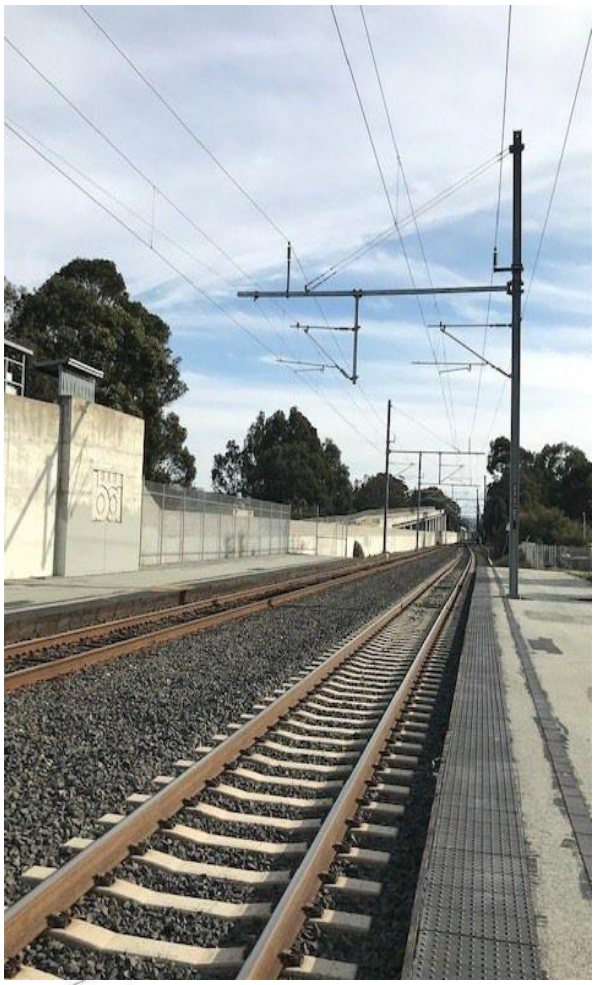
CalMod

OCS Orientation & Safety Awareness



January 2023

Emergency Response Personnel

Caltrain

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PCEP Project System Safety & Security

Philip Adams / Jim Brown

CalMod

OCS Safety Awareness

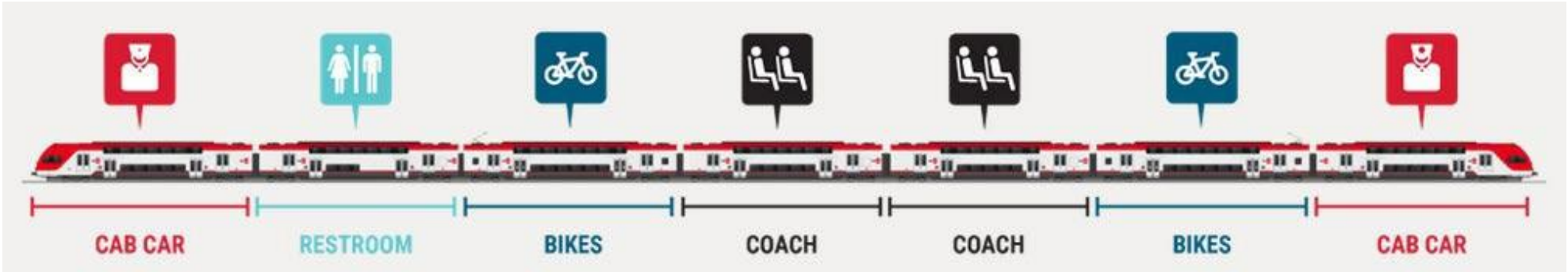
This presentation is for emergency response personnel (Fire, Police, EMS) who may be called upon to respond to emergencies on the Caltrain right-of-way.

This includes grade crossing incidents or emergencies at other Caltrain properties such as: stations, traction power facilities, maintenance facilities or yards.

Caltrain

Project Description

The CalMod Project entails purchasing 133 new Electric Multiple Unit (EMU) trains (19-7 car trainsets) and installing an Overhead Contact System (OCS) and traction power system to power them.



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Project Description

The project also includes:

- Signal System & Grade crossing modifications
- Communication System Upgrades
- Minor tunnel modifications; and
- Modifications to Central Equipment Maintenance and Operation Facility (CEMOF).

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System Description

- The electrification of Caltrain's 51 mile right-of-way between San Jose and San Francisco is scheduled to be completed in 2024.
- A 4-mile segment of track between MP 43.8 and 49.2 (Segment 4) will be completed and electrified within the 1st Quarter of 2023 so that Caltrain can start testing the new EMU's as they arrive.
- Construction of the 51-mile OCS is ongoing and will be tested in stages as the work progresses.

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Construction Segments

Segment 1: San Francisco to So. San Francisco

Segment 2: So. San Francisco to Menlo Park

Segment 3: Menlo Park to Santa Clara

Segment 4: Santa Clara to Tamien

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System Description

- 51-Mile (SF-SJ) 25-kV High Voltage Overhead Contact System includes a number of ‘phase breaks’, sectionalization disconnect switches, and other devices to regulate traction power.
- The OCS wires are mounted (under tension) on OCS poles a approximately 22-feet above the top of rail in order to maintain steady contact with the EMU pantograph.
- The System includes 10 traction power facilities:
  - Two Traction power substations (TPS-1 & TPS-2)
  - 7 Paralleling Stations (PS 1 thru 7)
  - 1 Switching Station (Redwood City)

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Definitions

- OCS: Overhead Contact System: Elevated power lines used by trains for power. Energized at 25,000 Volts-AC.
- At Risk Activities: Any work activity that has the potential to come within 10’ of OCS power lines (not covered by this training).
- Power Director or Electrical Controller: Person responsible for removing and restoring power to the OCS system.

Caltrain

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Definitions

- Traction Power Substation (TPS): an electrical installation that supplies traction power to the OCS and at which the voltage of the PG & E utility supply system (115,000 volts) is transformed to the OCS voltage of 25,000 volts.

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CalMod

Definitions

- High Voltage: A nominal voltage of 600 volts or more.
- Catenary: The combination of conductors, hangers and in-span hardware attached to the OCS poles which are ultimately used to support to the OCS wires.

Caltrain

CalMod

Definitions

- Paralleling Station: A sub-station that is used to boost and maintain power along the overhead contact wires between substations.
- Grounding: The establishment of a common reference voltage (typically 0V) between power sources and/or electrical equipment.
- Switching Station: a station designed to switch the power from one substation to the other if needed.

