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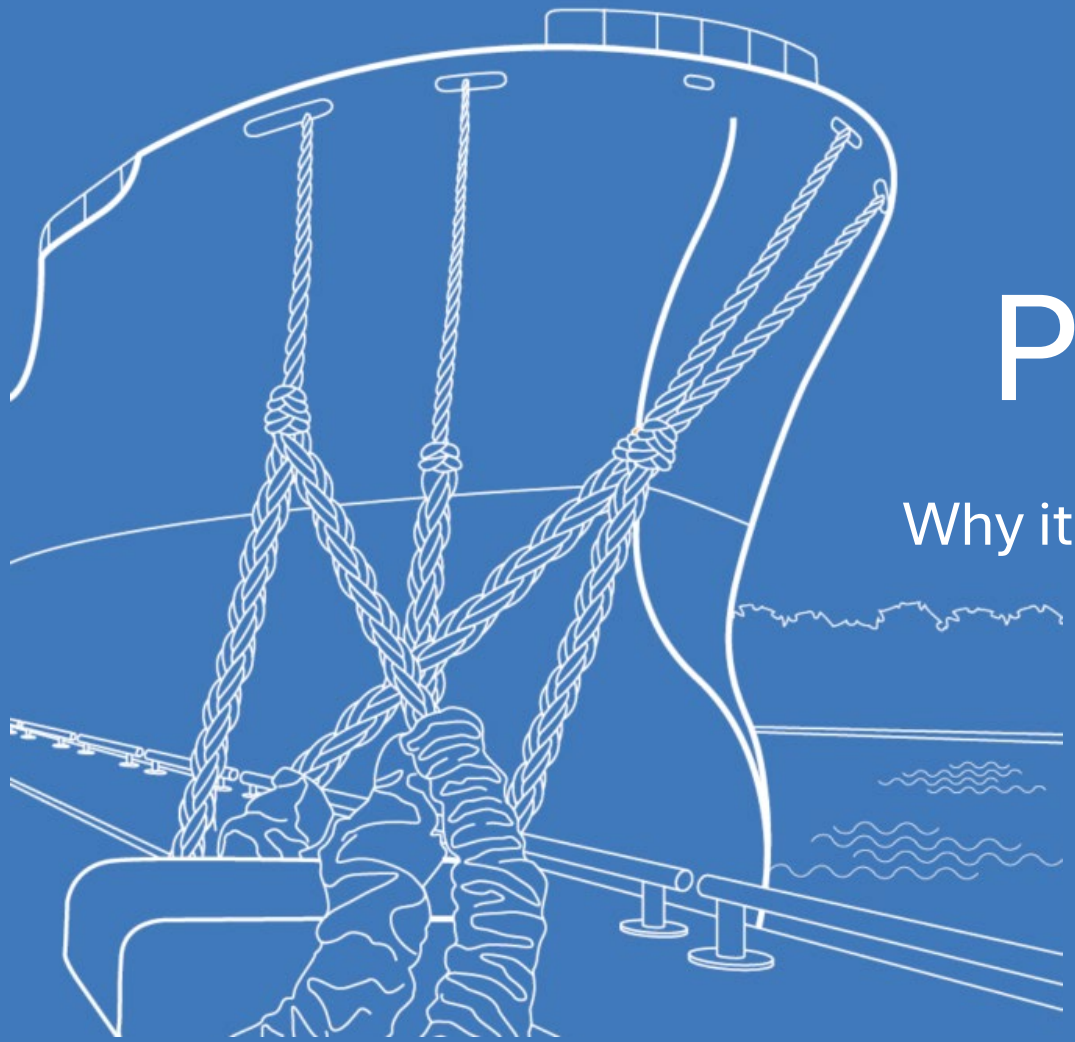

Parted Mooring Lines

Why it happens | What happens | How to mitigate risk


Holmes


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Footage
courtesy of I-Pole


Holmes

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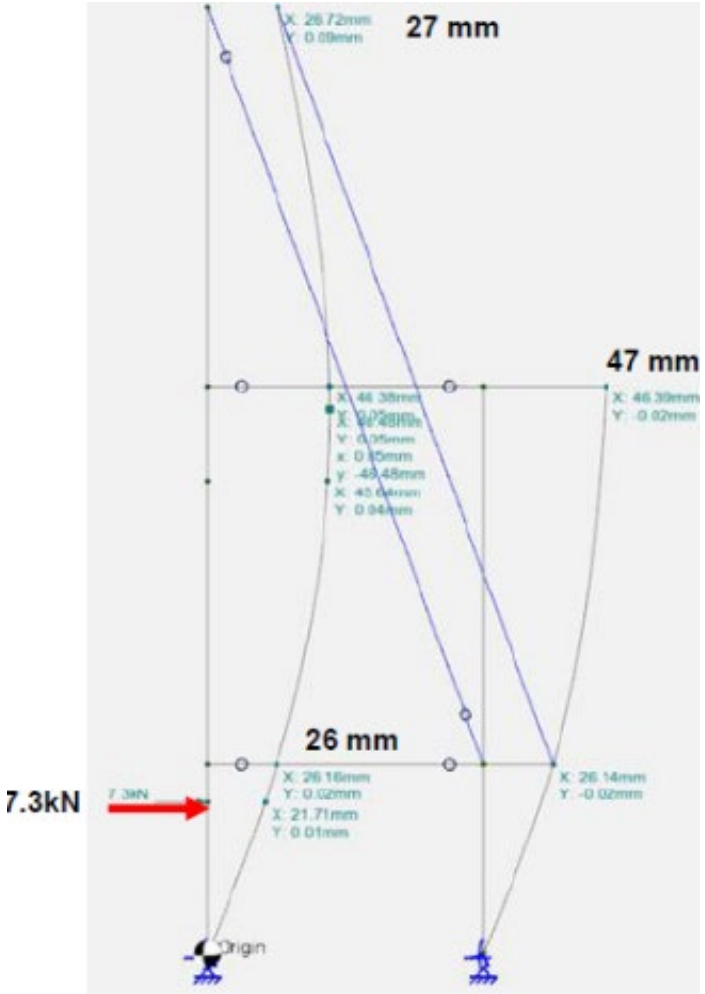
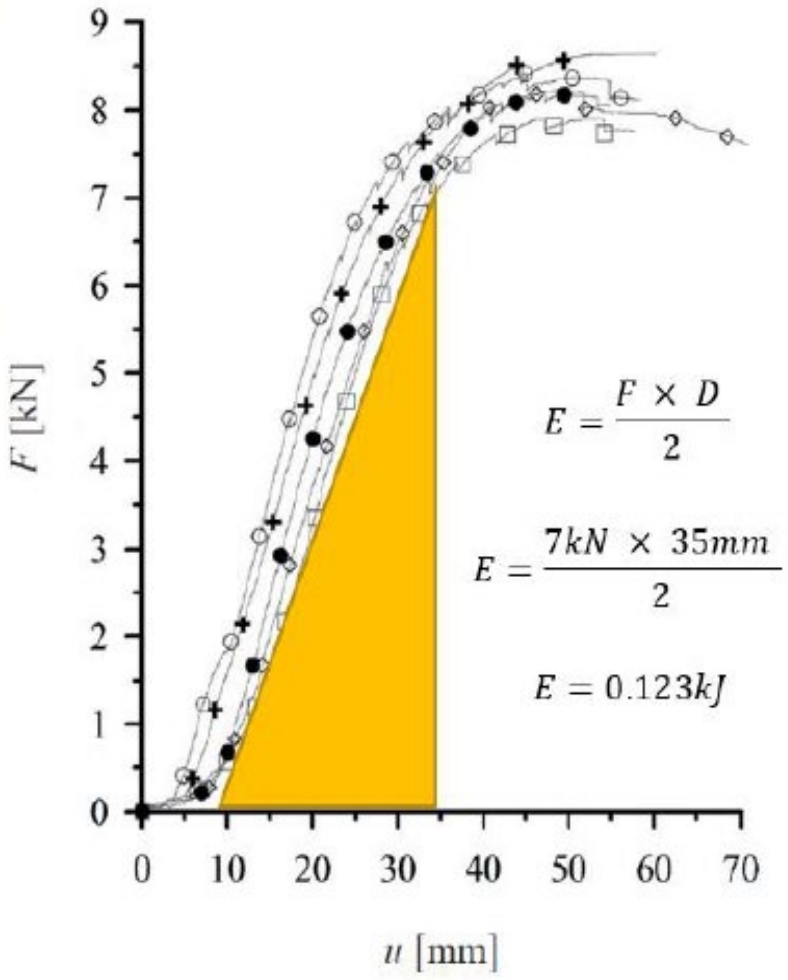
Conventional design






Heln


RIVA VOLI
RIVA VOLI
Holmes
Holmes

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PIANC
The World Association for Waterborne Transport Infrastructure

