Improving Conveyor Belt Availability, Production, and Safety

LUNA EX.TRACT

LUNA

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Global Segment Lead - Mining

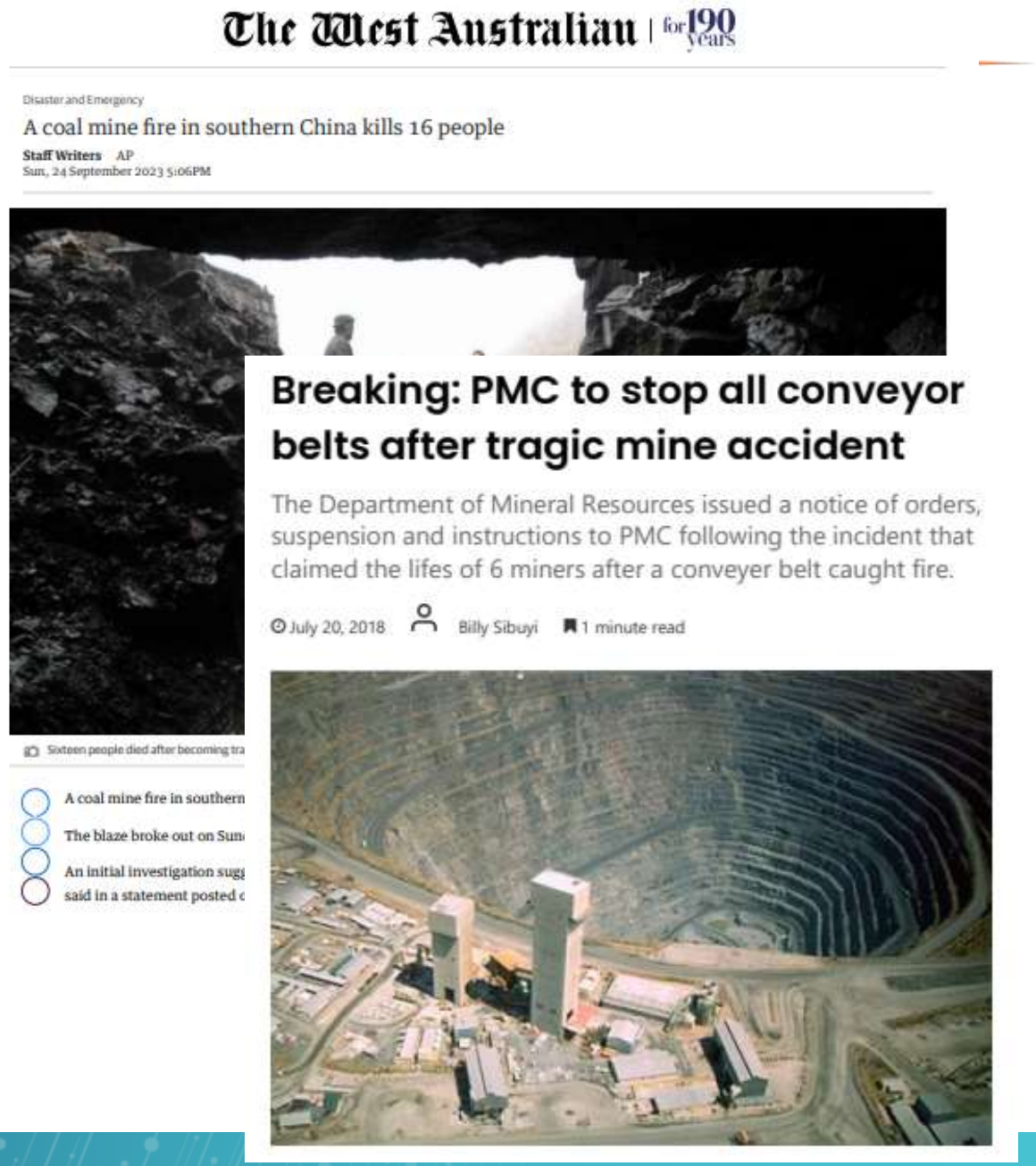
Introduction

- Conveyor belt systems are crucial to the operation.
- Idlers are critical in supporting and guiding the belt.
- Conveyors span kilometers, with thousands of bearings prone to failure.
- Over 10% of breakdowns are caused by idler failure.
- Friction from overheated idler bearings, seized idler sets, or other mechanical failures can lead to conveyor belt fires.
- Fires and mechanical failures threaten worker safety, can cause significant financial losses, equipment downtime and reputational damage.

$270,000 / Hour

Introduction

Commodity	$ / Hr 1.8m Belt
Gold	$ 385,935
Silver	$ 154,839
Copper	$ 534,960
Platinum	$ 189,290
Palladium	$ 275,613
Zinc	$ 173,880
Nickel	$ 227,860
Coal	$ 135,000
Iron ore	$ 201,600
Niobium	$ 270,000



The West Australian | for 190 years

Disaster and Emergency

A coal mine fire in southern China kills 16 people

Staff Writers AP
Sun, 24 September 2023 5:06PM

Sixteen people died after becoming tra

A coal mine fire in southern

The blaze broke out on Sun

An initial investigation sugg
said in a statement posted

Breaking: PMC to stop all conveyor belts after tragic mine accident

The Department of Mineral Resources issued a notice of orders, suspension and instructions to PMC following the incident that claimed the lifes of 6 miners after a conveyer belt caught fire.

July 20, 2018 Billy Sibuyi 1 minute read

The Need for Conveyor Condition Monitoring

- Worn bearings, bent frames, and material build-up, effects idlers.
- Addressing issues is crucial to prevent larger problems; belt misalignment, excessive vibrations, and unplanned downtime.
- Early fault detection helps prevent downtime, reduce maintenance costs, and extend the lifespan of conveyor belts.
- Improves operational efficiency, minimizing unscheduled maintenance and preventing disruptive conveyor system failures and potential fires.

The Need for Conveyor Condition Monitoring

(a) Roller Seizure

(b) Shaved Rubber

(c) Bearing Failure

(d) Sheered Idler holder

(e) Roller on Fire

(f) Damaged Rollers

The Need for Conveyor Condition Monitoring

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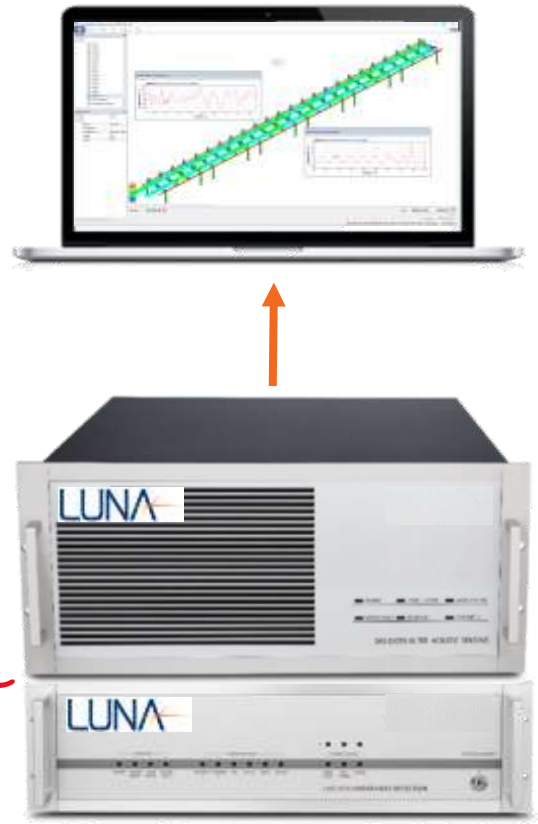
Conveyor Condition Monitoring