Caltrain

CalMod

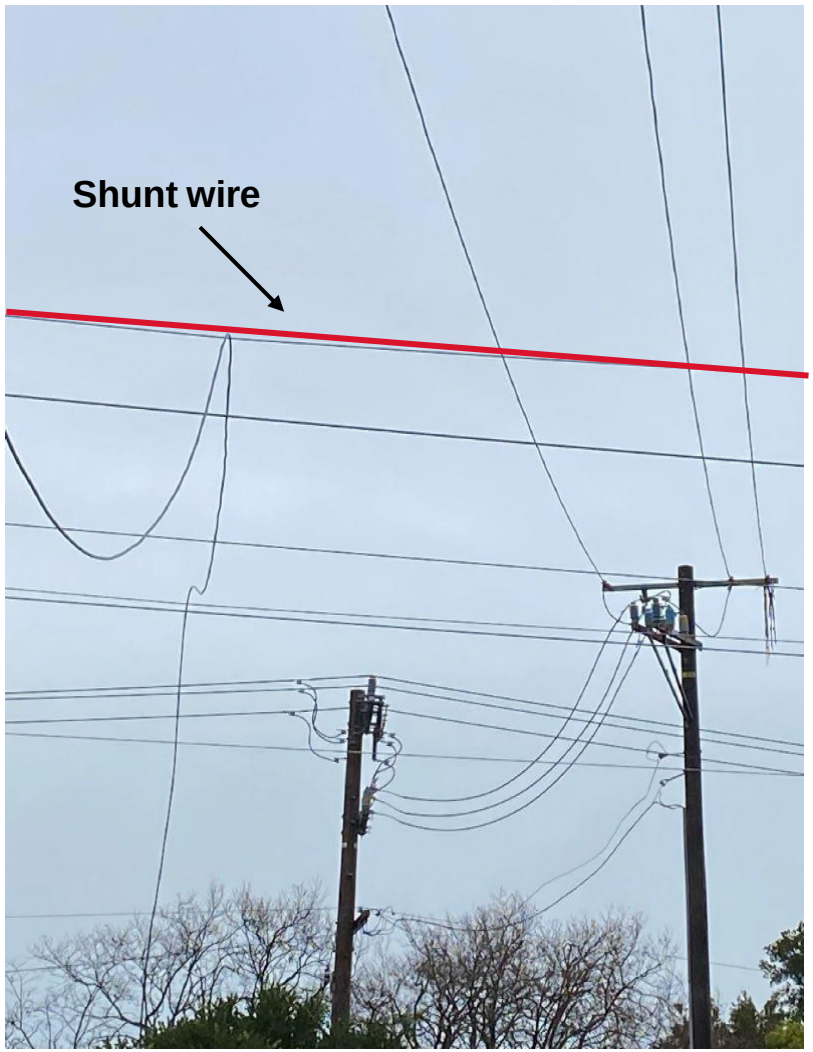
Definitions

- Traction Power Return System: a system comprising of running rails, impedance bonds, static or ground wires, return cables and the earth, each of which provides a part of the electrically continuous return path for the traction currents.

Caltrain

Definitions

- Shunt wire: a wire strung between two OCS poles parallel to the track on both sides underneath PG&E overhead high voltage wires.



Definitions

- Electrical Operating Instructions (EOI): Procedures established to ensure safety for those working at or in proximity of the OCS.
- Qualified Electrical Worker or Nominated Person*: a qualified TASI MOW or Balfour Beatty employee trained to work or maintain the overhead contact system.

**This is the person you should look for when arriving on Caltrain property who can confirm power-off.*

Definitions

- **Safety Zone:** a 10’ horizontal and vertical distance around the overhead contact wire that must be maintained (at a minimum) for work to be performed without power having being removed.
- **Isolation Plan:** plan that must be followed when requesting, removing or restoring OCS power.
- **Clearance Form:** form used to confirm isolation of the OCS by the BB Nominated Person.

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Overhead Contact System (OCS)

- Poles and Wires
  - Poles ~200 feet apart along ROW
  - Poles 30 to 50 feet tall
  - 4 wires between poles per track
    - Feeder
    - Static
    - Messenger
    - Contact
  - Contact wire installed approx. 22’ above rail.
  - Shunt wire placed under PG&E wires where they cross tracks.
  - Milepost markers (and pole ID) on each pole.

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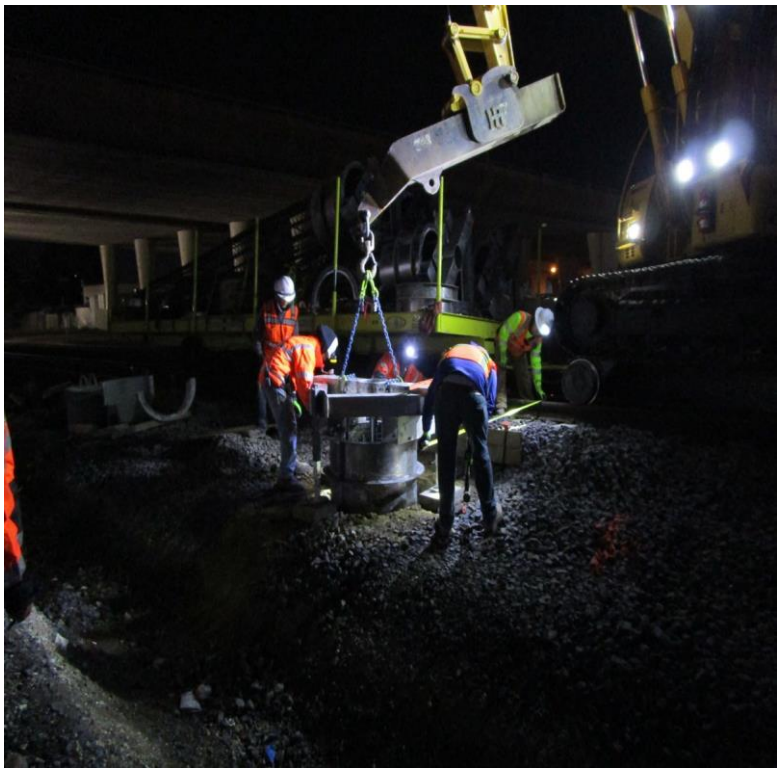
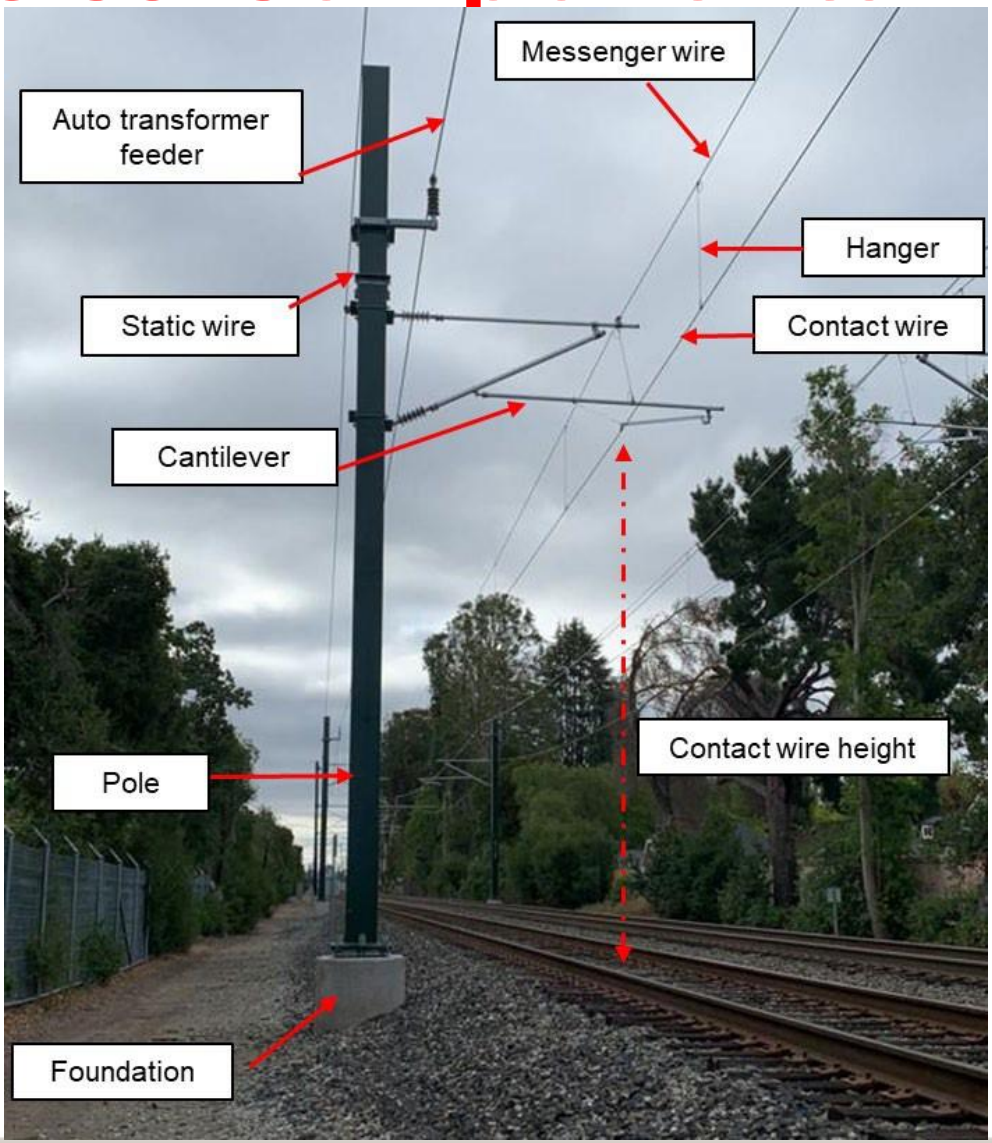
OCS Components

