REGIONAL CONNECTOR TRANSIT CORRIDOR PROJECT
Contract No. E0119

Systems Testing and Cutover Plan Requirements

Task No. 7.9.07 (Deliverable No. PH2.7.9.07.03)

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1.0 INTRODUCTION

The Regional Connector will provide a direct connection from the 7th Street/Metro Center Station to the Metro Gold Line. The alignment will extend underground from the 7th Street/Metro Center Station following Flower Street, curving east under the 2nd Street tunnel and 2nd Street, and continuing under the intersection of 1st and Alameda Streets, surfacing to connect to the Metro Gold Line tracks within 1st Street and north of Temple Street.

Task 7.3.9 (System Testing and Cut-Over Plan) of the Technical Scope of Services for the Advanced Conceptual Engineering (ACE) and Preliminary Engineering (PE) phases reads:

> Develop and identify the System Testing and Cut-Over Plan. Identify the interface philosophy with existing facilities and systems (Central Control Center, bus, rail, Police Department, Fire Department) and operational lines, stations and wayside. Show the requirements for testing of each subsystem.

This document contains the general Systems Testing and Cutover plan requirements (Section 2), as well as the list of expected activities and sequence in which they will be performed during phased cutover of Regional Connector project (Section 3). Project configuration is as defined in the March 30, 2012 Preliminary Engineering Submittal. While this document is expected to serve as a starting point for a contractor's cutover plan, the Design/Build Contractor shall be responsible for developing final cutover plan and ensuring correctness and constructability thereof.

2.0 CUTOVER REQUIREMENTS

Cut-over activities occur when systems such as Train Control, Traction Electrification (Power Substation, Overhead Contact System), Communications, and Trackwork are ready to be connected to the existing Metro Blue Line, Expo Line, Gold Line (Pasadena) and Gold Line (Eastside) operational system. Approved and coordinated cutover plans and test plans shall be developed by each Contractor (includes sub-contractors) in close coordination with all Contractors involved and with Metro or its Designee.

2.1 General Requirements

Cut-over is the staged process of changing and/or interfacing from and/or to the existing systems infrastructure, to the new and/or modified systems infrastructure. The systems infrastructure includes but is not limited to various systems disciplines such as train control, communications, traction electrification, and trackwork. The cutover process in essence provides a complete, functional and fully operational system for the entire new alignment configuration of the Project.

Each contractor shall develop a cutover plan and cutover test plan that reflect their specific discipline and the constraints of the existing systems infrastructure of the Metro Blue, Expo and Gold Lines, and the Division 20 yard for the standby generator upgrade.

Each Contractor shall develop cut-over plans and cut-over test plans for the 7 main areas of interface on the Regional Connector as follows:

A. Metro Blue Line at 7th/Metro Station interfaces; including the re-signaling up to Pico station;
B. Temporary “shoo-fly” interface at Alameda/1st Street;

C. Metro Gold Line (Pasadena) to Union Station interfaces;

D. Metro Gold Line (Eastside Extension) to Pico/Aliso Station ;

E. Division 20 (Red Line Yard) – Standby Generator interfaces;

F. Rail Operations Center (ROC) interfaces;
    1) Metro shall make all the necessary modifications/updates of the equipment at the ROC for system operation.
    2) Each Contractor shall support the End-to-End testing of the equipment located at the ROC.

G. Radio interface with local fire, police and sheriff
    1) Local fire, police and sheriff departments shall make the necessary modifications of the existing equipment at their Radio dispatching centers for their Radio system operation.
    2) Each Contractor shall support the End-to-End testing of the equipment located at the Radio dispatching centers for local fire, police and sheriff Radio system operation.

Each Contractor's cutover plan shall:

A. Identify and mitigate all hazards to system safety that arise from the staged cutover process from the existing system to the fully operational new/modified system.

B. Be structured to maintain the current level of passenger service as the cutover progresses and to minimize interference to the current mainline and yard operations.

C. Be consistent with the project system safety, system assurance, and system approval requirements.

Development of each Contractor's cutover plan shall be an iterative process taking account of an analysis of system safety hazards, passenger service, and risks, together with the application of measures to mitigate and control these risks.

Each Contractor shall develop detailed cutover plans and cutover test plans as defined in the following sections.

2.2 Cutover Plan Requirements

Each Contractor shall develop a cutover plan that sets out in detail the technical processes and activities of the cutover. The cutover plan shall address the overall system, each individual subsystem and interface, and shall include, but not be limited to, the following elements:

A. List of assumptions that the Contractor has made in building the plan.

B. The order of events for cutover including support and mobilization activities (cutover schedule).

C. The hazards and benefits seen in this approach.

D. Time frame and event sequence.

E. Infrastructure, utility and resource requirements.

F. Preparatory work, temporary and permanent modifications to existing systems.

G. Control arrangements between mainline territory (controlled by ROC) and yard territory (controlled by yard tower) for generator upgrade activities.

H. Material and logistic arrangement.

I. Site access and track allocation requirements.

J. Access to existing drawings and arrangement plans from Metro.

K. Hazard analysis of work activities, including possible public exposure.

L. Safety Training.

M. Activation criteria, start-up testing, integration testing and pre-revenue test support.

N. Personnel assignments.

O. Fallback arrangements, including response to test-related failures.

P. Document control and configuration management.

Q. Cleaning

2.3 Cutover Test Plan Requirements

Each Contractor shall develop a cutover test plan that sets out in detail the types of testing required during each stage of the cutover process. The cutover test plan shall address the overall system testing organization, individual subsystem testing, and interface testing. It shall include, but not be limited to, the following types of testing:

A. Local Field acceptance tests.

B. Qualification and EMC/EMI tests.

C. Installation inspection tests.

D. Field inspection tests.

E. Static and dynamic acceptance tests (includes safe braking tests).

F. Subsystems integration tests

G. Overall system integration tests.

H. Rail activation and start-up.

3.0 7TH/METRO & GOLD LINE INTERFACE CUTOVER PROCEDURES

Gold Line interface cutover consists of three stages: temporary shoo-fly installation and removal, activation of 1st Street segment (restoring rail service to Atlantic Avenue) and as a final phase, connection to existing US 101 bridge structure via Alameda cut & cover.

3.1 Shoo-fly Cutover

Temporary trackage will be constructed from the south end of the Little Tokyo platform and will join existing 1st Street tracks again just south of Garey Street. This will allow start of the tunneling and cut&cover construction underneath 1st/Alameda Street intersection, as well as provide access to median of 1st Street. Most of the shoo-fly track will be constructed without disturbing rail operation, except for the actual hard-rail connection between existing track and the shoofly. Contractor is expected to make minor modification to the signals system as outlined below. These changes should not have any effect on Alameda (Little Tokyo) Interlocking vital logic or on the logic in adjacent interlocking.