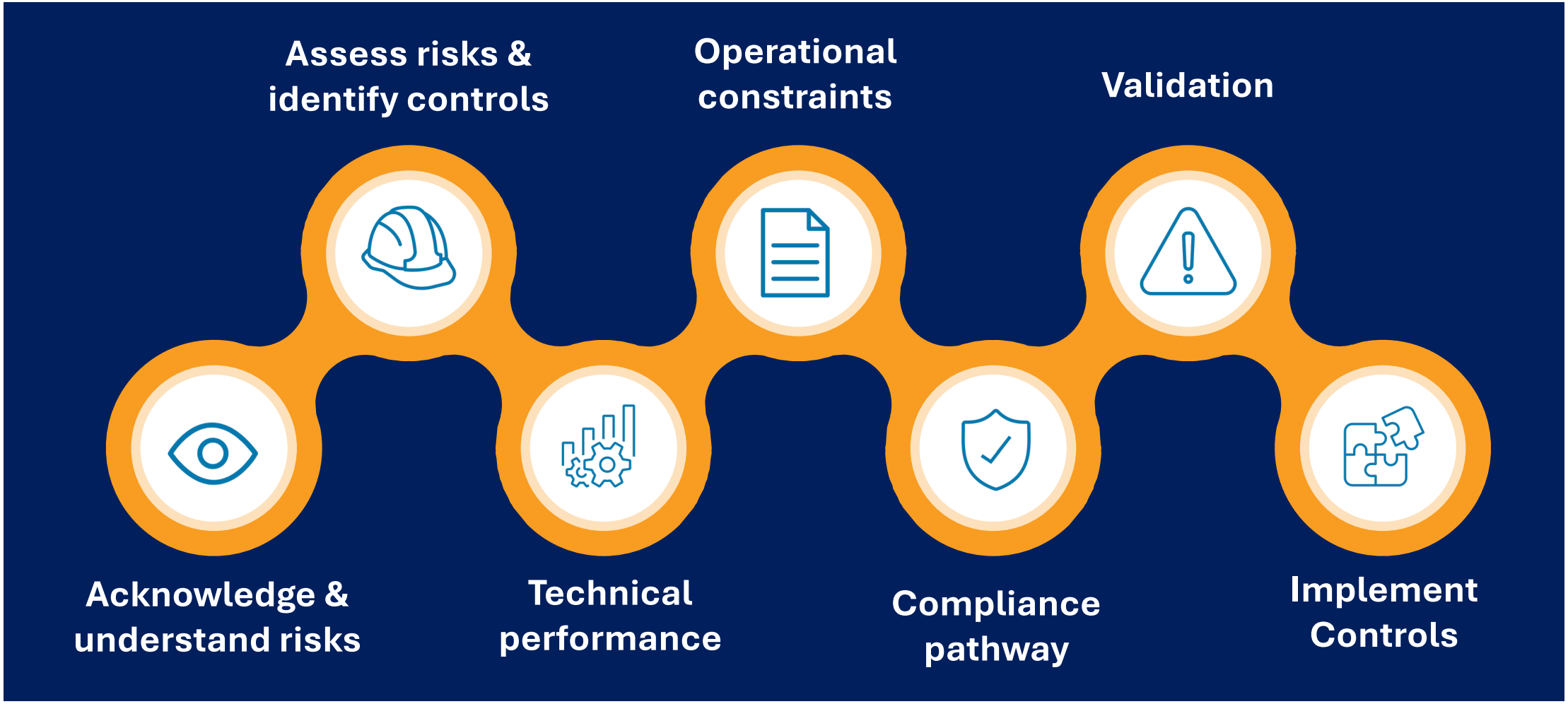
Maritime Navigation Commission

MarCom

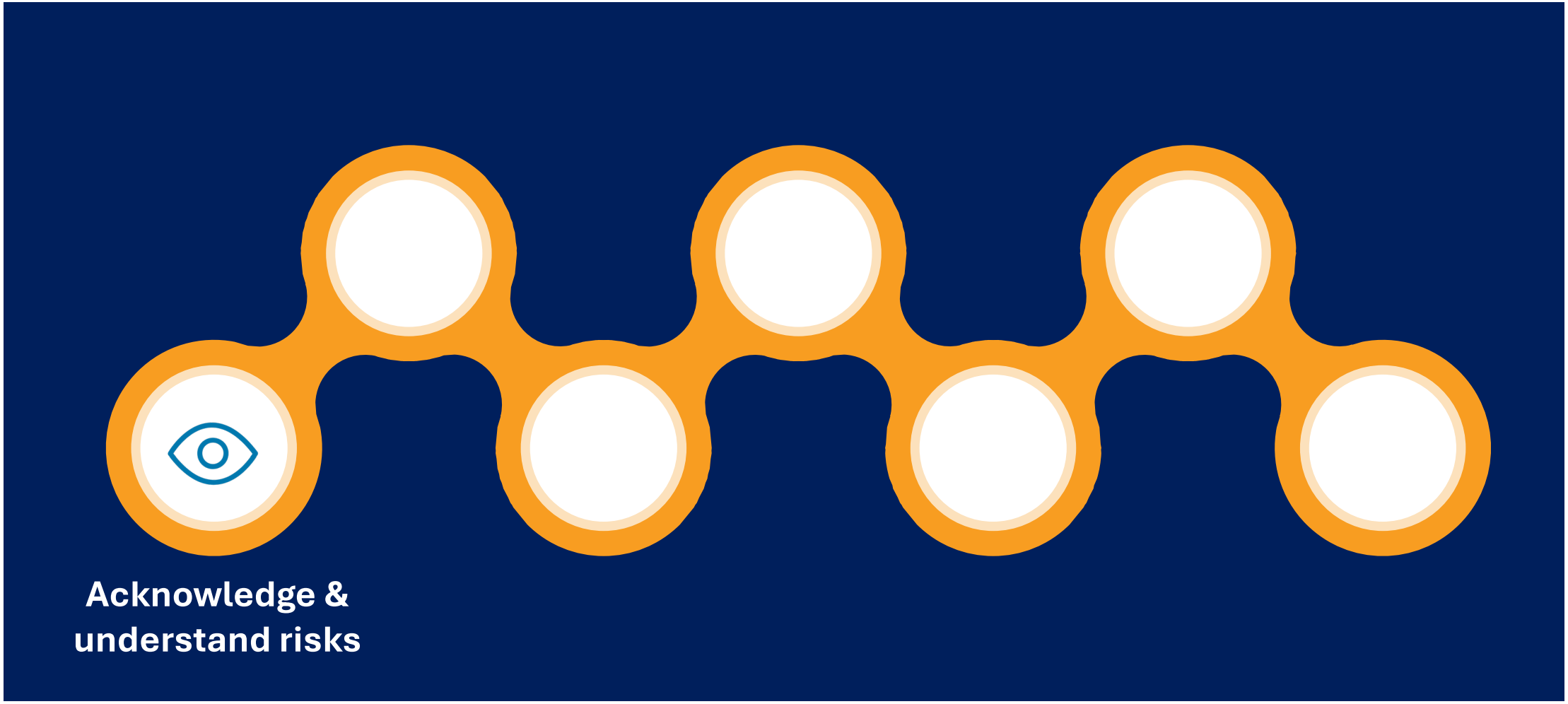
WG 251

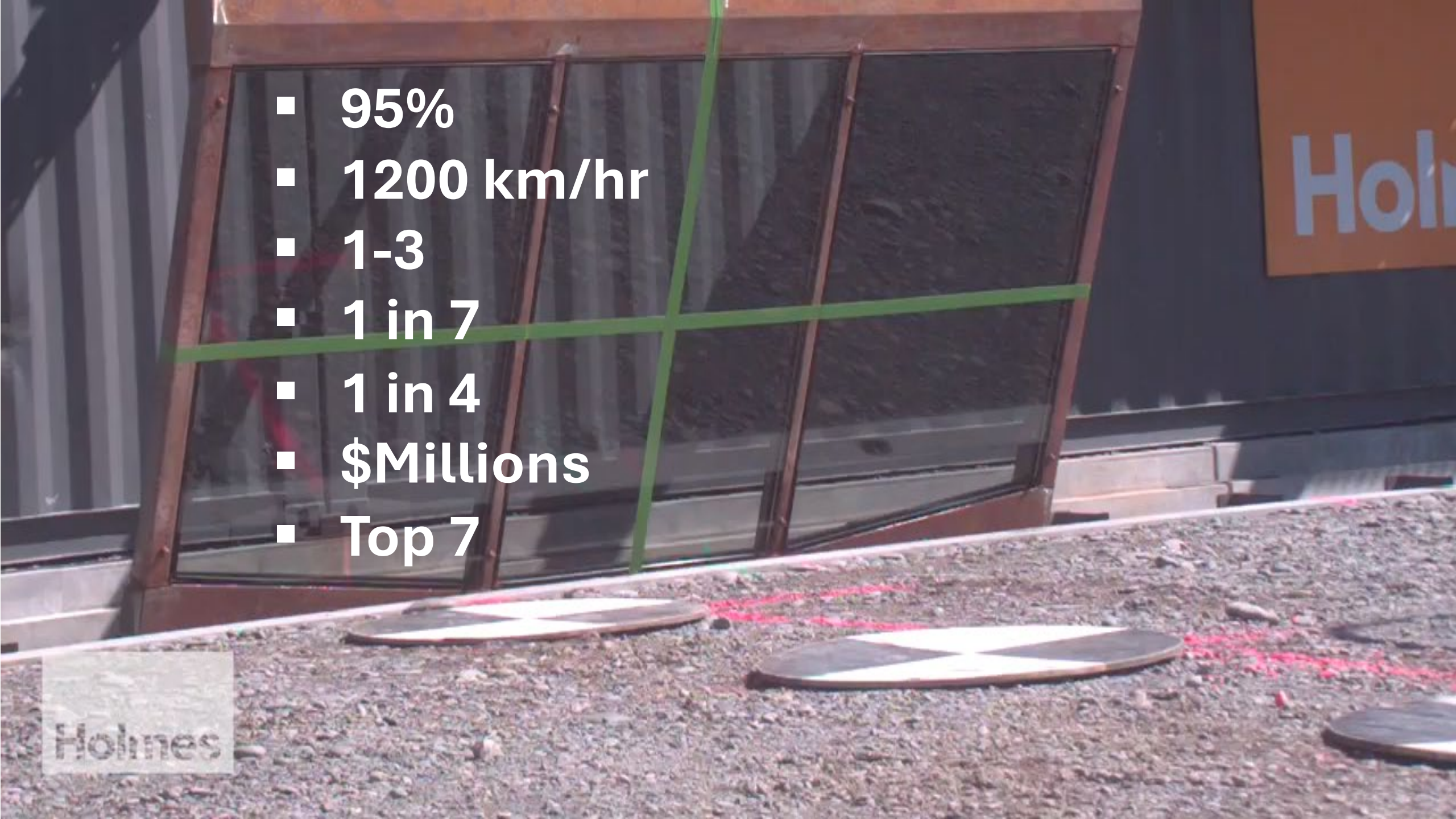
GUIDANCE ON THE DESIGN OF PARTED MOORING LINE ARRESTING SYSTEMS

Pathway: From risk to control



Pathway: From risk to control





- 95%
- 1200 km/hr
- 1-3
- 1 in 7
- 1 in 4
- $Millions
- Top 7

Causes of line failure

- Environment
- Rope condition
- Poor tension management
- Human error
- Mechanical faults
- Undersized mooring equipment

D/d ratio

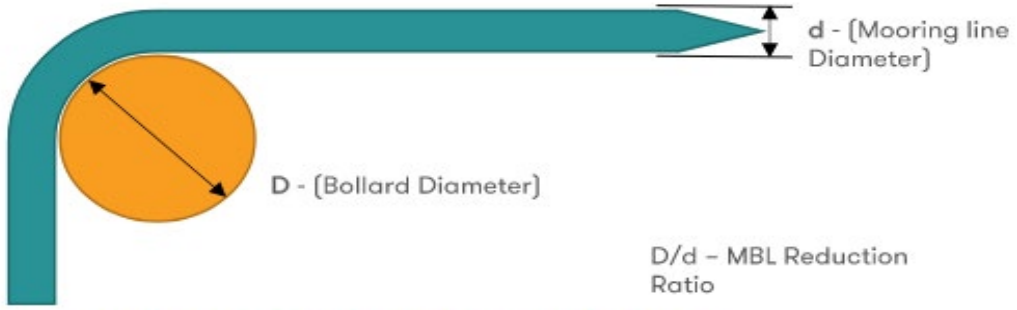
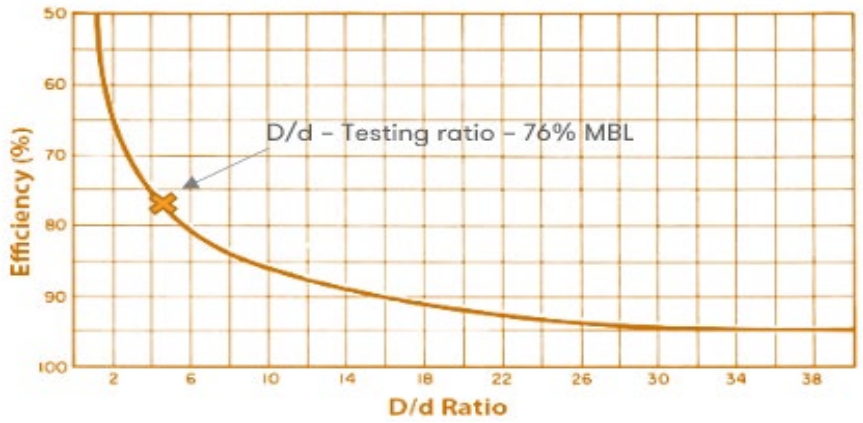


Figure 4: D/d schematic for lines around bollards.



