Striking the Balance

Getting Value Out of Bowtie Diagrams

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Topics

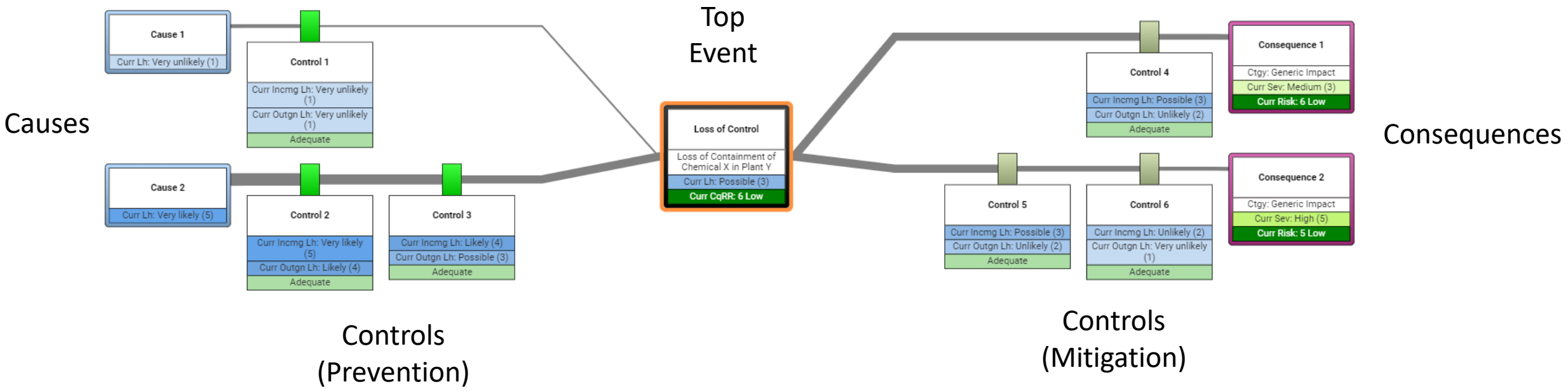
1. What are we trying to achieve?
2. What is a bowtie diagram?
3. What makes a good bowtie?
4. What are some common problems?
5. Conclusions

What are we trying to achieve?

- Manage our risk issues
  - Major hazard safety
  - Material risks etc.

- Achieve this by identifying:
  - Hazards
  - Causes and outcomes
  - Controls
  - Relationship between the controls and causes / outcomes

Sample Bowtie



Why Bowties?

- Simple, clear and easy to understand
- Can be used to analyse a wide range of scenarios
- Clear linkages between controls and the causes / consequences
- Good communication tool

Desirable features

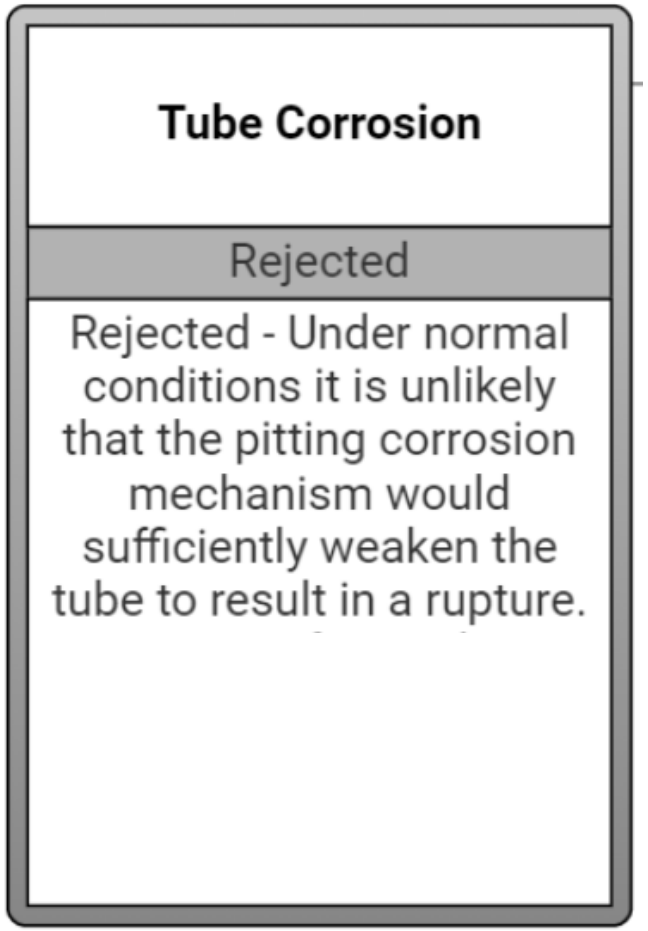
- Clarity
- Simplicity (or at least, not undue complexity)