During shoo-fly Work Area A construction (see Figure 3-1 and 3-2) following is expected to be done:

- Build a temporary cable containment system (ductbank, conduits, or any other means of supporting and protecting cable, as approved by Metro) in the shoo-fly construction area. Pullboxes or other means for temporary storage of coiled cable should be built at both end of this cable containment. Although contractor should not encroach into operating railroad territory until rail service is suspended for hard rail connection, pullboxes at the end of the cable containment shall be constructed such that they are located as close as possible to the existing Alameda Interlocking TC&C room and mid-track ductbank on the 1st Street (on the other end).

- Break into existing Little Tokyo TC&C room and pull train control local cable to a coupler case location on the shoo-fly & test cable.

- Install track wire and local cable in the coupler cases within shoo-fly track limits and terminate.

- Develop and factory test vital software for Union Station interlocking terminal operations (if software changes are required).

- Overhead Catenary System (OCS) work will include:

    - Install temporary pole foundations, catenary poles, down guys

    - Install cantilever, headspan supports for Shoo-fly OCS

When rail service is suspended for shoo-fly tie-in installation, following activities would be performed:

- Break into existing 1st Street ductbank and create new pullbox. This pullbox should be constructed far enough into existing rail territory, as to serve as an interface point for both shoo-fly and 1st Street Regional Connector tracks (stage 2 of the Gold Line Interface).

- Pull fiber optic cable for vital train control link between Alameda TC&C room and newly built interface pullbox. Contractor is to verify if temporary splicing is allowed, otherwise new fiber is required to be pulled from Alameda TC&C to Pico/Aliso TC&C. Splice communication cables, including SCADA fiber from Red Line Yard TPSS-01.

- For temporary grade crossing created by shoo-fly operation, means of triggering signals at this crossing need to be provided. Install vehicle detection loops between rail in approach to the new grade crossing or provide interface cable to the traffic control cabinet from Alameda TC&C room, if existing AF track circuits are used for train detection.

- Permanently remove pedestrian flashers #3 and #4.

- Restore Union Station for through operation.

- Install BLS/ETS and transfer trip from the new PB3 to the existing system pullbox as indicated in Figure 3-2. Splice the new ETS/TT cables at both location with the existing cables at both locations.

- Tests TT and BLS/ETS system between the two existing substations PGL TPS 110 and Eastside TPSS-01.

- String new OCS wires for shoo-fly and splice to the existing Gold Line catenary wires.

- Remove un-used OCS poles, foundations, supports and wires

- Pre-stress and complete the OCS and test.

- Perform integrated tesing and pre-revenue tests.

3.2 1st Street Cutover

Current Metro Gold Line Eastside Extension service will be permanently discontinued during this phase. Shoo-fly, Little Tokyo Station and associated Alameda interlocking TC&C as well as all trackage and equipment south of the US 101 bridge structure will be removed. 1st Street connector of the 1st/Central wye interlocking will be constructed to the extent possible and work will concentrate on establishing a permanent rail connection between 1st/Central and existing 1st Street tracks.

System work expected to be done during this phase includes (not necessarily in order in which it will be pefromed):

- Enabling terminal mode at Union Station

- Installing wayside train control equipment at the 1st Street connector

- Pulling local and express cable in the 1st Street connector (new fiber comm. and train control links to Pico/Aliso), install track wire and track loops.
- Removal of temporary traffic signals at shoo-fly grade crossing, associated traffic control case and train detection loops (if provided)
- Installing equipment needed for cab territory extension onto 1st Street bridge (work will be performed beyond the limit Regional Connector civil work), rebuild ductbank to accommodate additional ducts.
- Prior to the demolition of the Alameda TC&C room, install fiber cable from the existing Union South Train Control Bungalow to the existing Union CIC for train control SCADA communication with the existing communications RTU in the cabinet. Metro will modify the existing PLC to accommodate the train control SCADA indication and control points. Install VoIP telephone devices required in the Train Control Room.
- Salvage existing equipment from Alameda TC&C room and deliver it to Metro designated location.
- Install BLS/ETS units RC27 and RC28. Install MDS-RC16 and 17, DC Circuit Breaker B07, ac power panels and CIC cabinet inside the new wye-connection room.
- Install and terminate all ac power circuits, SCADA cables from electrical room at 1st/Central to the equipment located in the new wye-connection room, via ducbank/wireway under the emergency walkways.
- Install and terminate all positive feeders between OCS connection points and the disconnect switches MDS-16, MDS-17 and CB B07.
- Install and terminate new BLS/ETS cables from RC27 and 28 to TPSS at 2nd/Broadway.
- On the PGL shoo-fly segment disconnect BLS/ETS and transfer trip cables between the existing system pullbox and PB3. Remove existing BLS and ETS cables from PB3 up to Eastside TPSS-01.
- Install and terminate new ETS and transfer trip cables from 2nd/Broadway TPSS to the existing Eastside TPSS-01.
- Install transfer trip and ETS cables from Eastside TPSS-01 up to 1st/Central cable room for future connection and extention to the ETS and TT cables from the Union Station TPSS-P110.
- Perform field testing of new cable.
- Test transfer trip system, BLS/ETS system and the traction power system between 2nd/Broadway andEastside TPSS-01.
- Install permanent OCS pole foundations, permanent OCS poles and cantilever supports (poles in the 1st/Street U-Section (open cut) should be installed prior to the Eastside

service suspension). Most OCS tunnel supports and wire is expected to be installed before Regional Connector Service is extended to 1st/Central.

- Terminate OCS to existing MPA termination pole 1033 north of Little Tokyo Station (OCS wire and poles south of this location to be removed)
- String permanent OCS and splice to the existing OCS, remove Shoo-fly OCS poles, foundations, supports and wires.
- Pre-stress and test new overhead catenary.
- Perform integration and pre-revenue testing in conjunction with 7th/Metro.

Above mentioned work should be performed in two phases. Work area A encompasses part of 1st Street connector built while shoo-fly is operating (see Figures 3-3 and 3-4, Gold Line Interface Stage 2). It is expected that most of the work in this area is compelete prior to rail-service suspension. All cable needed to be pulled from 1st/Central further than Work Area A should be coiled and protected until it is possible to complete the work.

As soon as Gold Line Eastside rail service is suspended, work area B and C will become accessible. Contractor is expected to start work in area C (existing territory) and move to area B once civil work is done.

Approximately 200 feet of tunnel towards Alameda Street connector will be constructed for Stage 2. Contractor is expected to make use of this opportunity to install and test signal equipment on Union Station bound R1 and L1 tracks such that further equipment testing and installation under Stage 3 will have minimal impact on Regional Connector Eastside Extension service.

