Drilling Simulator 3

iPad Version 1.1

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Chapter 2

Disclaimer

These tools and materials are provided 'as is' without warranties of any kind, express or implied.

Please verify the tools provided by this application by yourself before you use them. Ensure you understand the impact of using these tools.

Any use you choose to make of these tools & materials is undertaken by you entirely at your own risk.

Note:

This app was created with an educational proposal to help students and teachers of drilling engineering and has no intention of replace the professional softwares.

It is also an useful tool for other professionals in the oilfield, such as technicals and engineers.

Thanks
CHAPTER 3

Introduction

This is a basic drilling simulator that simulates drilling operations based in panels for kick detection, shut-in the well, stabilization of pressures and the choke operations during the well control operations using a hydraulic choke panel simulator.

This is a new project based on apps "Drilling Simulator 2" and "Well Control Simulator 2" available in our portfolio on the App Store.
Features:

1. Driller Interface based on Pressure Gauge, Weight Indicator, Rotary Torque gauge and Geograph.
2. Choke Interface based on Hydraulic Choke Panel.
3. Graph in full screen (with background color in black or white) for analysis.
4. Pre-recorded data form
5. Standpipe and choke manifolds, float valve, failures schedule and multiple kicks.
6. Three codes (admin, instructor, student) to view the gas into the borehole, the pressure at bottom, at shoe and at bop and to enable / disable the Lag Time (by adjusting the choke to change the kill pressure and drill pipe pressure, etc).

Attention: The Initial codes: "0000"

Note: If lose the admin code:
1. Export all data files to iCloud;
2. Delete the app on iPad
3. Re-install it from App Store.
4. Use the initial code: "0000"
5. Import data files from iCloud

Other features also available:

A graphical very useful tool for training of roughnecks, derrickmen, drillers, toolpusher, drilling engineers and students in the well control procedures.

- Ability to drilling, kick detection, shut-in, stabilization of pressures;
- Interactive System: no pre-set methods;
- Ability to apply control methods: Driller’s method, wait and weight, dynamic volumetric and static volumetric (lubricate and bleed);
- Hydraulics and Hydrostatics;
- Behavior of the kick;
- Applied with subsea stack or surface stack;
- Set well with until 4 sections: riser, casing, liner, open hole ;
- Directional and Horizontal Wells (Type I)
- Set Drilstring with drillpipe1, drillpipe2, heavy weight, drill-collar1, drillcollar2
- Standpipe Manifold and Choke Manifold
- Drill Pipe Float Valve (non-ported)
Others apps very useful of our portfolio for Well Control:

- Drilling Hydraulics
- Kick Tolerance
- Leak-Off Test Simulator
- Leak-Off Test Analyzer
- Well Control Methods
- Well Control Worksheets

These tools can complement (work with) this simulator by creating files which can be used in this application;

Notes:

This is a basic modeling that simulates drilling operations based in panels for drilling, kick detection, shut-in the well, stabilization of pressures and the choke operations during the well control operations using a hydraulic choke panel simulator.

This simulator is limited and is not applied to some complex situations.

Please, report us bugs and suggestions for improvements.

Thanks
CHAPTER 4

Single Bubble Model

Kick Model in this simulator:

The model assumes that the kick starts as a single bubble at the bottom of the hole and migrates upward as a single bubble from the bottom to the surface.

In underbalanced condition (BHP< Form Pressure) during control, the single bubble volume is incremented with the inflow volume from formation to the well.

In Kick Condition:
BHP < Formation Pressure

1. Start at the bottom of the hole.

2. If there is a gas bubble into the borehole, it is incremented by inflow volume during kick circulation, applying the gas law. The gas bubble is recalculated, adding volume and mass of gas.

3. If will occur another kick, it restarts at the bottom of the hole.
CHAPTER 5

Data Files

This app work with the extension (*.ds3f)

It's recommended first to create a data file to work with this app and to enable the "Save" button on views. This app only opens data files locally in the Documents folder!

Use iCloud or others storage providers to import or export data files!
SECTION 1

Creating a New File

1. Input the file name in text box and tap on [+ New Surface] or [+ New Subsea] button.
2. The file will be created with default values.
3. The file will be saved on local document folder.
SECTION 2
Open a Data File

When TAP on “Open” button, the data that are on the Data File Highlighted are loaded in memory and can be saved with a new name (see Save As...)

Files on My iPad

File Name:
subsea directional 1 eob k3 3

bopvolumes 30 and 25.ds3f
New Data File.ds3f
Save Current Data to new data file .ds3f
subsea 1.ds3f
subsea directional 1 eob k3 3.ds3f
subsea directional 2.ds3f
subsea directional 4 dm 5 gas bop.ds3f
subsea directional 4 dm 6 gas bpo.ds3f

Current: #

Open
SECTION 3

Save

1. Input the File Name in the TextBox.
2. TAP on Save button. The data file is saved on local document folder.
On views (fast method, but to save only):

“Save” and “Save As…”

Use the button on toolbar:

- Current subsea 1.ds3f
- Save As ... (.ds3f)
  - Save Current Data to new data file
- bopvolumes 30 and 25.ds3f
- New Data File.ds3f
  - Save Current Data to new data file .ds3f
- subsea 1.ds3f
- subsea directional 1 eob k3 3.ds3f
- subsea directional 2.ds3f
- subsea directional 4 dm 5 gas bop.ds3f
- subsea directional 4 dm 6 gas bop.ds3f

Notes:

Save the exercise in several critical points to different data files:

Examples:

1. At the beginning of circulation
2. Gas near casing shoe
3. Gas after casing shoe
4. Gas near to bop (Subsea Stack)
5. Gas near to surface
6. All gas out
7. Kill Mud near to BHA
8. Kill Mud near to drill bit
9. Kill Mud near to casing shoe
10. Kill Mud near to bop
SECTION 4

Data File on iCloud

1. Check iCloud Settings
2. iCloud Drive --> ON

iCloud Container:

- Use this option to retrieve data files sent to iCloud from the same Apple ID on any device.
**iCloud Drive:**

Use this option to download/upload data files on iCloud Drive or other storage providers accessible via iCloud Drive interface.

![iCloud Drive interface](https://www.wellcontrol.com.br)

Using the **iCloud Drive** app (available on iOS 9)

17 items, 106.9 GB available on iCloud
Accessing other Storage Providers via iCloud Drive interface:

- iCloud
- Drive
- Dropbox
- More

Exporting data files to iCloud Drive:

- Directional
- Doc PDF
- Drilling Hydraulics
- Drilling Simulator
- Keywords
- Kick Game

Files:
- bopvolumes 30 and 25.ds3f
- New Data File.ds3f
- Save Current Data to new data file .ds3f
- subsea 1.ds3f
- subsea directional 1 eob k3 3.ds3f
- subsea directional 2.ds3f
- subsea directional 4 dm 5 gas bop.ds3f
- subsea directional 4 dm 6 gas boc.ds3f
- subsea directional 4 dm 6 gas boc.ds3f

Current: Open

iCloud Drive
SECTION 5

Data Files on Dropbox

1. Install the Dropbox app on your device
2. Do a login in the Dropbox app

Please Install the Dropbox App
With Dropbox installed, you can access all your stuff in your favorite apps, like this one!

Install Dropbox
Upload to Dropbox:

To submit a data file to Dropbox provider, use the Open In... button and open it in the Dropbox app:

subsea circ dm 6 k1 chokeline.ds3f
subsea circ dm 6 k1 out 2 bop open.ds3f
subsea circ dm 6 k1 out 2.ds3f
subsea circ dm 7 k1 out.ds3f
subsea circ dm 8 k2 bop.ds3f

AirDrop. Share instantly with people nearby. If they turn on AirDrop from Control Center on iOS or from Finder on the Mac, you'll see their names here. Just tap to share.
SECTION 6

Send a data file by Email

1. Select the data file.
2. TAP on ✉️ button.

1. Input the mail address to send:
2. Edit the subject.
Note: Configure an account mail on Mail app

To: name@mailserver.com,
Cc: 
Bcc: 
From: sender@mailserver.com
Subject: Driller Simulator 3

> 

subsea dir...ob k3 3.ds3f

Sent from my iPad
SECTION 7

Importing from other apps

**COMPATIBLES APPS ON OUR PORTFOLIO:**

1. Drilling Simulator 1
2. Drilling Simulator 2
3. Drilling Simulator 3
4. Drilling Hydraulics
5. Kick Tolerance
6. Leak-Off Test Simulator
7. MPD Simulator
8. Well Control Methods
9. Well Control Simulator
10. Well Control Worksheets

Tap on “Import from Other Apps” button on toolbar:

- iCloud Drive
- Dropbox

Apps on iCloud container

- Kick Tolerance
- Leak-Off Test Simulator
- MPD Simulator
- Well Control Methods

Select App

- iCloud Drive
- Dropbox

Data Files on iCloud container

- Kick Tolerance
- Default Surface KT.ktdf
- Exercise 01 cloudrive.ktdf
- Exercise 01.ktdf
- Exercise 02.ktdf
- Exercise 2.ktdf
- Kick 1 iPad7.ktdf
- Kick 1 iPod1.ktdf
- PAS-25.ktdf

Import
CHAPTER 6

Unit Systems

Select units per Unit System:
  METRIC, SI or OILFIELD

or per parameter.

Note about Gravity value used in the hydrostatic calculations:

Hydrostatic Pressure (Pa)
  = Gravity (m/s²) x Density (kg/m³) x Height (m)

This app uses the value **Gravity = 9.80665 m/s²**

→ Hydrostatic Pressure (Pa)
  = 9.80665 x Density (kg/m³) x Height (m)

→ Hydrostatic Pressure (psi)
  = 0.051948 x Density (ppg) x Height (ft)

<table>
<thead>
<tr>
<th>Pressure</th>
<th>METRIC</th>
<th>SI</th>
<th>OILFIELD</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>bar</td>
<td>kPa</td>
<td>psi</td>
<td>atm</td>
<td></td>
</tr>
<tr>
<td>Density</td>
<td>kg/l</td>
<td>kg/m³</td>
<td>ppg</td>
<td>lb/ft³</td>
</tr>
<tr>
<td>Gradient</td>
<td>bar/m</td>
<td>kPa/m</td>
<td>psi/ft</td>
<td>psi/m</td>
</tr>
<tr>
<td>Length</td>
<td>m</td>
<td>m</td>
<td>ft</td>
<td>ft</td>
</tr>
<tr>
<td>Diameter</td>
<td>mm</td>
<td>mm</td>
<td>inch</td>
<td>cm</td>
</tr>
<tr>
<td>Area</td>
<td>mm²</td>
<td>mm²</td>
<td>sq. in</td>
<td>cm²</td>
</tr>
<tr>
<td>Volume</td>
<td>liter</td>
<td>m³</td>
<td>bbl</td>
<td>ft³</td>
</tr>
<tr>
<td>Capacity</td>
<td>liter/m</td>
<td>m³/m</td>
<td>bbl/ft</td>
<td>bbl/m</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>l/min</td>
<td>m³/min</td>
<td>gpm</td>
<td>ft³/min</td>
</tr>
<tr>
<td>Power</td>
<td>kw</td>
<td>kW</td>
<td>hp</td>
<td>hp</td>
</tr>
<tr>
<td>Force</td>
<td>kgf</td>
<td>daN</td>
<td>lb</td>
<td>N</td>
</tr>
<tr>
<td>Jet Velocity</td>
<td>m/s</td>
<td>m/s</td>
<td>ft/s</td>
<td>ft/s</td>
</tr>
<tr>
<td>Temp Grad</td>
<td>°C/100m</td>
<td>°C/100m</td>
<td>°F/100ft</td>
<td>°F/100ft</td>
</tr>
<tr>
<td>Plastic Visc</td>
<td>mPa.s</td>
<td>mPa.s</td>
<td>cP</td>
<td>cP</td>
</tr>
<tr>
<td>Yield Point</td>
<td>kg/m²</td>
<td>N/m²</td>
<td>lb/100ft²</td>
<td>Pa</td>
</tr>
<tr>
<td>Hookload</td>
<td>ton</td>
<td>ton</td>
<td>kip</td>
<td>kip</td>
</tr>
<tr>
<td>Pipe Weight</td>
<td>kg/m</td>
<td>kg/m</td>
<td>lb/ft</td>
<td>lb/ft</td>
</tr>
<tr>
<td>Mass/Weight</td>
<td>kg</td>
<td>kg</td>
<td>lb</td>
<td>lb</td>
</tr>
<tr>
<td>Bop Volume</td>
<td>liter</td>
<td>liter</td>
<td>gal</td>
<td>gal</td>
</tr>
</tbody>
</table>
CHAPTER 7

