

Plant 1.0 MTPA ALUMINA REFINERY STREAM-5	Client NALCO	Contract Code NAL	Document ID 6695-ELT-G00-EC-0012	Contract No. 66-6695
	TECHNICAL SPECIFICATIONS – LOW VOLTAGE INDUCTION MOTORS			 नेशनल एल्युमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.
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<p>TKIS - India / Vendor</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Remarks for AC2 : This marked-up drawings is hereby approved for fabrication / manufacturing and shall be re-submitted after revision. This drawing should be revised only to the extent of TKIS - India / Owner / Client comments. Any other changes made by you will not be considered unless clearly highlighted in covering letter asking for approval.</p> <p>This approval / review does not absolve the supplier from the full responsibility for design and fabrication.</p> <p>Date : ___/___/___ Name : _____</p>	<p>TKIS - India / Owner / Client</p> <p>Category Codes (Submission Purpose)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 For Approval <input type="checkbox"/> 2 For Review / Comments <input type="checkbox"/> 3 For Information <input checked="" type="checkbox"/> 4 For Engineering <input type="checkbox"/> 5 For Enquiry <input type="checkbox"/> 6 For Order Placement <input type="checkbox"/> 7 Final & Approved <input type="checkbox"/> 8 Released for Construction <hr/> <p>Acceptance Codes (Approval Codes)</p> <ul style="list-style-type: none"> <input type="checkbox"/> 1 Approved <input type="checkbox"/> 2 Approved for Manufacturing / Fabrication with Comments as marked <input type="checkbox"/> 3 Not Approved / Resubmit <input type="checkbox"/> 4 Retained for Information / Records <input type="checkbox"/> 5 Reviewed <input type="checkbox"/> 6 Reviewed as Noted / Resubmit <p>Date : ___/___/___ Name : _____</p>
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Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
© Copyright 2015 : All rights reserved ThyssenKrupp Industrial Solutions (India) Private Limited				<h1 style="margin: 0;">Barcode</h1>					Category Code: 4

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				Rev 00

INDEX SHEET

The document Cover Sheet indicates revisions made in this document along with the purpose of issue of the revised document. The details of revisions made in the enclosures of this document are listed in the table of *Contents* below and the enclosures listed therein are an integral part of this document.

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Part	Doc. Size	Description	No. of Pages	Rev. No.	Revised Clauses
	A4	Index Sheet and Status of Revision	2	00	-
Part-I	A4	Design Data Sheet (Requirement)	3	00	-
Part-II	A4	Design Data Sheet (Vendor's Data)	1	00	-
Part-III	A4	Inspection and Test Plan	1	00	-

 नालको NALCO नेपाल एलुमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE INDUCTION MOTORS		Code	NAL		
				Contract no.	66-6695		
		PART - I DESIGN DATA SHEET (REQUIREMENT)		Doc.	6695-ELT-G00-EC-0012		
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GENERAL	001	Make : As per Vendor List- Electrical					
	002	Voltage and frequency					
		a) Rated voltage (Vr)	: 415 V +/- 10%				
		b) Frequency (f)	: 50 Hz +3% / - 5%				
		c) Combined variation	: The sum of absolute percent variations of a) & b) not exceeding 10%				
	003	Number of phases : 3 phase					
	004	Design ambient temperature : 50°C					
	005	Type of rotor : Squirrel cage					
	006	No. of body earth terminals : 2 Nos.					
007	Energy efficiency class : IE2 as per IS 12615						
008	Degree of enclosure protection : IP-56						
CODES	009	IS-8789, IS-4889, IS-4029,	010	IS-12615, IS-15999			
		IS/IEC 60034	011				
	012		013	IEC-60079-0, IEC-60079-7, IEC-60079-1, IS-9628			
	014	IS-1231, IS-2223, IS-7816, IS-12065,	015	IEC-60738-1-3			
		IS-12075, IS-6362, IEC-60034	016				
	017		018				
	019	ATEX 1999/92/EC		020			
	021	ISO-1940-1, NEMA-MG-1, IEEE-112		022			
	023		024				
	025		026				
027		028					
CHARACTERISTICS	029	Stator Winding					
		a. Winding Connection	: Star or Delta ≤100L, Delta >100L				
		b. Insulation	: Class-F, temperature rise limited to class B limits				
		c. Temperature Rise (by resistance method)					
		i) For Industrial/ Ex-'d'/ Ex-'n' motors	: 70°C over an ambient of 50°C resp.				
		ii) For Ex-'e' motors	: 70°C over an ambient of 50°C for single layer and 60°C for other insulated windings, resp.				
	030	Winding Treatment (non-VFD)		: Vacuum pressure impregnated for frame 315 & above otherwise varnished-baked			
	031	Tropical Protection		: Antifungus, Moisture resistant (Epoxy gel coating on winding overhang)			
	032	Temperature rise of bearings (skin temperature) & lubricant					
		i) At full load	: To suit the withstand temperature of lubricant but final temperature not exceeding 100 Deg C				
		ii) At no-load	: 15 Deg C above ambient of 50° C				
		iii) Lubricant	: UNIREXN-3 (Suitable for operation at temperature of 130 Deg C minimum)				
	033	Cooling Designation as per IS 6362		: IC411			
	034	Overvoltage withstand capacity, for Changeover of Power Supply : 150 % of rated voltage					
	035	Minimum Permissible Voltage for -					
		a. Starting at full load	: 80 % of rated voltage				
		b. 5 minute running without overheating	: 75 % of rated voltage (Occasionally)				
	036	Max. starting current		: 8.4 times rated full load current (including tolerance)			
	037	Maximum slip at full load		: % *			
	038	Shaft voltage		: Max. 200 mV *			
039	Min. starting torque		: As per IS 12615				
040	Noise Level		: 85 dB at 1 meter				
041	Class of Vibration severity		: Grade 'A' of IEC 60034-14, freely placed on test bench without bolting				
042	Balancing of rotor :						
	a. Up to 160 kW	: To meet vibration severity requirement *					
	b. Above 160 kW	:					
	i) Speed 3000 rpm & above and turbo compressor motor	: To meet vibration severity requirement *					
	ii) Other motors	: To meet vibration severity requirement *					

