ATTACHMENT C:

Standard Specification for 3.3kv Squirrel Cage Induction Motors

P0	05.02.2023	preliminary	I.S.	I.S.	PAGE **1** FROM **15**
REV.	**DATE**	**ISSUE**	**PREPARED**	**CKD**	**CLIENT APP'D**

Table of Content

1 General Conditions **3**

2 Applicable Standards and Codes **3**

3 Environmental and Grid Conditions **4**

4 Technical Specifications **4**

4.1 General **4**

4.2 Starting Conditions **4**

4.3 Insulation and Impregnation **5**

4.4 Control and Protective Devices **5**

4.5 Anti-condensation space Heaters **6**

4.6 Enclosure **6**

4.7 Terminal Boxes, Junction boxes and terminals **7**

4.8 Rotor Construction and Vibration Limits **8**

4.9 Bearing and Lubrication **8**

4.10 Efficiency **8**

4.11 Special Conditions for VSD Operated Motors **9**

4.12 Noise **9**

4.13 Painting **9**

4.14 Pre Start Ventilation system **9**

4.15 Nameplates and Labels **10**

5 Tests **10**

5.1 The motors will undergo the following witnessed tests, according to IEC60034: **10**

5.2 Options witness tests: **10**

6 Documentation **11**

7 Warranty **12**

8 Data sheet **13**

1 General Conditions

1.1 Introduction

This standard specification covers the general requirements applicable to the design, manufacture performance supply and transport to site, of 3.3KV, totally enclosed fan cooled squirrel cage induction motors drive by VSD.

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

This specification covers motors, which are supplied either directly by the manufacturer or as an integral part of equipment.

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
60034-all parts	Rotating electrical machines.
60072-all parts	Standardized dimensions and ratings
60079-all parts	Classification of hazardous locations
IECEx-002	Equipment Certification Program covering equipment for use in explosive atmospheres – Rules of Procedure
ATEX dir. 2014/34/EU	For hazardous areas

2.2.1 Motor manufacturer must present with his offer, a certificate of compliance, of the motor types in his offer, with one of the followings:

2.2.1.1 ATEX directive 2014/34/EU, issued by an authorized testing laboratory listed under directive 2014/34/EU

2.2.1.2 IECEx-002, issued by an authorized testing laboratory, listed under IECEx.

3 Environmental and Grid Conditions

3.1 Environmental conditions

3.1.1 Temperature…….. 5^0C to 40^0C, Humidity max. 95%, 30-60gr. Water per cubic meter of air

3.1.2 Altitude…….. Less than 100 m.

3.1.3 Ex Zone……..…. or Zone 2, IIC, T3

3.1.4 Location:……Outdoor, corrosive, with heavy industrial pollution, including H_2S and SO_2.

3.1.5 Operational conditions…….Motors will be designed for continuous operation and/or long periods of inactivity in a corrosive atmosphere of a petrochemical processing facility

3.2 Electrical Supply

3.2.1 3300V, ± 5%; 50Hz ± 2%; 3 phases, earthed through grounding resistor or directly.

4 Technical Specifications

4.1 General

4.1.1 All motors shall be built for continuous operation at a maximum speed of 120% rated speed.

4.1.2 Motors will be designed for operation at a service factor of 1.15

4.1.3 Motors speed control 30% ÷ 100%

4.2 Starting Conditions

4.2.1 The motors shall be suitable for direct on line starting and VSD starting.

4.2.2 Unless otherwise stated in the data sheets, the starting current in percent of F.L.C. will not exceed the following:

4.2.2.1 For motors above 450kW……550%

4.2.3 The breakdown torque of MV Motors will be not less than 2.0 times the nominal, torque in order to avoid stalling or deceleration when the voltage drops to 70% of nominal voltage.

4.2.4 With the exception of very high inertia driven machinery, the motors when supplied with rated voltage and frequency, will be able to withstand, as a minimum requirement, the following number of continuous starts.