Well Configuration

On Main View, tap on ✖️ button on toolbar to edit the Well
iPad on horizontal position:

Well with Liner

- **Measured TVD**
  - Top Depth: 5577.43 ft
  - Shoe Depth: 7545.93 ft
  - OD: 9.6750 in
  - ID: 8.7550 in
  - Grade: N80
  - Weight: 43.5 lb/ft

**Casing**
- Weight: 43.5 lb/ft
- Size: 244 mm
- Burst: 6330 psi
- Burst/DF: 5064 psi
- DF: 1.25
- 1.1 - 1.4
- 70 - 90

Burst -> Burst Pressure
DF -> Design Factor (values 1.1 to 1.4)
Also named “SF - Safety Factor” (values 70% - 90%)
Edit parameters from top to down

**Directional Terms**

- **KOP** - Kick Off Point
- **BUR** - Build Up Rate
- **DOR** - Drop Off Rate
- **DLS** - Dog leg Severity
- **RC** - Radius of Curvature
- **INC** - Inclination, Drift
- **TVD** - True Vertical Depth
- **MD** - Measured Depth
- **VS** - Vertical Section
- **CL** - Course Length = MD2 - MD1
- **N/S** - North / South coordinate
- **E/W** - East / West coordinate
- **TR** - Turn Rate
- **HD** - Horizontal Displacement
- **CD** - Closure Distance (= HD)
- **AZI** - Azimuth

### Calculator

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured Depth</td>
<td>7500 ft</td>
</tr>
<tr>
<td>Vertical Depth</td>
<td>7194.56 ft</td>
</tr>
<tr>
<td>Vertical Section</td>
<td>1023.34 ft</td>
</tr>
</tbody>
</table>
**Directional Well: TVD x MD projection**

**Surface Stack** (Land Rigs, Jack-Up Rigs, etc)
**Subsea Stack** (Semi-Submersible Platform, Drill Ship, etc)

- **Surface Stack**
  - Air Gap: 82.02 ft
  - Water Length: 3280.84 ft
  - Mud Line Depth: 3362.86 ft
  - Riser ID: 19.7500 in
  - Kill / Choke ID: 3.0000 in
  - Booster Line ID: 4.0000 in

- **Subsea Stack**

**Drill String**

**Edit Drill string labels:**

1: Drill Pipe 1  
2: Drill Pipe 2  
3: Heavy Weight  
4: Drill Collar 1  
5: Drill Collar 2

**Edit Drill String Sections (iPad on portrait position):**

<table>
<thead>
<tr>
<th>Section</th>
<th>Length (ft)</th>
<th>OD (in)</th>
<th>ID (in)</th>
<th>Weight (lb/ft)</th>
<th>Cap Int bbl/ft</th>
<th>Vol Int bbl</th>
<th>Displac bbl</th>
<th>Vol Steel bbl</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP 1</td>
<td>8858.27</td>
<td>5.0000</td>
<td>4.2760</td>
<td>19.50</td>
<td>0.0178</td>
<td>157.35</td>
<td>0.0065</td>
<td>57.79</td>
</tr>
<tr>
<td>DP 2</td>
<td>0.00</td>
<td>5.0000</td>
<td>4.2760</td>
<td>19.50</td>
<td>0.0178</td>
<td>0.00</td>
<td>0.0065</td>
<td>0.00</td>
</tr>
<tr>
<td>HW</td>
<td>328.08</td>
<td>5.0000</td>
<td>3.0000</td>
<td>49.00</td>
<td>0.0087</td>
<td>2.87</td>
<td>0.0155</td>
<td>5.10</td>
</tr>
<tr>
<td>DC 1</td>
<td>492.13</td>
<td>6.2500</td>
<td>2.8125</td>
<td>96.00</td>
<td>0.0077</td>
<td>3.78</td>
<td>0.0303</td>
<td>14.89</td>
</tr>
<tr>
<td>DC 2</td>
<td>164.04</td>
<td>6.7500</td>
<td>2.8125</td>
<td>102.00</td>
<td>0.0077</td>
<td>1.26</td>
<td>0.0366</td>
<td>6.00</td>
</tr>
<tr>
<td>Bit</td>
<td>9842.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Float Valve**

- **Nominal** 252.8 kip
- **Hookload** 165.26 kip
- **Total** 83.78 kip

**Traveling Assembly Weight** 120 kip

**Drill String Nominal Weight** 252.8 kip

**Buoyancy Factor** 0.8534

**Hook Load** 335.7 kip
Edit Drill String Sections (iPad on landscape position):

<table>
<thead>
<tr>
<th></th>
<th>Drill Pipe 1</th>
<th></th>
<th>Drill Pipe 2</th>
<th></th>
<th>Heavy Weight</th>
<th></th>
<th>Drill Collar 1</th>
<th></th>
<th>Drill Collar 2</th>
<th></th>
<th>Drill 6.7500</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>OD</td>
<td>5.0000</td>
<td></td>
<td>5.0000</td>
<td></td>
<td>5.0000</td>
<td></td>
<td>6.2500</td>
<td></td>
<td>164.04</td>
<td></td>
<td>6.7500</td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>4.2760</td>
<td>ft</td>
<td>0.00</td>
<td></td>
<td>4.2760</td>
<td>in</td>
<td>3.0000</td>
<td>in</td>
<td>2.8125</td>
<td>in</td>
<td>2.8125</td>
<td>in</td>
</tr>
<tr>
<td>OD (in)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ID (in)</td>
<td></td>
<td>in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bit</td>
<td>9842.52</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Hookload**

- **Float Valve**
  - **Drill String Float Valve (non-ported)**
  - Float Valves are run to prevent Drilling Fluids from back owing up the Drill String to the surface. It is basically a one way or Downhole Check Valve.
  - Float Valves may be used for additional Well Control and also to protect high cost tools such as Rotary Steerable, MWD/LWD, etc from Drilling Fluid, Cuttings and Metal Debris owing up the Drill String whilst running in the hole.
  - They are essential tools on MPD and UBD operations.

**Ported type:**
- Pressure-Monitoring Float Valve has a special port running through of the Float Valve. This Valve is used when monitoring the bit head for gas pressure and allowing differential pressure measuring when required.

**Capacities and Volumes**

<table>
<thead>
<tr>
<th></th>
<th>Internal</th>
<th>Va + VI</th>
<th>Cap x L</th>
<th>Annular Drill Pipe 1</th>
<th>Annular Drill Pipe 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ft</td>
<td>bbl/ft</td>
<td>bbl</td>
<td>ft</td>
<td>bbl/ft</td>
</tr>
<tr>
<td>Riser</td>
<td>3362.86</td>
<td>0.3789</td>
<td>1252.39</td>
<td>3362.86</td>
<td>0.3547</td>
</tr>
<tr>
<td>Casing</td>
<td>3937.01</td>
<td>0.0745</td>
<td>267.48</td>
<td>3937.01</td>
<td>0.0502</td>
</tr>
<tr>
<td>Liner</td>
<td></td>
<td></td>
<td></td>
<td>197.55</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Hole        | 2542.65  | 0.0702  | 142.31  | 1558.40               | 0.0459                |

**Capacities**

- **Annular Heavy Weight**
  - Riser: 0.3547 bbl
  - Casing: 0.0502 bbl
  - Liner: 0.0365 bbl

- **Annular Collar 1**
  - Riser: 0.3410 bbl
  - Casing: 0.0365 bbl
  - Liner: 0.0302 bbl

- **Annular Collar 2**
  - Riser: 0.3347 bbl
  - Casing: 0.0341 bbl
  - Liner: 0.0302 bbl

| Hole        | 328.08   | 0.0459  | 15.06   | 492.13                | 0.0322                |
| Choke Line  | 29.40    |         |         | 174.83                | 0.0002                |
| Booster Line| 52.27    |         |         | 304.26                | 0.0002                |

- **Surface to Bit**
  - Riser Annular: 99.80 bbl
  - Choke Line: 246 stk

- **Bit to Shoe**
  - Riser Annular: 893 stk
  - Choke Line: 2546 stk

- **Bit to BOP**
  - Riser Annular: 2792 stk

**Flowrates**

- **0.1195 bbl/stack**
  - **Surface to Bit**
  - **Bit to Shoe**
  - **Bit to BOP**
Internal Volume (just volume of fluid)
Calculated without the steel volume (drill string)

Well bore ID

Drill String ID
Vol = Va + Vi

Total Internal Volume
(volume of fluid + volume of steel)

Strokes Calculations

Strokes with Mud Pump #1

Strokes with Mud Pump #2
Mud (Drilling Fluid)

This app works just with parameters used in the hydraulics calculations:

-> Mud Weight, Plastic Viscosity, Yield Point and Initial Gel

<table>
<thead>
<tr>
<th>Formation Data @ Shoe Depth</th>
<th>Absorption Gradient</th>
<th>Fracture Gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>14.30 ppg</td>
<td>14.80 ppg</td>
</tr>
<tr>
<td></td>
<td>0.4987 psi/ft</td>
<td>0.7688 psi/ft</td>
</tr>
<tr>
<td>Porosity</td>
<td>35.0 %</td>
<td>Permeability</td>
</tr>
<tr>
<td></td>
<td>100 mD</td>
<td></td>
</tr>
</tbody>
</table>

Fracture and Absorption Gradients

The Absorption Gradient is the Leak Gradient detected on the LOT (Leak-Off Test)

On Mud & Gradients view:

Equipments

- Chokes 1 & 2 Diameter, Max: 1.5000 in
- Chokes 1 & 2 Coefficient: 65.0 %
- BOP Test Pressure: 5000 psi
- Vol to Close: 25 to Open: 30 gal
- Active Pit Capacity: 700.00 bbl
- Active Pit Volume: 500.00 bbl

Surface Circulation Volume:
- Circ. by flowline @ 100 spm: 30.00 bbl
- Circ. by choke @ 40 spm: 7.00 bbl

About the Surface Circulation Volume (SCV):

Surface Circulation Volume = Volume of the flow line, pipes, etc when circulating at the surface.

When occur a kick on the drilling, the driller stops the mud pump and the "Surface Circulation Volume" return to tank.

The calculation of the real volume of the kick = Static Vol. after shut-in the well - Dynamic Volume on drilling - Surface Circulation Volume.
**Bit Nozzles**

**BIT NOZZLES**

- Coefficient: 0.9500
- Total Flow Area: 0.3313 sq.in

**Mud Pumps:**

<table>
<thead>
<tr>
<th>MUD PUMPS</th>
<th>#1</th>
<th>#2 / 3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liner Diameter</td>
<td>6.5000</td>
<td>6.5000</td>
</tr>
<tr>
<td>Max Pressure</td>
<td>4200.0</td>
<td>4200.0</td>
</tr>
<tr>
<td>Stroke Length</td>
<td>12.000</td>
<td>12.000</td>
</tr>
<tr>
<td>Rod Diameter</td>
<td>2.0000</td>
<td>2.0000</td>
</tr>
<tr>
<td>Power</td>
<td>1300.0</td>
<td>1300.0</td>
</tr>
<tr>
<td>Efficiency</td>
<td>97.0</td>
<td>97.0</td>
</tr>
<tr>
<td>Pump Type</td>
<td>Triplex</td>
<td>Triplex</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>True Pump Output</td>
<td>0.1195</td>
<td>0.1195</td>
</tr>
<tr>
<td></td>
<td>5.0192</td>
<td>5.0192</td>
</tr>
</tbody>
</table>

* Mud Pump #3 used to Booster Line of the riser (Subsea only).
Surface Connections

<table>
<thead>
<tr>
<th>Elevation System</th>
<th>120 kip</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS Nominal Weight</td>
<td>263.6 kip</td>
</tr>
<tr>
<td>DS w/ Buoyancy</td>
<td>224.9 kip</td>
</tr>
<tr>
<td>Hook Load</td>
<td>345.2 kip</td>
</tr>
</tbody>
</table>

**SURFACE CONNECTIONS**

<table>
<thead>
<tr>
<th>Length</th>
<th>ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>in</td>
</tr>
<tr>
<td>Stand pipe</td>
<td>100.00</td>
</tr>
<tr>
<td>Hose</td>
<td>85.00</td>
</tr>
<tr>
<td>Swivel</td>
<td>22.00</td>
</tr>
<tr>
<td>Kelly</td>
<td>48.00</td>
</tr>
<tr>
<td>from Mud Pump to Stand pipe</td>
<td>6.00 bbl</td>
</tr>
<tr>
<td>Surface Lines *</td>
<td>9.57 bbl</td>
</tr>
</tbody>
</table>

* Volume included on surface to bit strokes.

