

INTEGRATED **ASSET INTEGRITY MANAGEMENT AND RBI IN CHEMICAL AND PETROCHEMICAL PLANTS**



PAM 2016

SPEAKER: Alberto Mura

COMPANY: Antea

Part 1

Contents



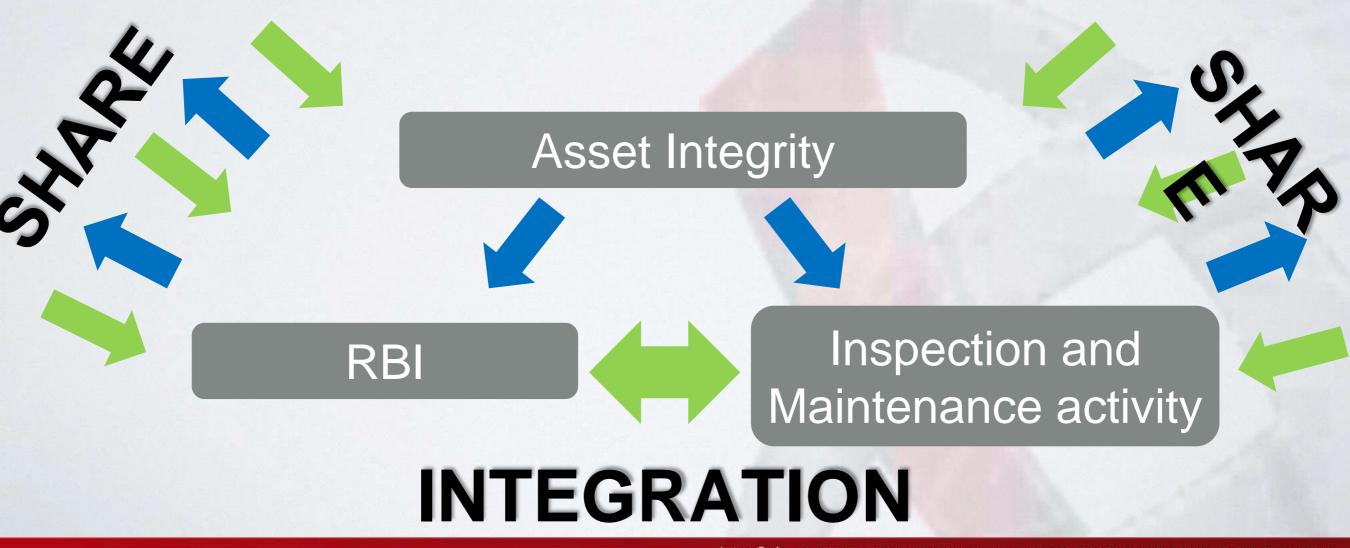
- >RBI and Inspection Activity
- ➤ Inspection Plan through RBI:
 - Data Collection
 - Risk estimation (Probability and Consequence)
 - Inspection Plan
 - Inspection and Maintenance Activity
 - Reassessment



Asset Integrity



The Asset Integrity Management outlines the **effectiveness** and **efficiency** of an asset as well as the health, safety and environment **protection** and the assurance that people, systems, processes and resources that **deliver integrity** are **in place** and **use** and **will perform** when required over the whole lifecycle of the asset.



Inspection and Maintenance



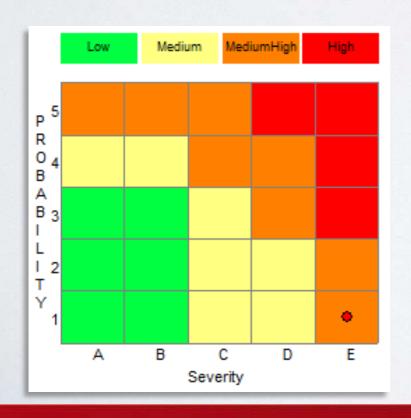
For many industries, in particular the 'major hazards' ones, the Maintenance and Inspection activity is the basis for safe and reliable operations and plays a central role in the achievement of production target and company profit. The **Maintenance** functions include mechanical, electrical, instrumental and civil functions, which are responsible for the monitoring, repair and maintenance of the equipment in the defined areas. The **Inspection** activity guarantees the quality adherence on the repair and maintenance activities through the monitoring of static equipment function in plant operations.

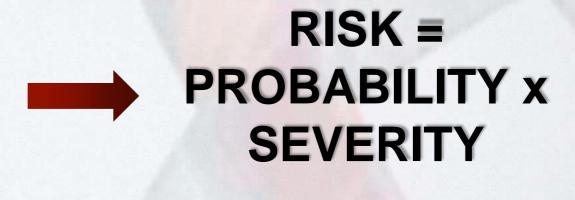


RBI Definition



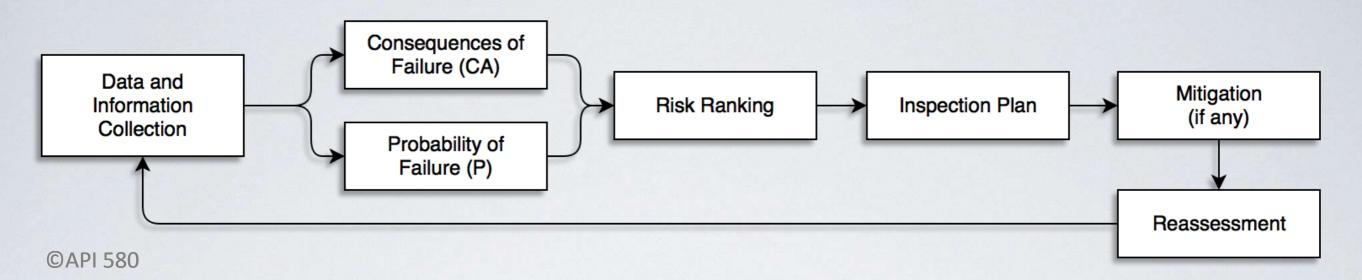
- The RBI (Risk-Based Inspection) is a process that assesses
 the industrial risks that can compromise both the pressurized
 equipment and the facilities integrity.
- The RBI deals with risks that can be controlled through proper inspections.
- The corrosion risk is assessed through the combination of the corrosion probability and the overall consequence factor on the risk matrix.





