Bowtie Analysis

Practical uses, benefits and its application to LNG tanker operations

James Sneddon
Principal Engineer

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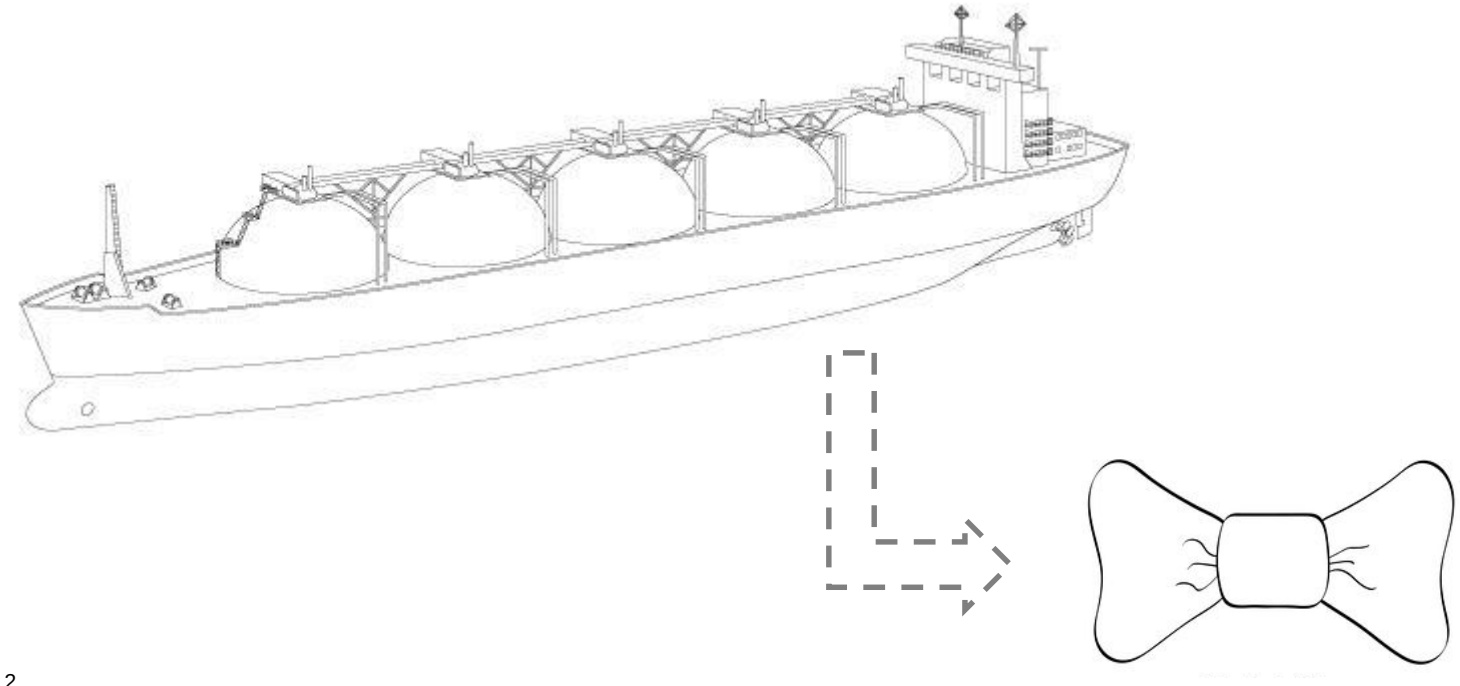
Purpose of Presentation

- Introduce bowtie methodology and its use as a risk assessment tool
- Discuss the practical uses, application and benefits of bowtie analysis, as observed cross-industry
- Provide a generic example of bowtie application for LNG tanker operations



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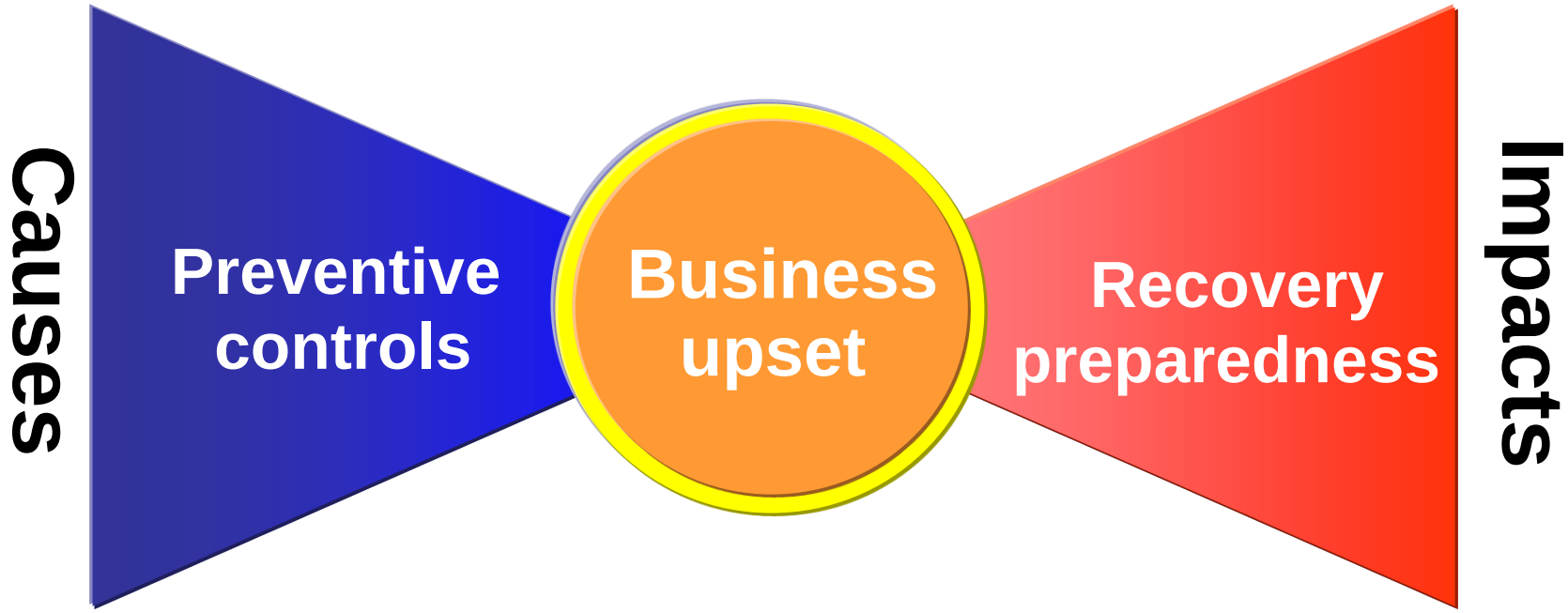
Bowtie Diagram

