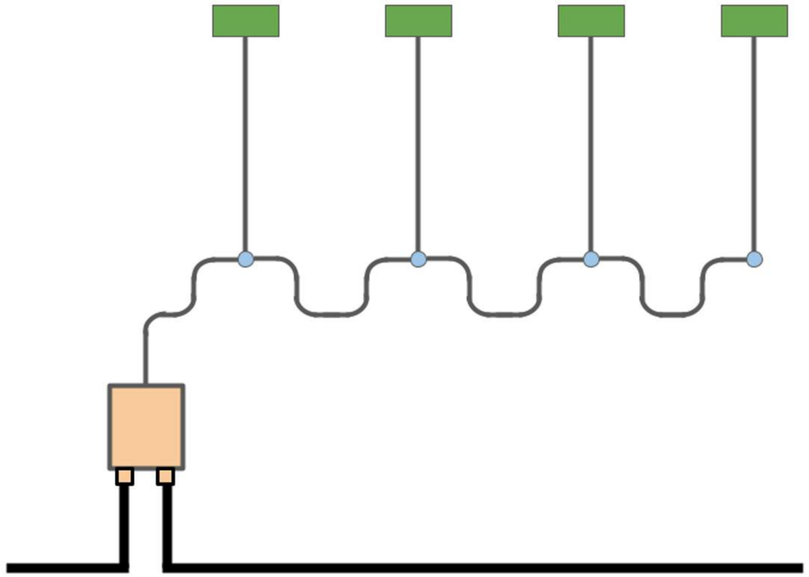
IMPACT OF NEW INTRINSICALLY SAFE (I.S.) LIGHTING ON UNDERGROUND MINING

Mojtaba Ghaderi – Engineering Manager

Overview

- Existing / standard I.S. lighting technology
- New I.S. lighting technology
- Challenges
- Applications for new I.S. lighting technology
- Summary

Standard I.S. Lighting Technology



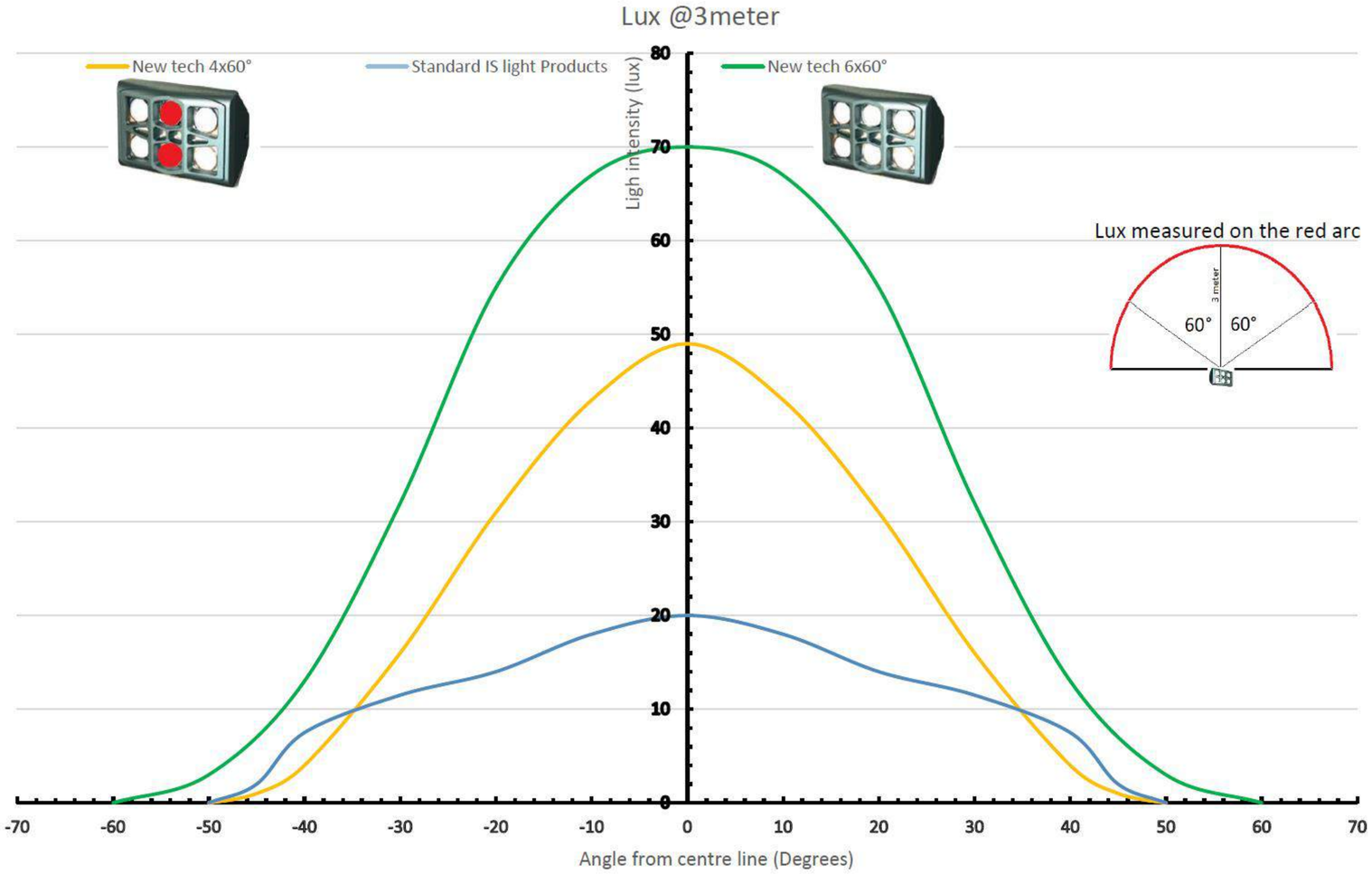
Example: Longwall area lighting

- 1 x ISPS
- 4 x I.S. lights on 4 roof supports
- 110/240 VAC input
- 12 VDC I.S. power

