

Commissioning Ground Mounted Distribution Substations and Switchgear Job Safety Analysis



Title: Commissioning Ground Mounted Distribution Substations and Switchgear	
Purpose and Scope: To provide instruction on the commissioning of Distribution Substations and Switchgear	
Staffing Resources: Electrical Linesperson, Electrical Mechanic, Competent Assistant, Switching Operator Authorisation, Switching Operator Assistant Authorisation	
Documentation/References: <u>BS001408R100</u> : Low Voltage Connections Manual (Supersedes P61J11 series of documents), <u>P53</u> Operate the Network Enterprise Process. Daily/Task Risk Management Plan <u>CS000501F115</u> . Health and Safety Risk Control Guide <u>ES000901R102</u> . Field Data Collection Form – Transformers/Regulators/Reactors <u>MN000301F101</u> . Underground Construction Manual. Distribution Substations & Switchgear Commissioning Test Report <u>SP0406C01</u> . Field Data Collection Form – HV Switches <u>NA000403F193</u> . Field Data Collection Form – Transformers/Regulators/Reactors <u>NA000403F194</u> . SWP <u>SP0407</u> Commissioning Test for HV Underground Cable (Up to 33KV). SWP <u>SP0405</u> Test LV Underground Cable Installations.	
Key Tools and Equipment: Phase Rotation Meter, Approved LV Test Instruments, Insulation barriers as required, Neutral Tag (IIN 2400801)	
Development Team: Graham Smith, Ken Feltham, Marshall Jones, Don McCormack, Keith Weisse, Stuart Trill	Date Completed: March 2008
Reviewed By: Gary Toon Gordon Edwards Carmelo Pasquale Carmelo Pasquale Carmelo Pasquale	Date Completed: 18/03/2008 12/02/2013 05/07/2014 29/08/2016 08/03/2017
Related SWP/SWMS Nos: <u>SP0405</u> , <u>SP0406</u> , <u>SWMS007</u> , <u>SWMS016</u>	SWP Owner Approval: GM Substations & ES&IS
Key Stakeholders: Customer Service GM's, Field Managers, Work Group Leaders	

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Task No.	Task Step	Hazard	Associated Risk	Consequence	Likelihood	Inherent Risk Score (Without control measures)
1	Daily Task Risk Management.	a. Work site, task or environment hazards.	a. Work site, task or environmental hazards not identified or considered in job planning. Lack of, or inadequate, control measures implemented to address hazards.			
2	Site planning and preparation to perform task	<ul style="list-style-type: none"> a. Work area <ul style="list-style-type: none"> o Ground conditions o Location to other plant/ vehicles b. Traffic and Pedestrians <ul style="list-style-type: none"> o Plant to be setup on busy road o Worksite/drop zone on public property c. Plant, Tools, Network Assets <ul style="list-style-type: none"> o Pre-start checks/inspections not performed by competent person o Out of test/unserviceable o Tools or plant not fit for purpose d. Competence of work crew e. Emergency Planning <ul style="list-style-type: none"> o Not completed or adequate for situation f. Working in trenches g. Isolation of Transformer not in accordance with P53 Operate the network h. Working near energised live parts i. LV mains/customer's installations not prepared for connection e.g. phase rotation not confirmed, test section not created or customer installations not prepared for test. 	<ul style="list-style-type: none"> a. Slips trips, falls. Unstable plant. Collision with other plant/vehicles b. Unauthorised entry to work site. c. Faulty or unsuitable plant, tools and equipment used to perform task. Voltage rating of tools and equipment not adequate for task. d. Tests not performed/ interpreted correctly, LV Mains energised with incorrect configuration, resulting in electric shock, damage to electrical equipment/appliances. e. Injury to workers, contact with live conductors/apparatus f. Engulfment, falls into open trenches g. – i. Electric Shock, Arc Flash, Toxic gases, damage to network, apparatus etc. 	<ul style="list-style-type: none"> Major Moderate Moderate Major Moderate Major Major 	<ul style="list-style-type: none"> Possible Possible Possible Unlikely Possible Unlikely Possible 	<ul style="list-style-type: none"> High Medium Medium Medium Medium Medium High
3	Prepare to energise	<ul style="list-style-type: none"> a. Transformer not isolated from HV & LV systems b. HV Switching sheet does not align with commissioning requirements c. Cable unterminated/ not tested 	<ul style="list-style-type: none"> a. – k. Electric Shock, Arc Flash e.g. burns, toxic gases, damage to network, apparatus etc. 	Major	Possible	High

