

Texas Department of Transportation  
IH 635 Managed Lanes Project  
Technical Provisions

**Attachment 19-1AA**

Performance and Measurement Table Baseline

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
1) ROADWAY – No changed requirements.									
2) DRAINAGE									
	2.1	Pipes and Channels	Each element of the drainage system is maintained in its proper function from the point at which water drains from the travel way to the outfall or drainage way.	24 hrs	7 days	6 months	Visual inspection supplemented by CCTV where required to inspect buried pipe work	Length with less than 90% of cross section clear (feet). Number of damaged pipes or channel. Instances of root intrusion. Instances of excess deflection.	Nil
	2.2	Drainage treatment devices	Drainage treatment and balancing systems, flow and spillage control devices function correctly and their location and means of operation is recorded adequately to permit their correct operation in Emergency.	24 hrs	7 days	6 months	Visual inspection	Devices functioning correctly with means of operation displayed (Number)	100%
	2.3	Travel Way	The travel way is free from water to the extent that such water would represent a hazard by virtue of its position and depth.	24 hrs	7 days	6 months	Visual inspection of water on surface	Instances of hazardous water build-up	Nil
	2.4	Discharge systems	Surface water discharge systems perform their proper function and discharge	24 hrs	7 days	6 months	Visual inspection and records	Non-compliances with legislation	Nil

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			to groundwater and waterways complies with the relevant legislation and permits.						

**3) STRUCTURES**

	3.5	Load ratings	All structures maintain the design load capacity.	24 hrs	28 days	6 months	Inspection and assessment in accordance with the requirements of AASHTO's Guide Manual for Condition Evaluation and Load and Resistance Factor Rating (LRFR) of Highway Bridges, the TxDOT Bridge inspection Manual, and the Federal Administration's Bridge Inspector's Reference Manual.	Number of load restrictions for Texas legal loads (including legally permitted vehicles)	Nil
	3.6	Surface coating	Include a re-coating schedule in the MMP.	N/A	N/A	1 year	Visual Inspection of gloss and color		
	3.7	Structural assessment	Evaluate structural damage to structures and liaise with emergency services to ensure safe working in clearing the incident.	24 hrs	28 days	6 months	Inspections and surveys as required by incident	Incident reports showing compliance	100%
	3.8	Graffiti	Graffiti is removed in a manner and using materials that restore the surface to a like appearance similar to adjoining surfaces.	N/A	N/A	24 hours	Visual inspection	Inspection records showing compliance	100%

**4) PAVEMENT MARKINGS, OBJECT MARKERS, BARRIER MARKERS AND DELINEATORS – No changed requirements.**

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<b>5) GUARDRAILS, SAFETY BARRIERS AND IMPACT ATTENUATORS</b>									
	5.1	Guard rails and safety barriers	All guardrails, safety barriers, concrete barriers, etc.) are maintained free of Defects. They are appropriately placed and correctly installed at the correct height and distance from roadway or obstacles.	24 hrs	7 days	6 months	Visual inspection	Length of road restraint systems correctly installed	100%
								Length free from defects	100%
								Length at correct height	100%
								Length at correct distance from roadway and obstacle	100%
<b>6) TRAFFIC SIGNS - No changed requirements.</b>									
<b>7) TRAFFIC SIGNALS – No changed requirements.</b>									
<b>8) LIGHTING – No changed requirements.</b>									
<b>9) FENCES, WALLS AND SOUND ABATEMENT – No changed requirements.</b>									
	9.2	Construction	Integrity and structural condition of the fence is maintained.	24 hrs	28 days	6 months	Structural assessment if visual inspection warrants	Inspection records showing compliance	100%
			Integrity and structural condition of the walls are maintained.	24 hrs	28 days	6 months	Structural assessment if visual inspection warrants	<ul style="list-style-type: none"> <li>• Vertical tolerance of wall 1/2" per 10' of wall height</li> <li>• Wall panel offset of 3/4" or less</li> <li>• No joint with exposed filter fabric or backfill material</li> <li>• No concrete to concrete contact</li> <li>• Loss of joint seal material</li> <li>• Settlement of backfill material</li> </ul>	Nil