New I.S. Lighting Technology

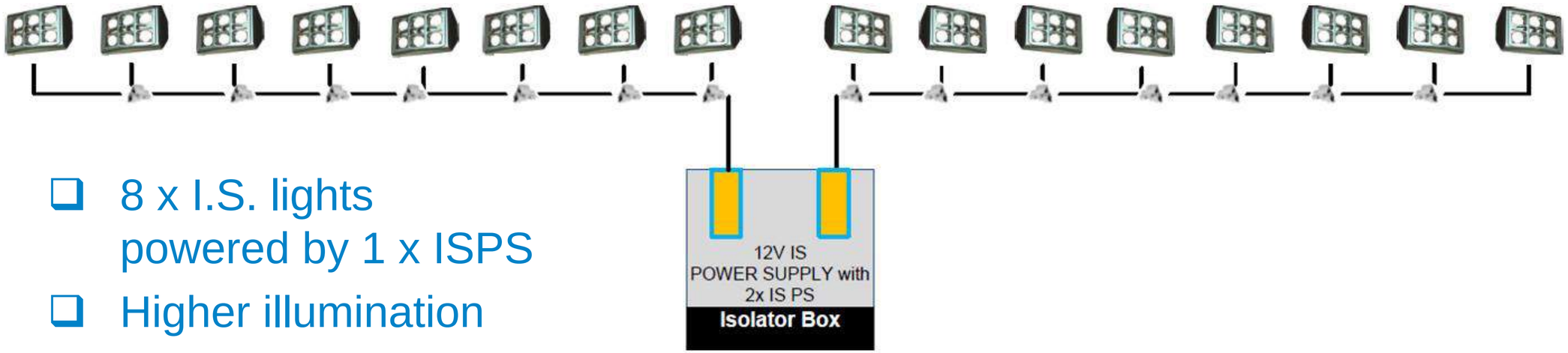
- Higher light output, up to 1500 lumens
- Lower power consumption
- Controllable
- Colour options, e.g. red, green, amber, etc.
- White colour temperature options, e.g.2700 K (warm white) to 5000K (daylight)

Comparison Of Standard And New Technology



Tailgate Illumination for remote mining with 1x new I.S. light

New I.S. Lighting Technology: Area Lighting



- 8 x I.S. lights powered by 1 x ISPS
- Higher illumination

- Fewer ISPS saves cost and space
- Simpler longwall relocation
- ISPS in every **16th shield**

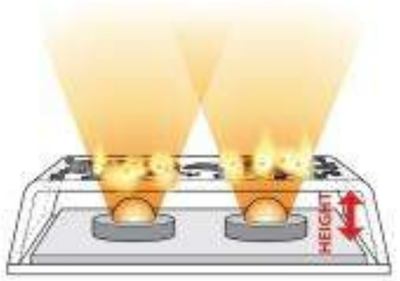
Challenges For New I.S. Lighting Technology

- Electrical power must be within Ex ia limits
- Optical illumination must not cause ignition

  IEC 60079-28:2015 explosive atmospheres: Protection of equipment and transmission systems using optical radiation

