



Lytle Tunnel: Operations and Maintenance (O&M) Manual

Interstate 71 (IR-71) under 4th St, 5th St, and Lytle Park
HAM-71-0134 (SFN 3106578)

February 5, 2018

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Cincinnati, Ohio

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Contents

1	Background	1
1.1	Background	1
1.2	Facility Description	1
1.3	Maintenance and Inspection	1
2	Axial Fans	2
2.1	Description	2
2.2	Operation	4
2.2.1	Troubleshooting	4
2.3	Safety	4
2.4	Maintenance	4
3	Isolation Dampers	6
3.1	Description	6
3.2	Operation	11
3.2.1	Troubleshooting	12
3.3	Safety	12
3.4	Maintenance	12
4	Carbon Monoxide (CO) Detection System	13
4.1	Description	13
4.2	Operation	15
4.2.1	Troubleshooting	16
4.3	Safety	16
4.4	Maintenance	16
5	Linear Heat Detection	17
5.1	Description	17
5.2	Operation	18
5.2.1	Troubleshooting	19
5.3	Safety	19
5.4	Maintenance	19
6	Standpipe	20
6.1	Description	20
6.2	Operation	25
6.2.1	Troubleshooting	25
6.3	Safety	25

6.4	Maintenance	25
7	Soundproofing	26
7.1	Description	26
7.2	Operation	28
7.2.1	Troubleshooting	28
7.3	Safety	28
7.4	Maintenance	28
8	Low Voltage Transformers	29
8.1	Description	29
8.2	Operation	31
8.2.1	Troubleshooting	31
8.3	Safety	31
8.4	Maintenance	31
9	Soft Starters	32
9.1	Description	32
9.2	Operation	34
9.2.1	Troubleshooting	34
9.3	Safety	34
9.4	Maintenance	34
10	Switchgear	35
10.1	Description	35
10.2	Operation	35
10.2.1	Troubleshooting	35
10.3	Safety	35
10.4	Maintenance	35
11	Panelboards	38
11.1	Description	38
11.2	Operation	38
11.2.1	Troubleshooting	38
11.3	Safety	38
11.4	Maintenance	38
12	Fire Alarms	40
12.1	Description	40
12.2	Operation	41
12.2.1	Troubleshooting	41
12.3	Safety	41

12.4	Maintenance	41
13	Uninterruptible Power Supply (UPS)	42
13.1	Description	42
13.2	Operation	44
13.2.1	Troubleshooting	44
13.3	Safety	44
13.4	Maintenance	44
14	Lighting	45
14.1	Description	45
14.2	Operation	49
14.2.1	Troubleshooting	50
14.3	Safety	50
14.4	Maintenance	50
15	SCADA	51
15.1	Description	51
15.2	Operation	53
15.2.1	Troubleshooting	54
15.3	Safety	54
15.4	Maintenance	54
16	HVAC	55
16.1	Description	55
16.2	Operation	57
16.2.1	Troubleshooting	57
16.3	Safety	57
16.4	Maintenance	57
17	Video/ITS System	58
17.1	Description	58
17.2	Operation	63
17.2.1	Troubleshooting	63
17.3	Safety	64
17.4	Maintenance	64
18	Tunnel Closed Notification System	65
18.1	Description	65
18.2	Operation	66
18.2.1	Troubleshooting	67
18.3	Safety	67

18.4	Maintenance	67
A.	XXX	68
B.	XXX	69

1 Background

1.1 Background

The Lytle Tunnel (ODOT Structure ID Bridge Number HAM-71-0134; Structure File Number 3106578) carries Interstate Route 71 (IR-71) underneath Lytle Park, Fourth Street and Fifth Street on the eastern edge of downtown Cincinnati, Ohio. The original tunnel design was completed in 1967 with construction beginning that year and the tunnel built and opened to vehicular traffic in 1970. Minor rehabilitations were performed in 1991, 1995, and again for the Fort Washington Way reconstruction. It is the longest vehicular tunnel in Ohio as well as the only tunnel on IR-71. A renovation project that modernized the lighting, fire detection, fire protection, communications and ventilation systems was completed in 2018.

1.2 Facility Description

The tunnel is a single complex three cell reinforced concrete box structure, but functionally operates as three separate tunnels or cells: three lanes northbound, two through lanes southbound and a single lane southbound exit ramp. Tunnel ventilation equipment is provided by an underground facility located east of the tunnel, under Lytle Park. The tunnel control room is located in a room above the Northbound and Ramp-E cells of the tunnel under the park. Access to the tunnel control room is via the entrance on Lytle Street.

1.3 Maintenance and Inspection

The tunnel shall be inspected in compliance with the latest version of the National Tunnel Inspection Standards. The tunnel maintenance and inspection should follow the guidelines of the latest versions of FHWA's *Highway and Rail Transit Inspection Manual* and FHWA's *Tunnel Operations, Maintenance, Inspection, and Evaluation (TOMIE) Manual*. As noted in the TOMIE manual in Section 3.9.5, "*Specific and manufacturers' recommended preventive maintenance procedures should take precedence over the guidelines contained in the table.*"

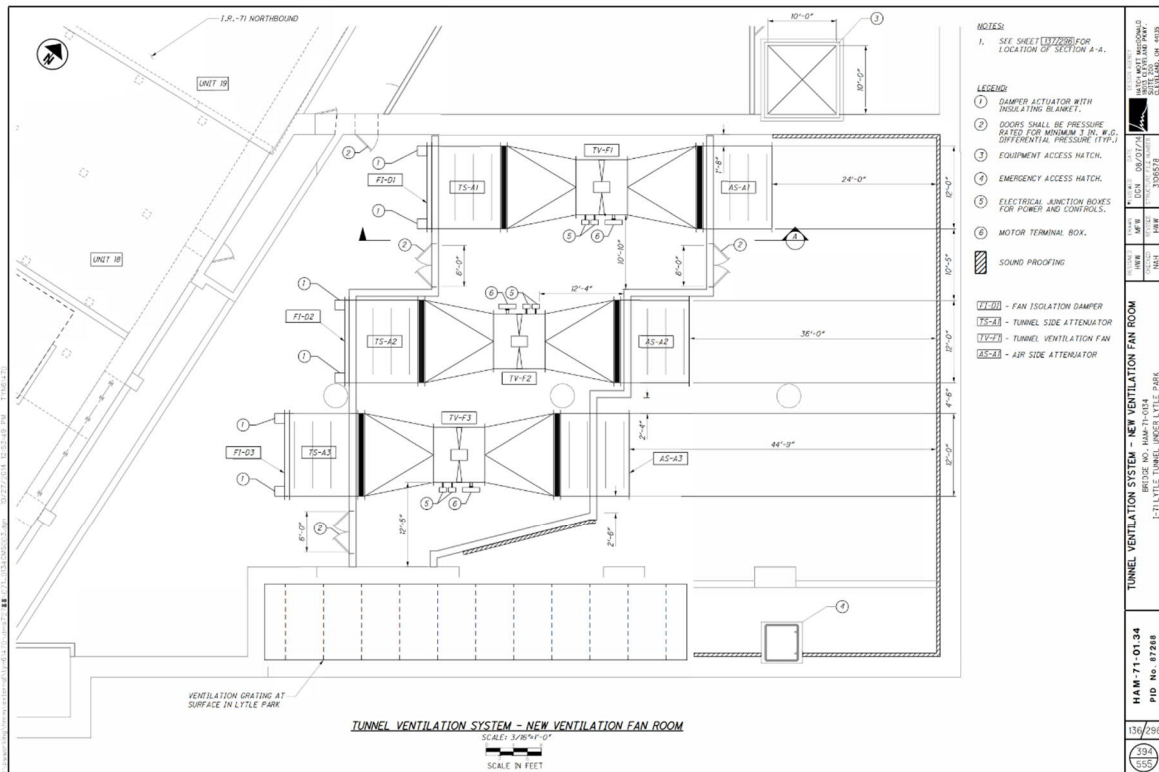
2 Axial Fans

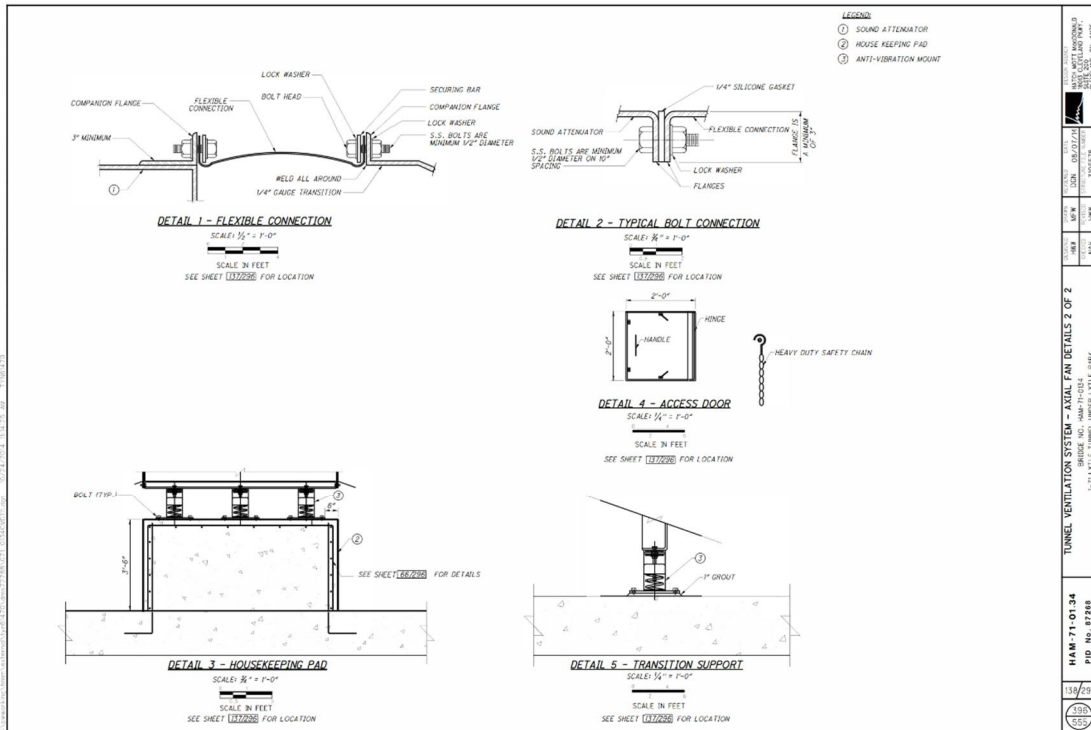
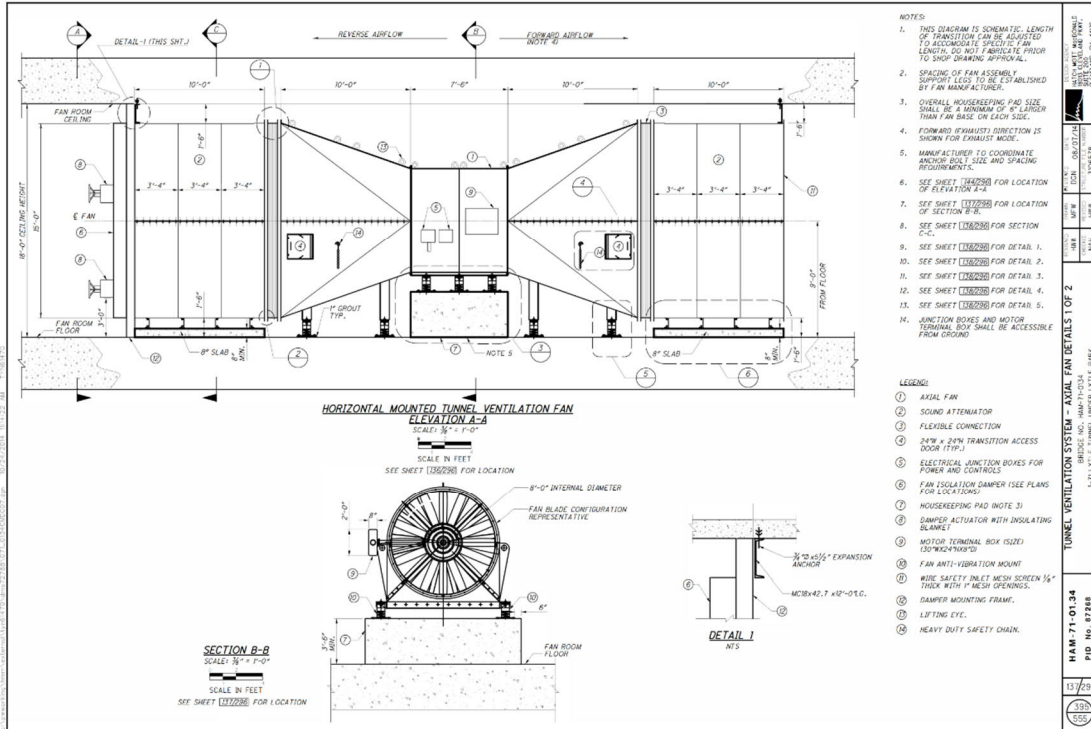
2.1 Description

Lytle Tunnel has an automated Tunnel Ventilation System (TVS) that maintains air quality under normal operating conditions and during a fire event. During normal operating conditions the TVS controls emissions levels within the tunnel providing a safe environment for motorists. In the event of a fire, the TVS controls smoke in the tunnel providing a tenable egress path to allow evacuation of motorists and emergency responders access when necessary.

The TVS employs 3 fully reversible axial fans located within the new ventilation fan room. The fans are utilized for high levels of carbon monoxide, during normal operations, and during emergency operations. Each fan is directly driven by a fully reversible two-speed motor that is situated within the fan casing. The electrical power for the three fans is split between two electrical power sources. Two fans are connected to one transformer and one fans is connected to another transformer. All three fans and their motors are identical. The TVS axial fans were manufactured by Clarge, model ATVCR. The fan locations are shown in Figure 2.1.

Figure 2.1: Fan Locations





1. Major Equipment Information

2. Periodic Preventative Routine Maintenance Schedule – Per ODOT's inspection and maintenance contract scope, all three (3) fans shall each be inspected and tested as specified in Appendix A and per the manufacturer's recommendations.

- Fan internals should be inspected at least once per month. Cleaning can be done with air or, preferably with a soft brush and vacuum. Additionally, every three months fans should be inspected to ensure that there is no build-up of dirt or other matter that would cause overheating of the motor or obstruct the impeller track.
- All fan shall be tested at least once per year to ensure they are working correctly both mechanically and electrically. They should be tested to ensure they can be actuated manually and remotely through the SCADA system. A two week notice to ODOT is required prior to testing.
- Fan motor manufacturer recommends both monthly and yearly maintenance of the fan motor. Monthly maintenance includes cleaning, checking connecting terminals and bolts. Yearly maintenance includes checking the inside of the motors. For a detailed fan motor maintenance check list refer to the fan motor O&M manual.
- Fan motor space heater maintenance would require removal of end shields.

3. Repair Parts and Materials List

4. Manufacturers Recommended Spare Parts

5. Special Tools and Equipment which include:

- Standard socket set, 1/2" drive.
- Philips and common screw driver set.
- Raw hide or rubber mallet
- Large and small pry bar.
- Standard grease gun.
- ½" drive 250 ft-lb torque wrench

6. Lubrication

- The component requiring most maintenance is the electric motor. Please see separate section for motor vendor recommendations regarding maintenance. Regular greasing of the electric motor according to the service interval recommended by the motor supplier should be followed for optimal motor performance. It is important that the noted weight should be applied and not more. Over-greasing of the motor can lead to impaired motor function and other problems. The fan is supplied with extended lubrication lines. It is important that not to continue to input grease even if no grease is coming out from the relief line. Be careful to use only grease approved for use at high temperature and do not mix with other types of grease.
- High temperature grease must be adopted according to the motor data sheet.
- The motors are supplied with loose leads. Where a terminal box is fitted, all cable terminations should be tightly secured.

7. Warranty Provisions:

- Only technicians authorized by TCF Clarage should carry out removal of the impeller blades from the hub. Unauthorized blade or impeller removal will invalidate the warranty on the unit. TCF Clarage Technicians can be reached at 763-551-7500.

8. Contract Maintenance

3 Isolation Dampers

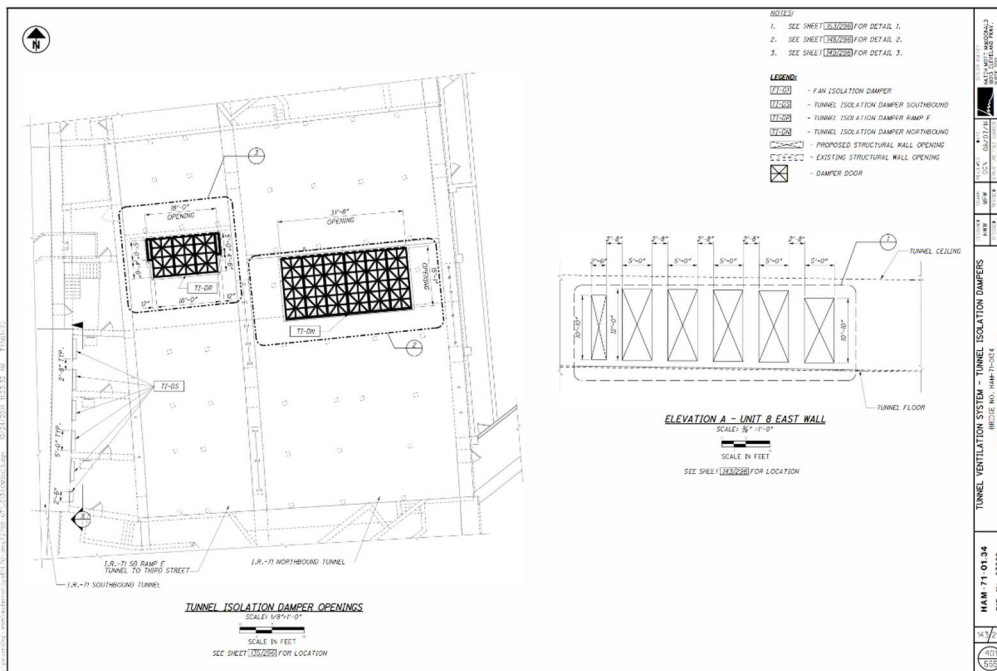
3.1 Description

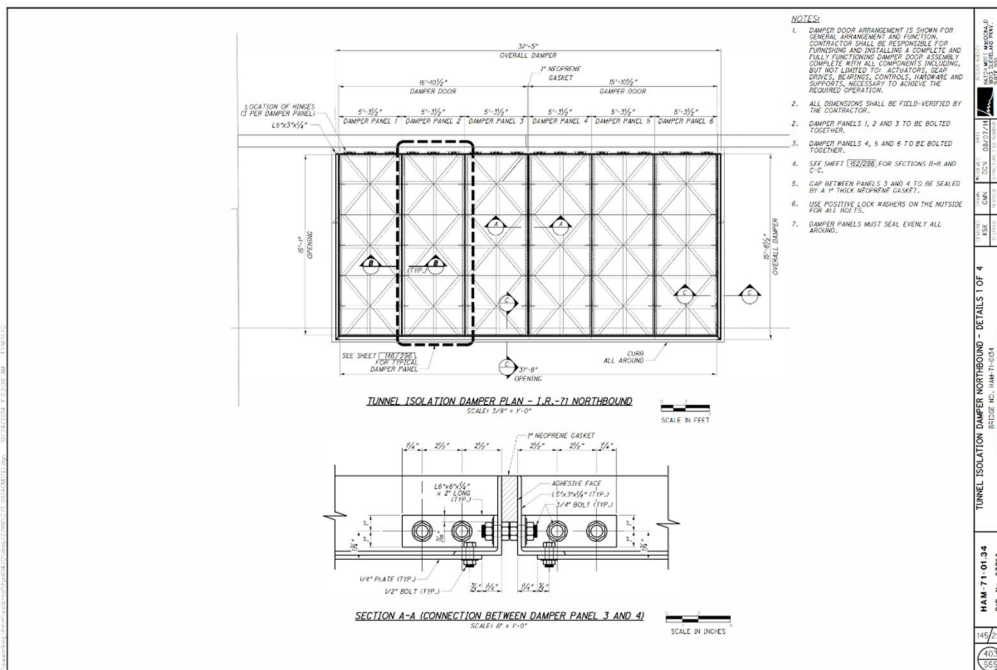
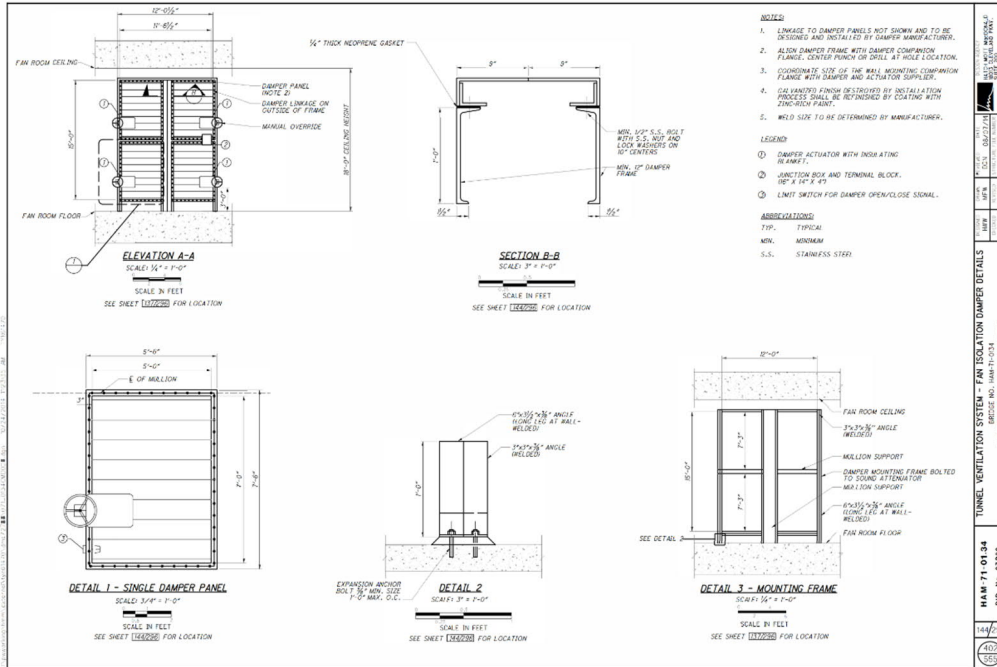
Lytle Tunnel's TVS employs a series of fan and tunnel isolation dampers to control air movement through the tunnel and to protect the TVS. Each fan assembly is fitted with one fan isolation damper driven by four electric actuators. Additionally, each of the three tunnels connects to the plenum via a tunnel isolation damper.