Basic Structure



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Bowtie Methodology

A short History…

- Exact origins of bow-tie methodology are hazy – believed to originate from ICI in the late 1970's
- Royal Dutch/Shell Group first major company to integrate bow-ties fully into business practices
- Use of bow-ties now widely spread between companies, industries, countries and from industry to regulator, e.g.:

  - Abu Dhabi National Oil Company (ADNOC)
  - UK Health and Safety Executive
  - French Government
  - Australian State Regulator
  - Land Transport Safety Authority of New Zealand
  - International standards (e.g. ISO 17776:2000)
  - International Association of Drilling Contractors (IADC)

Risk Evaluation and Management

HSE Management System

An **HSE-MS** is a structured set of controls for managing HSE risk in a business

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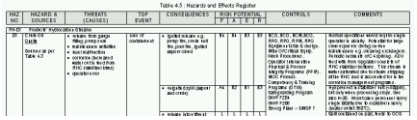
Where do Bowties fit in?

Identify Hazards

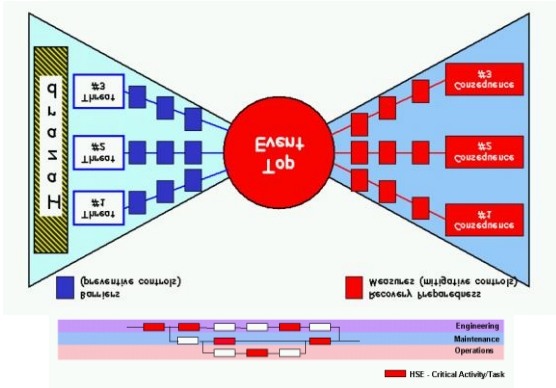


Develop Risk Scenario

Risk Management

Severity	CONSEQUENCE				FREQUENCY				
	People	Assets	Environment	Reputation	A Never heard of in industry	B Has occurred in industry	C Has occurred in company	D Occurs several times per year in company	E Occurs several times per year at location
0	No injury	No damage	No effect	No impact	Manage for Continuous Improvement				
1	Slight injury	Slight damage	Slight effect	Slight impact					
2	Minor injury	Minor damage	Minor effect	Limited impact					
3	Major injury	Localised damage	Localised effect	Considerable impact			Incorporate risk reduction measures		
4	1 - 3 fatalities	Major damage	Major effect	National impact					
5	Multiple fatalities	Extensive damage	Massive effect	International impact				Intolerable	

Assess Risk



Detailed Analysis of Significant Risks

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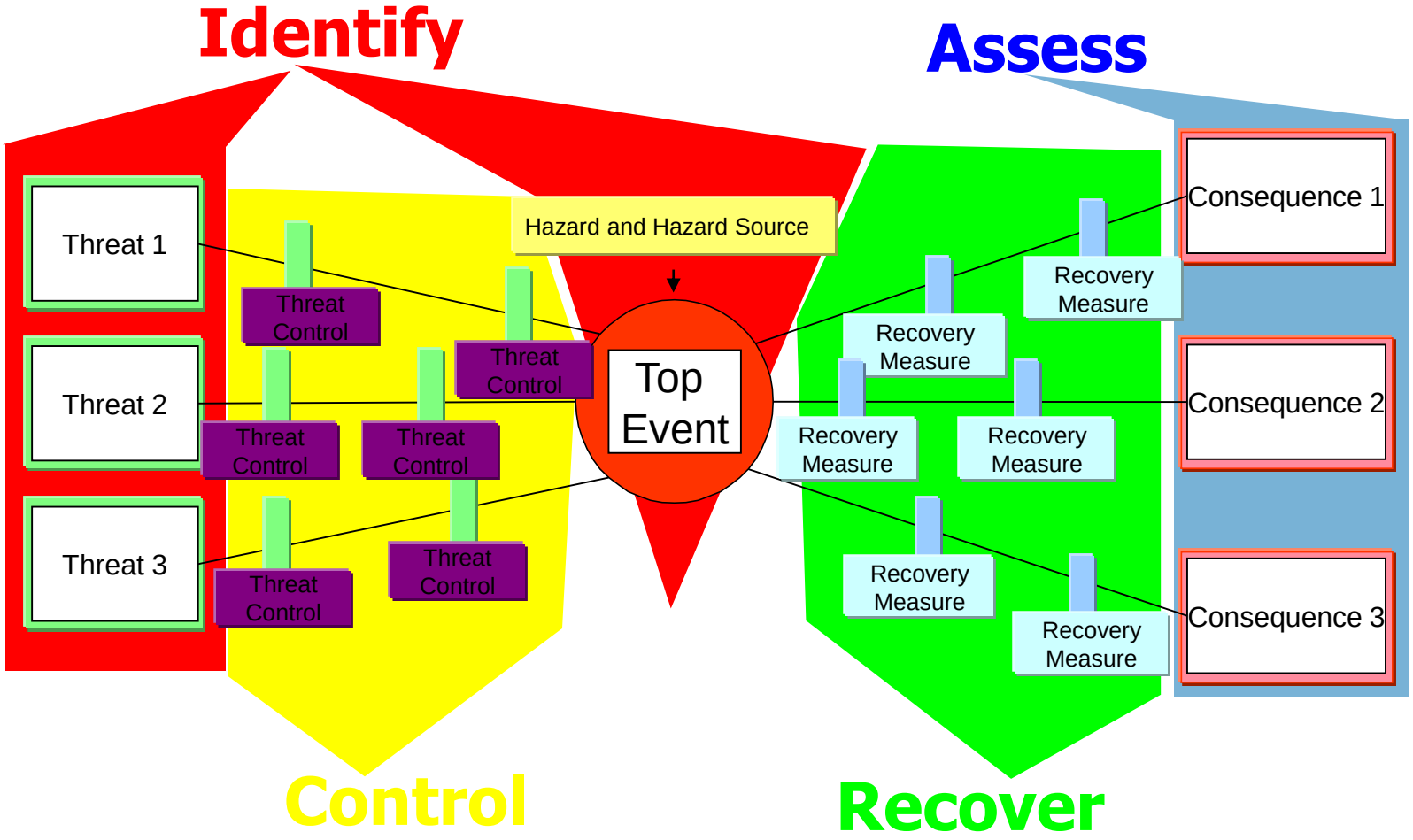
Bowtie Diagram