  *** *Not yet legislated but important for safety*

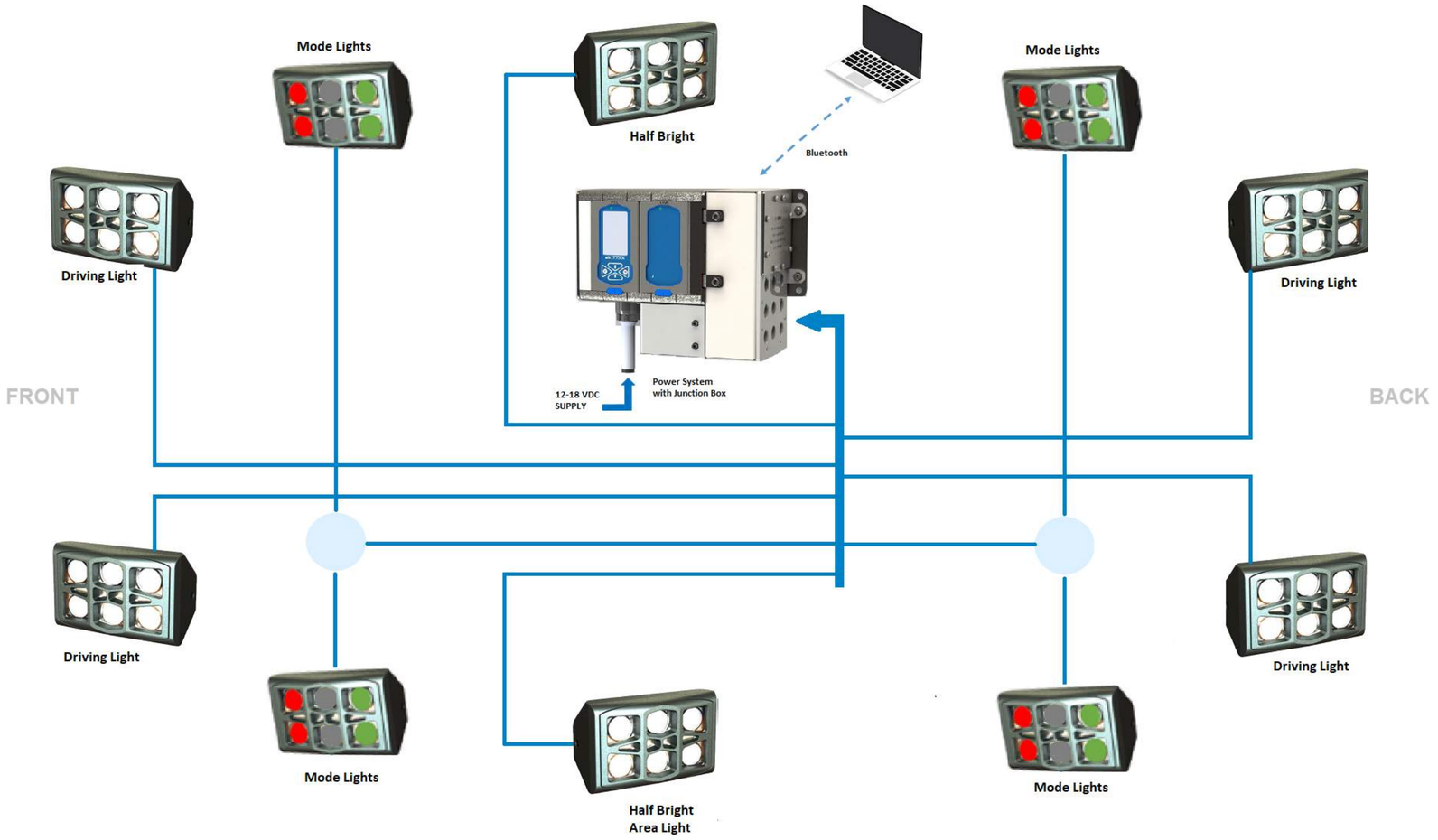
- Voltage drops on longer cable runs



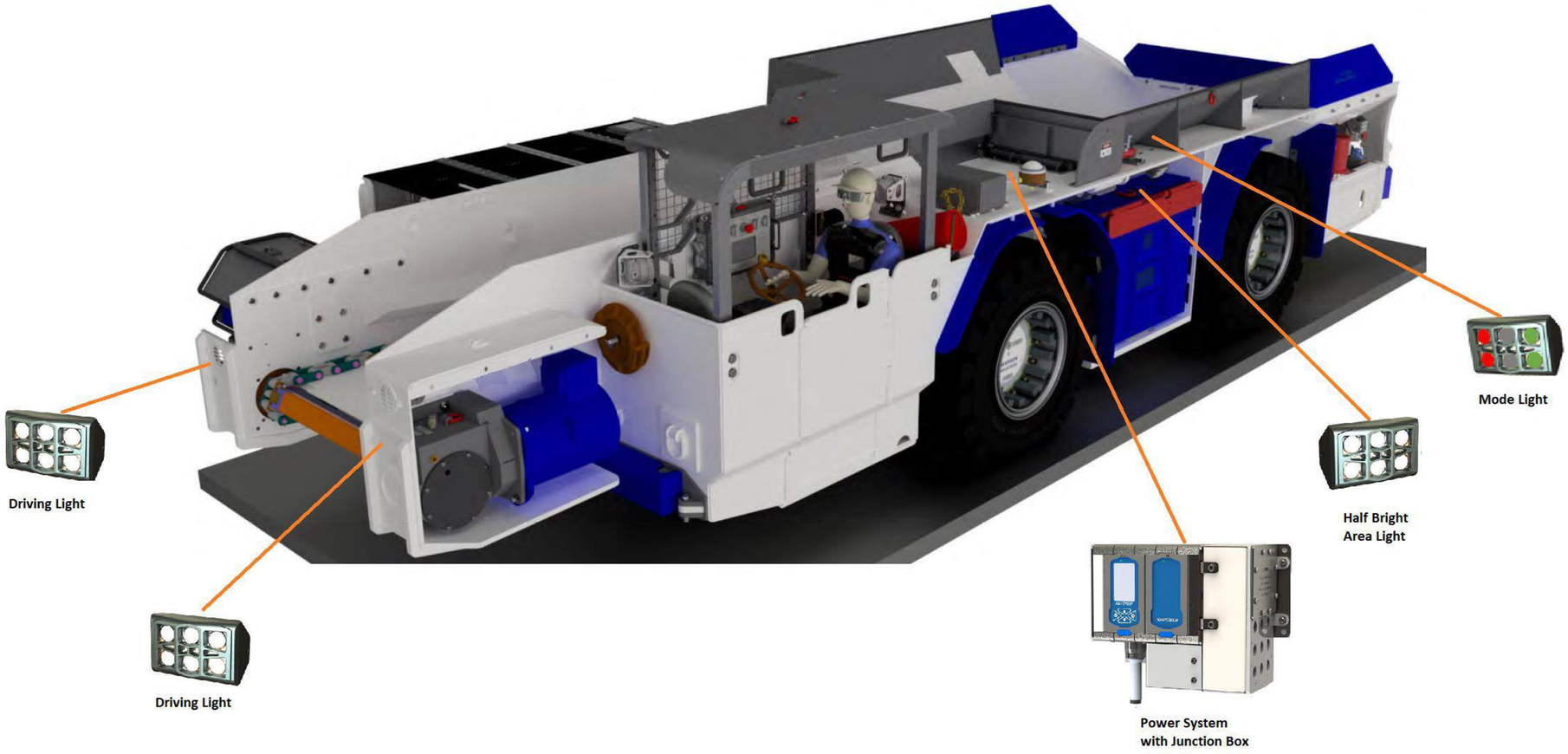
New technology means new applications…

- Area lights
- Flood lights
- Vehicle lights
- Shotcrete Shaft lights
- Soft Barriers – NO-GO
- Emergency lighting during power outages