Inspection Plan through RBI



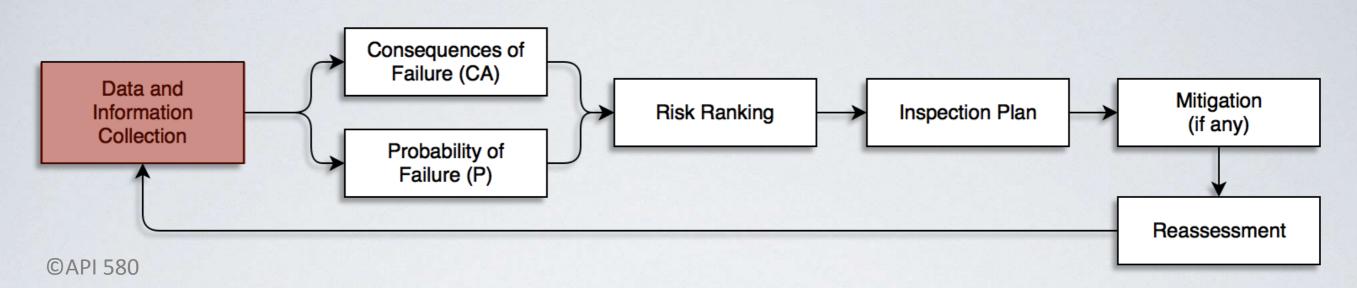


PROCESS STEPS:

- Data Collection
- 2. Risk estimation
- 3. Inspection and Maintenance activities
- 4. Reassessment

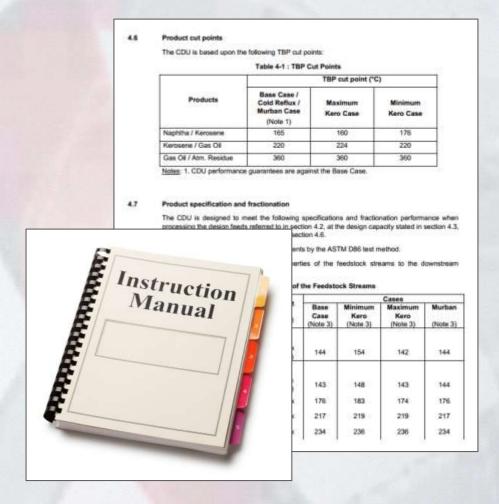




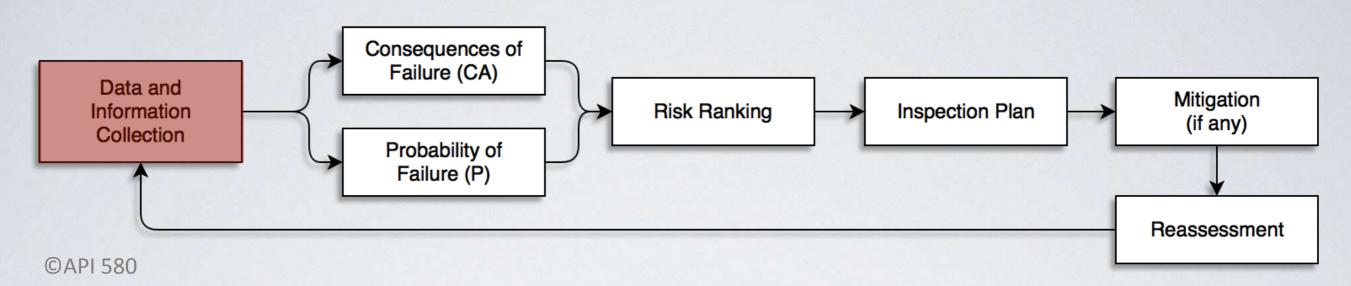


The document and information necessary for this kind of analysis involve many areas and departments.

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout ... Others





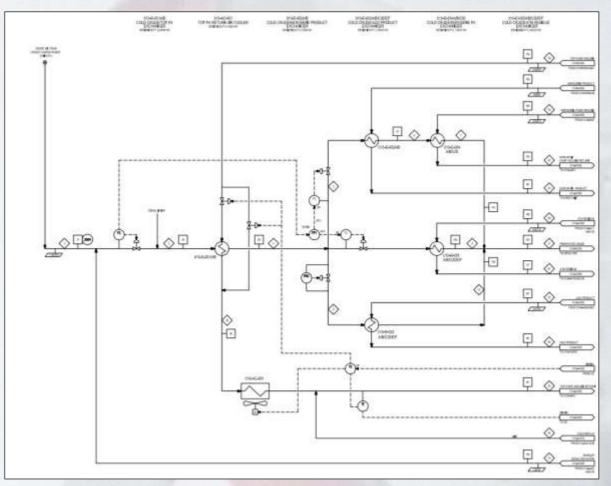


The document and information necessary for this kind of analysis involve many areas and departments.

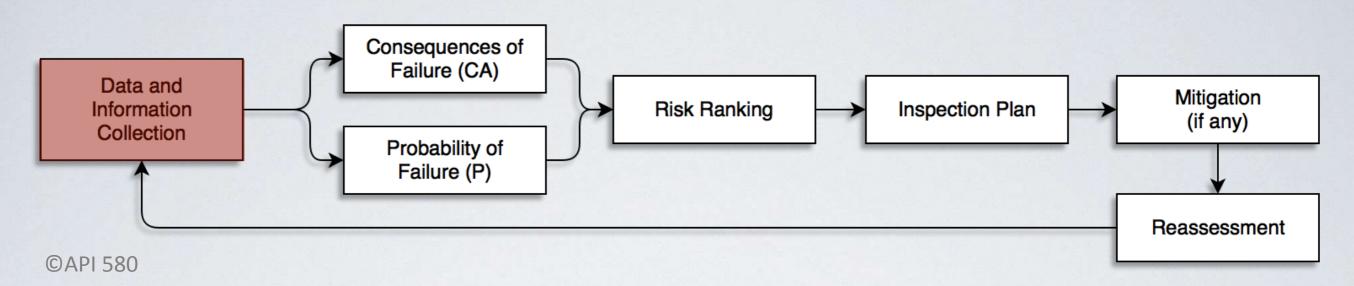
Data examples:

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout

... Others







The document and information necessary for this kind of analysis involve many

areas and departments.

Data examples:

Plant/Process Description

PFD (Process Flow Diagrams)

Heat & Mass Balance Diagrams

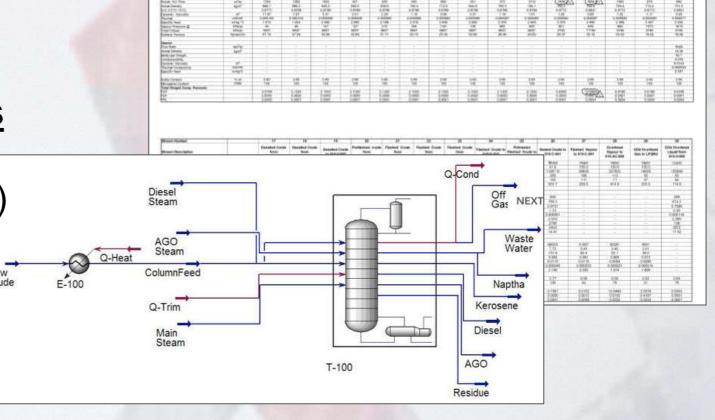
Material Selection Diagrams

P&ID (Process & Instrumentation)

