



**WOOD GROUP
KENNY**

Managing Integrity Status for Large Well Stocks

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Safety &
Assurance

Relationships

Social
Responsibility

People

Innovation

Financial
Responsibility

Integrity

Outline

- Well Integrity
- Large Well Stocks
- Conclusion



What is well integrity?

- Application of technical, operational & organizational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well.
- In the real world:
 - To ensure that the well is safe
 - To ensure the well is available for production
 - To optimise production rates, and
 - To minimise total costs



Integrity in wells vs other asset types

- They are complex multi materials, multi dimensional structure
- They are exposed to a range of harsh, changing environments
- They may have over 2000 Components
- They may extend several km into the ground, both vertical and horizontal sections, and
- Occluded Structures



'We're going to need a bigger rug or we're sunk.'



Why is Well Integrity important?

Catastrophic consequences of well failure

If we assume that the average percentage of shut in wells is 19% then the estimated global cost of well integrity issues is:

> US\$ 1 Billion Per Day

Remedial Cost

Environmental Cost

Legal Cost

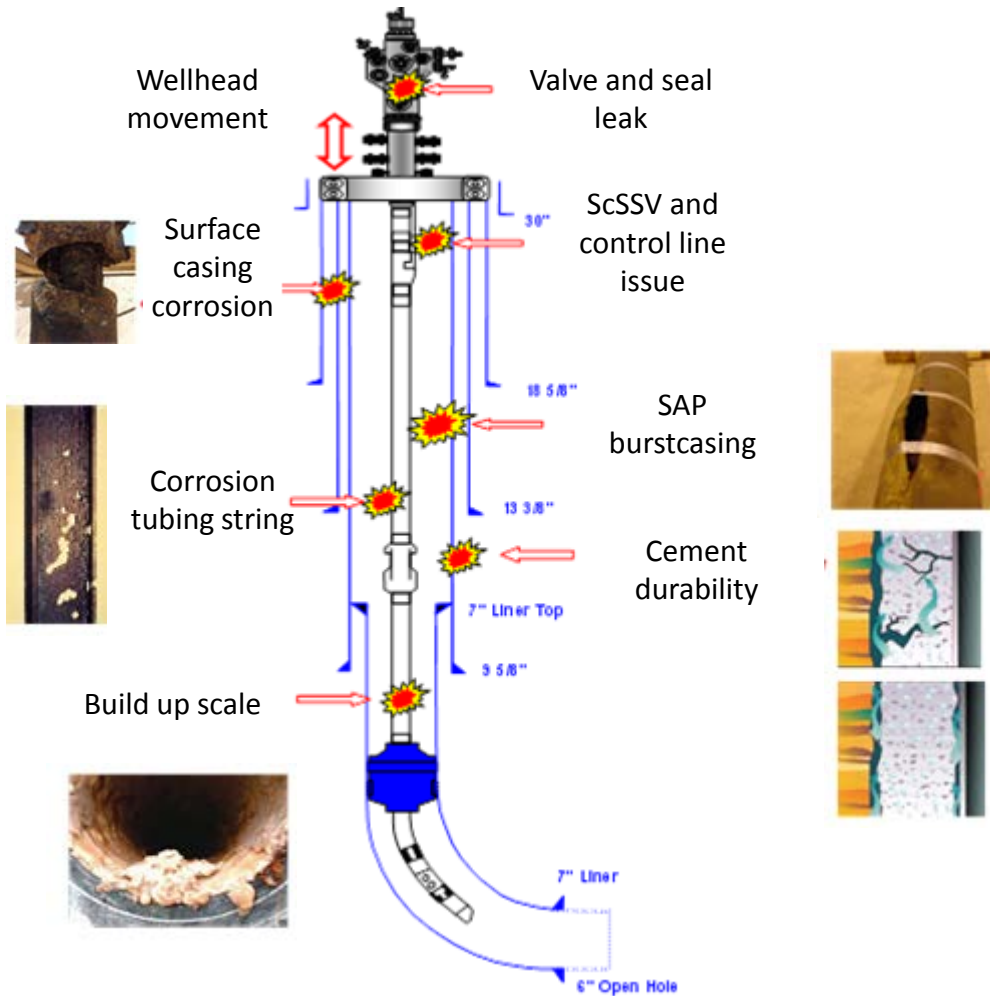
Organizational Cost

Reputation

Human Cost



Well Integrity Issues



In mature fields, approximately half of all workovers are related to WI problems



How common are well integrity issues?

Gulf of Mexico

(45%, 6,650 wells of 12,927)
Sustained Annulus Pressure



REF: US Minerals Management Service survey, 2004.

North Sea, UK

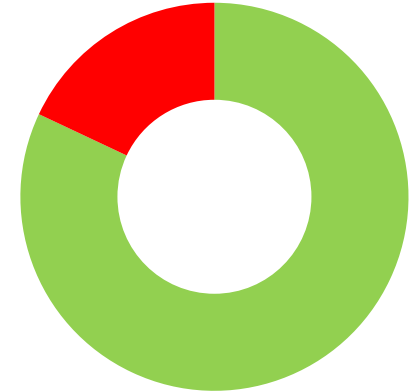
(34%, 1,600 of 4,700 wells)
At least one anomaly



REF: SPE forum North Sea Well Integrity Challenges, 2009.

North Sea, Norway

(18%, 482 of 2,682 wells)
One or more integrity failure



REF: Norwegian Petroleum Safety Authority, Well Integrity study, 2006.

Wells worldwide affected by integrity issues

~750,000



Challenges with large well stocks

