Asset, Ageing & Risk Management

Life Cycle Asset Management System

Using design data to reduce risks during operations

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Aberdeen – May 30th, 2013

Outline

1. Context and objectives
2. Methodology outline
3. Case study
4. Conclusions

WHO IS OXAND ?

Spin-off EDF in 2002

- INDEPENDENT INTERNATIONAL CONSULTANCY FIRM SPECIALIZED IN ASSET, AGEING & RISK MANAGEMENT

- FOCUS ON LIFE CYCLE OPTIMISATION OF HIGH RISK CAPITAL INTENSIVE ASSETS

- > **£ 1000bn** OF CAPEX CAPITALIZED IN ***SIMEO™***
- > **130** PERMANENT CONSULTANTS, > **£ 15m**

TRANSPORT (Railways, Ports…)

ENERGY (Oil & Gas, Nuclear…)




OXAND Oil & Gas Business Line

OXAND

Optimising Asset Performance

Availability (Kd), Safety

From design to deconstruction

Proprietary Database and Software SIMEO

Controlling Costs

Capital (CAPEX)
Maintenance(OPEX)
Cost of risks

Managing Risks

How high is the residual risk ?

PASS 55 (ISO 55000), ISO 31000, ISO 15288

SIMEO™ SIMULATOR

Client's data

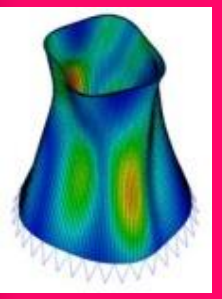
- strategy
- Maintenance policy
- Asset Inventory
- Historical data

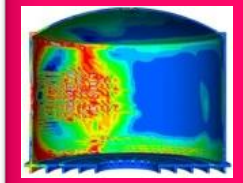
LIBRAIRIES

MODELS

ALGORITHMS

Deliverables





APACHE

PostgreSQL

ORACLE

MySQL

http://www

1. Context : a quick change in the approach of developing new assets

- **Projects are getting more and more complex**: deeper wells, greater water depth, “extreme” operating conditions

- **Requirements for greater analysis and control of RISKS**, intensive and better use of Data

- <u>During the design phase</u>, **new projects must integrate new solutions** for life extension and deconstruction

