SPgroup
Empowering the Future of Energy

Registered Earthworks Supervisor

Course Code: WSO02

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Ver 3.3

RES Course Introduction

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Companies doing Building Operations & Works of Engineering Construction* do many different things, such as:

- Building Operations
- Construction Works
- Civil Engineering Works

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*As mentioned under the Workplace Safety & Health (Construction) Regulations 2007

Some of these works are.....









Building Operations
Construction Works
Civil Engineering Works







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....but these companies do something that is the **SAME**– **Earthworks**!





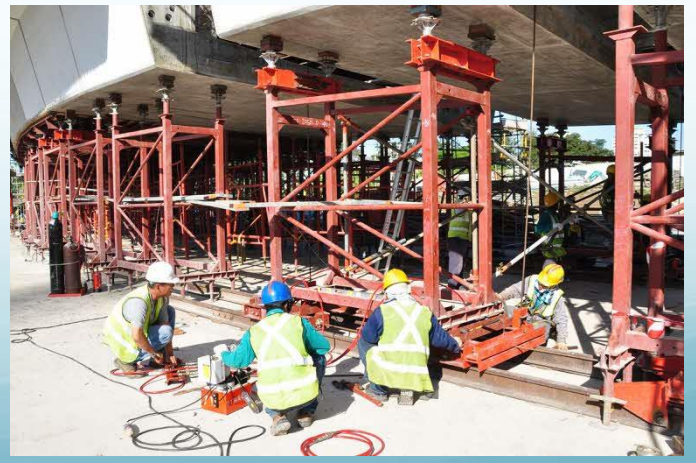


Building Operations
Construction works
Civil Engineering works

Do Earthworks







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Earthworks can cause Damage to underground utilities, such as electricity cables & gas pipes







Building Operations
Construction works
Civil Engineering works

Do Earthworks

Causes Damage









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Damage to underground utilities is **No Good for ALL**

To Public





Inconveniences



Risks to Safety

Building Operations
Construction works
Civil Engineering works

→ Do Earthworks → Causes Damage →

Damage affects Everyone

To Industries



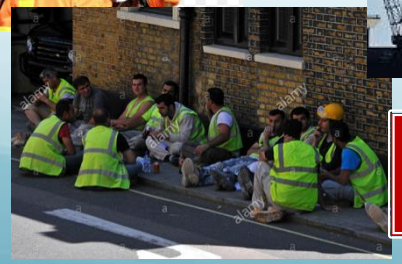


Downtime & High Costs

To Contractors







Workers & Equipment Idle



Higher Insurance costs

Prosecution

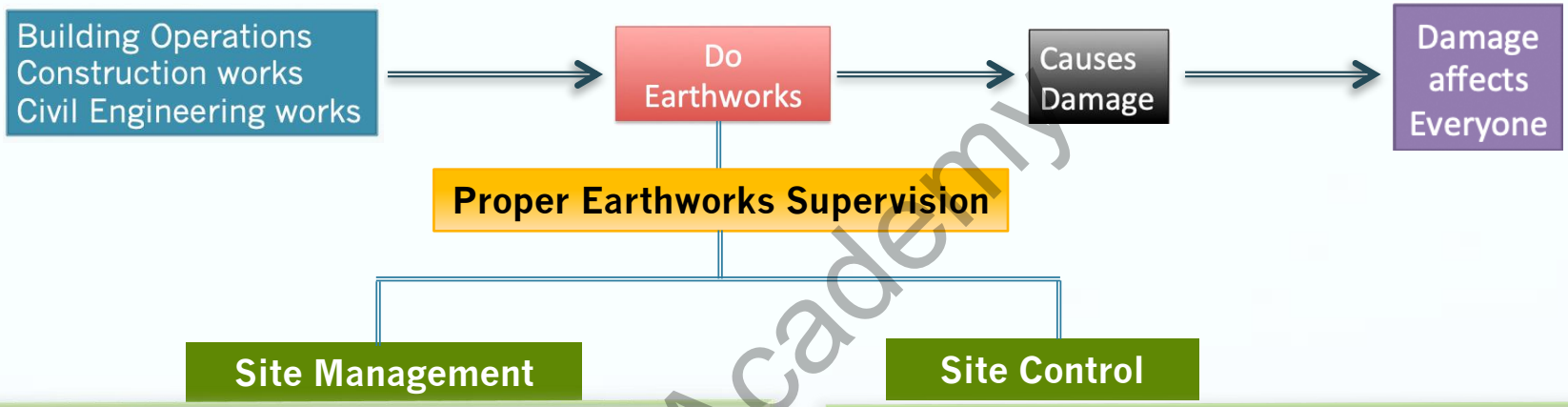


Poor Reputation



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YOU can help your company ***prevent damage*** when you are **RES**



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- Closely monitors all earthworks
- Use cable / gas plans and LCDW detection drawings effectively
- Communicate change to earthworks positions/methods to all parties
- Effective daily toolbox meetings
- Ensure required clearance are obtained from relevant SP sections
- Plan, Prepare, Do earthworks safely until completion
- Comply with SPPG's requirements and to apply SWPs to prevent damage from happening
- Work with SPPG, LCDW, REO and all stakeholders
- Good supervisory skills and effective communications

- Monitor and check documents for earthworks and all passes of earthworks workers to ensure validity, such as NCE, LRe, PTWs, REO, RES, LCDW and new contractor Passes
- Comply with legislative requirements and SPPG's requirements
- Have good understanding of what causes damage
- Supervise the entire duration of the earthworks
- Always be alert to stop unsafe practices
- Good knowledge of all cables & gas pipe at sites
- Ensure continuous compliance by all parties

This Course will give you this knowledge....and more!

Welcome to the RES Course!

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Chapter 1 (a)

Introduction:
Course Administration

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Course Content

1. Introduction
    a. Course Administration
    b. The Registered Earthworks Supervisor
    c. Organisational Structure of SPPG's Damage Prevention Teams
2. The Legislative Framework
    a. Introduction to Electricity Act
    b. Introduction to Gas Act
    c. Impact of Damage for Contractor, Regulator & Electricity Licensee

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Course Content

3. Introduction to SPPG's Underground Services
    a. The Grid Network
    b. The Gas Network
    c. Problems that affect Grid System
    d. Statistics of Cable Damage
4. Safe Work Procedures on Damage Prevention
    a. Preventing Damage
    b. Permit-to-Work System
    c. Cable Detection Works
    d. When a Cable or Gas Pipe is damaged

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Course Content

5. SPPG Requirements for Earthworks
    a. The Earthworks Notification Process
    b. Understanding the Letter of Requirements
    c. SPPG Requirements at SPPG Worksites
6. Registered Earthworks Supervisor Requirements
    - SS 576 : 2019 – Code of Practice for Earthworks in the Vicinity of Electricity Cables
7. Supervisory Skills in the Prevention of Damage to Electricity Cables
    a. Working with Registered Excavator Operator
    b. Effective Communications at Worksite

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Final Assessment

- Candidates are eligible to sit for the final assessments upon completion of the Registered Earthworks Supervisor Course with at least 75% attendance
- **Test** – Close Book
  - 20 MCQs (40 marks)
    - 2 marks / MCQ
  - 10 True/False Questions (10 marks)
    - 1 mark / correct answer
  - Total 50 marks
  - Passing is 75% (38/50)
- **Failures**
  - Retake Test by arrangement
  - Retest fee is payable

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Chapter 1 (b)

Introduction:
The Registered Earthworks Supervisor

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Why is the RES Scheme Needed?

To prevent damage to cable / gas pipe during earthworks with proper earthworks supervision

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How will RES Contribute to the Objective

- Electricity cables and gas pipelines serve as an important link in supplying reliable transmission and quality power/ gas to consumers.
- During earthworks, RES must adhere to good practices to prevent damage to cable/ gas pipeline that causes:
  - disruption to power/ gas supply;
  - potential financial loss; and
  - delay in project delivery

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What is RES?

Any person:

a. whose trade or occupation requires or includes supervision of earthworks;

b. who has successfully completed a course on prevention of damage to electricity cables and gas pipelines while carrying out earthworks, the "Registered Earthworks Supervisor Course" conducted by an accredited body and has sufficient relevant experience (with 2 years site supervisory experience); and

c. who is registered with the Transmission Agent Licensee, i.e., SP PowerGrid (SPPG)

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Implementation & Administration of RES Scheme

- From 1 April 2018, RES must be deployed for every earthworks site in the vicinity of HV cables & gas pipes
- Site personnel must complete and pass the RES course before they can register as RES with SPPG
- Non-compliance with SPPG's Letter of Requirements (LRe) would result in demerit points given to the RES
- Under the Performance Improvement Scheme (PIS), RES may have their passes suspended or revoked

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RES is Mandatory

- RES is mandatory and implemented under SPPG's Letter of Requirements (LRe) enforceable under Section 80(4)(a) of the Electricity Act and Section 32(3)(a) of the Gas Act
- Contractors must deploy RES at worksites whenever earthworks is carried out in the vicinity of HV cables and gas pipes (MP & GTP)
- SPPG will carry out regular visits and inspections to monitor compliance
  - Enforcement Checks by SPPG – Earthworks Surveillance and Patrolling (ESP) section

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RES to monitor and check

- Ensure his RES Pass is valid
- Check
  - Validity of LRe & NCE
  - SPPG Cable and Gas pipe plan
  - LCDW cable detection drawing
  - REO Pass and its validity
  - Clearance from relevant SP sections
- Monitor
  - All earthworks activities closely
  - PTWs and Risk Assessment issued at site
  - Daily tool-box meetings
- Communicate changes to earthworks positions and work methods to all parties
- New Contractor Pass with QR code shall be issued for renewal, replacement or apply for new REO or RES passes



OLD RES PASS



OLD REO PASS

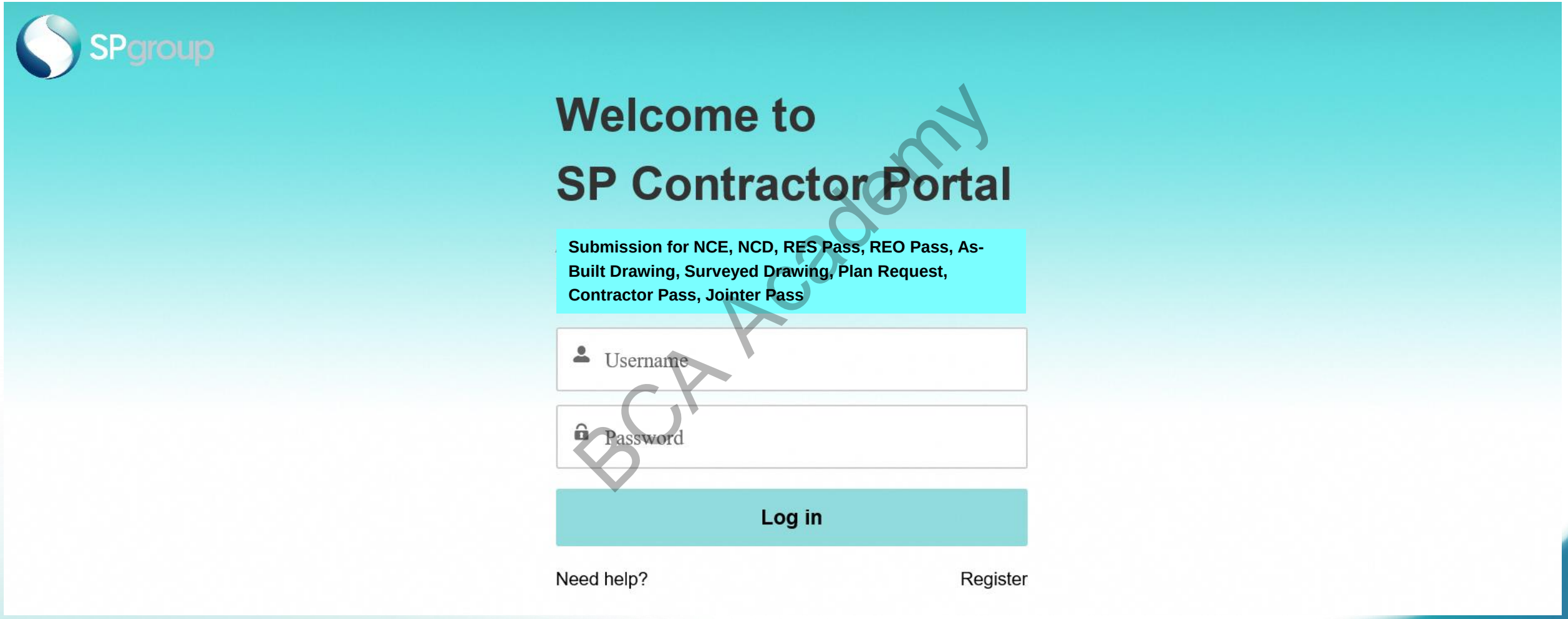


NEW CONTRACTOR PASS

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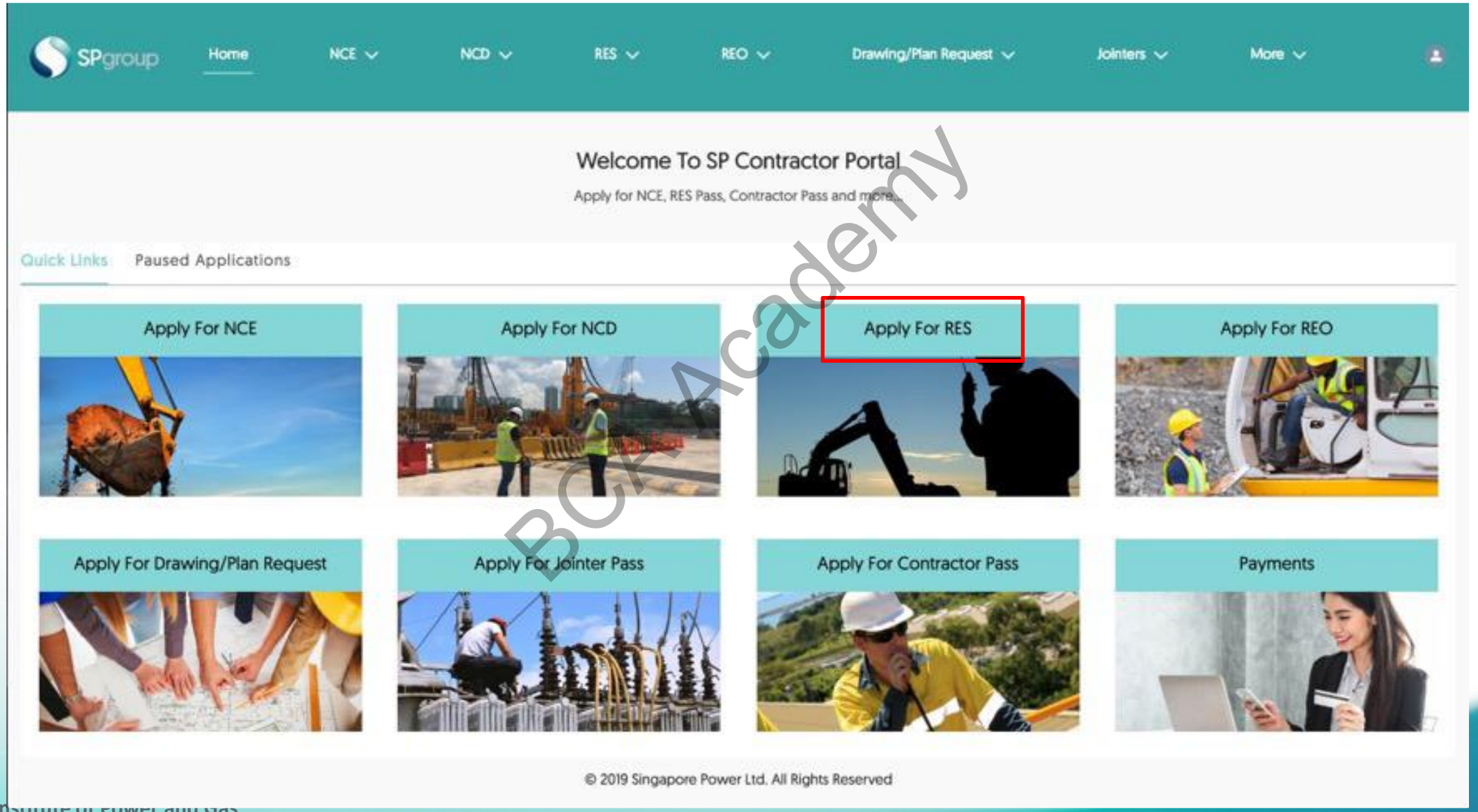
Registration of RES via SP Contractor Portal

https://contractorportal.spgroup.com.sg



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Apply for RES via SP Contractor Portal



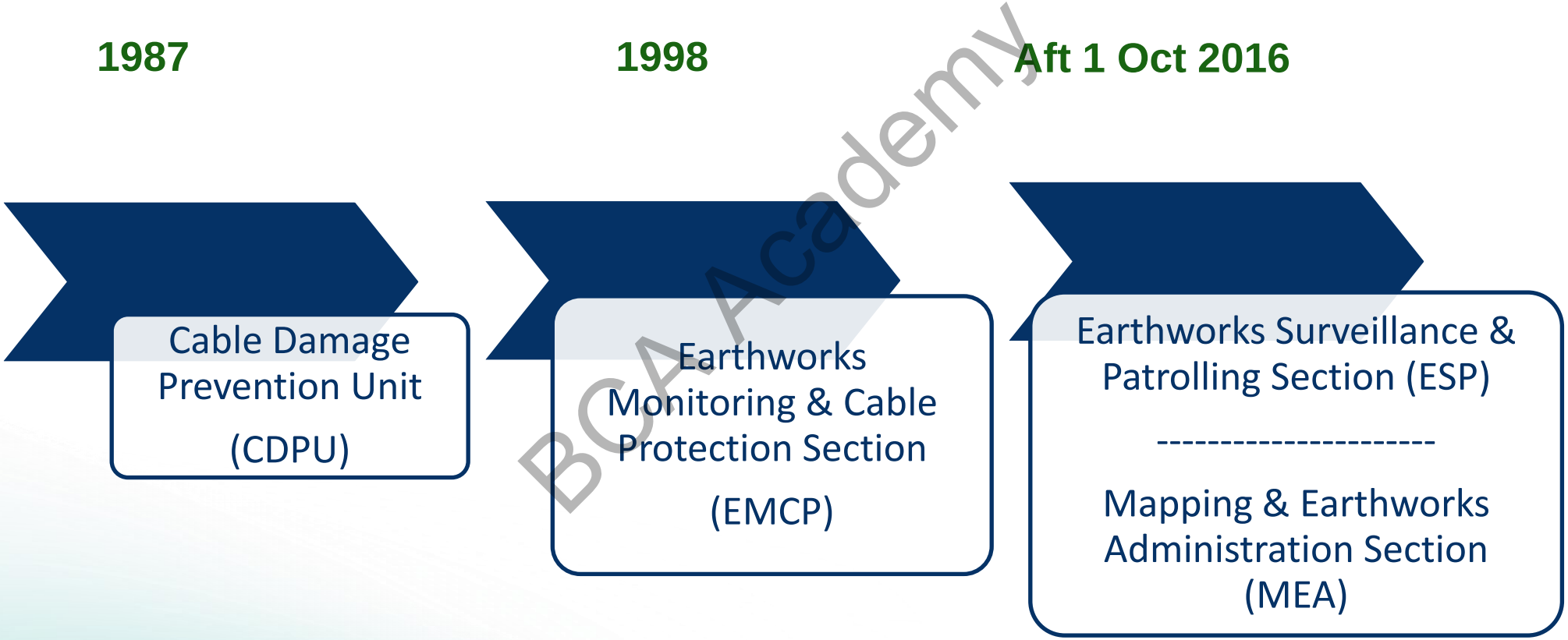
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Chapter 1 (c)

Introduction:
Organisational Structure
of
SPPG's Damage Prevention Teams

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How SPPG met with Cable Damage Prevention Challenges over the Years



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Common Abbreviations to Know

- **EMA** : **E**nergy **M**arket **A**uthority
- **GTP** : **G**as **T**ransmission **P**ipelines
- **HV** : **H**igh **V**oltage
- **LP** : **L**ow **P**ressure
- **LV** : **L**ow **V**oltage
- **MP** : **M**edium **P**ressure
- **NCE** : **N**otification for **C**ommencements of **E**arthworks
- **LRe** : **L**etter of **Re**quirements
- **LCDW** : **L**icensed **C**able **D**etection **W**orker
- **REO** : **R**egistered **E**xcavator **O**perator
- **RES** : **R**egistered **E**arthworks **S**upervisor
- **Tx** : **T**ransmission
- **Dx** : **D**istribution
- **RA** : **R**isk **A**ssessment

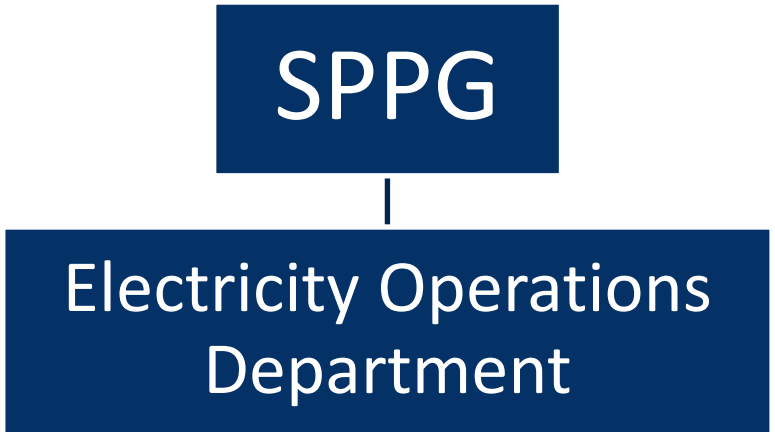
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Common Abbreviations to Know – SP PowerGrid Ltd

- **CSC** : **C**ustomer **S**ervice **C**entre (PowerGas Ltd)
- **DN** : **D**istribution **N**etwork
- **DPOM** : **D**istribution Pipeline **O**perations & **M**aintenance
- **ESC** : **E**lectricity **S**ervice **C**entre
- **EHVN** : **E**xtra **H**igh **V**oltage **N**etwork
- **ESP** : **E**arthworks **S**urveillance & **P**atrolling
- **IPU** : **I**nvestigation and **P**rosecution **U**nit
- **MEA** : **M**apping & **E**arthworks **A**dministration
- **RN** : **R**egional **N**etwork
- **SPPG** : **SP** Power**G**rid Ltd
- **TPOM** : **T**ransmission **P**ipeline **O**perations & **M**aintenance

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Damage Prevention Gets a Boost with 2 Sections



Mapping & Earthworks Administration Section (MEA)

Contractors planning to do earthworks will use e-Submission via SP Contractor Portal

- To request cable/gas plans
- To submit NCE
- To apply / renew REO & RES passes

Earthworks Surveillance & Patrolling Section (ESP)

ESP takes over NCE :

- Convene 1st site meeting before earthworks
- Issue LRe
- Monitor & visit worksites until completion of earthworks

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Roles & Responsibilities

Operation Management Branch

Mapping & Earthworks Administration (MEA)

- Process NCE submissions
- Process Cable & Gas Pipe Plan requests
- Process Transmission Cable As-Built & Gas Pipe Surveyed Drawing requests
- Process REO applications & manage REOs
- Process RES applications & manage RES

Email: mea@spgroup.com.sg

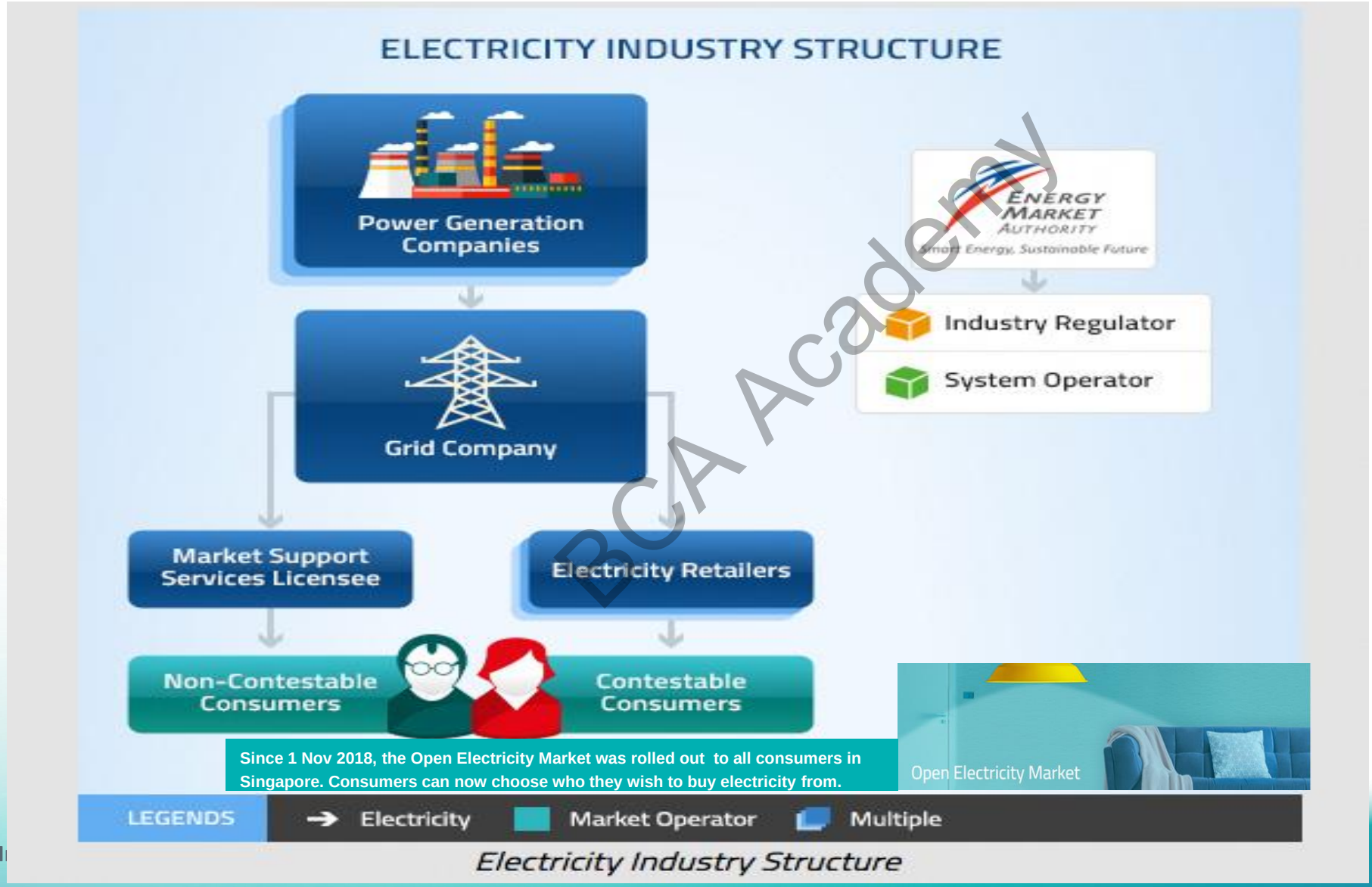
Earthworks Surveillance & Patrolling (ESP)

- Meet contractors at sites for LRe and cable damage prevention measures
- Visit High Risk Sites to ensure that Transmission Sections were referred
- Patrol Transmission cables/ GTP and MP gas pipes
- Step-up patrolling (when requested)
- Investigate Infringement cases and Submit case files to EMA
- Conduct briefings to Management Supervisors and contractors
- Issue Advisory Notices
- Stop Work Requests

Email: espsection@spgroup. com.sg

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Energy Market Authority (EMA) & Electricity Licensees



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Chapter 2 (a)

The Legislative Framework: Introduction to Electricity Act

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Electricity Act & Gas Act

What is "Earthworks"?

"earthworks" means-

a) any acts of excavating earth, rock or other material
(by whatever means)

b) any act done on, in or under the ground in connection with -





(i) any work for or relating to the construction, reconstruction, Extension, renovation, alteration, demolition or repair of any building, road, railway, bridge, viaduct, flyover, sewer or sewerage works,

(ii) any work for or relation to the laying, inspecting, repairing or renewing of any main, pipe, cable, fitting or other apparatus

(iii) any soil investigation work; or

(iv) such other works as are usually undertaken by a person carrying on business as a contractor in the construction industry or as a professional civil or structural engineer;

[Act 37 of 2021 wef 29/01/2022]

Page 10 of Elect Act 2001

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Electricity Act & Gas Act

What is "Earthworks"?

(c) any act of boring dredging, jacking, levelling, piling or tunnelling on or under any premises or street by any mechanical means: or

(d) the driving or sinking of any bar, rod, pole, picket, casing or tube into the ground

[Act 37 of 2021 wef 29/01/2022]

Page 10 of Elect Act 2001





Explanatory Notes:

1.(a) and (b) were previously read together where (a) applies only when the activities in (b) were carried out. Splitting (a) as a standalone means it is now to include everything that is done in which earth, rock or other material is excavated.

2.(c) will now include all the activities described that impinge the ground, and not just restricted to 'excavating earth, rock or other material'.

3.(d) has been enlarged to include more things that are driven or sunk into the ground and not just 'earth rods, casing or tube' as applied previously.

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Electricity Act & Gas Act

What is "Electricity Cable"?

"electricity cable" means a length of insulated single conductor or of 2 or more such conductors, whether or not the conductor or conductors are provided with an overall covering for mechanical protection, and —

(*a*) all other apparatus or devices connected to the conductor or conductors, as the case may be (including by any remote or wireless means); and

(*b*) any data communication cable used to monitor or control the transmission of electricity;

[Act 37 of 2021 wef 29/01/2022]

Page 12 of Elect Act 2001

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Note: Definition of "electricity cable" is extended to cover data communication cable used to monitor or control the transmission of electricity

Requirements involving LV Cables

Section	Offence	Penalty
79(1)	Shall not commence or carry out, or cause or permit the commencement or carrying out of, any earthworks within the vicinity of any low voltage electricity cable unless cable detection work by LCDW	• Fine $10,000 (max) or • 12 months jail or Both
79(2)	79(1) shall not apply if it is necessary to do so in the interest of public or private safety but shall give a notice within 7 days of the earthworks in writing stating the nature and extent of those earthworks	
79(3)	Only an LCDW or an electricity licensee can do cable detection works for the purpose of commencing or carrying out earthworks in the vicinity of any LV electricity cable	

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Requirements involving HV Cables

Section	Offence	Penalty
80(1)	Shall not commence or carry out, or cause or permit the commencement or carrying out of, any earthworks in the vicinity of any high voltage electricity cable unless (*a*) has given to the electricity licensee not less than 7 days notice in writing prior to the earthworks; **Give NCE** (*b*) has obtained the necessary information on the location of high voltage electricity cable and has consulted the electricity licensee on the steps to be taken to prevent the high voltage electricity cable from damage; and **Get cable plan & consulted with SPPG** (*c*) has caused cable detection work to be carried out by a LCDW to confirm the location of HV cable. **Cable detection by LCDW**	• Fine $100,000 (max) or • 5 years jail or • Both
80(2)	Only an LCDW can do cable detection works for the purpose of commencing or carrying out earthworks in the vicinity of any HV electricity cable	• Fine $10,000 (max) or • 12 months jail or Both
	The Authority may, if it thinks fit, modify the 7 day period for notice under subsection (1)(*a*) is to be given.	

Before you do earthworks

Who can do cable detection?

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Recent Amendments To Electricity Acts & Gas Acts in Jan 2022

The recent Electricity Act & Gas Act amendments in Jan 2022 have extended protection to the infrastructures

Cable Infrastructure

- Electricity Cable pipe-blocks
- Electricity Cable tunnels

Gas Infrastructure

- Concrete casings
- Pipe jacking sleeves
- Rock armour
- Valve chambers

(11) This section (except subsection (1)(*c*)) applies to any infrastructure (including cable pipe-blocks and tunnels) housing or intended to house any transmission electricity cable, as it applies to any high voltage electricity cable which belongs to or which is under the management or control of an electricity licensee, and for this purpose, a reference to an electricity licensee in this section is a reference to the person to whom the infrastructure belongs or that manages or controls the infrastructure.

Electricity Act *[Act 37 of 2021 wef 29/01/2022]*

(10) This section applies to any infrastructure (including valve chambers, pipe jacking sleeves, concrete casings and rock armour) housing or intended to house any gas transmission pipeline, as it applies to any gas plant or gas pipe in a gas pipeline network owned by, or under the management or control of, a gas transporter, and for this purpose, a reference to a gas transporter in this section is a reference to the person to whom the infrastructure belongs or that manages or controls the infrastructure.

Gas Act *[Act 37 of 2021 wef 29/01/2022]*

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Cable Infrastructure



Cable Tunnel

> 45 – 60m Depth

> 36km – Total length

> North South, East West, Jurong Island Line





Cable Pipeblock

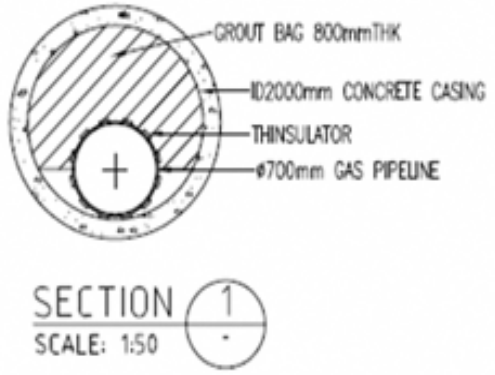
> Lay Pipes and concreted pipes

> For both transmission and distribution cables

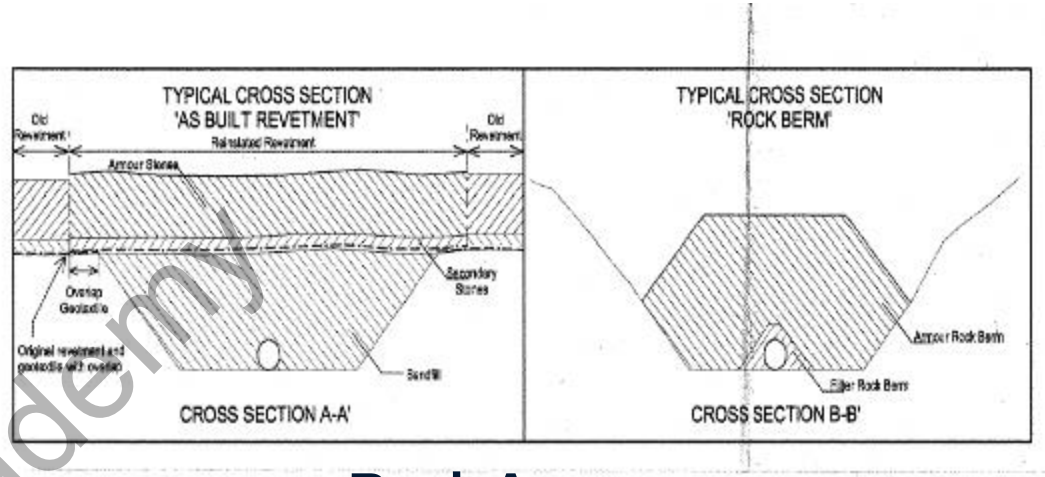
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Gas Infrastructure





Concrete Casing and Pipe Jacking Sleeve



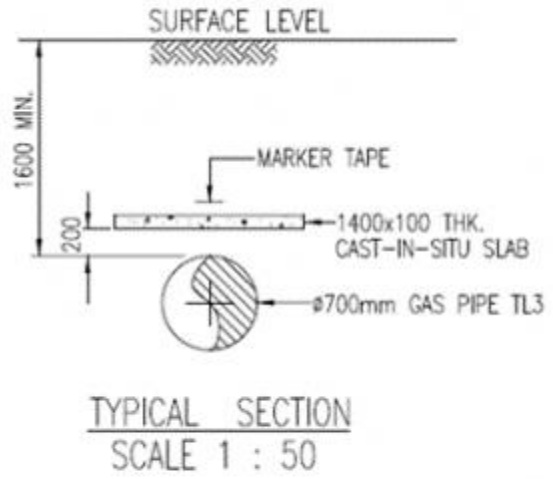
Rock Armour



Valve Chamber



Concrete Slabs



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5 Steps to Commence Earthwork for LV Cables

Electricity Act – Section 79(1) Before doing Earthworks for LV cables

- Section 79(1)

  Cable detection by LCDW

5 Steps to follow to Commence Earthworks

1. Get cable plans (e-submission)
2. Engage LCDW
3. Cable detection works
4. Cable detection drawing
5. Earthworks can start

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8 Steps to Commence Earthworks for HV Cables

Electricity Act – Section 80(1) Before doing Earthworks for HV cables

- Section 80(1)

a. Notification of earthworks (NCE)

b. Get cable plan
+ consult SPPG

c. Cable detection by LCDW

8 Steps to follow to Commence Earthworks

1. Get cable plans (e-submission)
2. Engage LCDW
3. Cable detection works
4. Cable detection drawing
5. Submit NCE (e-submission)
6. Site meeting with ESP
7. ESP issues LRe
8. Earthworks can start

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Requirements involving HV Cables

Section	Offence	Penalty
80(4) ***Duties of the person doing earthworks***	Person who carries out any earthworks shall — (*a*) comply with all reasonable requirements of the electricity licensee to prevent damage to the HV cable; (*b*) ensure that reasonable precautions are taken when doing earthworks to prevent any damage to HV cable (c) Allow electricity licensee reasonable access to the work site to inspect or take any necessary measures to protect the HV cable.	• Fine $100,000 (max) or • 5 years jail or • Both
80(5)	It is the duty of the electricity licensee upon receiving notice to — (*a*) promptly inform the location of HV cable and provide any information to enable exact location of the HV cable; (*b*) Advise on the precautions to be taken to prevent damage to the HV cable ; and (c) take all reasonable measures at the work site to protect HV cable from damage.	

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Requirements involving HV Cables

Section	Offence	Penalty
80(6) ***In cases of 'emergencies'***	80(1) shall not apply if it is necessary to do so in the interest of public or private safety but shall give a notice within 7 days of the earthworks in writing stating the nature and extent of those earthworks	• Fine $10,000 (max) or • 12 months jail or • Both
80(9)	Subject to subsection (10), in any proceedings for offences under (1) & (4), persons charged may prove defence — (*a*) that he took all reasonable steps to discharge his duty under subsection (1) or (4); or (*b*) that he took all reasonable precautions and exercised all due diligence to avoid the offence.	
80(10)	For an offence under (1) & (4), defence can claim he had acted on information supplied by an electricity licensee or a LCDW. The person must give within 14 clear days before the hearing, written information of his claims and who had provided it.	

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Offences for Damages

Section	Offence	Penalty
85(1)	Any person who – (a) removes, destroys or damages any electrical plant or electricity cable in the transmission network; ***No longer require the element of wilfulness*** (b) Causes or permits the removal, destruction or damage of such electrical cable; or (c) Or willfully or recklessly hinders or prevents such electrical plant or electricity cable from being used or operated in the manner in which it is intended to be used or operated.	• Fine $1m (max) or • 5 years jail or Both
85(4)	Any person may apprehend the person who commits the offence of damaging cable and hand over to a police officer	
85(5)	It can be used as defence under 1(a) or (b) that all reasonable precautions were taken and due diligence exercised to avoid the offence.	
85(6)	Defence can claim he had acted on information supplied by an electricity licensee or a LCDW. The person must give within 14 clear days before hearing, written information of his claims.	

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Damage to submarine electricity cables, etc.

85A. Any person who wilfully, recklessly or negligently —

(*a*) does any act, or causes or permits any act to be done, which damages or is likely to damage any submarine electric line or electricity cable in the territorial waters of Singapore that belongs to or that is under the management or control of an electricity licensee; or

(*b*) omits to do anything required to prevent any damage to any such submarine electric line or electricity cable,

shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $2 million or to imprisonment for a term not exceeding 5 years or to both.

[42/2018]

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Penalties under Electricity Act (Chapter 89A)

Offence	Fine & Jail Term
S79(1) Commence earthworks within vicinity of LV cable without engaging LCDW to do cable detection work S79(3) Only persons who are LCDW can carry out cable detection works S80(2)	❖ Fine $10,000 (max) or ❖ Jail 1 year (max) or ❖ Both
S80(1)(a) Failed to notify (NCE) SPPG within 7 days notice S80(1)(b) No cable plan & did not consult SPPG on damage prevention S80(1)(c) Failed to engage LCDW for HV cable detection S80(4)(a) Failed to comply SPPG requirements on damage prevention S80(4)(b) Failed to take reasonable precautions to prevent damage	❖ Fine $100,000 (max) or ❖ Jail 5 years (max)or ❖ Both
S85(1)(a) Removes, destroys or damages any electrical plant or electricity cable in the transmission network; S85(1)(b) Causes or permits the removal, destruction or damage of such electrical cable; or S85(1(c) Willfully or recklessly hinders or prevents such electrical plant or electricity cable from being used or operated in the manner in which it is intended to be used or operated	❖ Fine $1m (max) or ❖ Jail 5 years (max) or ❖ Both
S85A Damage to submarine electricity cable	❖ Fine $2m (max) or ❖ Jail 5 years (max) or ❖ Both

For details, please refers to Singapore Statutes Online: http:// statutes.agc.gov.sg

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Chapter 2 (b)

The Legislative Framework: Introduction to Gas Act

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Comparison of requirements involving Electricity Cables and Gas Pipelines

- Electricity Act
  - LV
    1. Cable detection by LCDW (need to get SPPG cable plans first)
  - HV
    1. Submit NCE
    2. Get cable plan + consulted with SPPG
    3. Cable detection by LCDW (need to get SPPG cable plans first)
- Gas Act
  - All Gas Pipes (LP, MP & GTP)
    1. Obtain SPPG gas plans
    2. Submit NCE
    3. Consult with SPPG (ESP, DPOM & TPOM sections)

Why is LCDW excluded for gas pipes?

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Requirements involving Gas Pipelines

Similar to Section 80 for HV cables under Electricity Act

Section	Offence	Penalty
32(1) ***Before you do earthworks***	Shall not commence or carry out, or cause or permit the commencement or carrying out of, any earthworks in the vicinity of any gas plant or gas pipe unless (*a*) has given to the gas transporter not less than 7 days notice in writing prior to the earthworks; (*b*) has obtained the necessary information on the location of gas plant or gas pipe and (*c*) has consulted the gas transporter on the steps to be taken to prevent the the gas plant or gas pipe from damage.	• Fine $100,000 (max) or • 5 years jail or • Both
32(2)	The Authority may, if it thinks fit, modify the 7 day period for notice under subsection (1)(*a*) is to be given.	

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Steps to Commence Earthworks for Gas Pipes

Gas Act - before doing Earthworks for Gas Pipes

- Section 32(1) Gas Pipes
  - a. Notification of earthworks (NCE)
  - b. Get gas plan information
  - c. Consult SPPG

Steps to Follow to Commence Earthworks

1. Get gas plans (e-submission)
2. Engage registered surveyor (GTP only)
3. Surveyor peg out GTP position

For GTP only

4. Submit NCE (e-submission)
5. Site meeting with ESP (MP & GTP)
6. ESP issues LRe (All gas pipes)
7. Earthworks can start

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Requirements involving Gas Pipelines

Section	Offence	Penalty
32(3) ***Duties of the person doing earthworks***	Person who carries out any earthworks shall — (*a*) comply with all reasonable requirements of the gas transporter to prevent damage to the gas plant or gas pipe; (*b*) ensure that reasonable precautions are taken when doing earthworks to prevent any damage to gas plant or gas pipe (c) Allow gas transporter reasonable access to the work site to inspect or take any necessary measures to protect the gas plant or gas pipe.	• Fine $100,000 (max) or • 5 years jail or Both
32(4)	It is the duty of the gas transporter upon receiving notice to — (*a*) promptly inform the location of gas plant or gas pipe and provide any information to enable exact location of the gas plant or gas pipe; (*b*) Advise on the precautions to be taken to prevent damage to the gas plant or gas pipe ; and (c) take all reasobable measures at the work site to protect gas plant or gas pipefrom damage.	

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Requirements involving Gas Pipelines

Section	Offence	Penalty
32(5) *In cases of 'public & private safety'*	32(1) shall not apply if it is necessary to do so in the interest of public or private safety but shall give a notice within 7 days of the earthworks in writing stating the nature and extent of those earthworks	• Fine $100,000 (max) or • 5 years jail or • Both
32(8)	Subject to subsection (9), in any proceedings for offences under (1) & (3), persons charged may prove defence — (*a*) that he took all reasonable steps to discharge his duty under subsection (1) or (3); or (*b*) that he took all reasonable precautions and exercised all due diligence to avoid the offence.	
32(9)	For an offence under (1) & (3), defence can claim he had acted on information supplied by gas transporter. The person must give within 14 clear days before the hearing, written information of his claims and who had provided it.	

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Offences for Damages

Section	Offence	Penalty
32A(1)	(a) Removes, destroys or damages any gas plant or gas pipe in a gas pipeline network ***No longer require the element of wilfulness*** (b) Causes or permits the removal, destruction or damage of such gas plant or gas pipe; or (c) Willfully or recklessly hinders or prevents the gas plant or gas pipe from being used or operated.	• Fine $1m (max) or • 5 years jail or • Both
32A(4)	It can be used as defence in subsection 1(a) or (b) that all reasonable precautions were taken and due diligence exercised to avoid the offence.	
32A(5)	Defence can claim he had acted on information supplied by a gas transporter. The person must give within 14 clear days before hearing, written information of his claims.	
32A(6)	Any person may apprehend the person who commits the offence of damaging gas pipe and hand to a police officer.	
32B	Damage to submarine pipelines.	• Fine $2m (max) or • 5 years jail or • Both

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Damage to submarine gas pipelines

32B. Any person who wilfully, recklessly or negligently —

(*a*) does any act, or permits or causes any act to be done, which damages or is likely to damage —

(i) any submarine gas pipeline in the territorial waters of Singapore that is owned by, or under the management or control of, a gas licensee; or

(ii) any infrastructure (including valve chambers, pipe jacking sleeves, concrete casings and rock armour) housing or intended to house any submarine gas pipeline in the territorial waters of Singapore; or

[Act 37 of 2021 wef 29/01/2022]

(*b*) omits to do anything required to prevent any damage to such submarine gas pipeline or infrastructure,

shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $2 million or to imprisonment for a term not exceeding 5 years or to both.

[43/2018]
[Act 37 of 2021 wef 29/01/2022]

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Penalties under Gas Act (Chapter 32A)

Offence	Fine & Jail Term
S32(1)(a) Failed to notify (NCE) SPPG within 7 days notice S32(1)(b) No gas plan S32(1)(c) Did not consult SPPG on damage prevention S32(3)(a) Failed to comply SPPG requirements on damage prevention S32(3)(b) Failed to take reasonable precautions to prevent damage	❖ Fine $100,000 (max) or ❖ Jail 5 years (max)or ❖ Both
S32A(1)(a) Removes, destroys or damages any gas plant or gas pipe in a gas pipeline network; S32A(1)(b) Causes or permits the removal, destruction or damage of such gas plant or gas pipe; or S32A(1)(c) Willfully or recklessly hinders or prevents such gas plant or gas pipe from being used or operated in the manner in which it is intended to be used or operated	❖ Fine $1m (max) or ❖ Jail 5 years (max) or ❖ Both
S32B Damage to submarine gas pipelines	❖ Fine $2 million (max) or ❖ Jail 5 years (max) or ❖ Both
For details, please refers to Singapore Statutes Online: http:// statutes.agc.gov.sg	

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Summary of Requirements for Electricity Cables & Gas Pipes

	Electricity Act		Gas Act		
	Electricity Cables		Gas Pipes		
	LV	HV	LP	MP	GTP
LCDW	✓	✓	✗	✗	✗
NCE	✗	✓	✓	✓	✓
LRe	✗	✓	✓	✓	✓
RES	✗	✓	✗	✓	✓

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✓ Required

✗ Not required

*** When working near LV cable or LP gas pipe, Contractor needs to have full time Site Supervisor**

Chapter 2 (c)

The Legislative Framework:

Impact of Damage

for

Contractor, Regulator & Electricity Licensee

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Role of Parties Involved

Contractor

- Ensure that **no** underground electricity cables & gas pipes are damaged or compromised by earthworks
- Comply with all requirements under Electricity Act & Gas Act when working in vicinity of electricity cables and gas pipelines
- Brief and educate all workers and down-line parties to be aware of their duties to prevent damage
- Work closely with SPPG

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Role of Parties Involved

Regulator (Energy Market Authority)

- Protect the interests of consumers and public in respect of the supply and use of Electricity and Gas
- Exercise licensing and regulatory functions, including the establishment of standards and codes
- Regulate Generation and Transmission licensees
- Licensing of cable detection worker - Section 81(1)
- Licensing of electrical worker - Section 82 (1)
- Lodge magistrate complaint to prosecute errant contractor who damage electricity cable and gas pipe under Electricity and Gas Act

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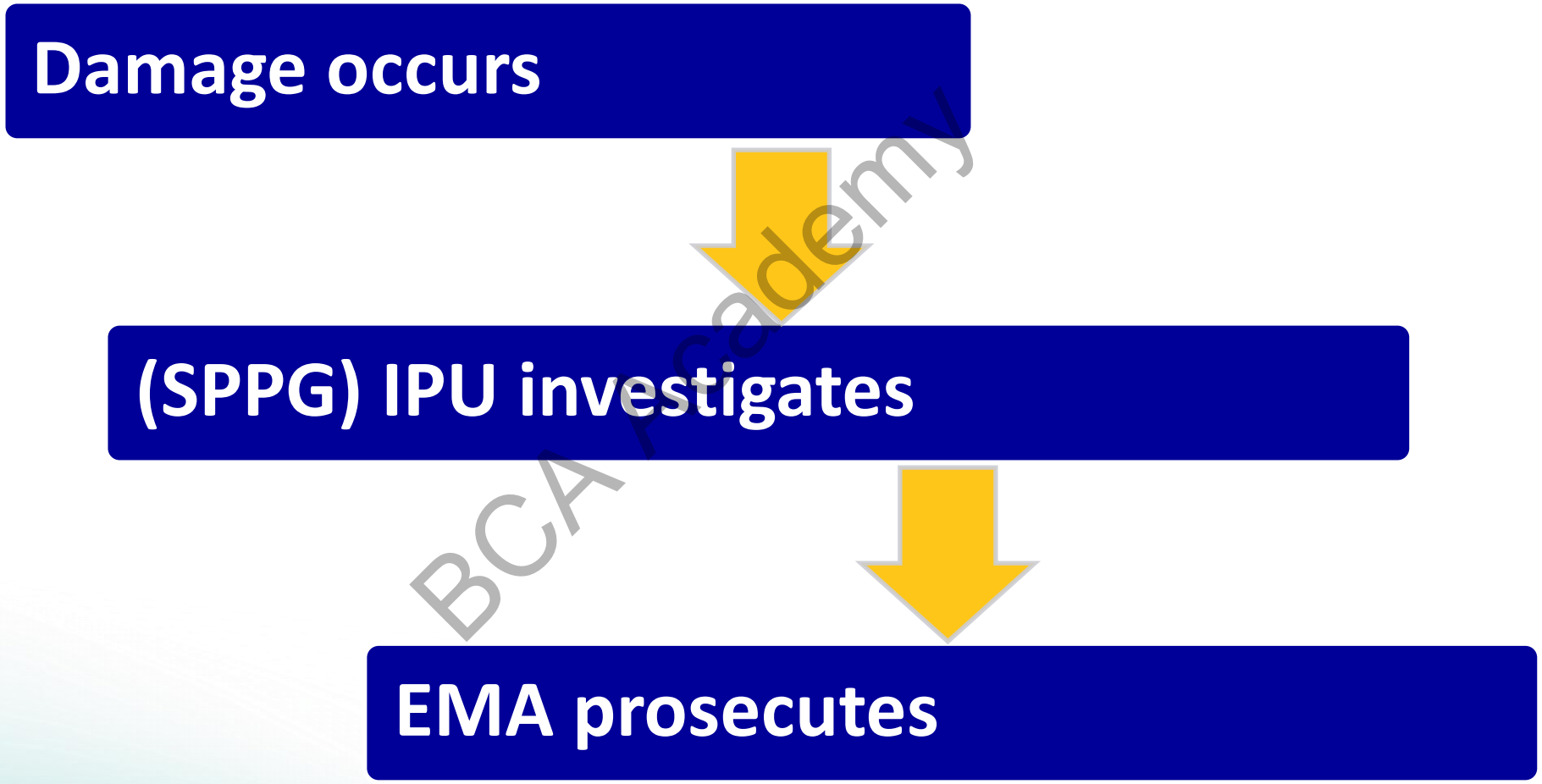
Role of Parties Involved

Transmission Licensee Agent (SPPG)

- SP PowerAssets Ltd (SPPA) is the Transmission Licensee who owns electricity transmission and distribution networks of Singapore
- SPPG is the Transmission Licensee Agent and is authorised to manage Singapore's electricity and gas transmission and distribution networks on behalf of SPPA
- ESP/MEA is regulated by EMA as the transmission licensee agent
  - Issue Cable and Gas Plans
  - Processing for Notice of Commencement of Earthworks(NCE) with issuance of Letter of Requirements(LRe) on damage prevention measures
  - Monitoring of Earthworks Sites
  - Register and monitor performance of REO and RES
- IPU - Carry out Cable and Gas pipe damage investigation

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Matrix for Prosecution



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Impact of Causing Damage

- Work stoppage
- Repair costs
- Prosecution & fines
- Case & name of contractors in EMA website

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Impact for non-compliance



- Contractors are prosecuted in Court
- Fines are high and affect company image



NO	LOCATION	VOLTAGE	CAUSE OF DAMAGE	SECTION	FINES
1	Havelock Rd (Subordinate Court)	6.6kV	Manual Excavation (Changkol)	95A(1)	$60,000
2	Jurong West St 64 In front of Blk 664	22kV	Soil Investigation Boring	80(4)a & 85(2)	$100,000
3	Upp Paya Lebar Rd Near Tai Seng Link Bldg	22kV	Mechanical Excavation	80(4) & 85(2)	$110,000
4	Defu Lane	6.6kV	Mechanical Excavation	80(4)a & 85(2)	$180,000
5	Seraya Avenue	66kV	Sheet Piling	80(4) & 85(2)	$170,000
6	Aljunied Crescent	230kV	Pipe Jacking	80(4)a & 85(2)	$170,000
7	Kallang Sector	230kV	Earth rod sinking	80(1) & 85(2)	$250,000

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Impact for non-compliance



- Contractors are prosecuted in Court
- Fines are high and affect company image



NO	LOCATION	GAS PIPE	CAUSE OF DAMAGE	SECTION	FINES
1	C'wealth Drive, Blk 75	LP	Mechanical Excavation	32 & 32A	$110,000
2	Punggol Field, Blk 196B	LP	Mechanical Excavation	32(1)(a) & 32A(2)	$110,000
3	Ubi Ave 2 junction of Ubi Rd 3	LP	Mechanical Breaker	32A	$100,000
4	Rochor Canal Rd near LP 23	LP	Mechanical Excavation	32 & 32A	$54,000
5	Marina Boulevard LP 23F	LP	Drilling for Grouting Work	32 & 32A	$40,000
6	Lor Paya Lebar ifo Hse 54	LP	Manual Excavation	32(1) & 32A(2)	$30,000
7	Mayfield Ave, No. 4	LP	Hydraulic Breaker	32(1) & 32A(2)	$30,000

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Impact for non-compliance

EMA will investigate all cable damage incidents and take firm action against parties who contravene Section 85 of the Electricity Act.

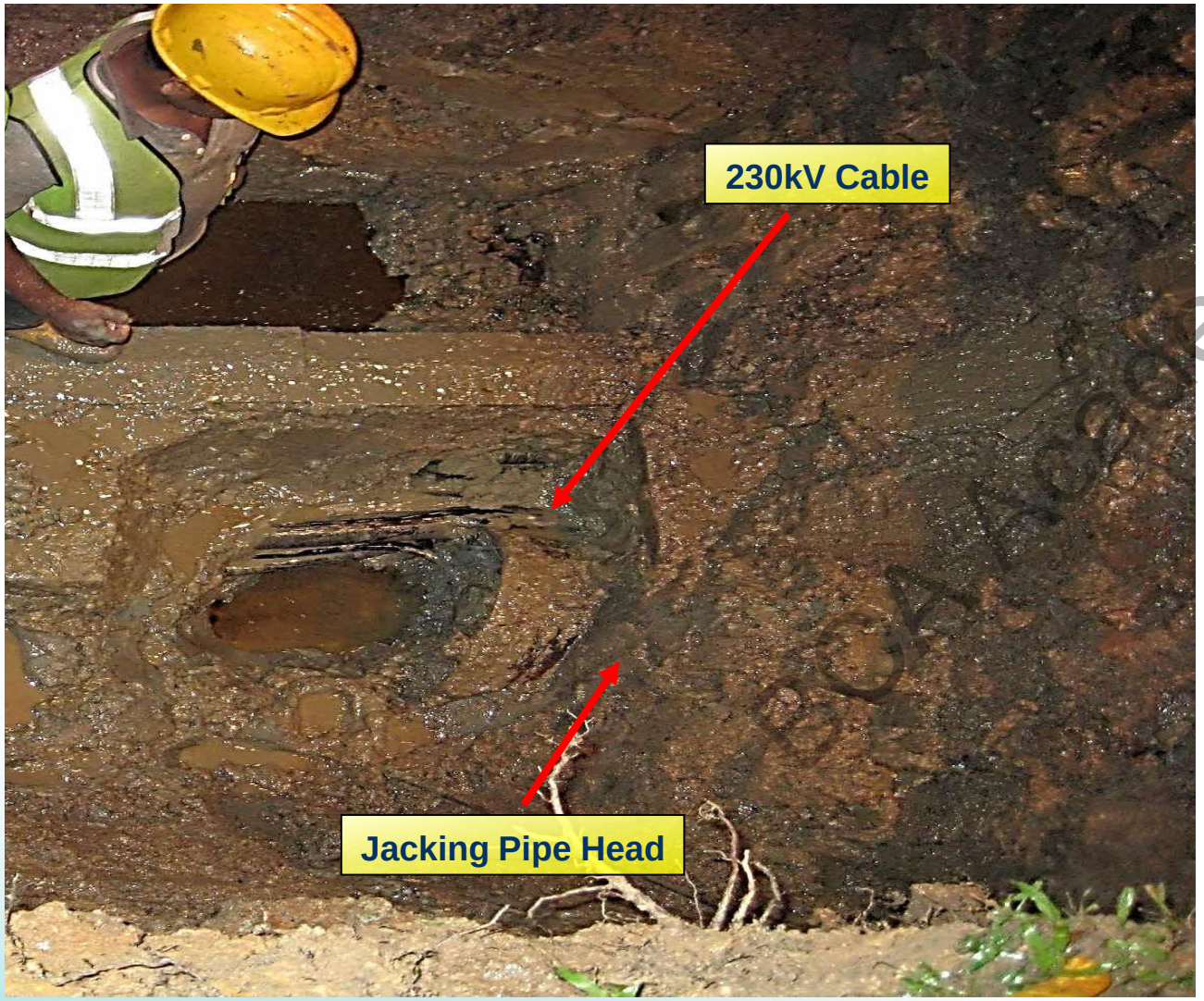
The table below shows the list of earthwork contractors who have been charged and convicted in Court in the last 2 years.