3.3 Alameda Street Cutover

Alameda Street connector work will start synchronously with 1st Street connector construction. Due to the complexity of this part of the interface, this will be the last part of Regional Connector to be put in service. Contractor should expect 1st/Central to have an operating revenue service to Pico/Aliso while working on Alameda Cutover in the vicinity of 1st Street wye and make every precaution as not impact operating railroad.

System work to be done during this phase includes:

- Building pullbox at the interface between existing Gold Line US101 bridge structure and new constructions (Gold Line Eastside Extension stationing 118+23)
- Pulling train control and communications cable, previously coiled north of 1st/Central to its final destination along Alameda Street connector or to Union Station;
- Installing wayside equipment along Alameda Street connector, including part of 1st/Street interlocking not installed under stage 2;
- Integration and pre-revenue testing (including complete 1st/Central Interlocking testing, which will require Regional Connector Eastside Service shut-down).

- Return of Union Station to through operation, permanent removal of all changes made to convert it to a terminal.
- In work area B at the portal install ETS units RC25 and RC26.
- Install MDS-RC12, RC13, RC-14 and RC-15 and DC circuit breaker unit B06 (ac power panels and CIC cabinet already in place from stage 2 work) inside the new wye-connection room.
- Install and terminate all positive feeders between the OCS connection points and the disconnect switches MDS-RC-12, RC-13, RC-14, RC-15 and circuit breaker unit B06.
- On RC segment ETS cables from 2nd/Broadway TPSS to 1st/Central TC&C room is installed, terminated and tested and in place (done prior to Stage 3 work).
- Install and terminate new BLS/ETS cables from North portal entrance ETS RC25 and ETS RC27 to TC&C room at 1st/Central.
- Install and terminate new ETS cables from 2nd/Broadway TPSS to the existing TPSS P110.
- Install, splice and terminate new ETS and TT cables from 2nd/Broadway TPSS to existing Eastside TPSS-01.
- Test the transfer trip system, BLS/ETS system and the traction power system between the existing TPSS at 2nd/Broadway, TPSS P110 and Eastside TPSS-01.
- OCS work done during this stage will be similar to that described in Section 3.2, with the exception that Alameda Street catenary will be interfacing with already energized and used in revenue service 1st Street catenary system (at the 1st/Central wye).

Most of the work done under this stage will concentrate in the work area B (Figures 3-5 and 3-6 depicting Stage 3). If additional work is needed to be done in work area A, or in part of Union Station South Interlocking which will impact existing train service, contractor shall request track access and bus bridging in advance. Request procedure and request cut-off times are described in contract documentation.

3.4 7th/Metro Cut-over

7th/Metro cut-over consists of a single cutover phase, to be split by contractor into multiple stages. Staged cut-over at 7th/Metro will allow the interlocking to continuously support terminal operations for Blue and Expo Lines. The upgrading of the existing EMP for ventilation control of the two adjacent stations shall be performed without causing downtime or interruption to the train operations.

Other system work, requiring service on the Blue/Expo lines to 7th/Metro to be suspended or resulting in reduced terminal capacity should be performed during weekend rail service suspension. Procedures to be followed in preparation of suspension of service request would be outlined in contract specifications.

3.4.1 New 7th/Metro TC&C Room

New TC&C room will be built about 200 feet away north of the existing 7th/Metro TC&C room, on the west side of the new 7th/Metro crossover. All interlocking logic and its power supply will be located in the new room.

It is a Metro requirement that both 7th/Metro platform tracks, as well as at least one tail track remains operational during the duration of the work. Cut-over plan should reflect this requirement and contain service plans for each stage of the cut-over, making use of the newly built tracks north of 7th/Metro if these are needed to compensate for tail track system work.

3.4.2 Existing 7th/Metro TC&C Room and Wayside Equipment

Current 7th/Metro interlocking is configured as a stand-alone signal system, without any interface to any of the adjacent signal installations. As part of the interlocking replacement, vital interface to Venice interlocking will be provided in order to enable traffic locking between two interlocking. Vital train control link to 2nd/Hope TC&C room is also provided as a part of this contract.

Since the existing interlocking track configuration remains essentially unchanged, current wayside equipment shall be reused to the extent possible. Contractor is expected to coordinate field visits with Metro personnel to assess condition of signal, switch machines, TWC loops, junction boxes, impedance bonds and other equipment slated to remain.

Cable – Contractor to determine condition of the existing local cable between current 7th/Metro TC&C room and field equipment. Cable tests, such is meggering for insulation resistance and checking conductor continuity should be done. Whether existing cable is found to be defective, new cable shall be pulled from the new 7th/Metro TC&C room. For all other local cable, existing TC&C room entrance racks could be used as a junction point between existing local cable and local cable being run from the new TC&C room. Additional entrance racks might be needed for this purpose.

Fiber optic cable, with available spares, exists between 7th/Metro TC&C room 79 and Red Line TC&C room 13, as well as between Room 13 and Pico TC&C room. If splicing for permanent installation is permitted, existing cable could be reused for the part of vital train control link to Venice interlocking.

Non train control equipment is slated to remain and continue to operate in the existing TC&C room and contractor should use extra caution when working around it.

3.4.3 7th/Metro System Cutover Work Description

System work to be done during 7th/Metro cut-over includes (see Figures 3-7 and 3-8 for details):

- Construction of the new 7th/Metro TC&C room and placement in service of the new #10 crossover, including tail track in the direction of the 2nd/Hope (available tail track length should accommodate 3-car light rail train).

- Construction of pullbox at the limit of civil work, as well as the new pullbox near existing TC&C room. Existing 9-way ductbank between existing TC&C and end of track, located

under track level walkway near track 2 shall be examined for usability and rebuilt, if needed before new cable is run.

- Pulling new cable to protect signals 2NP and 4NP
- Installing new TWC loops at signals 1N, 2N, 3N, 4N, pull cable from new TC&C room to these.
- Cutting in IJ's, installing proper power bonding and impedance bonds to convert detector circuits 1T, 2T, 3T and 4T to a double rail track circuits.
- Installing negative cable between center taps of existing impedance bonds at the portal (Stationing 36+56), removing and abandoning existing negative cable going to the breaker room.
- Establishing vital train control link to Venice Interlocking and making necessary hardware and software changes at that interlocking to enable bidirectional traffic between Venice and 7th/Metro.
- Establishing temporary circuits for phased cutover of 7th/Metro interlocking, interlocking testing for each such phase.
- Removal of relay-based logic, associated wiring, cable, power supplies from existing TC&C room.
- OCS at the existing crossover north of 7th/Metro will be modified. New section insulators, feeders and motorized disconnect switches (MDS) will be installed. Due to the lack of space in the existing cut&cover tunnel structure, MDS will be located in a niche, built in the new tunnel structure at approximate Regional Connector Stationing 5+60. Install conduits, cables and test these new MDS's at the existing North 7th/Metro crossover.
- Existing sectional insulators at the tail track end to be removed, new Regional Connector catenary to be connected and spliced with existing at the same location.
- Installing 34.5kV vacuum circuit breaker cubicle in the existing 7th/Metro TPSS. Install and terminate trainway feeder cable between 7th/Metro TPSS and Regional Connector via ductbank along 7th Street & Flower Street. Test completed trainway feeder system.
- Installing and testing transfer trip (TT) cable from existing Pico TPSS to newly constructed 2nd/Hope TPSS.
- Performing necessary modification to the existing ETS, including installing and testing tie-in between existing and new 7th/Metro TC&C rooms.

