

1. Information about OpenLab Drilling

The Web Enabled Drilling Simulator of OpenLab is based on NORCE's computer models of well flow and drill string mechanics. With the Web Enabled Drilling Simulator, these computer models are made available through an intuitive interface. Although the computer models behind the simulator are among the world's most detailed models of their kind, it has been created an environment where the user can easily run simulations and manage the results.

Until 2024 only two drilling methods (Conventional and Back pressure MPD) were available in OpenLab. Based on a series of model extensions, the OpenLab Drilling simulator was upgraded to enable simulation of the following drilling methods:

- Controlled mud level
- Riser lift pump
- External riser lift pump
- Open water drilling
- Reversed circulation
- Riserless drilling

In addition, since most of these new drilling methods involve a lift pump, a set of regulators have also been implemented to be able to use the lift pump to control the downhole pressure. For more information about the OpenLab Simulation environment, see openlab.app.

In this chapter we will present the basics of the web enabled drilling simulator.

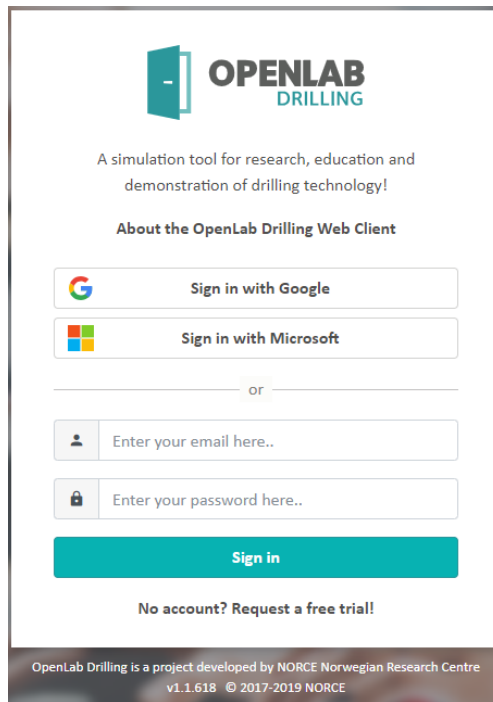
2. Account and Login

The Web Enabled Drilling Simulator is accessible through live.openlab.app. To learn how to create an account, the following information is provided.

Create an account

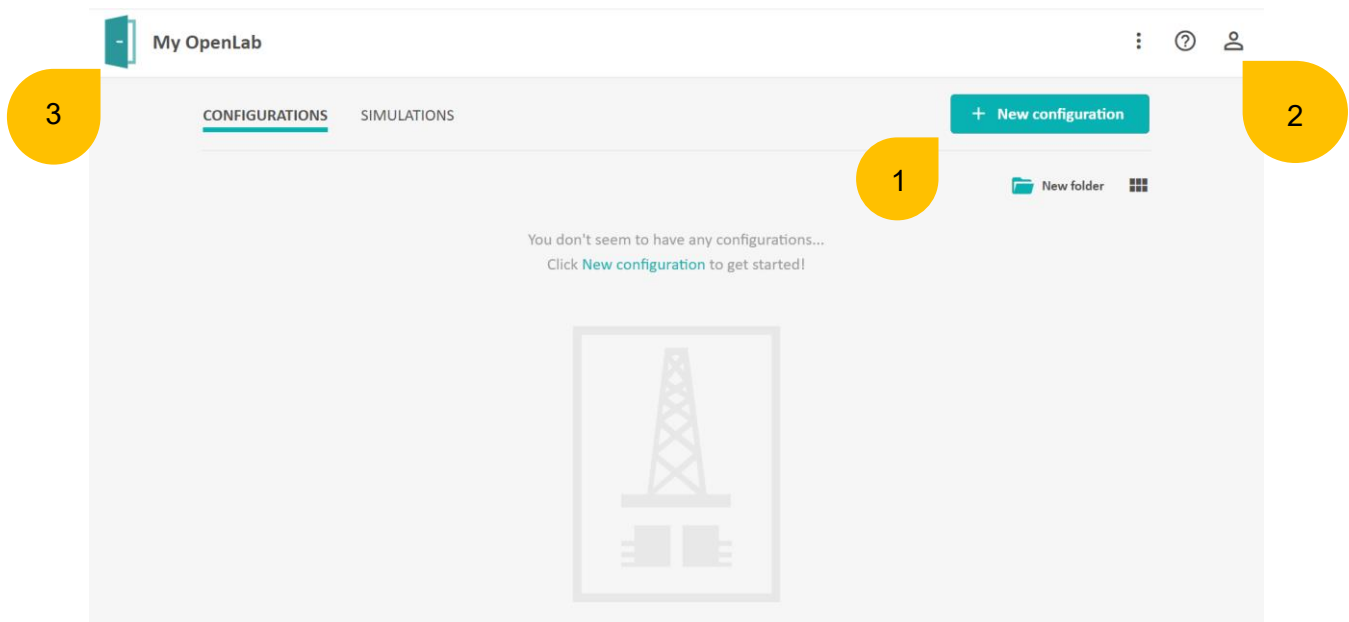
To create an account, start by navigating to <https://live.openlab.app/> where you should see a form similar to the image below. In case of not being signed up earlier, you may use a Google or Microsoft account to request a free trial.

