

SSRL Policies for Securing Electrical Hazards and Allowing Access to Accelerator Tunnels
Summary of Conclusions of the SSRL Tunnel Access Task Team
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Scope and Purpose

The SSRL accelerator tunnels contain electrical equipment having exposed conductors that operate at over 50 volts AC or DC, or at less voltage but high current, creating potentially hazardous situations and requiring treatment in accordance with Chapter 8 (Electrical Safety_ of the SLAC ES&H Manual and the SLAC *Lock and Tag Program for the Control of Hazardous Energy* (SLAC-I-730-0A10Z-001).

This document provides policies and guidance for procedure development to be used for securing electrical hazards and allowing access into SSRL's accelerator housings. As a guidance document, it shall be used in conjunction with referenced procedures and other hazard mitigation tools noted herein to meet electrical safety requirements.

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1. Guidelines for Securing Electrical Hazards for Working or Entering Accelerator Tunnel

“Each person performing maintenance or service activities or otherwise entering within an electrical hazard boundary must be in control of the associated hazardous energy.”

A person may obtain this control by at least one of the following:

- 1.1 Perform lock-out, tag-out and verification of de-energization of equipment associated with the exposed electrical hazards.
- 1.2 Perform lock-out of equipment associated with the exposed electrical hazards, relying on the certified verification of electrical hazard de-energization by a trained and authorized “Crew Lockout Leader” (CLL) as defined in the SLAC “Lock and Tag Program for the Control of Hazardous Energy” (SLAC-I-730-0A10Z-001), Chapter 8. Each worker has right to perform verification of electrical hazard de-energization independently of the CLL verification, either by observing that the operator’s locks are in place according to map or procedure and/or observing de-energization records, or by performing full verification.
- 1.3 For exposed electrical hazards included in a PPS redundant electrical hazard interlock **AND** that have also been locked-out and verified as being de-energized by the CLL, possess a PPS key (e.g. access gate keybank key) while in Controlled Access only. This protection does not apply in Permitted Access, where the tunnel can be accessed without a PPS key.

The PPS must be in a certified operational state as recorded in the appropriate Beam Authorization Sheet, and the PPS certification must include verification that electrical hazards are truly de-energized when shut down by the PPS electrical hazards interlock.

Sole dependence on the PPS without additional equipment lock-out for hazard de-energization is not acceptable at this time.

- 1.4 Be escorted by an authorized person having performed lock-out and tag-out with verification, either personally or via the crew lock-out verification, and having signed a tunnel entry sign-in form (under control of the SPEAR operator) that must be signed again after exit from the tunnel.

2. Comments on SSRL Policies for Securing Electrical Hazards and Allowing Access to Accelerator Tunnels

- 2.1 The SPEAR operators will serve as “Crew Lockout Leaders” (CLLs) for the SSRL Linac, Booster/BTS and SPEAR accelerator facilities. The Gun Test Facility (GTF) operator(s) will serve as the CLL for the 2 electrical hazards in the Linac vault associated with the GTF.

To maintain continuous control of the electrical hazards lock out by the operator(s), CLL responsibility shall be transferred from one operator shift to another in a formal way, as documented in the Operator Log-book, during each shift change.

If for any reason the Operator lock must be removed from the Operator lock box for a particular accelerator tunnel, the tunnel shall first be returned to No Access, including the requisite tunnel search if transitioning from Permitted Access. The operator shall describe in detail all steps and actions associated with unlocking the box, re-securing the electrical hazards as necessary, and re-locking the box. If the verified de-energized state of any electrical hazard is lost, that hazard(s) shall be re-verified as described in section 3. A new signed verification form showing that the specific electrical hazard(s) has been verified shall be posted at the Operator lock-box along with the original verification from for all electrical hazards. If there is any uncertainty that control of an electrical hazard(s) has been maintained by the operator(s) during this process, re-verification of electrical hazard(s) de-energization shall be required.

