

	Report	Technology
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Compiled by	Functional Responsibility	Functional Responsibility
Transformer Engineer	Lead Discipline Engineer	Electrical Engineering Manager
Date:	Date:	Date:

Authorised by

.....

Lead Reviewer

Date: _____

APPENDIX B: REVIEW CHECK SHEET OF WORK LEVEL 1 AND 2 (WHERE APPLICABLE)

Note: Minimum two reviews are required, however depending on the discretion of the lead reviewer both reviews can be performed separate or combined.

Station and Unit	Kusile Power Station
Transformer type (Generator, Unit, Station)	Generator Transformer
Make	SIEMENS Austria
Serial No	1804266
Rating (MVA)	910MVA
Voltage (HV/LV)	420/22kV
Year of manufacture	2018
Oil volume	131 501 litres
Vector group	YNd1
Impedance (%)	16.39% Tap 11
Scope of work	Installation of new transformer

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#	Description of activity	Activity complete (tick ✓)		Comments
		Y	N	
1	Project scope of work and project management			
1.1	Is there a project scope of work available and adequate including the design, manufacture / refurbishment, transportation, installation and commissioning			
1.2	Is there a defined structure for execution of the project in terms of roles and responsibilities, available and approved?			
1.3	Is there an agreed upon installation execution program (<i>timetable implementation</i>)?			
1.4	Is there a PQP with hold points and witness points agreed and approved?			
1.5	Has an appropriate sub-contractor been selected and approved?			
1.6	Was a Pre-site inspection by OEM and station done prior to manufacturing process? (<i>agreement and conclusion incorporated in the scope of work</i>)			
1.7	Has it been checked if the transformer will fit into the bay and have all modification been considered where applicable			
1.8	Was Condition Assessment of the transformer including the auxiliaries done?			
2	Design and manufacture including refurbishment			
2.1	Was Design Review in terms of internal and external performed?			
2.2	Was there any difficulty about order of windings in terms of copper availability and copper supply?			
2.3	Was the insulation of copper strands in terms of quality control, witness and hold points adhered to?			
2.4	Was factory work in terms of the work force / housekeeping hygienic acceptable?			

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2.5	Was refurbishment of parts in terms of process control, assessment report done?			
2.6	Was factory testing, witness, certification done?			
2.7	Was the manufacture PQP and test results accepted by the Client?			
3	Transportation – (refer to 240-56178825) latest revision and relevant checklists for <u>local</u> and <u>overseas</u>)			
3.1	Was dry-air pressure in the main tank and bottles checked prior to shipment from factory to Richards Bay?			
3.2	Was dry-air pressure in the main tank and bottles checked prior to road transport from Richards Bay to the power station?			
3.3	Was core and core clamp earthing meggered before off-loading transformer in Richards Bay			
3.4	Was core and core clamp earthing meggered after loading into the beam wagon and before it leaves Richards Bay?			
3.5	Was core and core clamp earthing meggered before off-loading transformer from the beam wagon at the station?			
3.6	Was core and core clamp earthing meggered after off-loading transformer from the beam wagon at the station?			
3.7	Was dry-air pressure in the main tank and bottles checked during storage at site?			
3.8	Has the client witnessed loading onto the Rotran vehicle?			
3.9	Was a visual inspection done prior to leaving the factory?			
3.10	Was the impact recorder prior to loading checked? Recorder should have been in operation.			
3.11	Was the impact recorder prior to road transport checked? Recorder should have been in operation.			
3.12	Was the impact recorder after offloading checked? Recorder should have been in operation.			

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3.13	Was the impact recorder when transformer is in final position checked? Recorder should be in operation. SFRA test done?			
3.14	Has delivery to site being concluded with a completed transport PQP and an Acceptance / Hand-over document			
4	Installation			
4.1	Was the agreed upon Installation PQP including witness and hold point during installation implemented?			
4.2	Has the system design been approved for all modification associated with the transformer (e.g. Civil work, fire system, protection etc.) <i>Applicable if there is any change on the existing design</i>			
4.3	Has the special method and procedure as required for movement of the transformer during the installation process on site approved? (Station must ensure that there is PQP in place with a hold point(s) for the above). Authorised rigger has to be present during the movement of the transformer.			
4.4	Were maintenance records and inspection tests made available for the equipment used for moving the transformer?			
4.5	Is there a Site Clean Conditions document?			
4.6	Is there ORHVS/PSR permit for Scope of work?			
4.7	Has the oil been tested for acceptance according to 240-56358900 and SANS 555			
4.7.1	On site before filling up or topping the transformer			
4.7.2	Before energizing the transformer			
4.7.3	Has a certificate been provided, certifying the cleanliness of the bags / tankers used site before storing the oil.			
4.8	Is the station retrofitting new bags unto existing units? Has a modification process followed?			
4.9	Were the paper samples or test blocks taken from the transformer and sent to Eskom Laboratory Services for moisture and degree of polymerisation analysis?			