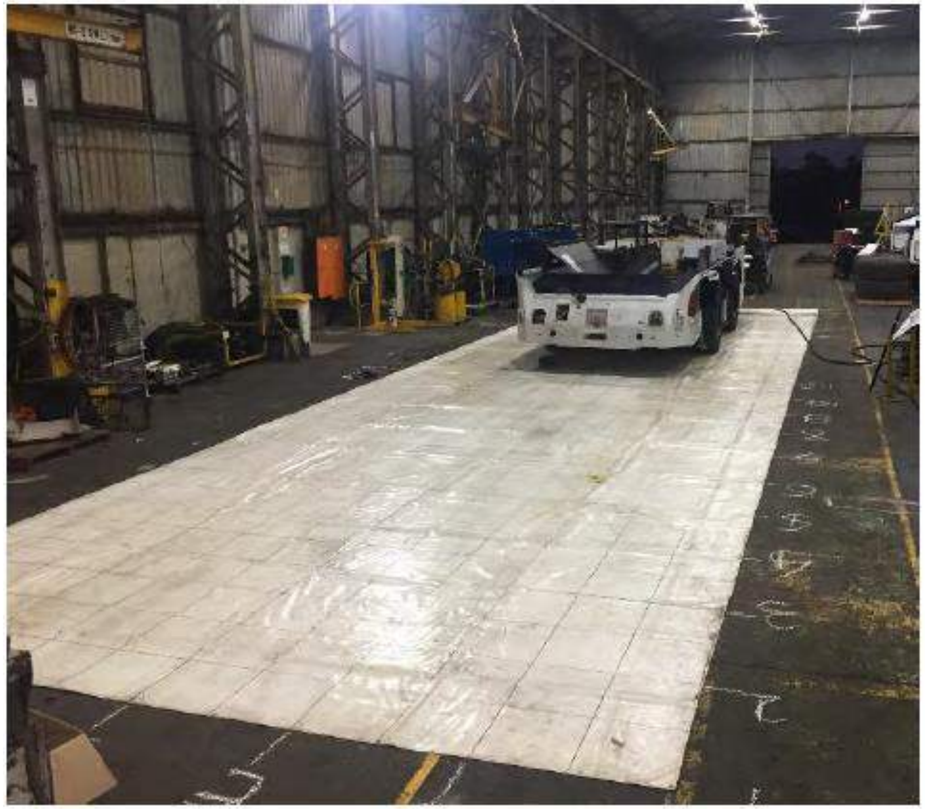
Case : Shuttle Car I.S. Lighting System



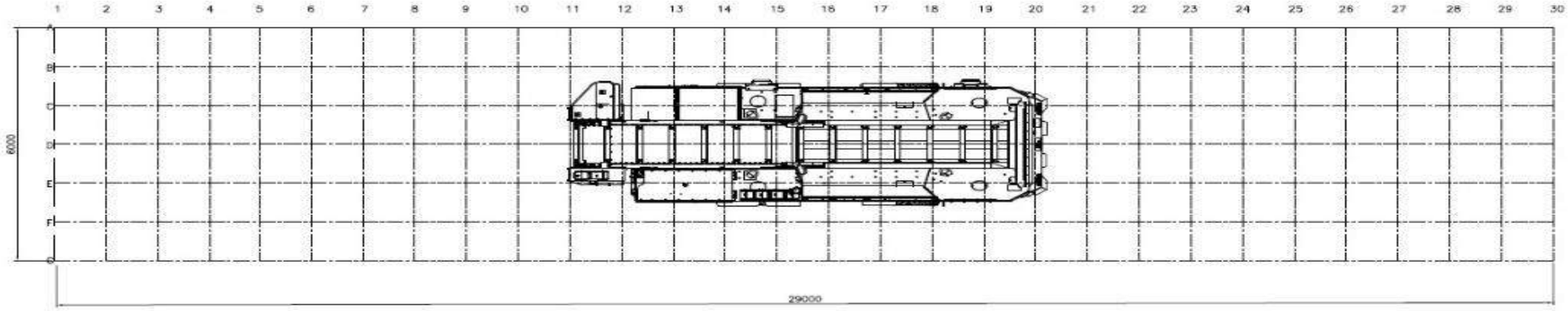
Case : Shuttle Car I.S. Lighting System



Case : Shuttle car lighting study



SC Illumination Study – Ex d lighting



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	1.4	1.35	1.36	6.95	0.86	0.56	0.39	0.12	0.15	0.36	0.53	0.63	1.86	4.23	9.5	7.9	2.44	0.87	0.28	0.26	0.37	0.52	1.58	1.6	4	4.63	4.08	1.62	3.36	2.8
B	2.81	2.76	2.91	2.95	3.6	3.35	2.8	2.2	1.5	0.46	0.98	0.55	1.23	5.01	29.45	11.44	1.66	0.37	0.13	0.56	5.4	4.91	15.42	11.9	9.44	7.02	5.73	5.23	4.93	3.75
C	3.97	4.45	5.32	6.08	7.23	8.85	13.05	19.6	38	66.9											118.7	36.85	16.98	11.15	9.24	8.77	7.68	6.63	5.34	4.32
D	4	5.05	6.13	8.31	10.35	14.83	19.13	24	19	2.6											10.5	10.46	22.7	20.05	14.91	10.88	8.41	6.69	5.02	4.18
E	3.86	4.9	5.56	7.18	8.23	11.48	13.68	18.7	31.9	18.4			DRIVERS CAB								111.06	41	19.98	13.08	8.85	6.1	3.5	1.04	4.26	3.63
F	3.4	3.9	3.98	4.98	4.81	6.44	6.23	3.68	1.5	0.7	0.7	0.12	0.1	1.9	27	6.25	1.14	0.1	0.03	1.1	0.63	4	3.82	7.51	7.3	6.31	4.6	3.84	2.75	2.76
G	2.31	2.55	2.1	2.18	1.27	0.58	0.46	0.15	0.1	0.1	0.54	0.45	0.75	2.1	5.08	3.9	1.3	0.32	0.07	0.16	0.1	0.25	0.58	0.81	0.76	1.09	2.24	3.02	2.28	2.1