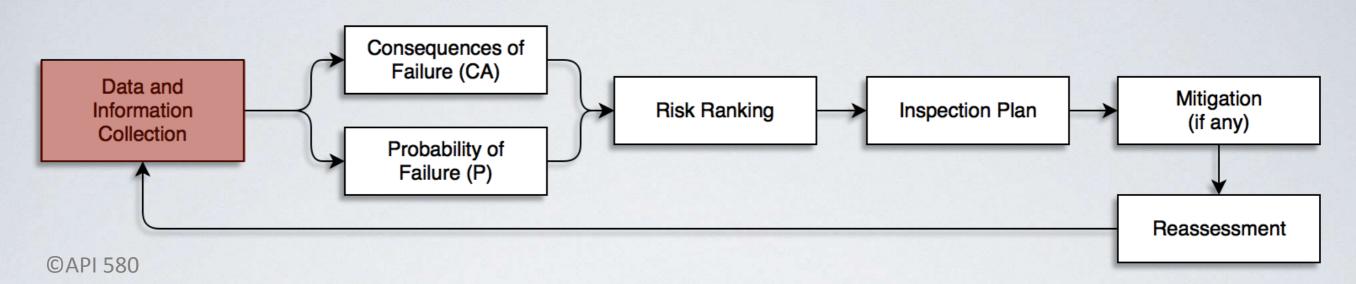
Equipment/Line/PSV lists

- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout

.. Others



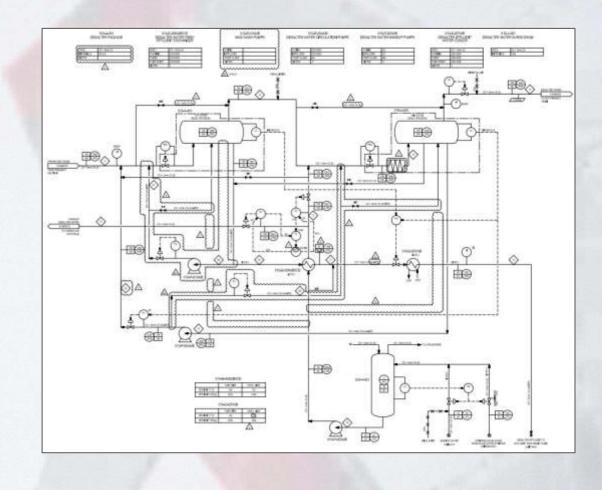




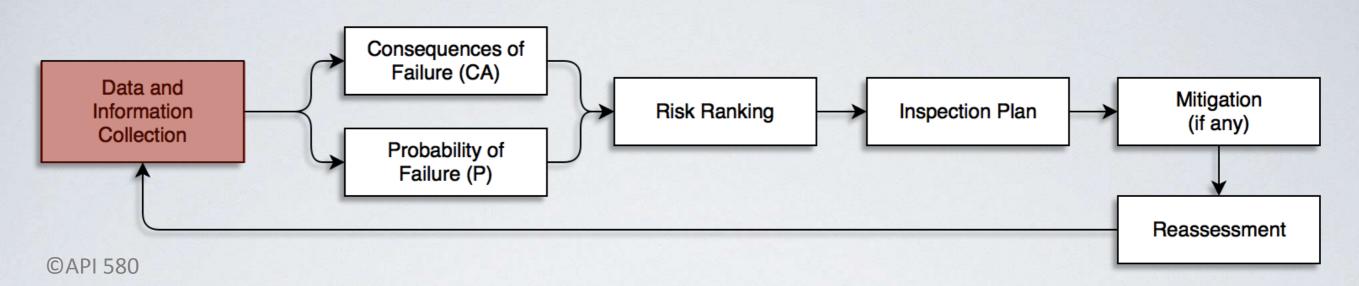
The document and information necessary for this kind of analysis involve many areas and departments.

Others

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout





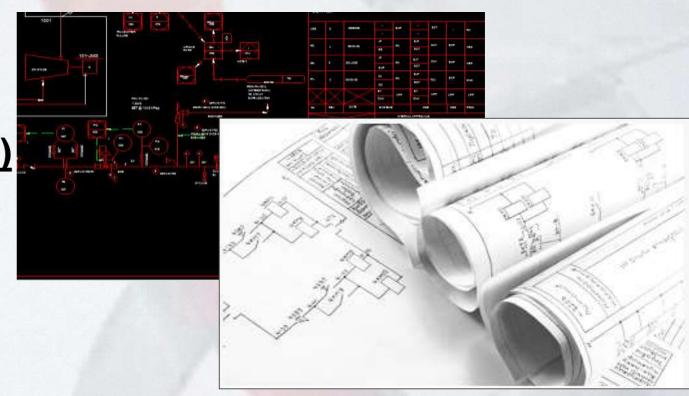


The document and information necessary for this kind of analysis involve many areas and departments.

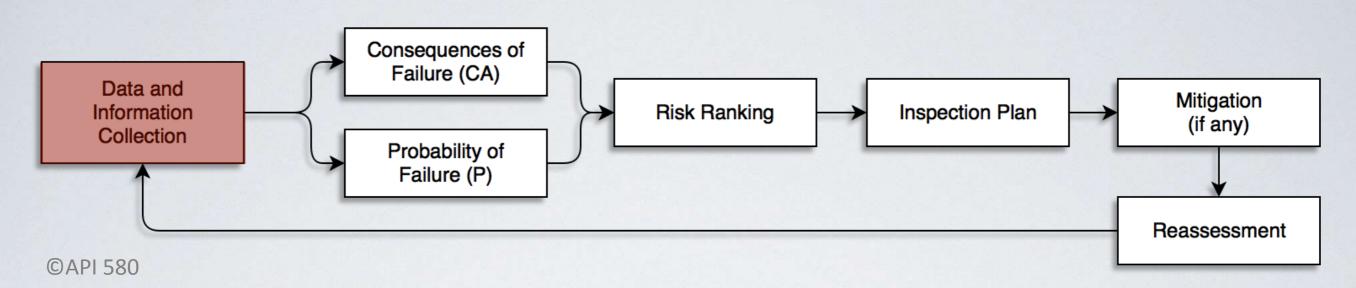
Data examples:

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout

.. Others







The document and information necessary for this kind of analysis involve many areas and departments.

Data examples:

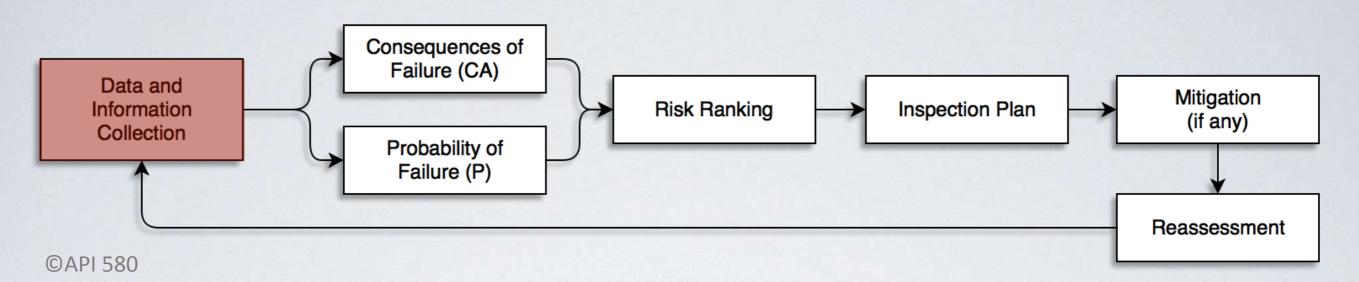
- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams

P&ID (Process & Instrumentation)

- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout ... Others

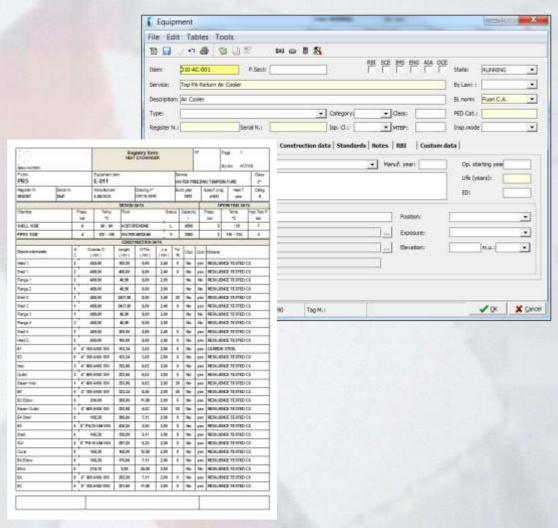




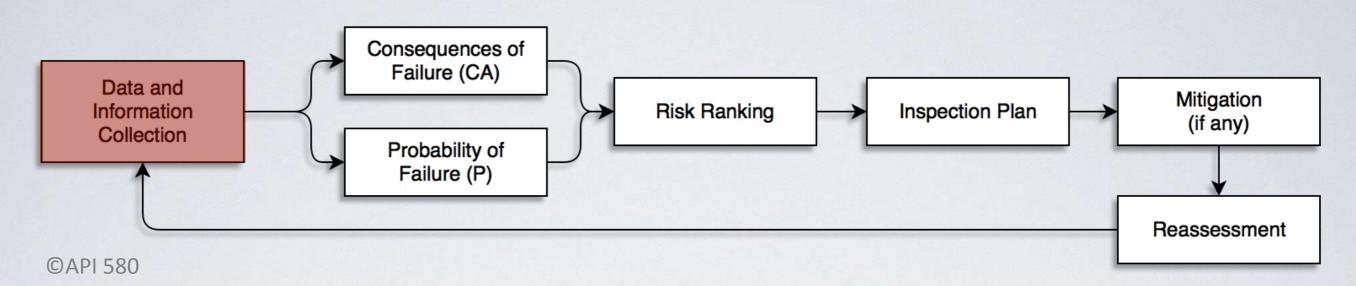


The document and information necessary for this kind of analysis involve many areas and departments.

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout ... Others

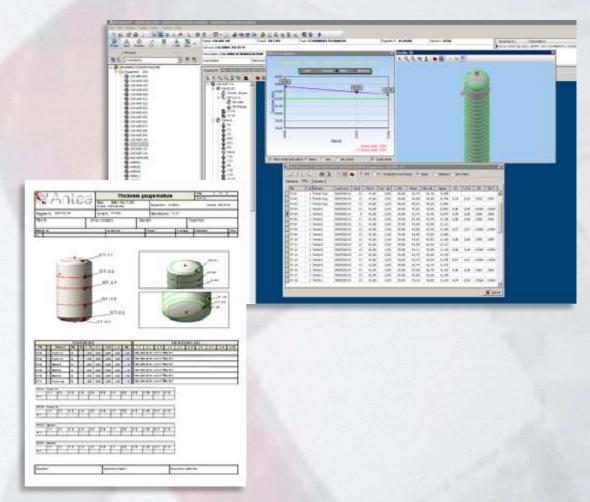




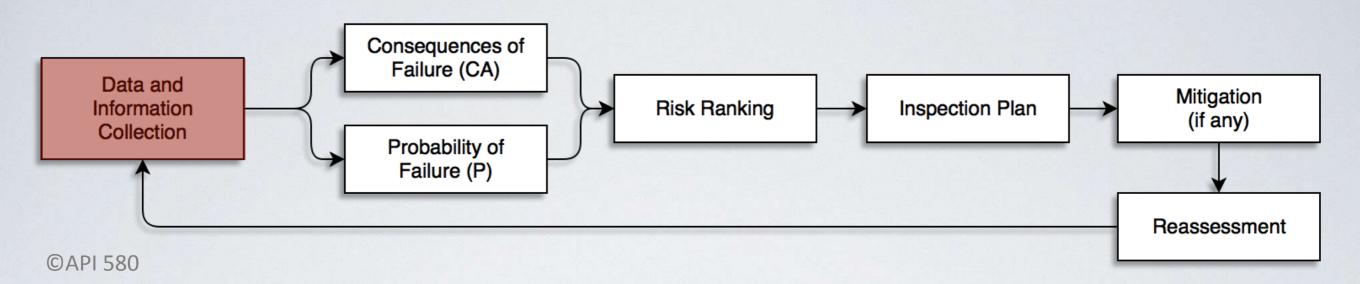


The document and information necessary for this kind of analysis involve many areas and departments.

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout ... Others



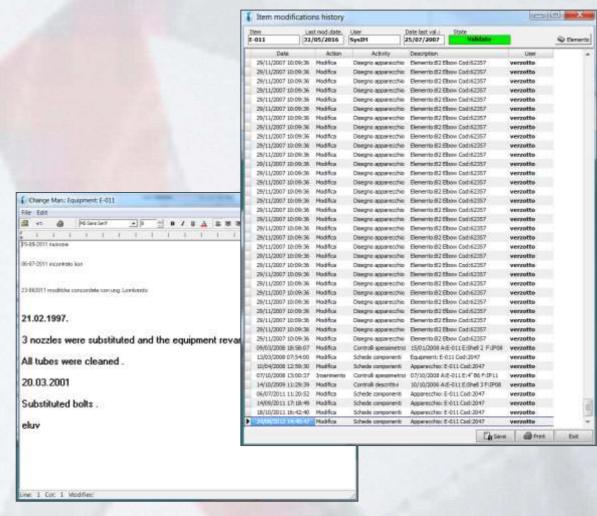




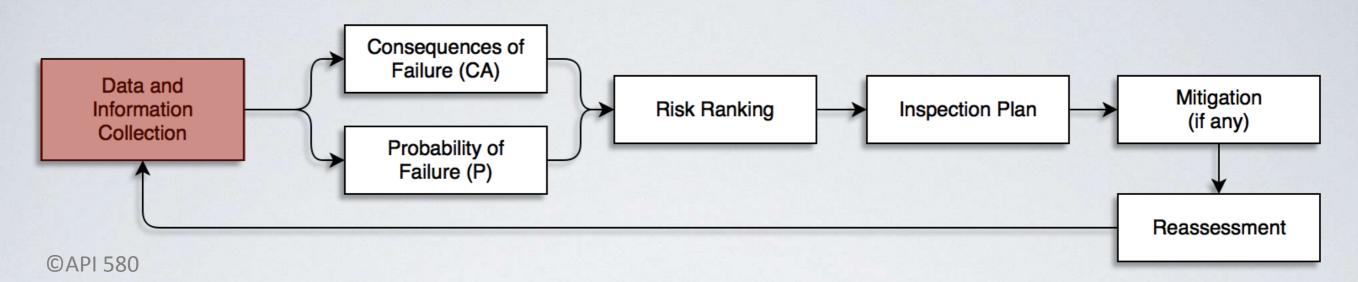
The document and information necessary for this kind of analysis involve many areas and departments.