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		<ul style="list-style-type: none"> d. Earthing tests not performed e. Surge arrester ratings not suitable f. Wiring, bridging and earthing not confirmed correct by visual inspection g. Connections not confirmed tight including cables from RMU to transformer h. Incorrect size and rating of HV and LV fuses i. Incorrect Cable/ Equipment identified for energisation j. Substation, switchgear and cables numbers/ labelling k. Access/Test Permit surrendered prior to commissioning l. Nameplate details against system voltage 				
4	Energise HV Supply	<ul style="list-style-type: none"> a. HV Phasing out (where required) b. HV apparatus/transformer faulty c. Ferroresonance caused by single phase energisation of UG cable d. Commissioning post energisation not performed e. LV Mains/customer's installations not correctly isolated/disconnected f. Incorrect connections g. Defective transformer e.g. insulation failure, open circuit on windings h. Voltages outside acceptable ranges 	<ul style="list-style-type: none"> a. – h. Electric Shock, Arc Flash e.g. burns, toxic gases, damage to network, apparatus etc. 	Major	Possible	High
5	Energise LV Mains/Customer's installation e.g. close links/fuses	<ul style="list-style-type: none"> a. Transformer neutral not earthed, High/Low volts on LV Mains (floating neutral) b. LV Mains/Customer's installation not prepared for LV connection tests correctly. c. Incorrect connections d. Incorrect cable /equipment energised. 	<ul style="list-style-type: none"> a. – d. Electric Shock, Arc Flash, Toxic gases, damage to network, apparatus etc. 	Major	Possible	High

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		e. Phase rotation not previously established				
6	<p>a. Re-instate worksite</p> <p>b. No de-brief of task conducted</p> <p>c. Plant not prepared for travel e.g. stabilisers not retracted, loads not secure</p>	<p>a. Impact to the environment, corporate image.</p> <p>b. Near misses, injuries, damage to plant, tools and equipment not reported, improvements to performance of subsequent tasks not discussed.</p> <p>c. Damage to plant, persons/vehicles struck by projectiles.</p>	<p>a. Impact to the environment, corporate image.</p> <p>b. Near misses, injuries, damage to plant, tools and equipment not reported, improvements to performance of subsequent tasks not discussed.</p> <p>c. Damage to plant, persons/vehicles struck by projectiles.</p>	<p>Moderate</p> <p>Moderate</p> <p>Moderate</p>	<p>Possible</p> <p>Unlikely</p> <p>Possible</p>	<p>Medium</p> <p>Medium</p> <p>Medium</p>

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Control Measures

Task No.	Elimination	Isolation	Substitution	Engineering	Administration	Personal Protective Equipment	Consequence	Likelihood	Residual Risk Score (Control measures implemented)
1a					Training: Field Risk Management ES000901R102. Health and Safety Risk Control Guide. Follow Project Risk Management Plan.	PPE as required in the Field / Workshop Personal Protective Equipment <u>CS000501R110</u>	Moderate	Unlikely	Low
2a					Plant and equipment setup and operated by competent persons in accordance with manufacturer's guidelines.		Minor	Unlikely	Low
2b					Implement Traffic Management Plans Implement <u>SWMS006</u> Working on or Near Roadways.		Moderate	Rare	Low
2c		Exclude traffic, public from Work Zone			Implement Traffic Management Plans Implement <u>SWMS006</u> Working on or Near Roadways.		Moderate	Rare	Low
2d					Training: Generic Field Induction for applicable position e.g. Working at Heights, Harnesses, Operate MEWP LV connection tests performed by persons assessed as competent in LVCM procedures.		Moderate	Rare	Low
2e					Implement <u>BS001404R160</u> Emergency Planning. Competence in MEWP rescue/escape, Pole Top Rescue, Switchboard Rescue and CPR.		Moderate	Rare	Low
2f					Implement <u>SWMS015</u> Excavations. If required implement SWMS relevant to working at heights e.g. SWMS001/002.		Moderate	Rare	Low
2g/h		If exclusion zones cannot be maintained to conductors and apparatus			Transformer isolated for access in accordance with P53 Operate the Network procedures. Apply relevant exclusion zones for associated nearby circuits in		Moderate	Rare	Low

