

Manufacturing Quality Plan- SHUNT REACTOR (765 kV Class)													
BHARAT HEAVY ELECTRICALS LIMITED - PIPLANI BHOPAL													
Customer: Power Grid Corporation of India LTD.				VENDOR CODE		23E2D2		MQP No. : SRB 112		Valid from : 28.10.2019			
				ITEM :		SHUNT REACTOR		Rev.No. : P0		Valid upto : 27.10.2020			
						765 KV CLASS		Date : 26/10/2019					
Section : RAW MATERIAL INSPECTION													
S.No.	Components / Operations & Description of Test	Type of Check	Quantum of Check / Sampling with basis	Reference Document for Testing	Acceptance Norms	Format of Record	Applicable Codes						Remarks
							1	2	3	4	5	6	
1.3.1	Visual check & Measurement of thickness	Measurement & Visual.	One sample per size per lot	BHEL Specn. AA 21111 TRE 218 POWERGRID Specn.	BHEL Specn. AA 21111 TRE 218 POWERGRID Specn.	CMTC	B	K	P	W	N	DO	
1.3.2	Checks for -			DO	DO								
1.3.2.1	Substance	Physical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.2	Density	Physical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.3	Moisture content	Physical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.4	Water absorption (Capillary rise)	Physical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.5	Air Permeability	Physical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.6	Tensile index	Mechanical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.7	Tear index	Mechanical	One sample per size per lot	BHEL Specification & AA21111	BHEL Specification & AA21111	CMTC	B	K	P	W	N	DO	
1.3.2.8	Electric strength in air	Electrical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.9	Ash Content	Chemical	One sample per size per lot	BHEL Specification & AA21111	BHEL Specification & AA21111	CMTC	B	K	P	W	N	DO	
1.3.2.10	Conductivity of 5% aqueous extract	Chemical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.11	PH of 5 % aqueous extract	Chemical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.3.2.12	Heat stability	Mechanical	DO	DO	DO	CMTC	B	K	P	W	N	DO	
1.4	CRGO STEEL					CMTC	B	K	P	W	N	DO	
1.4.1	INSPECTION OF PRIME CRGO COIL FOR VERIFICATION OF MANUFACTURERS IDENTIFICATION SLIP/ UNIQUE NUMBERING INSIDE PRIME CRGO ROLL & VISUAL INSPECTION OF PRIME CRGO	visual	100%	BHEL specn. /POWERGRID Specn./CRGO check list dtd. 07.06.2019/IS 3024 AA10905 /BP 10987 / BP 10988 / &BP 10984	BHEL specn./ POWERGRID Specn./CRGO check list dtd. 07.06.2019/IS 3024 AA10905 /BP 10987 / BP 10988 / &BP 10984	EMTC	B	K	U	W / Z	Y	CIP as per latest CRGO check list dtd. 07.06.2019 with amendment CC/QA&I/CRGO/Rev-01dtd. 20.11.2018	
1.4.2	Visual & Dimensional check for roll width & thickness	Measurement & Visual.	One sample per lot	DO	DO	CMTC & EMTC	B	K	U	W / Z	Y	DO....	
1.4.3	Checks for -	Testing	One Sample Per Lot	DO	DO								
1.4.3.1	Specific core loss	Electrical	DO	DO	As Per Specifications	TPL TC	D	L	U/V	W / Z	Y	CIP as per latest CRGO check list dtd. 07.06.2019 with amendment CC/QA&I/CRGO/Rev-01dtd. 20.11.2018 Testing will be done at Third party lab.	
1.4.3.2	Stacking factor	Mechanical	DO	DO	94.5.0% min	TPL TC	D	L	U/V	W / Z	Y	DO	
1.4.3.3	Surface insulation resistivity	Electrical	DO	DO	Av. Value 10 ohm cm ² min Individual value 5 ohm cm ² min.	TPL TC	D	L	U/V	W / Z	Y	DO	
1.4.3.4	Ageing test	Electrical	DO	DO	4% max increase in specific total loss	TPL TC	D	L	U/V	W / Z	Y	DO	
1.4.3.5	Magnetic Permeability	Electrical	DO	DO	As Per Specifications	TPL TC	D	L	U/V	W / Z	Y	DO	