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<b>10) ROADSIDE MANAGEMENT – No changed requirements.</b>									
<b>11) REST AREAS AND PICNIC AREAS – No changed requirements.</b>									
<b>12) EARTHWORKS, EMBANKMENTS AND CUTTINGS – No changed requirements.</b>									
<b>13) ITS and ETCS EQUIPMENT – No changed requirements.</b>									
<b>14) TOLLING FACILITIES AND BUILDINGS – No changed requirements.</b>									
<b>15) AMENITY – No changed requirements.</b>									
<b>16) SNOW AND ICE CONTROL</b>									
	16.1	Travel Lanes	Maintain travel way free from snow and ice.	1 hr or 2hrs as noted.	N/A	N/A	Maximum 1hr response time to complete manning and loading of spreading vehicles  Maximum 2hrs from departure from loading point to complete treatment and return to loading point  Maximum 1hr response time for snow and ice clearance vehicles to depart from base	Inspection records showing compliance	100%
<b>17) INCIDENT RESPONSE</b>									
	17.1	General	Respond to Incidents and Emergencies in accordance with Sections 22 and 24.	15 min	N/A	N/A	Response times met for 98% of Incidents measured on a 1 year rolling basis. No complaints from Emergency responders.	Inspection records showing compliance	100%
<b>18) CUSTOMER RESPONSE – No changed requirements.</b>									
<b>19) SWEEPING AND CLEANING – No changed requirements.</b>									
<b>20) BUILDINGS AND ENCLOSED FACILITIES</b>									

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	20.1	Buildings and Enclosed Facilities	All structural features of buildings and enclosed facilities (walls, roof, fenestrations, etc.) are safe functional and operational.	24 hrs	7 days	6 months	Perform visual inspection by a Texas Real Estate Commission (TREC) certified Professional Inspector that meets the National Academy of Building Inspection Engineers (NABIE) Standards of Practice for building inspection.	<ul style="list-style-type: none"> <li>All Elements are safe, functional and operational.</li> <li>Inspection and maintenance records showing compliance.</li> </ul>	100% 100%
	20.2.1	Electrical Systems, Normal, Electrical & Security Lighting	Lighting system fixtures, lamps and control functioning to provide the intended illumination level, lighting quality, duration, availability of sources and energy efficiency for the task.	8 hrs	7 days	6 months	Regularly scheduled visual inspection(s) of a frequency to determine adequate function for the particular system, both daytime and nighttime, as determined by the Developer. Nighttime lighting level readings of all exterior lighting quarterly. Preventative maintenance of lighting components, circuiting, re-lamping and testing per NFPA 70B, 101, 110 & 111	<ul style="list-style-type: none"> <li>Illumination levels of all lighting systems meet intended levels, quality and duration.</li> <li>All inspections conducted and documented.</li> <li>All preventative maintenance performed and documented in accordance with the referenced standards.</li> <li>Original energy efficiency requirements maintained.</li> </ul>	100% 100% 100% 100%

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	20.2.2	Electrical Systems, Fire Detection & Alarm	Fire detection and alarm systems provide the intended detection and notification functions.	4 hrs	7 days	6 months	Visual and demonstration testing monthly to meet the requirements of NFPA 70B and 72. Preventative maintenance of fire alarm components, circuiting, sources and testing per NFPA 70B, 72, 101, 110 & 111. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding.	<ul style="list-style-type: none"> <li>All fire alarm systems perform as designed and provide the intended level of protection.</li> <li>All detectors operating within manufacturer's tolerance for sensitivity and cleanliness.</li> <li>All inspections conducted and documented.</li> <li>All preventative maintenance performed and documented in accordance with the referenced standards.</li> </ul>	100% 100% 100% 100%
	20.2.3	Electrical Systems, Communications to include telephone, Network and CCTV	Communications systems serving their intended functions.	4 hrs	4 days	6 months	Visual and demonstration testing monthly to meet the requirements of NFPA 70B. Preventative maintenance of communication system components, circuiting, sources and testing per NFPA 70B. Follow manufacturer's recommendations for maintenance and testing where requirements are more stringent. Continuous monitoring through self-system diagnostics and failure detection.	<ul style="list-style-type: none"> <li>All equipment operating in accordance with manufacturer's recommendations for actual conditions of use.</li> <li>All inspections conducted and documented.</li> <li>All preventative maintenance performed and documented in accordance with the referenced standards.</li> <li>Database and communication system security breaches.</li> <li>Electronic retention of database files, back-ups and other stored media.</li> </ul>	100% 100% 100% Nil 100%

