



# Well Integrity Risks Across the Well Lifecycle

By George Galloway, Advisor

# Agenda

- Brief Introduction to myself and Well Academy
- Well Integrity vs Well Control
- Managing Well Integrity
- Consequential Risk of Well Integrity Failure
- Ensure Well Integrity Risk is Managed Effectively
  - In Design and Lifecycle Management
  - Incorporating Human Factors
- Concluding remarks

# Introduction to me



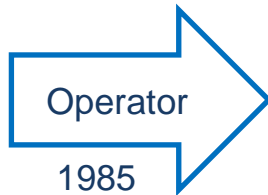
- Advisor
- Technical Consultant
- Membership Chair
- Founding Member



# Career Defining Moments



6<sup>th</sup> July 1988



20<sup>th</sup> April 2010



12<sup>th</sup> June 2019



# Introduction to Well Academy

- Founded in 2012 by oil & gas professionals passionate to improve well operations performance
- Global presence with centres in Apeldoorn, Perth and Houston
- Accredited (IWCF & IADC) well control training both DWC & WIPC
- Provides an extensive range of training courses across the well lifecycle
- Scenario based training incorporating human factors
- Only training provider with IWCF Level 5 accreditation
- 2020 acquired by Moduresources (MR Group)

# Well Academy History

The main logo for MR WELL ACADEMY, with 'MR' in red, 'WELL' in blue, and 'ACADEMY' in red.

Acquisitions by MR Group and now merged



# Facilities – Apeldoorn, Netherlands



# Well Integrity Training Courses

- Basic (Awareness) Well Integrity
  - 1-day course, aimed at operations staff
- Well Integrity Fundamentals (in collaboration with Simon Sparke, IWI)
  - Managing Well Integrity in the Operate Phase
  - 3-day course, aimed at operations staff or engineers, often project specific
- IWCF Level 5 (re-named Well Control in Design and Lifecycle Management)
  - Barrier assurance across the well life-cycle
  - Risk management
  - Aimed at experienced and knowledgeable candidates who play a critical role in well design, planning and execution.



# Well Control vs Well Integrity

## Well Control

- Containment of well fluids during well operations including drilling, completion & well intervention
- Achieved by having **temporary barriers** (drilling mud, kill weight brine, drilling BOPs, wireline pressure control equipment) to prevent unintentional flow of fluid from the well to the surface environment
- Relates to periods of well operations only



## Headline Well Control Events – The Impact



## Headline Well Control Events – The Legacy

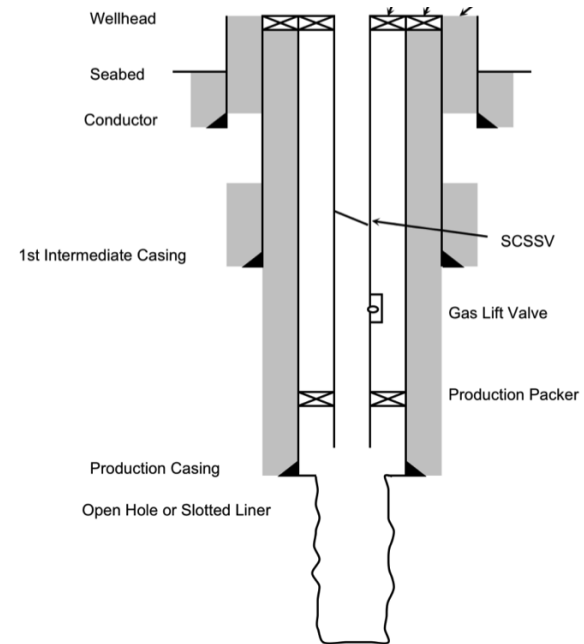
- Introduction of more rules and regulations e.g. EU offshore safety directive
- Requirement for well examination scheme became more universal
- Changes to well control training and assessment
- IOGP 476: Recommendations for enhancements to well control training, examination and certification
- Decreasing public support for oil and gas (fossil fuel) industry