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1.4.3.6	Ductility	Mechanical	DO	DO	Completion of one 160° bend without fracture	TPL TC	D	L	U/V	W / Z		Y	DO
1.5 A	PRECOMPRESSED PRESSBOARD	Note: BHEL shall ensure that insulation material tested at third party lab, random samples duly selected and witnessed by POWERGRID representative once in year											
1.5 A.1	Visual & dimensional check for thickness	Measurement & Visual.	IS 2500 Pt 1 AQL = 4% Inspection level 1 Lot Sample Size 2 to 90 3 91 to 280 13	BHEL specn. AA 21108 / TRE 184 or AA 21109 / TRE 185 POWERGRID Specn./IEC 60641	No surface defects & dimensions within tolerance.	CMTC	A/B	J/K	S/P	W		N	CIP on first lot of insulation item for each Reactor package on pressboards for review of : Mfr's TCs, six monthly TPL sample test reports and to verify traceability. Balance record review on surveillance basis.
1.5 A.2	Checks for		One sample of each size per lot	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.3	Density	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.4	Oil absorption	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.5	Moisture content	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.6	Shrinkage in air	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.7	Cohesion between plies	Mechanical	One sample of each size per lot	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.8	Tensile strength	Mechanical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.9	Elongation	Mechanical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.10	Compressibility in air	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.11	Electric strength	Electrical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.12	Ash content	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.13	pH value	Physical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 A.14	Conductivity of aqueous extract	Chemical	DO	DO	IEC 60641	CMTC	B	K	P/U	W / Z		N	DO
1.5 B	Moulded Components (Raw material)	Note: BHEL shall ensure that basic raw material for moulded components shall be jointly sealed random sample by insulation item manufacturer and POWERGRID representative at their works and send to TPL lab for all tests as per relevant IEC requirement once in year											
1.5 B.1	Visual Checks	Visual	One sample per lot	As per IEC60641-3-1, /Relevant standard/As per EM drg	No surface defect	CMTC	B	K	P	W/Z		Y	CIP on first lot of moulding component for each Transformer package for review of : Mfr's TCs



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Section : IN PROCESS INSPECTION				ITEM :	SHUNT REACTOR	Rev.No. : P0	Valid upto : 27.10.2020						
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							1	2	3	4	5	6	
2.1	MAGNETIC CORE												
A	Cut Lamination												
2.1.1	Check for thickness	Measurement	Each Reactor	BHEL drg. POWERGRID Specn./CRGO checklist dtd. 07.06.2019	BHEL drg. POWERGRID Specn./CRGO checklist dtd. 07.06.2019	EMTC	A/B	J/K	S	W/Z		Y	CIP as per CRGO checklist dtd. 07.06.2019
2.1.2	Check for burr	Measurement & Visual	DO	DO	DO	EMTC	A/B	J/K	U	W/Z		Y	
2.1.3	Check for bow , Edge camber & Waviness	Visual & measurement	DO	DO	DO	EMTC	A/B	J/K	S	W/Z		Y	
B	Core building												
2.1.4	CRGO sheet selection during core building & assy for testing of stacking factor, Magnetic polarization, specific core loss, Surface insulation resistivity,ductility & aging test during core stacking stage	Testing	sampling as per CRGO PGCIL check list	BHEL drg., POWERGRID Specn./CRGO checklist dtd. 07.06.2019 along with doc: CC/QA&I/CRGO/Rev01 dated 20.11.2018	BHEL drg., POWERGRID Specn./CRGO checklist dtd. 07.06.2019 along with doc: CC/QA&I/CRGO/Rev01 dated 20.11.2018	TPL TC	D	L	U/V	W/Z		Y	CIP for CRGO during core building as per checklist. Testing will be done at third party lab.
2.1.5	Check for core building & assy	Testing	100%	BHEL drg. POWERGRID Specn.	BHEL drg. POWERGRID Specn.		D	L	S	W/Z		Y	Record review for first unit of each contract
2.1.6	Insulation test at 3.5 KV DC for 1 minute	Testing	DO	BHEL Std. TR 10129 I PGCIL Specn.	BHEL Std. TR 10129 I PGCIL Specn.	EMTC	A	J	S	W/Z		Y	Record review for first unit of each contract & rest on surveillance basis
2.2	WINDING												
2.2.1	Brazing procedure &. Brazer qualification	Review	100%	BHEL Std. BP 0631199, PGCIL SPEC.& BHEL BRAZING PROCEDURE	Powergrid approved Brazers	EMTC	B	K	Q	W/Z		N	Review of Powergrid approval during POWERGRID inspection
2.2.2	Physical checking of drum label, surface finish, thickness, width of bare conductor & covered thickness of wdg conductor	Measurement & Visual	IS 2500 Pt - 1 AQL = 4% Inspection Level 1 Lot Sample size size 2 to 90 5 91 to 280 13	BHEL spec./ POWERGRID Specn	BHEL spec./ POWERGRID Specn	EMTC / Verification of incoming checklist	A	J	S	W/Z		N	Record review for first unit of each contract & rest on surveillance basis
2.2.3	Checking for Coil Mfg. -lead position, lead length, cross over /transposition location, ID, OD, Lateral Depth of Wdg. , No. of turns/ sections, lead anchoring, spacer block alignment	Measure-ment & Visual	100%	BHEL Elec. spec./ BHEL drg.,	BHEL Elec. spec./ BHEL drg.,	EMTC	A	J	S	W/Z		N	Record review for first unit of each contract & rest on surveillance basis