Physical inspection of conveyor components by workers:

- Hazardous conditions
- Moving machinery
- Extreme temperatures
- Extreme inclines and declines
- Long distances
- Uneven and slippery surface
- Humidity and obstacles

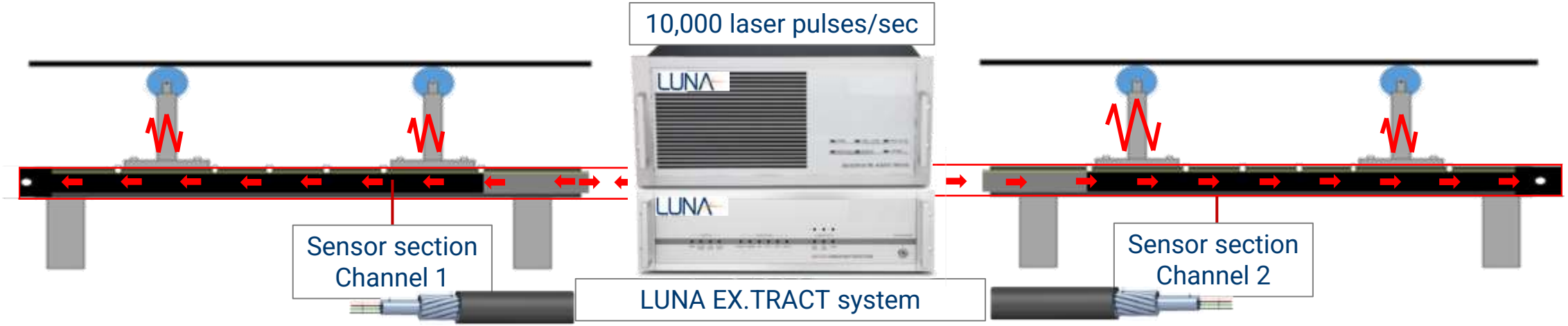
Conveyor Condition Monitoring

The LUNA EX.TRACT system transmits laser pulses through a retrofitted fiber optic sensor cable along the conveyor system.



Conveyor Condition Monitoring

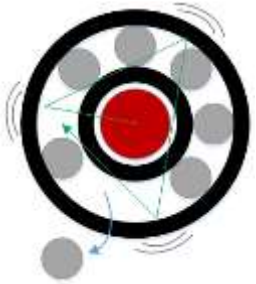
As bearings wear, they vibrate, transmitting vibrations through the conveyor's frame and onto the cable. These vibrations cause microscopic changes in the backscattered laser light.

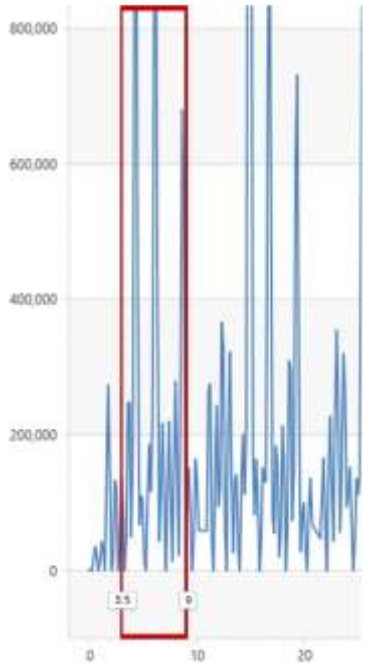


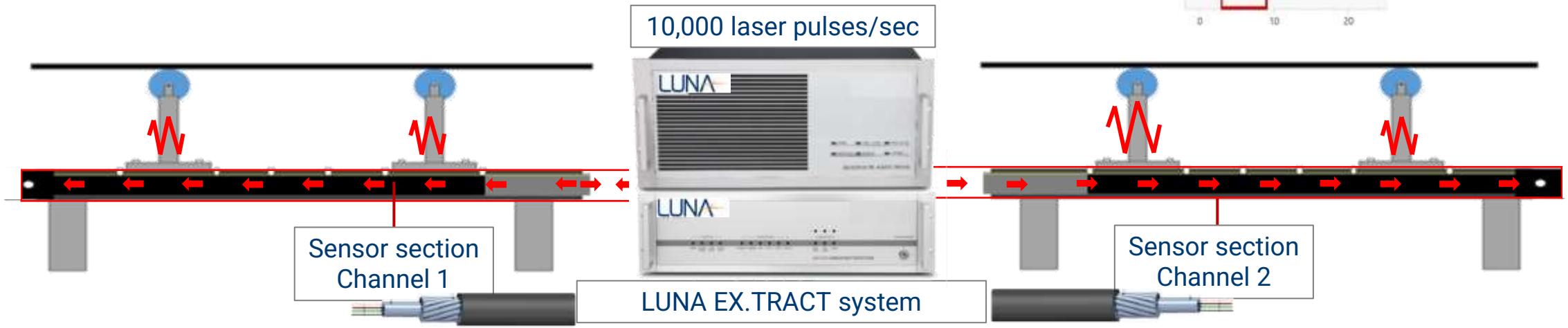
Conveyor Condition Monitoring

Knocking – Late Stage:

- Extremely low frequency, high magnitude signal
- Audible to the human ear
- Appears in the frequency plot as high magnitude spikes below 10Hz to 5Hz



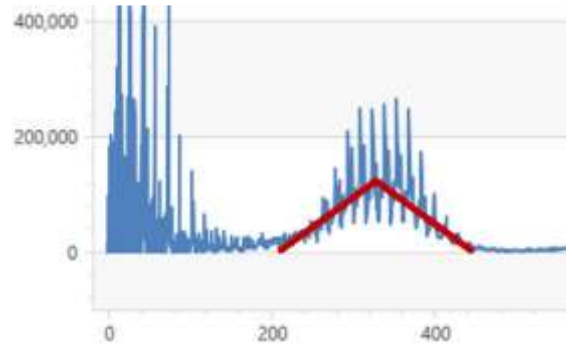


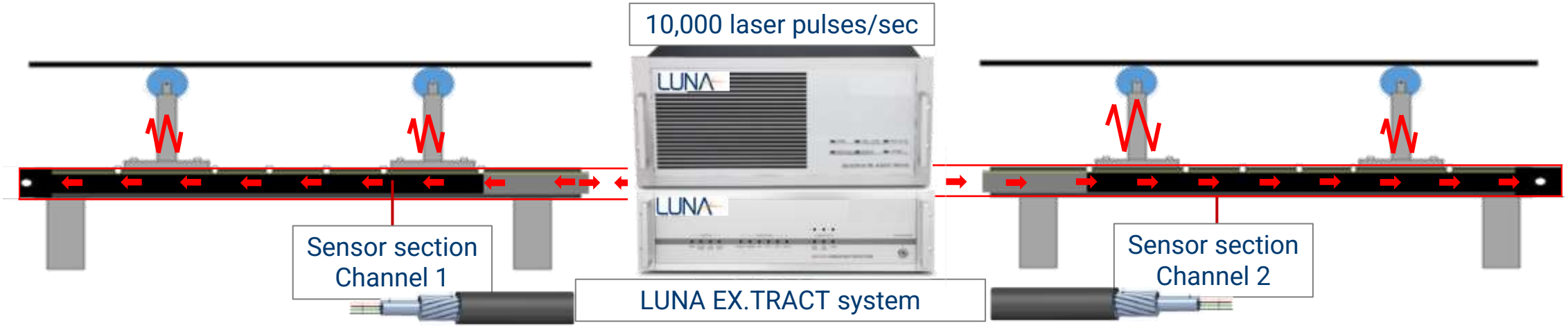


Conveyor Condition Monitoring

Squealing – Late stage:

- Is potentially audible to the human ear
- Appears as a haystack on the frequency plot at frequencies greater than 150Hz
- May migrate to higher frequencies as it gets closer to failure

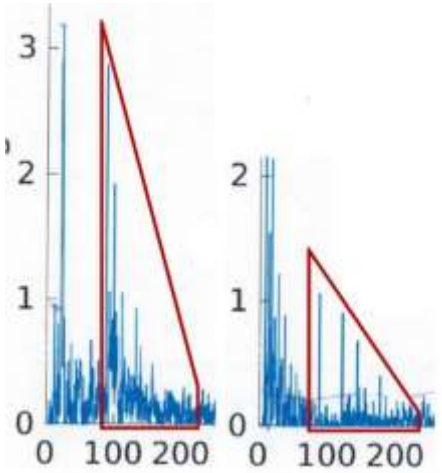


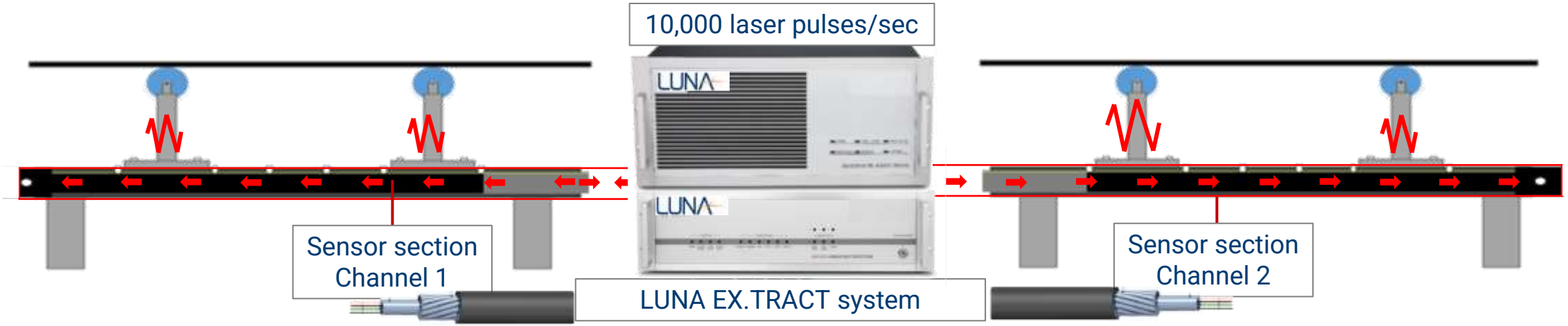


Conveyor Condition Monitoring

Rattling – Mid Stage

- Potentially not audible to the human ear:
- Seen at approximately 70-200Hz in the frequency range
- Similar in appearance/shape to rumbling but higher in the frequency range with a higher magnitude

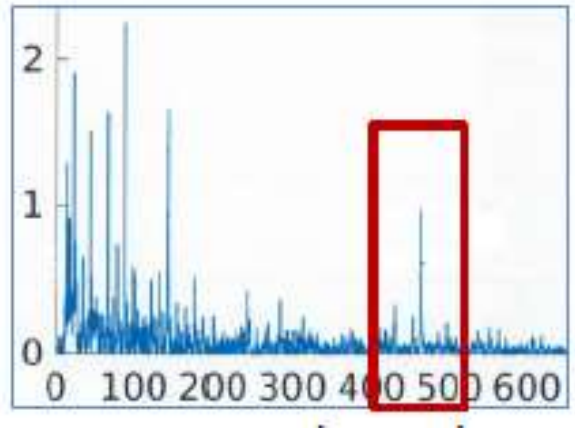


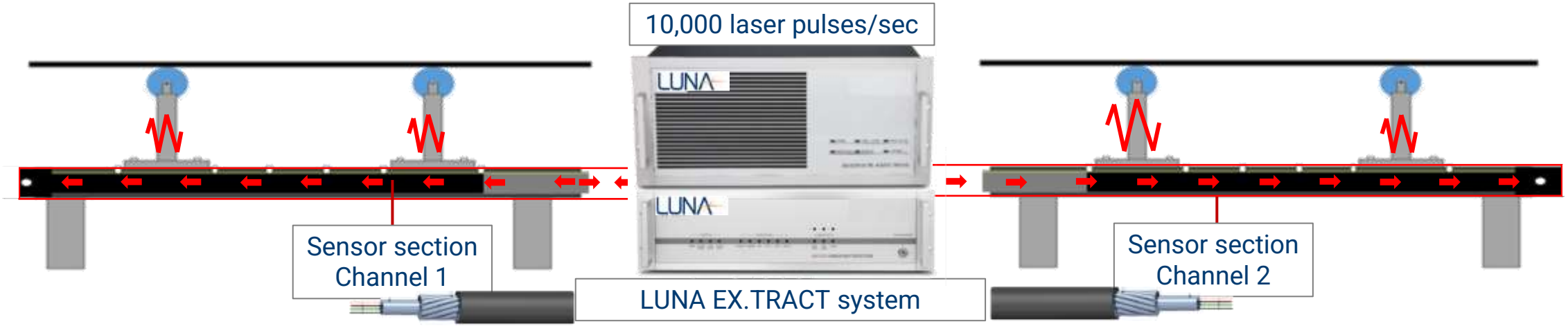


Conveyor Condition Monitoring

Squeaking – Mid Stage:

- Appears on the frequency plot as a strong individual spike.
- Spike appears at a higher frequency that knocking, rumbling and rattling.
- May progress to a bearing collapse or seizure.