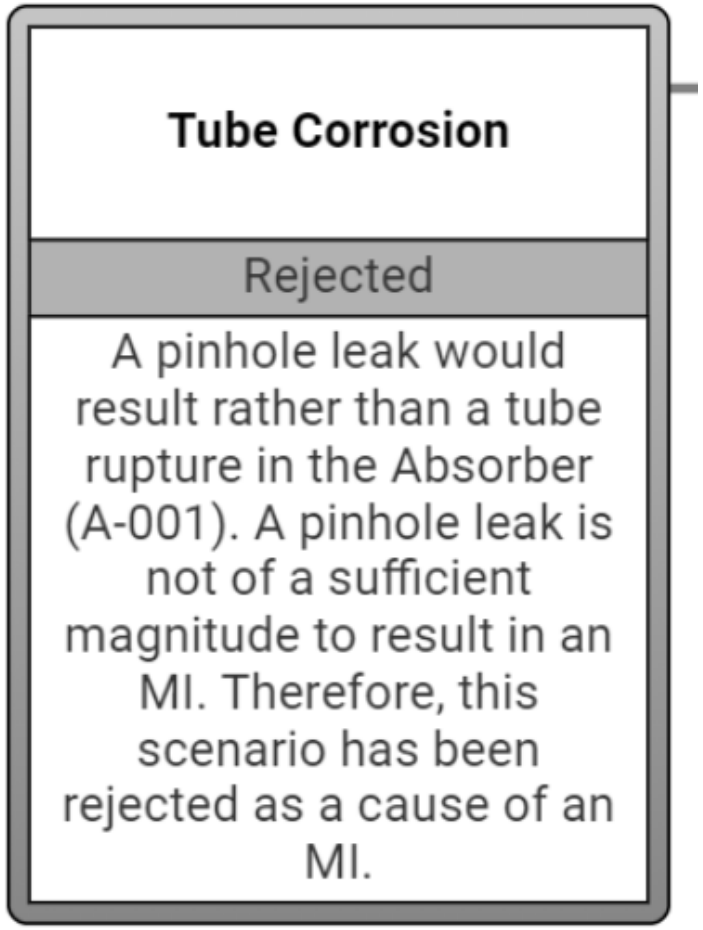
Common themes of ineffective bowties

- Top Events that are not significant
- Trivial or vague causes
- Poor control selection

Causes – Rejection Basis

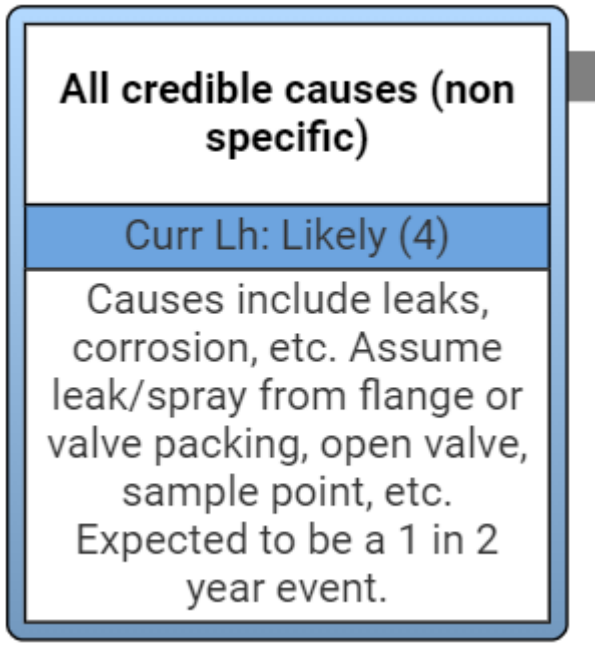
- Exclude causes that cannot result in the Top Event
- Ensure that causes are excluded on consequence and not likelihood