1. Context : Minimize Technological Risks

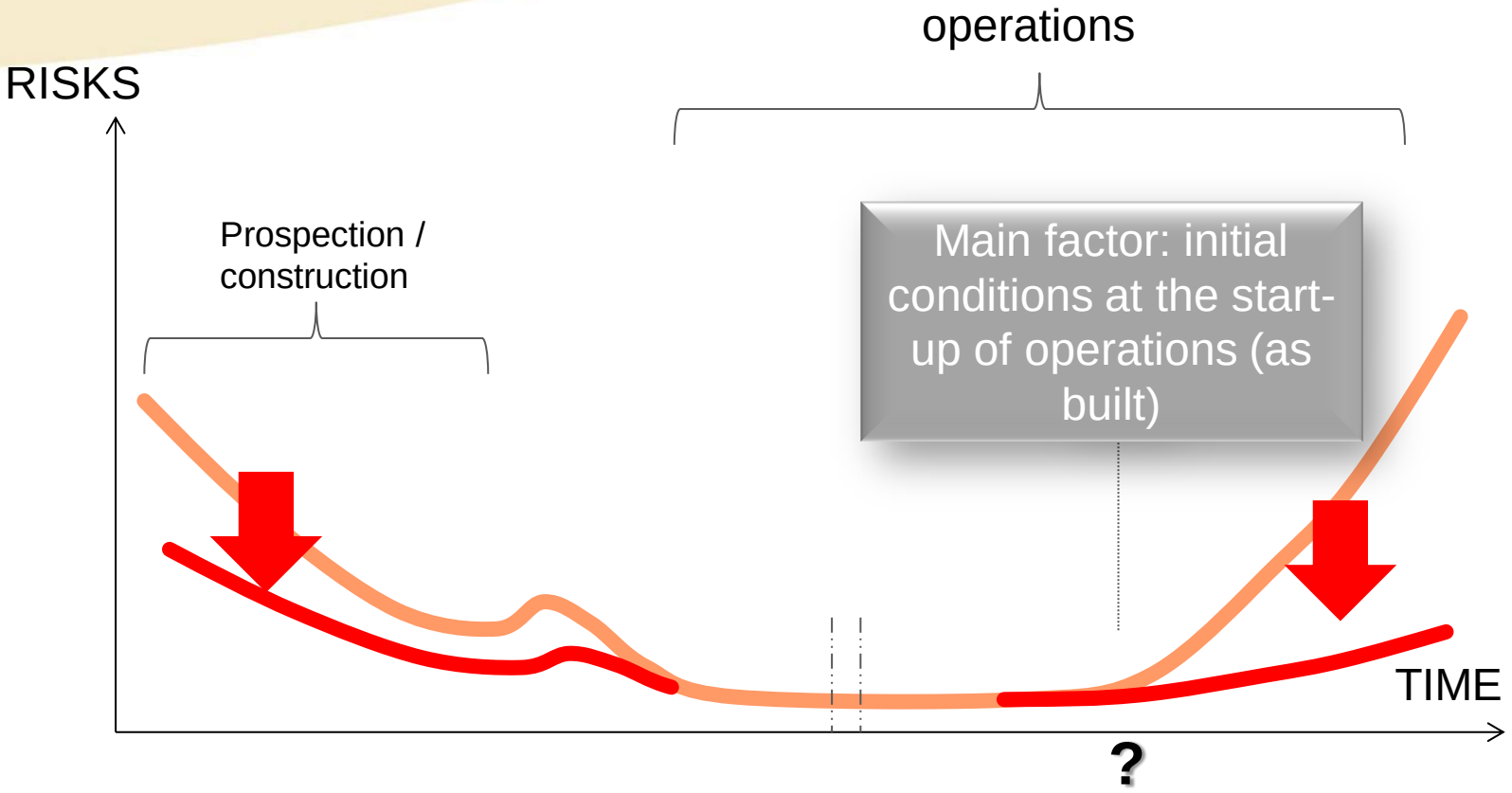
RISKS

Prospection /
construction

operations

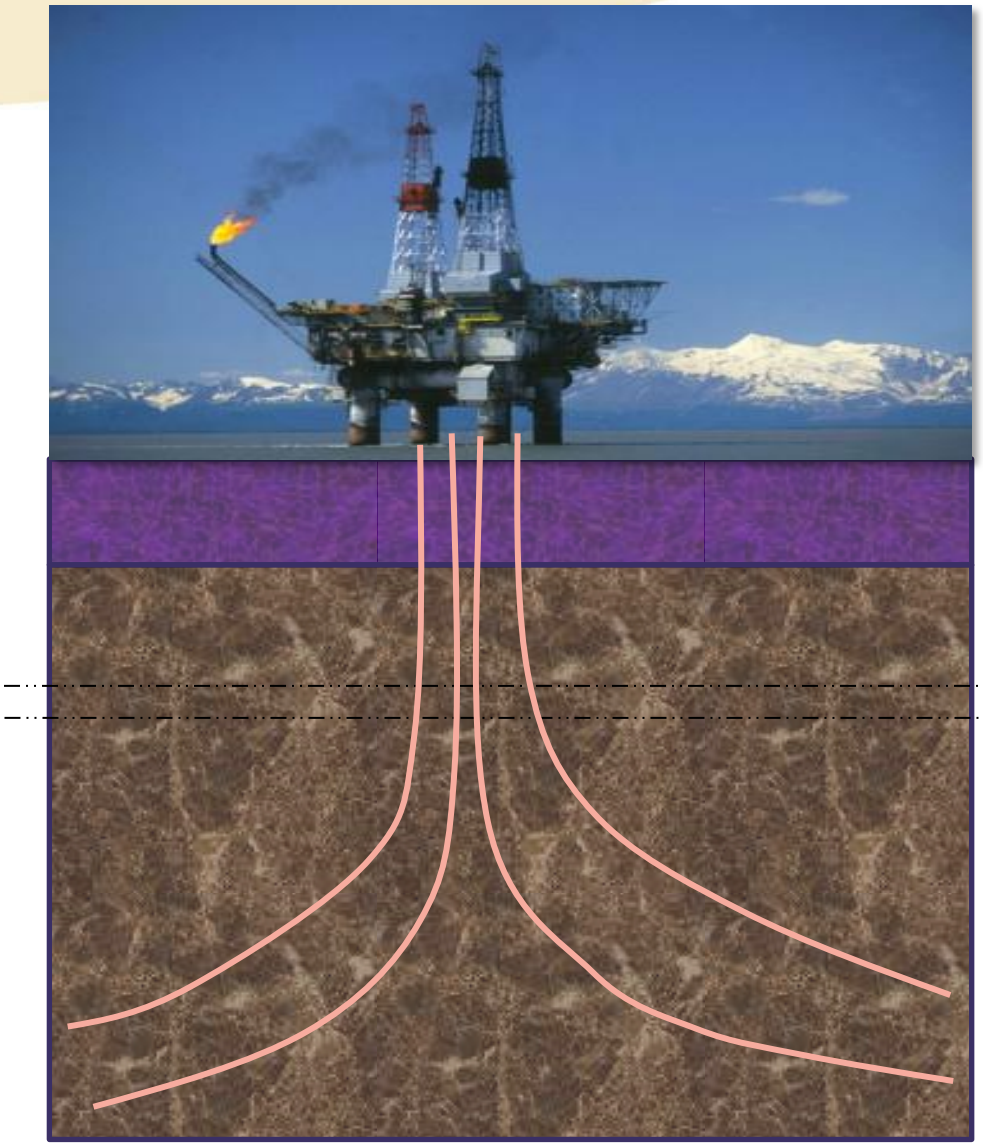
TIME

1. Context : Minimize Technological Risks during design



- Offer a long term vision for earlier decisions minimizing life cycle risks
- Balance between CAPEX / OPEX

WHERE ARE THE MAIN TECHNOLOGICAL RISKS



Surface facilities

- High number of systems and components
- Low uncertainties
- Easy access

Sub sea

- Low number of systems and components
- Medium level uncertainties
- Costly access

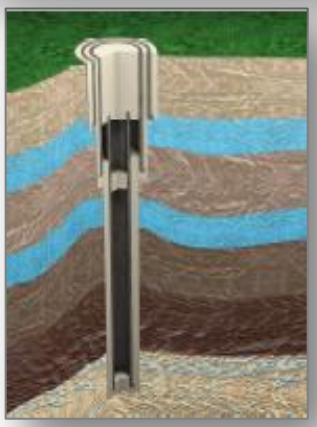
Sub surface

- Low number of systems and components
- High uncertainties
- Very Costly access

OBJECTIVES

- A full framework for optimising design of assets and operations processes to maintain a high level of performance :
  - Maximize availibility, safety
  - Minimize costs linked to unexpected events
- A full framework for maintaining level of risks acceptable during life cycle
- Tools to support the framework and processes

