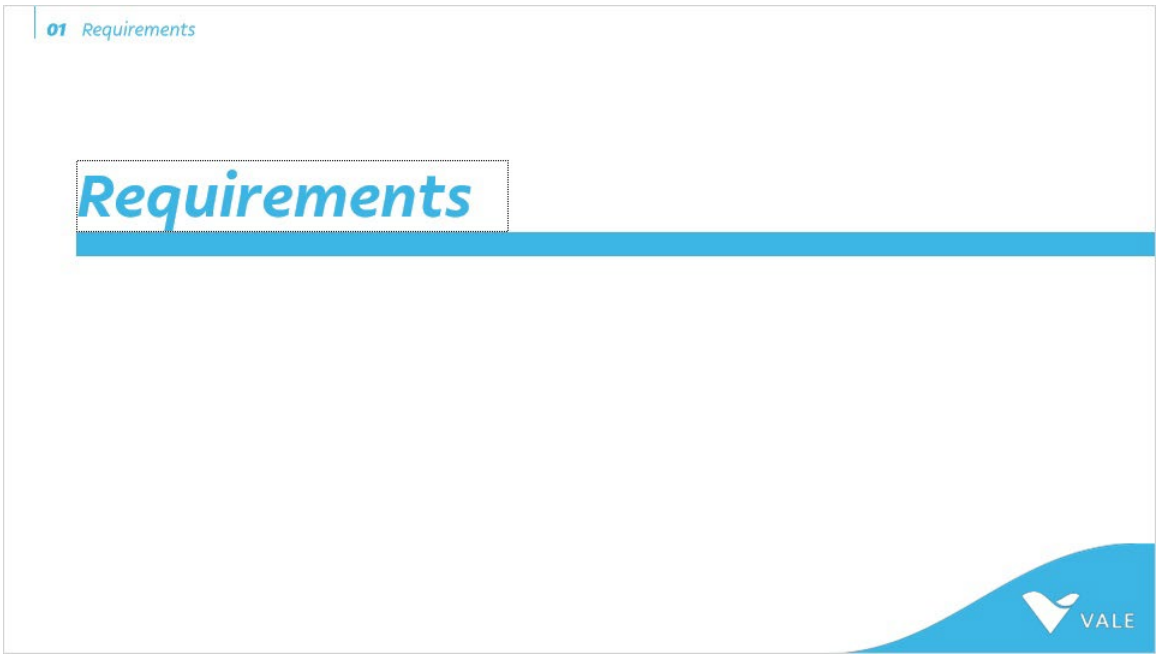
1.1 Slope Hazard Awareness Training

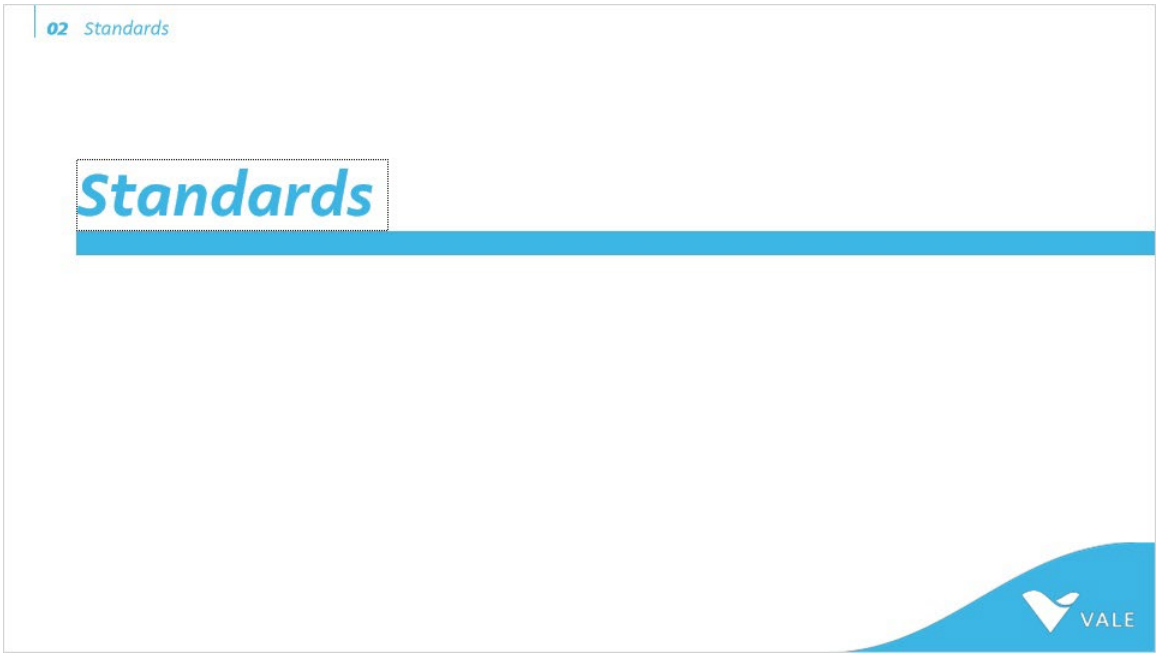
1.2 Ontario Regulations



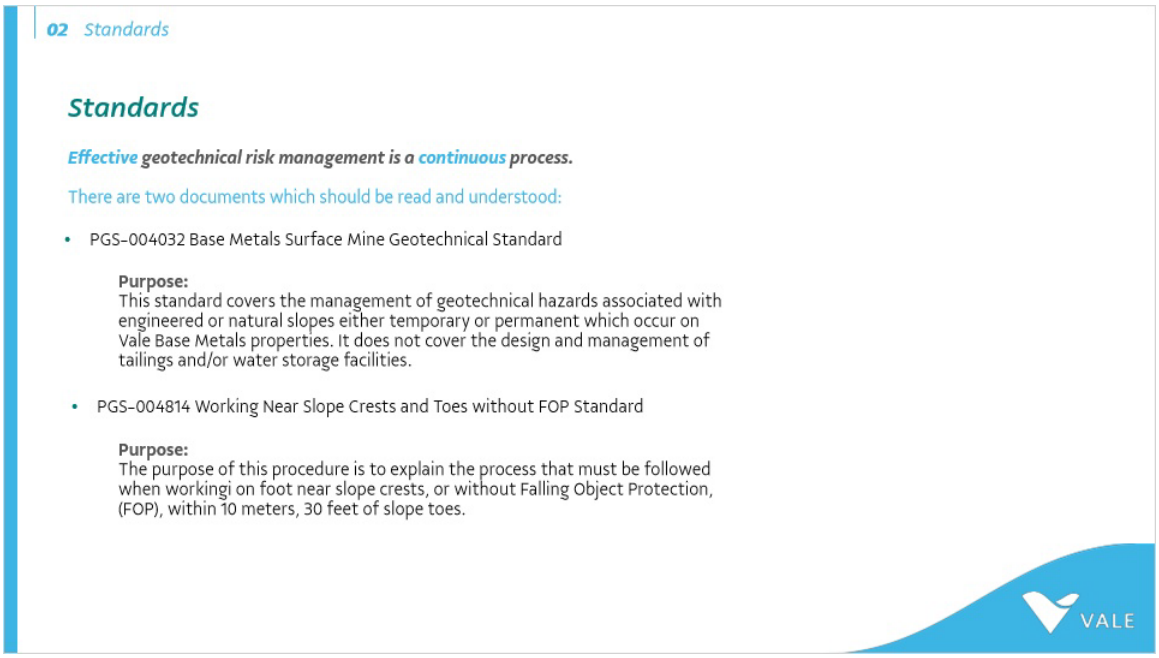
1.3 Ontario Regulations

1.4 Ontario Regulations

1.5 Ontario Regulations



1.6 Guidelines for Working on Energized Equipment



1.7 Establish Safe Work Practices

02 Standards

Surface Mine Geotechnical Standard

The Surface Mine Geotechnical Standard comprises topic areas that are made up of critical clauses.

The Surface Mine Geotechnical Standard does not cover the design and management of tailings and/or water storage facilities.

The Surface Mine Geotechnical Standard will be reviewed at least every 2 years.

Surface Mine Geotechnical Standard

VALE

PGS-004032, Rev.: 01-15/01/2021

Issuer Board: Vale Base Metals Executive Committee
Owner: Name: Vale Base Metals Head of Geology, Mine Design and Geotechnical
Target Audience: All Vale Base Metals employees.
Training Needed: (x) YES ( ) NO

Purpose:
This standard covers the management of geotechnical hazards associated with engineered or natural slopes either temporary or permanent which occur on Vale Base Metals properties. It does not cover the design and management of tailings and/or water storage facilities.

APPLICATION

This standard applies to Vale Base Metals globally, including its related companies.

PREPARED

- Alex Hossack – Manager, Geotechnical
- Ingrid Domergue-Schmidt – Senior Specialist, Mining
- Marc Ruest – Technical Leader, Geotechnical

REVIEWED

- All Vale Base Metals 1st Line and Vale 2nd Line senior geotechnical personnel.

CONTENT

The content of this standard is outlined in the following:

Vale Base Metals Surface Mine Geotechnical Standard

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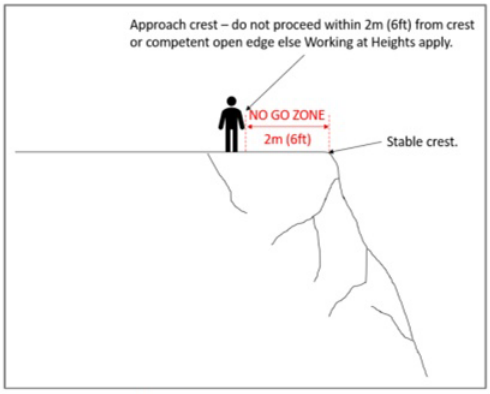
1.8 Working on Energized Equipment

02 Standards

Surface Mine Geotechnical Standard

PGS-004814 explains the process that must be followed when working on foot near slope crests and toes. It describes:

- the **hazards** of entering within or working near slope toes and crests, such as:
  - Open edges;
  - Sudden collapse of the crest of a slope;
  - Slope or Dump instability;
  - Individual, isolated rock falls.
- the **control measures** that must be put in place, such as:
  - Joint Risk Analysis prior to entering;
  - Safe distances;
  - "NO-GO zones".