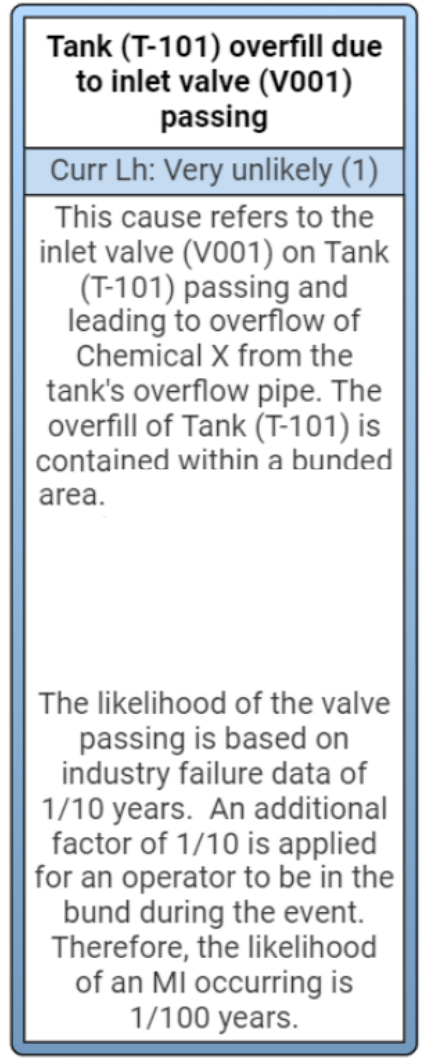




Causes – Vague

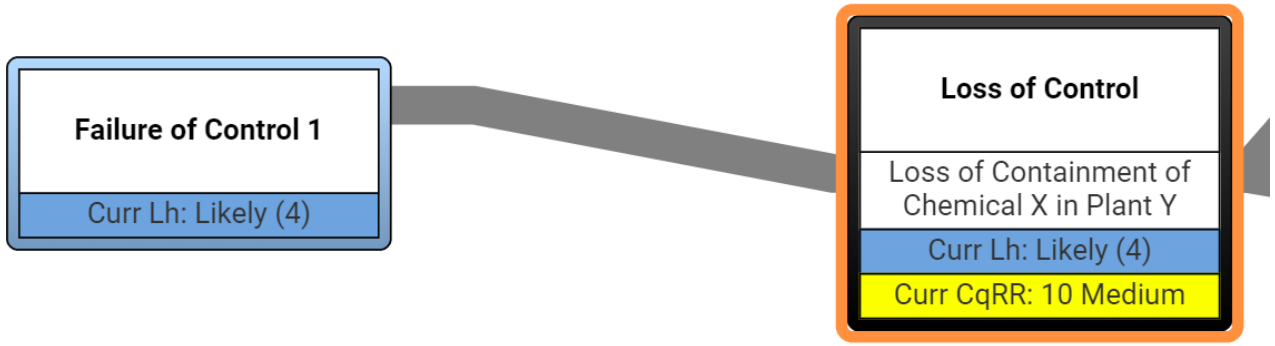
- Avoid vague cause descriptions
- Ensure that the cause description is clear and direct