Inconsistencies in guidance

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MBR (Factor × Rope Diameter)	Rope Manufacturer's General Recommendations	Theoretical Line Efficiency (according MBR)	Theoretical Breaking Load of 85T MBL line (according MBR)	Suitability for Mooring
2.5 × Diameter	Below lowest MBR of 3 and not recommended for any applications	40 - 50%	~34 - 42.5T	Not recommended for any applications
3 × Diameter	Light-duty, static loads, occasional redirection.	50 - 60%	~42.5 - 51T	Not recommended for mooring
5 × Diameter	Heavy-duty, moderate dynamic loads.	70 - 85%	~59.5 - 72.25T	Suitable for mooring with heavy loads with moderate dynamic applications.
7.5 × Diameter	Heavy-duty, critical dynamic applications.	85 - 90%	~72.25 - 76.5T	Recommended for mooring with heavy loads with critical dynamic applications

Extreme speeds. Small impact areas.

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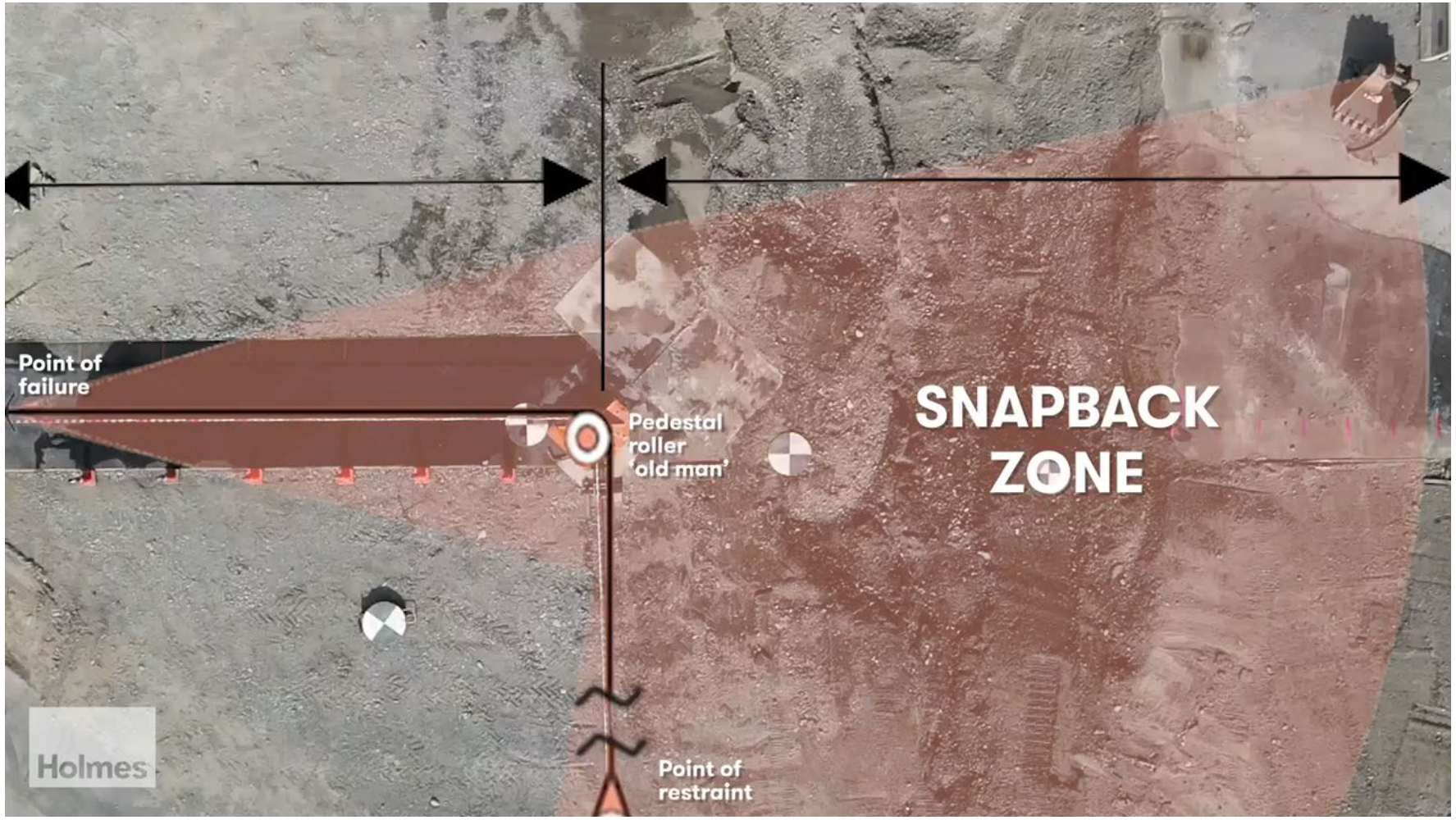
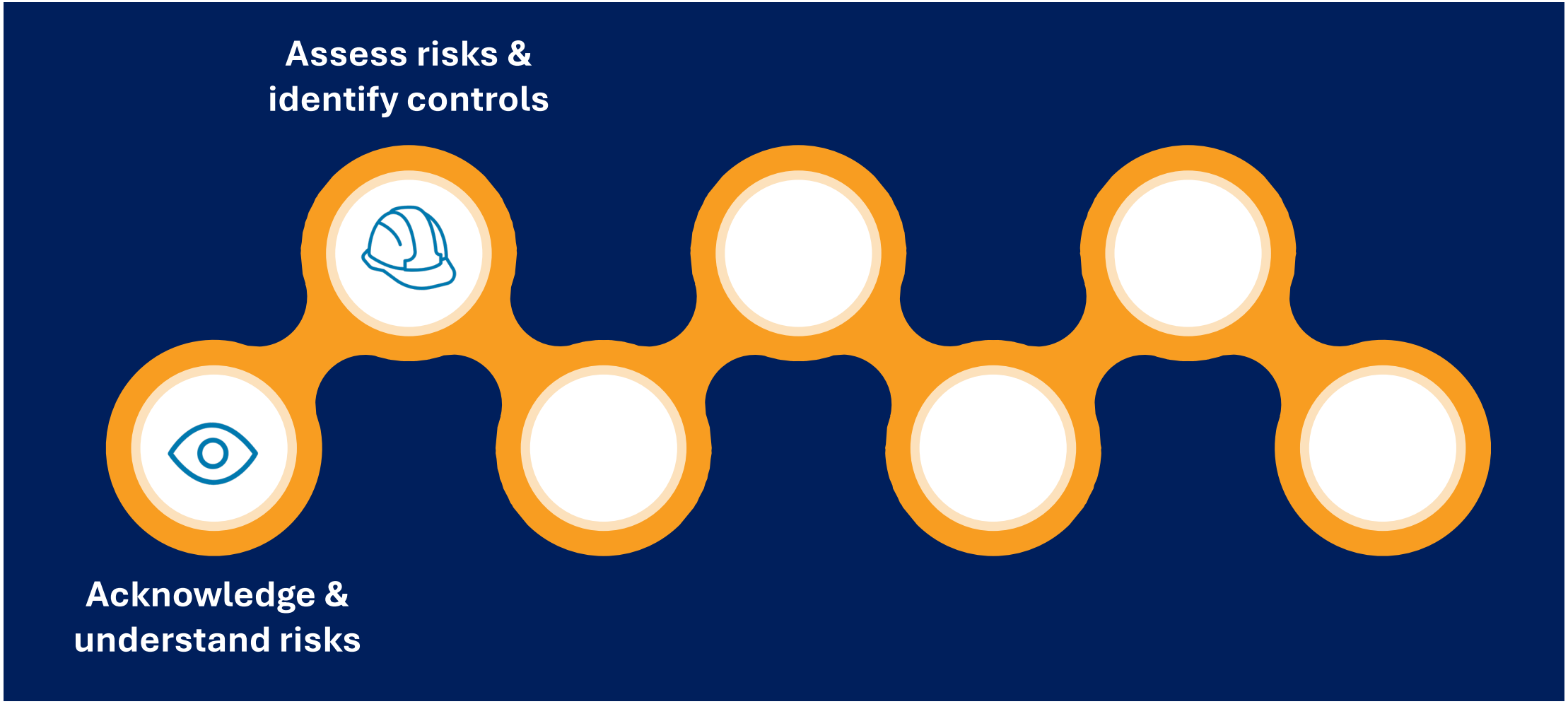