Some Key studies to optimize long term asset performance



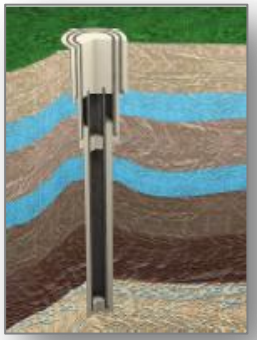
Risk-based integrity review

Initial condition evaluation « point zero »

Periodic Risk-based integrity review
Intervention Optimisation Studies

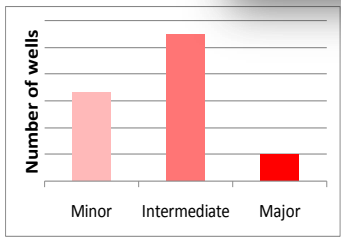
Design | **Construction** | **Operation** | **P&A**

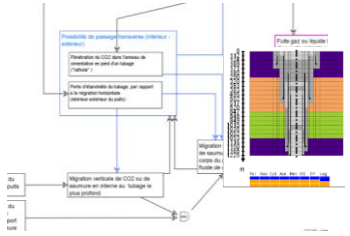
Global risk management process

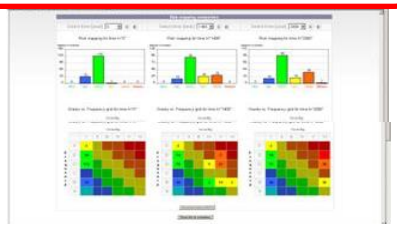


1. Classify Assets
2. Assess risks
3. Control & update

Process	Benefits
Well classification by severity potential	Well classification enabling graded approach and prioritization
WI Quantitative Risk Assessment	Quantitative & predictive decision support for Asset & Safety Management
Scheduled review of QRA & Well screening	Control of mitigation plans & risk monitoring of the well portfolio





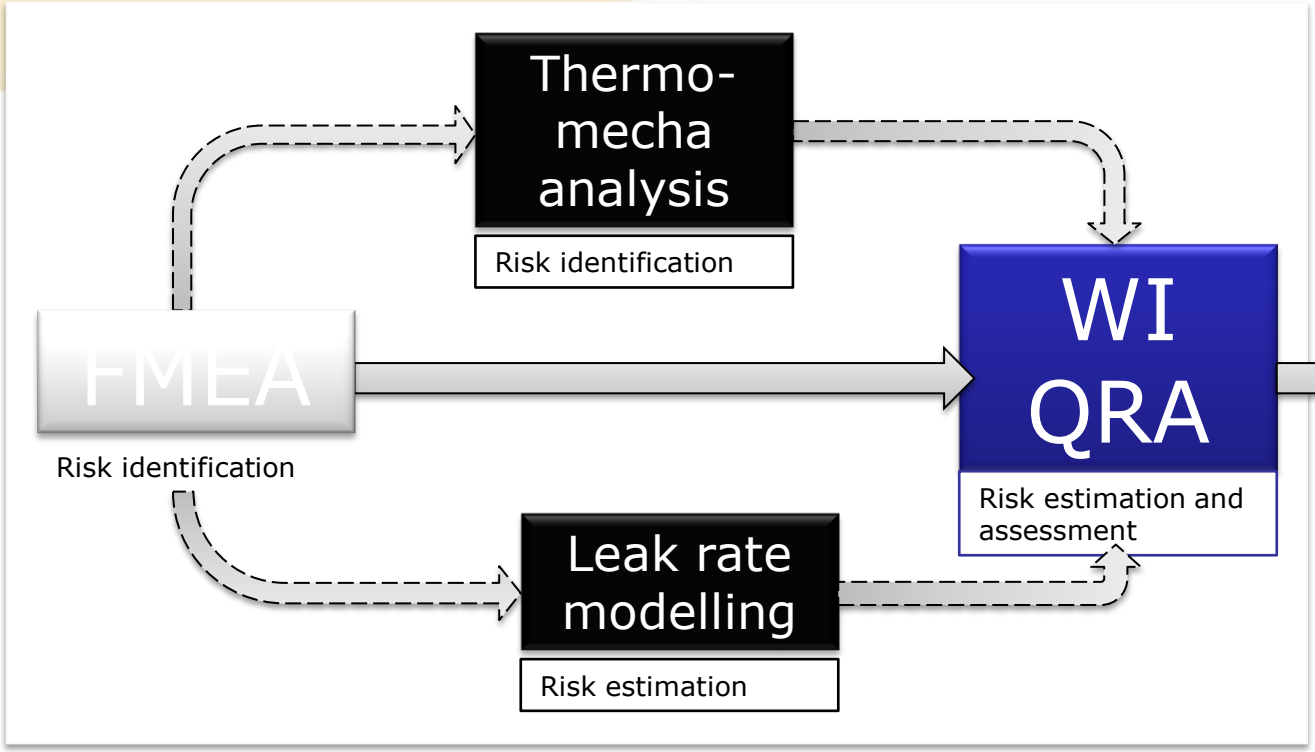


QRA due date or early update required?