In all there were 3,094 TP-Pole foundations installed along the 51 miles of the right of way.



OCS Components



Danger – OCS Overhead Wires

- The **Contact and Messenger Wire** are connected and carry 25,000 volts
- The **Feeder Wire** carries 25,000 volts
- All are “Live” and no one should be working within 10’ (horizontally or vertically) of any of these wires unless power has been tested, grounded and confirmed off by a Qualified Electrical Worker (QEW).

Danger - Overhead Wires

Red: Messenger wire, Contact wire and Cantilever. All are energized and contain 25,000 volts AC.

Blue: Feeder wire, energized and contains 25,000 volts AC.

Green: Static wire, connects poles to ground.

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Danger – Overhead Wires

Remember, tracks are powered independently, just because power has been removed from one track the other track is still live!

The train dispatcher will be attempting to move trains on the affected track into stations to avoid evacuating onto the right of way.

Caltrain

Danger – Overhead Wires

If you are going to use water on a train traction power must be isolated (removed) from <u>both tracks</u> to avoid coming in contact with the live wire.

Danger - Overhead Wires

- The cantilever is electrically connected to the contact and messenger wire and therefore ‘LIVE’ and carries 25,000 volts.
- Each cantilever is independent of each other regardless if it is shares the same OCS pole or not. This is so one track can be powered down if need be while the other remains live.
- Only Qualified Electrical Workers (QEW)’s are authorized to work on the cantilever and power must be confirmed off.

Cantilevers

One OCS pole can support multiple cantilever assemblies.

Back to Back Cantilever

- One OCS pole can support two or more cantilevers.
- Each track has the same four wires (messenger, contact, feeder and static) and are independent of each other.
- Make sure you know your location (MP and ID) and which track you will be working on.
- Look for a Caltrain/TASI employee of a Qualified Electrical Worker to verify.

Portal Structure

Depending on the nature of the emergency and the location, power may be required to be removed from multiple tracks.

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Long Reach Cantilever

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Bridge Arm Support

Tunnels, bridges and underpasses are all electrified and carry the same voltage (25,000 kV) as the rest of the OCS.

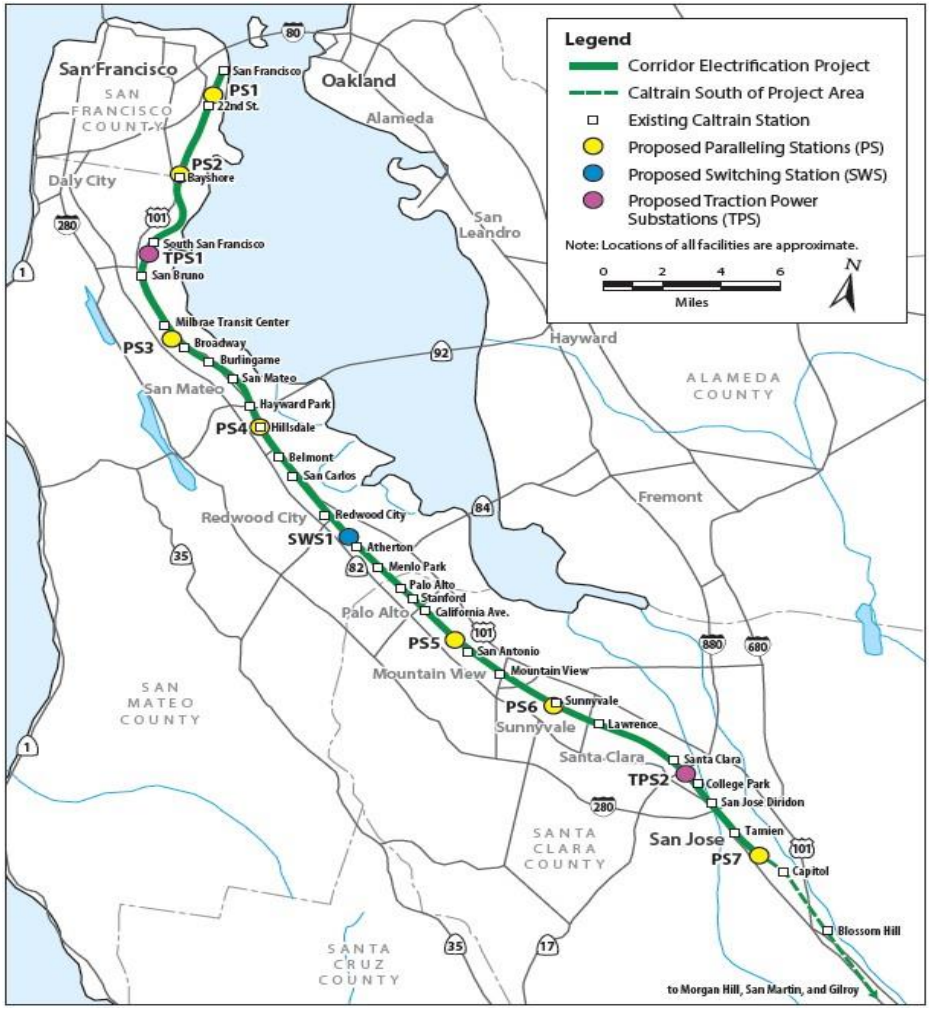
There is limited clearance between the OCS wires and the structures above.