- 2.2 All exposed electrical hazards in SSRL accelerator tunnels are locked out and verified by an accelerator operator or operators prior to allowing tunnel access according to the procedure described in Section 3.
- 2.3 Some operator-locked-out exposed electrical hazards are included in a PPS electrical hazard interlock and some are not. The exposed electrical hazards that are not included in the PPS but are locked out are all magnet power supplies having voltage < 50 V but current >10 A, so they present a “startle hazard” or “flash/melt” hazard if the magnet leads in the tunnel are shorted by some conducting object (e.g. a wrench or screwdriver). The SSRL ASD will endeavor to cover as many of these exposed hazards as practical within the next year.
- 2.4 Even though the lock-out of covered magnet electrical hazards not included in PPS electrical hazard interlocks is not strictly required, SSRL will include them in the operator lock-out procedure.
- 2.5. SSRL defines “major work” and “minor work” on exposed electrical hazards that are both included in the operator lock-out and in a PPS electrical hazard interlock. “Major work” denotes any work that significantly alters the configuration of the exposed electrical hazard, such as disconnecting magnet power leads, welding or drilling magnet coil conductors or connection components, etc. “Minor work” denotes work involving incidental contact with exposed electrically hazardous conductors without significant modifying them, such as tightening a connection bolt or cooling water connection, servicing a klixon, etc. While applying personal lock and tag to the Operator lock box for working on exposed electrical hazards included in a PPS electrical hazard interlock during Controlled Access is not strictly required by the guidelines in section 1, SSRL will require this lock and tag for “major work” on these electrical hazards. This requirement aids configuration control of hazardous electrical systems undergoing significant modification since the SLAC lock and tag policy requires personal locks and tags to remain in place until completion of work.
- 2.6 The **Linac vault** contains 4 magnets powered by supplies rated < 50V but with currents >10 A. whose leads are covered and are included in the operator lock-out. The Linac PPS has no electrical hazards interlock. Access to the vault will require a person to place his/her lock and tag on the Operator lock box if that person will work on or within 1 ft of the exposed or uncovered hazardous leads. Otherwise, no lock and tag other than the operator lock-out is necessary. Linac vault access and work requirements for the case where the electrically hazardous magnet leads are not covered are given in Table 2a, and those for the case with covers are given in Table 2b.
- 2.7 All but 3 exposed electrical hazards in the **Booster/BTS tunnel** are included in the PPS electrical hazard interlock, and all exposed electrical hazards are included in the operator lock-out. Controlled Access to the Booster/BTS tunnel will require a person to place his/her lock and tag on the Operator lock box if that person will work on or within 1 ft of the exposed or uncovered hazardous leads of magnets not included in the PPS, or if the person will perform “major work” on exposed electrical hazards included in the PPS. Otherwise, a gate key will suffice for Controlled Access, even if coming into contact with exposed electrical hazards included in the PPS and operator lock-out while doing “minor work”. Tunnel access and work requirements for the Booster/BTS tunnel are given in Table 3.
- 2.8 All of the exposed electrical hazards in the **SPEAR tunnel** are included in the operator lock-out and the PPS electrical hazard interlock. Controlled Access to the SPEAR tunnel will require a person to place his/her lock and tag on the Operator lock box if that person will perform “major work” on exposed electrical hazards. Otherwise, a gate key will suffice for Controlled Access, even if coming into contact with exposed electrical hazards while doing “minor work”. Tunnel access and work requirements for the Booster/BTS tunnel are given in Table 4.

3. Operator Lock-out and Verification of Electrical Hazards for SSRL Tunnel Access

Accelerator operators shall use the following steps to lock out the electrical hazards for an accelerator tunnel. The operator or operator team is considered to be "Crew Lock-out Leader" (CLL) for workers in tunnel, per SLAC "[Lock and Tag Program for the Control of Hazardous Energy](#)" (SLAC-I-730-0A10Z-001) on group lock-out (Chap. 8).