Date Convicted	Company/Contractor	Location of High Voltage Electricity Cable Damage	Date of High Voltage Electricity Cable Damage
09 Jun 2023	Tay Lee Seng Construction Pte Ltd	Along Canberra Link LP 51 to Canberra Link LP 71	21 Jun 2019
02 Dec 2022	Tong Shing Contractors Pte. Ltd.	Admiralty Road West near Lamp Pole No. 61	01 Dec 2018
04 Nov 2022	J J & K Engineering Pte Ltd	Woodlands Ave 5	21 Oct 2019
04 Nov 2022	Guthrie Engineering (S) Pte Ltd	Woodlands Ave 5	21 Oct 2019
21 Oct 2022	Chan & Chan Engineering Pte. Ltd.	Upper Changi Road LP26/1	31 Mar 2021
22 Jul 2022	TGE Engineering Pte. Ltd.	Blk 25 Eunos Crescent	25 Nov 2019
17 Jun 2022	LT Sambo Co., Ltd (Singapore Branch)	Marina Drive near Block 74	08 Feb 2018
03 Jun 2022	Presscrete Engineering Pte Ltd	In front of Lamp Pole No. N101S2 at Mandai Road	30 Sep 2017
03 Jun 2022	Presscrete Engineering Pte Ltd	In front of Lamp Pole No. N101S2 at Mandai Road	30 Sep 2017
31 May 2022	Yuan Ji Enterprises Pte Ltd	Old Jurong Road near Lamp Pole 14	15 Apr 2018
31 May 2022	Yuan Ji Enterprises Pte Ltd	Old Jurong Road near Lamp Pole 14	15 Apr 2018
23 Nov 2021	Fidecs Engineering Pte Ltd	In front of Block 261C, Sengkang East Way, near Lamp Pole No. 53	25 Apr 2018
17 Nov 2021	Kok Tong Construction Pte. Ltd.	Woodlands Square near Lamp Poles No. 3F and 4F, opposite Causeway Point	21 Nov 2018
11 Nov 2021	Kimaro Geotechnical Engineering Pte Ltd	East Coast Road / Bedok Road, near Lamp Pole No. 111	14 Mar 2018

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Consumers who are affected by cable damage incidents may wish to seek independent legal advice for any losses and damages that they may have suffered. They should do this before deciding if they want to pursue further legal action against the contractors.

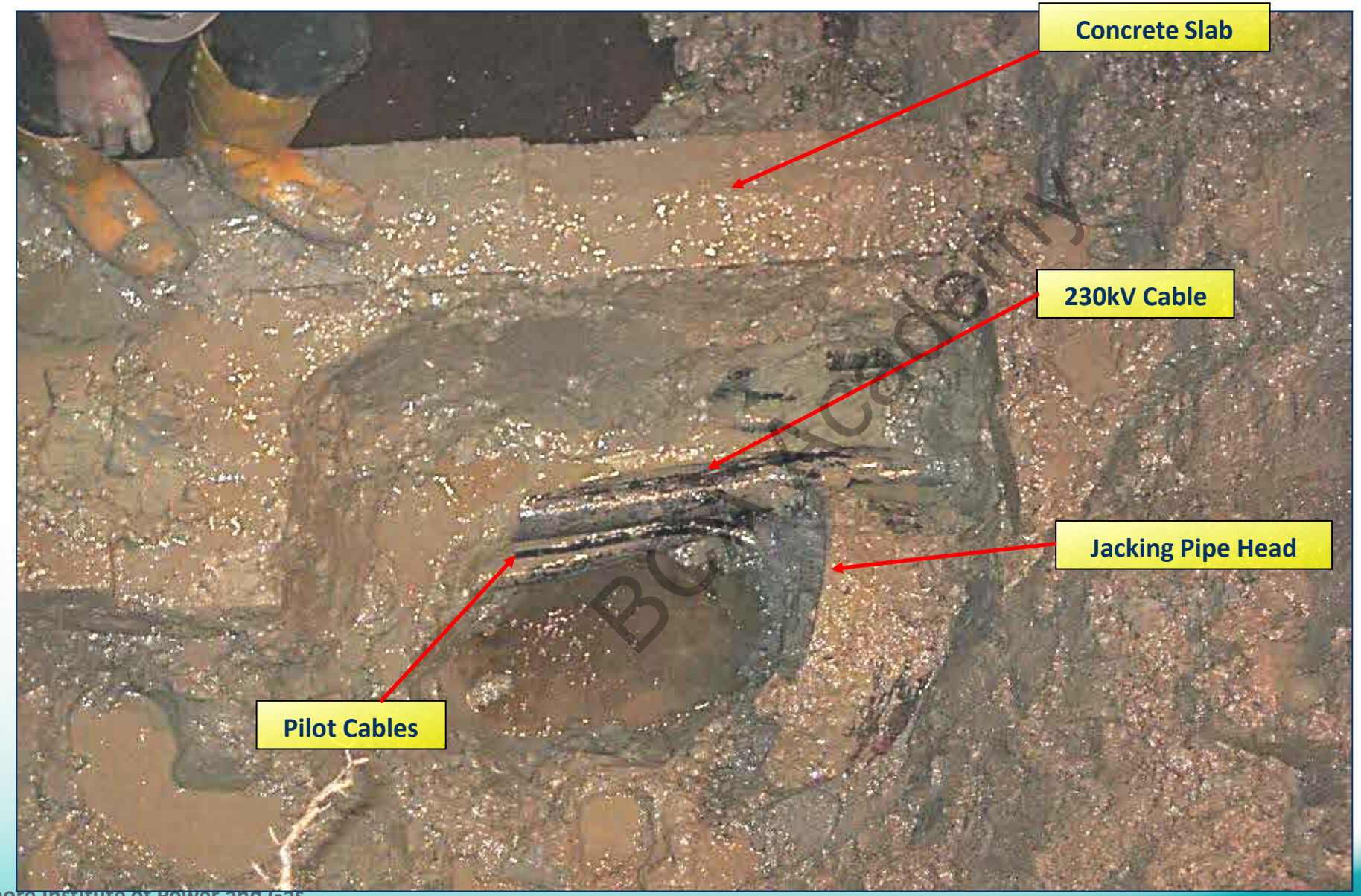
230kV Damage at Aljunied Crescent



- The damage occurred when workers were rushing to ‘close’ work before the end-of-year holidays.
- The work was originally ‘open-cut’ but contractor decided to do pipe-jacking.
- SPPG was not informed of the change of work methods.
- Pipe-jacking damaged the 230kV cable at a substantial depth.

SP Academy

Close-up View



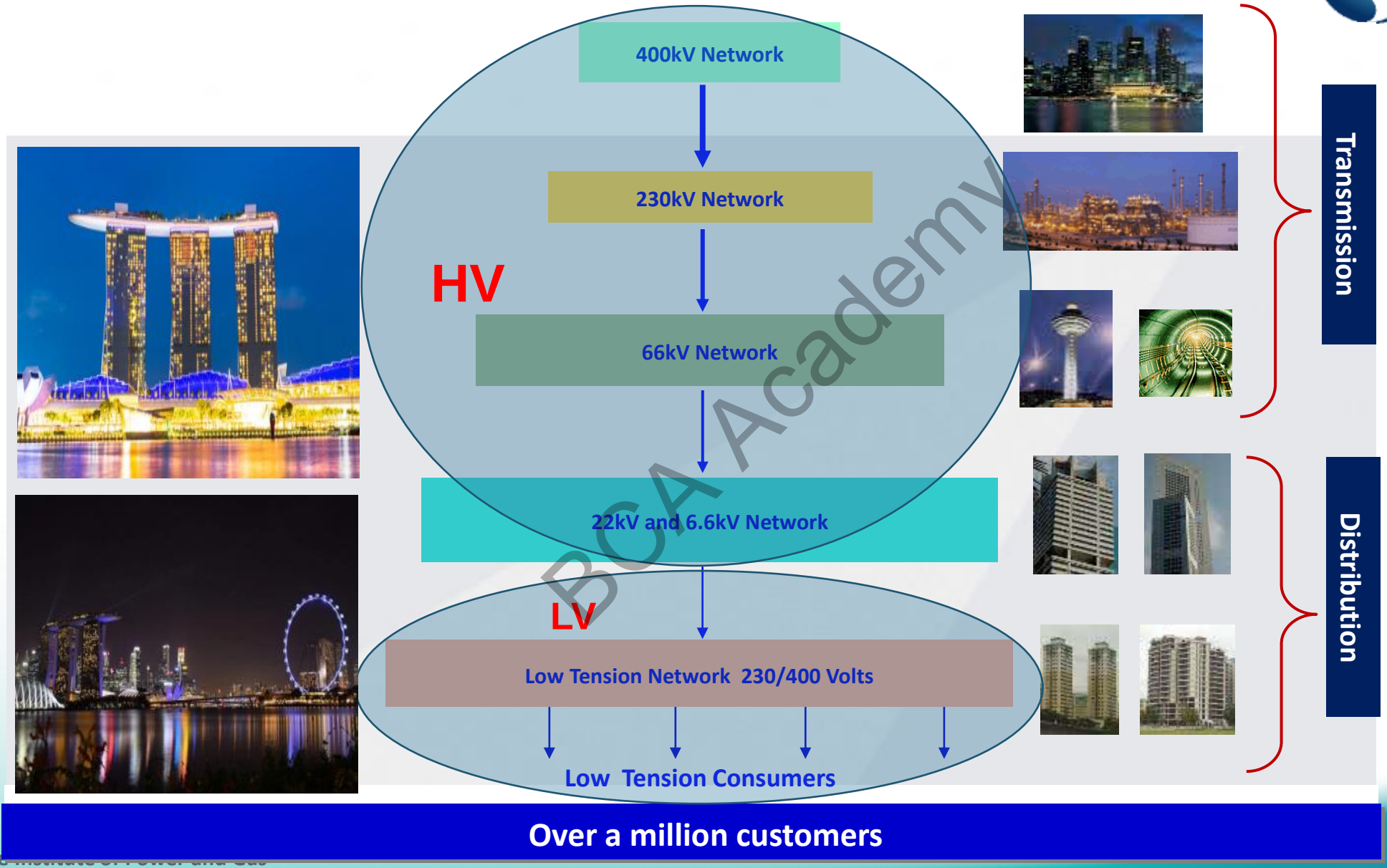
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Chapter 3 (a)

Introduction to SPPG's Underground Services: The Grid Network

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Understanding the Grid Network



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Types of Cables

High Voltage (HV) Cables:

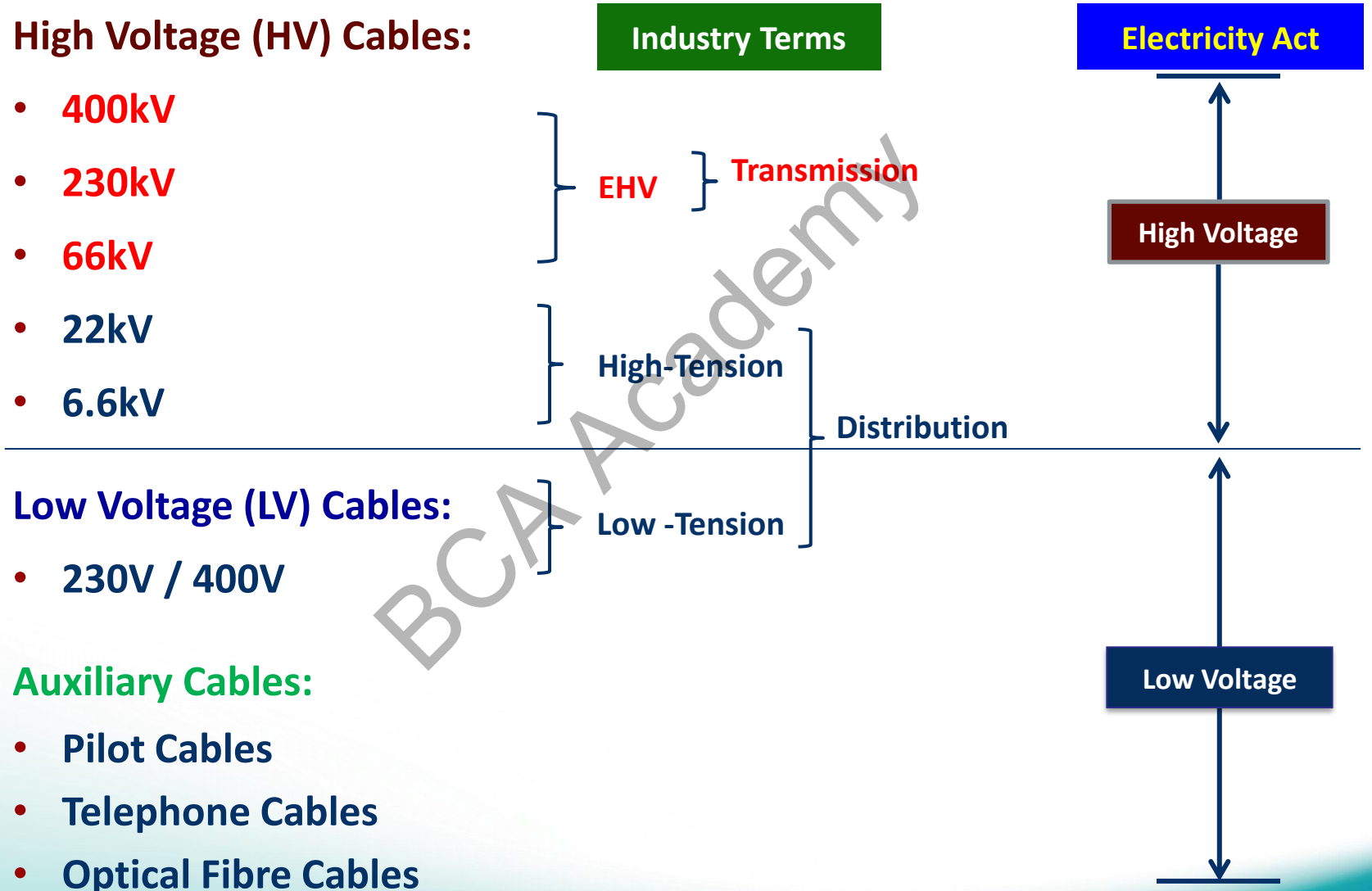
- 400kV
- 230kV
- 66kV
- 22kV
- 6.6kV

Low Voltage (LV) Cables:

- 230V / 400V

Auxiliary Cables:

- Pilot Cables
- Telephone Cables
- Optical Fibre Cables



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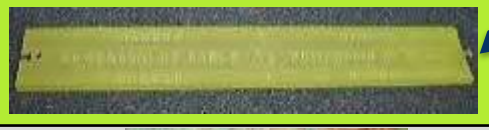
Types of Cables

NO	VOLTAGE	CABLE	CABLE ID MARKER / CONCRETE SLAB
1	400KV		 
2	230KV		   

All transmission cables have concrete slabs

SCA Academy

Types of Cables

NO	VOLTAGE	CABLE	CABLE ID MARKER / CONCRETE SLAB
3	66KV		 
4	22KV		
5	6.6KV	 	 
6	LV	 	 

Yellow-coloured HT PVC slab

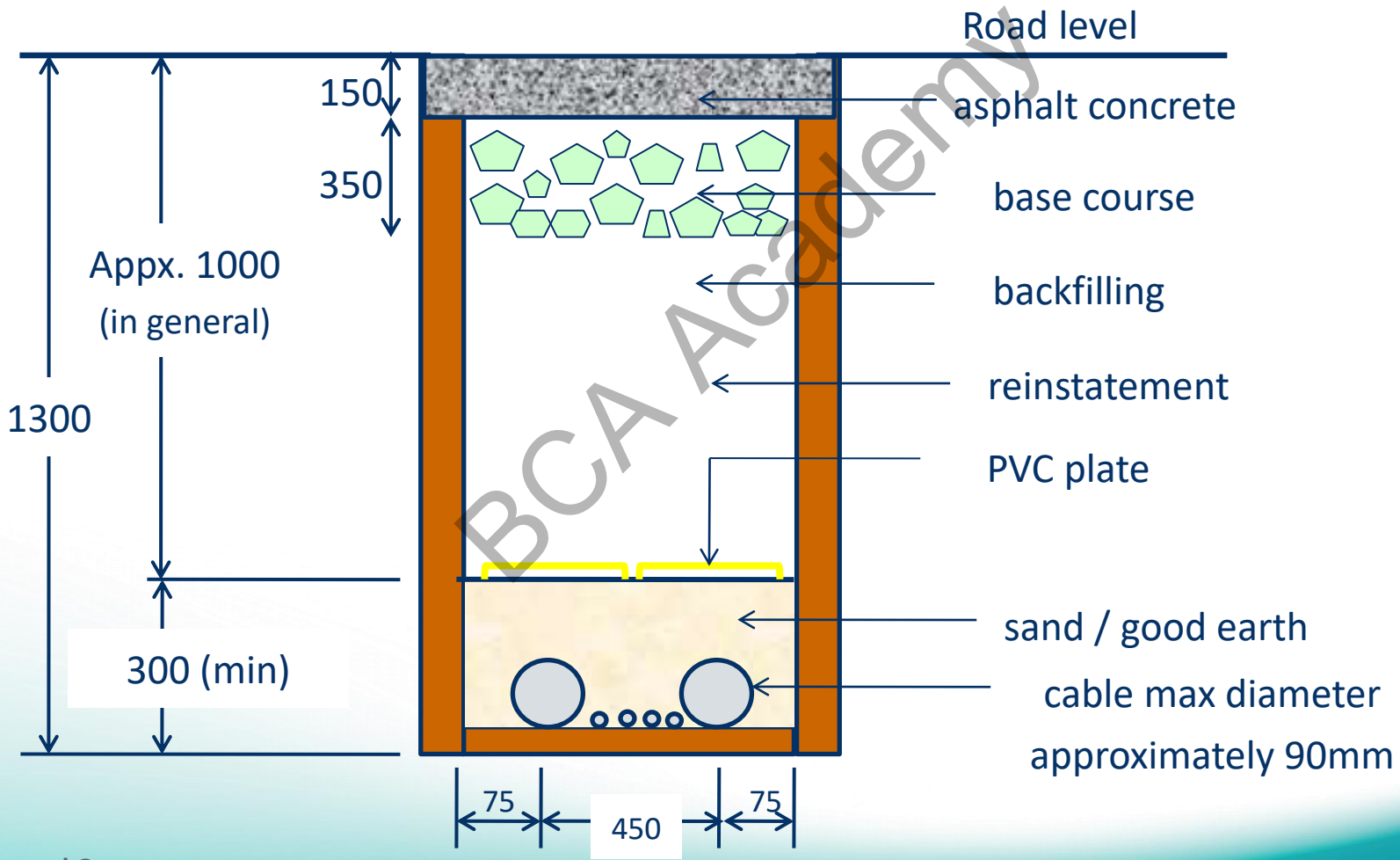
Red-coloured bricks

Black coloured LV PVC slab

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How are Cables Laid Underground?

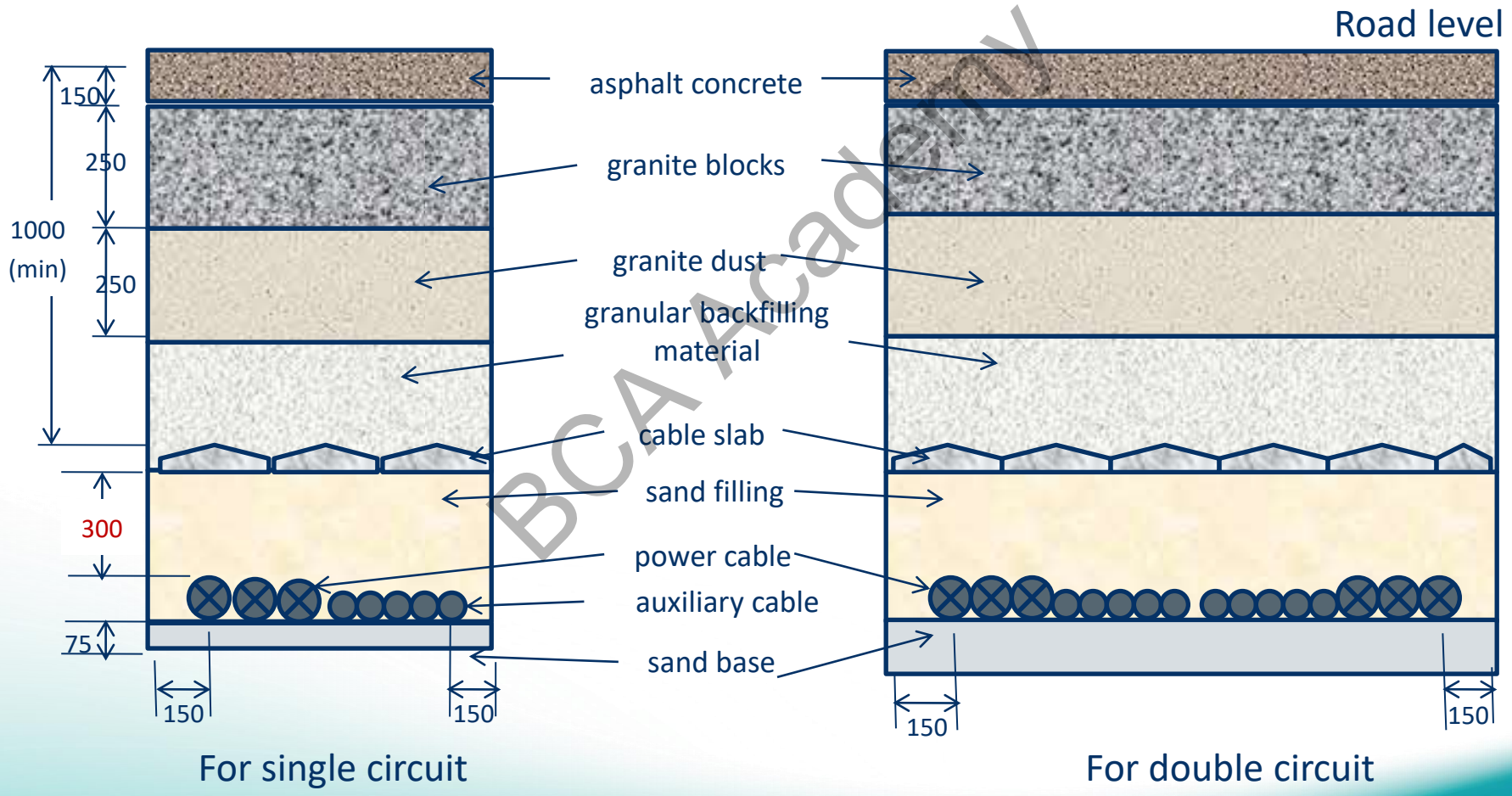
Example of Distribution Cable Trench (Direct Burial)



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How are Cables Laid Underground?

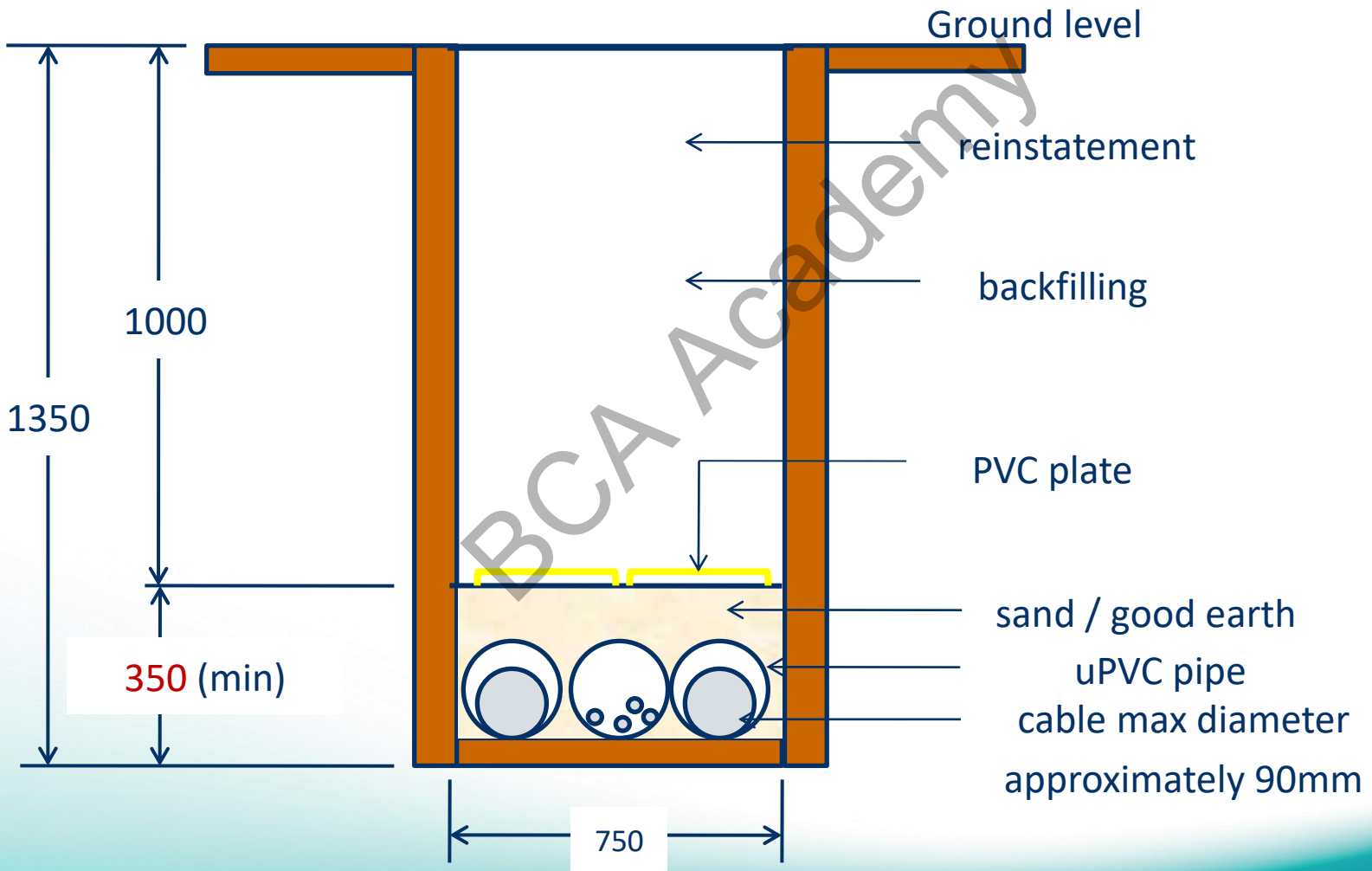
Example of Transmission Cable Trench (Direct Burial)



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How are Cables Laid Underground?

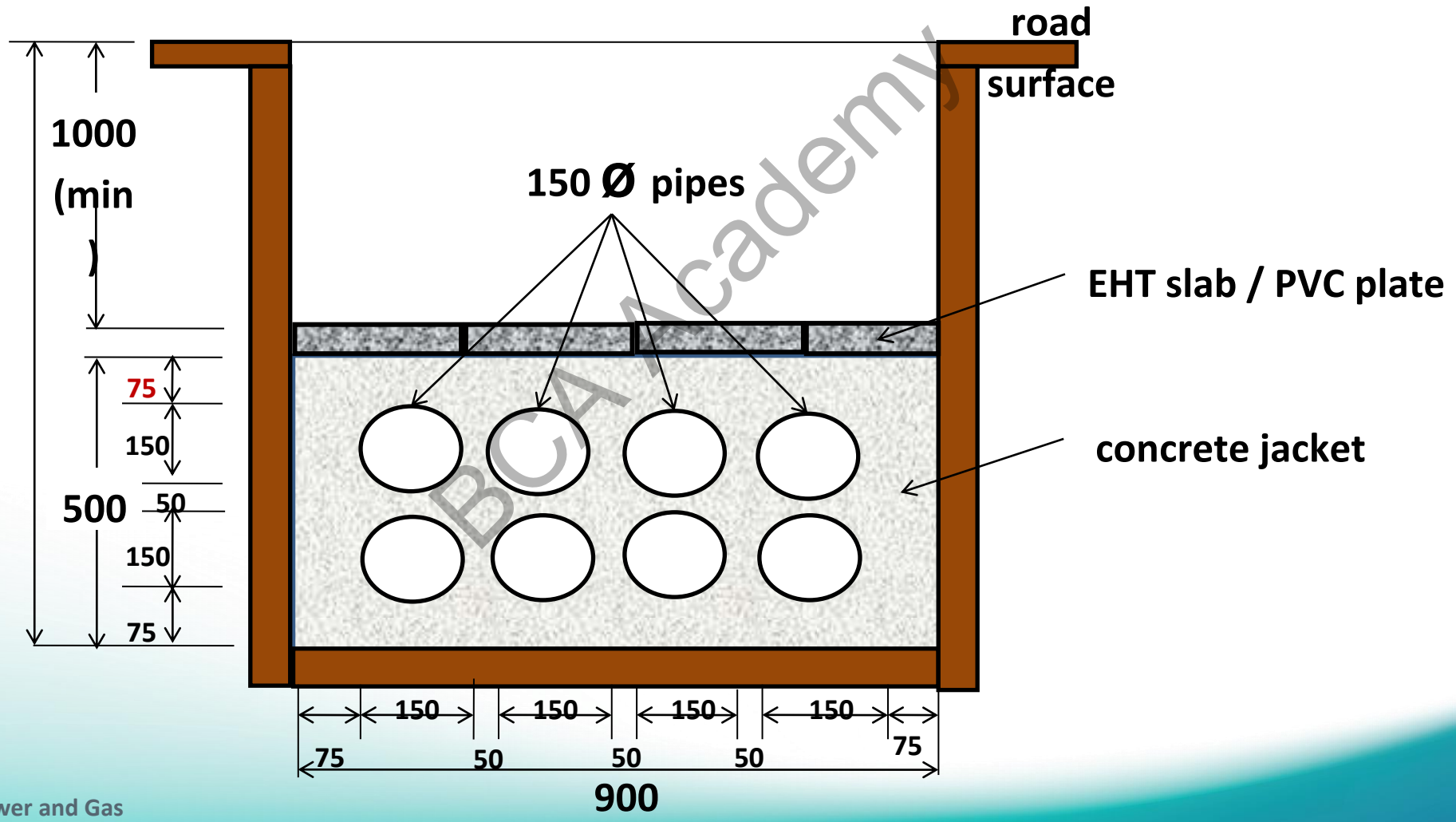
Example of Cables installed in uPVC pipes



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How are Cables Laid Underground?

Example of Section through concrete jacketed piping



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How are Cables Laid Underground?

Purpose of Standardising Cable & Trench Requireme

1. Similar maintenance procedure

2. Identification of assets

3. Setup common practices/rules

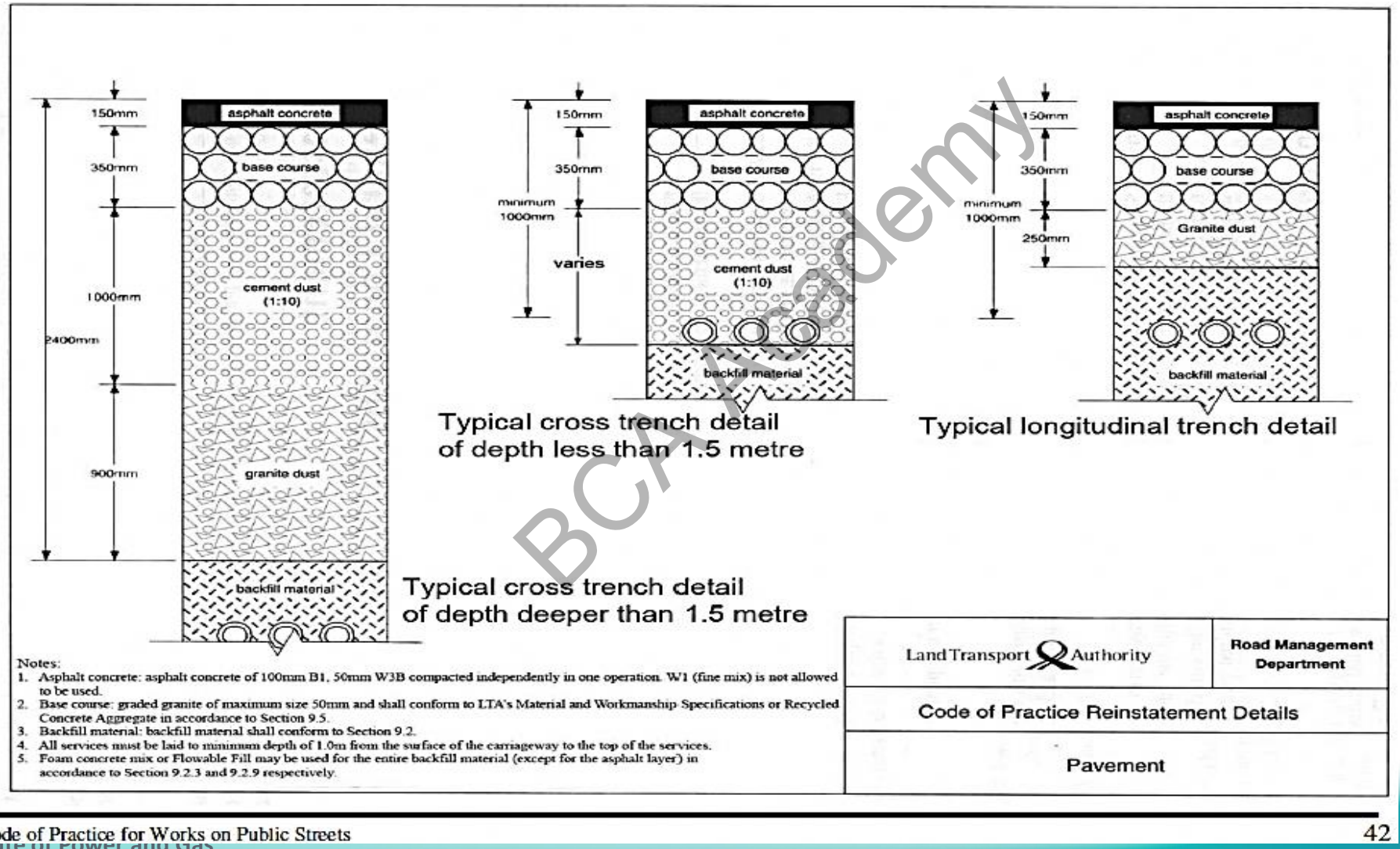




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How are Cables Laid Underground?

Example of Reinstatement Requirements



Underground Cable Network

Cable Joint



66kV cable joint



230kV cable joint

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Underground Cable Network

Oil Pressure Gauges In OG Box





Sub A



Underground oil storage tank



Sub B

Link Box

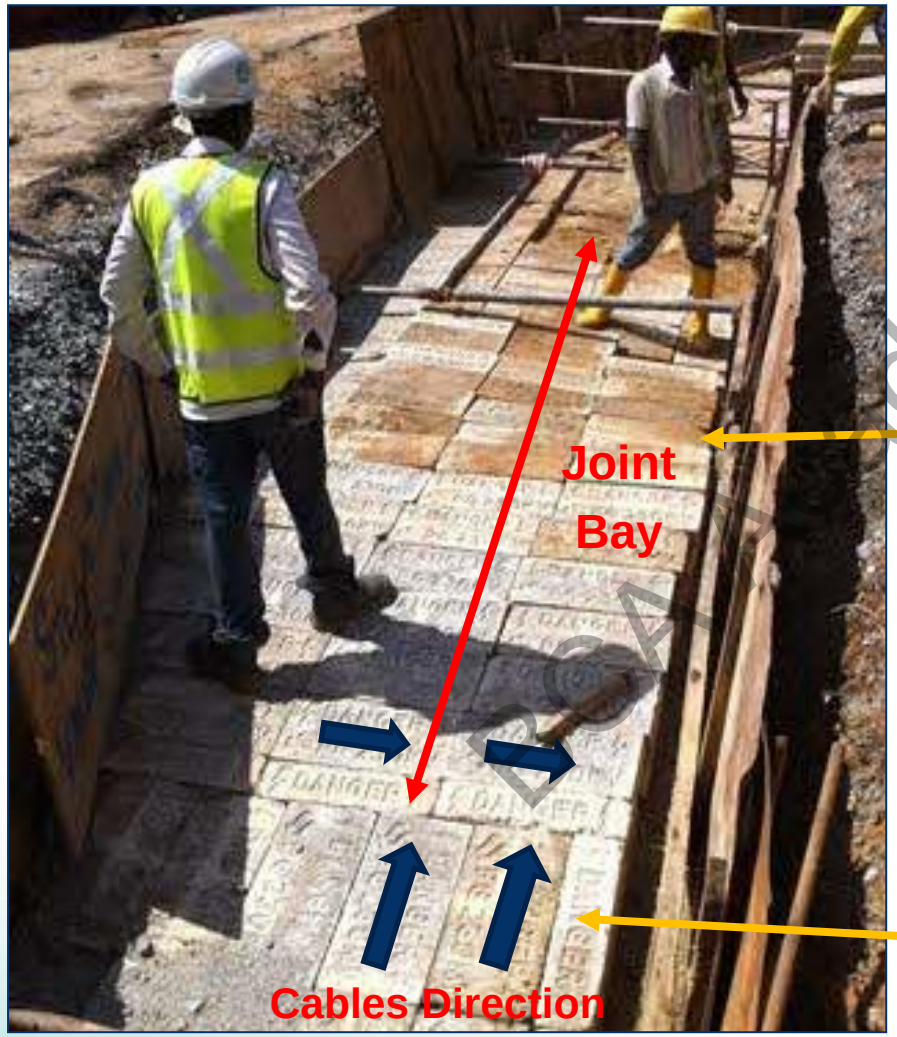






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Reinstatement EHV Cable Joint Bay



Cable Slabs are laid 90 degree across at joint bay

Cable Slabs are laid in line with cable direction

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Transmission Accessories



Overground Box for Cable Oil



Cable Oil Pressure Telemetry Panel



Overground Pressure Tank



Link Box

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Transmission OG Box and Pressure Tank

Oil Pressure Gauges In OG Box





Sub A



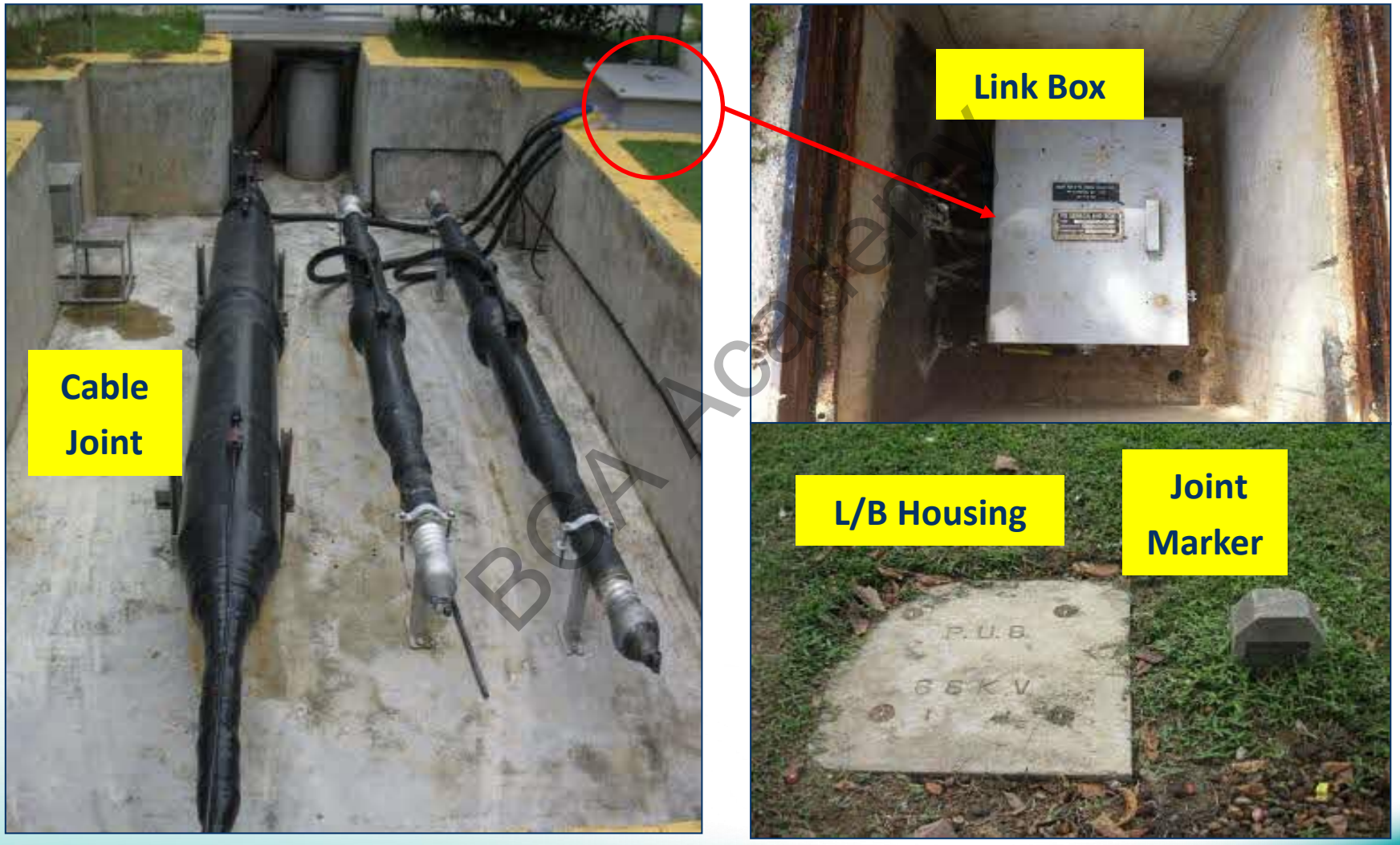
Sub B



Underground oil storage tank

Academy

Cable Joint with Link Box



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Chapter 3 (b)

Introduction to SPPG's Underground Services: The Gas Network

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Gas Network Overview

- 2 gas networks:
  - Town Gas (TG)
  - Natural Gas (NG)

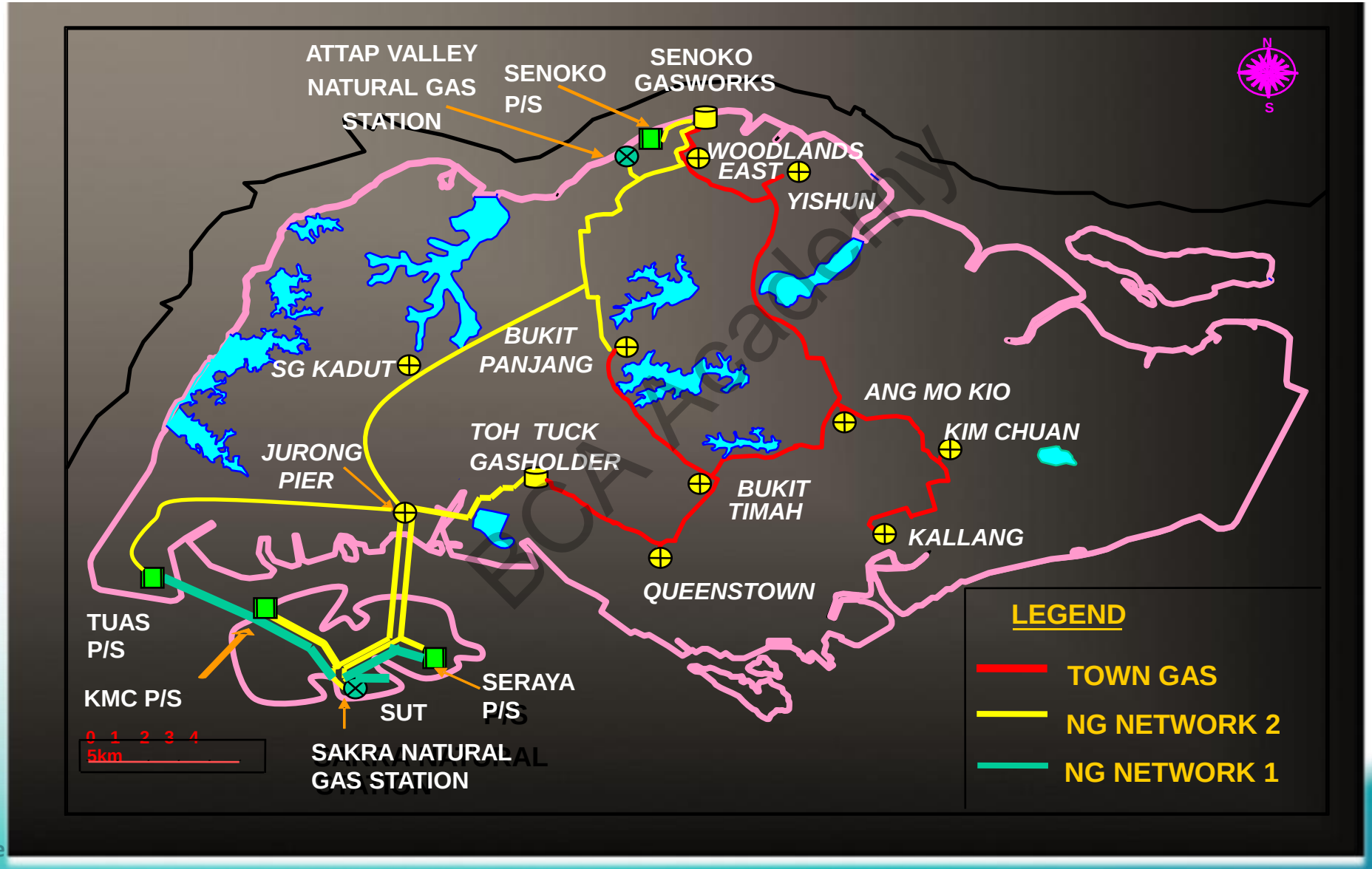
- Each network comprises
  - GTP - Transmission pipelines
  - MP - Medium pressure gas pipes
  - LP - Low pressure gas pipes

Transmission

Distribution

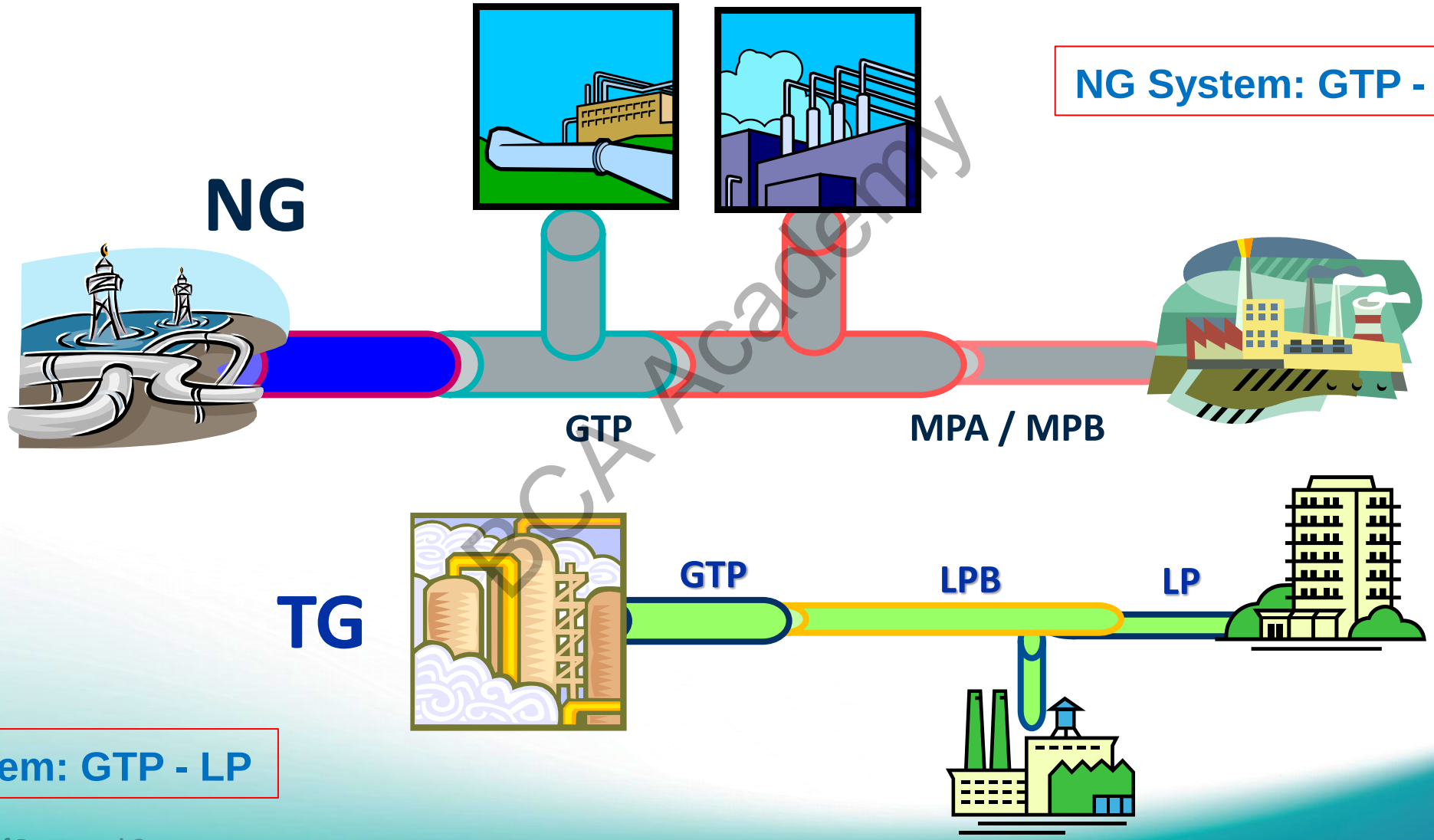
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Gas Transmission Network



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Gas Network Overview



NG System: GTP - MP

TG System: GTP - LP

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Natural Gas (NG) Transportation Process

From Indonesia or Malaysia

Submarine Pipelines

Natural Gas Receiving Station



Trans. Network

Metering Stations



To Gencos

Trans. Network



Offtake Stations

Medium Pressure Dist. Network

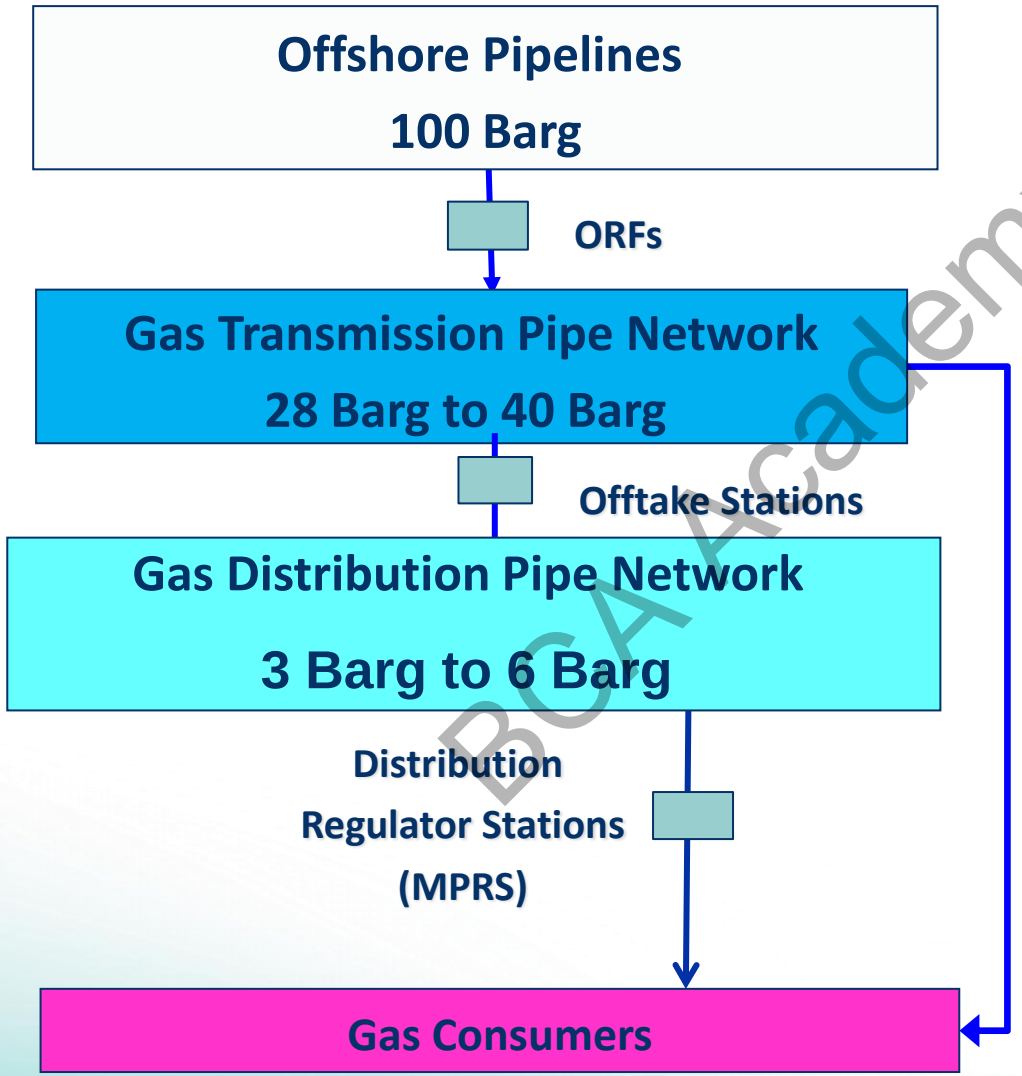


Metering & Pressure Regulating Skid

To Industrial Customers

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Overview of Natural Gas (NG) Network



1 Barg = 14.5038 psig

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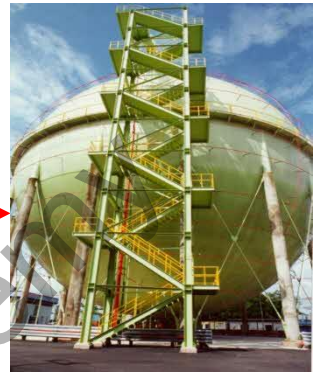
Town Gas (TG) Transportation Process

Senoko Gasworks (CityGas)



Trans. Pipeline

Gasholder at Toh Tuck



For emergency/ peak load shedding



Offtake Stations

LPB

Stepped down to low pressure

Regulator Stations

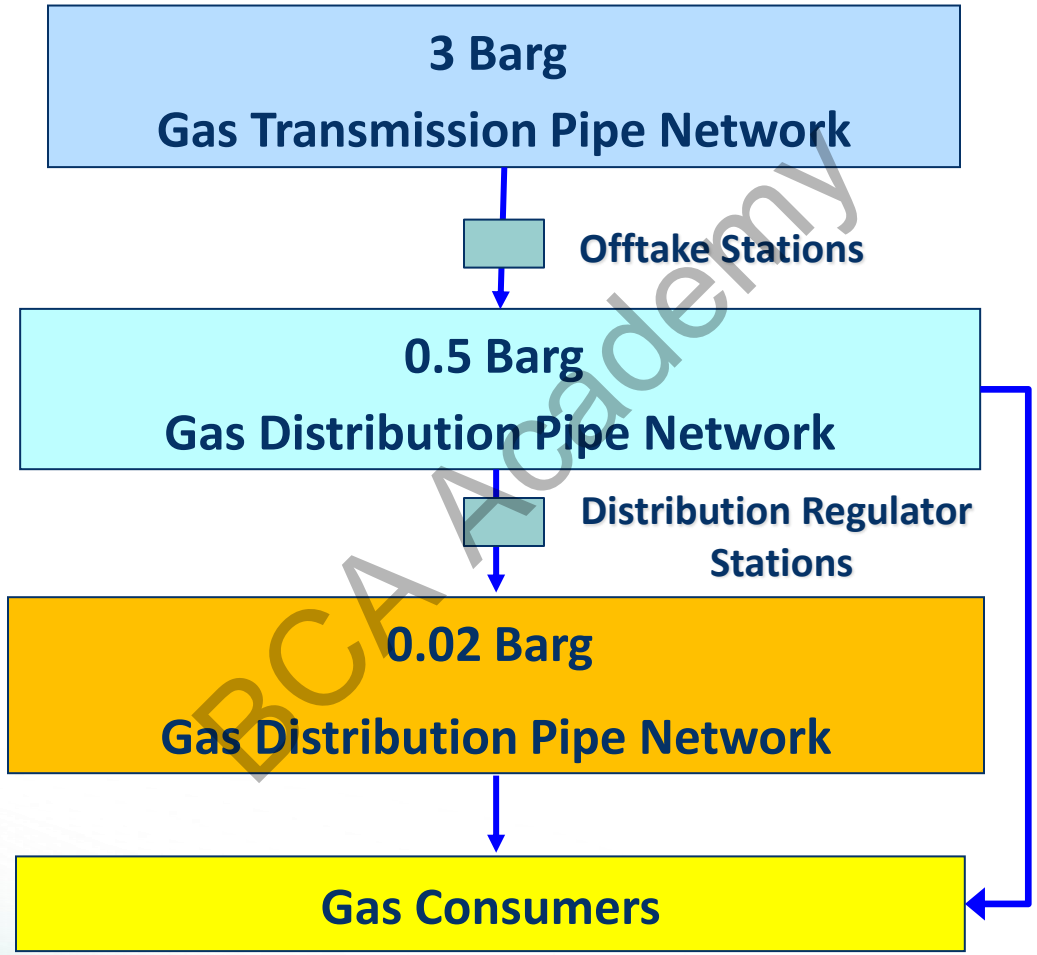


LP

To Industrial, Commercial & Residential customers

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Overview of Town Gas (TG) Network



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Types of Underground Gas Pipes (GTP, MP, LP)

NO	PIPE MATERIAL		GAS PIPE ID MARKER / CONCRETE SLAB
1	Polyethylene Pipes		
2	Ductile Iron Pipes		
3	Galvanised Iron Pipes		
4	Steel Pipes - Coatings (yellow or black) to protect against corrosion for GTP		

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New Gas Identification Marker