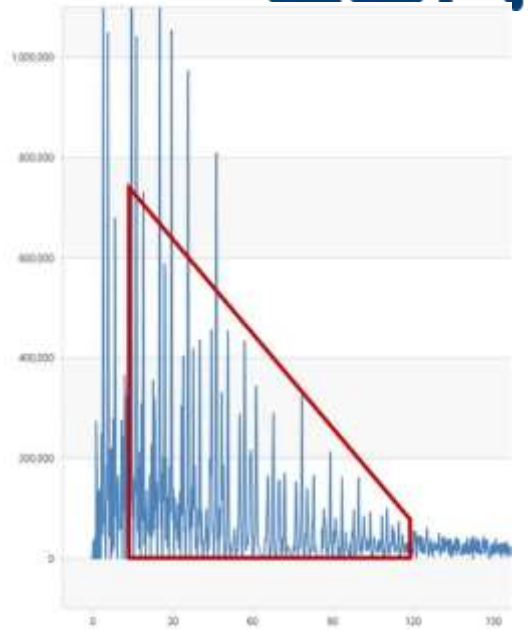


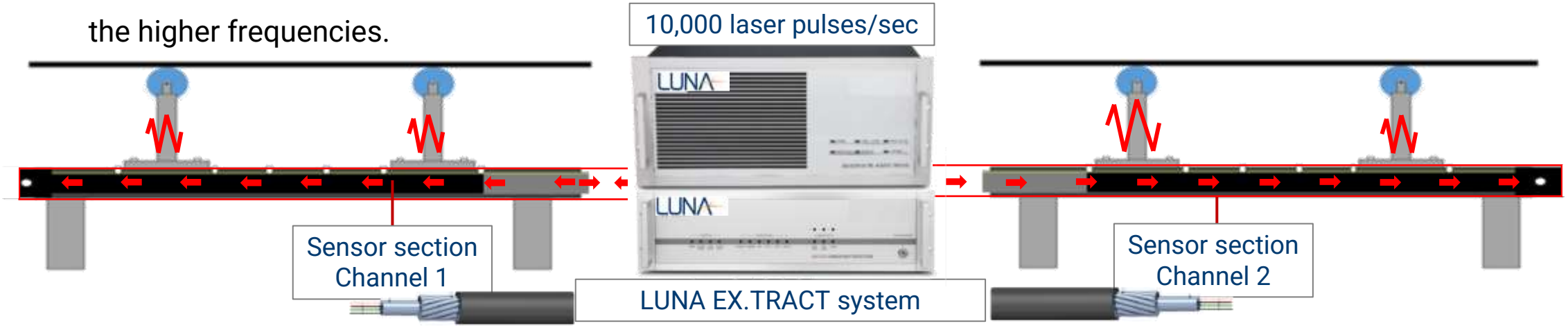


Conveyor Condition Monitoring

Rumbling – Early Stage:

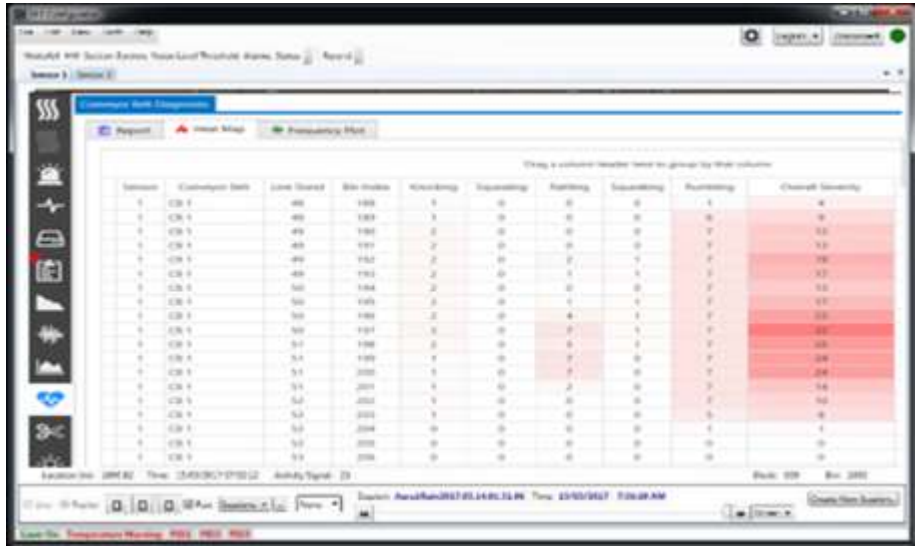
- Potentially not audible to the human ear in a noisy environment.
- Seen as spikes greater than 15Hz and up to 150Hz on the frequency plot (post FRF).
- Visually identified by it angling off in magnitude towards the higher frequencies.

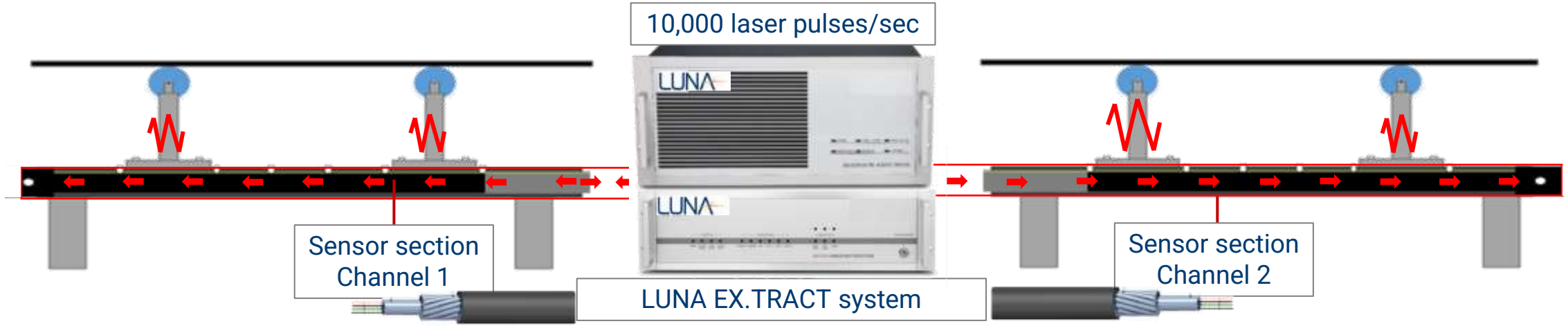




Conveyor Condition Monitoring

The system processes this data, generating a "heat map," and alerts operators, about potential failures.