The bigger the impact > The bigger the legacy

# Well Control vs Well Integrity

## Well Integrity

- Refers to mechanical “as built” condition of well
- Achieved by having competent **permanent barriers** (casing, cement, completion, wellhead & tree) which prevent unintentional fluid flow from a pressure source to the surface or sub-surface environment
- Whole of life cycle condition



## Headline Well Integrity Events – The Impact



*Elgin Franklin: 'Failure of casing due to corrosion resulted in gas leak.'*



*Aliso Canyon: '109,000 tonnes of methane gas released over 111 days.'*

## Headline Well Integrity Events – The Legacy

- A tightening of rules and regulations
- ISO 16530-1: 2017 Well Integrity – Part 1: Life Cycle Governance
- Well examination scheme extended to include the OPERATE phase
- Regulators pushing for more focus on managing well integrity
- Decreasing public support for oil and gas (fossil fuel) industry
- Dealing with an increasing number of orphaned wells (condition unknown)

## Managing Well Integrity - Policy

### How serious is the well operator in managing well integrity?

- The well operator shall have a policy that defines their commitments and obligations to safeguard HSE, asset and reputation with respect to well integrity
- The policy describes how well integrity is established and preserved through a documented management system
- The policy applies to all wells under the well operator's responsibility
- Well Integrity function should report direct to C-Suite level within organisation and ideally part of ESG compliance

## Managing Well Integrity - WIMS

This should describe in detail how it's done?

- Many operators implement a WIMS to ensure that well integrity is maintained throughout the well lifecycle
- Throughout the WIMS a combination of technical, operational and organisational processes are applied to manage well integrity
- WIMS will typically include the following elements:
- Risk assessment / organisational structure / well barriers / performance standards / well barrier verification / reporting and documentation / management of change / handover / audit



# Managing Well Integrity – The Human Factor

A new discipline or extension to existing ones?

| Activity  | Well engineering | Production operations | Subsurface engineering | Well integrity engineering |
|---|------------------|-----------------------|------------------------|----------------------------|
| Well basis of design                                  | C                | -                     | AR                     | I                          |
| Well detailed design                                  | AR               | -                     | C                      | I                          |
| ...   |                  |                       |                        |                            |
| Monitor well and annuli                               | -                | AR                    | C                      | -                          |
| ...   |                  |                       |                        |                            |
| Monitor compliance with WIMS                          | -                | C                     | C                      | A                          |
| ...   |                  |                       |                        |                            |
| R=Responsible, A=Accountable, C=Consulted, I=Informed |                  |                       |                        |                            |

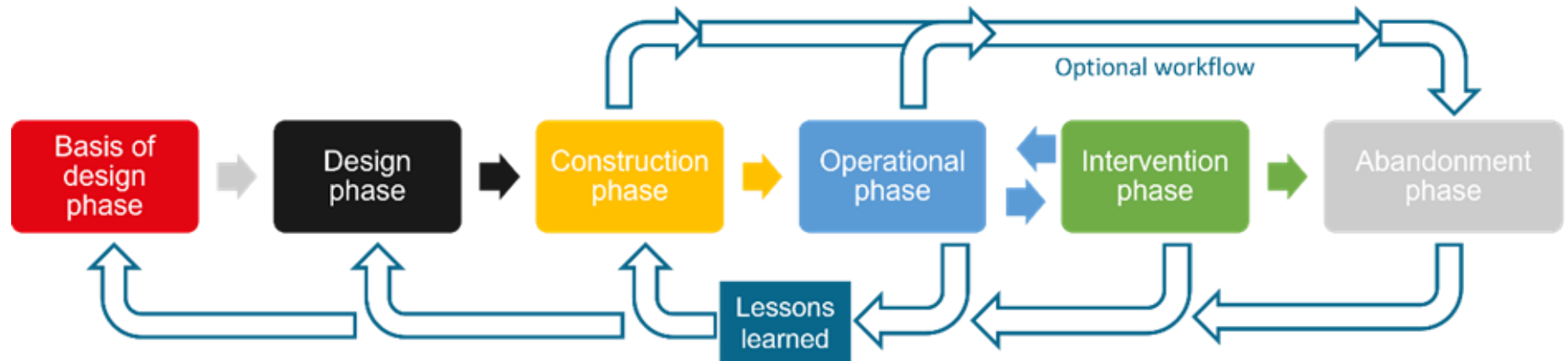
# Managing Well Integrity – The Human Factor