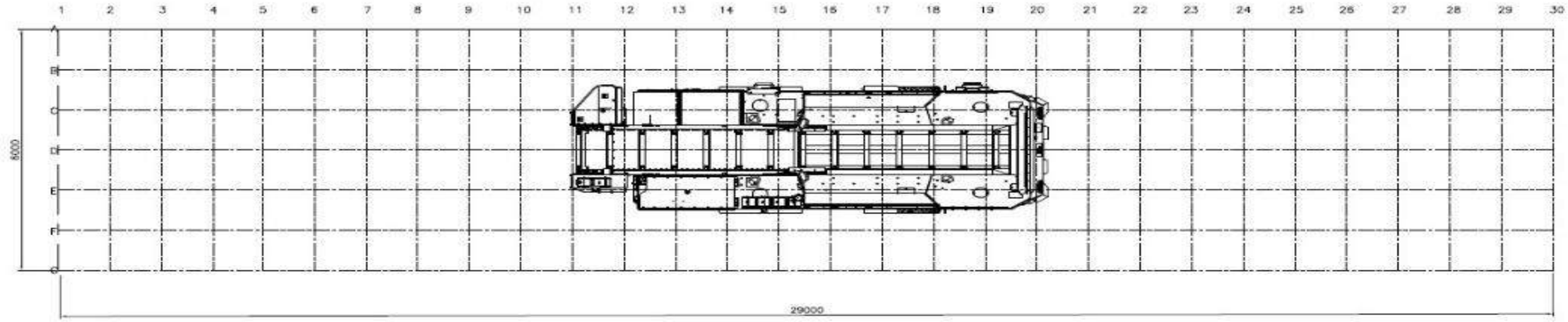
LIGHT SPECIFICATIONS

LIGHT TYPE	SPECIFICATION	OEM	OEM PART NUMBER	SWANSON PART NUMBER
HEAD AND TAIL LIGHTS	AIT251 (30W)	ATP	19483	1029156
AREA LIGHTS	BURNBRITE L.S. AREA LIGHT	BURNBRITE	142018	1048972
MODE LIGHTS	N/A	N/A	N/A	N/A

NOTES
1. GRID SQUARE SIZE 1M X 1M
2. BACKGROUND LIGHT LEVEL PRIOR TO TESTING 0.50 Lx

TEST UNIT SPECIFICATIONS
MANUFACTURER: RS PRO
MODEL: RS-3809
ACCURACY: ±3% (CALIBRATED TO STANDARD INCANDESCENT LAMP 2856°K AND CORRECTED LED DAY WHILE LIGHT SPECTRUM) 6% OTHER VISIBLE LIGHT SOURCE

SC Illumination Study – I.S. lighting



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	5.2	5.6	5.1	6.1	6.8	5.7	4.2	2.3	1	2.1	5.1	2.1	1.8	8.4	59.2	145	20	3.2	6.4	1.9	1	5.8	5.8	7.5	10	9.9	8.8	7.2	5.9	4.8
B	5.6	7.5	9.3	9.7	10.9	10.8	14.8	13.9	6.5	2.2	15.5	1.4	0.4	1	28.4	845	6.9	0.4	23.6	1.4	26.5	32.2	38.6	25.1	16.8	13.6	10.3	7.8	5.9	4.9
C	7.9	5.9	12.5	13.6	18.8	23.4	23.9	38.9	58.5	283											290	92.6	46	30	17.6	13.4	10.4	8.2	6.5	5.35
D	8.5	10.4	12.3	15.6	21	26.7	38.2	59.8	89.9	129											26.5	66.4	41.9	28.1	18.4	13.6	10.4	8.4	6.9	5.5
E	8.7	10.6	13.2	17.2	23.6	31.8	40.1	67.8	113.5	362			DRIVERS CAB								370	95	29.4	20.2	15.4	12.5	11	8.8	7.1	5.9
F	7.7	8.9	10.4	11.8	13.8	20.6	30.9	37.7	35.9	16.9	0.1	8.6	4.9	0.2	11.5	950	15.1	0.4	46.7	1.9	6.5	12.2	16	11.1	8.6	7.4	6.9	6.8	6.4	5.1
G	6.8	7.8	10	11.3	14.1	12.4	10.9	7.8	3.3	2.4	4.6	7.9	3.1	3.5	24.4	93	33.2	5.1	8.1	1.6	1.3	1.5	2.9	3.5	4.4	3.5	3.55	3.7	3.5	3.5

LIGHT SPECIFICATIONS

LIGHT TYPE	SPECIFICATION	OEM	OEM PART NUMBER	SWANSON PART NUMBER
HEAD AND TAIL LIGHTS	4 X WHITE @ 60 DEG BEAM 100% BRIGHTNESS 2 X RED @ 60 DEG BEAM	NAUTITECH	CX200-004	2014844
AREA LIGHTS	6 X WHITE @ 60 DEG BEAM 50% BRIGHTNESS	NAUTITECH	CX200-013	2014858
MODE LIGHTS	2 X GREEN @ 60 DEG BEAM 2 X AMBER @ 60 DEG BEAM 2 X RED @ 60 DEG BEAM 100% BRIGHTNESS	NAUTITECH	CX200-011	2014857

NOTES:
1. GREEN MODE LIGHTS USED DURING TESTING.
2. GRID SQUARE SIZE 1M X 1M
3. BACKGROUND LIGHT LEVEL PRIOR TO TESTING 0.00 Lx

TEST UNIT SPECIFICATIONS
MANUFACTURER: RS PRO
MODEL: RS-3809
ACCURACY: ±3% (CALIBRATED TO STANDARD INCANDESCENT LAMP 2856°K AND CORRECTED LED DAY WHILE LIGHT SPECTRUM) 6% OTHER VISIBLE LIGHT SOURCE.

RELATED DRAWINGS:
LIGHTING COMPONENT LAYOUT: 2014919
VISIBILITY STUDY: 2014979

SC Illumination Study - Comparison

This table illustrates the recorded illumination results at 1.5x stopping distance for a shuttle car traveling at 10 km/hr.

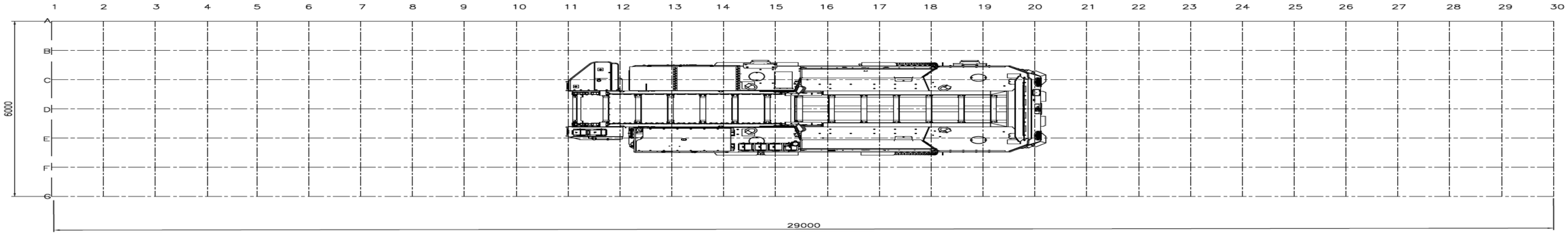
*** Only 2 banks (4 lights) in use

	STOPPING DISTANCE (m)	1.5X STOPPING DISTANCE (m)	MEASURED LUX INBYE @ 2.1m	MEASURED LUX OUTBYE @ 2.1m
NEW IS LED	1.4	2.1	**64**	**87**
Other FLP Light	1.4	2.1	12	20