 नालको NALCO नेशनल एल्युमिनियम कंपनी लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE INDUCTION MOTORS PART - I DESIGN DATA SHEET (REQUIREMENT)		Code		NAL	
				Contract no.		66-6695	
				Doc.		6695-ELT-G00-EC-0012	
				Rev.		00	
CHARACTERISTICS	043	Thermistor					
		a. Shall be provided for motors					
		i) non-VFD		:		75 kW and above	
		ii) VFD driven		:		All ratings	
		b. Type		:		PTC embedded in overhang portion of stator winding	
		c. Rated Operating Temperature T_{ROT}		:		$150^{\circ}C, + / - 5^{\circ}C$	
		d. No. of thermistors		:		1 No./ phase. All 6 terminals shall be brought into separate TB	
	044	Space heater					
		Space heater to be provided for motors & Voltage		:		30 kW and above, 240V, 1-Ph	
	045	Bi-Direction Rotation Required		:		Yes	
	046	On-line greasing facility for frame size 225 & above		:		Required	
	047	Shaft design		:		Suitable to withstand 10 times the rated torque (for transient conditions in case of reacceleration requirements)	
NO. OF STARTS		Starting Duty Cycle		Up to 200 kW		Above 200 kW	
	048	Equally Spaced Starts per Hour		4		3	
	049	Successive Starts From Cold Condition		3		2	
	050	Successive Starts From Hot Condition		2		1	
THERMAL CAPACITY	051	Minimum Hot thermal withstand time (rated Voltage)		:		8 seconds	
	052	Minimum Margin between starting time with motor coupled to load & Hot thermal withstand time for (rated Voltage) :					
		i. Starting time ≤ 5 s		:		3 s	
		ii. Starting time > 5 s		:		5 s	
	053	Requirement of starting duty cycle as specified elsewhere shall be complied					
TERMINAL BOX	054	Fault Withstand Capacity		:		Let through energy of fuse	
	055	Location of TB		:		Top or RHS while viewed from DE, Rotatable by 90°	
	056	Winding Leads & Terminals		:		All 6 leads brought out for frame $> 100L$	
	057	Insulators		:		Non Hygroscopic, Non-Flammable	
	058	End connection		:		Studs & lugs (crimped or brazed)	
	059	Separate terminal boxes for space heater & thermistor terminals shall be provided					
	060	Cable Glands: By LSTK Contractor, Type: Nickel plated Brass, Double comp., ISO metric, 1.5 mm thread pitch					
	Terminal blocks shall be suitable for LSTK Contractor cable sizes which shall be specified after order						
PAINTING	061	Primer		:		2 coats of epoxy based primer, spray painted	
	062	Final Paint		:		2 coats of epoxy based finish paint (acid alkali proof)	
	063	Final paint shade					
		a) For outdoor motors		:		Shade 632 of IS-5	
		b) For indoor motors		:		RAL-7032	
	064	Minimum Paint Thickness		:		60 Microns	
	065						
BEARING	066	Minimum Life		:		40,000 hrs at rated operating conditions	
	067	Online Greasing Facility		:		Required (except for pre-lubricated sealed bearings)	
	068	Radial Clearance for Antifriction bearing		:		C3 Class	
	069	Seals		:		Seals to prevent grease entering the motor cavity	
	070	Bearing type for special cases					
		Vertical & Flange Mounted		:		Thrust Bearing	
		V-Belt/ Toothed Belt Application		:		Roller bearing at Driving end	
APPLICATION CHECK	071	Application check to be carried out		:		i. All motors ≥ 75 kW including centrifugal pumps	
		for Non-VFD motors for		:		ii. Fans, Blowers, Compressors (reciprocating/ centrifugal), conveyors and agitators of all ratings	
	072	Application check procedure		:		Superimposed torque Vs speed curves for load and motor	
	073	Criteria for acceptance		:		Torque developed by motor shall be more than that required by driven equipment by at least 10% at all speeds in pull up region	
	074	Special requirement for pulsating load		:		i. Pull out torque at min. voltage shall be more than peak value of pulsating torque by at least 10%	
				:		ii. Current pulsation shall not be more than 40%	