**Rig Type:**

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>ft</td>
<td>in</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standpipe</td>
<td>100.00</td>
<td>5.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mud Hose</td>
<td>85.00</td>
<td>3.5000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swivel / TD</td>
<td>22.00</td>
<td>3.5000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kelly / Stands</td>
<td>48.00</td>
<td>4.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Set the height and difficulty to drill (soft to hard 100%) for formations #1, #2 and #3. The last (#4) is a kick formation. Set the parameters:

- permeability, difficulty to drill (soft to hard 100%), Pore Equivalent density and the fluid density.
Kick Settings

Set the Pore Equivalent Density and Fluid Density

or Set the Kick Data in this view:
### Mud & Gradients

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud Weight</td>
<td>9.60 ppg</td>
</tr>
<tr>
<td>Plastic Viscosity</td>
<td>15.0 cP</td>
</tr>
<tr>
<td>Yield Point</td>
<td>10.0 lb/100ft²</td>
</tr>
<tr>
<td>Initial Gel</td>
<td>5.0 lb/100ft²</td>
</tr>
<tr>
<td>Sea Water Density</td>
<td>8.50 ppg</td>
</tr>
<tr>
<td>MW Gradient @ 300 rpm</td>
<td>25 psi/ft</td>
</tr>
<tr>
<td>MW Gradient @ 600 rpm</td>
<td>40 psi/ft</td>
</tr>
<tr>
<td>Direct Reading Viscometer:</td>
<td></td>
</tr>
<tr>
<td>YP in lb/100ft²</td>
<td></td>
</tr>
<tr>
<td>PV in cP</td>
<td></td>
</tr>
</tbody>
</table>

### Temperature Gradient
- 1.400°F/100ft

### Temperature at Surface
- 26.0°C / 82.4°F
- 301.1 K / 542.0 °R

### Temperature at Mud Line
- 4.0°C / 39.2°F
- 277.1 K / 498.9 °R

### Formulation Data @ Shoe Depth

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption Gradient</td>
<td>14.30 ppg</td>
</tr>
<tr>
<td>Fracture Gradient</td>
<td>14.80 ppg</td>
</tr>
<tr>
<td>Porosity</td>
<td>35.0 %</td>
</tr>
<tr>
<td>Permeability</td>
<td>100 mD</td>
</tr>
</tbody>
</table>

### Buoyancy Factor
- 0.8534

### Shoe Depth Hydrostatic
- 3989.6 psi @ Shoe TVD

### Absorption Pressure
- 5942.9 psi Max @ surface

### Fracture Pressure
- 6150.7 psi Max @ surface

### Bottom Hole Hydrostatic
- 4908.5 psi @ Well TVD

### Bottom Hole Temperature
- 54.4 °C / 129.9 °F / 327.5 K / 589.6 °R
<table>
<thead>
<tr>
<th>Equipment</th>
<th>#1</th>
<th>#2 / 3*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liner Diameter</td>
<td>6.500 in</td>
<td>6.500 in</td>
</tr>
<tr>
<td>Max Pressure</td>
<td>4200.0 psi</td>
<td>4200.0 psi</td>
</tr>
<tr>
<td>Stroke Length</td>
<td>12.000 in</td>
<td>12.000 in</td>
</tr>
<tr>
<td>Rod Diameter</td>
<td>2.0000 in</td>
<td>2.0000 in</td>
</tr>
<tr>
<td>Power</td>
<td>1300.0 hp</td>
<td>1300.0 hp</td>
</tr>
<tr>
<td>Efficiency</td>
<td>97.0 %</td>
<td>97.0 %</td>
</tr>
<tr>
<td>Pump Type</td>
<td>Triplex</td>
<td>Triplex</td>
</tr>
<tr>
<td>Maximum Speed</td>
<td>120 spm</td>
<td>120 spm</td>
</tr>
<tr>
<td>True Pump Output</td>
<td>0.1195 bbl/stk</td>
<td>0.1195 bbl/stk</td>
</tr>
<tr>
<td></td>
<td>5.0192 gal/stk</td>
<td>5.0192 gal/stk</td>
</tr>
</tbody>
</table>

* Mud Pump #3 used to Booster Line of the riser (Subsea only).

### Bit Nozzles
- Coefficient: 0.9500
- Total Flow Area: 0.3313 sq.in

### Volume to Close BOP
- 45 gal

### Surface Connections
- Length: ft, ID: in
- Standpipe: 100.00 ft, 5.0000 in
- Mud Hose: 85.00 ft, 3.5000 in
- Swivel / TD: 22.0 ft, 3.5000 in
- Kelly / Stands: 48.0 ft, 4.0000 in

### Rig Type:
- (1) 12 9.5250
- (2) 12 9.5250
- (3) 12 9.5250
- (4) 0 0.0000

* Volume included on surface to bit.
CHAPTER 8

Pre-Recorded Data

Drilling Simulator 3

PRE-RECORDED - SURFACE STACK

WELL: 3937.01 ft
RIG: 3937.01 ft
DATE: Nov 24, 2010

WELL, FLUID, LOT AND EQUIPMENTS

- True Vertical Depth (TVD) 3937.01 ft
- Measured Depth (MD) 3937.01 ft
- Shoe Vertical Depth (TVDShoe) 2298.59 ft

Active Surface Volume 200.00 mbbl
Shoe Measured Depth (MD, Shoe) 2298.59 ft

MUD WEIGHT (pdm) 9.60
Fracture Gradient (gf) 16.50
BOP Test Pressure 5000 psi

Maximum Static Pressures

- Maximum Allowable Surface Pressure, MAASP = 0.019 x (pdm) + 29.52
- Maximum Casing Pressure: IRC x Total Casing Pressure x DF = 5000 psi
- Maximum BOP Pressure = 5000 psi

LENGTH, CAPACITY AND VOLUMES

Drill String ID (in) OD (in) C/t (bbl/ft) L (ft) VJ (bbl) Annular Drill: 2.8125 3.2500 0.0018 2296.59 53.03 Drill: 2.8125 0.0024 164.04 4.25

TOTAL DRILL STRING 2296.59 53.03 164.04 4.25

Surface connections 6.00 60 80
Internal Drill String 60.00 600 800
Surface to Bit (Surfacing Surface + Drill String) 60.69 670 870
Bit to Shoe 65.75 660 860
Bit to BOP 180.98 1817 1817
Bit to Surface 180.98 1817 1817
Drill String + Annular 241.68 2427 2437
Total Active Fluid System Volume 4475.68

Drill: 2.8125 3.2500 0.0018 2296.59 53.03 Drill: 2.8125 0.0024 164.04 4.25

TOTAL DRILL STRING 2296.59 53.03 164.04 4.25

Surface connections 6.00 60 80
Internal Drill String 60.00 600 800
Surface to Bit (Surfacing Surface + Drill String) 60.69 670 870
Bit to Shoe 65.75 660 860
Bit to BOP 180.98 1817 1817
Bit to Surface 180.98 1817 1817
Drill String + Annular 241.68 2427 2437
Total Active Fluid System Volume 4475.68

Sea Water Length (L) 3280.84 ft
Sea Water Density (psig) 8.50 pg
Mud Line Depth (Dm) 3382.86 ft
Mud Weight (pdm) 9.60
Fracture Gradient 14.80
BOP Test Pressure 5000 psi

Maximum Safe Pressure: (Burst Pressure x DF) - 0.0519 x (pdm) + 1500 psi

MUD PUMPS

PUMP 1 0.1207 97.0 0.0996 24 36 100.0 24 175 24
PUMP 2 0.1207 97.0 0.0996 24 36 100.0 24 320 28

VOLUMES AND STOKES

Surface Connections 6.00 60 80
Internal Drill String 60.00 600 800
Surface to Bit (Surfacing Surface + Drill String) 60.69 670 870
Bit to Shoe 65.75 660 860
Bit to BOP 180.98 1817 1817
Bit to Surface 180.98 1817 1817
Drill String + Annular 241.68 2427 2437
Total Active Fluid System Volume 4475.68

Sea Water Length (L) 3280.84 ft
Sea Water Density (psig) 8.50 pg
Mud Line Depth (Dm) 3382.86 ft
Mud Weight (pdm) 9.60
Fracture Gradient 14.80
BOP Test Pressure 5000 psi

Maximum Safe Pressure: (Burst Pressure x DF) - 0.0519 x (pdm) + 1500 psi

MUD PUMPS

PUMP 1 0.1207 97.0 0.0996 24 36 100.0 24 175 24
PUMP 2 0.1207 97.0 0.0996 24 36 100.0 24 320 28

VOLUMES AND STOKES

Surface Connections 6.00 60 80
Internal Drill String 60.00 600 800
Surface to Bit (Surfacing Surface + Drill String) 60.69 670 870
Bit to Shoe 65.75 660 860
Bit to BOP 180.98 1817 1817
Bit to Surface 180.98 1817 1817
Drill String + Annular 241.68 2427 2437
Total Active Fluid System Volume 4475.68
**PRE-RECORDED - SUBSEA STACK**

<table>
<thead>
<tr>
<th>WELL</th>
<th>RIG</th>
<th>DATE</th>
<th>BY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Nov 24, 2016</td>
<td></td>
</tr>
</tbody>
</table>

## WELL, FLUID, LOT AND EQUIPMENTS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Water Length (Lsw)</td>
<td>3280.84 ft</td>
</tr>
<tr>
<td>Sea Water Density (psw)</td>
<td>8.50 ppg</td>
</tr>
<tr>
<td>Mud Line Depth (Dml)</td>
<td>3362.86 ft</td>
</tr>
<tr>
<td>Mud Weight (pdm)</td>
<td>9.60 ppg</td>
</tr>
<tr>
<td>Fracture Gradient (ppg)</td>
<td>14.80 ppg</td>
</tr>
<tr>
<td>Active Surface Volume</td>
<td>500.0 bbl</td>
</tr>
<tr>
<td>True Vertical Depth (TVD)</td>
<td>9842.52 ft</td>
</tr>
<tr>
<td>Measured Depth (MD)</td>
<td>9842.52 ft</td>
</tr>
<tr>
<td>Shoe Vertical Depth (TVD, shoe)</td>
<td>8000.00 ft</td>
</tr>
<tr>
<td>Shoe Measured Depth (MD, shoe)</td>
<td>8000.00 ft</td>
</tr>
<tr>
<td>BOP Test Pressure (Pt,BOP)</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Casing Burst Pressure</td>
<td>6330 x 0.80 psi</td>
</tr>
<tr>
<td>BOP Pressure</td>
<td>4772 psi</td>
</tr>
</tbody>
</table>

## MAXIMUM STATIC PRESSURES

- Maximum Allowable At Surface Pressure, MAASP = 0.0519 x (p - pm) x TVD, sap = 2181 psi
- Maximum Casing Pressure: (Burst Pressure x DF) - 0.0519 x (pm x Dml - 8.50 x Lsw) = 4836 psi
- Maximum BOP Pressure = (Pt,BOP) - 0.0519 x (pm x Dml - 8.50 x Lsw) = 4772 psi
- Maximum Subsea Equipment Pressure: Smaller of (Max Casing or Max BOP) = 4772 psi

## VOLUMES AND STRESSES

<table>
<thead>
<tr>
<th>Stk</th>
<th>Vol (bbl)</th>
<th>Internal Drill String</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Surface to Bit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit to Shoe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit to BOP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bit to Choke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Well Circulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Riser Annular</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total Active Fluid System Volume</td>
</tr>
</tbody>
</table>

