11kV CB CONTROL

SUPERVISORY ON Rx (GOOSE) → NOT → HMI CONTROL ON

11kV CB CLOSE REQUEST (HMI) + HMI CONTROL ON → AND → HMI CLOSE COMMAND (HMI)
11kV CB CLOSE REQUEST (S/V) + SUPERVISORY ON Rx (GOOSE) → AND → SUPERVISORY CLOSE COMMAND (HMI)
ARC REQUEST + ARC ON SELECTED → AND → ARC CLOSE COMMAND (HMI)
→ OR → COMMAND CLOSE

11kV CB OPEN REQUEST (HMI) + HMI CONTROL ON → AND → HMI OPEN COMMAND (HMI)
11kV CB OPEN REQUEST (S/V) + SUPERVISORY ON Rx (GOOSE) → AND → SUPERVISORY OPEN COMMAND (HMI)
→ OR → COMMAND OPEN

HV MASTER TRIP

THE HV MTR LOGIC IS TO BE CONTAINED IN RELAY 1. ALL PROTECTION FUNCTIONS CONTAINED IN RELAY 2 MUST BE TRANSMITTED TO RELAY 1 BY MEANS OF GOOSE MESSAGES

Phase Segregated Indication (LED HMI S/V):
- TRANSFORMER DIFFERENTIAL TRIP
- LV RESTRICTED EARTH FAULT (LED HMI S/V)
- HV RESTRICTED EARTH FAULT (LED HMI S/V)
- STANDBY EARTH FAULT STAGE 2 (LED HMI S/V)
- ARC PROTECTION TRIP (LED HMI S/V)
- TRANSFORMER BUCHHOLTZ TRIP (LED HMI S/V)
- TAP CHANGER PRESSURE TRIP (LED HMI S/V)
- TRANSFORMER OVER PRESSURE TRIP (LED HMI S/V)
- NER OVER PRESSURE/ OIL TEMP TRIP (LED HMI S/V)

→ OR → HV MTR INITIATE → LATCH (S, R) → HV MTR (LED HMI S/V) → HV MTR Tx (GOOSE)

SUPERVISORY HV MTR RESET (S/V) + RESET (HMI) → OR → R

LV MASTER TRIP

THE LV MTR LOGIC IS TO BE CONTAINED IN RELAY 1. ALL PROTECTION FUNCTIONS CONTAINED IN RELAY 2 MUST BE TRANSMITTED TO RELAY 1 BY MEANS OF GOOSE MESSAGES

- WINDING TEMP TRIP (LED HMI S/V)
- OIL TEMP TRIP (LED HMI S/V)
- BANK INTERTRIP Rx (LED HMI S/V GOOSE)
- BANK INTERTRIP RECEIVE (LED HMI S/V)
- ARC LOCKOUT (LED HMI S/V)
- OVER CURRENT TRIP (Phase Segregated Indication LED HMI S/V)
- STANDBY EARTH FAULT STAGE 1 (LED HMI S/V)
- 132kV INTERTRIP RECEIVE Rx (GOOSE)
- DIRECTIONAL OVER CURRENT TRIP (Phase Segregated Indication LED HMI S/V) + 132kV DIFF TRIP Rx (GOOSE) → OR → AND
- ARC OFF SELECTED → DOC LV MTR

Required for intertrip of LV master trip of this transformer from future transformer to be fed by same 132kV circuit.

→ OR → LV MTR INITIATE → LATCH (S, R) → LV MTR (LED HMI S/V)

RESET (HMI) + SUPERVISORY LV MTR RESET (S/V) → OR → R

11kV CB TRIPS & INTERLOCKS

HV MTR + LV MTR + DIRECTIONAL OVER CURRENT TRIP → OR → 11kV CB PROTECTION TRIP (RELAY 1)

ALL PROTECTION FUNCTIONS CONTAINED IN RELAY 2 WHICH OPERATE LV MTR IN RELAY 1
→ OR → 11kV CB PROTECTION TRIP (RELAY 2)