no

yes

Overview of the Well Integrity QRA Methodology

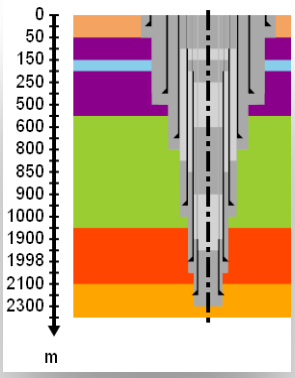


Qualitative assessment	Support studies	Quantitative assessment	WI Management
System characterisation	Estimation of potential leakage rates	Quantification of risks (likelihood, severity)	Risk-informed decision-making
Identification of failure modes and causes	Understanding of well behaviour	Ability to predict varying risk levels over time	Optimisation of operational procedures/practices
Assessment of prevention/mitigation controls	Indication of potential threats to WI (corrosion...)	Results to cover various scenarios	Ensure ability to produce while managing risks

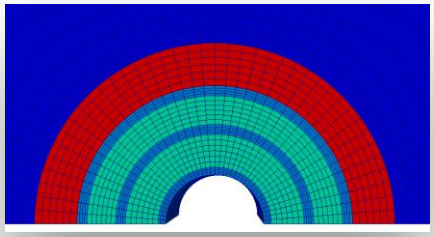
Methodology Workflow

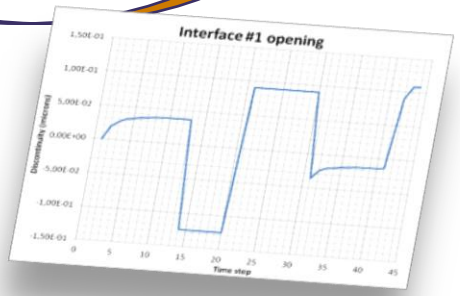
Data collection and analysis → **Mesh and boundaries definitions** → **Scenarios: base case + sensitivity** → **Conclusions and recommendations**

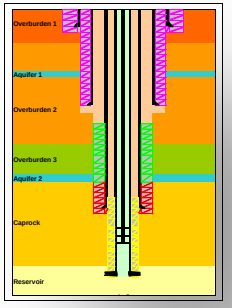
Iterative process

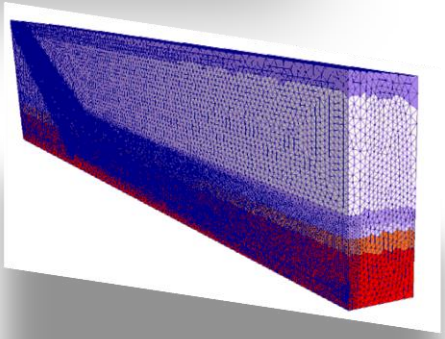


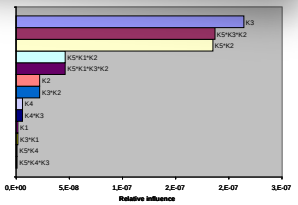
Section across 2 annuli





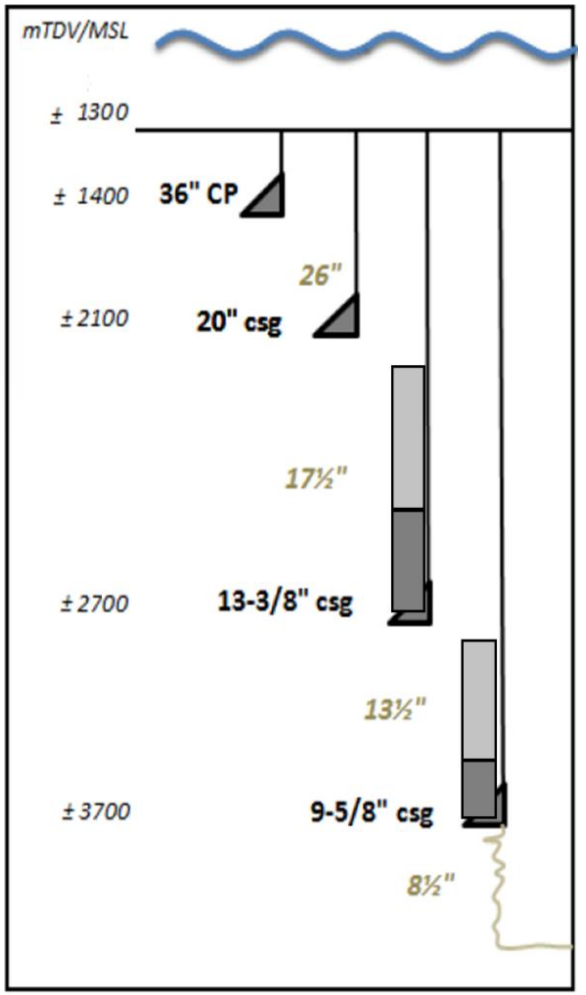






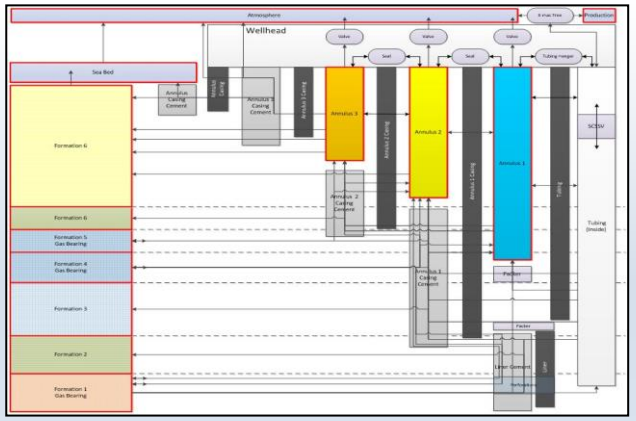
Business case
Context and needs

- **Context:**
  - *Offshore project*
  - *Pre-FEED phase*
- **Needs:**
  - *Check if proposed cement will contribute to avoid leakage into the geology or atmosphere*
  - *Propose recommendations regarding cement properties*
  - *→ Reassure project partners*
  - *→ Demonstrate authorities efficiency of well design*