## LENGTH, CAPACITY AND VOLUMES

<table>
<thead>
<tr>
<th>Drill String</th>
<th>ID (in)</th>
<th>OD (in)</th>
<th>Cv,l (bbl/ft)</th>
<th>L (ft)</th>
<th>Vi (bbl)</th>
<th>Cv,a (bbl/ft)</th>
<th>L (ft)</th>
<th>Vb (bbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drillpipe, DP1</td>
<td>4.2760</td>
<td>5.0000</td>
<td>0.0178</td>
<td>8858.27</td>
<td>157.3</td>
<td>0.0259</td>
<td>164.04</td>
<td>4.3</td>
</tr>
<tr>
<td>Drillpipe, DP2</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heavy Weight, HW</td>
<td>3.0000</td>
<td>5.0000</td>
<td>0.0087</td>
<td>328.08</td>
<td>2.9</td>
<td>0.0459</td>
<td>328.08</td>
<td>15.1</td>
</tr>
<tr>
<td>Drill Collar, DC1</td>
<td>2.8125</td>
<td>6.2800</td>
<td>0.0077</td>
<td>492.13</td>
<td>3.8</td>
<td>0.0502</td>
<td>200.00</td>
<td>100.4</td>
</tr>
<tr>
<td>Drill Collar, DC2</td>
<td>2.8125</td>
<td>6.7500</td>
<td>0.0077</td>
<td>164.04</td>
<td>1.3</td>
<td>0.0459</td>
<td>858.27</td>
<td>39.4</td>
</tr>
</tbody>
</table>

## Total Drill String

- Open Hole: 85000 ft
- Liner: 87550 ft
- Casing: 125150 ft
- Riser: 197500 ft
- Kill / Choke Line: 30000 ft
- Booster Line: 40000 ft

## MUD PUMPS

<table>
<thead>
<tr>
<th>PUMP</th>
<th>δ (bbl/stk)</th>
<th>(% )</th>
<th>δm (bbl/stk)</th>
<th>δmp = δ x e</th>
<th>SPM = Flow / (42.00 x δmp)</th>
<th>Flow (gpm)</th>
<th>SPM</th>
<th>Pump Pressure (psi)</th>
<th>Ch Line Loss (psi)</th>
<th>Casing Friction</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP 1</td>
<td>0.1232</td>
<td>97.0</td>
<td>0.1195</td>
<td>100.00 gpm</td>
<td>150.00 gpm</td>
<td>100.0</td>
<td>20</td>
<td>213</td>
<td>72</td>
<td>29</td>
</tr>
<tr>
<td>PUMP 2</td>
<td>0.1232</td>
<td>97.0</td>
<td>0.1195</td>
<td>20</td>
<td>30</td>
<td>150.0</td>
<td>30</td>
<td>384</td>
<td>140</td>
<td>33</td>
</tr>
</tbody>
</table>
Pre-Recorded Data (Directional Wells) On iPad Pro
### WELL, FLUID, LOT AND EQUIPMENTS

<table>
<thead>
<tr>
<th>WELL</th>
<th>WD (m)</th>
<th>TD (m)</th>
<th>MD (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1000.00</td>
<td>2544.29</td>
<td>3004.21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Density (g/l)</th>
<th>Specific Gravity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tool</th>
<th>Diameter (in)</th>
<th>Length (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit</td>
<td>3 1/4</td>
<td>130</td>
</tr>
<tr>
<td>Stinger</td>
<td>5 1/4</td>
<td>100</td>
</tr>
</tbody>
</table>

### MAXIMUM STATIC PRESSURES

- **Maximum Allowable Surface Pressure**, MAASP: \( 0.1704 \times (pf \times psh \times TD) \)
- **Maximum Casing Pressure**: \( 0.1704 \times (pf \times psh \times Lw) \)
- **Maximum BOP Pressure**: \( (pBOP) \times 0.1704 \times (pf \times psh \times Lw) \)

### LENGTH, CAPACITY AND VOLUMES

<table>
<thead>
<tr>
<th>Drill String</th>
<th>ID (in)</th>
<th>OD (in)</th>
<th>TCI (gal/ft)</th>
<th>L (m)</th>
<th>VI (bbbl)</th>
<th>Annular</th>
<th>CVa (gal/bbl)</th>
<th>L (m)</th>
<th>VA (bbbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drillpipe, DP1</td>
<td>4.2760</td>
<td>5.0000</td>
<td>0.0178</td>
<td>2704.21</td>
<td>157.6</td>
<td>0.0222</td>
<td>50.0</td>
<td>4.3</td>
<td></td>
</tr>
<tr>
<td>Drillpipe, DP2</td>
<td>4.2760</td>
<td>5.0000</td>
<td>0.0191</td>
<td>2704.21</td>
<td>157.6</td>
<td>0.0236</td>
<td>60.0</td>
<td>5.3</td>
<td></td>
</tr>
<tr>
<td>Casing Drill, DC1</td>
<td>2.8125</td>
<td>3.2500</td>
<td>0.0227</td>
<td>150.0</td>
<td>2.9</td>
<td>0.0348</td>
<td>100.0</td>
<td>14.1</td>
<td></td>
</tr>
<tr>
<td>Casing Drill, DC2</td>
<td>2.8125</td>
<td>3.2500</td>
<td>0.0227</td>
<td>150.0</td>
<td>2.9</td>
<td>0.0348</td>
<td>100.0</td>
<td>14.1</td>
<td></td>
</tr>
</tbody>
</table>

### MUD PUMPS

- **Flow Pressure**: \( (pFlow) \times 0.1704 \times (pf \times psh \times Lw) \)

### VOLUMES AND STROKES

<table>
<thead>
<tr>
<th>Tool</th>
<th>Volume (bbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stinger</td>
<td>95.8</td>
</tr>
<tr>
<td>Stinger</td>
<td>80.0</td>
</tr>
<tr>
<td>Stinger</td>
<td>80.0</td>
</tr>
<tr>
<td>Stinger</td>
<td>80.0</td>
</tr>
</tbody>
</table>

### Control Methods

- **Units**: Reach
- **Subsea directional 1 eob l3 3 3ds**: Reach
Chapter 9

Circulating System

The system is different for wells with surface stack or subsea stack.

1. For rigs with surface stack (land rigs, jack-up rigs, etc) only two mud pumps.
2. For subsea stack (semi-submersible, drill-ship, etc) are 3 mud pumps, with the mud pump #3 only for booster line.
3. This system allows circulation for Drill String or for Kill line only.
4. The return can be by flow line or by choke.
5. Use Standpipe manifold and Choke Manifold to set the path of the circulation.
6. Valves: GREEN -> OPEN and RED -> CLOSED
Drill String with return by Riser/Flow Line
Record the DP Pressure at Slow Circulating Rate.

Kill Line with return by Riser/Flow Line
Used to record the Kill/Choke Line Friction Losses at Slow Circulating Rate on Kill Pressure Gauge:
Drill String with return by Choke
Used normally to Well Control applying the circulation methods: Driller’s Method and Weight and Wait method

Kill Line with return by Choke
Used to Well Control applying the Dynamic Volumetric Method
Returning by Chokes

Using choke #1 only:

Using two chokes #1 and #2 in parallel

Using straight through flow

Pressure at choke = 0 (zero)

This is very important when recording the choke line friction losses.
CHAPTER 10

Drilling

Main Interface

iPad x iPad Pro on horizontal position

This app is optimized for iPad Pro
On vertical position

iPad, iPad Air, iPad Mini

Selecting Mud Pumps
For wells with surface stack:

Select MP 1 for Mud Pump #1 and MP 2 for Mud Pump #2.
The color is GREEN for SPM > 0.
Tap on “R” button to reset total strokes.

For wells with subsea stack:

Select MP 1 for Mud Pump #1 and MP 2 for Mud Pump #2.
The color is GREEN for SPM > 0.
The mud pump #3 is for the Booster Line (BL) only.

Set SPM Inc/Dec:
The Weight Indicator

Set Maximum Values:

Using Finger Gesture to change the Hookload:

Tap on well schematic with the finger and swipe up / down.

Move Drill-String to Up
- WOB

Tap on OFF button to enable the Auto Driller

Move Drill-String to Down
+ WOB

Hook Load on Yellow Scale and WOB on White Scale.

Auto Driller On -> Maintain WOB (Weight On Bit) constant

Digital Values on Graph:
Drill Bit Rotation

Tap on “-“ and “+“ buttons to set RPM (max = 200 rpm)

RPM Effects:

1. On Rotary Torque and Drill String Animation

2. On Drilling Rate (ROP - Rate Of Penetration)

Well Safety Status

GREEN: OPEN

RED: CLOSED

Choke Selected on control

The iPad Pro 12.9-inch version has this PLUS:
Drilling Parameters

<table>
<thead>
<tr>
<th>STROKES</th>
<th>FLOW RATE</th>
<th>MW IN</th>
<th>BIT DEPTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>827</td>
<td>501.9</td>
<td>9.60</td>
<td>9856.34</td>
</tr>
</tbody>
</table>

Graph

On Drilling

On Kick during drilling

Set Alarms

Maximum Pit Vol -> **“Vol High”** alarm

Maximum Flow Out -> **“Flow High”** alarm

On Kick
Informations with Code

Features by request from schools to apply test for students.

Parameters:
1. Lag Time
2. Kick Informations
3. Pressures at the borehole
4. Digital values in gauges
5. Enable Restart/remove buttons
6. Enable Files button (create/open/import)

With codes for ADMIN, INSTRUCTOR and STUDENT

Attention: The Initial codes: "oooo"

Notes:
If lose the admin code:
1. Export all data files to iCloud;
2. Delete app on iPad
3. Re-install it from App Store.
4. Use the initial code: "oooo"
5. Import data files from iCloud
Hydraulics with “Pressures in the borehole ON”:

| Drill Bit          | Pressure Gauge with “Show Digital Values ON”:
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Rate on bit</td>
<td><img src="image" alt="Pump Pressure" /> 2755 psi</td>
</tr>
<tr>
<td>Nozzles Loss</td>
<td></td>
</tr>
<tr>
<td>Hydraulic Power</td>
<td></td>
</tr>
<tr>
<td>HHP / Sq. Inch</td>
<td></td>
</tr>
<tr>
<td>Perc Nozzles Loss</td>
<td></td>
</tr>
<tr>
<td>Jet Velocity</td>
<td></td>
</tr>
<tr>
<td>Force of Impact</td>
<td></td>
</tr>
<tr>
<td>Absorption Pressure</td>
<td><img src="image" alt="Absorption Pressure" /> 5422.8 psi</td>
</tr>
<tr>
<td>Fracture Pressure</td>
<td><img src="image" alt="Fracture Pressure" /> 5612.4 psi</td>
</tr>
<tr>
<td>BOP Pressure</td>
<td><img src="image" alt="BOP Pressure" /> 1681.8 psi</td>
</tr>
</tbody>
</table>
|                     | ![Pressure Gauge](image) with “Show Digital Values OFF”:
|                     | ![Pressure Gauge](image)                       |

Hydraulics with “Pressures in the borehole OFF”:

The **Pump Pressure** is the reading at the pump discharge.