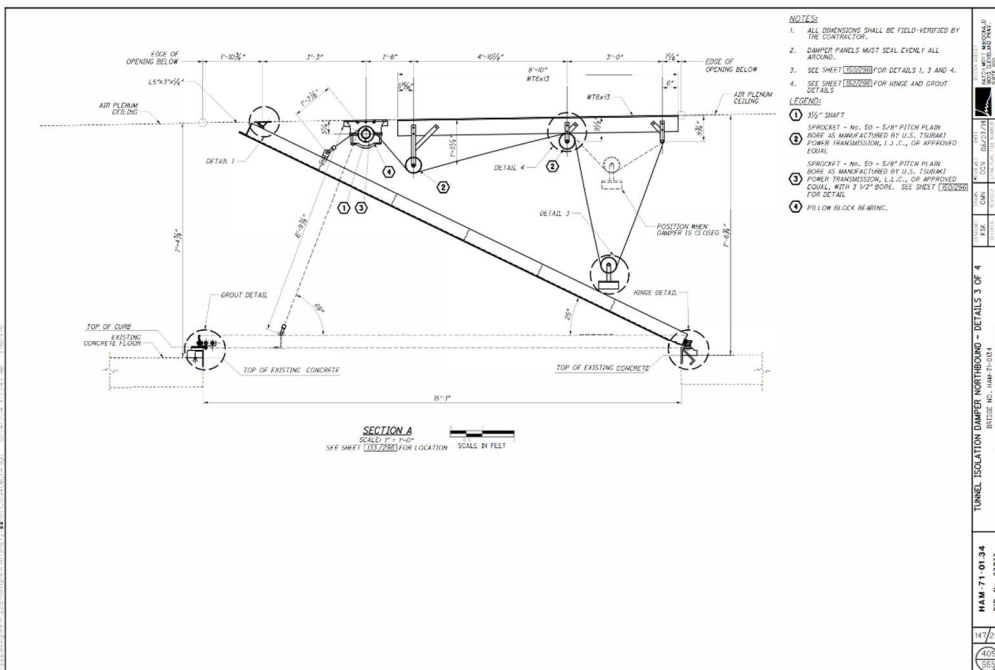
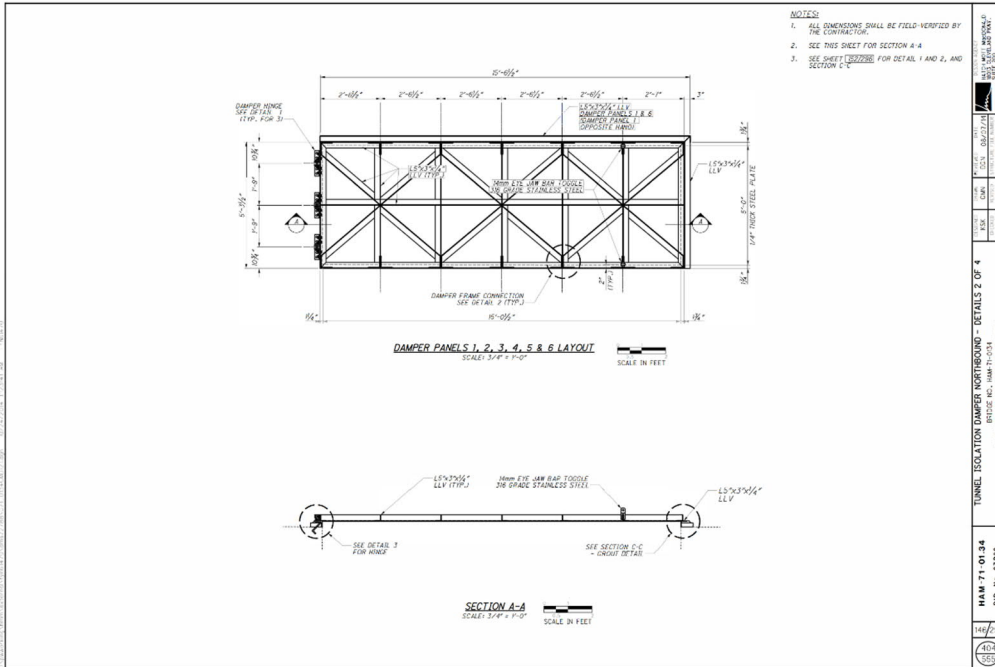
The fan isolation dampers, along with the Southbound tunnel isolation dampers, were manufactured by Greenheck Fan Corporation model HTD-630. The dampers are of the parallel blade type and are modular. Each actuator drives a series of linkages controlling the position of the blades. All actuators are spring turn, allowing them to fully close their associated modules in the case of power loss.

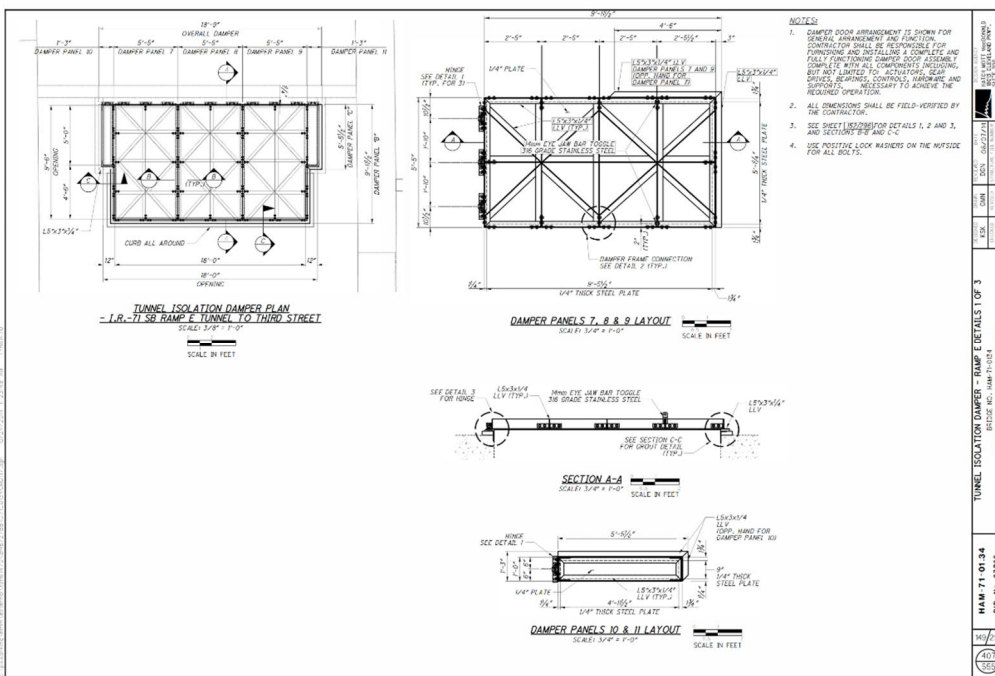
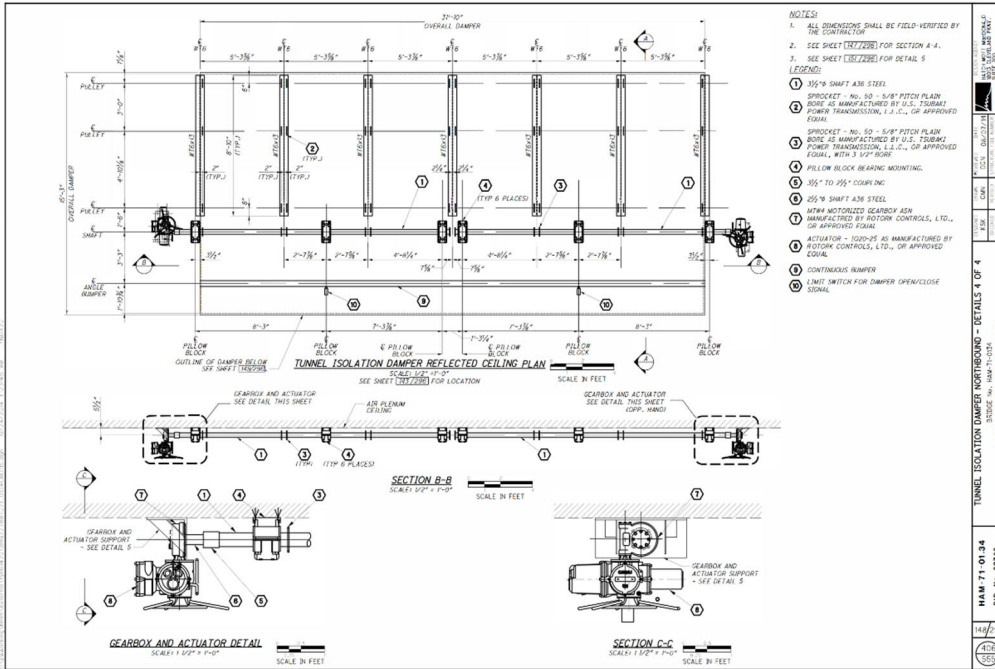
Both the Northbound tunnel and Southbound Ramp utilize coffin damper doors as tunnel isolation dampers. These dampers are driven using electric actuators driving shafts, a series of chains and sprockets. The locations of the various damper assemblies are shown in Figure 3.1.

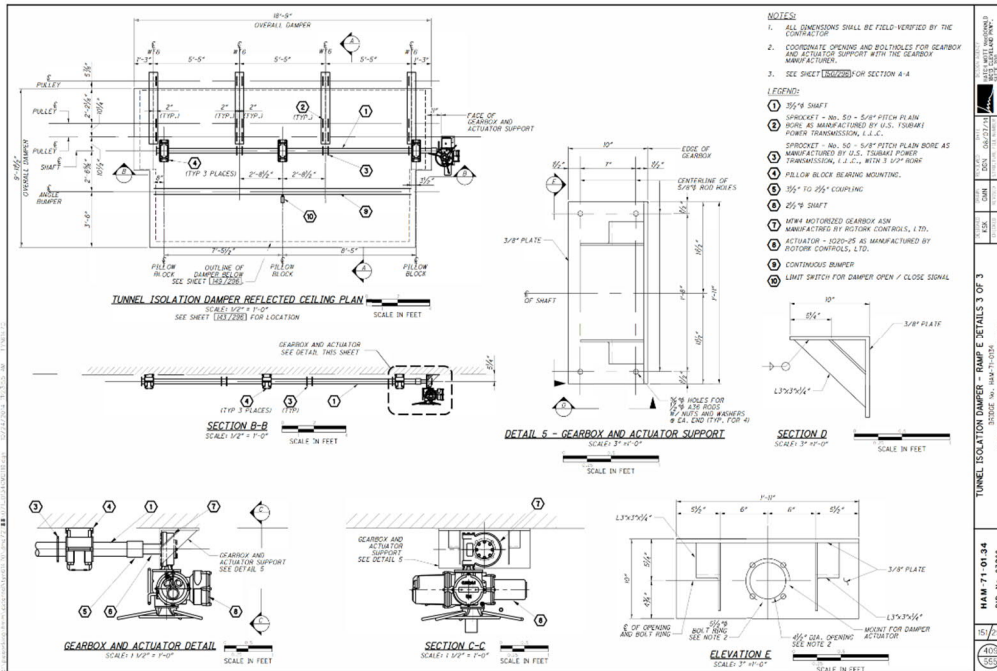
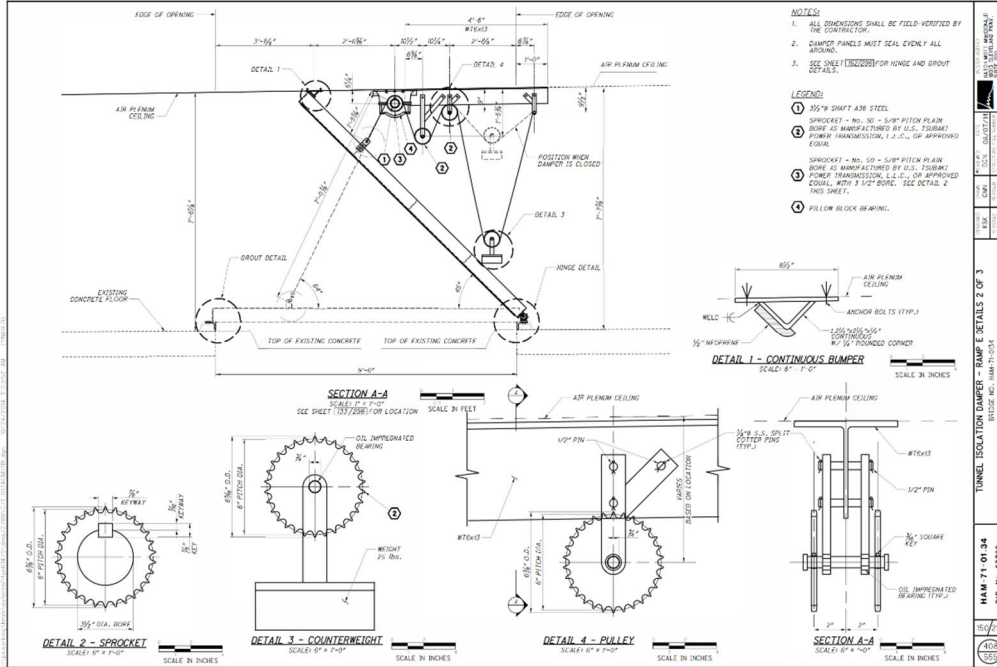
Figure 3.1: Isolation Damper Locations

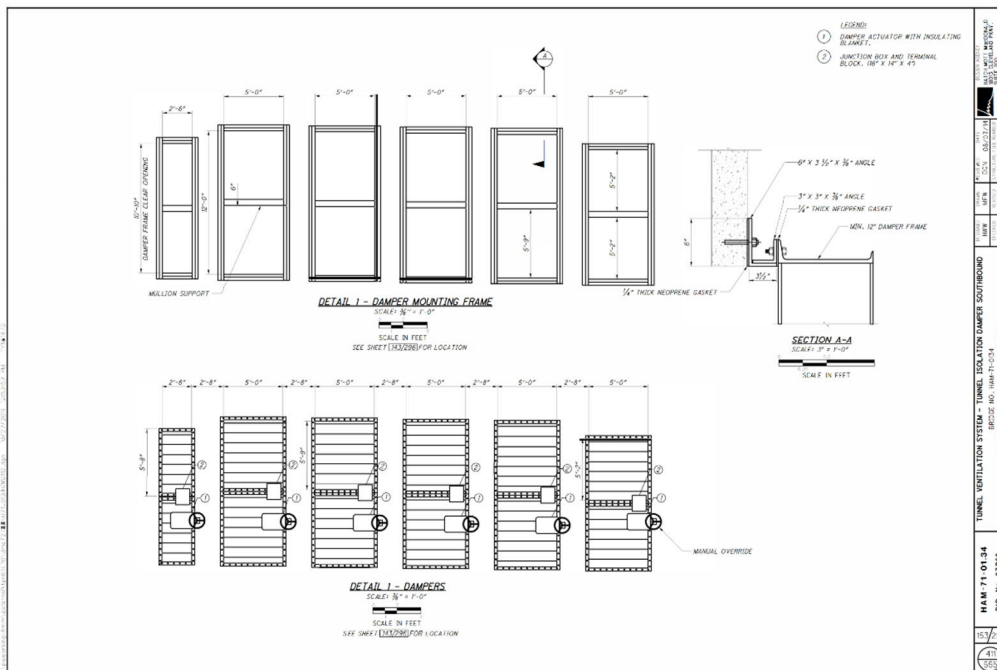
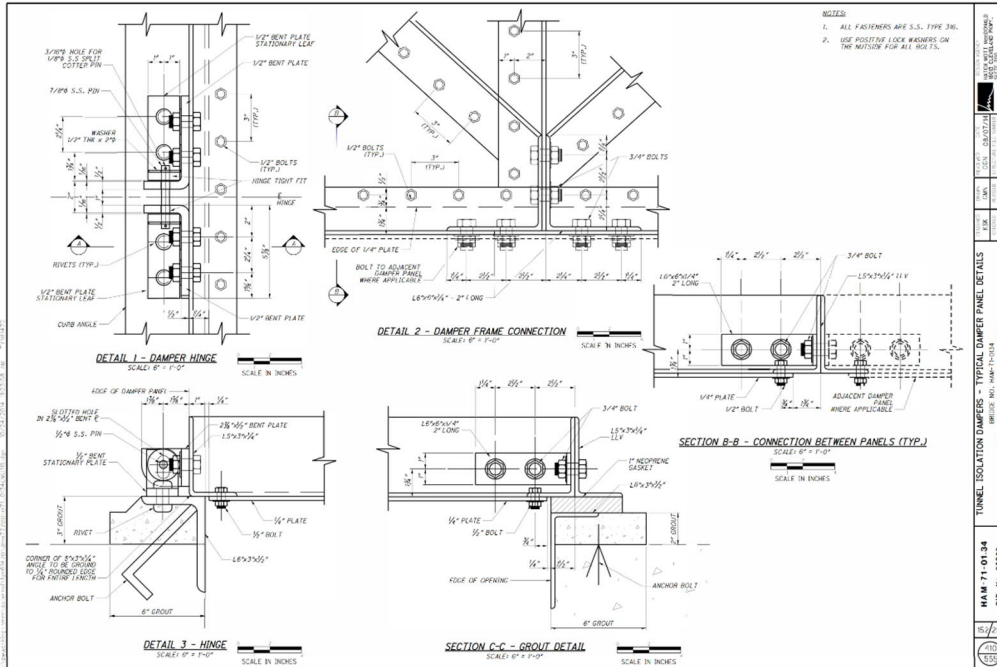












3.2 Operation

Both fan and tunnel isolation dampers are used to control the flow of air into or out of the tunnels. The various dampers operate in either a fully open or fully closed position, allowing or obstructing the airflow across them. The dampers were not designed to control the amount of air flowing across them.

Additionally, fan isolation dampers are used to isolate and protect the fans during operation. Fan Isolation Dampers are to be in the fully closed position, when their associated TVS axial fan is not running while other fans are. This is to protect the fans from wind milling in the opposite direction and air short-circuiting from one side of the new ventilation fan room to the other.

3.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

3.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

3.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information

2. Periodic Preventative Maintenance Schedule – Per ODOT's inspection and maintenance contract scope, the dampers, damper actuator and damper limit switches shall each be inspected and tested to ensure they are working properly.

- Blade damper manufacturer recommends routine maintenance includes both monthly and semi-annual checks.
- Each damper should be inspected on a semi-annual basis for premature corrosion of the dampers.

3. Repair Parts and Materials List

4. Manufacturers Recommended Spare Parts

5. Special Tools and Equipment

6. Lubrication

- The coffin damper door shaft bearings require lubrication using a lithium or lithium complex grease for bearing lubrication. Since the bearings are rotating at slow speeds, they only need to be lubricated every couple of months. However, since these are only in operation periodically, they need to be filled to 100%.
- The chains are to be lubricated with SAE 10W 40 oil every couple of months.
- Not Applicable for blade dampers. Dampers use oil impregnated bearings.