Example of No GO zone illustration near all open edges

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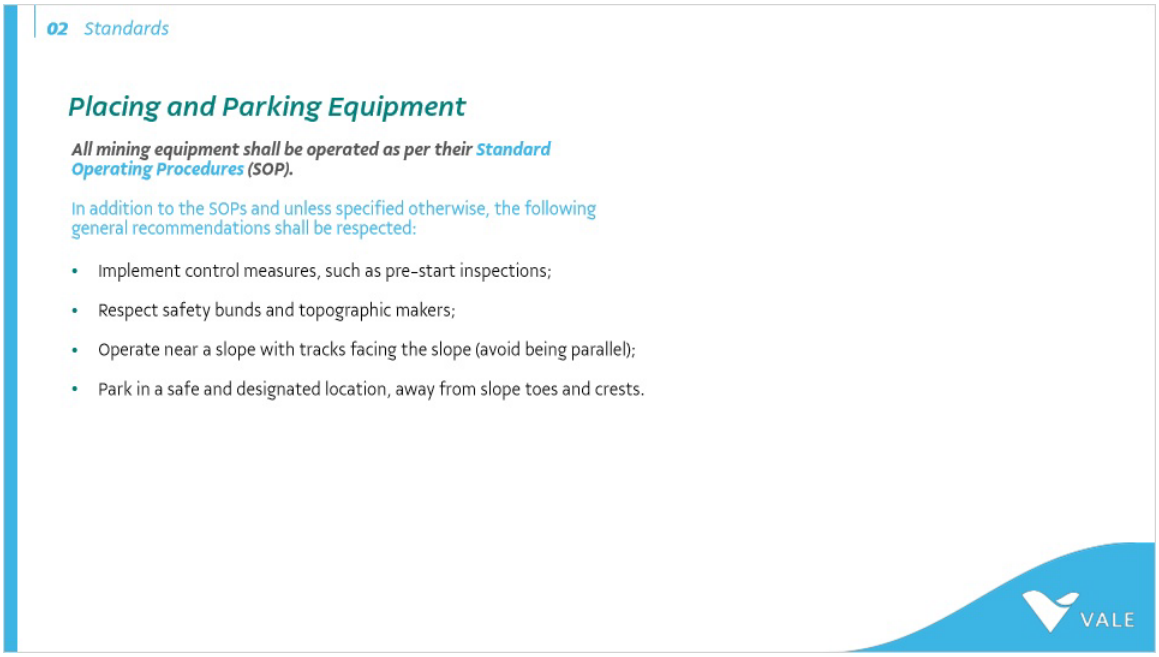
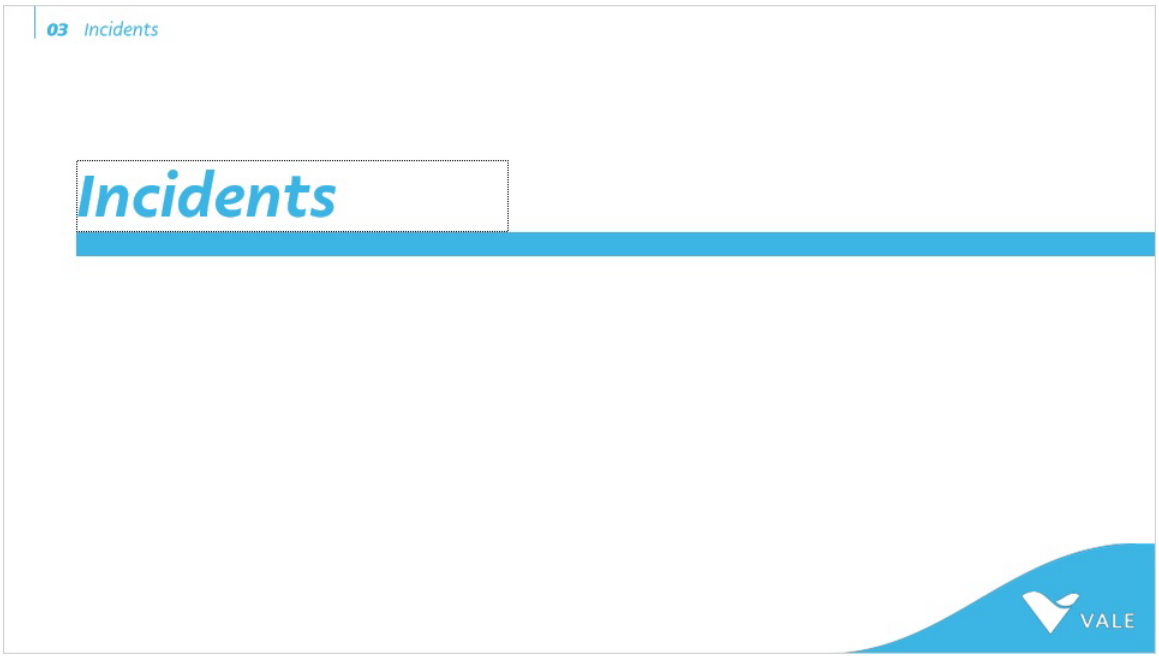
1.9 Select to Continue



