



# Let There Be Light

## Tunnel Lighting Controls



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# Introduction

- Contract 4509, IR 80, Carlin Tunnel Lighting
- Tunnel Lighting System
  - Nyx Hemera Tunnel Lighting Addressable Control System – Energy Management (TLACS-EM)

# General Background

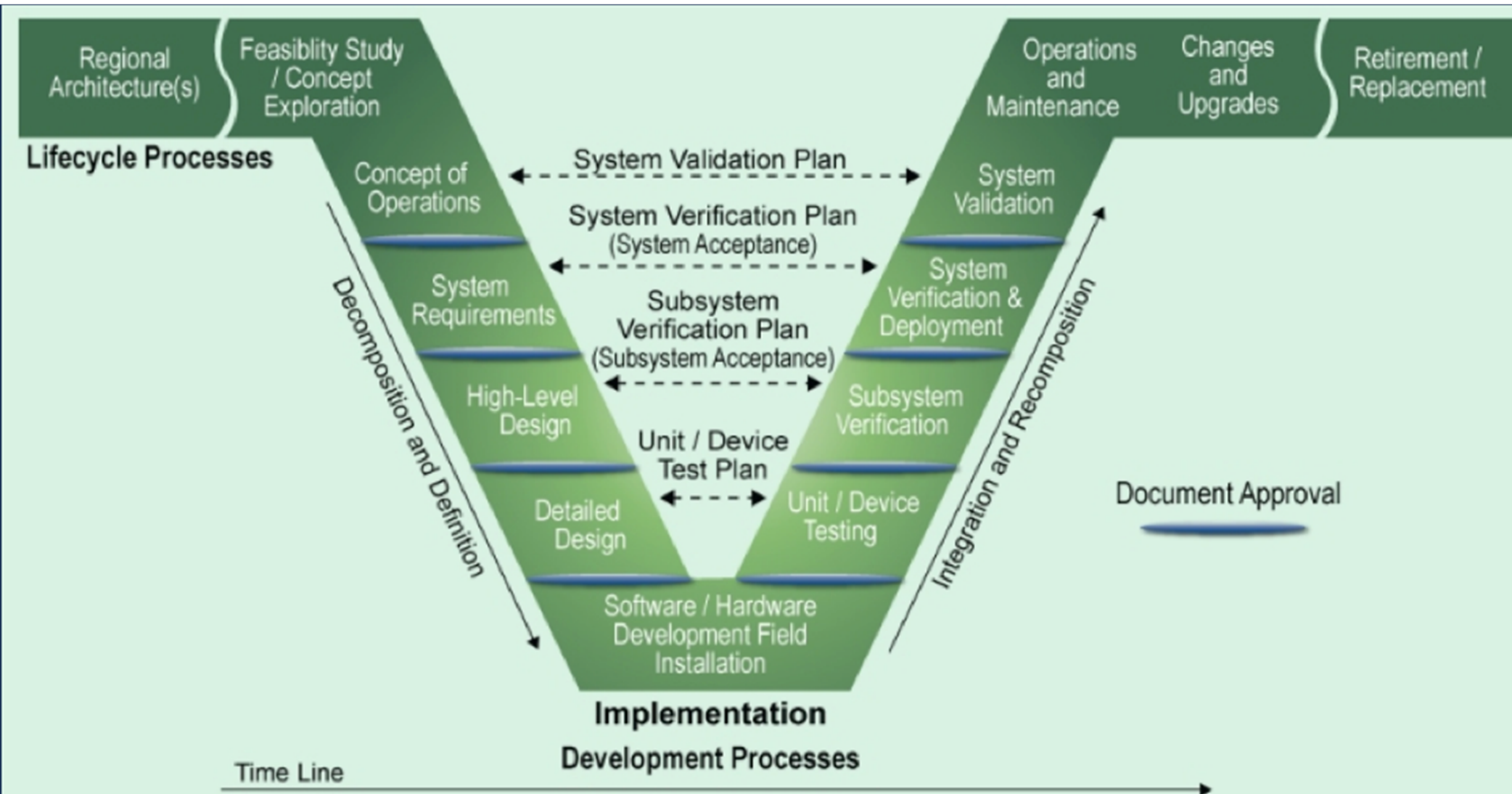
- Tunnel Lighting
  - Design Considerations



# 2013 Project Background

- Contract 3540, IR 80, Carlin Tunnel Lighting
  - Research
  - Systems Engineering
  - Selected System
  - Components
  - Operational Ability

# 2013 Project Systems Engineering



# 2013 Project Research

- Off-the-Shelf System
  - Controls
  - Lighting
- All Light Emitting Diodes (LED) Luminaires
- Hardwire Controls vs. Power-Line Carrier

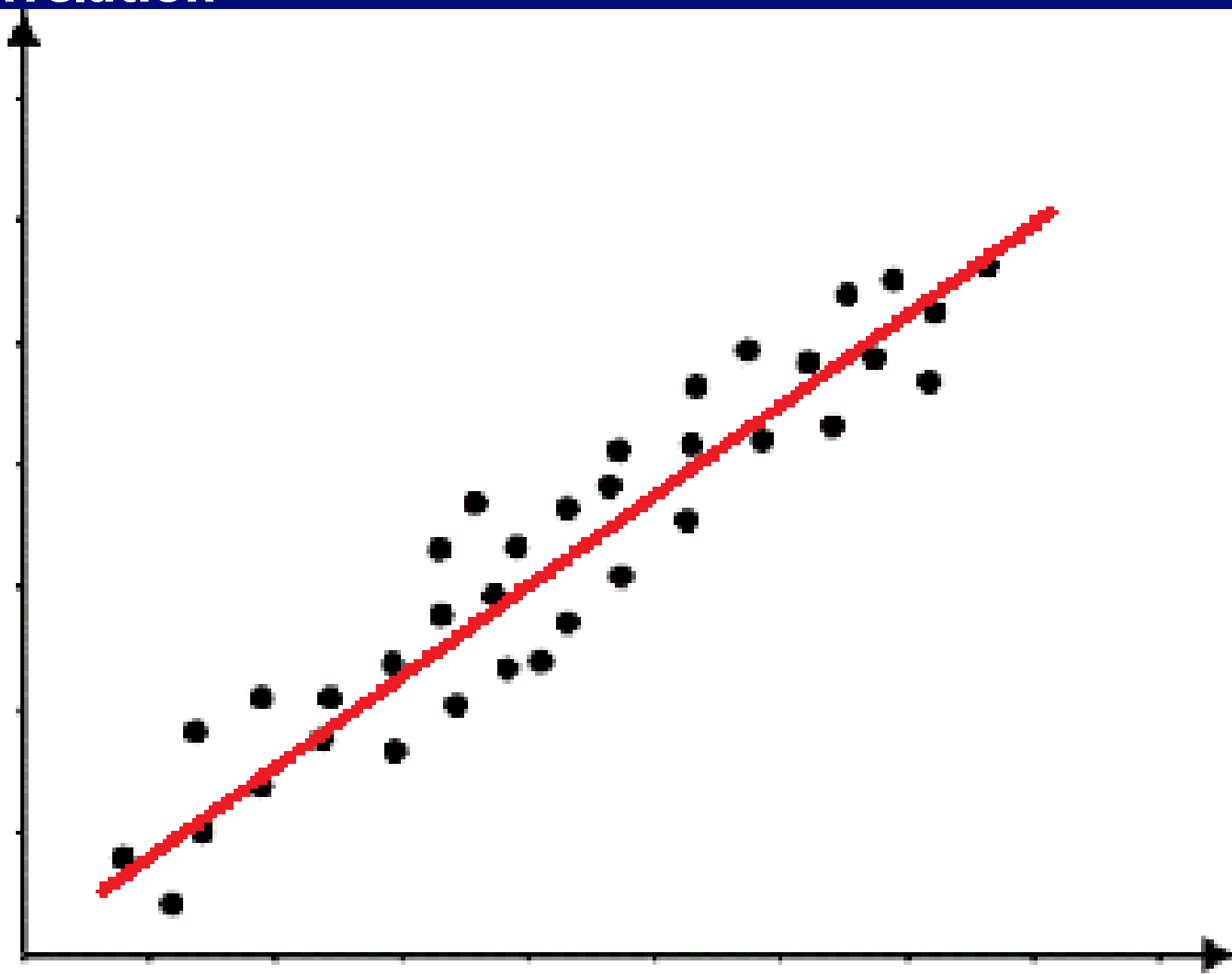
# 2013 Project Operational Ability

- Internal light levels positively correlated to external light levels
  - Mitigate “driving in to a dark tunnel”
- Maximum and minimum light levels
  - Prevent threshold temporary eyesight blinding
  - Ensure enough light to see internal tunnel environment without significantly impacting nighttime driver vision