***Orange ID marker still found in all existing gas pipes**

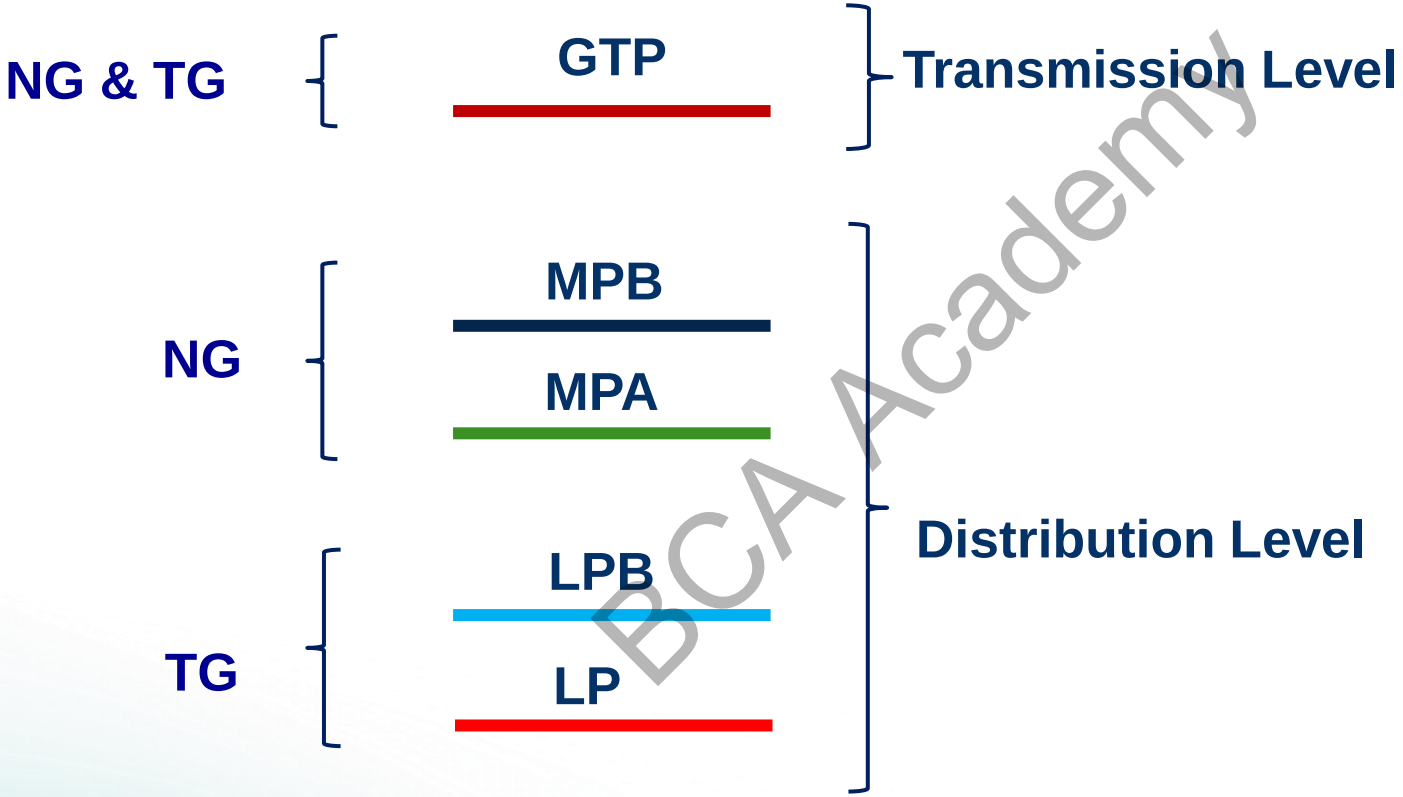


DANGER - Powergas Ltd

New yellow colour Gas Identification marker introduce in 2019 for all Distribution Gas Pipes

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Categories of Gas Pipeline



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Types of Underground Gas Pipes

Transmission Level (GTP) Gas Pipe – Natural Gas (NG) & Town Gas (TG)









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Types of Underground Gas Pipes

MP Gas Pipe (Natural Gas)



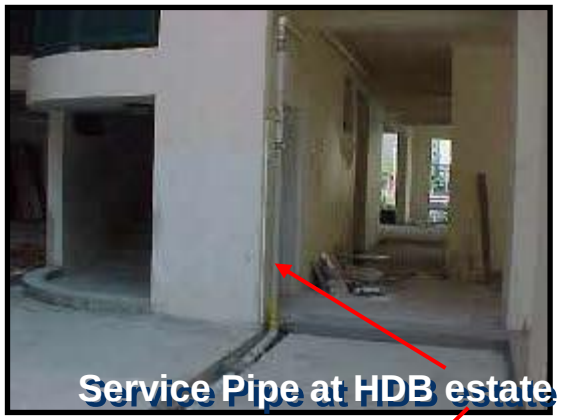






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Types of Underground Gas Pipes













LP Gas Pipe



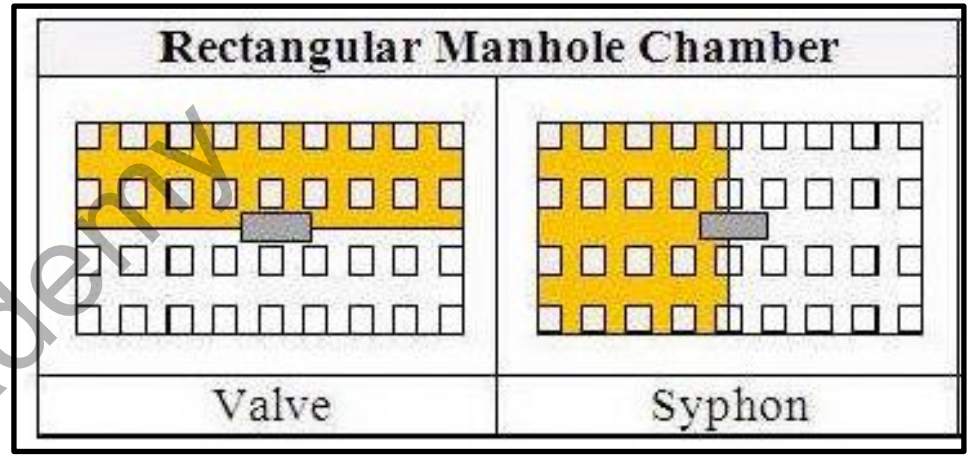
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Types of Underground Gas Pipes

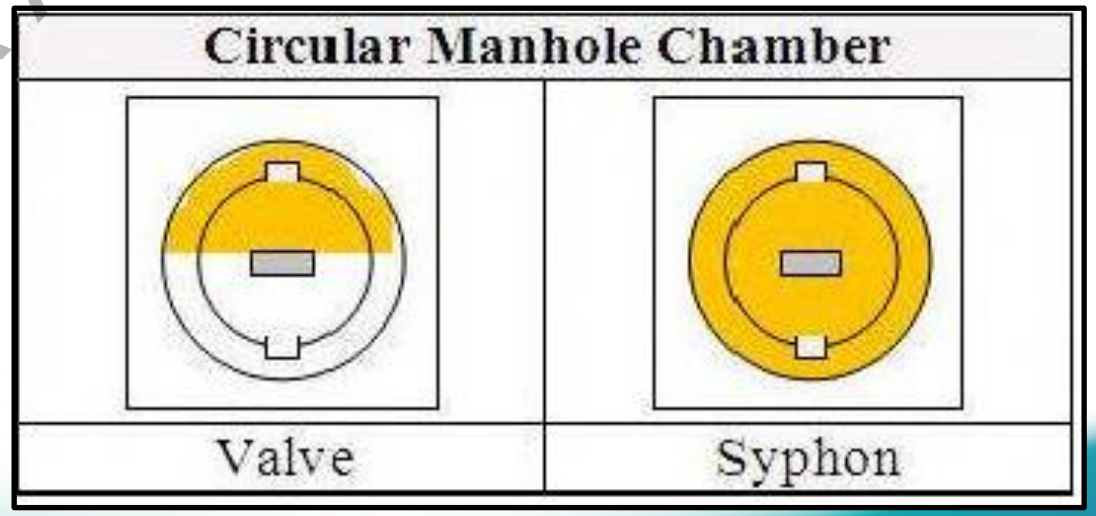
LP Gas Manholes











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Types of Underground Gas Pipes





Valve and Syphon Covers

- Do not cover or obstruct manhole covers. This is for emergency access i.e. shut valve or pump water out
- Peg or barricade the manhole covers
- Send in your request to raise or lower manhole covers via email to:

GasEnquiry@spgroup.com.sg

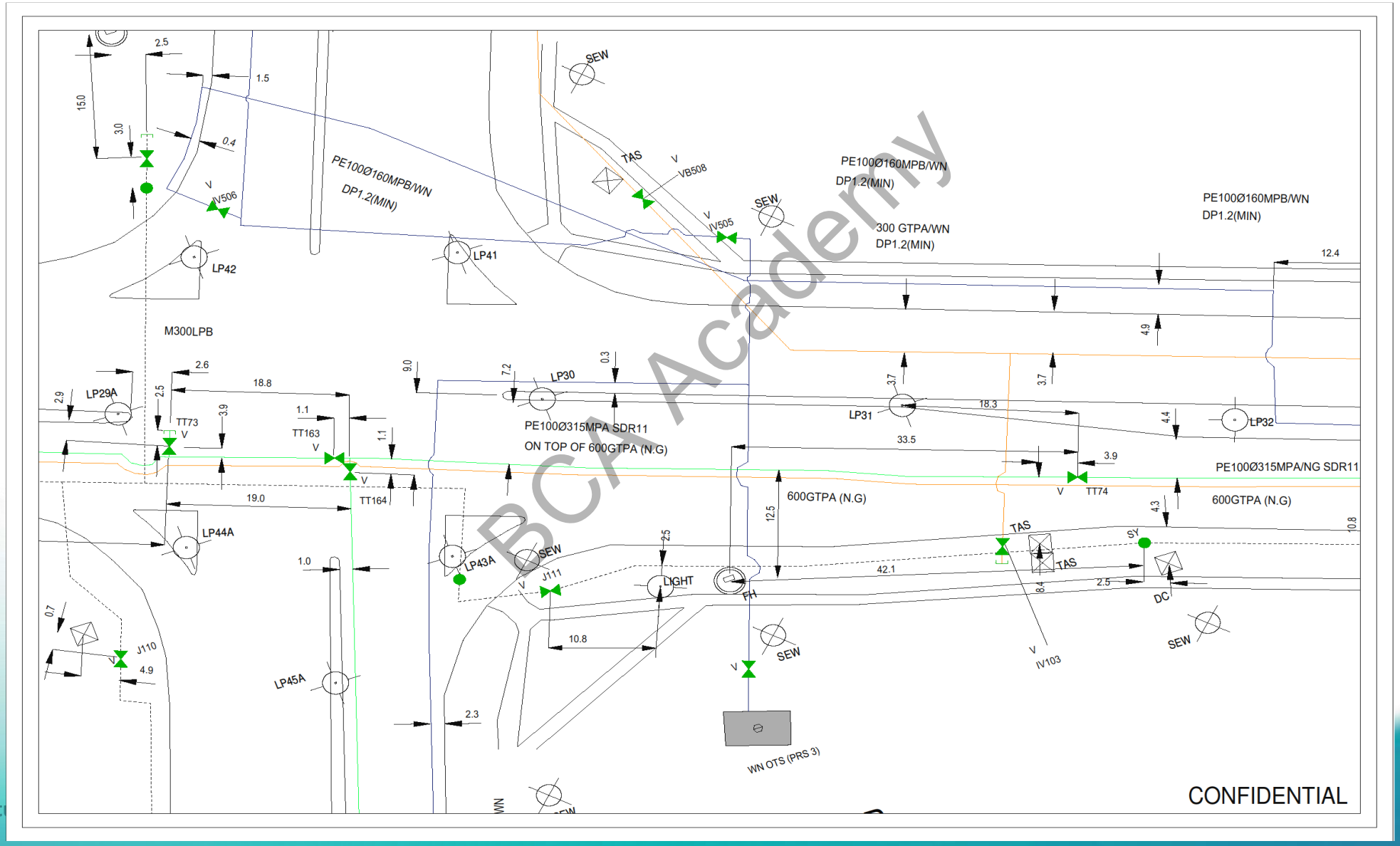
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Transmission Network - GTP (NG)

- Material : Steel
- Plan identification : GTP / GTPA
- Site identification : Warning marker
  Warning tape
  Concrete slab
  (some locations)

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Plan Identification – GTP (NG)

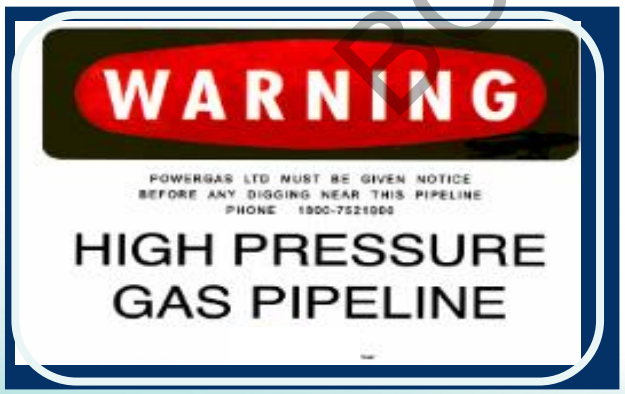


Site Identification











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Site Identification







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Site Identification – GTP (NG)



Concrete slab

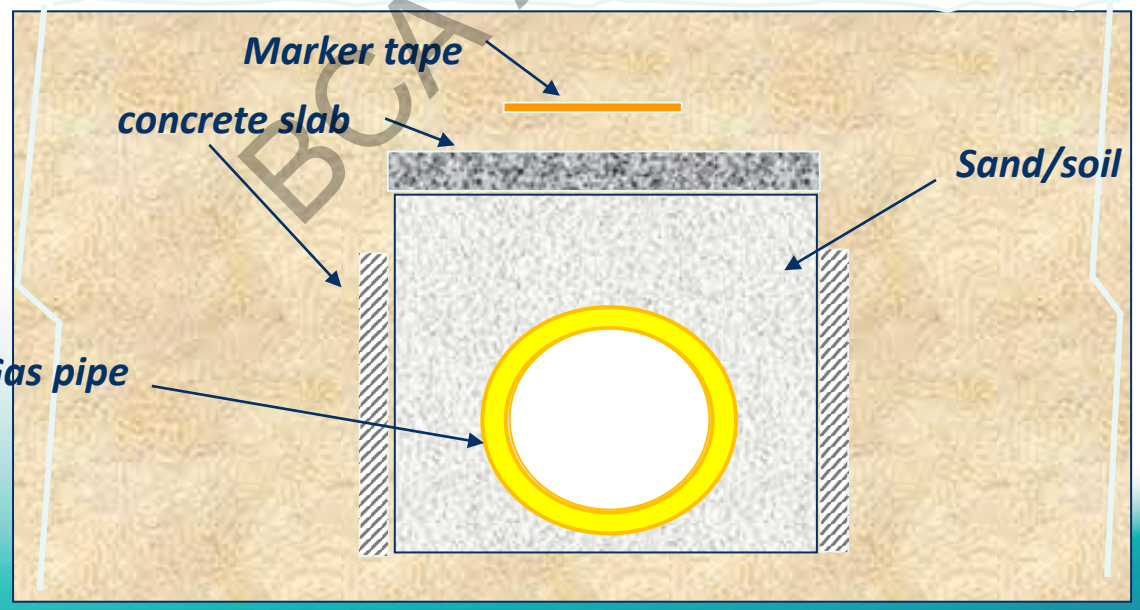


PVC marker tape



Warning Marker

ground level



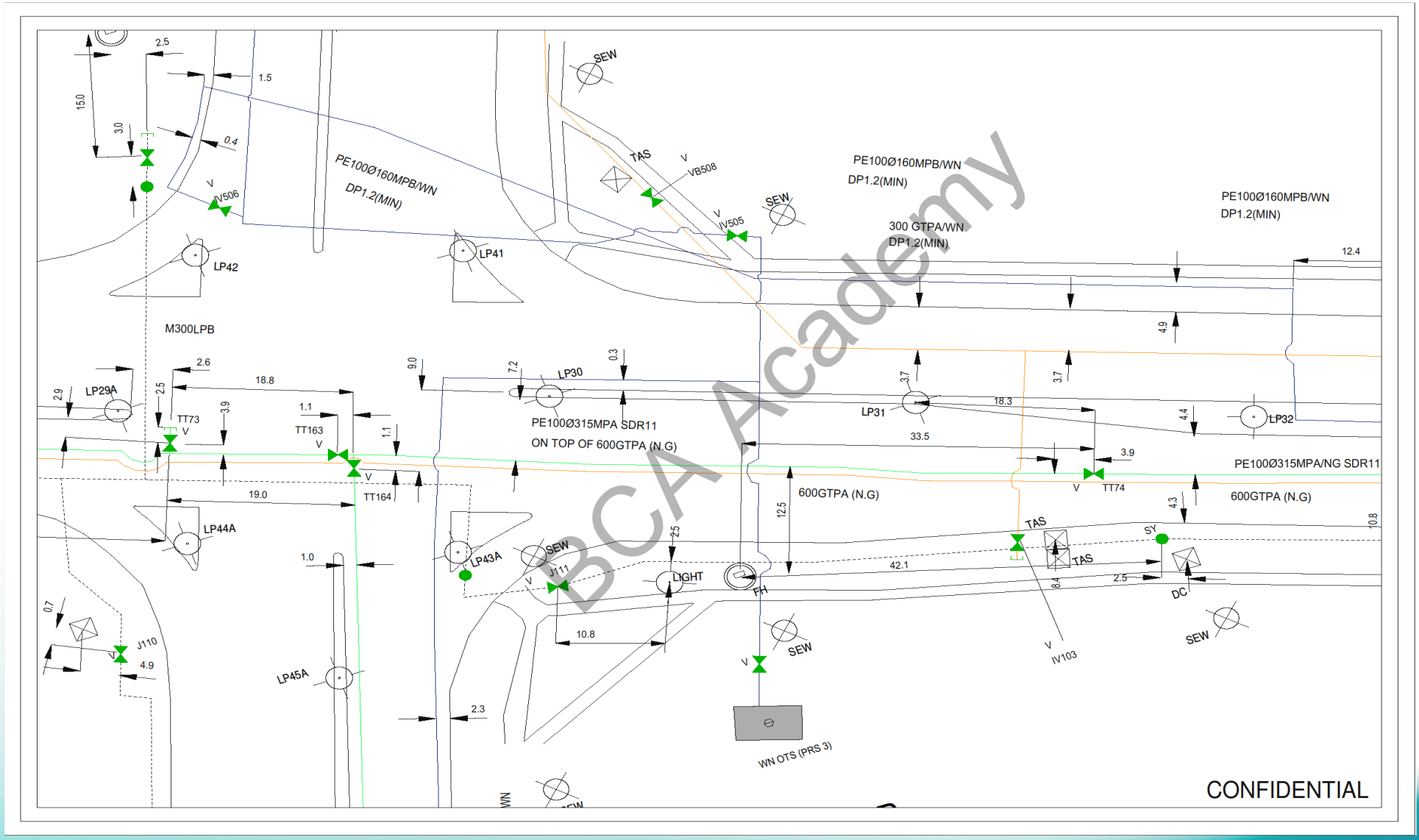
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Medium Pressure Network - MPB/ MPA (NG)

Material	:	PE (Polyethylene)
Plan identification	:	MPB / MPA
Site identification	:	Warning marker Warning tape Pre-cast Concrete Slabs (some locations)

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Site Identification – MPB/ MPA (NG)



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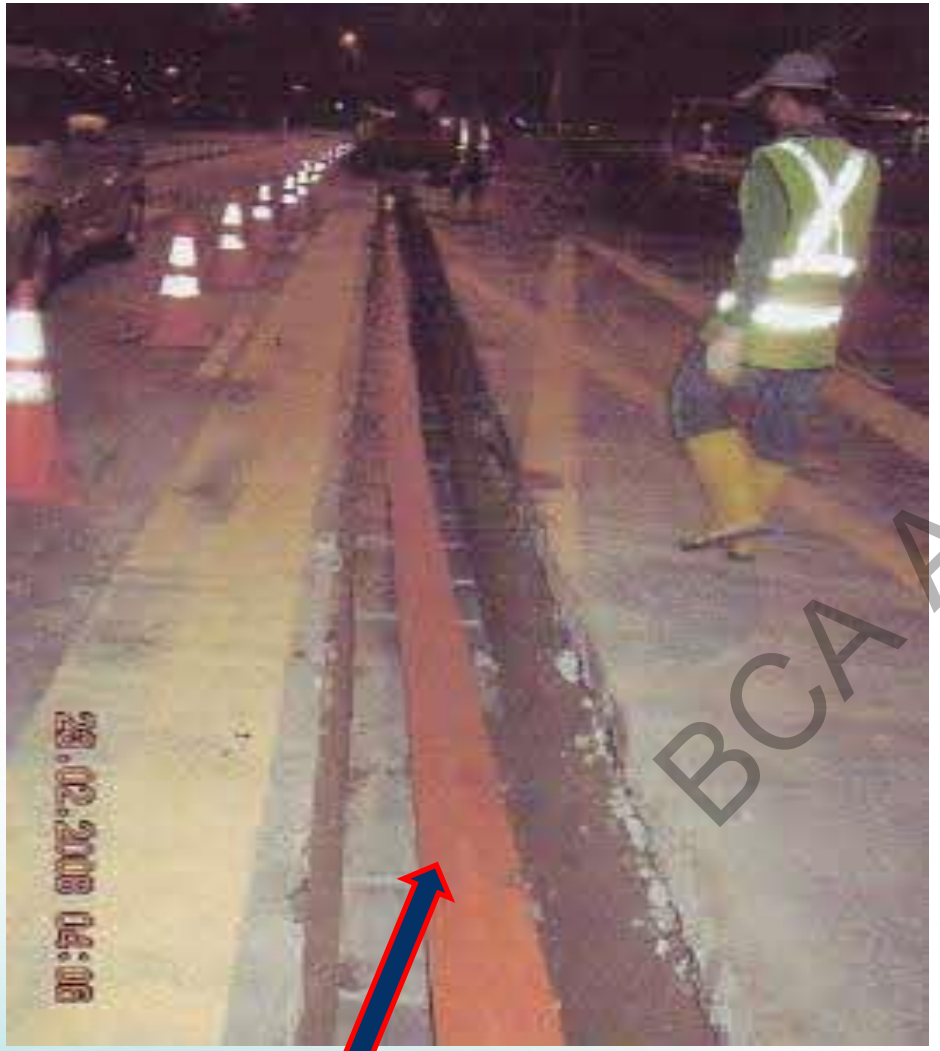
Site Identification – MPB/ MPA (NG)





Warning Markers

Site Identification – MPB/ MPA (NG)



Warning Tape



Pre-cast Concrete Slabs
(some locations)

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Transmission Network (TG)

Material	:	1. Steel 2. PE (polyethylene)
Plan identification	:	GTP
Site identification	:	Warning marker Warning tape Pre-cast Concrete Slabs (some locations)

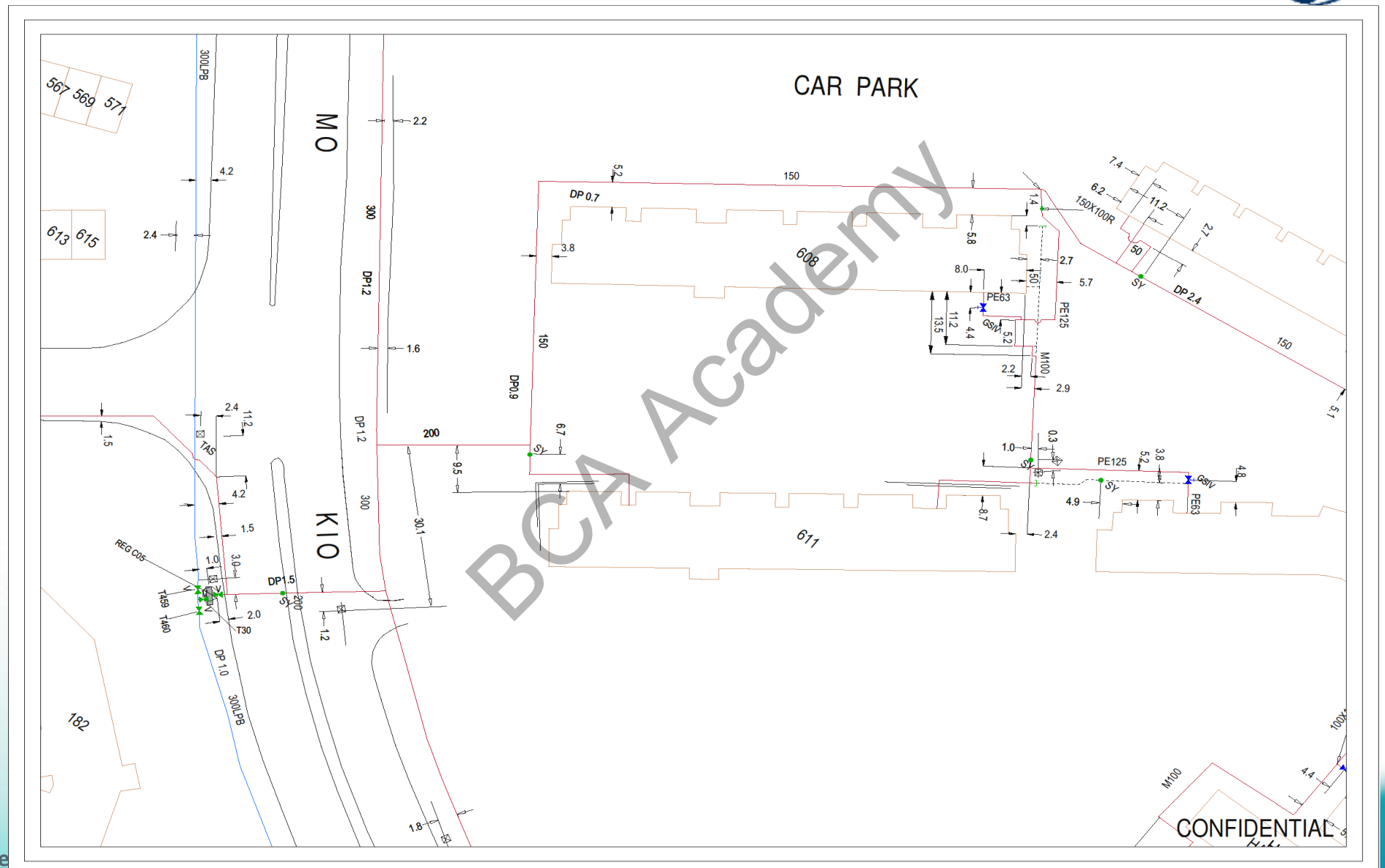
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Low Pressure Network - TG

Material	:	Steel/ DI/ CI/ PE/ GI
Plan identification	:	LPB / LP
Site identification	:	None (Backing materials for PE pipe is 100% quarry dust or sand)

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Plan Identification – LP (TG)



Site Identification – LP (TG)



Concrete slab & marker tape for Medium Pressure pipeline

PE pipe electronic markers



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Site Identification – LP (TG)

Laying of LP gas pipe & gas marker



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Site Identification – LP (TG)





RCA Academy

PE pipes used instead of DI pipes for all new construction

Site Identification – LP (TG)



Ductile Iron (DI) gas pipe

Polyethylene (PE) gas pipe



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Site Identification – LP (TG)









BCA Academy

Site Identification – LP (TG)



DI manhole cover on newly reinstated concrete pathway



DI Gate Valve with PE end

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Site Identification – District Regulator (TG)





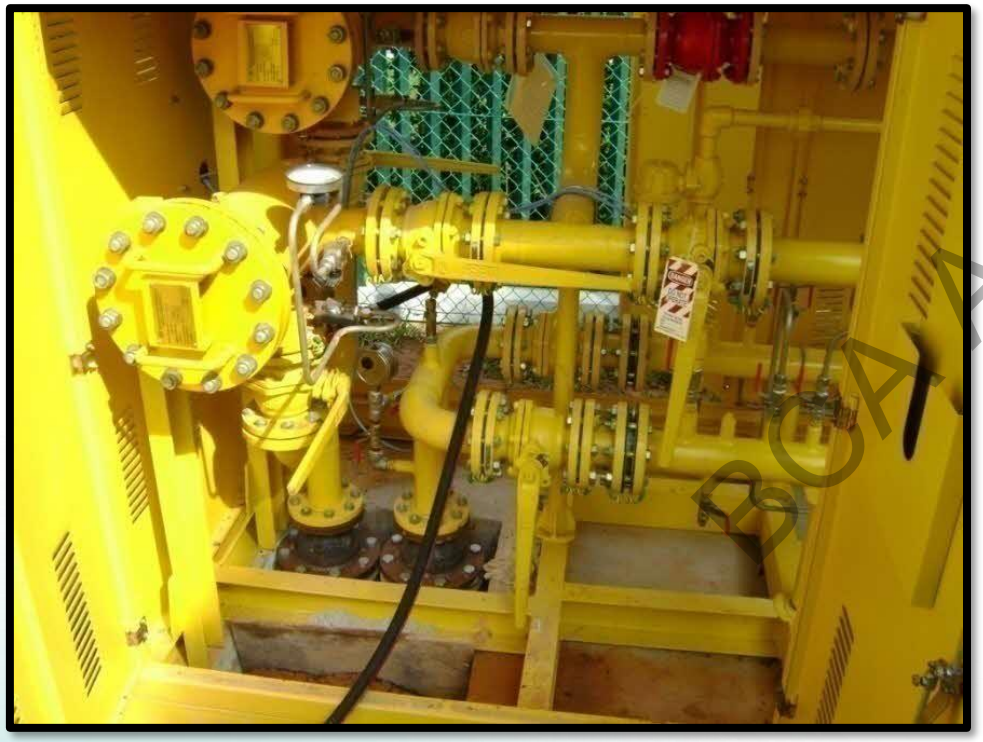
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District Regulator (TG)

OG Type (over-ground type)

Site Identification – MPRS (NG)

Metering and Pressure Reduction Skid (MPRS)





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PE Pipe Laying in Progress



PE Pipe Laying in Progress



BCA Academy

Operational Risk Mitigation



Daily Patrolling

Leak Survey by foot and vehicle





Air samples sucked and tested

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Operational Risk Mitigation

24 Hours Hotline

1800 752 1800













BCA Academy

Respond To Network Faults

Chapter 3 (c)

Introduction to Singapore Underground Services: Problems that affect Grid System

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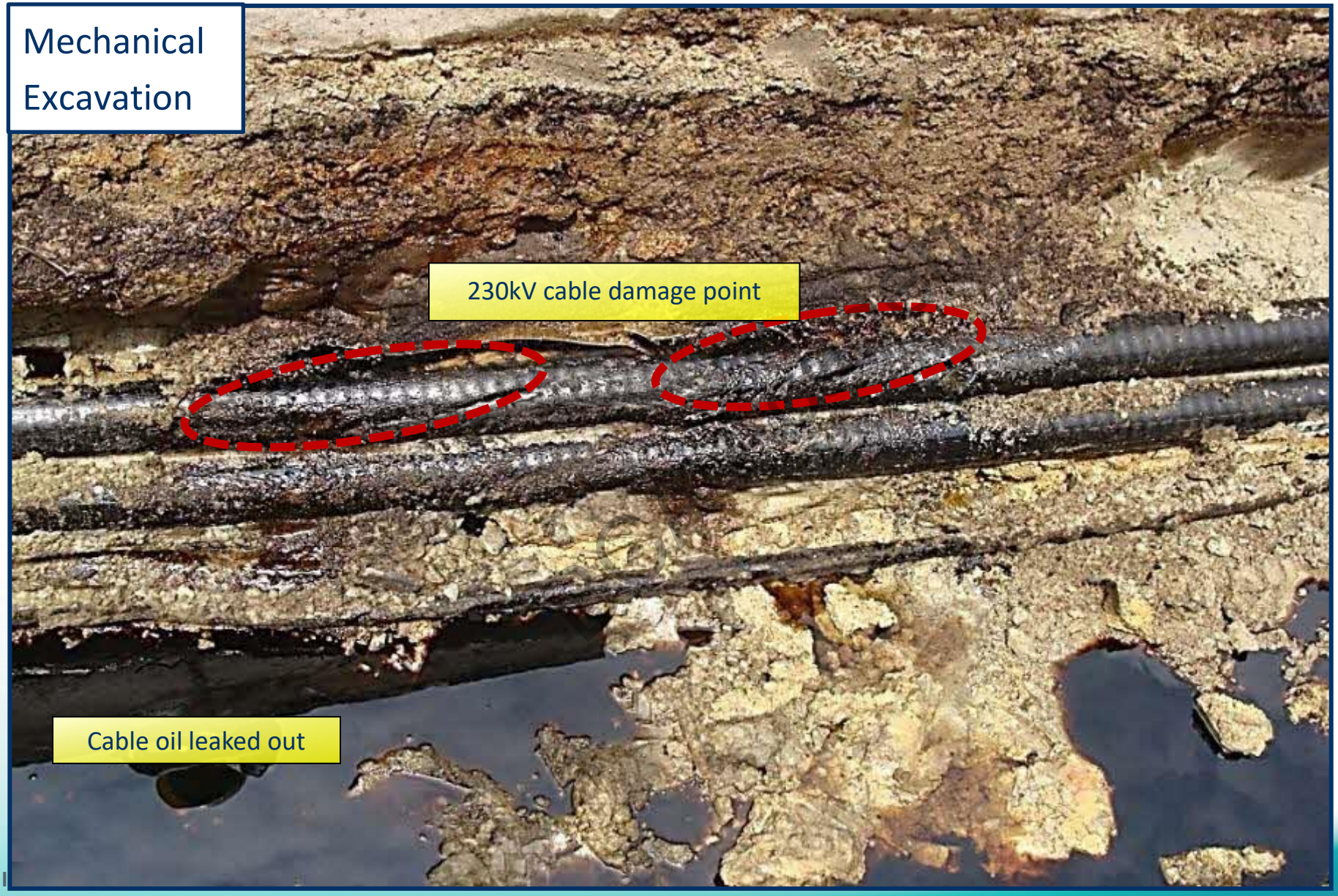
Common Causes of Damage

- Mechanical excavation
- Vertical drilling
- Installation of casing tube for boring
- Sheet piling
- Pipe-jacking
- Hand augering
- RC piling
- Sinking of earth rods
- Water intrusion from previous minor damage

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Direct Damage to Cables

Mechanical Excavation



General root cause/s for damage:

- Poor supervision
- Mechanical excavator used at cable positions

Direct Damage to Cables

A-Frame Vertical Drilling Machine for installing inclinometer



66kV Cable Damage

General root cause/s for damage:

- Did not refer to cable plan & LCDW detection drawing
- No trial hole
- Poor supervision

CM Academy

Direct Damage to Cables

Installation of casing tube for boring machine drill bit



66kV cable damage point

General root cause:
- Failed to supervise the full job effectively

A Classic Case Study

- Contractor engaged Registered Surveyor to plot the 66kV cable positions.
- The surveyed drawing was to show “accurate” cable positions and on where to put casing tube safely away from cables.
- A 66 kV cable was still damaged because workers did not put the cables back into the original positions as the suspended cables had developed “slacks” over a prolonged period.
- So, the surveyed drawing was not accurate in planning where to put the casing tube.

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Direct Damage to Cables



General root cause/s for damage:

- Poor supervision
- Workers not briefed of cable positions and preventive measures
- Cable plan & LCDW detection drawings not used
- No trial holes done

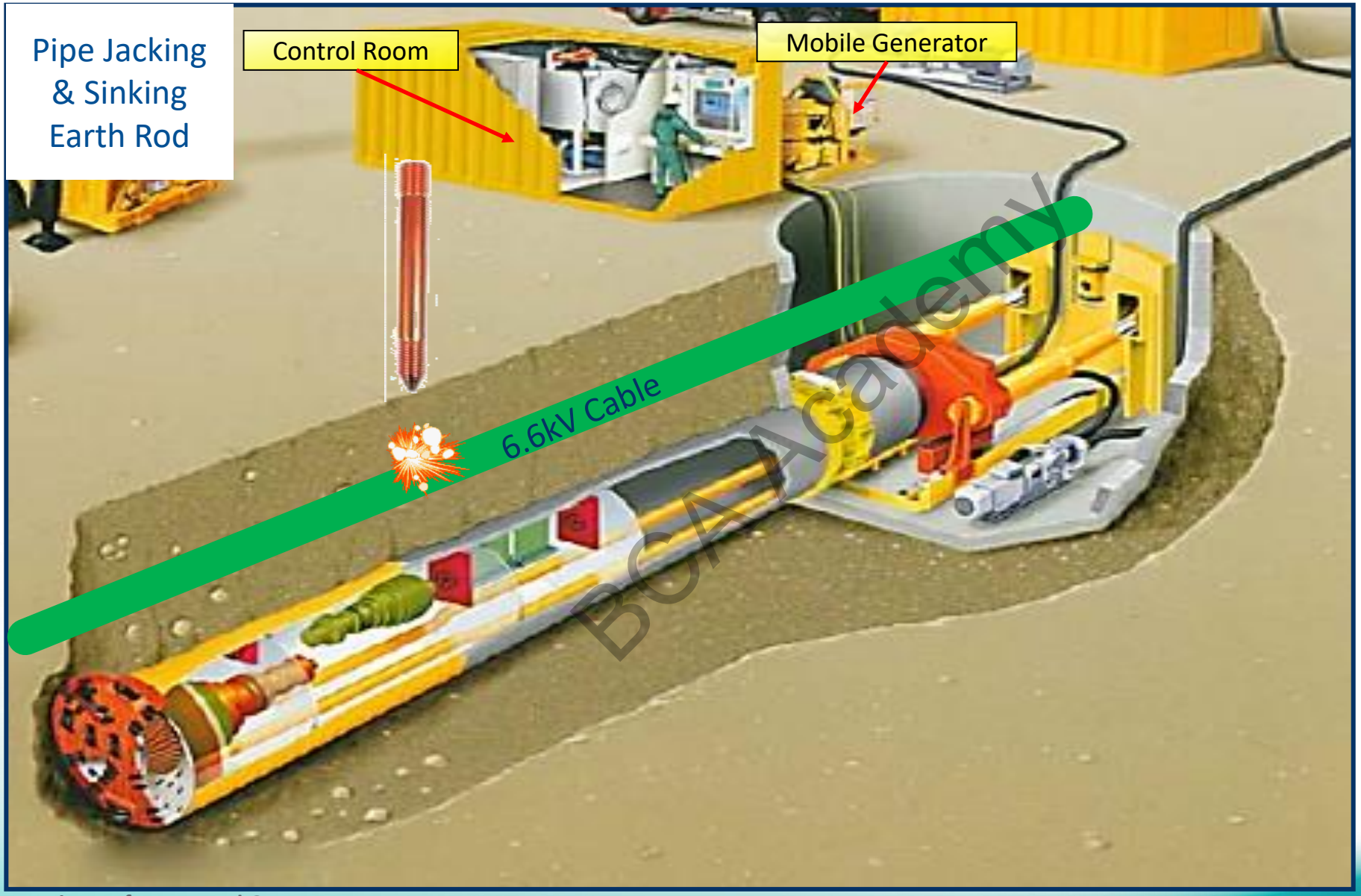
Direct Damage to Cables



General root cause/s for damage:

- Inadequate clearance between pipejacking route and cable
- Poor control of pipejacking path
- Trial holes done are not adequate / appropriate
- Poor supervision
- Untrained / inexperienced operator

Direct Damage to Cables



Direct Damage to Cables



Pipe Jacking Head

Cables Damage by Pipe Jacking

General root cause/s for damage:

- Did not refer to cable plan, LCDW detection drawing and As-Built Drawing
- No trial hole
- Poor supervision



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Direct Damage to Cables

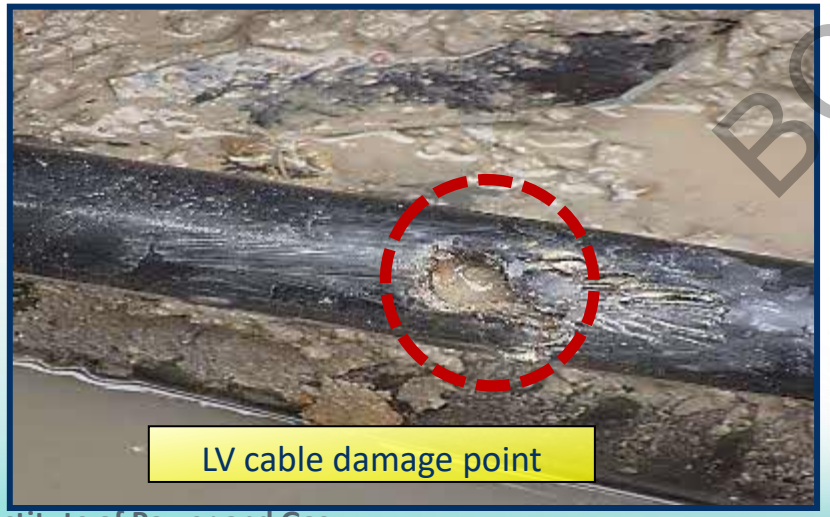
Hand Augering

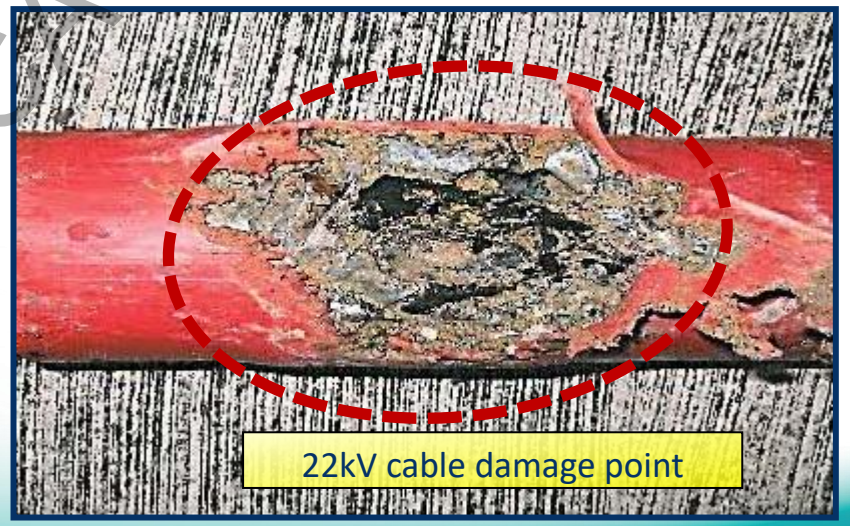




General Root causes:

- Fail to compare cable plans & LCDW Detection Drawings
- No trial hole, assuming hand auguring is a form of trial hole
- Taking shortcut
- No briefing to workers on cable positions and preventive measures





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Direct Damage to Cables

Reinforced - Concrete pile for building foundation



General Root causes:

- Communication failure
- Poor or absence of supervision
- Fail to brief / ensure operators understand where to insert piles
- Fail to brief workers of cable positions

Direct Damage to Cables

Sinking Earth rod for bus stop shelter



230kV cable damaged by Earth rod

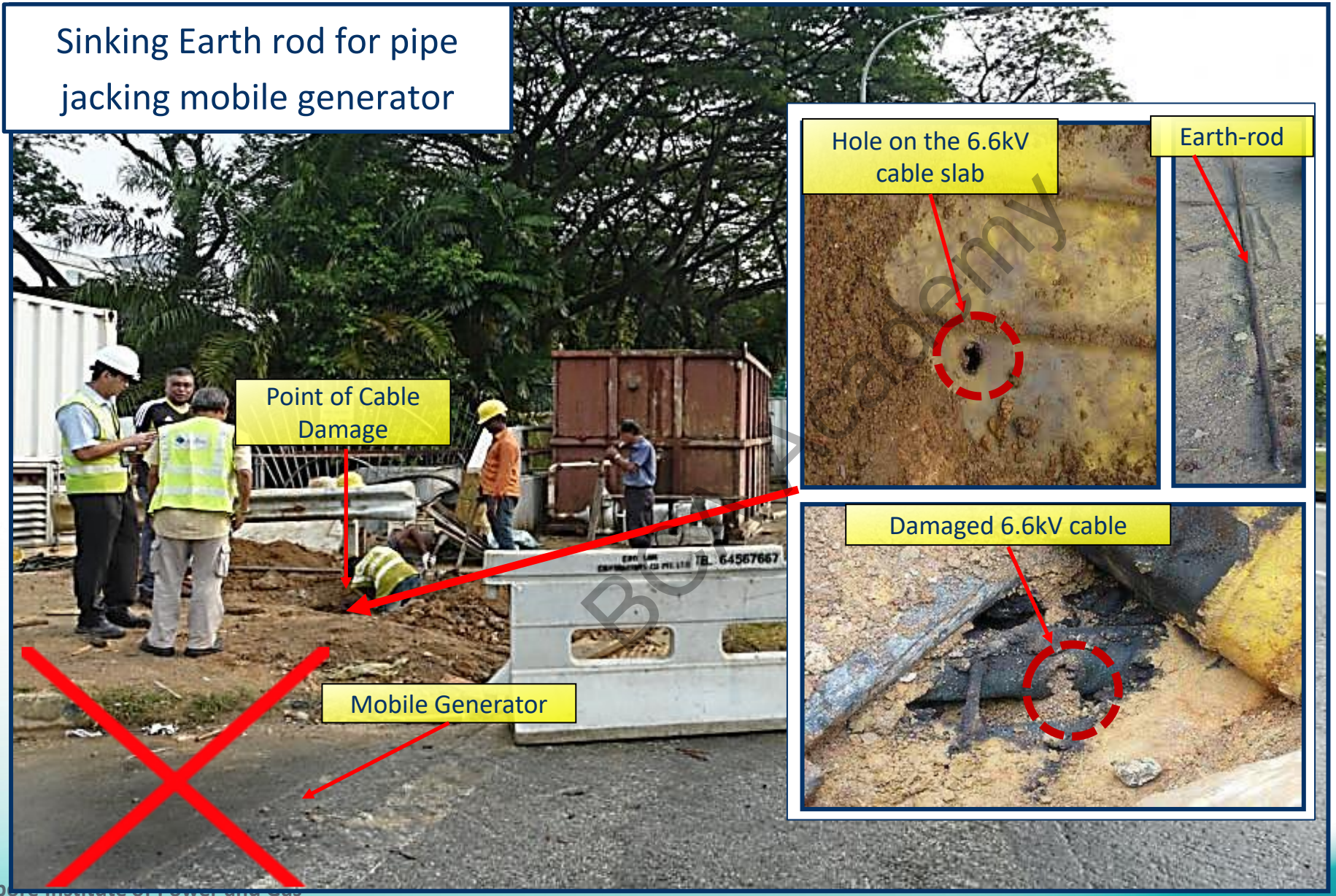
- Worker inserted earth rod & felt ‘vibrations’. He removed it and found the rod looked shorter but did not think twice before throwing it away.
- He proceeded with 2nd earth rod by moving a bit away from the 1st position.
- The 2nd rod went in smoothly and even returned a perfect zero Ohm reading.
- Following report of grid system tripping, SPPG team arrived and suspected the conspicuous earth rod had damaged the cable.
- This was confirmed upon excavation and as seen in the photo with 2 points of damage.

General root causes:

- Failed to refer to cable plans & LCDW detection drawings
- No trial holes
- Failed to brief workers

Direct Damage to Cables

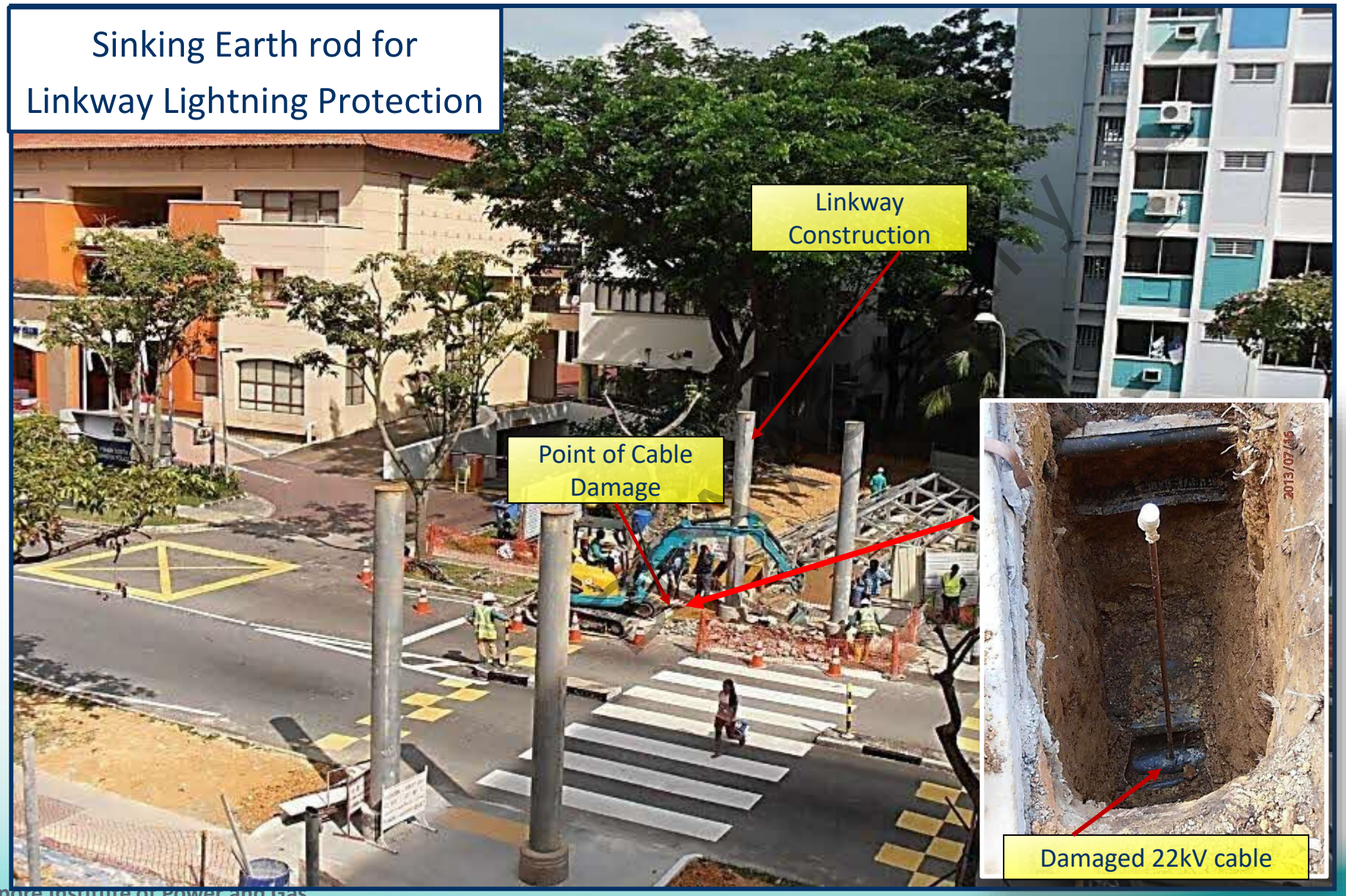
Sinking Earth rod for pipe jacking mobile generator



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Direct Damage to Cables

Sinking Earth rod for
Linkway Lightning Protection



Direct Damage to Cables



Direct Damage to Cables

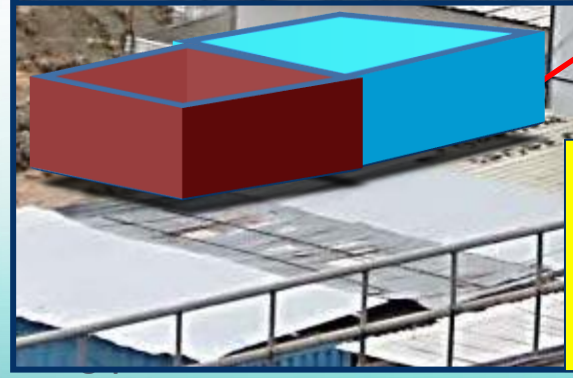
Sink earth rod at the newly shifted site office lightning protection without re-detection or trial hole



66kV Cable Damaged by Earth rod

Shifted Temporary Site Office

Original Site Office Position



General root causes:

- Failed to refer to both cable plans & LCDW detection drawings
- No trial holes
- LCDW was not re-engaged after change to site boundaries

- After the sheds were shifted, workers used LCDW drawing to confirm 66kV cables were on the pedestrian walkway outside the hoardings.
- Feeling safe and without doing trial holes, they proceeded to sink earth rod to provide electrical protection for the sheds. 66kV cable was damaged by the earth rod.
- Workers did not know that another work team had earlier shifted the hoardings further out to the pedestrian walkway but *LCDW was not called to do another cable detection.*

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Delayed Damage

Water Intrusion

Puncture hole on 22kV cable sheath



Water intrusion caused flash over



- Cables with surface damage and reinstated without repairing would explode and fail eventually because of 'water intrusion'.
- This could happen from days to weeks and even months. One case at a bus stop in Tampines took 5 years to fail from an earth rod that had the name of the contractor's company embossed.
- SPPG investigates all parties who had done earthworks in the affected area to identify the culprit.
- Costs of repair of cables compromised by water intrusion could be substantially more because of water intrusion, besides possible prosecution.
- Damage should be reported immediately to minimize additional adverse outcomes.

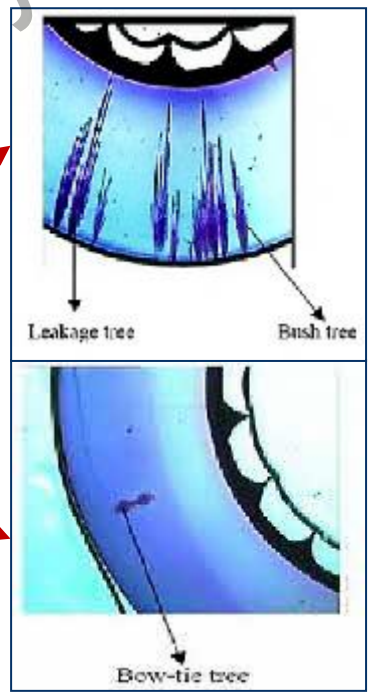
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Delayed Damage

Water Tree on XLPE Cable







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Microscopic inspection of Water Tree

Other Causes of Cable and Joint Failure

- Improper suspension and supports for exposed cables
- Heavy machineries resting on cables
- Soil movements or subsidence
- Reinstatement
- Vibrations
- Uprooting of trees

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Cables hanging without Suspension



General Root causes:

- **Poor or no supervision**
- **Ignorant workers**
- **Poor attitude**

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Tree uprooting



General Root causes:

- Poor understanding of damage prevention
- Unable to foresee problems and take preventive measures

Vibration / Soil Subsidence



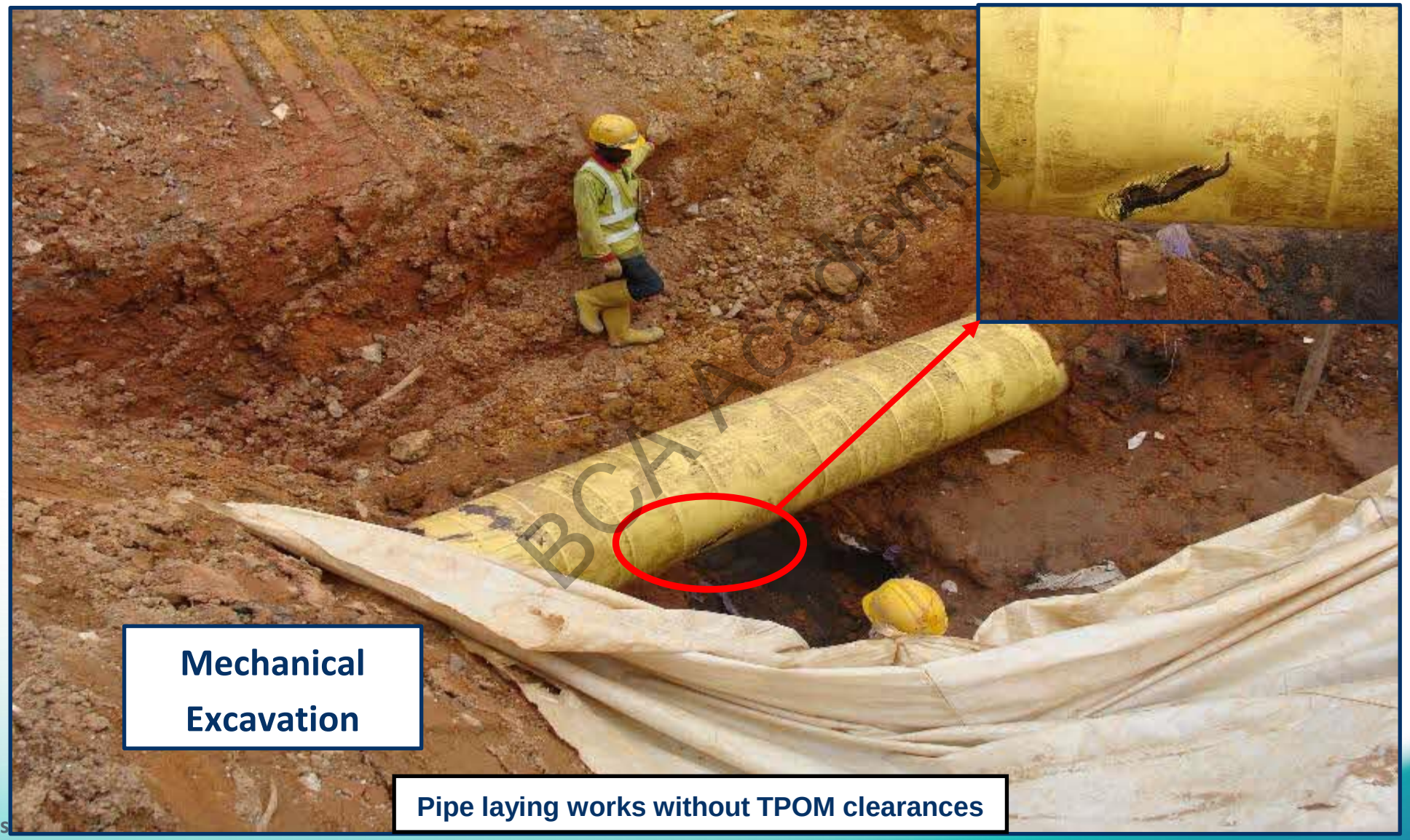
- This was a major soil subsidence following deep excavation works during the construction of a MRT Station.
- The shifting of the underground water table, oversight of tell-tale signs and inadequate protection led to the soil movement that brought part of a sub- station with it, among other damages.