And who needs to be competent at what?

| Activity                                | Well site operator | Well/WI engineer | Petroleum engineer | Well integrity engineer |
|---|--------------------|------------------|--------------------|-------------------------|
| Well design and load case analysis      | Awareness          | Skill            | Knowledge          | Knowledge               |
| Well barrier assessments as-constructed | Awareness          | Skill            | Skill              | Skill                   |
| ...                                     |                    |                  |                    |                         |
| Monitor well pressure within envelope   | Skill              | Skill            | Knowledge          | Skill                   |
| ...                                     |                    |                  |                    |                         |
| Assess well operating envelope          | Knowledge          | Skill            | Skill              | Skill                   |
| ...                                     |                    |                  |                    |                         |
| Run corrosion logs                      | Awareness          | Skill            | Skill              | Knowledge               |
| ...                                     |                    |                  |                    |                         |

# Well Integrity Risks Throughout the Well Lifecycle

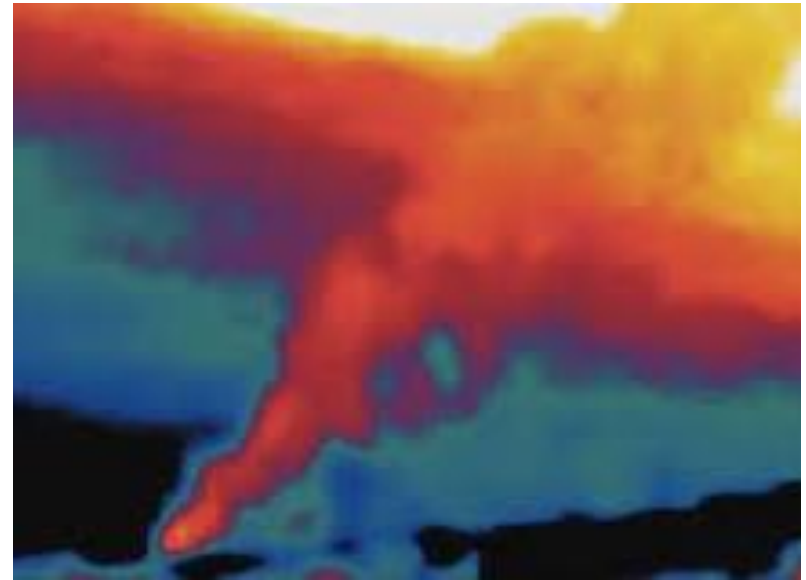
How does ownership contribute to the risks?