1.10 Ontario Regulations



1.11 Electrical Energized Work Permit

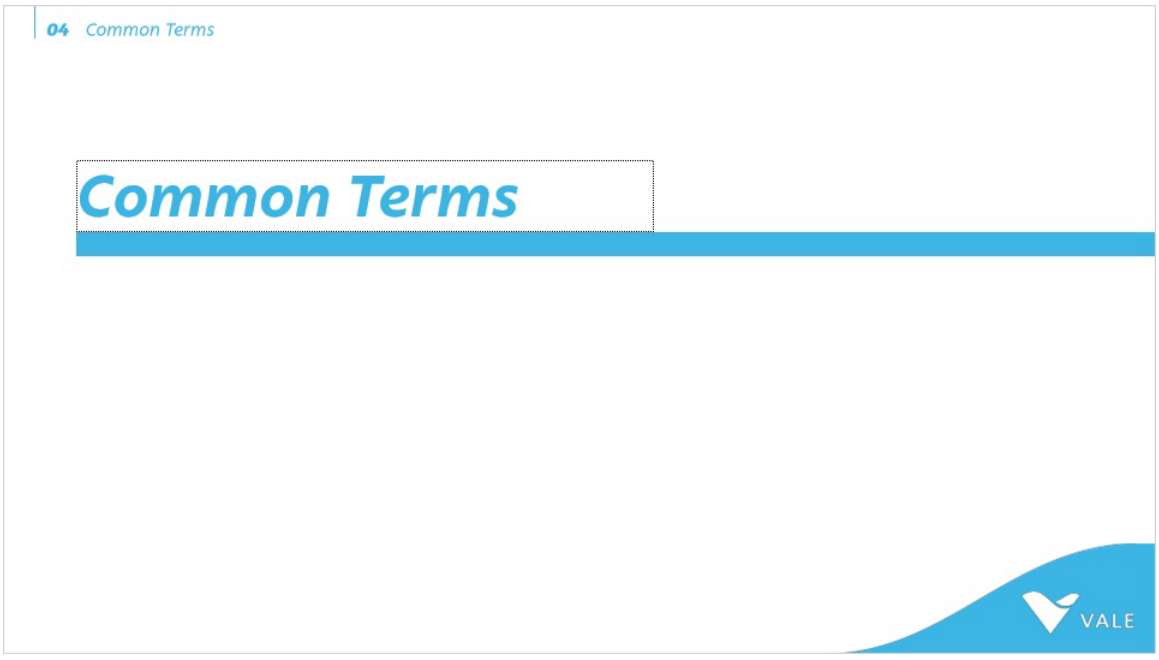
1.12 Electrical Energized Work Permit

1.13 Electrical Energized Work Permit

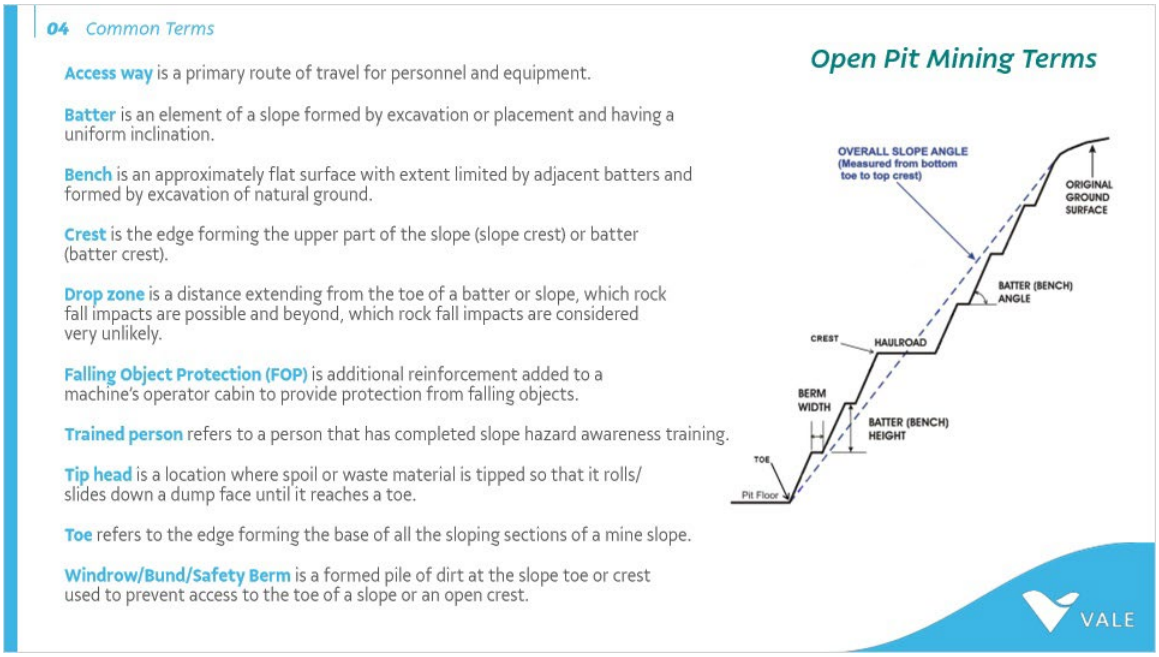
1.14 Electrical Energized Work Permit

1.15 Electrical Energized Work Permit