SCA Academy

Direct Damage to MP Gas Pipes



Direct Damage to Gas Transmission Pipe (GTP)



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Reinstatement / Improper Backfilling



Reinstatement





Improper Backfilling





General Root causes:

- Rush to complete job
- Ignore basic reinstatement procedures
- Fail to work with SPPG to ensure proper reinstatement

Proof

Summary of Problem Areas

- Cables beneath drains / pipes
- Lifting of old drains
- Mechanical excavation
- Encasement of cables in previous drain works
- Inadequate cables / gas pipes identification & protection
- Improper suspension and supports for exposed cables / gas pipes
- Heavy machineries resting on cables/gas pipes
- Soil movements or subsidence
- Reinstatement
- Vibrations
- Uprooting of trees

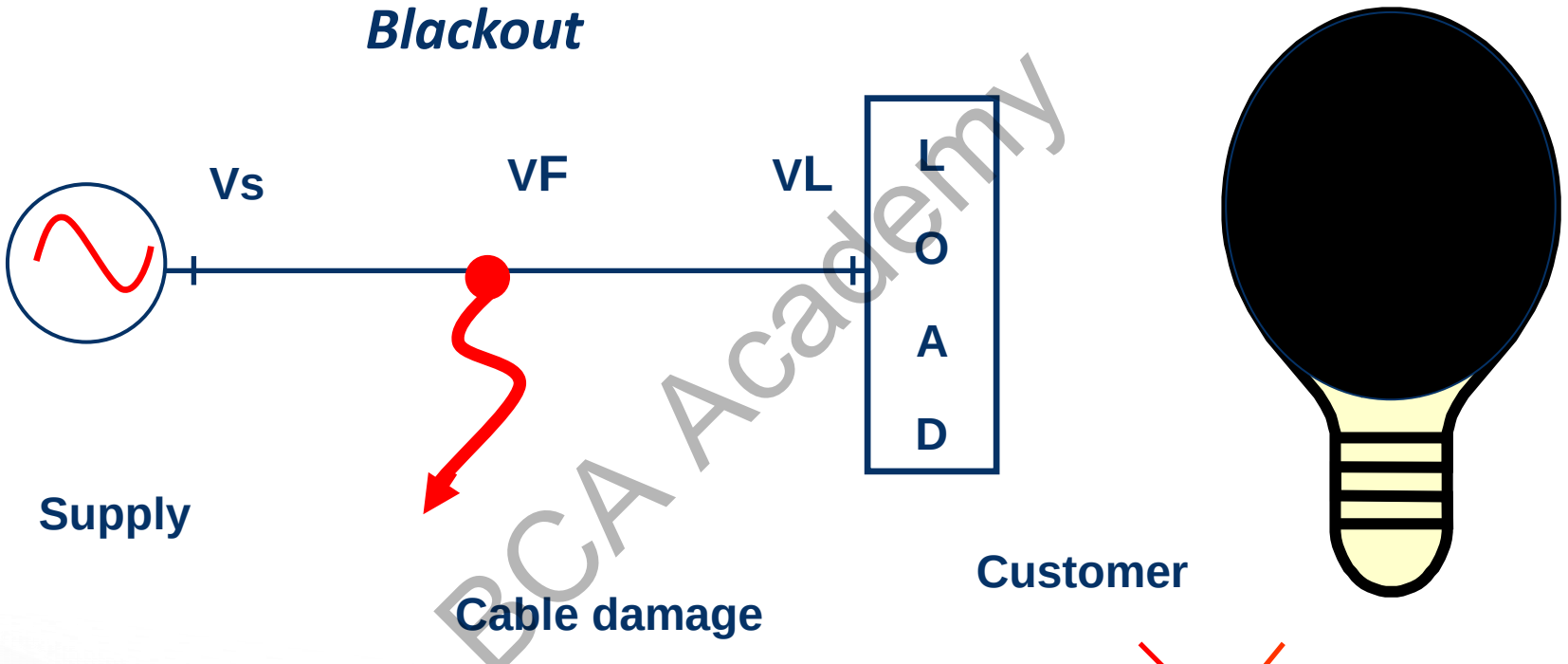
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Key Points to Prevention of Damage

- Planning for earthworks
  - LCDW
  - NCE
  - Diversions
- Continuous briefing of workers
- Engage RES
- Engage REO
- More Trial Holes
- Mark out, Peg out, Barricade cable / gas pipe corridor
- Progressive cable scanning and Re-Detection
- Active & sustained damage prevention measures

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Consequences of Damage



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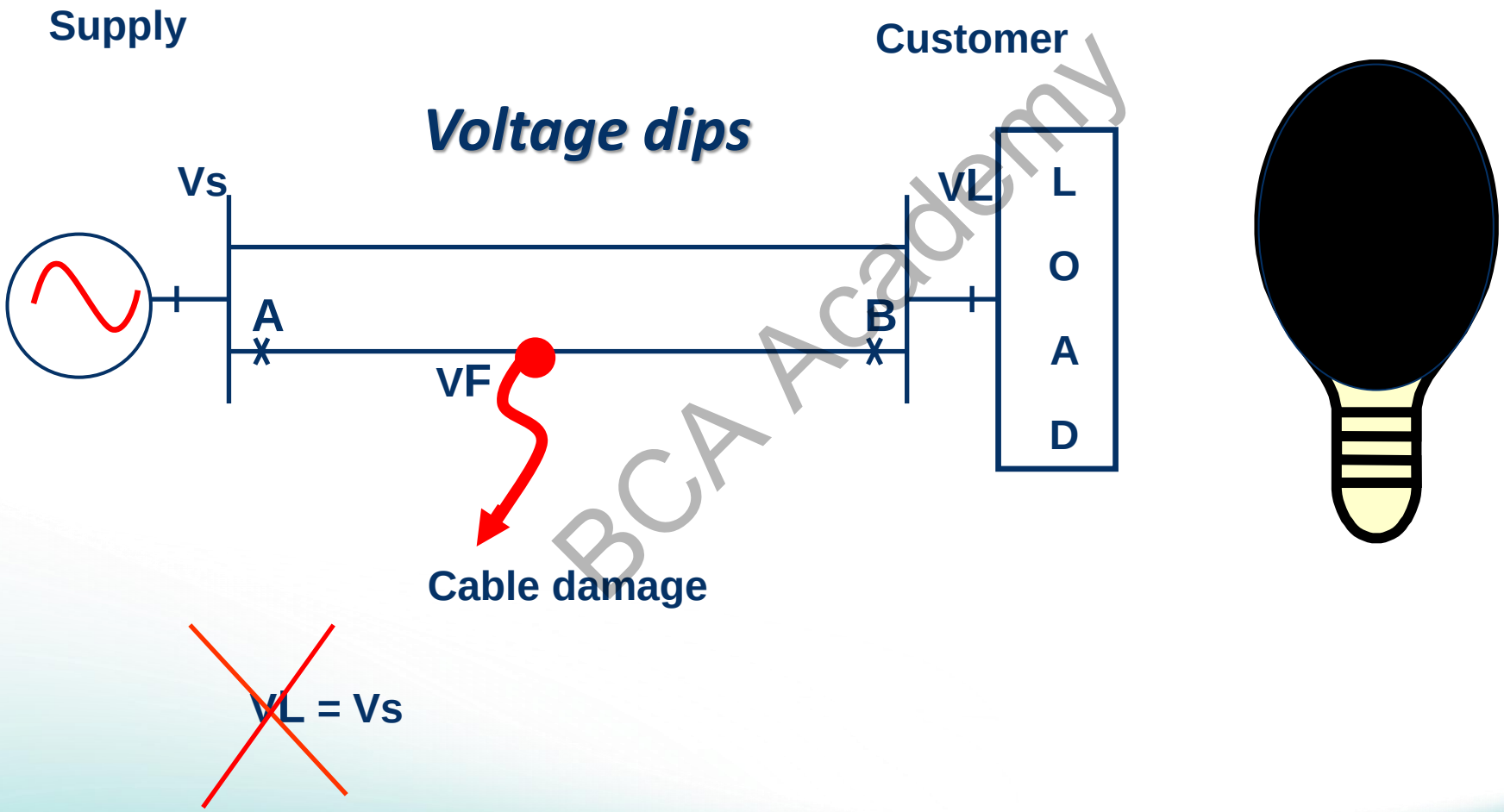
Consequences of Damage

Blackouts



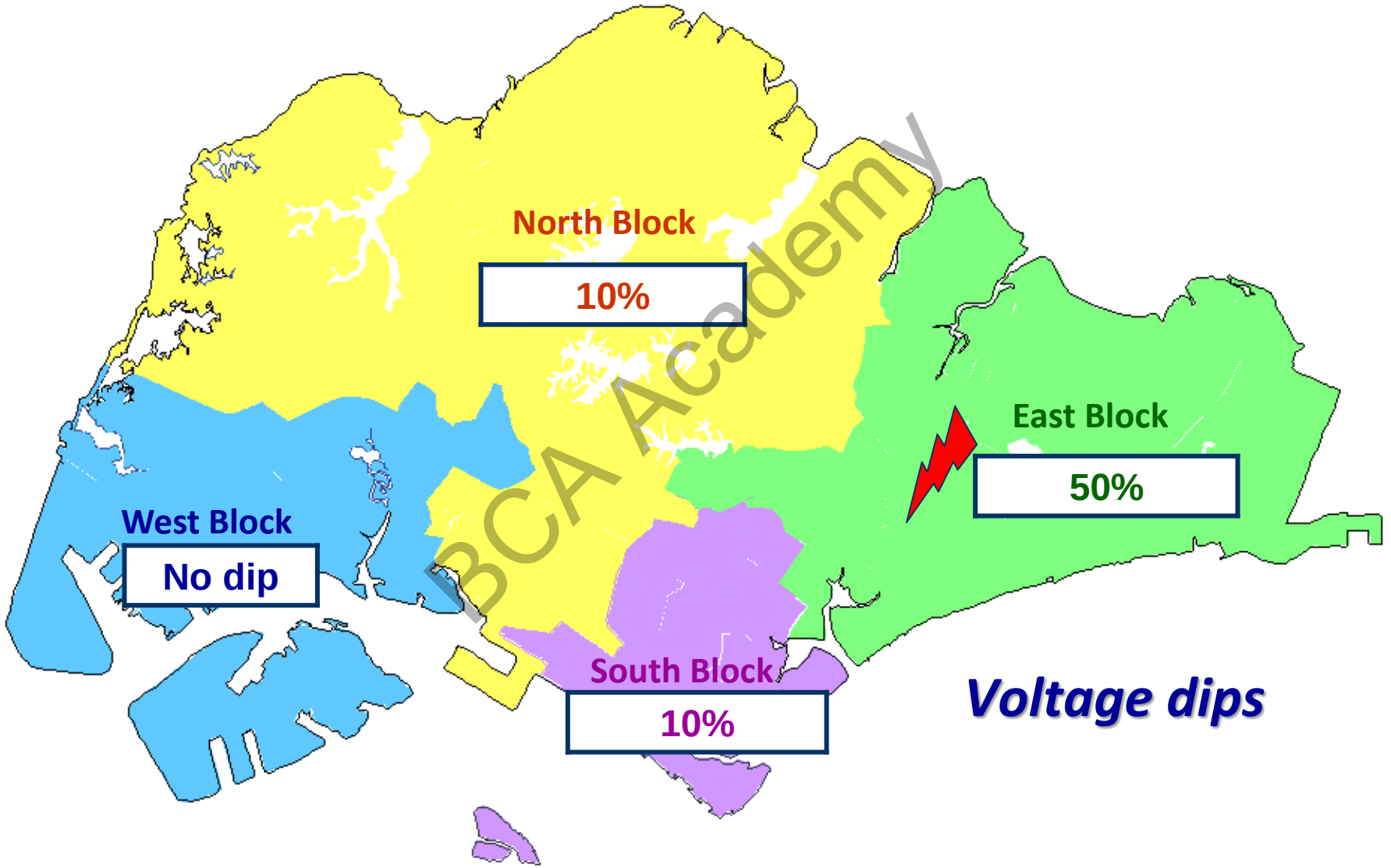


Consequences of Damage



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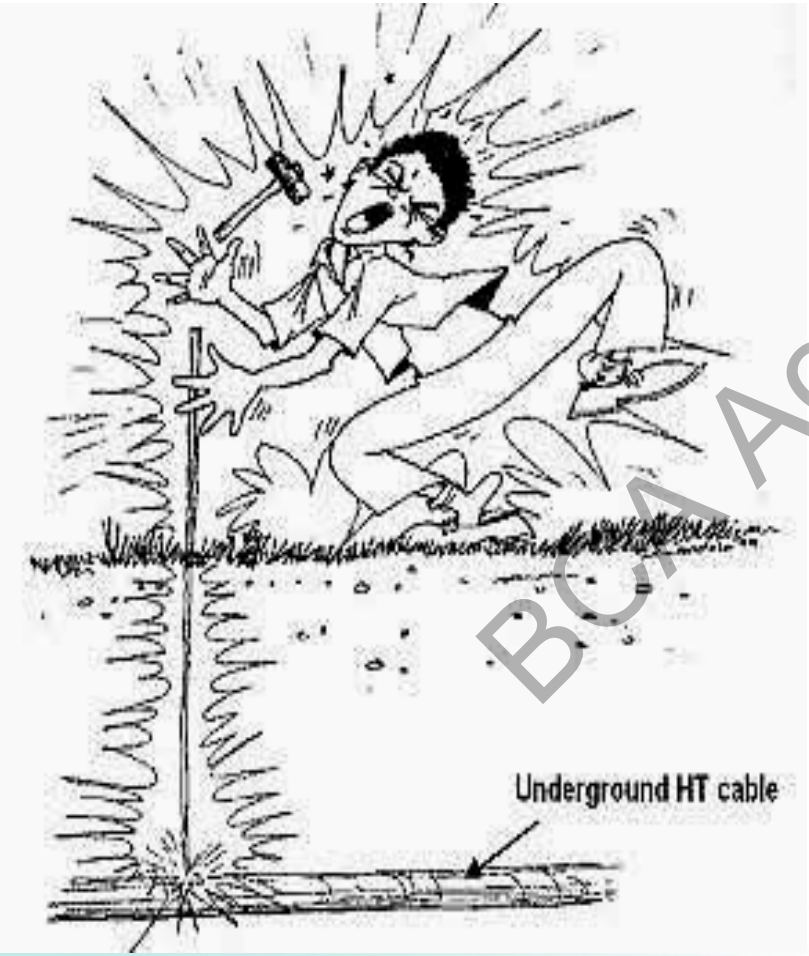
Consequences of Damage



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Consequences of Damage

❖ Risk of serious or fatal injury





Earth rod pierced through concrete cable slab



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Risk of Fatal Injury

Consequences of Damage

An explosion resulted. Worker suffered 39 percent burns on his body & died 11 days later

The worker used concrete breaker machine & hit a concrete slab that shielded a 6.6 kV HV cable

This accident could have been avoided if contractor had exercised proper supervision & management

June 16, 2002 : THE SUNDAY TIMES

21

Engineer not responsible for construction-site death

Coroner rules that Bangladeshi worker's death as a result of an explosion at the Havelock Road worksite was misadventure

By ALETHEA LIM

A MECHANICAL and engineering coordinator for the construction of the new Family and Juvenile Courts building has been cleared of any responsibility of causing a worker's death during an explosion at the worksite.

The accident on Dec 1, 2000, happened when workers hit a high-voltage underground electric cable while digging.

One of the three workers, Bangladeshi Anowar Hossain Kafil Uddin, 26, died from the explosion.

State Coroner James Leong yesterday found that Mr Robin Teo Cher Peng, 45, now an assistant manager with the Singapore Anti-Tuberculosis Association, was not "criminally negligent" and did not cause Mr Anowar's death, which was ruled to be misadventure.

However, Mr Leong noted that the practices and procedures adopted by the main contractor, Guan Choon Construction, in the management of the project "left much to be desired".

For instance, the workers hired by the contractor were carrying out earth work near a high-voltage electric cable without proper supervision.

Also, Mr Anowar and two of his fellow workers had not informed their foreman or any of their supervisors, including Mr Teo, as they had been instructed to, when they hit a concrete slab.

"While the accident could, perhaps, have been avoided if Guan Choon Construction had exercised proper supervision and management over the worksite, it was a sequence of unfortunate and unexpected events that brought about the deceased's unintentional death," said the coroner.

Guan Choon Construction, which ceased operations in March last year, had hired Mr Anowar and two others to extend the existing telecommunications cable from the edge of Havelock Road, where the court building was located, to the Ministry of Manpower (MOM) building, also on the same stretch of road.

The workers used a concrete-breaking machine and hit a concrete slab which shielded a 6.6kV high-voltage electric cable.

In the explosion that resulted, Mr Anowar suffered burns on 39 per cent of his body and died in hospital 11 days later.

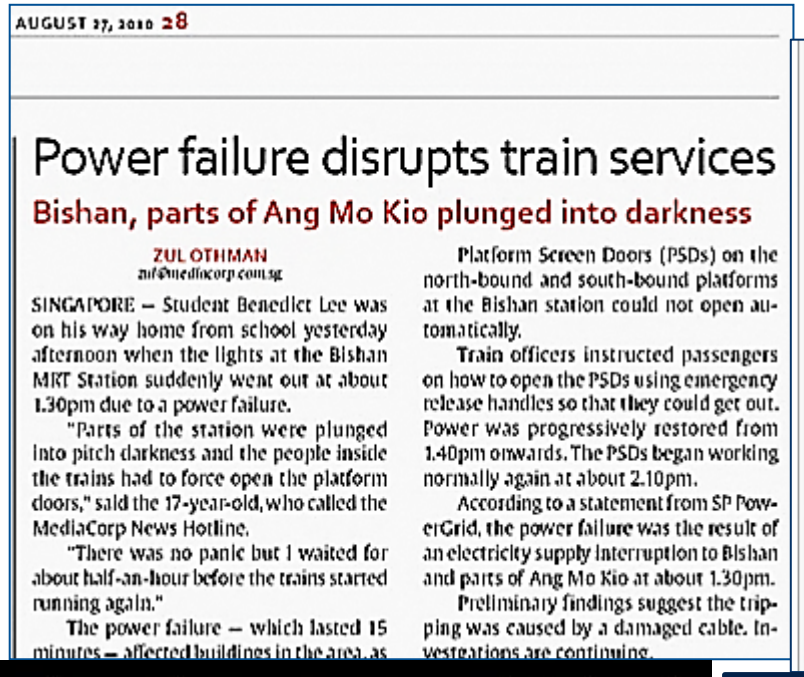
MOM found that Guan Choon Construction had breached the Factories Act, but it could not be prosecuted because it was no longer in business.

After yesterday's verdict, Mr Teo, who was represented by lawyer Suresh Divyanathan, said: "I'm relieved, and I now want to get on with my life."

SPP Academy

- Cable damage can lead to fatal injuries.
- The Coroner's findings that the incident occurred from contractor's poor supervision & management was reflected early in SPPG's report.
- The supervisor had repeatedly said he did not know why the workers started work before 8am that morning & what work they were doing when questioned by EMCP. This was unacceptable.
- This case also highlights that live cables nearer to the surface or exposed (without substantial ground protection) could result in flashovers when damaged.
- RES must ensure proper supervision & management during the entire duration of earthworks.

Extent and Effects of Outage



AUGUST 27, 2010 28

Power failure disrupts train services

Bishan, parts of Ang Mo Kio plunged into darkness

ZUL OTHMAN
zul@mediacorp.com.sg

SINGAPORE – Student Benedict Lee was on his way home from school yesterday afternoon when the lights at the Bishan MRT Station suddenly went out at about 1.30pm due to a power failure.

"Parts of the station were plunged into pitch darkness and the people inside the trains had to force open the platform doors," said the 17-year-old, who called the MediaCorp News Hotline.

"There was no panic but I waited for about half-an-hour before the trains started running again."

The power failure – which lasted 15 minutes – affected buildings in the area, as Platform Screen Doors (PSDs) on the north-bound and south-bound platforms at the Bishan station could not open automatically.

Train officers instructed passengers on how to open the PSDs using emergency release handles so that they could get out. Power was progressively restored from 1.40pm onwards. The PSDs began working normally again at about 2.10pm.

According to a statement from SP PowerGrid, the power failure was the result of an electricity supply interruption to Bishan and parts of Ang Mo Kio at about 1.30pm.

Preliminary findings suggest the tripping was caused by a damaged cable. Investigations are continuing.





THE STRAITS TIMES

BREAKING NEWS August 26, 2010 Thursday Updated 3.04 pm

Straits Times Headlines → Grads not repaying parents' CPF for studies

Singapore

HOME > BREAKING NEWS > SINGAPORE > STORY

Aug 26, 2010

Blackout in north S'pore

By Kimberly Spykerman

Shops had to resort to manual practices as their cash machines stopped working a their credit cards to pay. -- ST PHOTO: SHAHRIYA YAHAYA



14 – 26 Aug, 2010

66kV cable damaged at Potong Pasir caused a power outages in Bishan & AMK areas

Over 29,000 SPPG customers & 7,000 MRT commuters at 13 train stations were affected by the power outage.



Posted on 26 Aug 2010

Massive blackout on North-South line: 7,200 commuters, 13 stations affected

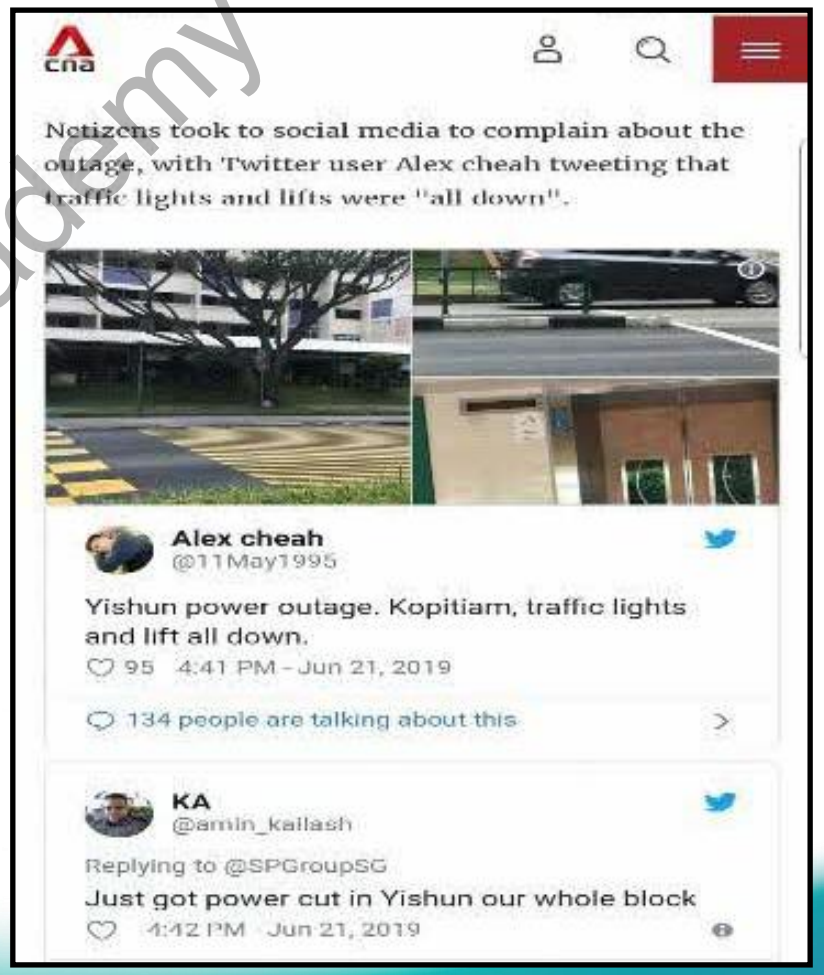
After a power outage caused the station doors to jam shut, commuters sat waiting in the dark until they were instructed to pull the emergency handle to force the doors open so they could alight the train at Bishan station.

BCA Academy

Extent and Effects of Outage

66kV Cable damage at Canberra Link on 21 June 2019
- Estimated 26,244 customers affected





BCA Academy

Extent and Effects of Voltage Dips



Wednesday, March 29 2000 The Straits Times

Split-second power dip wreaks havoc

Worst-hit were plants on Jurong Island which suffered shutdowns, production delays and huge losses

By LIANG HWEE TING

IT LASTED a mere 0.3 seconds. But the effects of last Friday's power dip on some petrochemical and wafer-fabrication plants lasted for hours if not days.

Production was set back, hundreds of thousands of dollars were lost and hundreds of workers were mobilised to work over the weekend to start up the plants again.

The dip also played havoc with computer screens and ATM machines.

But the worst hit was Jurong Island, Singapore's petrochemical-manufacturing hub where several plants were shut down at Merbau, Chawan, Sakara and Seraya.

Fifteen out of 20 petrochemical plants on Jurong Island and three wafer-fabrication plants at Woodlands contacted by The Straits Times reported varying degrees of damage — from delays in production to huge losses.

At Seraya Chemicals Singapore, its plant manager said the dip crippled equipment, seriously affecting production and causing loss of hundreds of thousands of dollars.

Another petrochemical plant at Sakara suffered a six-hour delay in production when two of its three major equipment failed. Its losses were put at slightly more than a quarter million dollars.

Phillips Petroleum Chemical Asia suffered a 75-tonne production loss.

Many plants had to resort to emergency shutdowns.

"From my vantage view at Pulau Ayer Chawan, I could see flare stacks being fired from a few plants," said engineer K. T. Low.

Flare stacks are normally fired to signify shutdowns.

One plant in Merbau mobilised its staff round-the-clock to restart the plant. Key engineers were called in over the weekend to supervise the start-up.

But not all plants were equally hard hit.

Petrochemical Corporation of Singapore reported only a partial impact.

It said two plants were shut down temporarily. They were restarted on Sunday.

Ethylene Glycols Pte Ltd, which had installed the Unlimited Power Supply (UPS) system, remained relatively unscathed.

According to Singapore Power, the dip was the result of equipment failure at the Power Seraya power station.

A Singapore Power spokesman said such dips were common in many countries.

"Singapore is actually quite fortunate because it rarely happens here."

Singapore Power has asked Power Seraya to investigate the matter and come out with a detailed report.

Singapore Power says its future action will depend on the findings.

There was a power dip earlier in January this year and eight transmission-voltage dips last year, Singapore Power said.

Resourceful engineers and plant managers are quick to offer suggestions to prevent similar production snags.

"One way to minimise the damage would be to install protective devices like a dip voltage-restorer," said chemical engineer Tan Yew Meng, 32.

"Another would be to have a sort of backup generator that can provide emergency electrical supply when such things happen."

Damage due to several factors

DURING a power dip, pumps, mixes, compressors and any other electricity-powered equipment will trip.

Wafer fabrication and petrochemical plants use equipment highly-sensitive to the quality of power. So a disruption in power supply, no matter how minuscule, could wreak considerable havoc.

The length of the disruption will determine the percentage dip in voltage. A 0.3-second disruption, for instance, could result in a 30-per-cent dip in voltage. The actual extent of damage depends on several factors like the length of the disruption, the amount of equipment, availability of safety features, et cetera. It is usually a combination of events.

But generally when all motive force is lost, equipment will trip and the plant will be forced to shut down and re-inventorise. Starting up a plant again takes between a few hours to a couple of days, depending on the damage done.

EDA Academy

230kV cable damage caused a Voltage Dip affecting Petrochemical and Wafer-Fab plants

It lasted a mere 0.3 seconds. But the effects of power dip on some Petrochemical and Wafer-fabrication plants lasted for hours if not days. Production was set back, hundreds of thousands of dollars were lost

……

Perception of Investors

Extent and Effects of Outage

To the Public

(a) Much inconveniences
(b) Risks to lives and properties

To the Industries

(a) Loss of production
(b) Increased cost

To the Contractor

(a) Work will stop
(b) Workers will lay idle
(c) Equipment will be non-productive
(d) Higher insurance premium for repair cost
(e) Subject to prosecution and fine
(f) Bad reputation (Contractor name published in EMA website)

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Extent and Effects of Outage

To SP Group

(a) Manpower and material resources diverted to unproductive work

(b) Affect the progress on the construction & maintenance work

(c) Loss of revenue

(d) Higher operational cost

(e) Affects reputation

(f) Affects network performance due to additional cable joints

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Earthworks Contractors Liability



From 1 Apr 2018, EMA and SPPG have implemented the Registered Earthworks Supervisor (RES) scheme to enhance cable / gas pipeline damage prevention. The RES scheme aims to ensure site supervisors are competent in cable / gas pipeline damage prevention measures, and adhere to them as required under SPPG's LRe. Only site supervisors who have passed the RES course, and are registered as a RES with SPPG, will be allowed to supervise worksites in the vicinity of high voltage cables and medium/high pressure gas pipelines. Any non-compliance with SPPG's LRe would result in demerit points being given to the RES. The RES will have his registration pass suspended or revoked if his total number of demerit points exceeds a specified threshold.

Beside complying with the requirements stipulated under the Electricity Act and SPPG's LRe, contractors are also strongly encouraged to refer to SS576:2012 (Code of Practice for Earthworks in the Vicinity of Electricity Cables) as a guide to best practices for earthworks near underground electricity cables to prevent cable damages. You may purchase a copy of the code of practice online.

According to Section 85(1)(a) of the Electricity Act (Chapter 89A), any person who removes, destroys or damages any electrical plant or electricity cable which is part of a transmission system that belongs to or under the management or control of an electricity licensee shall be guilty of an offence and shall be liable on conviction to a fine not exceeding $1 million or imprisonment for a term not exceeding 5 years or to both.

EMA will investigate all cable damage incidents and take firm action against parties who contravene Section 85 of the Electricity Act.

BCA Academy

Earthworks Contractors Liability

EMA will investigate all cable damage incidents and take firm action against parties who contravene Section 85 of the Electricity Act.

The table below shows the list of earthwork contractors who have been charged and convicted in Court in the last 2 years.

Date Convicted	Company/Contractor	Location of High Voltage Electricity Cable Damage	Date of High Voltage Electricity Cable Damage
09 Jun 2023	Tay Lee Seng Construction Pte Ltd	Along Canberra Link LP 51 to Canberra Link LP 71	21 Jun 2019
02 Dec 2022	Tong Shing Contractors Pte. Ltd.	Admiralty Road West near Lamp Pole No. 61	01 Dec 2018
04 Nov 2022	J J & K Engineering Pte Ltd	Woodlands Ave 5	21 Oct 2019
04 Nov 2022	Guthrie Engineering (S) Pte Ltd	Woodlands Ave 5	21 Oct 2019
21 Oct 2022	Chan & Chan Engineering Pte. Ltd.	Upper Changi Road LP26/1	31 Mar 2021
22 Jul 2022	TGE Engineering Pte. Ltd.	Blk 25 Eunos Crescent	25 Nov 2019
17 Jun 2022	LT Sambo Co., Ltd (Singapore Branch)	Marina Drive near Block 74	08 Feb 2018
03 Jun 2022	Presscrete Engineering Pte Ltd	In front of Lamp Pole No. N101S2 at Mandai Road	30 Sep 2017
03 Jun 2022	Presscrete Engineering Pte Ltd	In front of Lamp Pole No. N101S2 at Mandai Road	30 Sep 2017
31 May 2022	Yuan Ji Enterprises Pte Ltd	Old Jurong Road near Lamp Pole 14	15 Apr 2018
31 May 2022	Yuan Ji Enterprises Pte Ltd	Old Jurong Road near Lamp Pole 14	15 Apr 2018
23 Nov 2021	Fidecs Engineering Pte Ltd	In front of Block 261C, Sengkang East Way, near Lamp Pole No. 53	25 Apr 2018
17 Nov 2021	Kok Tong Construction Pte. Ltd.	Woodlands Square near Lamp Poles No. 3F and 4F, opposite Causeway Point	21 Nov 2018
11 Nov 2021	Kimaro Geotechnical Engineering Pte Ltd	East Coast Road / Bedok Road, near Lamp Pole No. 111	14 Mar 2018

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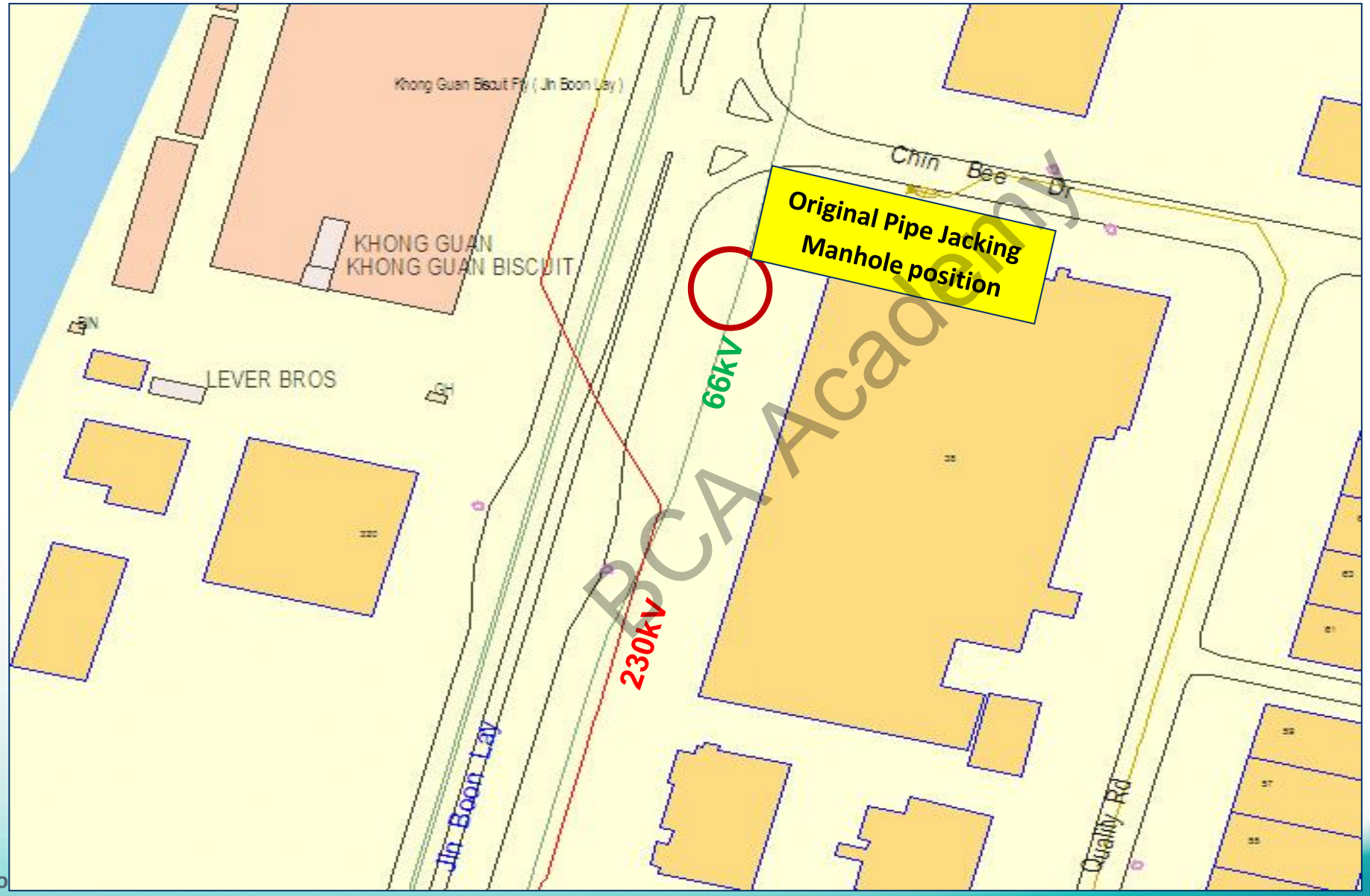
Consumers who are affected by cable damage incidents may wish to seek independent legal advice for any losses and damages that they may have suffered. They should do this before deciding if they want to pursue further legal action against the contractors.

Case Study #1 – 230kV Cable Damaged

Date @ Time of Damage	30.10.13 @ 1413hrs
Location	Jalan Boon Lay between LP 84 and LP 86
Cause of Damage	Sheet Piling
Nature of Works	Manhole and Sewer Works
LCDW	Yes
NCE	Yes
Outage (Duration)	No
Voltage Dip (Max Magnitude)	Yes (51.4%)
Customer Affected	Major Industries in Western Part of Singapore

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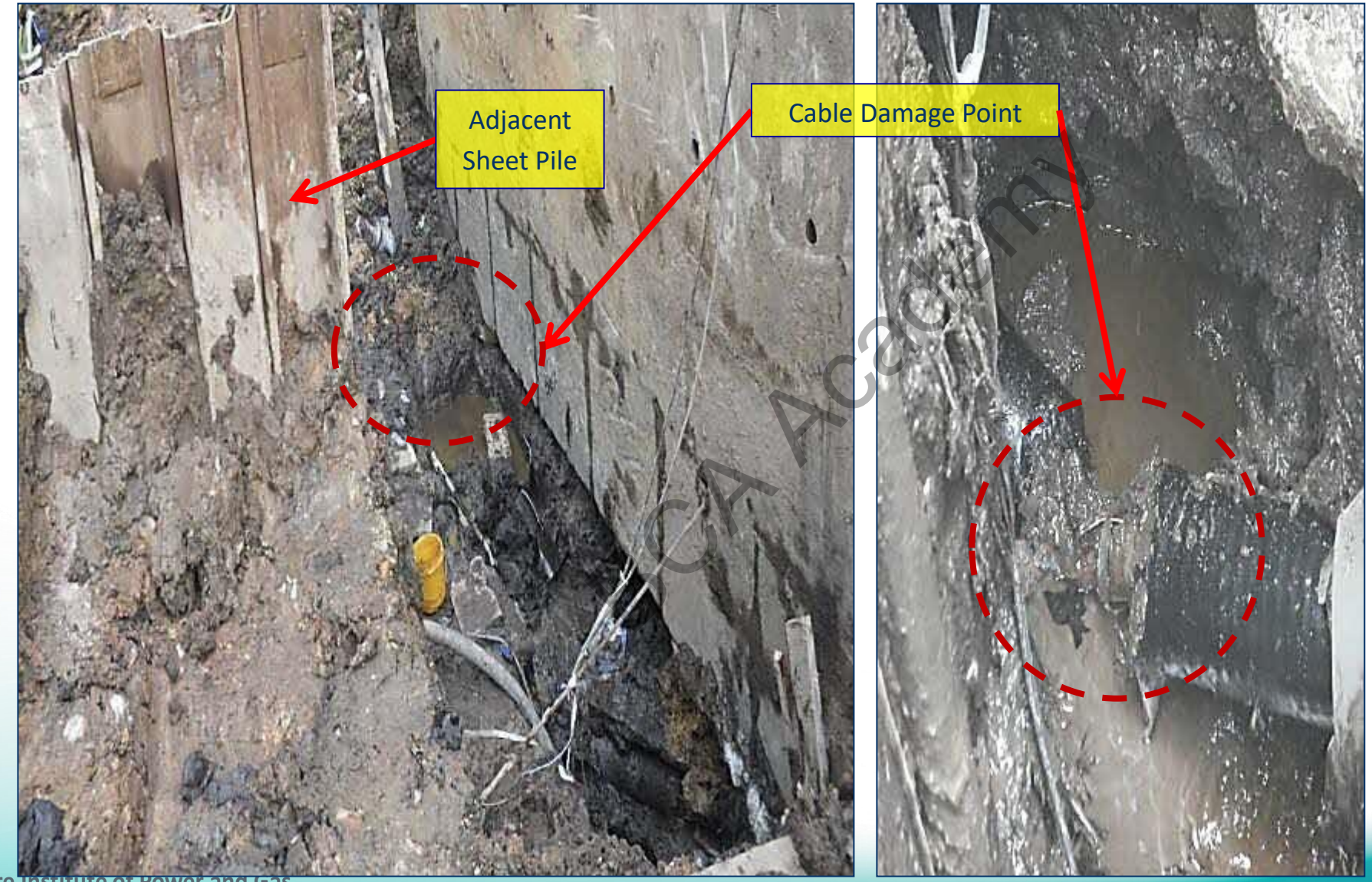
Sequence of Events – 30 Oct 13



Cable Damaged Location



Cable Damaged Location



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Group Discussion 1

Case Study – 230kV Cable Damaged

- Work in groups of 5 - 8.
- Discuss what were the mistakes that caused the damage?
- If you were the Supervisor, what would you take to avoid damage?
- Do you know of similar damage or near-damage to cables or gas pipes that you can share?

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Chapter 3 (d)

Introduction to Singapore Underground Services: Statistics of Cable Damage

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Review of Damage Statistics (Cable) 2013 to 2022

All	Year									
Voltage Level	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
400kV	0	1	0	0	0	0	0	0	0	0
230kV	5	3	5	0	0	0	0	2	0	0
66kV	4	2	0	1	3	2	2	2	3	3
22kV	10	7	9	9	6	9	1	2	5	9
6.6kV	15	8	5	9	7	7	3	1	6	6
LV(M)	37	39	22	24	24	24	24	17	21	22
LV(S)	79	54	26	26	47	46	40	31	41	54
LV	116	93	48	50	71	70	64	48	62	76
Pilot	0	1	3	0	1	2	1	2	0	3
Total exclude Pilot	150	114	67	69	87	88	70	55	76	94

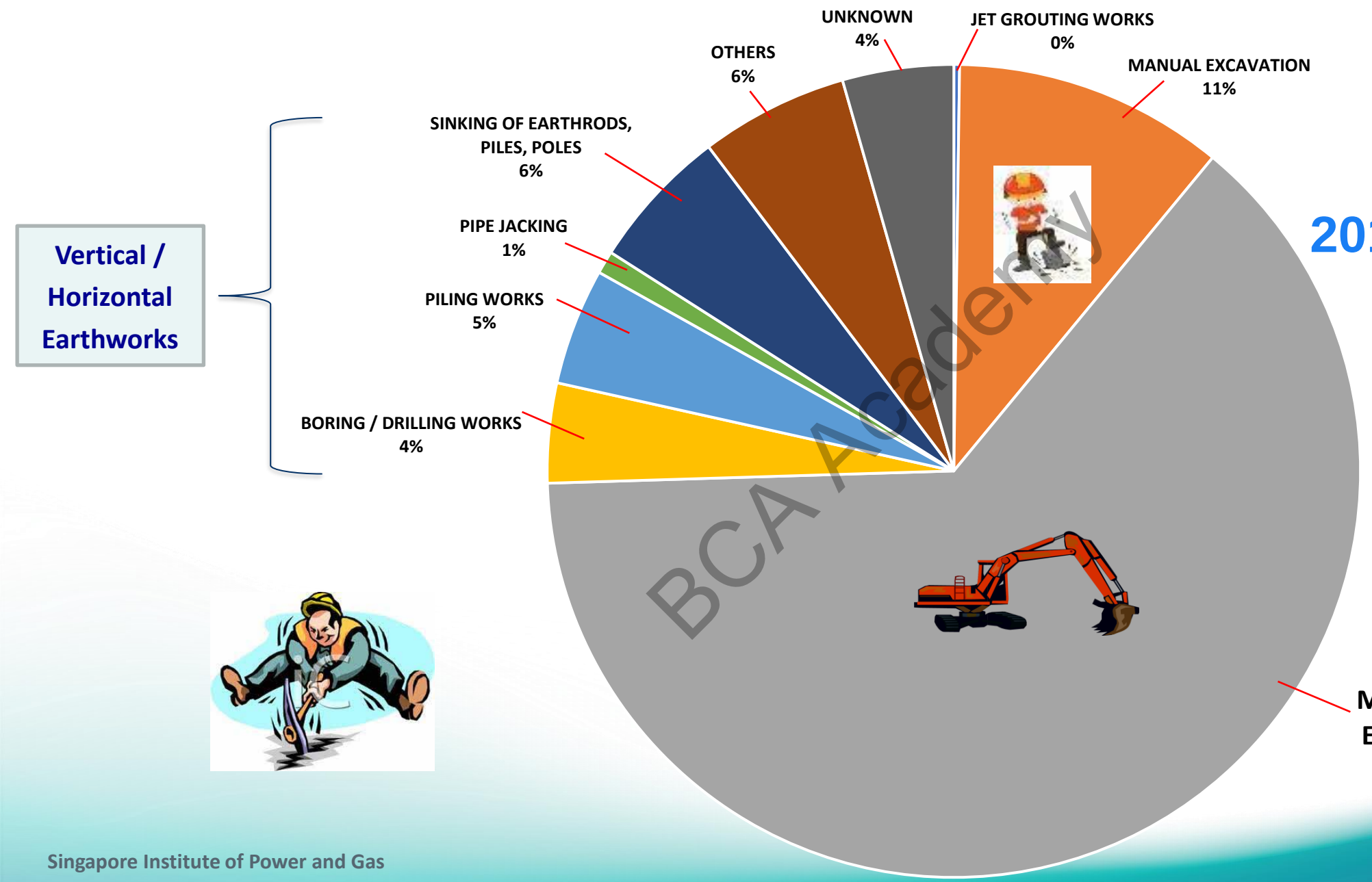
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Review Of Damage Statistics (Gas) 2013 to 2022

ALL	Year									
Gas Pipe	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
GTP	0	1	0	0	0	0	0	0	0	0
MP	5	2	0	0	2	1	0	0	0	0
LP	45	30	32	20	25	18	21	14	15	23
Total	50	33	32	20	27	19	21	14	15	23

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Causes of Damage



Vertical / Horizontal Earthworks

2013 to 2022

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Mechanical & Manual Excavations

- Mechanical excavation remained as #1 cause of damage from year 2013 to 2022
- Followed by 2nd place of manual excavation, that has been mooted as the 'safest' method

Discussion:

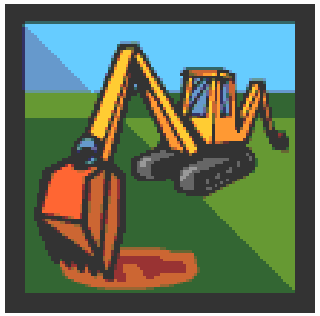
- What are the likely reasons for damage caused by mechanical and manual excavations?
- How should these activities be done to ensure no damage during earthworks?

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Areas to focus to reduce damage

Major cause of Cable Damage

MECHANICAL EXCAVATION





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- RES must compare LCDW Detection Drawing and SPPG Cable Plan to account for all cables prior to intended earthworks. If in doubt, consult LCDW and ESP officer

- Ensure REO is competent and responsible
  - Able to interpret LCDW detection drawing with SPPG cable plan
  - Do not use mechanical excavator near SPPG cables

- Extreme caution should be exercised while using electrical breaker
  - Risk of cable damage and electrocution

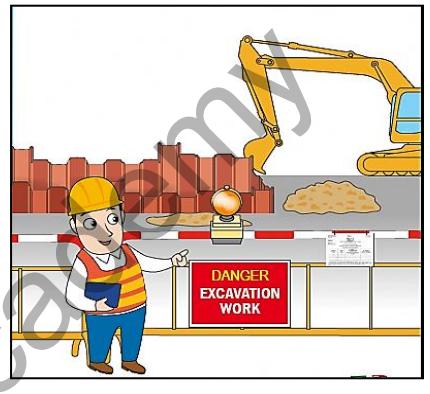
RES to coordinate with LCDW, REO and Workers in Preventing Damage

Areas to focus to reduce damage

Other Cause of Cable Damage

BORING, DRILLING, SHEET PILING, HDD





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- RES must ensure earthworks position is away from cable
- Trial hole to be dug at all boring/drilling/piling positions to ascertain the presence or absence of cable prior to intended earthworks
- Establish Depth of cables before doing Horizontal Directional Drilling (HDD)
- Hand augering is considered vertical drilling in SS576
- Insert and remove sheet piles with due care

RES to coordinate with LCDW, REO and Workers in Preventing Damage

Areas to focus to reduce damage

Other Cause of Cable Damage



SINKING OF EARTHRODS, PILES

- Must engage LCDW to carry out the cable detection work prior to earthworks
- RES must ensure earth rod position is away from cable
    - Trial hole to be dug at earth rod sinking position to ascertain the presence or absence of cable prior to intended earthworks

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PIPE JACKING



- Ensure adequate drilling clearance from the cable

  (at least 2m clearance from cables & gas pipes)

- Do not shift jacking / receiving pit without establishing cable positions at site

RES to coordinate with LCDW, REO and Workers in Preventing Damage

Areas to focus to reduce damage

Other Cause of Cable Damage

UPROOTING OF TREES

- Expose entire length of cable in the vicinity of tree roots (First most practical thing to do)
- Request for diversion if necessary
- Do not use mechanical excavator to remove tree roots
- Consult SPPG for advice

SOIL SUBSIDENCE, FALLEN OBJECTS

- Ensure adequate protection on exposed cable
- Ensure adequate shoring to prevent soil subsidence
  - Shoring/sheet pile positions should be carefully chosen to avoid cables

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RES to coordinate with LCDW, REO and Workers in Preventing Damage

Areas to focus to reduce damage

Other Cause of Cable Damage

SHIFTING CABLES

- Do not shift cables without presence of SPPG officer
- When in doubt consult SPPG for advice

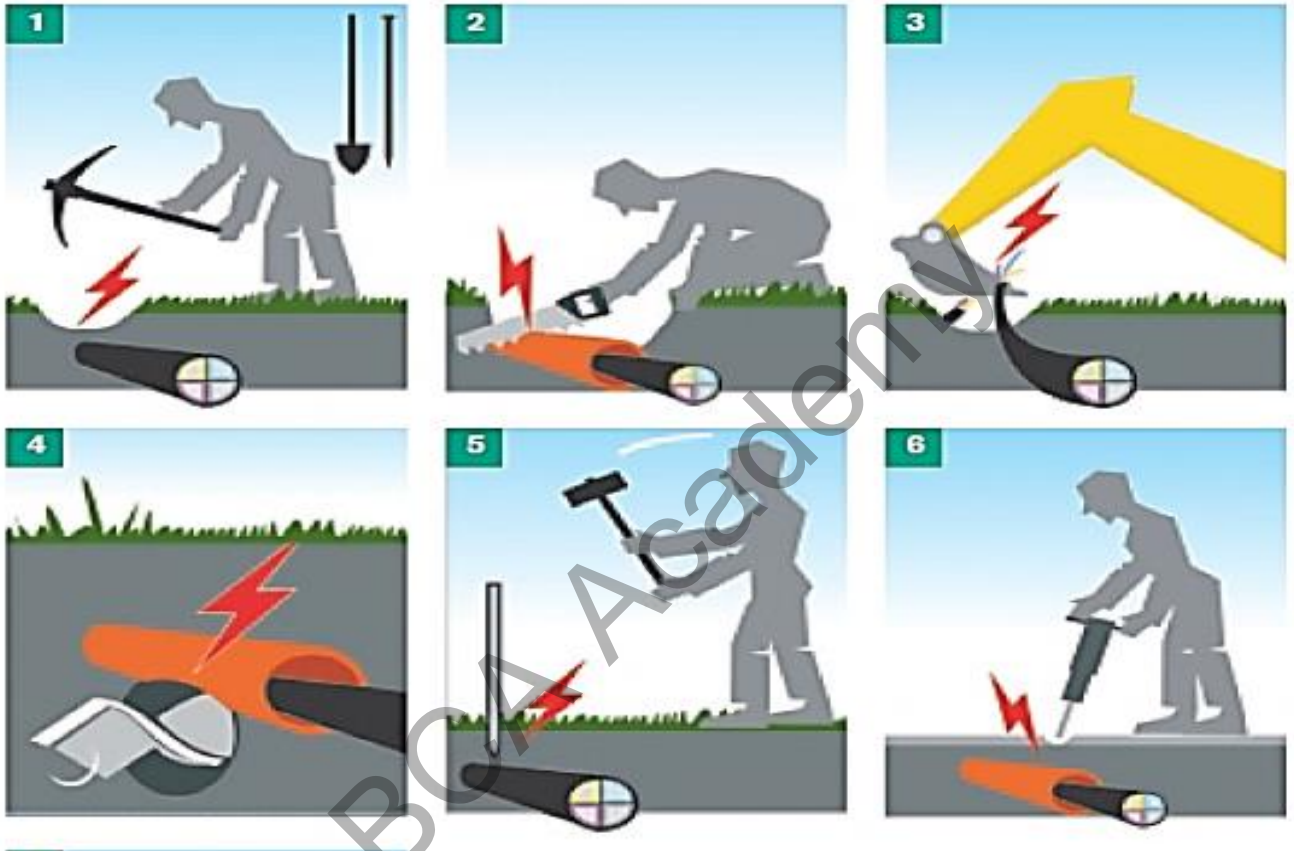
MANUAL EXCAVATION

- Practise progressive digging (step-by-step) using manual tools
- Consult SPPG for advice



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Activities that can lead to damage



1. Using Hand Tools
2. Cutting into Service Ducts
3. Mechanical Excavator
4. Moling (Trenchless)
5. Driving Earth-rods
6. Jackhammer
7. Concrete Saw

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Chapter 4 (a)

Safe Work Procedures on Damage Prevention: Preventing Damage

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SPPG Key Sections

22kV
6.6kV
LV
} Dx

Distribution Network Sections

DN1 DN2 DN3 DN4 DN5 DN6



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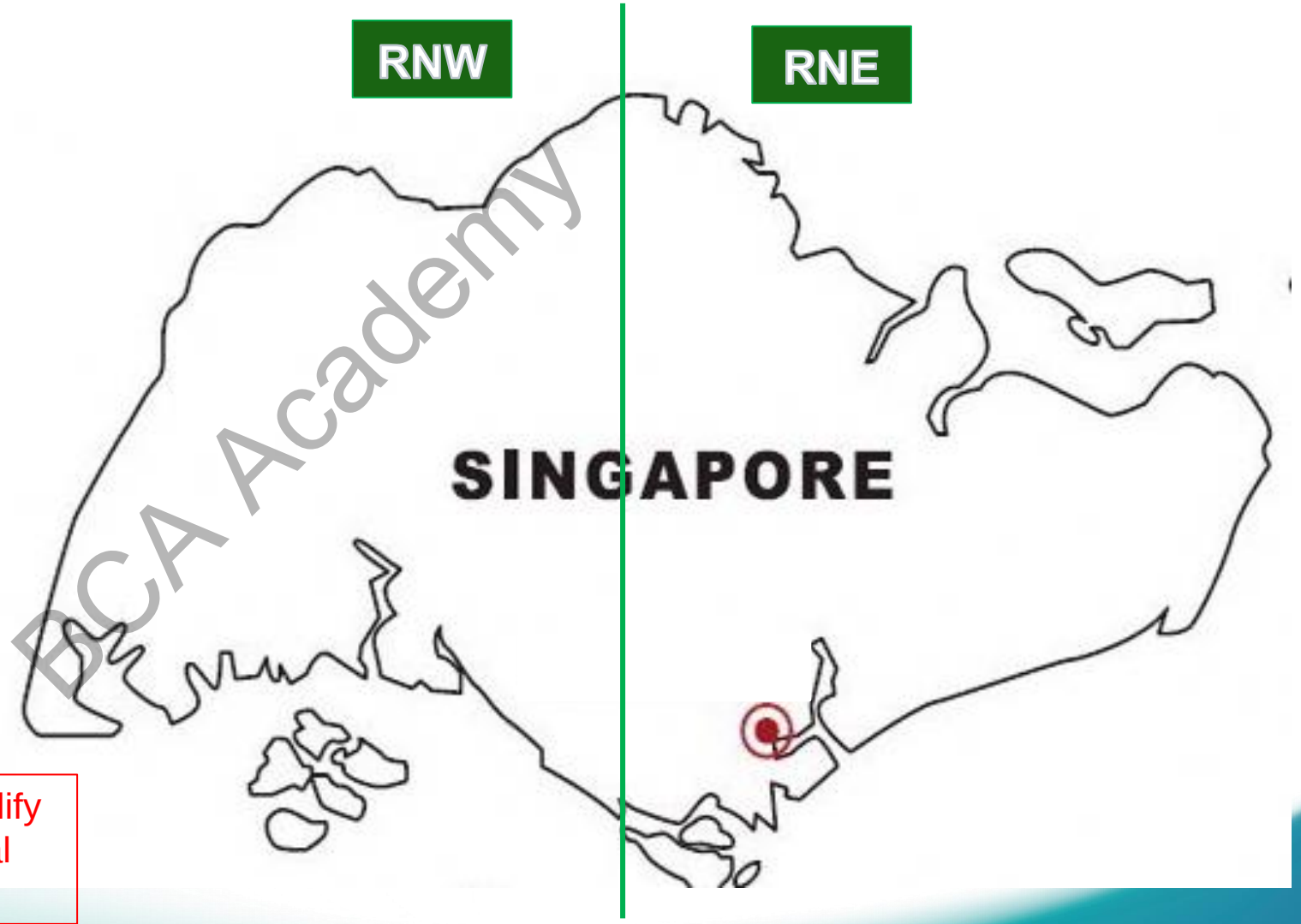
Note: Boundaries is for illustration only to simplify learning purpose and does not represent actual boundary demarcation in practice.

SPPG Key Sections

400kV
230kV
66kV
} Tx

Regional Network Sections

RNE RNW



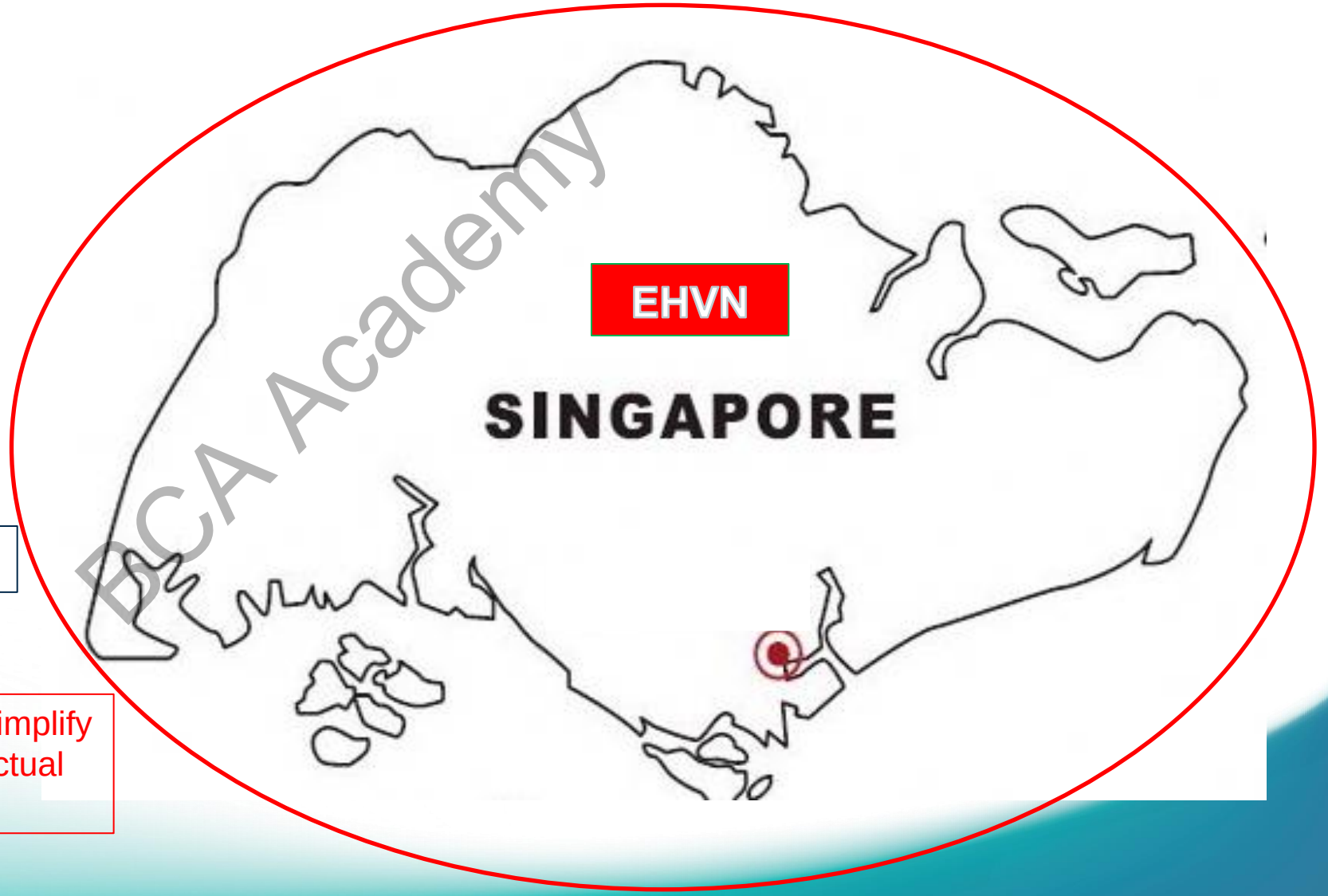
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Note: Boundaries is for illustration only to simplify learning purpose and does not represent actual boundary demarcation in practice.