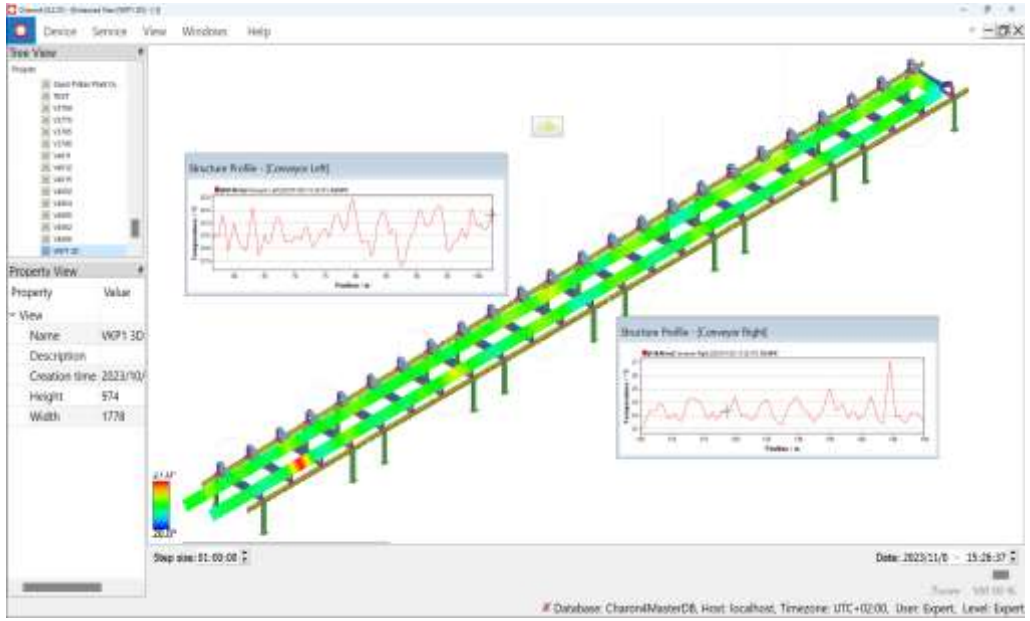




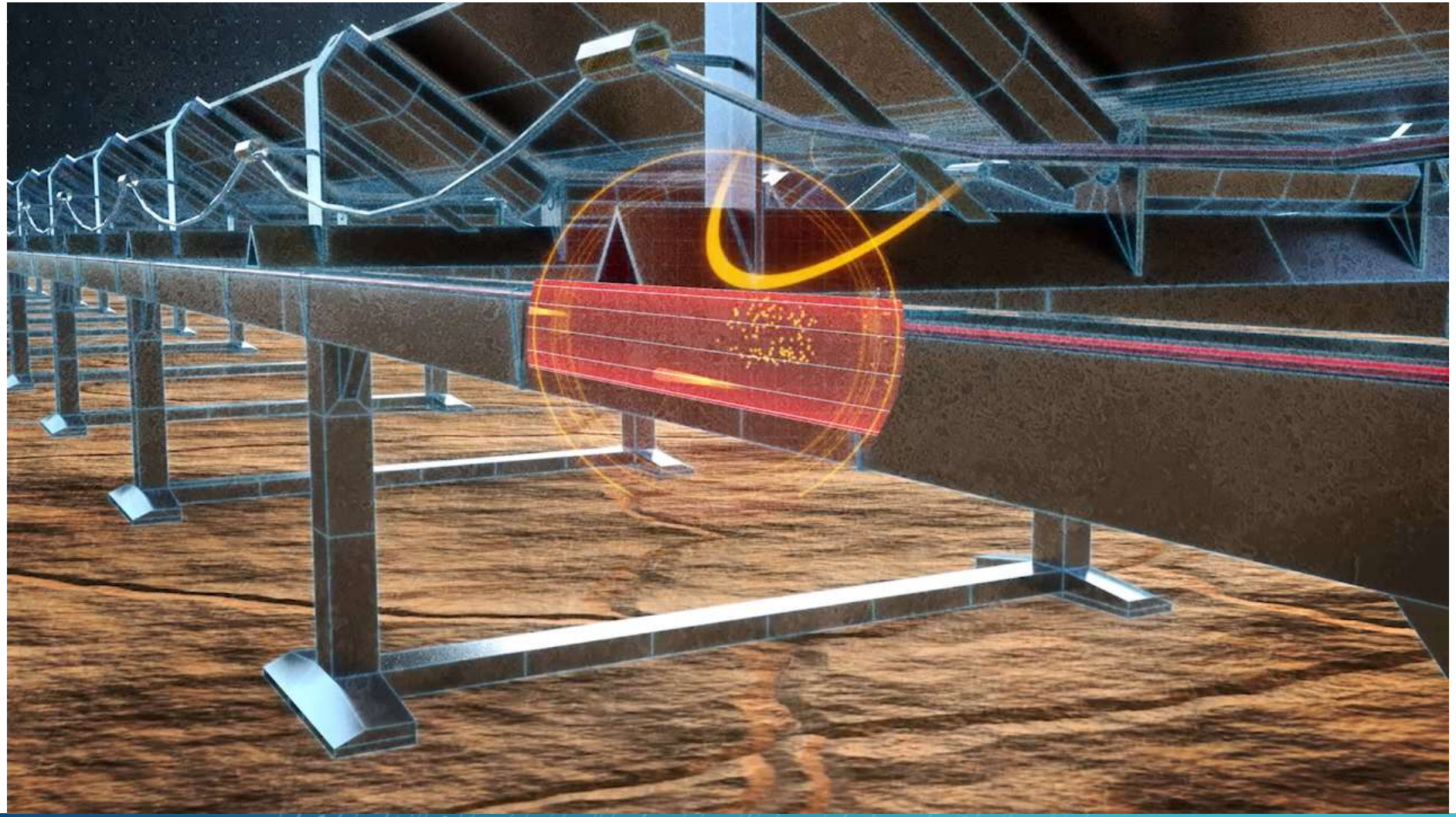
Conveyor Condition Monitoring

The fiber optic cable also measures the distributed temperature profile along the entire conveyor.

Alerting to conditions caused by frictional heating, that could potentially lead to fires.



Conveyor Condition Monitoring



Conveyor Condition Monitoring

LUNA EX.TRACT - Vibration/Acoustic

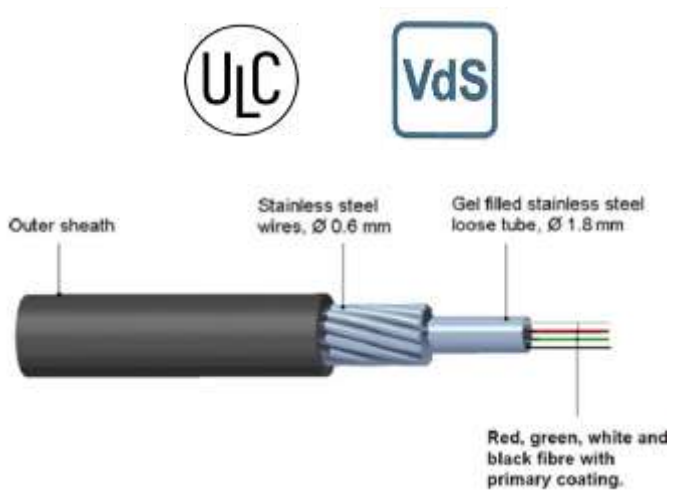
Monitoring Distance	14 km – up to 7 km of sensor fiber per channel
Optical Power Budget	4dB@ 1550 nm for 7 km
Number of Detection Channels	Two channels of simultaneous real time independent sensing
Sensing Technology	Coherent Optical Time Domain Reflectometry (COTDR)
Measurement Resolution	Nominal: 0.5 m (1.6 ft) between detection measurement points along the sensing fiber (2000 measurements per km of sensing fiber) 0- 10KHz
Linestand Location Accuracy	± 2 Line stands (If spaced 1m apart)
Cut Resilience	Sensing works to within 10 m of a sensor fiber cut

Conveyor Condition Monitoring

LUNA EX.TRACT - Temperature

Monitoring Distance	12 km – up to 6 km of sensor fiber per channel with full redundancy
Optical Power Budget	3dB@ 1550 nm for 6 km
Number of Detection Channels	Two to four channels of simultaneous real time independent sensing
Sensing Technology	Optical Frequency Time Domain Reflectometry (OFDR)
Measurement Resolution	Nominal: 0.25 m (0.8 ft) between detection measurement points along the sensing fiber (1000 zones per channel of sensing fiber) 0.01°C
Linestand Location Accuracy	± 2 Line stands (If spaced 1m apart)
Cut Resilience	Sensing works to within 10 m of a sensor fiber cut
Outputs	Up to 104x digital, Modbus TCP/IP, LON, DNP3