7. Warranty Provisions

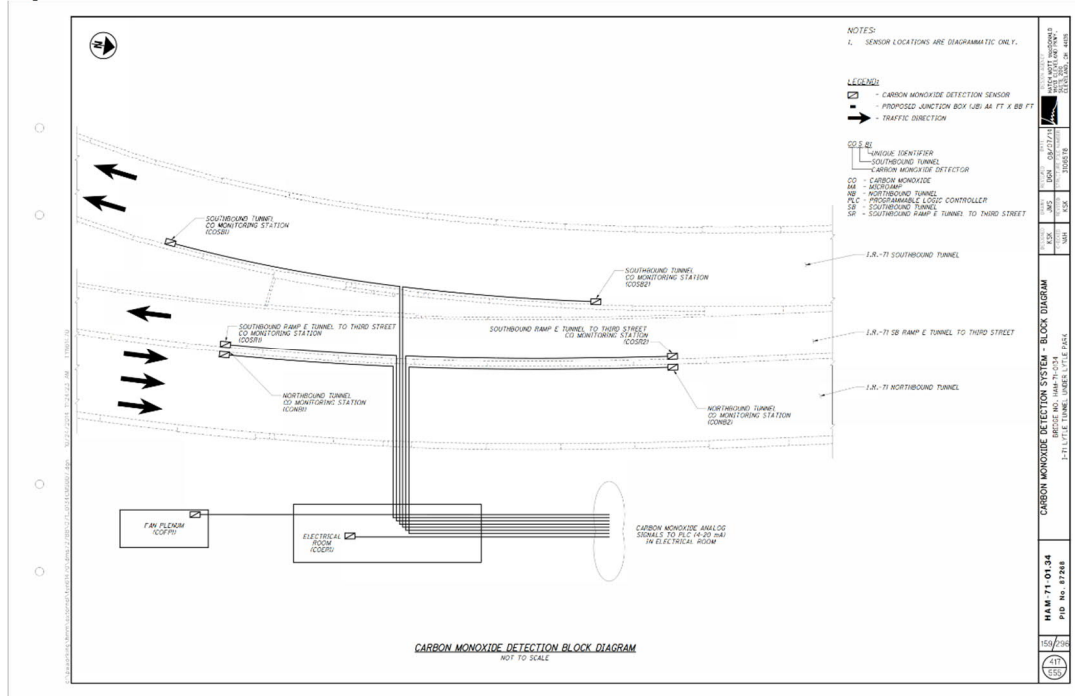
8. Contract Maintenance

4 Carbon Monoxide (CO) Detection System

4.1 Description

Lytle Tunnel Carbon Monoxide (CO) Detection System comprises of 8 monitoring stations; 2 stations per tunnel, one within the fan plenum and one in the electrical room. Each station continuously monitors the CO level using an electrochemical CO detector. Detectors are mounted to the walls at head height and send a 4-20 mA signal to the PLC. The CO Detection system uses Honeywell Sensepoint XCD as its CO detector. The locations of the 8 CO detectors are shown in Figure 4.1.

Figure 4.1: CO Locations in Tunnels



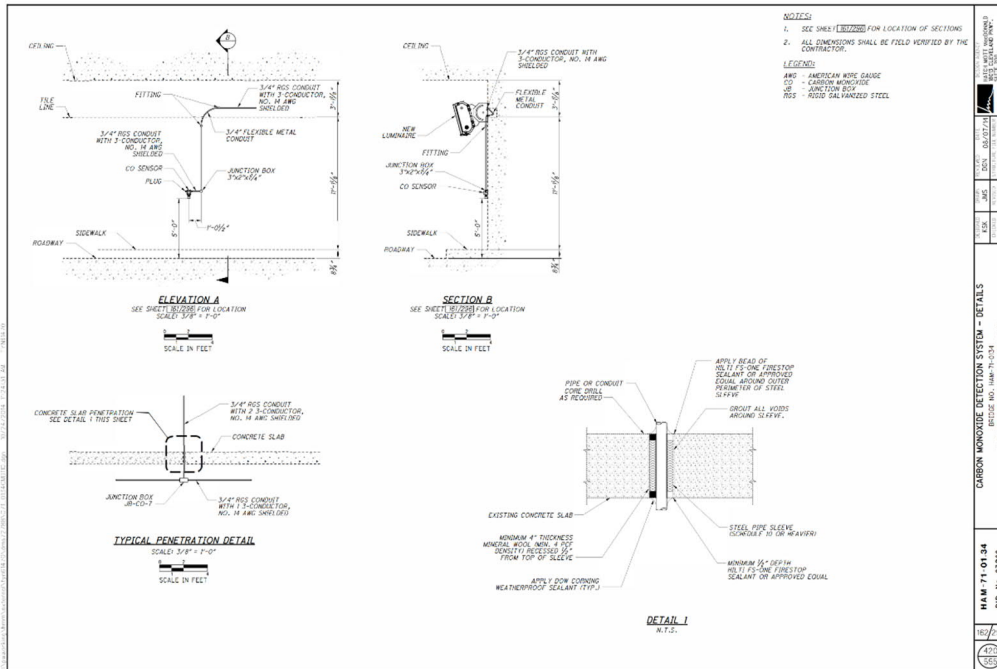
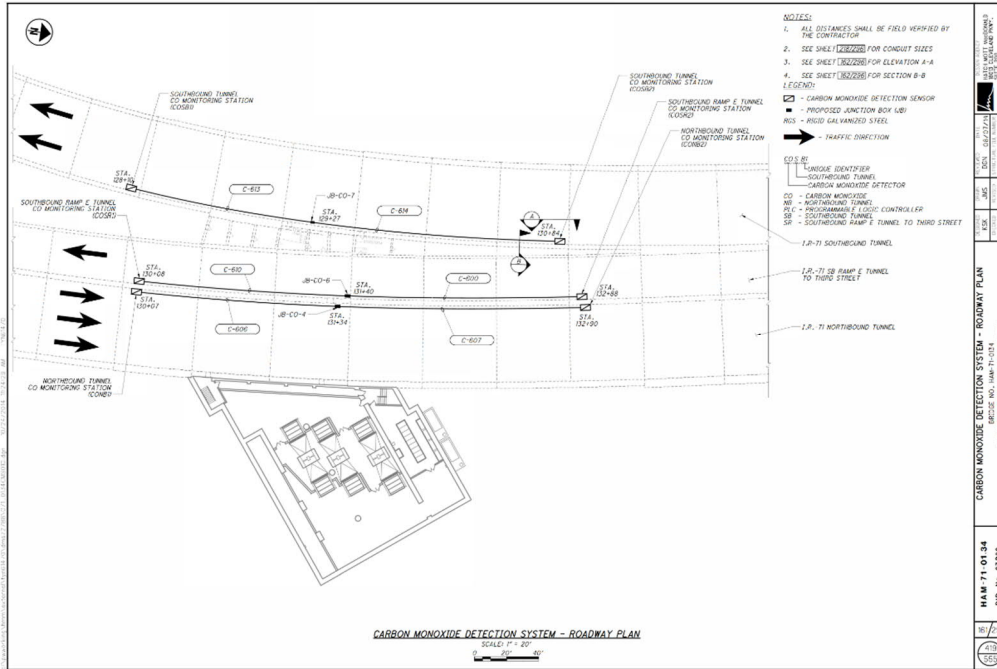
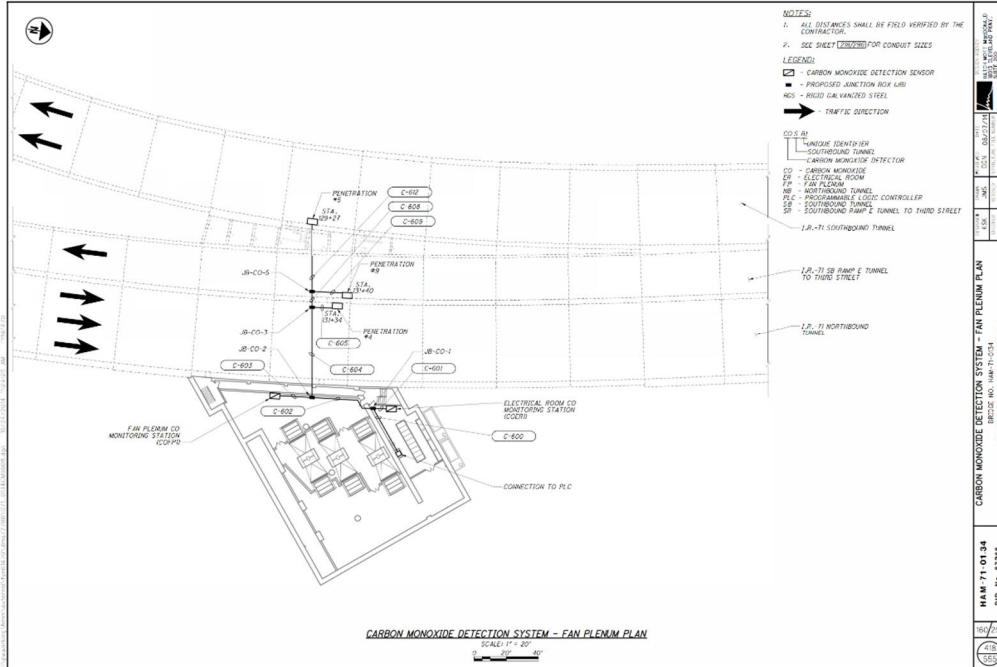


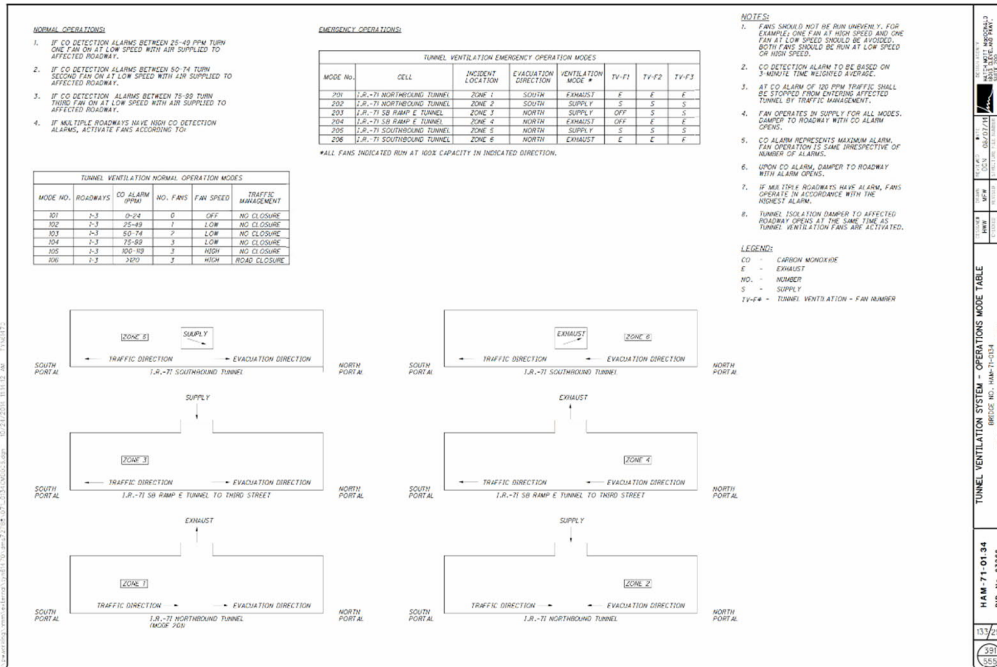
Figure 4.2: CO Locations in Fan Plenum



4.2 Operation

The CO electrochemical detectors continuously monitor CO levels at eight locations throughout the tunnel. The detectors then transmit a 4-20 mA signal to the PLC within the electrical room. The signal is used as an input for the TVS during normal operations. The SCADA system will direct the fan(s) to turn on and supply air to the affected tunnel. See Figure 4.3 for CO alarm operation.

Figure 4.3: CO Alarm Operation



4.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

4.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

4.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

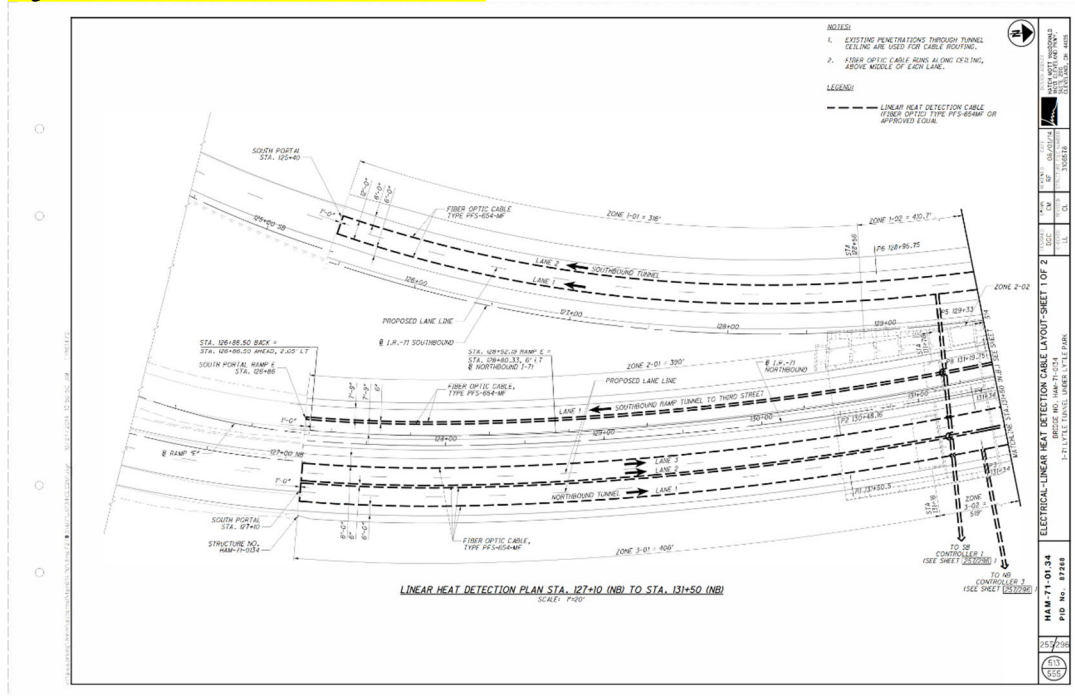
1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule and Calibration is required twice per year per ODOT's inspection and maintenance contract scope and per the manufacturer.
 - Calibration and maintenance is carried out using a Magnetic Wand, this allows a single user to undertake routine maintenance without needing to access internal components.
 - Verification is needed that information is relayed through the SCADA system to Cincinnati Fire Department (CFD) and ODOT's Traffic Management Center (TMC).
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
 - A magnetic wand is needed for calibration and maintenance.
6. Lubrication – Not Applicable
7. Warranty Provisions
8. Contract Maintenance

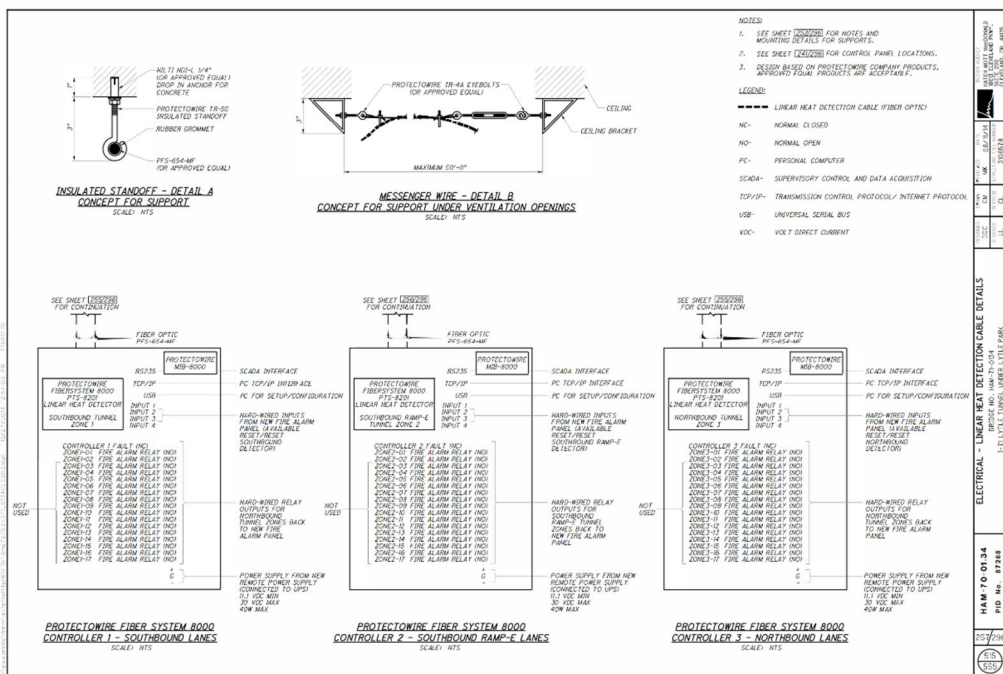
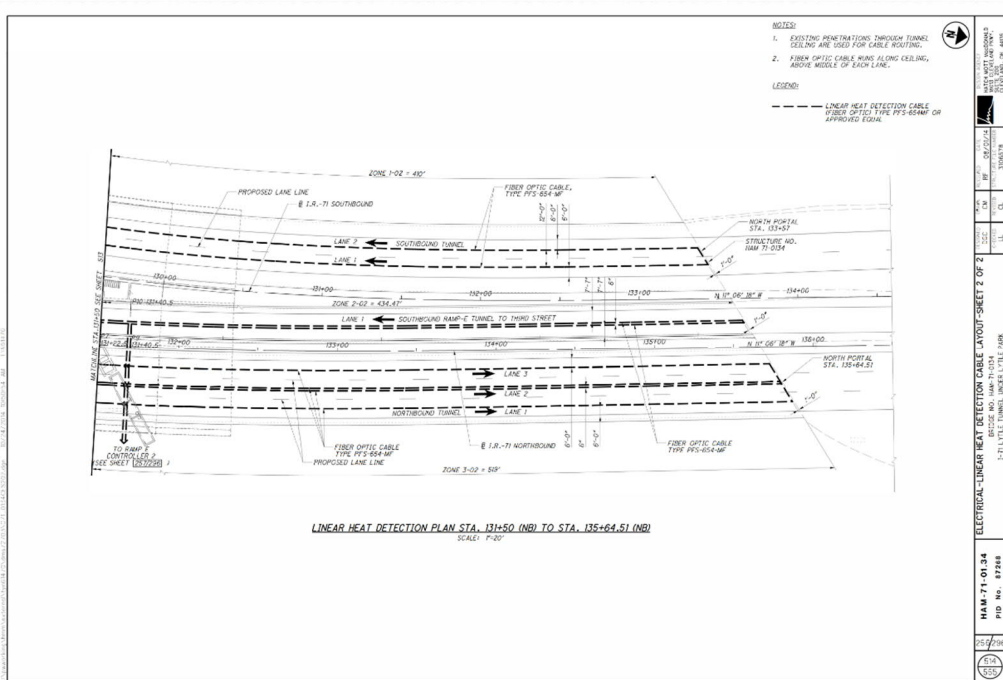
5 Linear Heat Detection

5.1 Description

Lytle Tunnel has linear heat detectors located in each tunnel on the ceiling. The locations are shown in Figure 5.1. The linear heat detectors are Protectowire FiberSystem 8000.

Figure 5.1: Linear Heat Detector Locations

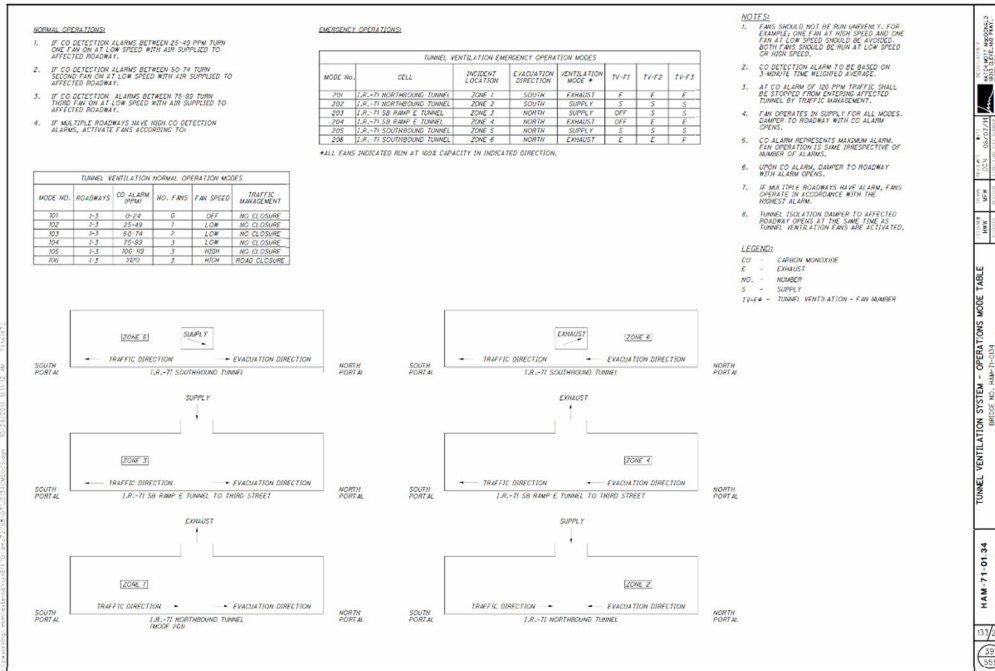




5.2 Operation

The linear heat detectors are capable of alarming a fire condition and locating the fire position within tens of feet. The SCADA system will direct the fan(s) to turn on and supply or exhaust air to the affected tunnel. See Figure 5.2 for emergency operations triggered by the linear heat detectors.