SPPG Key Sections

400kV
230kV
66kV
} Tx

Extra High Voltage Network Section



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Note: Boundaries is for illustration only to simplify learning purpose and does not represent actual boundary demarcation in practice.

Gas Network and Key Sections

GTP - Transmission pipelines

Transmission

Transmission Pipeline Operations & Maintenance

TPOM

MP - Medium pressure gas pipes

LP - Low pressure gas pipes

Distribution

Distribution Pipeline Operations & Maintenance

DPOM

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The Full-Cycle Process for Earthworks
(8 + 4 Steps for Earthworks)

Pre-Earthworks - 8 Steps

1. Get cable plans (e-submission)
2. Engage LCDW
3. Cable detection works
4. Cable detection drawing
5. Submit NCE (e-submission)
6. ESP visits worksite
7. ESP issues LRe
8. Earthworks starts

Earthworks Phase - 4 Steps

① **Plan for earthworks**
- Identify key parties
- Complying with legislations

② **Prepare for earthworks**
- Site control
- Identify cables / gas pipes
- Complying with LRe
- Daily briefingsto site personnel
- Keeping earthworks records

③ **Doing the earthworks**
- Provide effective & close supervision with RES
- Diversion / avoid cables / gas pipes
- Comply with good earthworks practices

④ **After the earthworks**
- Proper reinstatement & checks
- Notify ESP when job completed ahead of NCE end-date
- Keep the records

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① Planning for Earthworks

Identify Key Parties Involved

- SPPG (ESP / DN/ RN/ EHVN/ DPOM/ TPOM Sections)
- Principal
- RES
- LCDW
- REO

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① Planning for Earthworks

Role of Parties Involved

SPPG

Earthworks Surveillance & Patrolling (ESP) and MEA Sections

- Provide Cable and Gas Plans (MEA)
- Process Notice for Commencement of Earthworks (NCE)
- Conduct site meeting and provide Letter of Requirements within 7days
- Monitor NCE Earthworks sites

Distribution Network (DN) Sections

- Provide technical advice on protection of Distribution cables

Regional Network (RN) & Extra High Voltage Network (EHVN) Sections

- Provide technical advice on protection of Transmission cables

Distribution Pipe O&M (DPOM) & Transmission Pipe O&M (TPOM) Sections

- Provide technical advice on protection of Distribution & Transmission gas pipes

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① Planning for Earthworks

Identify Key Parties Involved

Principal

- Ensure contractor through contract document to obtain Cable & Gas plan and engage LCDW
- Advise contractor through contract document to consult SPPG for the proposed earthworks and submit NCE to ESP
- Implement PTW system to manage earthworks carried out by contractor

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① Planning for Earthworks

Complying with Legislative Requirements

- Purchase Cable and Gas plans from MEA
- Engage LCDW, RES and REO
- Submit Notice for Commencement of Earthworks (NCE) for HV Cables and All Gas Pipes



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② Preparing the Earthworks

Site Control

- **Do not** commence earthworks **without engaging LCDW** and **digging trial hole** to ascertain the presence or absence of cables
- **Implement Permit to work system** to ensure earthworks are properly **monitored** and **controlled**

Excavation only when RES present	Barricade planned location for earthworks	Earthworks site management and housekeeping
		

Academy

② Preparing the Earthworks

Cable identification

- Get cable plans and
- As-built drawing

All plans are indicative only

- Engage LCDW
  - ❖ Carry out cable detection work
  - ❖ Provide cable detection drawing
  - ❖ Peg and mark cable positions
- Trial Holes
  - ❖ Use mechanical excavator for premix or hardcore layer only
  - ❖ Use simple tools to dig trial holes manually with due diligence and care
  - ❖ Dig adequate and appropriate number of trial holes









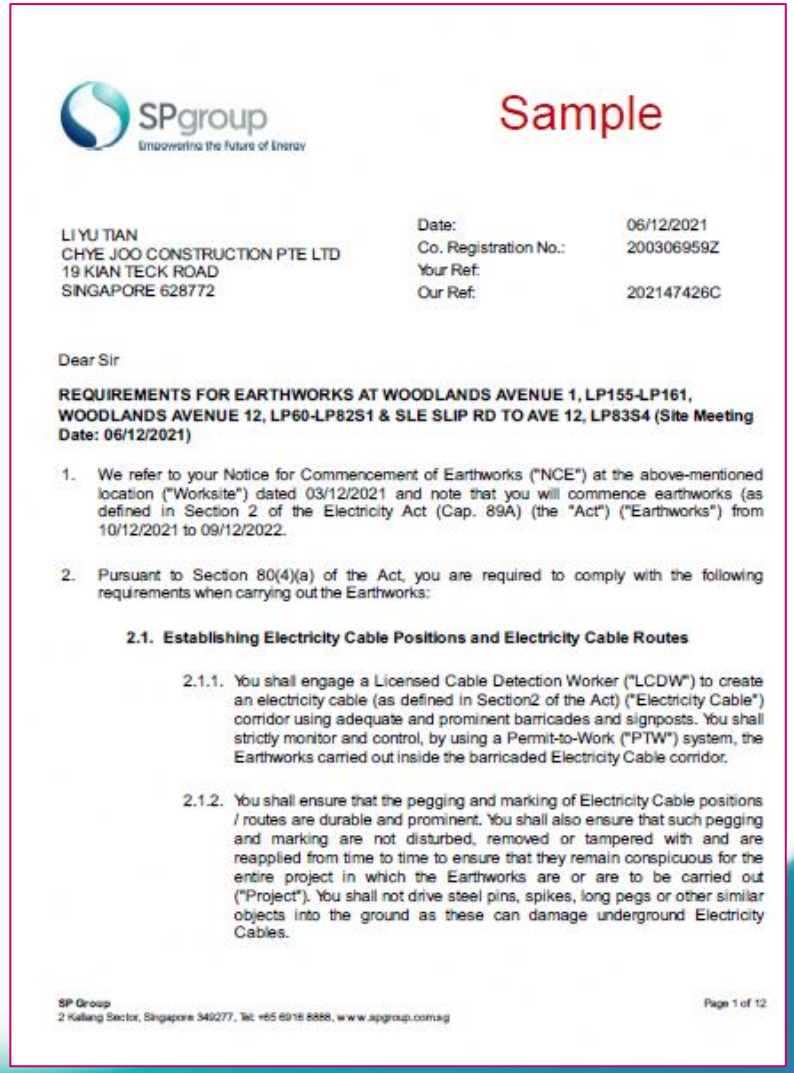
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② Preparing the Earthworks

Complying with SPPG Requirements

- Read & Understand SPPG Letter of Requirements (LRe)
- Implement damage prevention measures according to LRe
- Continuous compliance with LRe
- Conduct daily briefing to workers on cable position & requirements to prevent damage
- Make NCE, SPPG Cable Plan, LCDW Cable Detection Drawing, Trial hole Record and LRe available at site
- Request for cable diversion if cable is affected by earthworks
- When in doubt consult LCDW/ SPPG

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Empowering the Future of Energy

Sample

LI YU TIAN
CHYE JOO CONSTRUCTION PTE LTD
19 KIAN TECK ROAD
SINGAPORE 628772

Date: 06/12/2021
Co. Registration No.: 200306959Z
Your Ref:
Our Ref: 202147426C

Dear Sir

REQUIREMENTS FOR EARTHWORKS AT WOODLANDS AVENUE 1, LP155-LP161, WOODLANDS AVENUE 12, LP60-LP82S1 & SLE SLIP RD TO AVE 12, LP83S4 (Site Meeting Date: 06/12/2021)

1. We refer to your Notice for Commencement of Earthworks ("NCE") at the above-mentioned location ("Worksite") dated 03/12/2021 and note that you will commence earthworks (as defined in Section 2 of the Electricity Act (Cap. 89A) (the "Act") ("Earthworks") from 10/12/2021 to 09/12/2022.

2. Pursuant to Section 80(4)(a) of the Act, you are required to comply with the following requirements when carrying out the Earthworks:

2.1. Establishing Electricity Cable Positions and Electricity Cable Routes

2.1.1. You shall engage a Licensed Cable Detection Worker ("LCDW") to create an electricity cable (as defined in Section2 of the Act) ("Electricity Cable") corridor using adequate and prominent barricades and signposts. You shall strictly monitor and control, by using a Permit-to-Work ("PTW") system, the Earthworks carried out inside the barricaded Electricity Cable corridor.

2.1.2. You shall ensure that the pegging and marking of Electricity Cable positions / routes are durable and prominent. You shall also ensure that such pegging and marking are not disturbed, removed or tampered with and are reapplied from time to time to ensure that they remain conspicuous for the entire project in which the Earthworks are or are to be carried out ("Project"). You shall not drive steel pins, spikes, long pegs or other similar objects into the ground as these can damage underground Electricity Cables.

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Page 1 of 12

② Preparing the Earthworks

Daily Briefing to Site Personnel

Educate workers on:

- Awareness of cable positions
  - ✓ Pegs, Spray marks, Sign Boards, Cable corridors
- Damage prevention measures
- Risk of electrocution
- Outage and its impact
- No earthworks when in doubt
- SPPG and Legislative requirements
- Prosecution, fine and repair cost
- Revocation of REO pass if causing serious damage
- Good practices to adopt for Earthworks

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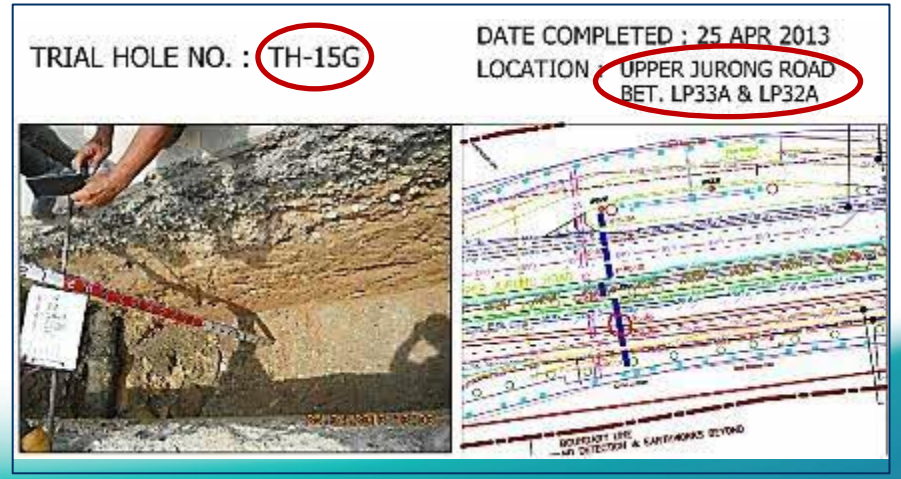


② Preparing the Earthworks

Keeping Earthworks Records

- Progressive Trial Hole records
- NCE record with SPPG LRe
- SPPG Cable Plan/Gas Plan
- LCDW Cable Detection Drawing
- Daily Tool-box, Utilities coordination Meeting records
- Risk Assessment records and PTW





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③ Doing the Earthworks

Provide effective & Close supervision

- Close monitoring of all earthwork activities at all times
  - ✓ RES to supervise earthworks activity
  - ✓ Daily tool-box meeting on cable positions
  - ✓ Communicate any changes in position or earthwork activities with work team and management
  - ✓ When in doubt consult LCDW/ SPPG



- Confirm earthworks are safe from cables by
  - ✓ Comparing LCDW drawing and SPPG Cable Plan
  - ✓ Dig appropriate and adequate trial holes manually
  - ✓ Account for all cables in the SPPG Cable Plan & LCDW drawing
  - ✓ Carrying out proper Risk Assessments on damage

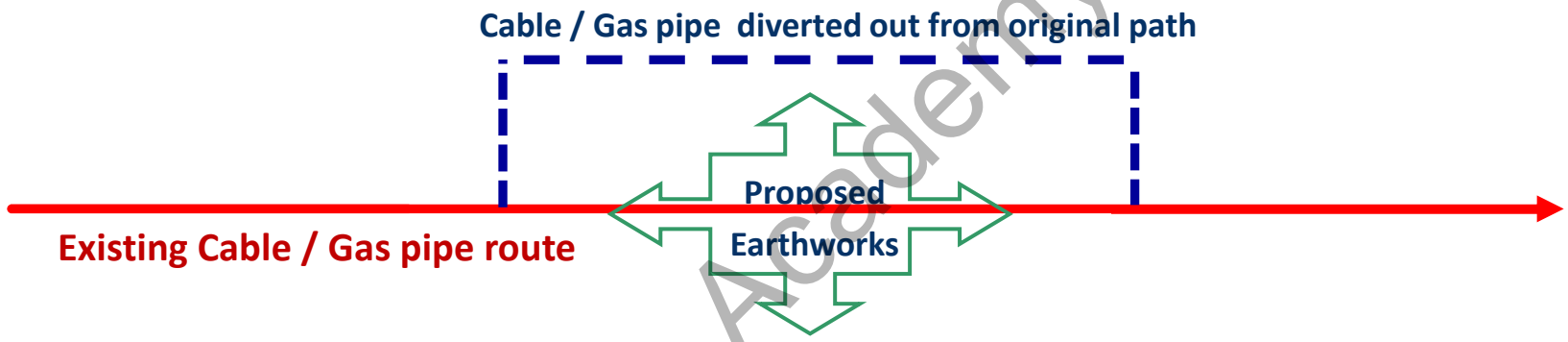
- Notify ESP for change of site management or earthworks position

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③ Doing the Earthworks

Effective Way to avoid Damage

❖ Cable / Gas pipe Diversion



After cable diversion,

❖Get LCDW for re-detection work

❖Get updated LCDW detection drawing and SPPG Cable Plan

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❖ Relocate earthworks position



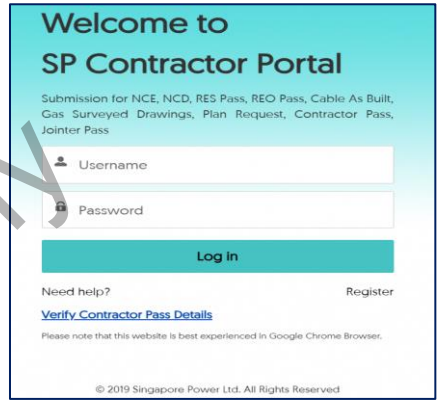
③ Doing the Earthworks

Good Earthworks Practices





Get Cable/Gas Plans & Engage LCDW



Submit NCE via E-Submission for HV cable and all Gas pipes



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Sample

LI YU TIAN
CHYE JOO CONSTRUCTION PTE LTD
19 KIAN TECK ROAD
SINGAPORE 628772

Date: 06/12/2021
Co. Registration No.: 200306959Z
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Page 1 of 12

Comply with SPPG requirements in LRe





Refer to both Cable Plan & LCDW drawing and Gas Plan at site at all times

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③ Doing the Earthworks

Good Earthworks Practices



Cable/Gas Pipe Positions
Pegged and Marked by LCDW/Surveyor



Dig appropriate & adequate trial holes
manually with due diligence & care



Re-detection by LCDW if needed



Exposed cable/ gas pipe must be protected

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③ Doing the Earthworks

Good Earthworks Practices



Deploy REO with Banksman



Mechanical excavation for Premix or Hardcore layer only



Contact ESP when earthworks within 3m from cable/gas pipe

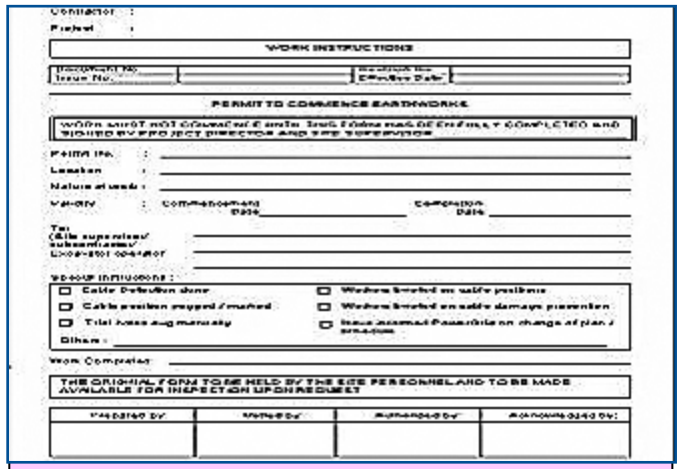


Contact ESP before under/over crossing of cable/gas pipe

BCA Acade

③ Doing the Earthworks

Good Earthworks Practices



Implement
Permit to Work system



Engage Registered
Earthworks Supervisor



Use steel plates to reduce
static load & heavy movement



Use proper shoring & shuttering
to prevent soil movement

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③ Doing the Earthworks

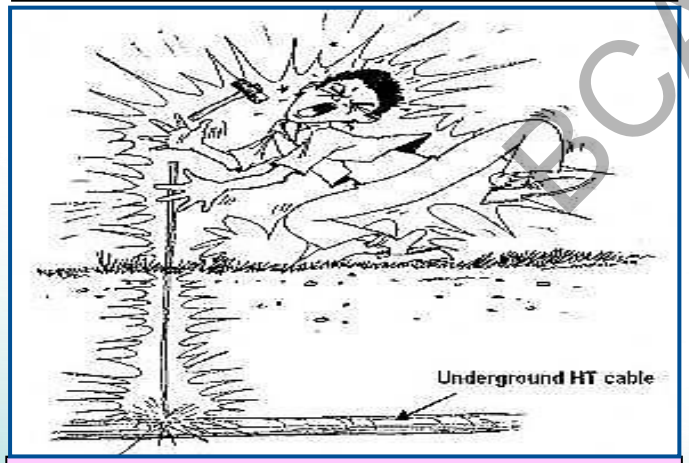
Good Earthworks Practices



Daily Tool Box Meeting
for Cable / Gas pipe positions



Do not excavate beyond
Cable ID Marker / Concrete Slab



Consult LCDW
before sinking earth rods



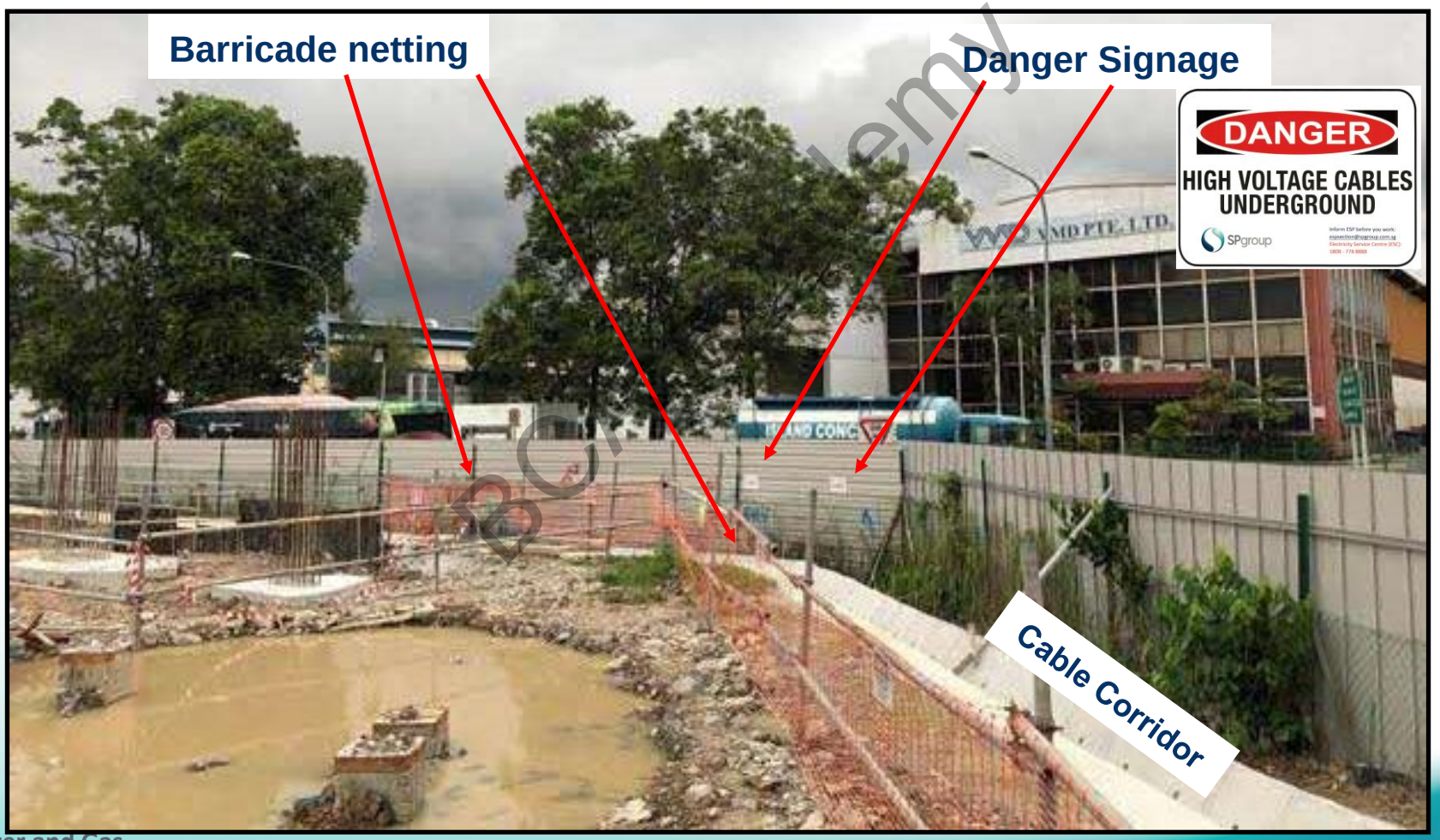
Do not break SPPA µPVC pipe
without SPPG consent

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③ Doing the Earthworks

Good Earthworks Practices

- Barricade and Mark out Cable / Gas Pipes Corridor with Signages



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③ Doing the Earthworks

Good Earthworks Practices

- **Progressive Scanning**



Removal of Premix/Hard-core Only



Manual Excavation with Due Care



Progressive Scanning

Bo A gen

③ Doing the Earthworks

Good Earthworks Practices

✓ **Look out for signs indicating presence of Cables**











Singapore Institute of Power and Gas





1. Cable bridge
2. Past LCDW markings
3. Cable / Joint markers
4. OG Box
5. OG Box
6. Sub-station

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③ Doing the Earthworks

Good Earthworks Practices

✓ **Look out for signs indicating presence of Gas pipes**



Warning Stickers



Warning stickers paste at the Public Lighting Pole



Gas Chambers



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Gas Requirements

- **For Low Pressure gas pipe**

✓ Dig trial holes to confirm gas pipe



- **For Medium Pressure gas pipe**

✓ Digging of trial holes only in the presence of PowerGas DPOM officer

✓ Mark out positions on site

- **For Transmission High gas pipe**

✓ Engage registered surveyor to confirm transmission gas pipe position

✓ Digging of trial holes only in the presence of PowerGas TPOM officer

✓ Mark out positions on site



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③ Doing the Earthworks

Exposed Cables



Advise contractors when they see exposed cables:

- ❖**STOP** all works
- ❖Cables might be **'LIVE'**
- ❖Cover cables with sandbags
- ❖Do **NOT** try to remove cable or cable slabs
- ❖Call SPPG and wait for ESP to come
- ❖**CANNOT** repair the cables by yourself

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24/7
ELECTRICITY SERVICE CENTRE

1800 - 7788888

④ After the Earthworks

Proper Reinstatement & Checks

- All protection slabs, concrete haunching & protection materials to be reinstated to their original condition
- Site inspection together with SPPG personnel must be arranged prior to backfilling works
- Backfilling to be compact, particularly beneath cable to prevent soil settlement

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NCE End-date

- When earthworks are completed ahead of time as stated in the NCE, inform ESP



Keeping records

- Backfilling and reinstatement photos

Summary of Good Practices

1. Get cable & gas plans
2. Engage LCDW / surveyors / REO / RES
3. Submit NCE to MEA
4. Comply with SPPG requirements (LRe)
5. Always refer to both cable plan, gas plan & LCDW drawing
6. Peg / mark all cables / gas pipe positions
7. Dig suitable & enough trial holes manually
8. Re-detection of cable if needed

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Summary of Good Practices

9. Protect all exposed cables / gas pipes
10. REO must be assisted by Banksman
11. Mechanical excavation for premix / hardcore layer only
12. Contact LCDW when earthworks is 3m from cables / gas pipes
13. Contact ESP before under / over-crossing of cables / gas pipes
14. Implement PTW and RA system for earthworks
15. Engage full-time supervisor and RES
16. Use steel plate to reduce load & heavy equipment
17. Provide proper shoring of trenches to prevent soil movement

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Summary of Good Practices

18. Remind workers daily on cable / gas pipe positions (Toolbox meeting)
19. Do not excavate beyond cable ID markers / concrete slabs
20. Consult LCDW before sinking earthrods
21. Do not break uPVC pipe without SPPG consent
22. Progressive scanning with cable detectors to keep track of cable signals
23. Look out for tell-tale signs of cables / gas pipes

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The Full-Cycle Process for Earthworks (8 + 4 Steps for Earthworks)

Pre-Earthworks - 8 Steps

1. Get cable plans (e-submission)
2. Engage LCDW
3. Cable detection works
4. Cable detection drawing
5. Submit NCE (e-submission)
6. ESP visits worksite
7. ESP issues LRe
8. Earthworks starts

Earthworks Phase - 4 Steps

① **Plan for earthworks**
- Identify key parties
- Complying with legislations

② **Prepare for earthworks**
- Site control
- Identify cables / gas pipes
- Complying with LRe
- Daily briefingsto site personnel
- Keeping earthworks records

③ **Doing the earthworks**
- Provide effective & close supervision with RES
- Diversion / avoid cables / gas pipes
- Comply with good earthworks practices

④ **After the earthworks**
- Proper reinstatement & checks
- Notify ESP when job completed ahead of NCE end-date
- Keep the records

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Chapter 4 (b)

Safe Work Procedures on Damage Prevention: Permit-to-Work System

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Sample of Permit To Work (PTW)



Contractor :

Project :

WORK INSTRUCTIONS

Document No.		Revision No.	
Issue No.		Effective Date	

PERMIT TO COMMENCE EARTHWORKS

WORK MUST NOT COMMENCE UNTIL THIS FORM HAS BEEN FULLY COMPLETED AND SIGNED BY PROJECT DIRECTOR AND SITE SUPERVISOR.

Permit No. :

Location :

Nature of work :

Validity : Commencement Date: Completion Date:

To:
(Site supervisor/ subcontractor/ Excavator operator

Special Instructions :

- ☐ Cable Detection done
- ☐ Cable position pegged / marked
- ☐ Trial holes dug manually
- ☐ Workers briefed on cable positions
- ☐ Workers briefed on cable damage prevention
- ☐ Have informed PowerGrid on change of plan / schedule

Others :

Work Completed:

THE ORIGINAL FORM TO BE HELD BY THE SITE PERSONNEL AND TO BE MADE AVAILABLE FOR INSPECTION UPON REQUEST

Prepared by:	Vetted by:	Authorised by:	Acknowledged by:

- To effectively manage & control earthworks within a site
- PTW also ensure that the following (6 nos.) checks are made prior to earthworks to prevent cable damages:

1. Cable Detection Done
2. Cable position pegged / marked
3. Trial holes dug manually
4. Workers briefed on cable positions
5. Workers briefed on cable damage prevention
6. Whether informed SPPG on change of plan / schedule

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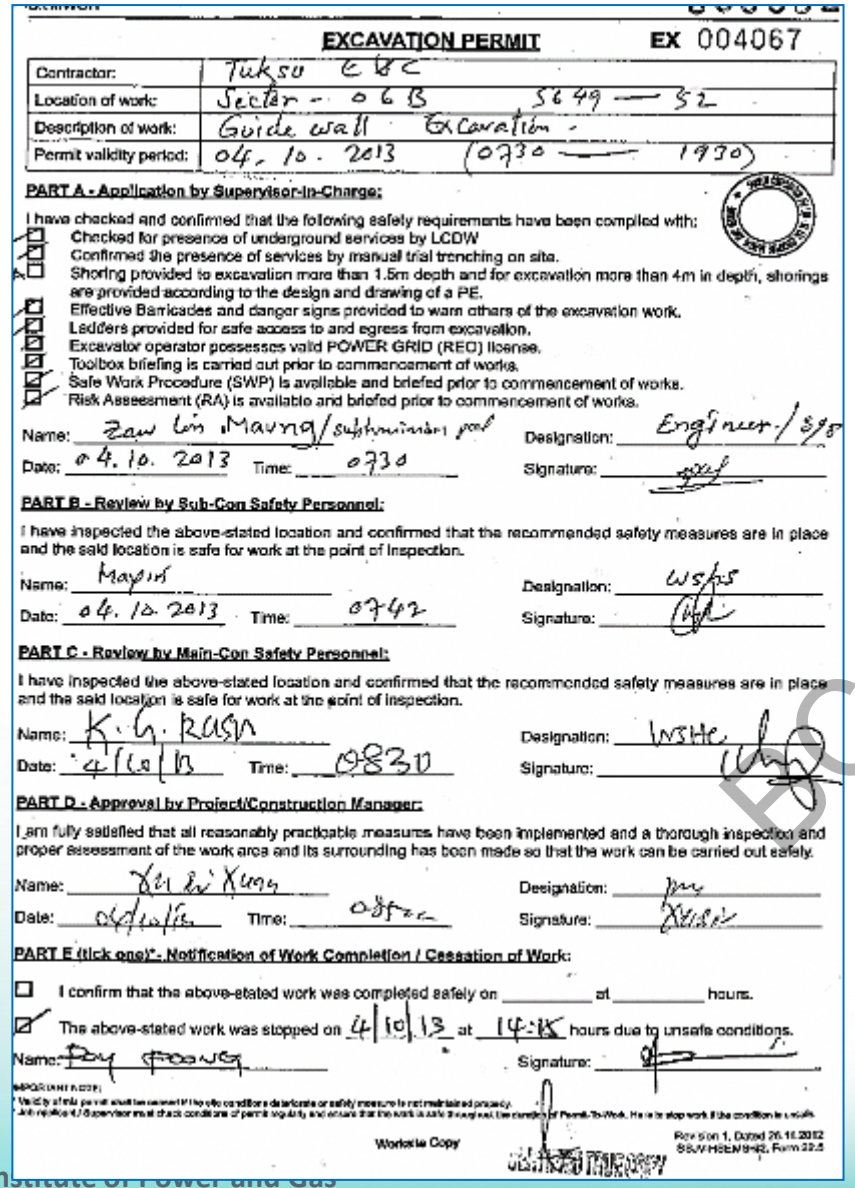
PTW Features

PTW should ensure:

- ✓ Submission of NCE to ESP when working in vicinity of HV cable and all gas pipes
- ✓ Validity of NCE even for Sub-sub Earthworks Contractors
- ✓ LCDW Cable Detection Works and Re-detection if needed
- ✓ Comparison of SPPG Cable Plan & LCDW Detection Drawing
- ✓ Manual excavation of adequate and appropriate trial holes to account for all cables and gas pipes
- ✓ Hand auguring not an alternative for manual excavation of trial holes
- ✓ No earthworks to be carried out in the vicinity of Transmission Cable(s) without prior approval on method statement from SPPG (Regional Network / Extra High Voltage Network Sections)
- ✓ Consult LCDW to determine the locations before sinking earth rods

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Implementing PTW & Controls



EXCAVATION PERMIT EX 004067

Contractor:	Tuksu C&C
Location of work:	Sector - 06B 5649 — 52
Description of work:	Guide wall Excavation -
Permit validity period:	04. 10. 2013 (0730 — 1930)

PART A - Application by Supervisor-In-Charge:

I have checked and confirmed that the following safety requirements have been complied with:

- ☑ Checked for presence of underground services by LCDW
- ☑ Confirmed the presence of services by manual trial trenching on site.
- ☐ Shoring provided to excavation more than 1.5m depth and for excavation more than 4m in depth, shorings are provided according to the design and drawing of a PE.
- ☑ Effective Barricades and danger signs provided to warn others of the excavation work.
- ☑ Ladders provided for safe access to and egress from excavation.
- ☑ Excavator operator possesses valid POWER GRID (REC) license.
- ☑ Toolbox briefing is carried out prior to commencement of works.
- ☑ Safe Work Procedure (SWP) is available and briefed prior to commencement of works.
- ☑ Risk Assessment (RA) is available and briefed prior to commencement of works.

Name: Zaw Lin Maung/Subhuniran Designation: Engineer/S&S

Date: 04. 10. 2013 Time: 0730 Signature:

PART B - Review by Sub-Con Safety Personnel:

I have inspected the above-stated location and confirmed that the recommended safety measures are in place and the said location is safe for work at the point of inspection.

Name: Mayin Designation: WSHO

Date: 04. 10. 2013 Time: 0742 Signature:

PART C - Review by Main-Con Safety Personnel:

I have inspected the above-stated location and confirmed that the recommended safety measures are in place and the said location is safe for work at the point of inspection.

Name: K. G. RUSH Designation: WSHC

Date: 4/10/13 Time: 0830 Signature:

PART D - Approval by Project/Construction Manager:

I am fully satisfied that all reasonably practicable measures have been implemented and a thorough inspection and proper assessment of the work area and its surrounding has been made so that the work can be carried out safely.

Name: Xu Bi Xiang Designation: PM

Date: 04/10/13 Time: 0830 Signature:

PART E (tick one)*: Notification of Work Completion / Cessation of Work:

- ☐ I confirm that the above-stated work was completed safely on _____ at _____ hours.
- ☑ The above-stated work was stopped on 4/10/13 at 14:15 hours due to unsafe conditions.

Name: Foo Foong Signature:

*APPLICANT'S COPY:

* Valid only if this permit shall be cancelled if the site condition deteriorate or safety measure is not maintained properly.

* And re-apply if Supervisor must check conditions of permit regularly, and ensure that the work is safely completed before the expiry of Permit-To-Work. He is to stop work if the condition is unsafe.

Worksite Copy

Revision 1, Dated 26.10.2012
SSUV HSENV/HS, Form 22.5

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PTW system shall be **implemented** and **approved by principal / main contractor** for earthwork activities within the site

Objectives of PTW:

- **Monitor & Control** Earthworks
- **Stop unauthorised** Earthworks

PTW system to be **Audit periodically** for its effectiveness

Chapter 4 (c)

Safe Work Procedures on Damage Prevention: Cable Detection Works

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RES must work closely with LCDW

- In this Chapter, we will learn:
  - What is involved in cable detection works by LCDW?
  - What LCDW does?
  - What is RES role in working with LCDW?
- How to use SPPG cable plan?
- How to interpret LCDW detection drawing?
- 3 Case Studies to strengthen learning.

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The role of LCDW

- Obtain SPPG Cable Plan from MEA
- Submit Notice for Commencement of Detection (NCD) to MEA
- Carry out Cable Detection works within Earthworks Boundary using suitable cable locator
- Remind contractor to submit NCE to MEA where HV cables / Gas pipes in vicinity of Earthworks
- Spray marking the detected cables positions/routes at site
- Provide LCDW Cable Detection Drawing to contractor with
  - Proposed Trial Hole locations
  - Minimum size 1m x 1m and depth 1m & until detected cables are exposed to Cable Slab level

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The role of LCDW

- If no cable is exposed after 1m of depth, LCDW shall carry out Re-detection or progressive scanning inside trial hole and continue with digging with due care if presence of cables is detected
- LCDW and RES shall compare number of cables in SPPG cable plan with number of cables identified at site and review the spray markings on site accordingly
- Brief Earthworks contractor and site personnel on the presence of cable positions and damage preventive measures
- Provide consultation to Earthworks contractor when necessary
- Submit Report on Damage (ROD) to IPU if cable is damaged

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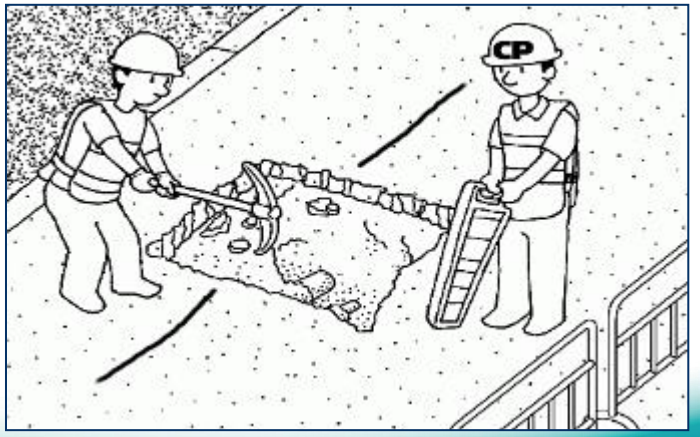


Good Cable Detection Works

- Only LCDW is allowed to carry out cable detection works
- Obtain relevant SPPG cable plans
- Know the cable Detection Boundary and Earthworks Boundary
- Study SPPG cable plans and identify all cables at Earthworks worksite
- Aware on possible bending of cables according to SPPG cable plans

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Trial Hole to ascertain Presence or Absence of Underground Cable/ Gas Pipe

Limitations of Cable Detection Work

LCDW uses a cable locator to detect electromagnetic signals from power cables and marks them on site and provide cable detection drawing

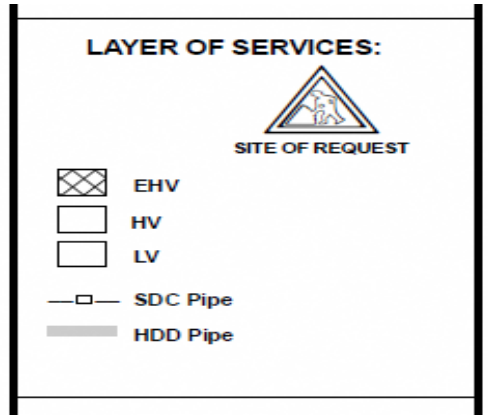
- Cable Detection marks are indicative only
- Cable Detection does not indicate the depth at which the underground cables are laid
- Detection work could be affected by interference of signals from other services and surrounding environment
- De-energised cable cannot be detected
- Difficult to detect energised cable with low load
  - Seek SPPG assistance to inject detectable signal at source ends



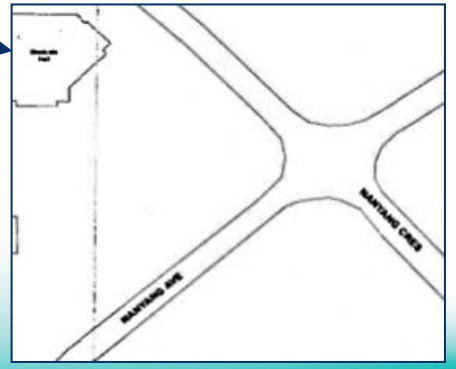
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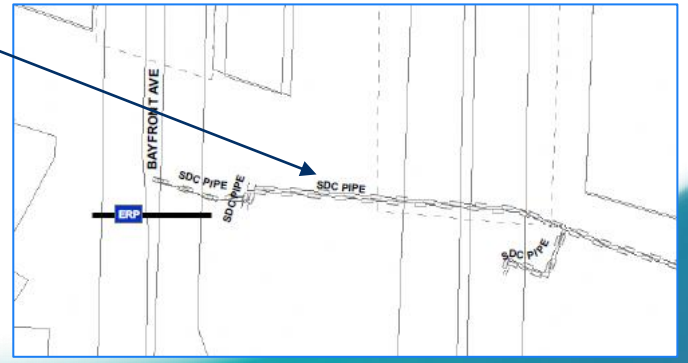
Interpreting SPPG Cable Plan

- SPPG Cable Plan and As-Built Drawing shows **indicative cable route** (Valid for 3 months)
- **Different voltage** levels are printed on **separate sheets (called 'layers')**
  - Up to 7 layers could be issued (one for each voltage cable identified as EHV or HV or LV and Works-in-Progress (WIP), if present)
- **EHV / HV / LV cable** indicators shown in legend information of plans
- **HDD** – Horizontal Directional Drilling Method (for EHV & HV cables)
- **SDC** – Singapore District Cooling (for SDC pipes)
- **Cable sizes** and arrangements are shown in the **annotations**
- Reference **landmark** (road name, building, OGB etc.)



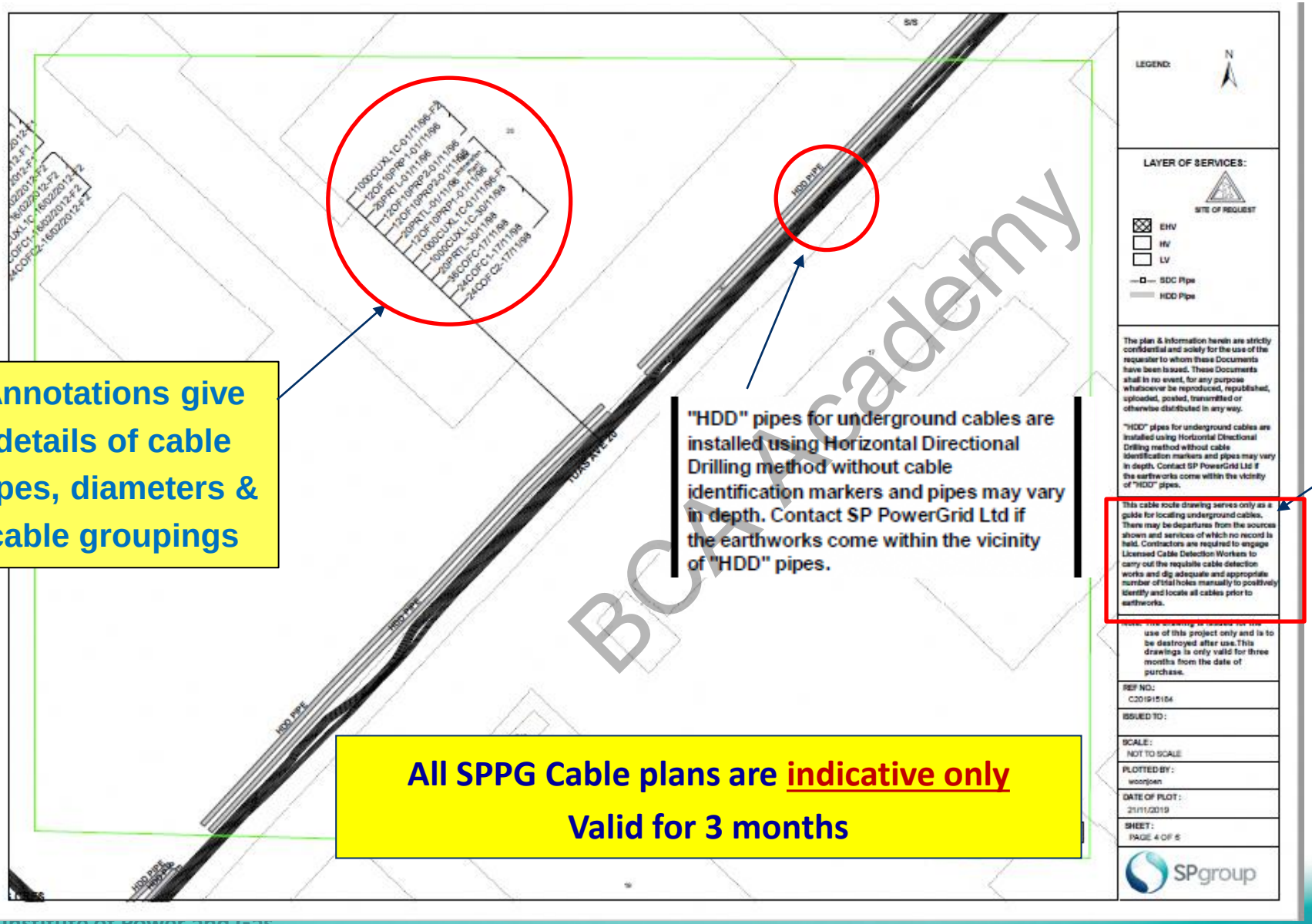
"HDD" pipes for underground cables are installed using Horizontal Directional Drilling method without cable identification markers and pipes may vary in depth. Contact SP PowerGrid Ltd if the earthworks come within the vicinity of "HDD" pipes.





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Cable Plans



Annotations give details of cable types, diameters & cable groupings

"HDD" pipes for underground cables are installed using Horizontal Directional Drilling method without cable identification markers and pipes may vary in depth. Contact SP PowerGrid Ltd if the earthworks come within the vicinity of "HDD" pipes.

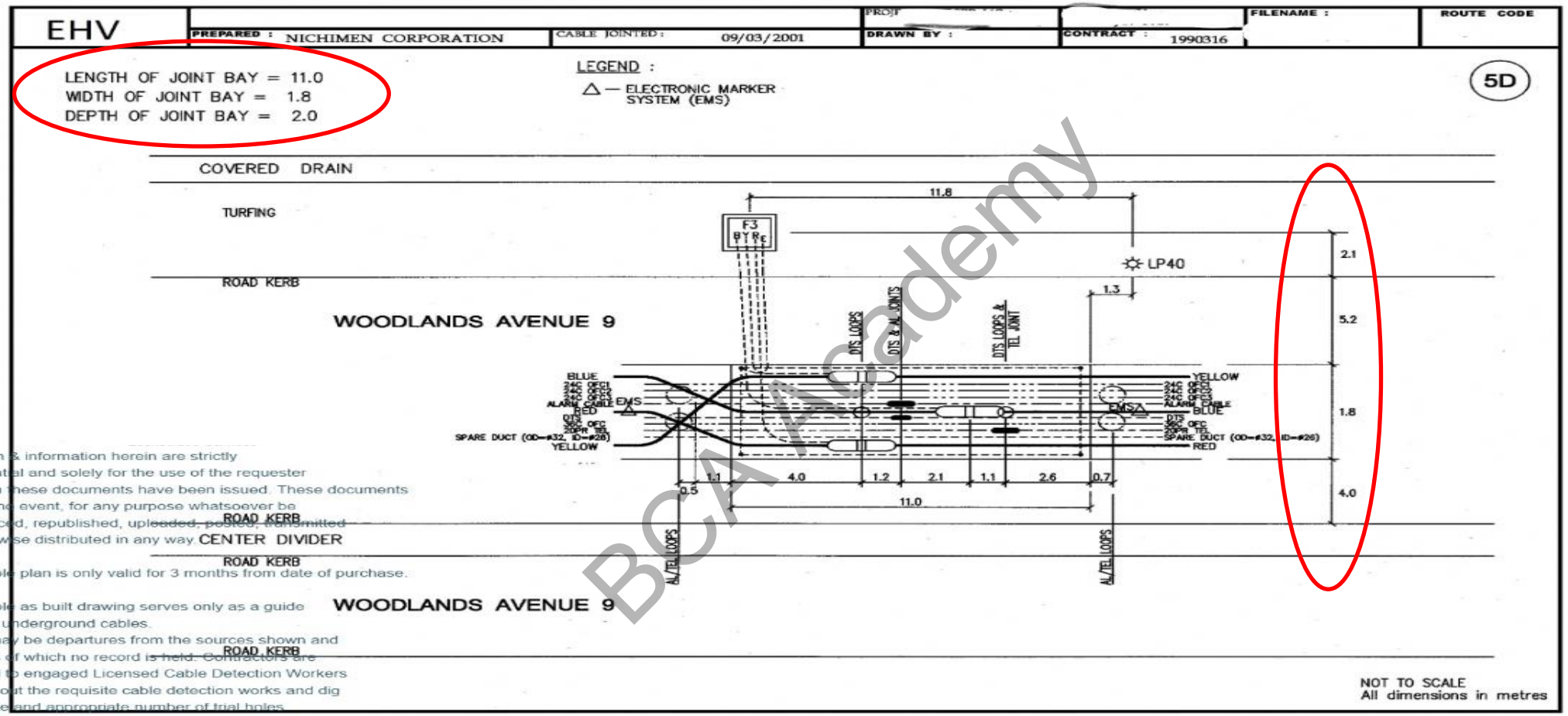
This cable route drawing serves only as a guide for locating underground cables. There may be departures from the sources shown and services of which no record is held. Contractors are required to engage Licensed Cable Detection Workers to carry out the requisite cable detection works and dig adequate and appropriate number of trial holes manually to positively identify and locate all cables prior to earthworks.

All SPPG Cable plans are indicative only

Valid for 3 months

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As-Built Drawing



The plan & information herein are strictly confidential and solely for the use of the requester to whom these documents have been issued. These documents shall in no event, for any purpose whatsoever be reproduced, republished, uploaded, posted, transmitted or otherwise distributed in any way.

This cable plan is only valid for 3 months from date of purchase.

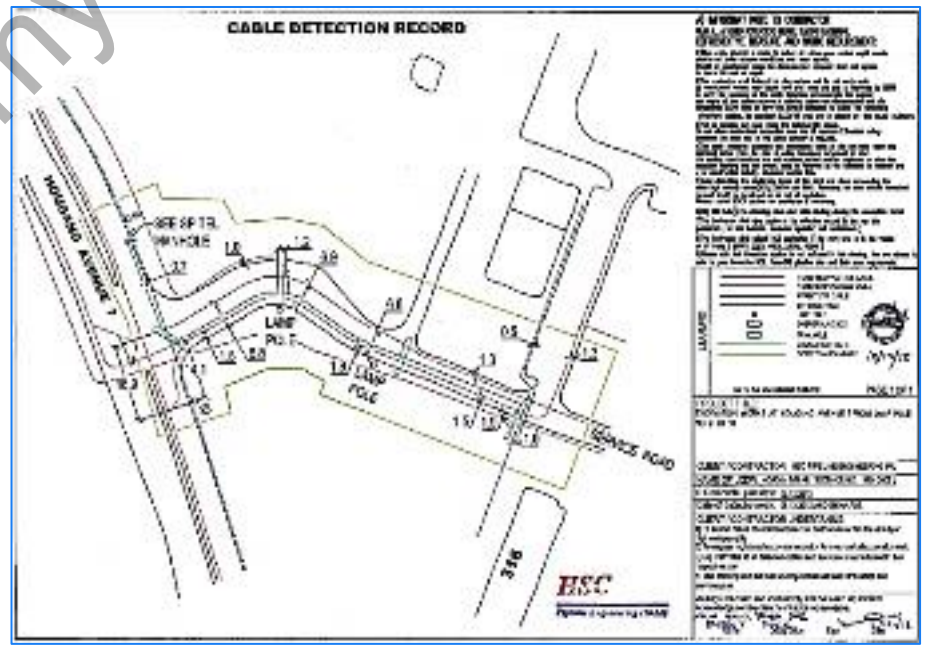
This cable as built drawing serves only as a guide locating underground cables.
There may be departures from the sources shown and services of which no record is held. Contractors are required to engaged Licensed Cable Detection Workers to carry out the requisite cable detection works and dig adequate and appropriate number of trial holes manually to positively identify and locate all cables prior to earthworks. If indoubt, please consult EHVN and/or RNE/RNW for further details.