Tensioning Systems

The overhead wires are under constant tension. If they break and become unattached they will tend to try to “re-coil” and basically follow tracks back to the end still connected.

Traction Power System

- 2 Traction Power Substations (TPS)
  - TPS-1: South San Francisco station
  - TPS-2: South of Santa Clara station
- 1 Switching Station (SWS)
  - Redwood City (MP 26.1)
- 7 Paralleling Stations (PS)
  - Located between San Francisco and San Jose



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Traction Power Substation

Two traction power substations are located along the 51 miles of track, TPS-1 (MP 9.04) on the north end and TPS-2 (MP 45.3) on the south end.

Each traction power substation provides 25kV AC power through the overhead wires to the trains pantograph.

The system is designed so that it can be operated even if one substation is out of service.

Only QEW's can access these facilities!

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Traction Power Substation

TPS-2 (MP 45.3)
1025 Stockton Avenue, San Jose

Caltrain

Traction Power Substation(TPS-2)

San Jose, CA

Paralleling Stations

PS-1: @ MP 0.9
PS-2: @ MP 4.8
PS-3: @ MP 14.9
PS-4: @ MP 19.9
PS-5: @ MP 31.8
PS-6: @ MP 38.6
PS-7: @ MP 49.0

Seven paralleling stations are located along the right-of-way to help balance the OCS voltage throughout the system. Only QEW's can access these areas!

OCS Initial Energization

The OCS will be energized in segments with Segment 4 (San Jose—Santa Clara) being the first.

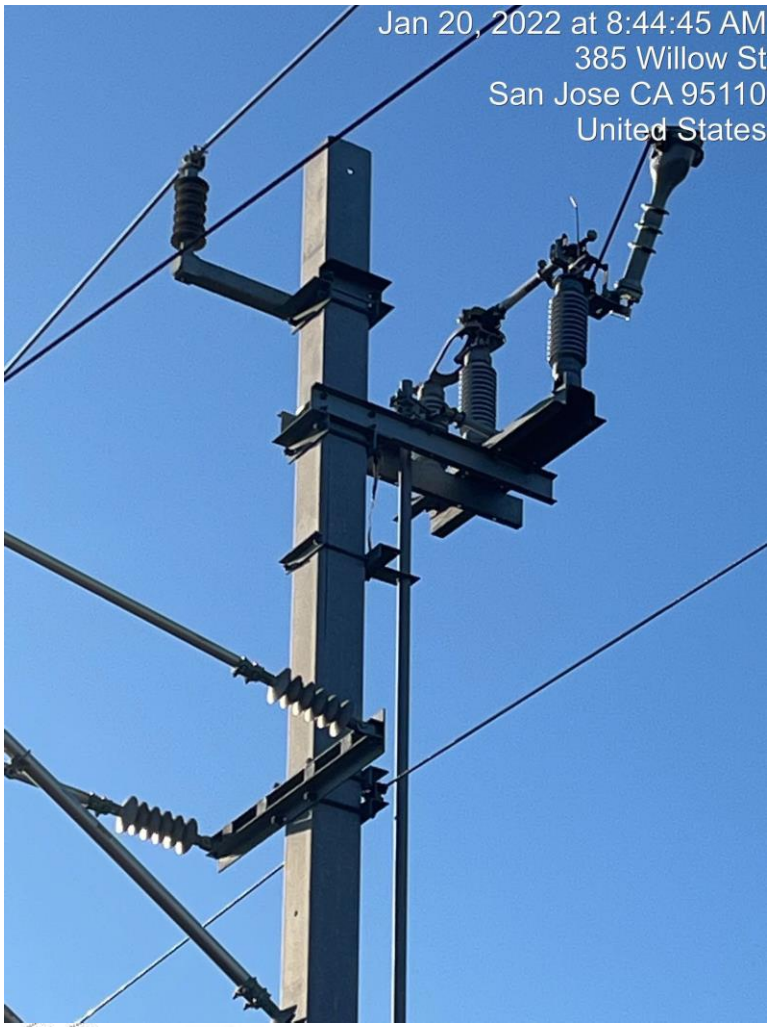
Tentative schedule

- Segment 4 (MP 43.80-51.64): Feb. 2023
- Segment 3 (MP 28.98-43.80): May 2023
- Segment 2 (MP 7.91-28.98): Fall 2023
- Segment 1 (MP 0.00-7.91): Winter 2024

OCS Power Management

- Sections of the OCS are independently controlled for each track through the use of a SCADA System or manually at substations or Sectionalization switches.
- The switchgear will initially be under the control of the Balfour Beatty designated Electrical Controller (BBEC), who can authorize the operation of the switchgear.

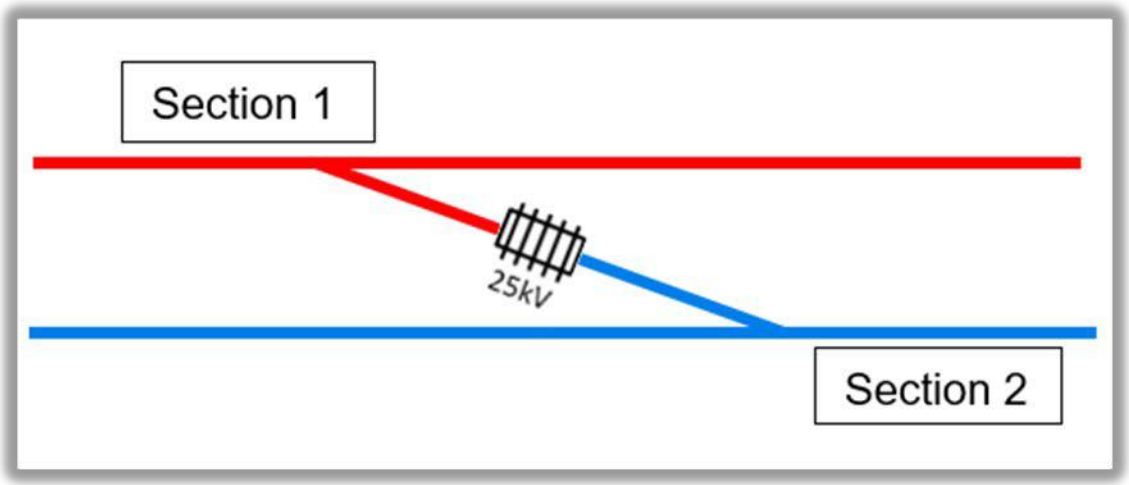
OCS Power



The Substation Traction Power Feeds are designed to open automatically (Trip) in the event of an overload or fault condition in any section.