- Large amounts of historical data
- Chasing data updates
- Multiple platforms, fields, countries
- Application of rules to a huge dataset in every reporting period
- Generating reports specific to stakeholder needs
- Differing regulatory requirements
- Prioritising actions with limited resource
- Planning CM / PM, interventions etc

Leads to
Firefighting
Rather than

“Looking after
what is
important.....!!”



Tools to manage large well stocks

- A comprehensive Well Integrity Management System (WIMS)
- Specific tools which can assist :
 - Well Failure Action Matrix (WFAM)
 - String Status Reporting



Well Integrity Management

- Fundamentals: ability to identify and categorise the integrity status of a well.
- A clearly written set of documentation is needed: WIMM (well integrity management manual).
 - Reference document to ensure adequate and sufficient of well integrity standard is applied.
 - Outline the expectations of life cycle management of well integrity.
 - Identify the roles and responsibilities of personnel for delivering well integrity assurance.
 - Functioning as a high level bridging document.

Well Failure Action Matrix

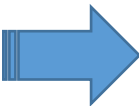
- A tool for distilling the following and integrating into the COMPANY WIMS:
 - National Regulations
 - International Standards (e.g. Norsok D-10, API RP14B)
 - COMPANY specific standard / best practices, and
 - External & Internal expertise
- Generates a set of well stock specific rules
- Once data is applied the outputs are:
 - Status of each safety critical element
 - Overall well integrity status, and
 - Decisions on what action needs to be taken



Simplified Well Failure Matrix example

Risk Factors / Well Type	Gas Injector	Artificial Lift Well	Gas Producer	Oil Producer	Water Injector	Subsea Wells
External leak from x-mass tree or wellhead	5	5	5	5	5	5
SCSSV and SSV/Upper Master Valve Failure	5	5	5	5	4	4
SCSSV Failure	5	5	5	5	4	4
Packer Plug Failure	4	4	4	4	3	4
Valve test degraded	3	3	3	2	1	1

Well with the status of 1, 2, 3 (healthy);
4 & 5 (unhealthy)