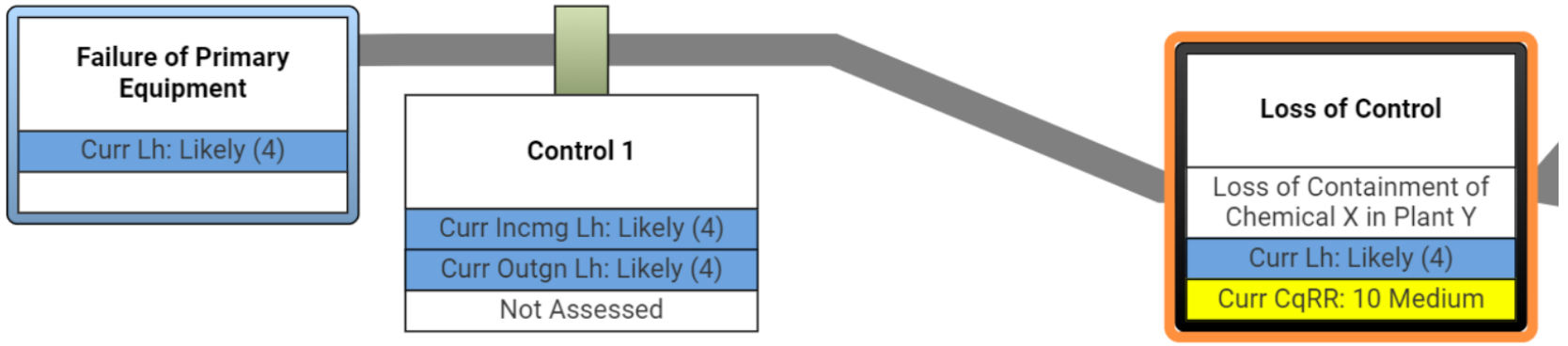
Causes – Failure of a Control

- Avoid defining a cause as the “failure of a control”



