WorleyParsons

resources & energy

Risk Based Inspection and extended inspection intervals

Dave Clarihew

HERA Pressure Equipment Workshop October 2016

EcoNomics

What we will cover

- What is RBI?
- The role of RBI in determining inspection intervals
- The RBI process
- Some limitations of RBI
- Questions

What is RBI?

"A risk assessment and management process that is focussed on loss of containment of pressurised equipment in processing facilities, due to material deterioration. These risks are managed primarily through equipment inspection."

- API RP580, *Risk Based Inspection*

RBI within current regulatory framework

- Two Approved Codes of Practice originally issued under HSE Act
  - *Design, Safe Operation, Maintenance and Servicing of Boilers*, 2000 (amended 2004)
  - *Pressure Equipment (Excluding Boilers)*, 2001
- Both reference AS/NZS 3788 *Pressure Equipment – In-service inspection*
- Appendix F of *Pressure Equipment ACoP* defines requirements for in-service inspection – including extension of intervals beyond ‘nominal’.

RBI within current regulatory framework

- AS/NZS 3788 Table 4.1 defines inspection requirements and periods for different pressure equipment and hazard levels including requirements for:
  - Commissioning inspection
  - First yearly inspection
  - External inspection
  - Internal inspection – nominal period
  - Internal inspection – extended period
- Without a suitable management system, the default inspection interval is 12 months (PE ACoP).
- With a suitable management system, and suitable operating experience, inspection interval may be up to nominal maximum.

RBI within current regulatory framework

- To extend inspection intervals beyond nominal, the PE ACoP requires
  - Controller to have an ISO certified management system
  - ITP to be recognised by the Secretary of Labour.

- Recognition of the ITP requires, amongst other criteria, the use of "*'risk based inspection' principles*".

RBI within current regulatory framework

- AS/NZS 3788:1996
  - Edition of standard when PE ACoP written.
  - Contains no mention of Risk Based Inspection

- AS/NZS 3788:2006
  - Current edition of standard
  - Risk Based Inspection is central, with Table 4.1 utilised when RBI is not.