1.16 Ontario Regulations



1.17 Establish Safe Work Practices



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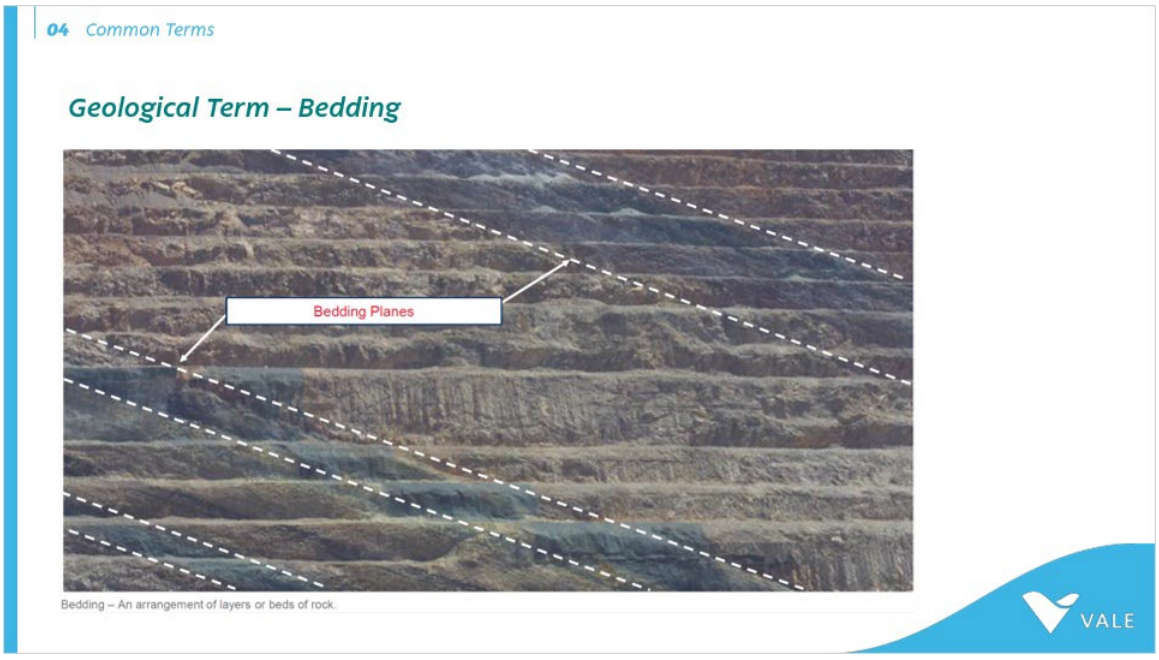
1.20 IS THIS ELECTRICAL WORK?



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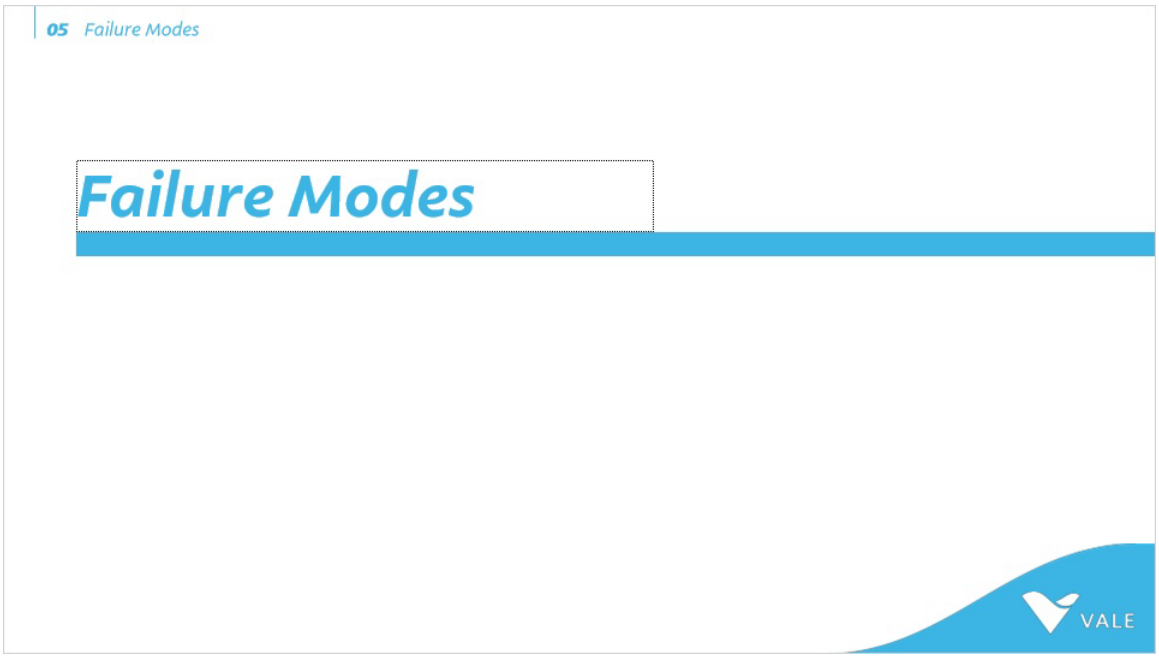
1.22 Ontario Regulations