# Positive Correlation

Variable 2

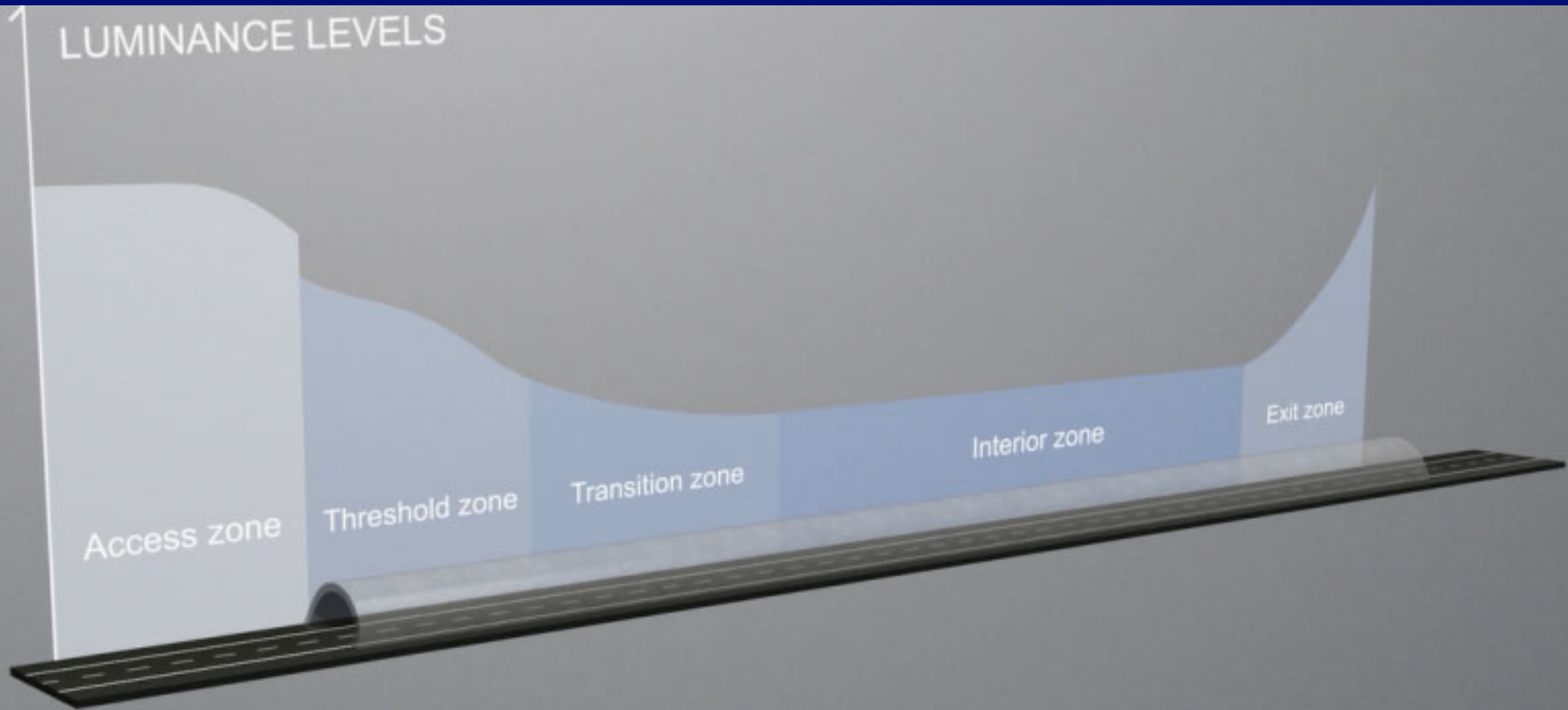


Variable 1

# 2013 Project Operational Ability

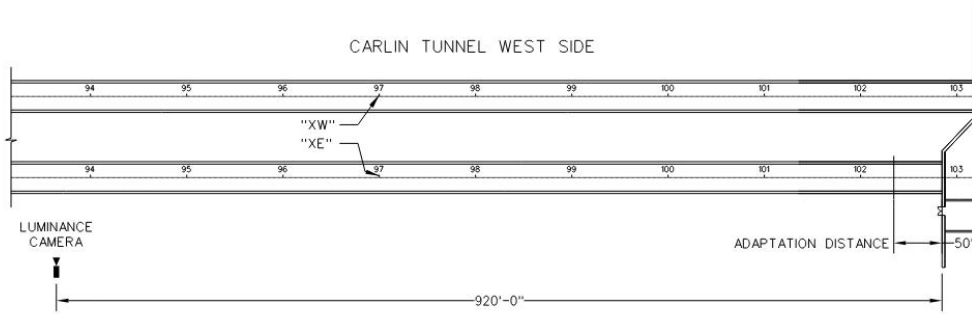
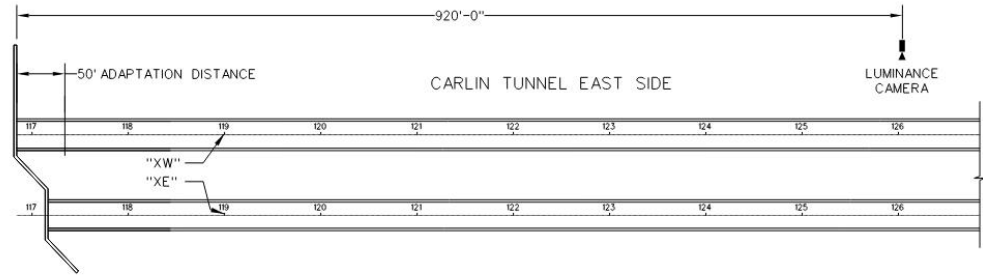
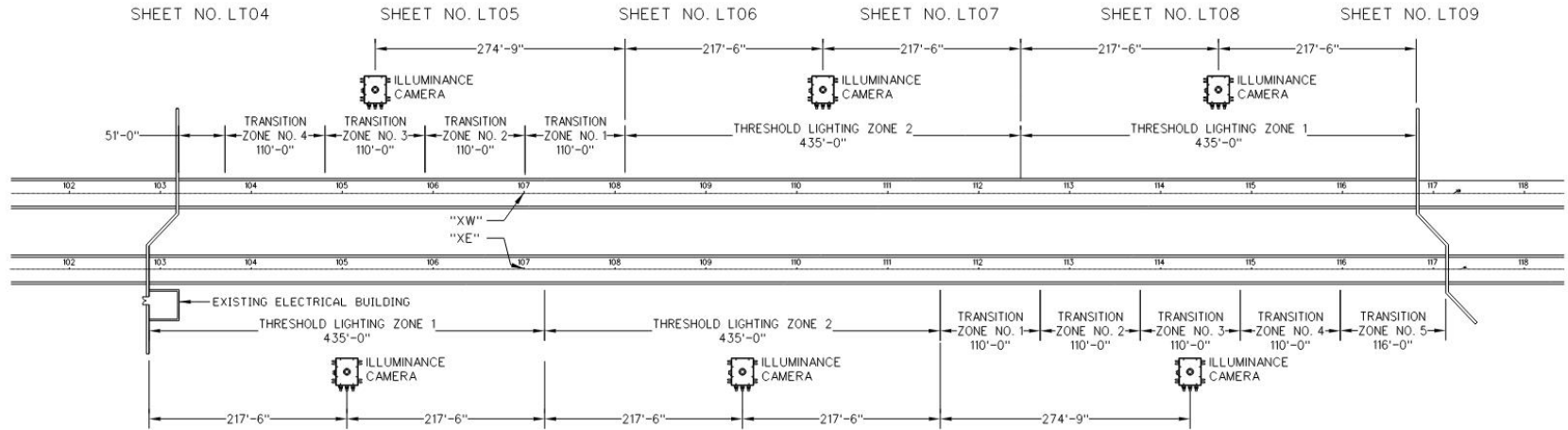
- Lighting zones
  - Access
  - Threshold
  - Transition
  - Interior
  - Exit

# Threshold Lighting



# Threshold Lighting

STATE	PROJECT NO.	COUNTY	SHEET NO.
NEVADA	SP1-080-4-(340)	ELKO	LT25



NOTE:  
DIMENSIONS ARE SHOWN  
FOR REFERENCE ONLY.

STATE OF NEVADA  
DEPARTMENT OF TRANSPORTATION  
**LIGHTING THRESHOLD  
PLAN SPECIAL  
DETAIL**

# 2013 Project Major Components

## ■ Luminaires

- Researched all tunnel lighting manufacturers
- Obtained IES files and performed lighting analysis calculations to determine number of luminaires needed to meet lighting design specifications
- Obtained samples of each luminaire
- Created life-cycle cost model including capital outlay and operational costs (power, maintenance)
  - Component replacement timeline
- Internal meeting with technical advisory committee (designers, maintainers) to evaluate maintainability and life-cycle cost of each luminaire for final selection



# 2013 Project Major Components

- Power System
  - Overview of power circuit feeding tunnel
  - Required filtering
    - Power/Harmonic filtering

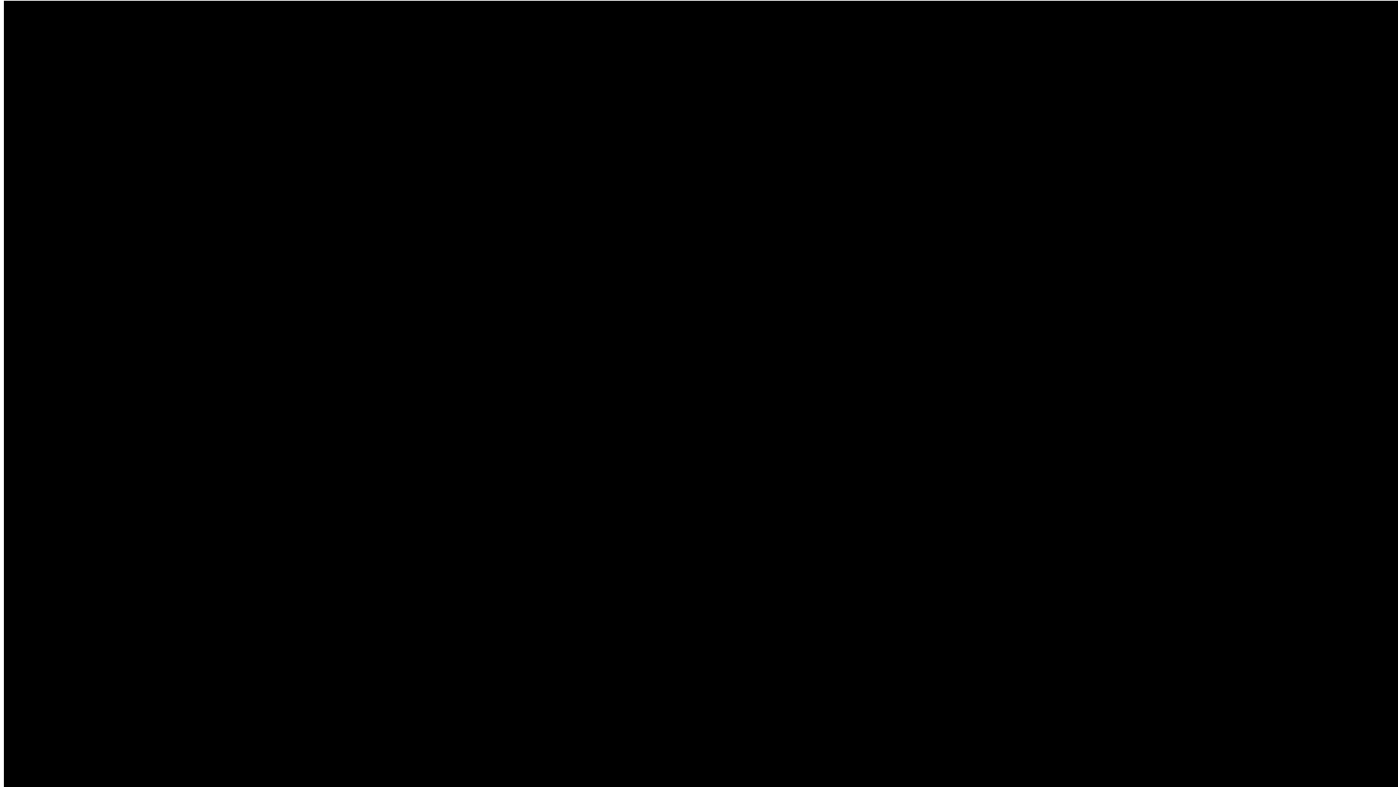
# 2013 Project Major Components

- Lighting Control System

- How [hardwire; power and communications]
  - Individual control of each luminaire
- What
  - Separate wiring vs. powerline carrier
- Why
  - Testimonials from US clients
    - Established powerline carrier (less expensive long-term maintenance and reduced capital outlay)

# 2013 Project

- Discovery Channel Video



# 2013 Project Comparison

Current Tunnel Lighting vs. Previous Tunnel Lighting



# Current Project Background

- Challenges Leading To Project Need
  - Discontinued Manufacturer Components
    - LED Boards
    - LED Drivers
  - NDOT Maintenance
    - Stockpile Depletion
    - Troubleshooting



# Maintenance Issues

- Mean time between component failure
  - System design based on manufacturer provided information
    - System installed and spare components should last for 20 years
    - Components would be available for 20-year period for replacements

# Current Project

- Contract 4509 – IR 80, Carlin Tunnel Lighting
  - Scope
    - Location
  - Schedule
  - Budget

# Lighting Control System

- Nyx Hemera Tunnel Lighting Addressable Control System – Energy Management (TLACS-EM)
- Major TLACS-EM Systems Components
  - Power-Line Carrier Communications (PLCC)
  - Lighting Control Cabinet (LCC)
  - Lighting Controller (LC)
  - Local Product Controller (LPC)
  - Lighting Control Sensors
    - Illuminance Camera - ILCAM
    - Luminance Camera - LCAM

