
- 9.3.4.10 Preventative maintenance procedures

9.4 Witness Testing

- 9.4.1 Witness testing will be included in the quote, including a review of the electrical and mechanical drawings for the purchased equipment to be done with the Supplier's Application Engineer or Project Manager prior to commencing the tests.
- 9.4.2 Witnessed testing procedure shall be submitted to, and approved by Purchaser at least 6 weeks before test date.
- 9.4.3 Any questions or clarifications, prior to commencing the test, will be addressed at this time. The Application Engineer will then host the Purchaser for the duration of the actual testing.
- 9.4.4 At the conclusion of testing, the customer will reconvene with the Application Engineer or Project Manager to discuss any concerns or issues that arose during the test.
- 9.4.5 Any modifications or changes requested by the Purchaser will be documented and discussed at this meeting.
- 9.4.6 The Project Manager or Applications Engineer will respond to the Purchaser at the earliest possible time with an outline of the financial and/or schedule impact of the changes.
- 9.4.7 The witness test shall include a VSD System Run Test that shall consist of operating the VSD connected to a test load.
- 9.4.8 During the testing of the VSD, a demonstration of the operator interface and functionality will be provided as well as demonstration of the operation of the VSD.
- 9.4.9 The VSD will be tested up to rated power at both steady state and varying speeds.
- 9.4.10 The VSD will also be tested for verification of service factor.
- 9.4.11 The VSD will be tested with its isolation transformer and its DC link. No substitutes are accepted during testing.
- 9.4.12 Manufacturer will include in his offer, as an option, testing the VSD with the actual intended motor as a load.

10 Documentation, Drawings and Manuals

- 10.1 With his offer manufacturer will include all documents and drawings, which are necessary, to evaluate the VSD.
- 10.2 Before starting manufacturing, one set of complete paper prints of the dimension drawing and electrical drawings, and one computerized version in PDF/word/dwg format will be sent to purchaser for approval
- 10.3 Supplier shall allow the Purchaser two (2) weeks to review the drawings. This period starts on the date that the drawings are shipped to Purchaser and ends on the date that the drawings are returned to the supplier.
- 10.4 Certified drawings, instruction and maintenance manuals (2 sets) shall be sent within 30 days of final product shipment. Final drawings and manuals will be submitted in PDF and DWG format as well, at no charge.

11 Spare Parts and Maintenance

- 11.1 Recommended spare parts list and prices shall be supplied with the bid.
- 11.2 Spare parts that are identified as being associated with long lead times and/or are critical to the unit's operation and/or are essential for start up will be marked separately in the list.
- 11.3 Supplier shall assist in determining an appropriate level of spare parts and their recommended storing conditions.
- 11.4 Supplier shall submit a maintenance program for the VSD. The program shall specify the intervals, the scope of work and tests, and the spare parts needed.

12 Warranty

Vendor shall include in the Bid 24 months warranty period of satisfactory operation under normal operating conditions for the VSD system, including all its sub components from date of supply to site, or 12 months from putting unit into operation, the earlier of the two dates.

The Vendor undertakes to repair within this period of any faulty components and equipment free of charge and within 48 hours of being notified.

APPENDIXES
6.6 KV VSD DATA SHEET

General Data	1.1	Data Sheet No.	1073-S-010/1	
	1.2	Plant/Unit:	ASHKELON	
	1.3	Project Name:	Feed Pump VFD	
	1.4	Motor Function:	Feed Pump	
	1.5	VSD Tag Number	P-51	
	1.6	Max./Min. Ambient. Temp.:	10-40°C	
	1.7	Altitude Over Sea Level	10m.	
	1.8	Relative Humidity:	70%	
	1.9	Specification:	1073-S-010	
Electrical data	2.1	System rated voltage/frequency	6600v /50Hz	
	2.2	System SCC [kA]	10	
	2.3	System Neutral type	Grounded via earthing resistor	
Driven Machine Data	3.1	Load Type	Centrifugal Pump	
	3.2	Motor rated power [KW]	950	
	3.3	Motor rated current [A]	95	
	3.4	No.x Type of Thermal device in motor Windings	6 x PT-100	
	3.5	No.x Type of Thermal device in motor bearings	2 x PT-100	
	3.6	Motor Anti Condensation Heater voltage	230v	
	3.7	Driven motor synchronous speed [r.p.m]	3000	
	3.8	Motor power cable type and cross section	3x50 N2XSJ	
	3.9	Motor power cable length [m.]	200	
VSD	4.1	Manufacturer:		
	4.2	VSD Type and Model		
		Description	Customer Requirements	Manufacturer VSD Data
VSD Data	5.1	Integrated Dry Transformer included in System	YES	
	5.2	Modular Design	YES	
	5.3	No. of converter pulses	>18	
	5.4	Requires Frequency Range:	25-60Hz	
	5.5	Nominal Continues Current for Normal duty:	77A	
	5.6	Work with two different motors is required on and off without the operator's intervention in the operation of VSD	YES	
	5.7	Aux. power supply: voltage/phases/frequency	230v/1/50Hz	
	5.8	Aux. fans power supply: voltage/phases/frequency	400v/3/50Hz	
	5.9	No.x Type of Thermal device in Trafo Windings	3 x PT-100	
	5.10	No.x Type of Thermal device in Motors	8 x PT-100	
	5.11	No. of programable digital inputs	14	

5.12	No. of programable digital outputs		
5.13	No. of analog inputs	4	
5.14	No. of analog outputs	2	
5.15	Monitoring and Control Software included	YES	

	Description	Customer Requirements	Manufacturer VSD Data
VSD Data	5.16	Remote Control, Monitoring and Programing via LAN / Bluetooth	YES
	5.17	Communication link Protocol	Modbus TCP or Modbus RTU
	5.18	Power Factor At: 100% Full Load:	-
	5.19	75% Full Load:	-
	5.20	50% Full Load:	-
	5.21	Efficiency At: 100% Full Load:	-
	5.22	75% Full Load:	-
	5.23	50% Full Load:	-
	5.24	Cooling Type	Air Fan/Column
	5.25	Noise level (measured at 1m.) [db] (max)	80
	5.26	Cable entry	Bottom in/Bottom out
	5.27	Cable connection In	3x50 N2XSY
	5.28	Input starter required (onload switch+contactor and fuses)	No
	5.29	Maintenance access	Front only
	5.30	Total Weight [kg.]	-
	5.31	Room space (WxLxH) [mm. max]	
	5.32	Combined Motor-VSD test	Hold
	5.33	Witnessed Test	YES
5.34	Training required	YES	
5.35	Prestart Commissioning required	YES	

6.1	Prepared By:	A.NAHARI	
6.2	Date:	07/06/2023	