

Annex A – Schedules A and B

THIS SCHEDULE FORMS PART OF SPECIFICATION 240-42587021 "SPECIFICATION FOR AIR CORE REACTORS" DATED 10/07/2020, REVISION 3.

SCHEDULES A AND B FOR 150 MVAR, 275 kV, 0.8 mH DAMPING REACTOR FOR HECTOR SHUNT CAPACITOR BANK.

SCHEDULE A: PARTICULARS OF ESKOM'S REQUIREMENTS AND

SCHEDULE B: SUPPLIER'S GUARANTEES OF TECHNICAL PARTICULARS OF EQUIPMENT OFFERED.

THIS SCHEDULE SHALL BE USED IN CONJUNCTION WITH ESKOM SPECIFICATION FOR AIR CORE REACTORS REF 240-42587021. IN CASE OF CONFLICT, THE TENDERER SHALL REQUEST CLARITY IN A FORM OF AN EMAIL OR LETTER TO ESKOM, AND SHALL COMPLY WITH THE LATEST REVISION OF ALL RELEVANT IEC STANDARDS.

WHERE XXXXX IS INDICATED, THE SUPPLIER MUST COMPLETE IN SCHEDULE B.

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
1	Delivery and off-loading			
1.1	Delivery to:			
1.1.1	Reactors	Address	Hector Substation, East Grid, KZN Province	
1.1.2	Spares (optional units)	Address	N/A	
1.2	Delivery effected not before	Date	As per project schedule	
1.3	Off-loaded from transport vehicle by supplier	Yes/No	Yes	
1.4	Transferred to intended operation position	Yes/No	Yes	
1.5	Installation	Indoor/ Outdoor	Outdoor	
2	Quantity			
2.1	Reactors		2	
2.2	Spares		0	
3	Erection			
3.1	Erected ready for service	Yes/No	Yes	
3.2	Erection complete not later than	Date	As per project schedule	
3.3	Erected for storage	Yes/No	Yes	
4	Environmental information			
4.1	Altitude above sea level	m	1800	

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
4.2	Ambient temperature			
4.2.1	Maximum	° C	45	
4.2.2	Minimum	° C	-10	
4.2.3	Daily average	° C	35	
4.2.4	Yearly average	° C	25	
4.2.5	Maximum average daily temperature variation	° C	20	
4.3	Relative humidity			
4.3.1	Minimum	%	50	
4.3.2	Maximum	%	96	
4.3.3	Average	%	68-83	
4.4	Solar radiation (maximum)	W/m ²	2.6 x 10 ³	
4.5	Wind loading	Pascals/ms ⁻¹	1200/40	
4.6	Pollution			
4.6.1	Type	Inland/ Coastal	Coastal	
4.6.2	Classification (IEC 60815)	mm/kV	31 (Very Heavy)	
4.6.3	Climatic conditions		Rain/dry/ hail/high UV radiation	
4.7	Seismic level	g	0.3	
5	System Details			
5.1	Maximum system voltage (U _m)	kV	302.5	
5.2	Temporary overvoltages			
5.2.1	For 10 min	kV	1.05 U _m	
5.2.2	For 1 min	kV	1.25 U _m	
5.2.3	For 5 s	kV	1.5 U _m	
5.2.4	For 1 s	kV	1.75 U _m	
5.3	Nominal system frequency	Hz	50	
5.4	Number of phases		3	
5.5	Three-phase system fault levels at the substation	kA	50	
5.6	Single-phase system fault levels at the substation	kA	XXXXX	
5.7	Interval between fault conditions (as per Clauses	hr	6	