Others

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout



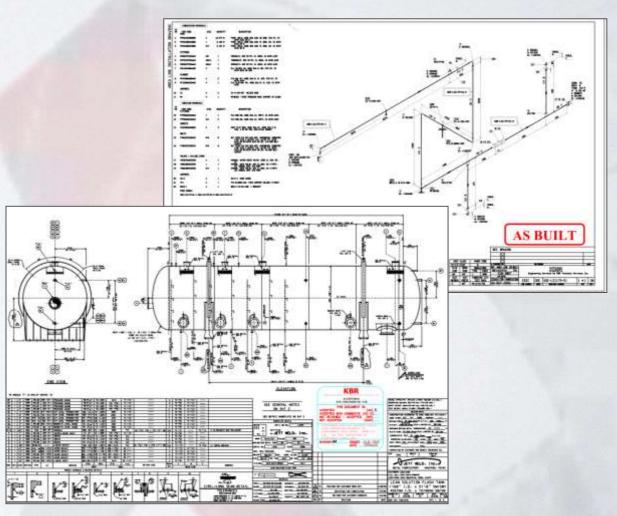




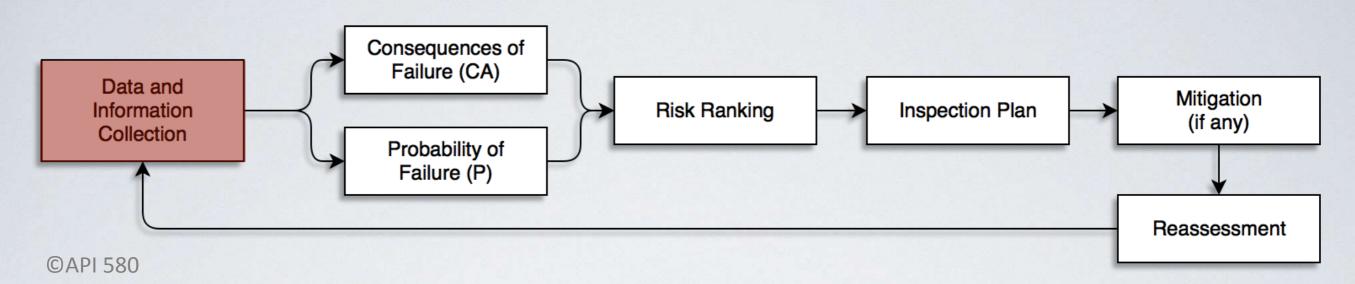
The document and information necessary for this kind of analysis involve many

areas and departments.

- Plant/Process Description
- PFD (Process Flow Diagrams)
- Heat & Mass Balance Diagrams
- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout ... Others







The document and information necessary for this kind of analysis involve many

areas and departments.

Data examples:

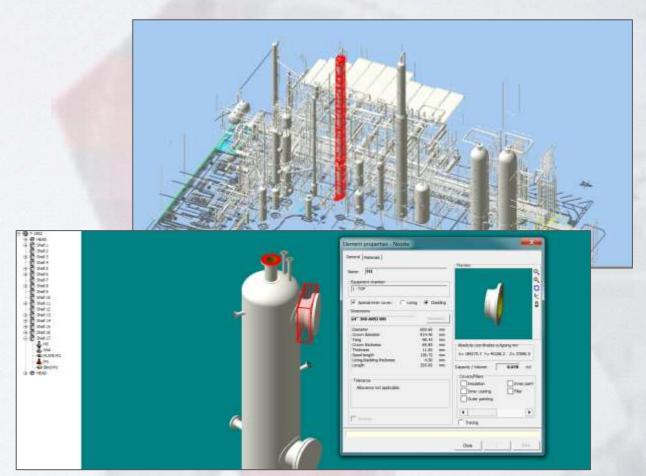
Plant/Process Description

PFD (Process Flow Diagrams)

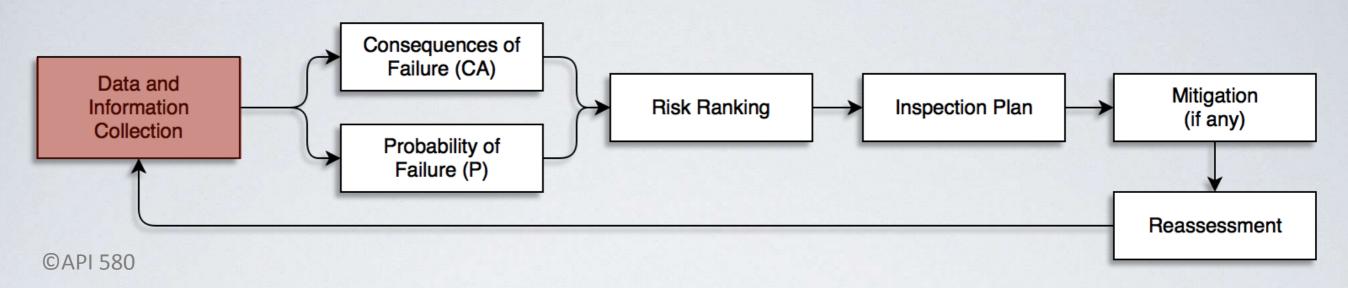
Heat & Mass Balance Diagrams

- Material Selection Diagrams
- P&ID (Process & Instrumentation)
- Equipment/Line/PSV lists
- Technical datasheets
- Inspection History
- Operation History
- Technical drawings
- 3D layout