An Overview…



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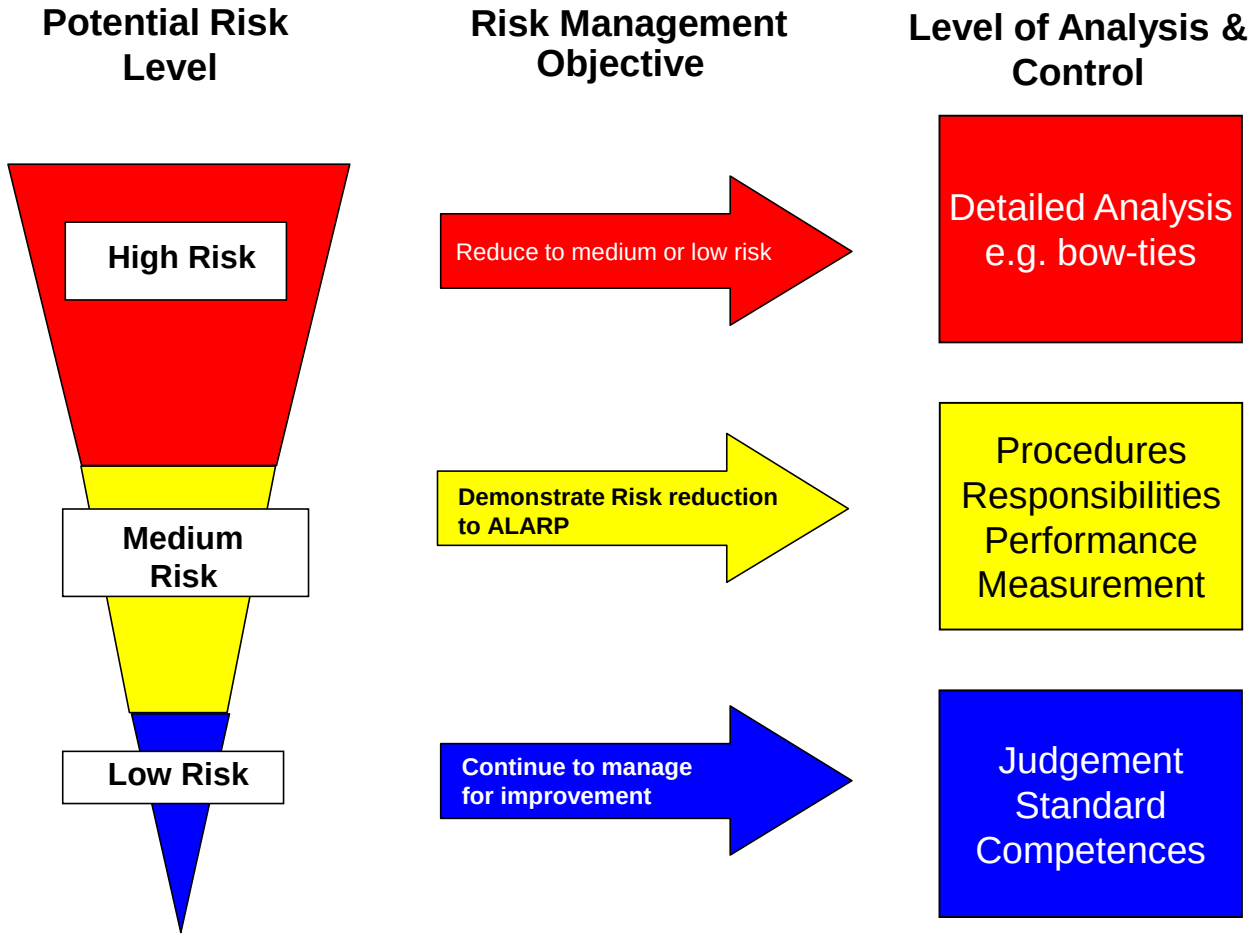
Bowtie Diagram

Typical Application



But method is equally applicable to routine risks as major risks

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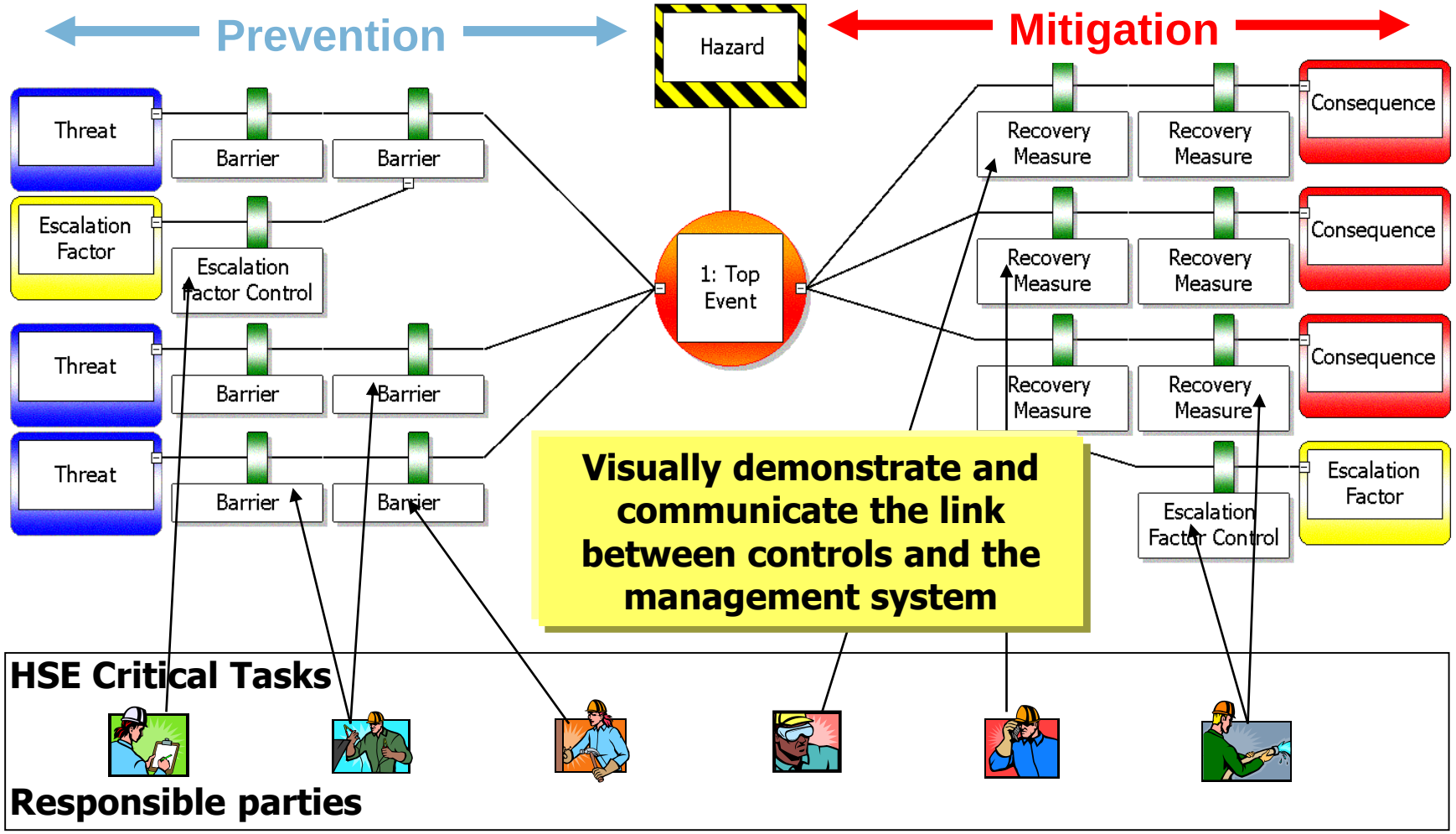
Practical Uses of Bowtie