Figure 5.2: Emergency Operations



5.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

5.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

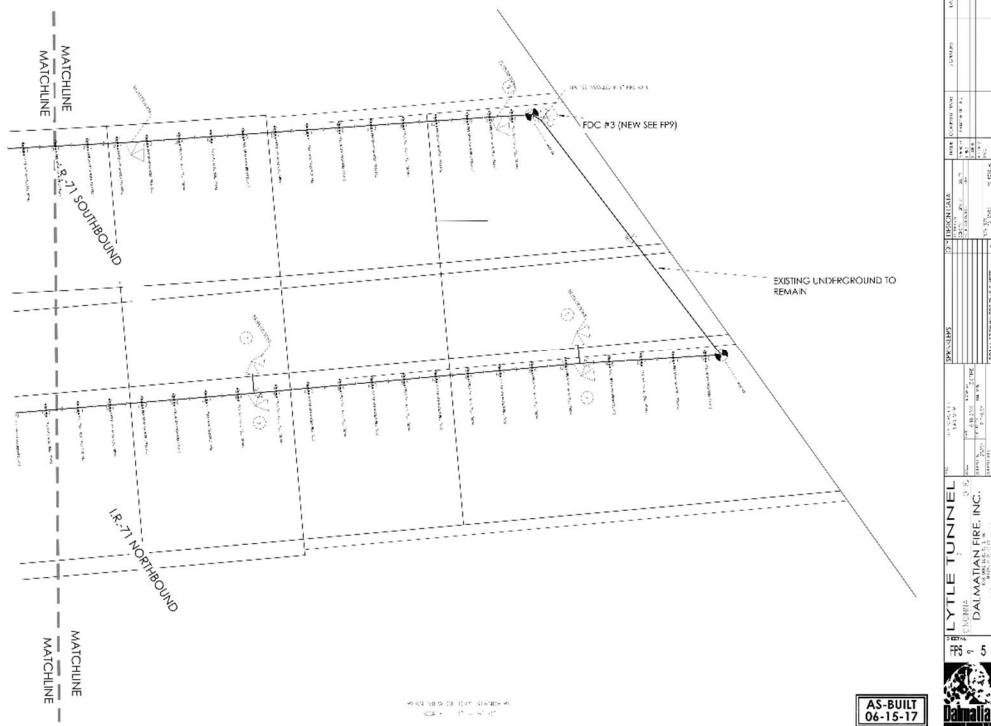
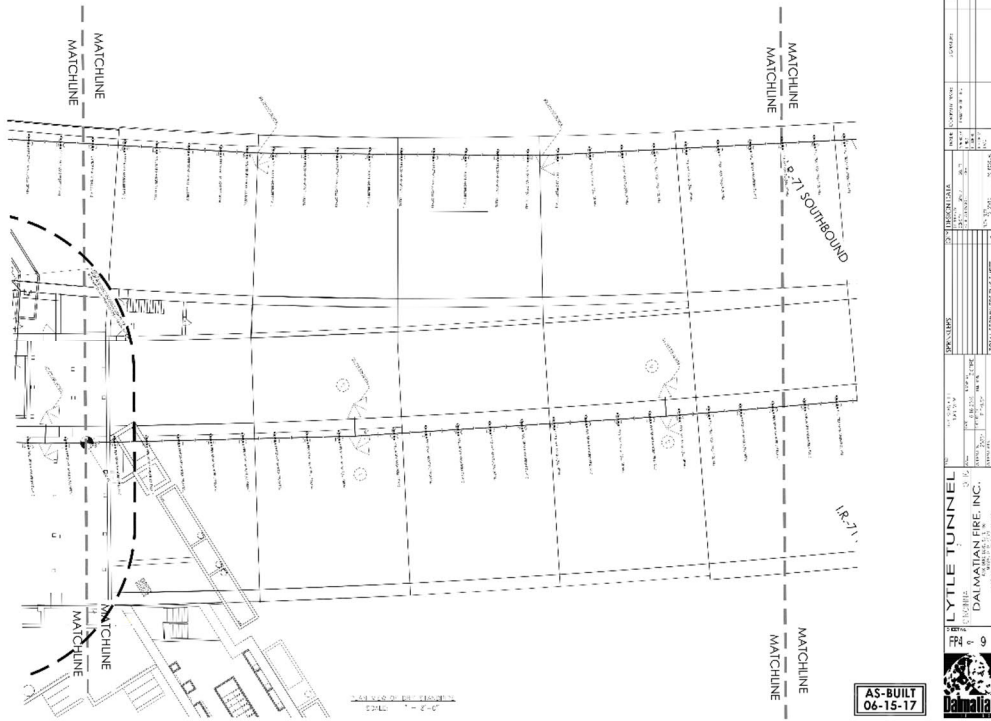
5.4 Maintenance

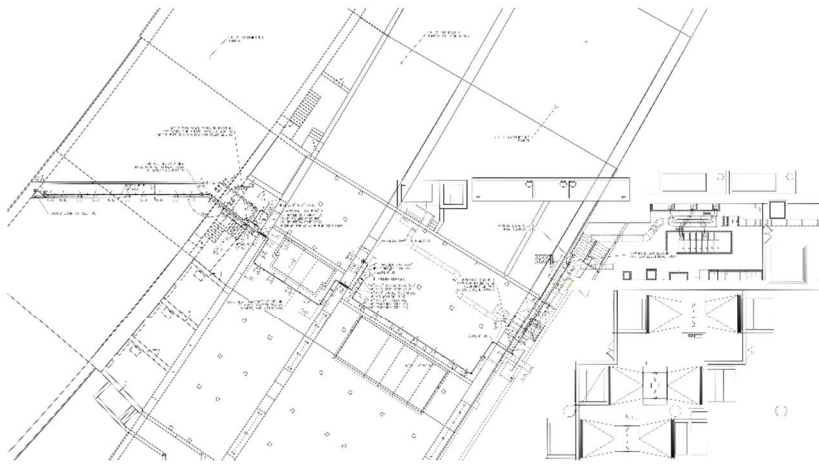
Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule – Testing is required annually per ODOT's inspection and maintenance contract scope. Verification is needed that information is relayed through the SCADA system to Cincinnati Fire Department (CFD) and ODOT's Traffic Management Center (TMC).
3. Repair Parts and Materials List - replacements fuse: 4A, 250V, The Protectowire Company, Inc. part no. 312004
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment – for connector cleaning: pure Isopropanol with cleaning paper or cartridge cleaning tools (OPTIPOP or CLETOP) or a card cleaner; for direct cleaning of the sensor plugs or for cleaning adapters: stick cleaner or the Diamond Ferrule Cleaner 2.5 (Diamond part number BCC 1030609)
6. Lubrication – N/A
7. Warranty Provisions - One year – Defects in material and workmanship from date of shipment.
8. Contract Maintenance

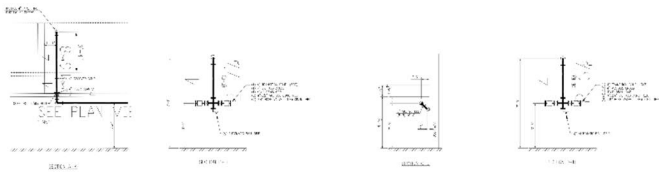
Refer to Appendix A for Maintenance Intervals.

Refer to Appendix B for Plan Sheets





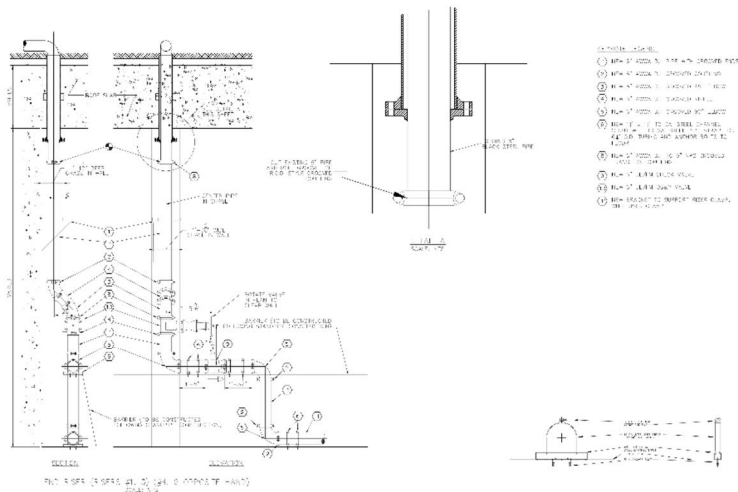
NEW WORK PLAN - FAN ROOM DRY STANDPIPE
SCALE: 1/4" = 1'-0"



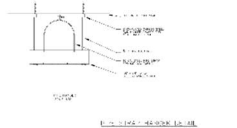
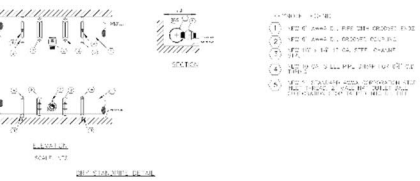
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STATE OF OHIO CERTIFIED
Professional Engineer
No. 10854
D. J. ...

PROJECT NO.	17-00000000
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CONTRACT DATE	...
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CONTRACT TYPE	...
CONTRACT STATUS	...
CONTRACT DESCRIPTION	...
CONTRACT LOCATION	...
CONTRACT OWNER	...
CONTRACT CONTRACTOR	...
CONTRACT SUBCONTRACTOR	...
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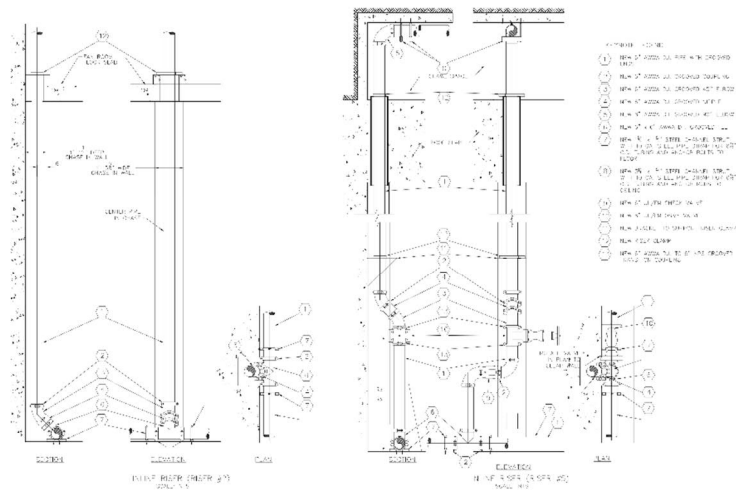
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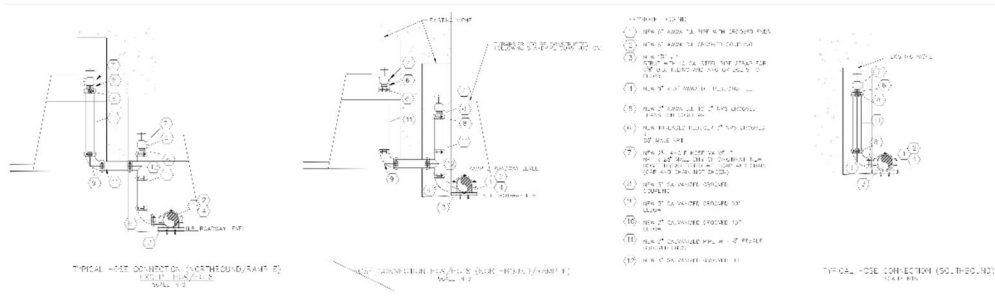


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Exp. 12/31/18
D. J. BROWN
D. J. BROWN & COMPANY, INC.
10000 W. BROADWAY, SUITE 100
CINCINNATI, OHIO 45240

NO.	DATE	DESCRIPTION
1	06/15/17	AS-BUILT

LYTLE TUNNEL
DALLMAN FIRE INC.
779 9



AS-BUILT
06-15-17

STATE OF OHIO CERTIFIED
MECHANICAL ENGINEER
No. 10453
Exp. 12/31/18
D. J. BROWN
D. J. BROWN & COMPANY, INC.
10000 W. BROADWAY, SUITE 100
CINCINNATI, OHIO 45240

NO.	DATE	DESCRIPTION
1	06/15/17	AS-BUILT

LYTLE TUNNEL
DALLMAN FIRE INC.
779 9

6.2 Operation

The fire department can pressurize the standpipe in order to help suppress fire incidents in the tunnel.

6.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

6.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

6.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information

2. Periodic Preventative Maintenance Schedule – Pressurizing of the system is required annually per ODOT's inspection and maintenance contract scope. Additional inspection and maintenance items include:

- Drain all low point drains at least semi-annually and annually.
- Operate all control valves by closing and opening and greasing of the control valve stems to prevent corrosion.
- Visually inspecting all fire hose valves annually to see that the caps are still in place and visually inspecting all three Fire Department connections (FDC) to see that the caps are in place.

3. Repair Parts and Materials List

4. Manufacturers Recommended Spare Parts

5. Special Tools and Equipment

6. Lubrication

- All control valves shall be greased as per manufacturer's recommendations.

7. Warranty Provisions

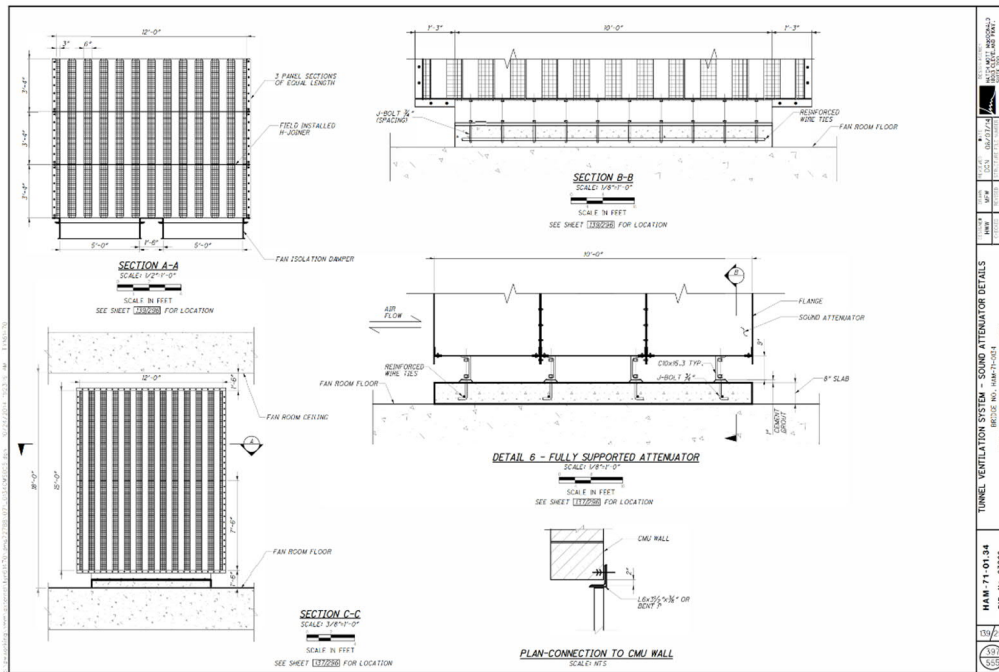
8. Contract Maintenance

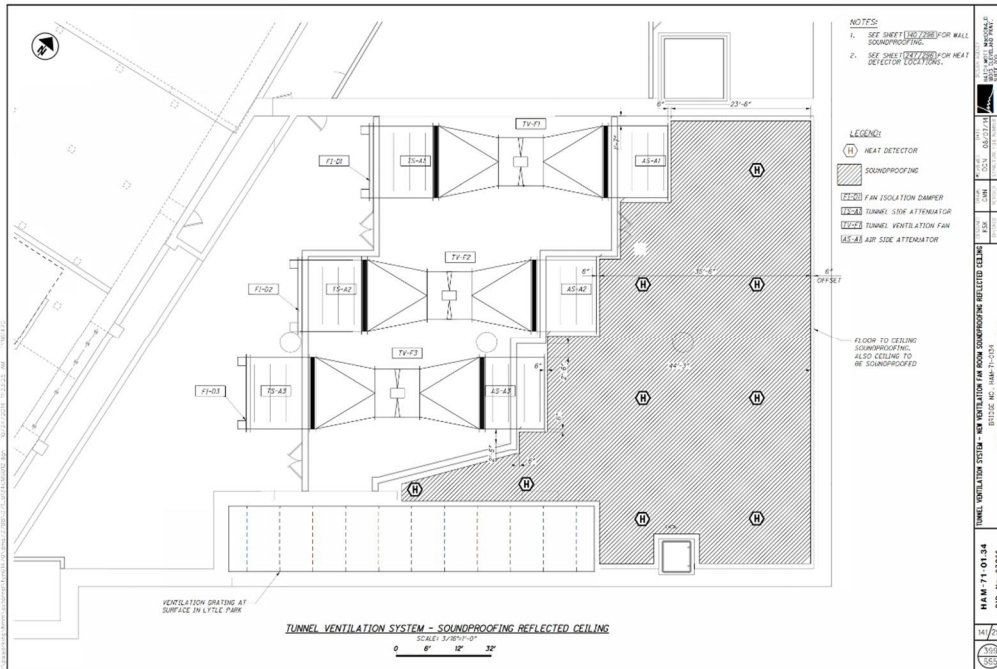
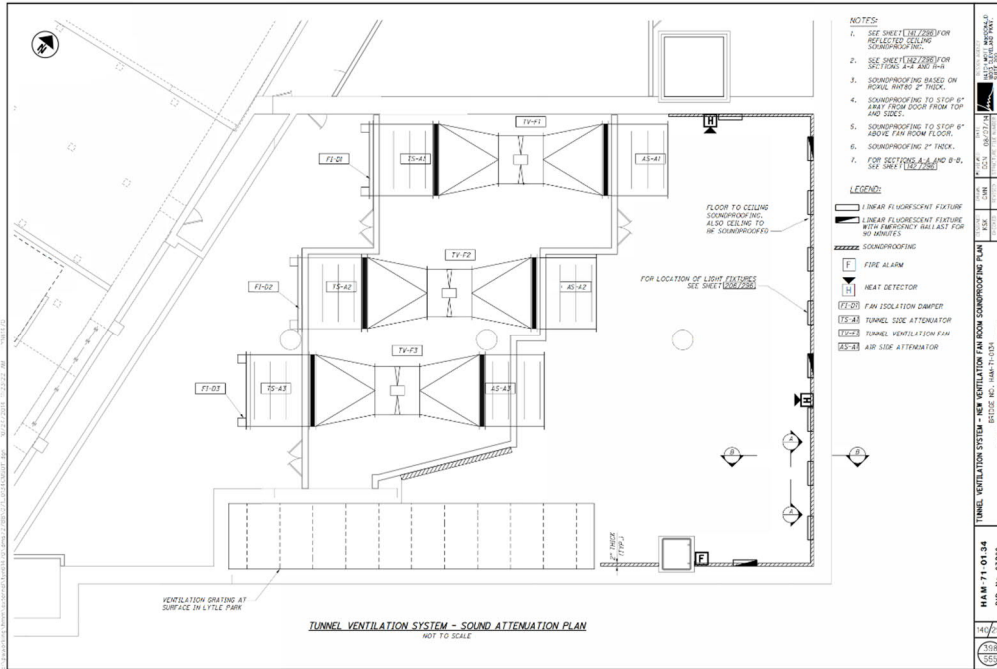
7 Soundproofing

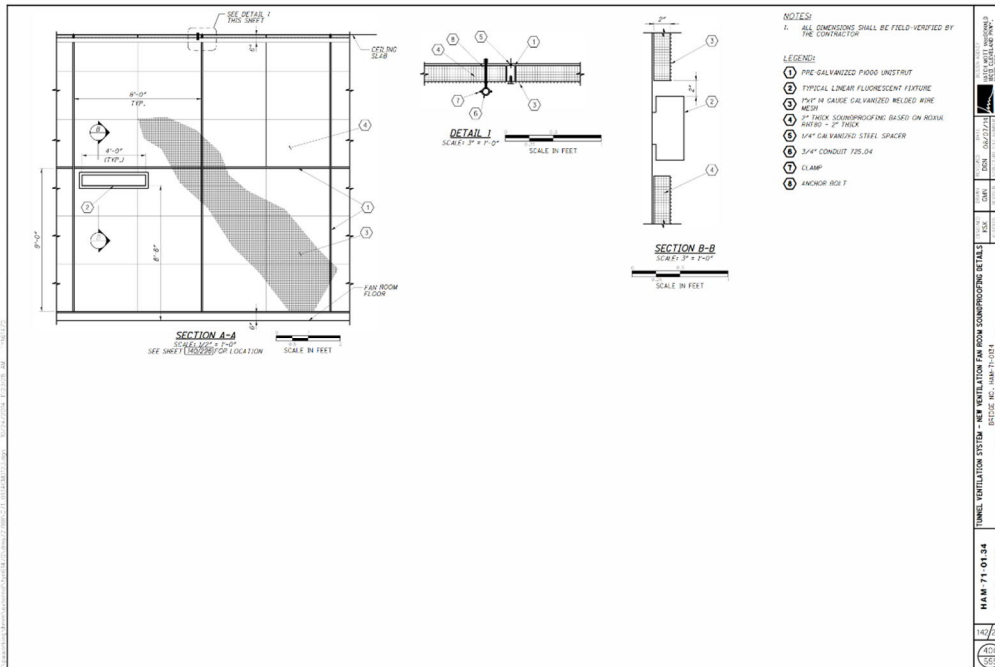
7.1 Description

Lytle TVS is fitted with soundproofing to meet NFPA requirements and bring sound levels to acceptable levels. Soundproofing employs both sound attenuation attached to TVS axial fans as well as soundproofing boards on the walls and ceilings of the fan plenum. Each of the three TVS axial fans is connected to a 10 ft long sound attenuator at each side. Additionally, soundproofing boards clad the walls and ceiling of the fan plenum leading to atmosphere. The locations are shown in Figure 7.1.