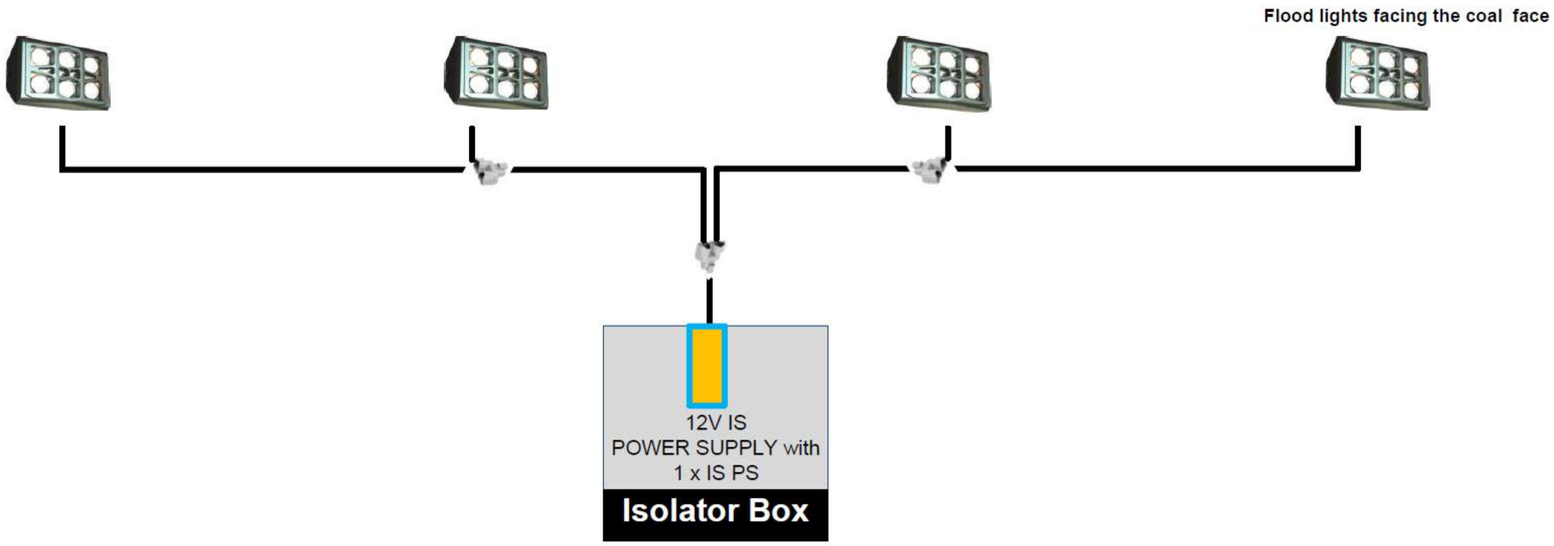
Graphical illustration below of variance between
Illumination (Shuttle Car **with NEW IS Lights**) – Illumination (Shuttle Car **with FLP Lights**)

New technology I.S. lights provide 5 times the brightness for area lights and headlights

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
A	3.8	4.25	4.14	5.15	5.94	5.14	3.81	2.18	0.85	1.84	4.57	1.47	-0.06	4.17	49.7	137.1	17.56	2.33	6.12	3.64	0.63	5.28	4.22	5.9	6	5.27	4.72	3.58	2.54	2
B	2.79	4.74	6.39	6.75	7.3	7.45	12	11.7	5	1.74	14.52	0.85	-0.83	-4.01	-1.05	833.6	5.84	0.03	23.47	0.84	21.1	27.29	23.18	13.2	7.36	6.58	4.57	2.57	0.97	1.15
C	3.93	1.45	7.18	7.52	11.57	14.55	10.85	19.3	20.5	214.1											171.3	55.75	29.02	18.85	8.36	4.63	2.72	1.57	1.16	1.03
D	4.5	5.35	6.17	7.29	10.65	11.87	19.07	35.8	70.9	126.4											16	55.94	19.22	8.05	3.41	2.72	1.99	1.71	1.88	1.32
E	4.84	5.7	7.64	10.02	15.37	20.32	26.42	49.1	81.6	343.6			DRIVERS CAB								258.9	54	9.42	7.12	6.55	6	7.5	3.76	2.84	2.27
F	4.3	5	6.42	6.82	8.99	14.16	24.67	34.02	34.4	16.2	-0.6	0.48	4.8	-1.7	-15.5	943.8	13.96	0.2	46.67	-0.2	5.87	8.2	12.18	3.59	1.3	1.29	2.3	2.96	3.65	2.34
G	4.49	5.25	7.9	9.12	12.83	11.82	10.44	7.65	3.2	2.3	4.06	7.45	2.35	1.4	19.32	89.1	31.9	4.78	8.03	3.44	1.2	1.25	2.32	2.69	3.61	1.61	1.31	0.68	1.22	1.4