# Consequential Risk of Well Integrity Failures

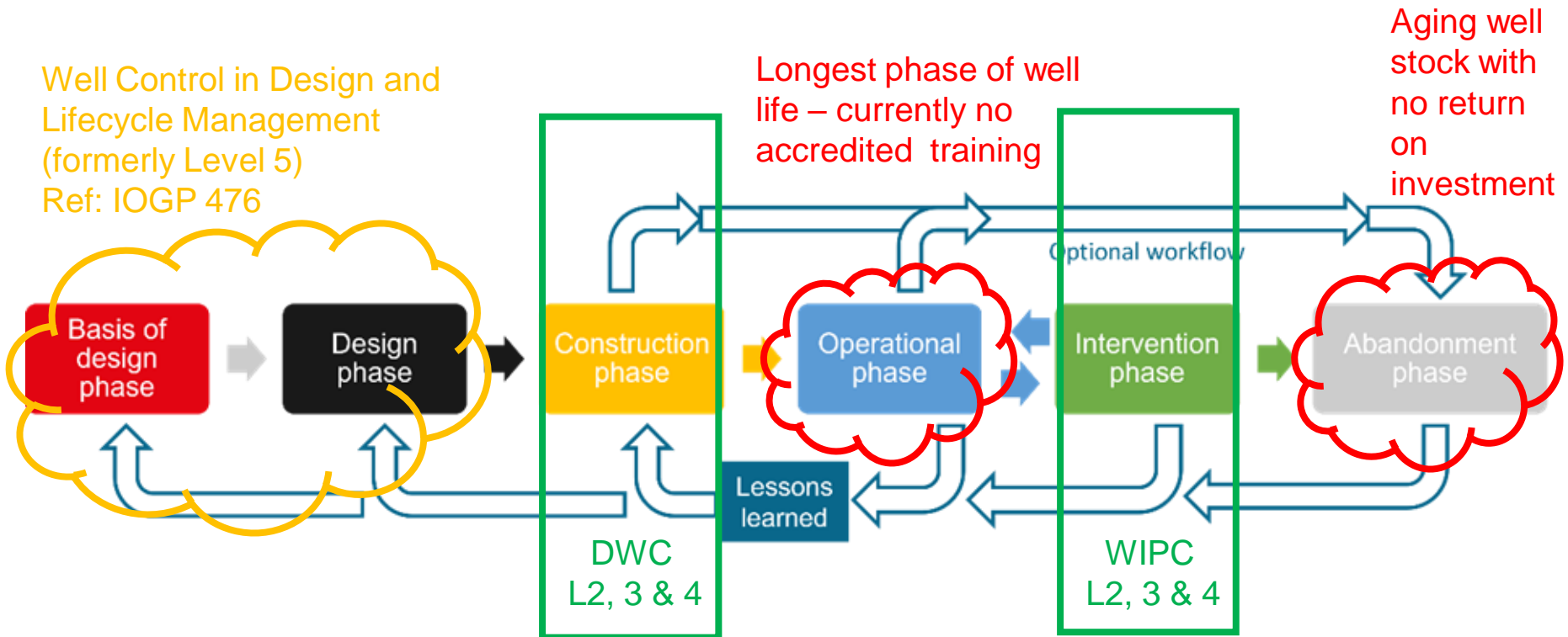
Repair costs / Loss of Production / Major Incident / More Regulations

- Methane leaks – potentially the largest impact
- How much has already leaked?
- Cost to prevent more leakage?
- GWP 28 times than CO<sub>2</sub>
- Impact on climate change



# View, Assess and Evaluate Well Integrity Risks

Well Control in Design and Lifecycle Management (formerly Level 5)  
Ref: IOGP 476



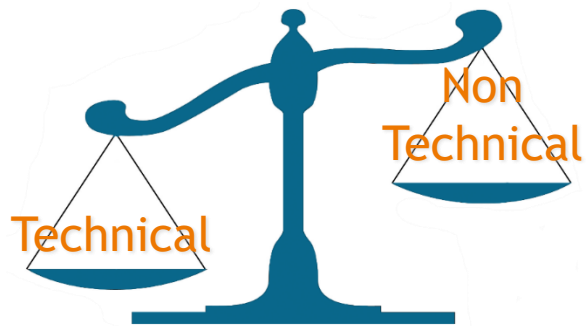
# Well Control in Design and Lifecycle Management

## Formerly Level 5

- Aimed at those who play a critical role in well design, and their approval
- Recognises the impact design, planning & programming has on well integrity assurance
- Provides delegates with skills to identify deviation from normal operating envelope and appropriate action to take
- Case study challenges delegates, and often fall short on addressing:
  - Management of change
  - Assessing risk
  - Barrier performance standards

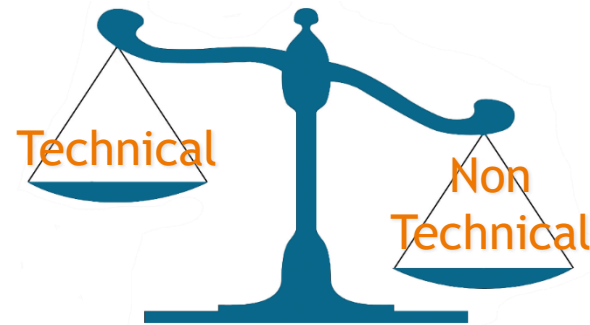
# Incorporating Human Factors

Increasing recognition of the role HF plays in incidents & accidents



Current  
emphasis

vs.



