

Safety Case Assessment Guide - Mechanical

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MINISTRY OF
MANPOWER

A Great Workforce A Great Workplace

A Great Workforce A Great Workplace

Importance of Mechanical Integrity

Loss of Containment → Potential Major Accident



Containment

Primary



When things go as intended



Loss of Containment

Secondary




When things go wrong



Mitigation



How do you know your plant is safe?



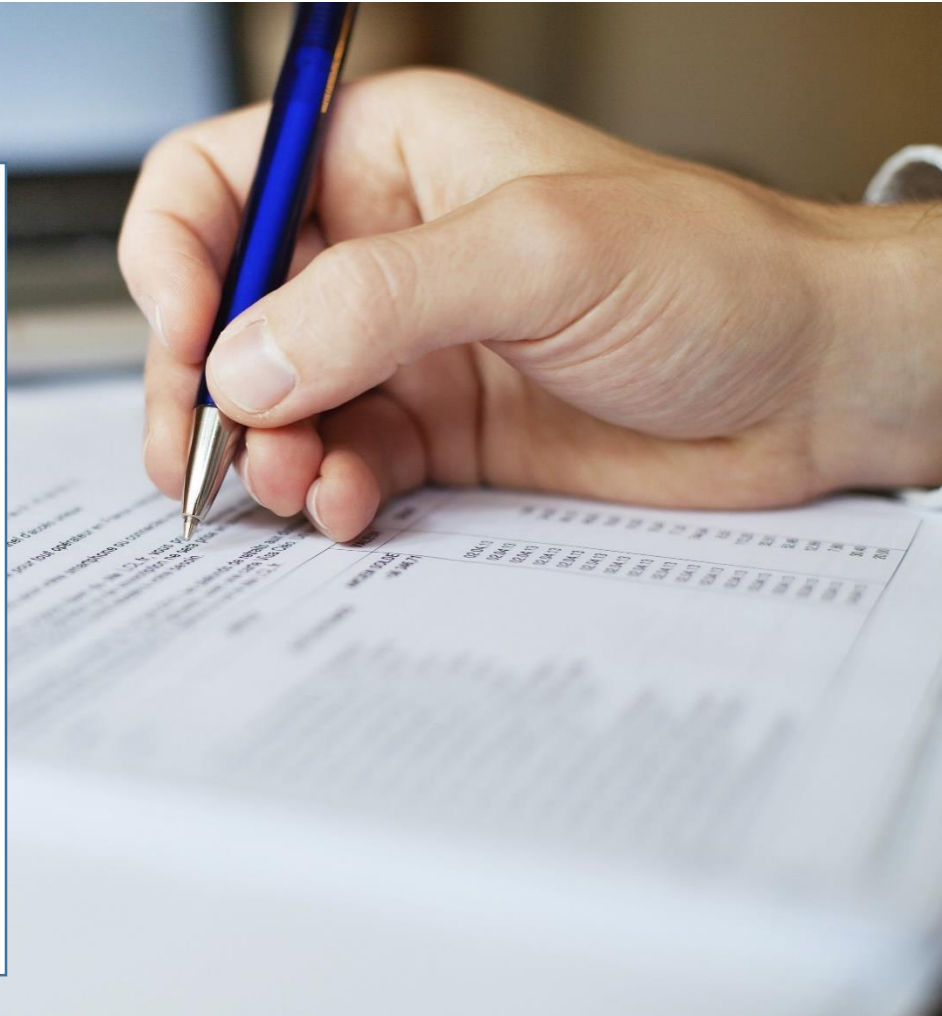
My plant equipment are working well....

How do you know your plant is safe?



What we are looking out for...

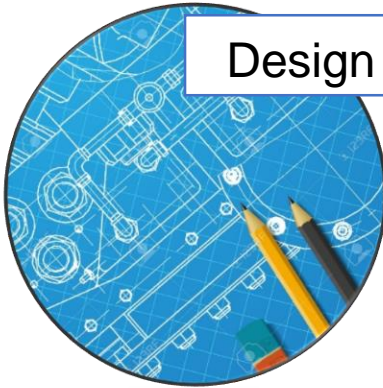
**Well-
Considered,
Thorough, &
evidence
based,
management
system**



Plant Lifecycle

Initial Integrity

Design



Construction



Continuing Integrity

Operation



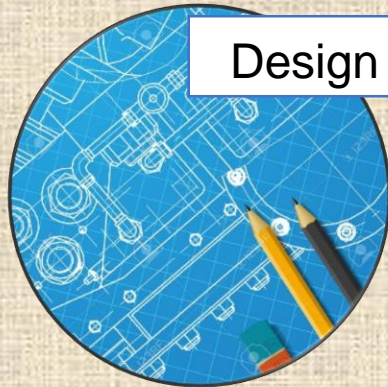
Maintenance



Modification



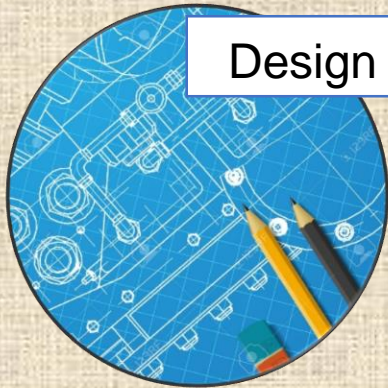
Design – Mechanical Integrity



Design

- 5.2.1.1:** Show that installations have been designed to an appropriate standard
- 5.2.1.3:** Show layout limits risks
- 5.2.1.4:** Show impact of utility failure on critical mechanical equipment
- 5.2.1.5:** Detail presence and integrity of mechanical measures for containment & mitigation
- 5.2.1.6:** Show all foreseeable direct causes of major accidents have been accounted