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	20.2.4	Electrical Systems, Distribution – normal, essential & emergency	Electrical system serving connected loads with intended capacity, voltage regulation, protection, control and monitoring.	2 hrs	3 days	6 months	<p>Regularly scheduled visual and operational testing of electrical equipment, circuits, protection devices, control and monitoring of a frequency to determine adequate function for the particular system.</p> <p>Preventative maintenance and testing per NFPA 70B, 110, 111, manufacturer’s recommendations and NETA MTS.</p> <p>Exercising of back-up generators under load where used as Emergency source, monthly.</p> <p>Exercising of ATS switches, semi-annually.</p> <p>Load testing of UPS systems where used as Emergency source, monthly.</p> <p>Monitoring and Testing of individual battery cell condition, annually.</p>	<ul style="list-style-type: none"> <li>• All equipment operating in accordance with manufacturer’s recommendations for actual conditions of use.</li> <li>• The electrical system and components serve the intended loads with proper capacity, voltage and frequency.</li> <li>• Protection devices calibrated and set properly for selective coordination.</li> <li>• All preventative maintenance in accordance with the referenced standards.</li> <li>• Where serving as a redundant source, availability of 100%.</li> <li>• All electrical outages within Developer control documented as to time, duration, loads affected, cause and resulting corrective measures taken.</li> <li>• Adequate on-site storage of fuel supply sufficient to meet the intended standby essential operating time.</li> <li>• Continuous monitoring of essential &amp; Emergency sources when consisting of a non-utility source.</li> </ul>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>



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	20.2.5	Electrical Systems, SCADA	SCADA system provides intended function of control, monitoring, communication and visual display of all connected systems including integration with other systems.	2 hrs	3 days	6 months	<p>Visual and demonstration testing monthly to meet the requirements of NFPA 70B. Preventative maintenance of SCADA components, wiring, communications, power supplies, sensors and visual displays per NFPA 70B. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding.</p> <p>Continuous monitoring through self-system diagnostics and failure detection.</p> <p>Like Safety preventative maintenance performed and reported bi-annually.</p>	<ul style="list-style-type: none"> <li>• All SCADA systems perform as designed and provide the intended level of control and monitoring.</li> <li>• All sensors and monitoring devices operating within manufacturer's tolerance for sensitivity.</li> <li>• Loss of critical or life safety functions due to equipment or system malfunction.</li> <li>• Software and system integration with other systems including ITS and ETCS, debugged, vendor supported and updated to latest release.</li> <li>• All inspections conducted and documented.</li> <li>• All preventative maintenance performed and documented in accordance with the referenced standards.</li> <li>• Loss of redundancy due to SCADA system malfunction where the controlled function is in support of other redundant systems.</li> </ul>	<p>100%</p> <p>100%</p> <p>Nil</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>Nil</p>

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	20.2.6	Electrical Systems, Grounding & LP	Grounding and lightning protection systems provide intended function and level of protection for equipment, structure and personnel protection.	24 hours	7 days	3 months	<p>Regularly scheduled visual inspection(s) of a frequency to determine adequate function for the particular system, as a minimum annually. Perform preventative maintenance and testing in accordance with NFPA 70B, 780, manufacturer's recommendations and NETA MTS. The fall of potential method shall be used to test the resistance to earth of all grounding electrode systems serving electrical services, lightning protection and alternate energy sources, every 5 years. The continuity of ground connections to remote earth shall be tested during replacement of equipment served or any major change of system configuration.</p> <ul style="list-style-type: none"> <li>• All bonding, grounding and lightning protection connections pass visual inspection and do not show signs of corrosion.</li> <li>• All fall of potential tests demonstrate proper resistance to earth.</li> <li>• All continuity tests show proper resistance.</li> <li>• Inspection &amp; maintenance records showing compliance</li> </ul>	100%	100%	100%	100%

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	20.3.1	Plumbing Systems	All plumbing systems (domestic water, gas, drains, sewerage) operational and functioning properly.	24 hrs	7 days	1 month	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	<ul style="list-style-type: none"> <li>• Maintenance performed and documented in accordance with the Maintenance Management Plan.</li> <li>• All equipment's physical condition is satisfactory and systems/equipment are operating per design</li> </ul>	100%  100%
	20.3.2	HVAC Systems	All heating, ventilating and air conditioning systems (chillers, air handling units, heating systems, etc.) operational and functioning properly.	8 hrs (2 hrs if serving critical space(s) or equipment).	7 days	1 month	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	<ul style="list-style-type: none"> <li>• Maintenance performed and documented in accordance with the Maintenance Management Plan.</li> <li>• All equipment's physical condition is satisfactory and systems/equipment are operating per design</li> </ul>	100%  100%