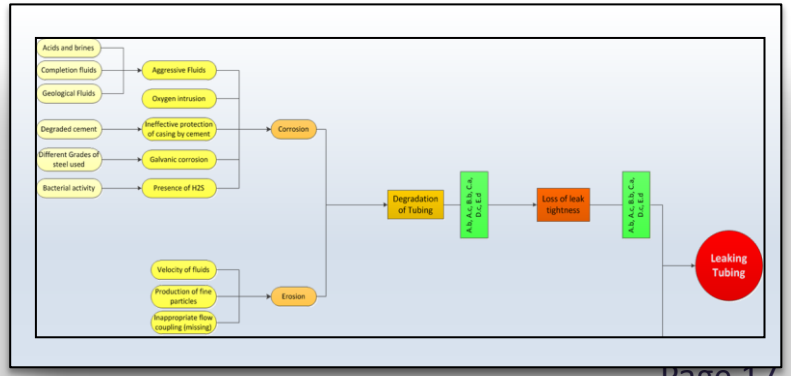
Failure Modes and Effects Analysis
Overview

Qualitative Approach of QRA

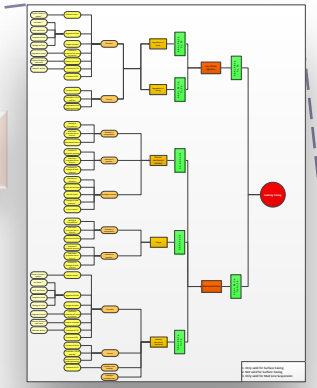


- **Providing a framework for :**
  - Understanding **threats** to well integrity
  - Identifying **component failure modes**
  - Characterising failure **scenarios**
  - Quantifying **likelihood** of failure
  - Assessing controls in place to prevent failure / mitigate consequences

- **Library of failure modes and causes:**
  - Industry & Oxand experience
  - Expert opinion
  - Industry research projects



Failure Modes and Effects Analysis
Failure Mode Diagrams



SIMEO™ Well-Base Library

Failure causes / factors

Acids and brines
Completion fluids
Geological Fluids
Aggressive Fluids
Oxygen intrusion
Degraded cement
Ineffective protection of casing by cement
Corrosion
Different Grades of steel used
Galvanic corrosion
Bacterial activity
Presence of H2S
Degradation of Tubing
Velocity of fluids
Production of fine particles
Erosion
Inappropriate flow coupling (missing)