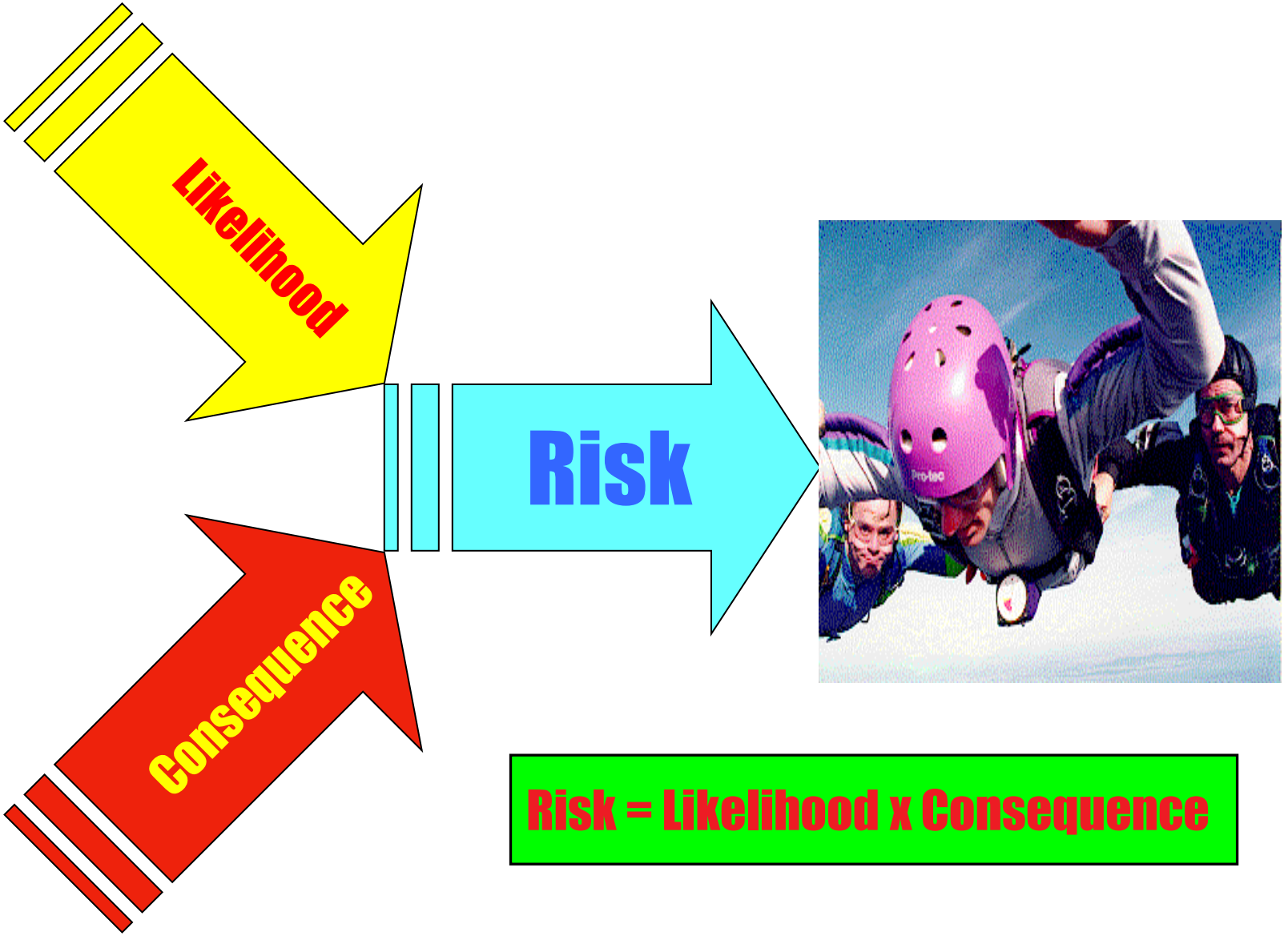
Summary

- RBI is required to support extended inspection intervals
- Some ambiguity in applicability of AS/NZS 3788:2006

The RBI Process

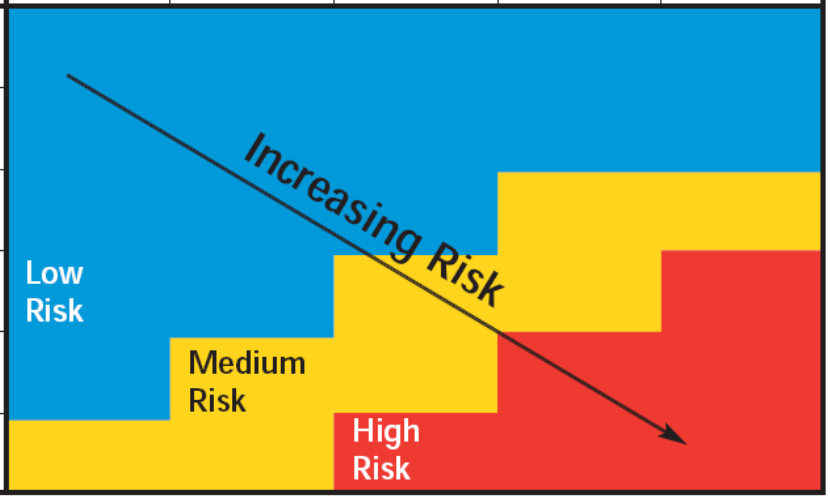
First, a brief look at assessing risk

Definition of Risk



Risk Assessment Matrix

Severity	CONSEQUENCES				INCREASING LIKELIHOOD				
	People	Assets	Environment	Reputation	A	B	C	D	E
					Never heard of in ..... industry	Heard of in .... industry	Incident has occurred in our Company	Happens several times per year in our Company	Happens several times per year in a location
0	No health effect/injury	No damage	No effect	No impact					
1	Slight health effect/injury	Slight damage	Slight effect	Slight impact					
2	Minor health effect/injury	Minor damage	Minor effect	Limited impact					
3	Major health effect/injury	Localised damage	Localised effect	Considerable impact					
4	PTD* or 1 to 3 fatalities	Major damage	Major effect	National impact					
5	Multiple fatalities	Extensive damage	Massive effect	International impact					



Once risks have been assigned to assets and failure modes, decisions can be made on where resources are best applied.