HV MTR → NOT → NO HV MTR
LV MTR → NOT → NO LV MTR
TRF ISOL CLOSED Rx (GOOSE)
→ AND → 11kV CB CLOSE INTERLOCK

132kV CB TRIPS

HV MTR + TRANSFORMER ISOLATOR OPEN (RELAY 1) → NOT → TRANSFORMER ISOLATOR NOT OPEN (RELAY 1) → AND → 132kV CB PROTECTION TRIP (RELAY 1)

ALL PROTECTION FUNCTIONS CONTAINED IN RELAY 2 WHICH OPERATE HV MTR IN RELAY 1
→ OR → AND → 132kV CB PROTECTION TRIP (RELAY 2)

TRANSFORMER ISOLATOR OPEN (RELAY 2) → NOT → TRANSFORMER ISOLATOR NOT OPEN (RELAY 2)
132kV CB PROTECTION TRIP (RELAY 1) → BANK INTERTRIP

Required for intertrip of LV master trip of future transformer to be fed by same 132kV circuit

AUTO RE-CLOSING

ARC ON PB + ARC ON REQUEST (HMI) + ARC ON REQUEST (S/V) → OR → S
ARC OFF PB + ARC OFF REQUEST (HMI) + ARC OFF REQUEST (S/V) → OR → R
LATCH → ARC ON SELECTED (HMI S/V) → NOT → ARC OFF SELECTED (HMI S/V)

ARC ON SELECTED → ARC ON INDICATION

ARC ON SELECTED + DIRECTIONAL OVER CURRENT TRIP + 132kV TRF TRIP Rx (GOOSE) → OR + 11kV CB CLOSED → AND → ARC INITIATE → LATCH (S, R) → ARC IN PROGRESS (LED to be non-latching in this instance: LED HMI S/V)
ARC RESET → R

ARC IN PROGRESS → TIMER (Pickup Delay 0-30 Sec Self Reset) → DEAD TIME OVER
VOLTAGE HEALTHY
→ AND → ARC REQUEST

ARC IN PROGRESS → TIMER (Pickup Delay 0-60 Sec Self Reset) → ARC RESET

ARC INITIATE + ARC IN PROGRESS → TIMER (Pickup Delay 1 Sec Self Reset) → AND → ARC LOCKOUT

TAP CHANGE CONTROL

TAP CHANGE SUPERVISORY ON REQUEST (S/V) + TAP CHANGE SUPERVISORY OFF REQUEST (S/V) → LATCH (S, R) → TAP CHANGE SUPERVISORY TAKE OVER (LED to be non-latching in this instance: LED HMI S/V)

TAP CHANGE SUPERVISORY TAKE OVER → NOT → TAP CHANGE SUPERVISORY OFF

TAP CHANGE AUTO REQUEST (HMI) + TAP CHANGE AUTO PB → OR
TAP CHANGE MANUAL REQUEST (HMI) + TAP CHANGE MANUAL PB → OR
LATCH → TAP CHANGE AUTO MODE (HMI S/V)

TAP CHANGE AUTO MODE → TAP CHANGE AUTO LED

TAP CHANGE AUTO MODE → NOT → TAP CHANGE MANUAL MODE

RAISE PUSH BUTTON + RAISE REQUEST (HMI) + TAP CHANGE MANUAL MODE → AND → MANUAL RAISE REQUEST
*VOLTAGE REGULATOR RAISE REQUEST + TAP CHANGE AUTO MODE → AND → AUTO RAISE REQUEST
→ OR → NON SUPERVISORY RAISE REQUEST

NON SUPERVISORY RAISE REQUEST + TAP CHANGE SUPERVISORY OFF → AND → NON SUPERVISORY RAISE
RAISE REQUEST (S/V) + TAP CHANGE SUPERVISORY TAKE OVER → AND → SUPERVISORY RAISE
→ OR → RAISE

NOTE:
Tap Change parallel operation (circulating current scheme) is to automatically detect parallel transformers by monitoring status of Bus Coupler and Bus Sections and racking position and status of transformer 11kV circuit breakers. This is to be implimented either by LCA Goose messaging between aproprate relays or by means of wiring from status contacts on switchgear.
Parallel scheme will raise and lower taps by means of "VOLTAGE REGULATOR RAISE REQUEST" and "VOLTAGE REGULATOR LOWER REQUEST".