Conveyor Condition Monitoring

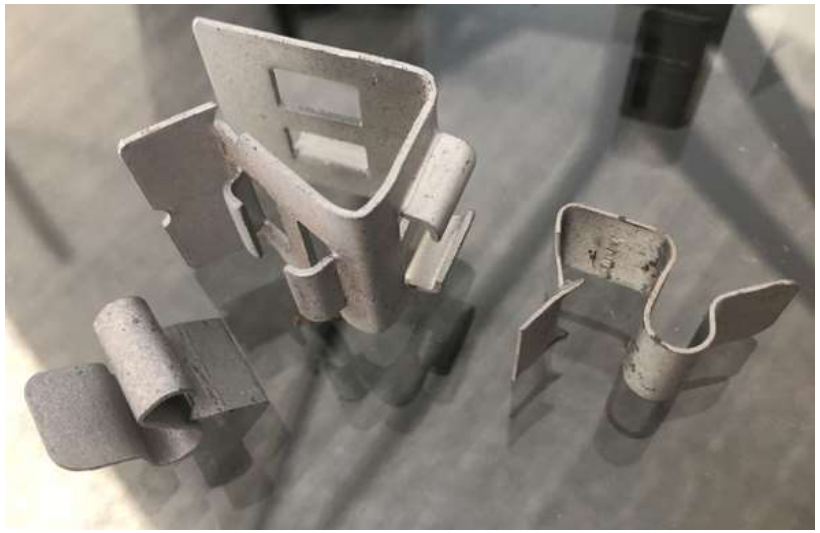


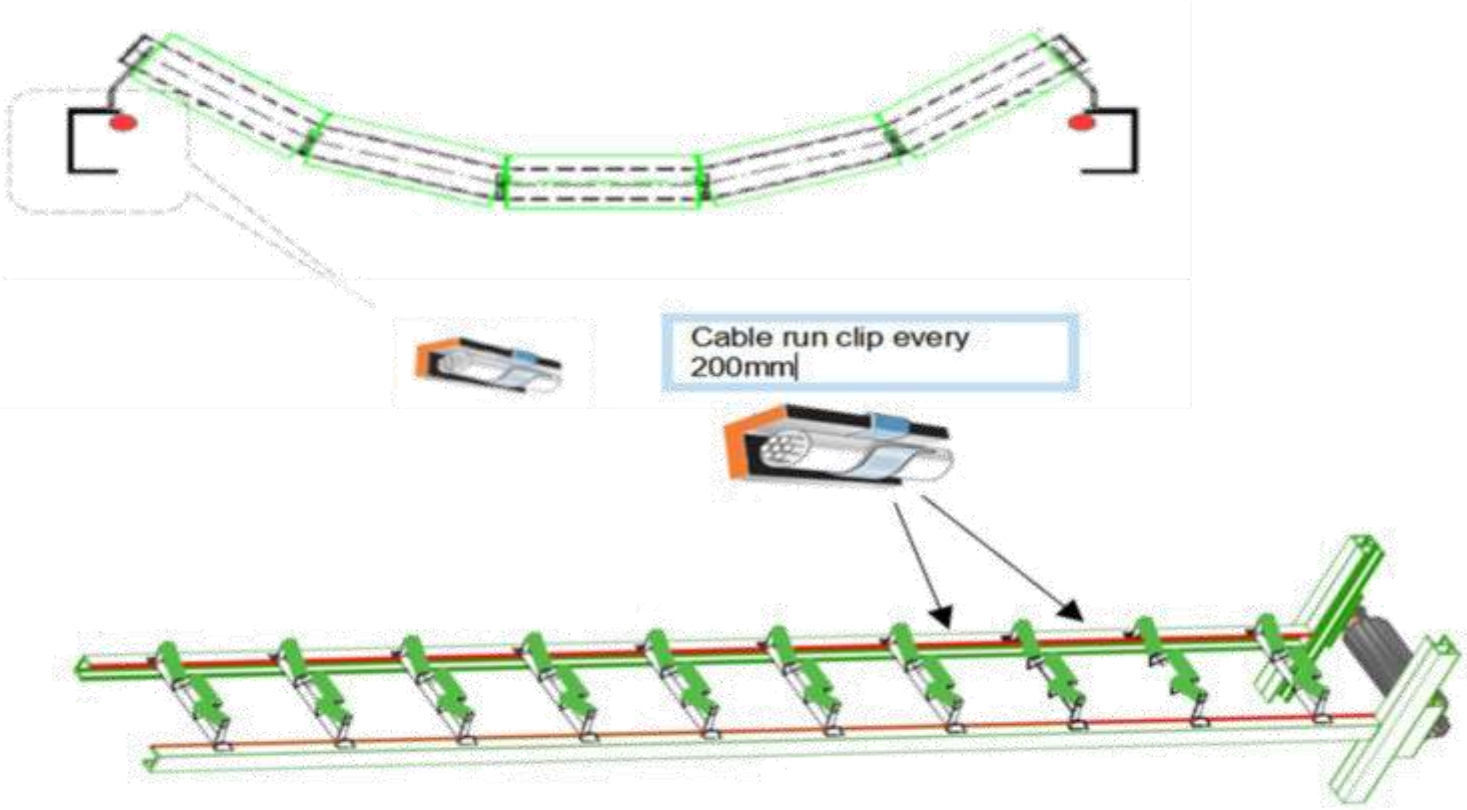
LUNA EX.TRACT – Fast Response Sensor Cable

Max. tensile strength	2,000N (IEC 60794-1-2, E1)
Max. crush resistance	10,000 N/dm (10 min.) (IEC 60794-1-2, E3)
Weight	44 kg/km
Optical fiber	2x 62.5/125µm MM Graded Index, 2x 9/125µm SM,
Temperature Range	- 50°C to + 150°C
Circuit Integrity with mechanical shock	EN 50200 – PH 90 (90 min, 830 °C)

Conveyor Condition Monitoring

The LUNA EX.TRACT system installation:





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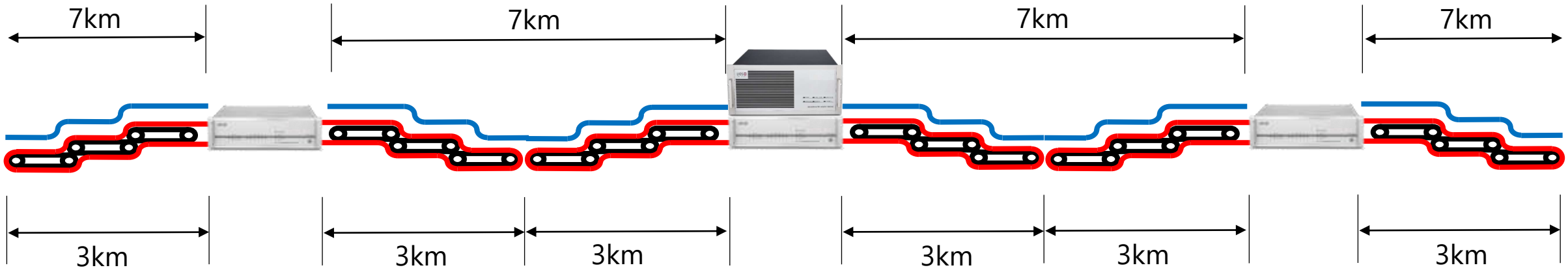
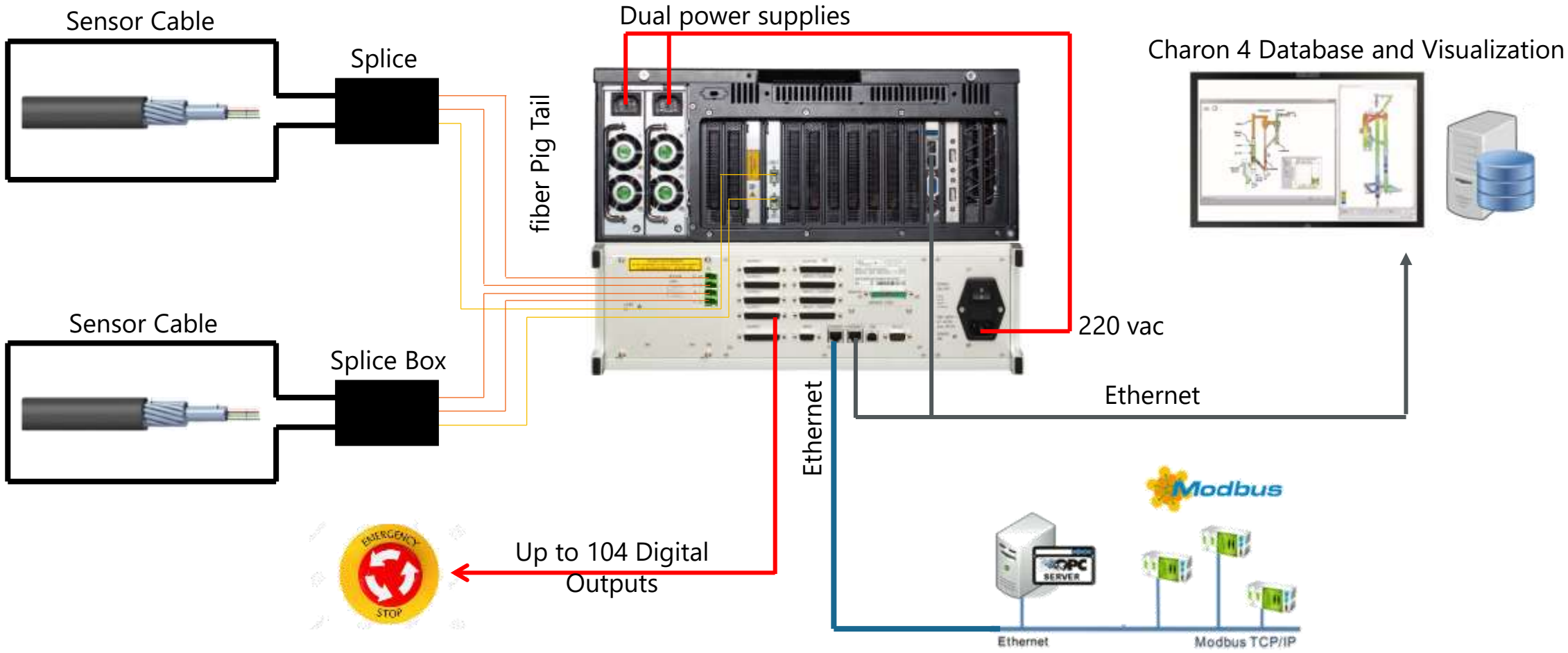


Conveyor Condition Monitoring

The LUNA EX.TRACT system interface:



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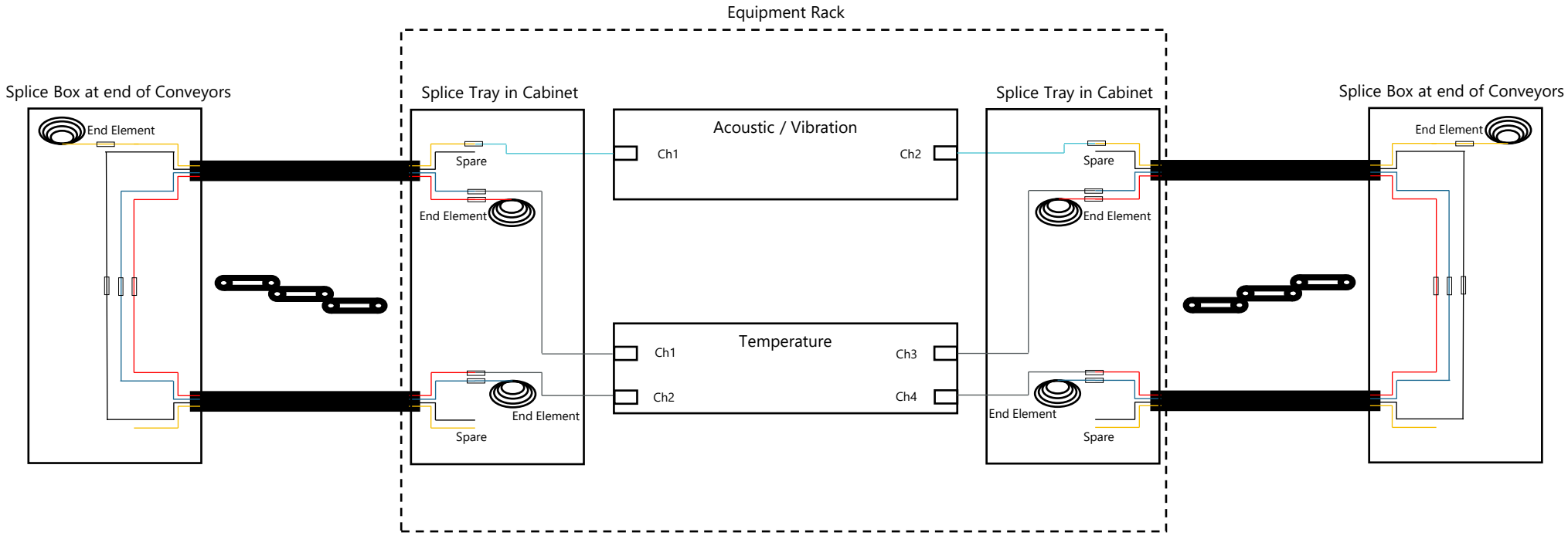

