	Business Management System Transformer and Switchgear Services Engineering Scope of Work	Document Identifier	240-94063834	Rev	1
		Effective Date	12/05/2017		
		Review Date	12/05/2020		
		Page	1 of 10		

CUSTOMER		STATION	
COMPONENT DESCRIPTION		PROJECT NO.	
ORIGINAL MANUFACTURER		RATING	
SERIAL NO.		AISLE (2.5 to 80 MVA)	

The scope of supply for refurbishment of transformers comprises refurbishing/overhaul and supplying of, where applicable, the main tank and auxiliaries comprising of Conservator tank, radiator/ coolers, valves, breather, cabling, Insulator bushings, Tap-changer, Buchholz relay, Pressure relief valve, Transformer oil, Factory Acceptance Test, transport to and from, etc as detailed in the Scope of Work.

		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
	UNTANKING				
1.	Off load transformer from transport and wash.				
2.	Conduct the following electrical tests:				
2.A	• 380V AC (Ratio and polarity, Magnetization & Impedance);				
2.B	• Resistance; and				
2.C	• Megger.				
3.	Mark and disconnect cabling and CT's.				
4.	Disconnect and remove insulators and turrets and CT brackets and send to Bushing Section.				
5.	Remove cabling and disconnect pipe work.				
6.	Disconnect tap changer shaft.				
7.	Mark tapping leads and disconnects tap changer.				
8.	Remove tap changer and send to Tap Changer Section.				
9.	Gauge open or Unbolt top cover and untank active part.				
10.	Place active part in bay and repeat electrical tests if necessary as per recommendation.				
11.	Inspect active part and provide recommendations.				
	DISMANTLE ACTIVE PART				
12.	Take measurement, make sketches of active part.				
13.	Take pictures on all sides and record top yoke condition.				
14.	Mark harness, undo connections and Remove harness.				
15.	Release pressure from active part and take pressure readings.				
16.	Unpack top yoke and remove top core clamps.				
17.	Mark all top blocking press frames and shunts				
18.	Remove top blocking, press frames and shunts.				
19.	Remove all windings, wrappers and slats, make sketches of set up.				
20.	Take paper samples for DP analysis.				

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		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
21.	Compile Engineering report with recommendations and repair SOW.				
	Or if new windings are not required:				
	WINDINGS				
22.	Take winding specs				
23.	Confirm the number of turns if any disparity				
24.	Work out the window height and pressures				
	HV windings				
25.	Repair and retape winding				
26.	Flush windings with warm clean oil				
27.	Place windings in a pot for dry out.				
28.	Remove windings from the pot and place under Hydraulic press				
29.	Apply assembly pressure and make adjustments as per winding spec.				
30.	Conduct continuity and parallel path tests under pressure				
31.	Repair winding insulation where necessary				
32.	Conduct final inspection and deliver windings to the assembly section.				
	LV windings				
33.	Repair and retape winding				
34.	Flush windings with warm clean oil				
35.	Place windings in a pot for dry out.				
36.	Remove windings from the pot and place under Hydraulic press				
37.	Apply assembly pressure and make adjustments as per winding spec.				
38.	Conduct continuity and parallel path tests under pressure				
39.	Repair winding insulation where necessary				
40.	Conduct final inspection and deliver windings to the assembly section.				
	Tapping windings				
41.	Place winding on a former and support				
42.	Remove end support and locking cylinder				
43.	Repair and retape winding				
44.	Retighten winding and replace end supports if necessary				
45.	Flush windings with warm clean oil				
46.	Place windings in a pot for dry out				
47.	Remove windings from the pot and place under Hydraulic press				
48.	Apply assembly pressure and make height adjustments				

