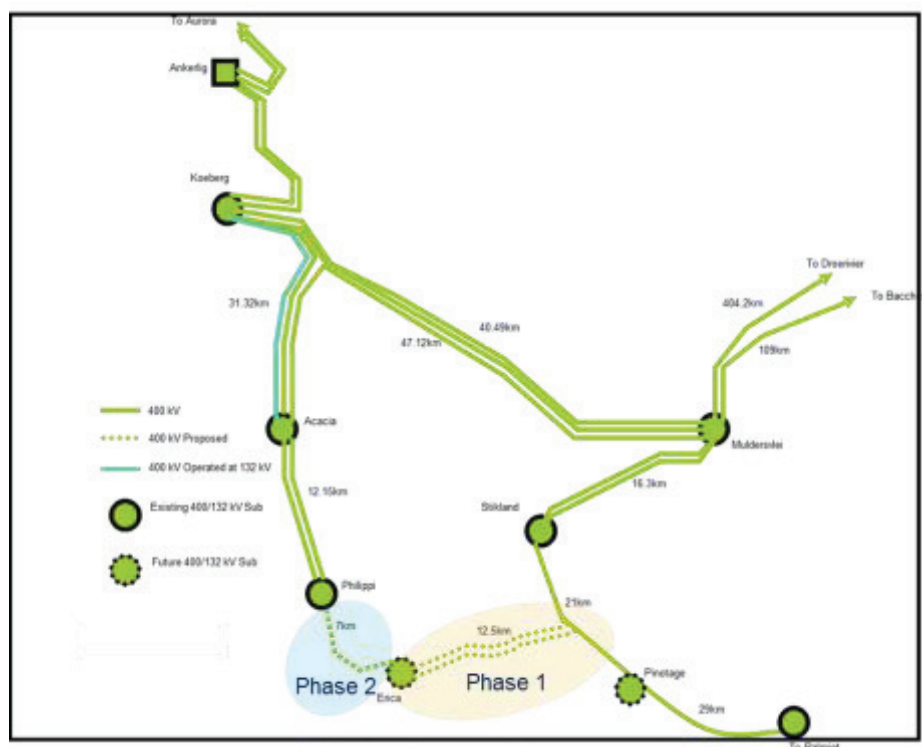


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Scheme (if applicable): City of Cape Town Strengthening			
Project Name: Philippi Substation Extension			
URS Revision Number:			
Project Originator/s			
GRID PLANNING	<input checked="" type="checkbox"/>	ASSET INVESTMENT PLANNING	<input type="checkbox"/>
		GRID	<input type="checkbox"/>
OTHER (Please Specify) <input type="checkbox"/> _____			
Planned Commercial Operation date: 2020			
Planning Report / Originator's Report	No. GP_14/01 GP_17/05	Revision	Date: February 2014 February 2017
Related Schemes/Projects	Current	City of Cape Town Strengthening (Erica Substation)	
	Future		
Originator: Ahmed Hansa		Compiler: Pamela Kamera	

High Level Scope of Work (Diagram if required) :



Upgrade Philippi Substation as follows:

- Establish a 400 kV busbar to accommodate the existing Acacia 1 and 2 400 kV lines, the future Erica 1 400 kV line and the existing Philippi 400/132 kV transformers.
- Install a third 500 MVA transformer and 3 x 15 mH transformer MV FCLRs.