4.0 DIVISION 20 – GENERATOR UPGRADE CUT-OVER

The work required to upgrade the emergency back-up power system (EBPS) requires careful planning and coordination with the Yard Control Tower. Work permits through track allocations shall be obtained. Temporary equipment shall be installed to ensure existing EBPS functionality is maintained while the permanent work is undertaken. Contractor shall prepare testing and cutover plan for the following phases:

- Temporary equipment installation
- Permanent equipment installation

APPENDIX A
7th/Metro (Blue/Expo) and Gold Line Interface Figures

Figure 3-1: Gold Line Train Control Interface – Stage 1 (Train Control and Communications)

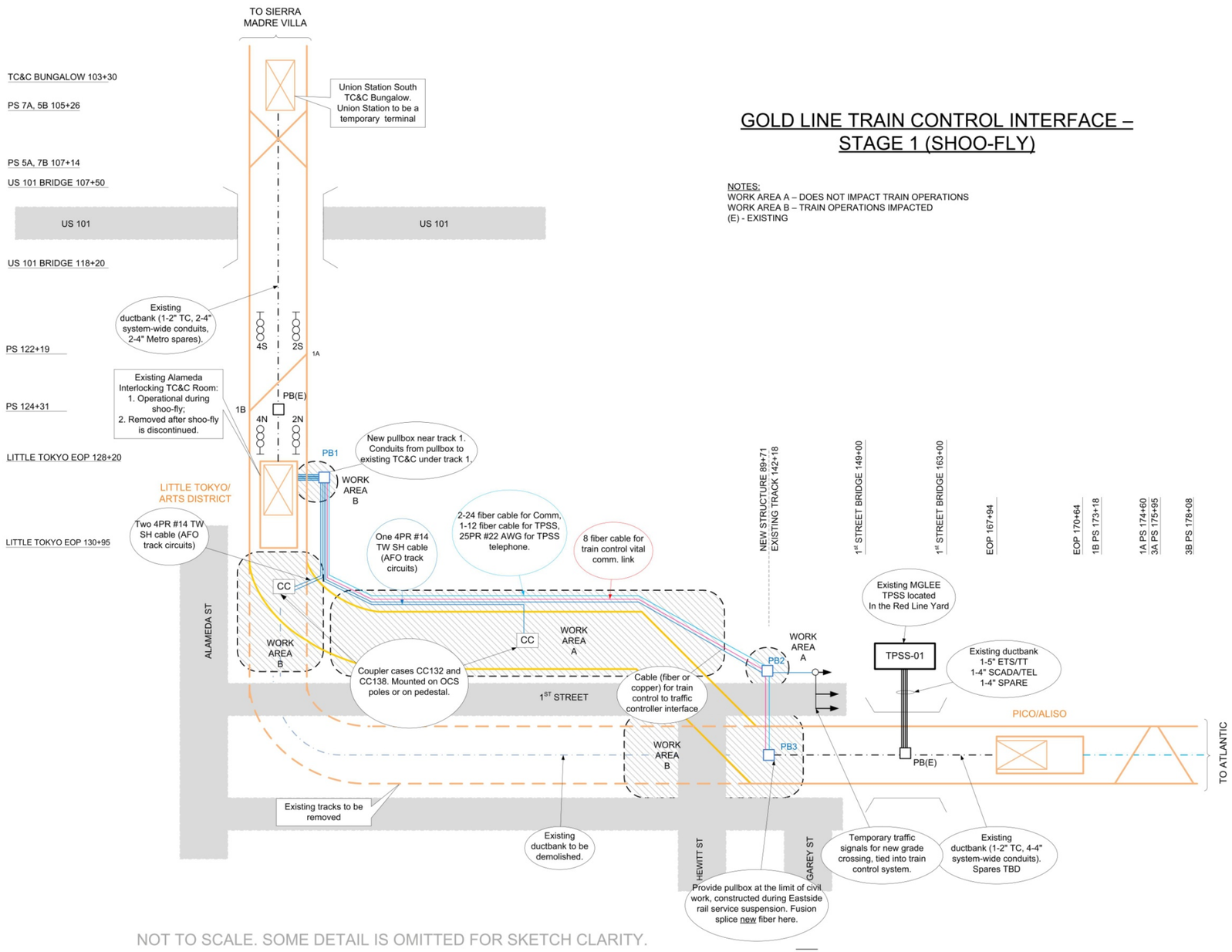


Figure 3-2: Gold Line Train Control Interface – Stage 1 (Traction Power)