Simplified Action Matrix example

Failure Status	Required Action	Mitigation
Lower Risk 1&2	The well can be operated in this condition.	Continue to check, test, monitor and maintain
Medium Risk 3	The well can be operated in this condition.	Enhanced monitoring of degraded component, life time modelling and replacement planning.
Higher Risk 4	A dispensation is required to operate during this period. If the dispensation is not granted then the well needs to be made safe and secure immediately.	Immediate technical review to determine mitigating actions. A dispensation must be obtained to operate but limited to only X month. Repairs to be done on urgent basis within Y month.
Higher Risk 5	Make well safe and secure immediately. Operation under dispensation is NOT allowed.	Immediately secure well and make it safe. Implement well integrity corrective actions. Repairs to be done on a critical basis.

IWIT[®]: Key features of a comprehensive WIMS

- Capture your data
 - Manual (spreadsheets)
 - Automated / Interfaced (iWIT NotePad)
- Store all data in a single database
- Access to data
 - from any computer
 - by anyone (with authorisation)
 - from anywhere; anytime
- Visualise your data
- Analyse your data
- Determine well integrity status
- Evaluates
 - Well diagnostic status
 - Monitors Annulus-pressure
 - Diagnostic test data
 - ID's sustained annulus pressure source and cause
 - Tubing corrosion rate
 - Determines erosion rate due to sand production
 - Remaining tubing life
- Customised reporting
- Predictive tools
- Investigation tools
- Combine your data with rules
- Real Time Status, and
- Fully configurable



Allows reporting at multiple levels



String Status Reporting

- Based on well classification from an expanded WFAM
- Example of information contain in string status report:
 - Current Well status: Healthy/Unhealthy
 - Current Unhealthy status: Baseline/Emerging
 - Monthly: Healthy/Unhealthy / Emerging Reports
 - Rectified category: Baseline/Emerging
 - Well Category: Flowing/Closed in
 - Unhealthy classification: Effective/Non-Effective/Depleted/NA
 - Unhealthy sub-classification: ECH/OPS/AI/RMD/FAC/RM/LMT
 - Estimated BOPD



String Status Reporting

With IWIT® string status report....

- Helps to effectively manage the well data
- Automated data collection
- Automated well classification
- Automated recommendation actions
- Pre-populated data forms which make status and action decisions more efficient
- Decision points are highlight changes in status for review by WI engineers
- Customized report which viewing across well integrity categories and the interrogation of issues, data and other statistics



String Status Reporting - Filtering

Filter criteria:

- Well hierarchy level (country, area, field and platform).
- Type of the well.
- Well status category (healthy or unhealthy).
- Month.
- Well location.
- String type (long or short).

