

# Well Integrity During Drilling Operations



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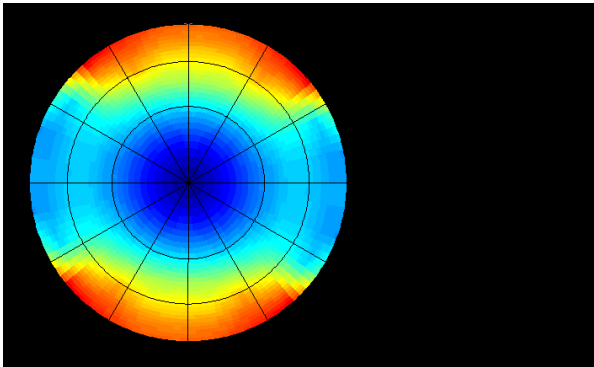
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# Disclaimer

Any opinions expressed by the presenter are not necessarily the opinions of INPEX Australia or INPEX Corporation.



- Wellbore Geomechanics for well design
- Pore Pressure, under pressure, over pressure, and fracture pressure
- Wellbore stability for vertical, high angle and horizontal wells
- Wellbore design for production, injection and monitoring
- Drilling fluid technology
- Drilling through faults, natural fractures, depleted zones, shallow gas....



$$S_v(z_0) = \int_0^{z_0} \rho dz$$

There is nothing I can say or do in this 25 minute Masterclass session that will enable a participant to ensure that he or she will not have any well integrity issues during drilling operations.

I can only hope that something I mention today triggers the thought process from within the participants that helps them avoid well integrity issues in the future.

Your minds are processing information many times faster than I am able to speak and than you are able to read the words and see the images on these slides. You are also taking in extraneous information. This is called thinking...it is the key to maintaining well integrity during drilling operations.

Historically most well integrity issues during drilling operations occur whilst drilling or tripping....

We are all here today in large part because of the Montara and Macondo incidents.

- Not drilling or tripping on Montara
- Not drilling or tripping on Macondo
- Most recent issue in Media, Elgin – Not drilling or tripping

## Definition – Well Integrity

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Well Integrity, in regards to oil wells, is defined by NORSOK D-010 as the...

“Application of **technical, operational and organizational** solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well”.

...from Wikipedia



MasterClass. Here, judges George and Gary run a masterclass .... which usually call back to some of the **challenges** from the previous week. For example, they may revisit the Mystery Box challenge and demonstrate some other dishes that could have been made or redo one of the contestants' dishes to give **tips on how it could have been improved.**



...From Wikipedia

- Mystery Box Challenge
- Pressure Test
- Team Challenge
- Invention Challenge





Every Well is like a mystery box, we don't really know what we will find inside until we actually drill it.

- Contingency plans are required
- Expect the unexpected
- Ability to react, think on your feet

# Pressure Test

- Performed properly
- Recorded properly
- Interpreted properly



Unquestionably the most difficult challenge today and absolutely the most important.

- Competence
- Chain of Command
- Roles and Responsibilities
- Interface and Communication

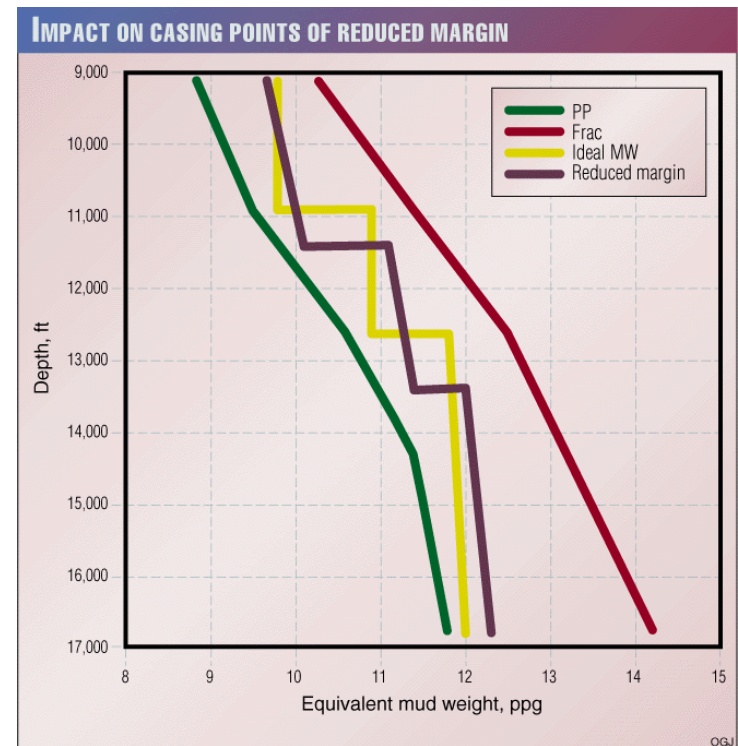
Sometimes in drilling we have to use the existing equipment, resources and information in a new and innovative way to ensure well integrity.

On a single well we may drill through:

- Normal pressure
- Abnormal pressure
- Subnormal pressure

Using

- Multiple mud systems
- Different BHAs and bit types
- Downhole Sensors



- Planning
- Right Ingredients
- Right team
- Good Technique and Execution
- Sample along the way

# Planning

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- Complete Basis of Well Design
  - Applicable Offset Wells
  - PP/FG Prediction
  - Purpose and use – exploration to producer or producer to injector
  - Anticipated fluid types and CO<sub>2</sub>, H<sub>2</sub>S, Hg
  - Detailed information on shallow formations and overburden
- Adequate Engineering Resources
  - Experienced drilling, completion, production technology, well test and subsea engineers if applicable
  - Robust management system and over sight of engineering
- Interface Management
  - Well Construction, Subsurface, Logistics, and field channels of communication open and understood
  - Communication with Management



## Ingredients *(far from a complete list)*

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- Casing weights, grades, material
- Casing wear allowance
- Drilling and completion fluids
- Cement
- Surface logging
- Downhole logging
- Annular Pressure Management Plan
- Management of Change
- HSE integrated into all facets
- Well Life Cycle Understood
- Handover and Handback procedures
- Independent Audit
- Risk Analysis

# Team

- Engineering Team
- Rig based Team
- Logistics Team
- Rig Contractor Team
- Subsurface Team
- 3<sup>rd</sup> Party Contractor Team
- Environmental Team
- Operations/Production Team
- Installation/Construction Team
- Commissioning Team
- Shut Down Team
- Business Support Team



- Detailed procedures including pre-job, on the job and after job
- Backups, redundancies and contingencies
- Experience, communication, trust & oversight
- Management of Change including risk analysis

“The highest level of performance that can be expected is the lowest level of performance that is tolerated”

Well Acceptance Criteria – minimum LOT/FIT values, cement job evaluation, casing setting depths achieved, maximum rotating hours or DLS not exceeded.

Sometimes the cooks in the kitchen get it wrong and tasting the dish along the way results in throwing it away and starting over.

To serve up a well with integrity, follow this recipe:

- Planning – No such thing as too much planning
- Ingredients – One bad ingredient can spoil the well
- Team – A coordinated broad based team effort is essential
- Technique and Execution – Plans and guidelines must be fit for purpose and followed – no shortcuts
- Sample – Ensure key well parameters are met along the way



