Appendix A – Plant Assembly Form

Site Date: _____ Logistics ID _____

Project Title: Plant to be used:

_____ HV Switchgear _____

_____ Transformer _____

_____ LV Equipment _____

_____ Details of any special assembly requirements:

Project No: _____

Proposed S/S name: _____ S/S No: _____

CABLE SIZES/FUSE SIZES/LABELS

	CIRCUIT	CABLE SIZE	FUSE SIZE	LABEL
HV	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			
LV	1			
	2			
	3			
	4			
	5			
	6			
	7			
	8			

LABELS FOR EXISTING SUBSTATIONS

Note: Modern SW/GR label sizes are known, please indicate sizes of older units

S/S NAME	MAKE/TYPE OF SW/GR	EXISTING LABEL	PROPOSED LABEL

Signed: _____ Tel: _____

Print: _____ Date: _____

Appendix B – Quality Control Checklist

Contractor Details

Company name		Preparation/Assembly location	
Contractor reference			

Plant Details

Transformer

Manufacturer's name		Type	
Serial number		Rating	
Cable connected or unit?			

HV Switchgear

Manufacturer's name		Type	
Serial number		Metering Unit Serial No	

LV Fuse cabinet

Manufacturer's name		Type	
Serial number			

Destination Details

Substation name		Substation number (if known)	

(Continued)

Quality Checks

Receipt

Job details recorded?		Initial inspection complete?	

Transformer

Drain valve operates?		HV connections complete?	
Oil level correct?		Lid fixings secure?	
LV connections complete?		Tap changer operates, and is locked off?	
Earth connections complete?			

HV Switchgear

Interlock check OK?		Oil tank examined?	
Oil tank cleaned?		Oil level correct?	
Oil seals fitted correctly?		Covers secured?	
HV trip test complete?		Fuse(s) fitted?	
HV connections complete?		Earth connections complete?	
EFI/CT fitted and Tested?		Metering Unit fitted?	
Destination Labels fitted?		X56 locks fitted?	

LV Fuse Cabinet

Cable cleats drilled?		LV fuses prepared?	
Ways/test sockets complete?		Stand-off pins positioned?	
LV connections complete?		A4/2 additional lock supplied?	
Termination fixings supplied?		MDI set?	

Metering CT & VT Testing

Commissioning complete?		CP510 forms completed?	
CP510 forms emailed to Data Management?			

Ensure micro-ohmmeter readings are within range given in procedure (for cabinet type) and record readings in μΩ (below):

Way number:							
R							
Y							
B							
N							

Cabinet with ganged ways

Ganged R to cable conn.							
Ganged Y to cable conn.							
Ganged B to cable conn.							

Destination labels fitted?		A4/2 locks fitted?	

Final Assembly

HV connections made?		LV connections made?	
Final earth connections made?		Destination labels fitted?	
S/S nameplates supplied?		Locked off?	
Danger of Death labels fitted?		Free from oil leaks?	
SF_6 pressure OK?		Assembly secure and stable?	
Cleaned?		Scratches touched up?	
'Filled with oil' label fitted		'Tested' label, Transformer Test Cert and Protection Test Results attached	

Additional Comment?

Name Signature Date

Appendix C – Protection Test Result Sheets

NOTE: The appropriate MICOM P116 SET Files for Depot Testing are available from the SP Electricity North West Library under the files named P116 Test 200, P116 Test 400 and P116 Test 800.

The SET files named Default 200 & 400 are the files to be uploaded to the relay for despatch to site, these set files have minimum settings applied. The correct site settings shall be applied during the commissioning process as per ES320.

The appropriate Set Files for the Lucy Sabre VRN2a Argus 7SR45 relay are available on the SP Electricity North West Library under the files named 7SR45 Test 100 and 200.

The SET files for the Argus 7SR45 relay in Lucy Sabre VRN2a for site commissioning is named 7SR45 Prot ENW. The correct site settings shall be applied during the commissioning process as per ES320.

C1 – TLF Protection Pre-Assembly Commissioning Sheet

Manufacturer / Type _____/_____

Serial Number: _____

CT Ratio: _____ CT Serial Numbers: R: _____

Y: _____

AC Wiring Insulation Resistance: _____Ω B: _____

DC Resistance Tests

CT		RESISTANCE MEASURED (Ω)	RESISTANCE OF MEASURING CIRCUIT (Ω)	TRUE RESISTANCE (Ω)
100/5 Ratio	R (L1)			
	Y (L2)			
	B (L3)			
50/5 Ratio	R (L1)			
	Y (L2)			
	B (L3)			

CT Magnetisation Characteristics

Secondary Current			50 mA	100mA	200mA	300mA	400mA	500mA	600mA	750mA	1A	1.5A	2A
Sec Volts	100/5 Ratio	R (L1)											
		Y (L2)											
		B (L3)											
	50/5 Ratio	R (L1)											
		Y (L2)											
		B (L3)											

NOTE: For all Schneider RMU's - CT Magnetisation Characteristic testing the maximum range used is 600mA.

CT Ratio & Polarity

		R-Y (L1-L2)			R-B (L1-L3)	
Ratio	Primary Current (A)	Secondary Current R (L1) CT (A)	Secondary Current Y (L2) CT (A)	Spill Current (mA)	Secondary Current B (L3) CT (A)	Spill Current (mA)
100/5	100					
50/5	50					

Primary Injection Overcurrent Test CT Ratio _____ (use service setting, if known)

PRIMARY CONNECTIONS	VOLT DROP AT 8A (V)		CURRENT TO TRIP (A)	EARTH FAULT SPILL AT 100A (MA)
	R (L1)	B (L3)		
R-Y (L1-L2)				
R-B (L1-L3)				
Y-B (L2-L3)				

Primary Injection Earth Fault Test CT Ratio _____ (use service setting, if known)

PRIMARY CONNECTIONS	VOLT DROP AT 16A (V)	CURRENT TO TRIP (A)
R-R (L1-L1)		
Y-Y(L2-L2)		
B-B(L3-L3)		

Voltage Presence Indication System (VPIS) Tests (if fitted)

NOTE: Sheet assumes RMU, if extensible switch make entries for (a) – (c) only

(a) 250V ac applied to L1 and Earth on Right Hand Switch Bushings

	LHS VPIS TEST POINTS			RHS VPIS TEST POINTS		
VPIS Points	**L1-Earth**	**L2-Earth**	**L3-Earth**	**L1-Earth**	**L2-Earth**	**L3-Earth**
Voltage (V)						

(b) 250V ac applied to L2 and Earth on Right Hand Switch Bushings

	LHS VPIS TEST POINTS			RHS VPIS TEST POINTS		
VPIS Points	**L1-Earth**	**L2-Earth**	**L3-Earth**	**L1-Earth**	**L2-Earth**	**L3-Earth**
Voltage (V)						

(c) 250V ac applied to L3 and Earth on Right Hand Switch Bushings

	LHS VPIS TEST POINTS			RHS VPIS TEST POINTS		
VPIS Points	**L1-Earth**	**L2-Earth**	**L3-Earth**	**L1-Earth**	**L2-Earth**	**L3-Earth**
Voltage (V)						

(d) 250V ac applied to L1 and Earth on Left Hand Switch Bushings

	LHS VPIS TEST POINTS			RHS VPIS TEST POINTS		
VPIS Points	**L1-Earth**	**L2-Earth**	**L3-Earth**	**L1-Earth**	**L2-Earth**	**L3-Earth**
Voltage (V)						

(e) 250V ac applied to L2 and Earth on Left Hand Switch Bushings

	LHS VPIS TEST POINTS			RHS VPIS TEST POINTS		
VPIS Points	**L1-Earth**	**L2-Earth**	**L3-Earth**	**L1-Earth**	**L2-Earth**	**L3-Earth**
Voltage (V)						

(f) 250V ac applied to L3 and Earth on Left Hand Switch Bushings

	LHS VPIS TEST POINTS			RHS VPIS TEST POINTS		
VPIS Points	**L1-Earth**	**L2-Earth**	**L3-Earth**	**L1-Earth**	**L2-Earth**	**L3-Earth**
Voltage (V)						

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C2 – Relay Protection Pre-Assembly Commissioning Sheet (excluding RN2D / RN6D with Micom P116 & VRN2a with 7SR45)

Manufacturer / Type _____/_____

Serial Number: _____

CT Ratio: _____ CT Serial Numbers: R: _____

Y: _____

AC Wiring Insulation Resistance: _____Ω B: _____

DC Resistance Tests

CT	RESISTANCE MEASURED (Ω)	RESISTANCE OF MEASURING CIRCUIT (Ω)	TRUE RESISTANCE (Ω)
R (L1)			
Y (L2)			
B (L3)			

CT Polarity Check (Flick Test)

CT	POLARITY CHECKED
R (L1)	
Y (L2)	
B (L3)	

Primary Injection Tests

PRIMARY CURRENT (A)	R-Y (L1-L2)			R-B (L1-L3)	
	Secondary Current R (L1) CT (A)	Secondary Current Y (L2) CT (A)	Spill Current (mA)	Secondary Current B (L3) CT (A)	Spill Current (mA)

Ammeter Check

Primary Current (A): _____ Ammeter Reading (A): _____

CT Magnetisation Characteristics

SECONDARY CURRENT		1MA	4MA	8MA	10MA	15MA	30MA	100MA
Sec Volts	R (L1)							
	Y (L2)							
	B (L3)							

CT Star Point Earth Link Resistance:_____Ω

Overcurrent Minimum Operation

PRIMARY CURRENT SETTING (A)	SECONDARY CURRENT AT MINIMUM OPERATION (A)		
	R-Y (L1-L2)	R-B (L1-L3)	Y-B (L2-L3)

Overcurrent Timing Test

CURRENT MULTIPLE	TIME MULTIPLIER	INJECTED CURRENT (A)	OPERATING TIME (S)		
			R-Y (L1-L2)	R-B (L1-L3)	Y-B (L2-L3)
2X					
4X					
High Set					

Earth Fault Minimum Operation

PRIMARY CURRENT SETTING (A)	SECONDARY CURRENT AT MINIMUM OPERATION (A)		
	R-E (L1-E)	Y-E (L2-E)	B-E (L3-E)

Earth Fault Timing Test

CURRENT MULTIPLE	TIME MULTIPLIER	INJECTED CURRENT (A)	OPERATING TIME (S)
2X			
4X			
High Set			

Relay Left Set At:

ELEMENT	NORMAL SETTING			HIGH SET SETTINGS	
	Current	Curve	Time Multiplier	Current Multiple	Time Multiplier
Overcurrent					
Earth Fault					

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C3 – Relay Protection Pre-Assembly Commissioning Sheet – RN2D

Site			**Circuit**		
Unit Type	Schneider RN2D-M-N4/21		**Relay Type**	Micom P116A1N2N14121111N	
Unit Serial No.			**Relay Serial No.**		
CT Ratio	200/1		**Prot CT Serial No.**	**L1.**	
				L2.	
				L3.	

Insulation Tests @1kV

CT IR Test @ 1kV:_____Ω

DC Resistance Tests

	MEASURED VALUE Ω	MEASURING CIRCUIT Ω	TRUE VALUE Ω
CT Earth Link			
L1 CT C11-C70			
L2 CT C31-C70			
L3 CT C51-C70			

Magnetisation Characteristics

	1mA	2mA	5mA	10mA	25mA	50mA	100mA
L1 CT C11-C70							
L2 CT C31-C70							
L3 CT C51-C70							

Ratio Check

PHASE	PRIMARY CURRENT	SECONDARY CURRENT				RELAY CURRENT DISPLAY			
		C12	C32	C52	C71	IA	IB	IC	IN
L1-L2	50								
L1-L3	50								
L1-E	50								

Relay Minimum Operation

ELEMENT	MIN OP CURRENT
IA Start	
IB Start	
IC Start	
IN_1 Start	

Relay Timing Tests

ELEMENT	INJECTION POINT	SECONDARY CURRENT	EXPECTED TIME (S)	ACTUAL TIME (S)
L1-L2	C11-C31	0.50	10.03	
L2-L3	C31-C51	0.50	10.03	
L3-L1	C51-C11	0.50	10.03	
L1-E	C11-C70	0.20	10.03	

VPIS Tests

APPLIED VOLTAGE	RING SWITCH 1 VPIS (V)			RING SWITCH 2 VPIS (V)		
300V	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
Ring Switch 1 L1						
Ring Switch 1 L2						
Ring Switch 1 L3						
Ring Switch 2 L1						
Ring Switch 2 L2						
Ring Switch 2 L3						

NOTE: Left set a minimum setting. Service settings to be applied on site and confirmed by secondary injection tests.

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C4 - Relay Protection Pre-Assembly Commissioning Sheet – RN6D

Site		Circuit	
Unit Type	Schneider RN6D-M-N4/21	Relay Type	Micom P116A1N2N14121111N
Unit Serial No.		Relay Serial No.	
CT Ratio	800/400/1	Prot CT Serial No.	L1.
			L2.
			L3.

Insulation Resistance Tests @1kV

CT IR Test @ 1kV		Ω

DC Resistance Tests

RATIO		MEASURED VALUE Ω	MEASURING CIRCUIT Ω	TRUE VALUE Ω
	CT Earth Link			
400/1	L1 CT C11-C210			
	L2 CT C31-C230			
	L3 CT C51-C250			
800/1	L1 CT C11-C110			
	L2 CT C31-C130			
	L3 CT C51-C150			

Magnetisation Characteristics

RATIO		1MA	2MA	5MA	10MA	25MA	50MA	100MA
400/1	L1 CT C11-C210							
	L2 CT C31-C230							
	L3 CT C51-C250							
800/1	L1 CT C11-C110							
	L2 CT C31-C130							
	L3 CT C51-C150							

Ratio Check

	PHASE	PRIMARY	SECONDARY CURRENT MA				RELAY CURRENT DISPLAY			
		Current	C12	C32	C52	C71	IA	IB	IC	IN
800/1	L1-L2	200								
	L1-L3	200								
	L1-E	200								
400/1	L1-L2	100								
	L1-L3	100								
	L1-E	100								

Relay Minimum Operation

ELEMENT	MIN OP
	Current
IA Start	
IB Start	
IC Start	
IN_1 Start	

7. VPIS Tests

APPLIED VOLTAGE	RING SWITCH 1 VPIS (V)			RING SWITCH 2 VPIS (V)		
300V	**L1**	**L2**	**L3**	**L1**	**L2**	**L3**
Ring Switch 1 L1						
Ring Switch 1 L2						
Ring Switch 1 L3						
Ring Switch 2 L1						
Ring Switch 2 L2						
Ring Switch 2 L3						

NOTE: Left set a minimum setting. Service settings to be applied on site and confirmed by secondary injection tests.