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
	8.5 and 9.5 in IEC 60076-6)			
5.8	Frequency of short circuit application / year (as per Clauses 8.5 and 9.5 in IEC 60076-6)		5	
5.9	Number of switching operations / day (as per Clause 9.4.3 in IEC 60076-6)		5	
6	Type			
6.1	Application	Current Limiting/ Damping/ Shunt/ Filter/ Discharge/ Smoothing Reactor	Damping	
6.2	Phases	1Ø/3Ø	1Ø	
6.3	Model		XXXXXX	
6.4	Physical layout for single-phase dry-type	Δ/in-line	In-line	
7	Reactor Rating			
7.1	Rated frequency (tuning / inrush / discharge)	Hz	50	
7.2	Rated power	MVA _r	XXXXXX	
7.3	Rated voltage	kV	275	
7.4	Rated continuous / power frequency current (I_N)	A	400	
7.5	Current density of windings at rated current	A/mm ²	XXXXXX	
7.6	Root sum square current (I_{rss})	A	400	
7.7	Current spectrum	A	2 nd - 0	
			4 th - 0	
			5 th - 0	
			7 th - 0	
7.8	Rated inrush current (Damping and filters) – provide calculations	kA	To match 50kA fault level and design offered	
7.9	Rated thermal short-time current (I_{KN}) - provide calculations	kA	31.5	
7.10	Rated short-time current duration or duty-cycle	s	1	
7.11	Rated mechanical short-time current- provide calculations	kA _{peak}	80	

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
7.12	Rated mechanical short-time duration	s	1	
7.13	Rated linear impedance	Ω	0.251	
7.14	Rated inductance	mH	0.8	
7.15	Tolerance on inductance	%	+2.5, -0	
7.16	Rated incremental inductance	mH	N/A	
7.17	Rated resistance	Ω	XXXXXX	
7.18	Rated short-time overload DC (Smoothing Reactors)	A	N/A	
7.19	Rated short-time overload current spectrum	A	N/A	
7.20	Short-time overload duration	s	N/A	
7.21	Overload capability (130% I_{MAX})	kA	Insert Value	
7.22	Magnetic clearance required			
7.22.1	MC1	mm	XXXXXX	
7.22.2	MC2	mm	XXXXXX	
7.22.3	Centre-to-centre	mm	≤ 3500	
7.23	Coupling factor	%	XXXXXX	
7.24	Quality factor (Q)		XXXXXX	
7.25	Tolerance of Quality factor (Q)	%	XXXXXX	
7.26	Total losses at rated current	kW	XXXXXX	
7.27	Coefficient of loss evaluation	R / kW	10 000	
8	Temperature rise at site altitude at maximum continuous current			
8.1	Hot spot temperature	$^{\circ}\text{C}$	XXXXXX	
8.2	Maximum hot spot temperature rise of windings	K	80	
8.3	Thermal time constant	min	XXXXXX	
8.4	Insulation class	(IEC 60076-11)	F	
8.5	Coating material required – see Clauses 3.3 and 3.8	Yes/ No	Yes	
9	Reactor details			
9.1	Type of cooling	AN	AN	
9.2	Line terminals		XXXXXX	
9.3	Mounting		XXXXXX	
9.4	Minimum clearance between base of insulators and ground level	mm	XXXXXX	
9.5	Single-phase switching	Yes/No	No	