Logical structured approach	**What are our major risks? Do we have any gaps in risk control?**
Communication	**How do we engage non-risk specialists?**
Formal demonstration	**Can we really demonstrate control of our risks?**
Specific risks	**Are these risks properly understood and controlled?**
Critical roles	**Do our people know what is expected of them?**
Competencies	**Are competence and control requirements aligned?**
Procedures	**Are they complete and effective?**
Auditing	**How can we focus audits on what really matters?**
Critical systems and performance standards	**What are they?**

Bowtie and HSE Critical Tasks



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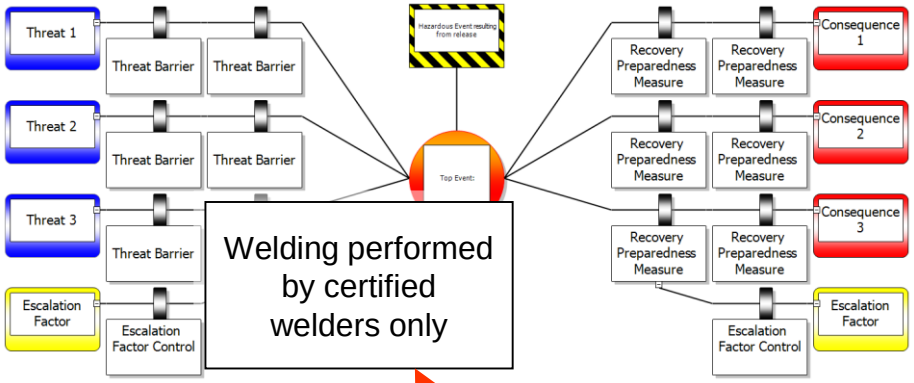
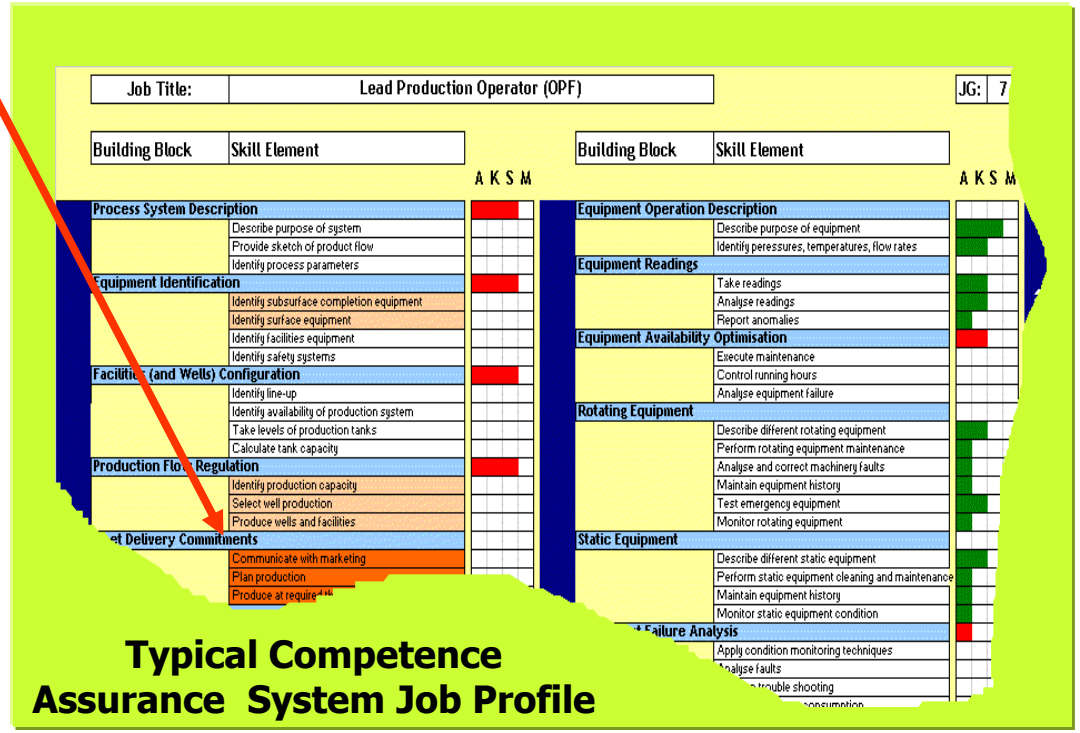
Bowtie and Operator Competencies