Conditions	Number of starts
Consecutive, 8 sec. starts with the motor coasting to rest between starts. First start is a cold start.	2
Consecutive 8 sec. starts with the motor coasting to rest and remaining idle for 5 minutes between starts. First start is a cold start.	3
Evenly spaced, 8 sec. starts, in first hour prior to continuous running. First start is a cold start.	4

4.3 Insulation and Impregnation

4.3.1 All motors will have a non-hygroscopic insulation including the leads running to the terminal box.

4.3.2 Insulation system will be suitable for environment of increased air-humidity, of 30-60 gr. water per m^3 air at least.

4.3.3 The motors will be fitted with at least class F insulation. The temperature rise will be limited to that associated with class B insulation, when operating in an ambient temperature not exceeding 40^0C.

4.3.4 The windings will be vacuum pressure impregnated with epoxy resins and tropicalized in order to prevent penetration of moisture and withstand corrosive vapors and fungus.

NOTE: In case manufacturer has a different impregnation process, he must state it clearly in his proposal, and send all relevant documentation explaining and proving the benefits of his method. Agreement to this deviation must be received from purchaser, prior to commencement of production.

4.4 Control and Protective Devices

4.4.1 Motors will have twelve (12) PT100 elements. Six (6) PT100 elements embedded in the motor windings, two (2) PT100 elements in each bearing, one PT100 element, measuring cold air entering the cooling system, and one PT100 element, measuring hot air leaving the cooling system, all PT100 elements will be of the 3-wire type. Connections will be made in one common, separate, terminal box, which will have its own threaded entrance holes.

4.4.2 shaft vibration monitoring probes, X and Y axis on each bearing, made by Bentley Nevada, shall be installed. Vibration probes shall be wired to a separate EExi control box, which will contain the transmitters.

4.4.3 All above-mentioned terminal boxes shall be certified for zone, gas type and temperature, same as the motor or higher.

4.5 Anti-condensation space Heaters

4.5.1 motors will be provided with anti-condensation space heaters for 230V, 50Hz, single phase.

4.5.2 Heaters' connections will be brought out to a separate control box. This separate box will have its own entrance hole and metallic gland, and shall be rated for the zone, gas type and temperature, same as the motor or higher.

4.5.3 Anti-condensation heaters, shall be easily accessible, so that their replacement or service will not require any major motor parts dismantle.

4.5.4 Heaters' surface temperature will not exceed the zone temperature classification limitations.

4.6 Enclosure

4.6.1 Motors shall be designed for outdoor installation, without any additional weather protection.

4.6.2 Motors shall be totally enclosed fan cooled, IP55 according to IEC Standard.

4.6.3 Motors shall be manufactured of gray cast iron or of steel plate construction. Aluminum motors will not be accepted.

4.6.4 Motors shall have drain holes, with removable plugs (where Ex area allows), located so, that water resulting from condensation and other causes can be drained from all pockets in the motor enclosure.

4.6.5 All external screws shall be made of stainless steel.

4.6.6 Unless otherwise stated in the data sheets, the cooling method will be IC411, IC511 or IC611.

4.7 Terminal Boxes, Junction boxes and terminals

4.7.1 All terminal boxes and junction boxes shall be certified for hazardous area equal to that of the motor, and will have a minimum degree of protection of IP55.

4.7.2 Unless otherwise stated in the data sheet, the MTB for motors larger than frame size 315, will be on the right hand side of the motor, when looking from the non drive end (RHS from NDE).

4.7.3 In case motor is fed by two or more power cables, the terminal box will be large enough to accommodate all cables and their accessories.

4.7.4 Motor manufacturer will drill and tap all terminal boxes and junction boxes, for cable entrances. Preparations will be for metallic glands.

4.7.5 Medium voltage Main Terminal Boxes

4.7.5.1 The MTB will be designed for high fault levels up to 500MVA, and it will be suitable for operation in the area specified in the data sheet.