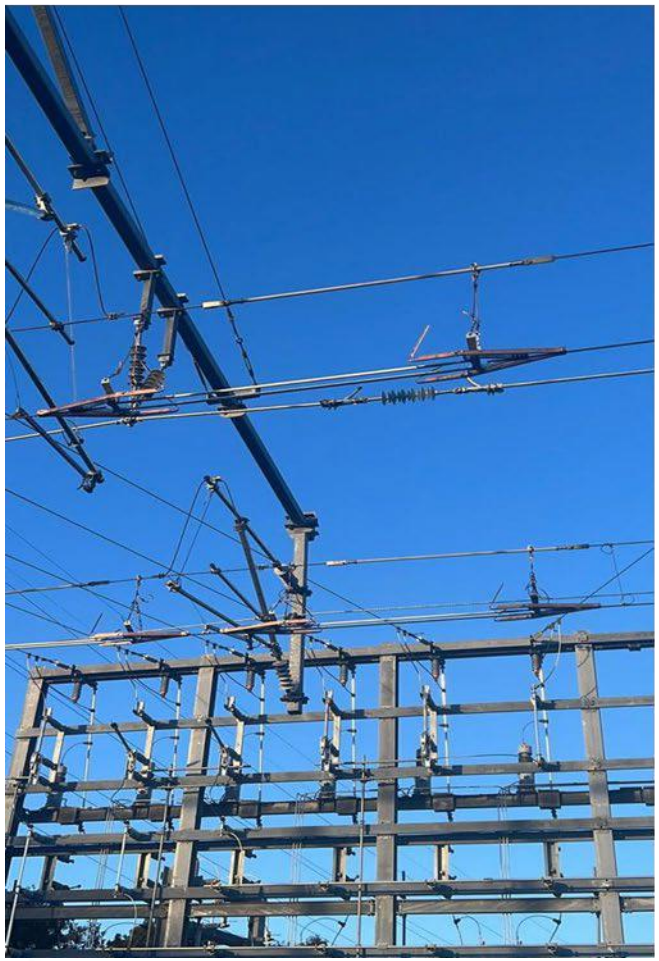
The OCS is further divided into sub-sections by section line disconnect switches which allows a sub section of the OCS to be isolated and grounded in case of fault, or for construction / maintenance purposes, while the electrical supply to other sections is maintained.

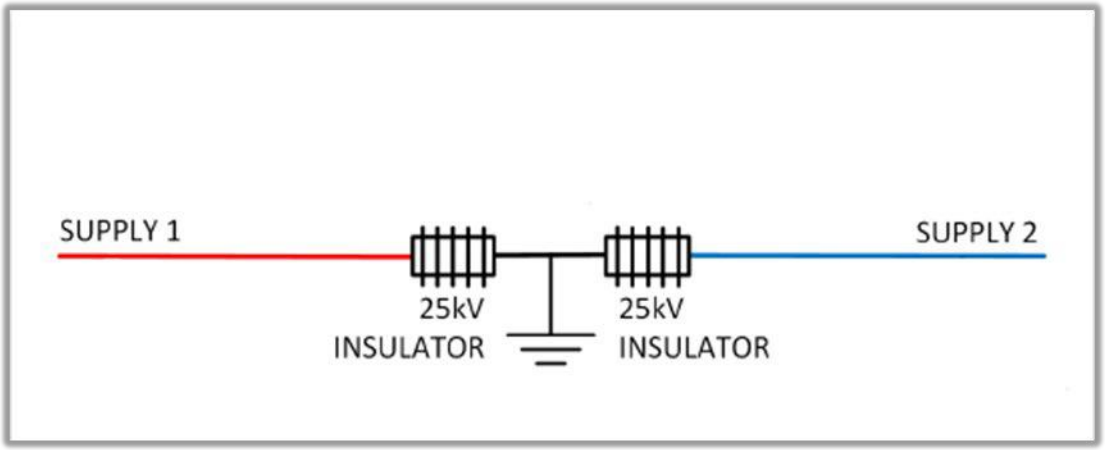
Phase Breaks



Section insulator are used at crossovers between two tracks where the electrical sections are fed from different circuit breakers. They are also used at switching locations to enable a break in the section for a temporary isolation.

Phase Break





Phase breaks are installed where different supply phases meet. Phase Breaks are found at feeder stations. Care needs to be taken working around neutral sections as both supplies need to be isolated to protect staff from coming into contact with the Live 25KV OCS.

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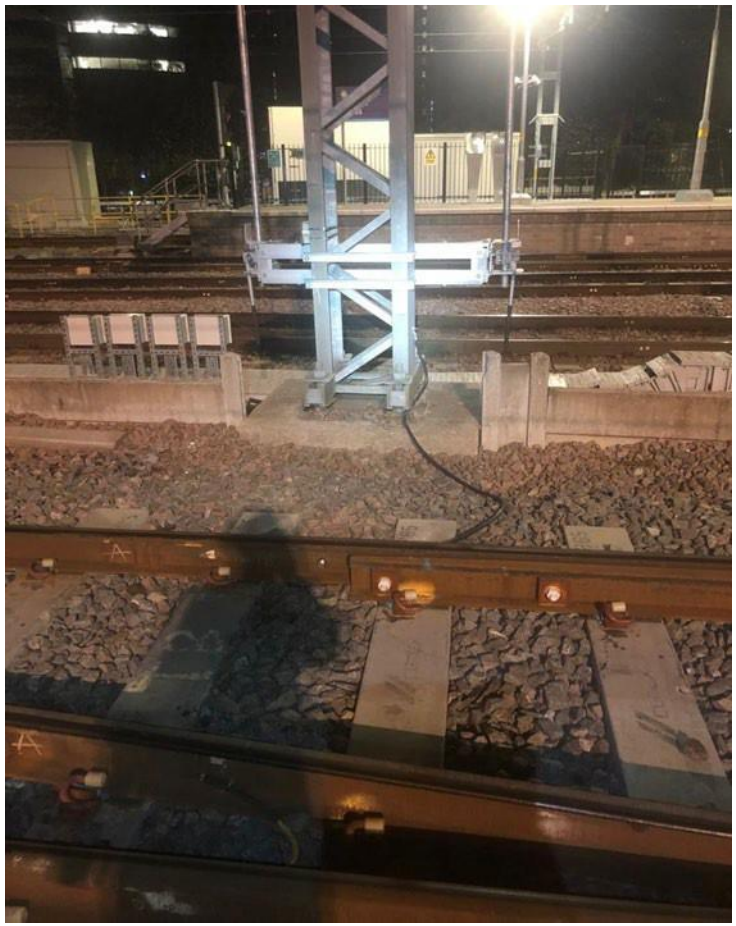
Grounding & Bonding

- Grounding and bonding is one of the most important components of the entire traction power system. It provides a path to prevent the build-up of electricity that otherwise could be dangerous.
- All conductors of electricity within 13’2” of the center of track are grounded, this includes light poles, benches, ticket machines, etc.
- Fencing along the ROW that is within 45’ from the center of track is also grounded.