LOWER PUSH BUTTON + LOWER REQUEST (HMI) + TAP CHANGE MANUAL MODE → AND → MANUAL LOWER REQUEST
*VOLTAGE REGULATOR LOWER REQUEST + TAP CHANGE AUTO MODE → AND → AUTO LOWER REQUEST
→ OR → NON SUPERVISORY LOWER REQUEST

NON SUPERVISORY LOWER REQUEST + TAP CHANGE SUPERVISORY OFF → AND → NON SUPERVISORY LOWER
LOWER REQUEST (S/V) + TAP CHANGE SUPERVISORY TAKE OVER → AND → SUPERVISORY LOWER
→ OR → LOWER

TAP CHANGE UNDER VOLTAGE + TAP CHANGE OVER CURRENT → OR → TAP CHANGE BLOCK → NOT → TAP CHANGE INTERLOCK

TAP CHANGE IN PROGRESS (LED to be non-latching in this instance: LED HMI S/V) → TIMER (Pickup Delay 0-30 Sec Self Reset) → TAP CHANGE TIME OUT ALARM (LED HMI S/V)

SEQUENTIAL SWITCHING

LV METER + ARC PROTECTION TRIP + STANDBY EARTH FAULT STAGE 2 → OR → SEQUENTIAL SWITCHING BLOCKED

TRANSFORMER DIFFERENTIAL TRIP + LV RESTRICTED EARTH FAULT + HV RESTRICTED EARTH FAULT + TRANSFORMER BUCHHOLTZ TRIP + TAP CHANGER PRESSURE TRIP + TRANSFORMER OVER PRESSURE TRIP + NER OVER PRESSURE/ OIL TEMP TRIP → OR → TIMER (Pickup Delay 3 Sec Self Reset) → SEQUENTIAL SWITCHING INITIATE (LED HMI S/V)

UPPER DISCONNECTOR CLOSED + CABLE EARTH SWITCH OPEN → AND → BUSBAR 1 SERVICE POSITION
BUSBAR 1 SERVICE POSITION + 11kV CB CLOSED → AND → CB CLOSED ON BB 1 Tx (GOOSE)
LOWER DISCONNECTOR CLOSED + CABLE EARTH SWITCH OPEN → AND → BUSBAR 2 SERVICE POSITION
BUSBAR 2 SERVICE POSITION + 11kV CB CLOSED → AND → CB CLOSED ON BB 2 Tx (GOOSE)
BUSBAR 1 SERVICE POSITION + SEQUENTIAL SWITCH INITIATE → AND → BB1 SEQ SW INITIATE Tx (GOOSE)
BUSBAR 2 SERVICE POSITION + SEQUENTIAL SWITCHING INITIATE → AND → BB2 SEQ SW INITIATE Tx (GOOSE)

ALARMS & INDICATION

TRIP CIRCUIT SUPERVISION (HMI S/V) → AND
LOWER DISCONNECTOR CLOSED (HMI S/V) + UPPER DISCONNECTOR CLOSED (HMI S/V) → OR → SERVICE POSITION → AND → TIMER (Pickup Delay 1 Sec Self Reset) → TCS ALARM (LED HMI S/V)

CABLE EARTH SWITCH CLOSED (HMI S/V)
CABLE EARTH SWITCH OPEN (HMI S/V)
11kV CB CLOSED (HMI S/V) → TRF 11kV CB CLOSED Tx (GOOSE)
11kV CB OPEN (HMI S/V)
LOWER DISCONNECTOR OPEN (HMI S/V)
UPPER DISCONNECTOR OPEN (HMI S/V)
TRANSFORMER ISOLATOR OPEN (RELAY 1) (HMI S/V) → TRF ISOL OPEN Tx (GOOSE)
TAP POSITION BCD BIT 1 (HMI S/V)
TAP POSITION BCD BIT 2 (HMI S/V)
TAP POSITION BCD BIT 3 (HMI S/V)
TAP POSITION BCD BIT 4 (HMI S/V)
TAP POSITION BCD BIT 5 (HMI S/V)