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SUBSTATION PLANT REQUIREMENTS					
Substation Name: Philippi Substation					
Transmission Grid: Western Cape OU					
Reliability Level (mark with "X")	N-0		N-1		N-2 X
Fault Levels (kA)	Existing		Future		
		1-phase	3-phase	1-phase	3-phase
	V1: 400 kV	14.53 kA	14.52 kA	20.57 kA	20.97 kA
	V2: 132 kV	25.25 kA	22.43 kA	26.21 kA	26.13 kA
	V3: xxx kV				
	V4: xxx kV				
Fault Current Design Requirement	As per Eskom Short-Circuit Current Management Policy V1: 400 kV 50 kA V2: 132 kV 31.5 kA V3:				
Power Transformers 1	MVA <input type="text" value="500"/> Voltage Ratio (kV) <input type="text" value="400/132"/> Quantity <input type="text" value="1"/>				
Power Transformers 2	MVA <input type="text"/> Voltage Ratio (kV) <input type="text"/> Quantity <input type="text"/>				
VOLTAGE 1: 400 kV					
DESCRIPTION (BAYS)	NEW	SPARE	FUTURE	COMMENTS & MVar :	
Feeders	2		1	Acacia 1, Acacia 2, Erica 1 (future)	
Transformers	3			2 x new for existing transformers, 1 x new for 3rd transformer	
Series Reactors					
Line Reactors					
Bus Reactors					
Shunt Capacitors					
Series Capacitors					
FACTS					
VOLTAGE 2: 132 kV					
DESCRIPTION (BAYS)	NEW	SPARE	FUTURE	COMMENTS & MVar:	
Feeders					
Transformers	1			For 3rd transformer at Philippi - with FCLRs	
Series Reactors	3			15 mH FCLRs in line with the transformers	
Line Reactors				LES will finalise as part of design	
Bus Reactors					
Shunt Capacitors					
Series Capacitors					
FACTS					
Fault levels shown assume the installation of 15 mH fault current limiting reactors in series with the transformers on the MV side (132 kV).					

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GRID REQUIREMENTS: (This highlighted section must ALSO be filled in for Grid projects)			
Pollution Level	Heavy <input type="checkbox"/>	Extra Heavy <input type="checkbox"/>	
Insulator Type Preference	Porcelain <input type="checkbox"/>	Composite <input type="checkbox"/>	
Transformers condition monitoring requirements (Please specify if required)			
Comments / Special Requirements:			
Secondary Plant Engineering			
Substation DC Voltage			
Bus-zone Ratios	V1:	V2:	V3:
Number of sets CT's on B/C & B/S			
Telecommunication Requirements			
Equipment to be decommissioned			
Comments/Other Requirements			



**Power Delivery Engineering
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LEGEND	NEW <input type="checkbox"/> N	REPLACE (WITH NEW) <input type="checkbox"/> RN	REPLACE (WITH EXISTING) <input type="checkbox"/> RE	DECOMMISSION <input type="checkbox"/> D	RE-USE <input type="checkbox"/> U
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BAY EQUIPMENT SCHEDULE – PRIMARY AND SECONDARY PLANT REQUIREMENTS (ADD ON AS REQUIRED)

BAY	BB1 ISOL	BB2 ISOL	CB	CT	TRANSFER ISOLATOR	LINE ISOLATOR	VT	LINE TRAP	SA	JB	PROT	TELE COMM	METERING	CONTROL	COMMENTS
<<>>kV Yard															
<<>>kV Yard															
<<>>kV Yard															
<<>>kV Yard															
COMMENTS															

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TRANSMISSION LINE DESIGN REQUIREMENTS (N/A for Grid Projects, see highlighted section below for Grid Projects)	
Line name	Philippi – Erica 400 kV line
Planned Construction completion date	2025
Initial conductor selected by the planner	3 x Tern 60°C
Approx. Length (km)	10 km
Voltage (kV)	400 kV
Worst N-1 contingency	Loss of Tower on Double Circuit Line supplying Erica (Pinotage – Erica & Stikland – Erica 400 kV lines)
PSS/E Base case files to be provided for at least 10 years and also indicate growth assumption for year 11 to year 25.	
PSS/E light load case files to be provided for at least 10 years (important for reactor sizing studies).	
Estimated Load Factor	0.7
<u>Ferranti Studies:</u> Planning study to include Ferranti study. Please indicate if line reactor needed. LES can be consulted to perform these studies. In cases where line reactors are deemed necessary, a Neutral End Reactor sizing study will be needed. This study will be co-ordinated by LES.	No
<u>Tower Type</u> Single/Double/Multi circuit tower	Single
<u>Reliability Levels</u> (Specify only if different levels required) Please indicate any special consideration to increase reliability level to above the normal levels, which will increase the initial capital costs and decrease the probability of line failure <u>132kV and 220kV lines will be designed to reliability level 1 (for dedicated feeders, level 2 will be chosen).</u> <u>275kV, 400kV lines will be designed to reliability level 2.</u>	