Figure 7.1: Soundproofing Locations







7.2 Operation

During operation, TVS fans generate high sound levels that exceed acceptable criteria set forth by NFPA. Noise propagates through the system as it is carried by the airflow. Soundproofing is added along the airpath to absorb and mitigate the high sound level.

7.2.1 Troubleshooting

Refer to the Manufacturer’s O&M Manual.

7.3 Safety

Refer to Manufacturer’s O&M Manual for specific equipment safety details.

7.4 Maintenance

Refer to Manufacturer’s O&M Manual for the following maintenance information:

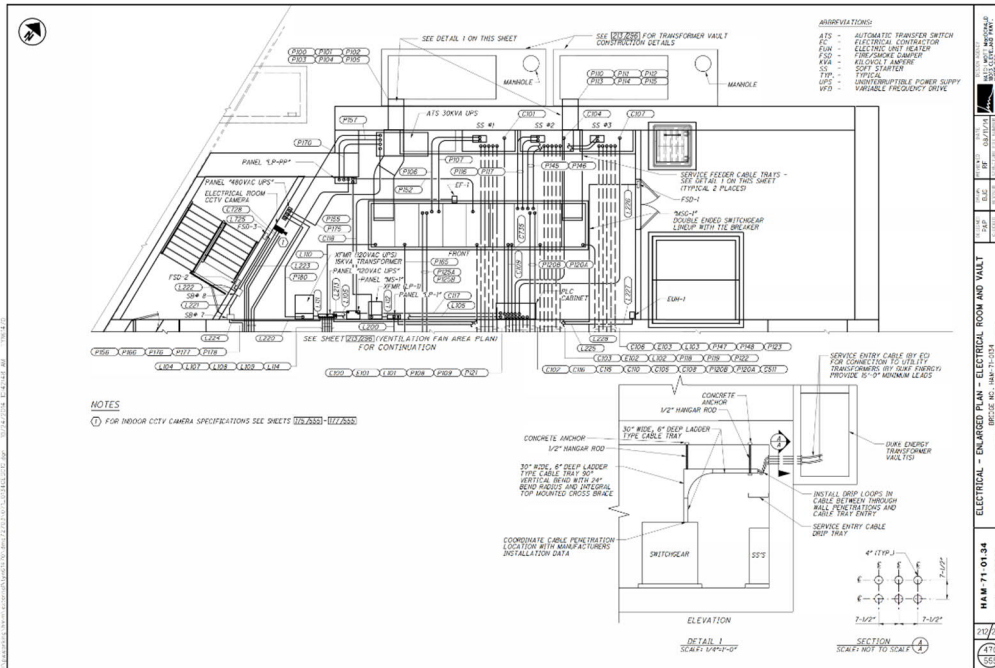
1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication – Not Applicable
7. Warranty Provisions
8. Contract Maintenance

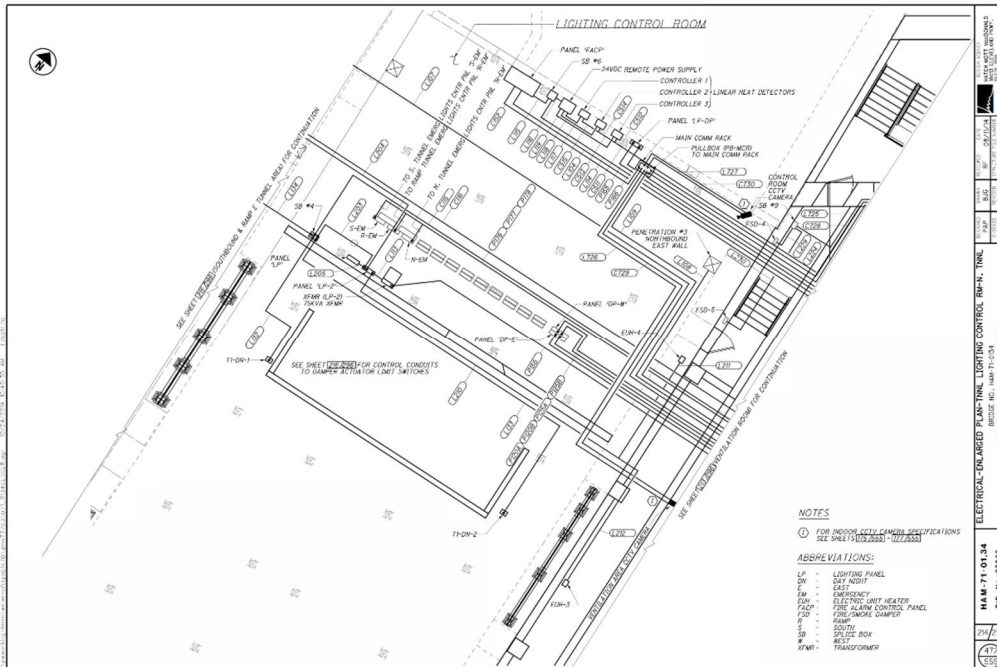
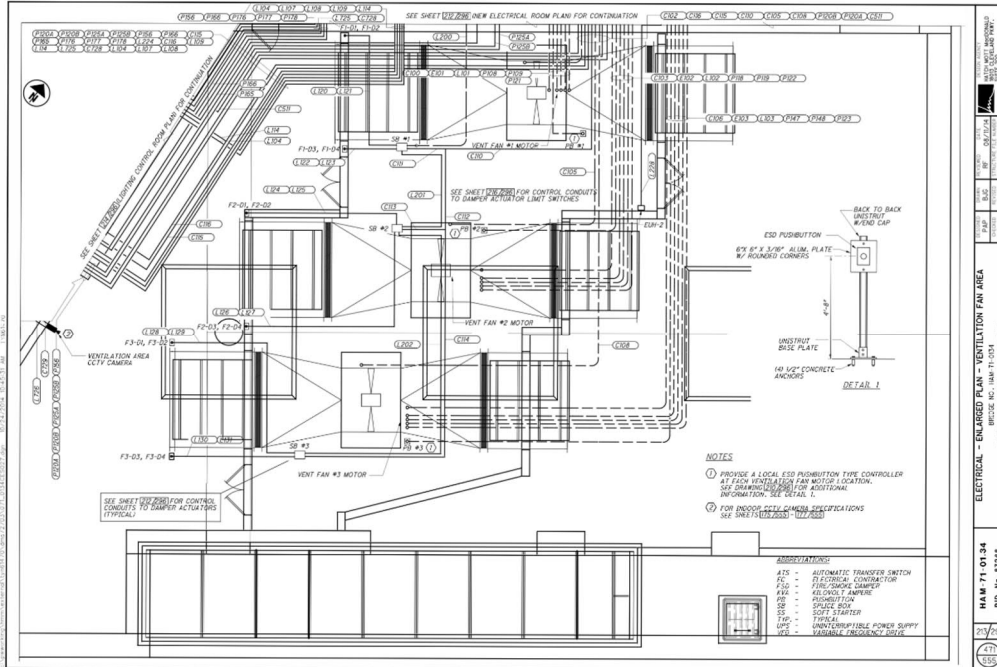
8 Low Voltage Transformers

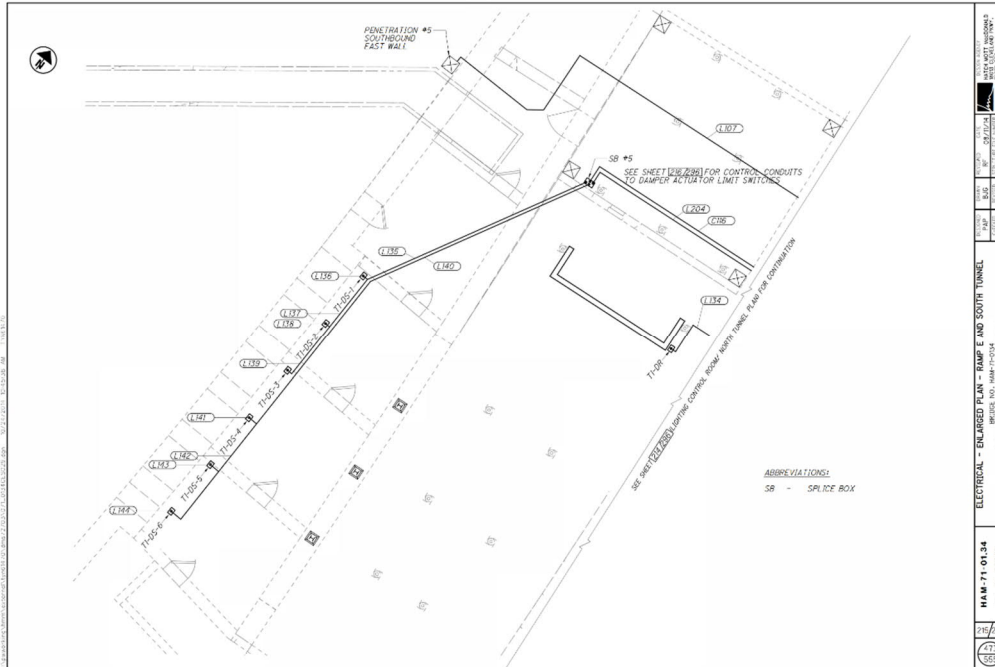
8.1 Description

Lytle Tunnel has 3 low voltage step down transformers. The transformers are Square D by Schneider Electric. The locations of the low voltage transformers are shown in Figure 8.1.

Figure 8.1: Low Voltage Transformer Locations







8.2 Operation

The step down transformers decrease voltage from the primary transformers maintained by Duke Energy.

8.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

8.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

8.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication – N/A
7. Warranty Provisions
8. Contract Maintenance

Refer to Appendix A for Maintenance Intervals.

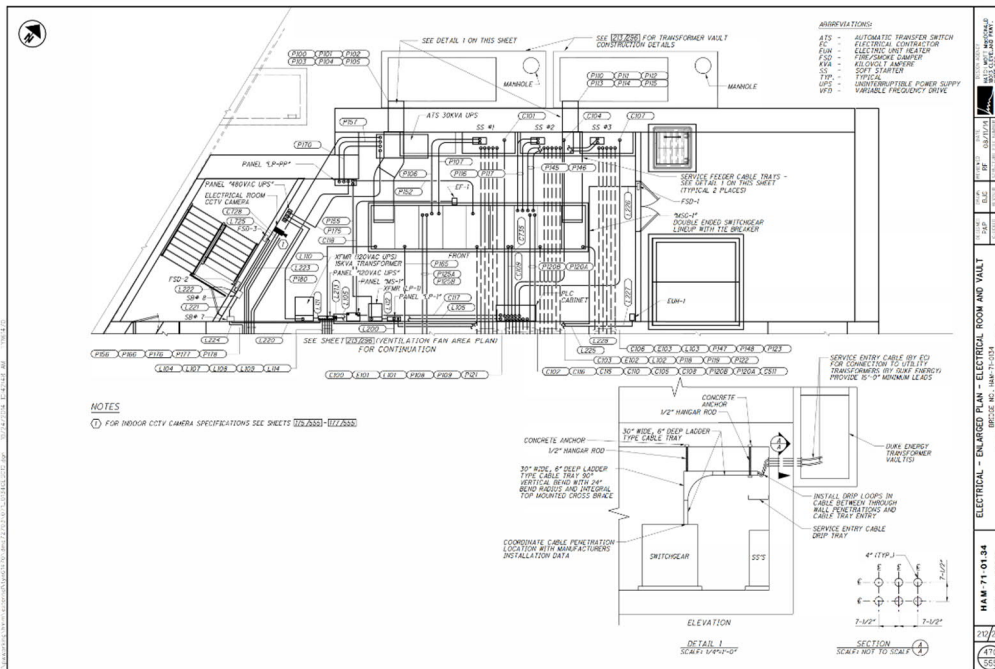
Refer to Appendix B for Plan Sheets

10 Switchgear

10.1 Description

Lytle Tunnel has low voltage switchgear located in the tunnel control room. The locations are shown in Figure 10.1. The low voltage switchgear is manufactured by Schneider Electric.

Figure 10.1: Switchgear Locations



10.2 Operation

The switchgear is used to control, protect and isolate electrical equipment.

10.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

10.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

10.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule
3. Repair Parts and Materials List – For SPD units: MA modules, diagnostic display assemblies;
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment:

To test a **modified differential ground fault protection system**:

- 1) A high current injection test unit capable of injecting 1000 A. Test jumpers are typically copper welding cables. Use cables and connections that give low impedance;

2) Hand-held test kit by Schneider Electric for Micrologic® Type A, H and P trip units. Use HHTK or FFTK test kits for secondary injection testing or test with primary injection.

PowerPact™ P-Frame and NS630b–NS1600 Circuit Breakers require:

- 1) Screwdriver, Pozidriv® #2 or 3, or slotted
- 2) Socket Wrench, 7 mm internal hex
- 3) Screwdriver, long-shanked slotted
- 4) Torque Wrench, 5/16 in. or 8 mm

Micrologic Electronic trip units require:

- 1) Torque-controlled screwdriver, set at 7 in-lbs (0.8 N•m) ± 10% (Lindstrom torque driver MAL500-2 or equivalent)
- 2) Micrologic Full-Function Test Kit (part number S33595)

Masterpact™ NW Low-Voltage Power/Insulated Case Circuit Breakers require –

- 1) Hex Key, 5 mm
- 2) Angled Socket Wrench, 1/2 in.
- 3) Straight Blade Screwdriver (#2 Pozidriv® or Slotted)
- 4) Torx® 20 Screwdriver
- 5) Cluster Reset Tool, Cat. No. CLUSRETOOL
- 6) Lifting Hooks, Cat. No. S48906
- 7) Crossbar - W-Frame, Cat. No. S48900; Y -Frame, Cat. No. S48901
- 8) Cradle Interlock Defeat Tool (Drawout Circuit Breaker Only, Provided)
- 9) Cluster Positioning Tool, Cat. No. S47542
- 10) Wago® Wire Insert Tool, Wago Part No. 209-129
- 11) 10 mm Hex Adapter for Cradle Racking Mechanism
- 12) Operation counter
- 13) Racking crank
- 14) HHTK or FFTK test tools
- 15) Stopwatch
- 16) External power supply
- 17) MX tripping time tester
- 18) FFTK test tool, FFTK report generator
- 19) Mobilith SHC00
- 20) Ohmmeter
- 21) “service life” software
- 22) Injection unit
- 23) Grease

6. Lubrication –

Masterpact NT and NW Circuit Breakers:

This operation is carried out after cleaning on certain mechanical parts as described in the maintenance procedures, using the various greases recommended by Schneider Electric. Grease must not be over applied because the excess, if mixed with dust, may result in mechanism malfunctions. Generally speaking, under normal operating conditions, the pole-operating mechanism does not require any regreasing as it is greased for the life of the product.

- The clusters and disconnecting-contacts must be greased according to the defined intervals using the greases indicated by Schneider Electric.
- The main contacts must not be greased.

Power-Style QED Switchboard:

For field maintenance re-lubrication of blade/jaw components in switches 600 V and below, use G20 High Performance Synthetic Grease from Dow Corning (Schneider Electric catalog number SWLUB). This grease is applicable for the following switches:

- Bolt-Loc
- QMB Main and Branch
- QMJ Branch
- QMQB1 Main and Branch

For bus/plug-on connections, use electric joint compound, Schneider Electric

catalog number PJC7201.

For Masterpact™ NW drawout connections, use only Schneider Electric catalog number S48899 Electric Joint Compound.

Power-Zone 4 Switchgear:

Perform the following steps to lubricate the traveling lifter assembly.

1. Make sure a good film of lubrication is always present in appropriate places.
2. All wheels and rollers must be lubricated properly with a multi-purpose grease. Brush a high-quality, multi-purpose grease onto the worm gear assembly. Repeat this procedure, as necessary, to maintain a continuous film of grease over the face of these gears.
3. Never operate the winch with the worm gear assembly dry.
4. Lubricate all other points of friction as needed with a high-quality, medium-weight oil. Avoid over saturation that produces oil dripping.

7. Warranty Provisions:

GE 469 Motor management relay – 10 years warranty;

8. Contract Maintenance

Refer to Appendix A for Maintenance Intervals.

Refer to Appendix B for Plan Sheets

Refer to Appendix A for Maintenance Intervals.

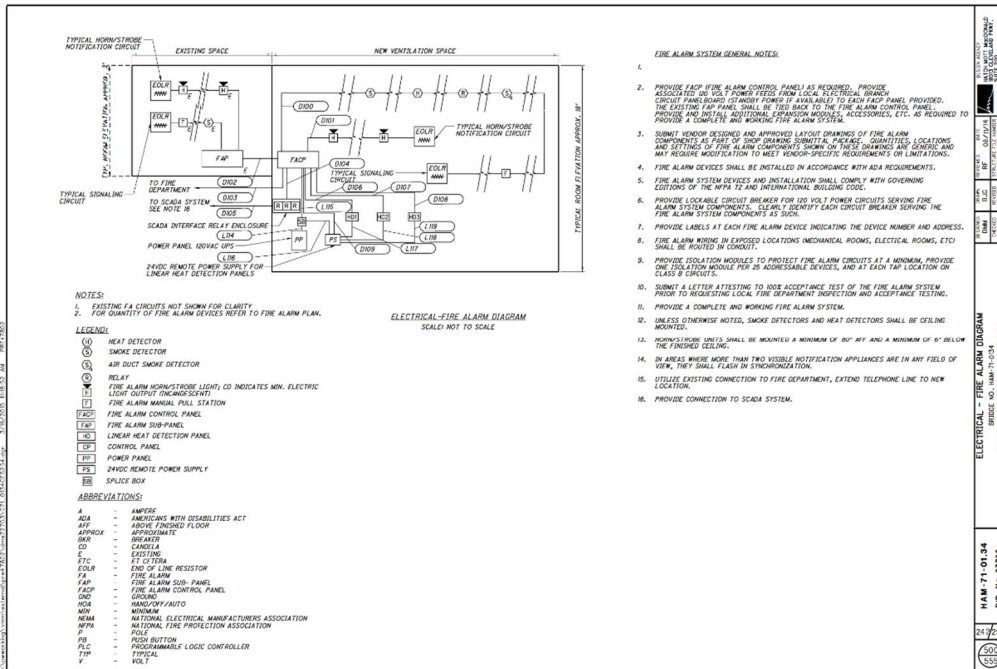
Refer to Appendix B for Plan Sheets

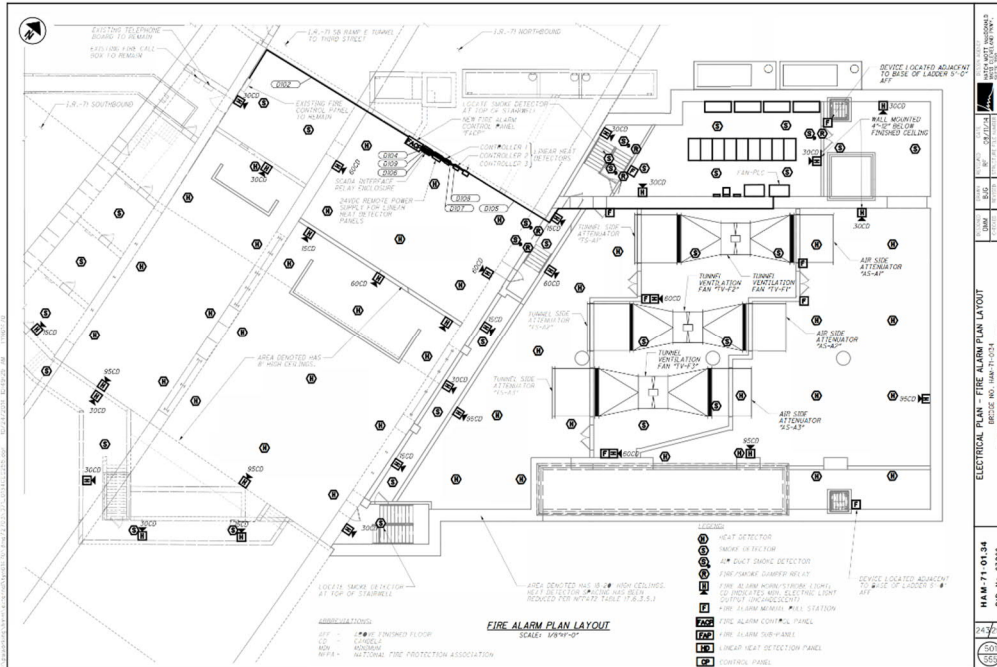
12 Fire Alarms

12.1 Description

Lytle Tunnel has fire alarms including manual stations, smoke detectors, and heat detectors located throughout the tunnel control rooms. The locations are shown in Figure 12.1. The fire alarms are made by SimplexGrinnell.