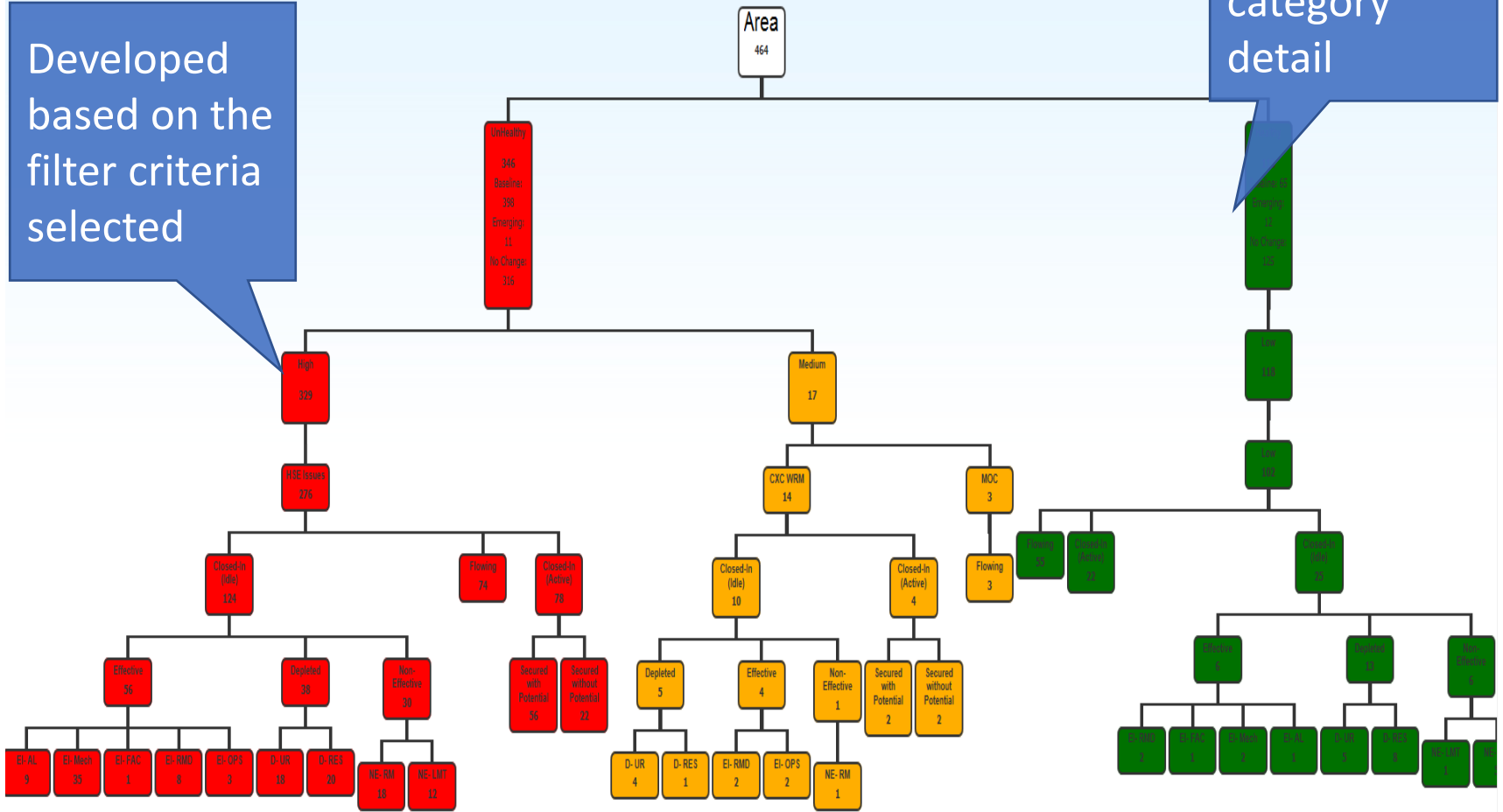


String Status Reporting

NG STATUS REPORT TREE VIEW - JULY-2015

Click on the "box" for category detail

Developed based on the filter criteria selected



Conclusion

- Well integrity often gets overlooked yet it is a crucial to prevent the worst types of incident experienced in our industry.
- An integrated enterprise wide Well Integrity Management System is essential provides:
 - Visibility of Risk
 - Enhanced Management of Risk
 - Enhances production
 - Allows optimisation of costs
 - Enables automated assignment of well classifications
 - Facilitates management of large volumes of historical data
 - Facilitate investigation of issues
 - Provides automation in reporting, data collection, status assignment, work orders
- Within a WIMS, the WFAM & string status reporting tools have been particularly effective in managing large well stocks.



Thank You



ScSSV Allowable Limit of Leak Rates

For gas wells: 15 SCF/min

For oil wells: 400 cm³/min

Well Type/ Tubing Size	Allowable Pressure Build Up in 15 Minutes (psi)					
	2-3/8"	2-7/8"	3-1/2"	4-1/2"	5-1/2"	7"
Oil Producer/Water Injector	315	210	140	80	50	30
Gas Producer/Water Injector	210	150	105	60	35	20

Ref: API RP 14B, Recommended Practice for Design, Installation, and Operation Subsurface Safety Valve System