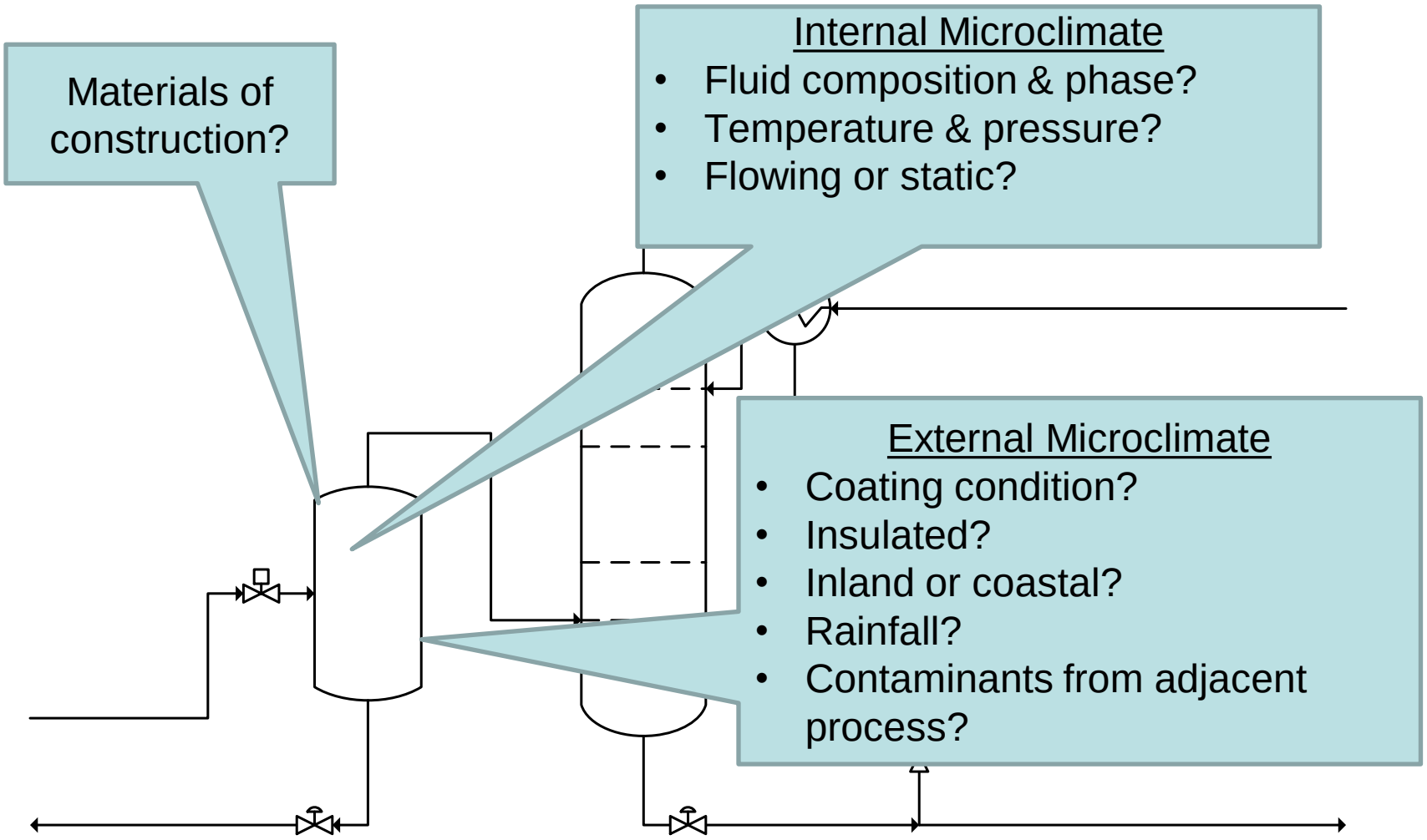
RBI Methodology - Assessment

What data do you need?

- **What were the original design parameters?**
- **Materials of construction?**
- **Environment?**
- **Corrosion mitigations?**
- **Inspection history?**

Validate data with those who know the asset

RBI Methodology - Example



RBI Methodology - Assessment

Consequences are specific to the Owner, the Asset, and often the Failure Mechanism

What are the consequences to <u>your</u> business?

Who could be injured?

How much would it cost to repair?

What would you lose while it was being repaired?

How would the local and wider environment be affected?