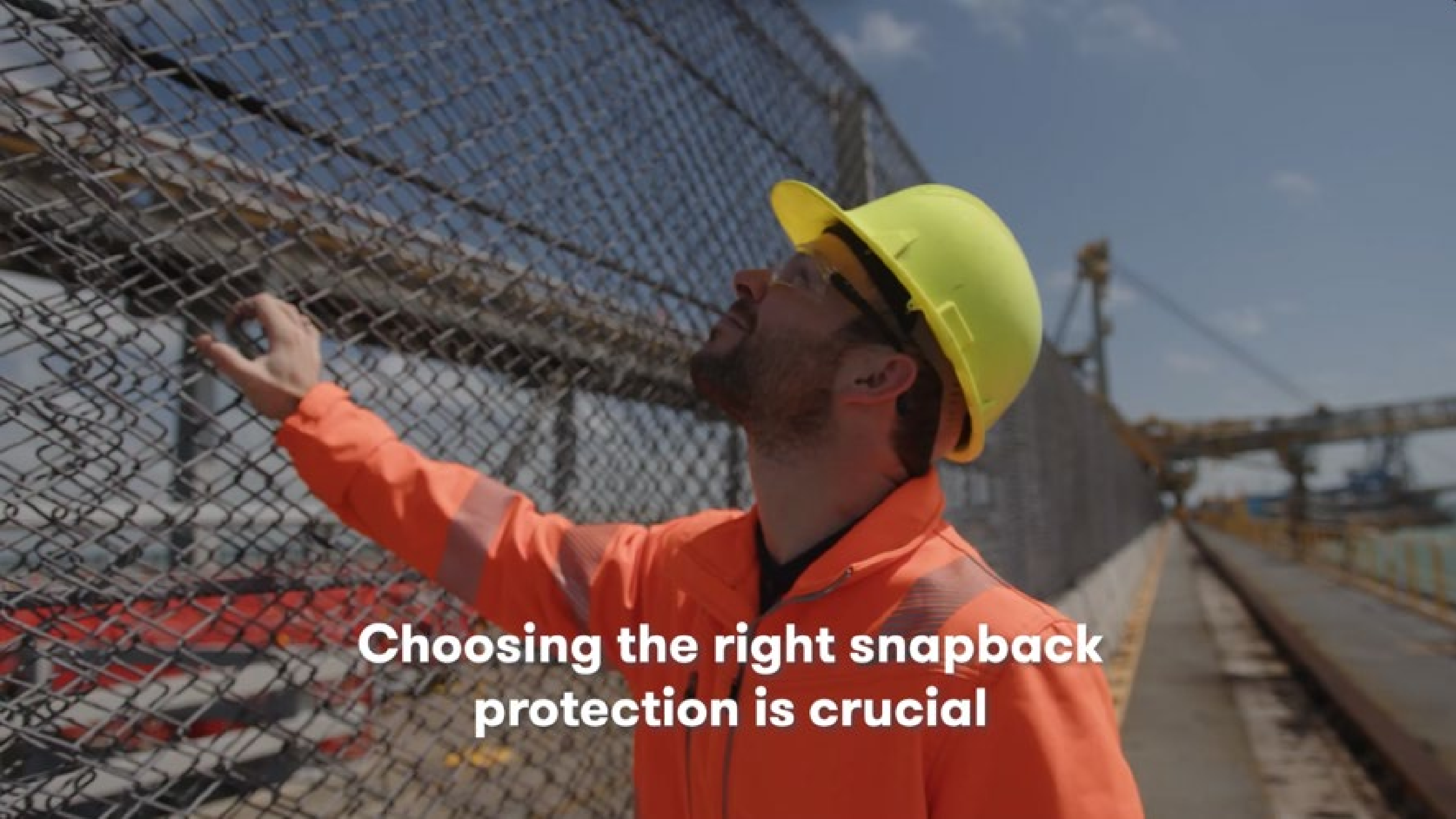

Holmes


2B-2

Rope impacts 150 ms after rupture

Pathway: From risk to control




Choosing the right snapback
protection is crucial

A Safe System approach

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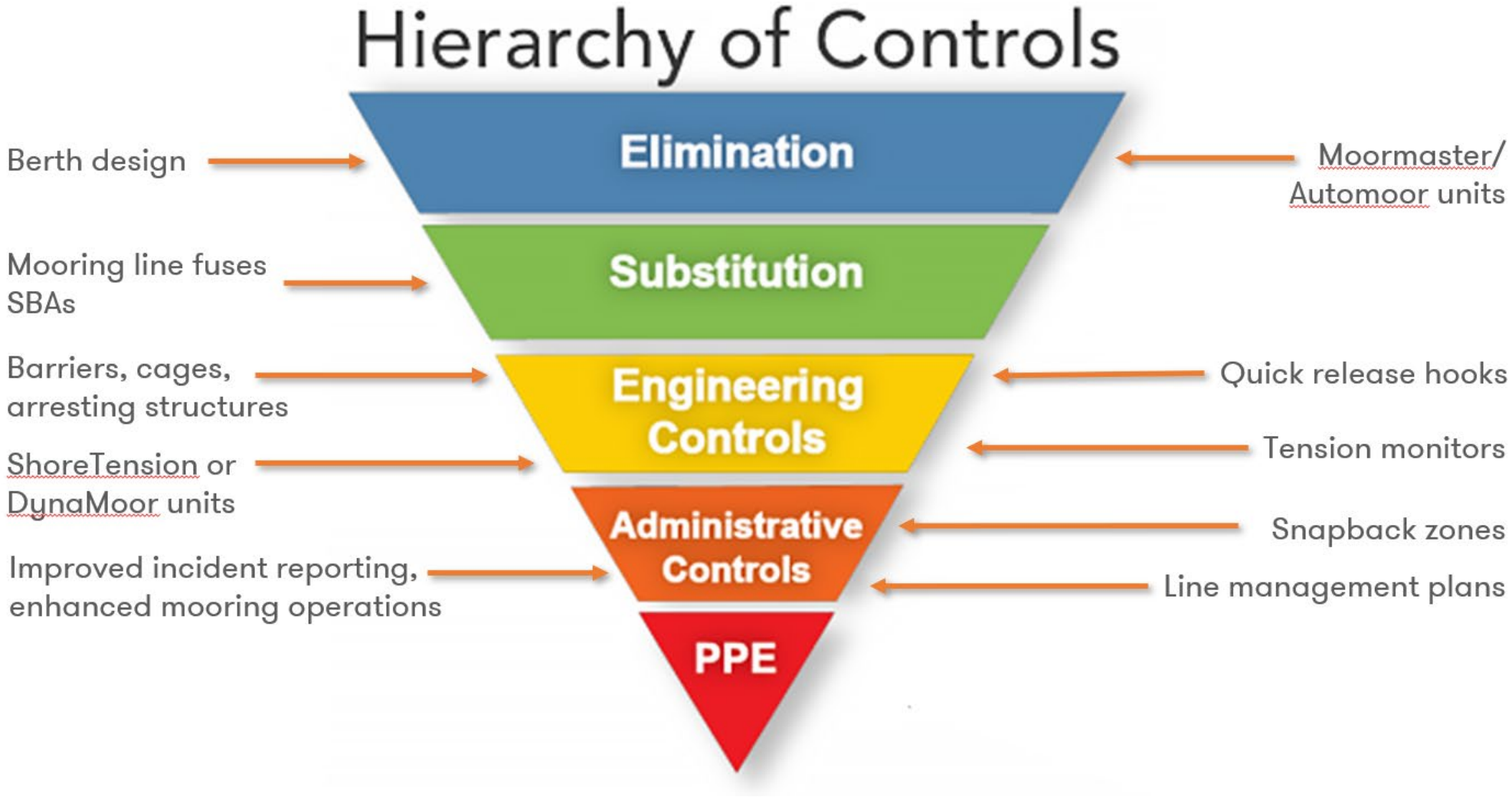
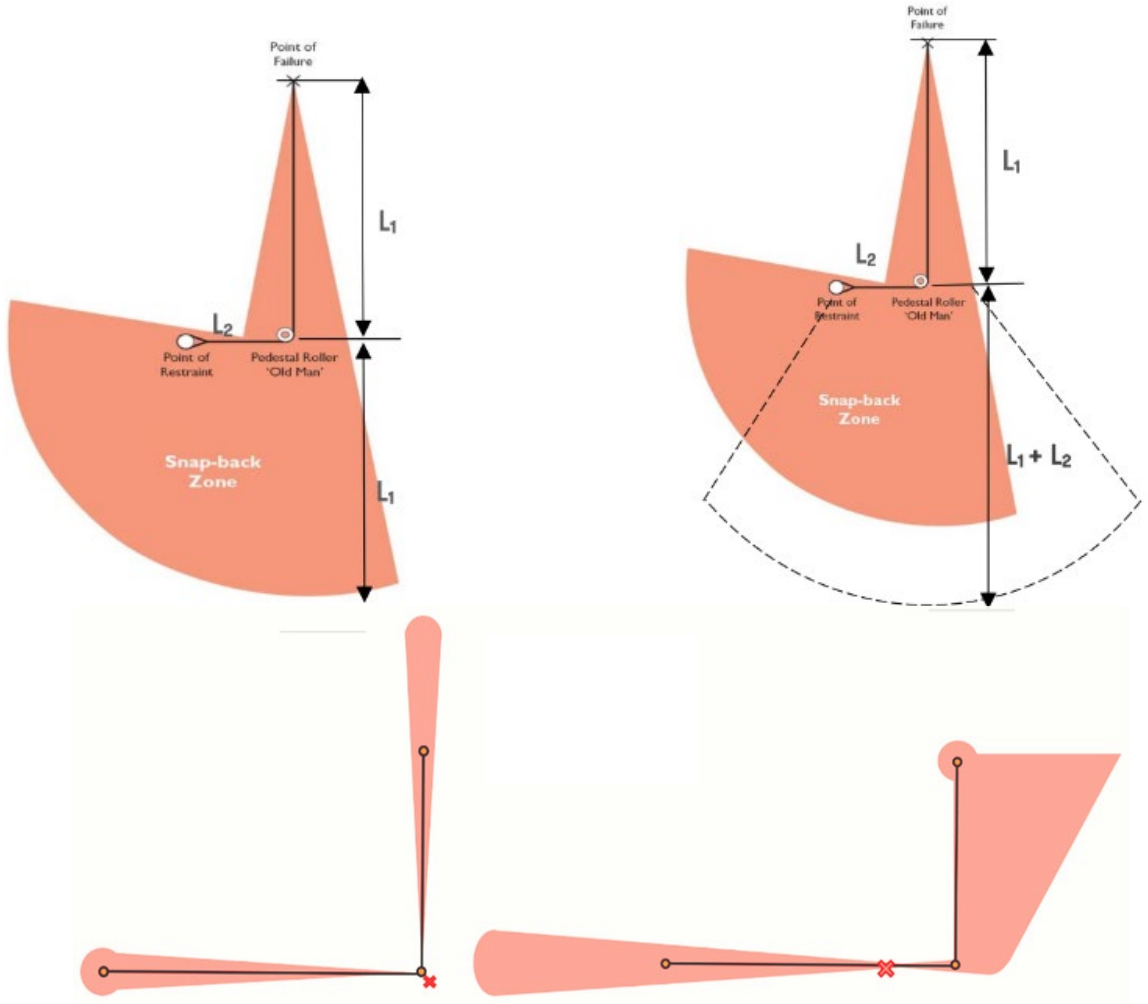
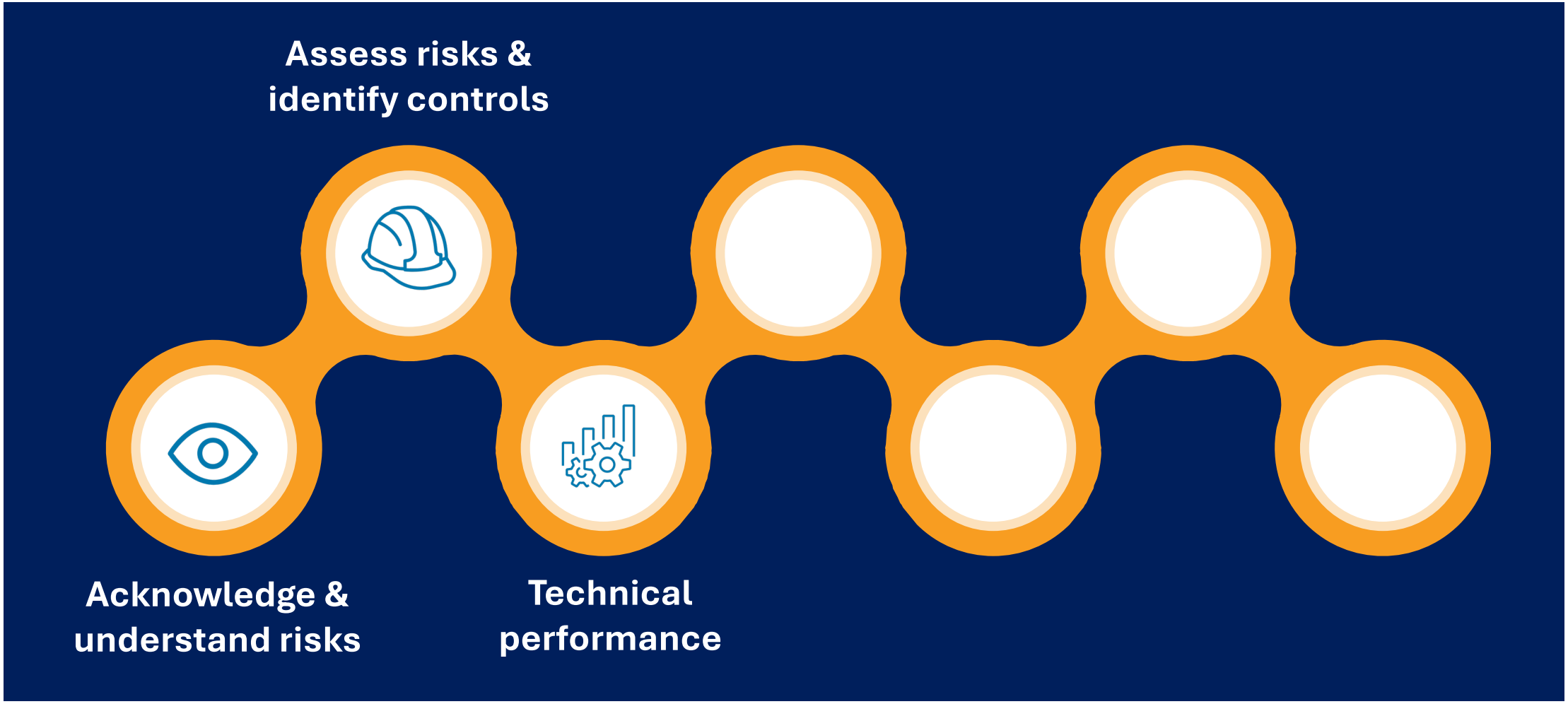