Figure 12.1: Fire Alarm Locations





12.2 Operation

The fire alarms will send an alarm signal to the SCADA system whenever the sensors detect an incident.

12.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

12.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

12.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication – N/A
7. Warranty Provisions – the fire alarm system is provided with 1 year warranty;
8. Contract Maintenance

Refer to Appendix A for Maintenance Intervals.

Refer to Appendix B for Plan Sheets

14 Lighting

14.1 Description

Lytle Tunnel has light-emitting diode (LED) lighting located on each side of each tunnel. Emergency lighting is on all the time and is UPS powered. The tunnel lighting is manufactured by Kenall, model LuxTran LTSI. The LED drivers are manufactured by Mean Well HVGC-320 series. The lighting controls are the T57-4 system manufactured by PLC Transportation. There is additional lighting located within the tunnel control rooms. The locations are shown in Figure 13.1. The valve-regulated lead-acid (VRLA) batteries are made by Panasonic and are rechargeable. The Surge Protection Device (SPD) is manufactured by Transtector, model Super Hy 240.

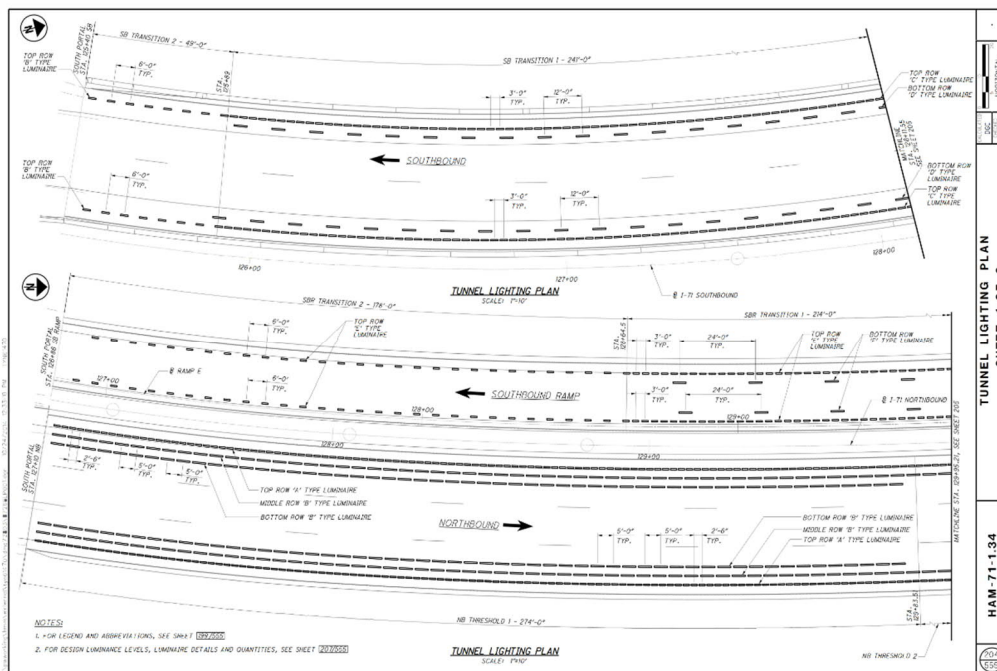
The SPD should be inspected ensure it is operational, the module is secure in the base and all wire connections are tight.

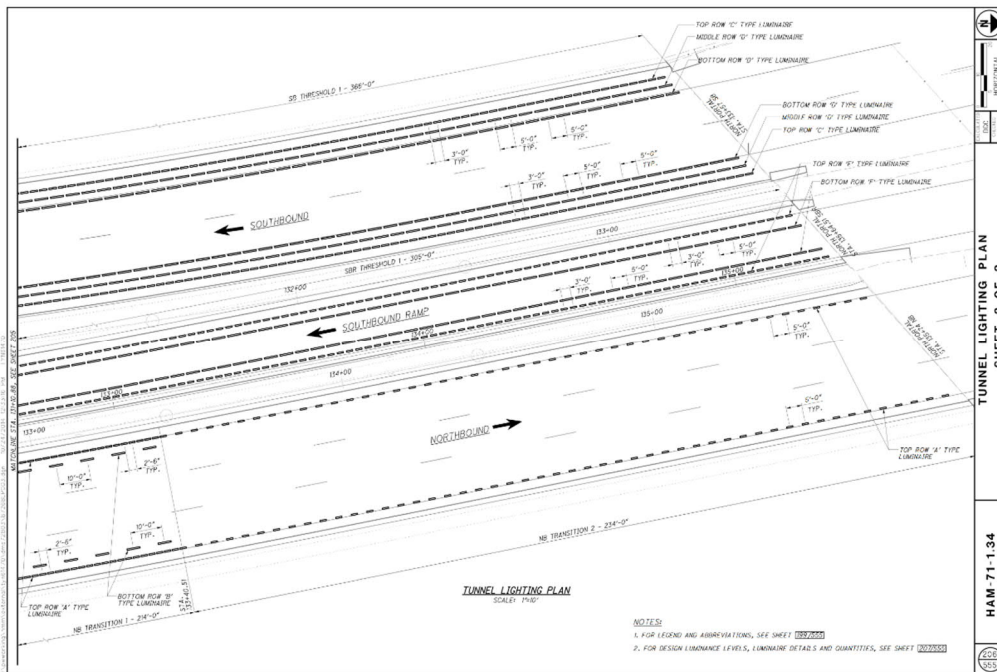
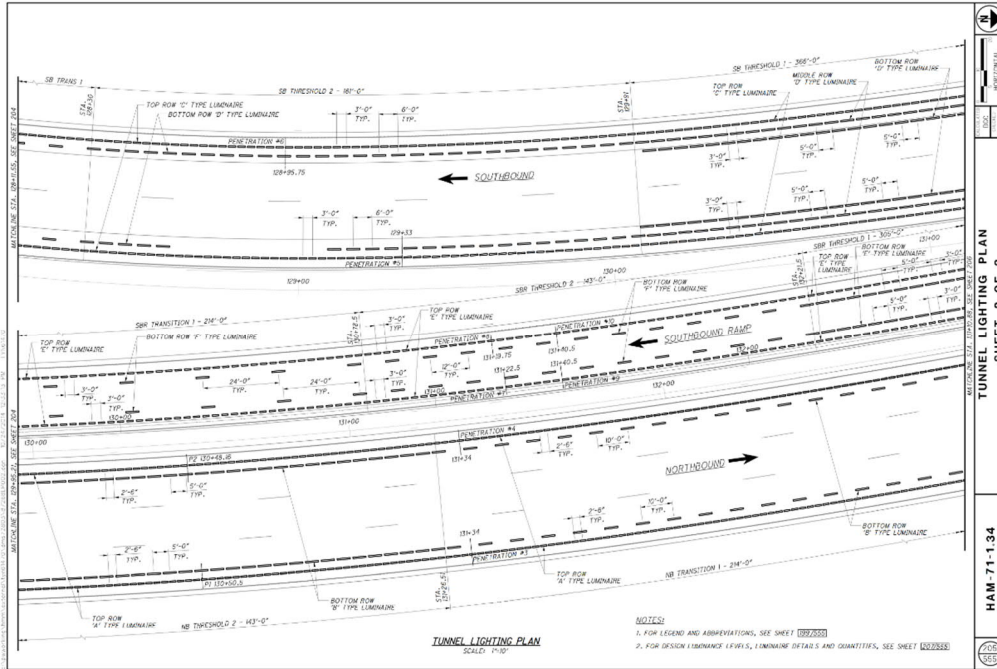
The programmable logic controller (PLC) battery needs to be replaced when the battery charge becomes low and an alarm is generated.

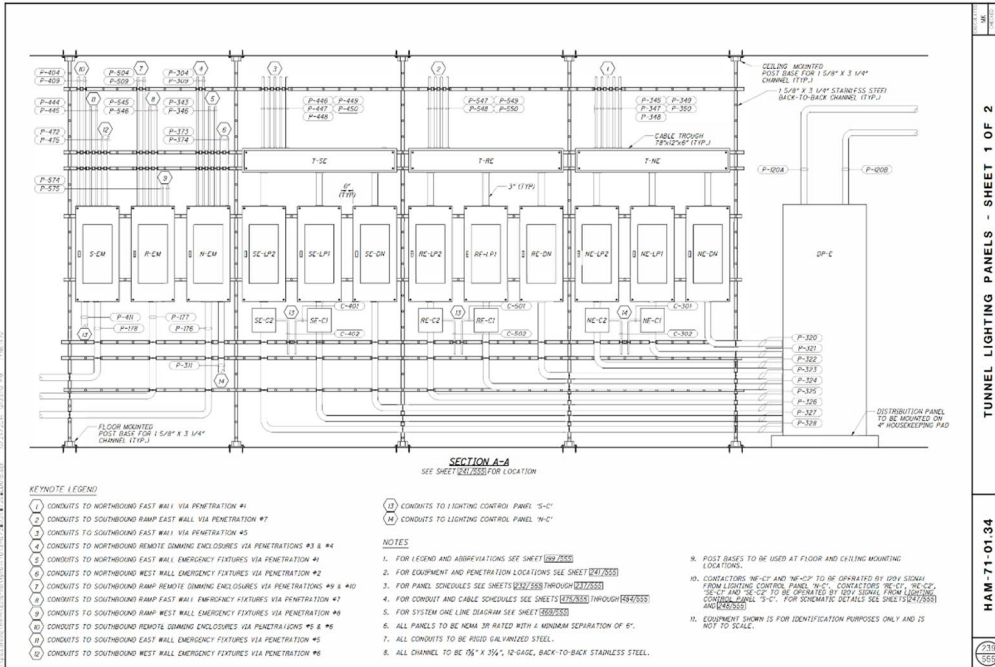
The maintenance requirements for the electric heaters made by Pentair are as follows:

1. Always disconnect power supply before inspecting or working on the fan package.
2. Generally the fan unit requires no maintenance since the bearings are permanently lubricated and sealed. The fan cannot be field serviced; it should be replaced if defective.
3. The foam filter inside the fan package should be periodically removed and washed with soap and warm water to keep it clean.

Figure 14.1: Lighting Locations



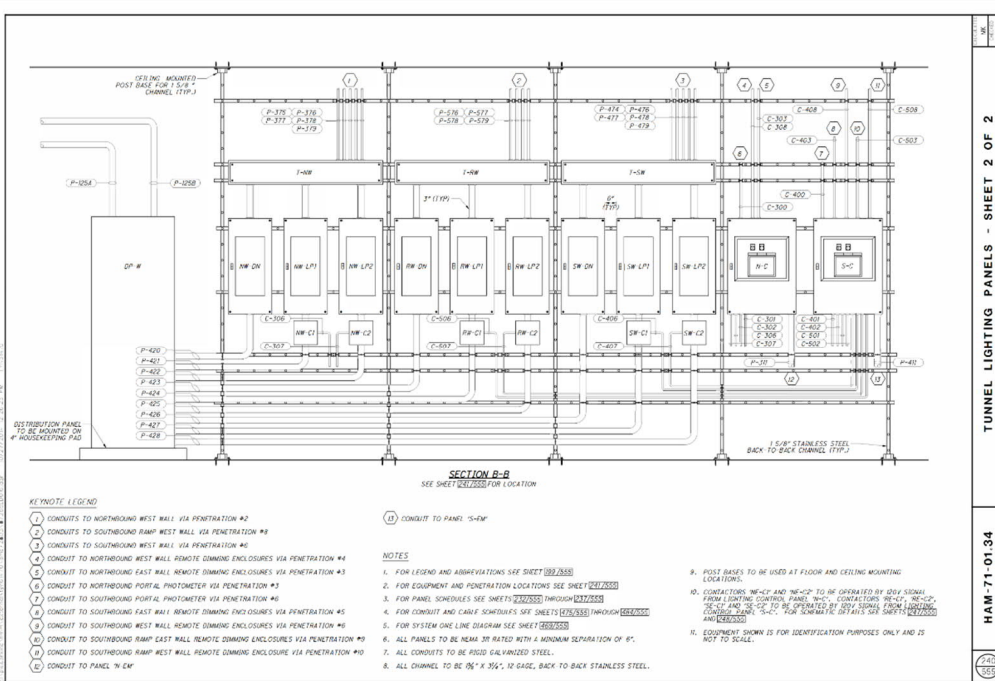




TUNNEL LIGHTING PANELS - SHEET 1 OF 2

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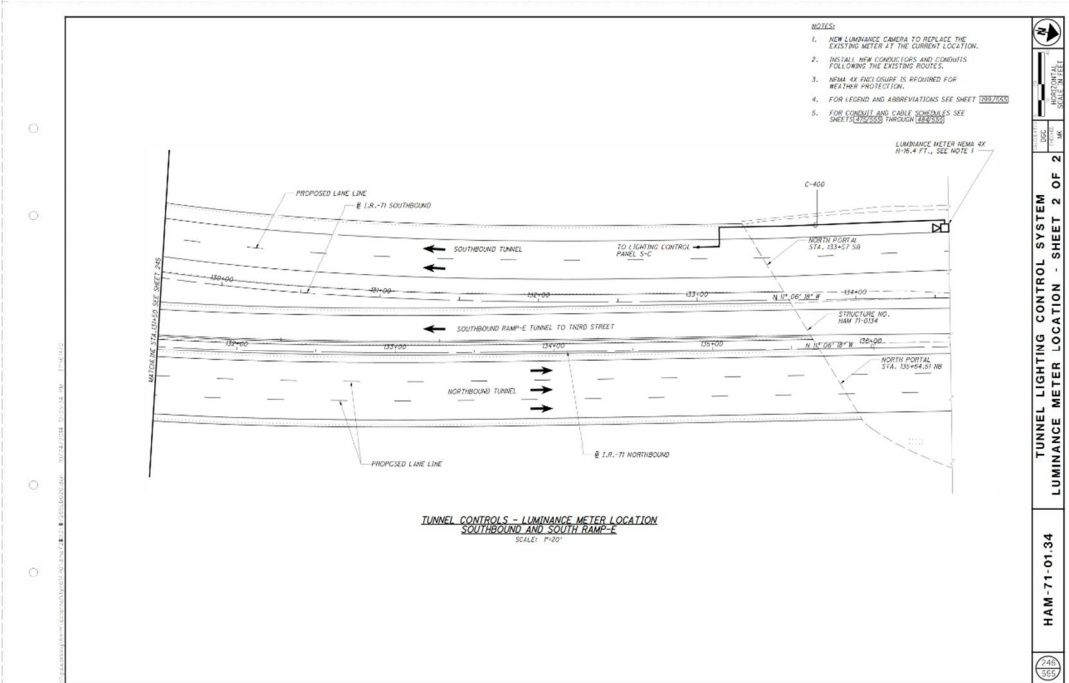
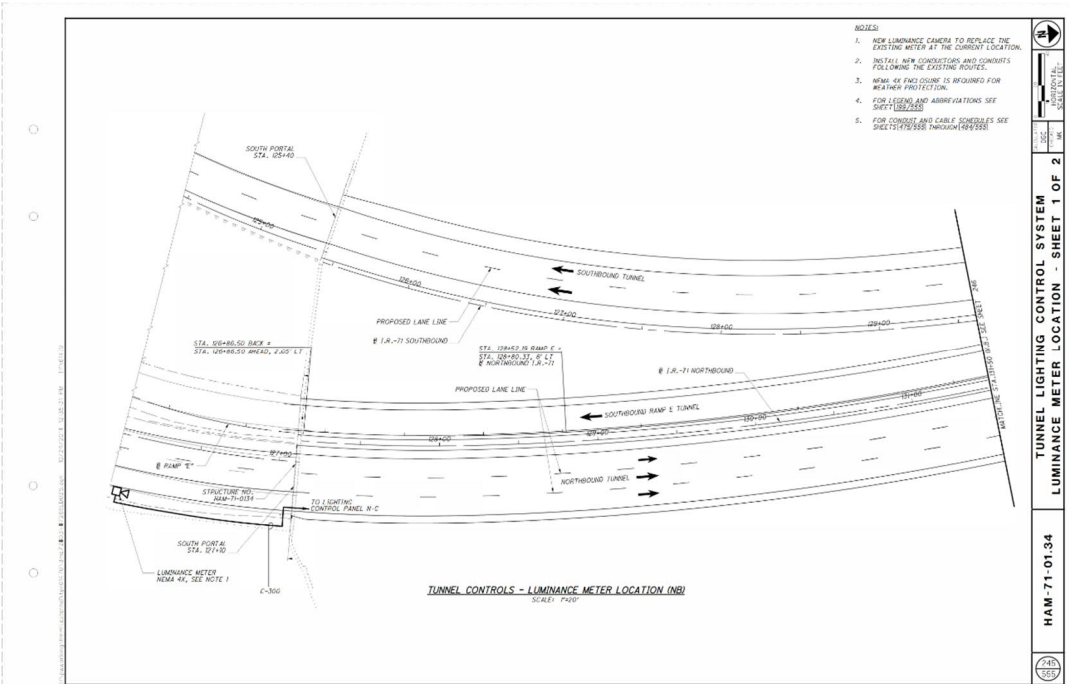
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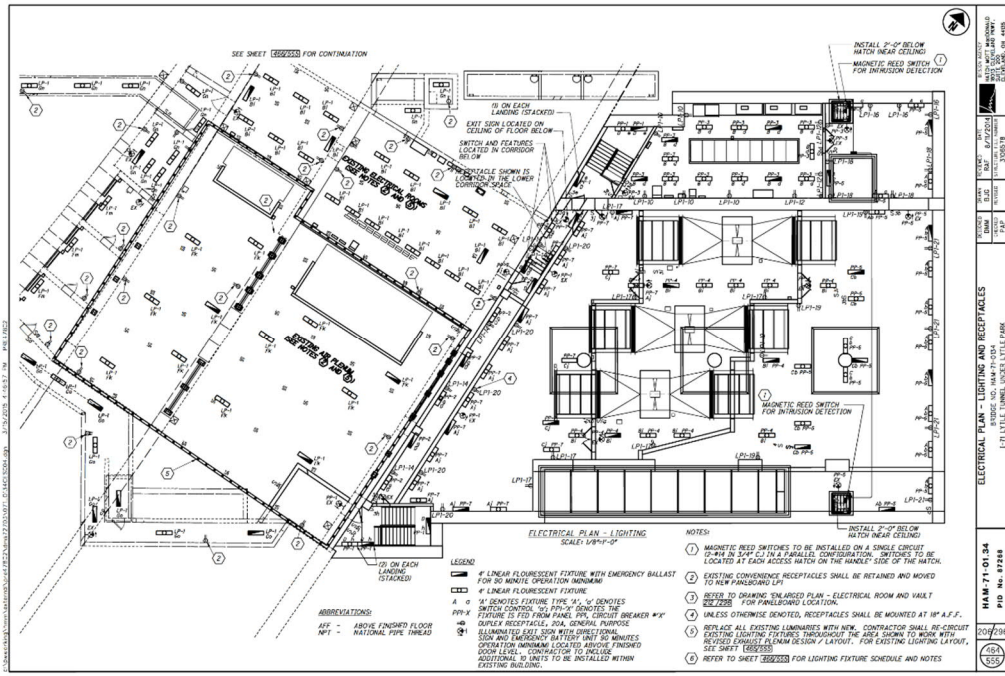
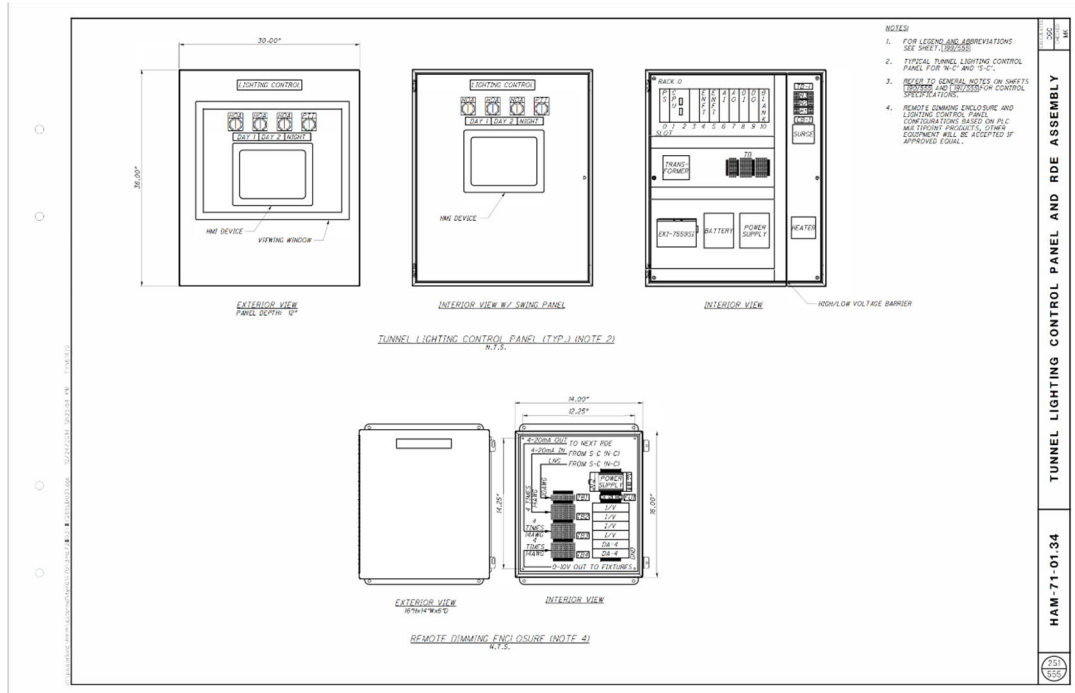


TUNNEL LIGHTING PANELS - SHEET 2 OF 2

HAM-71-01.34

210
0255





14.2 Operation

The lighting luminance levels are controlled by sensors that adjust the lighting levels to match the luminance levels outside the tunnels. There are luminance sensors located outside of each portal. The sensors at the north portal control the southbound tunnel and ramp tunnel (controller TLCP-S) and sensors at the south portal control the northbound tunnel (controller TLCP-N).