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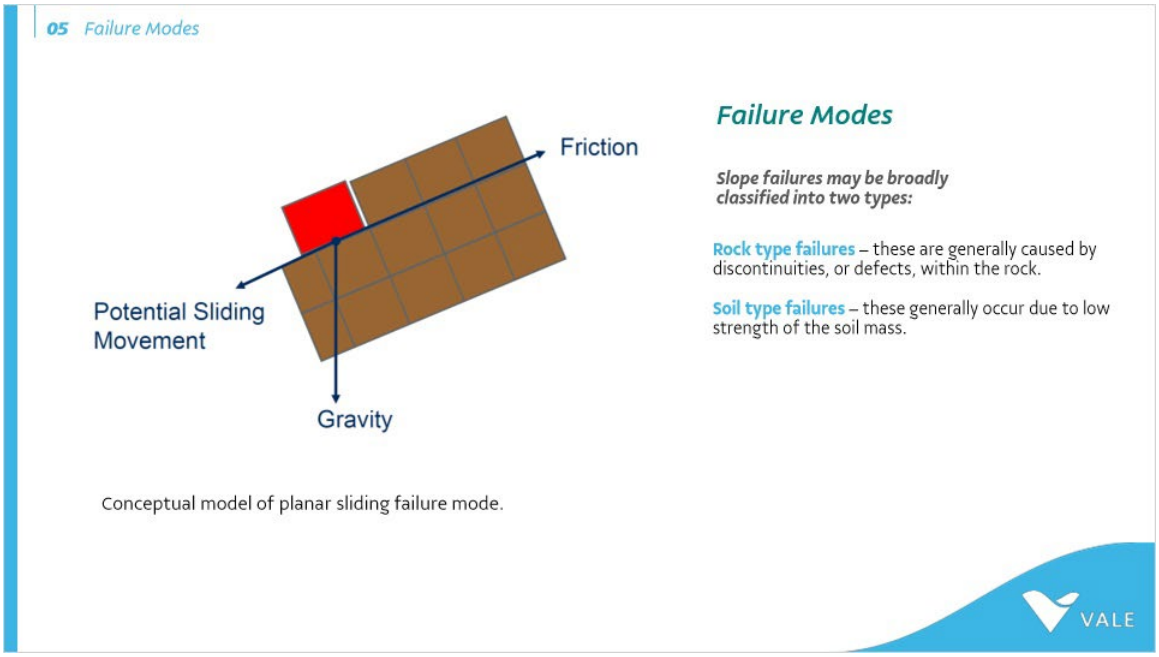

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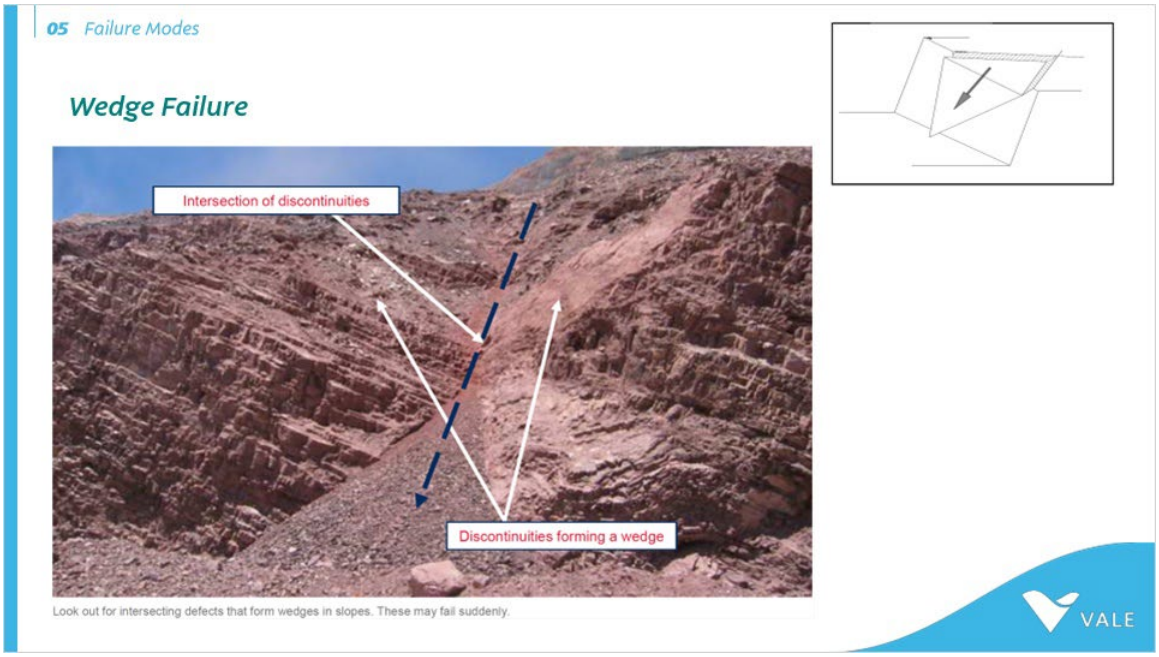