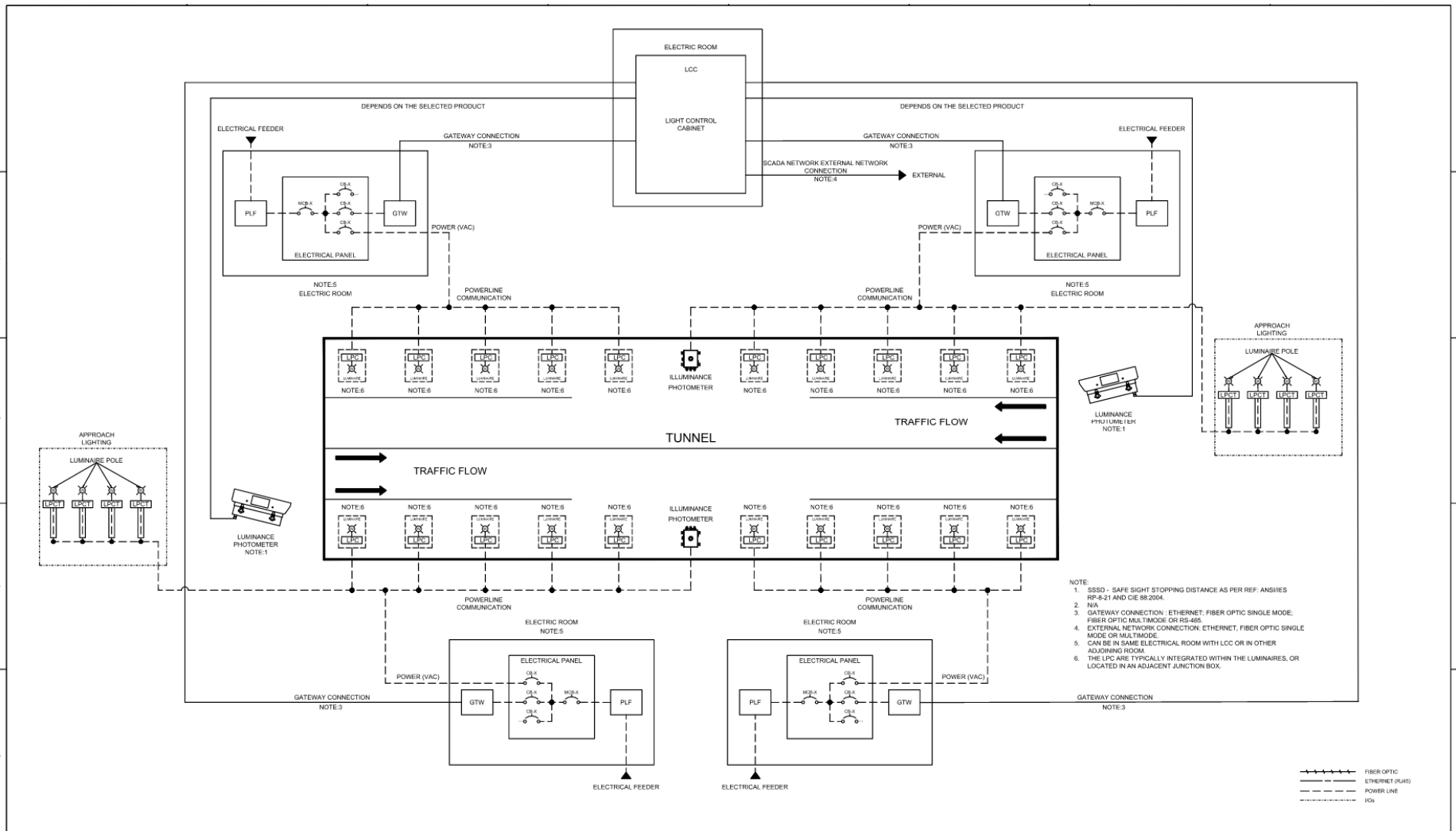
# Lighting Control System

- TLACS-EM



# Lighting Control System

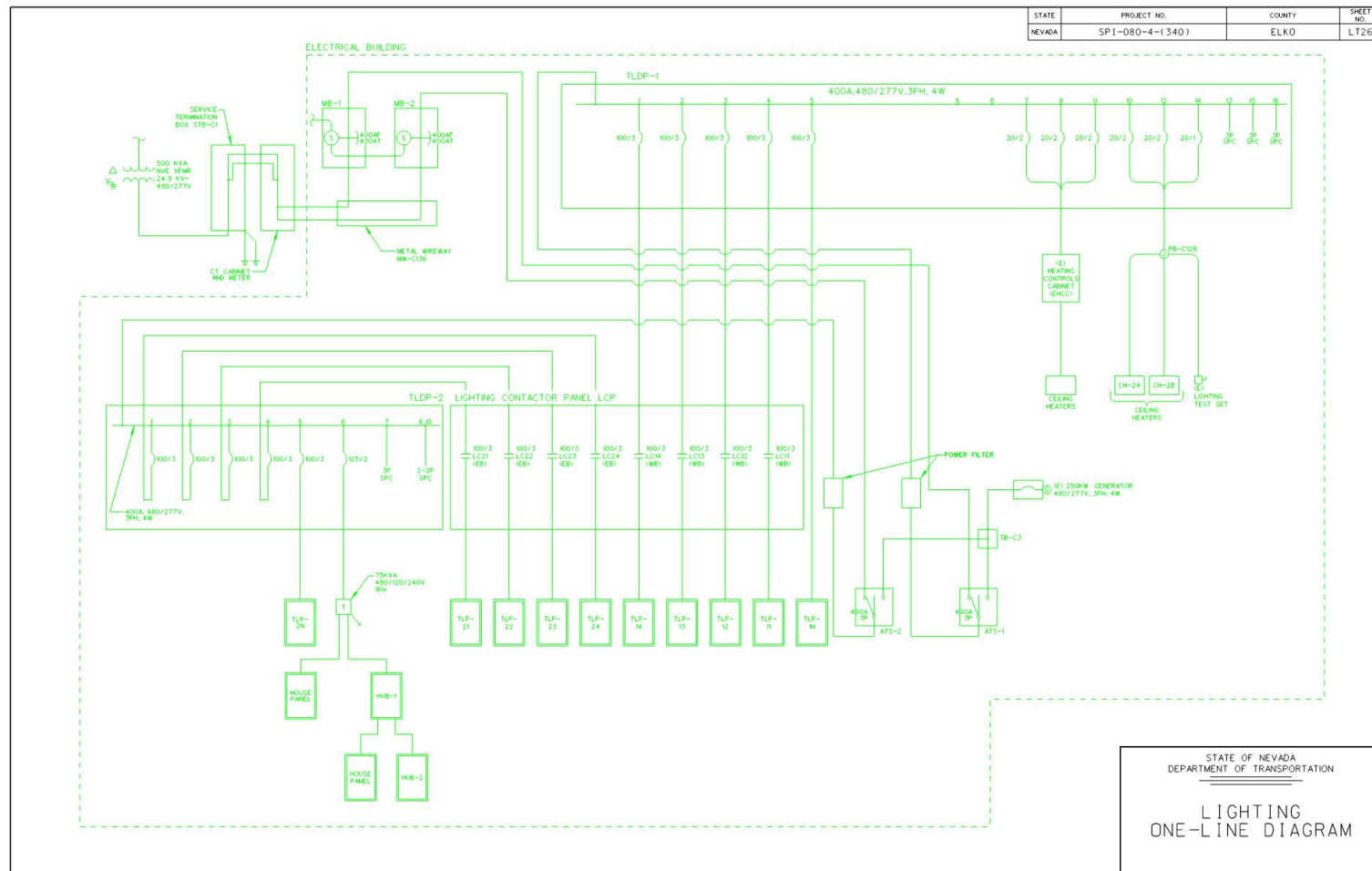
## System Diagram





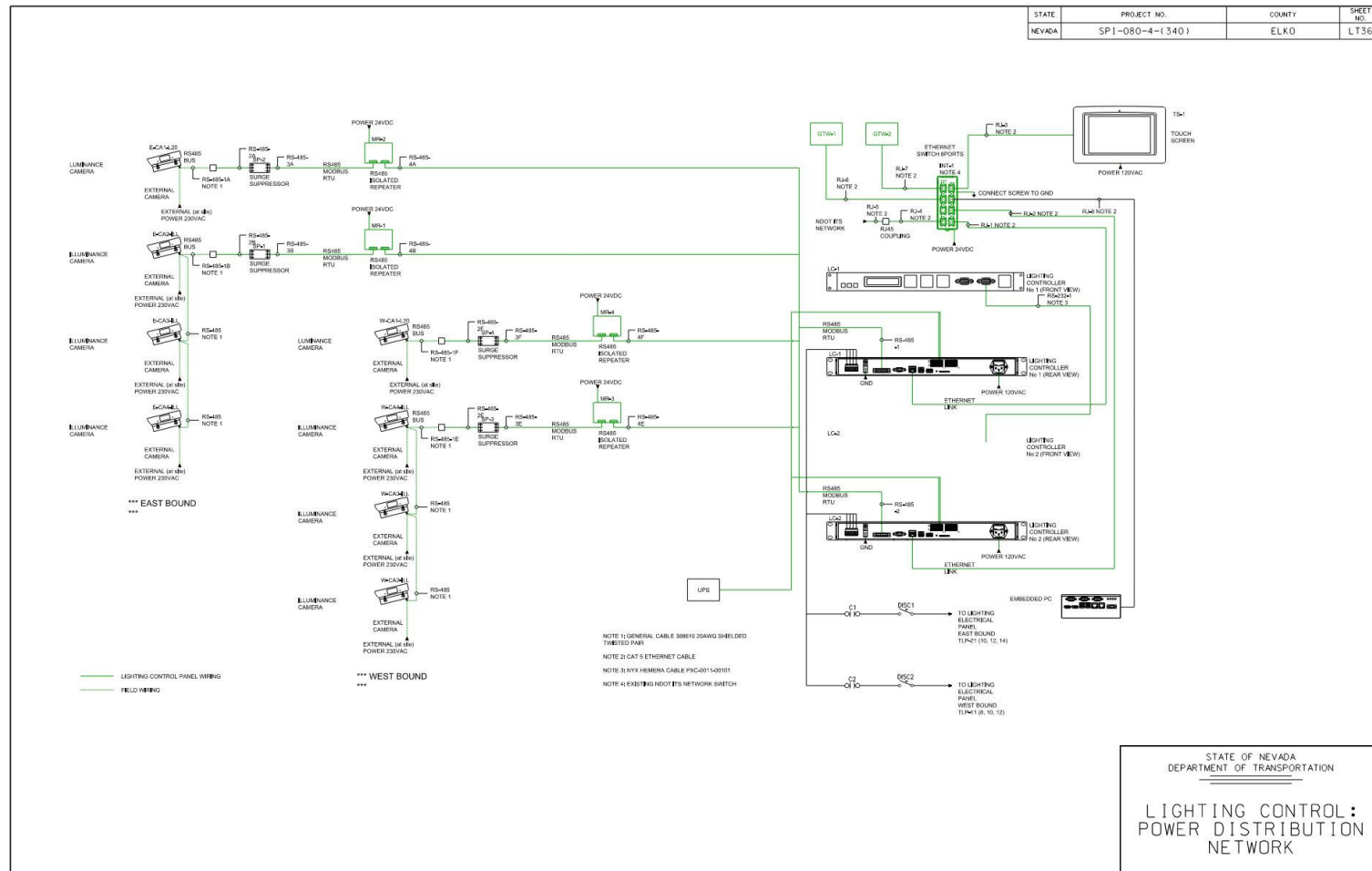
# Lighting Control System

- Lighting One-Line Diagram



# Lighting Control System

- Communications Distribution Network Diagram



# Power Supply

- Harmonic Filtering



# Power-Line Carrier Communications (PLCC)

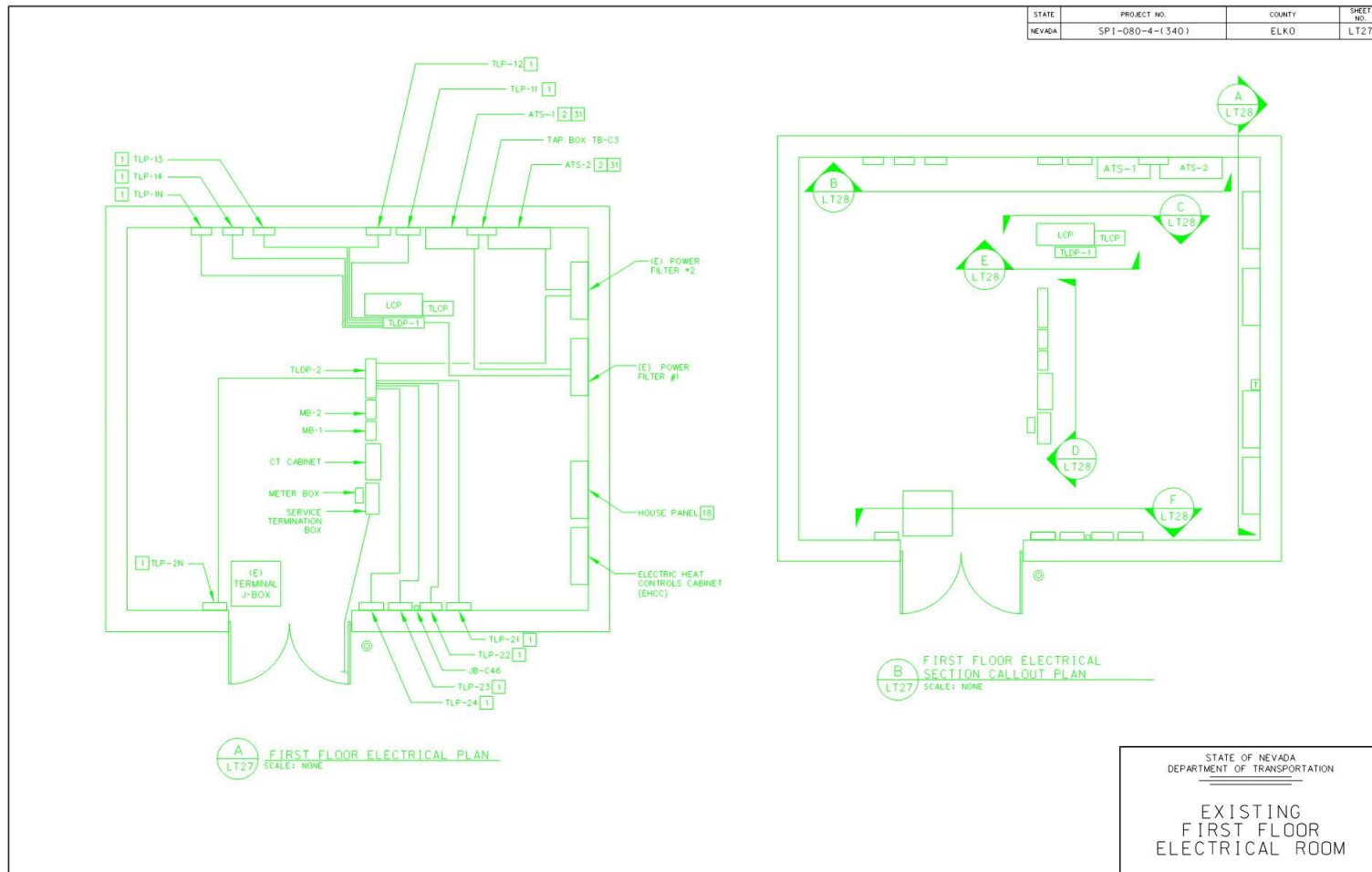
- Power-Line Communication





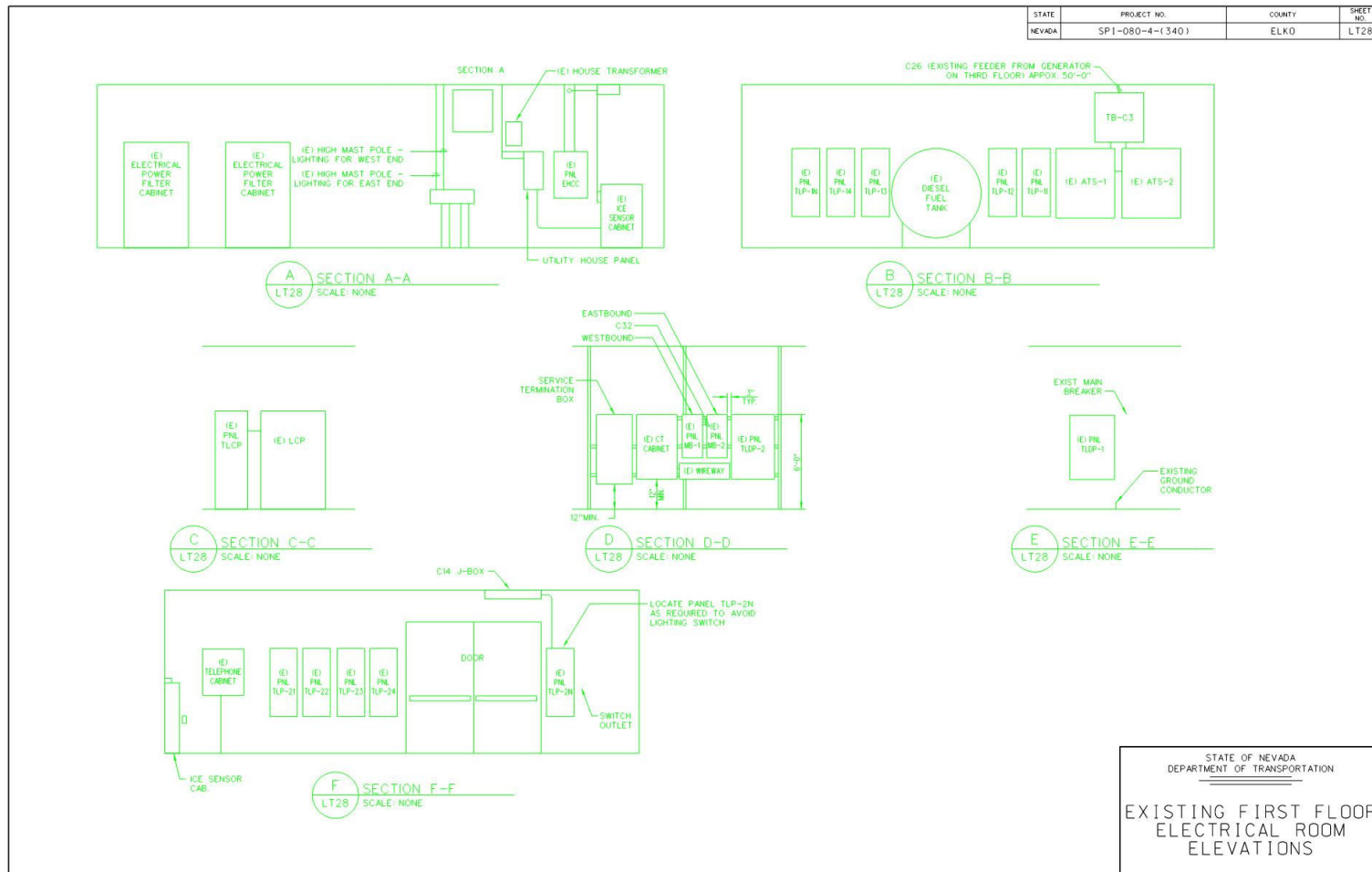
# Lighting Control Cabinet

## LCC Room – First Floor Plan View



# Lighting Control Cabinet

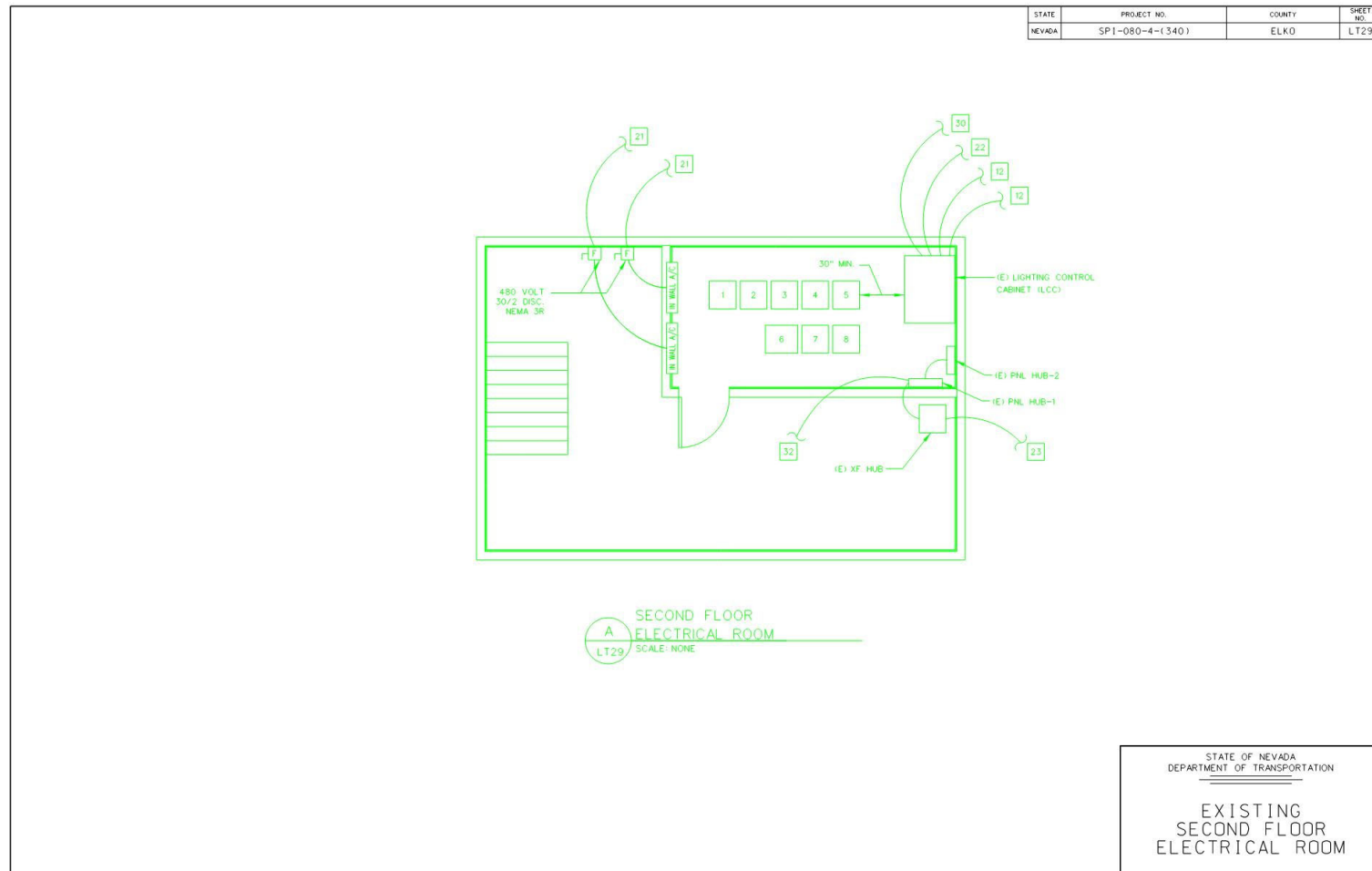
## LCC Room – First Floor Profile View





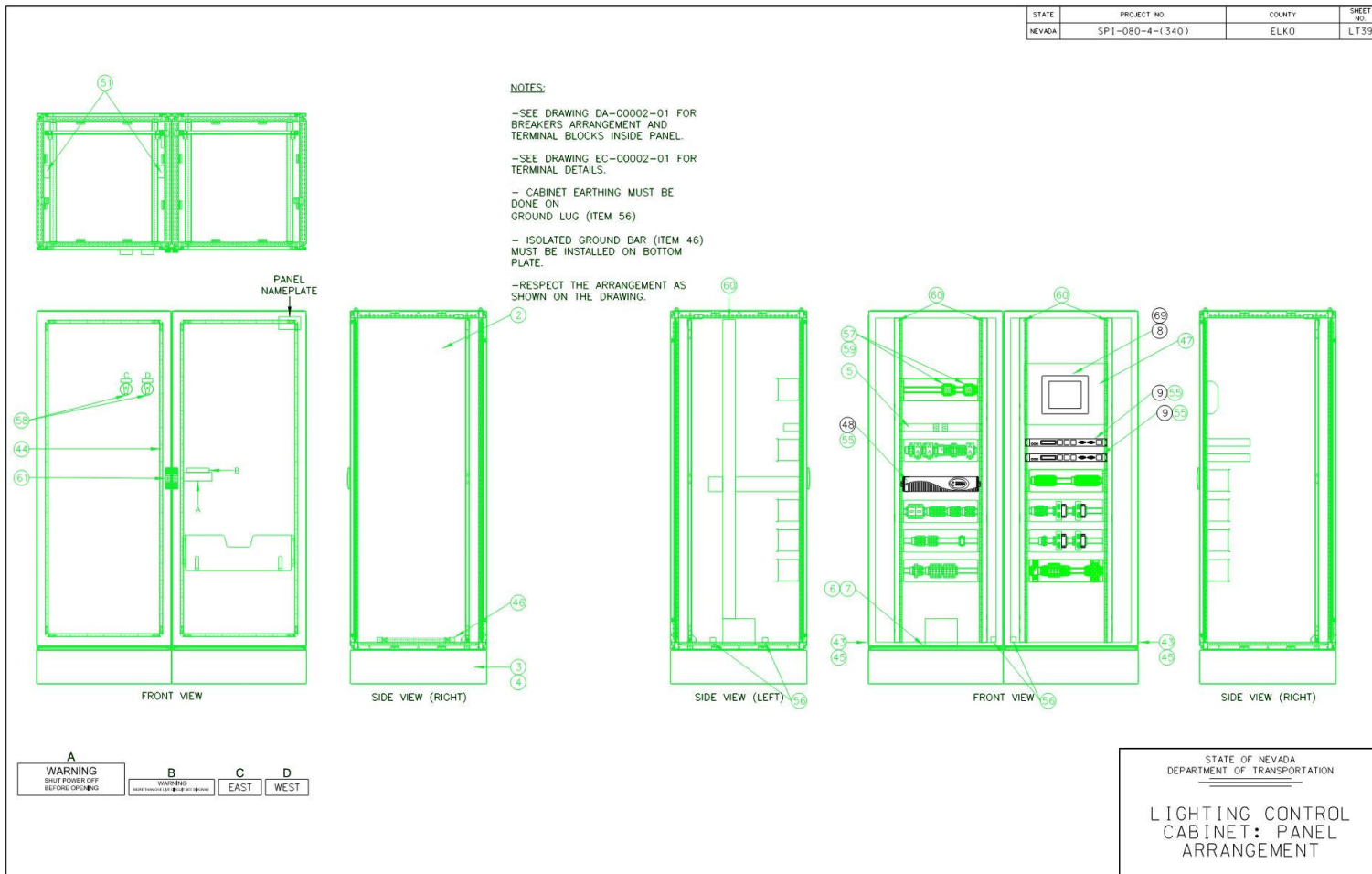
# Lighting Control Cabinet

## LCC Room – Second Floor – Plan View



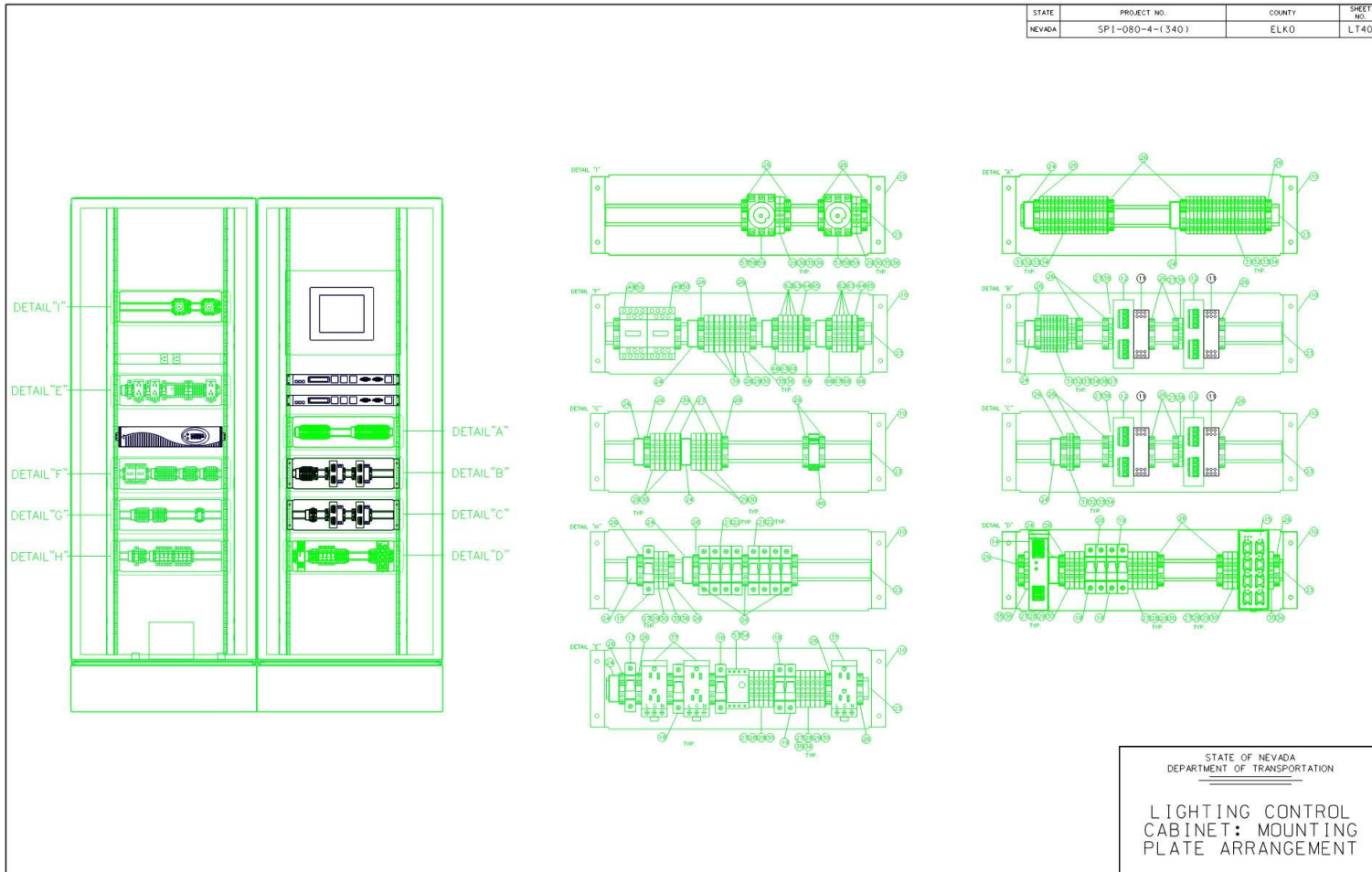
# Lighting Control Cabinet

## LCC Panel Arrangement



# Lighting Control Cabinet

## LCC Mounting Plate Arrangement



# Lighting Control Cabinet

## LCC Bill of Material (1)

		STATE	PROJECT NO.	COUNTY	SHEET NO.	
		NEVADA	SP1-080-4-(1340)	ELKO	LT43	
ITEMS						
ITEM	QTY	DESCRIPTION	NYX NUMBER	PART NUMBER	MANUFACTURER	IDENTIFICATION
①	1	TS8 UL TYPE 4X FREESTANDING ENCLOSURE	PTC-0027-TS84X	9978.423	RITTAL	ASM-E0007-01100
②	2	TS 5/S SIDEWALLS	PTC-0028-TS8SW	9978.426	RITTAL	
③	1	TS 100mm FRONT & BACK ELEMENTS	PTC-0029-TS84P	8701.800	RITTAL	