- A.** If accelerator electrical hazard(s) is in operation and de-energization can be monitored by computer control system recording program or by local real-time observation of volt meter during **transition** from energized to de-energized state, then use steps 1-6 for operator lock-out:
1. While in No Access, operator(s) runs the control setting for each operational electrical hazard having variable control to either:
 - a) zero, using the computer control system or local equipment control, if the lock-out component each hazard is not shared with others; or
 - b) ~5% of maximum setting where possible, either using the computer control system or local equipment control, if the lock-out mechanism for the hazard is shared with others (e.g. the MCCs for SPEAR power supplies)while monitoring the voltage transition for each, either using the computer control recording system or observing locally.
Electrical hazards without variable control (e.g. MCOR bulk supplies) are left on.
 2. Operator(s) turns off each electrical hazard, either from computer control system or locally with appropriately rated power switch, while monitoring the voltage transition for each, either using the computer control recording system or observing locally.
NOTE: an AC contactor system having push-button control and providing power to several power supplies (e.g. SPEAR MCCs) can be used for this step.
 3. Operator(s) locks out all electrical hazards and maintains possession of key(s).
 4. Operator(s) attempts to turn on each electrical hazard locally while monitoring the voltage for each, either using the computer control recording system or observing locally, to confirm that the hazard is not re-energized.
NOTE: an AC contactor system having push-button control and providing power to several power supplies (e.g. SPEAR MCCs) can be used for this step.
 5. Operator(s) locks keys in lock box with single-key Ops lock.
 6. After verifying that each electrical hazard is de-energized, either by analyzing the computer control records or having made local observations, the operator(s) signs form verifying each electrical hazard is off and posts signed form at lock box. Access state can be changed to Controlled or Permitted.
 7. Ops lock may not be removed from lock box unless tunnel is in No Access.
- B.** If accelerator electrical hazard(s) is not in operation and/or verification of de-energization as described in A is uncertain (e.g. computer system down, lose communication with computer-interfaced PS controllers, power supply malfunction, long uncontrolled shut-down, etc), then use steps 1-6 for operator lock-out:
1. If necessary, operator(s) turns off each electrical hazard locally with appropriately rated power switch.
NOTE: an AC contactor system having push-button control and providing power to several power supplies (e.g. SPEAR MCCs) can be used for this step.
 2. Operator(s) locks out all electrical hazards and maintains possession of key(s).
 3. Operator(s) attempts to turn on each electrical hazard locally while monitoring the voltage for each locally to confirm that the hazard is not re-energized.
NOTE: an AC contactor system having push-button control and providing power to several power supplies (e.g. SPEAR MCCs) can be used for this step.
 4. Operator(s) locks keys in lock box with single-key Ops lock.
 5. Operator(s) place tunnel in Controlled Access to allow a qualified verifier team (2 people minimum) to enter the tunnel, as needed, to conduct an electrical hazards-off verification procedure using appropriate volt meter and PPE. No other persons shall be allowed in tunnel. Qualified verifier team completes and signs a verification checklist ensuring that each electrical hazard is de-energized and submits checklist to operator(s).
 6. Upon receiving signed verification checklist, operator(s) signs form verifying each electrical hazard is off and posts signed form at lock box. Controlled or Permitted Access is then allowed.
 7. Ops lock may not be removed from lock box unless tunnel is in No Access.

Table 1: Procedures for Work in SSRL Accelerator Tunnel Following Operator Lock-Out of Exposed Electrical Hazards - General

NOTE: 1. All exposed electrical hazards in the tunnel are locked out and verified by the operator.