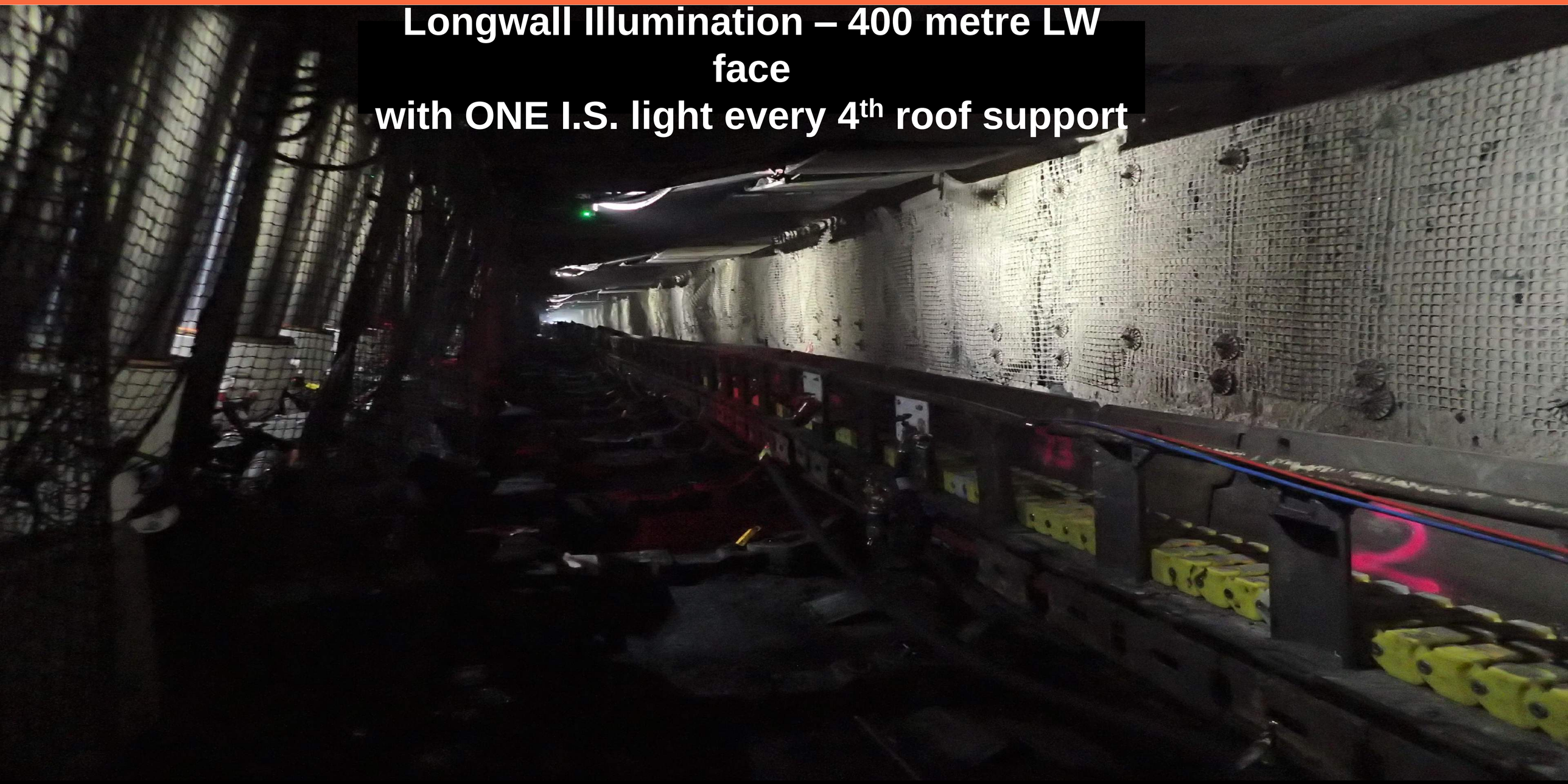


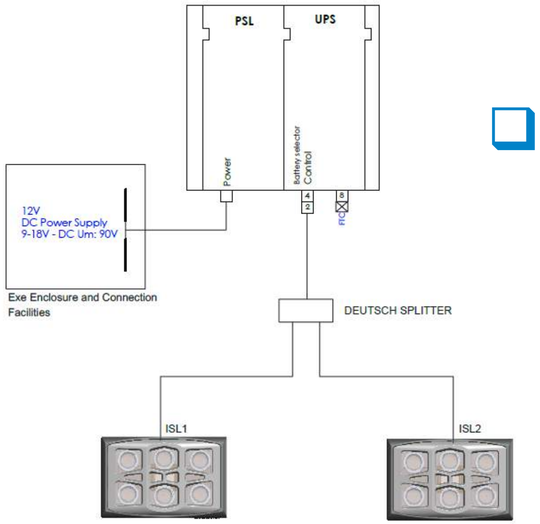
Flood Lighting for coal face



- 1 x flood light facing the coal face every 4th roof support
- High brightness to illuminate the face
- Illumination for face automation – cameras on shearer or roof supports

Longwall Illumination – 400 metre LW face with ONE I.S. light every 4th roof support