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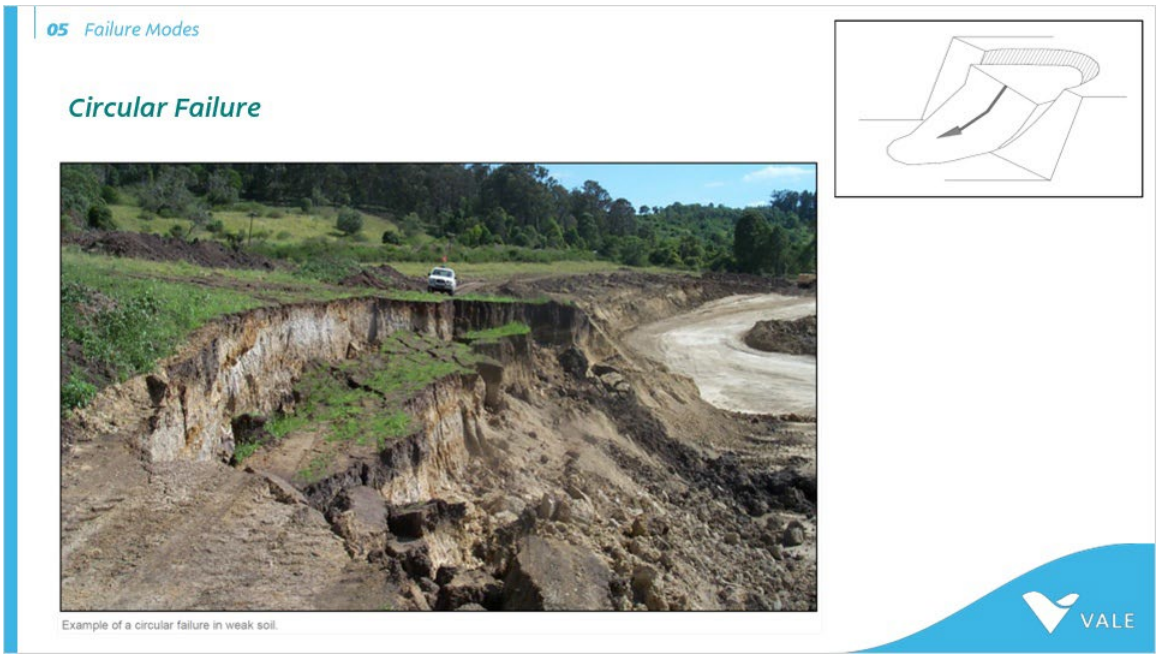

1.29 IS THIS ELECTRICAL WORK?

05 Failure Modes

Mining Induced Failures

Slope failures can also be due to:

- Surface and groundwater – can cause movement due to pressure on failure planes, lubrication of failure planes, erosion (undercutting of slope), or additional weight to the failing mass. Precipitation related events, such as intense rainfall and freeze-thaw cycles, can increase these effects.
- Blasting – can cause benches to fail and loosen blocks (vibrations & blast gases).
- Inappropriate slope design – not appropriate for the geotechnical conditions.
- Quality of excavation or slope maintenance – walls left with rocks hanging, over-steepened or without appropriate maintenance in time.
- Subsidence due to underground mining.

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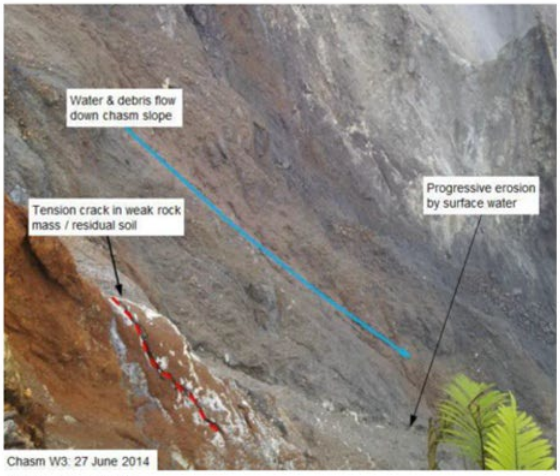
1.30 IS THIS ELECTRICAL WORK?

05 Failure Modes

Surface and Groundwater

The presence of water impacts upon stability as follows:

- Changes in effective stress.
- Increase in material weight due to saturation.
- Reduced friction (provides uplift).
- Provision of lateral force.



Ok Tedi Copper-Gold Mine.

The presence of water will always increase risk of instability!

Photograph of Ok Tedi Copper-Gold Mine showing the impact of surface water run-off on slope stability.

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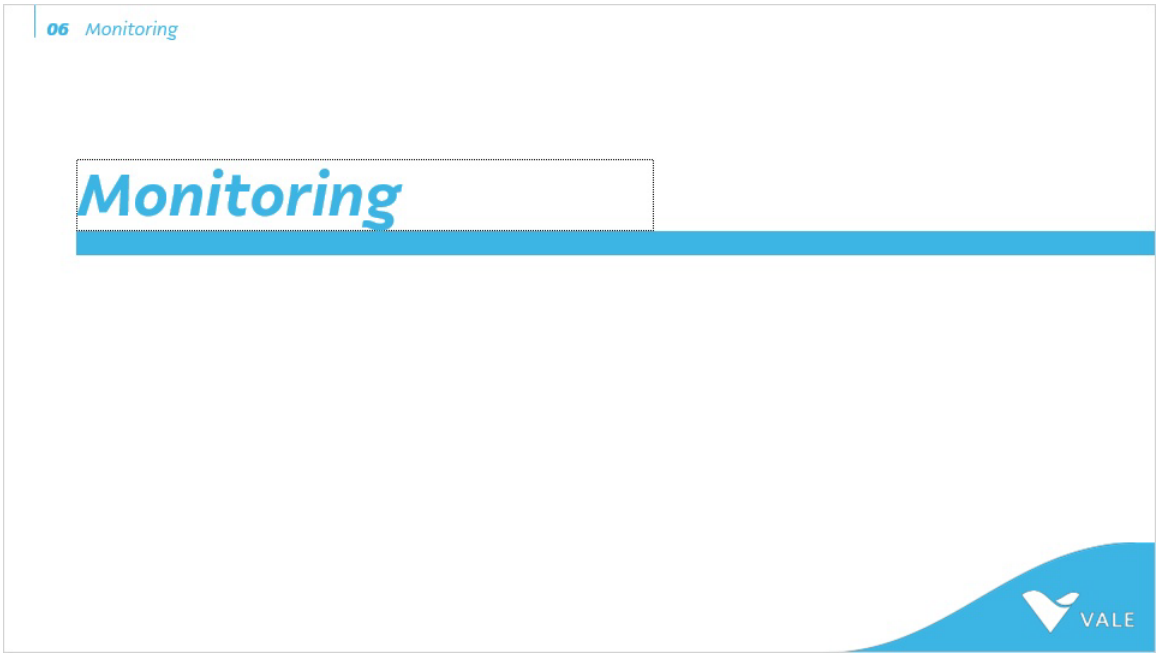
1.31 IS THIS ELECTRICAL WORK?