Failure mode

A.b, A.c, B.b, C.a, D.c, E.d

Loss of leak tightness

A.b, A.c, B.b, C.a, D.c, E.d

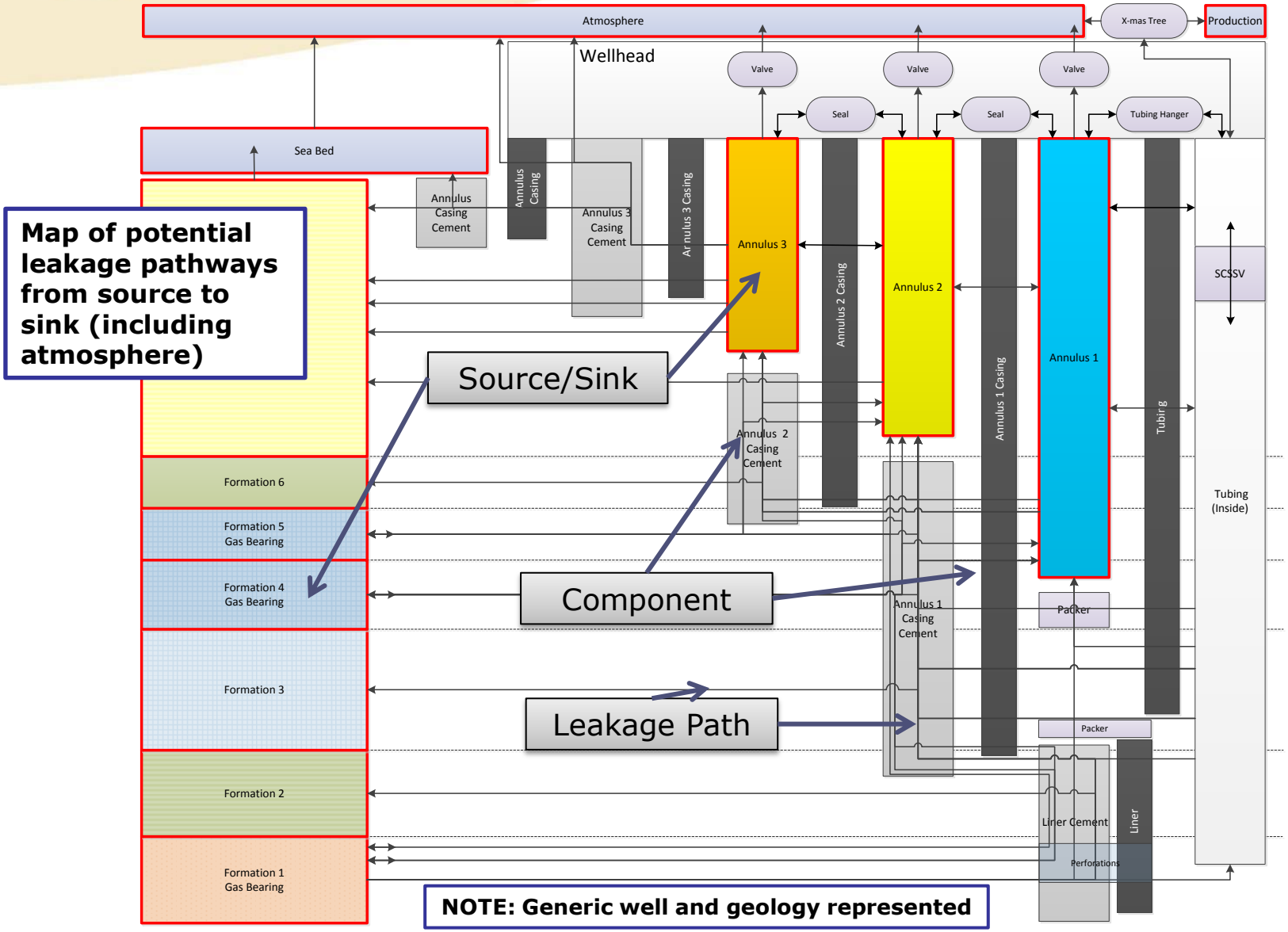
Immediate consequence

Leaking Tubing

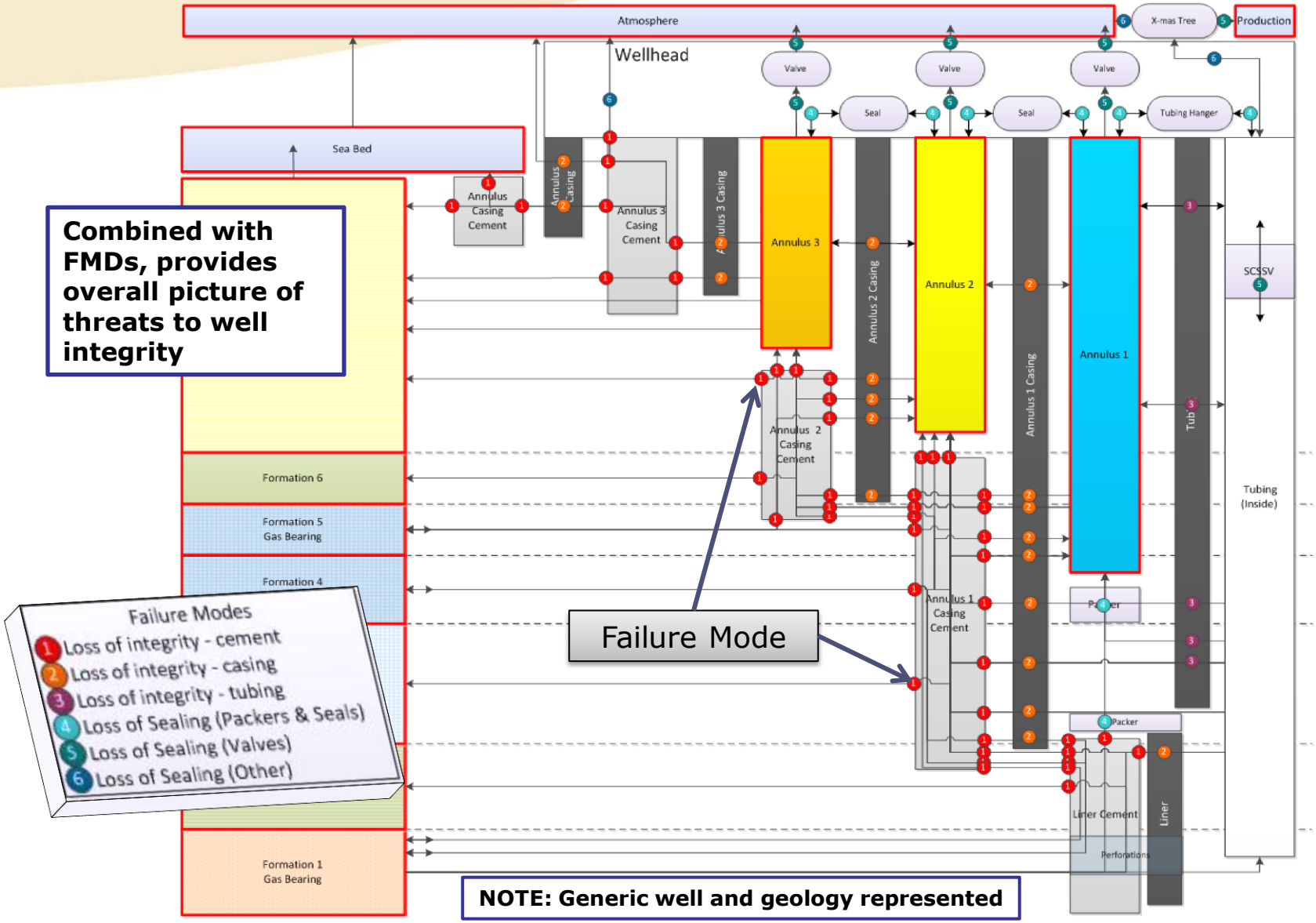
Controls for prevention / mitigation

- Design criteria
- Manufacturing/procurement specs
- Installation practices
- Operational procedures
- Maintenance doctrines
- Data gathering/analysis
- Etc...

