Reducing Well Control Incidents
A Case for Automation

Mark Gillard
Technical Manager
Agenda

- Introduction
- Data Analysis
- Why Automation?
- Automated Well Control
  - Human Factors
  - Reducing Influx Size
  - Cost Benefits
- Automated Well Control System
- Q&A
Meet Our Team

Bryan Atchison  
Managing Director  
Senior executive with long-standing career in Operators. Extensive experience in drilling, well engineering and offshore operations.

Eric Wesselingh  
Engineering Manager  
Experienced senior manager with 30 years’ experience in the oil and gas industry and strong background from Drilling Contractors.

Mark Gillard  
Technical Manager  
Experienced professional with over 40 years of well engineering experience working for Operators, Training Centre and Regulator.

Juliana Bond  
Corporate Communications Manager  
Very skilled journalist with over 15 years of experience in Media, Communications and Marketing.
Timeline

Safe Influx
Founded in October

2018
- Minimum Viable Product available
- Lloyd’s Register Technology Qualification achieved
- IP Agreement signed off by RGU
- OGTC funding awarded

2020
- Successful FIELD TRIAL and Technology Qualification extended to traditional land rigs

2021
- UK Patent granted
- Successful Safe Influx and Weatherford MPD RIG TRIAL
- OGTC funding awarded
- Conferences

2021
- SPE Technical Papers
- Conferences
- Finalist for the World Oil Awards

Finalist for the SPE Offshore Achievements Awards and Global Energy Awards

Global Partnership with Weatherford MPD

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Why Automated Well Control?

Drillers’ loss of Level 1 Situational Awareness (loss of attention) causes up to 67% of blowouts.

Loss of Well Control frequency is 6.04 wells/1000 for exploration wells in US GoM.

71% of Well Control Incidents caused by Human Factors.

Loss of Well Control frequency is 1.50 wells/1000 for exploration wells in a North Sea Standard operation.

The triggering causes of 54% of kicks could be mitigated or prevented by EKDS and automated response.
Well Control Incidents

Well Control Incidents (WCIs) timeline

- Global economic downturn
- Supply and Demand issues
- Macondo Blowout
- Norske started sharing WCIs
- IOGP started sharing WCIs
- Impact of Oil prices and activity levels
- COVID 19 impact on activity levels

Legend:
- British Columbia
- IOGP
- NOK
- BSEE
- TRRC
Data Analysis – Key Contributing Factors

Only 20-35% of Well Control incidents can be definitively attributed to **Technology Failure**
the remainder are attributed to either **Organisational Issues** or **Human Factors**
which could be mitigated by automation.
Automation in the Automotive Industry

Level 0 Autonomy
Level 1 Autonomy
Level 2 Autonomy
Level 3 Autonomy
Level 4 Autonomy
Level 5 Autonomy


- Electric Start
- 3 point seat belt
- Padded dashboard & steering wheel
- Dipping headlights, indicators, windscreen wipers
- Satnav
- Parking Assistance
- Dynamic Stability Control
- Traffic Jam Assist
- Semi Autonomous Braking, Blind Spot Monitoring
- Lane Departure System
- Lane Departure Alarm
- Adaptive Cruise Control
- Airbags

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ABS and Dynamic Stability Control
# The Benefits of Automation

<table>
<thead>
<tr>
<th>Safety</th>
<th>• The end result is pre-determined</th>
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<tbody>
<tr>
<td>Assurance</td>
<td>• Protocols, procedures and sequencing can be agreed before operations commence</td>
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<tr>
<td>Consistency</td>
<td>• the sequence duration is pre-determined</td>
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<tr>
<td>Execution</td>
<td>• the sequence will continue unless halted</td>
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Why Automated Well Control?

- Reduced Well Control Risks?
- Cost Effective Wells?
- Environmental Performance?
Safe Influx Automated Well Control Field Trial - Oct 2019 - YouTube
Drillers’ loss of Level 1 Situational Awareness (loss of attention) causes up to 67% of blowouts
Comparative Human Factors Analysis

Traditional vs. Automated Comparison

Hierarchical Task Analysis

Human Error Quantification

Human Error Identification

Screening, Performance Influencing Factors

94% Reduction in Probability of Human Error
Reducing Influx Size

- Minimise Surface Pressure
- Minimise 'Weak Point' Pressure
- Minimise flare/vent volumes
- Minimise Recovery Time
- Minimise 'on choke' time

Reduced Influx Size
Influx Volume

Influx Taken → Trigger Volume Reached → Driller Reaction → Space out → Shut down Rotation & pumps → Activate BOP control → BOP Closure
- 30 Sec – Ram preventer
- 45 Sec – Annular Preventer
→ Well Closed In

Manual Well Control

Influx Taken → Trigger Volume Reached → Space out → Shut down Rotation & pumps → Activate BOP control → BOP Closure
- 30 Sec – Ram preventer
- 45 Sec – Annular Preventer
→ Well Closed In

Automated Well Control

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A reduction in kick tolerance parameters could result in the modification of casing design standards and in some cases lead to a reduced casing scheme for a given well type.