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		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
49.	Replace top end support and locking cylinders				
50.	Conduct continuity and parallel path tests under pressure				
51.	Retape winding leads where necessary				
52.	Conduct final inspection and deliver windings to the assembly section.				
	MANUFACTURE WINDINGS				
53.	Manufacture three new HV windings as winding specs.				
54.	Manufacture three new MV windings as winding specs.				
55.	Manufacture three new LV windings as winding specs.				
56.	Manufacture three new Regulating windings as winding specs.				
57.	Manufacture associated winding insulation as winding specs.				
58.	Place windings under Hydraulic press and apply compacting pressure.				
59.	Conduct continuity and parallel path tests.				
60.	Place windings in a pot for dry out.				
61.	Remove windings from the pot and place under Hydraulic press again.				
62.	Apply assembly pressure and make adjustments as per winding spec.				
63.	Conduct final inspection and deliver windings to the assembly section.				
	REASSEMBLE ACTIVE PART				
64.	Lay the core down and unstack laminations or remove core clamps				
65.	Replace core insulation and step blocks				
66.	Restack and/ or reclamp core and place upright				
67.	Megger core insulation.				
68.	Replace or clean blocking, press frames and insulation.				
69.	Fit bottom blocking and support structures.				
70.	Fit windings to core referring to drawings				
71.	Fit all top blocking and press-rings.				
72.	Fit top core clamps.				
73.	Inspect, clean and retape HV, MV, LV and Tapping harnesses.				
74.	Supply and fit new tapping lead protection wrap at all clamping points				
75.	Pre dry active part in oven or vapour phase as required.				
76.	Retention windings to original specifications.				
77.	Replace top core insulation as required.				
78.	Pack 25% of top core.				
79.	Conduct pre-test to ensure correct ratios.				
80.	Complete packing of top core.				

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		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
81.	Arrange 380V tests after packing full top yoke (ratio, magnetization & Megger).				
82.	Fit harnessing and make temporary connections.				
83.	Arrange 380V test on temporary connections.				
84.	Make and tape final connections.				
85.	Conduct all low voltage tests (ratio & polarity, magnetization, impedance, resistance and Megger).				
86.	Deliver active part in a pot for final dry out.				
87.	Remove active part from the pot after dry out and place in a Bay.				
88.	Final jack, tighten all parts and Megger test active part.				
	REFURBUSH TANK AND PARTS				
89.	If transformer suffered major fault or have suspect welds then sandblast and crack test.				
90.	If sandblasted then the relevant painting preparation specification shall apply.				
91.	Clean and inspect tank and regasket tank.				
92.	Overhaul and regasket HV turrets, replace insulation as required.				
93.	Dry-out HV turrets in vapour phase.				
94.	Overhaul and regasket LV turrets and dry out.				
95.	Megger test and seal turrets.				
96.	Clean and inspect all pipe work and headers and seal.				
97.	Replace breathers				
98.	Inspect and clean marshalling kiosk if fitted.				
99.	Replace junction box with Marshalling Interface Box				
100.	Supply and fit new cables				
101.	Replace radiator valves				
102.	Overhaul cooling motors and fans (issue test certificates).				
103.	Overhaul pumps and issue test certificates.				
104.	Clean and flush cooler banks.				
105.	Pressure tests all coolers (supply test certificates).				
106.	Overhaul, test and fit Buchholz relay (supply test certificate).				
107.	Service all pressure devices (supply test certificates).				
108.	Supply and fit new micro switches to all pressure devices.				
109.	Replace bolts and nuts where required.				
110.	Replace WTI and OTI				
111.	Replace drain and filtration valves				
112.	Clean and regasket conservator tank				
113.	Replace conservator oil level gauges				
114.	Carry out pressure test on Air Cell.				
115.	Arrange various alterations with Boilershop; turrets, conservator tank, mounting				

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	Business Management System Transformer and Switchgear Services Engineering Scope of Work	Document Identifier	240-94063834	Rev	1
		Effective Date	12/05/2017		
		Review Date	12/05/2020		
		Page	5 of 10		