What incidents  
actually tell us

A human factor is the contributory cause of > 70% of incidents

# Incorporating Human Factors

## Behavioural Markers



- Situational awareness
- Decision making
- Communication
- Teamwork
- Leadership
- Stress & Fatigue



# Incorporating Human Factors

## Well Operations Crew Resource Management (WOCRM)

- Significant work done post Macondo - WOCRM / Scenario training etc
- Focus mostly on well construction phase - drilling crew drills & simulated exercises
- Equally applicable to other wellsite teams – intervention, well handovers etc.
- Check out IOGP (reports 501/502/503/509),
- IWCF Free to Download WOCRM programme
- HPOG website, SPE HF technical section
- HF still not widely adopted across well life cycle activities

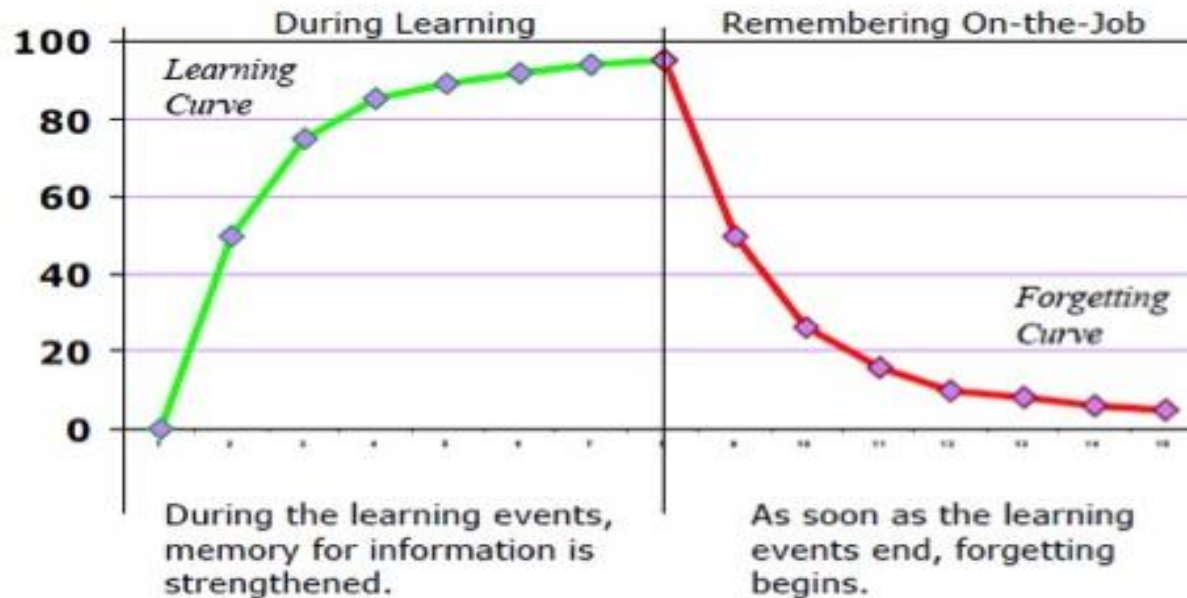
## What Else Needs to be Done

### In a Changing World

- Lessons learnt freely shared and fed back into the design phase
- Mandated or accredited well integrity training & assessment
- Address significant loss of experience and drop in competence levels
- Increase uptake of Well Control in Design and Life Cycle Management
- Re-categorise “soft skills” training as “safety critical” training
- Accredited training programmes not relevant in a changing world for
  - Managed pressure drilling (MPD) operations
  - Carbon capture and storage projects
  - Geothermal projects

# Continuous Professional Development (CPD)

## Typical Learning and Forgetting Curves



## Continuous Professional Development (CPD)

- Engineering institutes: requiring professional registered engineers to keep CPD records
- Failing to do so could result in losing their professional title
- 2 (or 5) yearly certification is not enough to prove individual competency
- Self paced learning e-learning modules continue to improve
- IOGP 476 April 2023 promotes continuous learning
- Team based continuous learning at the worksite should be encouraged
- Recommend CPD in place for safety critical positions



**End**

Any Questions?