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	20.3.4	Fire Suppression Systems	All fire suppression systems (sprinkler, standpipe, clean agent, fire extinguishers, etc.) operational and functioning properly.	2 hrs	7 days	1 month	Inspection, maintenance, and rehabilitation plans shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and applicable NFPA standards.	<ul style="list-style-type: none"> <li>• Maintenance performed and documented in accordance with the applicable NFPA code.</li> <li>• Physical condition and configuration of fire protection equipment is satisfactory and proper, respectively, based on visual inspection.</li> <li>• No alarms, supervisory or trouble signals on fire alarm control panels.</li> </ul>	100%  100%  100%

**21) SUBSURFACE MANAGED LANE ELEMENTS**

	21.1	Subsurface Structures including but not limited to tunnels and tunnel ancillary facilities and spaces  (General Purpose lane cantilever structure and supports – see Element Category 3)	All subsurface structures shall be free of Defects.	24 hrs	28 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA “Highway and Rail Transit Tunnel Inspection Manual, 2005” and the FHWA “Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005”.	<ul style="list-style-type: none"> <li>• Free of moderate or severe Defects</li> <li>• Free of any conditions exposing rebar</li> </ul>	Nil  Nil
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	21.2	Structural Supports & Connections for all miscellaneous structural attachments or supports. Specific items may include but not limited to include support for signage, ventilation equipment, fire detection and protection items, safety items, and any item attached to a larger structural element.	Structural Supports & Connections for all miscellaneous structural attachments or supports shall be free of defects.	24 hrs	7 days	3 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	<ul style="list-style-type: none"> <li>• Connections shall be full capacity in accordance with the design and manufacturer's requirements</li> <li>• Free of loss of connection material due to impact, corrosion, or wear.</li> <li>• Free of loose connections or bolts.</li> <li>• Free of deterioration or damage of base structure material</li> <li>• Free of movement of supported item.</li> <li>• Free of excessive vibration of supported item.</li> </ul>	100%  Nil  Nil  Nil  Nil

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	21.3	Retaining Walls	As a minimum the items listed as defects in the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" Chapter 4, Section A.	2 hrs	7 days	3 months	A subsurface retaining wall inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual and the FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual.	<ul style="list-style-type: none"> <li>Moderate or severe conditions of concrete as defined by FHWA</li> <li>Vertical tolerance of wall 1/2" per 10' of wall height</li> <li>Wall panel offset of 3/4" or less</li> <li>No joint with exposed filter fabric or backfill material</li> <li>No concrete to concrete contact</li> <li>Loss of joint seal material</li> <li>Settlement of structures or backfill material resulting with non compliance of pavement criteria</li> </ul>	100% 100% 100% 100% 100% Nil Nil
	21.4	Waterproofing	The Subsurface Managed Lanes Structures shall be free of leaks.	24 hrs	28 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	<ul style="list-style-type: none"> <li>Adherence to maximum allowable water infiltration rate defined in Technical Provision.</li> <li>Free of dripping water on travel lanes</li> <li>Full compliance with additional requirements in the referenced FHWA Inspection Manual</li> <li>Free of water infiltration causing unsafe conditions</li> </ul>	100% Nil 100% Nil

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	21.5	Finishes	All finishes shall be free of Defects.	24 hrs	28 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed, documented as part of the Maintenance Management Plan, and adhered to. The plan shall be based on the FHWA "Highway and Rail Transit Tunnel Inspection Manual, 2005" and the FHWA "Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, 2005".	<ul style="list-style-type: none"> <li>• Maintain level of reflectivity and brightness consistent with lighting level criteria.</li> <li>• Free of loose or damaged finish materials</li> <li>• Fully functional Emergency equipment such as exit signage, lights, hose cabinets, fire alarm boxes and communications equipment.</li> <li>• Maintain colors and design characteristics consistent with aesthetic requirements.</li> </ul>	100% Nil 100% 100%
	21.6	Drainage	Subsurface drainage and pumping systems fully operational and clear of debris.	2 hrs	7 days	6 months	An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.	<ul style="list-style-type: none"> <li>• Maintenance performed and documented per the Maintenance Management Plan.</li> <li>• Flow rates established per design</li> <li>• Blockage due to sedimentation or calcification</li> <li>• Fully functional pumping components and systems, screeds, and control and monitoring equipment.</li> </ul>	100% 100% Nil 100%