Design – Mechanical Integrity



Design

- 5.2.1.7:** Show how normal loads and foreseeable extremes have been accounted
- 5.2.1.8:** Show that materials of construction used are suitable
- 5.2.1.12:** Show systems for classifying areas of potential flammable atmosphere and associate equipment selection

Construction – Mechanical Integrity



Construction

5.2.2.1:

Show how installations have been constructed to appropriate standards

5.2.2.2:

Show how construction is assessed and verified

Maintenance – Mechanical Integrity



Maintenance

- 5.2.4.1: Show an appropriate maintenance regime is established**
- 5.2.4.2: Show appropriate procedures for to account for hazardous conditions**
- 5.2.4.3: Show critical equipment and systems are examined by a competent person at suitable intervals**
- 5.2.4.4: Show that results of periodic examination and maintenance are used to ensure continued safety**

Modification/Decommissioning – Mechanical Integrity



Modification

5.2.5.1:

Show systems for ensuring modifications are adequately designed, installed and tested

Show decommissioned facilities do not increased risk to remaining facilities

Common Unit Operations

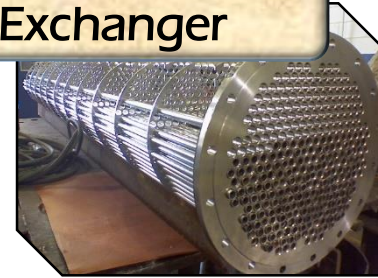
Pipework



Storage Tank



Heat Exchanger



Reactor



Pumps



Distillation Column



Using pipework as an illustration

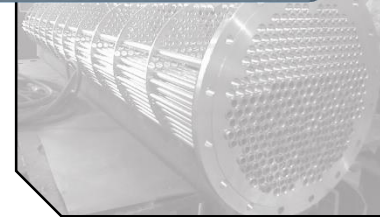
Pipework



Storage Tank



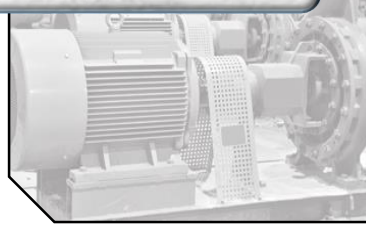
Heat Exchanger



Reactor



Pumps



Distillation Column



A real life example....

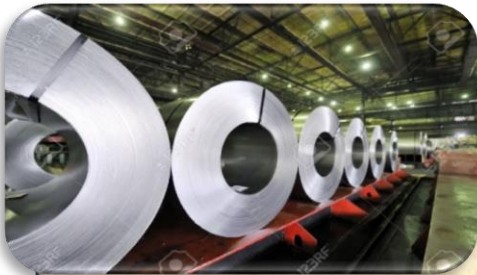


Sulfidation Corrosion



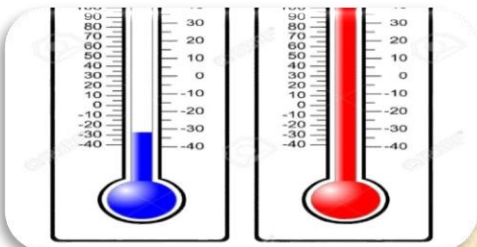
Corrosion (Sulfidation)

- Rxn between Sulphur compounds & Iron
- Causes thinning in iron-containing materials



Material (Carbon Steel)

- $>9.0\% \text{wt Cr}$ increases resistance
- $>0.1\% \text{wt Si}$ increases resistance



Temperature

- 230°C to 540°C

Pipework Design for Sulfidation Corrosion

Pipework



5.2.1.1:

Show that installations have been designed to an appropriate standard

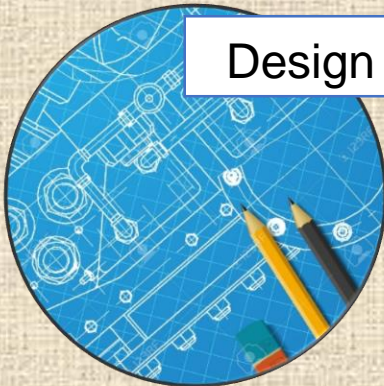
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Design



5.2.1.5:

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Pipework Design for Sulfidation Corrosion

Pipework



5.2.1.7:

Show how normal loads and foreseeable extremes have been accounted

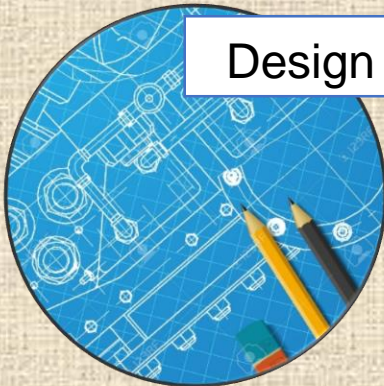
5.2.1.8:

Show that materials of construction used are suitable

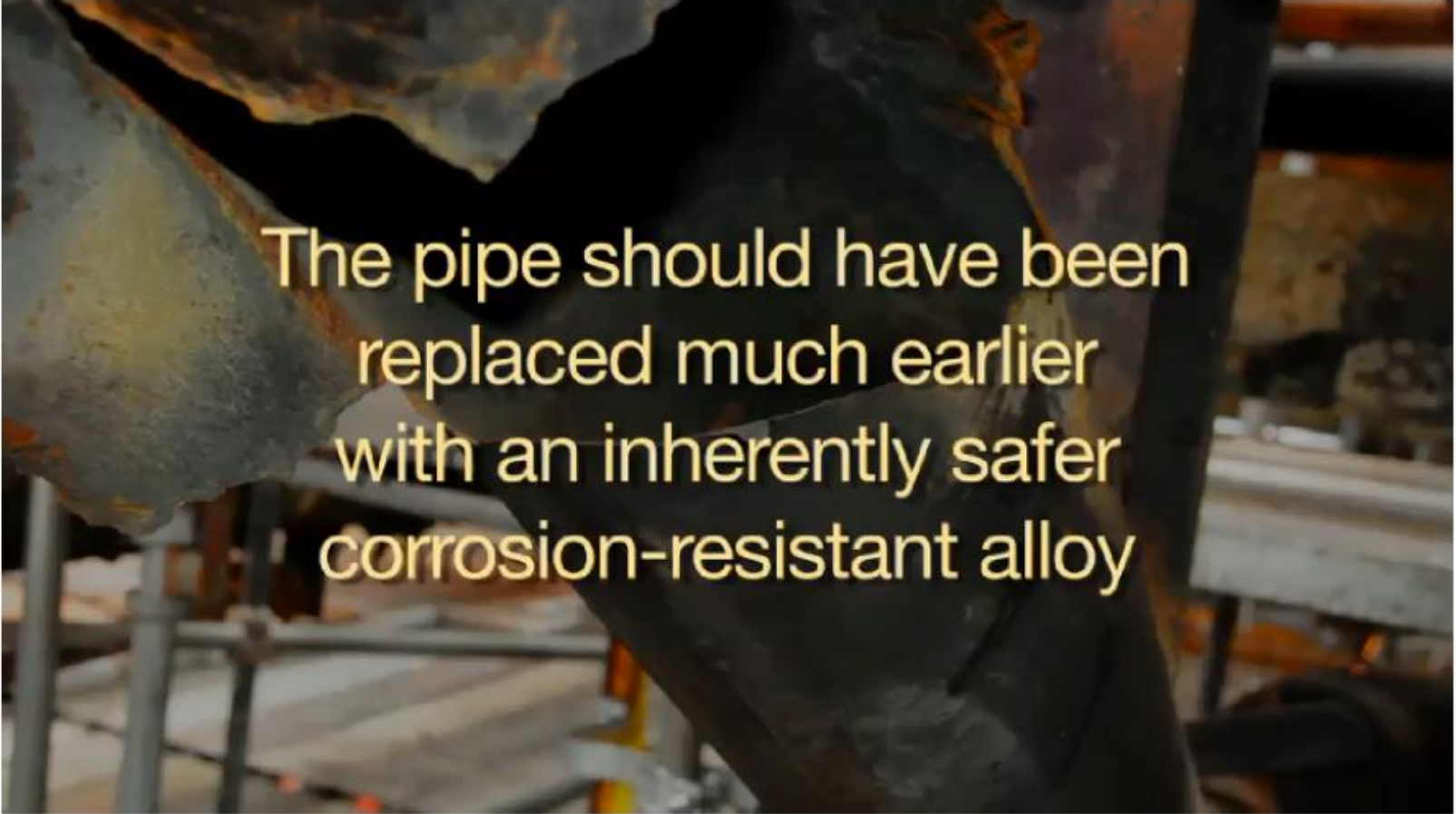
5.2.1.12:

Show systems for classifying areas of potential flammable atmosphere and associate equipment selection

Design



Key CSB Findings



The pipe should have been replaced much earlier with an inherently safer corrosion-resistant alloy

Pipework Construction for Sulfidation Corrosion

Pipework



5.2.2.1:

Show how installations have been constructed to appropriate standards

5.2.2.2:

Show how construction is assessed and verified

Construction



Pipework Maintenance for Sulfidation Corrosion

Pipework



5.2.4.1: Show an appropriate maintenance regime is established

5.2.4.2: Show appropriate procedures for to account for hazardous conditions

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5.2.4.4: Show that results of periodic examination and maintenance are used to ensure continued safety

Maintenance



Key CSB Findings



Key CSB Findings



Key CSB Findings



Key CSB Findings



What if there are insufficient demonstration?

“This conversation might take a while.....”



Thank You