Snapback zones: False friends?

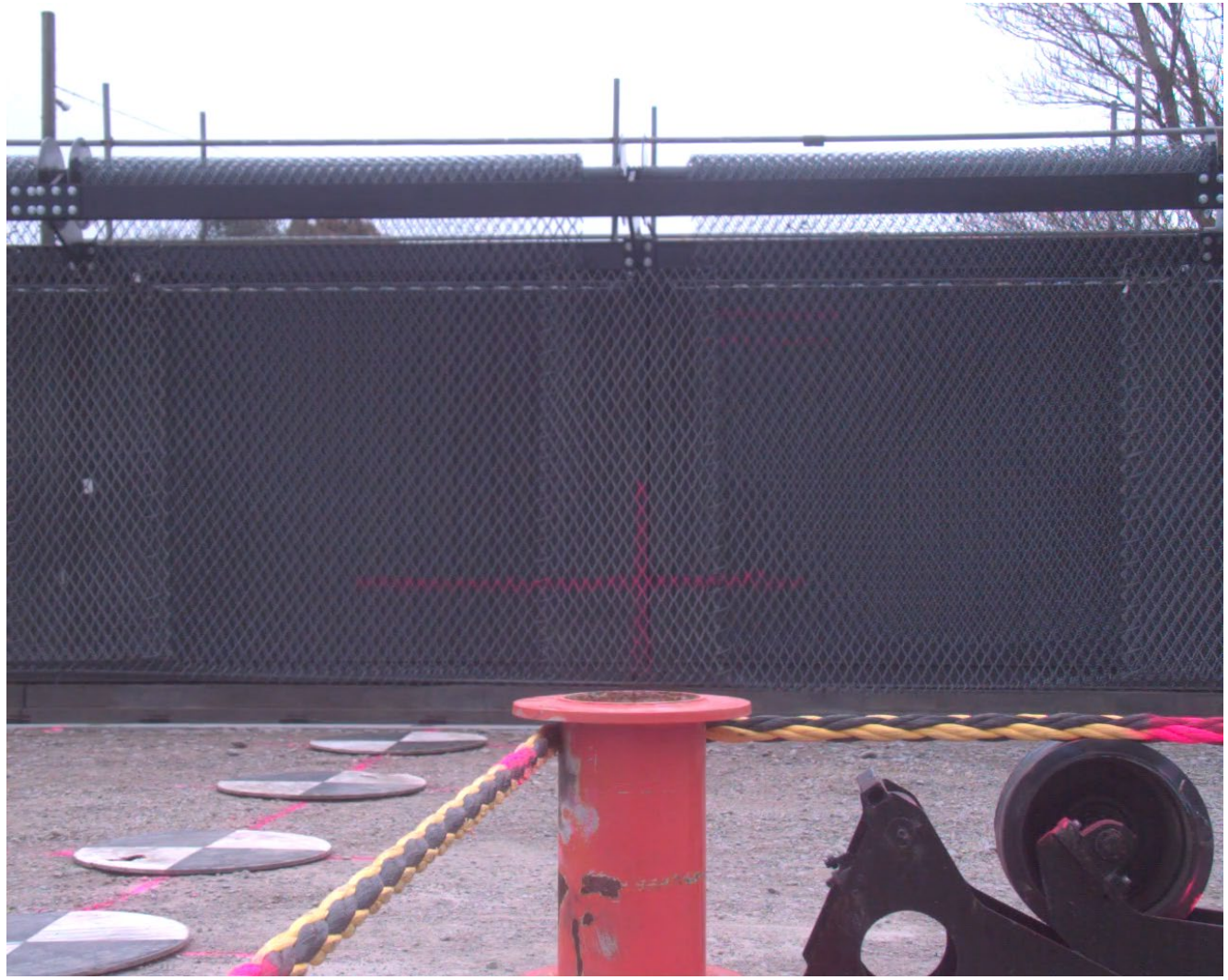


Pathway: From risk to control



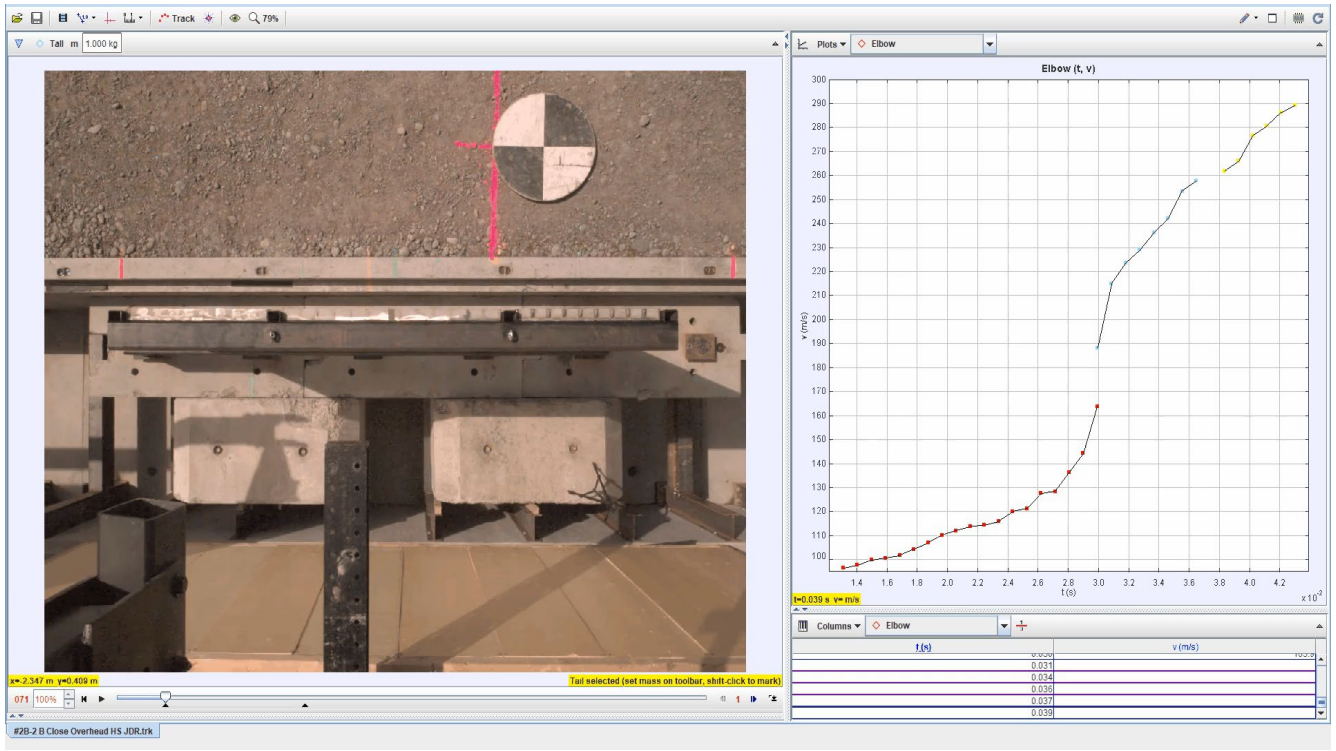
Defining technical performance

- Design for worst-case events that are unlikely but possible.