Study on UKCS Jurassic and Palaeocene targets has indicated that a 20% reduction in well costs could be achieved.
Total Cost of Risk – Well Control

TCoR Model

- HUMAN FACTORS
  - Kick Tolerance
  - Asset Damage & Repair Cost
  - Drilling Cost

Cost of Risk Model

- HUMAN Factors
  - Deepwater Semi US GOM
  - Kick
  - Recovery
  - Cost

TCoR Results

- Deepwater Semi US GOM
  - TCoR - Manual Well Control
  - Blowout Risk
  - Kick Recovery Risk
  - Insurance Savings
  - TCoR - Automated Well Control

Key Points

- Cost of Risk often not articulated in well AFE

- Potential for up to 50% Risk Cost Savings per well with Automated Well Control

- TCoR Model could include NPV of deferred / lost production

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Why Automated Well Control?

**Reduced Well Control Risks**
- Reduction in probability of human error by 94%
- Enhanced decision-making, efficiency and safety

**Cost Effective Wells**
- Smaller influx volumes
- Reduced well control costs
- Reduction in casing and well costs by 20%

**Environmental Performance**
- No spills
- Reduced carbon footprint
Why Automated Well Control?

### Reduced Well Control Risks
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### Cost Effective Wells
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Automated Well Control - System Topology

Rig Equipment
- Flow meter

Safe Influx Automated Well Control System
- Influx Detected
- PLC Cabinet

Existing Rig Equipment
- Stop
- Top Drive
- SPACE OUT
- Mud Pumps
- Drawworks
- BOP

Victus™ MPD
Weatherford

Future Inputs
- EKDS
- Real-time Downhole Data
- Real-time Mud Properties

HMI Screen

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Equipment Selected for Auto Shut-In Control

- Annular Preventer
- Upper Pipe Ram
- Middle Pipe Ram
- Lower Pipe Ram
- Draw Works
- Top Drive
- Mud Pump 1
- Mud Pump 2
- Mud Pump 3

System is Healthy
Safe Influx Monitoring
Automated Well Control Enabled

Flow Line Gain
- Current Flow Gain (%): +0.0
- High Gain Setpoint (%): +2.0
- Reset: Drilling Flow (bbl/m) +25.2
- Current Flow (bbl/m): +25.2

Draw Works Space Out Height
- Current Height (ft): +40.5
- Upper Setpoint (ft): +84.2
- Middle Setpoint (ft): +84.2
- Lower Setpoint (ft): +38.5

Shut-In Sequence
- Monitoring: No Action Required
- No Action Required

Auto Well Control
- ON
- OFF

Data Comms
- PLC 1
- PLC 2
Automated Well Control – System Overview

**Overall Philosophy**
- Uses *existing* rig monitoring equipment as Input for Influx Detection
- Interfaces with, and controls, *existing* rig drilling equipment
- *Existing* Rig Safety Systems remain fully functional
- Can be installed on both Conventional and Cyber based Drilling Systems
- Efficient install process minimizing impact on Operations

**System Design (Cyber)**
- Small Footprint (PLC Cabinet and HMI Screen)
- Easy Interface with Existing Drilling Controls Systems
- Interface arrangements to stay in place for future re-instatement

**System Installation**
- **Rig Survey** 2 Persons for 2-3 days (no impact on Operations)
- **Design / Fabrication** 3-4 months (driven by PLC supply)
- **Installation / Commissioning** 2 Persons for 2-4 days (limited impact on operations, most can be done off-line)
- **Training** ½ - day (Driller, Tool Pusher, AD as a minimum)
Assurance Journey

- Linked to Weatherford Victus™ Intelligent MPD system
- Extensive rig testing (Aberdeen and Houston)
- Extensive simulator testing
- SIL2 compliant
- API 16D conformance
- EU and UK design standards
- High specification equipment - Siemens
- Lloyds Register Technology Qualification Process
- Finesse - bespoke automation

UK patent
Tested for Success | Weatherford Victus™ Intelligent MPD and Safe Influx Automated Well Control - YouTube
## Useful Links

www.safeinflux.com

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<th>SPE-206385-MS</th>
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Safe Influx Automated Well Control
Protection against blowouts
Risk and cost reduction
Peace of mind

www.safeinflux.com

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