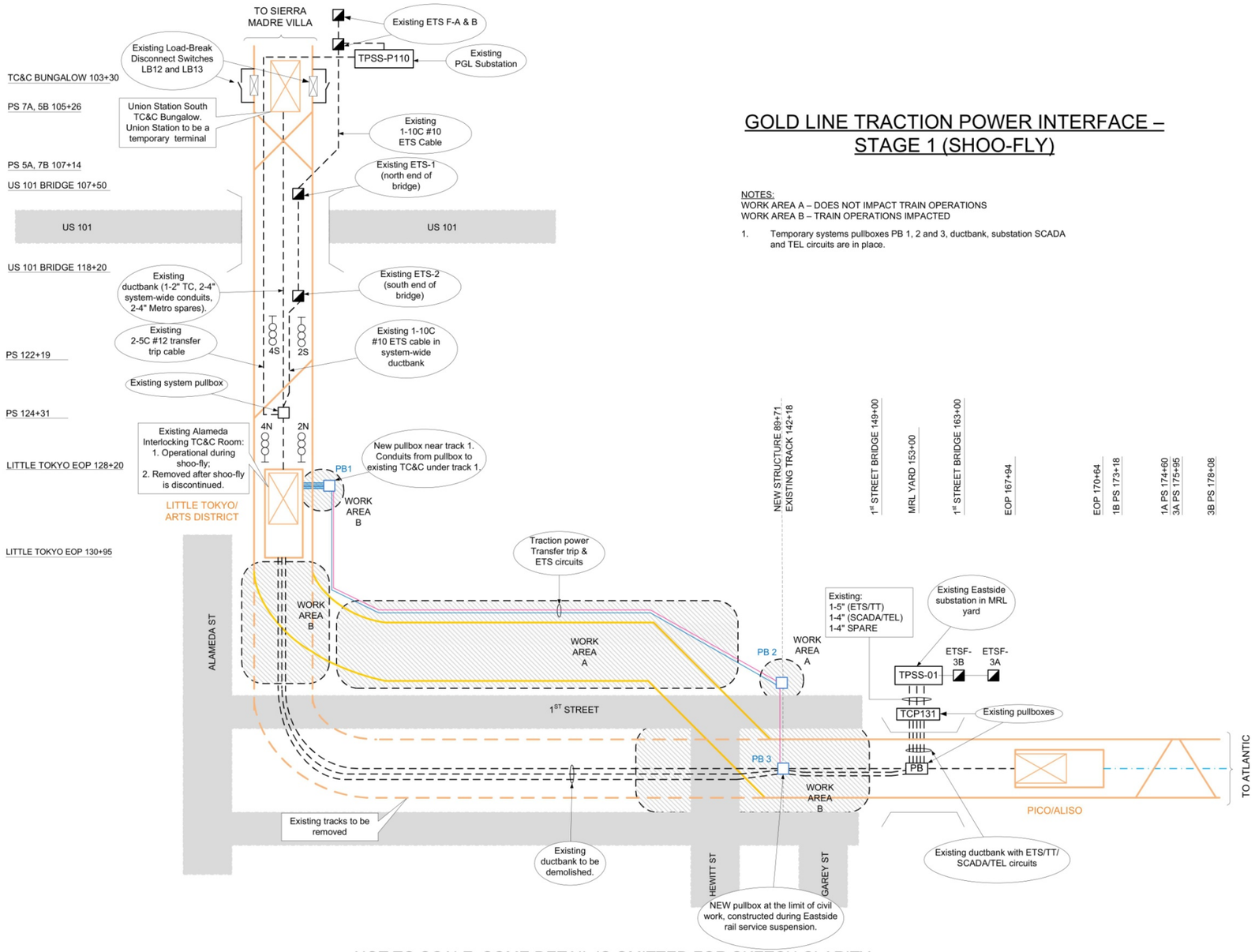


Figure 3-3: Gold Line Train Control Interface – Stage 2 (Train Control and Communications)

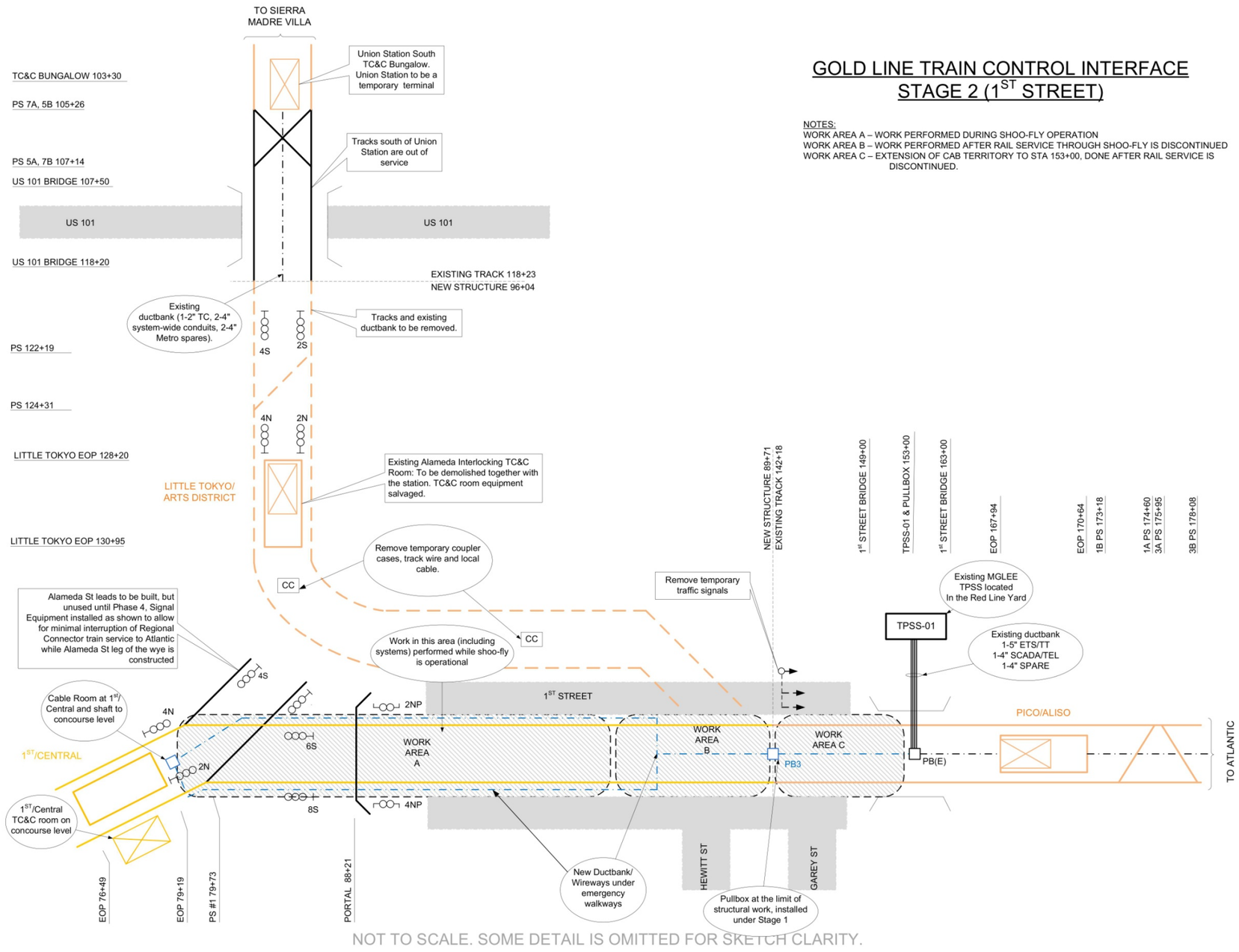


Figure 3-4: Gold Line Train Control Interface – Stage 2 (Traction Power)