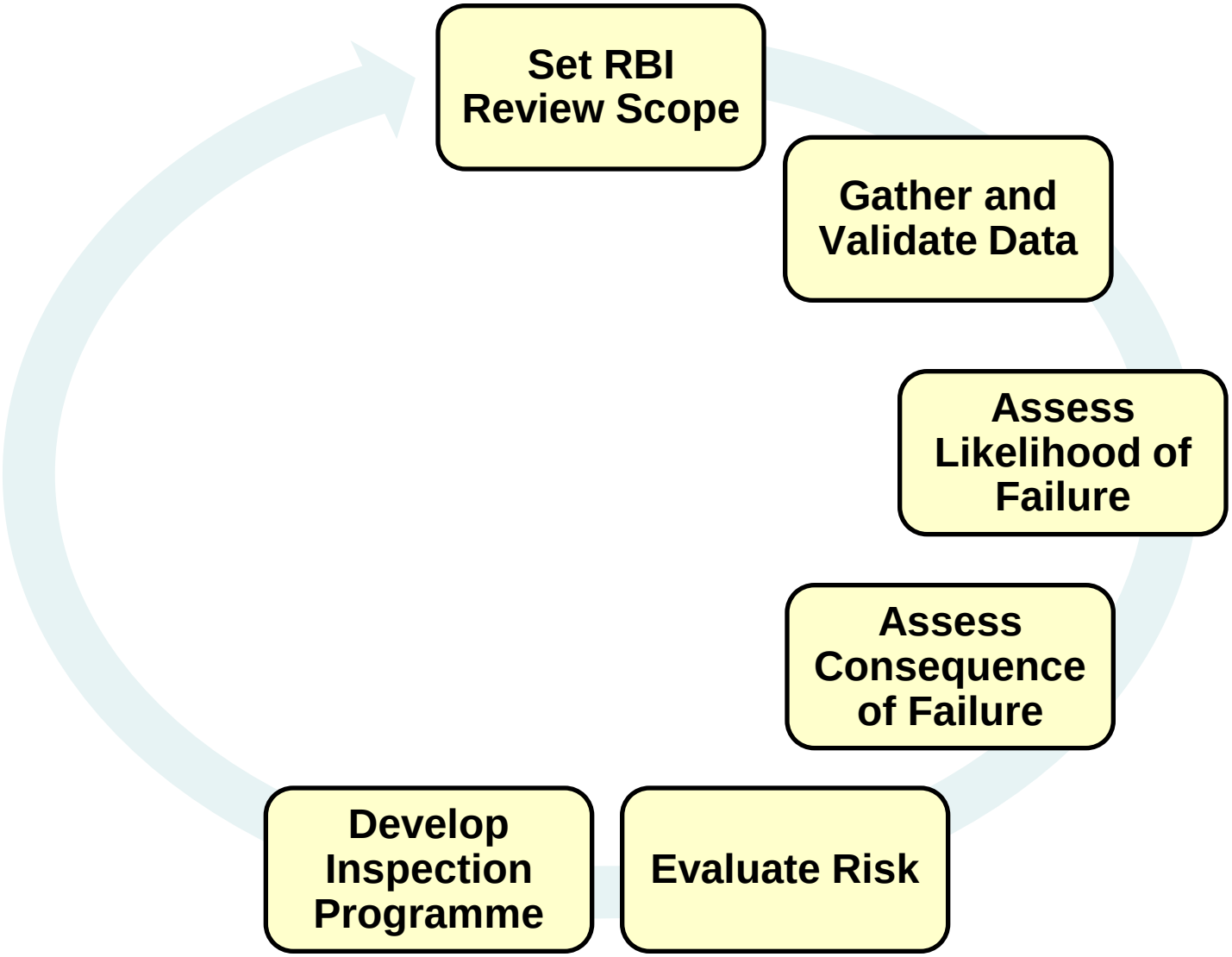
RBI Methodology - Assessment

Likelihood x Consequence = Risk

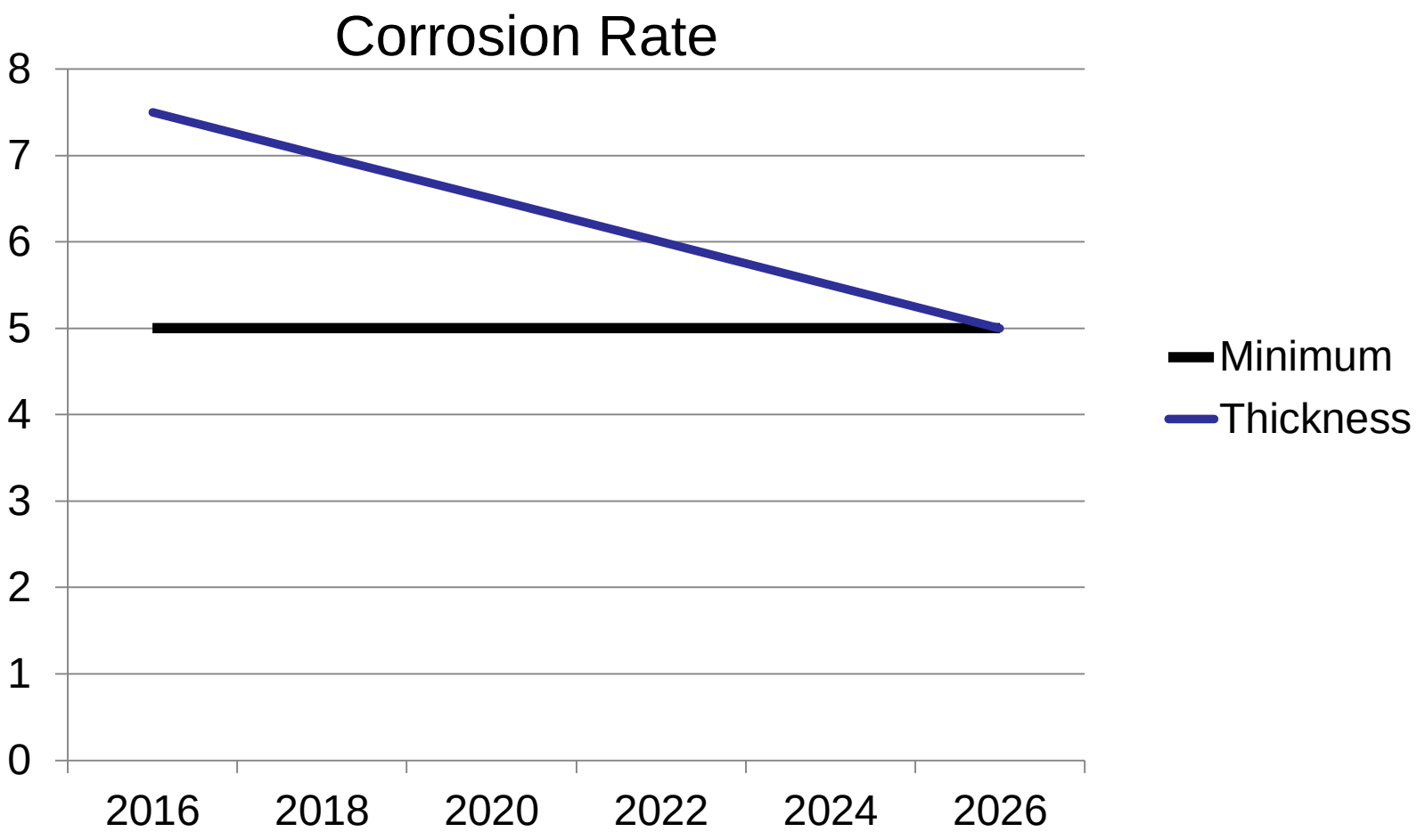
What is an acceptable risk for your business?
What is an acceptable risk for your stakeholders?
Who decides?