Verify that competence and control requirements are aligned



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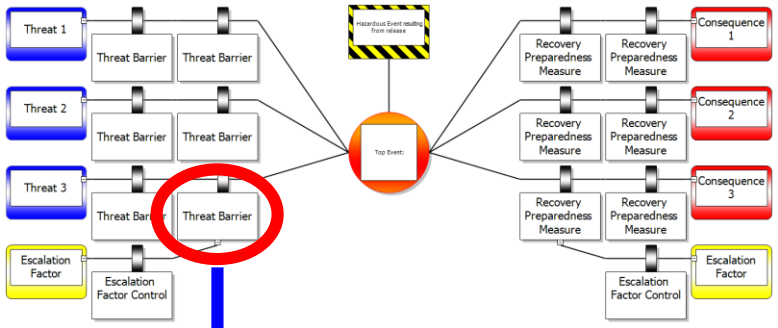
Bowtie and Training & Development



Competent people provide resilience against major risks

…to ensure each risk control works…

HSE-critical task

HSE-critical task catalogue

HSE-critical role

Accountability packs

Task competencies

Training requirements

Assess people against requirements

…use Competency Mgmt System

SkillsXP

Personal T&D plans

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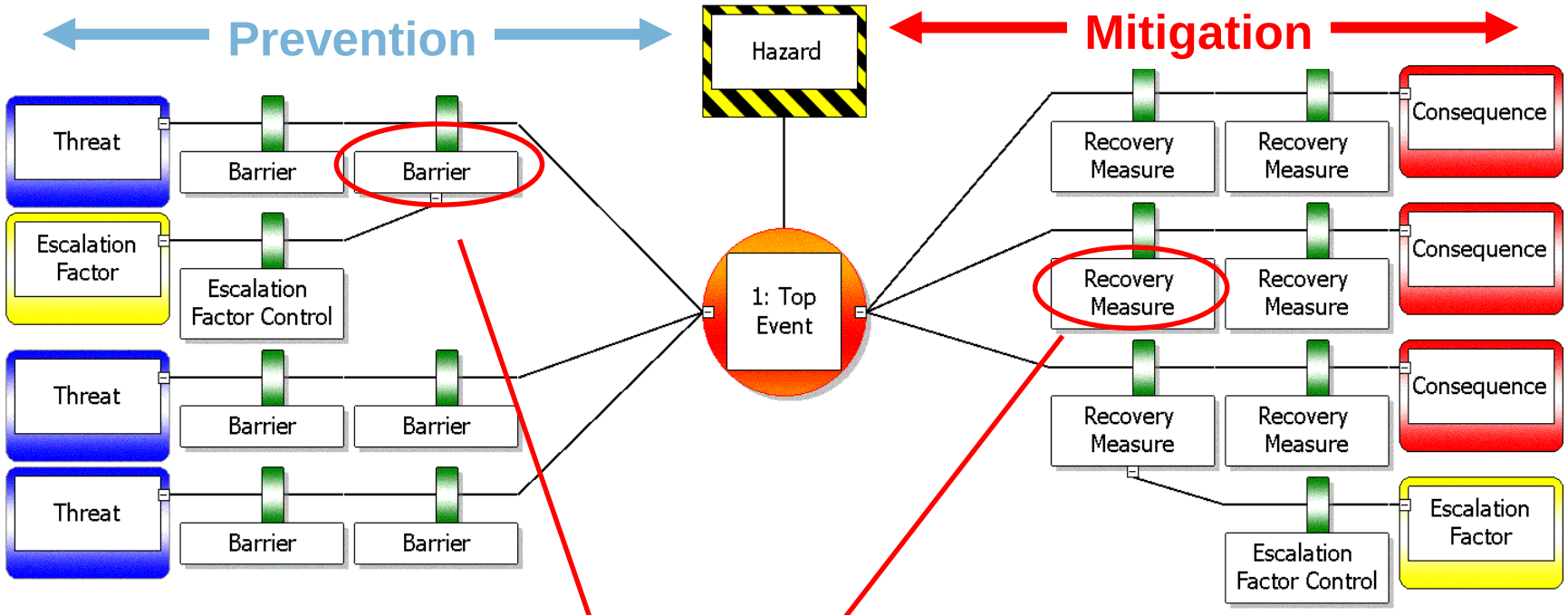
Critical Systems



Establish performance standards for these systems
Maintenance management system should flag HSE-critical systems and tasks

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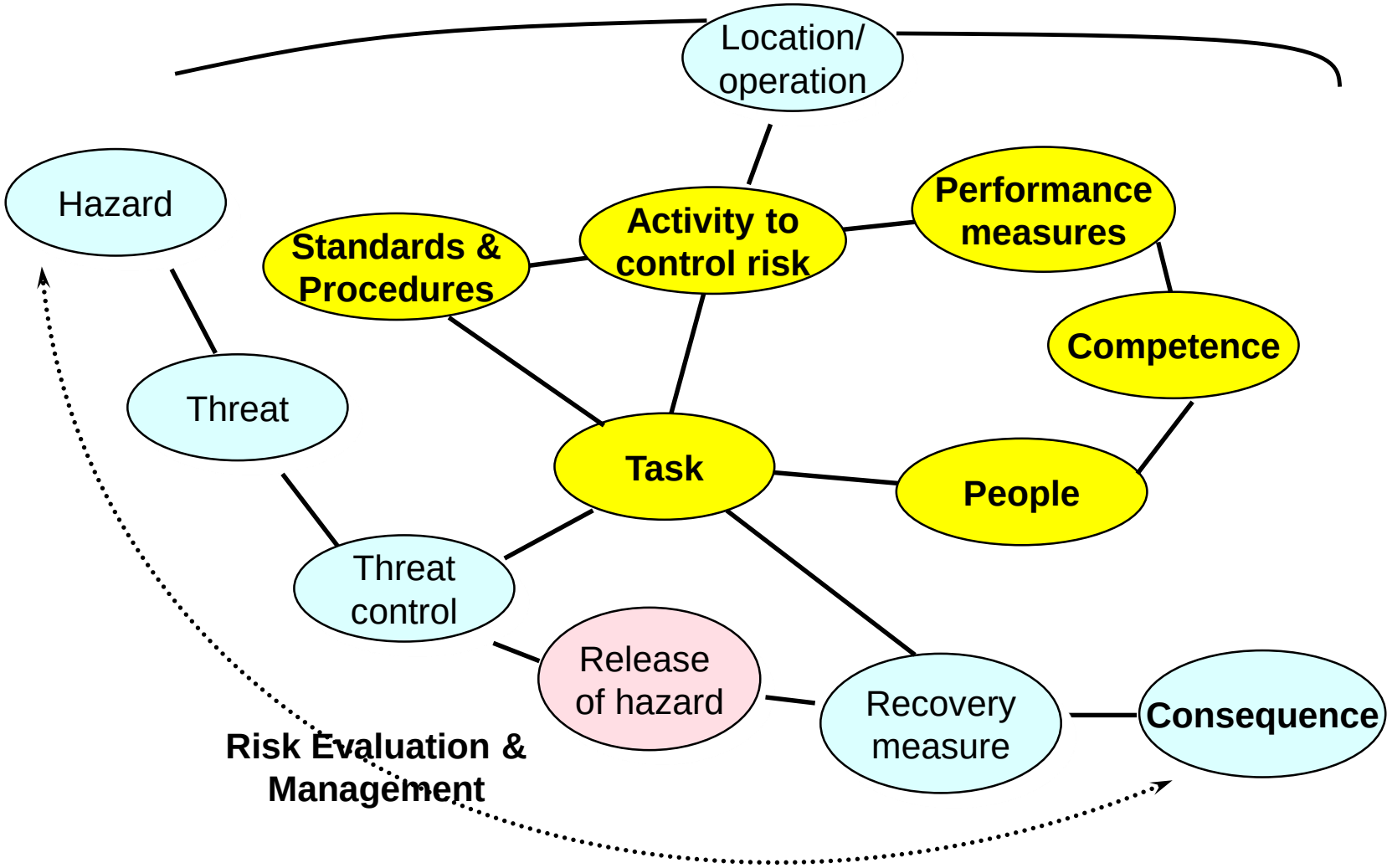
Total Hazard Control