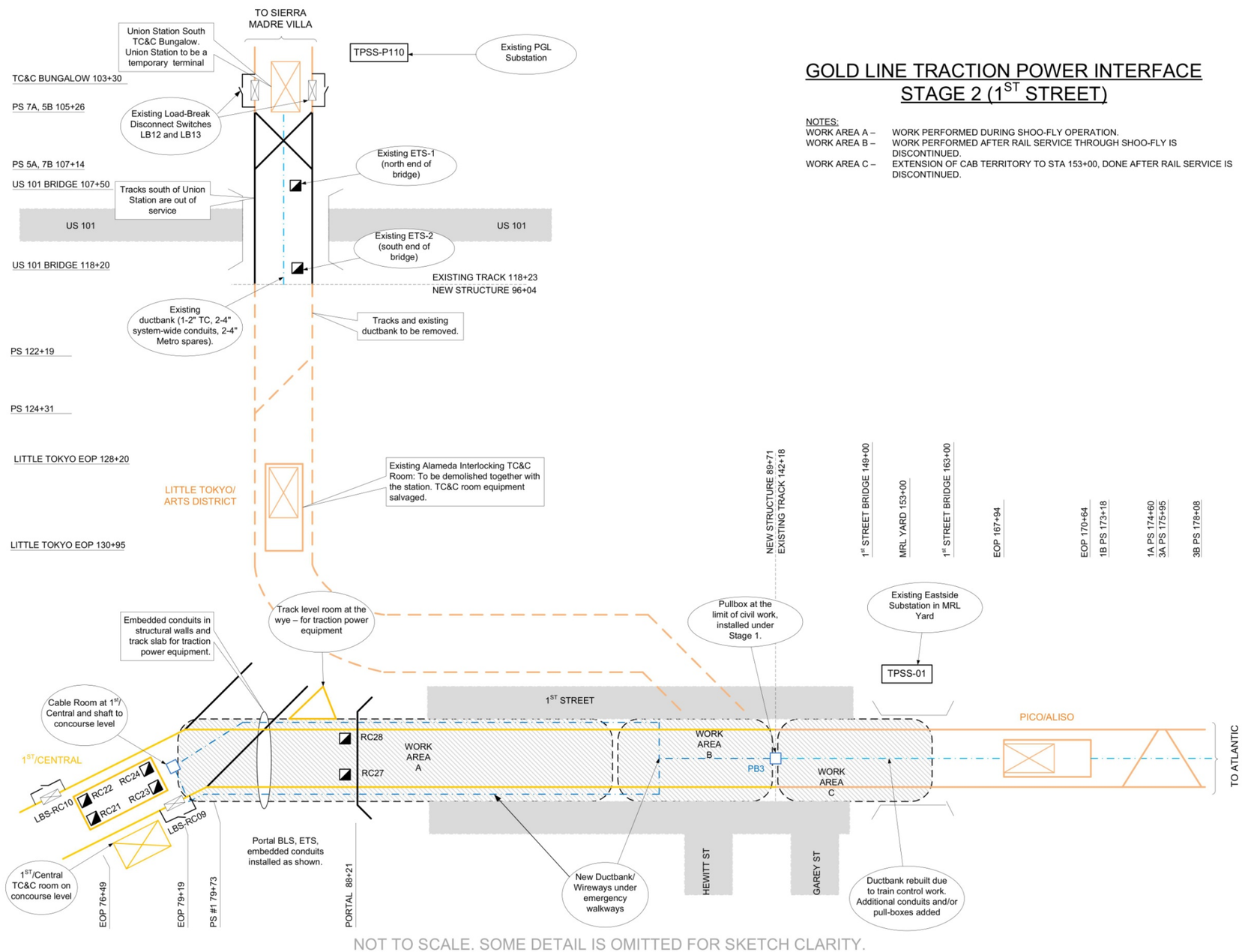


Figure 3-5: Gold Line Train Control interface – Stage 3 (Train Control and Comm.)

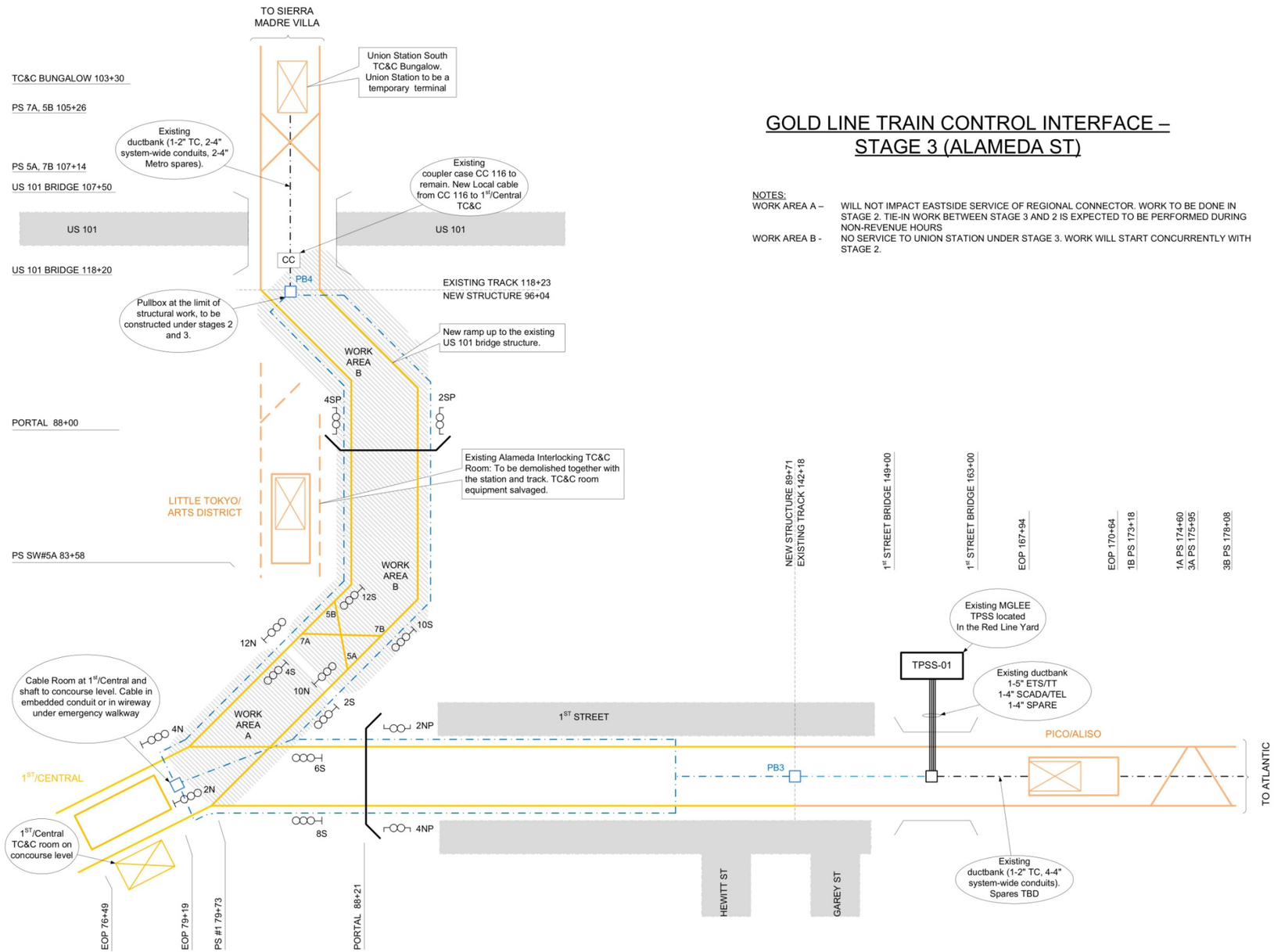


Figure 3-6: Gold Line Train Control interface – Stage 3 (Traction Power)