L/T/V = lock/tag/verify PA = Permitted Access CA = Controlled Access

Work Type	Work Description	Tunnel Exposed Electrical Hazard Control	Work Plan ⁽¹⁾
1	“Major work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. disconnecting, drilling or welding magnet leads, etc.)	PA: Lock/tag on Ops lock box CA: Lock/tag on Ops lock box	-
2	- “Minor work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. tightening coil connections or water fittings, servicing klaxons, etc..) - Work on non-hazardous equipment within 1 ft of exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. photon beam lines, water circuits, alignment, etc.) - Tunnel inspection with possible or known contact with exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (including search)	PA: Lock/tag on Ops lock box CA: PPS gate key if Ops-locked equipment in PPS; Lock/tag on Ops lock box if Ops-locked equipment not in PPS	-
3	Work on hazardous electrical equipment not controlled by the tunnel access lock-out (e.g. re-terminating ion pump cables) within 1 ft of exposed conductors of hazardous equipment controlled by Ops tunnel access lock-out	PA: Lock/tag on Ops lock box + L/T/V for electrical hazard not included in Ops lock-out CA: PPS gate key if all Ops-locked equipment in PPS + L/T/V for electrical hazard not included in Ops lock-out; Lock/tag on Ops lock box if any Ops-locked equipment not in PPS + L/T/V for elec. hazard not in Ops lock-out	EWP for work on elec. hazard not in Ops lock-out
4	Work on hazardous electrical equipment not controlled by tunnel access lock-out >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: L/T/V for electrical hazard not included in Ops lock-out (+ lock/tag on Ops lock box if person not tunnel electrical hazard-qualified) CA: L/T/V for electrical hazard not included in Ops lock-out (PPS gate key needed for entry only)	EWP for work on elec. hazard not in Ops lock-out
5	- Work on non-hazardous equipment >1ft from exposed conductors of hazardous elect. equipment controlled by Ops tunnel access lock-out - Tunnel inspection >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: None (lock/tag on Ops lock box if person not tunnel electrical hazard-qualified) CA: None (PPS gate key needed for entry only)	-
6	Escorted inspection or tour with or without known contact with exposed conductors of hazardous electrical equipment controlled by tunnel access lock-out	PA: Lock/tag on Ops lock box for escort; escorted persons sign in/out CA: PPS gate key per person if all Ops-locked equip. in PPS; Lock/tag on Ops lock box for escort + PPS gate key per person if any Ops-locked equip. not in PPS; Ops log-in/out in all cases	-

¹ In all cases, it is assumed that staff have valid routine JHAMs and, if required, non-routine JHAMs and/or EWPs, as enforced by supervisors.

**Table 2a: Procedures for Work in SSRL Accelerator Tunnel Following Operator Lock-Out of Exposed Electrical Hazards
Linac Vault With Exposed Electrical Hazards**

- NOTES:**
1. All exposed electrical hazards for the injector gun and linac are locked out by SPEAR operators; those for the GTF are locked out by GTF operators.
 2. The Linac PPS has no electrical hazard interlock and only 2 access states: Permitted Access and No Access.

L/T/V = lock/tag/verify PA = Permitted Access CA = Controlled Access

Work Type	Work Description	Tunnel Exposed Electrical Hazard Control	Work Plan ⁽¹⁾
1	“Major work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. disconnecting, drilling or welding magnet leads, etc.)	PA: Lock/tag on Ops lock box	-
2	<ul style="list-style-type: none"> - “Minor work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. tightening coil connections or water fittings, servicing klixons, etc..) - Work on non-hazardous equipment within 1 ft of exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. photon beam lines, water circuits, alignment, etc.) - Tunnel inspection with possible or known contact with exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (including search) 	PA: Lock/tag on Ops lock box	-
3	Work on hazardous electrical equipment not controlled by the tunnel access lock-out (e.g. re-terminating ion pump cables) within 1 ft of exposed conductors of hazardous equipment controlled by Ops tunnel access lock-out	PA: Lock/tag on Ops lock box + L/T/V for electrical hazard not included in Ops lock-out	EWP for work on elec. hazard not in Ops lock-out
4	Work on hazardous electrical equipment not controlled by tunnel access lock-out >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: L/T/V for electrical hazard not included in Ops lock-out (+ lock/tag on Ops lock box if person not tunnel electrical hazard-qualified)	EWP for work on elec. hazard not in Ops lock-out
5	<ul style="list-style-type: none"> - Work on non-hazardous equipment >1ft from exposed conductors of hazardous elect. equipment controlled by Ops tunnel access lock-out - Tunnel inspection >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out 	PA: None (lock/tag on Ops lock box if person not tunnel electrical hazard-qualified)	-
6	Escorted inspection or tour with or without known contact with exposed conductors of hazardous electrical equipment controlled by tunnel access lock-out	PA: Lock/tag on Ops lock box for escort; escorted persons sign in /out	-

¹ In all cases, it is assumed that staff have valid routine JHAMs and, if required, non-routine JHAMs and/or EWPs, as enforced by supervisors.