Caltrain

OCS Pole Grounding



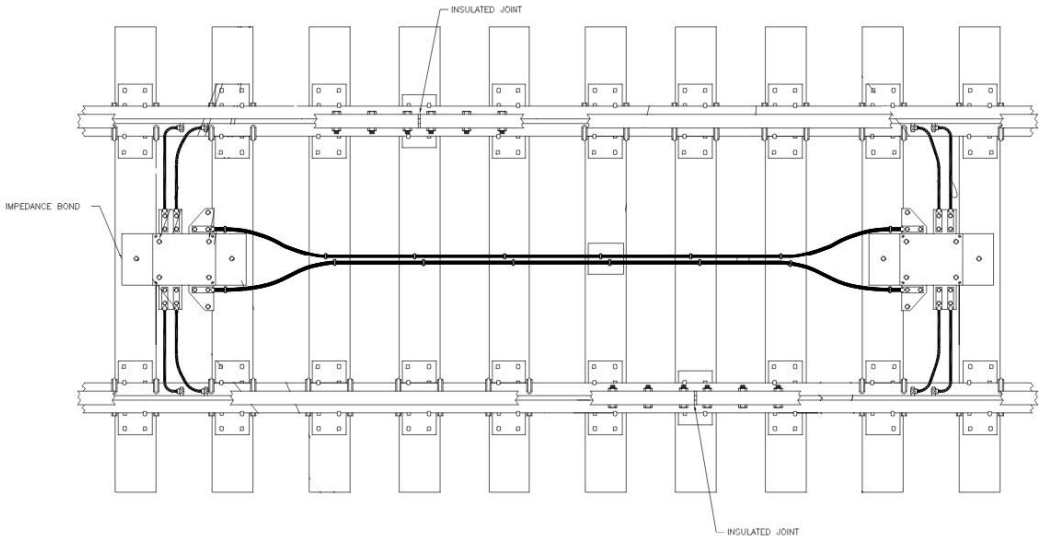
All the supporting OCS structures are connected to the return rail (ground) so that the power network is short-circuited if an insulator fails.

Where an aerial ground wire (Static wire) is connected to the multiple structures the requirement for traction return grounds are less frequent.

CalMod

Impedance Bonds

- Impedance Bonds (IBs) are located throughout the system in the gauge of the track.
- They provide an electric path for the traction return current around insulated joints.
- Do not come in contact with a disconnected cable as they may be potentially hazardous.



Caltrain

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Pantograph

Roof mounted device that transmits current between the contact wire and the EMU propulsion system.

Current flows from the contact wire into the carbon contact strips on the pan head and continues to the main electrical connection which supplies power to the EMU.

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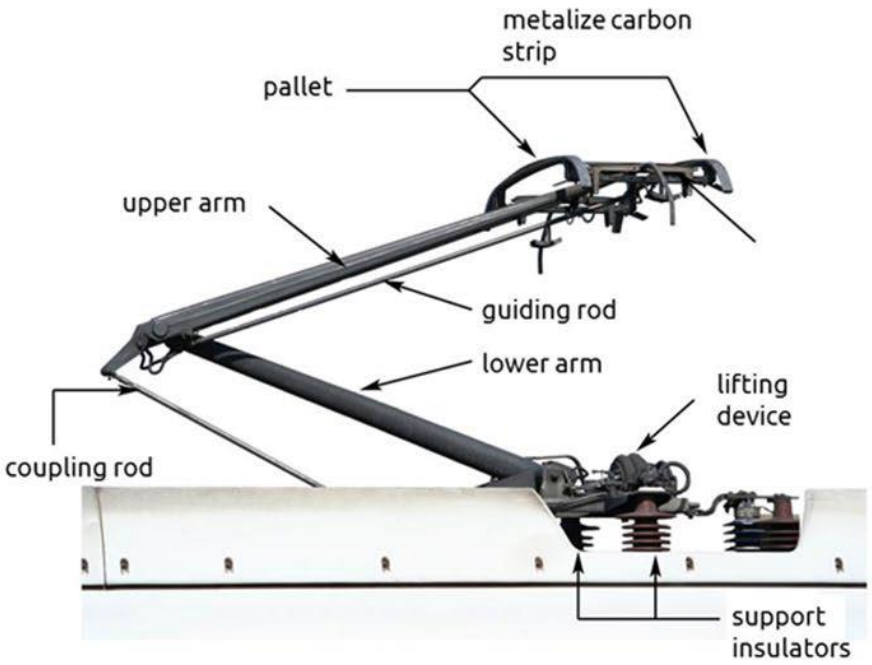
Pantograph

The current is collected from the contact wire via the pantograph and passes through the train's traction equipment before passing through its axles and wheels to the traction return rail.



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OCS Safety - General

Although we are energizing in phases, always assume that the overhead contact wire is LIVE and treat it that way.

- Under no circumstances should you ever attempt to rescue someone who is in contact with the overhead wire until you receive confirmation that power has been removed.
- If the OCS wire comes down on a vehicle, from a safe distance, direct the driver to attempt to drive away.
- If that action is not possible direct the occupants to remain in the vehicle until the power has been confirmed off.

Caltrain

Hazard: Live Electrical Equipment

Any work (or emergency recovery activities) that has the potential to come within the 10’ Safety Zone will need to follow the “25kV Electrical Safe System of Work Procedure” that contains the Isolation Process used for removing and restoring power.

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Hazard – Live Electrical Equipment

The Overhead Contact System, pantograph and roof mounted electrical equipment on a train are extremely dangerous. Never-

- Touch;
- Get within 10 feet of;
- Allow anything to touch

Any electrical components or wire until power has been confirmed off!