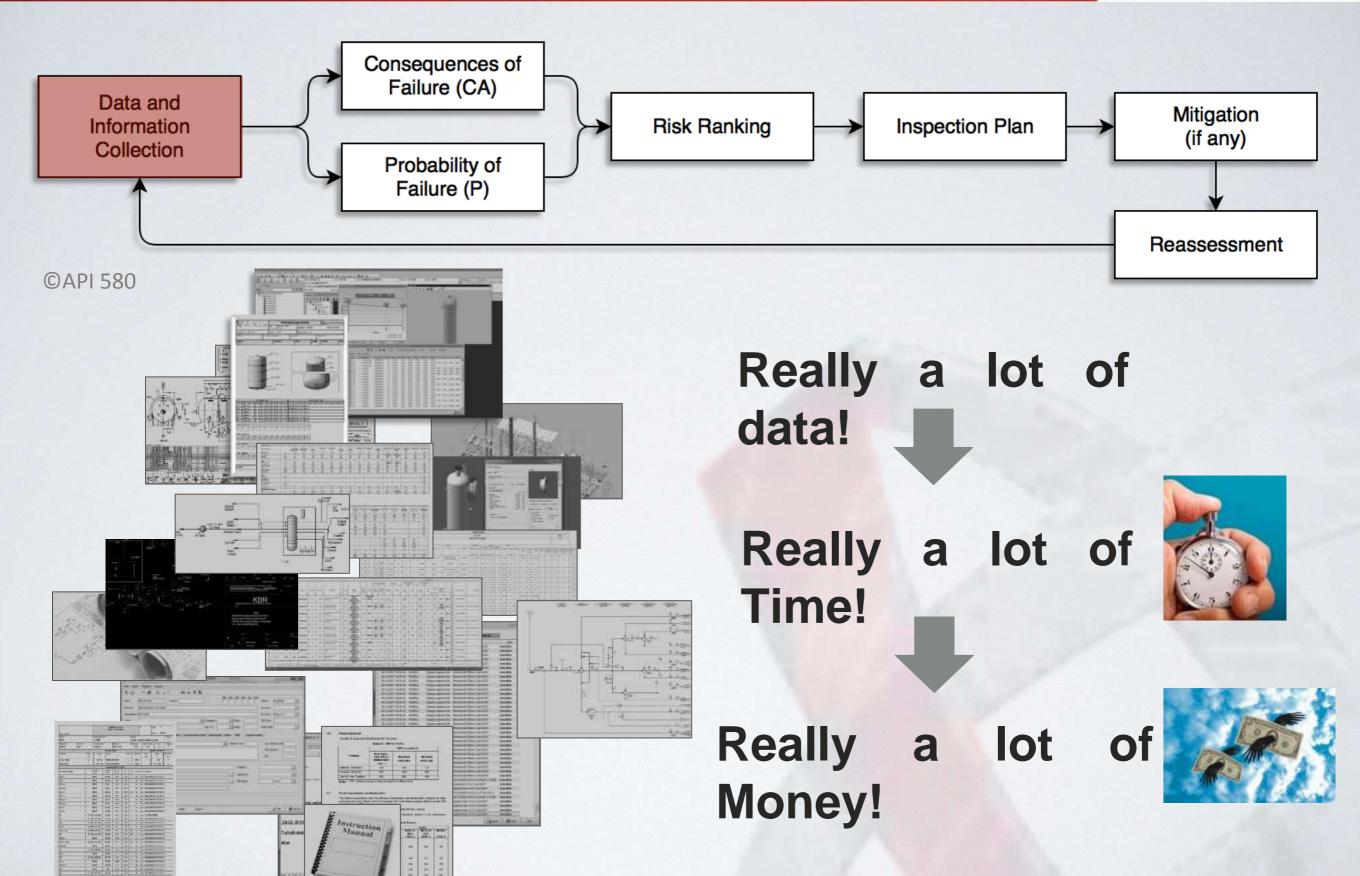


Typical places of storage:

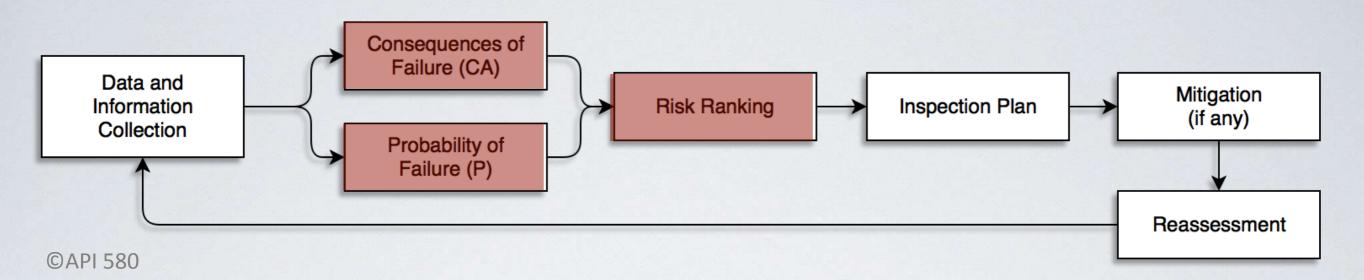


In most cases, even with a Server database solution, there are different sources and different software that are **NOT INTEGRATED**







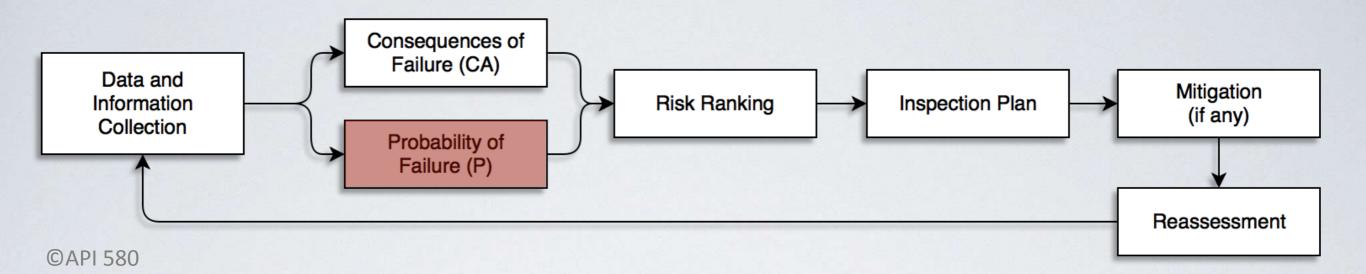


There are several standards that describe RBI methodology, such as API 581 or DNV-RP-G101, providing different approaches.

They can be summarized as follows:







API 581 quantitative

Probability of failure (P) is calculated by analyzing all the damage mechanisms in a quantitative way.

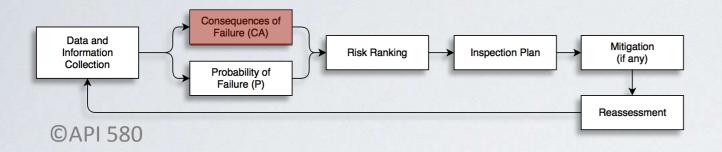
$$P(t) = gff * D_{f-total} * F_{MS}$$

Depending on the type of thinning (local or generalized), the damage factor is calculated through the following formulas:

Local:
$$D_{f-total} = \max[D_{f-gov}^{thin}, D_{f-gov}^{extd}] + D_{f-gov}^{scc} + D_{f}^{htha} + D_{f-gov}^{brit} + D_{f}^{mfat}$$

Generalized:
$$D_{f-total} = D_{f-gov}^{thin} + D_{f-gov}^{extd} + D_{f-gov}^{scc} + D_{f}^{htha} + D_{f-gov}^{brit} + D_{f}^{mfat}$$