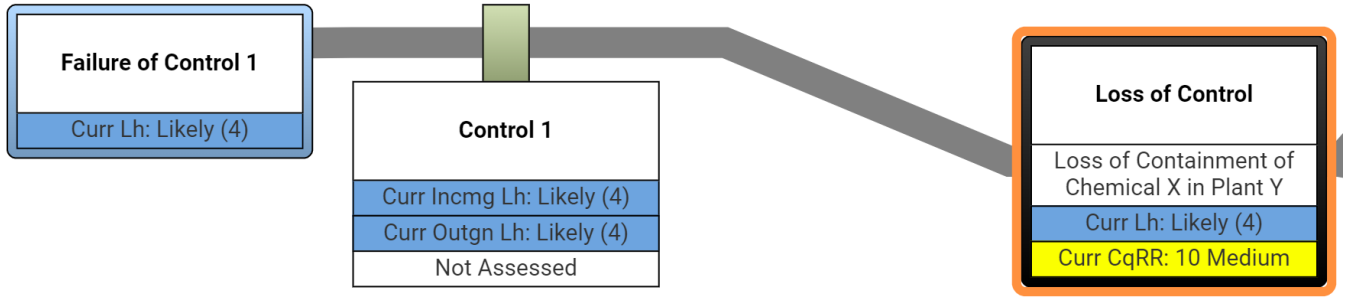
Causes – Failure of a Control

- Redefine the cause

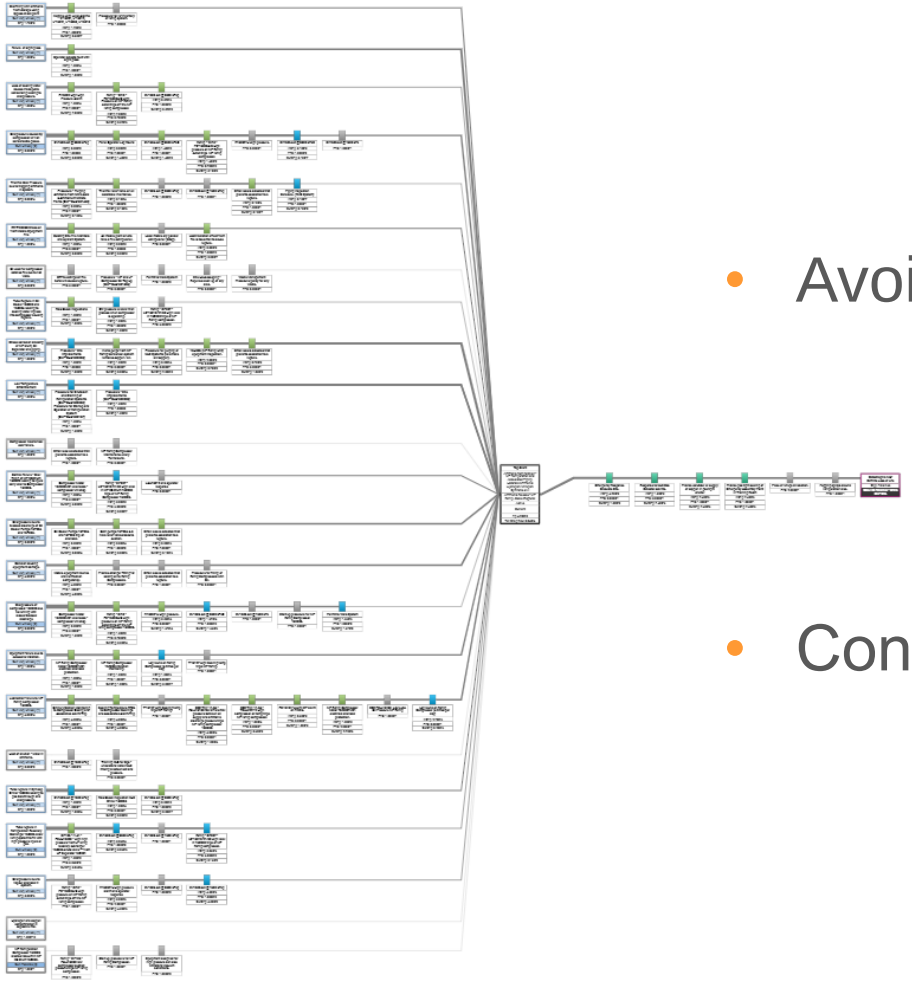


- May often relate to the failure of primary equipment

- If unavoidable, include the control as a barrier (without risk reduction credit)



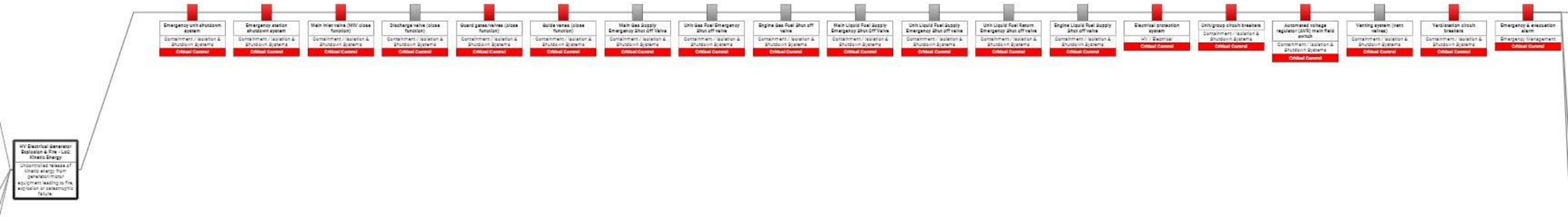
Causes – Numbers of Causes



- Avoidance of excessively large number of causes
- Consider using a “General” or “Site-wide” bowtie