4.7.5.2 Purchaser must approve the size and the construction of the MTBs.

4.7.5.3 MTB shall be provided with a suitable angular bottom adaptor 30^0-45^0, to the horizontal, to overcome the possible small distance between ground and bottom of MTB, which might force feeding cable to bend sharply. Manufacturer can suggest other solutions for the problem.

4.7.6 Terminals

4.7.6.1 The size, type, quantity and functionality of terminals shall be suitable to the cables and their function as stated in the data sheet.

4.7.6.2 Connection of two wires to one terminal or under one screw will not be permitted.

4.7.6.3 All connections will be clearly marked for easy identification.

4.7.6.4 Motors will have external earthing bolt and an internal one in the MTB as well.

4.7.6.5 Control wiring terminals will be of a type that withstands the operating vibration of the motor.

4.7.6.6 Cables that are run on motor's outer surface (i.e. bearing temperature, or vibration measurement), will be protected by metallic conduit.

4.8 Rotor Construction and Vibration Limits

4.8.1 Rotors will be dynamically balanced.

4.8.2 Driving end shaft end shall be drilled and threaded to facilitate fitting of coupling.

4.8.3 The shaft shall be made of one-piece heat-treated, forged steel. In case welded rotor is manufacturer's standard, it must be stated clearly in his offer and receive a written approval by purchaser before manufacturing the rotor.

4.8.4 Vibration levels will not exceed the values specified in IEC standard, as "GRADE-B".

4.8.5 The rotor shall be balanced with half key.

4.8.6 motor's rotor cage bars shall be made of copper.

4.9 Bearing and Lubrication

4.9.1 Unless otherwise specified, statistical life of 90% of the bearings (L10 life), will be 40,000 hours with a 24 hours per day of fully loaded operation.

4.9.2 Supplier shall determine and recommend the optimal bearing system for the driven equipment.

4.9.3 sleeve bearings are not allowed.

4.9.4 The temperature device will be installed close to the heat- generating surface according to IEC 60034-11.

4.9.5 Motors will be provided with grease nipples for re-greasing, suitable for use during operation and relief devices for automatic removal of excess grease.

4.9.6 The standard grease used for electrical motors is "SKF LGHQ2" the motor should be supplied with this grease. If this grease is not suitable for a specific application or from any other reason the supplier should note it in offer.

4.9.7 Motors will have insulated non-drive end house bearing. Accessories if exists on the insulated house bearings, such as oil pipes and thermal sensors, must be insulated as well.

4.10 Efficiency

4.10.1 Motors will be of the IE3 efficiency group, or better.

4.10.2 The efficiency will be stated and guaranteed at motor nominal output power, and at 75%, and 50% power.

4.10.3 Efficiency of motors will be given at nominal voltage and 50Hz.

4.11 Special Conditions for VSD Operated Motors

4.11.1 The motor will be equipped with a "reinforced insulation system".

4.11.2 Motors will have insulated non-drive end house bearing. Accessories if exists on the insulated bearings, such as oil pipes and thermal sensors, must be insulated as well.

4.12 Noise

4.12.1 Noise level of motors in dB (A) will not exceed the values recommended in IEC standard.

4.12.2 The Manufacturer will specify the noise level of each motor.

4.12.3 The noise level will be determined by using “A- weighing curve", and the sound levels will be expressed in dB (A).

4.13 Painting

4.13.1 Motor Painting standard will be category "C4 M", according to ISO12944, as a minimum.

4.13.2 Paint system durability shall be for 15 years as a minimum.

4.13.3 Special anticorrosive protection will also be provided for the shaft ends.

4.14 Pre Start Ventilation system

4.14.1.1 Manufacturer will carry out the risk assessments recommended in IEC 60079-7 and submit the results to the customer.

4.14.1.2 Manufacturer will supply the motor with inlet and outlet blanked flanged pipes, for pre-start purging purposes.

4.14.1.3 In case manufacturer has carried out a gas environment test on the type of motor offered, he shall attach his declaration of passing successfully the test to his offer.