 नालको NALCO नेपाल एलुमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE INDUCTION MOTORS PART - I DESIGN DATA SHEET (REQUIREMENT)		Code		NAL		
				Contract no.		66-6695		
				Doc.		6695-ELT-G00-EC-0012		
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VFD CONTROLLED MOTORS	075	Winding : Dual enamel coated wires & vacuum pressure impregnated insulation						
	076	Bearing : One side insulated frame/ insulated bearing for frame ≥ 280						
	077	Cooling : Special design for reduced cooling at low speeds or separate motor driven fan for constant torque application						
	078	Design Basis : Stator critical						
	079	Combined testing of motor & VFD at motor works : For Ex 'e', Ex 'n' (mandatory) & Ex 'd' motors (if required based on vendor confirmation) (Also See Note-2)						
	Note : VFD application motors shall be suitable for stress category C as per IEC 60034-18-41							
NAME PLATE	080	Content : As per standard						
	Additional Information							
	'I _e ' for increased safety motor			Class for energy efficient motor				
	Certificate no., temperature class & Gas group for Hazardous area application if applicable							
	Direction of Rotation							
	Separate nameplate for motor tag no. & service							
DOCUMENTS / DRAWINGS		Description				Prints for Review / Approval	Final, As-Built documents	
	081	TEST CERTIFICATES				For No. of copies of drawing/documents to be issued by LSTK Contractor for Approval/Review/Information during Detail Engineering and as a part of final, As built documentation - LSTK Contractor to refer requirement indicated elsewhere in the tender		
		a) Routine & Type Test Certificates						
		b) Certificates as mentioned in Part-III, Section D						
	082	PERFORMANCE CURVES / GRAPHS						
		a) For motors rated 75 kW & above						
		i. Hot & Cold withstand curves with heating & cooling time constants						
		ii. Starting Current vs Time Curves for 80%, 100% & 110% Vr						
		iii. Negative Phase Sequence Withstand Current vs Time Curves						
		iv. Torque vs Speed curve of motor at 100% & 80% of rated voltage superimposed on equipment torque vs speed curve						
		b) Application check for screw compressor, reciprocating pumps, fans, blowers, agitators & conveyors of all ratings by plotting Torque vs Speed curve of motor at 100% & 80% of rated voltage superimposed on equipment torque vs speed curve						
	083	DRAWINGS						
		a) GA Drawing Showing Mounting Details/ Dimensions of Motor						
		b) Detailed Drawing for Each Terminal Box						
		c) Design Data Sheet PART-I						
		d) Design Data Sheet PART-II						
		e) Quality Assurance Plan and Inspection Test Procedure						
084	MANUAL / DOCUMENTS							
	a) Installation, Operation & Maintenance Manuals							
084	Notes:							
	1) For items marked "*" thus, data to be furnished / confirmed by LSTK Contractor during detail engineering.							
	2(a) Combined testing shall be carried out at Motor vendors work and shall be witnessed by certifying authorities. Switching frequency shall be 4 kHz. Motor temperature rise shall be as per this Specification.							
	Motor vendor shall obtain necessary certification for installation of motor in Hazardous area as defined in this specification.							
	2(b) VFD application Motors which are not tested in combination with VFD, shall be fed with additional 15% of total losses (as Harmonic loading), during heat run test without VFD.							
	3 Motor frames shall be constructed of ferrous materials, and protected with a caustic resistant paint coating.							
	4 Ventilating fans shall be made of steel, or a caustic-resistant non-metal. Nonferrous alloys are prohibited. Cooling tubes or ducts, if used, shall be mild steel. Cooling tubes shall be easily accessible for cleaning.							
	5 Stator laminations shall not be exposed to external cooling air. End cowls shall be constructed of steel or a caustic-resistant fibre reinforced plastic. Terminal boxes shall be robustly constructed of caustic-resistant material. Aluminium alloys are not permitted.							