Controls – Keeping it Real

- More controls is not better
- Limit things to “real” controls

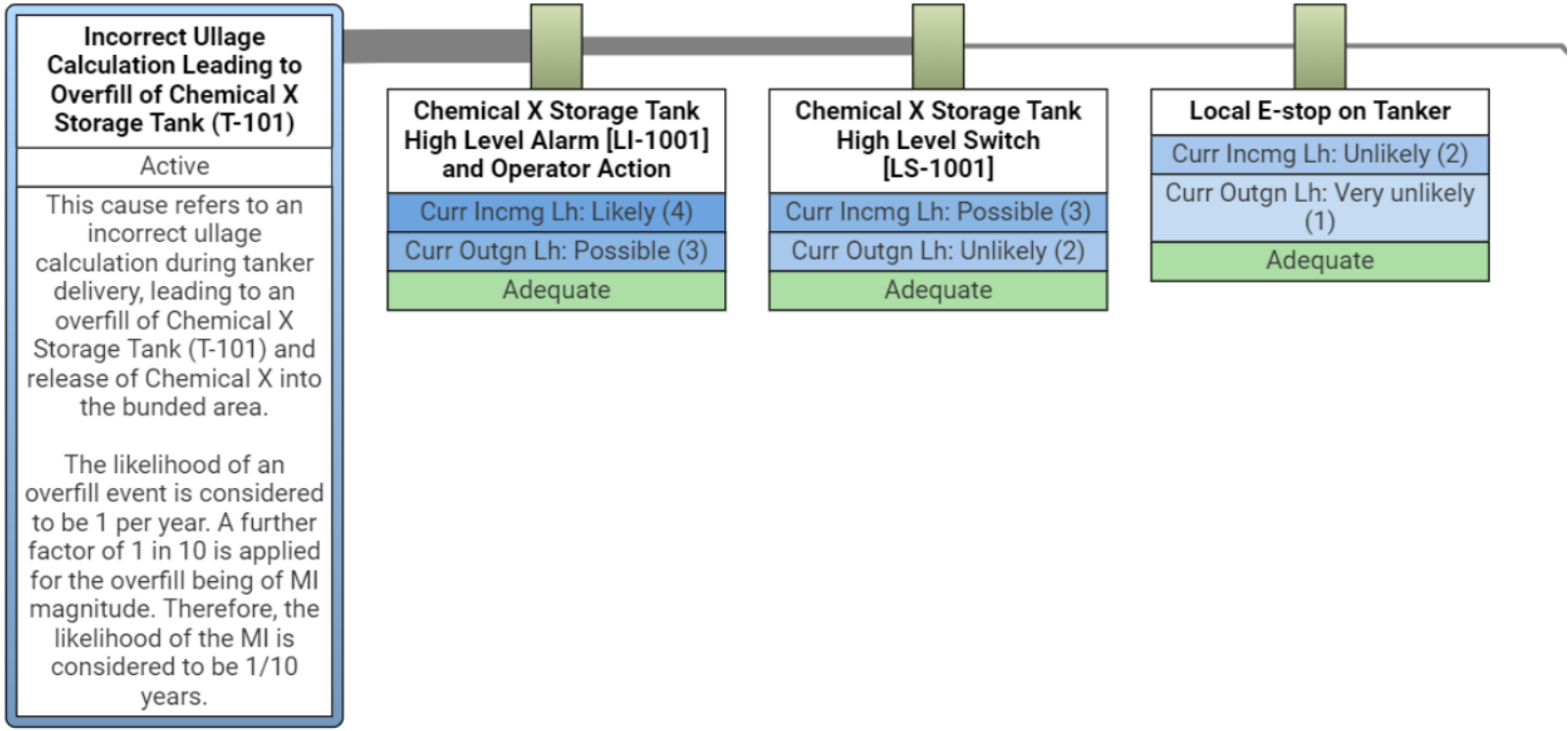


Controls - Characteristics of “Real” Controls

• Implemented	The control must be fully implemented, i.e. the control must be in place.
• Effective	The control must be effective – if the control functions as intended, it should prevent the Top Event or significantly mitigate its consequences.
• Reliability	The control should be sufficiently reliable, i.e. it should have a low probability of failure on demand.
• Auditable	It should be practical to audit the control so that its performance may be established.
• Monitored	Systems should be in place to monitor the performance of the control, to ensure that it remains functional.