4.15 Nameplates and Labels

4.15.1 All information pertaining to the motor will be stamped /engraved on a series 300 stainless steel or nickel copper alloy nameplates. No printing will be accepted. The information will on name plate shall be according to IEC requirements.

4.15.2 The following data shall be included on a separate plate:

4.15.2.1 VSD duty

4.15.2.2 Distance to magnetic center.

4.15.2.3 The direction of rotation will be marked on the frame by a metallic arrow.

4.15.3 Nameplates will be securely fastened by pins of stainless steel or rivets, and will be located in a place that will ensure visibility.

4.15.4 Terminal boxes will be labeled as well.

5 Tests

5.1 The motors will undergo the following witnessed tests, according to IEC60034:

5.1.1 Full Routine test

5.2 Options witness tests:

5.2.1 Temperature rise test

5.2.2 Efficiency and power factor test

5.2.3 Starting current

5.2.4 Starting torque.

5.2.5 Vibration tests

5.2.6 Over speed test

5.2.7 Noise measurement.

6 Documentation

6.1 Attached to the offer, supplier will submit the following:

6.1.1 Hazardous area certificate of the motor, MTB and control boxes, and compatibility to hydrogen area.

6.1.2 Full catalogue, data sheets and mechanical dimensions of the offered motors.

6.1.3 Impregnation system process.

6.2 Prior to manufacturing, the supplier will furnish the following:

NOTE: Manufacturing will not start production before purchaser's approval of the following documents

6.2.1 Certified motor data sheet

6.2.2 Certified drawings with overall dimensions for installation and foundation design data.

6.2.3 Drawings of the wiring and control.

6.2.4 Drawings and data of all terminal boxes.

6.2.5 Certified Torque/current vs. speed curves.

6.2.6 Painting specifications.

6.2.7 A complete set of maintenance and installation instructions.

6.2.8 A recommended list of spare parts.

6.2.9 Inspection and test program (ITP)

6.3 After the tests have been carried out, the supplier will furnish the following:

6.3.1 Full test reports, signed by the manufacturer and the witness.

7 Warranty

7.1 The supplier will guarantee that the motors supplied are free of fault, in design, workmanship and/or material, and is of sufficient size and capacity, and of proper materials, to fulfill satisfactorily the operating conditions specified.

7.2 Should any defect in material, workmanship, or any other kind of defect develop during the first year of operation, but not later than 24 months from shipment, the supplier agrees to make all necessary repairs, and replacements of defective parts, free of charge, and will pay all transportation fees involved.

7.3 If the defect or failure of function cannot be repaired, the supplier agrees to replace promptly, free of charge, the said part or parts, or the entire motor.

7.4 Should any defect be found which was due to faulty design, during the first two years of operation, but not later than 30 months from shipment, the supplier agrees to replace the motor with a newly designed motor of the same specification and size. In that case, the guarantee period will commence from the start of operation of the new motor.