④	1	TS SIDE PLINTH 5/STEEL	PTC-0030-TS84P	8701.080	RITTAL	
⑤	1	RACK-MOUNT POWER DISTRIBUTION UNIT	PTR-0005-PWR12	9970.843	RITTAL	PB-1
⑥	2	TRANSFORMER RAILS	PTC-0037-SUPPR	4362.000	RITTAL	
⑦	1	TRANSFORMER 277/120VAC 1500VA	PXT-0013-1500V	SP1500NJ	HAMMOND SEE NOTE 2	LCC
⑧	1	TOUCH SCREEN	PTC-0026-VTPC1	VTPC150PF	VARTECH SEE NOTE 2	TS-1
⑨	2	LIGHTING CONTROLLER (NWC)	NWC-PL31-1-1-FCC	NWC-PL31-1-1-FCC	Nyx Hemera technologies	LC-1/LC-2
⑩	9	MOUNTING PLATE	DA-00003-01	SEE DRAWING DA-00003-01 OR EQUIVALENT NYX HEMERA		
⑪	4	SURGE SUPPRESSOR	PTD-0031-485SU	HESP4DR	B&B ELECTRONICS	SP-1/SP-2/SP-3/SP-4
⑫	4	MODBUS ISOLATED REPEATER	PTD-0036-485RP	4850PDR1	B&B ELECTRONICS	MR-1/MR-2/MR-3/MR-4
⑬	1	CIRCUIT BREAKER 15A	PTD-0008-BR15A	1492-GH150	ALLEN BRADLEY SEE NOTE 2	CB-4
⑭	1	POWER SUPPLY 120VAC/24VDC 2.5A	PTD-0029-TR24V	TRIO-PS/1AC/24DC/2.5	PHOENIX CONTACT	PS-1
⑮	1	ETHERNET SWITCH 8 PORTS	PTD-0033-ETH8P	FL SWITCH SFNT 8TX	PHOENIX CONTACT	INT-1
⑯	2	CIRCUIT BREAKER 10A	PTD-0003-BR10A	1492-GH100	ALLEN BRADLEY SEE NOTE 2	CB-6/CB-11
⑰	2	CIRCUIT BREAKER 5A	PTD-0007-BR05A	1492-GH050	ALLEN BRADLEY SEE NOTE 2	CB-13/CB-14
⑱	4	CIRCUIT BREAKER 1A	PTD-0005-BR01A	1492-GH010	ALLEN BRADLEY SEE NOTE 2	CB-170/CB-176/CB-178/CB-164
⑲	1	CIRCUIT BREAKER 2A	PTD-0006-BR02A	1492-GH020	ALLEN BRADLEY SEE NOTE 2	CB-172
⑳	8	FUSE HOLDER	PTD-0009-PF30A	1492-FB1C30	ALLEN BRADLEY SEE NOTE 2	FU-C1-L1/FU-C1-L2/FU-C1-L3/FU-C1-N FU-C2-L1/FU-C2-L2/FU-C2-L3/FU-C2-N