**Table 2b: Procedures for Work in SSRL Accelerator Tunnel Following Operator Lock-Out of Exposed Electrical Hazards
Linac Vault With Covered Hazards**

- NOTES:**
1. All electrical hazards for the injector gun and linac are locked out by SPEAR operators; those for the GTF are locked out by GTF operators. All electrical hazards are covered.
 2. The Linac PPS has no electrical hazard interlock and has only 2 access states: Permitted Access and No Access.

L/T/V = lock/tag/verify PA = Permitted Access CA = Controlled Access

Work Type	Work Description	Tunnel Exposed Electrical Hazard Control	Work Plan ⁽¹⁾
1	“Major work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. disconnecting, drilling or welding magnet leads, etc.)	PA: Lock/tag on Ops lock box	-
2	<ul style="list-style-type: none"> - “Minor work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. tightening coil connections or water fittings, servicing klixons, etc..) - Work on non-hazardous equipment within 1 ft of exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. photon beam lines, water circuits, alignment, etc.) - Tunnel inspection with possible or known contact with exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (including search) 	PA: Lock/tag on Ops lock box	
3	Work on hazardous electrical equipment not controlled by the tunnel access lock-out (e.g. re-terminating ion pump cables) within 1 ft of covered conductors of hazardous equipment controlled by Ops tunnel access lock-out	PA: L/T/V for electrical hazard not included in Ops lock-out	EWP for work on elec. hazard not in Ops lock-out
4	Work on hazardous electrical equipment not controlled by tunnel access lock-out >1ft from covered conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: L/T/V for electrical hazard not included in Ops lock-out	EWP for work on elec. hazard not in Ops lock-out
5	<ul style="list-style-type: none"> - Work on non-hazardous equipment >1ft from covered conductors of hazardous elect. equipment controlled by Ops tunnel access lock-out - Tunnel inspection >1ft from covered conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out 	PA: None	-
6	Escorted inspection or tour	PA: None	-

¹ In all cases, it is assumed that staff have valid routine JHAMs and, if required, non-routine JHAMs and/or EWPs, as enforced by supervisors.

**Table 3: Procedures for Work in SSRL Accelerator Tunnel Following Operator Lock-Out of Exposed Electrical Hazards
Booster/BTS Tunnel**

- NOTES:** 1. All exposed electrical hazards in the tunnel are locked out and verified by the operator.
2. Some exposed electrical hazards in Booster tunnel are not controlled by the PPS. All electrical hazards are included in Ops lock-out.