In the end you must have all connections in place for effective hazard control



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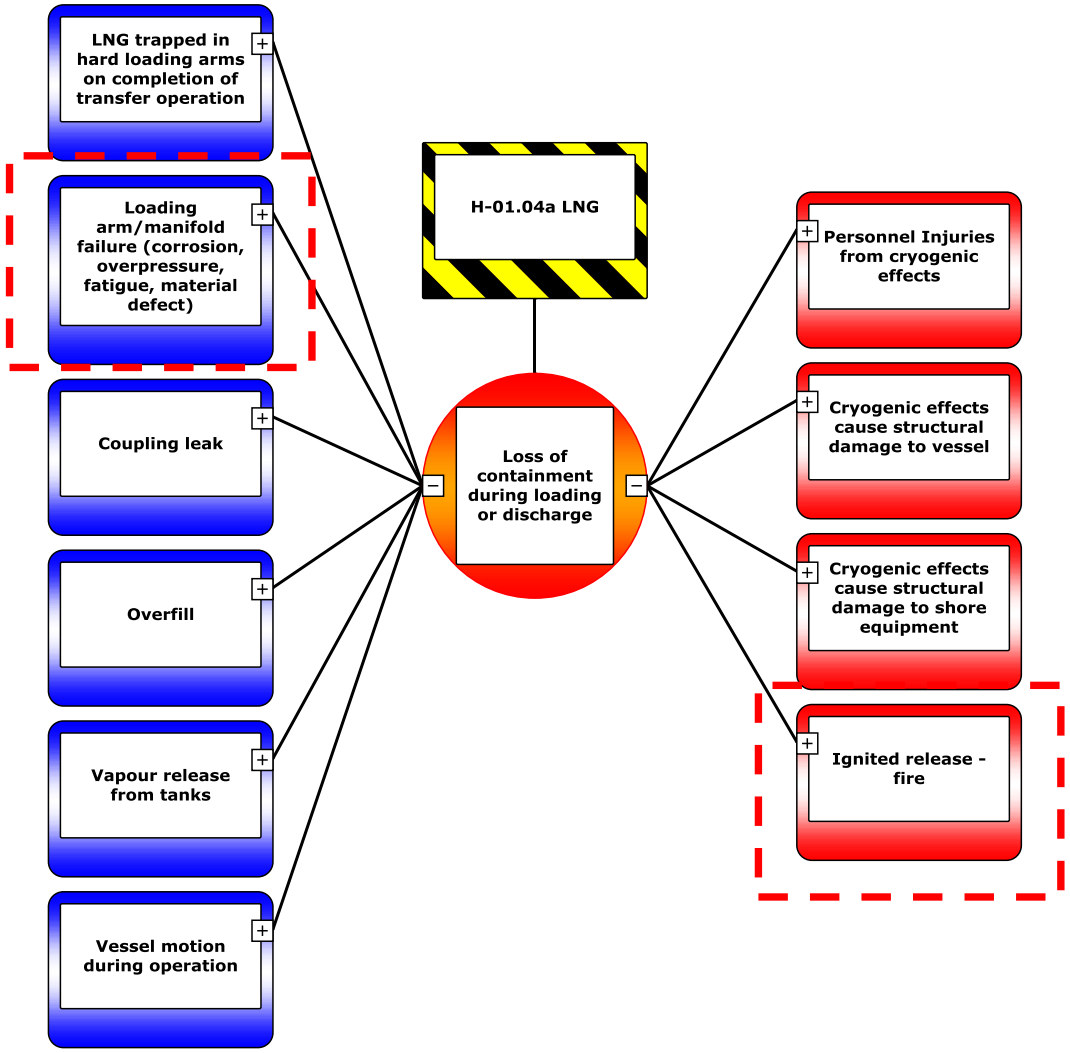
Example Bowtie; LNG Tanker operations