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Task No.	Elimination	Isolation	Substitution	Engineering	Administration	Personal Protective Equipment	Consequence	Likelihood	Residual Risk Score (Control measures implemented)
		isolated in accordance with P53 Access the Network requirements			accordance <u>P53H05R05</u> Reference Document: Exclusion Zones. Implement <u>SWMS007</u> Live LV Work. <u>Caution</u> <i>If tap position changer is within the exclusion zone, isolate HV to the transformer, test and earth. Issue access permits then change tap position.</i>				
2i					Prepare LV mains, customer's installation as required by chosen LVCM Procedure/s Implement <u>SWMS007</u> Live LV Work.	Class 00 gloves	Moderate	Rare	Low
3a- I		Isolate cable from HV systems including secondary sources of supply in accordance with Ergon Energy high voltage isolation and access procedures.			Isolate LV cable to be tested from all sources of supply and tagged in accordance with LV isolation requirements. Ensure all members of working party sign on and understand requirements of LV Isolation Section of Daily/Task Risk Management Plan. Apply relevant exclusion zones for associated nearby circuits in accordance <u>P53H05R05</u> Reference Document: Exclusion Zones. Confirm HV/LV cables are tested and applicable Test/Commissioning Sheets, Authorisations are filled out: Confirm that correct cable/equipment are to be energised where multiple cable have been installed Apply requirements of <u>SWMS015</u> Excavations. Perform low resistance tests across circuit breakers contacts and fuses as		Moderate	Rare	Low

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Task No.	Elimination	Isolation	Substitution	Engineering	Administration	Personal Protective Equipment	Consequence	Likelihood	Residual Risk Score (Control measures implemented)
					<p>required.</p> <p>Confirm all cable ends are terminated prior to energisation.</p> <p>Ensure all members of working party are notified and sign off Permit at surrender.</p> <p>Confirm transformer nameplate voltages and configurations are consistent with system requirements and record details on <u>NA000403F193</u> HV Switches - Field Data Collection Form and <u>NA000403F194</u> Transformers/Regulators/Reactors - Field Data Collection Form <u>or</u> update via the relevant Field Data Collection Update Forms on the ToughPad.</p> <p>Perform visual inspection and earth tests to ensure mechanical and electrical integrity of substation earthing system including MEN bonds.</p> <p>HV and LV cable tests to be completed.</p> <p>Confirm wiring, bridging and earthing correct by visual inspection and connections tight including RMU to transformer cables.</p> <p>Safety signs e.g. Danger HV and Authorised Persons Only to be displayed.</p>				
4		If required to alter transformer tap setting isolate prior to changing voltage tap. If any tasks require			<p>Confirm LV supply no loads volts within statutory limits.</p> <p>Confirm transformer LV connections, phases/neutral with main neutral and MEN disconnected.</p> <p>De-energise transformer and reconnect main neutral and MEN after polarity test.</p>		Moderate	Rare	Low

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Task No.	Elimination	Isolation	Substitution	Engineering	Administration	Personal Protective Equipment	Consequence	Likelihood	Residual Risk Score (Control measures implemented)
		persons to be within exclusion zone, need to isolate, test, earth and issue Access Permit.							
5					<p>Conduct LV connections tests on LV mains/customer's installation/s as per Low Voltage Connections Manual. Ensure all final tests have been carried out and completed works have been built to the design plan &/ construction standards.</p> <p>Where multiple cables have been installed confirm that any unterminated cables have been left energised and the correct equipment has been energised. Confirm the cabinet / padmount is locked, or the pillar lid is replaced and securely bolted down, where work has been carried in these areas.</p> <p>Make the site electrically and mechanically safe and tidy the area before leaving.</p>		Moderate	Rare	Low
6	Items which may become projectiles during transport, secured in storage compartments.			Utilise cargo nets, tie-downs	<p>Seek advice if environmental impacts have been identified.</p> <p>Remove all waste and dispose of correctly.</p> <p>On completion of allotted task, conduct debrief, discuss changes to controls, near misses. Identify areas for improvement. Document/report to supervisor.</p>		Minor	Rare	Very Low

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Risk Likelihood Table

Likelihood Rating	Definition of Likelihood of Occurrence Rating
Almost Certain	(1) Reasonably expected to occur (<12 months) (2) Will occur in most circumstances
Likely	(1) Likely to occur within next 3 years (2) Probably occur in near future
Possible	(1) Likely to occur within next 10 years (2) Might occur at some time
Unlikely	(1) Not specifically expected to occur but may occur some time in future (<10 years) (2) May occur in exceptional circumstances
Rare	(1) Foreseeable but not normally expected to occur (>10 years) (2) Requires a chain of related unlikely events to occur