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It provides details, information of cable/joint location and depth/dimesion -
If in doubt please contact RN or EHVN

Understanding LCDW drawing

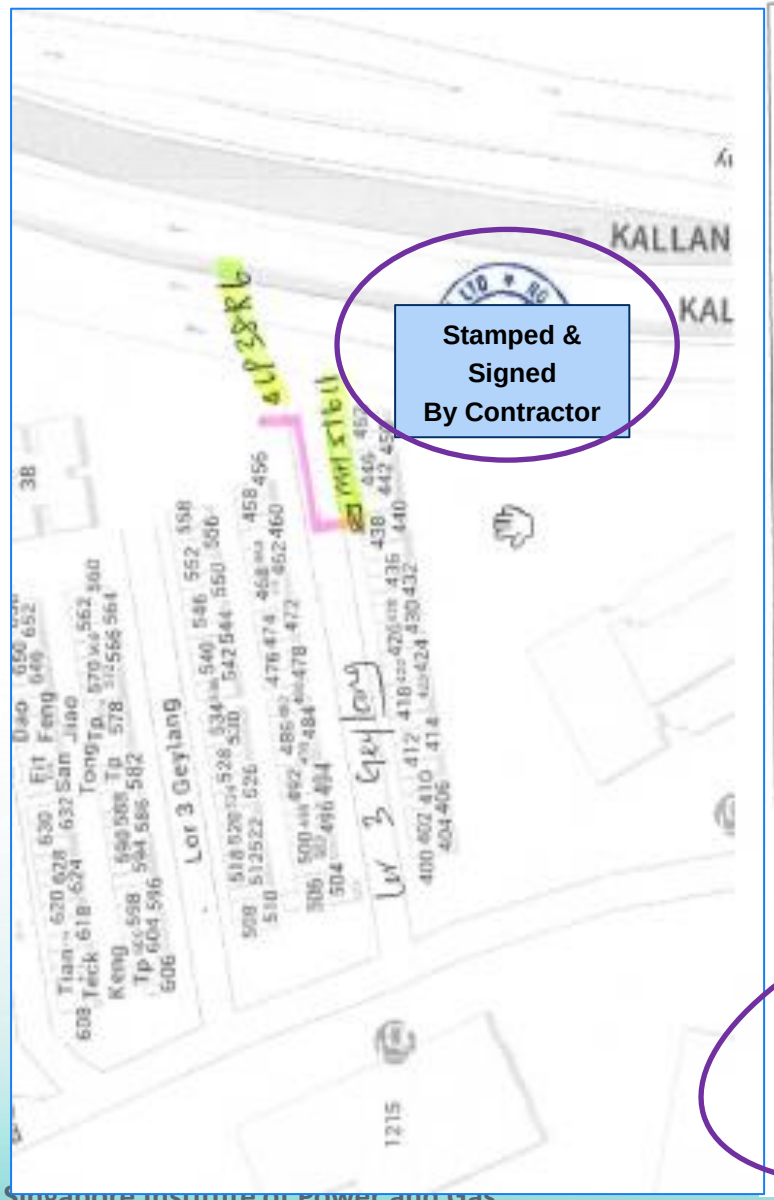
- Site reference based on prominent Road Name, Landmarks, OGB, Lamp Pole no. and etc.
- Recommended trial hole positions
- Cable position / route
- Earthworks / Cable Detection Boundary
- Cable Voltage Level (LV/HV)
- Other services / signal detected
- Single line does not indicate one cable
  (Single line could mean a bundle of cables)
- There are maximum of 7 cable plan layers that can be issued

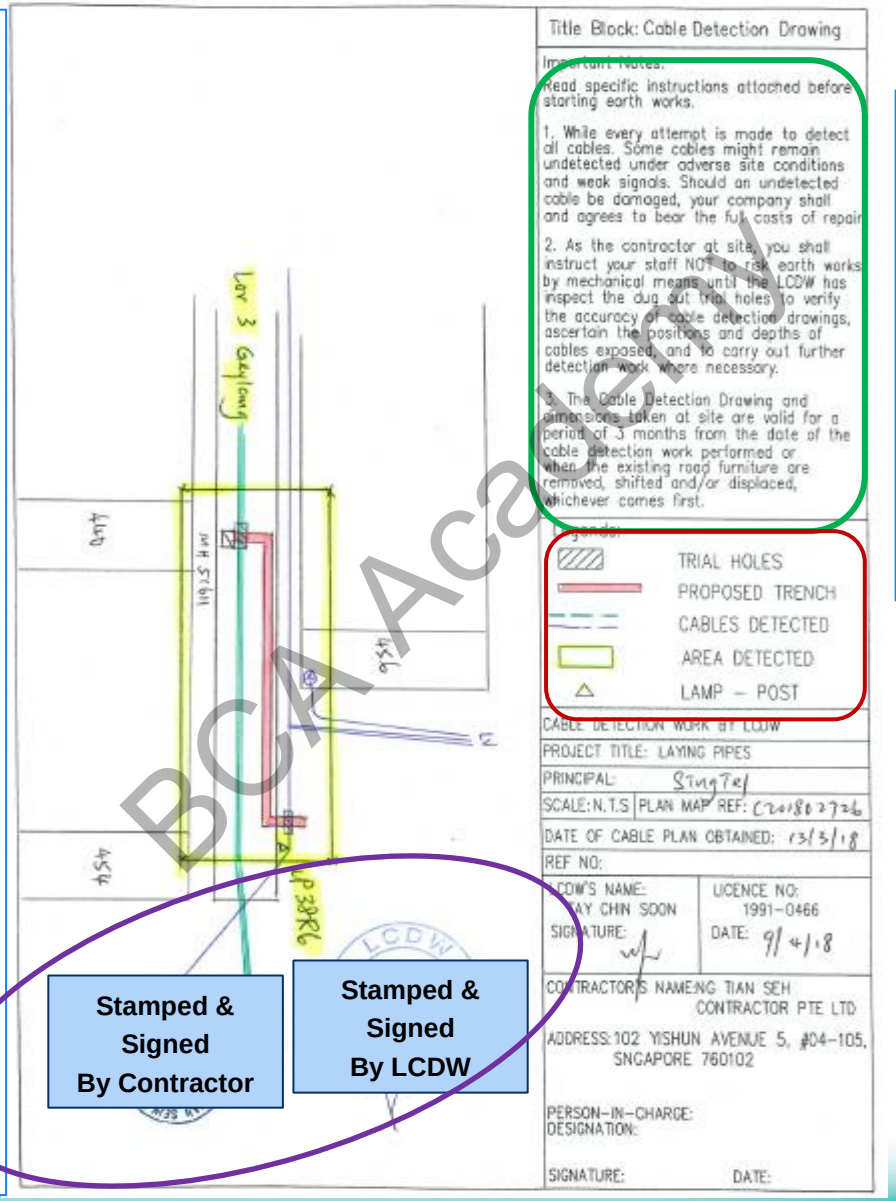


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Trial Hole to ascertain Presence or Absence of Underground Cable/ Gas Pipe

LCDW Cable Detection Works and Drawing

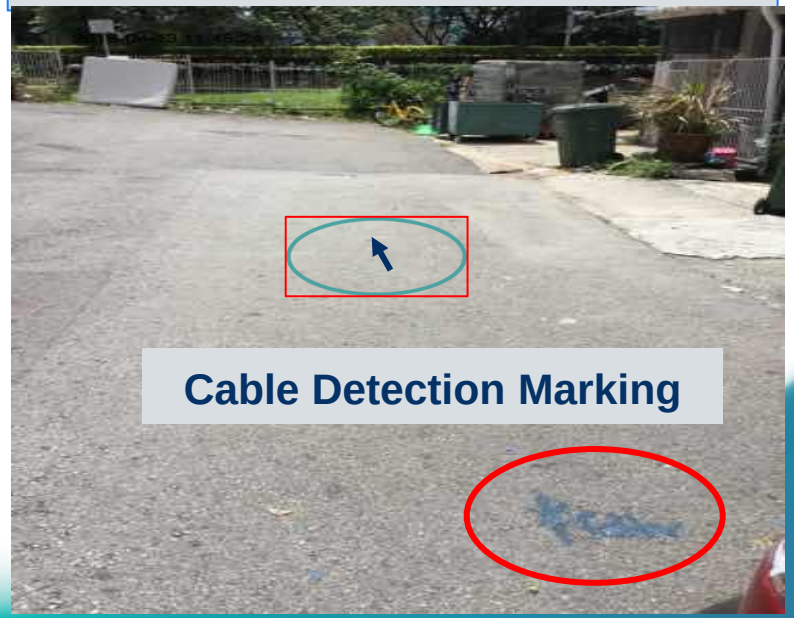




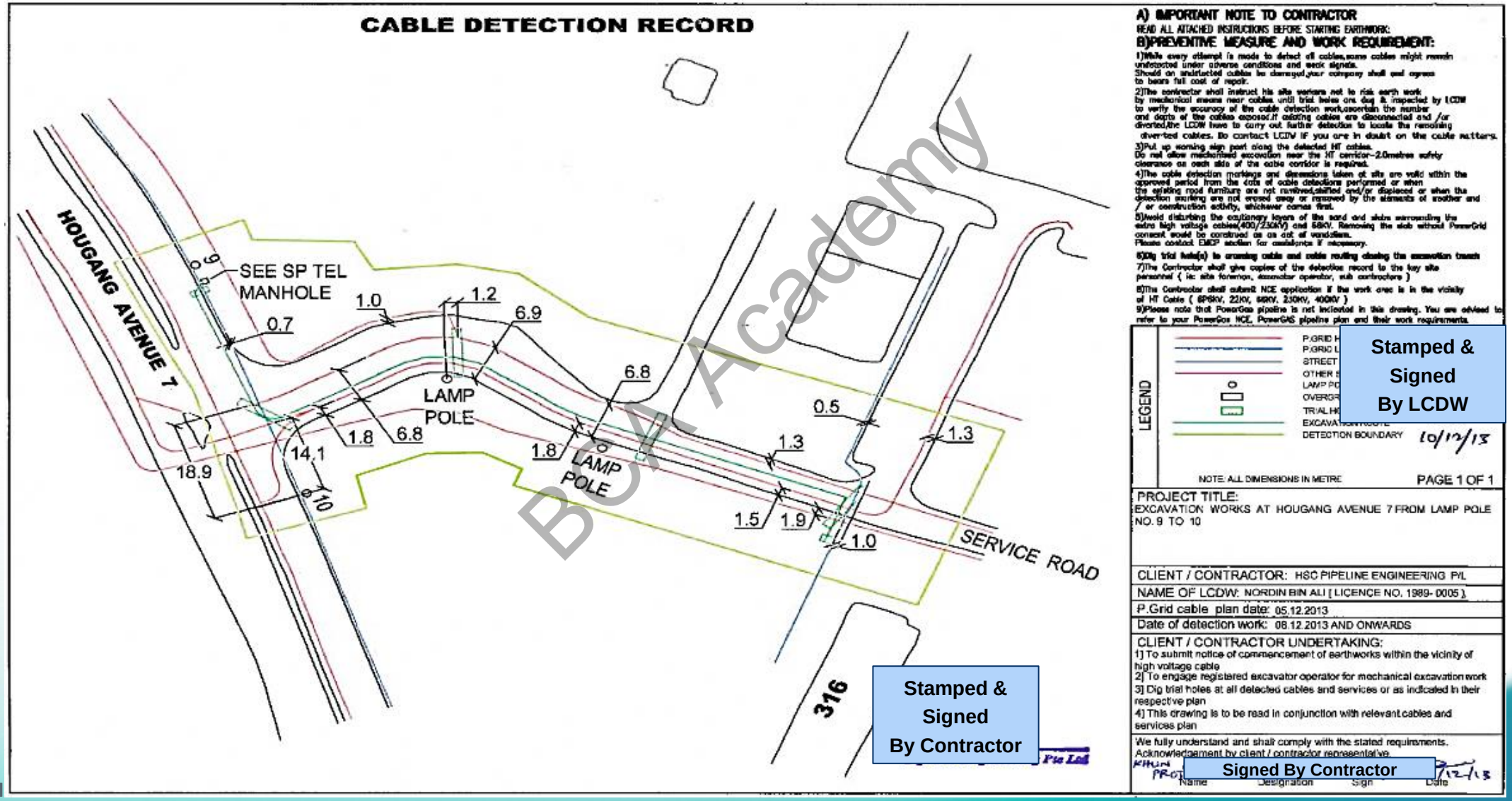
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Check Cable Detection Works

- Detection Area
- Legends
- LCDW's Instruction
- Stamped and Signed by LCDW and contractor
- Compare with Cable Map
- Cable detection markings

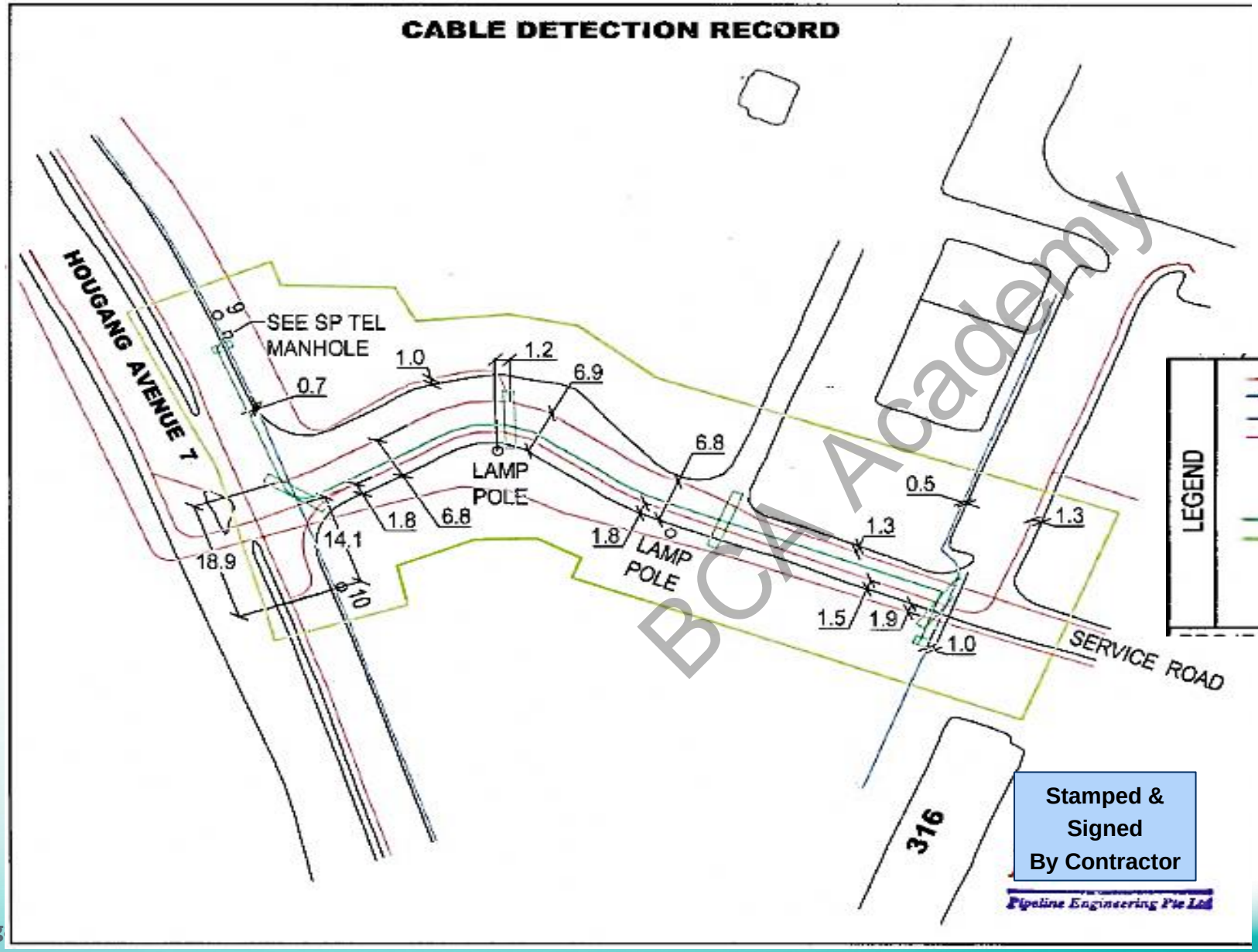


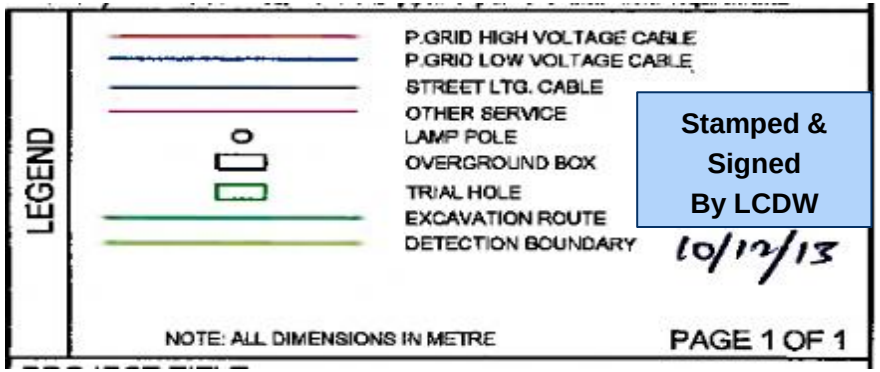
LCDW Cable Detection Drawing



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Interpreting the LCDW Cable Detection Drawing





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Declaration of Undertaking in LCDW Cable Detection Drawing

PROJECT TITLE:
EXCAVATION WORKS AT HOUGANG AVENUE 7 FROM LAMP POLE NO. 9 TO 10

CLIENT / CONTRACTOR: H Contractor EERING P/L

NAME OF LCDW: LCDW [LICENCE NO. LCDW

P.Grid cable plan date: 05.12.2013

Date of detection work: 08.12.2013 AND ONWARDS

CLIENT / CONTRACTOR UNDERTAKING:

1] To submit notice of commencement of earthworks within the vicinity of high voltage cable

2] To engage registered excavator operator for mechanical excavation work

3] Dig trial holes at all detected cables and services or as indicated in their respective plan

4] This drawing is to be read in conjunction with relevant cables and services plan

We fully understand and shall comply with the stated requirements.
Acknowledgement by client / contractor representative.

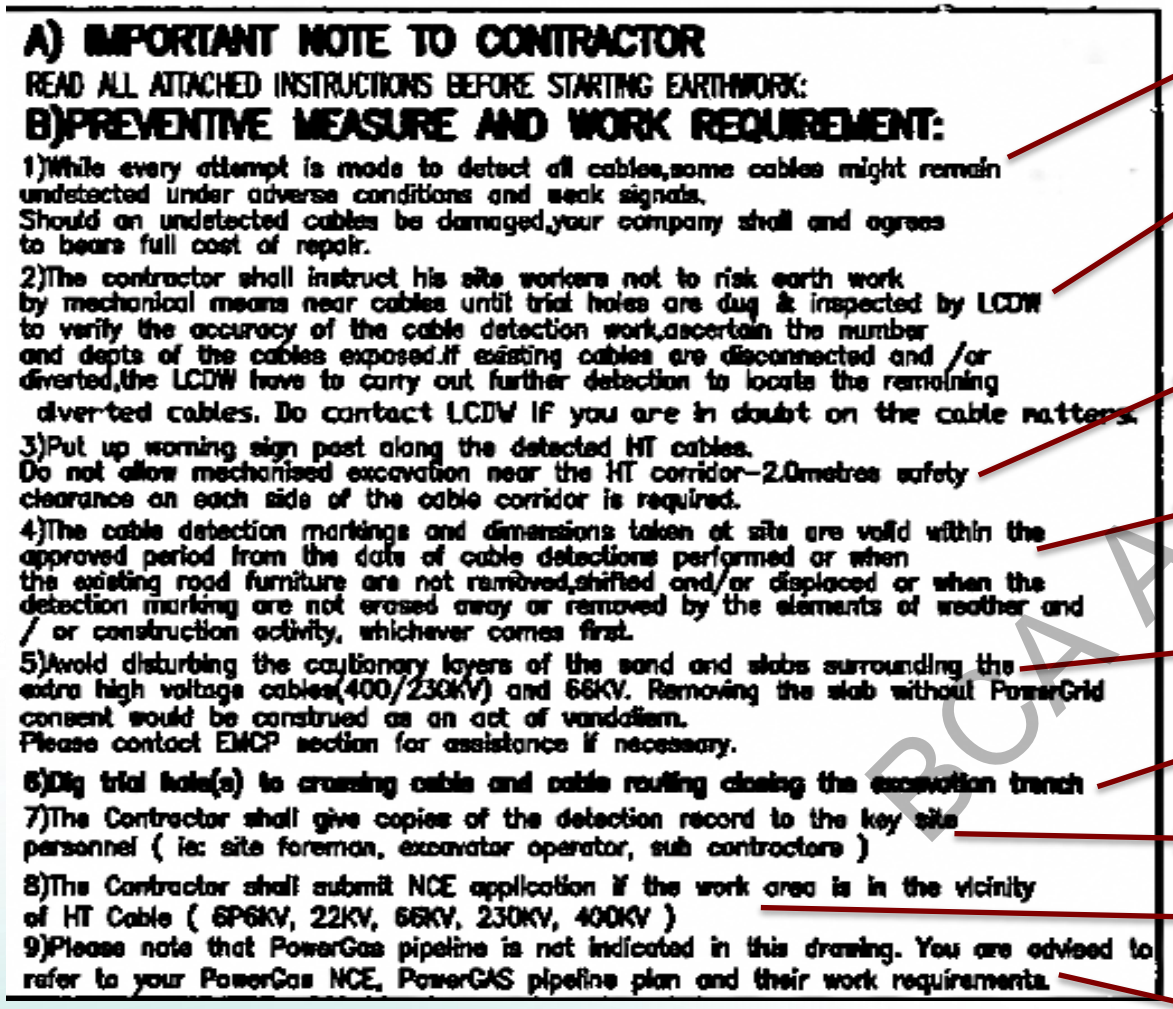
Contractor

Name | Designation | Sign | Date 12/13

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① Submit NCE.
② Engage REO.
③ Dig trial holes.
④ Refer to service plans.

The LCDW Report in the Cable Detection Drawing



A) IMPORTANT NOTE TO CONTRACTOR

READ ALL ATTACHED INSTRUCTIONS BEFORE STARTING EARTHWORK:

B)PREVENTIVE MEASURE AND WORK REQUIREMENT:

1)While every attempt is made to detect all cables,some cables might remain undetected under adverse conditions and weak signals.
Should an undetected cables be damaged,your company shall and agrees to bears full cost of repair.

2)The contractor shall instruct his site workers not to risk earth work by mechanical means near cables until trial holes are dug & inspected by LCDW to verify the accuracy of the cable detection work,ascertain the number and depts of the cables exposed.If existing cables are disconnected and /or diverted,the LCDW have to carry out further detection to locate the remaining diverted cables. Do contact LCDW if you are in doubt on the cable matters.

3)Put up warning sign post along the detected HT cables.
Do not allow mechanised excavation near the HT corridor-2.0metres safety clearance on each side of the cable corridor is required.

4)The cable detection markings and dimensions taken at site are valid within the approved period from the date of cable detections performed or when the existing road furniture are not removed,shifted and/or displaced or when the detection marking are not erased away or removed by the elements of weather and / or construction activity, whichever comes first.

5)Avoid disturbing the cautionary layers of the sand and slabs surrounding the extra high voltage cables(400/230KV) and 66KV. Removing the slab without PowerGrid consent would be construed as an act of vandalism.
Please contact EMCP section for assistance if necessary.

6)Dig trial hole(s) to crossing cable and cable routing closing the excavation trench

7)The Contractor shall give copies of the detection record to the key site personnel (ie: site foreman, excavator operator, sub contractors)

8)The Contractor shall submit NCE application if the work area is in the vicinity of HT Cable (6P6KV, 22KV, 66KV, 230KV, 400KV)

9)Please note that PowerGas pipeline is not indicated in this drawing. You are advised to refer to your PowerGas NCE, PowerGAS pipeline plan and their work requirements.

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① The LCDW drawing is indicative only and cable may remain undetected. Contractor bears repair cost of damage

② No mechanical excavation unless trial holes are done to verify cable positions & depths. LCDW to be called to do this & redetection after cable diversion

③ Put up warning signs at cable position. No mechanical excavation at cable corridor with **2m*** safety clearance

④ Cable positions become void when prominent road markers, pegging, paint marks on road, etc are shifted or erased

⑤ Do not disturb beyond the slab level of Transmission cables

⑥ Dig trial holes at cable crossings

⑦ Key persons should be given copies of LCDW detection drawings

⑧ Submit NCE for HV cables

⑨ Gas pipes are not in this drawing and the relevant gas plans should be referred to

*The latest SPPG requirement has been changed to 3m for HV cables, LP & MP gas pipes and 5m for GTP.

Common Mistakes in Assumption

- Assuming 1 line in LCDW Detection Drawing to be 1 cable
  - Note: 1 line could indicate a band of signals / bundle of cables
- Assuming cable running straight as shown in LCDW Detection Drawing
- Ignoring the unknown but detected signal
- Wrong projection of distance of cable from prominent landmarks
  - Note: LCDW Detection Drawing is indicative only
- Assuming common depth for cables
- Failure to compare LCDW Detection Drawing with SPPG Cable Plan to account for all underground cables



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Trial Hole to ascertain Presence or Absence of Underground Cable/ Gas Pipe

Measures to Avoid Mistakes

Compare SPPG Cable Plan with LCDW Cable Detection Drawing:

- Check the number of layers in SPPG Cable Plan
- Look out for cables in the Work in Progress (WIP) Layer of SPPG Cable Plan
- Verify if LCDW drawing has accounted for all cables
- Superimpose and compare SPPG Cable Plan and LCDW Cable Detection Drawing for dissimilarities
- Dig adequate and appropriate trial holes by manual mean with due care and account for all underground cables
- Consult LCDW/ SPPG when in doubt

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Case Studies

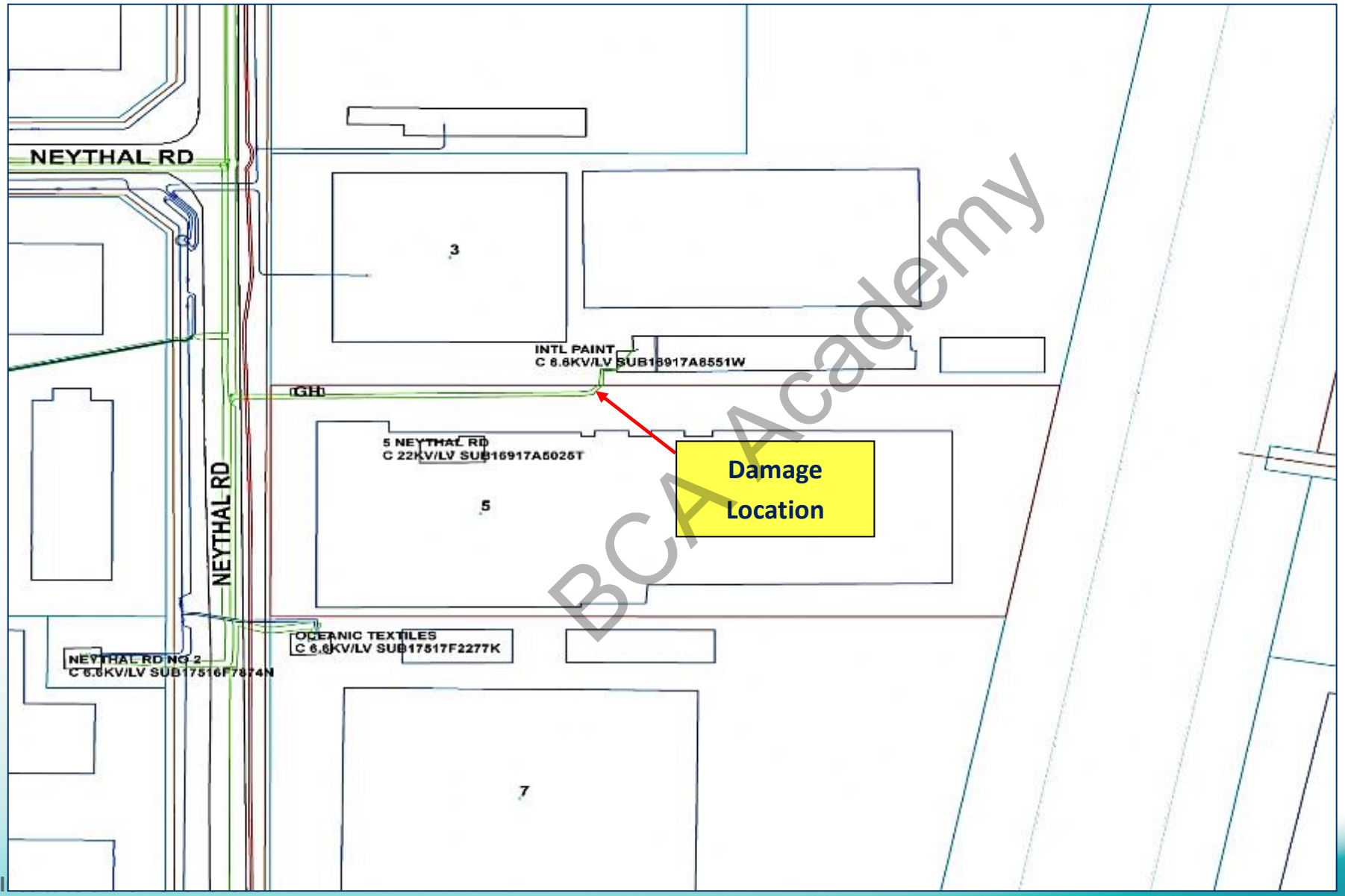
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Case #2 – 6.6kV Damage at 5 Neythal Road

Date / Time of Damage	8.11.13 / 1002hrs
Location	Inside 5 Neythal Road
Cause of Damage	Mechanical Excavation
Nature of Works	Addition & Alteration Works
LCDW	Yes
Trial Hole Dug	No
NCE	Yes
Outage (Duration)	Yes (48min)

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Damaged Cable Location



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Damaged Cable Location



Damaged Cable Location





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Points to Note

LCDW had:

- **Failed to detect the turning point of the subject 6.6kV cable to No.3 Neythal Road**

Contractor had:

- **Failed to compare SPPG Cable Plan and LCDW Detection Drawing**
- **Failed to dig trial hole to account for all known cables**

Group Discussion 2

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Group Discussion 2

Case #1: 6.6kV Damage@5 Neythal Road

- **Applying generally:**
  - **What were the possible reasons why LCDW could miss out critical positions of cables?**
  - **What actions or non-actions could have led the contractor to damage cables?**
- **If you were the RES in this work, what would you have done to prevent the damage?**

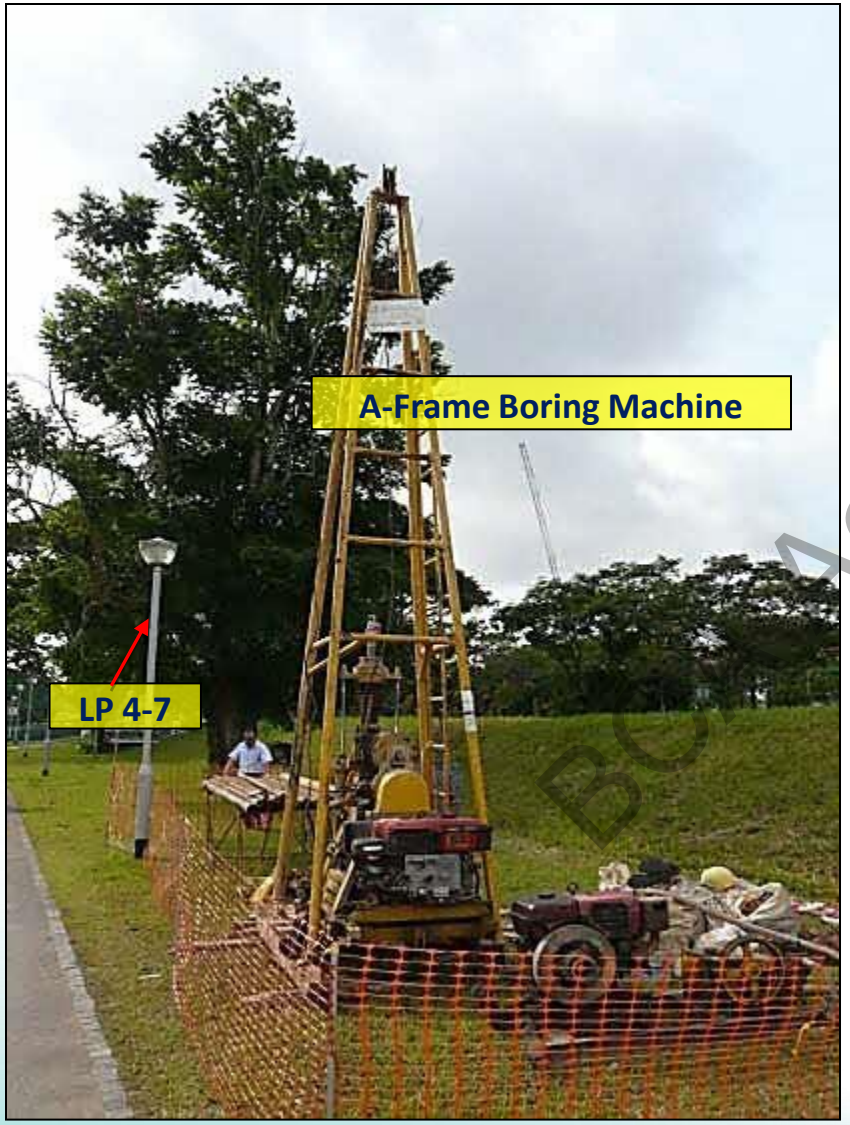
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Case #3 – 66kV Damage at Bishan Park Connector

Date / Time of Damage	22.9.13 / 1050hrs
Location	Sin Ming Ave (Bishan Park Connector) near LP 4-7
Cause of Damage	Boring
Nature of Works	Soil Investigation
LCDW	Yes
Trial Hole Dug	No
NCE	No
Outage (Duration)	Network Stability Affected

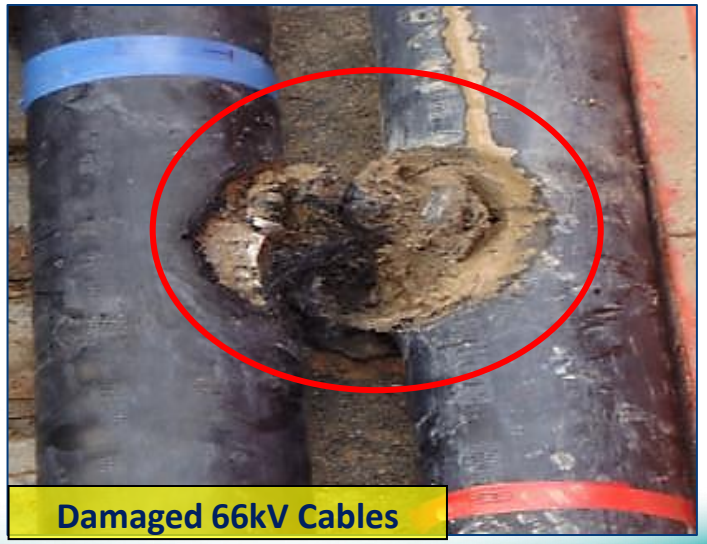
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Damaged Cable Location



Bored Hole Location before Damaged Cable Exposed





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Points to Note

LCDW had:

- ❖ Failed to indicate the presence of 66kV cable in LCDW drawing
- ❖ Failed to provide contractor with a proper LCDW drawing

Contractor had:

- Failed to submit NCE which is violation of Electricity Act
- Used hand auguring to test for presence / absence of cables as alternative to trial hole
- Assumed cable position without digging adequate and appropriate trial hole to establish 66kV cable position
- Failed to refer to SPPG cable plans and LCDW drawing to account for all known cables

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Group Discussion 3

Group Discussion 3

Case #2: 66kV Damage @ Bishan Park Connector

- **How can you ensure that LCDW detections are ok?**
- **LCDW did not show 66kV cable in his detection drawing & contractor did not submit NCE**
  - **Discuss the legal implications for both**
  - **If contractor wants to avoid cables so that there are no need to do earthworks in the vicinity of HV cables and so, do not need to submit NCE, how can this be done properly?**

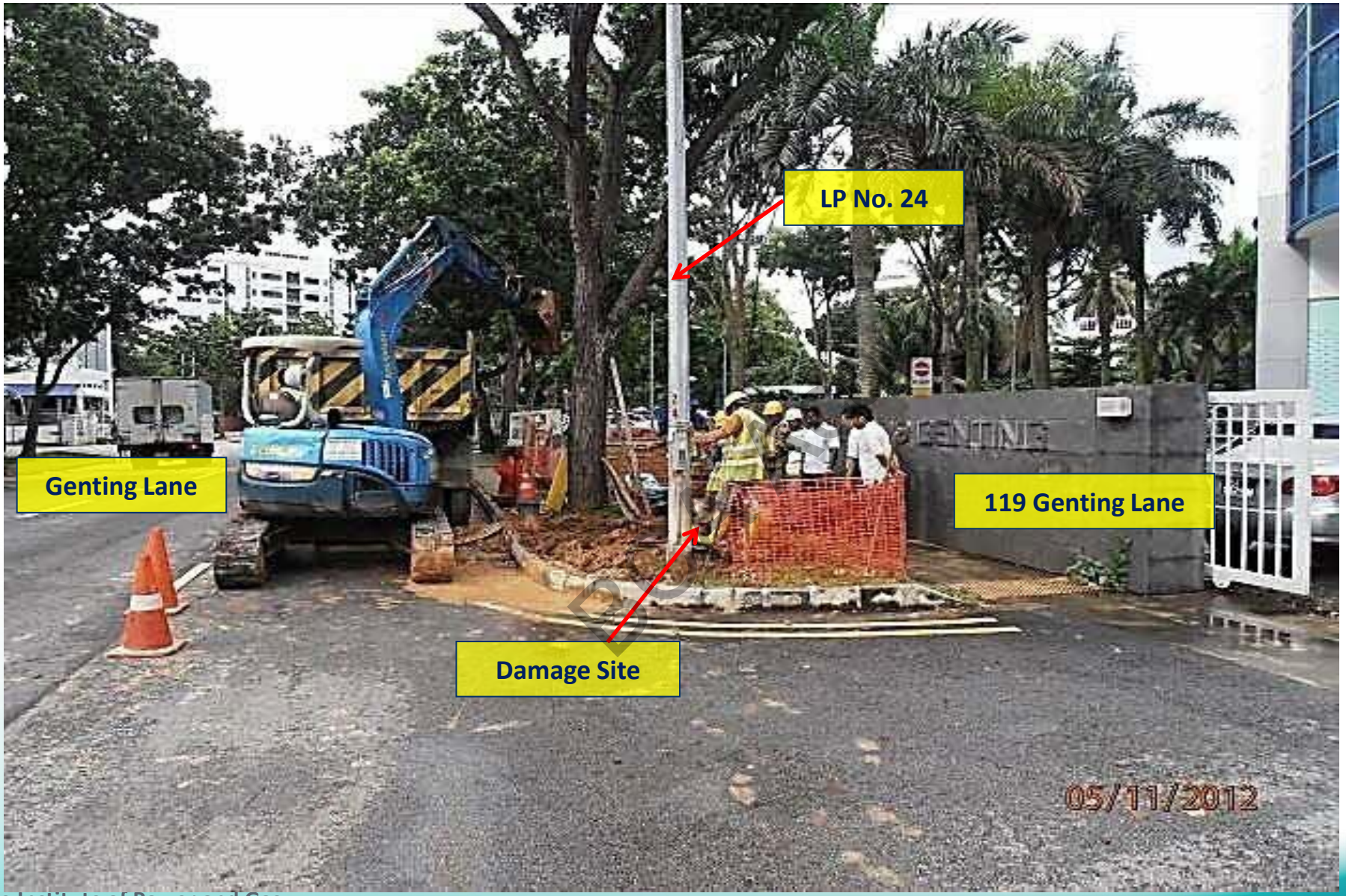
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Case #4 – 22kV Cable Damage at 119 Genting Lane

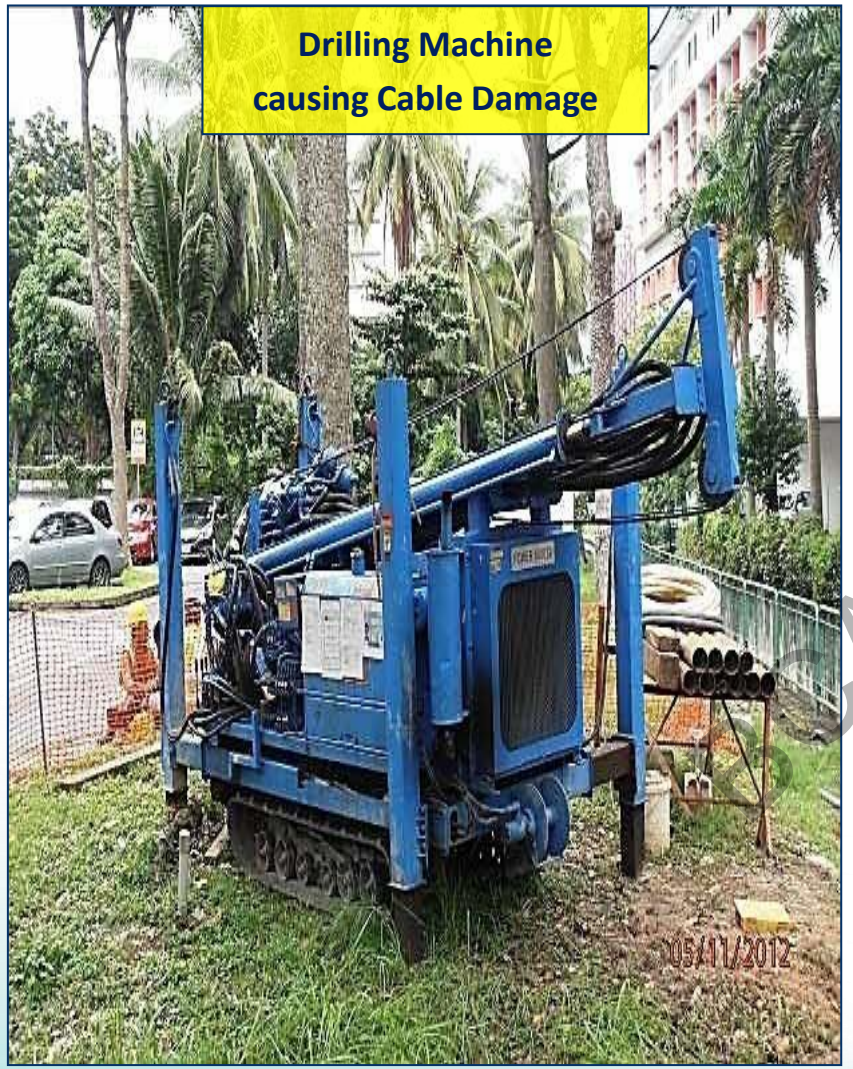
Date / Time of Damage	5.11.12 / 1555hrs
Location	Outside Entrance of 119 Genting Lane
Cause of Damage	Drilling
Nature of Works	Soil Investigation
LCDW	Yes
Trial Hole Dug	No
NCE	Yes
Outage (Duration)	Network Stability Affected

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Damaged Cable Location



Damaged Point





Points to Note

Contractor had:

- **Assumed cable positions directly at the LCDW markings**
  - **Cable marking not exact representation of position**
- **Failed to compare SPPG Cable Plan and LCDW Detection Drawing**
- **Used hand auguring as alternative to trial hole**
  - **Trial hole by manual means must establish the presence or absence of underground cables**

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Group Discussion 4

Group Discussion 4

Case #3 – 22kV Cable Damage at 119 Genting Lane

- When is hand augering usally done?
- What are your experience with hand augering?
- What are your views of the practice of using hand augering as substitute for trial holes?
- Under present SPPG requirements, how should hand augering be conducted?

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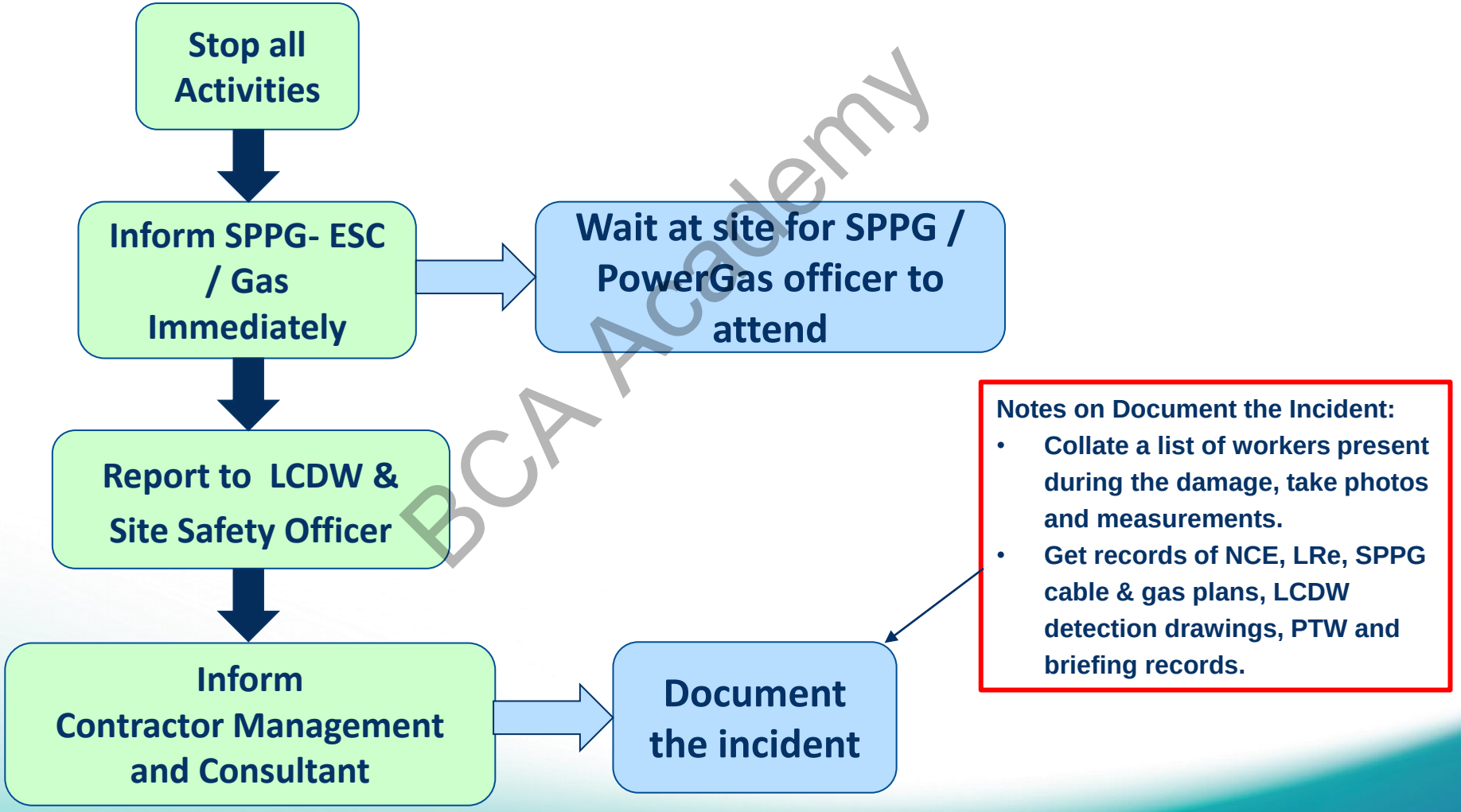
Chapter 4 (d)

Safe Work Procedures on Damage Prevention: When a Cable or Gas Pipe is damaged

BCA Academy

Implement Good Reporting System

When Damage Happens to Electricity Cables & Gas Pipes



BCA Academy

Implementing Good Reporting System

2. Pursuant to Section 80(4)(a) of the Act, you are required to comply with the following requirements when carrying out the Earthworks:

2.5. Seek Consultation with SPPG: ESP, Distribution Network ("DN"), Regional Network ("RN") and Extra High Voltage Network ("EHVN") sections

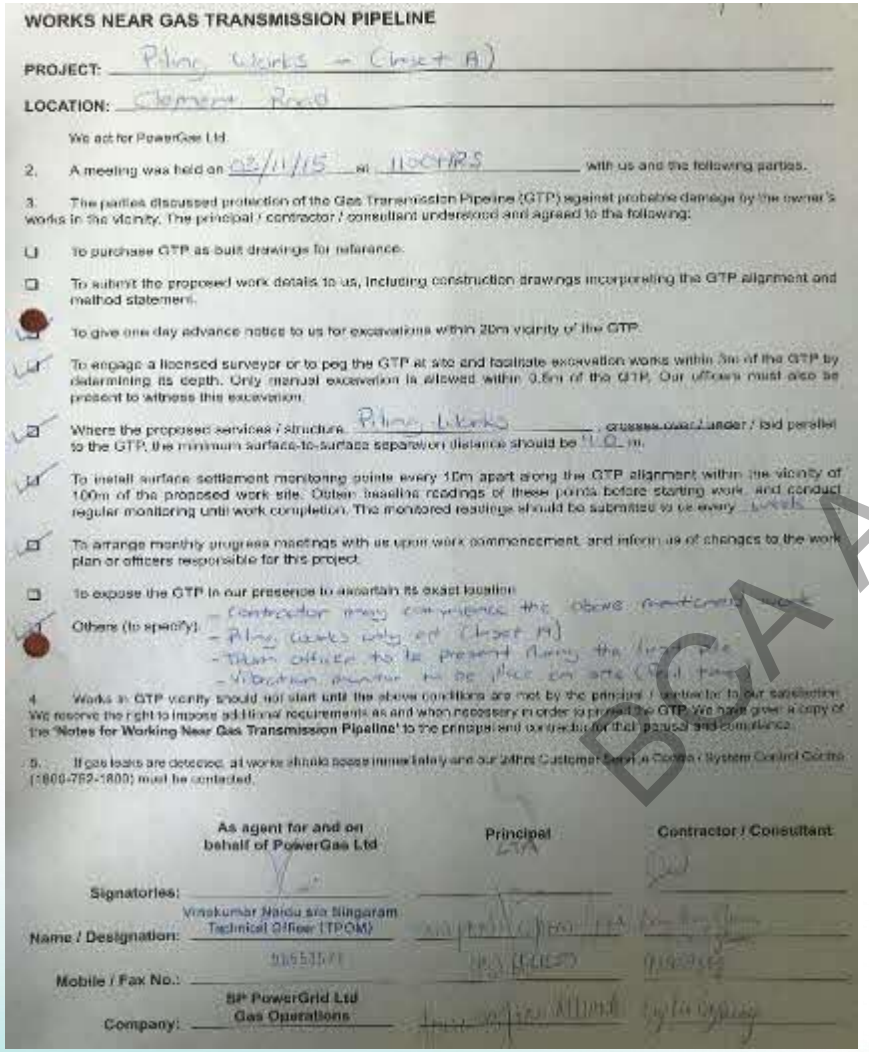
2.5.1. You shall contact and consult SPPG for approval to carry out any Earthworks when such Earthworks are within 3 metres of any Electricity Cable and / or when there is a need to work beyond the Electricity Cable slab.

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Be it Clearance, In Principal No Objection or No further Comments given by SPPG

Implement Good Reporting System

- Clearance from TPOM / DPOM



WORKS NEAR GAS TRANSMISSION PIPELINE

PROJECT: Piling Works - Cluster A)

LOCATION: Clementi Road

We act for PowerGas Ltd.

2. A meeting was held on 03/11/15 at 1100HRS with us and the following parties.

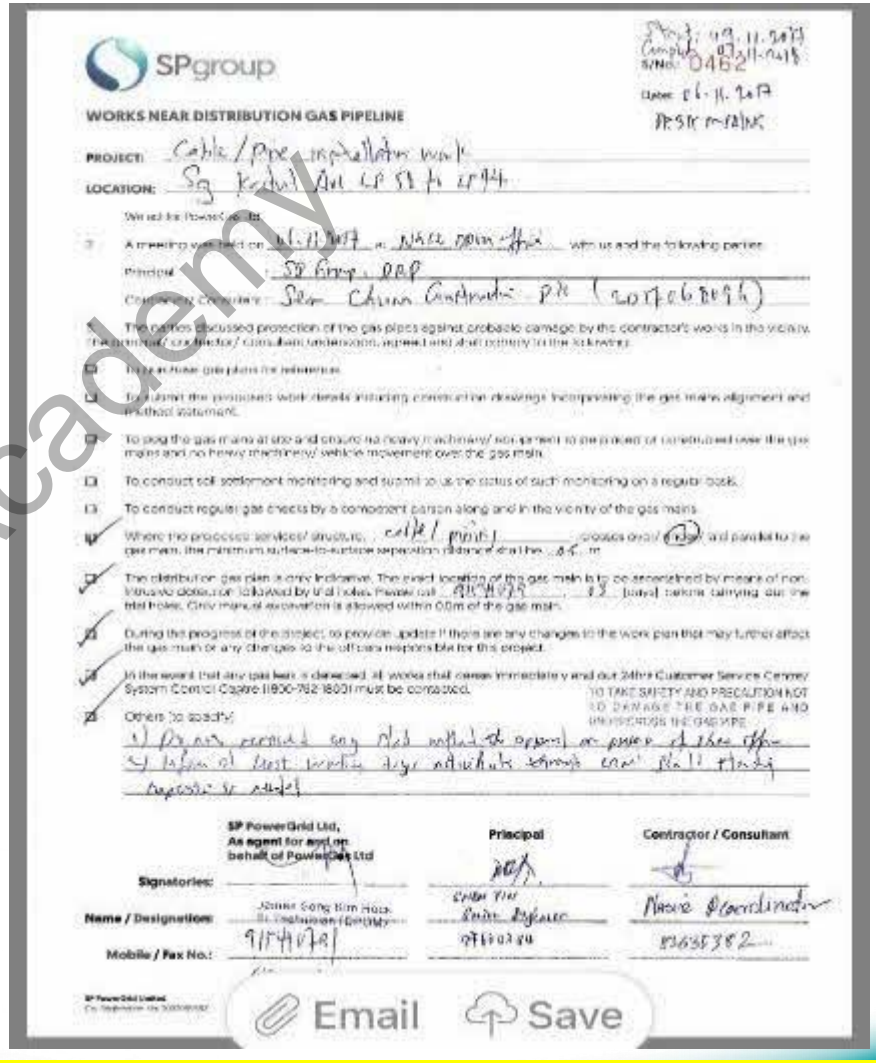
3. The parties discussed protection of the Gas Transmission Pipeline (GTP) against probable damage by the owner's works in the vicinity. The principal / contractor / consultant understood and agreed to the following:

- ☐ To purchase GTP as built drawings for reference.
- ☐ To submit the proposed work details to us, including construction drawings incorporating the GTP alignment and method statement.
- ☑ To give one day advance notice to us for excavations within 20m vicinity of the GTP.
- ☑ To engage a licensed surveyor or to peg the GTP at site and facilitate excavation works within 3m of the GTP by determining its depth. Only manual excavation is allowed within 0.5m of the GTP. Our officers must also be present to witness this excavation.
- ☑ Where the proposed services / structure, Piling Works, crosses over / under / laid parallel to the GTP, the minimum surface-to-surface separation distance should be 1.0 m.
- ☑ To install surface settlement monitoring points every 10m apart along the GTP alignment within the vicinity of 100m of the proposed work site. Obtain baseline readings of these points before starting work, and conduct regular monitoring until work completion. The monitored readings should be submitted to us every 1 week.
- ☐ To arrange monthly progress meetings with us upon work commencement, and inform us of changes to the work plan or officers responsible for this project.
- ☐ To expose the GTP in our presence to ascertain its exact location.
- ☑ Others (to specify):
  - Contractor may commence the above mentioned work
  - Piling Works only at Cluster A)
  - Them officer to be present during the trial pit
  - Vibration monitor to be place on site (2nd time)

4. Works in GTP vicinity should not start until the above conditions are met by the principal / contractor to our satisfaction. We reserve the right to impose additional requirements as and when necessary in order to protect the GTP. We have given a copy of the 'Notes for Working Near Gas Transmission Pipeline' to the principal and our onus for that passes and commences.

5. If gas leaks are detected, all works should cease immediately and our 24hrs Customer Service Centre / System Control Centre (1800-752-1800) must be contacted.

	As agent for and on behalf of PowerGas Ltd	Principal	Contractor / Consultant
Signatories:			
Name / Designation:	Vinakumar Naidu s/o Singaram Technical Officer (TPOM)		
Mobile / Fax No.:	93653571		
Company:	SP PowerGrid Ltd Gas Operations		



SPgroup

WORKS NEAR DISTRIBUTION GAS PIPELINE

PROJECT: Cable / Pipe installation work

LOCATION: Sg Kadut Rd CP 52 to CP 94

We act for PowerGas Ltd.

2. A meeting was held on 01.11.2017 at MAIN OFFICE with us and the following parties.

Principal: SP Group, DDP

Contractor / Consultant: Sim Chiam Construction Pte (Contractor)

3. The parties discussed protection of the gas pipes against probable damage by the contractor's works in the vicinity. The principal / contractor / consultant understood, agreed and shall comply to the following:

- ☐ To purchase GTP plans for reference.
- ☑ To submit the proposed work details including construction drawings incorporating the gas mains alignment and method statement.
- ☑ To peg the gas mains at site and ensure no heavy machinery was operated to the proximity of construction over the gas mains and no heavy machinery/ vehicle movement over the gas mains.
- ☐ To conduct soil settlement monitoring and submit to us the status of such monitoring on a regular basis.
- ☐ To conduct regular gas checks by a competent person along and in the vicinity of the gas mains.
- ☑ Where the proposed services/ structure, cable / piping crosses over / under and parallel to the gas main, the minimum surface-to-surface separation distance shall be 0.6 m.
- ☑ The distribution gas plan is only indicative. The exact location of the gas main is to be ascertained by means of non-intrusive detection and followed by trial holes. Please call 9838 1979 [24hr] before carrying out the trial holes. Only manual excavation is allowed within 0.6m of the gas main.
- ☑ During the progress of the project, as provider, update if there are any changes to the work plan that may further affect the gas main or any other gas in the vicinity that we are responsible for this project.
- ☑ In the event that any gas leak is detected, all works shall cease immediately and our 24hrs Customer Service Centre / System Control Centre (1800-752-1800) must be contacted.
- ☑ Others (to specify):
  1) Please provide any Rd cutting permit prior to the work
  2) Inform at least working days advance before any Rd cutting activities is required

TO TAKE SAFETY AND PRECAUTION NOT TO DAMAGE THE GAS PIPE AND UNDERGROUND CABLES

	SP PowerGrid Ltd, As agent for and on behalf of PowerGas Ltd	Principal	Contractor / Consultant
Signatories:			
Name / Designation:	James Song Bin Hock Sr Technician (TPOM)	Colin Tan Senior Engineer	Manic Coordinator
Mobile / Fax No.:	91744178	97603240	83635382

Email Save

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Clearance is required for all trial holes and standing supervision is needed for trial holes on MP and GTP pipes

Implementing Good Reporting System

- Submitting work proposal to SPPG Cable Sections

RE: NCE No. 2 xxxxx CLEMENTI ROAD LP 183 TO LP191,CLEMENTI CRESCENT NEAR LP 1 TO P 1/1 & LP 17 TO LP 18) - crossing 230kv cables vicinity.

Reply | Reply All | Forward | ...

Mon 14/9/2020 9:37 AM

SPPG Officer reply

Hi Kumar,

According to your recent submission, in principle ESP has no further comment for your above-mentioned works. You propose to do overcrossing of SPPG cables (600mm).

Please proceed with caution and comply with SPPG Letter of Requirements (LRe) while working within/near our cable corridors.

Please inform ESP if there are any changes to your propose works and follow according to the method of statement given.

Do kindly submit a photo report of the final work, to ensure all requirements is as per proposed.

If your contractor saw a cable joint Slab during the SI work, please stop and inform ESP officer.

Do print out this approval and place it on site.

ESP - LCK team kindly take note.

Thank you.

Abdul Rashid
ESP

In Principle No further Comment

SPPG Officer Name and Contact number

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ESP or other Cable Section giving the "In Principle No further Comment" to the work proposal

Action to take & Safety Measure

When Cable is Damaged :

- ✓ Immediately **STOP** all earthworks
- ✓ **Keep out** all personnel from the work site
- ✓ Treat each cable as **'LIVE'**
- ✓ **Cordon-off** the worksite
- ✓ Inform **ESC, LCDW, Site Safety Officer, Management & Consultant** immediately
- ✓ If there are **injuries**, perform **first-aid** and alert the authorities for assistance (e.g. SCDF 995)
- ✓ **Tampering** with damaged underground **electricity cables** can cause **injuries or fatalities**
- ✓ **Remain on-site** to assist SPPG officers on their arrival

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Things that should not be done

When Cable is Damaged DO NOT:

- **Continue with earthworks**
- **Touch the cable**
- **Remove any cable ID slab/marker**
- **Attempt to cover-up the incident**
- **Attempt to repair or modify damaged cable**
- **Leave the worksite**

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Action to take & Safety Measure

When Gas Pipe is Damaged :

- ✓ Immediately **STOP** all earthworks
- ✓ **Keep out** all personnel from the work site
- ✓ **Cordon-off** the worksite
- ✓ Call Customer Service Centre (CSC) : 1800-7521800
- ✓ If there are **injuries**, perform **first-aid** and alert the authorities for assistance (e.g. SCDF 995)
- ✓ **Tampering** with damaged underground **gas pipe** can cause **injuries or fatalities**
- ✓ **Remain on-site** to assist SPPG officers on their arrival

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Things that should not be done

When Gas Pipe is Damaged DO NOT:

- Use naked flame to detect gas leak
- Use cell phone in the vicinity
- Turn on/off switches or appliances
- Burn incense near gas pipe
- Remove any ID Marker / Slab
- Not attempt to repair

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Short Exercise - Before Starting Earthworks

- You are now at a brand new site. What are the first steps to take to prepare for the project?
  - What utilities are inside the ground?
    - Cables, gas pipes, water pipes, sewers & sewerage, telco cables, etc
  - What should you do first?
  - As RES, you have a direct role for SPPG?
    - Cables
      - LV, HV
    - Gas Pipes
      - LP. MP, GTP

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5 Steps for LV Cables

The Law

Electricity Act – Section 79(1) Before doing Earthworks for LV cables

- Section 79(1)

  Cable detection by LCDW

Steps to comply with the Law

5 Steps to follow to Commence Earthworks

1. Get cable plans (e-submission)
2. Engage LCDW
3. Cable detection works
4. Cable detection drawing
5. Earthworks can start

8 Steps for HV Cables

The Law

Electricity Act – Section 80(1) Before doing Earthworks for HV cables

- Section 80(1)

  a. Notification of earthworks (NCE)

  b. Get cable plan + consult SPPG

  c. Cable detection by LCDW

Steps to comply with the Law

8 Steps to follow to Commence Earthworks

1. Get cable plans (e-submission)
2. Engage LCDW
3. Cable detection works
4. Cable detection drawing
5. Submit NCE (e-submission)
6. Site meeting with ESP
7. ESP issues LRe
8. Earthworks can start

7 Steps (GTP) & 5 Steps (MP & LP) Gas Pipes

The Law

Gas Act - before doing Earthworks for Gas Pipes

- Section 32(1) Gas Pipes

  a. Notification of earthworks (NCE)

  b. Get gas plan information

  c. Consult SPPG

Steps to comply with the Law

Steps to Follow to Commence Earthworks

1. Get gas plans (e-submission)
2. Engage registered surveyor (GTP only)
3. Surveyor peg out GTP position

   For GTP only
4. Submit NCE (e-submission)
5. Site meeting with ESP (MP & GTP)
6. ESP issues LRe (All gas pipes)
7. Earthworks can start

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Chapter 5 (a)

SPPG Requirements for Earthworks: The Earthworks Notification Process

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NEW SP CONTRACTOR PORTAL

****ANNOUNCEMENT: NEW SP CONTRACTOR PORTAL**
& CLOSURE OF MEA COUNTER OPERATIONS

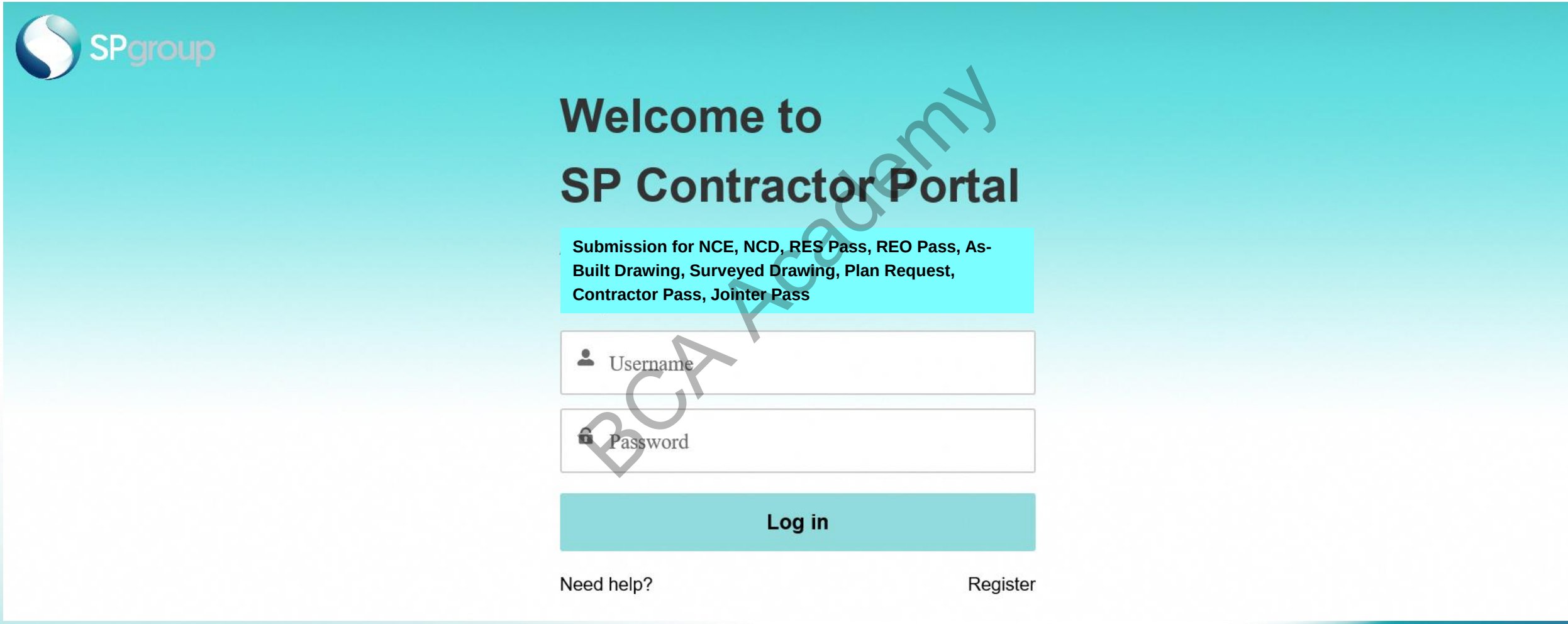
Effective from 1st April 2019, SPPG has launched a new SP Contractor Portal for NCE, NCD, REO, RES, As Built, Surveyed Drawing, Plan Request, Contractor and Jointer Pass applications. With the launch of the new portal, our counter services at 25 Pasir Panjang Road — Pasir Panjang Depot Office, Singapore 117536, will cease operating from 1st July 2019.