8 Data sheet

General Data	**1.0**	**Customer Data**		
	1.1	**Data Sheet No.**		
	1.2	**Location:**		
	1.3	**Plant/Unit:**		
	1.4	**Project Name:**		
	1.5	**Motor Function:**		
	1.6	**Motor Tag Number**		
	1.7	**Max./Min. Ambient. Temp.:**	**0-40^{0}C**	
	1.8	**Altitude Over Sea Level**	**10m.**	
	1.9	**Relative Humidity:**	**90%**	
	1.10	**Atmosphere:**	**Petrochemicals**	
	1.11	**Enviroment classification**	**Zone 2**	
	1.12	**Type:**	**TEFC**	
	1.13			
	1.14	**Specification:**	**1073-S-007**	
	1.15	**Prepared By:**		
	1.16	**Date:**		
	2.0	**Customer Motor Requirements**		
Electrical Data	**2.1**	**Motor Type:**	**Cage Rotor**	
	2.2	**Rated Output**		**Kw**
	2.3	**Rated Voltage:**	**3300**	**V**
	2.4	**Phases:**	**3**	
	2.5	**Frequency:**	**50**	**Hz**
	2.6	**Stator Winding Connection:**		
	2.7	**Number Of Terminals:**	**6**	
	2.8	**Starting Method:**	**V.S.D**	
	2.9	**Insulating Class:**	**F**	
	2.10	**Stator Wind. Max. Temp.class**	**B**	
	2.11	**Efficiency Class**	**EFF-3**	
	2.12	**Thermal Protection Device Type**	**ACC.TO. SPEC**	
	2.12.1	**Mounted in a separate terminal box**	**YES**	
	2.12.2	**Control Cable Entries – Number/Size**	**1/M20**	
	2.13	**No.of Thermal Protection Device in winding**		
	2.14	**No.of Thermal Protection Device in bearings**		
	2.15	**Anti Condensation Heater type**		
	2.15.1	**Mounted in a separate terminal box**	**YES**	
	2.15.2	**Control Cable Entries – Number/Size**	**1X M20**	
	2.16	**Stating Freq. (No. Of Starts/1H from hot) :**		
	2.17	**Duty**	**S1**	
	2.18	**Service Factor:**	**1.15**	
	2.19	**Synchronous Speed:**		**r.p.m**

Mechanical Data	2.20	Cable Size		mm^2
	2.21	Cable Type		
	2.22	Enclosure Material:	CAST IRON	
	2.23	Type Of Enclosure - Motor:	IP-55	
	2.24	Terminal Box Enclosure	IP-55	
	2.25	Power Cable Entries – Number/size		
	2.26	Terminal Box Location	ACC.TO. SPEC	
	2.27	Paint Standard	Epoxy	
	2.28	Frame Size:		
	2.29	Type Of Load:		
	2.30	Type Of Coupling:		
	2.31	Bearing Lubrication Type:	Grease	
	2.32	Mounting:		
	2.33	Canopy for vertical mounted motor		
	2.34	Direction Of Rotation (Viewed From The Drive End)	BIDIRECTIONAL	
	2.35	Vibration Category:	NORMAL	
	2.36	Method of Cooling:		
	2.37	AREA CLASSIFICATION:	ZONE 2- hazardous area	
	3.0	**Manufacturer Motor Data**		
General Data	3.2	Prepared By:		
	3.3	Date:		
	3.4	Manufacturer:		
	3.5	Motor Type		
	3.6	Frame Size:		
	3.7	Environment classification		
	3.8	Type:		
	3.9	Rated Power		Kw
Electrical Data	3.10	Full Load Current:		A
	3.11	Locked Rotor Current:		x I_n
	3.12	No Load Current:		A
	3.13	Power Factor At: 100% Full Load:		
	3.13.1	80% Full Load:		
	3.13.2	70% Full Load:		
	3.13.3	50% Full Load:		
	3.13.4	No Load:		
	3.14	Efficiency Class		
	3.14.1	Efficiency At: 100% Full Load:		%
	3.14.2	80% Full Load:		%
	3.14.3	70% Full Load:		%
	3.14.4	50% Full Load:		%
	3.15	Rated Torque:		Kg-m
	3.16	Locked Rotor Torque:		x T_n

	3.17	**Breakdown Torque:**		**x T_n**

Mechanical Data	**3.18**	**Bearing Type On DE**		
	3.19	**Bearing Type On NDE**		
	3.20	**Method of Cooling:**		
	3.21	**Max. Permis. Temp. Of Bearings**		
	3.22	**Type Of Enclosure - Motor:**		
	3.23	**Terminal Box Enclosure**		
	3.24	**Net Weight:**		**Kg.**
	3.25	**Weight Of Rotating Parts:**		**Kg.**
	3.26	**Rotor Moment of Inertia**		**Kg-m^2**