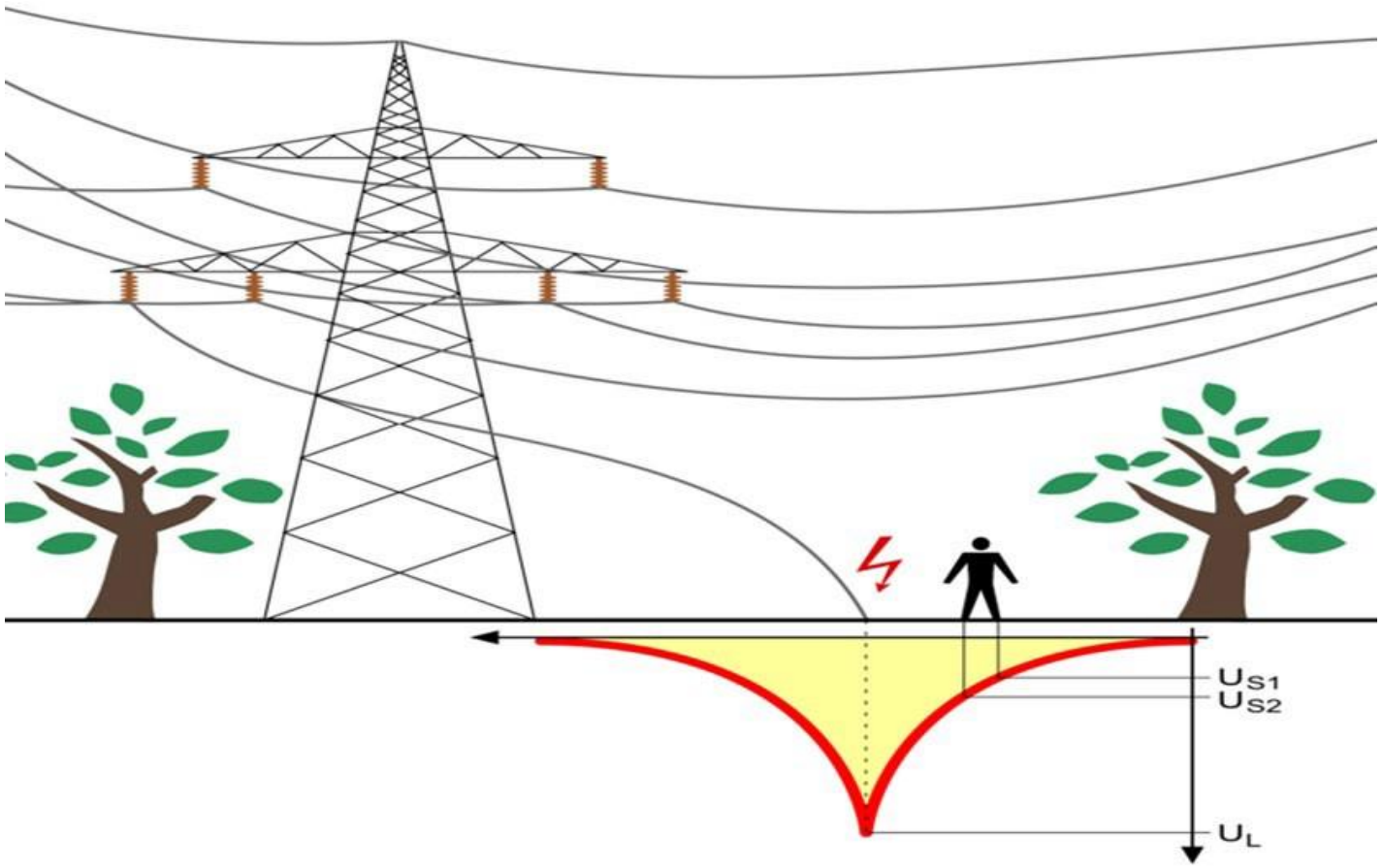
Caltrain

High Voltage

High Voltage electricity follows all paths to ground.

If there is a down OCS wire stay at least 25’ away!

You do not have to “physically” touch an energized OCS wire to draw a potentially deadly current.



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At Risk Work

Employees working from the track whose equipment or materials, (e.g., scaffolds, man-lifts/bucket trucks) may come within 10’ of OCS are working at risk.

Isolation Procedures need to be followed.

Isolation Procedure is not covered in this class!

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25kV Electrical Safe System of Work Procedure

Isolation Process

Planning

- All work shall be subjected to risk assessment in relation to the danger from live parts of the OCS, and other live equipment
- Submit pre-work request to Balfour Beatty Isolation Planning Manager (BBIPM)
- Planning commences between team and BBIPM

Isolation Permit

- Balfour Beatty Electrical Controller (BBEC) authorised Form EC-Nom
- Balfour Beatty Nominated Person (BBNP) de-energizes on appointed date, installs grounds and provides Clearance Form to team

Construction

- Team undertake work. When complete and clear of OCS, hand back Clearance Form duly signed as surrendered

Hand back

- BBNP removes grounds from OCS and surrenders all Clearance Forms to BBEC
- BBEC cancels all Form EC-Nom's and instructs BBNP to reenergize
- BBNP follows reenergization instructions and confirms to BBEC system fit for Electric Traction

Caltrain

Permit To Work on or near the OCS Clearance Form

CLEARANCE FORM

This Form certifies that the Overhead Contact System (OCS) including Feeders are electrically isolated where necessary and grounded and constitutes a Permit to Work on or near these

WARNING: - THE ISSUE OF THIS CLEARANCE PERMIT DOES NOT MEAN THAT TRAIN MOVEMENTS ARE STOPPED ON THE TRACKS CONCERNED AND WHERE NECESSARY SUCH ARRANGEMENTS SHALL BE MADE IN ACCORDANCE WITH TRACK ALLOCATION PROCESS

Part 1.

Issued To_____(Name)_____(Cert. No)_____(Employer)

For the purpose of carrying out the following work:

_____The following equipment is Grounded

Equipment	Working Limits		Tracks(s)	Remarks
	At/from structure	To structure		
OCS Equipment				
Feeders				

ALL OTHER OVERHEAD CONTACT SYSTEM (OCS) EQUIPMENT MUST BE REGARDED AS LIVE AND DANGEROUS AND MUST NEITHER BE TOUCHED NOR APPROACHED

This CLEARANCE permit is to be released not later than_____Hours, on .....date

Issued by

_____(name)_____signature Message No _____

I undertake to ensure that all persons for whom I am responsible fully understands the extent of the Isolation and the working limits before work commences. I fully understand all electrical hazards as briefed by the Nominated Person

Received by_____(name)_____(signature)

Part 2. (For use if permit holder is relieved – continue on back of form if necessary)

I am now in charge of the work under this Clearance Form and fully understand the conditions, and have notified the issueror Balfour Beatty Electrical Controller

	1	2	3	4
Name				
Signature				
Name of person Relieved				
Signature of person relieved				
Date and Time (hours)				

CLEARANCE FORM (page 2)

Part 3. The work for which this Clearance Form was issued is completed. All persons for whom I am responsible, and all materials areclear of the OCS including Feeders, and they have been instructed that the OCS must now be regarded as LIVE and DANGEROUS.

I hereby release my Overhead Catenary Permit. The OCS is fit (*)_ for the passage of electric traction or NOT fit_ for the passage of electric traction/other (describe)_____Delete as required.