For mud pumps aligned to the drill string, the Pump Pressure includes the losses in the line from the mud pump to standpipe.
### Set Maximum Values on Graph

<table>
<thead>
<tr>
<th>Graph Maximum Values</th>
<th>Restart Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure</td>
<td>5000 psi</td>
</tr>
<tr>
<td>Flow Rate</td>
<td>1000 gpm</td>
</tr>
<tr>
<td>Active Volume</td>
<td>1000 bbl</td>
</tr>
<tr>
<td>Drilled</td>
<td>82 ft</td>
</tr>
<tr>
<td>Weight On Bit</td>
<td>110 kip</td>
</tr>
<tr>
<td>Drilling Rate</td>
<td>164 ft/h</td>
</tr>
<tr>
<td>Hook Load</td>
<td>441 kip</td>
</tr>
<tr>
<td>Rotary Speed</td>
<td>100 rpm</td>
</tr>
</tbody>
</table>

#### Set Sound Level

**Tap on icon on toolbar:** ☀️

**Sound Level**

- **Set Alarms**: 0%
  - Maximum Pit Gain: 5.0 bbl
  - Maximum Flow Out: 500 gpm

**Reset Failures** (Red Color)

- **Mud Pump**: Set to 1
- **BOP Fracture**: Set to 1

**Icon on toolbar:**

- Sound ON: ☀️
- Sound OFF: 🕒

**Example:** SPM > 120 on Mud Pump #2

**Tap on PUMP 2 button in red color:**

- Reset Failures
Plot directional well on Main view

Tap on icon: ① this icon is hidden on vertical wells

Select TVD / MD option to plot

Send Screenshot by email

Tap on icon on toolbar:  
Attachments in PDF and PNG image formats:

<table>
<thead>
<tr>
<th>Cancel</th>
<th>Drilling Simulator for iPad - Simulation</th>
<th>Send</th>
</tr>
</thead>
<tbody>
<tr>
<td>To:</td>
<td>Drilling Simulator for iPad - Simulation</td>
<td></td>
</tr>
<tr>
<td>Cc/Bcc</td>
<td>Images: 1.2 MB</td>
<td></td>
</tr>
<tr>
<td>Subject:</td>
<td>Drilling Simulator for iPad - Simulation</td>
<td></td>
</tr>
<tr>
<td>Attachments:</td>
<td>1. DS_20151129_102647.png</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. DS_20151129_102647.pdf</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 11

Kick Detection on Drilling

Warning signs of kick on drilling in this simulator:

Positive Indicators of the Kick
1. Increase in Flow Out
2. Increase in Active Pit Volume
3. Flow out with pumps off

Secondary Indicators of the Kick
1. Decrease in DP Pressure
2. Increase in Drilling Rate
3. Increase in Rotary Torque
4. Decrease in Hook
The kick informations On show formations and kick in hole

show formations  kick in hole

The formations and kick in hole visual can be hidden

no formations  no kick in hole
In Mud/Gradient view:

**Mud & Gradients**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud Weight</td>
<td>9.60 ppg</td>
</tr>
<tr>
<td>Plastic Viscosity</td>
<td>15.0 cP</td>
</tr>
<tr>
<td>Yield Point</td>
<td>10.0 lb/1000ft</td>
</tr>
<tr>
<td>Initial Gel</td>
<td>5.0 lb/1000ft</td>
</tr>
<tr>
<td>Sea Water Density</td>
<td>8.50 ppg</td>
</tr>
<tr>
<td>Absorption Gradient</td>
<td>14.30 ppg</td>
</tr>
<tr>
<td>Fracture Gradient</td>
<td>14.80 ppg</td>
</tr>
<tr>
<td>Porosity</td>
<td>35.0 %</td>
</tr>
<tr>
<td>Permeability</td>
<td>100 mD</td>
</tr>
<tr>
<td>Temperature Gradient</td>
<td>1.400 F/100ft</td>
</tr>
<tr>
<td>Temperature at Surface</td>
<td>28.0 °C</td>
</tr>
<tr>
<td>Temperature at Mud Line</td>
<td>4.0 °C</td>
</tr>
<tr>
<td>Buoyancy Factor</td>
<td>0.8534</td>
</tr>
<tr>
<td>Shoe Depth Hydrostatic</td>
<td>3763.2 psi</td>
</tr>
<tr>
<td>Absorption Pressure</td>
<td>5605.6 psi</td>
</tr>
<tr>
<td>Fracture Pressure</td>
<td>5801.6 psi</td>
</tr>
<tr>
<td>Bottom Hole Hydrostatic</td>
<td>4968.5 psi</td>
</tr>
<tr>
<td>Bottom Hole Temperature</td>
<td>54.4 °C</td>
</tr>
</tbody>
</table>

**Formation Data @ Shoe Depth**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption Gradient</td>
<td>14.30 ppg</td>
</tr>
<tr>
<td>Fracture Gradient</td>
<td>14.80 ppg</td>
</tr>
<tr>
<td>Porosity</td>
<td>35.0 %</td>
</tr>
<tr>
<td>Permeability</td>
<td>100 mD</td>
</tr>
<tr>
<td>Temperature Gradient</td>
<td>1.400 F/100ft</td>
</tr>
<tr>
<td>Temperature at Surface</td>
<td>28.0 °C</td>
</tr>
<tr>
<td>Temperature at Mud Line</td>
<td>4.0 °C</td>
</tr>
<tr>
<td>Buoyancy Factor</td>
<td>0.8534</td>
</tr>
<tr>
<td>Shoe Depth Hydrostatic</td>
<td>3763.2 psi</td>
</tr>
<tr>
<td>Absorption Pressure</td>
<td>5605.6 psi</td>
</tr>
<tr>
<td>Fracture Pressure</td>
<td>5801.6 psi</td>
</tr>
<tr>
<td>Bottom Hole Hydrostatic</td>
<td>4968.5 psi</td>
</tr>
<tr>
<td>Bottom Hole Temperature</td>
<td>54.4 °C</td>
</tr>
</tbody>
</table>

**Units**

- **Code**: admin, instructor, student
In Formations view

- **F1**: Height 3.28 ft, Soft/Hard: 30.0%
- **F2**: Height 3.28 ft, Soft/Hard: 50.0%
- **F3**: Height 3.28 ft, Soft/Hard: 40.0%

**Kick**
- Permeability: 300 mD, Fluid Density: 2.00 ppg
- Pore Equiv. Density: 10.75 ppg
- Soft/Hard: 60.0%

**Show Kick Information**
- Codes: admin, instructor, student

**Set the Kick (no drilling)** button disabled
CHAPTER 12

Shut-in

This simulator provides a simplified model to close the bop. There is not a full bop stack panel.

The shut-in in this simulator is executed only by closing the BOP and the remote choke.

The shut-in can be "hard shut-in" or "soft shut-in".

There is a flow meter and the volume to close and to open can be entered on the settings.
Hard Shut-in

Maintain the remote choke closed on drilling:

On kick detect (kick gain volume ~ 3 bbl) close the BOP. In this example, volume to CLOSE BOP = 25 gal.

The Kill and Choke pressures increase. On BHP (bottom hole pressure) > hydrostatic into the drillstring, the Drillpipe Pressure increase, too.

On BHP = Formation Pressure (stabilization of pressures), Drillpipe Pressure = SIDPP (Shut-In Drillpipe Pressure) and Kill and Choke Pressures = SICP (Shut-In Casing Pressure).

Before the stabilization of pressures, the graph is a curve.

After the stabilization of pressures, the gas migration continues (constant in this Single Bubble Model) and the graph is linear.

We recommend to record pressures x minutes (in regular intervals like 1 min) to detect the changing on graph from curve to linear (the stabilization of pressures).
Soft Shut-In

Maintain the choke open (50%) on drilling. After the kick detection, close the BOP following the closing of the choke.

On kick detect (kick gain volume ~ 3 bbl) close the BOP. In this example, volume to CLOSE BOP = 25 gal.

After BOP closed, start closing the choke...

In this method, the pressures increase faster due gas expansion and migration effects during the closing the choke. These effects is greater on deepwater due choke line friction.

After choke fully closed, check for stabilization of pressures.

In this example, SIDPP = 244 psi and SICP = 373 psi.
After the stabilization of pressures, the gas migration continues (constant in this Single Bubble Model) and the graph is linear.

**Velocity of Migration of Gas Kick**

A velocity of migration of the gas kick depends of yield point of drilling fluid (mud), of the kick volume and of inclination of well.

For example, for Yield Point = 10 lbf/100ft², kick volume = 10 bbl on vertical well, the velocity of migration is near 1000 ft/h.

A small kick volume has a velocity of migration greater in this simulator.

It is possible in this soft shut-in method the occurrence of the trapped pressure. To check, open the choke until pressure drops 50 psi, close and check if both pressures remain, is yes repeat this step until both pressures increase immediately after the closing the choke because there is no more trapped pressure.
CHAPTER 13

Setting a Kick (no drilling)

It is possible in this simulator to set a kick without need drill until the kick formation.
Before to set a kick without drilling

Set the BOP: Open or Closed

Set the standpipe manifold and the choke manifold

and set the choke: Open or Closed
Set the kick in Formations View:

**Set an Initial Kick without drilling**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kick Depth</td>
<td>9835.71 ft</td>
</tr>
<tr>
<td>Permeability</td>
<td>300.0 mD</td>
</tr>
<tr>
<td>Kick Volume</td>
<td>10.0 bbl</td>
</tr>
<tr>
<td>SIDPP</td>
<td>500.0 psi</td>
</tr>
<tr>
<td>SICP</td>
<td>630.0 psi</td>
</tr>
<tr>
<td>Drilled accumulated</td>
<td>16.40 ft</td>
</tr>
<tr>
<td>Well Depth</td>
<td>9858.92 ft</td>
</tr>
</tbody>
</table>

**Current Kick**

<table>
<thead>
<tr>
<th>Volume (bbl)</th>
<th>Pressure (psi)</th>
<th>Depth (ft)</th>
<th>Length (ft)</th>
<th>Top (ft)</th>
<th>Density (ppg)</th>
<th>Mass (lb)</th>
<th>Hydrost (psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: 10.000</td>
<td>5437.19</td>
<td>9835.71</td>
<td>337.74</td>
<td>9497.96</td>
<td>2.29</td>
<td>965.85</td>
<td>40.26</td>
</tr>
<tr>
<td>2:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3:</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Units: Set the Kick (no drilling)

Note the "drilled accumulated = 16.40 ft" parameter on set the kick. This is necessary for flow from kick formation into borehole.

**For a hard Shut-In Example:**

Input this data on default subsea vertical well.
With BOP Closed and Choke Closed, there is not curve of stabilization of pressure:

![Drilling Simulator 3](image)

In this hard shut-in example, the kick volume remain near same value.

Note: Kick Volume entered = 10 bbl. But kick volume = 8.8 bbl.

Drilled = 16.4 ft on hole size = 8.5 in => 0.0702 bbl/ft

Hole (drilled) volume= 16.4 x 0.0702 = 1.15 bbl

A Soft Shut-In example:

BOP Open and Choke Open (50%).

![Drilling Simulator 3](image)
Set the BOP to Close and wait for conclusion.

The pressures increase on closing the choke...

After Bop closed, close the Choke:

And the kick volume increased to 36.5 bbl.

kick volume in cyan color in graph.
Well Control

Choke Interface

iPad x iPad Pro on horizontal position
On vertical position

iPad, iPad Air, iPad Mini
Choke Control

Choke Open Gauge

Rig Air Supply enable the Choke Control

Mud Pumps 1 & 2

Both the mud pump 1 and 2 in parallel, but the digital values are for each mud pump selected.

Digital Panel

Note: Mud Pump 3 to Booster Line (BL) only.
**Graph Settings**

At top of the screen, on left

Graph Historical:

This app works with the last 360 min of simulation. Save the current data to dat file. After 360 min, occur a shift from begin.

Select X axis to Plot:

Plot Pressure and Pit Volume versus:

- x Time
- x Strokes
- x Kick Vol

Select the Maximum Pressure on Gauge:

<table>
<thead>
<tr>
<th>Maximum Gauge Pressure, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
</tr>
</tbody>
</table>

Max Pressure

<table>
<thead>
<tr>
<th>Max Pressure, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>705</td>
</tr>
</tbody>
</table>

Max Pressure

<table>
<thead>
<tr>
<th>Max Pressure, psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>705</td>
</tr>
</tbody>
</table>
Show Graph or Well options

For iPad / iPad Mini on Horizontal position:

For iPad Pro on Horizontal position:
Shows Graph and Well on the same screen:
Graph on vertical position

iPad and iPad Mini

Set Sound Level

Sound Level

- Background
- Mud Pump
- Accum. Pump
- Hyd Choke
- Gas Out

Informations with Code

Set Graph

- Failures
- Code
- Kill Mud

Code: admin

Codes: admin, instructor, student

Note: These codes are non-cryptographed

Set Lag Time

Show Kick Informations

Show Failures Menu Button

Show Pressures in the borehole

Show Digital values in Gauges

Enable Restart/Remove buttons

Enable Create/Open/Import Files

Lock on Toolbar
Lock / Unlock options on toolbar

Set Lag Time
Show Kick Informations
Show Pressures in the borehole
Show Digital values in Gauges

Attention: The Initial codes: "0000"

Notes:
If lose the admin code:
1. Export all data files to iCloud;
2. Delete app on iPad
3. Re-install it from App Store.
4. Use the initial code: "0000"
5. Import data files from iCloud
Show pressure in the borehole ON

Show pressure in the borehole OFF

Show Kick Informations ON

Menu Item on toolbar: (Disabled if Kick Informations OFF)

Set the Kill Mud Weight

Tap on “Kill Mud” item on top menu:

1. Input the Kill Mud Weight
2. Select Enable Option
3. Tap on “Set” button
Graph in Full Screen

iPad on Horizontal position

iPad on Vertical Position
### Pre-Recorded Data menu item on toolbar:

- **Hyd**

### Pre-recorded Data on surface stack:

**Drilling Simulator 3**

**WELL**: 3937.01 - True Vertical Depth (TVD)

- **Date**: 9 de julho de 2016
- **By**:...

