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1. INTRODUCTION

The line will run in a northerly direction from the Eskom Oranjemond substation near Alexander Bay in the Northern Cape to the remote substation in Namibia. The substation in Namibia, Obib, is approximately 95 km away however Eskom will only be responsible for the design and construction of the first 2 km of the line.

The line is a single circuit 400 kV line and will utilise the 517 series strain towers. In addition to this the line will also make use of the 540 B double circuit structure in a semi - delta single circuit configuration.

To achieve this 400 kV connection, the Eskom network in the area will require some modifications. The newly built Gromis – Oranjemond 1 line was built at 400 kV but is currently operating at 220 kV since there is currently no 400 kV injection at Oranjemond substation.

To achieve a 400 kV injection at Oranjemond substation the Gromis – Juno line, which is currently at the very late stages of its construction phase, will have to be built and energized. Along with this, the Gromis and Oranjemond substations will require new 400 kV yards.

The Gromis – Oranjemond 1 line will also have to be deviated at Gromis and Oranjemond substations to terminate at the 400 kV yard instead of the 220 kV yard. The deviations at both ends of this line will be included in the scope of work of this project. This deviation will make use of the 518 series towers.

2. DOCUMENT CONTENTS

2.1 SCOPE SUMMARY

The scope of work for the ESKOM – NAMPOWER 2nd 400 kV interconnector includes the following two Steps as listed below:

Step 1: Deviate existing 400kV Gromis – Oranjemond line at both subs.

- At Oranjemond from existing T270 to new T271.
- At Gromis from existing T2, four new towers to new feeder bay.
- At Oranjemond, dismantle existing T271
- At Gromis, dismantle existing T1
- JB at Gromis gantry and T10
- JB at Oranjemond gantry and T266
- New Joint Box (JB) at T270 and gantry (3 structures including gantry)
- New JB at T2 and 400kV gantry (6 structures including gantry)
- 1x 16kA Optical-fibre Groundwire (OPGW) and 1x 19/2.7 steel wire (Greased)
- New dead ends for existing T2 and T270
- New phase conductor and hardware from T2 to T001D to T001A up to gantry
- New phase conductor from T270 to T271 to gantry

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- New hardware for T271 and gantry
- New earth wire and hardware for T2 to T001D to T001A up to gantry
- New earth wire and hardware from T270 to T271 to gantry

Step 2: Build New 400kV line to NamPower

- From Oranjemond to across border – 2km new line
- Gantry plus 5 new towers
- 1x 12kA OPGW and 1x 19/2.7 steel wire (greased)
For T3 and T4, 540B structure, only supply hardware for one circuit

2.2 PURPOSE

Scope of Works Document for the deviation of existing Gromis – Oranjemond 400 kV line at both Gromis and Oranjemond 400 kV line and the building of the new 400 kV line towards the Namibia border for the 2nd 400 kV Interconnector from Oranjemond Substation.

2.3 APPLICABILITY

This document shall apply to the ESKOM – NAMPOWER 2nd 400 kV Interconnector project only.

2.3.1 NORMATIVE/INFORMATIVE REFERENCES

2.3.1.a.1 NORMATIVE

Parties using this document shall apply the most recent edition of the documents listed below:

- 240-4717 2520 (TRMSCAAC6 or latest) - The Standard for the Construction of Overhead Powerlines
- ISO 9001:2015 Quality Management System
- ISO 14001: 2015 Environmental Management System
- National Environmental Management Act, 1998 (NEMA) (Act No 107 of 1998)
- Occupational, Health and Safety Act 85 of 1993
- SANS10280 - Overhead power lines for conditions prevailing in South Africa

2.3.1.a.2 INFORMATIVE

- Occupational Health and Safety Risk Assessment Procedure, 32-520
- Occupational Health and Safety Act, 1993, Construction Regulations, 2014

2.4 SAFETY, HEALTH AND ENVIRONMENT

- Personal Protective Equipment (PPE) as per contractor and SHE spec requirements.
- Risk Assessments with Prevention/mitigation measures

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- Emergency procedures
- Covid – 19 safety regulations
- Access roads
- Qualification/training requirements.
- Safety regulations applicable to groundwork under power lines will need to be followed.
- Detailed safe work procedures by the contractor required as per Construction Regulations.

3. DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

Term	Definition
Construction work	The erection, maintenance, alteration, renovation, repair, demolition or dismantling of or addition to a building or any similar structure
	The installation, erection, dismantling or maintenance of a fixed plant where such work includes the risk of a person falling
	The construction, maintenance, demolition or dismantling of any bridge, dam, canal, road, railway, runway, sewer or water reticulation system or any similar civil engineering structure
Contractor	An employer who performs construction work and includes principal contractors
Detailed Inspection	Visual inspection where defects and or risks have been identified on the powerline. This to be done daily before any activities can commence, this information should be communicated to all workers.
Pole top inspection	<p>Detailed inspection of all components of the powerline where ground-inspection cannot identify damages, defects and or risks.</p> <p>Competent and experienced linesmen with experience in tower assembly, erection and stringing should conduct this inspection.</p> <p>Photographic evidence of all the damages, defects, and risks to be submitted on the report.</p> <p>The report should be submitted daily on tower that is being worked on.</p> <p>The inspection will be conducted on the earth-peaks, cross-arms, beam of tower, k-frames, body (including extensions) and legs (including extensions).</p> <p>This inspection will be conducted visually to identify the following defects:</p> <ol style="list-style-type: none"> 1. Tower member and plates damages (cracks, bending, crumbling, visible gaps between members, elongation of members, deformation and bends on the members.

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	<ol style="list-style-type: none"> 2. Hardware deformed and or under load not designed for the item. Fatigue on existing hardware components due to unbalanced loads on the structures. 3. Insulators showing signs of damages, including cracks on the end-fittings, and bent stems on the ball fitting. 4. Both surface and component surface corrosion in terms of plates, joints, and members. These will be investigated during the permanent recovery project.
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3.2 Abbreviations

Term	Definition
LES	Lines Engineering Services
SOW	Scope of Work
PPE	Personal Protective Equipment
OHS Act	Occupational Health and Safety Act
SHE	Safety Health and Environment
OPGW	Optical-fibre Groundwire
JB	Joint Box

4. LINE DETAILS

The Gromis – Oranjemond 400kV line was constructed and commissioned in the year 2018, the summary of the line is on Table 1, 2 and 3. More information about the towers and conductors can be found on the Design and Specification document.

Table 1: Line details summary.

Construction Year	2018
Line Length	131 km
Conductor	Triple Tern (Greased) 450 mm spacing Templated @ 60 – Degrees Celsius
Insulators	Composite long-rod insulators
Towers	517 – series Self-support 518 – series Self support 529 A Cross-rope guyed towers
Earthwire	Greased Steelwire (19/2.7)
Fibre	16 kA AFL 17.3 mm Fibre OPGW

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Table 2: Tower data and location.

Twr Pref No	Bend?	Type	S_Type	Cond Att.	Deg. Lat	Deg. Long	Height Above MSL
1GRO-ORA 1	Y	517	F	25	-29.598676S	17.180403E	133.7
1GRO-ORA 2	Y	517	E	29	-29.595200S	17.178518E	135.1
1GRO-ORA 3	N	529	A	31.5	-29.591574S	17.176227E	134.5
1GRO-ORA 4	N	529	A	33	-29.587523S	17.173668E	134.6
1GRO-ORA 5	N	529	A	30	-29.583401S	17.171064E	139.9

1GRO-ORA 266	N	529	A	18	-28.560823S	16.607004E	136.2
1GRO-ORA 267	N	529	A	28.5	-28.558629S	16.605439E	119.2
1GRO-ORA 268	N	517	A	22	-28.555572S	16.603260E	114.9
1GRO-ORA 269	Y	517	E	21	-28.552624S	16.601158E	75.5
1GRO-ORA 270	Y	517	E	19	-28.549896S	16.600921E	69.4
1GRO-ORA 271	Y	517	F	18	-28.547184S	16.600535E	60.7

Table 3: Conductor Spans on the affected section.

Tower Prefix	From Tower	To Tower	Type	No. Cond.	Earth Wire	Earth Wire2	Length	Chainage	Temp.	Constr. Year
1GRO-ORA	1	2	TERN	3	19/2.7	AF16k17.3d0.215-66	426.0m	0.426km	60C	2018
1GRO-ORA	2	3	TERN	3	19/2.7	AF16k17.3d0.215-66	459.0m	0.885km	60C	2018
1GRO-ORA	3	4	TERN	3	19/2.7	AF16k17.3d0.215-66	513.0m	1.398km	60C	2018
1GRO-ORA	4	5	TERN	3	19/2.7	AF16k17.3d0.215-66	522.0m	1.920km	60C	2018

1GRO-ORA	266	267	TERN	3	19/2.7	AF16k17.3d0.215-66	287.0m	128.801km	60C	2018
1GRO-ORA	267	268	TERN	3	19/2.7	AF16k17.3d0.215-66	400.0m	129.201km	60C	2018
1GRO-ORA	268	269	TERN	3	19/2.7	AF16k17.3d0.215-66	386.0m	129.587km	60C	2018
1GRO-ORA	269	270	TERN	3	19/2.7	AF16k17.3d0.215-66	303.0m	129.890km	60C	2018
1GRO-ORA	270	271	TERN	3	19/2.7	AF16k17.3d0.215-66	303.0m	130.193km	60C	2018