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Consequence Table

Primary Impacts	Definitions of Consequence Impact Rating				
	Catastrophic	Major	Moderate	Minor	Insignificant
Health & Safety	<ul style="list-style-type: none"> • Circumstances that lead to a Single Fatality. 	<ul style="list-style-type: none"> • Circumstances that lead to Serious Injury, Hospitalisation, Lost Time Injury. 	<ul style="list-style-type: none"> • Circumstances that lead to First Aid being required. 	<ul style="list-style-type: none"> • Circumstances that lead to a Near Miss. 	<ul style="list-style-type: none"> • Not applicable.
Environmental	<ul style="list-style-type: none"> • Long term impact to sensitive environments. Negative widespread national and international media coverage. • Emergency response involving external emergency services. 	<ul style="list-style-type: none"> • Medium term impact to sensitive or non-sensitive environments. • Negative state media coverage. 	<ul style="list-style-type: none"> • Moderate impacts to non-sensitive environments or minor impact to sensitive environments. • Many complaints received from community and customers. 	<ul style="list-style-type: none"> • Minor impacts to non-sensitive environments. • Isolated community and customer complaints. 	<ul style="list-style-type: none"> • Incident contained on-site. • Impact tolerated without complaints.
Financial	<ul style="list-style-type: none"> • >\$20M 	<ul style="list-style-type: none"> • \$5M to \$20M 	<ul style="list-style-type: none"> • \$1M to \$5M 	<ul style="list-style-type: none"> • \$200,000 to \$1M 	<ul style="list-style-type: none"> • <\$200,000
Corporate Reputation	<ul style="list-style-type: none"> • Parliamentary inquiry. • Shareholder intervention. 	<ul style="list-style-type: none"> • Formal ministerial direction. • Highly critical and sustained publicity. • State-wide media coverage. 	<ul style="list-style-type: none"> • Negative questions on notice in Parliament. • Negative questions at local council. • Critical but not sustained publicity and media coverage. 	<ul style="list-style-type: none"> • Single local issue that has potential to spread if not managed quickly. • Community outrage results in reprioritising work program. 	<ul style="list-style-type: none"> • Low level Parliamentary question. • GM Service Delivery involvement and adverse media reports.
Legal & Regulatory	<ul style="list-style-type: none"> • Prosecution of Directors & or Managers. • Loss of operating licence. 	<ul style="list-style-type: none"> • Prosecution of Company / Regulatory Penalty. 	<ul style="list-style-type: none"> • Major Adverse Audit Report leading to significant works required. • Regulatory Improvement Notice or Fine. 	<ul style="list-style-type: none"> • Minor Adverse Audit Report leading to minor works required. 	<ul style="list-style-type: none"> • Minor Adverse Audit Report with no material ongoing impact.
Reliability & Service Delivery	<ul style="list-style-type: none"> • Outage duration greater than 40,000,000 customer minutes. • Business terminating interruption to major 	<ul style="list-style-type: none"> • Outage duration 5,000,000 to 40,000,000 customer minutes. • Major financial loss (>\$5M) to major customer. 	<ul style="list-style-type: none"> • Outage duration 1,000,000 to 5,000,000 customer minutes. • Significant financial loss (\$1M to \$5M) to major 	<ul style="list-style-type: none"> • Outage duration 200,000 to 1,000,000 customer minutes. • Financial loss (<\$1M) to major customer. 	<ul style="list-style-type: none"> • Outage duration less than 200,000 customer minutes.

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Primary Impacts	Definitions of Consequence Impact Rating				
	Catastrophic customer (>10MW).	Major	Moderate customer.	Minor	Insignificant

Level of Risk Matrix

Likelihood \ Consequence	Rare	Unlikely	Possible	Likely	Almost Certain
Catastrophic	Medium	High	High	Extreme	Extreme
Major	Medium	Medium	High	High	Extreme
Moderate	Low	Medium	Medium	High	High
Minor	Very Low	Low	Medium	Medium	Medium
Insignificant	Very Low	Very Low	Low	Medium	Medium

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Risk Tolerance / Acceptability Table

RISK TOLERABILITY CRITERIA, APPROVAL & ACTION REQUIREMENTS				
LEVEL of RISK	RISK		ACTION REQUIREMENTS	
	APPROVAL	REPORTING	ACTION	
	POSITION			
Extreme - Intolerable (stop exposure immediately) Immediate action required, needs active management - introduce new or changed risk controls to reduce the RESIDUAL level of risk to the Tolerable Range. 				
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