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
9.6	Number of coils per phase		XXXXXX	
9.7	Winding material		XXXXXX	
9.8	Insulation material		XXXXXX	
9.9	Mass of one coil	kg	XXXXXX	
9.10	Coil dimensions			
9.10.1	Diameter	mm	XXXXXX	
9.10.2	Height	mm	XXXXXX	
9.11	Dimensions of unit including pedestals			
9.11.1	Diameter	mm	XXXXXX	
9.11.2	Height	mm	XXXXXX	
9.12	Capacitance of one coil			
9.12.1	Series capacitance	pF	XXXXXX	
9.12.2	Ground capacitance	pF	XXXXXX	
9.13	Number of concentric coils		XXXXXX	
9.14	Number of turns in each coil		XXXXXX	
9.15	Arrangement of coils			
9.15.1	Spacing between coils of same phase	mm	XXXXXX	
9.15.2	Spacing between coils of different phases	mm	XXXXXX	
9.16	Maximum amplitude of vibration peak to peak at operating temperature and I_N	Absolute maximum Average maximum	100µm 30µm	
9.17	Maximum audible noise level of individual reactor according to Clause 3.5	dB	≤75	
9.18	Distance at which noise level is to be measured	mm	2000	
9.18	Reactor corona shielding	Yes/No	XXXXXX	
9.19	Pollution mitigation - see Clauses 3.3 and 3.8	Yes	RTV coating minimum	
9.20	Sound abatement		XXXXXX	
9.21	Life expectancy	yrs	40	
9.22	Manufacturer		XXXXXX	
9.23	Country of manufacture		XXXXXX	
10	Reactor insulation			
10.1	Insulation level (BIL)	kV peak	550	
10.2	60s power frequency withstand voltage	kV rms	460	

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
10.3	Interturn voltage withstand	kV	XXXXXX	
10.4	External voltage grading	mm/kV	31	
10.5	Reference temperature	°C	75	
10.6	Temperature rise test voltage	kV	U _{max}	
10.7	Temperature rise test duration	hr	XXXXXX	
10.8	Short-circuit current test - provide calculations	A	XXXXXX	
10.9	Short circuit shot duration	s	XXXXXX	
10.10	Number of short circuit shots		N/A	
10.11	Q factor test frequencies	Hz	XXXXXX	
11	Pedestal insulator SANS/IEC 60168, Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000V. Single copies of all certificates and full reports of type tests performed by an accredited test authority shall be submitted with a tender offer	Yes/ No	Yes	
11.1	Material	Porc/Si	Porc	
11.2	Type		XXXXXX	
11.3	Minimum creepage distance	mm	XXXXXX	
11.4	60s power frequency withstand voltage	kV rms	XXXXXX	
11.5	Lightning impulse withstand test voltage at sea level (1.2/50µs full wave)	kV peak	XXXXXX	
11.6	Steady mechanical load factor		XXXXXX	
12	Tests – Compulsory Requirement			
12.1	Measurement of impedance	Yes/No	Yes	
12.2	Measurement of losses	Yes/No	Yes	
12.3	Lightning impulse	Yes/No	Yes	
12.4	Temperature rise	Yes/No	Yes	
12.5	Acoustic sound level	Yes/No	Yes	
12.6	130% Overload for one hour	Yes/ No	Yes	
13.	Special requirements:			
13.1	To be supplied together with associated equipment	Yes/ No	Yes	
13.2	Pedestal adaptor plates to be provided	Yes/No	Yes	
13.3	Storage and maintenance procedure	supplied	Yes	
13.4	Must be fully interchangeable with the	Yes/No	Yes	

Technical specifications				
Item	Description	Units	Schedule A	Schedule B
	installation on site.			
13.5	Minimum design safety margin factor		1.2	
13.6	<p>For filter reactors acoustic compliance, a frequency sweep should be conducted across the frequency spectrum up to 5 kHz (audible noise test system dependant from the manufacturer). IEC 60076-6 specifies this special test (section 9.10.11), and should be used as reference, with the results shown as calculated (IEC 60076-10) together with measured values. The requirement must be satisfied without an acoustic shield.</p> <p>Calculations of audible noise levels for the reactors showing compliance to the specification is required. Test report for audible noise reactors showing the third octave spectrum levels from measurements is required. In meeting the audible noise criteria, the third octave spectrum levels from calculation and measurements should be given in the test reports.</p>	Yes/No	Yes	
13.7	Note: All pertinent design parameters including mounting requirements will be assessed/confirmed as part of the design review program. The successful bidder will be required to demonstrate acceptability of the design offered and compliance to safety margins.			
14.	Deviations			
Clause	Description of deviation	Proposed alternative		Accept/Reject