Failure Modes and Effects Analysis
Leakage Pathway Diagrams



Failure Modes and Effects Analysis
Leakage Pathway Diagrams

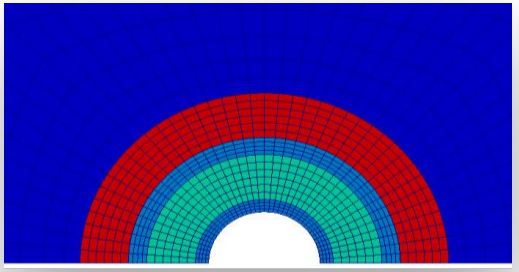


Combined with FMDs, provides overall picture of threats to well integrity

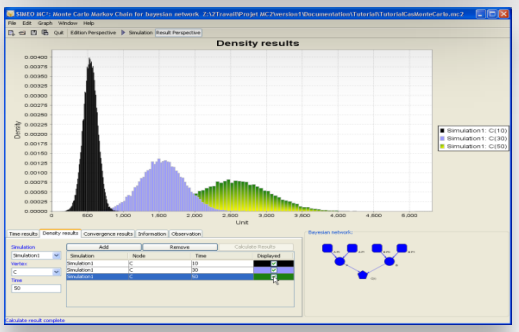
NOTE: Generic well and geology represented

Supporting Studies
Some examples

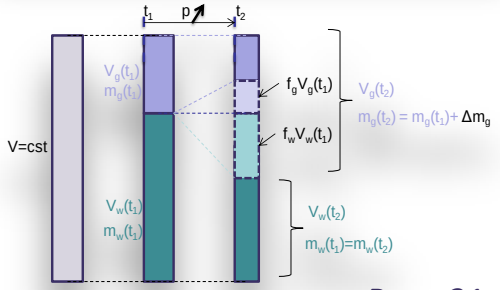
- **Thermo-mechanical modelling**
  - Indications of **likelihood** of failures



- **Leakage rate estimation**
  - **Quantitative estimation of leakage rates** (indication of severity)

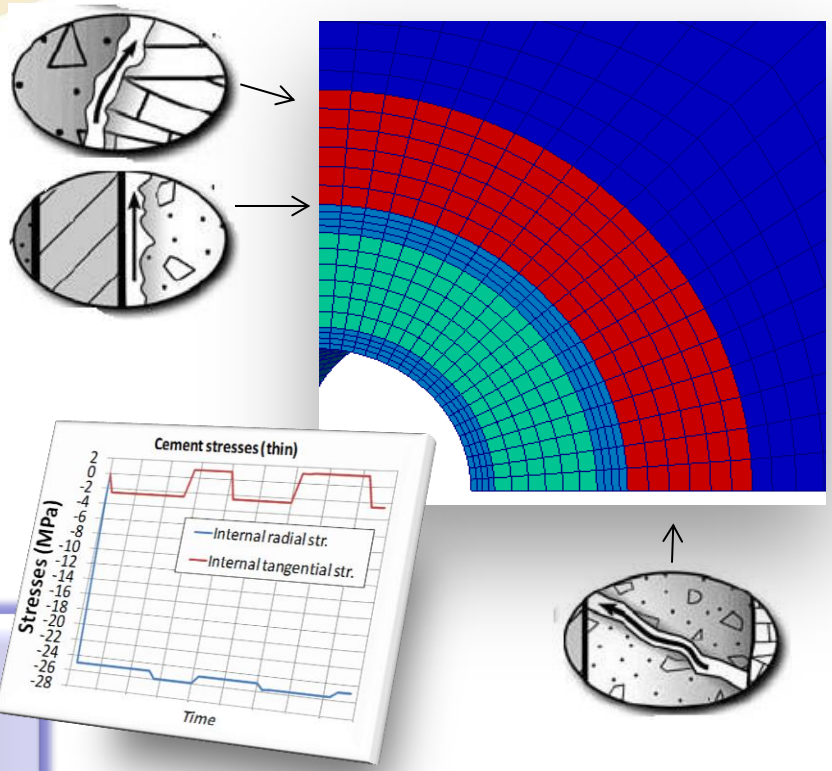


- **Calculations of annulus pressures and inventories in reduced integrity conditions**

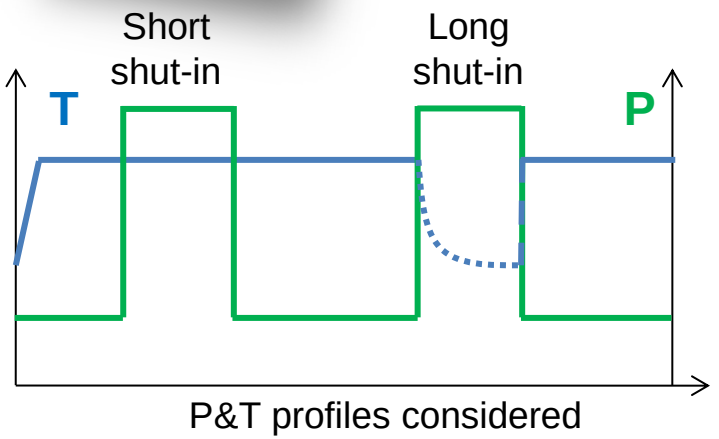


Business case

- **Potential failure and leakage paths:**
  - *Casing deformation*
  - *Micro-annuli opening at interfaces → potential leakage*
  - *Cement cracking*