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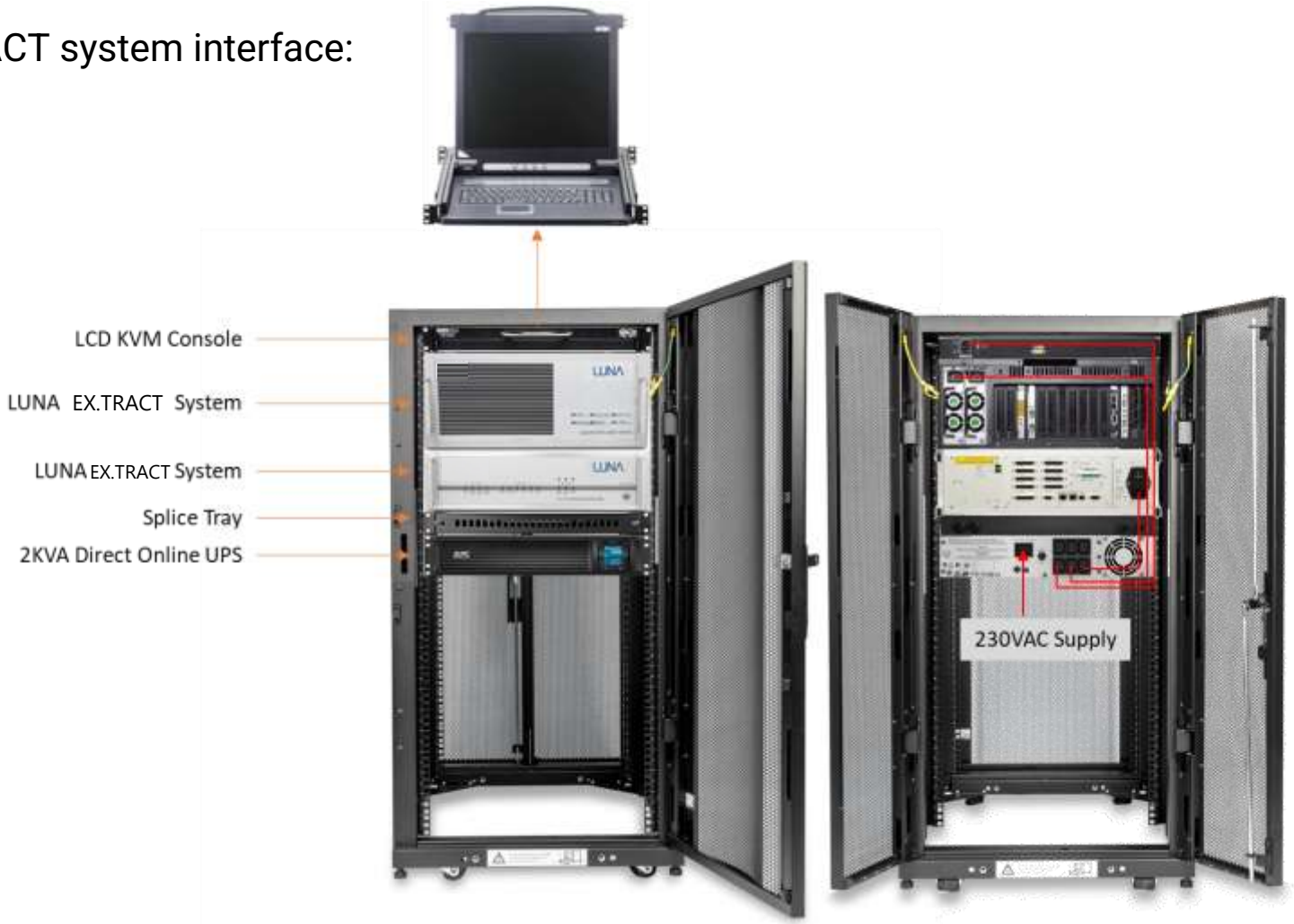
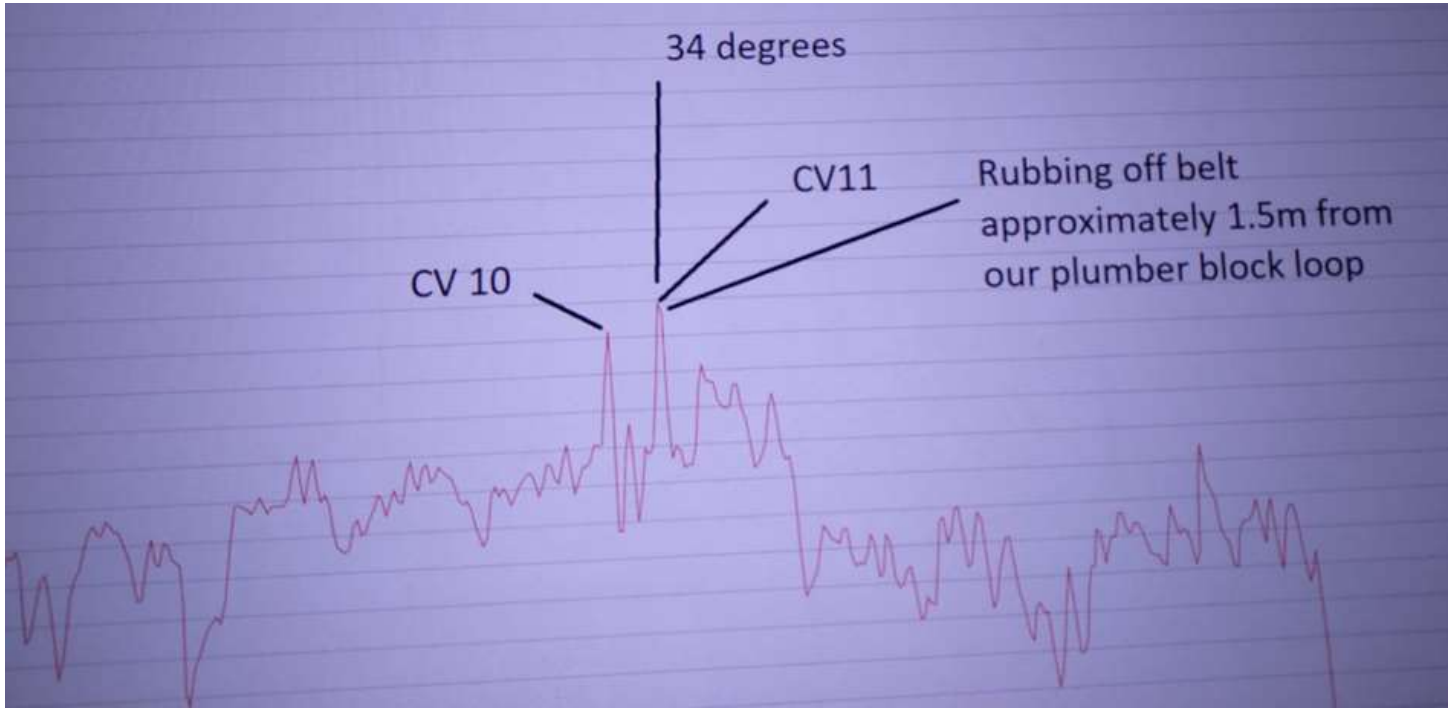


Impact of Idler Condition Monitoring



Impact of Idler Condition Monitoring

- 3% more conveyor availability.
- 5% reduction in hours of planned maintenance.
- 10% reduction in hours of unplanned maintenance.
- 50% reduction in the number of people required for belt checking.
- 50% reduction in man-hours spent on walking the belt.
- 90% reduction in idlers replaced annually due to failure.
- 30% reduction in idlers replaced annually as a preventive measure.
- 99% reduction in potential friction related fires, “DMRE mandated”.

Return on Investment

- 10% of all unscheduled maintenance and breakdowns, were due to idler related failures.
- With the LUNA EX.TRACT conveyor condition monitoring system, the availability should increase with a minimum of 1.5% to 3%.
- The calculation excludes the additional savings in labor, replacement and repair costs.
- The ROI is purely based on additional production availability; as a result, capital investment is recovered within months.

Return on Investment

		USD per Ton	Grade	Total
Average TPH - Current	4,000	$ 135.00	50	$ 67.50	**$ 270,000.00**

	Availability	MTBF avg	MTTR avg
Current conveyor availability	88.41%	13	0.8
Availability with condition monitoring	92.72%	14.3	0.5

	TPH	USD per Ton	Grade	Total
Average TPH - with condition monitoring	4,195	$ 135.00	50	$ 67.50	**$ 283,183.24**

Increased production value per Hr	**$ 13,183.24**
Cost to supply and install 30km DXS System	$ 2,449,483.94
Hours required for ROI	186
Weeks to recover investment	**2**

Conclusion

- LUNA EX.TRACT Conveyor condition monitoring is essential and cost effective for any conveyor belt system.
  - reduced downtime,
  - minimized maintenance costs,
  - increased production,
  - improved safety.
- LUNA EX.TRACT Distributed fiber optic sensing technology provides a powerful solution for early detection of failing idlers and prevention of conveyor belt fires.
- LUNA EX.TRACT conveyor condition monitoring system will lead to significant improvements in overall performance, increasing operational profitability and improving safety of your operation and workforce.

Questions ?

“Not every failure is a fire, but every failure is down time, if we can prevent failures, we can surely prevent fires” Herbert Schmitz