The programmable automation controller (PAC) is manufactured by GE PACSystems. This PAC contains a real time clock (RTC) battery with an estimated life of 5 years and must be replaced every 5 years on a regular maintenance schedule.

14.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

14.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

14.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule – The lighting system shall be tested to ensure it is working correctly per ODOT's inspection and maintenance contract scope. Exact locations of malfunctioning and/or burnt out lights shall be documented. Lumens shall be tested and documented in each of the 3 lighting zones during dark (nighttime) hours within each bore and upon completion of the cleaning.
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment – Cisco SFP and SFP+Transceiver Module: wrist strap, antistatic mat or antistatic foam, fiber-optic end-face cleaning tools and inspection equipment. Cisco IE 2000 Switch: Ratcheting torque flathead screwdriver that exerts up to 15 in-lb (1.69 N-m) of pressure, For the protective ground connector, obtain a single or pair of stud size 6 ring terminals (such as Hollingsworth part number R3456B or equivalent), Crimping tool (such as Thomas & Bett part number WT2000, ERG-2001, or equivalent), 10-gauge copper ground wire (such as Belden part number 9912 or equivalent), For DC power connections, use UL- and CSA-rated, style 1007 or 1569 twisted-pair copper appliance wiring material (AWM) wire (such as Belden part number 9318), Wire-stripping tools for stripping 10- and 18-gauge wires, a number-2 Phillips screwdriver, a flat-blade screwdriver;
6. Lubrication – N/A
7. Warranty Provisions – The LED driver is warrantied for 5 years; the lighting control system is warrantied for 2 years; the Luxtran fixture is warrantied for 10 years from the date of manufacture; the universal signal conditioners are warrantied for 5 years; 4 channel dimming amplifier for lighting controller is warrantied for 2 years;
8. Contract Maintenance

Refer to Appendix A for Maintenance Intervals.

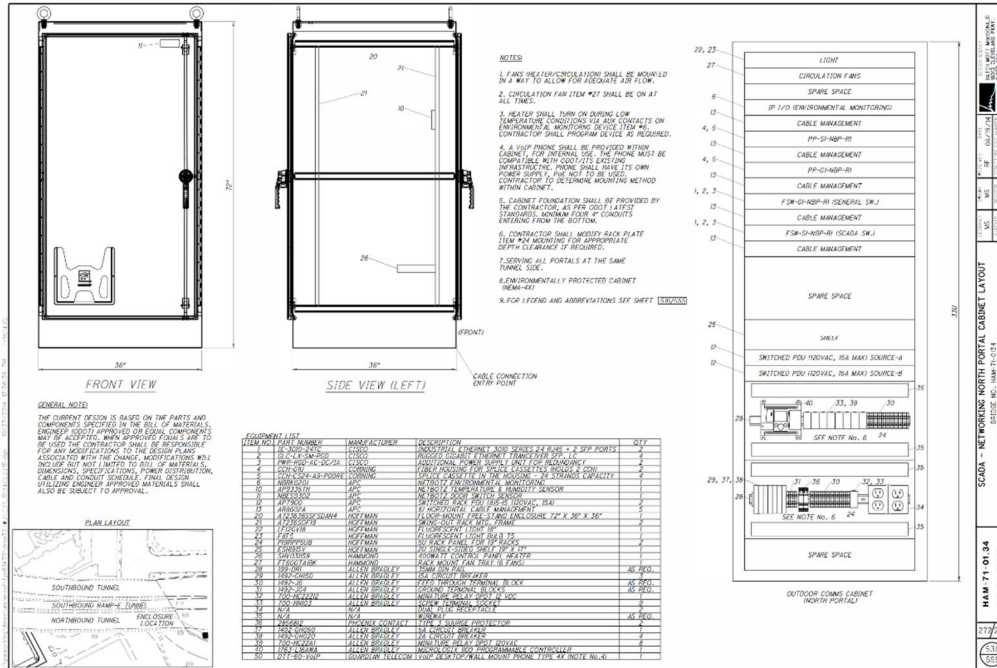
Refer to Appendix B for Plan Sheets

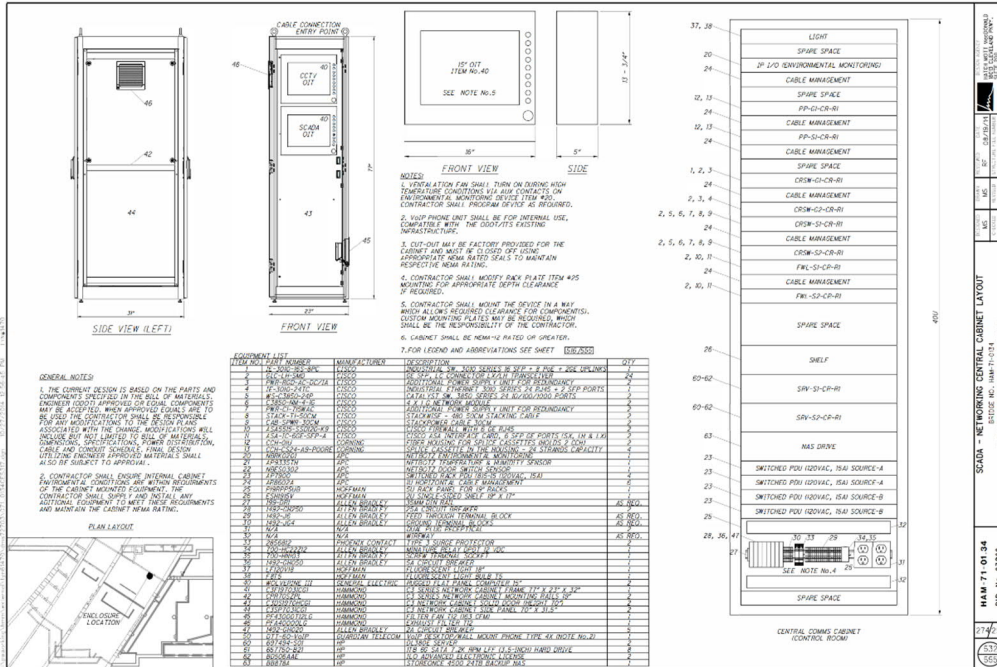
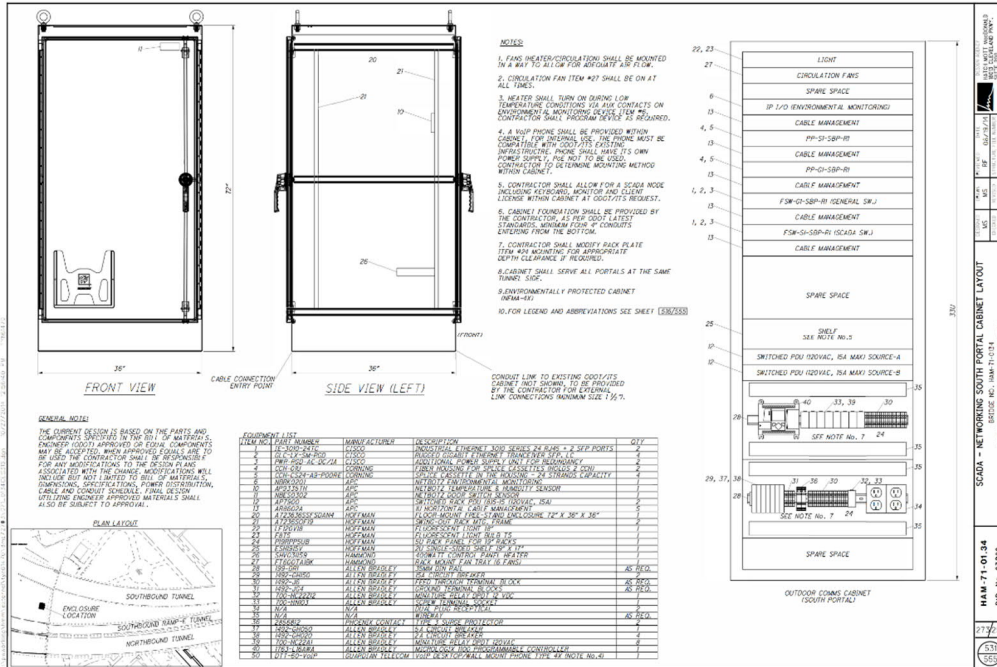
15 SCADA

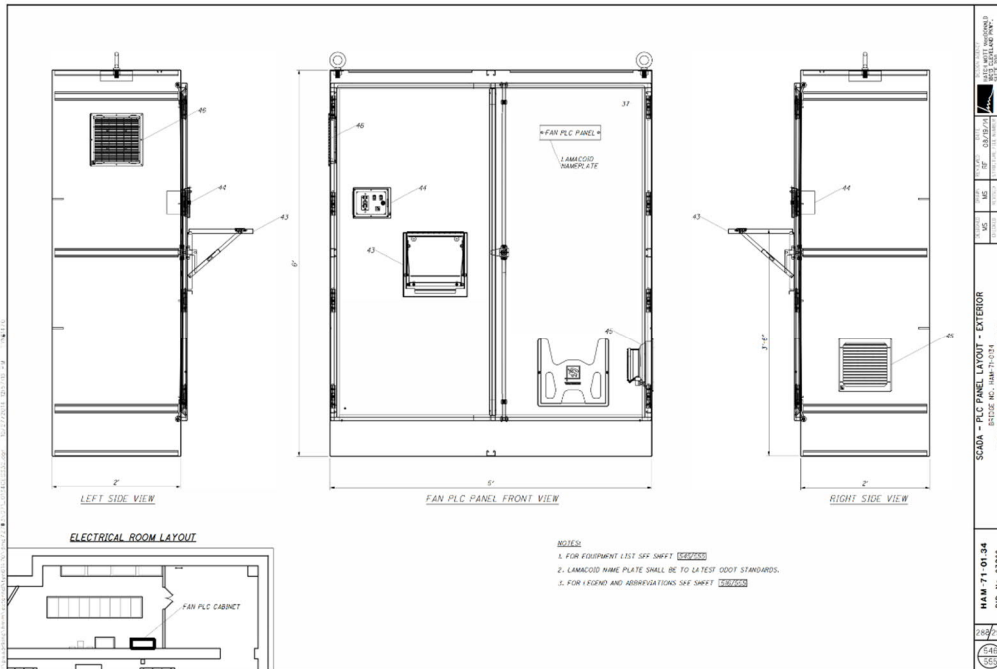
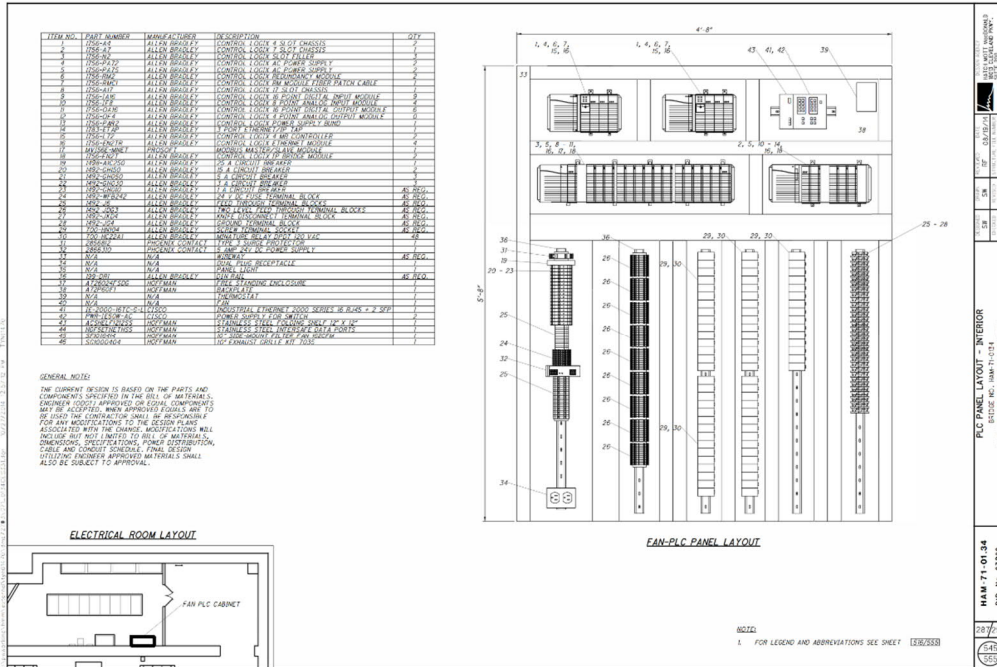
15.1 Description

The Supervisory Control and Data Acquisition (SCADA) system connects tunnel components including ventilation, linear heat detection, carbon monoxide, fire alarm and Intelligent Transportation Systems (ITS). These features all communicate with each other and provide a reliable fire life safety system. The locations are shown in Figure 15.1.

Figure 15.1: SCADA Locations







15.2 Operation

The SCADA system is monitored and interconnected and can be controlled remotely. When a fire incident is detected the fire alarm is activated and the signal is sent to emergency responders and SCADA directs the flashers atop the “Tunnel Closed Do Not Enter When Flashing” signs ahead of each portal to Flash.

15.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

15.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

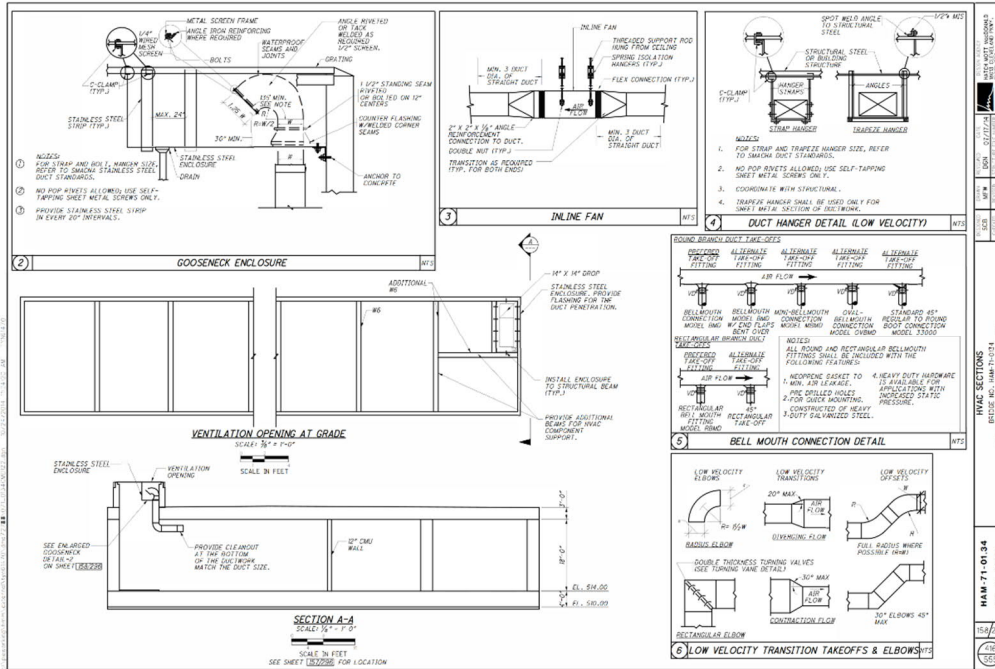
15.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication – N/A
7. Warranty Provisions
8. Contract Maintenance

Refer to Appendix A for Maintenance Intervals.

Refer to Appendix B for Plan Sheets



16.2 Operation

The HVAC system heats, ventilates and/or cools the equipment as needed.

16.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

16.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

16.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

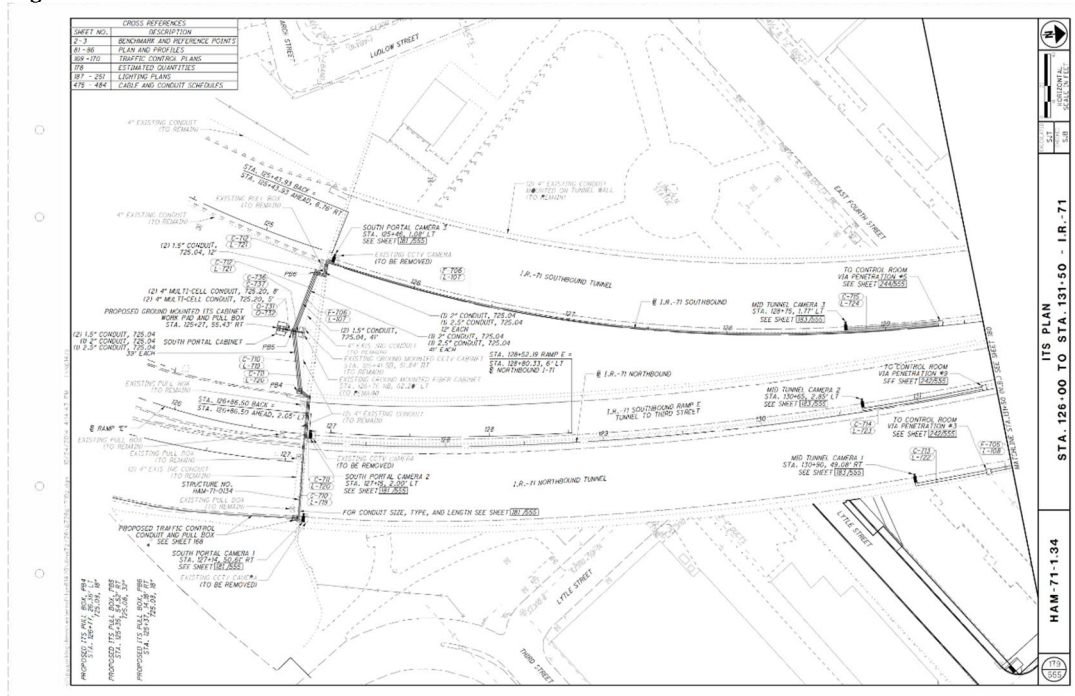
1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication
7. Warranty Provisions
8. Contract Maintenance