Appropriate levels of risk are documented in a risk matrix

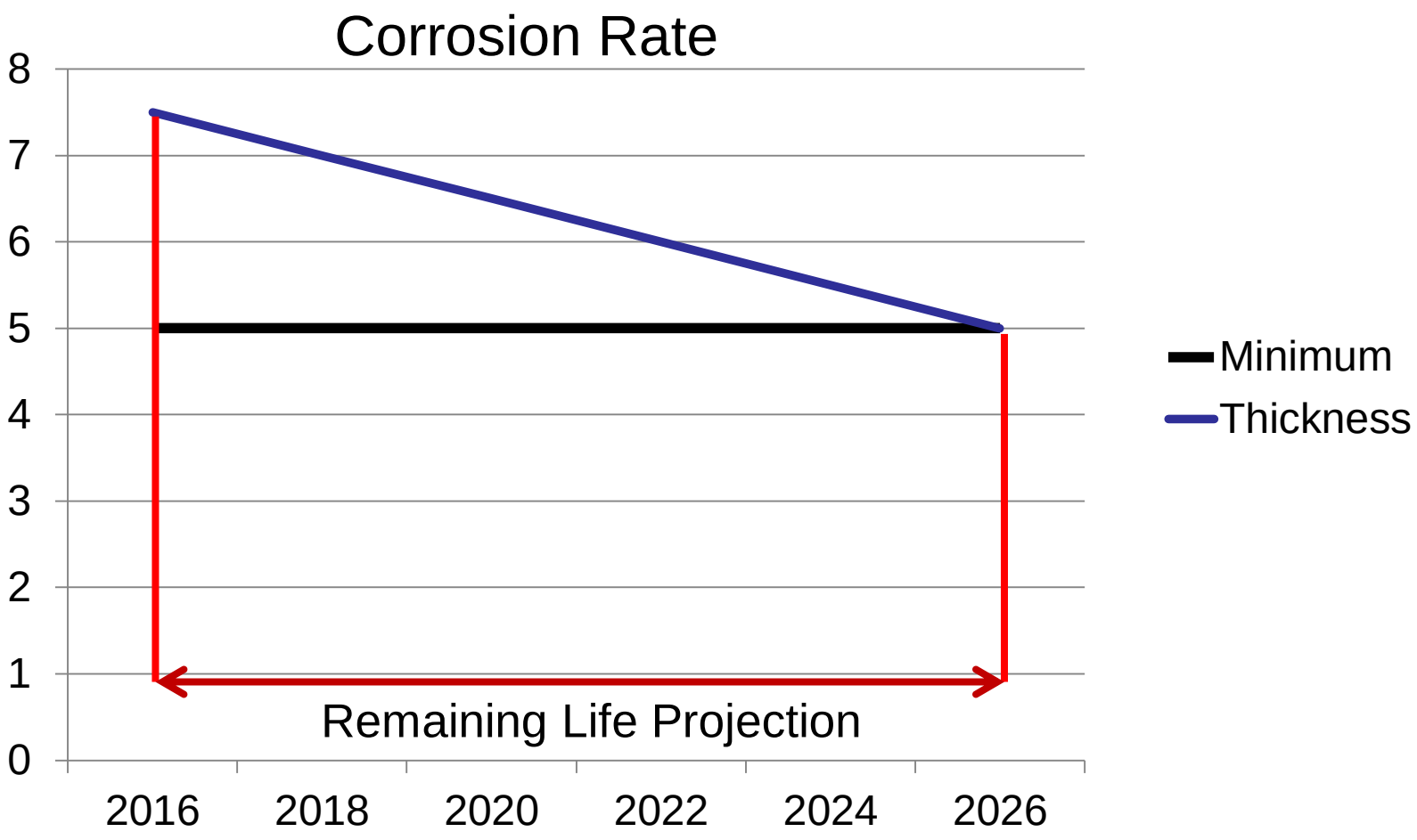
RBI Methodology - Implementation



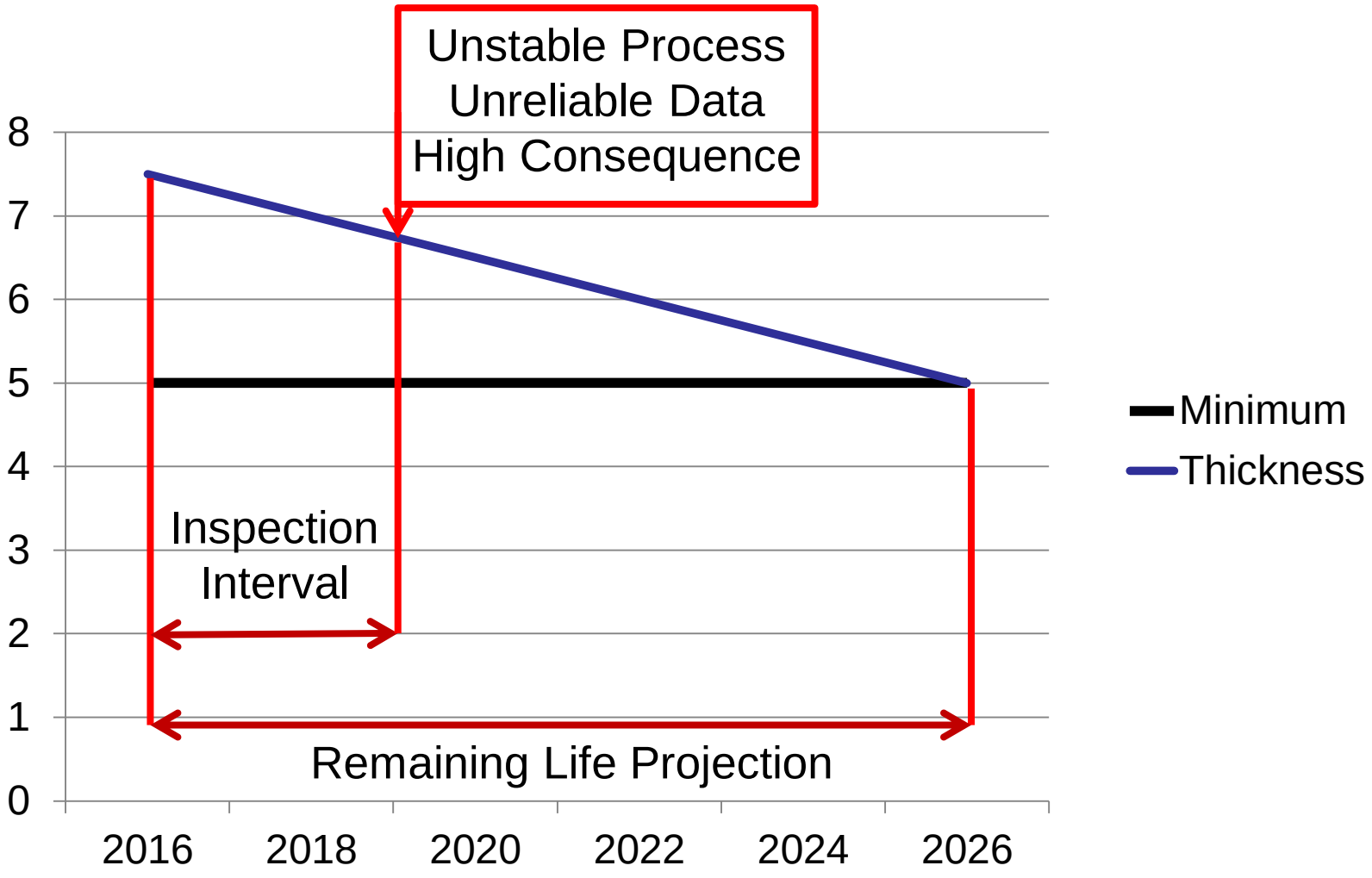
Inspection Interval



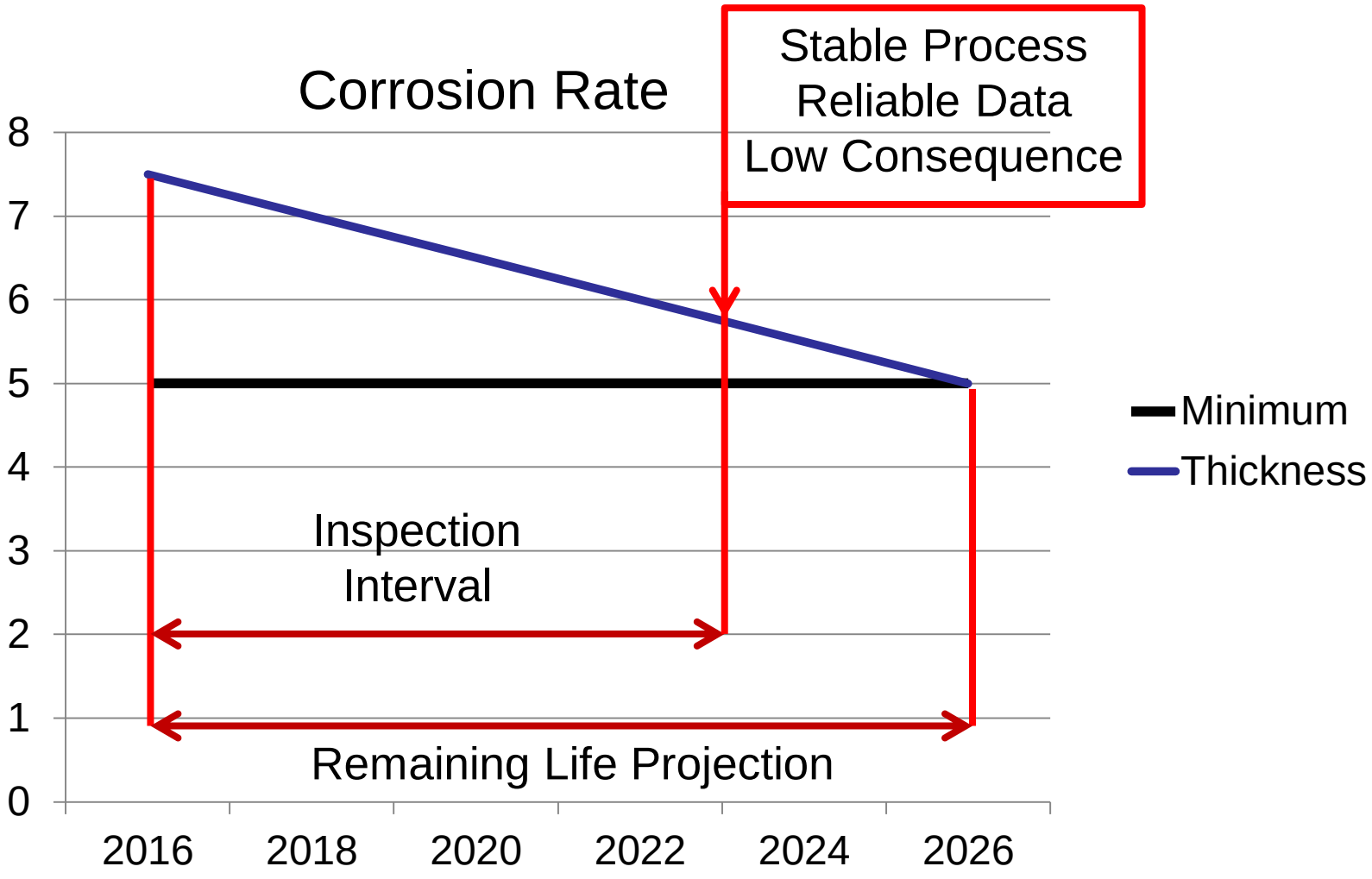
Inspection Interval



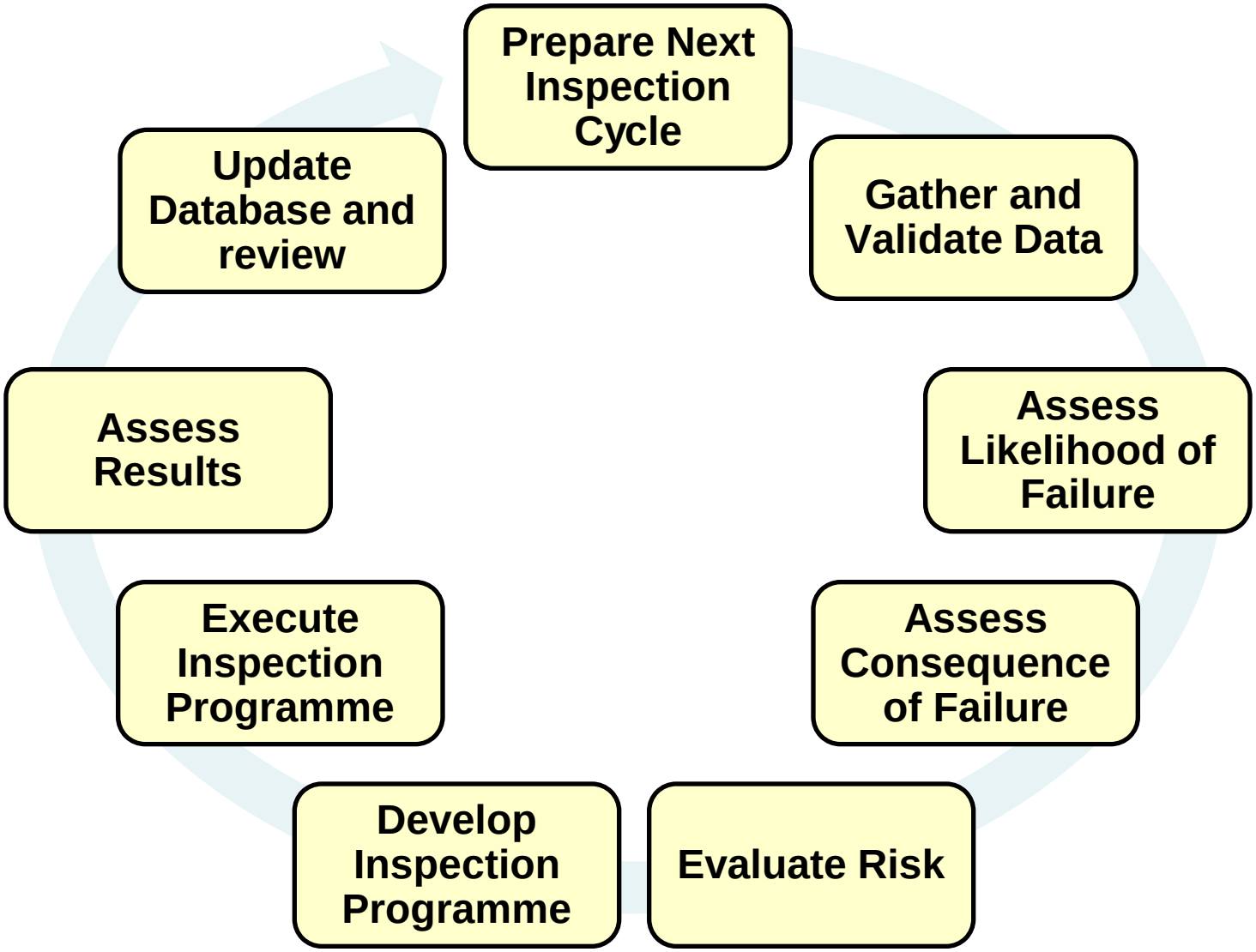
Inspection Interval



Inspection Interval



RBI Methodology - Implementation



Benefits of RBI

- Optimises inspection methods, extent and frequency to address actual integrity risks to the plant - cost effectively.
- Process helps all stakeholders focus on asset integrity.
- Provides key information for management of the asset throughout its lifetime.