Defining technical performance

- Design for worst-case events that are unlikely but possible.
- Consider real-world parameters: line type, tension, placement.



Defining technical performance

- Design for worst-case events that are unlikely but possible.
- Consider real-world parameters: line type, tension, placement.
- Impact severity is critical.

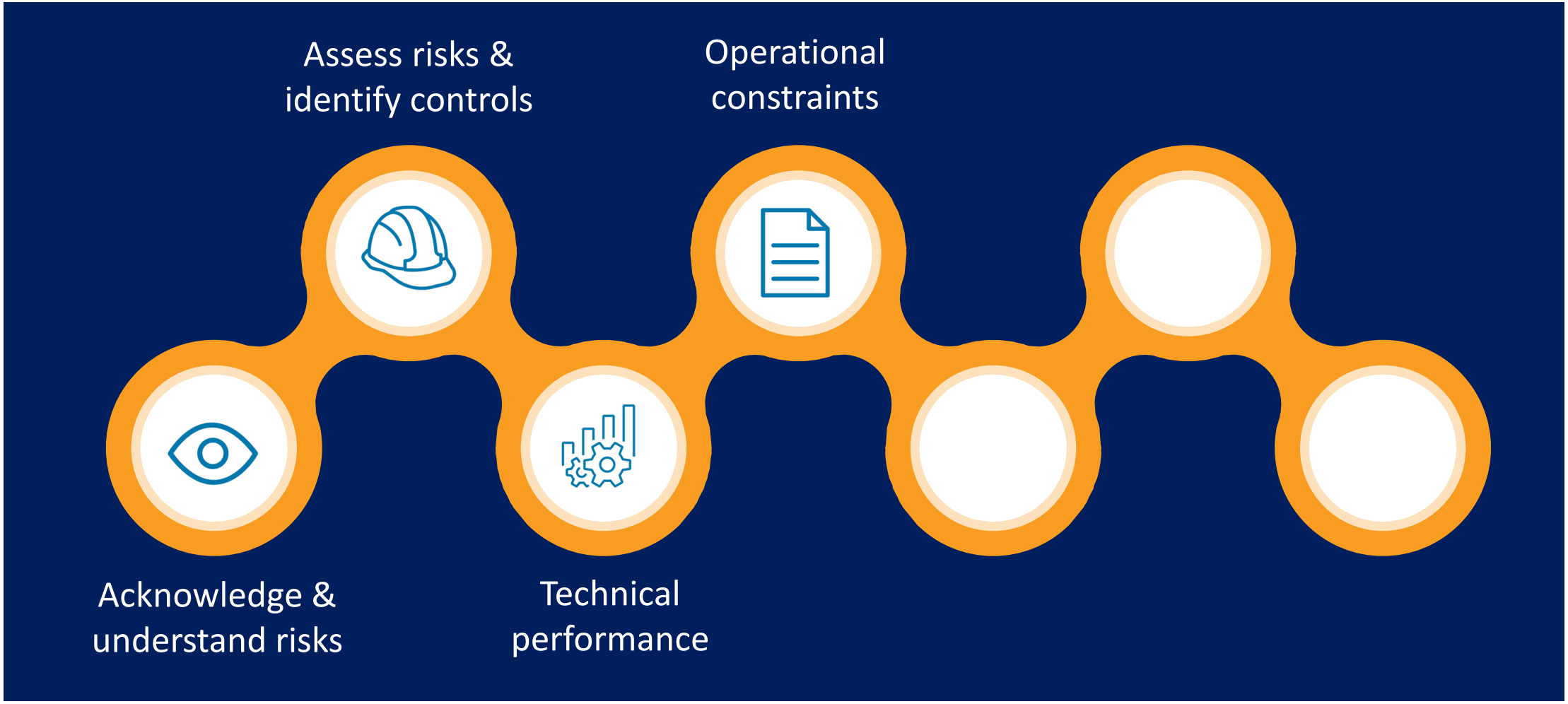

1 2
3 3

Defining technical performance

- Design for worst-case events that are unlikely but possible.
- Consider real-world parameters: line type, tension, placement.
- Impact severity is critical.
- Avoid secondary hazards such as debris

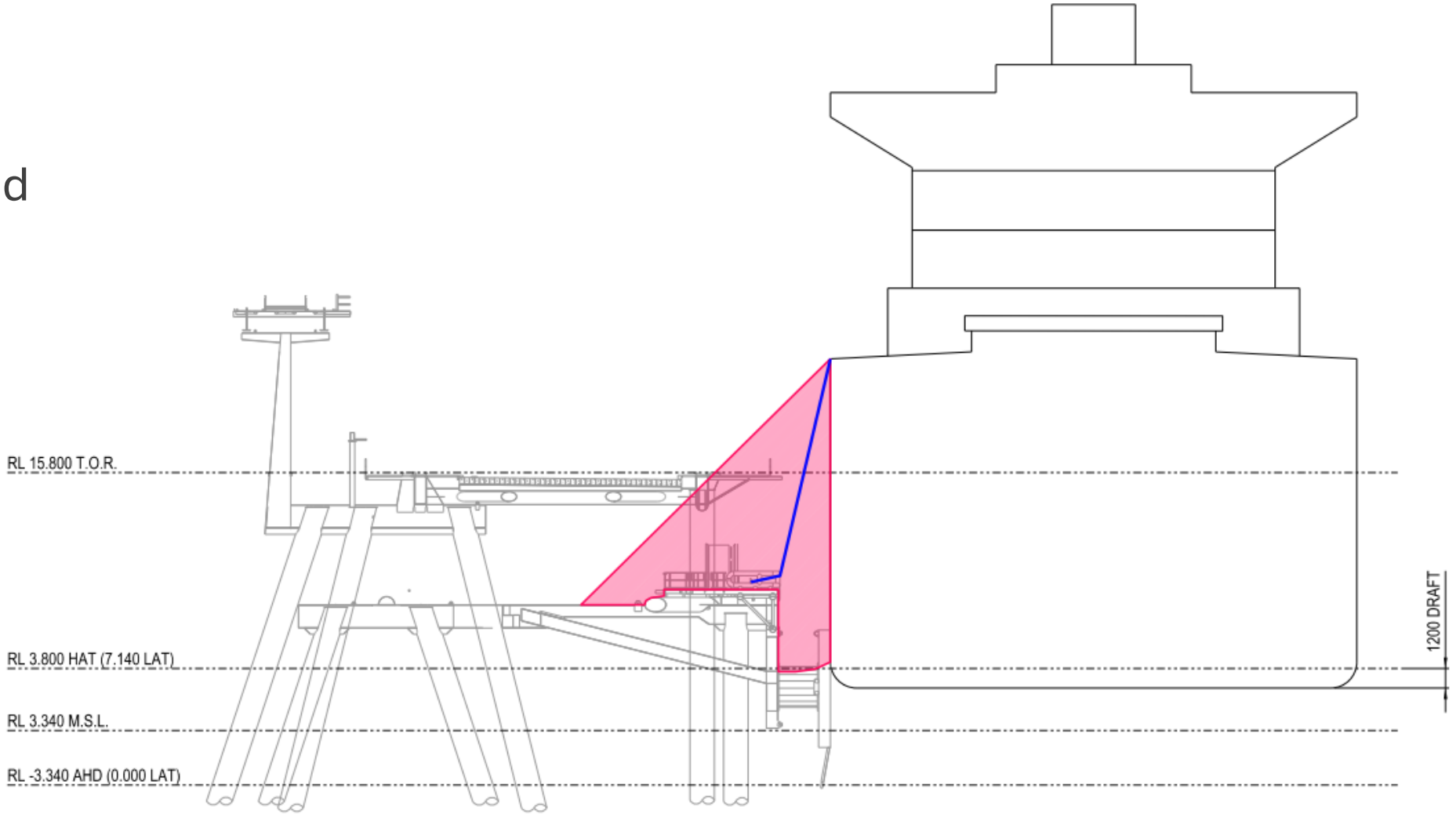
Debris Code	Max Velocity (m/s)	Weight (g)	Max Energy (J)
1	57.7	53	88.3
2	152.5	46	534.9
3	143.7	52	536.9
4	76.6	38.5	113.0
5	110.5	101.5	619.7
6	67.7	46.0	105.5
.22LR Projectile	330.0	2.6	163.0

Pathway: From risk to control



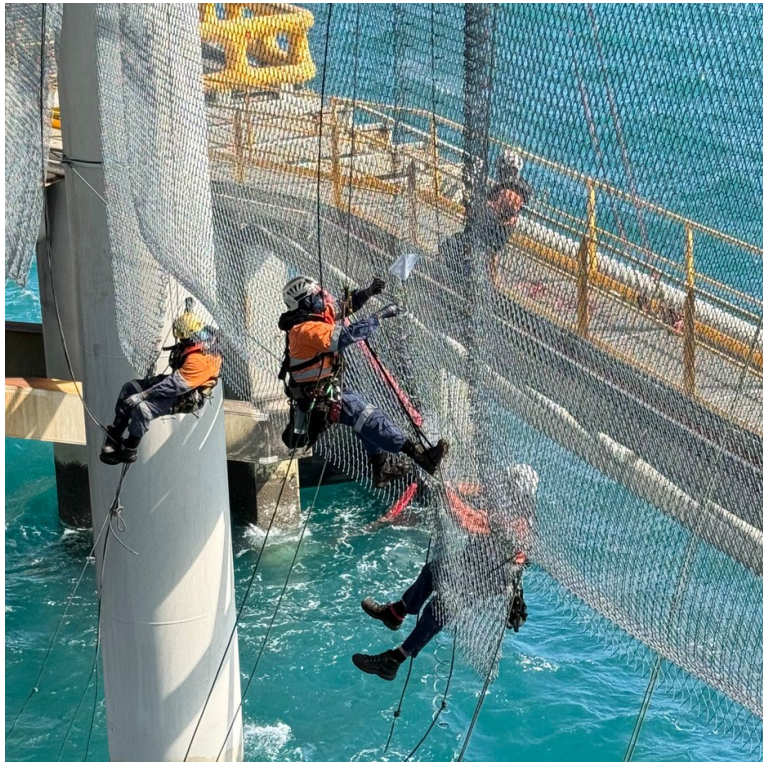
Operational constraints

- Coverage and placement.