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5. PROJECT RISKS

The following risks can be encountered on site and must be considered when compiling Safe Work Procedures:

- Detailed inspection to be done on all existing towers to identify additional risks before work commences.
- Unstable and uneven ground during construction on all towers.
- Space constraints and access for heavy duty equipment for towers within the existing Substations.
- Working in proximity to an active Orange river. Environmental sensitive and protected area (NEMA and WULA) requirements to be observed throughout.
- Unknown Depth and water flow speeds on the Orange river (drowning and beaching risks).
- Working at heights.
- Vandalism and Damage to infrastructure (towers & conductors) due to the outage on the line.
- Construction in the vicinity and proximity of live and energized infrastructure within the two substations. Earthing of the line to be done accordingly.
- Only Three towers (Twr 001, 002, and 271) to be decommissioned, the rest of the existing line to be worked on should not be DAMAGED during construction.
- Conductor and Groundwire Hardware & insulators on the decommissioned towers to be re-used and should not be damaged. This will be kept at the Substation close to the decommissioned tower.

A generic risk assessment matrix has been included LES1227 on Appendix G of the Line Design and Specification document.

6. DETAILED SCOPE OF WORKS

This scope of works only addresses the deviation of existing line and construction of the new section to the Namibian border. All work to be done as per the Detailed Design and Specification document LES1227 and OPGW and Hardware Scope of works document LES1500.

Step 1: Deviate existing 400 kV Gromis – Oranjemond line at both subs.

- Isolate & Earth existing line
- Build new tower T271 and connect to new Substation Gantry
- Implement correct earthing for the new towers to the Substation as per the ESKOM Earthing Standard (this includes measurements and mitigations).
- At Oranjemond deviate the line from existing T270 to new T271.
- Re-use Side A of tower T270 hardware and insulators.
- Fit new jumpers on new tower T271 and T270
- At Oranjemond, dismantle existing T271.
- Build four new towers T001A-T001D connect to new Substation Gantry.

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- Implement correct earthing for the new towers to the Substation as per the ESKOM Earthing Standard (this includes measurements and mitigations).
- String and regulate conductor and earthwire on the new section.
- At Gromis deviate from existing T002, to new tower T001D and onto the new feeder bay.
- Re-use Side B of tower T002 hardware and insulators.
- Fit new jumpers on new towers and existing tower T002.
- At Gromis, dismantle existing T001.
- Scrap biproducts of the decommissioned sections.
- Safely store hardware and insulators at both Gromis and Oranjemond as per Grid requirements.

OPGW summary scope (refer to OPGW SoW document)

- New JB at Gromis gantry and T010
- New JB at Oranjemond gantry and T266
- New JB at T270 and gantry (3 structures including gantry)
- New JB at T002 and 400kV gantry (6 structures including gantry)
- String 1x 16kA Optical-fibre Groundwire (OPGW) and 1x 19/2.7 steel wire (Greased)
- New dead ends for existing T002 and T270
- New phase conductor and hardware from T002 to T001D to T001A up to gantry
- New phase conductor from T270 to T271 to gantry
- New hardware for T271 and gantry
- New earth wire and hardware for T002 to T001D to T001A up to gantry
- New earth wire and hardware from T270 to T271 to gantry

Step 2: Build New 400 kV line to NamPower (Oranjemond to across border – 2 km new line)

- Peg bend points of the new towers as per the Staking Table.
- Perform soil nomination of the new tower.
- Procure and install new towers (5 x towers).
- Perform earth resistance test for new towers.
- Implement correct earthing for the new towers to the Substation as per the ESKOM Earthing Standard (this includes measurements and mitigations).
Dress all tower with new hardware and gantry, for T3 and T4, 540B structure only supply hardware for one circuit
- String and regulate new OPGW and Steelwire as per staking table on the new towers to gantry (1x 12kA OPGW (greased) and 1x 19/2.7 steel wire (greased)).
- String and regulate new Triple Tern (greased) conductor at 60-Degrees Celsius for new towers to gantry. For T3 and T4, 540B structure, only string three phases for one circuit as per the specification.

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- Fit vibration dampers on the groundwires
- Fit spacer dampers on the new section and existing conductors being re-used.
- Label entire line.
- Place phasing disks as per the specification.
- Install anti-vandal measures as per specification.
- Install anti-climb devices on all new towers.
- Rehabilitate all construction areas.

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