_____(signature)_____(name)_____(employer)

Date_____Time_____Received by_____(signature)_____(name)

White copy: - Permit Receiver Blue copy: - Permit Issuer Pink copy: - remains in book

Safe Work Area

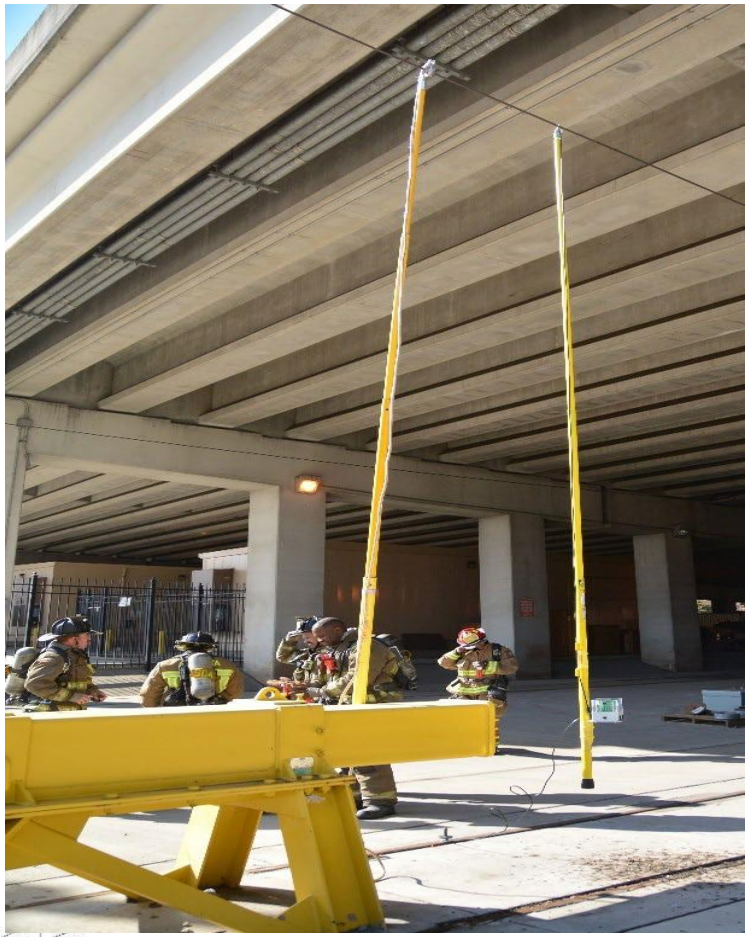
In order to ensure the area where you will be working is safe in an emergency the Qualified Electrical worker will:

1. Test the wire to confirm power has been removed;
2. Ground the wire to ensure no current can reach your work site.
3. Notify the Dispatcher that both items above were completed.

Safe Work Area

- Emergency response personnel should wait until the Caltrain Dispatcher notifies their dispatcher that the power has been removed, the area has been tested, grounded and is safe to operate in.

Grounding the OCS



The Hot Stick (voltage sensing device) and Grounding Poles allow the qualified TASI/BBII employee to ensure the power has been removed and safely grounded prior to allowing anyone to work in the area.

Hot Stick (voltage sensing device)

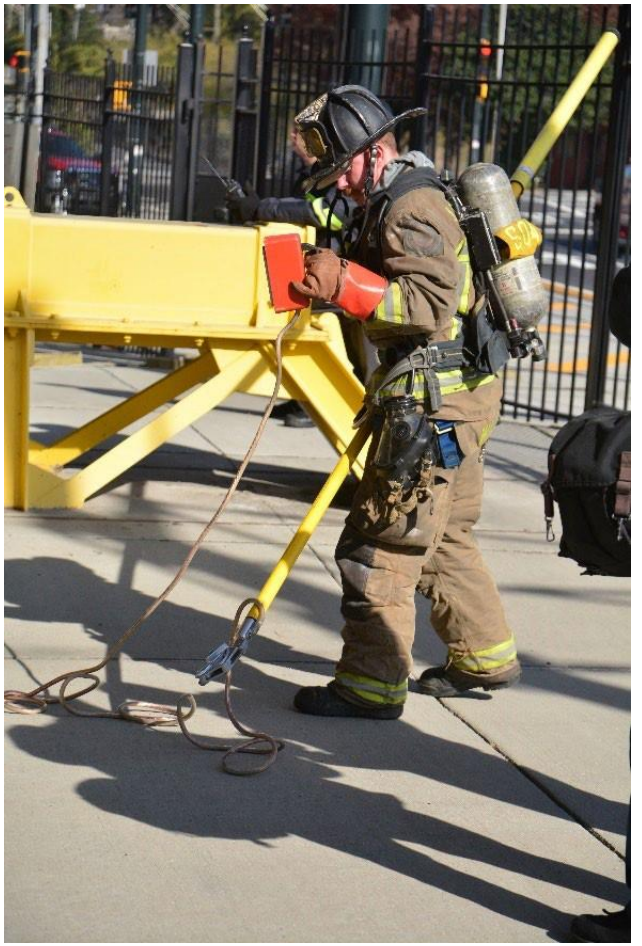
The “Hot Stick” (voltage sensing device) is used by the Qualified Electrical Worker to test the overhead contact wire to ensure power has been removed from the area.

The QEW will energize the stick to show the stick is working. Once power has been removed and the wires grounded the QEW will test the wire again to show it has been de-energized.

Grounding the OCS

- *The Ground Poles are used to form a closed loop that returns the 25 kV to ground to ensure that there is no current in the line section.*

- These are connected on each end of the work zone once zero voltage is confirmed on the Hot Stick.



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Safe to Work

Until a Qualified TASI or BBII employee tests and grounds the OCS the system is to be considered live and no one should be working within 10’ of the wires!

This includes TASI and Caltrain employees, Fire, Police and EMS personnel.

Caltrain

Restoring Power

- After the emergency or maintenance is completed, the area between the grounding rods will be checked to ensure there is no one still on the tracks.

- Once confirmed that the area is clear the QEW (Nominated Person) will remove the ground rods and notify the dispatcher that it is safe to restore power.

Restoring Power

- The restoration of power must be followed in accordance with the Isolation Procedure.
- First Responder Incident Commander notifies their Command Center and the onsite Caltrain Person-in-Charge that the area is clear of their personnel and equipment.
- First Responder Command Center to Caltrain Command Center notification is required verifying that the incident site is clear.

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Restoring Power

- Caltrain will then follow power restoration protocols in accordance with the Isolation Procedure that includes verification that all personnel and equipment are clear of the site prior to requesting the restoration of power.
- The Isolation Procedure must be followed by everyone at every emergency. No exceptions!

Once power is restored its business as usual.

Caltrain

24 hr. Safety Hotline

We are providing 24 hr/7 day a week Safety coverage on the PCEP project.

If you have any questions or safety concerns regarding the project please call:

650-288-5070

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In closing, remember:

Make sure the power has been removed and confirmed off before performing any work that may come within 10’ of the OCS wires.

Caltrain

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Thank you!

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QUESTIONS?