For enquires on NCE/REO/RES applications, please call +65 6916 5021.
For enquires on plan request submissions, please call +65 6916 5022.

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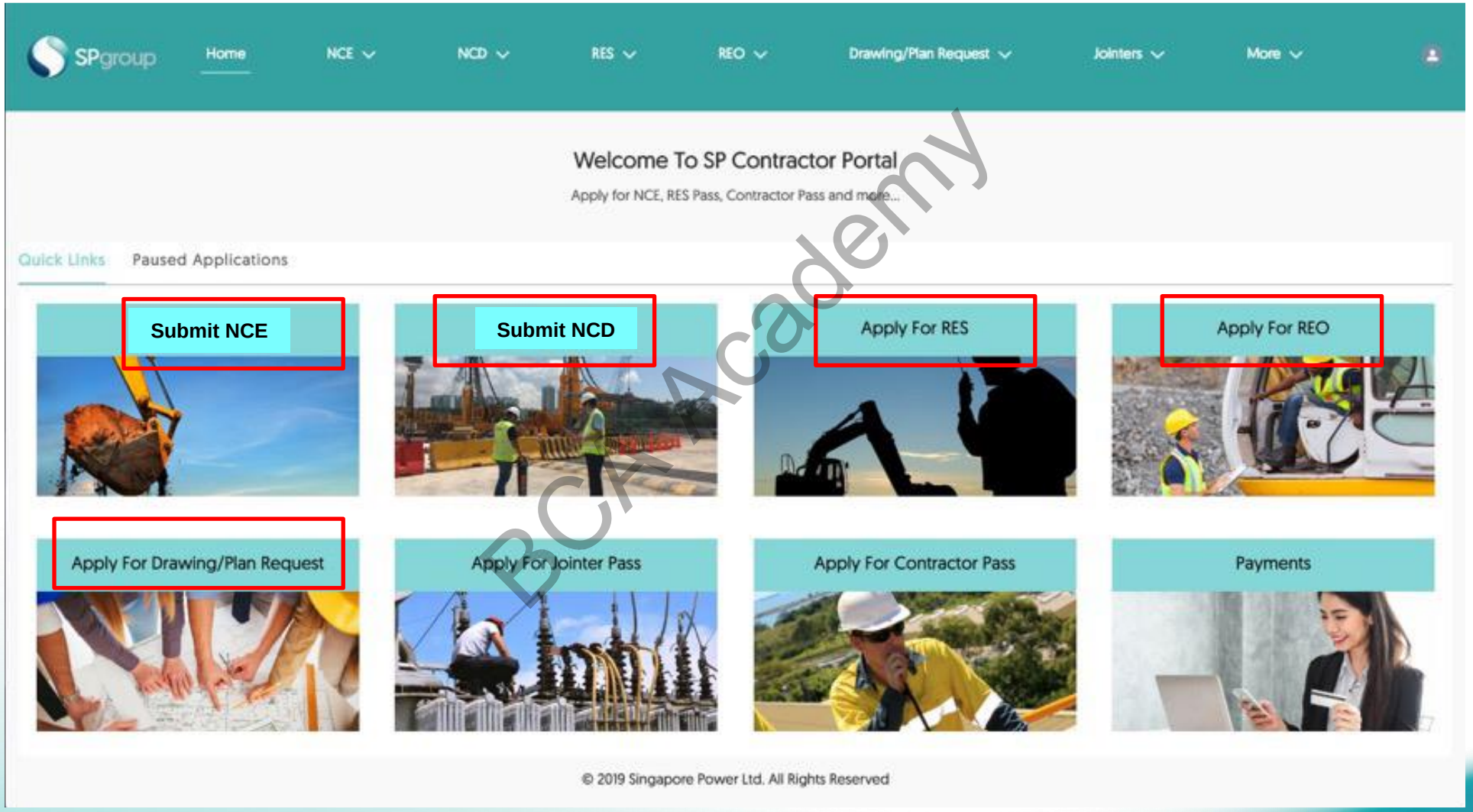
Registration of NCE via SP Contractor Portal

https://contractorportal.spgroup.com.sg



BCA Academy

Submission for NCE, RES, REO, Drawing/Plan Request, etc. via SP Contractor Portal



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Information & Resources of Earthworks on SP Website

Log into the SPPG Homepage :

www.spgroup.com.sg/home



FAQs For Earthworks



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https://ifaqs.flexanswer.com/CFP/Pages/SP/explorefaq.aspx

Other Resources

Resources

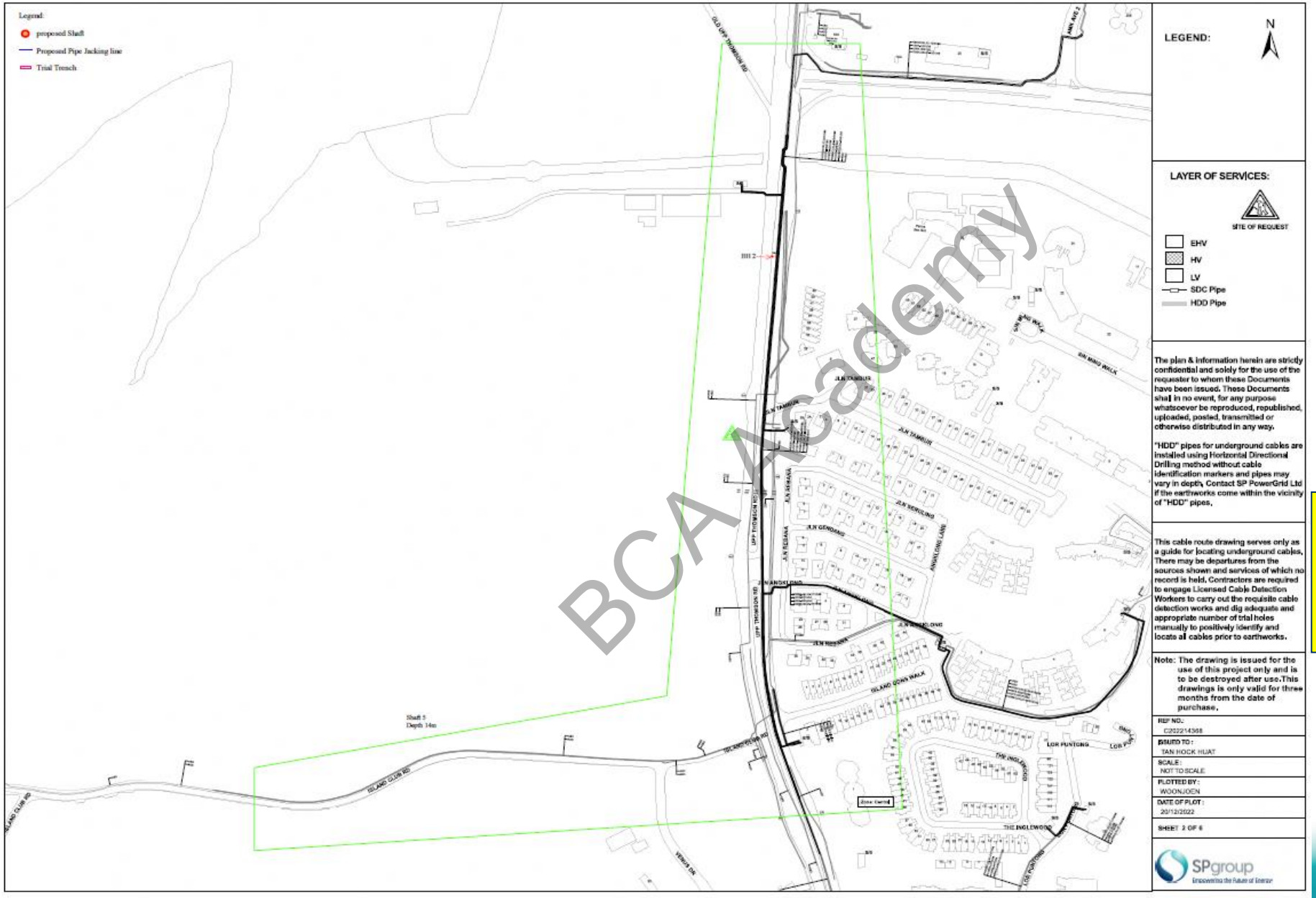
Earthworks

Type something to search

INFO	FAQs eBusiness Portal
INFO	Letter of Requirements for Cable
INFO	Letter of Requirements for Gas (Gas Transmission Pipeline and Medium Pressure Pipeline)
INFO	Letter of Requirements for Gas (Low Pressure)

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Get Cable Plans

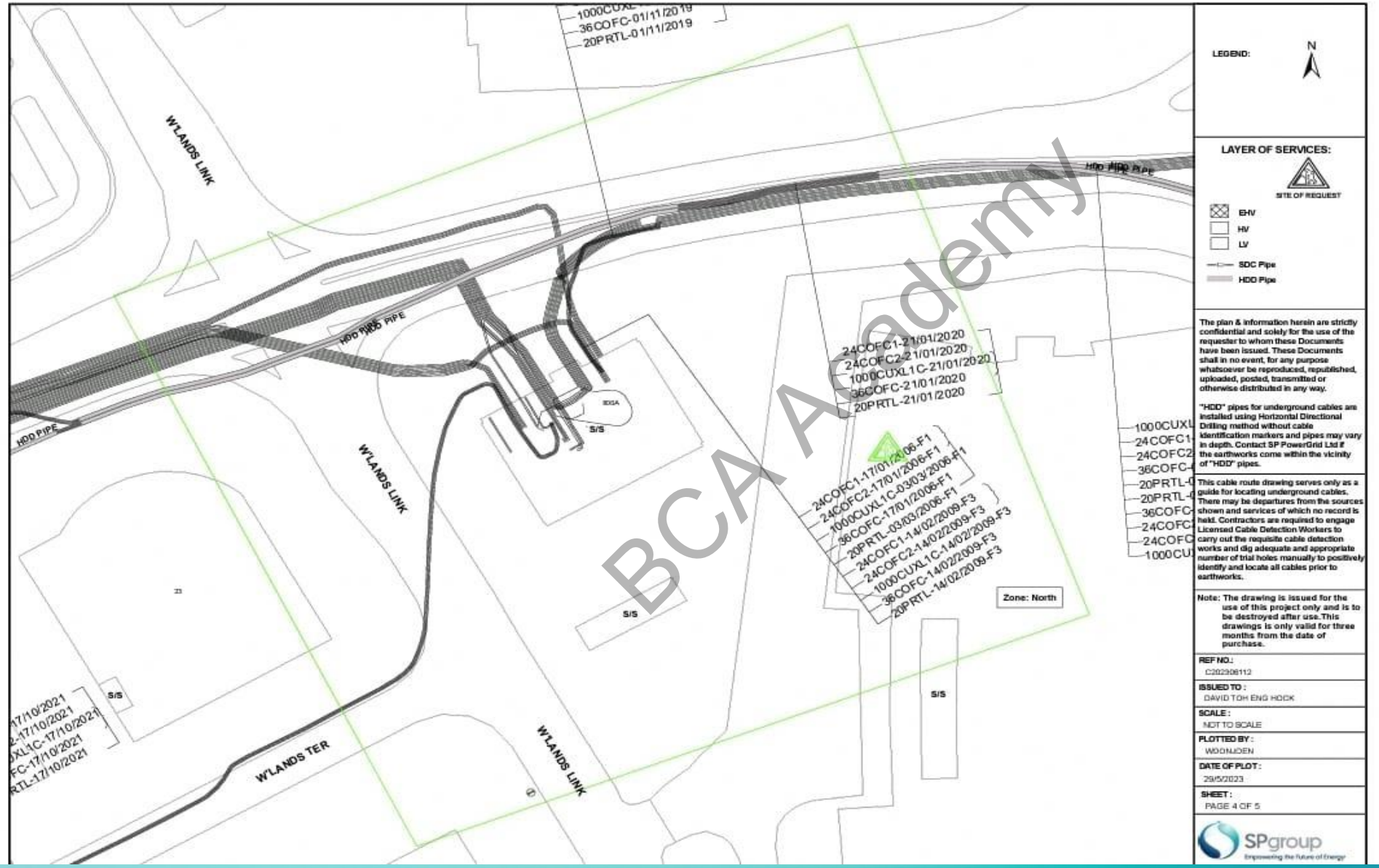


All SPPG Cable plans are

indicative only

Valid for 3 months

Get Cable Plans



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All SPPG Cable plans are

indicative only

Valid for 3 months

Engage LCDW

Engage LCDW to carry out the following tasks:

- **Cable detection work to ascertain presence or absence of cables**
- **Provide LCDW cable detection drawing**
- **Pegs & marks cable positions at site**

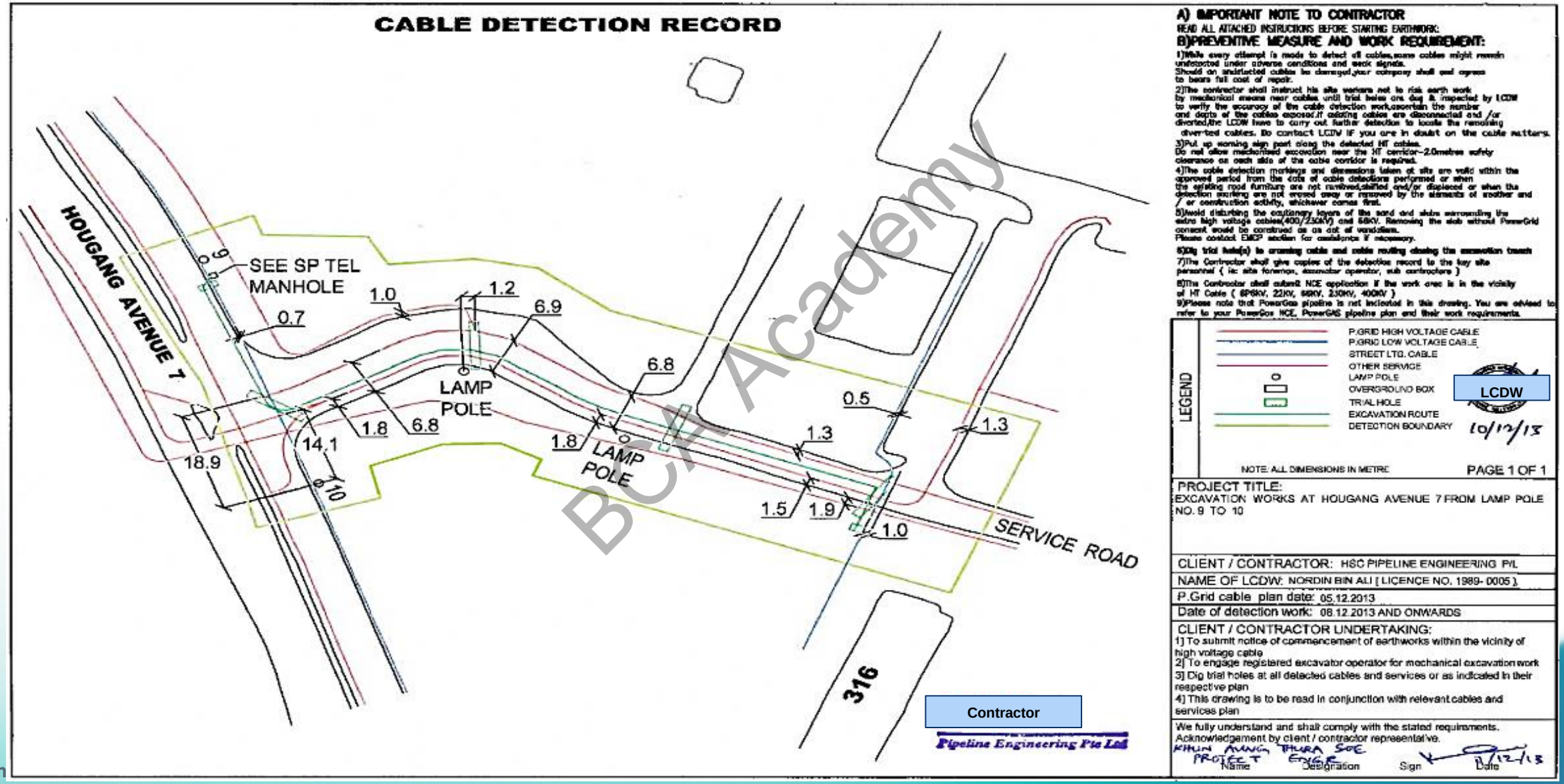
(RES to ensure all cable positions are pegged at all times)

- **Thorough briefings on cables position to all site staffs**



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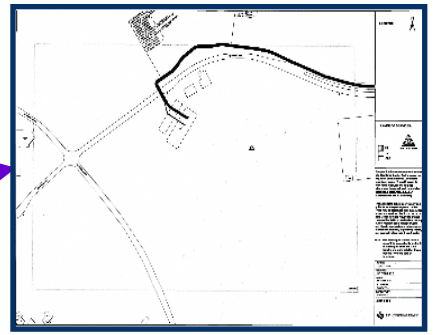
LCDW Cable Detection Drawing

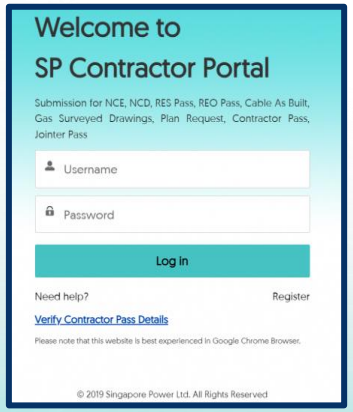


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Before Commencement

All SPPG Cable/ Gas plans
are indicative only
Validity is 3 months



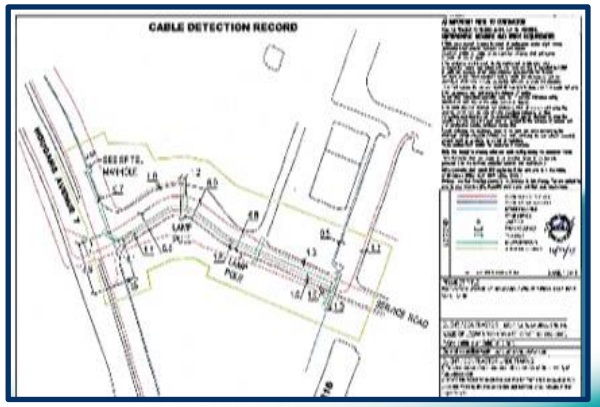


Submit Cable/Gas Plan Request form via e-submission

Engage LCDW



LCDW Cable Detection Drawing



Engage LCDW to carry out the following tasks:

- Cable detection work to ascertain presence or absence of cables
- Provide LCDW cable detection drawing
- Pegs & marks cable / gas pipe positions at site
- Thorough briefings on cables/gas pipes position to all site staffs

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NCE Application Process

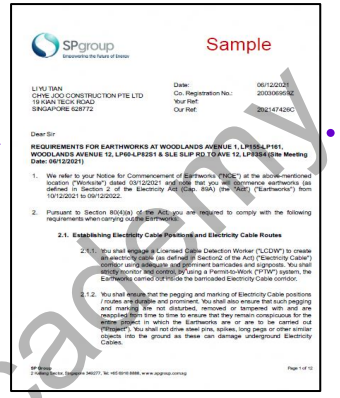
-Notice for Commencement of Earthworks (NCE)

Check NCE





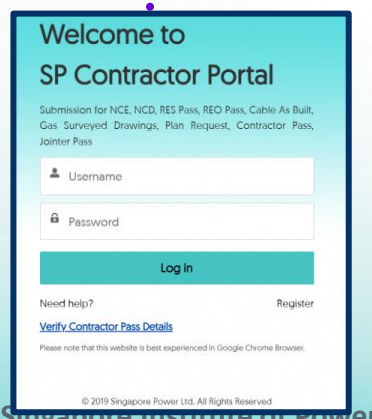
Site Meeting



LRe send online



Site re-visit



NCE submission via E-Submission



Till Job completed

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Chapter 5 (b)

SPPG Requirements for Earthworks: Understanding the Letter of Requirements

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SPPG's Letters of Requirements

- Letters of Requirements (LRe) are issued in response to NCEs submitted by earthworks contractors.
- LRe contains 'reasonable requirements' by ESP to help earthworks contractors avoid damage to cables and gas pipes during earthworks.
- Requirements in the LRe are enforceable under Section 80(4)(a) of the Electricity Act and Section 32(3)(a) of the Gas Act.
- Persons carrying out earthworks who fail to comply are liable to be prosecuted and fined up to $100K or imprisoned up to 5 years or both.
- RES may be given demerit points for non-compliance with LRe during earthworks.

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LRe for Cables & Gas Pipes

- LRe are issued for earthworks in the vicinity of:
  - High Voltage (HV) cables
  - Low Pressure (LP) gas pipe
  - Medium Pressure (MP) / Gas Transmission Pipelines (GTP)

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Areas of Coverage in LRe for HV Cables

1. Establishing electricity cable position and electricity cable route
2. Risk management
3. Worksite management
4. Trial holes
5. Seek consultation with SPPG
6. Protection of electricity cables and electricity cable diversions
7. NCE submission by sub-contractors and NCE extension
8. Powered mechanical excavation works
9. Vertical and horizontal drilling / prevention works
10. Pressure grouting works
11. PTW and Records

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Areas Covered in LRe for LP, MP & GTP Gas Pipes

1. Trial holes
2. Marking of gas pipes, engagement of surveyors and purchase of surveyed drawings
3. Risk management (MP & GTP)
4. Worksite management
5. Seek consultation with SPPG: Gas operations (DPOM and TPOM)
6. Protection of gas pipe and gas pipe diversion
7. NCE submission by sub-contractor(s), NCE extension & site meeting
8. Powered mechanical excavation
9. Pressure grouting works
10. PTW and Records

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Requirements explained

Establishing Cable Positions and Routes (2.1)

a) Engage LCDW



- To create cable corridors using adequate barricades/signposts
  - Work inside the cable corridor must be monitored and controlled using a PTW system
  - PTW to be approved by the site Project Manager or his authorised deputy

b) Pegging and marking of cable positions/routes by LCDW must be durable and prominent

- Ensure that cable position/route markings are not disturbed, removed or tampered
- Markings to be re-applied from time to time to ensure that they remain prominent for the entire duration of the earthwork activities
- Do not use steel pins, spikes, long pegs as it could damage underground cables

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Requirements explained

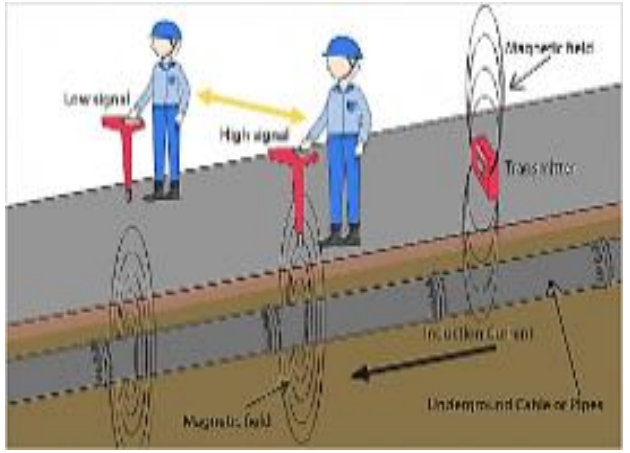
Establishing Cable Positions and Routes (2.1)

c) Cable positions markings must be clearly indicated at all times

- Engage the LCDW to reconfirm cable positions before reapplying missing or faded pegs and surface markers

d) Re-engage LCDW to carry out re-detection and update cable detection drawings & brief all site personals after

- Any cable diversion
- Decommissioning of substations
- Newly commissioned substations
- Cable termination works
  - Included not able to locate LCDW detected cable



e) Ensure pegs are installed at an interval no longer than 3m

- Markings to indicate voltage levels (HV, LV) and approximate depth

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Requirements explained

Risk Management (2.2) – Introductory Explanation

- Risk Assessment (RA) is mandatory under WSH Act and must be done prior to carrying out any work.
- Its purpose is to identify hazards that could cause injuries or harm to workers, damage to properties and other consequences, such as environmental impacts.
- The requirements, processes and methodologies for conducting RA is given under the WSH (RM) Regulations and RMCP.
- SPPG requires that earthworks contractors shall include earthworks that could lead to to cables and gas pipes damage into RA so that appropriate control measures are taken to prevent damage.
- ESP will ask to see the RA for earthworks activities at the worksites to evaluate if adequate control measures are taken.

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Requirements explained

Risk Management (2.2)

- Conduct RA for all intended earthworks.
- RA shall identify the control measures to be taken to prevent damage to cables and gas pipes.
- Changes to work schedules and earthworks methods must be reviewed in the RA and appropriate control measures must be added to prevent damage.
- Inform SPPG of the changes and any impact in writing.
- RA should be made available to SPPG when requested.
- The RA must be briefed to all workers to take the necessary control measures as stated.

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Inventory of Work Activities

Improvement Works To Surface Car Parks (Batch 71)		
No.	**Process/Location**	**Work Activities**
1	Excavation works	Worker may hit by excavator
		Damages to service
		Machinery or equipment falling into excavation
		Removal of excavated material & vehicular movement may pose danger at blind spot.
		Person falling into excavation
		Person injured by protruding items in excavation
		Collapse of excavation after adverse weather
		Flooding in excavation area after adverse weather
		Gassing, fire & explosion
		Collapse of sides of excavation
2	Stockpile	Soil erosion
3	Disposal / backfilling	Person(s) hit by excavator

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Requirements explained

Site Management (2.3)

a) Provide **full-time Registered Earthworks Supervisor (RES)** to monitor and supervise site **earthworks activities** for the entire duration

- Instruct workers to take appropriate measures to prevent cable damage

b) Conduct **daily site briefings** to remind workers about the location of cables

- Brief workers in languages or other means understood to all
- Every new staff must be briefed before starting work
- Keep records of briefings and the attendance list

c) **Notify ESP** officer of:



- Change of site management/LCDW/RES/REO
- Changes in methods of Earthworks
- Shifting or offset of planned earthworks positions

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Requirements explained

Trial Holes (2.4)

a)Dig adequate number of appropriate trial holes by manual means

b)For trial holes within 3m of transmission (66kV / 230kV / 400kV) cables

- Contact **ESP officer**
- Give at least 3 days' advance notice





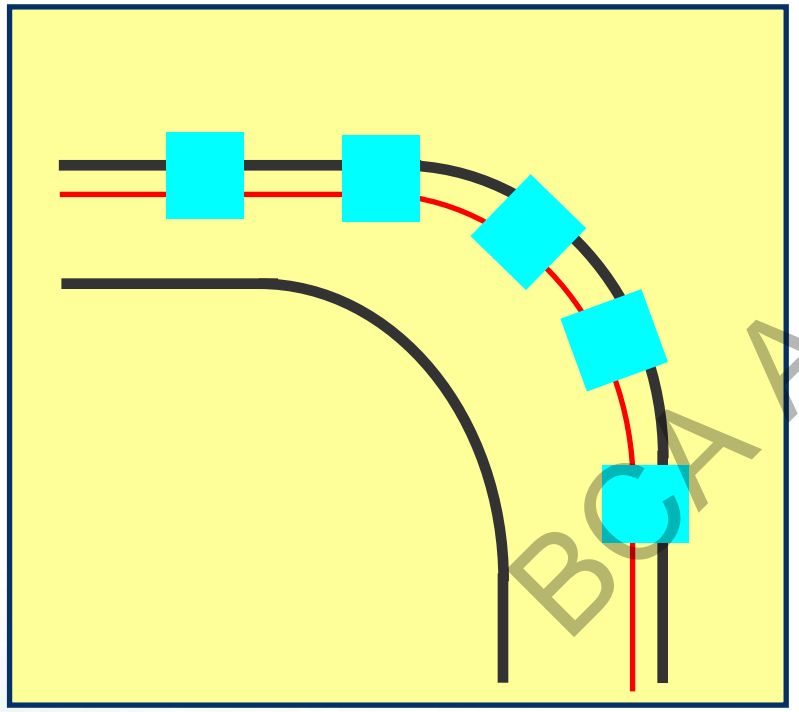
Trial Hole by Manual Excavation with Due Care and Progress Scanning by LCDW

ESP Academy

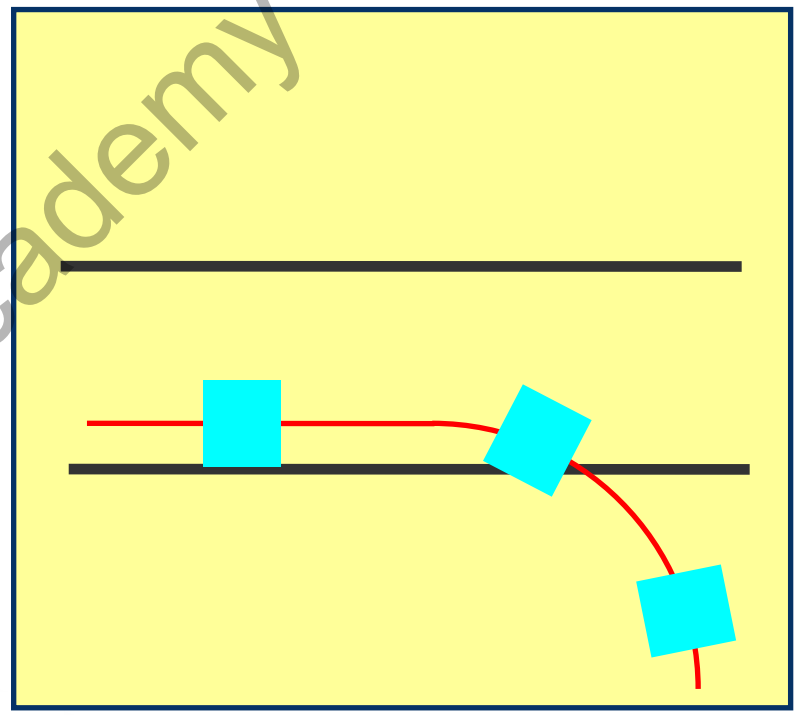
Trial Hole to ascertain Presence or Absence of Underground Cable/ Gas Pipe

Trial Holes

- **Change of Cable direction**



At road bends



Where cable turns

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Trial Holes

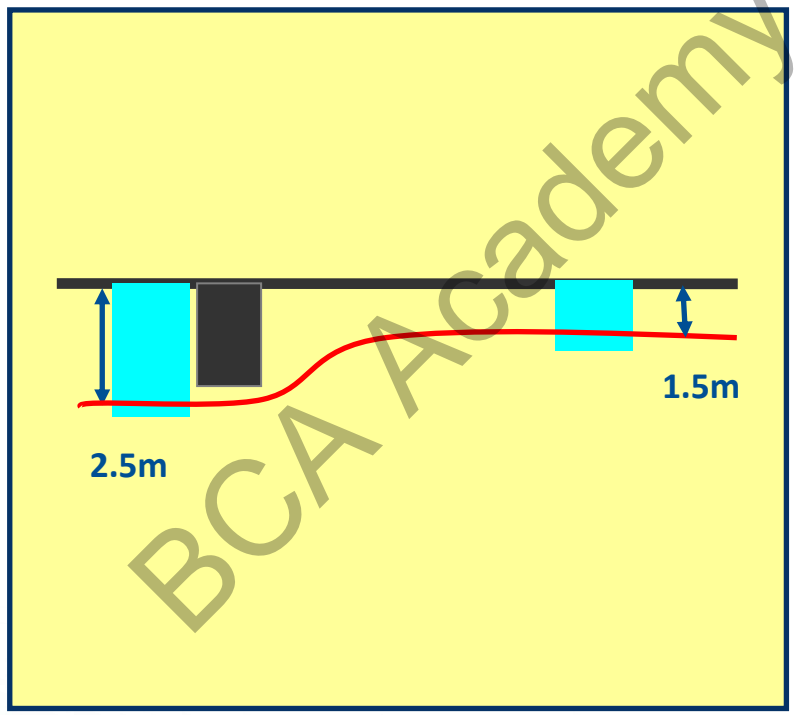
- **Dig more trial holes especially at bends**



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Trial Holes

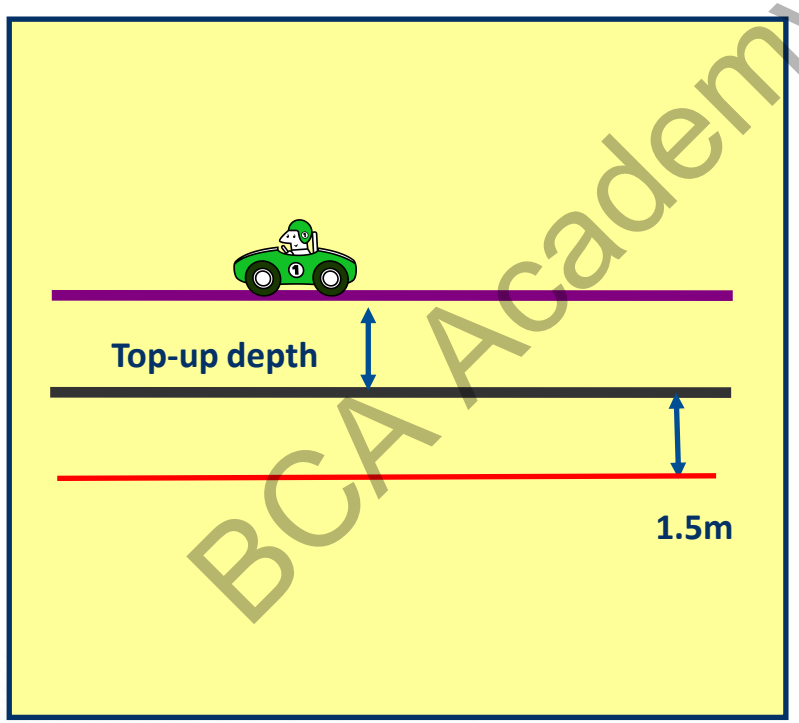
- **Cable depth are indicative**



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Trial Holes

- **Reclaimed / Top-up Land**



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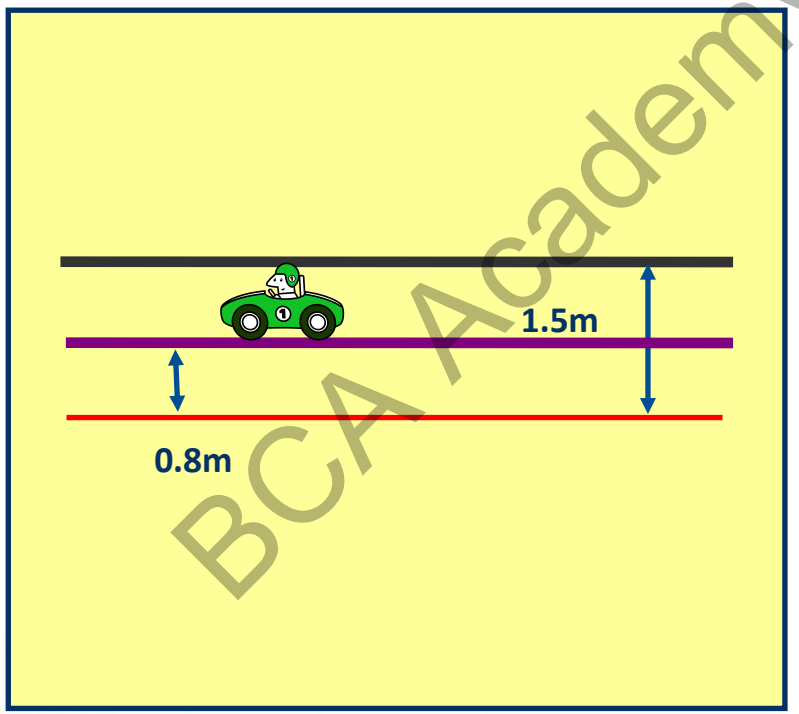
New Ground Level

Initial Ground Level

Cable

Trial Holes

- **Trimmed Surface**



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Initial Ground Level

New Ground Level

Cable

Requirements explained

Trial Holes (2.4)

c) No excavation beyond the cable slabs without consulting SPPG

d) Do not use hand augering as an alternative method for trial hole

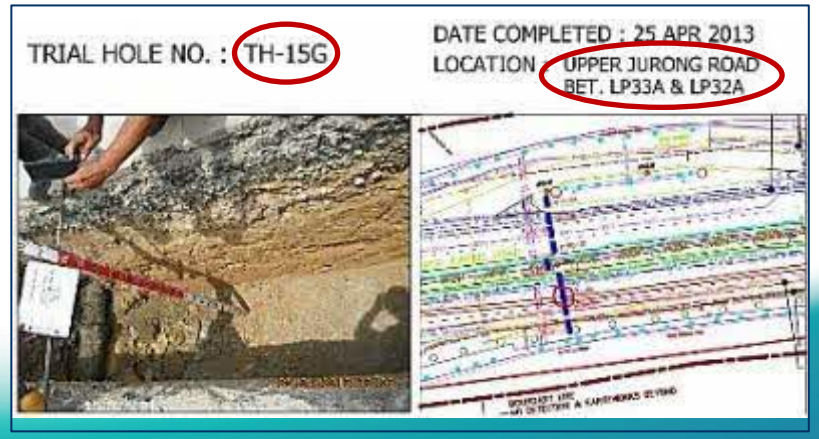
- Hand augering is classified as vertical drilling - SS 576 : 2012

e) For vertical drilling works, carry out a trial hole at the actual position of each drilling point

f) Trial hole photos must have dimensions, location, depth, date and time

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Requirements explained

Seek Consultation with SPPG: ESP, Distribution Network ("DN"), Regional Network ("RN") & Extra High Voltage Network ("EHVN") – (2.5)

Consult ESP and DN or RN or EHVN Section when

Proposed earthworks within 3 metres of any electricity cable(s)

- ❑ **Provide method statement with measures to protect cables for 66kV / 230kV / 400kV cables**

- ➢ **Before under-crossing or over-crossing of Transmission cables**
- ➢ **Deep excavations which may result in ground settlement**
- ➢ **If temporary/permanent structure is proposed on top of cables**



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Requirements explained

Seek Consultation with SPPG: ESP, Distribution Network ("DN"), Regional Network ("RN") & Extra High Voltage Network ("EHVN") – (2.5)

- Cables and accessories shall be **accessible** to SPPG officers and vehicles
  - Ensure that no temporary or permanent structure over the cables

- Contact the **ESP Officer** for advice on **working close** to 22kV / 6.6kV / LV
  - Do not shift, dent or break any of our existing utility PVC pipes

- Contact the **ESP Officer** when any **foreign object** (woods, rocks etc.) **obstructs** your earthworks in the vicinity if SP PowerAssets' cables

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Requirements explained

Protection of Cables, Gas Pipes and Diversion (2.6)

a) Do not excavate beyond cable slab level, unless with concurrence and in the presence of SPPG Officer.

b) Provide protective steel plates over cable positions where

- Mechanical excavator/ heavy vehicles/ equipment are likely to traverse or parked on top (to distribute and reduce impact and weight from heavy vehicles or equipment)

c) Ensure proper and adequate shoring and shuttering to prevent possible soil movement and damage to electricity cables

- Obtain method statement with a PE endorsement (if necessary)

d) Reduction of ground surface at cable position should be made with written request to SPPG. SPPG could require the affected cable to be diverted to maintain its initial depth. Contractor shall bear the costs of diversion.

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Requirements explained

Protection of Cables, Gas Pipes and Diversion (2.6)

e) Suspend exposed high voltage cables with concurrence from SPPG

- Suspension to be properly designed and PE endorsement (if necessary)
- Exposed cables to be protected with gunny sacks/half gutter PVC pipes
- No suspension of Cable Joint is permitted

f) Take precautions for hot works near exposed electricity cables

- Heat/Sparks/Naked flames could damage cable sheaths

g) The minimum clearance between the external wall of LP Gas Pipe and Piles / Diaphragm Wall is 5m

e) The minimum clearance between the external wall of LP Gas Pipe and other services is 0.3m

f) The minimum clearance for Pipe Jacking from cables and gas pipes is 2m

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Requirements explained

Protection of Cables, Gas Pipes and Diversion (2.6)

j) Operation of Electricity cables should not be hindered

- If proposed earthworks likely to cause hindrance
  - Divert electricity cables
  - Re-design earthworks location to avoid cable

k) Remove rocks/boulders/obstacles found in a trench with due care and diligence

l) Stop work and report to ESC / CSC for damage or suspected damage to any electricity cable(s) or gas pipe(s)

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Requirements explained

NCE Submission & Site Meeting (2.7)

a) Attend meeting as and when required

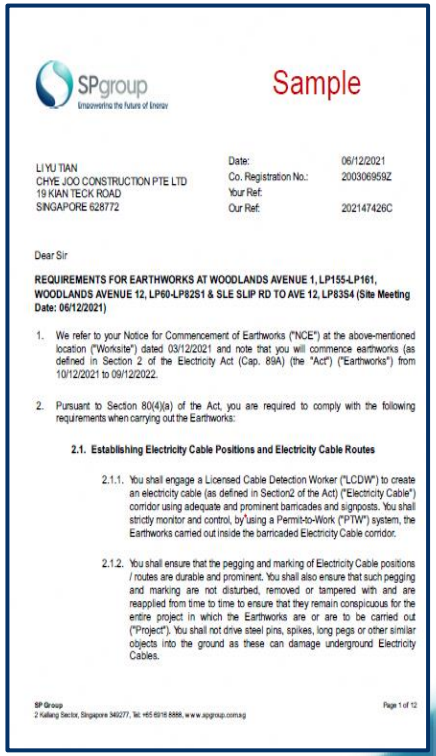
b) Ensure sub-contractors engage LCDW and submit NCE prior to earthwork

c) Apply for new NCE when existing NCE is going to expire **(no NCE extension is allowed)**

d) Daily site briefing records shall have date, time, venue, person conducting, signatures of attendees and contents discussed

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Sample

LI YU TIAN
CHYE JOO CONSTRUCTION PTE LTD
19 KIAN TECK ROAD
SINGAPORE 628772

Date: 06/12/2021
Co. Registration No.: 200306959Z
Your Ref:
Our Ref: 202147426C

Dear Sir

REQUIREMENTS FOR EARTHWORKS AT WOODLANDS AVENUE 1, LP155-LP161, WOODLANDS AVENUE 12, LP60-LP82S1 & SLE SLIP RD TO AVE 12, LP83S4 (Site Meeting Date: 06/12/2021)

1. We refer to your Notice for Commencement of Earthworks ("NCE") at the above-mentioned location ("Worksite") dated 03/12/2021 and note that you will commence earthworks (as defined in Section 2 of the Electricity Act (Cap. 89A) (the "Act") ("Earthworks") from 10/12/2021 to 09/12/2022.

2. Pursuant to Section 80(4)(a) of the Act, you are required to comply with the following requirements when carrying out the Earthworks:

2.1. Establishing Electricity Cable Positions and Electricity Cable Routes

2.1.1. You shall engage a Licensed Cable Detection Worker ("LCDW") to create an electricity cable (as defined in Section2 of the Act) ("Electricity Cable") corridor using adequate and prominent barricades and signposts. You shall strictly monitor and control, by using a Permit-to-Work ("PTW") system, the Earthworks carried out inside the barricaded Electricity Cable corridor.

2.1.2. You shall ensure that the pegging and marking of Electricity Cable positions / routes are durable and prominent. You shall also ensure that such pegging and marking are not disturbed, removed or tampered with and are reapplied from time to time to ensure that they remain conspicuous for the entire project in which the Earthworks are or are to be carried out ("Project"). You shall not drive steel pins, spikes, long pegs or other similar objects into the ground as these can damage underground Electricity Cables.

Requirements explained

Mechanical Excavation (2.8)

a) Engage **only** REO to operate mechanical excavators



b) Usage of mechanical excavator or hand-held power tool **only** for removal of premix concrete and hard-core layers






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Requirements explained

Mechanical Excavation (2.8)

c) REO to be in full control of the mechanical excavator to prevent cable damage

- Do not use excavator near to exposed cables
- Excavator bucket should not be used to scoop earth/water from trench with cables



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Requirements explained

Vertical and Horizontal Drilling / Penetration Works (2.9)

a) For sinking and driving of earth rods/ casing/ tubes/ sheet / bore piles/ poles
   - Consult LCDW
   - Check SPPG Cable Plan along with LCDW Cable Detection Drawing
   - Dig appropriate trial holes to determine suitable and safe positions

b) For sinking earth rods and sinking /extraction of sheet piles, trial holes to locate closest edge of cable slab (kept at least 2m away) and for sinking earth rods positioning require to be determined by the LCDW in the presence of an ESP officer.

c) For sheet piles, the stretch of closest edge of cable slabs should be exposed.

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Requirements explained

Pressure Grouting Works (2.10)

a) Ascertain alignment of electricity cables are not inside of the grouting zone.

b) Ensure protective measures are provided to protect electricity cables.

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Requirements explained

PTW and Records (2.11)

a) Implement PTW system to monitor & control all earthwork activities
   - PTW system to be periodically audited for its effectiveness

b) Display at site where the earthwork is carried out
   - NCE
   - SPPG cable plans / gas plans
   - LCDW cable detection drawings
   - LRe

c) Keep progressive records of earthworks
   - Photographs / Movement charts
   - Work Schedules
   - Trial holes

General Requirement

- Comply with additional requirements from ESP/SPPG

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Chapter 5 (c)

SPPG Requirements for Earthworks:
SPPG Requirements at SPPG worksites

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SPPG Requirements at SPPG worksites

- All work within SPPG sites or others' site with earthworks in the vicinity of cables and gas pipes, *Progressive shoring* is required to the following requirements:
  - 'Progressive shoring' refers to providing shoring to closely follow excavation and not allowing unprotective vertical surfaces. At the same time, the length of trench excavated should be controlled to ensure manageability for each excavation phase.
  - Progressive Shoring for unpaved trenching $\geq$ 1m, paved trenching $\geq$ 1.3m
  - For trench $\geq$ 1.5m, the shoring need to follow PE design
  - Progressive shoring and final shoring design shall be endorsed by PE and Method of Installation / Removal reviewed by PE

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SPPG Requirements at SPPG worksites

  - For SPPG sites, contractors must seek approval from Project Officer with photo evidence to show proper shoring in place before proceeding with further excavating
  - If soil conditions are unstable, shoring shall be provided immediately regardless of depth (even when <1m)

- Daily tool-box meetings are to be conducted and highlight the relevant services within the worksite area, work related risks, mitigating measures and safe work process
- HDD (Horizontal direct drilling) route alignment be traced accurately and HDPE (High Density Poly-ethylene) pipes installed accordingly to plan

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Worksite Management

- Engagement of RES - wef 1 April 2018
- Engagement of REO - wef from 1997
- Re-engagement of LCDW to carry out cable re-detection
- Use of Banksman to assist the REO
- Permit-To-Work
- Records of Trial Hole Photographs
- Apply for new NCE before existing NCE is going to EXPIRE

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Seek Consultation for Approval – For Cables

- Earthworks within 3 metres of any electricity cable or need to work beyond the slab
  - Undercrossing/over crossing Tx Cables
  - Deep excavations which may result in ground movement/ settlement
  - Construction of structure on top of Tx Cables

- SPPG officer to be present when involving undercrossing/ overcrossing

- Consult SPPG when shifting, denting or breaking any SPPG uPVC pipes, shifting any electricity cable or joint

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Seek Consultation for Approval – For Gas Pipes

- Contact TPOM Section when proposed earthworks are within 5 metres of any Gas Transmission Pipe (GTP)
- Contact DPOM Section when proposed earthworks are within 3 metres of any Medium Pressure Gas Pipes (MP) or Low Pressure (LP)
- Contact Customer Service Centre (1800-7521800) if you find any live or unknown Gas Pipes
- Proposed earthworks involve overcrossing, undercrossing, require exposing or diversion of Gas Pipes

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Example of Progressive Shoring

Progressive Shoring



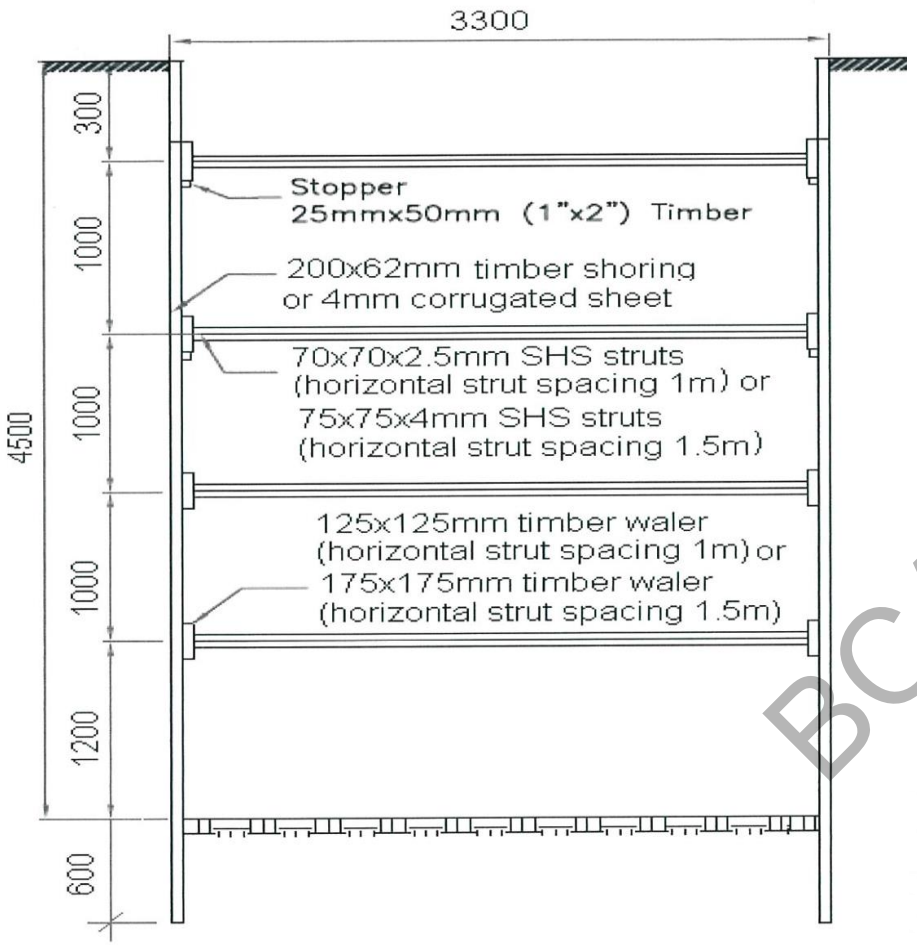


Final Shoring

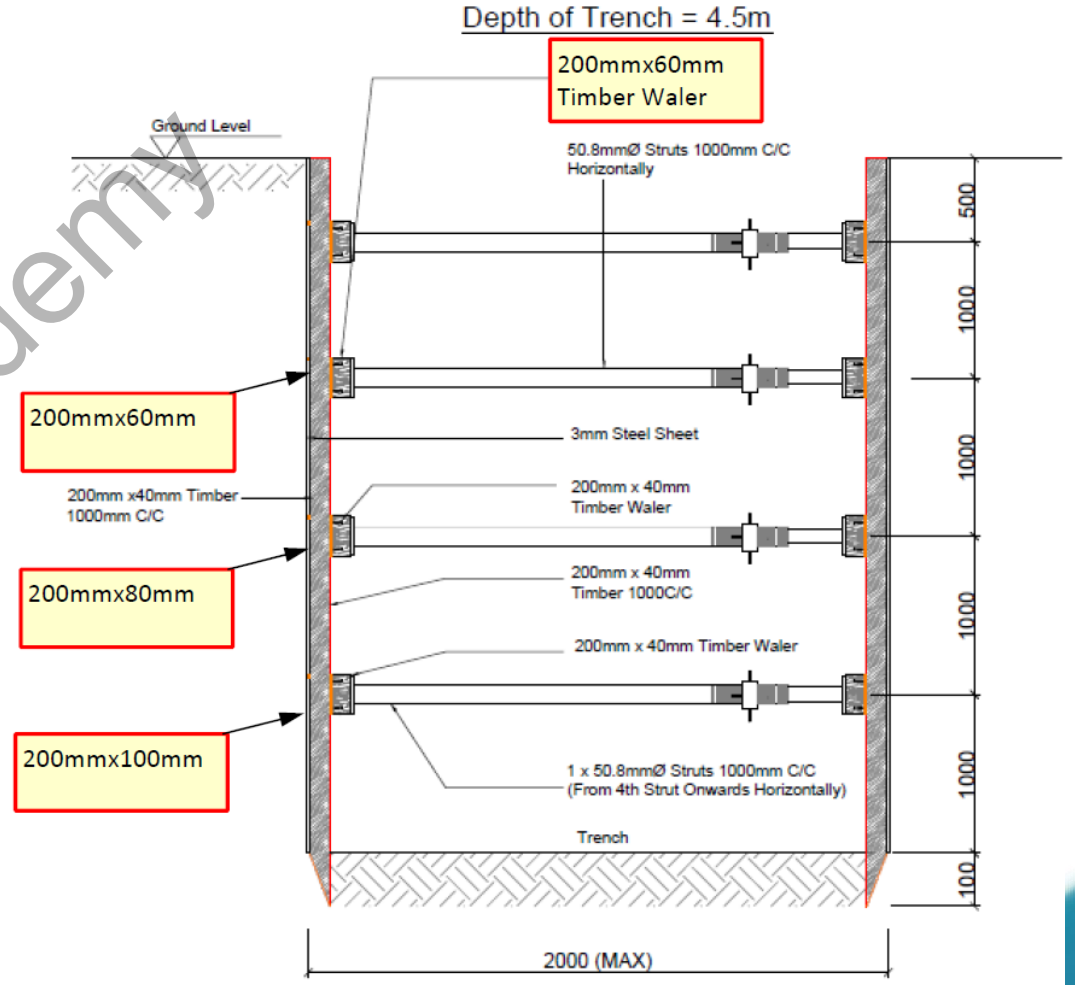


Progressive and Final Shoring in Accordance to PE Design

Examples of Progressive Shoring Designs



Adopt 125x125mm timber walers for horizontal strut spacing of 1m, adopt additional 2 nos. 150X150mm timber walers for horizontal strut spacing of 2m



Timber Shoring for Max 2.0m Width Trench Depth = 4.5m, [Excavation Stage 3m Opening]

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CCTV monitoring at SPPG worksites

To install CCTV (Arlo Pro or equivalent) to monitor SPPG contractor's work at all SPPG worksites

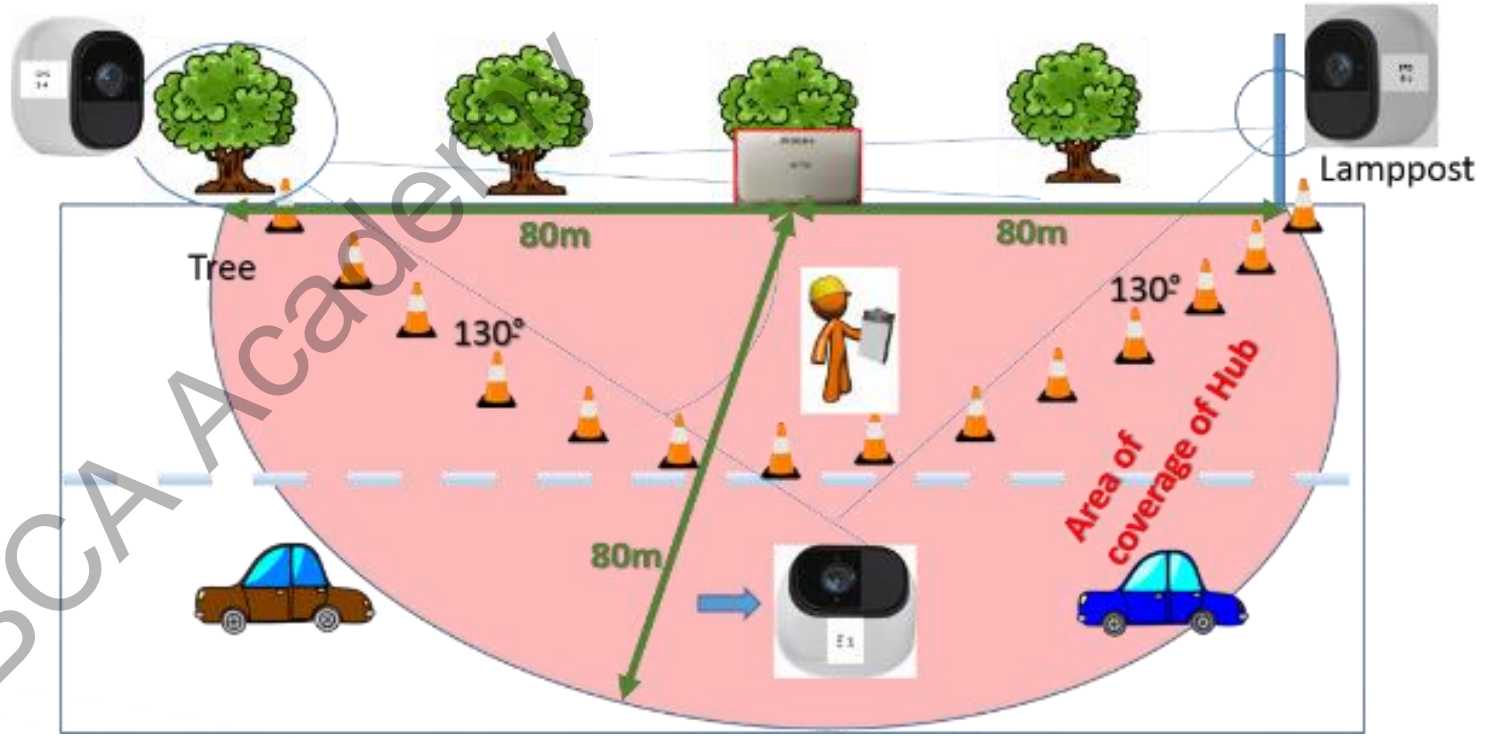
Benefits:

- Site workers are more likely to comply to SOP and SWP due to remote monitoring (Increase site safety awareness and alertness)
- Minimize cable / gas pipe damage from more care from workers at site
- Evidence from CCTV can expedite investigation process for cable / gas pipe damage
- Allows remote monitoring –Multiple sites can be monitored at the same time
- Inexpensive CCTV system based on long-term investment and damage costs

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Camera Deployment

- For all site works, min of 3 cameras should be showing 3 different angle
- Ensure cameras show a good overview of worksite



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Photos of CCTV monitoring

- Cameras at excavation site



SP Academy

Photos of CCTV monitoring

- Cameras at excavator



CCTV Monitoring at SPPG Worksites

- Having CCTV footage at multiple views and on-demand surveillance would minimize cable/gas pipe damages and prevent delays in Contractor's work.