Example 1: LNG; Loss of Containment during Loading or Discharge



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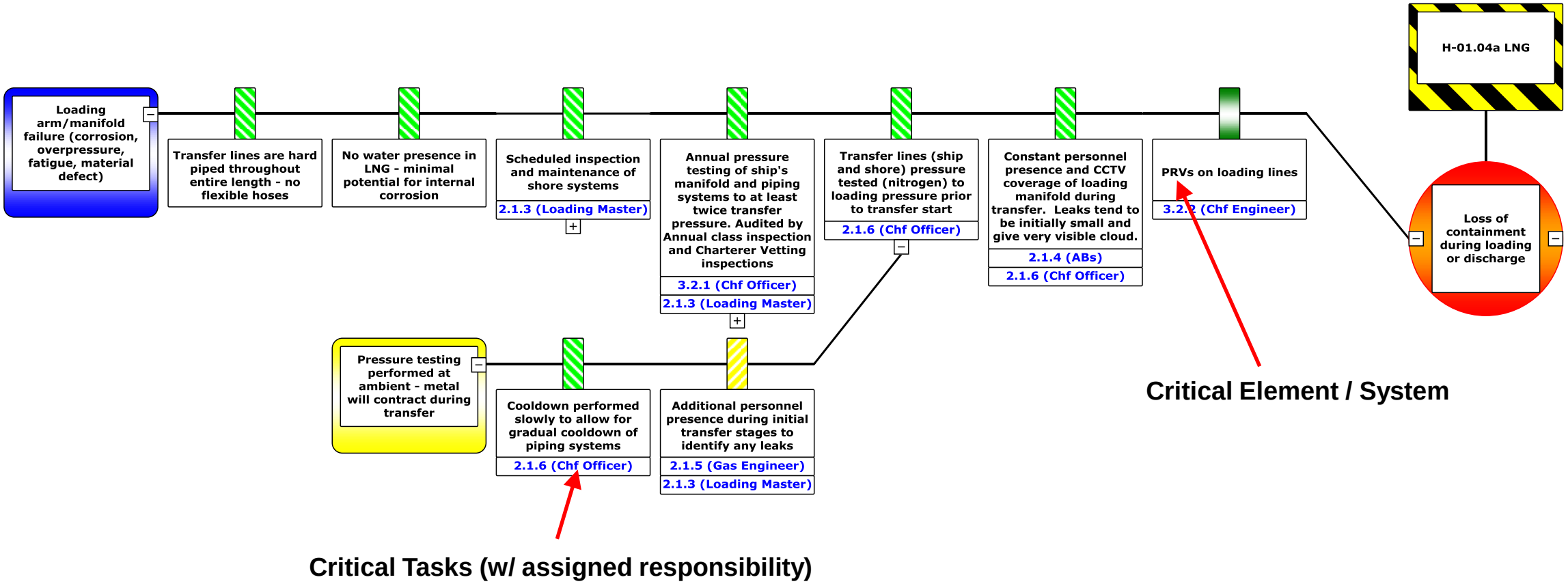

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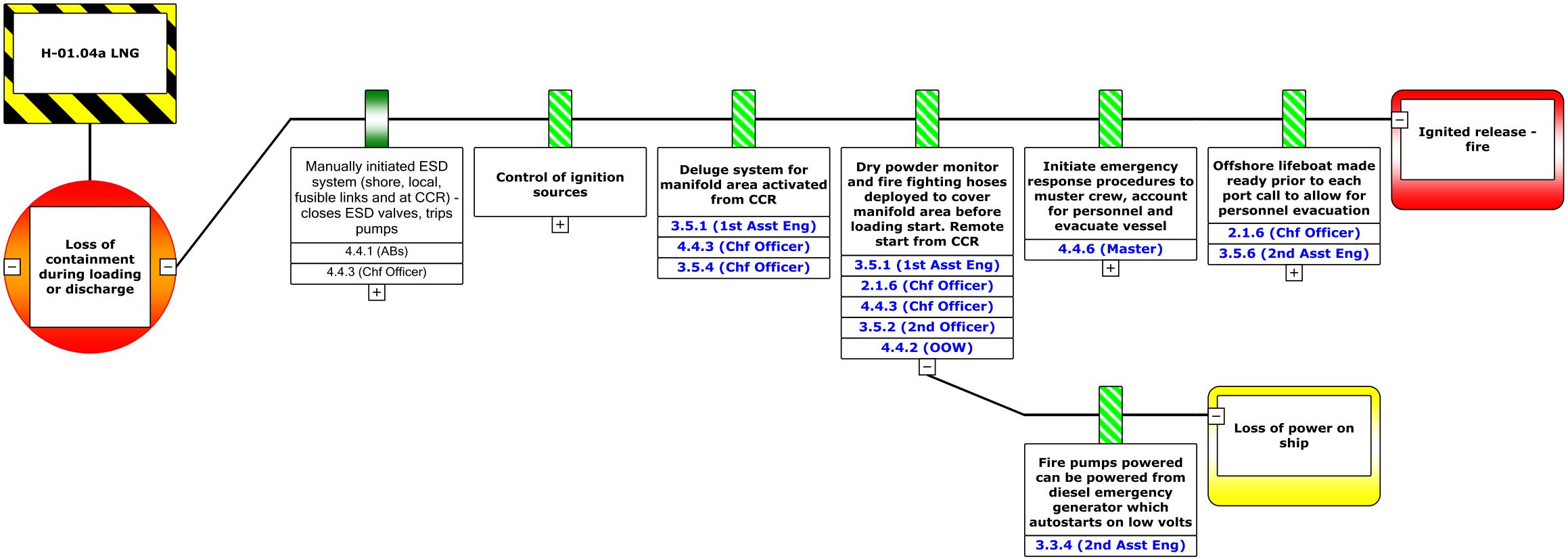