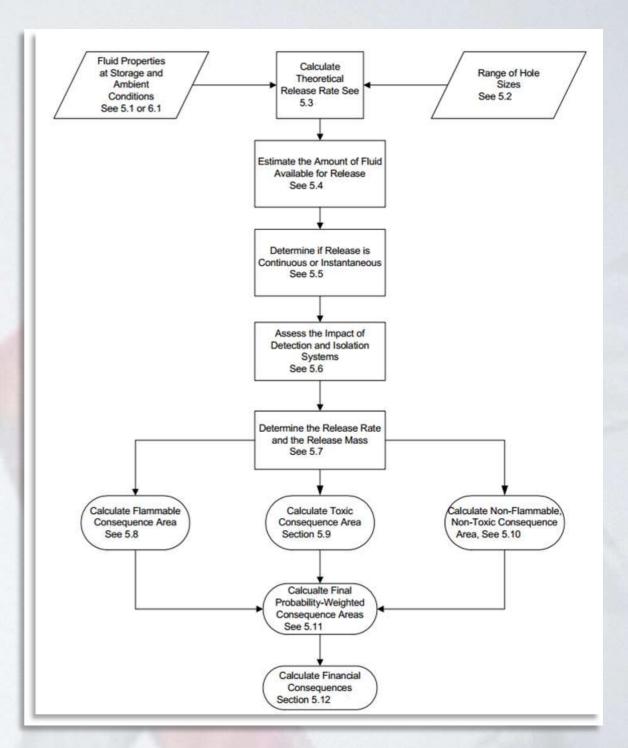


API 581 quantitative

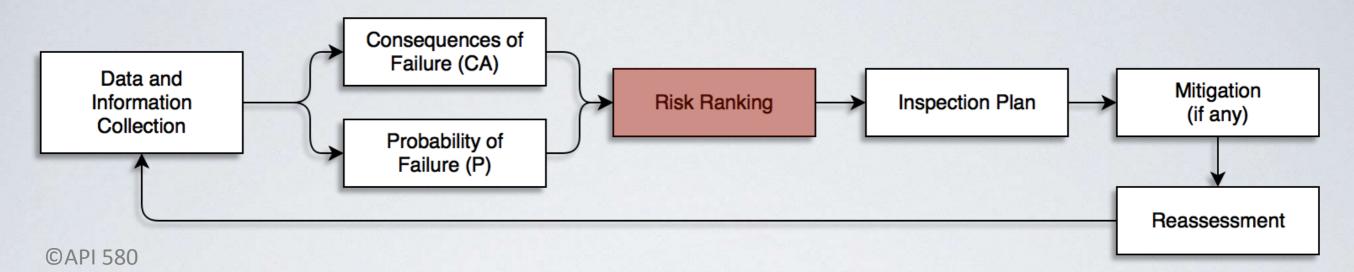
Consequence of Failure (CA) is calculated considering the flammable, toxic and non-flammable/non-toxic consequence, depending on the fluid type.

The final value is the "Final consequence area".

It can be assessed as Consequence Area (CA) or Financial Consequence (FC)







API 581 quantitative

The Consequence Area is calculated through the formula:

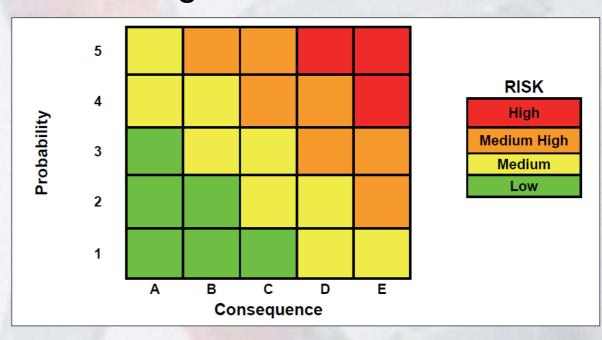
$$R(t) = P(t) * CA$$

while the Financial Consequence is calculated through:

$$R(t) = P(t) * FC$$

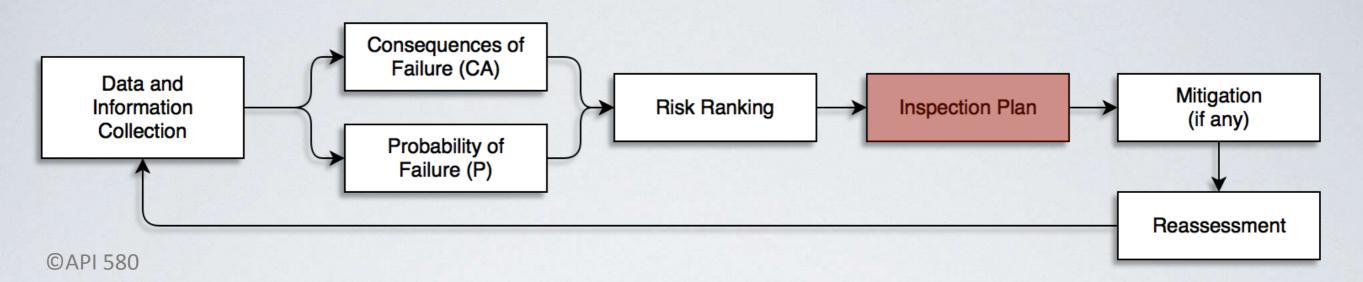
The **Risk Matrix** presents the value of consequence on the horizontal axis and the value of probability on the ordinate axis.

The standard provides the calculation of the **actual** and **future** risk.



Inspection Plan





After the definition of the position in Risk Matrix, the Inspection Plan follows.

In general, the standards offer the following possibilities:

Inspection frequency is defined from the position of the equipment in the Risk matrix.

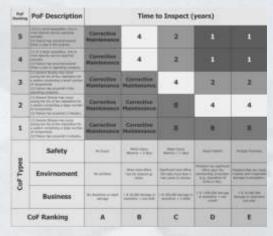
To define the inspection date, add the frequency to the last inspection.

Future Inspection Date is estimated calculating the future risk.

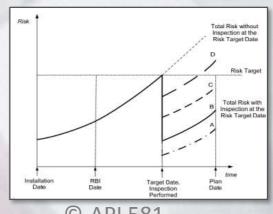
By fixing a target risk and calculating the risk in the future, it is possible to define an inspection date.

Inspection technique and coverage depend on the dama

Inspection technique and coverage depend on the damage mechanisms involved and on the equipment typology!

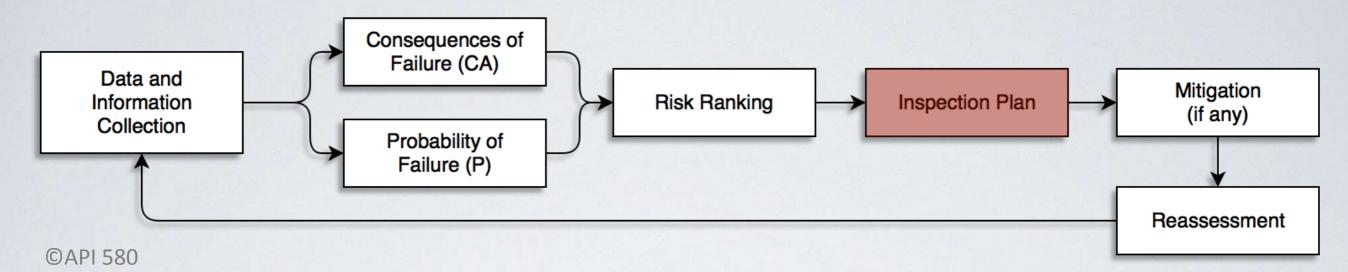


© DNV-RP-G101



Inspection Plan





API 581 quantitative approach

The variables that influence the risk are:

- time since the last inspection for each damage mechanism;
- the inspection effectiveness for each damage mechanism.