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4.10	Is there a logbook from the plant operator of the Oil Processing Plant available?			
4.11	Has the insulation integrity of HV coil, HV turret, Coil wrappers etc... checked?			
4.12	Has the station got a check sheet for checking the correct torque and locking washers for all bolts and nuts on electrical connections e.g. LV, HV, barrier board, selector and diverter			
4.13	Is there a procedure that was followed, for the HV turret installation and torque of the HV bushings connections?			
4.14	Was a safety induction conducted?			
4.15	Check implementation of housekeeping and safety awareness/precaution.			
4.16	Was cognisance taken of the weather conditions prior to opening the transformer? Is there a contingency plan in case the weather changes? (<i>Various components have to be blanked off and pressurized with dry air while work is stopped e.g. over-night periods or any waiting period while other components are being assembled</i>)			
4.17	Has earthing been done and integrity checked, report submitted before energising?			
4.18	Was OEM's vacuum and filling procedures followed exactly? (<i>When the OEM's requirements are out of line with the Eskom requirements it is important to raise a concern with the Project Engineer and OEM representative</i>) <i>NB: Point from which vacuum is to be drawn should be according to the OEM requirements, confirm the position</i>			
4.19	Was Vacuum Gauge calibrated? (<i>Gauge must be fitted in such a place as to give readings representative of the main tank vacuum not that of the vacuum plant</i>).			
4.20	Was vacuum stable at <0.1 kPa for 48 hours?			
4.21	Was vacuum leak rate test done according to the requirement of <25 Torr/second?			

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4.22	Was All oil plant terminals and hose pipes earthed while filling?			
4.23	Was the Oil entering the transformer between 50-70 °C?			
4.24	Was Oil filling speed at <67 l/min?			
4.25	Was oil circulation done for 48 hrs at 40-70 °C, after the transformer is completely filled?			
4.26	Was cold circulation performed not less than 12hrs?			
4.27	Were all transformer points bled?			
5	Commissioning			
5.1	Was the protection functionality tested and setting checks including CT, relays, trip circuit done?			
5.2	Was a full DC trip test performed?			
5.3	Has the tap changer been run full range?			
5.4	Were all alarms from sensor to panel tested?			
5.5	Was Cooling system components, fail and alarm signals checked (<i>Flow meter indication and failure alarms</i>)			
5.5	Were Oil and winding temperature settings checked and alarm and trip signals tested? (<i>In accordance with OEM settings, in cases where OEM settings are lower than Eskom settings</i>)			
5.6	Were the overload settings on auxiliary motors checked?			
5.7	Were the Buchholz relay alarms and trip functions tested to ensure they operate correctly?			
5.8	Were the conservator Oil level indicators, alarm signals checked?			
5.9	Were the oil levels for the various tanks sections checked including silica gel oil bath?			
5.10	Was the silica gel breathers checked?			
5.11	Were the pressure relief devices settings and trip signals tested including diverter switch and main tank ?			
5.12	Was bushing oil levels checked?			

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5.15	Was all foreign objects from the transformer removed and the bay cleaned?			
5.13	Check and ensure that the bay perimeter walls are in good condition and that oil cannot flow across transformer bays?			
5.14	Check that the drainage system is not blocked			
5.15	Was the tap selectors checked and set as per stations' requirement?			
5.16	Was the maximum temperature needle/knob on the Temperature Instruments reset?			
5.17	Was the cooling system operational i.e. flow, direction checked? The cooling system has to be fully functional prior to permit clearance			
5.18	Was the online condition monitoring equipment/s operational with alarm signals monitored for 24 hours at the control centre?			
5.19	Was the valve status checked and confirmed to be in accordance with the OEM requirements?			
5.20	Was the Tan delta test performed on the bushings according to Doble M400/5000?			
5.21	Was the Tan delta test performed on the transformer windings according to Doble M400/5000?			
5.22	Was SFRA performed on site and compared with OEM results (frequency sweep or Impulse test)?			
5.23	Was FDS performed on site?			
5.24	Was Ductor test performed on the diverter switch?			
5.25	Was the Turn Ratio performed?			
5.26	Was Vector Group test performed?			
5.27	Was the Impedance Test performed?			
5.28	Was the Winding Resistance performed?			
5.29	Was the Excitation test performed?			
5.30	Was the Insulation Resistance test (<i>megger test</i>) between windings and windings and earth performed?			
5.31	Was the Core to Earth insulation resistance measured?			
5.32	Was the CT polarity verified?			

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5.33	Was the PT&M documentation related to protection modifications and settings checked?			
5.34	Was clearance given by PT&M to energise the unit, after test performed and protection checked?			
5.35	Were the sprinkler system nozzles placed back at the original positions?			
5.36	Was the fire protection system commissioned and checked ?			
5.37	Was oil sample for Dielectric Strength (> 70kV/2.5cm) and Moisture (< 10ppm) for energising clearance taken ?			
5.38	Has minimum impregnation time of 96 hours been adhered to with a minimum of 48 hours standing time?			
5.39	Confirm speed test on 20kV and 400kV breakers			
5.40	Was the Generator busbar ducting air pressure tested?			
5.41	Has Holding- and Witness Points been adhered to on all the PQPs by Transformer System Engineer and approved contractor?			
5.42	Is Transformer Book of Life (<i>transformer history</i>) updated with relevant Information?			
5.43	Was oil sample taken on Unit Transformers and results confirmed?			
5.44	Is a Synchronising and Hot commissioning plan in place? Signed and approved?			
5.45	Short Circuit Test performed? Was the transformer gradually loaded e.g. 100MVA at a time with 30 min intervals or as per OEM requirements. (During loading temperature must be monitored, abnormal sounds etc reported.)			

Note: The following items needs to be completed before energising and verified by the Lead Reviewer

Table 1:Pre-Energisation holds points:

<i>Pre-Energisation Hold points</i>	<i>Responsibility</i>	<i>Status</i>
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<i>Items outstanding</i>		

Table 2: Other Requirements – not restricting energisation

	<i>Responsibility</i>	<i>Status</i>	<i>Completion date</i>
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