**WELL, FLUID, LOT EQUIPMENTS**

- **Active Surface Volume**: 200.00 bbl
- **Rose Weight**: 9.60 gpg
- **Liquid Overbalance Differential**: 0.4987 psig

**MAXIMUM STATIC PRESSURES**

- **Maximum Casing Pressure**: 1529.56 psi
- **Minimum BOP Test Pressure**: 529.38 psi

**LENGTH, CAPACITY AND VOLUMES**

- **Drill String ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

**MUD PUMPS**

<table>
<thead>
<tr>
<th>N°</th>
<th>SPM (bbl/min)</th>
<th>Flow (gpm)</th>
<th>SPM Pump Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP 1</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
<tr>
<td>PUMP 2</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**VOLUMES AND STROKES**

- **Surface Connections (kbbls)**: 80
- **Surface to Bit (Surface Connections + Drill String)**: 160
- **Bit to Shoe**: 80
- **Bit to BOP**: 80
- **Bit to Choke**: 80
- **Booster Line**: 80
- **Riser Annular**: 80

**Pre-Recorded - Surface Stack**

- **Drill String ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

- **Wellbore ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

- **Casing ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

**MUD PUMPS**

<table>
<thead>
<tr>
<th>N°</th>
<th>SPM (bbl/min)</th>
<th>Flow (gpm)</th>
<th>SPM Pump Pressure</th>
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</tr>
<tr>
<td>PUMP 2</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**VOLUMES AND STROKES**

- **Surface Connections (kbbls)**: 80
- **Surface to Bit (Surface Connections + Drill String)**: 160
- **Bit to Shoe**: 80
- **Bit to BOP**: 80
- **Bit to Choke**: 80
- **Booster Line**: 80
- **Riser Annular**: 80

**Pre-Recorded - Subsea Stack**

- **Drill String ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

- **Wellbore ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

- **Casing ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

**MUD PUMPS**

<table>
<thead>
<tr>
<th>N°</th>
<th>SPM (bbl/min)</th>
<th>Flow (gpm)</th>
<th>SPM Pump Pressure</th>
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<tr>
<td>PUMP 1</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
<tr>
<td>PUMP 2</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**VOLUMES AND STROKES**

- **Surface Connections (kbbls)**: 80
- **Surface to Bit (Surface Connections + Drill String)**: 160
- **Bit to Shoe**: 80
- **Bit to BOP**: 80
- **Bit to Choke**: 80
- **Booster Line**: 80
- **Riser Annular**: 80

**Pre-Recorded - Subsea Stack**

- **Drill String ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

- **Wellbore ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

- **Casing ID (in)**: 2.750
- **OD (in)**: 2.875
- **Total Open Hole**: 2308.12 ft

**MUD PUMPS**

<table>
<thead>
<tr>
<th>N°</th>
<th>SPM (bbl/min)</th>
<th>Flow (gpm)</th>
<th>SPM Pump Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUMP 1</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
<tr>
<td>PUMP 2</td>
<td>0.1232</td>
<td>97.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**VOLUMES AND STROKES**

- **Surface Connections (kbbls)**: 80
- **Surface to Bit (Surface Connections + Drill String)**: 160
- **Bit to Shoe**: 80
- **Bit to BOP**: 80
- **Bit to Choke**: 80
- **Booster Line**: 80
- **Riser Annular**: 80
CHAPTER 15

Failures Schedule

This simulator has a failures schedule with random option based on pump strokes as a delay parameter:

- Mud Pumps 1 and 2 “power end failure” or “fluid end failure”,
- Chokes 1 and 2 “plugged” or “washed”,
- One Drill Bit Nozzle “plugged” or “washed”

Random option is applied only for:

1. Mud Pump 1
2. Choke 1
3. One Bit Nozzle
Mud Pump failures

**Power End:** The mud pump stops. Flow rate to zero. DP Pressure and Choke Pressure drops the friction losses.

=> Start closing the choke trying to maintain the Choke Pressure (on surface stack) until to close the choke fully (0%).

Example:

Vertical well on landing rig, drillpipe float valve, circulating a kick by the driller’s method:

---

Set the failure scheduled to the next 10 strokes:

1. Input 10 strokes
2. Select the Mud Pump 1 “Power End” option
3. Select “Enable”
4. Tap on Set button.
5. Close the popup view
6. Check parameters on 10 strokes (114 + 10 = 124)
Look for trapped pressure after shut-in.
Restart circulation with mud pump 2

Align the mud pump 2 on the standpipe manifold:

Start mud pump 2 trying maintaining the choke pressure

Fluid End

The circulation flow drops slowly until zero. DP Pressure and Choke Pressure drops by reduction of the friction losses.

=> Start closing the choke trying to maintain the Choke Pressure (on surface stack) and stopping the mud pump until to zero spm and choke closed (shut-in).

Current Status

<table>
<thead>
<tr>
<th>Pump 1 Failure</th>
<th>BOP Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump 2 Failure</td>
<td>Fracture</td>
</tr>
</tbody>
</table>

Failure Schedule

Next strokes to failure event 10 stk

<table>
<thead>
<tr>
<th>Mud Pump 1</th>
<th>Mud Pump 2</th>
<th>Choke 1</th>
<th>Choke 2</th>
<th>One Bit Nozzle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>Power End</td>
<td>Fluid End</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Normal</td>
<td>Power End</td>
<td>Fluid End</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Normal</td>
<td>Plugged</td>
<td>Washed</td>
<td>Normal</td>
<td>Normal</td>
</tr>
<tr>
<td>Normal</td>
<td>Plugged</td>
<td>Washed</td>
<td>Normal</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Note: Reset Bit Nozzles on drill bit settings.

Random Enable Set
Note: In this case the simulator does not detect the failure in mud pump 1. So set the mud pump 1 to fail manually.
One Bit Nozzle Plugged

DP Pressure increases without effects on the Choke pressure. Usually when set a failure on mud pump, also set “One Bit Nozzle” plugged option on the next restart. This effect will occur after shut-in and the next restart a mud pump.

In this event, the simulator set one nozzle to zero, on starting on nozzle 1,...

To reset this failure, set a new value to the nozzle on settings. On restart, the DP Pressure is greater for a same value to flow rate and choke pressure.

On restart:
One Bit Nozzle Washed

DP Pressure decreases without effects on the Choke pressure.

Failure Schedule

<table>
<thead>
<tr>
<th>Component</th>
<th>Normal</th>
<th>Power End</th>
<th>Fluid End</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mud Pump 1</td>
<td>Normal</td>
<td>Power End</td>
<td>Fluid End</td>
</tr>
<tr>
<td>Mud Pump 2</td>
<td>Normal</td>
<td>Power End</td>
<td>Fluid End</td>
</tr>
<tr>
<td>Choke 1</td>
<td>Normal</td>
<td>Plugged</td>
<td>Washed</td>
</tr>
<tr>
<td>Choke 2</td>
<td>Normal</td>
<td>Plugged</td>
<td>Washed</td>
</tr>
<tr>
<td>One Bit Nozzle</td>
<td>Normal</td>
<td>Plugged</td>
<td>Washed</td>
</tr>
</tbody>
</table>

Note: Reset Bit Nozzles on drill bit settings.

Random Enable Set
**Choke Plugged**

Both DP Pressure and Choke Pressure increase.

=> Stop mud pump immediately due possibility of fracture of formation.

Normally in this case, can to occur trapped pressure.

**Current Status**

- Pump 1 Failure
- BOP Failure
- Pump 2 Failure
- Fracture

**Failure Schedule**

- Next strokes to failure event: 10 stk

- Mud Pump 1: Normal
- Power End
- Fluid End

- Mud Pump 2: Normal
- Power End
- Fluid End

- Choke 1: Normal
- Plugged
- Washed

- Choke 2: Normal
- Plugged
- Washed

- One Bit Nozzle: Normal
- Plugged
- Washed

Note: Reset Bit Nozzles on drill bit settings.

Random: Enable

Set
Choke Washed

Both DP Pressure and Choke Pressure decrease.

=> Stop mud pump immediately and close the valve to isolate the choke.

Normally in this case, can to occur a new kick at bottom.

Failure Schedule

Next strokes to failure event 10 stk

Mud Pump 1 Normal Power End Fluid End
Mud Pump 2 Normal Power End Fluid End
Choke 1 Normal Plugged Washed
Choke 2 Normal Plugged Washed
One Bit Nozzle Normal Plugged Washed

Note: Reset Bit Nozzles on drill bit settings.

Random Enable Set
Align to choke fold:

Remote Choke 2
Straight Through
Remote Choke 1

Kill Line
Choke Line

choke 2 mani-
Select the choke 2 to operate:

Restart the circulation with the choke 2, maintaining the last choke pressure:
CHAPTER 16

Float Valve (non-ported)

Float Valves are run to prevent Drilling Fluids from back owing up the Drill String to the surface. It is basically a one way or Downhole Check Valve. Float Valves may be used for additional Well Control and also to protect high cost tools such as Rotary Steerable, MWD/LWD, etc from Drilling Fluid, Cuttings and Metal Debris owing up the Drill String whilst running in the hole.

They are essential tools on MPD and UBD operations.

This feature in this simulator shows the effects of a float valve into the drill string on shut-in and definition of the SIDPP.
Set the Float Valve in Setting view

Drill String Float Valve (non-port)

Float Valves are run to prevent Drilling Fluids from back flowing up the Drill String to the surface. It is basically a one way or Downhole Check Valve.

Float Valves may be used for additional Well Control and also to protect high cost tools such as Rotary Shearheads, MWD/LWD, etc from Drilling Fluid, Cuttings and Metal Debris going up the Drill String whilst running in the hole.

They are essential tools on MPD and UBD operations.

Ported type:

Pressure-Monitoring Float Valve has a special port running through of the Float Valve. This valve is used when monitoring the bit head for gas pressure and allowing differential pressure measuring when required.

Set the kick and perform the shut-in. Look that the Drill Pipe Pressure is ZERO.

iPad on landscape position
How to get the SIDPP with float valve in the drillstring?

Bring the mud pump slowly until the opening of the float valve, checking changing on the choke pressure. Stop mud pump immediately.

Before to start the mud pump, record the choke pressure.

SICP = 362 psi

After the occurrence of the changing on choke pressure, stop immediately the mud pump and record the the DP Pressure and the new choke pressure.

Choke Pressure = 387 psi and DP Pressure = 270 psi

SIDPP = DP Pressure - (Difference on Choke Pressure)

SIDPP = 270 - (387 - 362) => SIDPP = 245 psi
Chapter 17

Kick Induced by Swabbing

It is possible in this simulator to induce a kick by swabbing to practice the volumetric method (lubricate and bleed) on surface stack and dynamic volumetric method on subsea stack.
Step by Step on surface stack

Preparing the well to induce a kick by swabbing

On formation view, set the Pore Equivalent Density near to Mud Weight.

For example: Mud Weight = 9.6 ppg

=> Pore Equivalent Density = 9.5 ppg

On main view, drill until 3 ft (~ 1.0 m) into the kick formation

Prepare to trip up: RPM = 0, SPM = 0 and WOB = 0
swipe the finger up on well picture until tripping out

Perform the shut-in

Apply the volumetric method to control.

Like this graph from another example:
CHAPTER 18

Exercise

This is an example using the default with surface stack well.