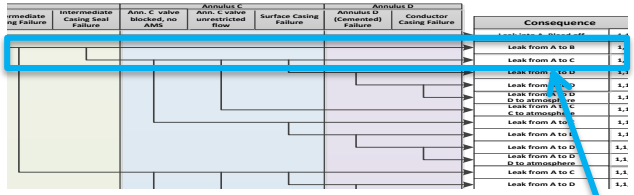
- **Parameters**
  - *Properties of geology*
  - *Evolution of cement properties over time (aging)*
  - *Initial casing thickness*
  - *Orthotropy of geological stresses*
  - *Evolution of P&T over time*

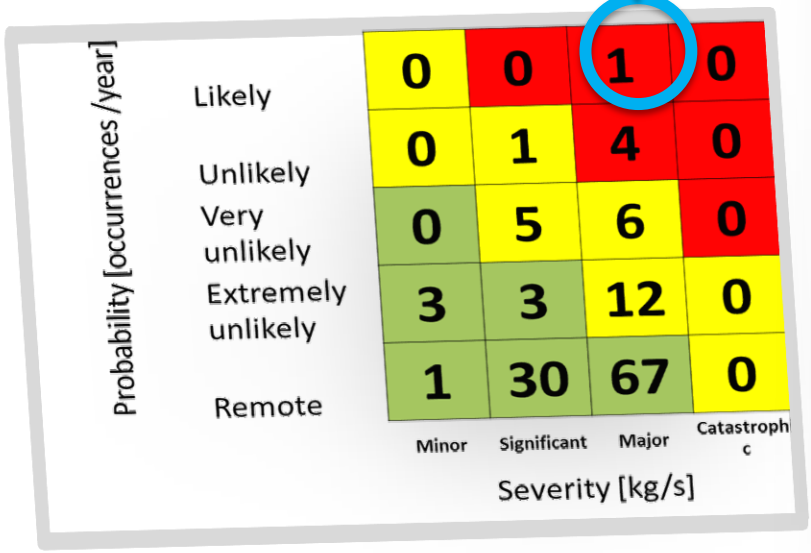


Quantitative Risk Assessment Model *Results*

Quantification of risk:

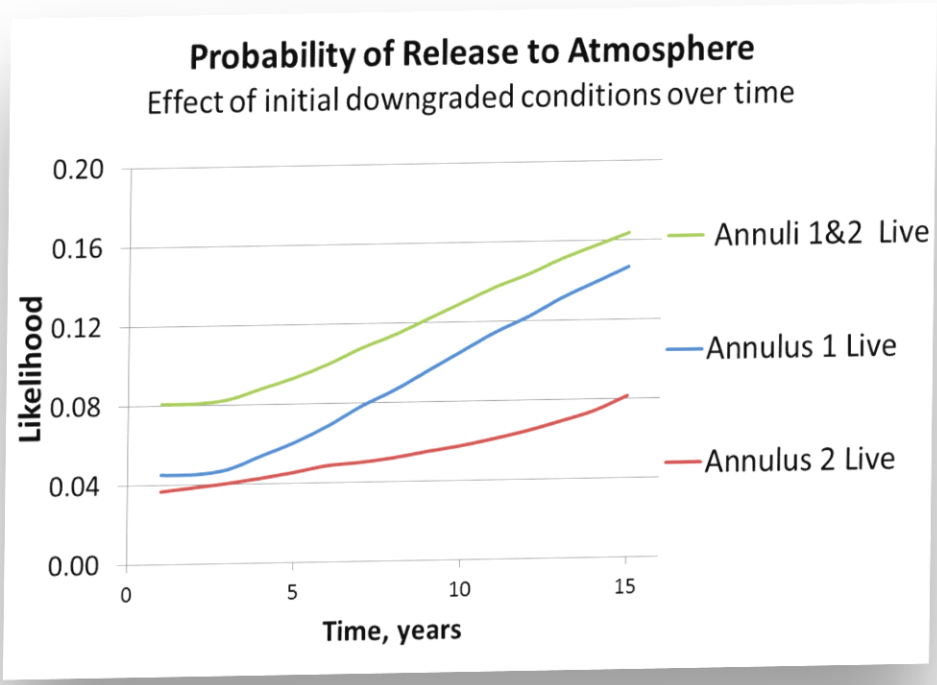
- Scenarios are classified in risk grids





Prediction of risk levels over time:

- risk levels due to ageing components/materials



A FULL RISK MANAGEMENT SYSTEM FROM DESIGN TO END OF LIFE

1 – Predictive Life Cycle Risk assessment

2 - Corrective actions

3- Integrate Risk mitigation actions in project planning

SIMEO™

4 – Risk Informed Decision System

5- Control and quantifiy Costs/Benefits

Conclusions

A risk-informed decision approach provides benefits for decision making at all stages of the lifecycle

Design

Determining optimum well design, component specs...

Operations

Developing operational risk management plans, maintenance strategies...

Abandonment

Planning abandonment to ensure safety, minimise disruption to production...

... when deployed as part of a successful overall risk management process

Asset, Ageing & Risk Management

Thank you