㉑	8	FUSE CLASS CC 600V 1A	PDP-1009-1A600	ATDR1	FERRAZ SHAWMUT SEE NOTE 2	
㉒	3	DIN RAIL 35MM (LENGTH 2M)	PTD-0034-TS35G	TS-35	ENTRELEC SEE NOTE 2	
㉓	11	MARKER CARRIER	PTD-0011-SCHT5	SCHT 5	WEIDMULLER	
㉔						
㉕	44	END BRACKET	PTD-0013-WEW35	WEW-35/2	WEIDMULLER	
㉖	11	END PLATE	PTD-0015-WAP25	WAP 2.5-10	WEIDMULLER	
㉗	NOTE	CROSS CONNECTOR (SCREW) FOR WDU 6	PTD-0018-WOV61	WOV 6/X	WEIDMULLER	
㉘	102	TERMINAL MARKER FOR WDU 6 AND WDU 4 BL.	PTD-0019-WS126	WS 12/6.5 MC	WEIDMULLER	
㉙	45	TERMINAL BLOCK	PTD-0020-WDU6	WDU 6	WEIDMULLER	
㉚	NOTE	CROSS CONNECTOR (PLUG) FOR WDU 4	PTD-0021-ZOV4N	ZOV 4N/X	WEIDMULLER	
㉛	5	END PLATE FOR WDU 4	PTD-0035-WAPWD	WAP WDU/WTR4/ZZ	WEIDMULLER	
㉜	98	TERMINAL MARKER FOR WDU 4	PTD-0019-WS126	WS 12/6.5	WEIDMULLER	
㉝	49	TERMINAL BLOCK (DOUBLE)	PTD-0023-WDU42	WDU 4/ZZ	WEIDMULLER	
㉞	18	TERMINAL MARKER FOR WPE 4	PTD-0019-WS126	WS 12/6.5	WEIDMULLER	
㉟	9	EARTH TERMINAL BLOCK	PTD-0025-WPE4	WPE 4	WEIDMULLER	
㊱	3	ELECTRICAL OUTLET 120VAC 15A	PTD-0037-DR15A	6720005430	WEIDMULLER	PO-UPS/PO-1/PO-2
㊲	6	ISOLATED GROUND TERMINAL BLOCK	PTD-0026-WDU4B	WDU 4 BL	WEIDMULLER	
㊳	5	PARTITION PLATE	PTD-0028-WAP16	WAP 16+35 WTW 2.5-10	WEIDMULLER	
㊴	1	MOUNTING RAIL OUTLET RJ45 COUPLING	PTD-0053-RJ45C	8946920000	WEIDMULLER	IE-TD-RJ45
NOTE:						
1-CHOICE OF NUMBER OF POLES ARE LEFT TO THE PANEL BUILDER.		2-OR EQUIVALENT				

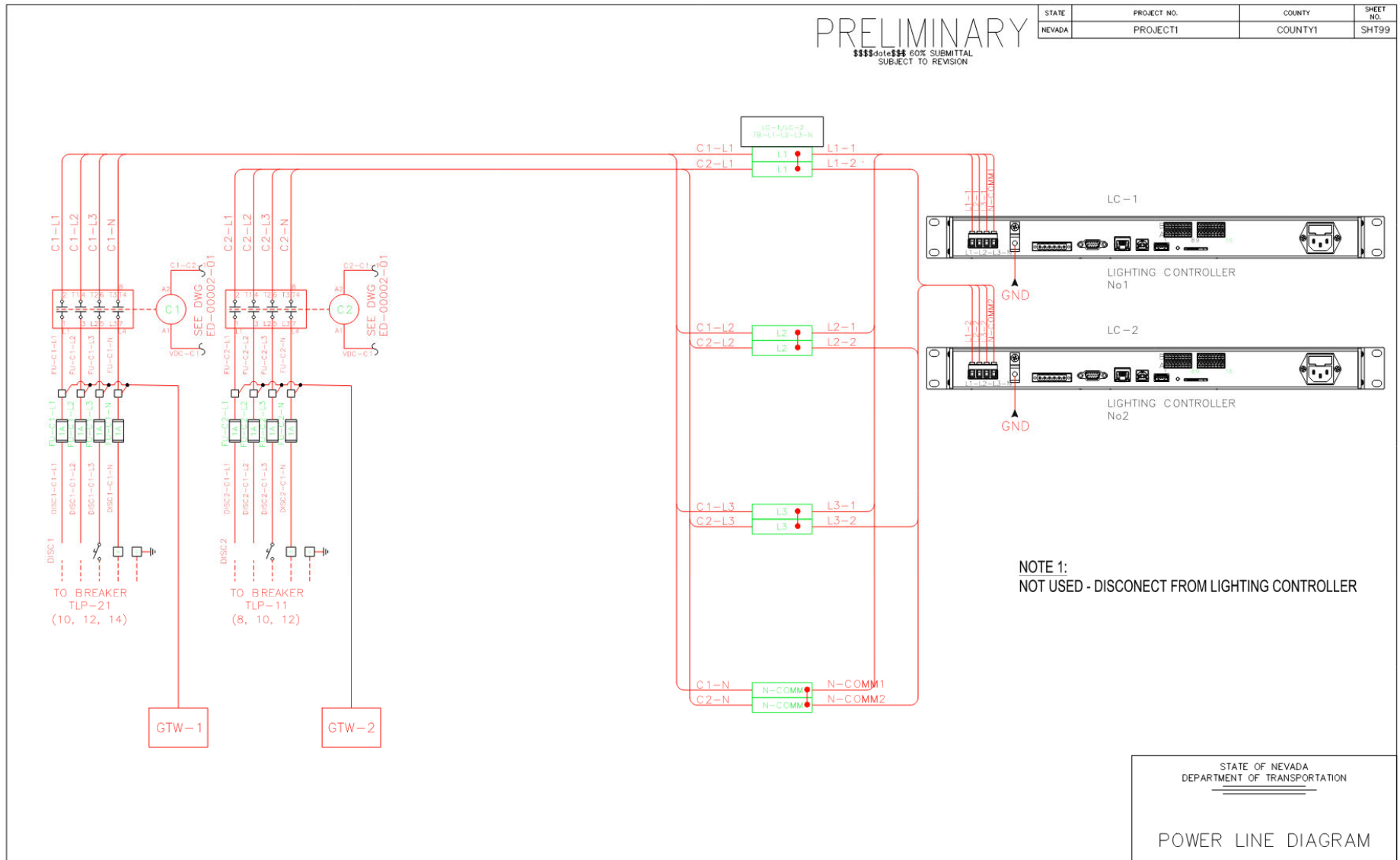
STATE OF NEVADA  
DEPARTMENT OF TRANSPORTATION