TRANSFORMER BUCHOLTZ ALARM (LED HMI S/V)
NER ALARM (LED HMI S/V)
WINDING TEMP ALARM (LED HMI S/V)
OIL TEMP ALARM (LED HMI S/V)
TAP CHANGE OIL LEVEL ALARM (LED HMI S/V)
TRANSFORMER OIL LEVEL ALARM (LED HMI S/V)
COOLER FAIL ALARM (LED HMI S/V)
TAP CHANGE AC FAIL (LED HMI S/V)
TCS ALARM
TAP CHANGE TIME OUT ALARM
HV MTR
LV MTR
UNDER VOLTAGE (LED HMI S/V)
CB GAS LOW (LED HMI S/V)
CB GAS LOCKOUT (LED HMI S/V)
CB SPRING CHARGE TIME (LED HMI S/V)
RELAY WATCHDOGS (LED HMI S/V)
UNDER VOLTAGE (LED HMI S/V) → UNDER VOLTAGE Tx (GOOSE)
→ OR → GENERAL ALARM Tx (GOOSE)

RED PHASE CURRENT (HMI S/V)
WHITE PHASE CURRENT (HMI S/V)
BLUE PHASE CURRENT (HMI S/V)
RED-WHITE VOLTAGE (HMI S/V)
WHITE-BLUE VOLTAGE (HMI S/V)
RED-BLUE VOLTAGE (HMI S/V)
APPARENT POWER (HMI S/V)
REAL POWER (HMI S/V)
REACTIVE POWER (HMI S/V)
WINDING TEMPERATURE (HMI S/V)
OIL TEMPERATURE (HMI S/V)
VOLTAGE SYMMETRY (LED HMI S/V)
CURRENT SYMMETRY (LED HMI S/V)
LOCAL POSITION (11kV CB) (HMI S/V)

LEGEND

	DIGITAL VARIABLE
	INHERENT FUNCTION OF RELAY
	CONTACT OUTPUT STATE
	DIGITAL INPUT STATE
	TRIP CIRCUIT SUPERVISION
S/V	DIGITAL VARIABLE CONTROLLED FROM SCADA GATEWAY
HMI	DIGITAL VARIABLE CONTROLLED FROM HMI
GOOSE	DIGITAL VARIABLE STATE TRANSMITTED/RECEIVED TO/FROM REMOTE RELAY
LED	ASSOCIATED VARIABLE COPIED TO LATCHING LED ON FACE OF RELAY
HMI	ASSOCIATED VARIABLE REPORTED TO HMI FOR MIMIC DISPLAY AND EVENT RECORD
HMI-E	ASSOCIATED VARIABLE REPORTED TO HMI FOR EVENT RECORD ONLY
S/V	ASSOCIATED VARIABLE COPIED TO SCADA GATEWAY
	WHERE INHERENT FUNCTIONIS IN NON IEC 61850 RELAY, VARIABLE IS TO BE WIRED TO AN INPUT ON OTHER RELAY

NOTE:
The purpose of this drawing is to clarify the requirements ot the associated contract enquiry specification and the issue of this with the specification does not absolve the successful contractor from his normal responsibility to provide a satisfactory scheme or submit drawings of systems proposed for approval by the Engineer.

DRAWN	JRL				
DATE	2015-08-19				
CHIEF DRAUGHTPERSON		REFERENCE DRAWINGS:	REVISIONS:	BY:	DATE:
PLANNING OFFICER		**ETHEKWINI ELECTRICITY**			
PROTECTION ENGINEER		PROPOSED 132kV SUBSTATION WITH COMBINED 132kV FEEDERS & TRANSFORMER FEEDERS			
PLANNING ENGINEER		132/11kV TRANSFORMER PROTECTION & CONTROL LOGIC SCHEMATIC(FIXED PATTERN)			
PROJECTS ENGINEER					
PLAN./PROJ. MANAGER					
APPROVED B.DHROOMAND DEPUTY HEAD: H.V. OPERATIONS		SCALE: NTS	DRAWING NUMBER: TD 75,1		REV: