Eskom	Scope of Work – Substation Engineering	Technology

Mookodi 3rd Transformer Scope of Work: Stringing, Cabling and Earthing

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……	……	……
Christy Thomas	**Christinah Mohloki**	**Allen Masuku**
Design Engineer	**Design Engineer**	**Project Manager**
Substation Engineering	**PTM &C Engineering**	**Tx Project delivery**
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1. INTRODUCTION

Mookodi 400/132kV Substation is located outside Vryburg in the North West province. The substation is linked to the Transmission grid through Ferrum and Mercury substations via the 400kV lines that connect to the 400kV Busbar. At present the Mookodi substation is supplying the Vryburg Munic and Bophirima substations. Mercury substation supplies Mookodi, which then supplies Ferrum substation.
A line reactor is installed on the Mercury line. There is also the Waterloo IPP that feeds into Mookodi substation.

The Department of Mineral Resources and Energy released the 2019 Integrated Resource Plan (IRP 2019) in October 2019. The IRP 2019 will see around 6 GW of new solar PV capacity and 14.4 GW of new wind power capacity commissioned by 2030. The 2020 TDP Generation Assumptions allocated generation capacity across the country in line with the IRP 2019. Due to the favourable sun and wind in the Northern Cape, the province has around 3.3 GW of committed renewable generation with over 10 GW expected by 2030.

The study has highlighted the need for substantial infrastructure investment and the business is required to respond to the aggressive plans for the country to achieve a diversified energy mix by 2030. In this light, it is crucial that all project development activities are prioritised on each of the required project schemes, at least to a point of execution readiness. The minimum strengthening required in the North-West and Limpopo Province to meet the IRP 2019 renewable generation integration aspirations is summarized in the Grid Planning report GP-21/15.

In fact, the Mookodi Substation capacity will be insufficient to accommodate the full 825MW generations expected to be installed at the substation. Given the load forecast and generation forecast for Mookodi substation, it is foreseen that Mookodi substation will require an additional 500MVA Transformer by 2025.

The primary objective of the project is to install first 400/132/22 kV 500 MVA transformer and a 22/0.4 kV auxiliary transformer, cater for a spare 500MVA transformer bay, 4 x 400kV spare feeder bays and 9 x 132 kV spare feeder bays. Hence extend both 400kV and 132kV yard terrace and extend both 400kV and 132kV busbars in the north-western and south-western directions.

2. REFERENCES

[1] (240-55922824) - Substation Layout Design Guideline

[2] Occupational Health and Safety Act (OHS Act) 85 of 1993

[3] (32-727) - Eskom Safety, Health, Environment and Quality policy

[4] (240-120804300) - Standard for the Labelling of electrical Equipment within Eskom Wires Networks

[5] (240-82736997) - Stringing, Cabling, Earthing, and Erection Specification for Transmission Substations

[6] (240-53113927) - Specification for Substation Clamps for Stranded Aluminium Conductors

[7] (240-83534936) – Tubular and Stranded Conductor Clamps Additional to the Existing Standards

[8] (240-53113923) – Specification for Substation Clamps for Tube Aluminium Conductors

[9] 240-68972408 – Standard for Flexible and Tubular Conductor Heights and Phase Spacing

[10] 0.54/393 – Earthing Standards

3. PURPOSE OF THE PROJECT

The purpose of the project is to install the first 400/132/22 kV 500 MVA transformer and a 22/0.4 kV auxiliary transformer, cater for a spare 500MVA transformer bay, 4 x 400kV spare feeder bays and 9 x 132 kV spare feeder bays. Both 400 kV and 132 kV HV yards are to be extended in the north-western and south-western directions to establish these. The scope of work for the project includes the extension of 400kV and 132kV busbars on either ends to cater for future 400kV feeder bays and 132kV feeder bays. The upcoming Kimberley Strengthening Phase 3 and Cape Corridor Phase 5 schemes were considered while developing the Scope of Work for this Mookodi project.

The 400kV yard is constructed as double busbar selection and bypass system. The busbars consist of 250mm x 6WT Tubular conductor. The existing busbar system is currently equipped with one Bus Coupler namely Bus Coupler B providing 2 zones of Busbar. Addition of a second Bus Coupler namely Bus Coupler A and Busbar 1 Bus Section 1 will provide 3 zones of 400kV Busbar. Existing Bypass Busbar will be extended and converted to a Transfer Busbar with a Transfer Bus Coupler linking Busbar 1 and Busbar 2.

The 132kV yard is constructed as double busbar selection. The busbars consist of 200mm x 6WT Tubular conductor. The Busbar 1 and Busbar 2 are coupled with Bus Coupler B providing 2 zones of Busbar. Addition of a second Bus Coupler namely Bus Coupler A and Busbar 1 Bus Section 2 will provide 3 zones of 132kV Busbar. The double busbar design provides for “n-1” contingencies in accordance with the requirements of the South African Grid Code

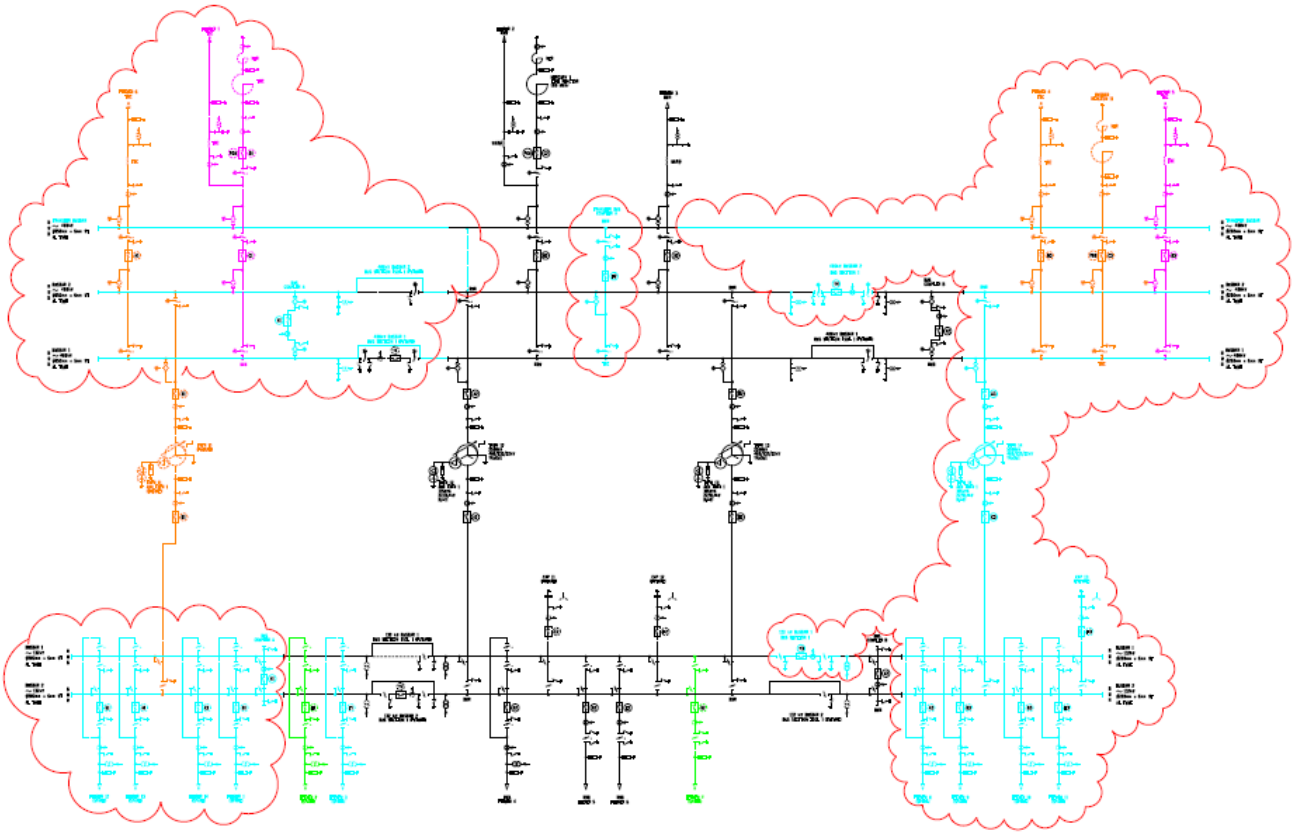

FIGURE 1: MOOKODI SED (MOO21P05-SE-D6) SHOWING AREA TO BE CONSTRUCTED IN BUBBLES

4. SCOPE OF WORK

Note that this document must be used in conjunction with the design drawings as well as all specifications, procedures, guidelines and standards mentioned therein. Work will be performed in a live substation, and therefore all necessary safety procedures and precautions must be adhered to. The engineering scope of work for this project includes the following:

The primary objective of the project is to install first 400/132/22 kV 500 MVA transformer and a 22/0.4 kV auxiliary transformer, cater for a spare 500MVA transformer bay, 4 x 400kV spare feeder bays, 2 x 400kV Busbar Reactor bays and 9 x 132 kV spare feeder bays. Hence extend both 400kV and 132kV yard terrace and extend both 400kV and 132kV busbars in the north-western and south-western directions. The existing fences and will be dismantled and relocated. The access control building will be relocated.

The high-level scope of work for the 400kV system is as follows:

- Extend 400kV Busbar 1 and Busbar 2 in the north eastern direction to install a Bus Coupler A and
- Busbar 1 Bus Section 1, and to cater spare bays for Transformer 11, Feeder 1, Feeder 6, Busbar
- Reactor 12 and Busbar 2 Bus Section 1.
- Extend 400kV Busbar 1 and Busbar 2 in the south western direction to install first 500 MVA
- Transformer 14 and to cater spare bays for Feeder 4, Busbar Reactor 11 and Feeder 5.
- Establish Transfer Busbar by extending existing Bypass Busbar 2.
- Transfer Bus Coupler A will be installed in the existing spare Busbar Reactor 11 bay.
- Install 400kV Transformer 14 bay
- Install 1 x 500 MVA 400/132/22kV YNaOd1 Auto Transformer.
- Install 1 x 315 kVA 22/0.4 kV Dyn11 Auxiliary Transformer
- Install 400kV Bus Coupler A
- Install 400kV Transfer Bus Coupler A
- Equip 400kV Busbar 1 Bus section 1
- Decommission existing Busbar 1 Earthing Switch placed in the Busbar 1 Bus Section 2 Future Bay
- Install Busbar 1A CVT

The high level scope of work for the 132kV system is as follows:

- Extend 132kV Busbar 1 and Busbar 2 in the north eastern direction to install Bus Coupler A and to cater spare bays for Transformer 11, Feeder 1, Feeder 12, Feeder 13 and Feeder 14.
- Extend 132kV Busbar 1 and Busbar 2 in the south western direction to install Transformer 14 and to cater spare bays for Feeder 8, Feeder 9, Feeder 10, Feeder 11 and Capacitor 13.
- New spare feeder bays are built with bypass facility
- Existing spare feeder 3 will be the nineth spare bay under this project
- Install 132kV Transformer 14 bay
- Install 132kV Bus Coupler A
- Equip 132kV Busbar 1 Bus section 2
- Decommission existing Busbar 1 Earthing switch placed in the Busbar 1 Bus Section 1 Future Bay
- Install 132kV Busbar 1B VT

5. PRIMARY PLANT REQUIREMENTS

Erection, earthing and Stringing of 400kV & 132kV Primary plant equipment are:

Once the new foundation and the steel are erected by the civil contractor and suppliers of equipment has erected their equipment per bay, the contractor will be required to do the stringing of all the primary plant equipment. All work must be carried out under dead conditions, will be on a scheduled outage. The contractor will install the following free issued equipment; Post Insulators, Surge arresters and Auxiliary transformer. The contractor will be free issued with Conductors and clamps. The contractor will find installed primary plant equipment (Current Transformers (CTs), Voltage Transformers (VTs), Isolators, Circuit breakers (CBs), Post Insulators (PIs) and line-trap) in the HV yards as per drawings. Stringing per bays will be as follows according to drawings:

- Contractor to do earthing with flat copper (50x3mm) to all primary plant equipment and secondary plant equipment according to drawings and specifications.
- Overhead earth wire for lightning protection to be installed to cover the new 132kV and 400 kV Tubular busbars.
- Erection, Earthing and string of following:

Item No.	Equipment	Description	Total	Erection	Earthing	Stringing
1	Current Transformer	400 kV, 25 mm/kV	**12**	**X**	**X**	**X**
2	Earth Switch	400 kV, single mech, 110 V dc, 25 mm/kV	**1**		**X**	**X**
3	Conventional Isolator	400 kV, single mech, RHES, 25 mm/kV	**1**		**X**	**X**
4	Conventional Isolator	400 kV, single mech, LHES, 25 mm/kV	**1**		**X**	**X**
5	Conventional Isolator	400 kV, single mech, 2ES, 25 mm/kV	**3**		**X**	**X**
6	Isolator, pantograph (set)	400 kV, 0ES,25 mm/kV	**2**		**X**	**X**
7	Isolator, pantograph (set)	400 kV, 1ES, 25 mm/kV	**2**		**X**	**X**
8	Surge Arrestor	400 kV, 25 mm/kV	**3**	**X**	**X**	**X**
9	Post Insulator	400 kV, C6-1550, 25 mm/kV	**30**	**X**	**X**	**X**
10	Post Insulator	400 kV, C10-1550, 25 mm/kV	**111**	**N/A**	**N/A**	**N/A**
11	Circuit Breaker (set)	400 kV, 3ϕ ARC, 25 mm/kV	**4**		**X**	**X**
12	CVT	400/220V	**3**	**X**	**X**	**X**
13	Auto Transformer	400/132/22 kV, YNa0d1	**1**		**X**	**X**

Table 1: Prelim 400kV Bill of Material for Major Equipment

Item No.	Equipment	Description	Total	Erection	Earthing	Stringing
1	Voltage Transformer	132 kV, 25 mm/kV	**3**	**X**	**X**	**X**
2	Conventional Isolator	132 kV, LH ES, 25 mm/kV	**1**		**X**	**X**
3	Isolator, pantograph (set)	132 kV, 0ES, 25 mm/kV	**1**		**X**	**X**
4	Conventional Isolator	132 kV, 2ES, 25 mm/kV	2		X	X
5	Isolator, pantograph (set)	132 kV, 1ES,25 mm/kV	**2**		**X**	**X**
7	Circuit Breaker (set)	132 kV, 3ϕ ARC, 25 mm/kV	**3**		**X**	**X**
9	Surge Arrestor	132 kV, 25 mm/kV	**3**	**X**	**X**	**X**
10	Current Transformer	132 kV, 25 mm/kV	**9**	**X**	**X**	**X**
11	Earth Switch	132 kV, 25 mm/kV	**1**		**X**	**X**
12	Post Insulator	132 kV, C6-550, 25 mm/kV	**10**	**X**	**X**	**X**
12	Post Insulator	132 kV, C10-550, 25 mm/kV	**72**	**N/A**	**N/A**	**N/A**

Table 2: 132kV Bill of Material for Major Equipment

Item No.	Equipment	Description	Total	Erection	Earthing	Stringing
1	Surge Arrestor	22 kV, 31 mm/kV	**3**	**X**	**X**	**X**
2	Auxiliary Transformer	22/0.4kV 315kVA Dyn11	**1**	**X**	**X**	**X**

Table 3: 22kV Bill of Material for Major Equipment

400KV SYSTEM

- **400/132/22KV Transformer 14**

Stringing 1x400kV/132kV Transformer-14 and bays: 400kVside bay must string all primary equipment (400kV side Power transformer, 400kVCTs, 400kV Isolators, 400kV Surge arresters, 400kV circuit breakers, and 400kV Post insulators from Busbar (BB1&BB2) to 400kV side of Transformer and connect Neutral to earth.

- **400kV Bus Coupler A**

Stringing of 1x400kV **Bus Coupler A** (BB1&BB2): Per bay must string all primary equipment (400kVCTs, 400kV Isolators, 400kV circuit breakers and 400kV Post insulators from Busbar(BB1&BB2) to end termination of **Bus Coupler A**.

- **400kV Transfer Bus Coupler A**

Stringing of 1x400kV **Transfer Bus Coupler A** (BB1&BB2): Per bay must string all primary equipment (400kVCTs, 400kV Isolators, 400kV circuit breakers and 400kV Post insulators from Busbar(BB1&BB2) to end termination of **Transfer Bus Coupler A**

- **400kV Busbar 1 Bus Section 2**

Stringing of 1x400kV **Busbar 1 Bus Section 2** (BB1&BB2): Per bay must string all primary equipment (400kVCTs, 400kV Isolators, 400kV circuit breakers and 400kV Post insulators from Busbar(BB1&BB2) to end termination of **Busbar 1 Bus Section 2**

- **400V Transfer Busbar CVT**

Stringing and earthing

132KV SYSTEM

- **132kV transformer-14**

Stringing 1x400kV/132kV Transformer-14 and bay: 132kVside bay must string all primary equipment (132kV side Power transformer, 132kVCTs, 132kV Isolators, 132kV Surge arresters, 132kV circuit breakers, and 132kV Post insulators from Busbar (BB1&BB2) to 132kV side of Transformer and connect Neutral to earth.

- **132kV Bus Coupler A**

Stringing of 1x132kV **Bus Coupler A** (BB1&BB2): Per bay must string all primary equipment (132kVCTs, 132kV Isolators, 132kV circuit breakers and 132kV Post insulators from Busbar(BB1&BB2) to end termination of **Bus Coupler A**.

- **132kV Busbar 1 Bus Section 1**

Stringing of 1x132kV **Busbar 1 Bus Section 1** (BB1&BB2): Per bay must string all primary equipment (132kVCTs, 132kV Isolators, 132kV circuit breakers and 132kV Post insulators from Busbar(BB1&BB2) to end termination of **Busbar 1 Bus Section 1**

- **132V Busbar 1A VT JB**

Stringing and earthing

- **22kV transformer-14**

22kV side bay must string all primary plant (22kV side Power transformer, 22/0.4kV Auxiliary transformer, 22kV surge arresters) from 22kv side of power transformer to end of 22kV Auxiliary Surge arresters and connect Neutral to earth.

SECONDARY SCOPE OF WORK

The scope of work for this project will comprise the following activities

400kV Scope of Work (Transformer 14, Bus Coupler A, Trans Bus Coupler A , Bus Section &VTJB)

- Install new Transformer protection scheme ((Transformer 14) – 6TA2300 M1,M2 &Tap change panel
- Install new Transfer bus coupler protection scheme (Transfer Bus Coupler "A")– 6BC2310 M1& M2 panels on the allocated space as per approved control room layout
- Install new bus coupler protection scheme (Bus Coupler "A"– 6BC2210 M1& M2 panels on the allocated space as per approved control room layout
- Install new bus coupler protection scheme (Bus Section 2– 6BC2210 M1& M2 panels on the allocated space as per approved control room layout
- Install new cables between the existing 400kV Bus zone panel and all interfacing panels as perthe approved latest cable block drawing.

132kV Scope of Work (Bus Coupler A, Bus Section 1)

- Install new bus coupler protection scheme (Bus Coupler "A"– 6BC2210 M1& M2 panels on the allocated space as per approved control room layout
- Install new bus coupler protection scheme (Bus Section 1– 6BC2210 M1& M2 panels on the allocated space as per approved control room layout
- Install new cables between the existing 132kV Bus zone panel and all interfacing panels as per the approved latest cable block drawing.
- Try to keep the ferrule numbers and cable numbers intact. Install safety labels
- Enclose cables in surface trenches again after installation and termination.

400kV and 132kV Cabling required in project

AC RETICULATION

From	To	Function	Cable Type	No of
Auxiliary Transformer 14	TRANSFORMER 14 TDB	AC	BVX4QCV	2
TRANSFORMER 14 TDB	TRANSFORMER 13 TDB	AC	BVX4QCV	2
AC BOARD	TRANSFORMER 14 TDB	AC	BVX4NCV	2
TRANSFORMER 14 TDB	TRANSFORMER 14 MARSHALLING KIOSK	AC	BVX4LCV	1
TRANSFORMER 14 TDB	TRANSFORMER 14 TAP CHANGE DRIVE	AC	BVX4ECV	1

TRANSFORMER 14 JB

JB-M1	MK	DC	BVX7DCV	1
JB-M 2	MK	DC	BVX19DCV	1

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JB-M 2	MK	DC	BVX19DCV	1
JB-COM	MK	DC	BVX19DCV	1
JB-COM	MK	DC	BVX19DCV	1
JB-M1	MK	CT	BVX19DCV	1
JB-M1	MK	CT	BVX19DCV	1
JB-M2	MK	CT	BVX19DCV	1
JB-M2	MK	CT	BVX19DCV	1
JB-COM	DGA	DC	BVX7DCV	1
MK	DGA	AC	BVX4ECV	1
MK	Drykeep	AC	BVX4ECV	1
JB-COM	Sergi	DC	BVX19DCV	1
JB-M2	TCD	DC	BVX19DCV	1
JB-M2	TCD	DC	BVX19DCV	1
JB-COM	Aux Trfr	Aux Trfr	BVX12DCV	1
JB-COM	MK	Cooler Control	BVX19DCV	1
JB-M1	Trfr RP- M1	DC	BVX2ECV	1
JB-M2	Trfr RP- M2	DC	BVX2ECV	1
JB-COM	PLUGBOX	AC	BVX2ECV	1
MK	SERGI	AC	BVX4ECV	1
JB-M1	DIP	FO	12MM HDD	1
JB-M2	DIP	FO	12MM HDD	1
JB-M2	Trfr TCP	FO	12MM HDD	1

TRANSFORMER 14
400/132kV BREAKER JB
MAIN 1

JB-M1	CB 1-R	Status	BVX12DCV	1
JB-M1	CB 1-W	Status	BVX12DCV	1
JB-M1	CB 1-B	Status	BVX12DCV	1
JB-M1	Iso BB1 R	Status	BVX7DCV	1
JB-M1	Iso BB1 W	Status	BVX7DCV	1
JB-M1	Iso BB1 B	Status	BVX7DCV	1
JB-M1	Iso BB2	Status	BVX7DCV	1
JB-M1	ESCB2	Status	BVX7DCV	1
JB-M1	EST	Status	BVX7DCV	1
JB-M1	CT1-R	CT Cores	BVX7DCV	1
JB-M1	CT1-W	CT Cores	BVX7DCV	1
JB-M1	CT1-B	CT Cores	BVX7DCV	1
JB-M1	VTBB1	DC,MCB,Trip	BVX2ECV	1
JB-M1	TRFR 1 RP M1	DC Supply,EM Trip	BVX12ECV	1
JB-M1	TRFR 1 RP M1	FO	12MM HDD	1

TRANSFORMER 14
400/132kV BREAKER JB
MAIN 2

JB-M2	CB 1-R	Status	BVX12DCV	1
JB-M2	CB 1-W	Status	BVX12DCV	1
JB-M2	CB 1-B	Status	BVX12DCV	1
JB-M2	Iso BB1 R	Status	BVX7DCV	1
JB-M2	Iso BB1 W	Status	BVX7DCV	1
JB-M2	Iso BB1 B	Status	BVX7DCV	1
JB-M2	Iso BB2	Status	BVX7DCV	1
JB-M2	Iso T	Status	BVX7DCV	1
JB-M2	ESCB2	Status	BVX7DCV	1
JB-M2	EST	Status	BVX7DCV	1
JB-M2	CT1-R	CT Cores	BVX7DCV	1
JB-M2	CT1-W	CT Cores	BVX7DCV	1
JB-M2	CT1-B	CT Cores	BVX7DCV	1
JB-M2	TRFR 2 RP M2	DC Supply,EM Trip	BVX12ECV	1
JB-M2	TRFR 2 RP M2	FO	12MM HDD	1

TRANSFORMER 14 400kV
BREAKER JB COMMON

JB-COM	CB 1-R	Heater Supply R	BVX2ECV	1
JB-COM	CB 1-W	Heater Supply W	BVX2ECV	1
JB-COM	CB 1-B	Heater Supply B	BVX2ECV	1
JB-COM	CB 1-R	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	CB 1-W	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	CB 1-B	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	Iso BB1 R	Heater Supply	BVX2ECV	1
JB-COM	Iso BB1 W	Heater Supply	BVX2ECV	1
JB-COM	Iso BB1 B	Heater Supply	BVX2ECV	1
JB-COM	Iso BB1 R	Control & Motor	BVX12DCV	1
JB-COM	Iso BB1 W	Control & Motor	BVX12DCV	1
JB-COM	Iso BB1 B	Control & Motor	BVX12DCV	1
JB-COM	ESCB2	Heater Supply	BVX2ECV	1
JB-COM	ES2T	Heater Supply	BVX2ECV	1
JB-COM	Plug Box	AC Heater & Lamp Supply	BVX2ECV	1
JB-COM	DC Board	DC Motor & SR Supply	BVX4HCV	1
JB-COM	VTBB	AC HEATER	BVX2ECV	1

TRANSFORMER 14
PROTECTION PANEL MAIN 1

Trfr RP-M1	400kV BB 1 VT JB	HV VT	BVX4ECV	1

Trfr RP-M1	132kV Trfr VT JB	MV Trfr VT	BVX4ECV	1
Trfr RP-M1	Trfr JB	REF CT	BVX4ECV	1
Trfr RP-M1	Trfr JB	Tertiary CT	BVX4ECV	1
Trfr RP-M1	400kV Buszone Panel	HV Buszone	BVX7DCV	1
Trfr RP-M1	132kV Buszone Panel	MV Buszone	BVX7DCV	1
Trfr RP-M1	DC Board	DC Supply	BVX2ECV	1
Trfr RP-M1	AC Board	230V AC EL	BVX2ECV	1

TRANSFORMER 14
PROTECTION PANEL MAIN 2

Trfr RP-M2	400kV BB 1 VT JB	HV VT	BVX4ECV	1
Trfr RP-M2	132kV Trfr VT JB	MV Trfr VT	BVX4ECV	1
Trfr RP-M2	Trfr JB	REF CT	BVX4ECV	1
Trfr RP-M2	Trfr JB	Tertiary CT	BVX4ECV	1
Trfr RP-M2	400kV Buszone Panel	HV Buszone	BVX7DCV	1
Trfr RP-M2	132kV Buszone Panel	MV Buszone	BVX7DCV	1
Trfr RP-M2	DC Board	DC Supply	BVX2ECV	1
Trfr RP-M2	AC Board	230VAC EL	BVX2ECV	1

400kV Transfer Busbar

BB2A VTJB	CVT - R	BB2A VT Red	BVX7ECV	1
BB2A VTJB	CVT- W	BB2A VT White	BVX7ECV	1
BB2A VTJB	CVT - B	BB2A VT Blue	BVX7ECV	1
400kV BUS SECTION 1 BREAKER JB COMMON				
JB-COM	CB 1-R	Heater Supply	BVX2ECV	1
JB-COM	CB 1-W	Heater Supply	BVX2ECV	1
JB-COM	CB 1-B	Heater Supply	BVX2ECV	1
JB-COM	CB 1-R	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	CB 1-W	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	CB 1-B	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	Iso 1	Heater Supply	BVX2ECV	1
JB-COM	Iso 1	Control & Motor	BVX12DCV	1
JB-COM	Iso 2	Heater Supply	BVX2ECV	1
JB-COM	Iso 2	Control & Motor	BVX12DCV	1
JB-COM	Iso BB2A	Heater Supply	BVX2ECV	1
JB-COM	Iso BB2B	Heater Supply	BVX2ECV	1
JB-COM	ESCB2A	Interlock & Status	BVX12DCV	1
JB-COM	ESCB2B	Interlock & Status	BVX12DCV	1
JB-COM	Plug Box	AC Heater & Lamp Supply	BVX2ECV	1
JB-COM	DC Board	DC Motor & SR Supply	BVX4HCV	1

400kV BUS SECTION 1 PROTECTION MAIN 1				
Bus Coupler -M1	BB1 VT JB	BB1 VT	BVX4ECV	1
Bus Coupler M1	BB2 VT JB	BB2 VT	BVX4ECV	1
Bus Coupler -M1	Breaker CT	Breaker JB M1	BVX4ECV	1
Bus Coupler -M1	Buszone	Buszone	BVX7DCV	1
Bus Coupler -M1	DC Supply	DC Board	BVX2ECV	1
Bus Coupler -M1	230VAC EL	AC Board	BVX2ECV	1
Bus Coupler -M1	230VAC	AC Board	BVX2ECV	1
Bus Coupler 6BC7100-M1	Tranfer Bus Wiring	Tranfer Bus Wiring	BVX19DCV	1
Bus Coupler 6BC7100-M1	Tranfer Bus Wiring	Tranfer Bus Wiring	BVX19DCV	1
Bus Coupler 6BC7100-M1	Tranfer Bus Wiring	Tranfer Bus Wiring	BVX19DCV	1
Bus Coupler 6BC7100-M1	FSP 1	FO	12MM HDD	1
Bus Coupler 6BC7100-M1	IDF	Alarm	TPH10AX	1

400kV BUS SECTION 1 PROTECTION MAIN 2				
Bus Coupler 6BC7100-M2	BB1 VT JB	BB1 VT	BVX4ECV	1
Bus Coupler 6BC7100-M2	BB2 VT JB	BB2 VT	BVX4ECV	1
Bus Coupler 6BC7100-M2	Breaker CT	Breaker JB M1	BVX4ECV	1
Bus Coupler 6BC7100-M2	Buszone	Buszone	BVX7DCV	1
Bus Coupler 6BC7100-M2	DC Supply	DC Board	BVX2ECV	1
Bus Coupler 6BC7100-M2	230VAC EL	AC Board	BVX2ECV	1
Bus Coupler 6BC7100-M2	230VAC	AC Board	BVX2ECV	1
Bus Coupler 6BC7100-M2	Tranfer Bus Wiring	Tranfer Bus Wiring	BVX19DCV	1
Bus Coupler 6BC7100-M2	Tranfer Bus Wiring	Tranfer Bus Wiring	BVX19DCV	1
Bus Coupler 6BC7100-M2	Tranfer Bus Wiring	Tranfer Bus Wiring	BVX19DCV	1
Bus Coupler 6BC7100-M2	FSP 2	FO	12MM HDD	1
Bus Coupler 6BC7100-M2	IDF	Alarm	TPH10AX	1

400kV BUS COUPLER BREAKER JB MAIN 2				
JB-M2	CB - R	Status	BVX12DCV	1
JB-M2	CB - W	Status	BVX12DCV	1
JB-M2	CB - B	Status	BVX12DCV	1
JB-M2	Iso BB1	Status	BVX7DCV	1
JB-M2	Iso BB2	Status	BVX7DCV	1
JB-M2	ESCB1	Status	BVX7DCV	1
JB-M2	ESCB2	Status	BVX7DCV	1
JB-M2	ESBB1	Status	BVX7DCV	1
JB-M2	ESBB2	Status	BVX7DCV	1
JB-M2	CT1-R	CT Cores	BVX7DCV	1
JB-M2	CT1-W	CT Cores	BVX7DCV	1

JB-M2	CT1-B	CT Cores	BVX7DCV	1
JB-M2	MV BB1 VT 2	DC,MCB,Trip	BVX2ECV	1
JB-M2	MV BB2 VT 2	DC,MCB,Trip	BVX2ECV	1
JB-M2	BC RP-M2	DC Supply,EM Trip	BVX12ECV	1
JB-M2	BC RP-M2	FO	12MM HDD	1

400kV BUS COUPLER BREAKER JB COMMON

JB-COM	CB - W	Heater Supply	BVX2ECV	1
JB-COM	CB - W	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	Iso 1	Heater Supply	BVX2ECV	1
JB-COM	Iso 1	Control & Motor	BVX12DCV	1
JB-COM	Iso 2	Heater Supply	BVX2ECV	1
JB-COM	Iso 2	Control & Motor	BVX12DCV	1
JB-COM	ESCB1	Heater Supply	BVX2ECV	1
JB-COM	ESCB2	Heater Supply	BVX2ECV	1
JB-COM	Plug Box	AC Heater & Lamp Supply	BVX2ECV	1
JB-COM	DC Board	DC Motor & SR Supply	BVX4HCV	1

400kV BUS COUPLER
PROTECTION MAIN 1

BC RP-M1	BB1 VT JB	BB1 VT	BVX4ECV	1
BC RP-M1	BB2 VT JB	BB2 VT	BVX4ECV	1
BC RP-M1	Breaker JB -M1	Breaker CT	BVX4ECV	1
BC RP-M1	Buszone	Buszone	BVX7DCV	1
BC RP-M1	DC Board	DC Supply	BVX2ECV	1
BC RP-M1	AC Board	230VAC EL	BVX2ECV	1
BC RP-M1	AC Board	230VAC	BVX2ECV	1
BC RP-M1	FSP 1	FO	12MM HDD	1
BC RP-M1	IDF	Alarm	TPH10AX	1

400kV BUS COUPLER
PROTECTION MAIN 2

BC RP-M2	BB1 VT JB	BB1 VT	BVX4ECV	1
BC RP-M2	BB2 VT JB	BB2 VT	BVX4ECV	1
BC RP-M2	Breaker JB - M2	Breaker CT	BVX4ECV	1
BC RP-M2	Buszone	Buszone	BVX7DCV	1
BC RP-M2	DC Board	DC Supply	BVX2ECV	1
BC RP-M2	AC Board	230VAC EL	BVX2ECV	1
BC RP-M2	AC Board	230VAC	BVX2ECV	1
BC RP-M2	FSP 2	FO	12MM HDD	1
BC RP-M2	IDF	Alarm	TPH10AX	1

132kV CABLE
REQUIREMENTS

TRANSFORMER 14 BREAKER
JB MAIN 1

JB-M1	CB	Status	BVX12DCV	1
JB-M1	Iso BB1	Status	BVX7DCV	1
JB-M1	Iso BB2	Status	BVX7DCV	1
JB-M1	ESBB	Status	BVX7DCV	1
JB-M1	ESB2	Status	BVX7DCV	1
JB-M1	EST	Status	BVX7DCV	1
JB-M1	CT1-R	CT Cores	BVX7DCV	1
JB-M1	CT1-W	CT Cores	BVX7DCV	1
JB-M1	CT1-B	CT Cores	BVX7DCV	1
JB-M1	MV BB1VT 1	DC,MCB,Trip	BVX2ECV	1
JB-M1	MV BB2VT 1	DC,MCB,Trip	BVX2ECV	1
JB-M1	TRFR 1 RP M1	DC Supply,EM Trip	BVX12ECV	1
JB-M1	TRFR 1 RP M1	FO	12MM HDD	1

TRANSFORMER 14 BREAKER
JB MAIN 2

JB-M2	CB	Status	BVX12DCV	1
JB-M2	Iso BB1	Status	BVX7DCV	1
JB-M2	Iso BB2	Status	BVX7DCV	1
JB-M2	ESBB	Status	BVX7DCV	1
JB-M2	ESB2	Status	BVX7DCV	1
JB-M2	EST	Status	BVX7DCV	1
JB-M2	CT1-R	CT Cores	BVX7DCV	1
JB-M2	CT1-W	CT Cores	BVX7DCV	1
JB-M2	CT1-B	CT Cores	BVX7DCV	1
JB-M2	MV BB1VT 2	DC,MCB,Trip	BVX2ECV	1
JB-M2	MV BB2VT 2	DC,MCB,Trip	BVX2ECV	1
JB-M2	TRFR 1 RP M2	DC Supply,EM Trip	BVX12ECV	1
JB-M2	TRFR 1 RP M2	FO	12MM HDD	1
JB-M2	TC PANEL	FO	12MM HDD	1

TRANSFORMER 14 BREAKER JB COMMON

JB-COM	CB	Heater Supply R	BVX2ECV	1
JB-COM	CB	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	Iso 1	Heater Supply	BVX2ECV	1
JB-COM	Iso 1	Control & Motor	BVX12DCV	1

JB-COM	Iso 2	Heater Supply	BVX2ECV	1
JB-COM	Iso 2	Control & Motor	BVX12DCV	1
JB-COM	ESBB	Heater Supply	BVX2ECV	1
JB-COM	ESCB2	Heater Supply	BVX2ECV	1
JB-COM	EST	Heater Supply	BVX2ECV	1
JB-COM	Plug Box	AC Heater & Lamp Supply	BVX2ECV	1
JB-COM	DC Board	DC Motor & SR Supply	BVX4HCV	1

BUS COUPLER BREAKER JB Backup

JB-Backup	CB	Status	BVX12DCV	1
JB-Backup	Iso BB1	Status	BVX7DCV	1
JB-Backup	Iso BB2	Status	BVX7DCV	1
JB-Backup	ESCB1	Status	BVX7DCV	1
JJB-Backup	ESCB2	Status	BVX7DCV	1
JB-Backup	ESBB1	Status	BVX7DCV	1
JB-Backup	ESBB2	Status	BVX7DCV	1
JB-Backup	CT1-R	CT Cores	BVX7DCV	1
JB-Backup	CT1-W	CT Cores	BVX7DCV	1
JB-Backup	CT1-B	CT Cores	BVX7DCV	1
JB-Backup	MV BB1 VT 2	DC,MCB,Trip	BVX2ECV	1
JB-Backup	MV BB2 VT 2	DC,MCB,Trip	BVX2ECV	1
JB-Backup	BC RP-M2	DC Supply,EM Trip	BVX12ECV	1
JB-Backup	BC RP-M2	FO	12MM HDD	1

BUS COUPLER BREAKER JB COMMON

JB-COM	CB - W	Heater Supply	BVX2ECV	1
JB-COM	CB - W	Spring Rwd,Control & Motor	BVX19DCV	1
JB-COM	Iso 1	Heater Supply	BVX2ECV	1
JB-COM	Iso 1	Control & Motor	BVX12DCV	1
JB-COM	Iso 2	Heater Supply	BVX2ECV	1
JB-COM	Iso 2	Control & Motor	BVX12DCV	1
JB-COM	ESCB1	Heater Supply	BVX2ECV	1
JB-COM	ESCB2	Heater Supply	BVX2ECV	1
JB-COM	Plug Box	AC Heater & Lamp Supply	BVX2ECV	1
JB-COM	DC Board	DC Motor & SR Supply	BVX4HCV	1

BUS COUPLER PROTECTION MAIN 1

BC RP-M1	BB1 VT JB	BB1 VT	BVX4ECV	1
BC RP-M1	BB2 VT JB	BB2 VT	BVX4ECV	1
BC RP-M1	Breaker JB -M1	Breaker CT	BVX4ECV	1
BC RP-M1	Buszone	Buszone	BVX7DCV	1
BC RP-M1	DC Board	DC Supply	BVX2ECV	1
BC RP-M1	AC Board	230VAC EL	BVX2ECV	1
BC RP-M1	AC Board	230VAC	BVX2ECV	1
BC RP-M1	FSP 1	FO	12MM HDD	1
BC RP-M1	IDF	Alarm	TPH10AX	1

BUS COUPLER PROTECTION BACKUP

BC-Backup	BB1 VT JB	BB1 VT	BVX4ECV	1
BC-Backup	BB2 VT JB	BB2 VT	BVX4ECV	1
BC-Backup	Breaker JB - M2	Breaker CT	BVX4ECV	1
BC-Backup	Buszone	Buszone	BVX7DCV	1
BC-Backup	DC Board	DC Supply	BVX2ECV	1
BC-Backup	AC Board	230VAC EL	BVX2ECV	1
BC-Backup	AC Board	230VAC	BVX2ECV	1
BC-Backup	FSP 2	FO	12MM HDD	1
BC-Backup	IDF	Alarm	TPH10AX	1

BUS SECTION BREAKER JB Backup

JB-Backup	CB	Status	BVX12DCV	1
JB-Backup	Iso BB1	Status	BVX7DCV	1
JB-Backup	Iso BB2	Status	BVX7DCV	1
JB-Backup	ESCB1	Status	BVX7DCV	1
JJB-Backup	ESCB2	Status	BVX7DCV	1
JB-Backup	ESBB1	Status	BVX7DCV	1
JB-Backup	ESBB2	Status	BVX7DCV	1
JB-Backup	CT1-R	CT Cores	BVX7DCV	1
JB-Backup	CT1-W	CT Cores	BVX7DCV	1
JB-Backup	CT1-B	CT Cores	BVX7DCV	1
JB-Backup	MV BB1 VT 2	DC,MCB,Trip	BVX2ECV	1
JB-Backup	MV BB2 VT 2	DC,MCB,Trip	BVX2ECV	1
JB-Backup	BC RP-M2	DC Supply,EM Trip	BVX12ECV	1
JB-Backup	BC RP-M2	FO	12MM HDD	1

BUS SECTION BREAKER JB COMMON

JB-COM	CB - W	Heater Supply	BVX2ECV	1
JB-COM	CB - W	Spring Rwd,Control & Motor	BVX19DCV	1

JB-COM	Iso 1	Heater Supply	BVX2ECV	1
JB-COM	Iso 1	Control & Motor	BVX12DCV	1
JB-COM	Iso 2	Heater Supply	BVX2ECV	1
JB-COM	Iso 2	Control & Motor	BVX12DCV	1
JB-COM	ESCB1	Heater Supply	BVX2ECV	1
JB-COM	ESCB2	Heater Supply	BVX2ECV	1
JB-COM	Plug Box	AC Heater & Lamp Supply	BVX2ECV	1
JB-COM	DC Board	DC Motor & SR Supply	BVX4HCV	1

BUS SECTION PROTECTION
MAIN 1

BC RP-M1	BB1 VT JB	BB1 VT	BVX4ECV	1
BC RP-M1	BB2 VT JB	BB2 VT	BVX4ECV	1
BC RP-M1	Breaker JB -M1	Breaker CT	BVX4ECV	1
BC RP-M1	Buszone	Buszone	BVX7DCV	1
BC RP-M1	DC Board	DC Supply	BVX2ECV	1
BC RP-M1	AC Board	230VAC EL	BVX2ECV	1
BC RP-M1	AC Board	230VAC	BVX2ECV	1
BC RP-M1	FSP 1	FO	12MM HDD	1
BC RP-M1	IDF	Alarm	TPH10AX	1

BUS SECTION PROTECTION
BACKUP

BC-Backup	BB1 VT JB	BB1 VT	BVX4ECV	1
BC-Backup	BB2 VT JB	BB2 VT	BVX4ECV	1
BC-Backup	Breaker JB - M2	Breaker CT	BVX4ECV	1
BC-Backup	Buszone	Buszone	BVX7DCV	1
BC-Backup	DC Board	DC Supply	BVX2ECV	1
BC-Backup	AC Board	230VAC EL	BVX2ECV	1
BC-Backup	AC Board	230VAC	BVX2ECV	1
BC-Backup	FSP 2	FO	12MM HDD	1
BC-Backup	IDF	Alarm	TPH10AX	1

COMMON EQUIPMENT
CABLING REQUIREMENTS
400kV BUSZONE

Buszone	Transformer 14 Breaker JB M2	Trfr 14 CT	BVX4ECV	1
Buszone	Trans Bus/C Breaker JB M2	B/C T CT	BVX4ECV	1
Buszone	Bus Coupler A Breaker JB M2	B/C A CT	BVX4ECV	

Buszone	Bus Section 2 Breaker JB M2	B/S2 CT	BVX4ECV	1
Buszone	Transformer 14 Breaker JB Com	Trfr 14 Isolator Status	BVX4ECV	1
Buszone	Bus Coupler T Breaker JB Com	B/C T Trfr 2 Isolator Status	BVX4ECV	
Buszone	Bus Section 2 Breaker JB Com	B/S 2 Isolator Status	BVX4ECV	1
Buszone	Bus Coupler A Breaker JB Com	B/C A Trfr 2 Isolator Status	BVX4ECV	1
400kV Buszone	Common Equipment Panel	FO	12MM HDD	1

132kV BUSZONE

Buszone	BS breaker JB	BS 2 CT	BVX4ECV	1
Buszone	BC A Breaker JB	BC A CT	BVX4ECV	1
Buszone	Trfr 14 MV Breaker JB M2	Trfr 1 MV CT	BVX4ECV	1
Buszone	Feeder 1 Breaker JB Com	Feeder Isolator Status	BVX7DCV	1
Buszone	Feeder 2 Breaker JB Com	Feeder Isolator Status	BVX7DCV	1
Buszone	Feeder 6 Breaker JB Com	Feeder Isolator Status	BVX7DCV	1
Buszone	BS 2 Breaker JB Com	BS 2 Isolator/ Breaker Status	BVX12DCV	1
Buszone	BC A Breaker JB Com	BC A Isolator/ Breaker Status	BVX12DCV	1
Buszone	Trfr 14 MV Breaker JB Com	Trfr 14 MV Isolator Status	BVX7DCV	1
132kV Buszone	Common Equipment Panel	FO	12MM HDD	1

INTERNAL TARIFF METERING PANEL

ITM Panel	DC Board	DC Supply		1
ITM Panel	DC Board	DC Supply		1
ITM Panel	Trfr 1 MV Breaker JB M2	Trfr 1 MV CT	BVX4ECV	1
ITM Panel	Trfr 2 MV Breaker JB M2	Trfr 2 MV CT	BVX4ECV	
ITM Panel	Trfr 1 MV VT JB	Trfr 1 MV VT	BVX4ECV	
ITM Panel	Trfr 2 MV VT JB	Trfr 2 MV VT	BVX4ECV	
ITM Panel	Common Equipment Panel	FO	12MM HDD	1
ITM Panel	IDF	Alarm	TPH10AX	1

				1
TAP CHANGE PANEL			BVX2ECV	1
TCP	DC Board M1	DC Supply	BVX2ECV	1
TCP	DC Board M2	DC Supply	BVX2ECV	1
TCP	132kV MEAS PANEL	VT INPUT	BVX4ECV	1
TCP	132kV MEAS PANEL	CT INPUT	BVX4ECV	1
TCP	Common Equipment Panel	FO	12MM HDD	
TCP	IDF	Alarm	TPH10AX	
ADDITIONAL F/O CABLES				
FSP 1	FSP 2	FO	12MM HDD	2
FSP 1	GATEWAY PANEL 1	FO	12MM HDD	2
FSP 2	GATEWAY PANEL 2	FO	12MM HDD	2
FSP 1	Common Equipment Panel	FO	12MM HDD	1
FSP 2	Common Equipment Panel	FO	12MM HDD	1
132kV BUSBAR 1B				
BB1 VTJB1	CVT - R	BB1 VT RED	BVX4ECV	
BB1 VTJB1	CVT- W	BB1 VT WHITE	BVX4ECV	1
BB1 VTJB1	CVT - B	BB1 VT BLUE	BVX4ECV	1
BB1 VTJB1	PLUG BOX	HEATER	BVX2ECV	1
132kV TRANSFORMER 14				
TRFR14 VTJB	CVT - R	BB1 VT RED	BVX7ECV	1
TRFR14 VTJB	CVT- W	BB1 VT WHITE	BVX7ECV	1
TRFR14 VTJB	CVT - B	BB1 VT BLUE	BVX7ECV	1

ADDITIONAL INFORMATION

#	Quantity	Drawing #	Rev	Description
1	**1**	**Moo21P05-SE-E44 sheet 3**	**0**	**Operational Floodlighting 400/230V AC Schematic and Cable**
2	1	Moo21P05-SE-D6	0	Station Electric Diagram
3	1	Moo21P05-SE-D7	0	Key Plan
4	1	Moo21P05-SE-D8	0	Foundation and Trench drawing
5	1	Moo21P05-SE-D10	0	Earthmat layout
6	1	Moo21P05-SE-D11	0	Overhead Earthwire Layout
7	1	Moo21P05-SE-D12 sheet 1	0	132kV Tubular Busbar Layout
8	1	Moo21P05-SE-D12 sheet 2	0	400kV Tubular Busbar Layout
9	1	Moo21P05-SE-D13	0	Steelwork Marking Plan
10	1	Moo21P05-SE-D16 sheet 0	0	Bay Cover Sheet
11	1	Moo21P05-SE-D16 sheet 2A	0	Conductor & Hardware sheet
12	1	Moo21P05-SE-D16 sheet 3	0	400kV Bus Coupler A
13	1	Moo21P05-SE-D16 sheet 3A	0	400kV Bus Coupler A - Earthing
14	1	Moo21P05-SE-D16 sheet 4	0	400kV Feeder 1 (spare)
15	1	Moo21P05-SE-D16 sheet 7	0	400kV Feeder 4 (spare)
16	1	Moo21P05-SE-D16 sheet 10	0	400kV BB1 BS2 with CVT and BB ES
17	1	Moo21P05-SE-D16 sheet 10	1	400kV BB1 BS2 with CVT and BB ES
18	1	Moo21P05-SE-D16 sheet 10A	0	400kV BB1BS2 with CVT & BB ES - Earthing
19	1	Moo21P05-SE-D16 sheet 13	0	400kV Transformer 11 (Spare)
20	1	Moo21P05-SE-D16 sheet 16	0	400kV Transformer 14 bay
21	1	Moo21P05-SE-D16 sheet 16A	0	400kV Transformer 14 bay - Earthing
22	1	Moo21P05-SE-D16 sheet 18	0	400kV Busbar Intertie (Decommission)
23	1	Moo21P05-SE-D16 sheet 19	0	400kV Transfer Bus Coupler A
24	1	Moo21P05-SE-D16 sheet 19A	0	400kV Transfer Bus Coupler A - Earthing
25	1	Moo21P05-SE-D16 sheet 47	0	400kV Feeder 5 (spare)
26	1	Moo21P05-SE-D16 sheet 48	0	400kV Feeder 6 (spare)
27	1	Moo21P05-SE-D16 sheet 20	0	132kV Bus Coupler A
28	1	Moo21P05-SE-D16 sheet 20A	0	132kV Bus Coupler A - Earthing
29	1	Moo21P05-SE-D16 sheet 21	0	132kV Feeder 1 bay (Spare)

30	1	Moo21P05-SE-D16 sheet 22	0	132kV Feeder 2 bay (Spare)
31	1	Moo21P05-SE-D16 sheet 23	0	132kV Feeder 3 bay (Spare)
32	1	Moo21P05-SE-D16 sheet 28	0	132kV Feeder 8 bay (Spare)
33	1	Moo21P05-SE-D16 sheet 29	0	132kV Feeder 9 bay (Spare)
34	1	Moo21P05-SE-D16 sheet 31	0	132kV BB1 BS2 with BB VTs
35	1	Moo21P05-SE-D16 sheet 31A	0	132kV BB1 BS2 with BB VTs - Earthing
36	1	Moo21P05-SE-D16 sheet 34	0	132kV BB1BS1(Fut)with BBVT&ES (Decomm)
37	1	Moo21P05-SE-D16 sheet 37	0	132kV Trfr 11 (Spare)
38	1	Moo21P05-SE-D16 sheet 40	0	132kV Trfr 14 bay
39	1	Moo21P05-SE-D16 sheet 40A	0	132kV Trfr 14 bay - Earthing
40	1	Moo21P05-SE-D16 sheet 40B	0	132kV Trfr 14 Tertiary Bay
41	1	Moo21P05-SE-D16 sheet 40C	0	132kV Trfr 14 Plinth drawing
42	1	Moo21P05-SE-D16 sheet 41	0	132kV Feeder 10 bay (Spare)
43	1	Moo21P05-SE-D16 sheet 42	0	132kV Feeder 11 bay (Spare)
44	1	Moo21P05-SE-D16 sheet 43	0	132kV Feeder 12 bay (Spare)
45	1	Moo21P05-SE-D16 sheet 44	0	132kV Feeder 13 bay (Spare)
46	1	Moo21P05-SE-D16 sheet 45	0	132kV Feeder 14 bay (Spare)
47	1	Moo21P05-SE-E43	0	Access control building Electrical installation & Schematic Diagram
48	1	Moo21P05-SE-E43 sheet 1	0	Security Lighting Layout
49	1	Moo21P05-SE-E43 sheet 2	0	Security Lighting SLDB1 and SLDB2 Schematic Diagram Layout
50	1	Moo21P05-SE-E44 sheet 1	0	Operational Floodlighting Cable route and Mast Location layout
51	1	Moo21P05-SE-E44 sheet 2	0	Operational Floodlighting 400/230V AC Schematic and Cable block diagram