**LIGHTING CONTROL  
CABINET: BILL OF  
MATERIAL**



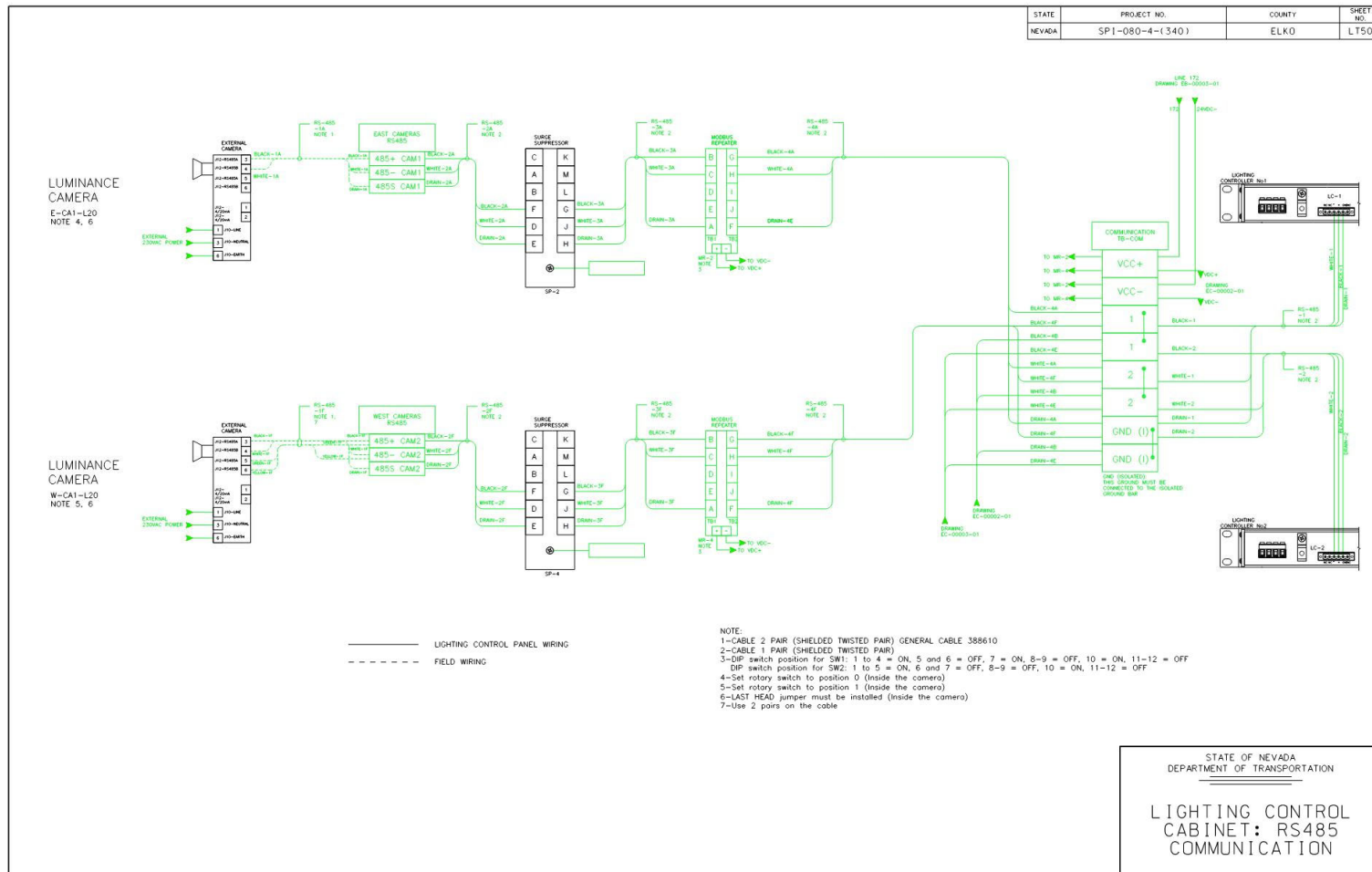
# Lighting Control Cabinet

## LCC Power Line Diagram



# Lighting Control Cabinet

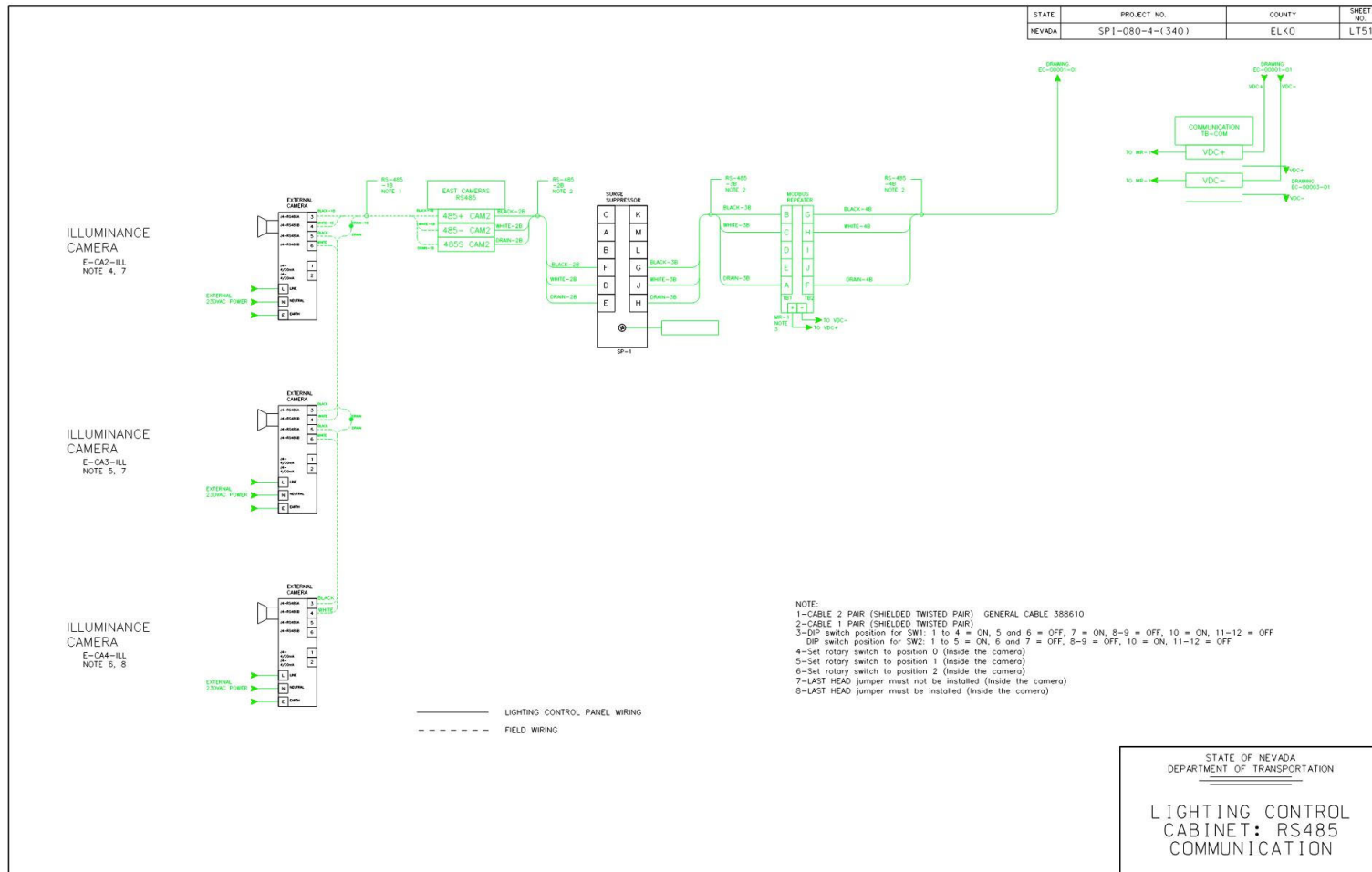
## LCC RS485 Communications Diagram - LCAM





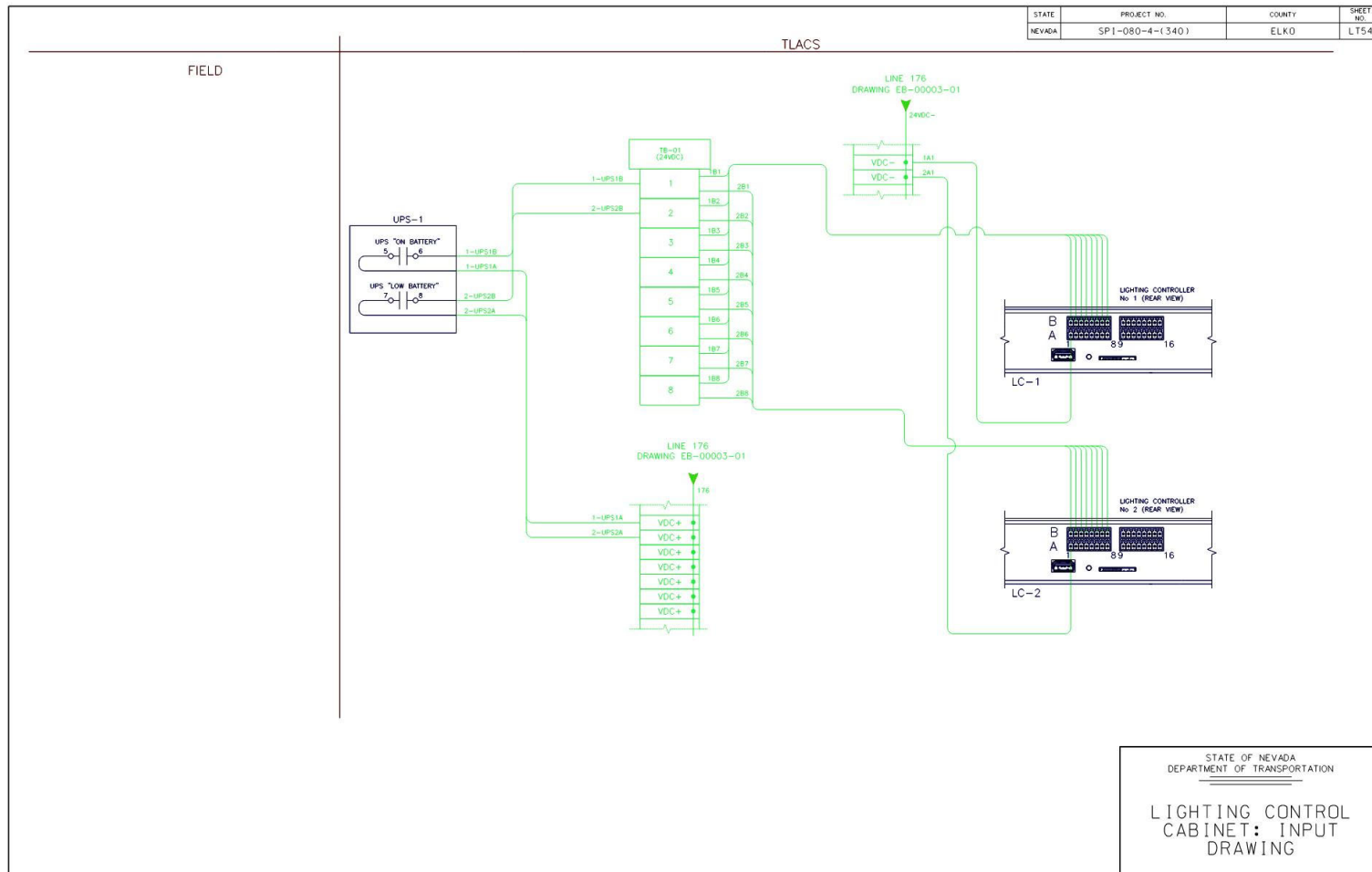
# Lighting Control Cabinet

## LCC RS85 Communications Diagram - ILCAM



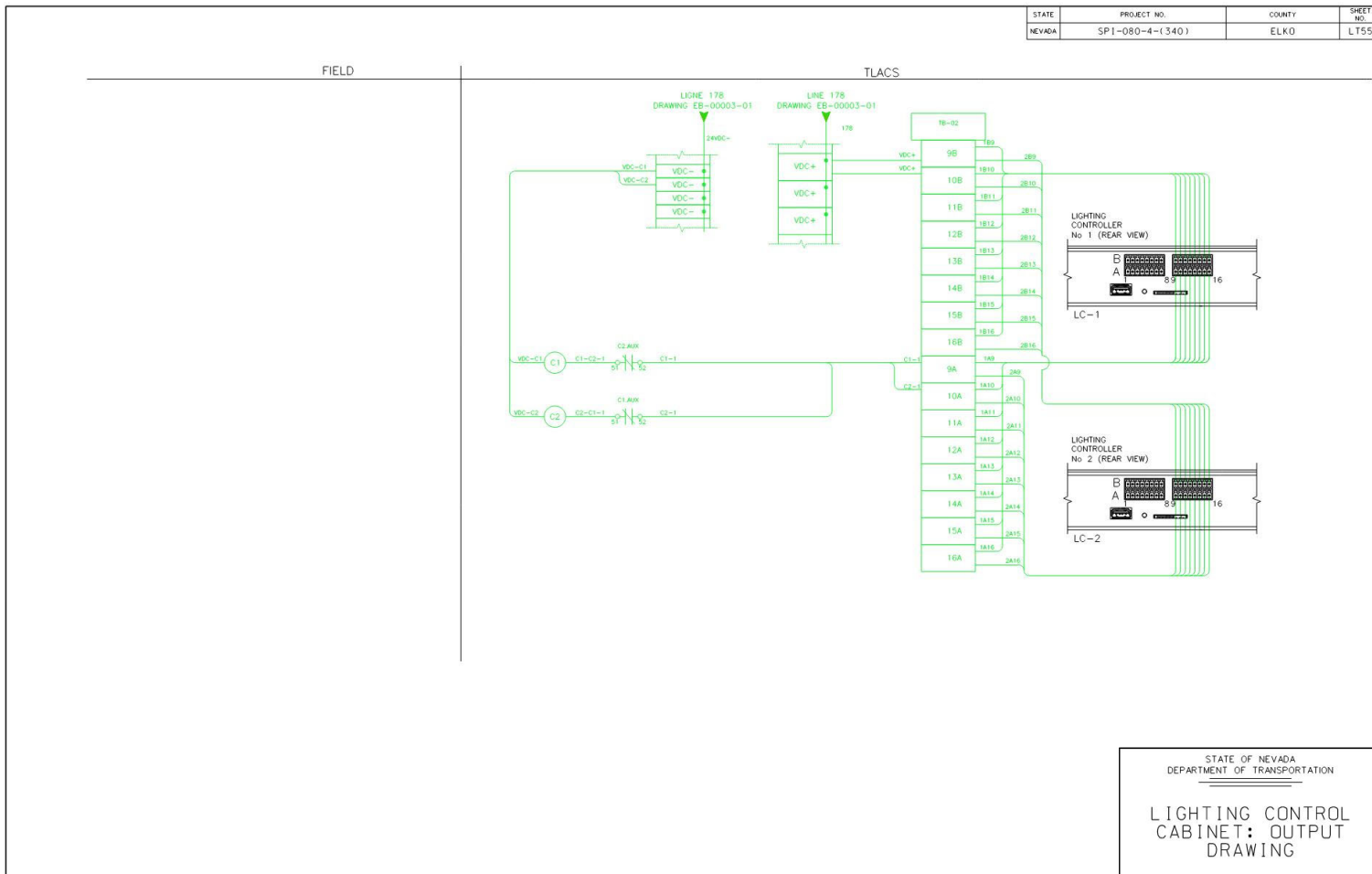
# Lighting Control Cabinet

## LCC Input Diagram



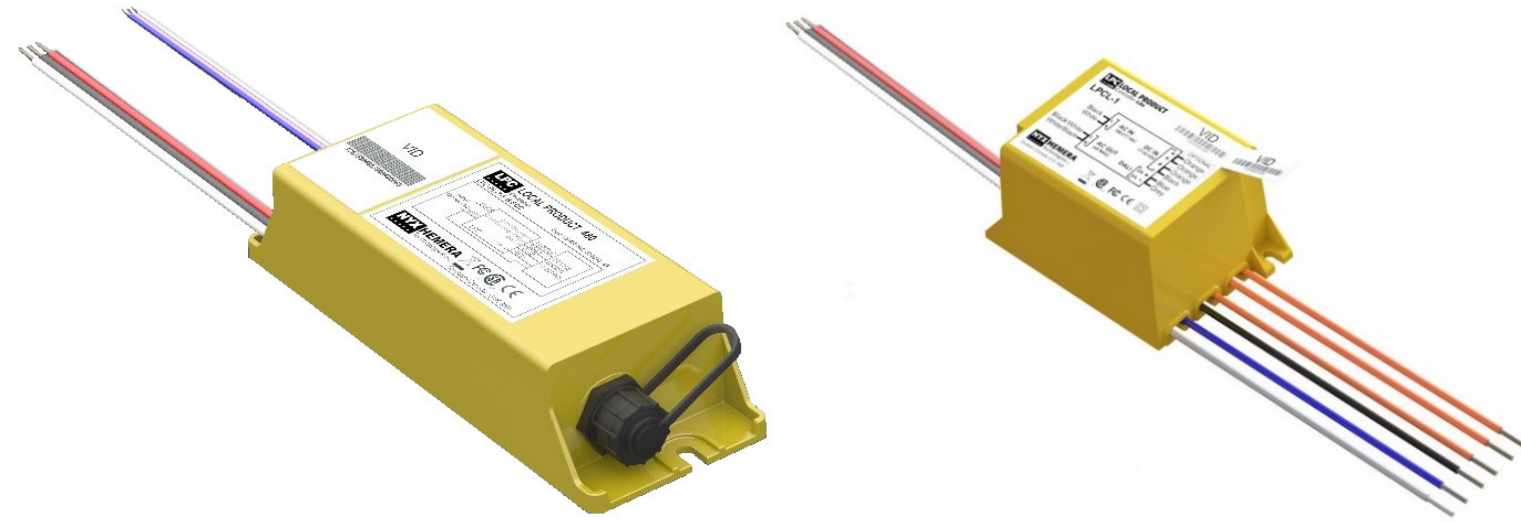
# Lighting Control Cabinet

## LCC Output Diagram



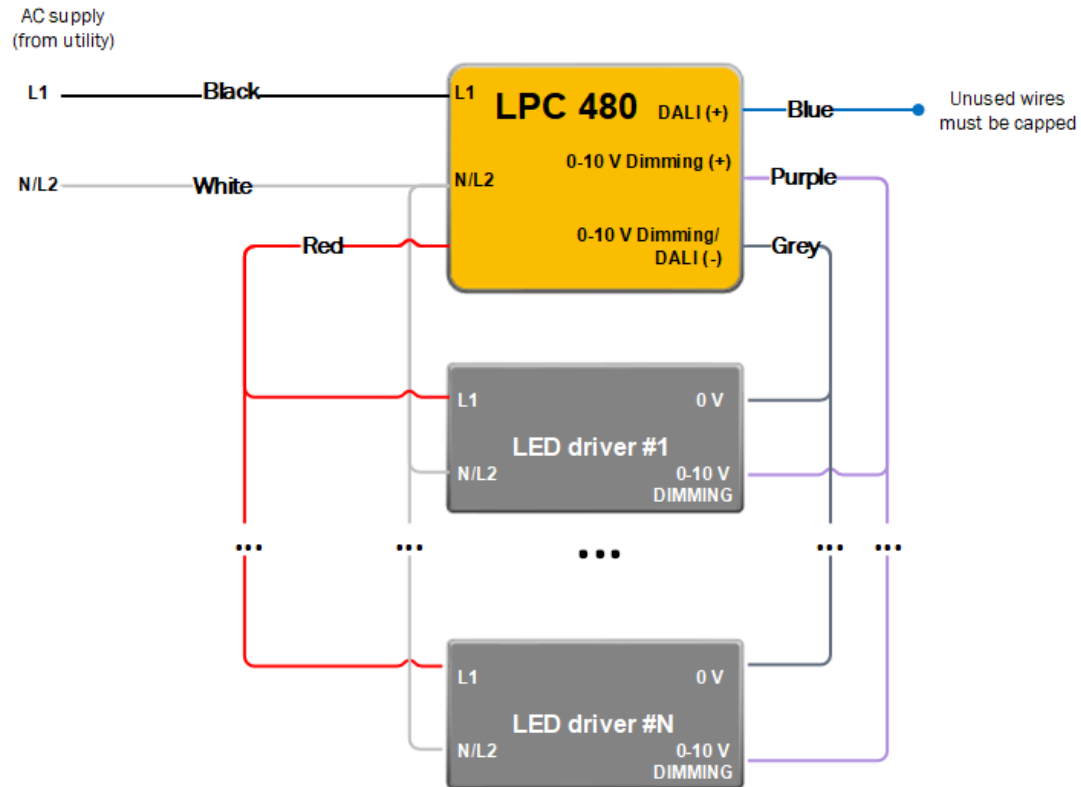
# Local Product Controller

- Tunnel Specific LPC
- Luminaire Driver
  - Dim levels



# Local Product Controller

- Block Diagram



# Lighting Control Sensors

- Luminance
  - External Tunnel Threshold Illumination
- Illuminance
  - Internal Tunnel Roadway Lighting