 नालको NALCO नेपाल धातुपुर्जितकाल कारखाना लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE INDUCTION MOTORS PART - III INSPECTION TEST PLAN			Code	NAL		
					Contract no.	66-6695		
					Doc.	6695-ELT-G00-EC-0012		
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Sr. No.	Tests	Reference documents	Sample size	Scope of Inspection				
				Vendor	Owner / Consultant / LSTK Contractor	Remark		
A	Type Tests							
i	Full load test to determine efficiency, power factor & slip	IS 12615, IS 4029, IEC-60034-2, IS 15999	On one motor of each rating	P	W			
ii	Temperature rise test	IS 12615, IS 4029, IEC-60034-1		P	W			
iii	Momentary overload test	IS 12615, IEC-60034-1, IS 15999		P	W			
iv	Overspeed test (120% of rated speed for 2 min.)	IS 12615, IEC-60034-1		P	W		Optional test	
B	Routine Tests & Optional Tests							
i	Visual inspection & dimensional checks	Approved GA drawings	One of each kW/ Frame/ Type	P	W			
ii	Measurement of resistance of windings of stator & wound rotor	IS 12615, IS 4029, IEC-60034-1, IS 15999	100%	P	W			
iii	No load test at rated Voltage	IS 12615, IS 4029, IEC-60034-1, IS 15999		P	W			
iv	Locked rotor test	IS 12615, IS 4029, IS 15999		P	W			
v	Reduced voltage running up test (for squirrel cage motor)	IS 12615, IS 15999		P	W			
vi	Open circuit voltage ratio of stator & rotor windings (for slip ring motors)	IS 4029, IEC-60034-1		P	W			
vii	Resistance measurement of space heaters, RTD's & BTD's and Thermistors	-		P	W			
viii	High Voltage test (HV) on Stator, RTD/BTD, Thermistor and Space Heater	IS 12615, IS 4029, IEC-60034-1		P	W			
ix	Insulation Resistance test before & after HV Test	IS 12615, IS 4029, IS 7816		P	W			
x	Test for vibration severity of motor (for rating 55 kW & above)	IS 12615, IS 12075, IEC-60034-14		P	W			
xi	Test for noise level of motor (for rating 55 kW & above)	IS 12615, IS 12065, IEC-60034-9		P	W			
C	Additional Tests							
i	No load running for ½ hr. after completing all tests for all motors	IS 4029, IEC-60034-1	100%	P	W		Refer Note-2	
ii	Shaft voltage measurement for motors of rating 55 kW & above	IS 4029		P	W			
iii	Balancing of Rotor	ISO-1940		P	R			
D	Certificates							
i	Certificate from approved testing authority like CMRI/ CPRI/ BASEEFA/ PTB/ UL/ FM/ LCIE for installation in hazardous area	-	100%	P _{PROTO}	R			
ii	Approval from statutory authority like PESO for use in hazardous area	-		P _{PROTO}	R			
iii	Certificate for short-circuit withstand capability of main terminal box	-	Each size/ type/ model	P _{PROTO}	R			
iv	Certificate for test for degree of protection for enclosure	IEC-60034-5	Each type	P _{PROTO}	R			
v	Combined testing for motor and VFD (if applicable)	As per Part V of VFD spec	One of each kW/ Frame/ Type	P	W			
Notes:								
1) R = Review of test certificates; W = Witness, P = Perform (on project equipment), P _{PROTO} = Perform (on prototype)								
2) To be carried out for motors for which temperature rise test has not been performed.								