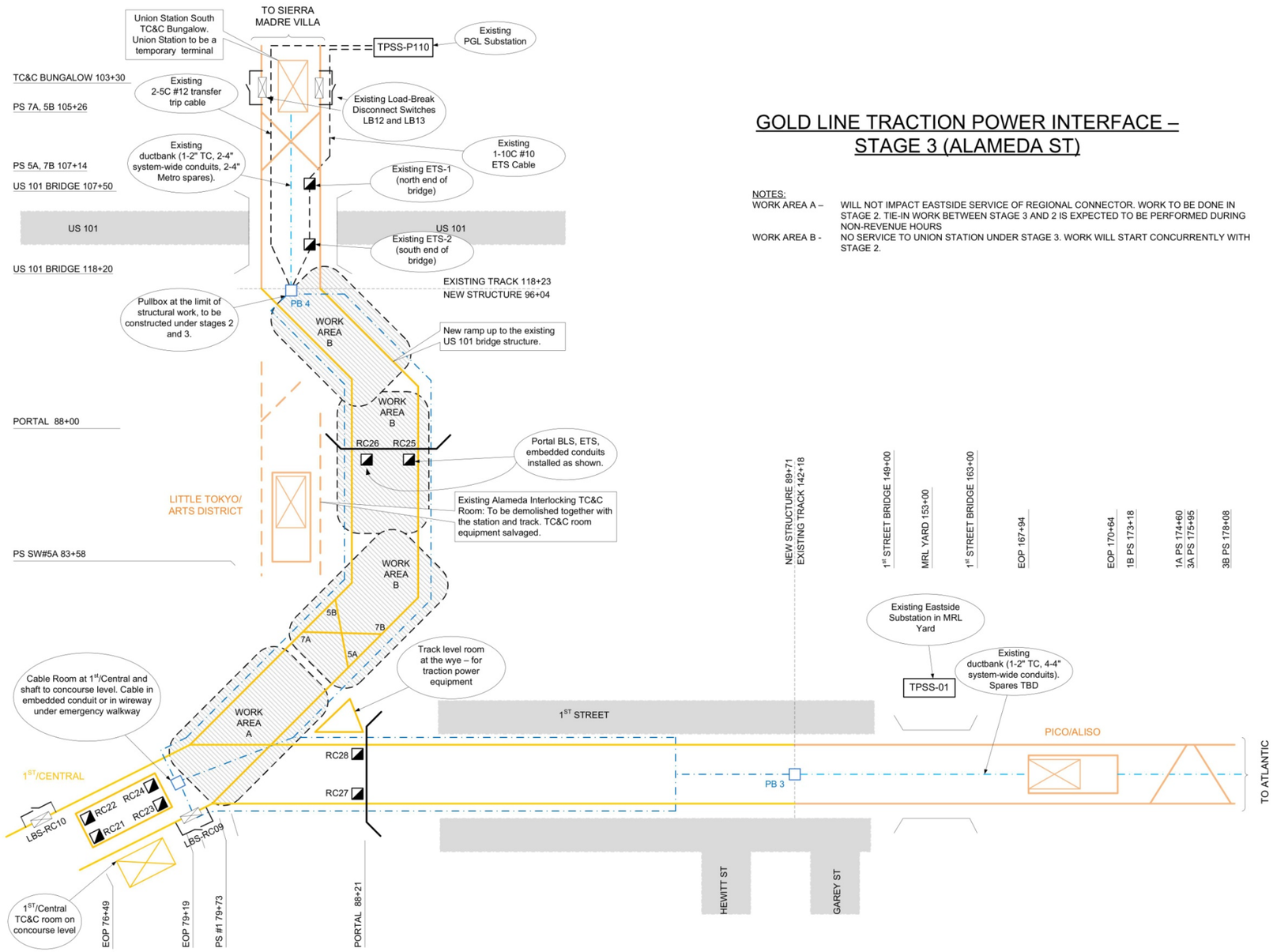


Figure 3-7: 7th/Metro Cutover (Train Control and Communications)