1.32 IS THIS ELECTRICAL WORK?

1.33 Ontario Regulations



1.34 Ontario Regulations

1.35 IS THIS ELECTRICAL WORK?

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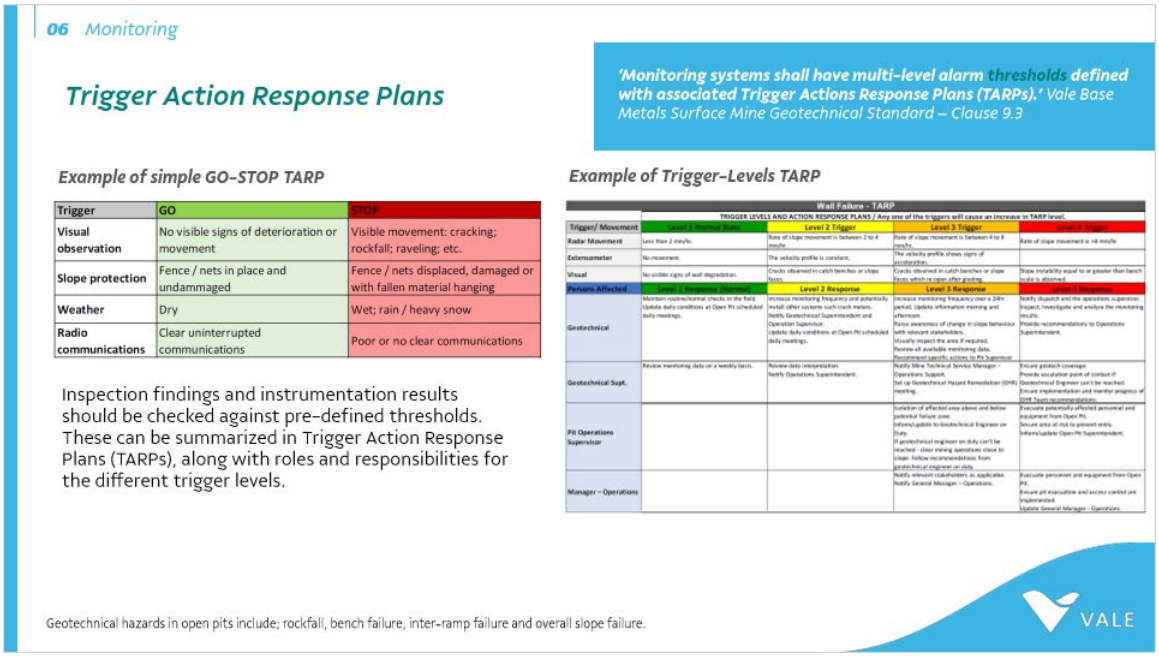

1.38 Ontario Regulations

1.39 IS THIS ELECTRICAL WORK?

07 Warning Signs

Warning Signs Prior to Failure

What to look for:

- Dribbling of rocks, material or small block falls.
- Cracks or joints opening up in bench or mine floor.
- Changes in line or level of benches.
- Floor heave.
- Unexpected movement of material.
- Overhangs of material.
- Rills of material (stream-like flow) at the wall slope toe.
- Bulging of the wall batters.
- Increase or decrease in water flow and/or water ponding.
- Failure of ground support.

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1.40 IS THIS ELECTRICAL WORK?

07 Warning Signs

Bench with visible tension cracks indicating instability.

Tension Cracks

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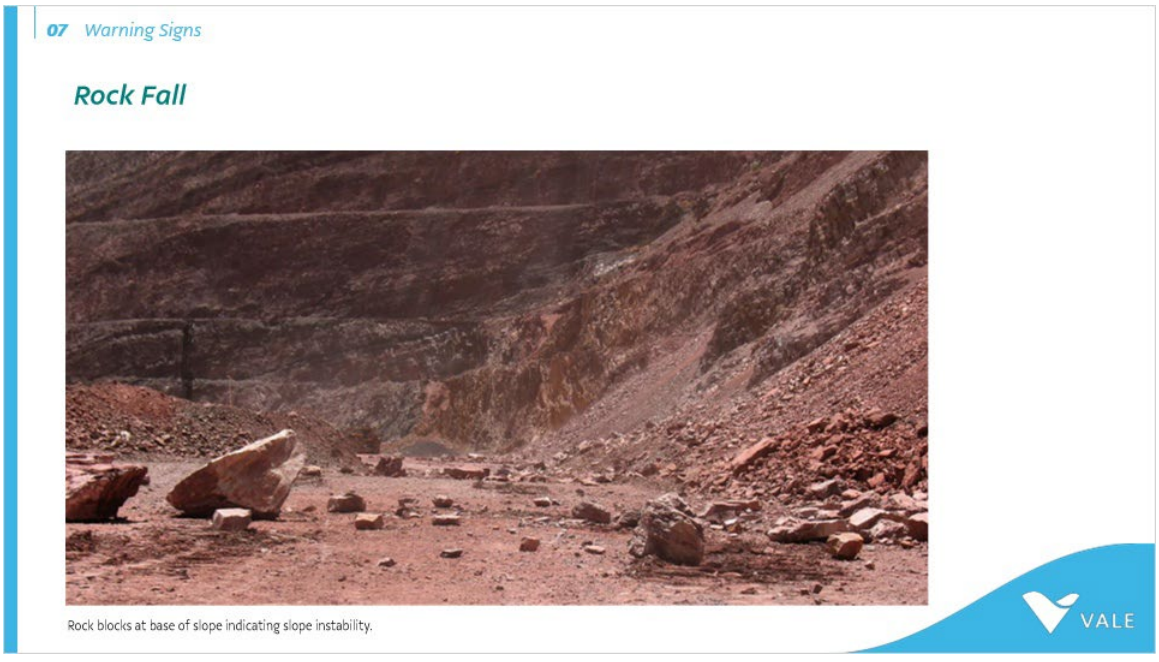
1.41 IS THIS ELECTRICAL WORK?