# Communications Integration

- Network integrated
- Remote access
  - Monitoring purposes



# Lighting Control System

- TLACS-SCADA

- The following **Interfaces** slides were provided by Nyx Hemera.

# Interfaces

## TLACS-SCADA: Overview Page

**Overview** | **Eastbound Entrance** | **Interior** | **Westbound Entrance** | **FAN and Beacon** | **Comm. View** | **Alarms** | NYX HEMERA Technologies | 07 : 40 : 41

**Exterior Zone**

Zone Name	Number of LPC	Number of Alarms	LSR
Exterior	6	0	2

**Eastbound Entrance Zones**

Zone Name	Number of LPC	Number of Alarms	LSR
Threshold 1	25	0	3
Threshold 2	6	0	3
Transition 1	11	0	3
Transition 2	7	0	3

**Interior Zone**

Zone Name	Number of LPC	Number of Alarms	LSR
Interior	0	0	3

**Luminance Photometer TLACS1\_WB\_LCAM**

Luminance	96
LSR	3
Temperature	30
Status	ON

**Luminance Photometer TLACS1\_EB\_LCAM**

Luminance	56
LSR	3
Temperature	31
Status	ON

**Westbound Entrance Zones**

Zone Name	Number of LPC	Number of Alarms	LSR
Threshold 1	0	3	3
Threshold 2	0	3	3
Transition 1	0	3	3
Transition 2	0	3	3

**MANUAL CONTROL**  
HAND - OFF - AUTO

**SYSTEM INFO AND OVERRIDE**  
TLACS1

**ZONE OVERRIDE STATUS**

EXTERIOR	
EB THR 1	
EB THR 2	
EB TR 1	
EB TR 2	
INTERIOR	
WB TR 2	
WB TR 1	
WB THR 2	
WB THR 1	

**Alarm Log**

Alarm Description	Time ON	Duration	Severity	Condition
MODEM_UPS_B - LPC Warning (communication intermittent)	10/4/2023 7:12:40 AM		1	ON
MODEM_UPS_A - LPC Warning (communication intermittent)	10/4/2023 7:12:40 AM		1	ON
LCC_SPD14_SPD15_SPD16 - SPD Broken	10/4/2023 7:12:40 AM		1	ON

**To Fan and Beacon View (Separate Training Module)**

**All Top Nav Bar buttons remain available in the FAN and Beacon interface.**

# Interfaces

## TLACS-SCADA: Fan and Beacon

- VFD status and monitoring through PLC
- Accessible via computer of Tunnel Control Cabinet (TCC)

The interface is divided into several sections:

- PLC Status:** Shows 'Communication OK' with a green bar.
- CO Monitor Info:** Includes 'CO Sensor Mode' (1 - FANS OFF), 'CO Override Status', and various CO sensor readings (EB and WB) in PPM.
- Flashing Beacon:** Shows 'Status' (Flashing Active) and 'Remaining time (s)' (0). A 'Config' section shows 'Push Button delay (minutes)' set to 2.
- FAN Info:** Displays status for FAN 1 and FAN 2, including 'Communication VFD', 'Drive Ready', 'Running', 'At set point', 'Emergency Stop', 'VFD Fault', 'Fault Code', 'Alarm/Warning Code', 'Speed', 'Current', 'Power', 'Energy', 'Run Time', and 'Time since Last Run'. It also features 'Hand Auto OFF' controls for HOA.
- FAN Config:** Contains 'General' settings (Automatic Ventilation Period: 168 hours, duration: 10 minutes), 'FAN Speed' (FAN Speed Set Point: 100%), 'Hi Sensor (1 FAN)' thresholds (Up: 70 PPM, Down: 60 PPM, Delay: 15 min), and 'Hi Hi Sensor (2 FANS)' thresholds (Up: 120 PPM, Down: 110 PPM, Delay: 30 min).
- Alarm Log Table:** A table at the bottom showing a list of alarms with columns for Alarm Description, Time On, Condition, Duration, and Severity.

Alarm Description	Time On	Condition	Duration	Severity
N048 - Bad Drive/Luminaire Current	8/17/2023 8:48:03 AM	OFF	0:00:29:08	1
N027 - Bad Drive/Luminaire Current	8/17/2023 8:42:34 AM	OFF	0:01:34:24	1
N023 - Bad Drive/Luminaire Current	8/17/2023 8:42:34 AM	OFF	0:01:33:46	1
N024 - Bad Drive/Luminaire Current	8/17/2023 8:42:34 AM	OFF	0:01:33:44	1
N028 - Bad Drive/Luminaire Current	8/17/2023 8:42:34 AM	OFF	0:01:33:44	1
N026 - Bad Drive/Luminaire Current	8/17/2023 8:42:33 AM	OFF	0:01:34:23	1
N029 - Bad Drive/Luminaire Current	8/17/2023 8:42:33 AM	OFF	0:01:34:22	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

**PLC Status**

Communication OK █

**CO Monitor Info**

CO Sensor Mode: 1 - FANS OFF

CO Override Status:

Hi Hi Remaining time (s): 0

Hi Remaining time (s): 0

EB CO sensor 1: 3 PPM ●

EB CO sensor 2: 5 PPM ●

EB CO sensor 3: 6 PPM ●

WB CO sensor 1: 3 PPM ●

WB CO sensor 2: 1 PPM ●

WB CO sensor 3: 0 PPM ●

**Flashing Beacon**

Status

Flashing Active ●

Remaining time (s): 0

Config

Push Button delay (minutes): 2

**PLC Status**

Displays the communication status between the PLC and the SCADA (Green = OK, Red = Fault)

Emergency Stop:

VFD Fault: █

Fault Code: 0 █

Alarm/Warning: █

Alarm/Warning Code: 0 █

Speed: 0 %

Current: 0 A

Power: 0.0 kW

Energy: 500 kWh

Run Time: 50.7 H

Time since Last Run: 5 H

Emergency Stop:

VFD Fault: █

Fault Code: 0 █

Alarm/Warning: █

Alarm/Warning Code: 0 █

Speed: 0 %

Current: 0 A

Power: 0.0 kW

Energy: 342 kWh

Run Time: 54.3 H

Time since Last Run: 5 H

HOA

Hand Auto OFF

HOA

Hand Auto OFF

**FAN Config**

General

Automatic Ventilation Period (Hours): 168

Automatic Ventilation duration(minutes): 10

FAN Speed

FAN Speed Set Point (%): 100

**Hi Sensor (1 FAN)**

	New Value	Active
Threshold Up (PPM)	0	70
Threshold Down (PPM)	0	60
Threshold Down Delay (min)	15	15

APPLY

**Hi Hi Sensor (2 FANS)**

	New Value	Active
Threshold Up (PPM)	0	120
Threshold Down (PPM)	0	110
Threshold Down Delay (min)	30	30

APPLY

Alarm Description	Time On	Condition	Duration	Severity
N048 - Bad Driver/Luminaire (current)	8/17/2023 10:48:03 AM	OFF	0:00:29:08	1
N027 - Bad Driver/Luminaire (current)	8/17/2023 9:42:54 AM	OFF	0:01:34:24	1
N023 - Bad Driver/Luminaire (current)	8/17/2023 9:42:54 AM	OFF	0:01:33:45	1
N024 - Bad Driver/Luminaire (current)	8/17/2023 9:42:54 AM	OFF	0:01:33:44	1
N026 - Bad Driver/Luminaire (current)	8/17/2023 9:42:54 AM	OFF	0:01:33:44	1
N028 - Bad Driver/Luminaire (current)	8/17/2023 9:42:53 AM	OFF	0:01:34:25	1
N029 - Bad Driver/Luminaire (current)	8/17/2023 9:42:53 AM	OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

The screenshot displays the TLACS-SCADA interface for Fan and Beacon monitoring. It is divided into several sections:

- PLC Status:** Shows 'Communication OK' with a green bar.
- CO Monitor Info:** (Highlighted in yellow)
  - CO Sensor Mode: 1 - FANS OFF
  - CO Override Status: (Empty)
  - Hi HI Remaining time (s): 0
  - HI Remaining time (s): 0
  - EB CO sensor 1: 3 PPM
  - EB CO sensor 2: 5 PPM
  - EB CO sensor 3: 6 PPM
  - WB CO sensor 1: 3 PPM
  - WB CO sensor 2: 1 PPM
  - WB CO sensor 3: 0 PPM
- Flashing Beacon:**
  - Status: Flashing Active (Green light icon)
  - Remaining time (s): 0
  - Config: Push Button delay (minutes): 2
- Alarm Log Table:**

Alarm Description	Time On	Severity
N048 - Bad Driver/Luminaire (current)	8/17/2023 10:48:03 AM	1
N027 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	1
N023 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	1
N024 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	1
N026 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	1
N028 - Bad Driver/Luminaire (current)	8/17/2023 9:42:33 AM	1
N029 - Bad Driver/Luminaire (current)	8/17/2023 9:42:33 AM	1

### CO Monitor Info

#### CO Sensor Mode

- 1 – FANS OFF
- 2 – HI SENSOR READING (1 fan ON, activates @ CO >70 ppm)
- 3 – HI-HI SENSOR READING (2 fans ON, activates @ CO >120 ppm)

CO Override Status: Indicates if there is an override made on the local PLC interface for test and maintenance purposes

HI-HI Remaining time (s): Time before deactivation of HI-HI mode

HI Remaining time (s): Time before deactivation of HI mode

EB/WB CO Sensor Readings: Ranges from 0 ppm to 200 ppm

#### EB/WB CO Sensor Indicator Light

- Green = OK
- Red = Failure, triggers HI-HI mode instantly

# Interfaces

## TLACS-SCADA: Fan and Beacon

### FAN Info

Communication VFD: Communication status between the VFD and the SCADA (Green = OK, Red = Fault)

Communication IO: Communication status between the remote I/Os of the VFDs and the SCADA (Green = OK, Red = Fault)

Drive Ready: Ready-to-run status reported by VFD

Running: Running status reported by VFD

At set point: At-set-point status reported by VFD

Emergency Stop: Emergency stop status reported by VFD

VFD Fault: Fault status reported by VFD (refer to Fault Code)

Fault Code: Displays fault code returned by VFD (refer to project manual and/or manufacturer's literature; use for troubleshooting)

Alarm/Warning: Alarm or warning status reported by VFD (refer to Alarm/Warning Code)

Alarm/Warning Code: Displays alarm or warning code returned by VFD (refer to project manual and/or manufacturer's literature; use for troubleshooting)

The screenshot displays the SCADA interface for two fans. The 'FAN Info' panel (left) shows status indicators for FAN 1 and FAN 2, including Communication VFD, Communication IO, Drive Ready, Running, At set point, Emergency Stop, VFD Fault, Fault Code, Alarm/Warning, and Alarm/Warning Code. Below these are numerical readouts for Speed, Current, Power, Energy, Run Time, and Time since Last Run. At the bottom are 'Hand' and 'Auto' control buttons for each fan. The 'FAN Config' panel (right) shows configuration settings for 'General' (Automatic Ventilation Period: 168 hours, duration: 10 minutes), 'FAN Speed' (FAN Speed Set Point: 100%), and 'Hi Sensor' settings for both FAN 1 and FAN 2, including Threshold Up/Down (PPM) and Threshold Down Delay (min). An 'APPLY' button is present for each sensor configuration section.