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C5 – Relay Protection Pre-Assembly Commissioning Sheet – VRN2a with 7SR45 Relay

Site		Circuit	
Unit Type	Lucy Sabre VRN2a	Relay Type	Siemens 7SR4504-1HB20-1AA0/HH
Unit Serial No.		Relay Serial No.	
CT Ratio	200/100/1		

1 Insulation Tests @1kV

CT IR Test @ 1kV:_____Ω

2 DC Resistance Tests

Ratio		MEASURED VALUE Ω	MEASURING CIRCUIT Ω	TRUE VALUE Ω
	CT Earth Link			
100/1	L1 CT C11-C210			
	L2 CT C31-C230			
	L3 CT C51-C250			
200/1	L1 CT C11-C110			
	L2 CT C31-C130			
	L3 CT C51-C150			

3 Magnetisation Characteristics

RATIO		1mA	2mA	5mA	10mA	25mA	50mA	100mA
100/1	L1 CT C11-C70							
	L2 CT C31-C70							
	L3 CT C51-C70							
200/1	L1 CT C11-C70							
	L2 CT C31-C70							
	L3 CT C51-C70							

4 Ratio Check

RATIO	PHASE	PRIMARY CURRENT	SECONDARY CURRENT				RELAY CURRENT DISPLAY			
			C110 (1)	C130 (2)	C150 (3)	C72 (4)	Ia	Ib	Ic	Ig/In
200/1	L1-L2	50								
	L1-L3	50								
	L1-E	50								
			C210 (5)	C230 (6)	C250 (7)	C72 (4)	Ia	Ib	Ic	Ig/In
100/1	L1-L2	25								
	L1-L3	25								
	L1-E	25								

5 Relay Minimum Operation

ELEMENT	MIN OP CURRENT
IL1 Pickup	
IL2 Pickup	
IL3 Pickup	
IE Pickup	

6 Relay Timing Tests

ELEMENT	INJECTION POINT	SECONDARY CURRENT	EXPECTED TIME (S)	ACTUAL TIME (S)
L1-L2	C11-C31	1.00	10.03	
L2-L3	C31-C51	1.00	10.03	
L3-L1	C51-C11	1.00	10.03	
L1-E	C11-C70	0.50	10.03	

7 VPIS Tests

APPLIED VOLTAGE	RING SWITCH 1 VPIS (V)			RING SWITCH 2 VPIS (V)		
300V	L1	L2	L3	L1	L2	L3
Ring Switch 1 L1						
Ring Switch 1 L2						
Ring Switch 1 L3						
Ring Switch 2 L1						
Ring Switch 2 L2						

Ring Switch 2 L3						

NOTE: Left set a minimum setting. Service settings to be applied on site and confirmed by secondary injection tests.

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C6 - Earth Fault Indicator(s) (EFI) Pre-Assembly Commissioning Sheet

Manufacturer / Type _____/_____

Serial Number: _____

CT Ratio: Normally 500/1

CT Serial Numbers:

Ring Switch 1	CT Serial Number
L1	
L2	
L3	

Ring Switch 2	CT Serial Number
L1	
L2	
L3	

AC Wiring Insulation Resistance: _____Ω

CT IR Test @ 1kV:_____Ω

DC Resistance Tests

CT		MEASURED VALUE Ω	MEASURING CIRCUIT Ω	TRUE VALUE Ω
Ring Switch 1	L1			
	L2			
	L3			
Ring Switch 2	L1			
	L2			
	L3			

Magnetisation Characteristics

Secondary Current		1mA	2mA	5mA	10mA	25mA	50mA	100mA	200mA
Ring Switch 1	L1								
	L2								
	L3								
Ring Switch 2	L1								
	L2								
	L3								

CT Ratio and Polarity Check

RATIO	PRIMARY CURRENT (A)	L1 – L2			L1 – L3	
		Secondary Current R CT (A)	Secondary Current Y CT (A)	Spill Current (mA)	Secondary Current B CT (A)	Spill Current (mA)
500/1	125					
500/1	125					

NOTE: EFI Shorting Links Shall be Replaced After Testing

Shorting Links Replaced: _____

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C7 - Relay Protection Pre-Assembly Commissioning Sheet – CE2

Site			**Circuit**		
Unit Type	Schneider CE2-N121/21		**Relay Type**	Micom P116A1N2N14121111N	
Unit Serial No.			**Relay Serial No.**		
CT Ratio	200/1		**Prot CT Serial No.**	**L1.**	
				L2.	
				L3.	