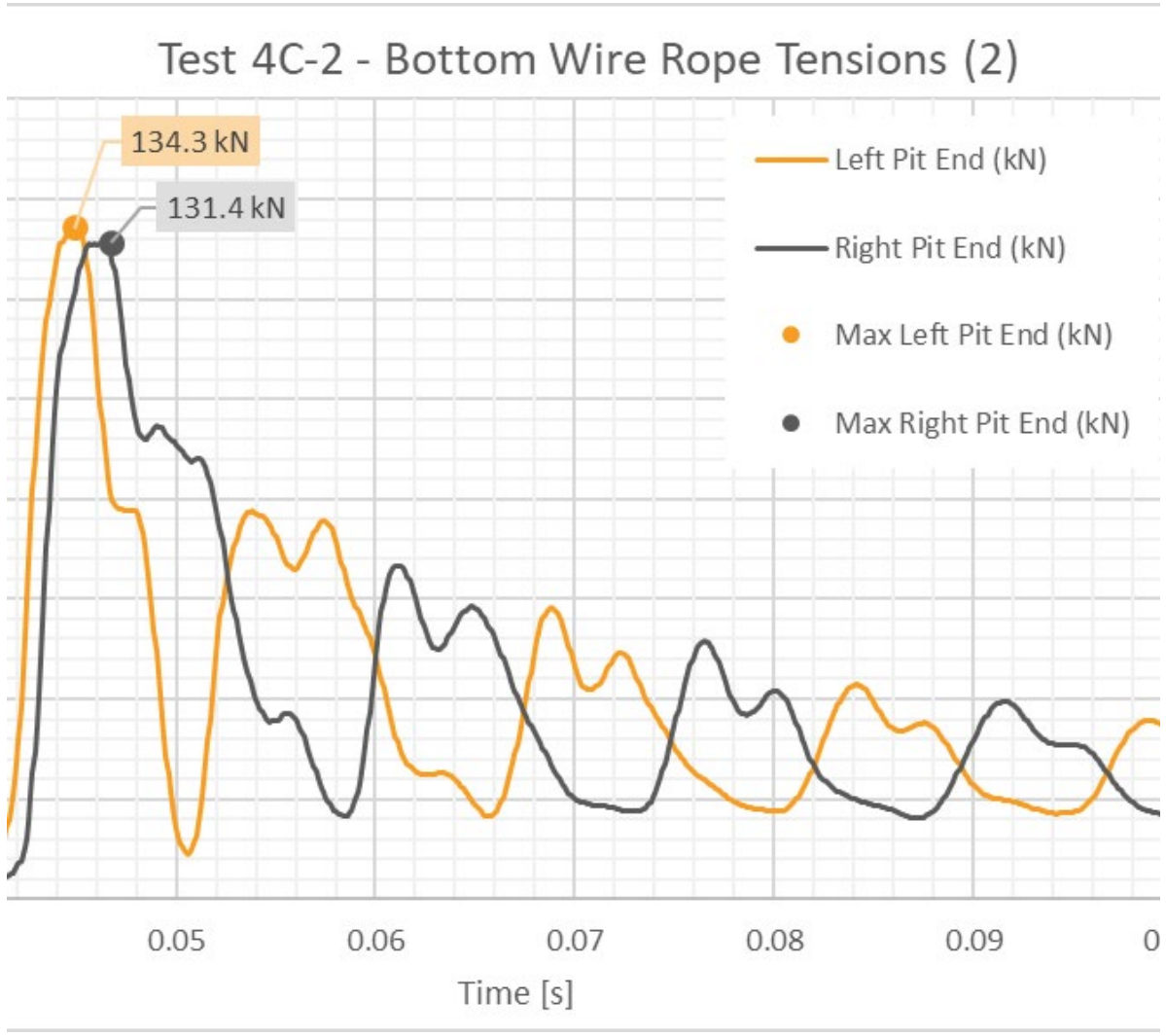
Operational constraints

- Coverage and placement.
- Installation constraints.



Operational constraints

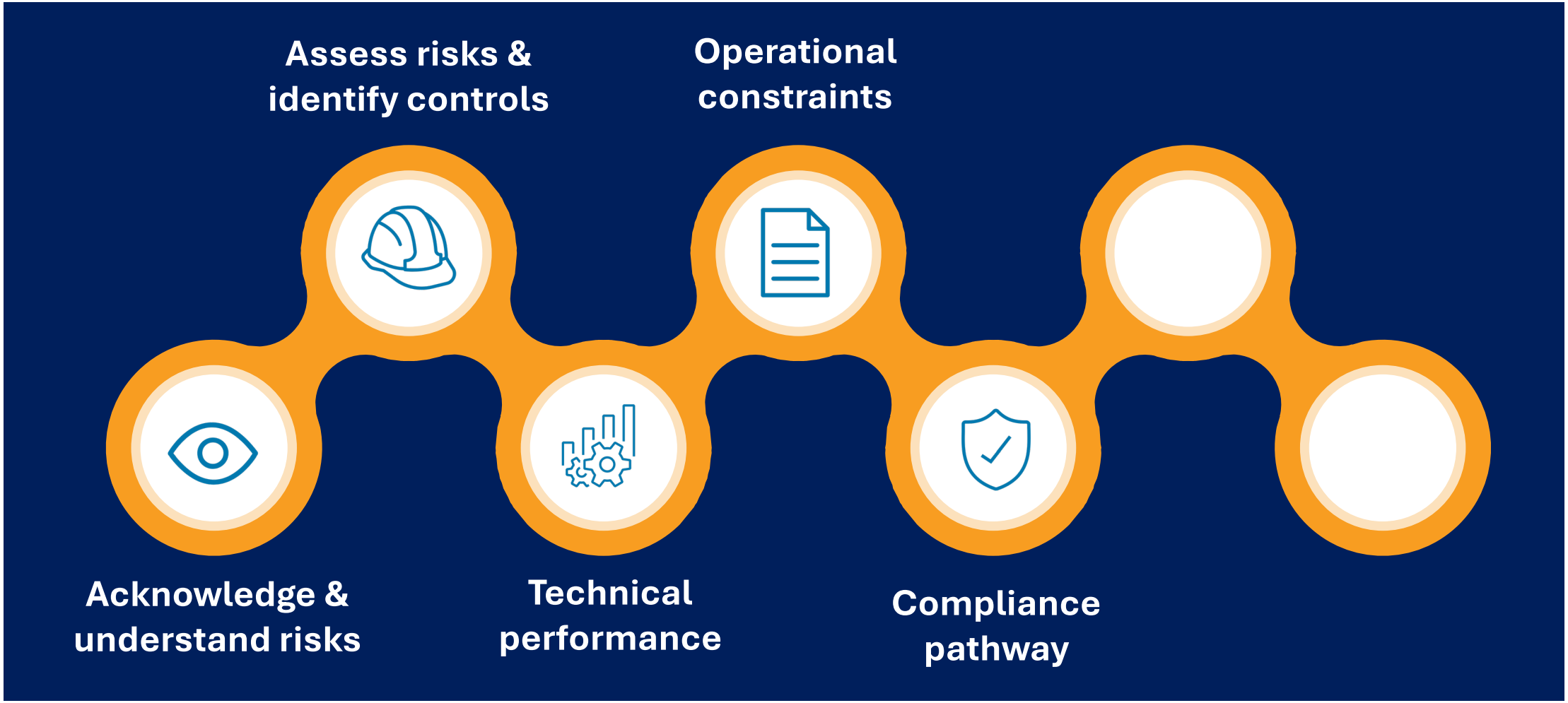
- Coverage and placement.
- Installation constraints.
- Structural.



Operational constraints

- Coverage and placement.
- Installation constraints.
- Structural.
- Environment.