1.42 IS THIS ELECTRICAL WORK?



1.43 IS THIS ELECTRICAL WORK?

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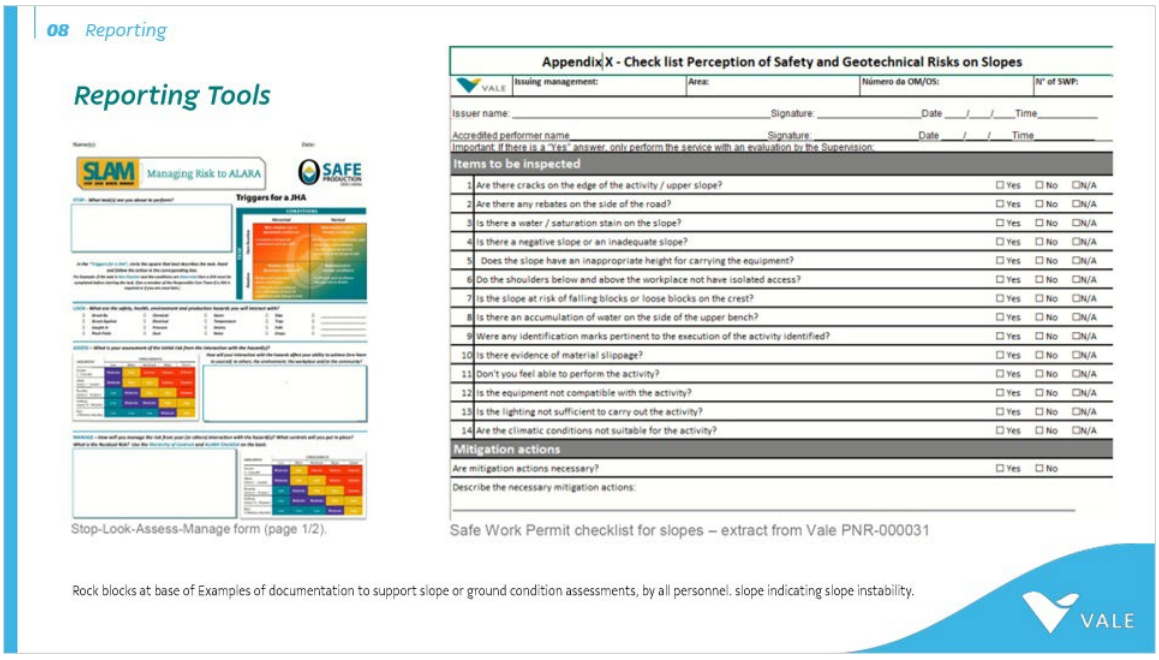
1.45 Ontario Regulations

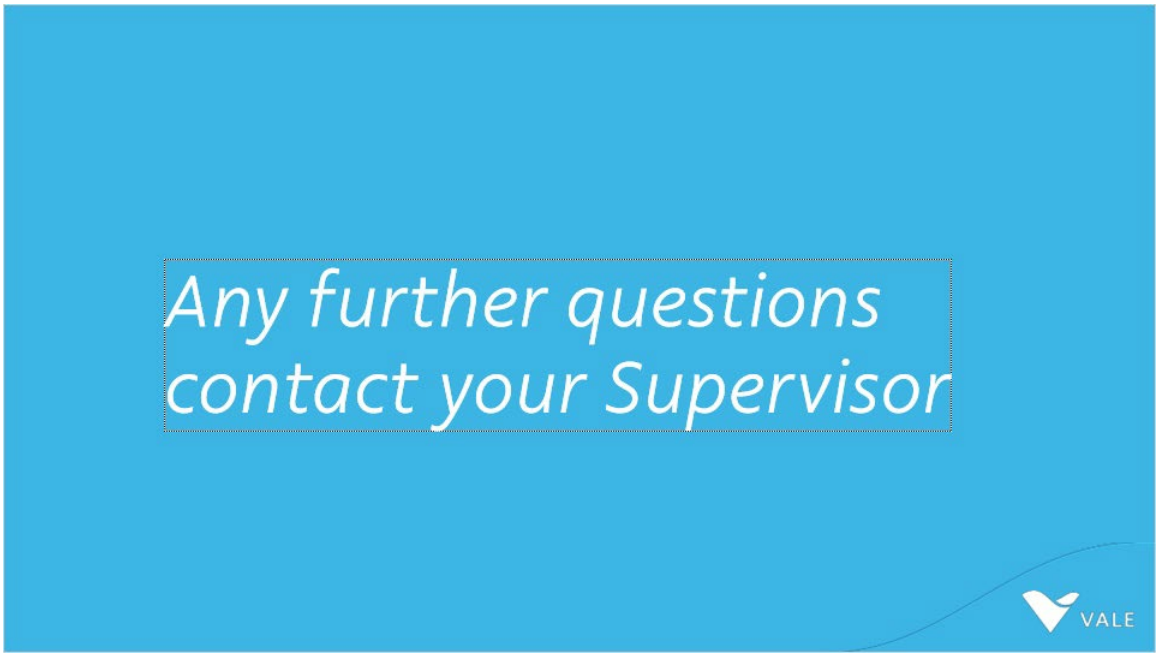
1.46 Ontario Regulations

1.47 Ontario Regulations

1.48 IS THIS ELECTRICAL WORK?



1.49 Any further questions?



1.50 Start The Module Quiz