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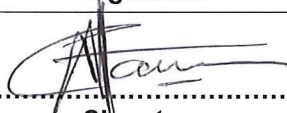
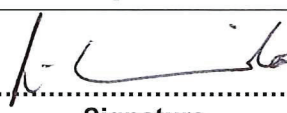
<p><u>500kV, 765kV lines and 600kV HVDC lines will be designed to reliability level 3.</u></p> <p>NB: Concept studies can be done to give an indication of the cost impact of designing the line to the next higher reliability level. Please indicate if these studies are required.</p> <p><i>Ref: Reliability levels as per SANS10280 and IEC60826</i></p>																																																																																					
<p>Future upgrade consideration:</p> <p><i>Please indicate if LES needs to build in flexibility to be able to upgrade the line:</i></p> <p>Example:</p> <ul style="list-style-type: none"> - 400kV to 500kV. - Convert from HVAC to HVDC. - Add more conductors in future (eg. 3 tern to 4 tern). <p><i>LES will then cost out these options in the pre-concept or concept design phase, and consult with planning to make a decision.</i></p>																																																																																					
<p>Assumptions for load growth calculations (N.B: Load forecast must match PSSE case file load flows):</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Year</th><th>2017</th><th>2018</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th><th>2026</th><th>2027</th><th>2028</th><th>2029</th></tr> </thead> <tbody> <tr> <td>Normal Operation (MVA)</td><td></td><td></td><td></td><td></td><td></td><td></td><td>25</td><td>27</td><td>70</td><td>82</td><td>84</td><td>87</td><td>90</td></tr> <tr> <td>Emergency (MVA) (n-1)</td><td></td><td></td><td></td><td></td><td></td><td></td><td>460</td><td>471</td><td>485</td><td>500</td><td>515</td><td>530</td><td>546</td></tr> </tbody> </table> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Year (continued)</th><th>2030</th><th>2031</th><th>2032</th><th>2033</th><th>2034</th><th>2035</th><th>2036</th><th>2037</th><th>2038</th><th>2039</th><th>2040</th><th>2041</th><th>2042</th></tr> </thead> <tbody> <tr> <td>Normal Operation (MVA)</td><td>92</td><td>95</td><td>98</td><td>101</td><td>104</td><td>107</td><td>110</td><td>114</td><td>117</td><td>120</td><td>124</td><td>128</td><td>132</td></tr> <tr> <td>Emergency (MVA) (n-1)</td><td>562</td><td>579</td><td>597</td><td>614</td><td>633</td><td>652</td><td>671</td><td>692</td><td>712</td><td>734</td><td>756</td><td>778</td><td>802</td></tr> </tbody> </table>		Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Normal Operation (MVA)							25	27	70	82	84	87	90	Emergency (MVA) (n-1)							460	471	485	500	515	530	546	Year (continued)	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	Normal Operation (MVA)	92	95	98	101	104	107	110	114	117	120	124	128	132	Emergency (MVA) (n-1)	562	579	597	614	633	652	671	692	712	734	756	778	802
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<p>Other Requirements or comments</p> <p>Eg.</p> <ul style="list-style-type: none"> - Indicate any known servitude restrictions. - Need for <u>high performance lines</u> because of sensitive network or customers or other reasons. LES can introduce extra measures to minimise pollution, bird, fire and lightning faults. These will add to costs. 																																																																																					

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TRANSMISSION LINE DESIGN REQUIREMENTS (Highlighted Section for Grid Projects ONLY)	
Line Name	
REQUIREMENTS/COMMENTS (Describe all your requirements here)	

Approval Documentation Attached			
Document Name	No. & Rev	Date	Comments

Revision Control			
Rev. No	Date	By	Comments
1	Mar 2017	P. Kamera	Changed scope of work to include the installation of the 3 rd transformer, which was previously excluded.

SIGNATORY BLOCK			
GRID PLANNING <input checked="" type="checkbox"/>	ASSET INVESTMENT PLANNING <input type="checkbox"/>	GRID <input type="checkbox"/>	
OTHER(Please Specify) <input type="checkbox"/>			
COMPILER Senior Engineer	P. Kamera Name	 Signature	29/03/2017 Date
FUNCTIONAL RESPONSIBILITY Chief Engineer	A. Hansa Name	 Signature	29/03/2017 Date
AUTHORIZED BY Senior Manager	L. Naidoo Name	 Signature	29/03/2017 Date