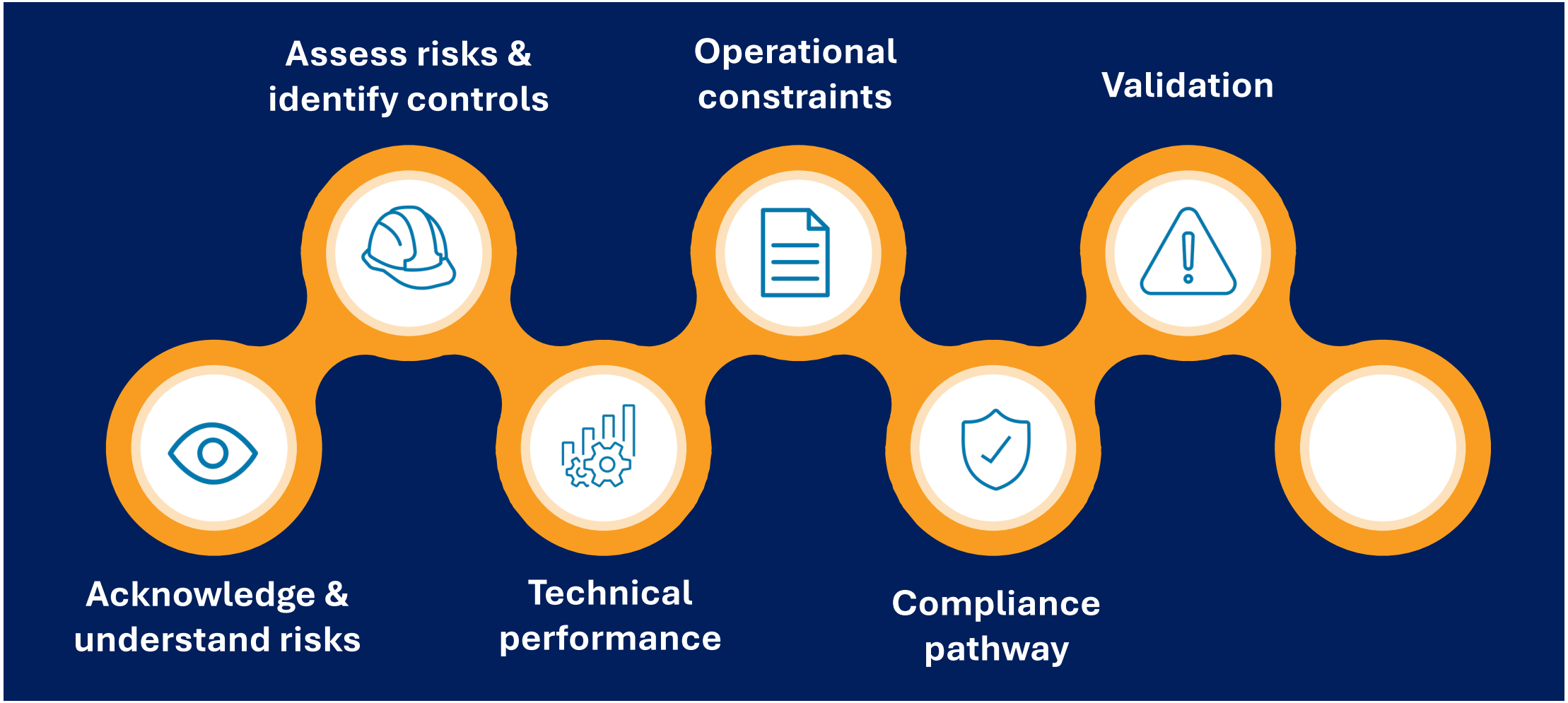
Pathway: From risk to control



Compliance

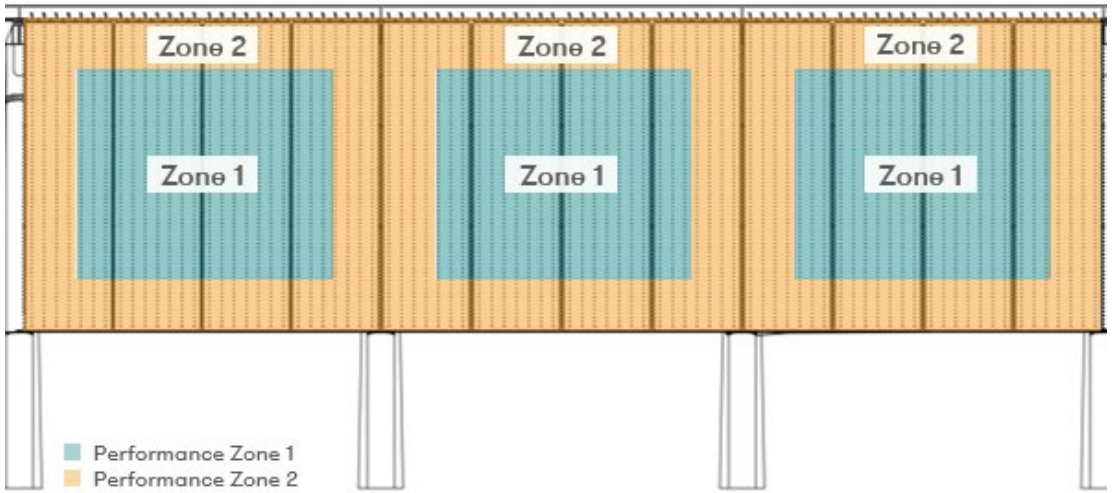
- ULS design approach, supported by ISO 2394 for reliability and AS/NZS 1170 for structural actions
- MEG4 , ALARP and Emerging Technologies.
- Role of operator.
- Testing evidence.

Pathway: From risk to control



Proving performance

- Performance varies by zone: central areas more flexible, edge zones stiffer, edge performance sets design limits.



Proving performance

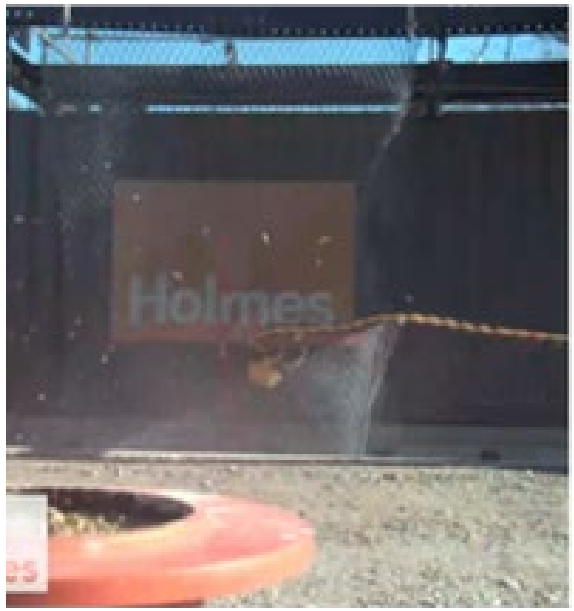
- Performance varies by zone: central areas more flexible, edge zones stiffer, edge performance sets design limits.
- Safe working width and debris management.

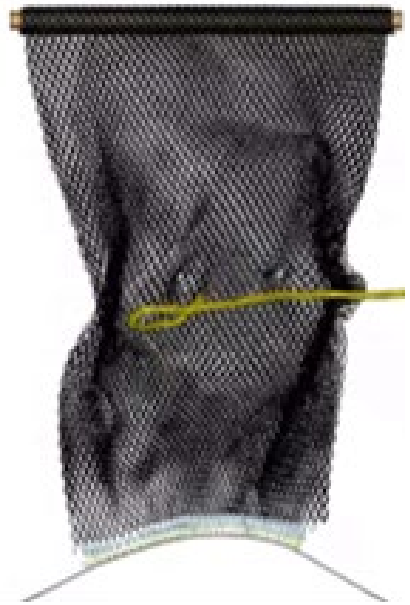
Proving performance

- Performance varies by zone: central areas more flexible, edge zones stiffer, edge performance sets design limits.
- Safe working width and debris management.
- Robust boundary connections, strong anchoring systems and panel-to-panel links.

Proving performance

- Performance varies by zone: central areas more flexible, edge zones stiffer, edge performance sets design limits.
- Safe working width and debris management.
- Robust boundary connections, strong anchoring systems and panel-to-panel links.
- Efficient load transfer.



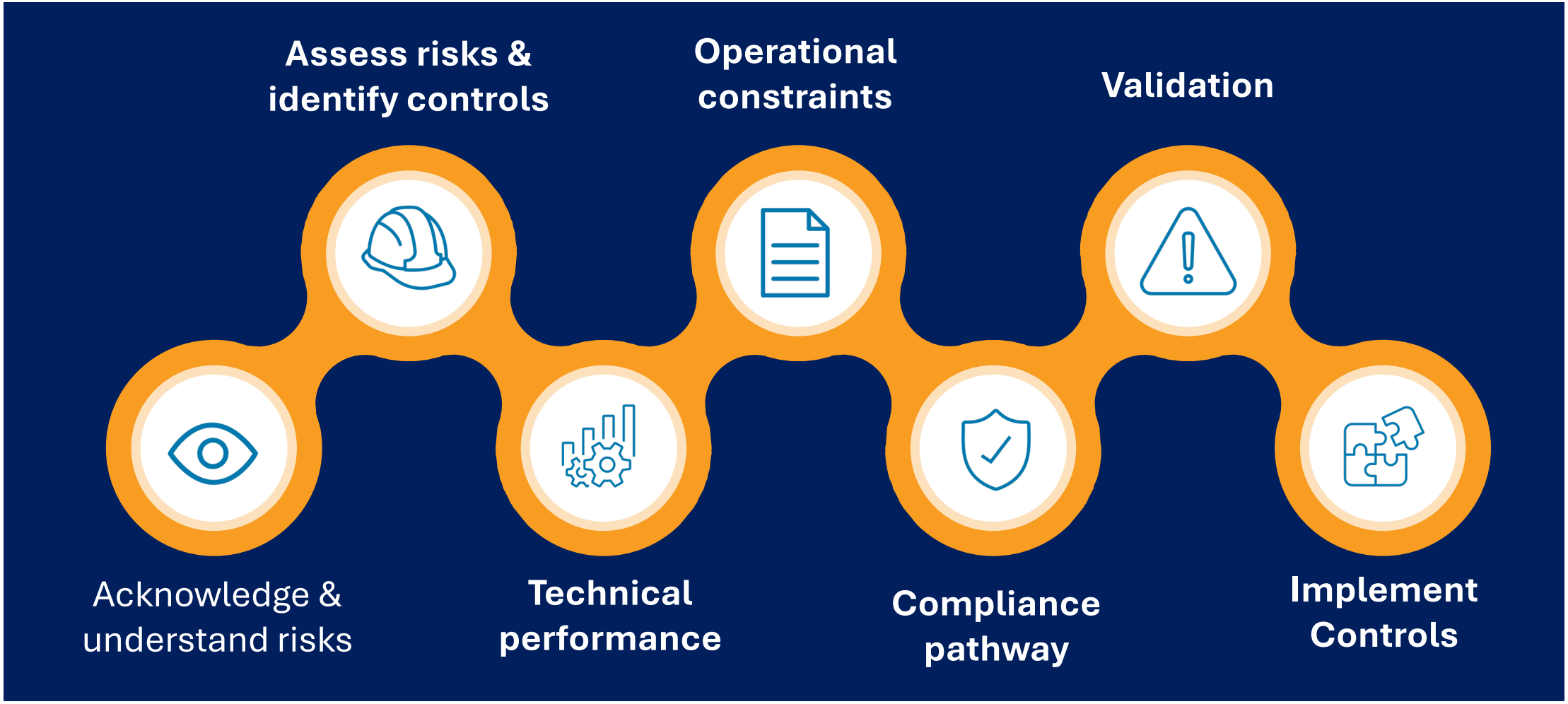


Analogous methodologies

- Performance validated for reliability and safety.
- Full-scale physical testing is essential.
- Calibrated computer simulations support design assessment.

Product Framework	Performance Requirements	Energy Level (kJ)	Basis for Approval	Evaluation Criteria	Relevant Standard/Guideline
Roadside Hardware	High velocity vehicle impact	97 – 806	Full-scale testing	Structural adequacy, occupant risk, residual energy	AS/NZS 3845 series, MASH (2016), EN 1317:2010 series
Roadside Hardware	Computer simulation	—	Simulation validation	Model correlation to test results	NCHRP Report 179, CEN/TS 17342:2019
Carpark Barrier	Low velocity vehicle impact	4 – 36	Calculation or testing	Structural adequacy	AS/NZS 1170 series
Roll-over Protective Structure	Low velocity vehicle roll-over	~30*	Full-scale testing	Structural adequacy, occupant protection	AS 2294
Rockfall Protection Barriers	High velocity concrete block impact	85 – >4,500	Full-scale testing	Structural adequacy, personal/asset protection	ETAG 027
FIA Debris Fences	Debris/flying object containment	40 – 1,000	Testing/Calculation	Structural adequacy, debris containment	FIA 3502-2018

Pathway: From risk to control



1

Acknowledge the risk.

2

Understand & Plan for risk: Safe System approach.

3

Validate your systems.


Technical papers available at:
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