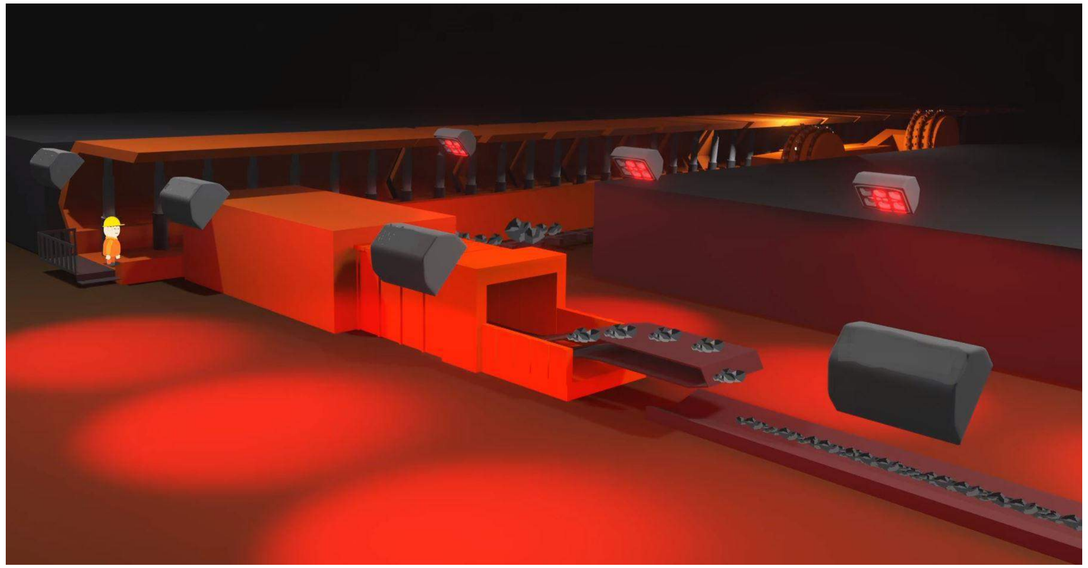
APPLICATION: Emergency I.S. Lighting

When methane levels are exceeded, in Zone 0 conditions

- New technology allows high illumination from battery power
  - Much brighter than cap lamps
  - Operating time over 9 hours per light
- When power is out …
  - Illumination of roadways and intersections
  - Rescue cages and refuge chambers can be fitted with safe lighting in methane rich environments
  - Sufficient illumination to complete repairs or remove hazards
  - Visibility of the cable area around tethered equipment when replacing damaged cables
  - Area lighting around DCBs, conveyor drives, and switchgear

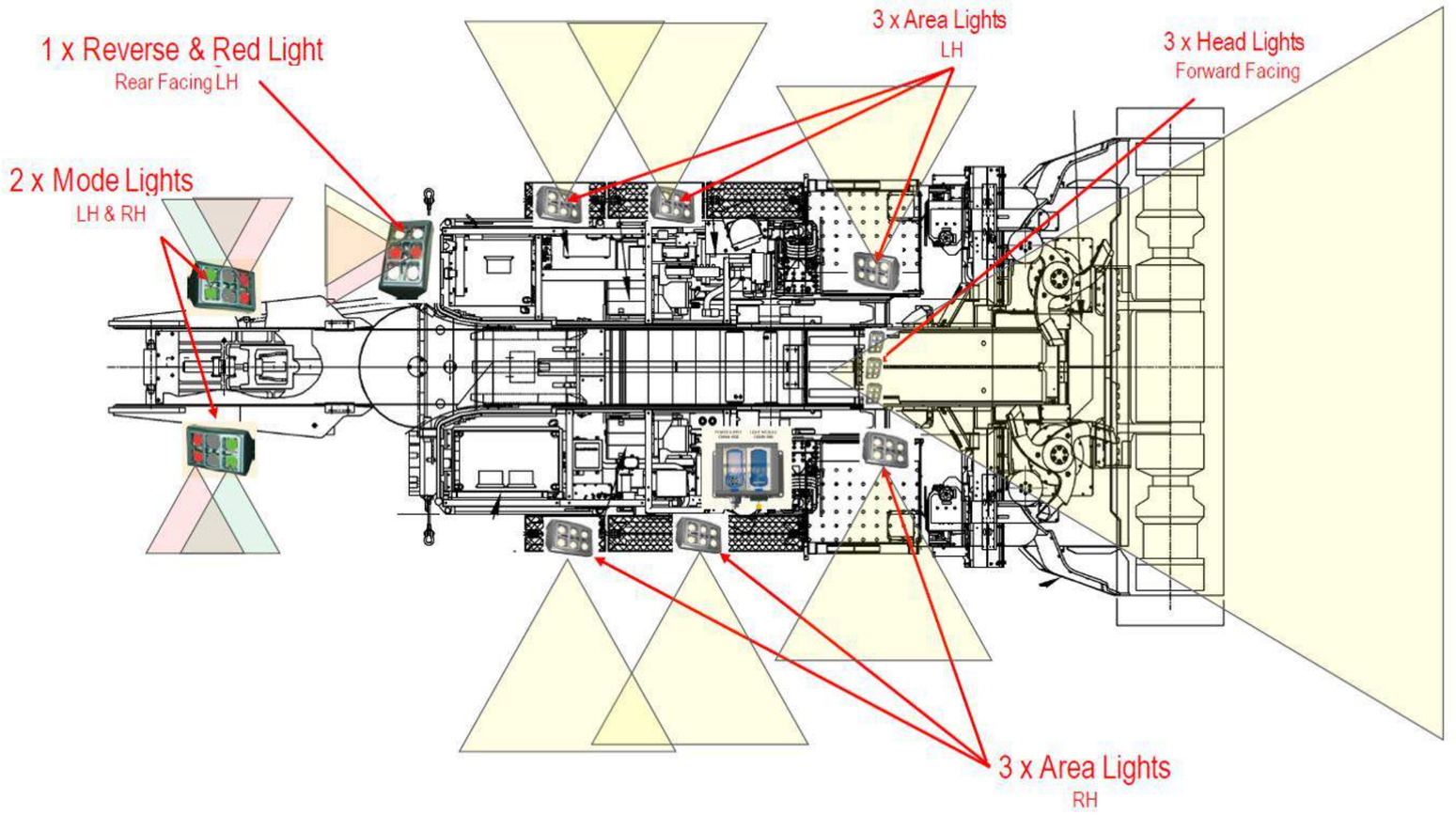
APPLICATION: BSL Go / No-Go Zones

- Controlled, coloured lights create a “soft barrier” for personnel safety
- BSL Push Lights – logic sourced from CMEs controls lights when machine is in operation during BSL push/advance
- Around the BSL during services moves and cable retractions when power is off
- Illumination at the Tail Gate during gas trips



APPLICATION: Continuous Miner

Superior illumination, lower risk profile for HPIs



APPLICATION: Continuous Miner

Acknowledgements

- **Waratah Engineering, SC illumination study**
- **Komatsu, CM lighting**
- **Narrabri, flood lighting on face**
- **Metropolitan, tail-gate lighting**

Summary

- New I.S. lighting technology provides more illumination using less I.S. power
- Reduces cost and space in enclosures
- Improved lighting for mining productivity
- Enables new lighting applications
- Migration of Ex d lighting technology

QUESTIONS?