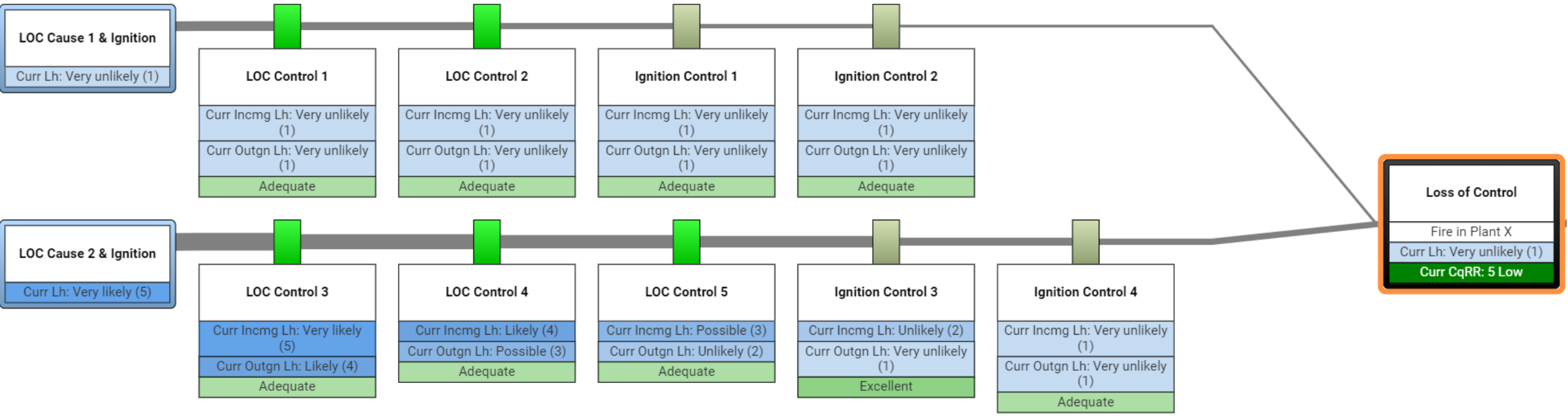
Controls – Be Specific

- Be specific!
- Linkages to the cause / outcome

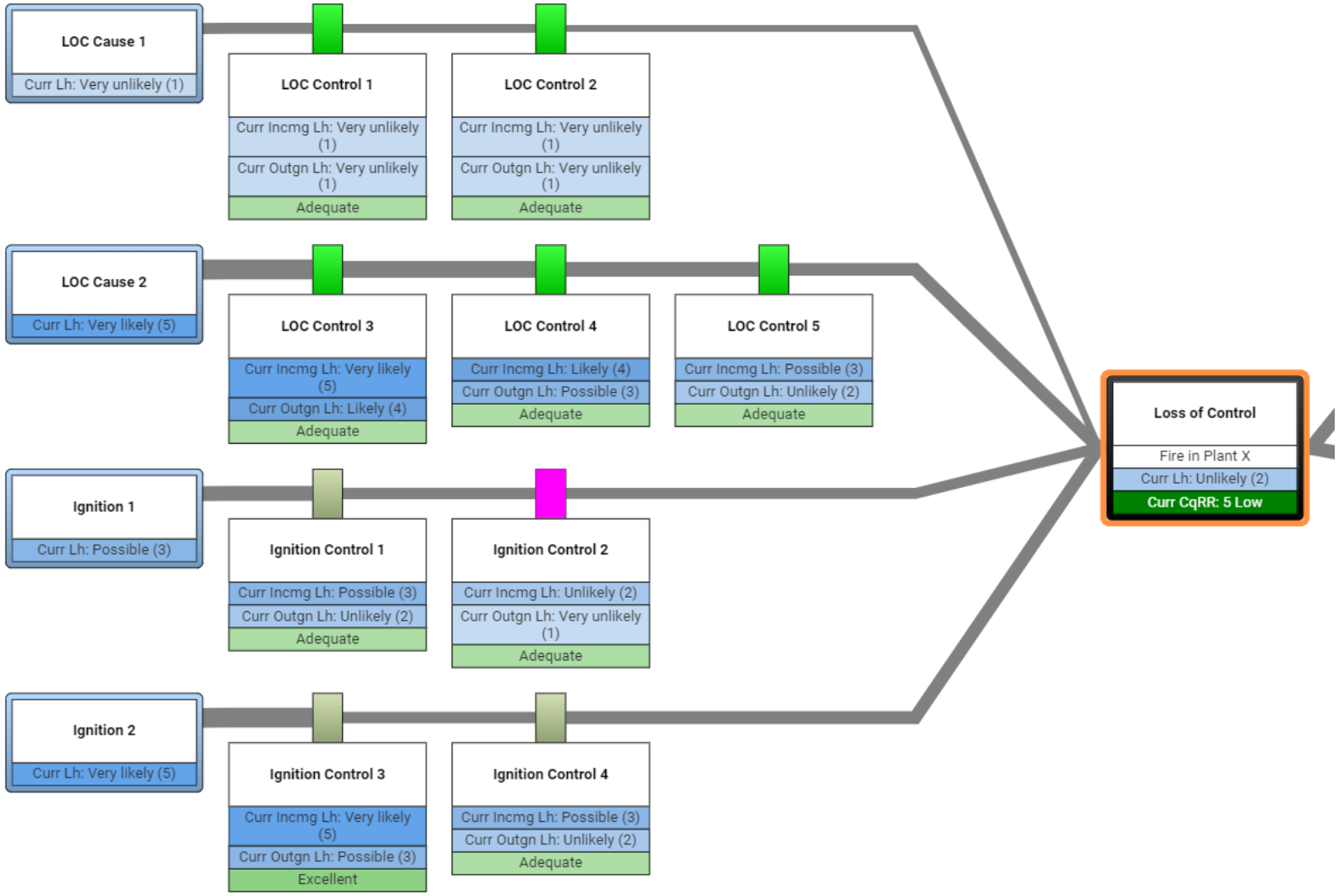


Top Event – Definition as an Outcome

- Definition of the Top Event as an outcome



Top Event – Definition as an Outcome



Software Tools

- Some tools used will have limitations, some will be powerful

“All modelling is wrong, it’s just that some modelling is useful”

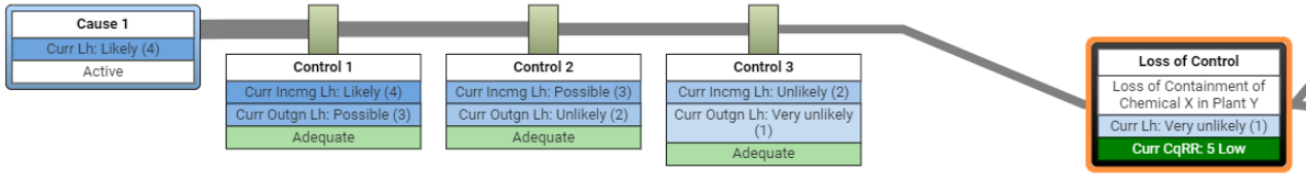
- A bowtie may not be able to precisely represent every hazard

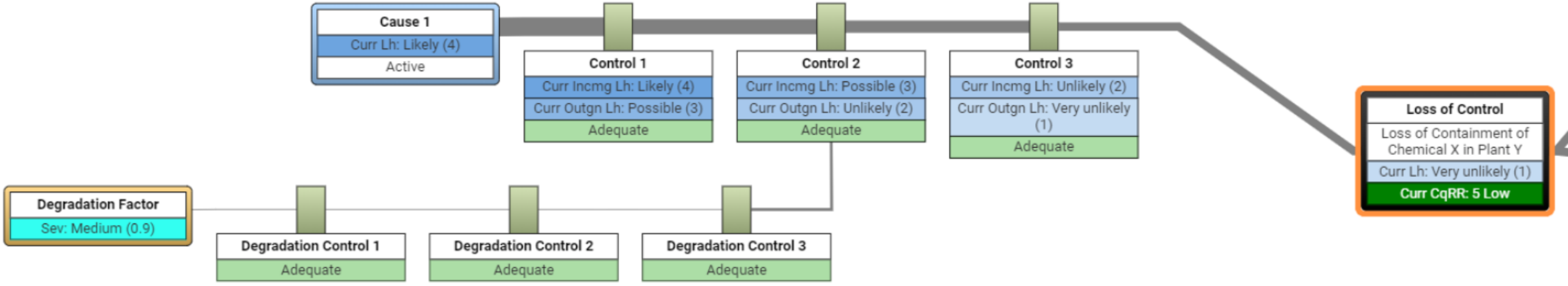
OR

- A perfect representation of a hazard may result in an overly complex bowtie

Software Tools

- Powerful bowtie software tools are available
- Able to undertake complex analysis
- *Just because you can, doesn't mean you should*





Rulesets

- Develop a clearly defined ruleset
- Use it to test the suitability of causes, controls etc.

- Should cover:
  - Study Boundaries
    - Minimum impact threshold
  - Controls
    - Control criteria
    - Control adequacy (quantitative / semi-quantitative analysis)
  - Risk assessment
    - Methodology
    - Tolerability criteria

Conclusions

Rule #1 – Keep your eye on the prize!

- Keep things as simple as practical
- Add complexity only where it adds value
- Be specific in descriptions
- Ensure linkages are clear
- Everything must have a purpose