		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
	brackets installation and various blanking plates				
	BOILERSHOP				
116.	Manufacture various blanking plates				
117.	Install MIB mounting brackets				
118.	Make turret alterations to suit new bushings				
119.	Make conservator tank alterations for Air cell installation				
120.	Make alterations for welded top cover				
121.	Tag weld and final weld top cover				
	BUSHINGS				
122.	Off load all bushings.				
123.	Conduct 10kV test on all bushings.				
124.	Take oil samples from bushings and have analysed.				
125.	Replace existing bushings new RIP type.				
126.	Modify exit leads to suit new bushings.				
127.	Modify turrets to suit new bushings				
	HV TEST BUSHINGS				
128.	Place bushing in upright position for 24hrs (OIP)				
129.	Install 1 bushing at a time in test tank.				
130.	Fill tank with oil and bleed				
131.	HV test bushing (PD, TanD and Capacitance) and supply test certificates.				
132.	Remove bushing and pack in crate.				
	RING TYPE CT's				
133.	Mark all connections as per nameplate.				
134.	Remove CT's from turrets or active part.				
135.	Carry out electrical tests to determine if serviceable, replace CT's if faulty.				
136.	Overhaul CT's and dry out (retape as required).				
137.	Refit during final tanking of active part ensuring correct polarity.				
	SERVICE INSULATORS				
138.	Check and inspect insulators.				
139.	Clean insulator shells.				
140.	Renew all seals and gaskets.				
141.	Assemble insulator.				
142.	Paint flanges and parts.				

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	Business Management System Transformer and Switchgear Services Engineering Scope of Work	Document Identifier	240-94063834	Rev	1
		Effective Date	12/05/2017		
		Review Date	12/05/2020		
		Page	6 of 10		

		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
	TAPCHANGER (ON LOAD)				
	Box type:				
143.	Open front cover and inspect for defects.				
144.	Remove all contact epoxy boards and inspect for cracks or any other defects.				
145.	Remove barrier board and inspect for cracks/defects.				
146.	Inspect all contacts, shafts and flexibles for wear/defects.				
147.	Record transitional resistor values and compare with nameplate information where applicable.				
148.	Inspect mechanical drive mechanism for defects.				
149.	Replace all gaskets and seals.				
150.	Replace all defective parts.				
151.	Re-assemble tap changer.				
152.	Mechanically operate tap changer to check for correct operation.				
153.	Oil leak test tap changer.				
154.	Dry out tap changer.				
155.	Fit tap changer to transformer and carry out speed trace.				
	Separate diverter/selector type				
156.	Remove diverter from cylinder.				
157.	Inspect all contacts, shafts and flexibles for wear/defects on diverter and selector.				
158.	Record transitional resistor values and compare with nameplate information where applicable.				
159.	Inspect drive mechanism, gears and couplings for defects.				
160.	Check and service bevel gear.				
161.	Check, clean and inspect drive shafts.				
162.	Replace all gaskets and seals.				
163.	Replace all defective parts.				
164.	Clean all contacts and assembly structures.				
165.	Re-assemble tap changer.				
166.	Mechanically operate tap changer to check for correct operation.				
167.	Clean, lubricate mechanism box and repair/replace defective parts.				
168.	Electrically test mechanism box to check for correct operation.				
169.	Oil leak test diverter cylinder.				
170.	Dry out tap changer.				
171.	Fit tap changer to transformer or selector tank.				
172.	Carry out speed trace and continuity tests.				

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		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
173.	If separate selector tank(s) regasket and oil leak test.				
	If diverter cylinder requires replacement				
174.	Remove contacts from old cylinder.				
175.	Remove paper based cylinder from bases.				
176.	Machine/clean grooves in bases.				
177.	Supply new fibre glass cylinder.				
178.	Machine cylinder to specification.				
179.	Drill contact holes.				
180.	Fit and secure cylinder to bases according to specification.				
181.	Fit contacts with new seals.				
182.	Seal completed cylinder for oil leak test.				
183.	Oil leak test.				
184.	Repair leaks if required.				
185.	Drain oil.				
	OFF LOAD TAP CHANGER				
186.	Mark all connections.				
187.	Remove off load tap changer.				
188.	Inspect all contacts, spring tensions and shafts.				
189.	Operate to check free movement.				
190.	Refit tap changer.				
191.	Check for correct operation.				
	VAPOUR PHASE				
192.	Pre-dry out active part in a pot or vapour phase.				
193.	Final dry out active part in a pot.				
194.	Purchase virgin oil and polish to Eskom spec.				
195.	Take oil sample for quality, kV and moisture before filling.				
196.	Draw vacuum for 12/24/48hrs after final tanking active part.				
197.	Fill transformer with oil under vacuum.				
198.	Circulate oil for 12/24/48hrs and allow 12/24/48hrs standing time.				
199.	Take oil samples for kV, moisture and DGA.				
200.	Request Test department to perform final and HV test on the transformer.				
201.	Take oil sample again for DGA before Heat run test.				
202.	Take oil sample for DGA after Heat run test.				
203.	Drain oil from transformer and inform tanking bay to remove parts.				