- The CCTV monitoring can also benefit Contractors by using it for Safety Management and to meet requirements imposed by other Agencies.

- Contractor shall ensure CCTV system at SPPG worksite is in working condition at all times. Should any part of the CCTV system is found faulty or breakdown, contractor is to temporarily suspend all earthworks activities at the worksite.

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Chapter 6

Registered Earthworks Supervisor Requirements: SS 576 : 2019 – Code of Practice for Earthworks in the Vicinity of Electricity Cables

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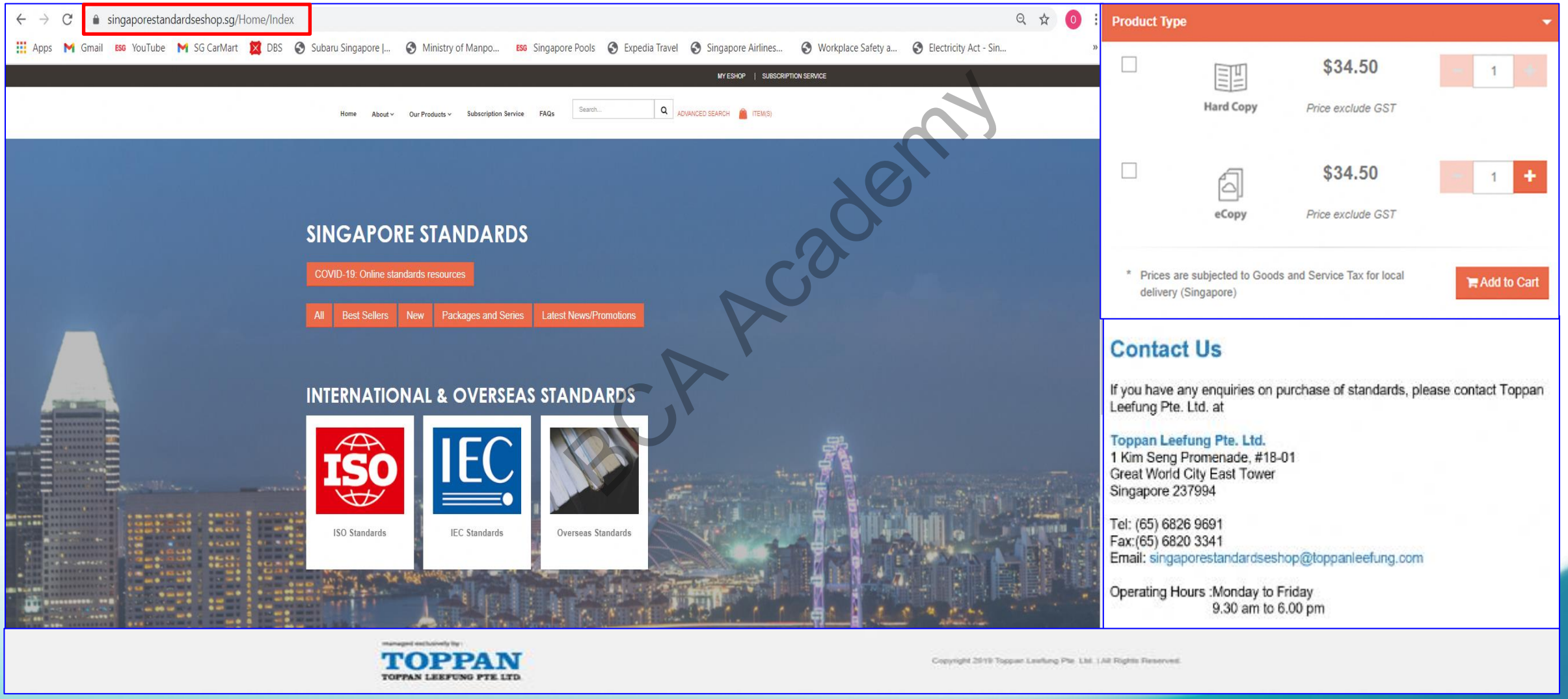
SS 576 : 2019 – Code of Practice for Earthworks in the Vicinity of Electricity Cables



- SS 576 : 2012 was first published in Nov 2012 and first revision was approved on 2 Aug 2019 as SS 576 : 2019
- Technical Committee comprised of
  - Government agencies
  - Professional engineer groups
  - Contractors' associations
- RES shall have the knowledge of SS 576 : 2019

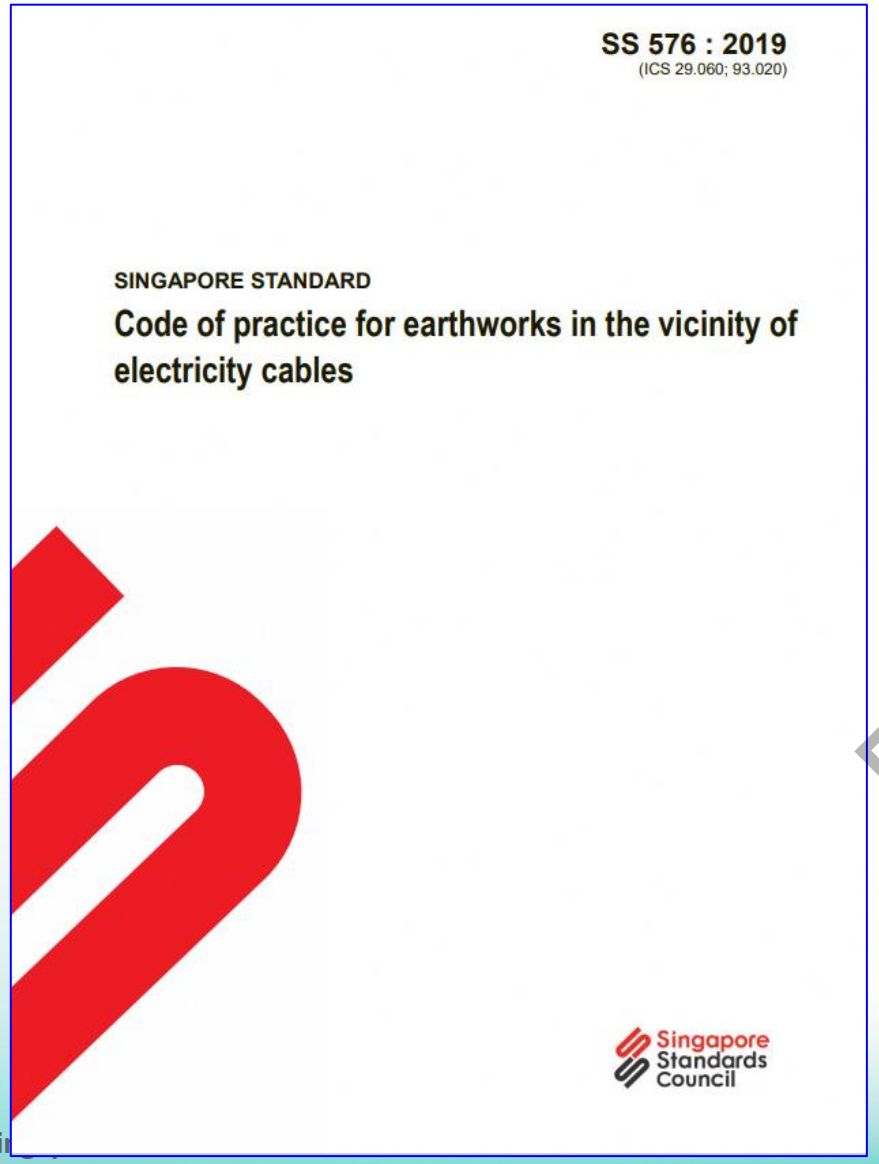
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Where to buy?



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What is SS 576 : 2019?



This standard covers best practices for earthwork activities near underground electricity cables to reduce the possibility of cable damages. Earthworks can involve excavations in the construction of buildings, roads, viaducts, flyovers and sewers, laying of pipes and cables, soil investigation works, boring, dredging, jacking and piling, and sinking of earth rod. The intent of the standard is to minimise the number of damages to electricity cables caused by earthworks undertaken by contractors, which could adversely affect electricity consumers.

This is a revision of SS 576 : 2012, Singapore Standard developed to serve as a guide to best practice for earthworks activities near underground electricity cables to reduce the possibility of cable damages. The intent of the standard is to minimise the number of damages to electricity cables caused by earthworks undertaken by contractors.

The key changes of this revision are as follows:

- Inclusion of a new clause 9.3 on personal protective equipment.
- Deletion of the informative Annex on "Relevant sections of the Electricity Act legal requirements".
- Deletion of the informative Annex on "Forms".

(The latest forms can be obtained on SPPG web site)

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What is the meaning of ‘vicinity’?

- Physical distance of cable from earthworks.
  - Where are the cables / gas pipes?
    - 5m, 10m, 20m, etc
- How will earthworks affect the cable?
  - What is the type of earthworks to be done?
  - How will the planned earthworks cause damage to the cables/gas pipes?
  - What are the entire associated activities to carry out the earthworks?
    - All related activities that could cause damage must be considered.
    - How will these associated activities cause damage to cables within the work area?

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Table 1 (of SS 576 : 2019) – Works below ground level in the vicinity of underground cables

Types of work below ground level	Distance* (m)
Trench or other excavation works in stable ground conditions up to 1.5 m in depth	3
Trench or other excavation works in stable ground conditions over 1.5 m in and up to 5 m in depth	5
Trench or other excavation works in stable ground conditions over 5 m	10
Vertical penetration including sheet piling, ground investigation and any kind of drilling or core sampling or ramming	3
Welding or other hot works near exposed underground cables	10

- Measurement is taken from both extreme edges of the underground cable or bundle of cables to determine whether works will be considered to be in its vicinity.

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The distance given here are not absolute and serves only as a guideline.
Other considerations must be taken to decide on the "vicinity".
e.g., contractors must give additional distance if the soil condition is unstable.

Key Stakeholders

- Key Stakeholders are defined in Section 3 – Terms and Definitions of SS 576 : 2019
  - Transmission Agent Licensee – SP PowerGrid Ltd (SPPG);
  - Principal;
  - Contractor – includes main contractors and subcontractors;
  - Registered Earthworks Supervisor (RES);
  - Licensed Cable Detection Worker (LCDW); and
  - Registered Excavator Operator (REO)

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Key Stakeholders

General responsibilities of Key Stakeholders

- The Principal, Contractor, LCDW and RES :
  - Familiarise and comply with the legislation – Electricity Act (Cap 89A) relating to carrying out earthworks in the vicinity of electricity cables;
  - Familiarise with the following processes,
    - ❖ Consultation with SPPG with respect to:
      i. cable detection work;
      ii. cable diversion; and
      iii. protection schemes for cables;
    - ❖ Response in the event of a cable damage or an emergency situation.
- The Principal and Contractor :
  - Must put in place a Permit-to-Work System for carrying out earthworks at the worksite.

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Transmission Agent Licensee

- Responsibilities of Transmission Agent Licensee
  - Provide cable route plans upon request;
  - Put in place a system to accept Notice of Commencement of Earthworks (NCEs);
  - Conduct site meetings with Contractor;
  - Issue a Letter of Requirements advising the Contractor of measures to be implemented to prevent damage to high voltage cables;
  - Visit the site periodically;
  - Investigate all cases of cable damage and acts of non-compliance by Contractors; and
  - Submit Investigation Case Files to EMA, the Regulator.

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Principal

- Responsibilities of Principal

Specify in the contract documents that their Contractors –

1. shall obtain SPPG cable route plans; and
2. to engage a LCDW to do cable detection work prior to commencement of earthworks;
3. shall consult SPPG whenever their proposed earthworks in the vicinity of electricity cables; and
4. to implement a Permit-to-Work System to monitor and control earthworks within their worksite

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Contractor

- Responsibilities of Contractor
  - Comply with the Electricity Act (Cap 89A), SS 576 : 2019 and SPPG requirements;
  - Engage LCDW to carry out cable detection work prior to earthworks;
  - Engage REO to operate mechanical excavator;
  - Shall have a RES supervising the entire excavation work;
  - Submit NCE to SPPG for High Voltage cables;
  - Do Risk Assessment on earthworks activities in the vicinity of electricity cables;
  - Review the risk assessment and notify SPPG of any impact on cables and joints, if there are changes to earthworks activities or in work methods
  - Conduct and keep records of daily briefings to all workers on cables positions and damage prevention measures
  - Shall implement a Permit-to-Work system to manage effectively all the earthworks and ensure that no unauthorised earthworks that could cause cable damage

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Licensed Cable Detection Worker (LCDW)

- Responsibilities of LCDW
  - Submit request for cable route plans and NCD to SPPG
  - LCDW shall do the cable detection work personally and mark the indicative cable routes on site
  - After cable detection work is completed, advise Contractor to submit NCE
  - LCDW shall specify the number of Trial Holes and where they are to be dug, collate trial hole information and produce a written cable detection report
  - LCDW shall advise Contractor that trial holes shall be done manually except for hard surfaces, supervised by RES and the cables can not be exposed beyond its slab level. In cases where the indicated cables shall not be located, the Contractor and LCDW shall consult SPPG before proceeding with any further excavation.
  - LCDW shall conduct a briefing for all relevant site personnel (e.g., Project/ Construction Managers, Site Supervisors and Excavator Operators) on the route and position of cables and the preventive measures to be implemented to avoid cable damage
  - If a cable is damaged during the earthworks, the LCDW shall conduct a site investigation and submit a Report on Damage(ROD) to SPPG promptly

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Registered Excavator Operator (REO)

- Responsibilities of REO
  - Before carrying out earthworks, REO shall assess his working area and do the following:
    - ❖ he shall not carry out any earthworks if the cable detection work was not carried out by LCDW
    - ❖ he shall check the LCDW cable detection drawings and look out for the position of cable markings applied on the ground by LCDW
    - ❖ He shall be familiar with the position and route of the cables after referring to the LCDW cable detection drawings and the markings on the ground
    - ❖ He shall check with his supervisor to find out if an NCE has been submitted to SPPG and shall not proceed with the earthworks if there is no Permit-to-Work issued to him
  - When operating his excavator, REO shall not dig beyond the top layer hard surface of those positions where there are cables
  - REO shall remain in complete control of his machine, be mindful of how he move around within the work area and operate it safely to prevent damage to cables
  - If a cable is damaged, REO shall inform his supervisor and report to SPPG immediately

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Registered Earthworks Supervisor (RES)

- Responsibilities of RES

Establishing Cable Positions and Cable Routes prior to earthworks

1. Ensure LCDW mark out all detected cables locations at site

2. When in doubt, consult LCDW/SPPG immediately

3. When unknown cables are found which was not detected by LCDW or indicated in the SPPG Cable Plans , stop earthworks and inform SPPG immediately

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Registered Earthworks Supervisor (RES)

- Responsibilities of RES

Trial Holes to ascertain the presence or absence of SPPG cables

4. Ensure trial holes are dug manually
   - To ascertain their exact positions if there are existing cables
   - **To verify that there are no cables** at the proposed earthworks locations

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Exercise: How to do trial hole to confirm NO cables?

We have learned how to do progressive scanning to do Trial Hole to account for "**LIVE**" cables

1. Call in the LCDW
2. Check SPPG cable plans and LCDW cable detection drawing to ensure proposed earthworks is away from cables
3. Use cable detector to check and confirm NO signal from ground
4. Dig trial holes manually [minimum: 1m(W) x 1m(L) x 1m(D)]
5. Progressive scanning from 1m onwards
6. "Layer-by-Layer" manual excavation
7. If there is still no signal at 1.5m and with LCDW's concurrence, earthworks can proceed
8. If in doubt as the SPPG cable plans indicated cables at the working area, stops the work and consult SPPG immediately

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Registered Earthworks Supervisor (RES)

- Responsibilities of RES

Site Management

5. Ensure PTW, SPPG Cable Plan and LCDW Cable Detection Drawing are available on site for reference, cross checking and monitoring to prevent cable damage

6. Ensure that the REOs are approved with valid passes

7. Shall conduct regular checks during the excavation works

8. Shall contact and consult SPPG before proceeding with under-crossing and over-crossing of SPPA cables

9. Shall implement appropriate measures as required by SPPG to protect the existing cables, e.g. SPPG Letter of Requirements

10. Ensure that all exposed trenches are properly secured and hoarded up to prevent access by public. All trenches shall be backfilled upon completion of works

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Registered Earthworks Supervisor (RES)

- Responsibilities of RES

When cable damage occurs

11. RES shall stop all excavation earthworks immediately and report to ESC, LCDW, consultants and his employer

12. Ensure that excavation earthworks can only resume after the approval obtained from SPPG

Addendum:
RES to ensure shoring works to be constructed immediately when encounter any unfavourable soil condition during trench excavation

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Reminder for RES

- RES shall

➢ Able to foresee and prevent damage through proper protection methods

➢ Able to interpret SPPG cable plan with LCDW cable detection drawing

➢ Able to understand and comply with Statutory requirements for earthworks

➢ Aware of the Do's and Don'ts of earthworks near electricity cables/ gas pipes

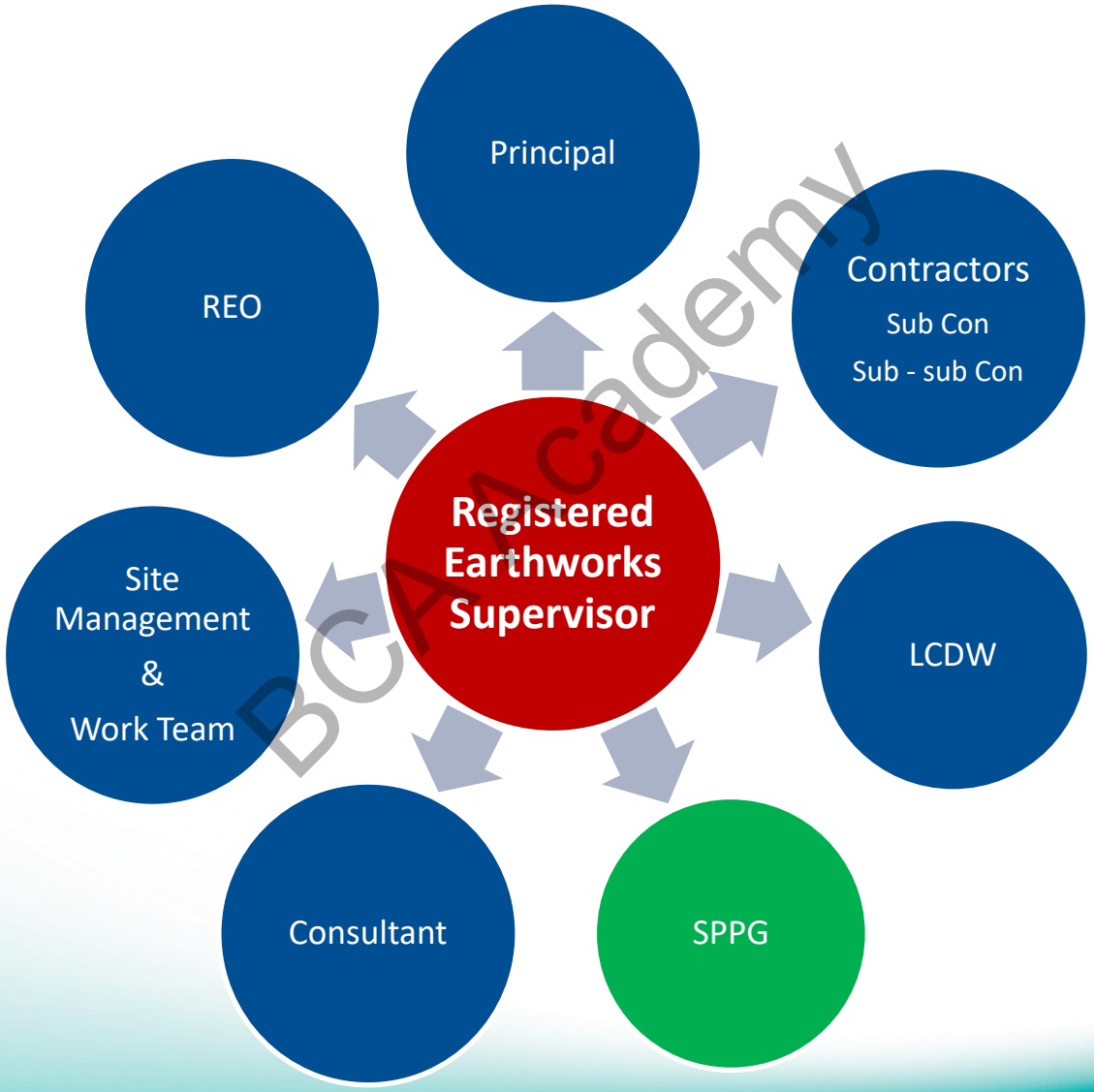
➢ Able to analyze site condition & conduct risk assessment for damage prevention

➢ Have the knowledge of types of underground cables/ gas pipes within worksite

➢ Able to understand the SPPG requirements, implement and enforce PTW system

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Interactive Role in multi-layer worksite



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Working with SPPG

Comply with SPPG Letter of 'Requirements for Earthworks

Consult ESP NCE Officer:

- ✓ Earthworks are within 3 metres of any electricity cable(s)
- ✓ When there is a need to work beyond cable slabs
- ✓ Earthworks within 3 metres radius of 66kV / 230kV / 400kV cables,
- ✓ When in doubt

Consult Distribution/Regional Network or EHVN Section:

- ✓ When Working close to 22kV / 6.6kV / LV cables
- ✓ Before under-crossing or over-crossing of transmission cables (66kV and above)
- ✓ if a permanent / temporary structure is proposed to be constructed on top of cables

Contact ESC immediately:

- ✓ When there is any damage or suspected damage to electricity cable(s)

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Performance Improvement Scheme for RES

- RES is expected to display a high standard of management and control of earthworks at site to prevent cables and gas pipes damage
- RES can achieve this by:
  - Complying with all legislative requirements
  - Following the '8 + 4 Steps' process for earthworks
  - Implement safe earthworks practices
- RES will be given demerit points, get suspended or have their registration revoked if they fail to do so or compromise the safety of cables and gas pipe

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Performance Improvements Scheme for RES

PERFORMANCE IMPROVEMENT SCHEME (PIS) FOR REGISTERED EARTHWORKS SUPERVISOR (RES)
LIST OF VIOLATIONS & PENALTIES

ITEM	VIOLATION	PENALTY
1	Unsupervised / Supervised earthworks which resulted in the damage of:	
	i) 400kV / 230kV / 66kV Electricity Cable**	i) Revocation of RES pass for 1 Year
	ii) 22kV / 6.6kV Electricity Cable**	ii) Damage causing either a Supply Outage or Voltage Dip: Revocation of RES pass for 6 months Damage not causing a Supply Outage or Voltage Dip: 20 demerit points
	iii) LV Electricity Cable** ***	iii) Damage causing either a Supply Outage or Voltage Dip: 15 demerit points Damage not causing a Supply Outage or Voltage Dip: 10 demerit points

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Performance Improvements Scheme for RES

iv) Gas Transmission Pipeline (3 bar (TG) / 28 bar / 40 bar)	iv) Revocation of RES pass for 1 Year
v) Gas Medium Pressure Pipeline (3 bar – 7 bar)	v) Damage causing either a Supply Interruption or Leak: Revocation of RES pass for 6 months Damage not causing a Supply Interruption or Leak: 20 demerit points
vi) Gas Low Pressure Pipeline (0.5 bar and below)***	vi) Damage causing either a Supply Interruption or Leak: 15 demerit points Damage not causing a Supply Interruption or Leak: 10 demerit points

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Performance Improvements Scheme for RES

2	A)	Attempt by RES to tamper or repair damaged Electricity Cable** / Gas pipe	A) Revocation of RES Pass for 1 year
	B)	Failure to ensure LCDW marked out all detected electricity cable** locations at site before any earthwork	B) 10 demerit points
	C)	Supervised mechanical excavation / piling works without referring to LCDW's Detection Drawing & SPPG Cable / Gas plan and records of trial holes dug according to LCDW's recommendations	C) 20 demerit points
	D)	Allowed REO to dig with a mechanical excavator beyond the premix / hard core surface layer	D) Suspension of RES Pass for 3 months
	E)	Failure to ensure that trial holes are manually dug (with due care & diligence) according to the LCDW's recommendations to a size of minimum 1m by 1m with minimum depth of 1m or until the Electricity Cable** PVC or Concrete Slab are exposed	E) 20 demerit points

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Performance Improvements Scheme for RES

	F)	Supervised REO / worker to excavate beyond the level of Electricity Cable** /Gas pipe ID Marker / PVC or Concrete Slab without SPPG's consent	F) Suspension of RES Pass for 1 year
	G)	Failure to report to SPPG – Electricity Service Centre on any discovery of Electricity Cable** damage or to Gas Customer Service Centre on any discovery of Gas pipe damage	G) 10 demerit points
	H)	Failure to monitor worksite operations for the entire duration of any earthworks	H) 15 demerit points
3	A)	Tampering with RES Pass / Transferring RES Pass for others to use	A) Revocation of RES Pass for 1 year
	B)	Using expired RES Pass	B) Suspension of RES Pass renewal for 3 months

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Performance Improvements Scheme for RES

	C) D)	Failure to report loss of RES Pass to SP PowerGrid Ltd Unable to show RES Pass on request	C) 10 demerit points D) 10 demerit points
4		Accumulation of 25 demerit points within 12 months	Suspension of RES Pass for 6 months
5		Committed Two Violations on separate incidents within 6 months	Suspension of RES Pass for 6 months*

Last revised on 4 Nov 2022

Note: When a pass is revoked, retraining and application for a new pass is only allowed after the period of revocation.
* RES is required to complete serving the suspension period for the prior violation(s) before serving the suspension period for this violation. This penalty is not applicable if the RES pass is revoked for the second violation.

**Under the Electricity Act (Chapter 89), "electricity cable" means a length of insulated single conductor or of 2 or more such conductors, whether or not the conductor or conductors are provided with an overall covering for mechanical protection, and —
(a) all other apparatus or devices connected to the conductor or conductors, as the case may be (including by any remote or wireless means); and
(b) any data communication cable used to monitor or control the transmission of electricity.

***Applicable to an RES whose employer is served Letter of Requirements from SP PowerGrid Ltd stating the requirement to provide an RES to supervise earthworks within the worksite. It is also applicable to an RES where there is a LV electricity cable within 3m of HV voltage electricity cable, gas low pressure pipeline within 3m of gas medium pressure pipeline or within 5m of gas transmission pipeline.

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Damage Prevention as part of Safe Construction Work

- Make damage prevention as part of project planning
- Include damage prevention into safe work practices
- Conduct risk assessments to identify the potential hazards of Electrocution or Burns from cable damage by:
  - ✓ Sinking earth rod
  - ✓ Hand held power tools
  - ✓ Hand augering
  - ✓ Uncontrolled manual excavation
  - ✓ Mechanical Excavation
  - ✓ Sheet piling
  - ✓ Boring

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Where to Get Help

- ✓ Always refer to Both SPPG Cable/Gas Plan and LCDW Detection Drawing
- ✓ When in doubt, stop work and contact SPPG

HELP ON CABLE DAMAGE PREVENTION

MEA/ESP Sections

General Enquiries 6916 5119
Helpline on Cable Plans 6916 5022

ENQUIRIES ON 400kV AND 230kV CABLES

Extra High-Voltage Network Section ..... 6916 5485 /5487

ENQUIRIES ON 66kV CABLES

Regional Network East/West ..... 6916 5227 / 6916 5557

ENQUIRIES ON 22kV CABLES AND BELOW

Distribution Network 1 Section.....6916 5728
Distribution Network 2 Section.....6916 5047 / 6311
Distribution Network 3 Section.....6916 5398 / 5400
Distribution Network 4 Section..... 6916 5057 / 5048
Distribution Network 5 Section.....6916 5015 / 5703
Distribution Network 6 Section.....6916 5741 / 6994

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Electricity Service Centre (ESC) : 1800 778 8888 and Gas Emergency Hotline : 1800 752 1800 - (24-Hour Hotline)

Where to Get Help

- ✓ Always refer to Both SPPG Cable/Gas Plan and Trial Hole records
- ✓ When in doubt, stop work and contact SPPG

HELP ON GAS PIPE DAMAGE PREVENTION	
Earthworks Surveillance and Protection Section	
General Enquiries	6916 5119
Mapping And Earthwork Administration Section	6916 5021 / 6916 5022
ENQUIRIES ON TRANSMISSION GAS PIPES (GTP)	
Transmission Pipelines Operations & Maintenance (TPOM)	6916 6136 / 6916 6144
ENQUIRIES ON LOW / MEDIUM PRESSURE (LP/MP) GAS PIPES	
Distribution Pipelines Operations & Maintenance (DPOM)	6916 5948 / 6916 7833

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Electricity Service Centre (ESC) : 1800 778 8888 and Gas Emergency Hotline : 1800 752 1800 - (24-Hour Hotline)

Our Basic Belief

Damage can be Prevented….



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Our Basic Belief

...If You *Plan* Your Earthworks

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Chapter 7(a)

Supervisory Skills in the Prevention of Damage to Electricity Cables: Working with Registered Excavator Operator

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Purpose of REO Scheme

- To ensure the availability of competent and skilled excavator operators in Singapore
- To train and educate excavator operators to operate mechanical excavators safely for not causing damage
- To minimize cable damage cases due to mechanical excavation works

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Role of REO

- Assess the Earthworks area
- Check if cable detection works had been carried out by LCDW.
  If not, he must not carry out any earthworks and explain it to his supervisor
- Check the LCDW Cable Detection Drawing before carrying out earthworks
- Look out for LCDW cable markings on the ground before excavating
- Know cable/gas pipe positions and no mechanical excavation beyond top layer hard surface of those positions where there are cables/gas pipes

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Role of REO

- Shall remain in complete control of mechanical excavator and operate it safely to prevent damage

- Bucket or other attachments fixed to the excavator should not be applied within the excavated trench or trial hole where cables/gas pipes are exposed

- Do not put excavator bucket for workers to scoop in earth for removal / scoop out water / to level the earth or for any other purpose within excavated trench or trial hole where cables/gas pipes are exposed

- REO shall work closely with trained Banksman and supervised by full time Supervisor/RES to look out for blind spots to prevent damage

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Earthworks Supervisor working together with REO to enhance result in Damage Prevention

- Build up rapport
- Train competent Banksman
- Provide on site support when required
- Co-ordinate all earthwork activities together
- Effective communication among RES, Supervisor and REO
- Promptly feedback lapses at site





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When to use Mechanical Excavator

- REO to use Mechanical Excavator only
  - For top layer hard surface/premix layer
  - In the presence of full time Supervisor or RES
  - When the excavator is fully equipped

- Protect cables first before proceeding to remove obstacles (boulders, rocks etc) from excavated trenches with due care and diligence

- Do not use Mechanical Excavator:-
  - Around electricity Cables/ Gas pipes
  - To clear water / remove manual excavated earth from trench
  - To dig trial holes

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Performance Improvement Scheme for REO

PERFORMANCE IMPROVEMENT SCHEME (PIS) FOR REGISTERED EXCAVATOR OPERATOR (REO)
LIST OF VIOLATIONS & PENALTIES

ITEM	VIOLATION	PENALTY
1	Operating excavator which resulted in the damage of:	
	i) 400kV / 230kV / 66kV Electricity Cable**	i) Revocation of REO pass for 1 year
	ii) 22kV / 6.6kV Electricity Cable**	ii) Damage causing either a Supply Outage or Voltage Dip: Revocation of REO pass for 6 months Damage not causing a Supply Outage or Voltage Dip: 20 demerit points
	iii) LV Electricity Cable**	iii) Damage causing either a Supply Outage or Voltage Dip: 15 demerit points Damage not causing a Supply Outage or Voltage Dip: 10 demerit points

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Performance Improvement Scheme for REO

		iv) Gas Transmission Pipeline (3 bar (TG) / 28 bar / 40 bar)	iv) Revocation of REO Pass for 1 year
		v) Gas Medium Pressure Pipeline (3 bar – 7 bar)	v) Damage causing either a Supply Interruption or Leak: Revocation of REO Pass for 6 months Damage not causing a Supply Interruption or Leak: 20 demerit points
		vi) Gas Low Pressure Pipeline (2 kPa / 20 kPa / 50 kPa)	vi) Damage causing either a Supply Interruption or Leak: 15 demerit points Damage not causing a Supply Interruption or Leak: 10 demerit points

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Performance Improvement Scheme for REO

2	A)	Attempt by REO to tamper or repair damaged Cable / Gas pipe	A) Revocation of REO Pass for 1 year
	B)	Using excavator to excavate beyond the premix / hard core surface layer	B) Suspension of REO pass for 3 months
	C)	Using excavator to excavate beyond the level of Cable /Gas pipe ID Marker / PVC Slab / Concrete Slab	C) Suspension of REO Pass for 1 year
	D)	Carrying out mechanical excavation / piling works without close supervision by a full-time site supervisor	D) 15 demerit points
	E)	Carrying out mechanical excavation / piling works without referring to SPPG Gas plan or LCDW Detection Drawing & SPPG Cable plan	E) 10 demerit points

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Performance Improvement Scheme for REO

	F)	Using excavator that puts Cable / Gas pipe at risk of damage by dumping debris / sharp object / concrete trash or placing heavy object on top of Cable / Gas Pipe	F) 15 demerit points
	G)	Failure to report to SP PowerGrid Ltd – Electricity Service Centre on any discovery of Cable damage or to Gas Customer Service Centre on any discovery of Gas pipe damage	G) 10 demerit points
	H)	Taking instruction from unauthorised parties to excavate	H) 10 demerit points
3	A)	Tampering with REO pass / Transferring REO pass for others to use	A) Revocation of REO Pass for 1 year
	B)	Using expired registration pass	B) Suspension of REO Pass renewal for 3 months
	C)	Failure to report loss of REO pass to SP PowerGrid Ltd	C) 10 demerit points
	D)	Failure to show REO pass on request	D) 10 demerit points

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Performance Improvement Scheme for REO

4		Accumulation of 25 demerit points within 12 months	Suspension of REO Pass for 6 months
5		Committed Two Violations on separate incidents within 6 months	Suspension of REO Pass for 6 months*

Last revised on 4 Nov 2022

Note: When a pass is revoked, retraining and application for a new pass is only allowed after the period of revocation.

*REO is required to complete serving the suspension period for the prior violation(s) before serving the suspension period for this violation. This penalty is not applicable if the REO pass is revoked for the second violation.
**Under the Electricity Act (Chapter 89), "electricity cable" means a length of insulated single conductor or of 2 or more such conductors, whether or not the conductor or conductors are provided with an overall covering for mechanical protection, and —
(a) all other apparatus or devices connected to the conductor or conductors, as the case may be (including by any remote or wireless means); and
(b) any data communication cable used to monitor or control the transmission of electricity.

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CASE STUDIES

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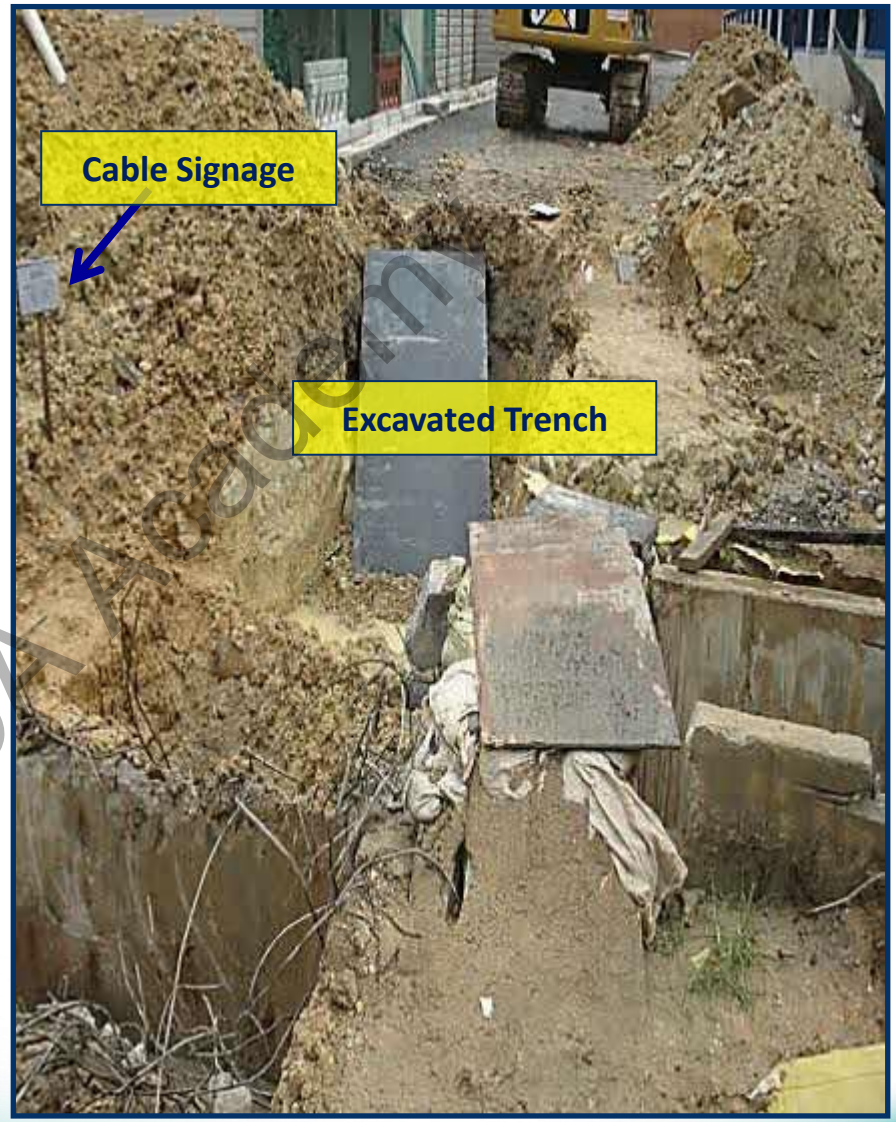
Case #5 – LV Damage at Tampines ST 91

Date (Time) of Damage	7.1.13 (1803hrs)
Location	Btw Tampines NPC & Blk 931 Tampines St 91
Cause of Damage	Mechanical Excavation
Nature of Works	Construction of drain
LCDW	Yes (main contractor)
NCE	Yes (main contractor)
Outage (Duration)	Yes (42 Minutes)

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Damaged Cable Location (Drain Construction)





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Damage Point





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Points to Note

- Main contractor failed to supervise full time on sub contractor despite PTW issued
- Unauthorised earthworks carried out showing failure of PTW
- Errant earthworks supervisor from sub-contractor act as REO to carry out mechanical excavation work

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Case #6 – 22kV Damage at Marina Coastal Drive

Date (Time) of Damage	9.6.13 (1458hrs)
Location	Marina Coastal Drive LPT6F
Cause of Damage	Mechanical Excavation
Nature of Works	Gas Pipe Laying Works
LCDW	Yes
NCE	Yes
Outage (Duration)	Yes (103 Minutes)

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Damaged Cable Location



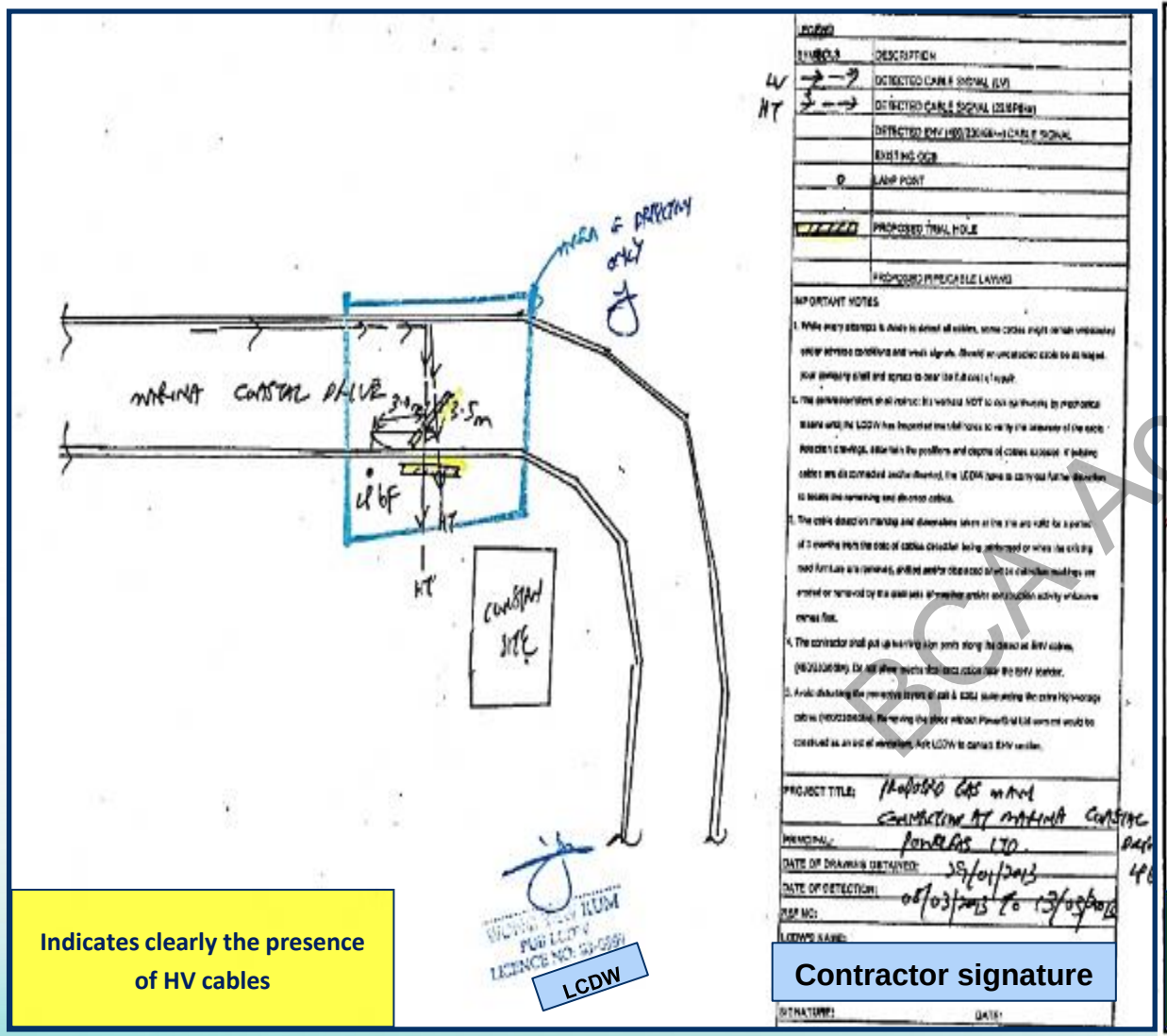
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Damaged Point

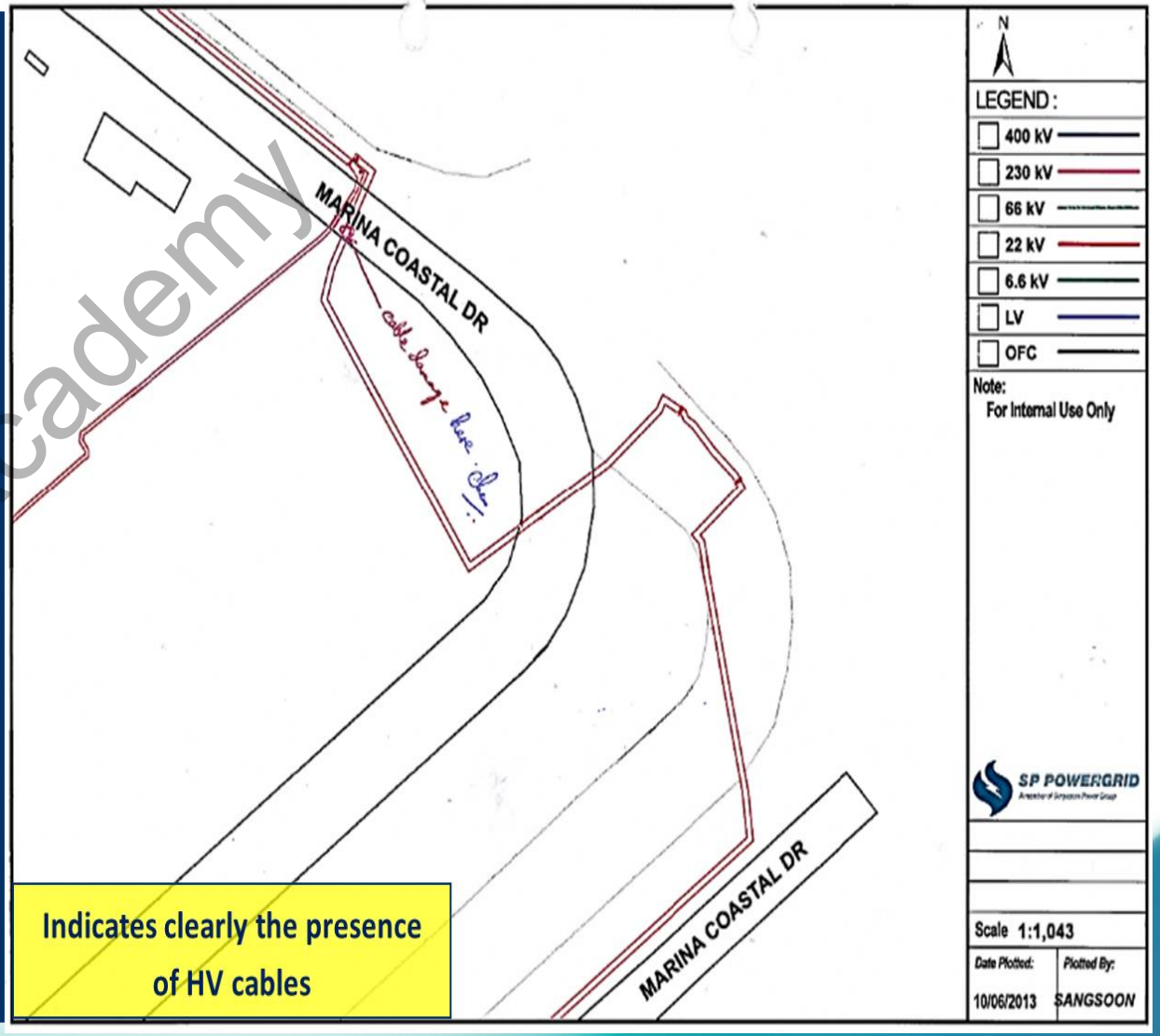




LCDW Cable Detection Drawing



Indicates clearly the presence of HV cables



Indicates clearly the presence of HV cables

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Points to Note

- REO failed to check LCDW Cable Detection Drawing for the presence of 22kV cables
- No full time Earthworks Supervisor supervised REO
- REO applied mechanical excavation beyond hardcore/ premix layer
- REO registration pass revoked for damaging 2x 22kV cables

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Chapter 7 (b)

Supervisory Skills in the Prevention of Damage to Electricity Cables: Effective Communication at Worksite

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What Can Cause Miscommunications

- Personal perceptions or assumptions can create miscommunications.
- Watch these videos:
  - Video #1 : Direct verbal communication can fail both parties when there is language incompetency.
  - Video #2 : We are influenced by our own perceptions of things and interpret situations we see and hear directly based on our own database of experiences with incorrect results.
- These are real errors in communications that occur daily.
- We have to be mindful of these and give instructions properly to ensure that damage to cables and gas pipes do not occur.

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Challenges in Communication with Multi-National Work Team

Communication is a challenge
due to influx of foreign workers



Earthworks Supervisor needs to work with
multinational work teams of different cultures

Effective communication is required to ensure that the workers:



- **Understand instruction and messages**
- **Follow the law and company safety rules**
- **Understand the existence of potential hazard**
- **Take precaution to protect underground services**
- **Work as a team to achieve project goals**

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Cultural Difference and Interpreting Instruction

How to overcome “CULTURE SHOCK”?

- deal with psychological stress
- communicate effectively
- establish interpersonal relations

Different communication methods

- Facial expressions
- Spatial behaviour
- Body contact
- Gestures
- Vocalisation
- Bodily movement
- Posture

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Cultural Difference and Interpreting Instruction

Overcome language barrier by:

- Using simple English
- Hand gestures
- Speaking slowly for workers to understand
- Use pictures to help with understanding

















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Cultural Difference and Interpreting Instruction

- Workers may not understand what you are saying
- Take your time
- Don't hesitate to explain more

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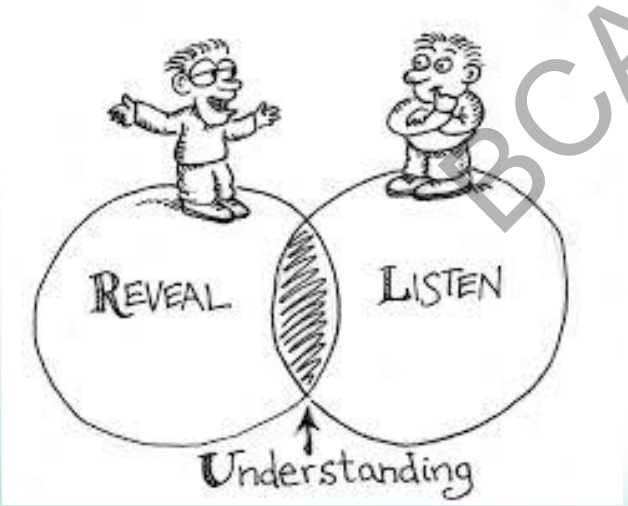


Positive Affirmations

To ensure instructions are understood:

- ✓Ask workers to repeat their tasks
- ✓Encourage them to take down notes
- ✓Simply ask if they understand after finished talking



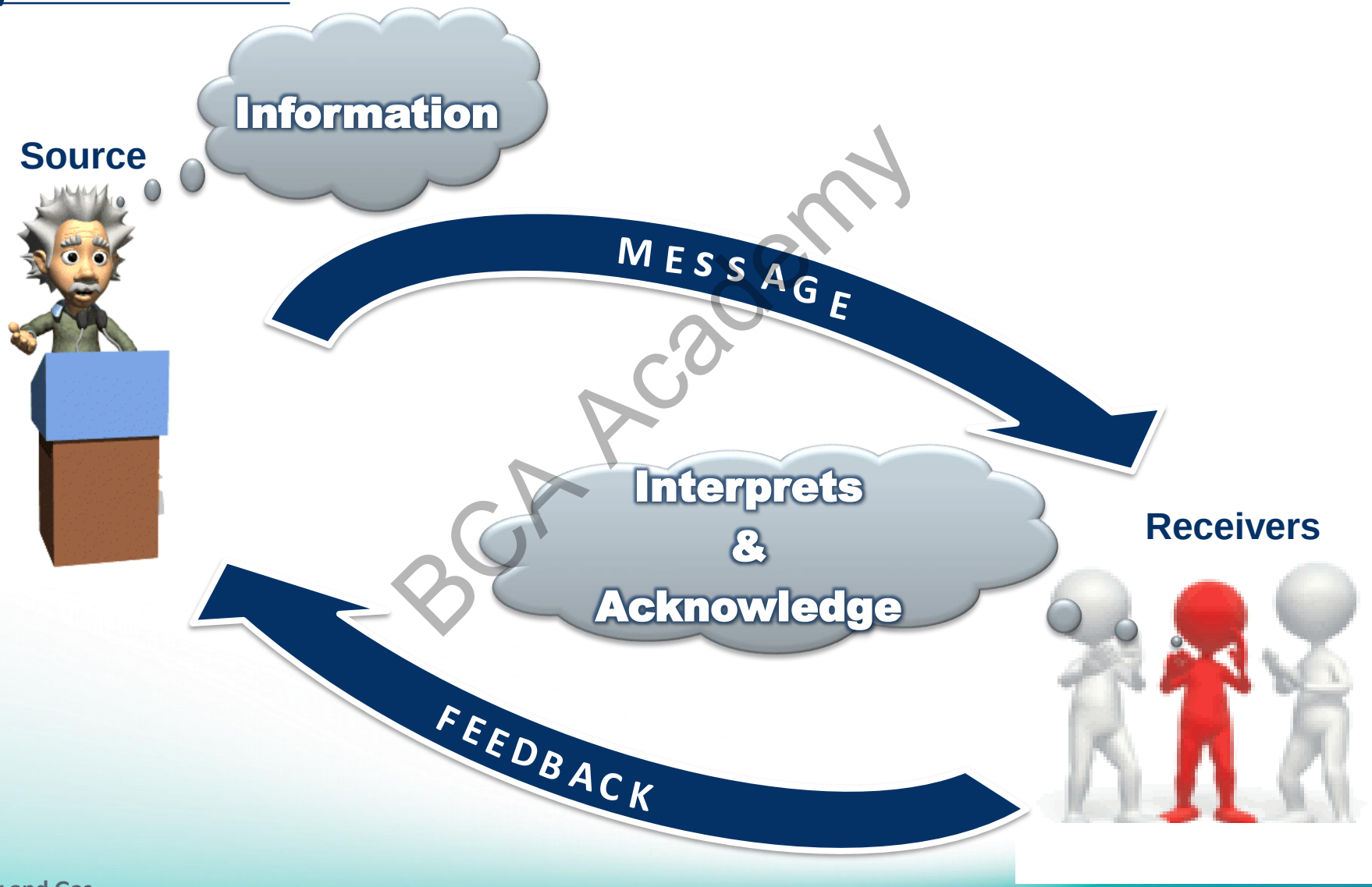




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Positive Affirmations

2-Way communication



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Monitoring effectiveness of Communication

Earthworks Supervisor should

- ✓ Gather regular feedback from work team
- ✓ Conduct daily meeting to observe the understanding of instructions
- ✓ Carry out spot checks on workers
- ✓ Measure the performance of workers at site



Written

- ✓ Reports, memos, instruction



Oral

- ✓ Briefing, meeting, counselling

Interpersonal

- ✓ Conversation skills, listening skills, assertive skills, conflict management

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Unexpected Action/ Behavior by Worker

- ✓ Attempt to repair cable
- ✓ Attempt to cover up the damage
- ✓ Shifting of earthworks position
- ✓ Run away after cable had been damaged
- ✓ Use excavator bucket to clear water in trench
- ✓ Carrying out excavation without supervision and approval
- ✓ Taking short-cuts (excavate without doing trial-hole)
- ✓ Failure to observe safety (bucket not fastened properly)
- ✓ Assuming cable route and proceeding with earthworks
- ✓ Operating excavator without registration pass







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Case Study #7

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Sequence of Events – 9th July 13

Supervisor briefed work team on cables positions at site

↓

On 8.7.13, work team completed 3 out of the 5 boreholes

↓

On 9.7.13, boring operator with supervision proceeded with pre-boring on 4th borehole for preparation of borehole casing installation

↓

Supervisor walked away to attend to other matters

↓

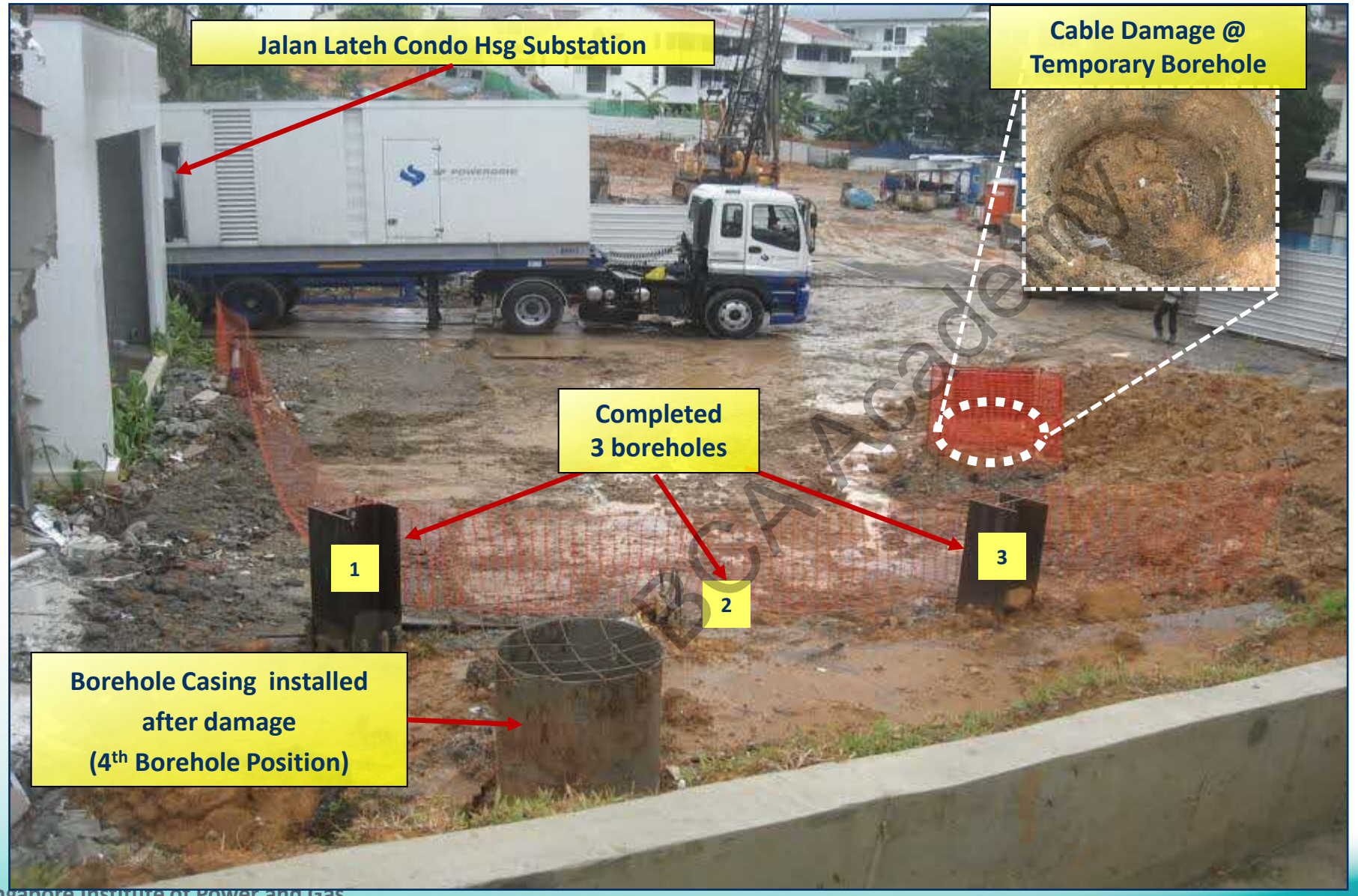
Boring operator on his accord bore a hole elsewhere to place borehole casing in upright position without knowing cable positions

↓

Boring machine drill bit damaged 2x6.6kV Cables & 2xPilot Cables

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Damaged Cable Location



- This photo was taken after the 4th borehole was correctly installed.
- Note that at the time of the damage, 4th borehole was still not done.
- The worker did #4 at the wrong position & damaged the cable at the position shown with a dotted circle.

Points to Note

Site Supervisor had:

- Failed to ensure that all workers had understood instructions
- Failed to supervise the entire earthworks activity
- Failed to ensures that all workers are present during daily briefings and follows instructions always

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THE END

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