L/T/V = lock/tag/verify PA = Permitted Access CA = Controlled Access

Work Type	Work Description	Tunnel Exposed Electrical Hazard Control	Work Plan ⁽¹⁾
1	“Major work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. disconnecting, drilling or welding magnet leads, etc.)	PA: Lock/tag on Ops lock box CA: Lock/tag on Ops lock box (+ PPS gate key)	-
2	- “Minor work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. tightening coil connections or water fittings, servicing klixons, etc..) - Work on non-hazardous equipment within 1 ft of exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. photon beam lines, water circuits, alignment, etc.) - Tunnel inspection with possible or known contact with exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (including search)	PA: Lock/tag on Ops lock box CA: Lock/tag on Ops lock box (+ PPS gate key) if exposed electrical hazard not included in PPS; PPS gate key if exposed electrical hazard included in PPS	-
3	Work on hazardous electrical equipment not controlled by the tunnel access lock-out (e.g. re-terminating ion pump cables) within 1 ft of exposed conductors of hazardous equipment controlled by Ops tunnel access lock-out	PA: Lock/tag on Ops lock box + L/T/V for electrical hazard not included in Ops lock-out CA: Lock/tag on Ops lock box if Ops-locked exposed elec. hazard not included in PPS + L/T/V for elec. hazard not in Ops lock-out; PPS gate key if Ops-locked exposed elec. hazard in PPS + L/T/V for elec. hazard not in Ops lock-out	EWP for work on elec. hazard not in Ops lock-out
4	Work on hazardous electrical equipment not controlled by tunnel access lock-out >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: L/T/V for electrical hazard not in Ops lock-out (+ lock/tag on Ops lock box if person not tunnel electrical hazard-qualified) CA: L/T/V for electrical hazard not included in Ops lock-out (PPS gate key needed for entry only)	EWP for work on elec. hazard not in Ops lock-out
5	- Work on non-hazardous equipment >1ft from exposed conductors of hazardous elect. equipment controlled by Ops tunnel access lock-out - Tunnel inspection >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: None (lock/tag on Ops lock box if person not tunnel electrical hazard-qualified) CA: None (PPS gate key needed for entry only)	-
6	Escorted inspection or tour with or without known contact with exposed conductors of hazardous electrical equipment controlled by tunnel access lock-out	PA: Lock/tag on Ops lock box for escort; escorted persons sign in/out CA: Lock/tag on Ops lock box for escort + PPS gate key per person; Ops log-in/out	-

¹In all cases, it is assumed that staff have valid routine JHAMs and, if required, non-routine JHAMs and/or EWPs, as enforced by supervisors.

**Table 4: Procedures for Work in SSRL Accelerator Tunnel Following Operator Lock-Out of Exposed Electrical Hazards
SPEAR Tunnel**

NOTES: 1. All exposed electrical hazards in SPEAR tunnel are controlled by the PPS and are included in Ops lock-out.

L/T/V = lock/tag/verify PA = Permitted Access CA = Controlled Access

Work Type	Work Description	Tunnel Exposed Electrical Hazard Control	Work Plan ⁽¹⁾
1	“Major work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. disconnecting, drilling or welding magnet leads, etc.)	PA: Lock/tag on Ops lock box CA: Lock/tag on Oock box	-
2	- “Minor work” directly on exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. tightening coil connections or water fittings, servicing klixons, etc..) - Work on non-hazardous equipment within 1 ft of exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (e.g. photon beam lines, water circuits, alignment, etc.) - Tunnel inspection with possible or known contact with exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out (including search)	PA: Lock/tag on Ops ps llock box CA: PPS gate key	-
3	Work on hazardous electrical equipment not controlled by the tunnel access lock-out (e.g. re-terminating ion pump cables) within 1 ft of exposed conductors of hazardous equipment controlled by Ops tunnel access lock-out	PA: Lock/tag on Ops lock box + L/T/V for electrical hazard not in Ops lock-out CA: PPS gate key + L/T/V for elec. hazard not in Ops lock-out	EWP for work on elec. hazard not in Ops lock-out
4	Work on hazardous electrical equipment not controlled by tunnel access lock-out >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: L/T/V for electrical hazard not included in Ops lock-out (+ lock/tag on Ops lock box if person not tunnel electrical hazard-qualified) CA: L/T/V for electrical hazard not included in Ops lock-out (PPS gate key needed for entry only)	EWP for work on elec. hazard not in Ops lock-out
5	- Work on non-hazardous equipment >1ft from exposed conductors of hazardous elect. equipment controlled by Ops tunnel access lock-out - Tunnel inspection >1ft from exposed conductors of hazardous electrical equipment controlled by Ops tunnel access lock-out	PA: None (lock/tag on Ops lock box if person not tunnel electrical hazard-qualified) CA: None (PPS gate key needed for entry only)	-
6	Escorted inspection or tour with or without known contact with exposed conductors of hazardous electrical equipment controlled by tunnel access lock-out	PA: Lock/tag on Ops lock box for escort; escorted persons sign in/ out CA: PPS gate key per person; Ops log-in/out	-

¹In all cases, it is assumed that staff have valid routine JHAMs and, if required, non-routine JHAMs and/or EWPs, as enforced by supervisor.