

# SUBSTATION EARTH TESTING JOB SAFETY ANALYSIS



Title: Substation Earth Testing JSA	
Purpose and Scope: To identify the hazards and control measures associated with measuring step and touch potentials and measuring earth mat resistance using the remote injection method	
Staffing Resources: EFM experienced in the use of test equipment. Competent assistant. Both staff are required to be trained in switchboard rescue and resuscitation and manual handling techniques. Both staff are to have appropriate Switching & Access authorisations for the roles they are required to perform and have the ability to assess and maintain relevant exclusion zones from exposed live electrical apparatus.	
Documentation/References: IEEE Std 80, AS2067-1984, P53 HVIA Procedures, ESO Code of Practice – Works, ESO Code of Practice – Electrical Work, Carry Out Field Testing Job Safety Analysis SP0506R01	
Key Tools and Equipment: Generator, Matching Transformer, Spectrum Analyser, RMS Multimeter, Current Tong, Earth Stakes and Hammer, Insulated Leads, 20 kg 8 cm diameter weights, 1000 ohm loading resistor	
Development Team: Graham Smith, Matthew Ogg, Robert Bates	Date Completed: 20 November 2003
Reviewed By: Brad Elliot	Date Completed: 21 November 2003
Related SWP No.: SP05xx	SWP Owner Approval: Neil Dwyer, Manager Technical Services
Key Stakeholders: John Cass, Manager Transmission Services	

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Task No.	Task Step	Hazard	Most Likely Breakdown Event (Loss Of Control)	Most Likely Outcome (Incident Outcome)	Risk Score	
					Existing Controls	Additional/ Alternate Controls
	<p>Many of the hazards, breakdown events, outcomes, risk scores and control measures associated with remote injection testing of substation earthmats have been identified in "Carry Out Field Testing Job Safety Analysis" SP0506R01 and it's Standard Work Practice SP0506. The activities identified include:</p> <ul style="list-style-type: none"> <li>• Preliminary Planning</li> <li>• Load Vehicle</li> <li>• Travel to worksite</li> <li>• Entry to worksite</li> <li>• Toolbox Meeting</li> <li>• Unload Vehicle and Set up Test Equipment</li> <li>• Carry Out Test</li> <li>• Strip down test equipment, return plant to service, load vehicle</li> <li>• Return to depot</li> <li>• Unpack, drawing markups, complete test reports</li> </ul> <p>This JSA identifies additional hazards and control measures uniquely associated with carrying out substation earth testing.</p>					
5.1	Inject current between earthmat under test and remote earthmat	Electrical	Inadvertent contact with live generating equipment	Electric shock, burns	M	L
5.3	Run out remote earth lead from earthmat under test and connect to measuring equipment	Electrical	System earthfault at time of connecting measuring equipment and subsequent contact with induced or transferred potential rise	Electric shock, burns	L	

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## Existing Control Measures

Task No.	Elimination	Substitution	Engineering	Administration	Personal Protective Equipment	Risk Ranking			
						C = Consequences	E = Exposure	P = Probability	Risk Score
5.1			Use of insulated leads. Connect to busbar/line at high level connections clear of personnel contact. Only use generator with covered LV terminals.	Rope off and apply signage to zones at the substation under test and the remote earthmat where dangerous voltages exist	Long cotton shirt/pants, safety shoes, safety helmet.	3	5	4	M
5.3			Use of insulated leads. Use of insulated connectors.	Test during fine weather only	Long cotton shirt/pants, safety shoes, safety helmet.	2	5	4	L

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Additional/Alternative Control Measures

Task No.	Elimination	Substitution	Engineering	Administration	Personal Protective Equipment	Risk Ranking			
						C = Consequences	E = Exposure	P = Probability	Risk Score
5.1				Appoint safety observer at all sites where dangerous voltages are utilised		3	5	5	L

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## 1: DETERMINE CONSEQUENCE: - The most likely outcome of a potential incident resulting from exposure to the identified hazard.

Level	Descriptor	Definition
5	Disaster	Fatality; toxic release off-site with detrimental effect; financial loss (>\$1,000,000).
4	Very Serious	Extensive injuries (e.g. permanent disability, amputation) requiring medical treatment, hospitalisation and long term rehabilitation; off-site release with no detrimental effects loss of production capability; financial loss (\$500,000 to \$1,000,000).
3	Serious	Disabling injuries requiring medical treatment and rehabilitation (e.g. broken limbs, hospitalisation); on-site release contained with outside assistance; financial loss (\$50,000 to \$500,000).
2	Substantial	Medical treatment required (e.g. stitches, removal of foreign body); on-site release immediately contained; financial loss (\$5,000 to \$50,000).
1	Minor	First aid treatment; negligible environmental damage; financial loss (<\$5,000).

## 2: DETERMINE EXPOSURE: - How often a person interacts with a hazard.

Level	Descriptor	Definition
1	Continuous	Many times a day.
2	Frequent	Daily.
3	Occasional	Weekly.
4	Infrequent	Between weekly and monthly.
5	Rare	Between monthly and yearly.
6	Very Rare	Less than once a year.

## 3: DETERMINE PROBABILITY

The likelihood of the breakdown event and nominated consequences occurring once the person is exposed to the hazard.

Level	Descriptor	Definition
1	Almost Certain	Breakdown event will almost certainly occur from exposure to hazard.
2	Quite Possible	Not unusual for breakdown event occurring, even 50/50 chance.
3	Unusual but Possible	Unusual for breakdown event to occur but possible.
4	Remotely Possible	Remote possibility of breakdown event occurring but history of occurrence exists within industry.
5	Conceivable but Unlikely	No known history of breakdown event occurring after years of exposure but is conceivably possible.
6	Practically Impossible	Practically impossible for breakdown event to occur. Has never occurred before and is not likely to occur.

## 4: RISK ASSESSMENT MATRIX

Consequences (How Bad?)	Probability x Exposure				
	1 to 2	3 to 5	6 to 10	11 to 23	24 to 36
	Likelihood (How often?)				
	Almost certain will occur	Quite possible could occur	Possible	Unlikely but possible	Extremely unlikely
5. Disaster	Extreme	Extreme	Extreme	High	Moderate
4. Very Serious	Extreme	Extreme	High	Moderate	Low
3. Serious	Extreme	High	High	Moderate	Low
2. Substantial	High	Moderate	Moderate	Low	Low
1. Minor	High	Moderate	Low	Low	Low

## 5: RISK TREATMENT STRATEGY

Risk Score	Required Actions
Low	Implement control measures and verify compliance by routine monitoring.
Moderate	Action required within agreed timeframe to minimise risk to "As Low As Reasonably Practicable" (ALARP). Further action may be required and management responsibility specified to take this action. The ALARP principle implies that controls have been determined such that the level of risk-reducing action is in proportion to the benefit obtained.
High	Action as soon as possible to minimise risk to acceptable level. Requires attention by senior management and measures should be put in place to reduce the probability, exposure and/or consequence of the outcome occurring to ALARP.
Extreme	Same treatment as for high risks however immediate action required to minimise risk to acceptable level.

(Adapted from AS/NZS 4360:1999 Risk Management and NSCA Risk Score Calculator, 2001)