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	21.7	Fire Protection	Fire protection systems (e.g., fire detection, alarm, notification and suppression systems) fully functional and operational.	2 hrs	7 days	3 months	Inspection, maintenance, and rehabilitation plans shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and applicable NFPA standards.  Life Safety preventative maintenance performed and reported bi-annually.	<ul style="list-style-type: none"> <li>• Maintenance performed and documented in accordance with the Maintenance Management Plan and applicable NFPA code.</li> <li>• Physical condition and configuration of fire protection equipment is satisfactory and proper, respectively, based on visual inspection.</li> <li>• No alarms, supervisory or trouble signals on fire alarm control panels.</li> </ul>	100%   100%   100%



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	21.8.1	Electrical Systems, Normal & Emergency Lighting	Lighting system fixtures, lamps and control functioning to provide the intended illumination level, light output, lighting quality, duration and energy efficiency, for the location.	8 hrs	7 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.</p> <p>Daytime and nighttime lighting level readings of all lighting levels, quarterly.</p> <p>Calibration of luminance meter, every 3 years.</p> <p>Walk tests of emergency lighting equipment to demonstrate proper function.</p> <p>Life Safety preventative maintenance performed and reported bi-annually.</p> <p>Preventative maintenance of lighting circuiting and sources per NFPA 70B, 101, 110 &amp; 111.</p>	<ul style="list-style-type: none"> <li>• Illumination levels of all lighting systems meet intended levels, quality and duration.</li> <li>• All inspections conducted and documented.</li> <li>• All preventative maintenance performed and documented in accordance with the referenced standards.</li> <li>• Original energy efficiency requirements maintained.</li> <li>• Luminance meter calibrated.</li> </ul>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

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	21.8.2	Electrical Systems, Fire Detection & Alarm	Fire detection and alarm systems provide the intended detection and notification functions.	2 hrs	4 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, manufacturer's recommendations, NFPA 70B and 72. Preventative maintenance of fire alarm sources and testing per NFPA 70B, 72, 101, 110 &amp; 111. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding. Continuous monitoring through self-system diagnostics and failure detection.</p> <ul style="list-style-type: none"> <li>• All fire alarm systems perform as designed and provide the intended level of protection.</li> <li>• All detectors operating within manufacturer's tolerance for sensitivity and cleanliness.</li> <li>• All inspections conducted and documented.</li> <li>• All preventative maintenance performed and documented in accordance with the referenced standards.</li> </ul>	100%	100%	100%	100%

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	21.8.3	Electrical Systems, Communications to include AM/FM Rebroadcast, 2-way Radio, Telephone and CCTV	Communications systems serving their intended functions	4 hrs	4 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations. Operational tests using 2-way radio equipment and frequencies to match outside agencies served, weekly. Continuous monitoring through self-system diagnostics and failure detection. CCTV system compliance with NFPA 72 inspection and maintenance requirements for fire detection, where used.</p> <ul style="list-style-type: none"> <li>• All equipment operating in accordance with manufacturer's recommendations for actual conditions of use.</li> <li>• 2-way radio system performance conforms with up-to-date using agency specifications</li> <li>• CCTV system complies with all requirements required to function as second means of fire detection.</li> <li>• All inspections conducted and documented.</li> <li>• All preventative maintenance performed and documented in accordance with the referenced standards.</li> <li>• Database and communication system security breaches.</li> <li>• Electronic retention of database files, back-ups and other stored media.</li> </ul>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>Nil</p> <p>100%</p>	