- Documents decision process and supporting data.
- Increases confidence in asset integrity

Limitations

- Inspection management alone cannot assure integrity – RBI needs to be extended to Risk Directed Integrity Management.

- What if the inspection is the damage mechanism?

Example – Sulphuric Acid Storage

- Sulphuric acid is commonly stored in tanks or vessels made of carbon steel.
- Corrosion rates are very low – as long as concentrations remain in the 95–98% range and velocities are low.
- Corrosion rates increase sharply if concentration drops.

Example – Sulphuric Acid Storage

- What is the risk of inspection?

Risk = likelihood x consequence

- Likelihood of diluting acid into the severely corrosive range while cleaning is almost certain.
- Temporary pumping arrangements and presence of heavy vehicles increases likelihood of loss outside the tank.
- Consequences of cleaning also change relative to in-service conditions.
  - More people in the vicinity for longer periods
  - Different range of chemicals present – alkalis, inhibitors

Example – Sulphuric Acid Storage

- Compare risks and benefits
  - Cleaning and internal visual inspection, or
  - Remain in service, with inspections from outside only, and
  - Closely manage the environment – acid concentration.
- Required integrity controls are not limited to inspections – process control and monitoring, and the supporting management systems, are critical too.
- Note: internal inspection does not necessarily require internal access (AS/NZS 3788).

Summary

Inspection alone cannot assure integrity.

RBI can be a highly effective tool, but it does not provide a stand-alone, comprehensive integrity management process. It is best implemented in the context of Risk Directed Integrity Management.

RBI principles are required to be applied when assessing equipment for extended inspection intervals – but currently there are regulatory ambiguities, and clarification would be useful.

Summary

RBI is a process, not a project.

WorleyParsons

resources & energy