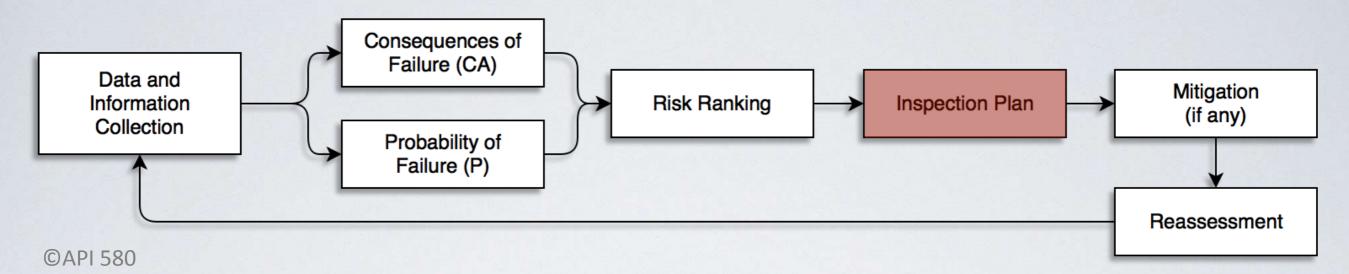
It is necessary to define a limit risk value (Risk Target) not to be exceeded.

The results of the study are aimed to:

- establish a date of inspection;
- establish the inspection effectiveness (type of inspection, inspection locations and details).

Inspection Plan

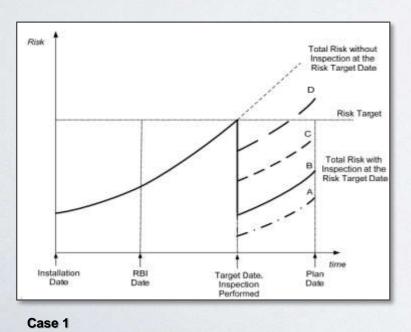


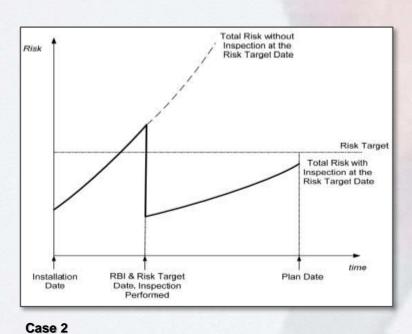


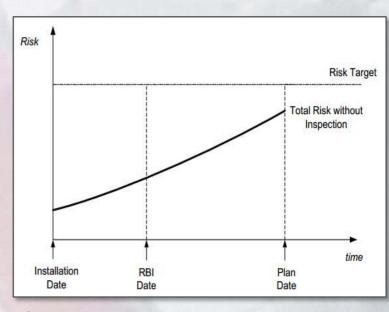
API 581 quantitative

MPP GEC at the RBI date is less than the Risk Target, the software calculates the future date when the risk will reach the limit. This is a recommended date, in order to perform the inspection (Target Date). The RBI evaluation time limit is the Plan Date, when the risk is planned. It could be a shutdown or a mandatory inspection, or just a convenient date.

If the RBI date risk is later than the Risk Target, an immediate inspection is recommended. If the risk at RBI date is earlier than the Risk Target and the risk limit is not reached before the Plan Date, an inspection is not recommended.

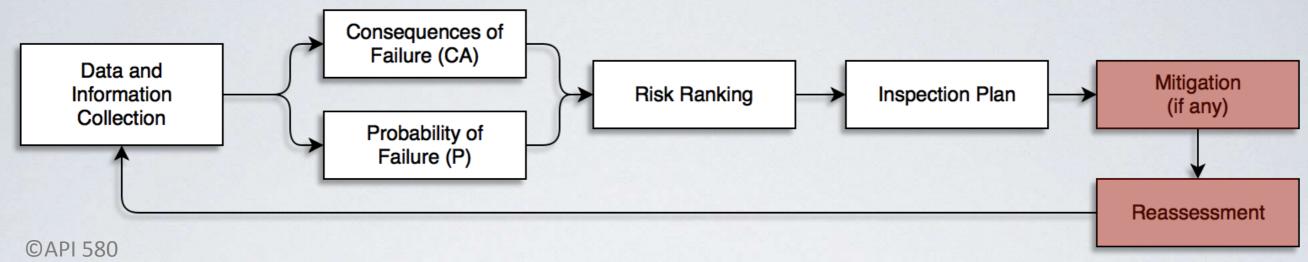


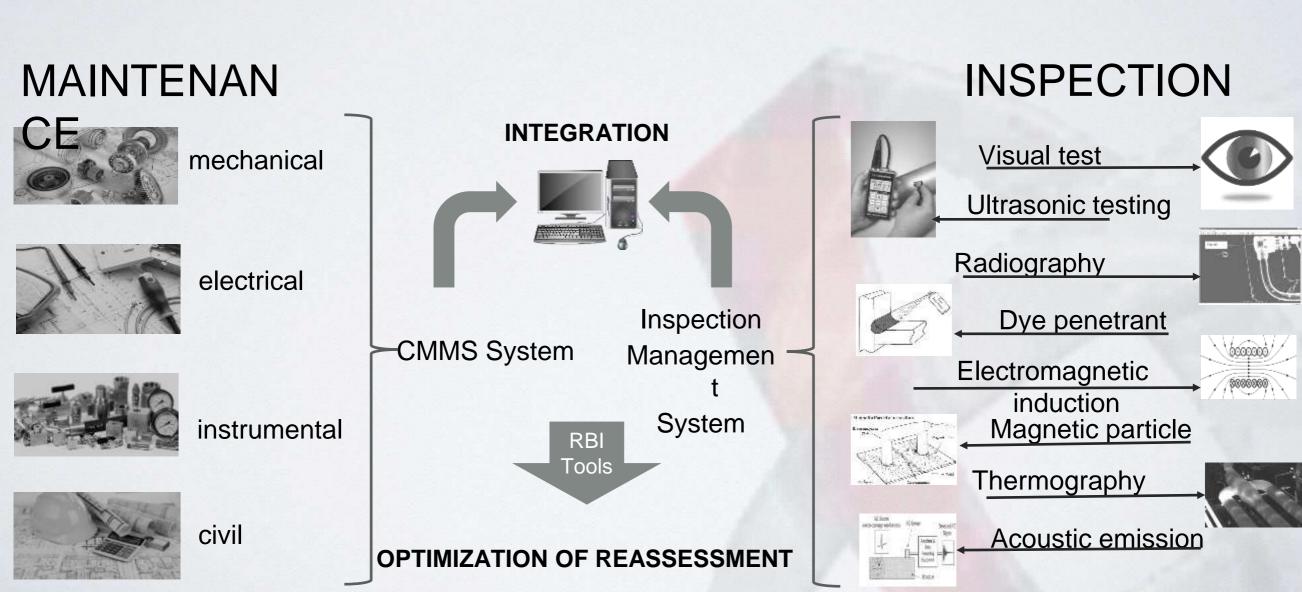




Inspection & Maintenance activity







Conclusion



The **integration** of all the information and data concerning the Asset Integrity with the ones from the other plant activities is essential in terms of **optimization**, **time and cost saving** in the plant operations.

A good integration could be reached:

- sharing information;
- integrating softwares usage;
- creating of the appropriate procedures.

An investment in the Asset Integrity is a gain in the near future!



THANKS FOR YOUR ATTENTION









Accountable		Alberto Mura
File Name		IPAMC Iran abstract Mura
Revisions		
R01	07/10/2016	Alberto Mura
R02	22/10/2016	Alberto Mura
This document is © 2016 Antea s.r.l.		