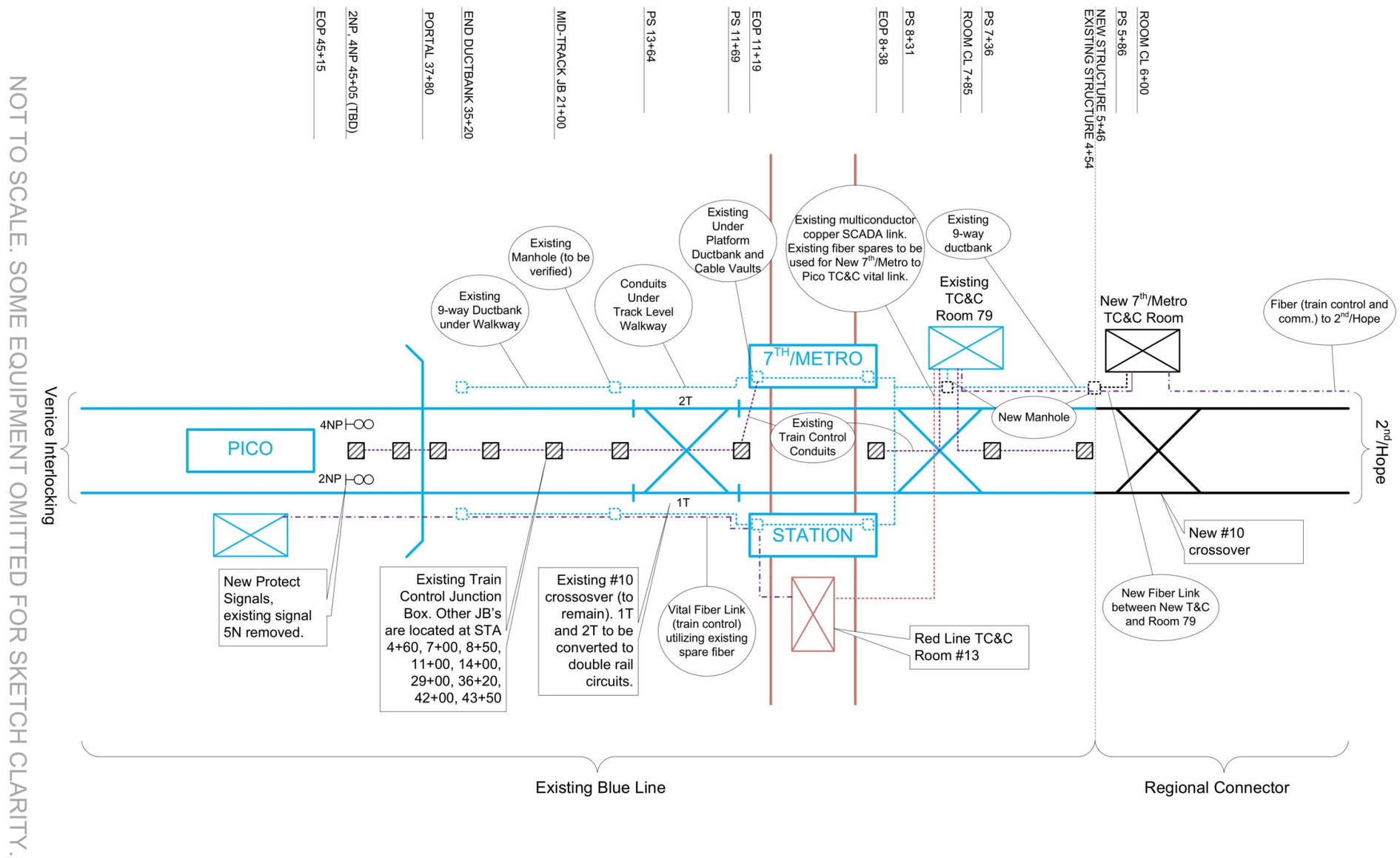
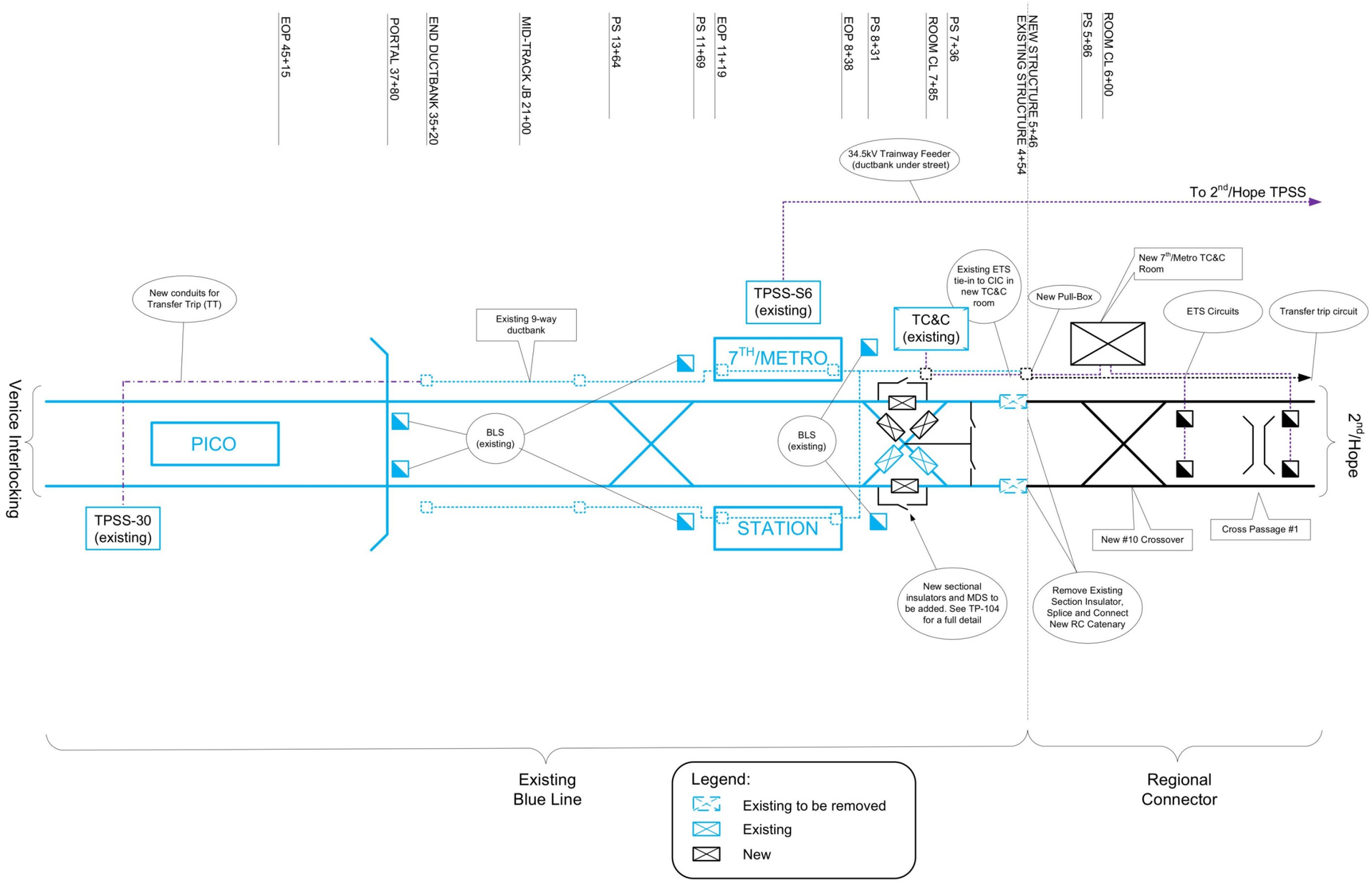


Figure 3-8: 7th/Metro Cutover (Traction Power and OCS)



NOT TO SCALE. SOME EQUIPMENT OMITTED FOR SKETCH CLARITY.

APPENDIX B
List of Acronyms

LIST OF ACRONYMS

AF	Audio Frequency
BLS	Blue Light Station
CB	Circuit Breaker
CIC	Central Instrument Case
DC	Direct Current
EBPS	Emergency Backup Power System
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ETS	Emergency Trip System
MDS	Motorized Disconnect Switch
MPA	Midpoint Anchor
OCS	Overhead Catenary System
PB	Pullbox
PGL	Pasadena Gold Line
ROC	Rail Operations Control
RTU	Remote Terminal Unit
SCADA	Supervisory Control and Data Acquisition
TC&C	Train Control and Communications
TPSS	Traction Power Sub Station
TT	Transfer Trip
VoIP	Voice over Internet Protocol