1. Creating a data file
2. Well Configuration
3. Pre-Recorded Data
4. Drilling
5. Kick Detection
6. Shut-in and stabilization of pressures
7. Calculating well control parameters
8. The App “Well Control Methods”
9. Applying the wait and weight method
10. Graphical Analysis

Creating a data file:

Input the text “Exercise 1” in the text box and tap on “+ new Surface” button.
### SECTION 1

**Well Configuration**

![Well Configuration Diagram](image)

Set to Directional Well

1. **KOP = 2000 ft**
2. **BUR = 3 degree/100 ft**
3. **Angle = 60 degree**
4. **MD = 4000 ft**

---

**Internal**

- **Float Valve**
- **Hookload**

<table>
<thead>
<tr>
<th>Length (ft)</th>
<th>OD (in)</th>
<th>ID (in)</th>
<th>Weight (lb)</th>
<th>Cap Int (bbl)</th>
<th>Vol Int (bbl)</th>
<th>Displac Vol Steel (bbl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP 1</td>
<td>2945.56</td>
<td>5.0000</td>
<td>4.2760</td>
<td>19.50</td>
<td>0.0583</td>
<td>0.00214</td>
</tr>
<tr>
<td>DP 2</td>
<td>0.00</td>
<td>5.0000</td>
<td>4.2760</td>
<td>19.50</td>
<td>0.0583</td>
<td>0.00214</td>
</tr>
<tr>
<td>HW</td>
<td>328.08</td>
<td>5.0000</td>
<td>3.0000</td>
<td>40.00</td>
<td>0.0287</td>
<td>2.87</td>
</tr>
<tr>
<td>DC 1</td>
<td>459.32</td>
<td>6.2500</td>
<td>2.8125</td>
<td>96.00</td>
<td>0.0252</td>
<td>0.00252</td>
</tr>
<tr>
<td>DC 2</td>
<td>154.04</td>
<td>6.7000</td>
<td>2.8125</td>
<td>102.00</td>
<td>0.0252</td>
<td>1.26</td>
</tr>
<tr>
<td>Bit</td>
<td>3937.01</td>
<td>Nominal</td>
<td>135.1 kip</td>
<td>60.69</td>
<td>44.48</td>
<td></td>
</tr>
</tbody>
</table>

---

**External**

- **Riser Casing**
- **Riser Liner**
- **Choke Line**
- **Booster Line**

**Units**

- **Mud/Grad**
- **Bt/Equip**
- **Forms**
- **Pre-Recorded**

---

**Drilling Simulator 3**
Set Float Valve

Float Valves are run to prevent Drilling Fluids from back- ways up the Drill String to the surface. It is basically a one way or Downhole Check Valve.

Float Valves may be used for additional Well Control and also to protect high cost tools such as Rotary Steerable, MWD/LWD, etc from Drilling Fluid, Cuttings and Metal Debris going up the Drill String whilst running in the hole.

They are essential tools on MPD and UBD operations.

**Ported type:**
Pressure-Monitoring Float Valve has a special port running through the Float Valve. This Valve is used when monitoring the bit head for gas pressure and allowing differential pressure measuring when required.
Set Mud and Gradients

- Mud Weight: 9.60 ppg
- MW Gradient: 0.487 psi/ft
- Plastic Viscosity: 15.0 cp
- @ 300 rpm: 25
- Yield Point: 10.0 lb/100 ft²
- @ 600 rpm: 40
- Initial Gel: 5.0 lb/100 ft²
- Rheological Model: Bingham
- Temperature Gradient: 1.400 °F/100 ft
- Temperature at Surface: 28.0 °C, 82.4 °F
- Porosity: 35.0 %
- Permeability: 100 mD
- Buiancy Factor: 0.8534
- Shoe Depth Hydrostatic: 1133.9 psi
- @ Shoe TVD: 2273.6 psi
- Absorption Pressure: 1889.8 psi
- Max @ surface: 755.9 psi
- Fracture Pressure: 1942.8 psi
- Max @ surface: 814.9 psi
- Bottom Hole Hydrostatic: 1697.6 psi
- @ Well TVD: 3403.9 psi
- Bottom Hole Temperature: 54.5 °C, 130.1 °F
Set Drill Bit and Equipments

- Chokes 1 & 2 Diameter, Max: 1.5000 in
- Chokes 1 & 2 Coefficient: 65.0 %
- BOP Test Pressure: 5000 psi
- Vol to Close: 16.0 to Open: 20.0 gal

Note:

- Chokes 1 & 2 Diameter, Max: 1.5000 in
- Chokes 1 & 2 Coefficient: 65.0 %
- BOP Test Pressure: 5000 psi
- Vol to Close: 16.0 to Open: 20.0 gal

Set Formations

- F1: Height: 3.28 ft, Soft: 30.0 %, Hard
- F2: Height: 3.28 ft, Soft: 50.0 %, Hard
- F3: Height: 3.28 ft, Soft: 40.0 %, Hard

Save to file

Current: Exercise 1.ds3f
Section 2

Pre-recorded Data

1. Align the circulation to the drill string
2. Set pump #1 speed to 30 spm
3. Record the “DP Pressure” on Choke Panel

<table>
<thead>
<tr>
<th>MUD PUMPS</th>
<th>STK</th>
<th>SPM</th>
<th>MP1</th>
<th>MP2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow-in</td>
<td>150.0</td>
<td>97.7</td>
<td>9.60</td>
<td></td>
</tr>
<tr>
<td>Bit volume</td>
<td>25</td>
<td>197.2</td>
<td>4900.00</td>
<td></td>
</tr>
<tr>
<td>MUD closed</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUD (bbl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill String</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total KT</td>
<td>25</td>
<td>197.2</td>
<td>4900.00</td>
<td></td>
</tr>
<tr>
<td>Choke 1 &amp; 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow-in</td>
<td>150.0</td>
<td>97.7</td>
<td>9.60</td>
<td></td>
</tr>
<tr>
<td>Bit volume</td>
<td>25</td>
<td>197.2</td>
<td>4900.00</td>
<td></td>
</tr>
<tr>
<td>MUD closed</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUD (bbl)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drill String</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total KT</td>
<td>25</td>
<td>197.2</td>
<td>4900.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DP Pressure</th>
<th>psi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow-in</td>
<td>150.0</td>
</tr>
<tr>
<td>Bit volume</td>
<td>25</td>
</tr>
<tr>
<td>MUD closed</td>
<td>0</td>
</tr>
<tr>
<td>MUD (bbl)</td>
<td></td>
</tr>
<tr>
<td>Drill String</td>
<td></td>
</tr>
<tr>
<td>Total KT</td>
<td>25</td>
</tr>
<tr>
<td>Choke 1 &amp; 2</td>
<td></td>
</tr>
<tr>
<td>Flow-in</td>
<td>150.0</td>
</tr>
<tr>
<td>Bit volume</td>
<td>25</td>
</tr>
<tr>
<td>MUD closed</td>
<td>0</td>
</tr>
<tr>
<td>MUD (bbl)</td>
<td></td>
</tr>
<tr>
<td>Drill String</td>
<td></td>
</tr>
<tr>
<td>Total KT</td>
<td>25</td>
</tr>
</tbody>
</table>

Initial Circulation Pressure = 324 psi

@ 36 spm => Slow Circulation Rate = 150 gpm

<table>
<thead>
<tr>
<th>WELL, FLUID, LOT AND EQUIPMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>True Vertical Depth (TVD)</td>
</tr>
<tr>
<td>Measured Depth (MD)</td>
</tr>
<tr>
<td>Shoe Vertical Depth (TVDS)</td>
</tr>
<tr>
<td>Active Surface Volume</td>
</tr>
<tr>
<td>Mud Weight (lb/gal)</td>
</tr>
<tr>
<td>Fracture Gradient (psi/ft)</td>
</tr>
<tr>
<td>BOP Test Pressure</td>
</tr>
<tr>
<td>Maximum Allowable Riser Pressure, MAARIP = 0.019 x (psi/ft) x TVDS</td>
</tr>
<tr>
<td>Maximum Annular Pressure = BOP Test Pressure</td>
</tr>
<tr>
<td>Maximum BOP Pressure = BOP Test Pressure</td>
</tr>
</tbody>
</table>

Maximum Equipment Pressure: Smaller of (Maximum Riser or Maximum BOP)

<table>
<thead>
<tr>
<th>LENGTH, CAPACITY AND VOLUMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drill String</td>
</tr>
<tr>
<td>Drilpipe, DP1</td>
</tr>
<tr>
<td>Drilpipe, DP2</td>
</tr>
<tr>
<td>Heavy Weight, HW</td>
</tr>
<tr>
<td>Drill Collar, DC1</td>
</tr>
<tr>
<td>Drill Collar, DC2</td>
</tr>
<tr>
<td>Total Drill String</td>
</tr>
<tr>
<td>WELLBORE</td>
</tr>
<tr>
<td>Open Hole</td>
</tr>
<tr>
<td>Liner</td>
</tr>
<tr>
<td>Casing</td>
</tr>
<tr>
<td>MUD PUMPS</td>
</tr>
<tr>
<td>NP</td>
</tr>
<tr>
<td>PUMP 1</td>
</tr>
<tr>
<td>PUMP 2</td>
</tr>
<tr>
<td>80%</td>
</tr>
</tbody>
</table>

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**Section 3**

**Drilling**

**Steps**

1. Set circulating system
2. Close the choke to hard shut-in
3. Drilling
4. Kick Detection
5. Stop Drilling and save to data file
6. Shut-In
7. Stabilisation of pressures
8. Record Kick Volume, SIDPP and SICP
9. Get SIDPP with float valve
10. Save to iCloud

**Set circulating system**

**Close the Choke to Hard Shut-In**
Drilling

SPM = 100, RPM = 80 and WOB = 30 kip

Set Pause and save to a new data file “Exercise 1 Drilling”

Kick Detection

Set Alarms: Max Pit Vol = 3 bbl and Max Flow Out = 450 gpm

Set Alarms

Maximum Pit Gain 3.0 bbl
0 20

Maximum Flow Out 449.4 gpm
0 1000

Continue drilling until alarms ON

Set Pause and save to a new data file “Exercise 1 Kick”

Current Exercise 1 Drilling.ds3f

Save As ... Exercise 1 Drilling
Shut-In

RPM = 0, WOB = 0 and SPM = 0

=> Close the BOP

=> Set return to Trip Tank

### Stabilization of Pressures

Record the parameters:

<table>
<thead>
<tr>
<th>TIME</th>
<th>DP PRESS</th>
<th>CHOOSE PRESS</th>
<th>DIFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 min</td>
<td>0 psi</td>
<td>60 psi</td>
<td>60</td>
</tr>
<tr>
<td>2 min</td>
<td>0 psi</td>
<td>100 psi</td>
<td>40</td>
</tr>
<tr>
<td>3 min</td>
<td>0 psi</td>
<td>136 psi</td>
<td>36</td>
</tr>
<tr>
<td>4 min</td>
<td>0 psi</td>
<td>165 psi</td>
<td>29</td>
</tr>
<tr>
<td>TIME</td>
<td>DP PRESS</td>
<td>CHOKE PRESSURE</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>5 min</td>
<td>0 psi</td>
<td>188 psi</td>
<td></td>
</tr>
<tr>
<td>6 min</td>
<td>0 psi</td>
<td>205 psi</td>
<td></td>
</tr>
<tr>
<td>7 min</td>
<td>0 psi</td>
<td>221 psi</td>
<td></td>
</tr>
<tr>
<td>8 min</td>
<td>0 psi</td>
<td>233 psi</td>
<td></td>
</tr>
<tr>
<td>9 min</td>
<td>0 psi</td>
<td>242 psi</td>
<td></td>
</tr>
<tr>
<td>10 min</td>
<td>0 psi</td>
<td>250 psi</td>
<td></td>
</tr>
<tr>
<td>11 min</td>
<td>0 psi</td>
<td>256 psi</td>
<td></td>
</tr>
<tr>
<td>12 min</td>
<td>0 psi</td>
<td>261 psi</td>
<td></td>
</tr>
<tr>
<td>13 min</td>
<td>0 psi</td>
<td>265 psi</td>
<td></td>
</tr>
<tr>
<td>14 min</td>
<td>0 psi</td>
<td>268 psi</td>
<td></td>
</tr>
</tbody>
</table>

==> SIDPP = 0 psi (drillstring with FLOAT VALVE)

==> SICP = 268 psi (drop due changing annular in BHA)

<table>
<thead>
<tr>
<th>Kick</th>
<th>Volume</th>
<th>Pressure</th>
<th>Depth</th>
<th>Top</th>
<th>Length</th>
<th>Height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>bbl</td>
<td>psi</td>
<td>ft</td>
<td>ft</td>
<td>ft</td>
<td>ft</td>
</tr>
<tr>
<td>10.163</td>
<td>1830.24</td>
<td>3697.52</td>
<td>3384.82</td>
<td>312.70</td>
<td>159.44</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Density</th>
<th>Mass</th>
<th>Hydrostatic</th>
<th>Temperature</th>
<th>Z Factor</th>
<th>Migration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.38</td>
<td>1017.49</td>
<td>19.70</td>
<td>587.59</td>
<td>0.7255</td>
<td>15.31</td>
</tr>
</tbody>
</table>
How to get the SIDPP with float valve in the drillstring?