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		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
204.	Pressurize transformer with Nitrogen for welding of top cover (Eskom Tx std).				
205.	Release Nitrogen after welding and fit impact recorder.				
206.	Pressurize transformer with dry air to 25kPa and monitor with pressure log sheet.				
	FINAL TANKING AND DISPTACH				
207.	Final tank active part.				
208.	Bolt main cover or fit temporary clamps and fit all parts (bushings, tap changer, ancillary parts and connect ring type CT's, test for polarity).				
209.	Arrange 380V test on transformer after final tanking (ratio, polarity, impedance and magnetization).				
210.	Hand over the transformer to Vapour phase section to prepare for HV test				
211.	Remove all parts from transformer and blank off after draining.				
212.	Weld top cover and allow 24hrs standing time to check leaks (Eskom Tx std).				
213.	Arrange release of Nitrogen, fitting of impact recorder on transformer and pressurising with dry air.				
214.	Megger test core to earth before and after loading on transport.				
215.	Load transformer and parts for transportation to site.				
	TESTING OF TRANSFORMER				
216.	Perform the following tests with 25% top yoke packed:				
217.A	• Ratio;				
217.B	• Magnetization; and				
217.C	• Megger.				
217.	Perform the following tests with full top yoke;				
218.A	• Ratio and vector group;				
218.B	• Magnetization;				
218.C	• Impedance; and				
218.D	• Megger.				
218.	Perform 380V ratio and vector group tests with temporary connections;				
219.	Perform the following tests with on permanent connections;				
220.A	• Ratio and vector group;				
220.B	• Magnetization;				
220.C	• Impedance;				
220.D	• Resistance; and				
220.E	• Megger.				
220.	Perform Megger test after final dry out.				
221.	Perform final Tan delta test on bushings.				
222.	Perform Speed trace test on tap changer.				

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	Business Management System Transformer and Switchgear Services Engineering Scope of Work	Document Identifier	240-94063834	Rev	1
		Effective Date	12/05/2017		
		Review Date	12/05/2020		
		Page	9 of 10		

		CUSTOMER		ROTEK QC	
		WP	HP	WP	HP
223.	Perform the following tests after final tanking:				
224.A	• Ratio and vector group;				
224.B	• Magnetization;				
224.C	• Impedance;				
224.D	• Resistance;				
224.E	• Megger; and				
224.	CT ratio, polarity and megger.				
225.	Obtain DGA results and request to HV test transformer.				
226.	Conduct the following low voltage tests after oil filling:				
227.A	• Ratio and vector group;				
227.B	• Magnetization;				
227.C	• Impedance;				
227.D	• Resistance;				
227.E	• Megger;				
227.F	• SFRA; and				
227.	Conduct the following HV tests:				
228.A	• Tan delta test;				
228.B	• Separate source;				
228.C	• Induced overvoltage test;				
228.D	• Switching impulse test ($\geq 275\text{kV}$ and SI compliant);				
228.E	• Lightning impulse test;				
228.F	• No load loss;				
228.G	• Load loss;				
228.	Arrange oil samples for DGA after HV test				
229.	Perform megger test prior and after loading on transport.				
	PAINTING OF TRANSFORMER AND PARTS				
230.	Check that all parts are sealed as required before cleaning.				
231.	Tilt or lift tank to enable base painting.				
232.	Clean and abrade surfaces prior to painting.				
233.	Apply coatings to transformer and parts as per client specification.				
234.	And check paint thicknesses.				
235.	Bring tank to upright position again.				
236.	Clean and abrade surfaces prior to painting.				
237.	Apply coatings to transformer and parts as per client specification.				
238.	And check paint thicknesses.				
239.	Remove all protection applied (masking tape, etc.).				

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	Business Management System Transformer and Switchgear Services Engineering Scope of Work	Document Identifier	240-94063834	Rev	1
		Effective Date	12/05/2017		
		Review Date	12/05/2020		
		Page	10 of 10		

REMARKS/COMMENTS	

COMPILED BY		APPROVED BY	
SIGNATURE		SIGNATURE	
DATE		DATE	