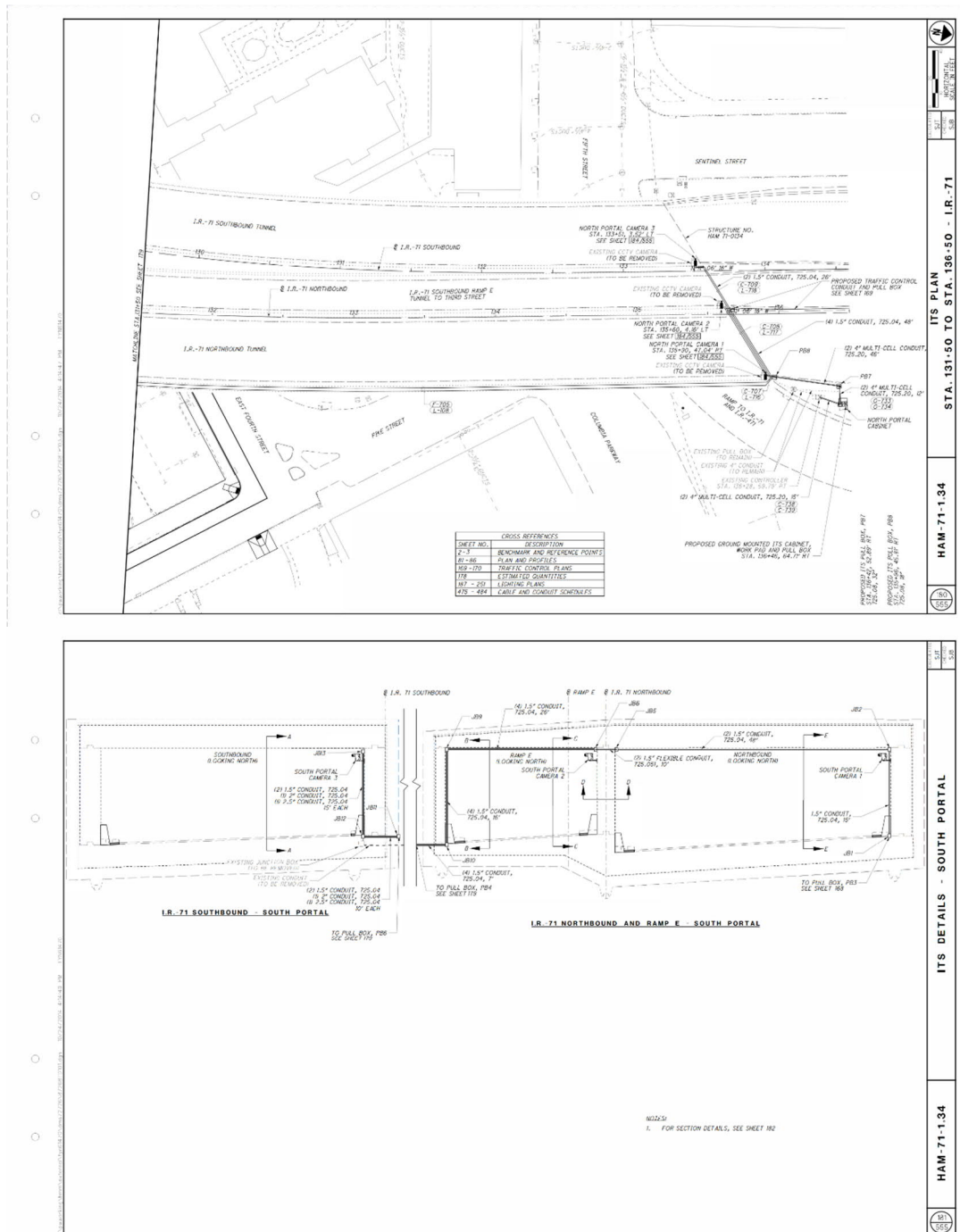
17 Video/ITS System

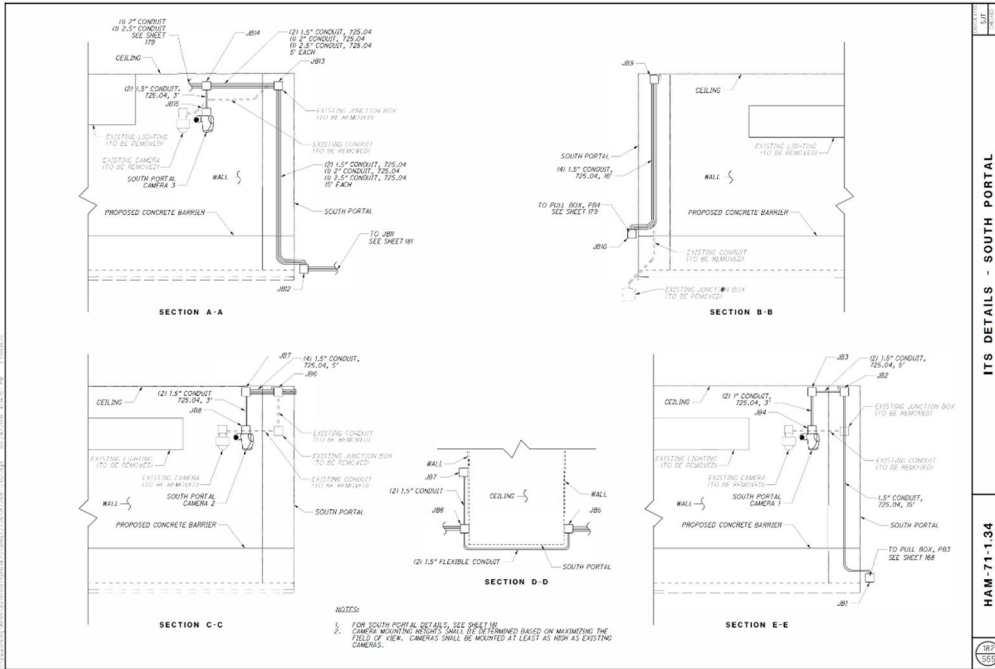
17.1 Description

The video/Intelligent Transportation Systems (ITS) system consists of cameras located each of the tunnels and security cameras located within the tunnel control rooms, conduit in the southbound tunnel and conduit feeding the cameras. Additionally, there are ITS controllers located outside each portal. The tunnel cameras are connected to ODOT's ITS system. The tunnel camera locations are shown in Figure 17.1 and security cameras are shown on Figure 17.2.

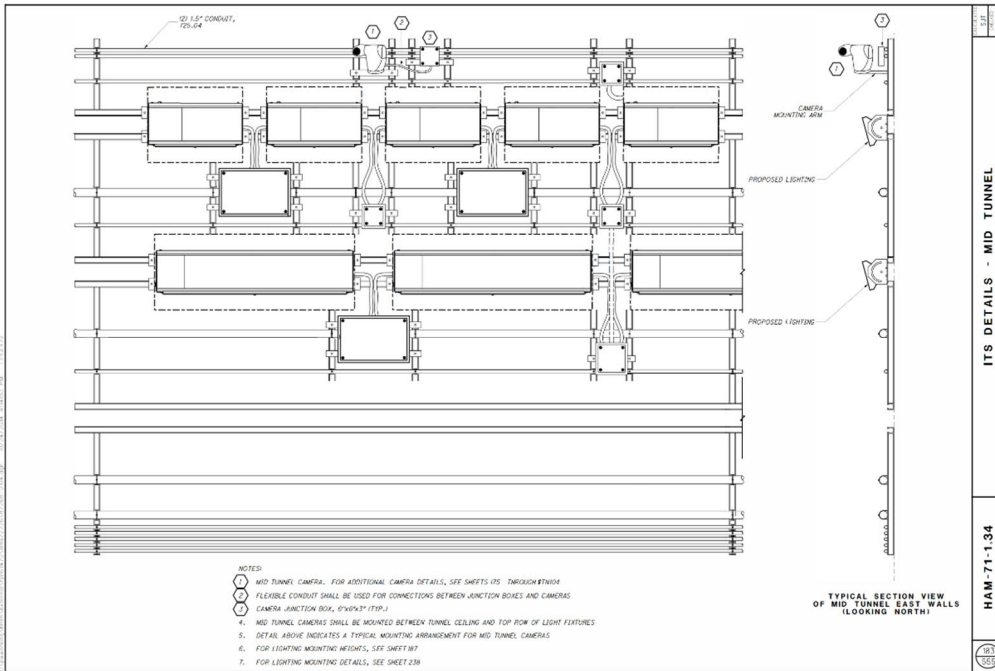
Figure 17.1: Tunnel Camera Locations







ITS DETAILS - SOUTH PORTAL
HAM-71-134
BRP
055



ITS DETAILS - MID TUNNEL
HAM-71-134
BRP
055

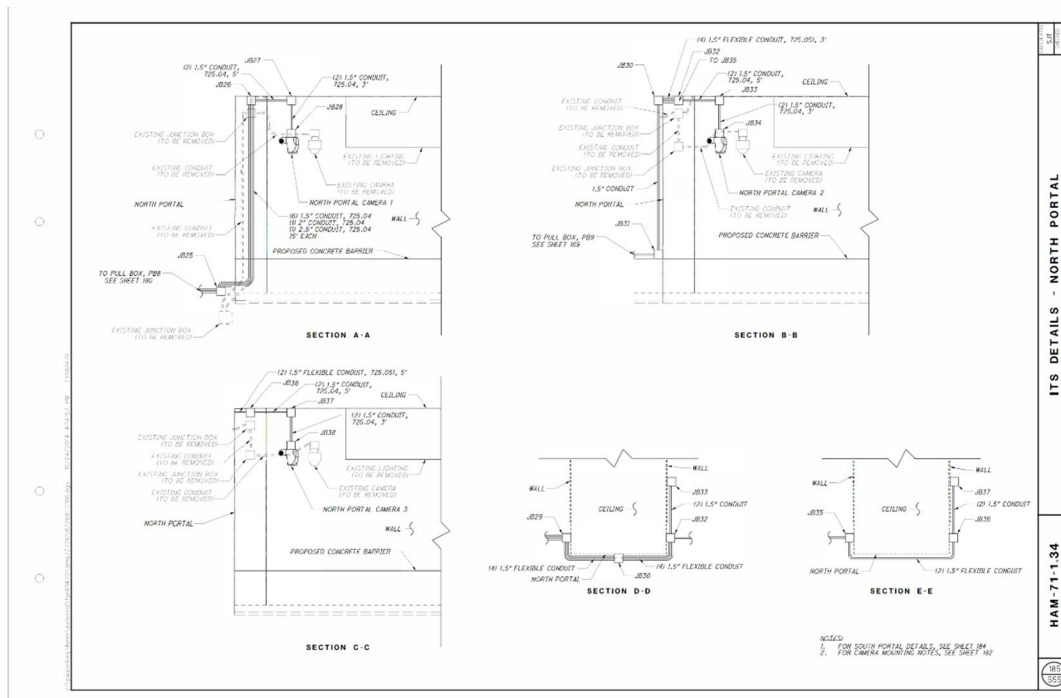
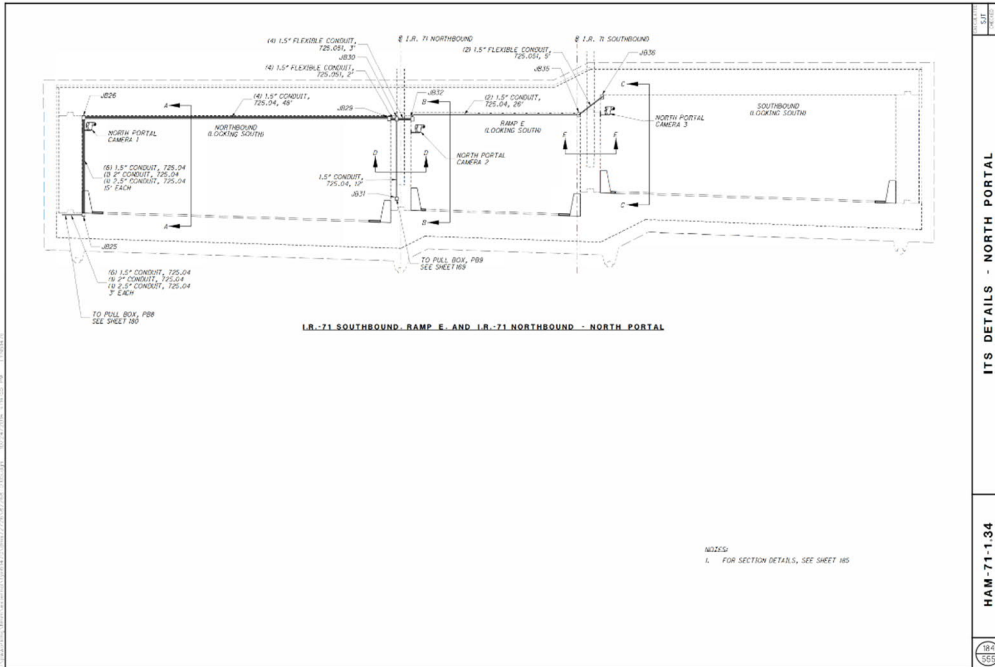
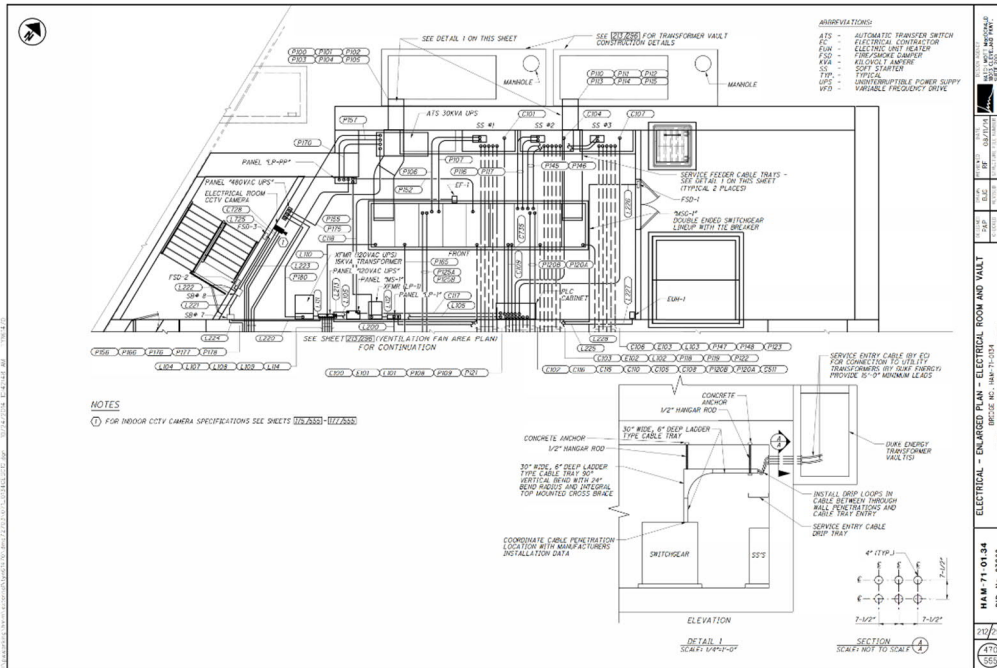


Figure 17.2: Security Camera Locations



17.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

17.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule – Per ODOT's inspection and maintenance contract scope, the Video / ITS System including cameras and conduit systems in the tunnel and mechanical room will be visually inspected. ODOT's Traffic Management Center (TMC) will be immediately notified of any issues. This inspection will be documented in a report.
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication – N/A
7. Warranty Provisions
8. Contract Maintenance

Refer to Appendix A for Maintenance Intervals.

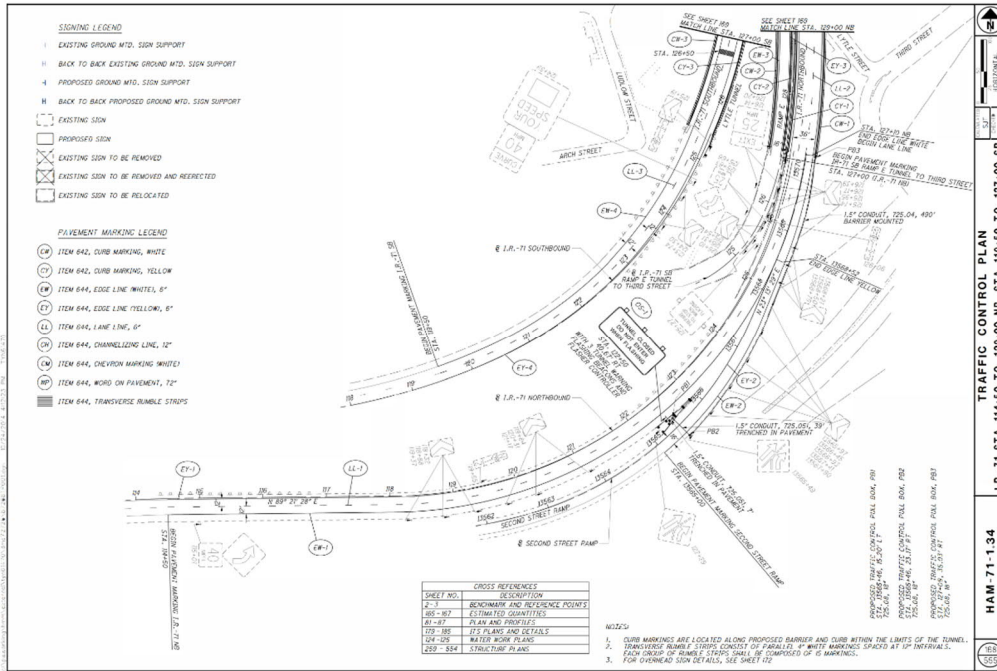
Refer to Appendix B for Plan Sheets

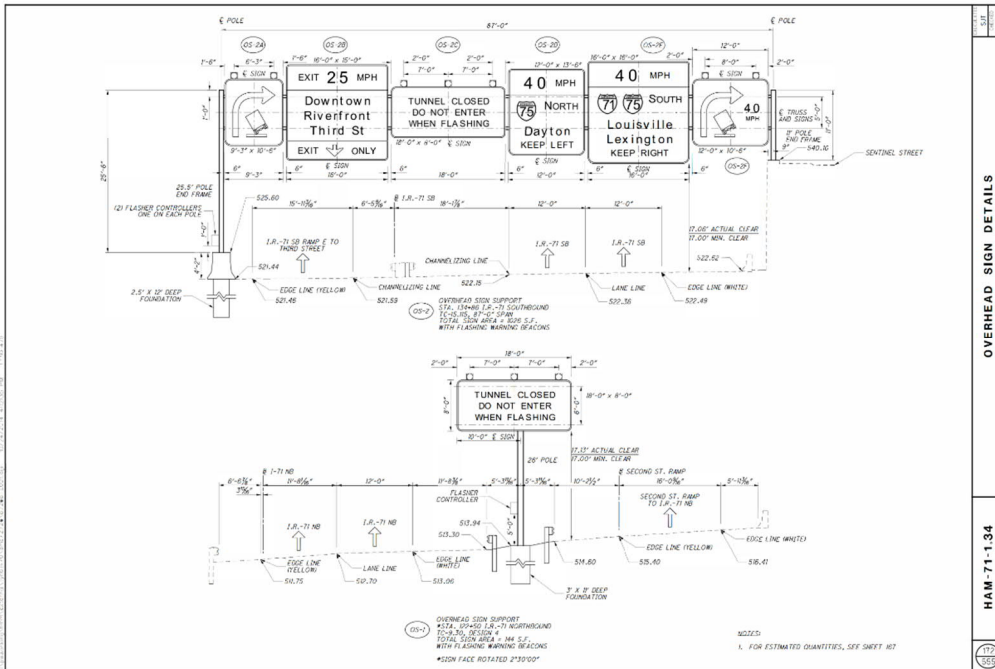
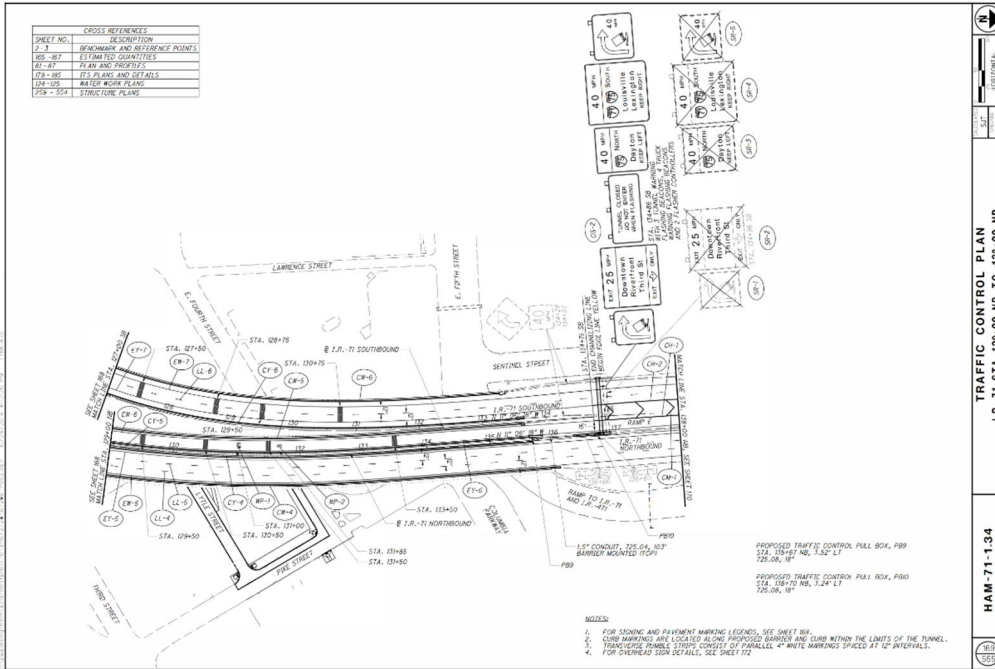
18 Tunnel Closed Notification System

18.1 Description

“Tunnel Closed Do Not Enter When Flashing” signs with flashing beacons atop the signs are located outside each of the portals. The locations of the “Tunnel Closed Do Not Enter When Flashing” signs are shown in Figure 18.1.

Figure 18.1: Tunnel Closed Do Note Enter When Flashing Signs Locations





18.2 Operation

The flashers above these “Tunnel Closed Do Not Enter When Flashing” signs are activated upon receiving a signal from the Supervisory Control and Data Acquisition (SCADA) system. Vehicles are prohibited from entering the tunnels when the flashers are on.

18.2.1 Troubleshooting

Refer to the Manufacturer's O&M Manual.

18.3 Safety

Refer to Manufacturer's O&M Manual for specific equipment safety details.

18.4 Maintenance

Refer to Manufacturer's O&M Manual for the following maintenance information:

1. Major Equipment Information
2. Periodic Preventative Maintenance Schedule – Per ODOT's inspection and maintenance contract scope, the Tunnel Closed Notification System including will be annually tested. ODOT's Traffic Management Center (TMC) will be immediately notified of any issues. The testing inspection will be documented in a report.
3. Repair Parts and Materials List
4. Manufacturers Recommended Spare Parts
5. Special Tools and Equipment
6. Lubrication
7. Warranty Provisions
8. Contract Maintenance

A. XXX

B. XXX