Bring the mud pump slowly until the opening of the float valve, checking changing on the choke pressure. Stop mud pump immediately.

Before to start the mud pump, record the choke pressure.

SICP = 269 psi

After the occurrence of the changing on choke pressure, stop immediately the mud pump and record the the DP Pressure and the new choke pressure.

Choke Pressure = 276 psi and DP Pressure = 214 psi

SIDPP = DP Pressure - (Difference on Choke Pressure)

SIDPP = 214 - (276 - 269) => SIDPP = 207 psi

Save to new data file “Excercise 1 Stab 2”

Fill the your Kill Sheet for Control applying the Wait and Weight Method.

We recommend the our App “Wait and Weight Worksheets” to calculations.

It is available on our Portfolio on the App Store

Please, see the next section.
SECTION 4
Well Control Method

Steps

1. The our Apps “Wait and Weight Worksheets”
2. The Wait and Weight Method
3. Export data file to iCloud
4. Open “Wait and Weight Worksheets”
5. Import data file from iCloud
6. Calculations
7. Worksheets

The “Wait and Weight Worksheets” for iPad

Well Control
Wait and Weight Method
Worksheets
applied to the drilling of oil wells

Available in our Portfolio on the App Store
About the Wait and Weight Method

During drilling operation of oil wells, there may be inflow of formation fluids into the well, which is an undesirable condition. The driller should detect such events and closing the well immediately. Record information after the closing of the well corresponding to stabilization of pressure, volume gain, SIDPP (Shut-In Drilpipe Pressure) and SICP (Shut-In Casing Pressure). In the case of operations on floating units (subsea stack), this term could be redefined as Shut-In Choke Pressure.

The control method to be applied is the Wait and Weight method. The circulation should be made with the Kill Mud Weight in two steps:
1. Fill the drill string until the bit by keeping the pressure following the table strokes versus pressure.
2. Complete circulation of the annular to the surface keeping the pressure of circulation with the kill mud constant named FCP - Final Circulation Pressure. On subsea stack, after the choke fully open, the pump pressure increases until FCP 2.

Attention: about drill bit off bottom
This method should only be applied with the drill bit in the bottom hole or when the kick is completely in annular of the drill string.

ICP = Pks + SIDPP
ICP - Initial Circulating Pressure, psi
Pks - Recorded pump pressure at the kill rate speed, psi
SIDPP - Shut-In Drilpipe Pressure, psi

Notes about floating units:

a) Pks must be recorded by circulating riser;
b) Record the friction loss in the choke line at the kill rate speed, psi;

\[
\Delta \text{stk} = 100 \text{ strokes}
\]

\[
\Delta \rho = \frac{(\text{ICP} - \text{FCP})}{\text{Stk to Bit} \times 100}
\]

\[
\text{FCP} = \frac{\text{Pks} \times \text{KM}}{\text{TVD}}
\]

FCP - Final Circulation Pressure, psi
KM - Kill Mud Weight, ppg
OM - Original Mud Weight, ppg
SIDPP - Shut-In DP Pressure, psi
TVD - True Vertical Depth, ft

<table>
<thead>
<tr>
<th>Summary:</th>
<th>STEPS</th>
<th>DP Pressure</th>
<th>CHOOSE Pressure</th>
<th>STROKES to pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bring the pump to kill speed</td>
<td>SICP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Circulate to fill drill string with kill mud following the table strokes vs. pressure</td>
<td>TABLE</td>
<td>DRILL STRING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Circulate to fill annular with kill mud</td>
<td>FCP</td>
<td>BIT to Surface</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Export the data file “Exercise 1 Stab 2” to iCloud

Files on My iPad

- Exercise 1 Kick drilling stopped.ds3f
- Exercise 1 Kick Shut-in.ds3f
- Exercise 1 Kick.ds3f
- Exercise 1 Stab 2.ds3f
- Exercise 1 Stab.ds3f
- Exercise 1.ds3f
- New Data File.ds3f

Current: Exercise 1 Stab 2.ds3f
Open the “Wait and Weight Worksheets” app

Import the data file from “Drilling Simulator 3”

On form 1, edit the Pressure at Slow Circulating Rate (SCR)
Edit volume of surface lines, SCR and others

On form 2, edit the “casing Friction”, the Kick Data (SIDPP, SICP, Volume and Time)

Set real values for KMW

When start the circulation of the method, set ICP and FCP to real values.
Print the form 2 updated

MAXIMUM ALLOWABLE ANNULUS SURFACE PRESSURE (MAASP) at Choke

MAASP WITH PRESENT MUD WEIGHT:

\[
16.50 - 9.60 \times 0.0519 \times 2273.69 = 815 - 28 = 787 \text{ psi}
\]

EQ. MW (LOT), ppg
Original MW, ppg
LOT TVD, ft
Static Casing Friction
Dynamic

MAASP WITH KILL MUD WEIGHT:

\[
15.50 - 10.80 \times 0.0519 \times 2273.69 = 673 \text{ psi}
\]

EQ. MW (LOT), ppg
Kill Mud Weight, ppg
LOT TVD, ft

KICK DATA

SIDPP: 207 psi  SICP: 268 psi  VOLUME: 10.13 bbl  Time of Incident: 00:24 h

CALCULATIONS

KILL MUD WEIGHT (KMW):

\[
\frac{207}{10.80} \times \frac{3403.99}{36} = 10.77 \text{ ppg}
\]

SIDPP, psi  SICP, psi  VMD, ft  Original Mud Weight, ppg

INITIAL CIRCULATING PRESSURE (ICP):

\[
324 + 531.0 = 855 \text{ psi
}
\]

SIDPP, psi  DP Pressure, psi @ SCR of 36 rpm

FINAL CIRCULATING PRESSURE (FCP):

\[
364.5 \times 10.80 + 9.60 = 364 \text{ psi
}
\]

DP Pressure, psi  Kill Mud Weight, ppg  Original Mud Weight, ppg

FORMULAS

\[
\begin{align*}
\text{SURFACE TO BIT (DRILL STRING ONLY)} & \quad \text{KOP} \quad \text{EOB} \quad \text{BIT} \\
\text{STROKES} & \quad \text{MINUTES} & \quad 0 & \quad 0 & \quad 267 & \quad 7 & \quad 584 & \quad 16 & \quad 623 & \quad 17 \text{ sfl / min} \\
\text{DP PRESSURE} & \quad \text{psi} & \quad 531 & \quad 453 & \quad 370 & \quad 364 \\
\text{PRESSURE DROP} & \quad \text{psi / 100 STK} & \quad 29.3 & \quad 26.2 & \quad 13.2 \\
\end{align*}
\]

\[
\begin{align*}
\text{SURFACE TO KOP} & \quad \text{KOP TO EOB} & \quad \text{EOB TO BIT} \\
\text{psi} & \quad \text{psi} & \quad \text{psi} & \quad \text{psi} \\
\end{align*}
\]

Set the ranges for the graph

1. Bring mud pump up to slow circulation rate 36 rpm, keeping Choke Pressure = SICP
2. Reset Strikes Counter after pump the surface lines volume 9.57 bbl / 96 strikes
3. Maximum Pressure at Choke 787 psi until 696 strokes (open hole)
4. Pump the Kill Mud to fill the drill string following the table / graph, starting with DP Pressure = ICP
5. Keep Drill Pipe Pressure = FCP 364 psi until kill mud reaches the surface 1852 strokes (bit to choke)
SECTION 5
Killing the Well

STEPS
1. The Kill Sheet
2. Reset Total Strokes
3. Set the Kill Mud (KM)
4. Starting the circulating
5. Set the Initial Circulation Pressure
6. Set a Safety Margin ~ 36 psi
7. Reset again at 96 strokes (surfaces lines)
8. Apply the “DP Pressure x Strokes” table
9. Reset Strokes when KM reaches the Drill Bit
10. Set the Final Circulation Pressure (FCP)
11. Maintain FCP until Kill Mud out (Annular filled with Kill Mud)
Reset Strokes

Set the Kill Mud Weight
1. Select Enabled
2. Input KMW = 10.8 ppg
3. Tap on "SET" button

Kill Mud Weight 10.8 ppg
Total Volume pumped to drillstring 0.0 bbl
Total Volume pumped to kill line 0.0 bbl
Kill Mud Color  Brown Purple Pink Green

Starting Circulating
1. Set Choke Rate to a slow value (3 of 10)
2. Set Rig Air Supply to ON
3. Open the choke slowly
4. Increment SPM and open choke trying maintain Choke Pressure constant ~ SICP = 368.
5. When SPM reaches 36 spm, set choke to DP Pressure = ICP + Safety margin (= 531) (Safety Margin = 0 psi in this example)
Reset Total Strokes (Surface Lines)

-> when reaches 96 strokes (Surface Lines)

Adjust choke to Apply the table “DP Pressure x Strokes”

<table>
<thead>
<tr>
<th>KILL MUD AT:</th>
<th>SURFACE</th>
<th>KOP</th>
<th>EOB</th>
<th>BIT</th>
<th>DP PRESSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>STROKES</td>
<td>MINUTES</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>267</td>
<td>7</td>
<td>584</td>
<td>16</td>
</tr>
<tr>
<td>PRESSURE DROP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PER 100 STROKES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface to KOP</td>
<td>KOP to EOB</td>
<td>EOB to BIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.3</td>
<td>26.2</td>
<td>13.2</td>
<td>psi</td>
<td>/ 100 stk</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nr.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
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<tr>
<td>Strokes</td>
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<td>100</td>
<td>200</td>
<td>297</td>
<td>300</td>
<td>400</td>
<td>500</td>
<td>584</td>
<td>600</td>
<td>623</td>
<td>1100</td>
<td>1200</td>
<td>1300</td>
<td>1400</td>
<td></td>
</tr>
<tr>
<td>DP Press</td>
<td>531</td>
<td>532</td>
<td>472</td>
<td>453</td>
<td>444</td>
<td>415</td>
<td>392</td>
<td>370</td>
<td>368</td>
<td>364</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Kill Mud in the Drill String
Set the Final Circulating Pressure = 364 psi
Kill Mud Out (complete)

Stop Mud Pump
Bottom Hole Pressure x Formation Pressure

It is very important to apply a Safety Margin to Kill Mud Weight, the Trip Margin.

=> The Trip Margin (normally 0.2 to 0.5 ppg)
SECTION 6
Graphical Analysis

<table>
<thead>
<tr>
<th>Ranges</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure, psi</td>
<td>0</td>
<td>2200</td>
</tr>
<tr>
<td>Pit Volume, bbl</td>
<td>180.0</td>
<td>250.0</td>
</tr>
<tr>
<td>Time, min</td>
<td>0</td>
<td>110</td>
</tr>
<tr>
<td>Strokes</td>
<td>0</td>
<td>5000</td>
</tr>
<tr>
<td>Kick Volume, bbl</td>
<td>0.0</td>
<td>50.0</td>
</tr>
</tbody>
</table>

Maximum Gauge Pressure, psi: 1000, 2000, 3000, 5000, 10000

Plot Pressure and Pit Volume versus: x Time, x Strokes, x Kick Vol

Carriers: Driller, KILL, Choke

Units: 11/22 PM, Show Well, TVD, MD

www.wellcontrol.com.br
Drilling Simulator 3
About

This app was developed based on our experience. There is no comparison with any other software.

Our goal was to create a low-cost application with the help of experts to share with drilling engineers, technicians, drillers, students and teachers of drilling engineering.

There is no intention to replace the professional softwares.

You can contribute with suggestions for improvements, correcting the translation to english, reporting bugs and spreading it to your friends.

Please visit our support url and see other applications for Oil & Gas for iPhone, iPod Touch, iPhone and Mac.