Insulation Resistance Tests @1kV

CT IR Test @ 1kV		**Ω**

DC Resistance Tests

	MEASURED VALUE Ω	MEASURING CIRCUIT Ω	TRUE VALUE Ω
CT Earth Link			
L1 CT C11-C70			
L2 CT C31-C70			
L3 CT C51-C70			

Magnetisation Characteristics

	1mA	2mA	5mA	10mA	25mA	50mA	100mA
L1 CT C11-C70							
L2 CT C31-C70							
L3 CT C51-C70							

Ratio Check

PHASE	PRIMARY	SECONDARY CURRENT MA				RELAY CURRENT DISPLAY			
	Current	C12	C32	C52	C71	IA	IB	IC	IN
L1-L2	50								
L1-L3	50								
L1-E	50								

Relay Minimum Operation

ELEMENT	MIN OP
	Current
IA Start	
IB Start	
IC Start	
IN_1 Start	

Relay Timing Tests

ELEMENT	INJECTION	SECONDARY	EXPECTED	ACTUAL
	Point	Current	Time (s)	Time (s)
L1-L2	C11-C31	0.50	10.03	
L2-L3	C31-C51	0.50	10.03	
L3-L1	C51-C11	0.50	10.03	
L1-E	C11-C70	0.20	10.03	

VPIS Tests

APPLIED VOLTAGE	VPIS (V)		
300V	**L1**	**L2**	**L3**
L1			
L2			
L3			

NOTE: Left set a minimum setting. Service settings to be applied on site and confirmed by secondary injection tests.

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____

C8 - Relay Protection Pre-Assembly Commissioning Sheet – CE6

Site			**Circuit**		
Unit Type	Schneider CE6-N213/21		**Relay Type**	Micom P116A1N2N14121111N	
Unit Serial No.			**Relay Serial No.**		
CT Ratio	800/400/1		**Prot CT Serial No.**	**L1.**	
				L2.	
				L3.	

Insulation Resistance Tests @1kV

CT IR Test @ 1kV		**Ω**

DC Resistance Tests

RATIO		MEASURED VALUE Ω	MEASURING CIRCUIT Ω	TRUE VALUE Ω
	CT Earth Link			
400/1	**L1 CT C11-C210**			
	L2 CT C31-C230			
	L3 CT C51-C250			
800/1	**L1 CT C11-C110**			
	L2 CT C31-C130			
	L3 CT C51-C150			

Magnetisation Characteristics

RATIO		1mA	2mA	5mA	10mA	25mA	50mA	100mA
400/1	L1 CT C11-C210							
	L2 CT C31-C230							
	L3 CT C51-C250							
800/1	L1 CT C11-C110							
	L2 CT C31-C130							
	L3 CT C51-C150							

Ratio Check

	PHASE	PRIMARY	SECONDARY CURRENT MA				RELAY CURRENT DISPLAY			
		Current	C12	C32	C52	C71	IA	IB	IC	IN
800/1	L1-L2	200								
	L1-L3	200								
	L1-E	200								
400/1	L1-L2	100								
	L1-L3	100								
	L1-E	100								

Relay Minimum Operation

ELEMENT	MIN OP
	Current
IA Start	
IB Start	
IC Start	
IN_1 Start	

Relay Timing Tests

ELEMENT	INJECTION	SECONDARY	EXPECTED	ACTUAL
	Point	Current	Time (s)	Time (s)
L1-L2	C11-C31	0.50	10.03	
L2-L3	C31-C51	0.50	10.03	
L3-L1	C51-C11	0.50	10.03	
L1-E	C11-C70	0.20	10.03	

VPIS Tests

APPLIED VOLTAGE	VPIS (V)		
300V	L1	L2	L3
L1			
L2			
L3			

NOTE: Left set a minimum setting. Service settings to be applied on site and confirmed by secondary injection tests.

Tested by (signature): _____

Print Name: _____

Company: _____

Date: _____