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				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.8.4	Electrical Systems, Distribution – Normal, Essential & Emergency	Electrical system serving connected loads with intended capacity, voltage regulation, protection, control and monitoring.	2 hrs	3 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations. Preventative maintenance and testing of essential &amp; Emergency sources per NFPA 110 and 111.</p> <p>Exercising of back-up generators under load where used as essential &amp; Emergency sources, monthly.</p> <p>Exercising of ATS switches, semi-annually.</p> <p>Load testing of UPS systems where used as essential &amp; Emergency source, monthly.</p> <p>Monitoring and Testing of individual battery cell condition, annually.</p>	<ul style="list-style-type: none"> <li>• All equipment operating in accordance with manufacturer's recommendations.</li> <li>• Loss of electrical source to connected loads due to electrical system component or installation failure.</li> <li>• Protection devices calibrated &amp; set properly.</li> <li>• Preventative maintenance in accordance with the referenced standards.</li> <li>• Where serving as a redundant source, availability of 100%.</li> <li>• All electrical outages within Developers control documented as to time, duration, loads affected, cause and corrective measures taken.</li> <li>• The capacity, duration and availability of non-utility essential or emergency sources meet the design requirements.</li> <li>• Adequate on-site storage of fuel supply sufficient to meet the intended standby essential operating time.</li> <li>• Continuous monitoring of essential Emergency sources when consisting of a non-utility source.</li> </ul>	<p>100%</p> <p>Nil</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET							
				Category 1		Category 2										
				Hazard Mitigation	Permanent Remedy	Permanent Repair										
	21.8.5	Electrical Systems, SCADA	SCADA system provides intended function of control, monitoring, communication and visual display of all connected systems including integration with other systems.	2 hrs	3 days	6 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations. Follow manufacturer's recommendations for maintenance and testing where requirements are more demanding. Continuous monitoring through self-system diagnostics and failure detection.</p> <ul style="list-style-type: none"> <li>• SCADA systems provide the intended level of control and monitoring.</li> <li>• Trouble conditions corrected and cleared within 72 hours.</li> <li>• All sensors and monitoring devices operating within manufacturer's tolerance for sensitivity.</li> <li>• Loss of critical or life safety functions due to equipment or system malfunction.</li> <li>• Software and system integration with other systems including ITS and ETCS, debugged, vendor supported and updated to latest release.</li> <li>• Inspections and preventative maintenance in accordance with the referenced standards.</li> <li>• Availability on-site or within 2 hours of spares for all critical components serving critical or life safety functions.</li> <li>• Loss of redundancy due to SCADA system malfunction where the controlled function is in support of other redundant systems.</li> </ul>	100%	100%	100%	Nil	100%	100%	100%	100%	Nil

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.8.6	Electrical Systems, Grounding & LP	Grounding and lightning protection systems provide intended function and level of protection for equipment, structure and personnel protection.	24 hours	7 days	3 months	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway and Rail Transit Tunnel Maintenance and Rehabilitation Manual, manufacturer's recommendations and NFPA 780.</p> <p>The fall of potential method shall be used to test the resistance to earth of all grounding electrode systems serving electrical services, lightning protection and alternate energy sources, every 5 years.</p> <p>The continuity of ground connections to remote earth shall be tested during replacement of equipment served or any major change of system configuration.</p>	<ul style="list-style-type: none"> <li>• All bonding, grounding and lightning protection connections pass visual inspection and do not show signs of corrosion.</li> <li>• All fall of potential tests demonstrate proper resistance to earth.</li> <li>• All continuity tests show proper resistance.</li> <li>• Inspection &amp; maintenance records showing compliance</li> </ul>	<p>100%</p> <p>100%</p> <p>100%</p> <p>100%</p>

**Performance and Measurement Table Baseline**

ELEMENT CATEGORY	REF	ELEMENT	PERFORMANCE REQUIREMENT	RESPONSE TO DEFECTS			INSPECTION AND MEASUREMENT METHOD *	MEASUREMENT RECORD *	TARGET
				Category 1		Category 2			
				Hazard Mitigation	Permanent Remedy	Permanent Repair			
	21.9	Ventilation System	Ventilation System fully functional and operational.	2 hrs	7 days	1 month	<p>An inspection, maintenance, and rehabilitation plan shall be developed and adhered to. The plan shall be based on the FHWA Highway and Rail Transit Tunnel Inspection Manual, FHWA Highway, Rail Transit Tunnel Maintenance and Rehabilitation Manual, and manufacturer's recommendations.</p> <p>Life Safety preventative maintenance performed and reported bi-annually.</p> <p>Life safety components of the tunnel ventilation system tested annually,</p> <p>Verification of OCC activation and separately, local activation of tunnel ventilation life safety response, annually.</p>	<ul style="list-style-type: none"> <li>• Maintenance performed and documented per the Maintenance Management Plan.</li> <li>• Physical condition and configuration of fire protection equipment is satisfactory and proper, respectively, based on visual inspection.</li> <li>• Supervisory Control and Data Acquisition system operates and monitors system properly.</li> </ul>	<p>100%</p> <p>100%</p> <p>100%</p>

\* Items in these columns shall be reviewed annually by Developer as part of the MMP to comply with Technical Documents and/or Good Industry Practice