





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> <table border="0"> <tr><td><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td><input type="checkbox"/></td><td>7</td><td>Final & Approved</td></tr> <tr><td><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <p>Acceptance Codes (Approval Codes)</p> <table border="0"> <tr><td><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <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>	<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	<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>TKIS - India / Owner / Client</p> <p>Category Codes (Submission Purpose)</p> <table border="0"> <tr><td><input type="checkbox"/></td><td>1</td><td>For Approval</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>For Review / Comments</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>For Information</td></tr> <tr><td><input checked="" type="checkbox"/></td><td>4</td><td>For Engineering</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>For Enquiry</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>For Order Placement</td></tr> <tr><td><input type="checkbox"/></td><td>7</td><td>Final & Approved</td></tr> <tr><td><input type="checkbox"/></td><td>8</td><td>Released for Construction</td></tr> </table> <hr/> <p>Acceptance Codes (Approval Codes)</p> <table border="0"> <tr><td><input type="checkbox"/></td><td>1</td><td>Approved</td></tr> <tr><td><input type="checkbox"/></td><td>2</td><td>Approved for Manufacturing / Fabrication with Comments as marked</td></tr> <tr><td><input type="checkbox"/></td><td>3</td><td>Not Approved / Resubmit</td></tr> <tr><td><input type="checkbox"/></td><td>4</td><td>Retained for Information / Records</td></tr> <tr><td><input type="checkbox"/></td><td>5</td><td>Reviewed</td></tr> <tr><td><input type="checkbox"/></td><td>6</td><td>Reviewed as Noted / Resubmit</td></tr> </table> <p>Date : ___/___/___ Name : _____</p>	<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	<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
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Rev.	Status	Description	Date	Prepared	Date	Checked	Date	Approved	AC
			<div style="text-align: center; font-size: 2em;">Barcode</div>						Category Code: 4
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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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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 कार्पोरेशन लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE INDUCTION MOTORS PART - I DESIGN DATA SHEET (REQUIREMENT)		Code	NAL			
				Contract no.	66-6695			
 thyssenkrupp				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				
CHARACTERISTICS	027			028				
	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						

<div> नैलको एलुमिनियम कम्पनी लिमिटेड National Aluminium Company Ltd.</div>			LOW VOLTAGE INDUCTION MOTORS		Code		NAL	
Contract no.		66-6695						
<div> ThyssenKrupp</div>			PART - I DESIGN DATA SHEET (REQUIREMENT)		Doc.		6695-ELT-G00-EC-0012	
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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 °C, + / - 5 °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%			

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 PART - I DESIGN DATA SHEET (REQUIREMENT)					
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 cowl 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.			

[illegible]

NOTES: 1. ALL THE ABOVE DATA TO BE FURNISHED BY VENDOR.
2. DATA FURNISHED SHALL BE APPLICABLE FOR ANY TYPE OF MOTOR MOUNTING (I.E. B3 / V1 ETC.)
3. VENDOR SHALL FURNISH COOLING TIME CONSTANT AND HEATING TIME CONSTANT FOR MOTORS RATED ABOVE 75 KW.

 नालको NALCO नैसर्गिक धातु निर्माण कम्पनी लिमिटेड National Aluminium Company Ltd.		LOW VOLTAGE INDUCTION MOTORS			Code	NAL		
		PART - III			Contract no.	66-6695		
		INSPECTION TEST PLAN			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.						