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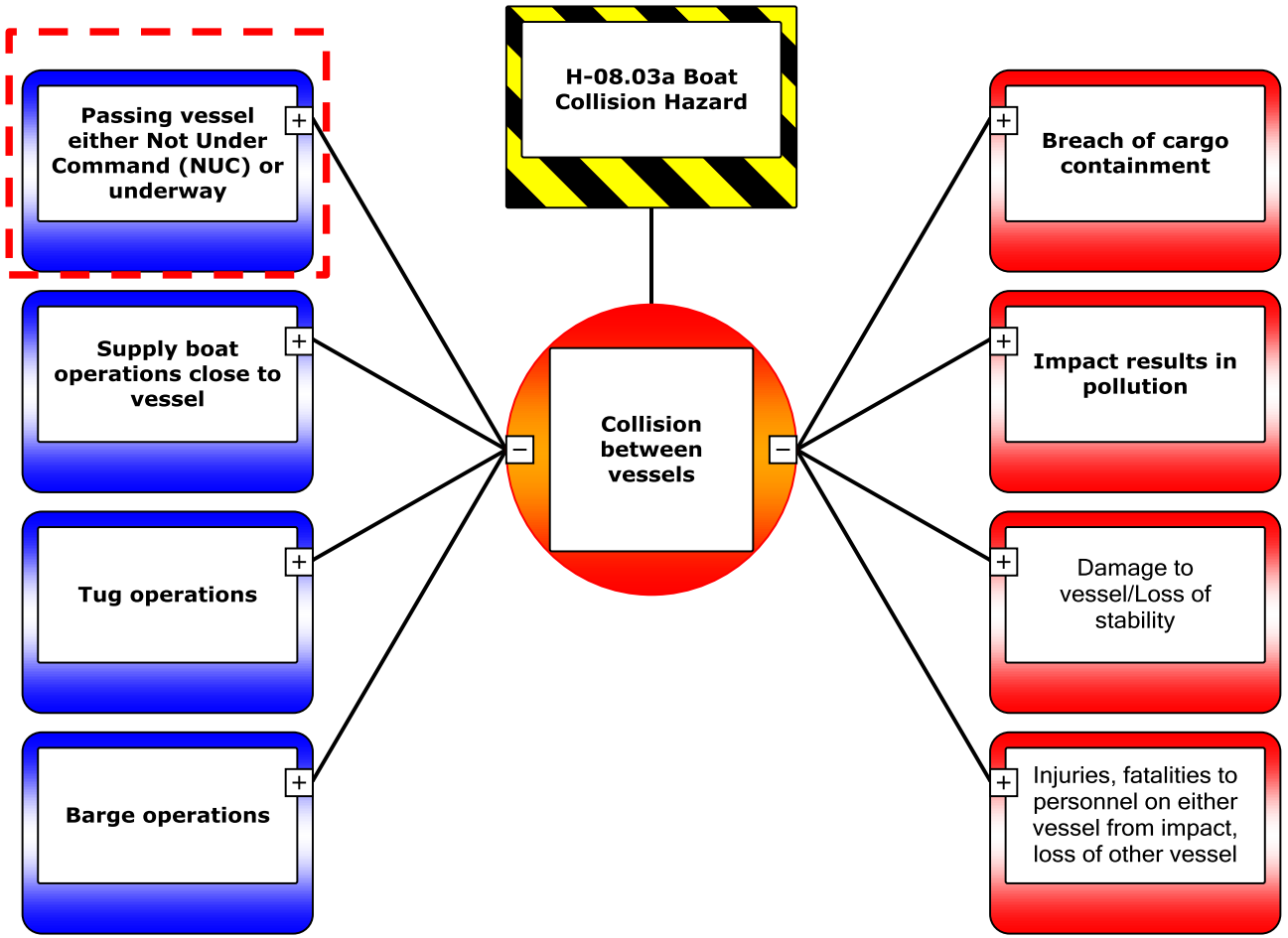
Example Bowtie; LNG Tanker operations

Example 2: Boat Collision; Collision between vessels



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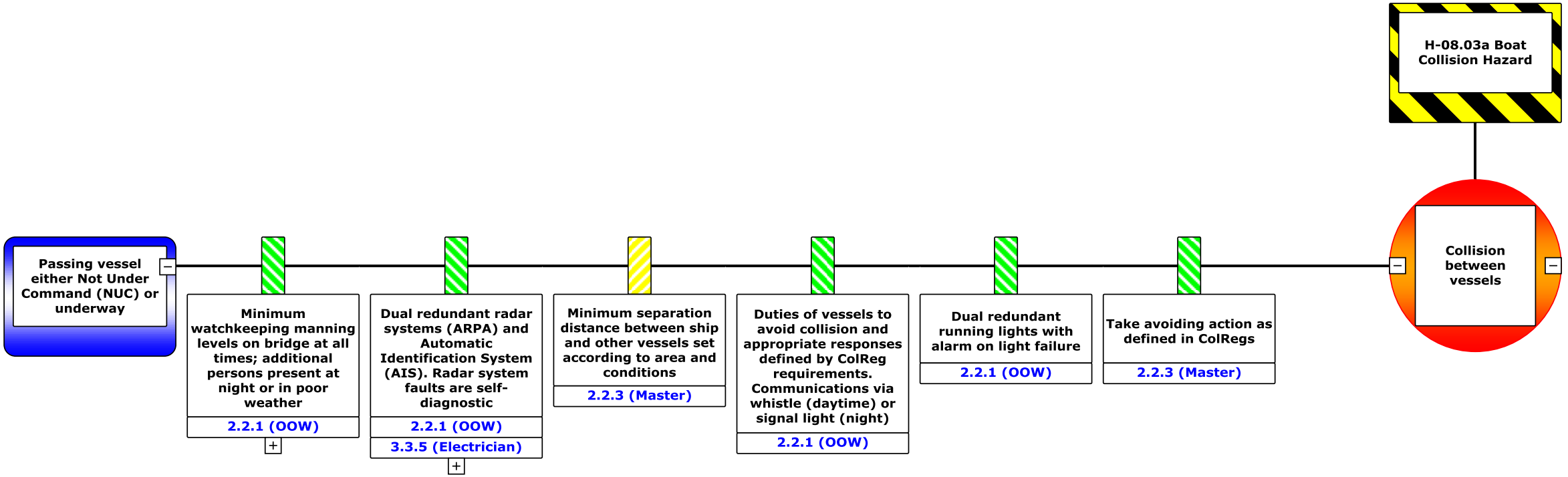

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Benefits of Bowtie Analysis

- Goes beyond usual risk assessment ‘snapshot’ and highlights links between risk controls and management system
- Helps to ensure that risks are managed rather than just analysed
- Forces a comprehensive and structured approach to risk assessment
- Excellent for communicating risk issues to non-specialists
- Ownership – involves people, gains buy-in, practical approach
- Operations – assigns responsibility for hazard controls and links to asset integrity
- All risks – not just HSE
- Risk reduction - identifies where resources should be focussed for risk reduction, i.e. prevention or mitigation

Limitations of Bowtie Analysis

- Qualitative – does not replace QRA
- Does not replace techniques like or HAZOP or FMECA
- Depends on experience of personnel and active participation
- Ensure controls in bowtie are truly independent
- Not obvious which controls are most important
- Use as a communication tool (simple bowtie) vs complete demonstration of hazard management (detailed bowtie) – potential conflict

But if you want to remove mystique of risk management and obtain insights into your risk controls that are easy to understand and easy to communicate, there is no better method than bowties

Summary

- The Bowtie Diagram is a user-friendly, graphical illustration of how hazards are controlled, supporting a complete and comprehensive approach to risk management
  - Linkage to HSE Management Systems;
  - Assigning Critical Tasks, Procedures, Competencies
  - Identifying Safety Critical Equipment, Processes
- The total methodology demonstrates not only what controls are in place today, but why they will still be there tomorrow.
- Bowtie controls link into all aspects of our management systems

Questions?

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