Condition	Duration	Severity
OFF	0:00:29:08	1
OFF	0:01:34:24	1
OFF	0:01:33:43	1
OFF	0:01:33:44	1
OFF	0:01:33:44	1
OFF	0:01:34:25	1
OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

### FAN Info (Continued)

Speed: Real-time speed value (%) reported by VFD

Current: Real-time current value (A) reported by VFD

Power: Real-time power value (kW) reported by VFD

Energy: Real-time energy consumption value (kWh) reported by VFD

Run Time: Current run time of VFD (in hours); this value is used to determine which VFD will initiate in Mode 2

Time since Last Run: Time elapsed since the last run of the VFD (in hours); this is value used to determine if a fan needs to run after a preconfigured period

HOA: Displays the current selection of the physical HOA switch as reported by the VFD

FAN 1		FAN 2	
Communication VFD	<input checked="" type="checkbox"/>	Communication VFD	<input checked="" type="checkbox"/>
Communication ID	<input checked="" type="checkbox"/>	Communication ID	<input checked="" type="checkbox"/>
Drive Ready	<input checked="" type="checkbox"/>	Drive Ready	<input checked="" type="checkbox"/>
Running	<input type="checkbox"/>	Running	<input type="checkbox"/>
At set point	<input type="checkbox"/>	At set point	<input type="checkbox"/>
Emergency Stop	<input type="checkbox"/>	Emergency Stop	<input type="checkbox"/>
VFD Fault	<input checked="" type="checkbox"/>	VFD Fault	<input checked="" type="checkbox"/>
Fault Code	0	Fault Code	0
Alarm/Warning	<input checked="" type="checkbox"/>	Alarm/Warning	<input checked="" type="checkbox"/>
Alarm/Warning Code	0	Alarm/Warning Code	0

FAN 1		FAN 2	
Speed	0 %	0 %	
Current	0 A	0 A	
Power	0.0 kW	0.0 kW	
Energy	500 kWh	342 kWh	
Run Time	50.7 H	54.3 H	
Time since Last Run	5 H	5 H	

Condition	Duration	Severity
OFF	0:00:29:08	1
OFF	0:01:34:24	1
OFF	0:01:33:45	1
OFF	0:01:33:44	1
OFF	0:01:33:44	1
OFF	0:01:34:25	1
OFF	0:01:34:23	1



# Interfaces

## TLACS-SCADA: Fan and Beacon

**PLC Status**

Communication OK ■

**CO Monitor Info**

CO Sensor Mode

CO Override Status

Hi Hi Remaining time (s)

Hi Remaining time (s)

EB CO sensor 1

EB CO sensor 2

EB CO sensor 3

WB CO sensor 1  PPM ●

WB CO sensor 2  PPM ●

WB CO sensor 3  PPM ●

**Flashing Beacon**

**Status**

Flashing Active ●

Remaining time (s)

**Config**

Push Button delay (minutes)

**FAN Config**

Automatic Ventilation Period (Hours): Used to set the time interval between automatic ventilation process; default value is 68 hours (7 days)

Automatic Ventilation duration (minutes): Used to set the duration of the automatic ventilation process; default value is 10 minutes

**FAN Config**

**General**

Automatic Ventilation Period (Hours)

Automatic Ventilation duration(minutes)

**FAN Speed**

FAN Speed Set Point (%)

**Hi Sensor (1 FAN)**

	New Value	Active
Threshold Up (PPM)	<input type="text" value="0"/>	<input type="text" value="70"/>
Threshold Down (PPM)	<input type="text" value="0"/>	<input type="text" value="60"/>
Threshold Down Delay (min)	<input type="text" value="15"/>	<input type="text" value="15"/>

APPLY

**Hi Hi Sensor (2 FANS)**

	New Value	Active
Threshold Up (PPM)	<input type="text" value="0"/>	<input type="text" value="120"/>
Threshold Down (PPM)	<input type="text" value="0"/>	<input type="text" value="110"/>
Threshold Down Delay (min)	<input type="text" value="30"/>	<input type="text" value="30"/>

APPLY

Alarm Description	Time On	Condition	Duration	Severity
N048 - Bad Driver/Luminaire (current)	8/17/2023 10:48:03 AM	OFF	0:00:29:08	1
N027 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:34:24	1
N023 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:33:43	1
N024 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N026 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N028 - Bad Driver/Luminaire (current)	8/17/2023 9:42:33 AM	OFF	0:01:34:25	1
N029 - Bad Driver/Luminaire (current)	8/17/2023 9:42:33 AM	OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

The interface is divided into several functional areas:

- PLC Status:** Shows 'Communication OK' with a green progress bar.
- CO Monitor Info:** Includes settings for CO Sensor Mode, CO Override Status, and remaining times for Hi Hi and Hi sensors. It also lists EB and WB CO sensors.
- Flashing Beacon:** Shows 'Status' (Flashing Active) and 'Config' (Push Button delay: 2 minutes).
- FAN Info:** Displays 'Communication VFD' and 'Communication ID' for FAN 1 and FAN 2, all in green.
- FAN Config:**
  - General:** Automatic Ventilation Period (Hours) set to 168, Automatic Ventilation duration (minutes) set to 10.
  - FAN Speed:** FAN Speed Set Point (%) set to 100.
  - Hi Sensor (1 FAN):** Threshold Up (PPM) 0, Active 70; Threshold Down (PPM) 0, Active 60; Threshold Down Delay (min) 15, Active 15.
  - Hi Hi Sensor (2 FANS):** Threshold Up (PPM) 0, Active 120; Threshold Down (PPM) 0, Active 110; Threshold Down Delay (min) 30, Active 30.
- Control Panels:** 'Time since Last Run' (5 H) and 'HOA' (Hand/Auto) controls for FAN 1 and FAN 2.
- Alarm Log:** A table at the bottom showing a series of 'Bad Driver/Luminaire (current)' alarms.

### FAN Speed

FAN Speed Set Point (%): Used to set the speed at which the fans will start in Auto mode (i.e., when CO levels are above thresholds)

It is the same speed at which the fans will run after the Automatic Ventilation process

Alarm Description	Time On	Condition	Duration	Severity
N048 - Bad Driver/Luminaire (current)	8/17/2023 10:48:03 AM	OFF	0:00:29:08	1
N027 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:34:24	1
N023 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:33:43	1
N024 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N026 - Bad Driver/Luminaire (current)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N028 - Bad Driver/Luminaire (current)	8/17/2023 9:42:33 AM	OFF	0:01:34:25	1
N029 - Bad Driver/Luminaire (current)	8/17/2023 9:42:33 AM	OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

**PLC Status**

Communication OK █

**FAN Info**

FAN 1 █ FAN 2 █

**FAN Config**

**General**

Automatic Ventilation Period (Hours)

Automatic Ventilation duration(minutes)

**FAN Speed**

FAN Speed Set Point (%)

**HI Sensor (1 FAN)**

	New Value	Active
Threshold Up (PPM)	<input type="text" value="0"/>	<input type="text" value="70"/>
Threshold Down (PPM)	<input type="text" value="0"/>	<input type="text" value="60"/>
Threshold Down Delay (min)	<input type="text" value="15"/>	<input type="text" value="15"/>

**Hi Hi Sensor (2 FANS)**

	New Value	Active
Threshold Up (PPM)	<input type="text" value="0"/>	<input type="text" value="120"/>
Threshold Down (PPM)	<input type="text" value="0"/>	<input type="text" value="110"/>
Threshold Down Delay (min)	<input type="text" value="30"/>	<input type="text" value="30"/>

**HI Sensor (1 FAN)**

Threshold Up (PPM)

- New Value: Used to set the level (ppm) at which Mode 2 will activate (from Mode 1)
- Press the APPLY button to set the New Value as the Active Value

Threshold Down (PPM)

- New Value: Used to set the level (ppm) at which Mode 2 will deactivate (to Mode 1)
- Press the APPLY button to set the New Value as the Active Value

Threshold Down Delay (min)

- New Value: Used to set the time period (minutes) during which Mode 2 will remain active after the Threshold Down value has been reached (to Mode 1)
- Press the APPLY button to set the New Value as the Active Value

Alarm Description	Time OK	Condition	Duration	Severity
N046 - Bad Driver/Luminaire (ournent)	8/17/2023 10:46:03 AM	OFF	0:00:29:08	1
N027 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:34:24	1
N023 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:43	1
N024 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N026 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N025 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:33 AM	OFF	0:01:34:25	1
N028 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:33 AM	OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

### PLC Status

Communication OK █

### FAN Info

FAN 1      FAN 2

Communication VFD █      █

### FAN Config

#### General

Automatic Ventilation Period (Hours)

Automatic Ventilation duration(minutes)

#### FAN Speed

FAN Speed Set Point (%)

#### Hi Sensor (1 FAN)

	New Value	Active
Threshold Up (PPM)	<input type="text" value="0"/>	<input type="text" value="70"/>
Threshold Down (PPM)	<input type="text" value="0"/>	<input type="text" value="60"/>
Threshold Down Delay (min)	<input type="text" value="15"/>	<input type="text" value="15"/>

#### Hi Hi Sensor (2 FANS)

	New Value	Active
Threshold Up (PPM)	<input type="text" value="0"/>	<input type="text" value="120"/>
Threshold Down (PPM)	<input type="text" value="0"/>	<input type="text" value="110"/>
Threshold Down Delay (min)	<input type="text" value="30"/>	<input type="text" value="30"/>

### HI-HI Sensor (2 FANS)

Threshold Up (PPM)

- New Value: Used to set the level (ppm) at which Mode 3 will activate (from Mode 2)
- Press the APPLY button to set the New Value as the Active Value

Threshold Down (PPM)

- New Value: Used to set the level (ppm) at which Mode 3 will deactivate (to Mode 2)
- Press the APPLY button to set the New Value as the Active Value

Threshold Down Delay (min)

- New Value: Used to set the time period (minutes) during which Mode 3 will remain active after the Threshold Down value has been reached (to Mode 2)
- Press the APPLY button to set the New Value as the Active Value

Alarm Description	Time OK	Condition	Duration	Severity
N048 - Bad Driver/Luminaire (ournent)	8/17/2023 10:48:03 AM	OFF	0:00:29:08	1
N027 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:34:24	1
N023 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:43	1
N024 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N026 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N025 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:33 AM	OFF	0:01:34:25	1
N029 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:33 AM	OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

The screenshot displays the TLACS-SCADA interface with several key sections:

- PLC Status:** Shows 'Communication OK' with a green progress bar.
- CO Monitor Info:** Includes 'CO Sensor Mode' set to '1 - FANS OFF', 'CO Override Status', and a list of CO sensors (EB and WB) with their remaining times.
- FAN Info:** Shows status for FAN 1 and FAN 2, including 'Communication VFD', 'Communication ID', 'Drive Ready', and 'Running' indicators.
- FAN Config:** Contains configuration for 'General' (Automatic Ventilation Period: 168 hours, duration: 10 minutes), 'FAN Speed' (Set Point: 100%), 'Hi Sensor (1 FAN)', and 'Hi Hi Sensor (2 FANS)' with various threshold and delay settings.
- Flashing Beacon:** Shows 'Status' (Flashing Active) and 'Config' (Push Button delay).

### List of alarms

- Description
- Time at which alarm turned ON
- Condition (alarms turn OFF when trigger conditions are no longer met)
  - ON = active, not acknowledged
  - OFF = not active, not acknowledged
  - ACK = active, acknowledged
  - OFF (ACK) = not active, acknowledged
- Duration

Alarm Description	Time On	Condition	Duration	Severity
N048 - Bad Driver/Luminaire (ournent)	8/17/2023 10:48:03 AM	OFF	0:00:29:08	1
N027 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:34:24	1
N023 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:43	1
N024 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N026 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:34 AM	OFF	0:01:33:44	1
N028 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:33 AM	OFF	0:01:34:25	1
N029 - Bad Driver/Luminaire (ournent)	8/17/2023 9:42:33 AM	OFF	0:01:34:23	1

# Interfaces

## TLACS-SCADA: Fan and Beacon

The interface is divided into several main sections:

- PLC Status:** Shows 'Communication OK' with a green progress bar.
- CO Monitor Info:** Displays CO sensor modes and readings for EB and WB sensors.
- FAN Info:** Provides detailed status for FAN 1 and FAN 2, including VFD status, drive ready, running, and various fault codes.
- FAN Config:** Contains configuration settings for General (Automatic Ventilation Period and duration), FAN Speed (FAN Speed Set Point), and Hi Sensor thresholds for both 1 FAN and 2 FANS.
- Flashing Beacon:** Shows beacon status and configuration.

At the bottom, an alarm history table is visible with columns for Condition, Duration, and Severity. The table contains several rows of data, with some cells highlighted in red.

**Callout 1: Single Checkmark = Acknowledge selected alarms**  
 The alarms still exist in the system, but have been seen. You should investigate their cause.

**Callout 2: Double Checkmark = Acknowledge all alarms**

**Callout 3: Single X Mark = Reset selected alarms**  
 OFF alarms will be cleared from the system.  
 ON alarms will get a new timestamp in the Time ON column.

**Callout 4: Circled X Mark = Reset all alarms**

**Callout 5: Speaker Icon = Sound ON/OFF**

**Callout 6: Sheet + Magnifier = Alarm history**

# Interfaces

## TLACS-SCADA: Fan and Beacon

- VFD Operation Alarms reported in TLACS-SCADA
- Alarms that will be sent via email

Log Description	Email Alert
FAN1 - Fan 1 Running	
CO Sensor Mode - ONE FAN ON	
CO Sensor Mode - TWO FANS ON	
CO Sensor Mode - CO monitor Invalid Value	X
CO Override Status - Override Active	X
VFD PLC Com Fail - VFD PLC Communication failure	X
VFD1Alarm - Alarm <<AlarmWordFan1>>	X
VFD1ComFail - Communication Failure	X
VFD1Fault - Fault <<FaultWordFan1>>	X
VFD1HOA - HAND Mode	X
VFD1HOA - OFF Mode	X

# Interfaces

## TLACS-SCADA: Fan and Beacon

- CO monitor alarms reported in TLACS-SCADA

Log Description	Email Alert
EB_CO_Sensor1 - Calibration	X
EB_CO_Sensor1 - Cleaning mode	X
EB_CO_Sensor1 - Fault	X
EB_CO_Sensor1 - Maintenance	X
EB_CO_Sensor1 - Overrange	X
EB_CO_Sensor1 - Unknown Error	X

- Alarms that will be sent via email



# Conclusion

- Contract 4509, IR 80, Carlin Tunnel Lighting
- Tunnel Lighting System
  - Nyx Hemera Tunnel Lighting Addressable Control System – Energy Management (TLACS-EM)

Questions?