In order to unlock the full features, extend the simulations time or being able to take a tour of our Control Room, please [contact us](#). More information about pricing or plans can be found in the following [page](#).



1. 2.1 Home Page

After logging in, you will be directed to the Home Page which gives an overview of your Configurations and Simulations as seen in the following image.



Here you can create (1), move and delete configurations. In the top right corner, you will find your personal settings (2) and other user-specific information. You can always go back to the Home Page by clicking the OpenLab Icon (3) in the top left corner.

For the best experience, a Google Chrome Web Browser is recommended. It also runs on Edge, Firefox and Safari. However, some of the components might not work properly.

It is also possible to use the Web Enabled Drilling Simulator at any screen size including a mobile device, however some functionalities are hidden for smaller mobile sizes.

2. 3. Configuration

The Web Enabled Drilling Simulator is designed to run simulations, each of which requires a specific configuration. Each simulation is based on a distinct configuration that contains hundred of parameters.

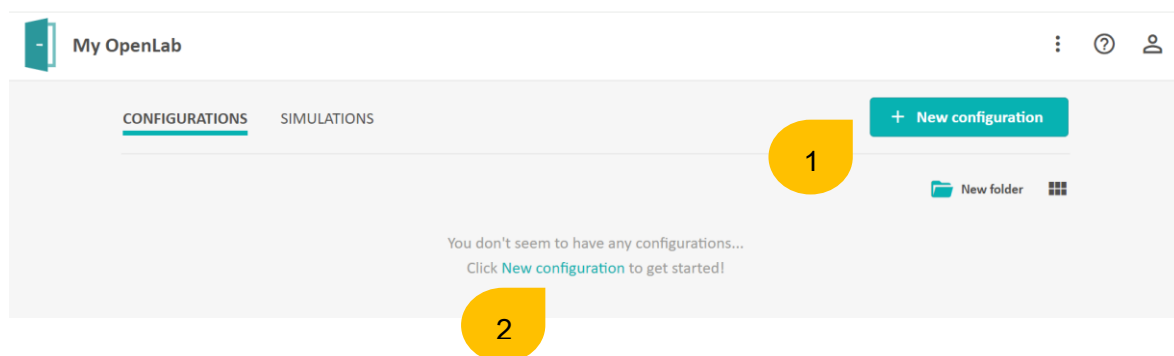
This input parameters are used by advance computer models to calculate well flow and drill string behavior. Because of the complexity of parameters, deterring the exact values for evert component can be challenging for users.

To simplify this process, OpenLab provides templates configurations that users can start from and modify as needed. Validation rules are build in to prevent unphysical setups or parameter values outside acceptable ranges.

3.1 Create a Configuration

A new configuration can be created from the Home Page, or by editing any existing configuration.

- 1) To create a new configuration, simply click the “New configuration” button (1)(2)



The following image will appear as to designate the configuration of the well.

New configuration ✕

Name your configuration

My Configuration

Choose rig

Offshore Onshore

Choose well template

InclinedWell 2500m ▼

Move to folder 📁 Create new folder

None ▼

Create new configuration

2) The configuration does need to have a new name and a type of rig. The main options are:

- Offshore
- Onshore

In each rig, there are different templates to select. These templates are examples of wells of different length and inclination.

The templates for each rig are the following ones:

- Offshore:
 - HorizontalWell 1220 m
 - InclinedWell 2100 m
 - InclinedWell 2500 m
 - InclinedWell 2500 m Well Control
 - InclinedWell 5000 m
 - InclinedWell 5000 m DeepWater
 - Mariner InclinedWell 2500 m
 - VerticalWell 2500 m
- Onshore:
 - LandRig 2500 m
 - Ullrigg InclinedWell 2500m
 - Ullrigg U5

3) From the “Choose well template” dropdown list, select the one it will best fit the planned well.

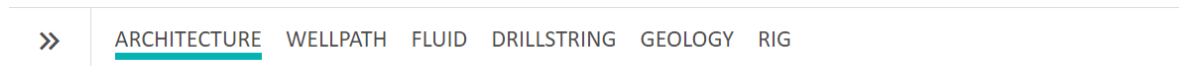
4) Finally, it is selected or made a folder to place this configuration.

The new configuration will then be visible on the Home Page, or in one of the folders.

It is also possible to mark some of the configurations as favorites. They will then appear at the top of the Home Page under the “Favorites” heading.

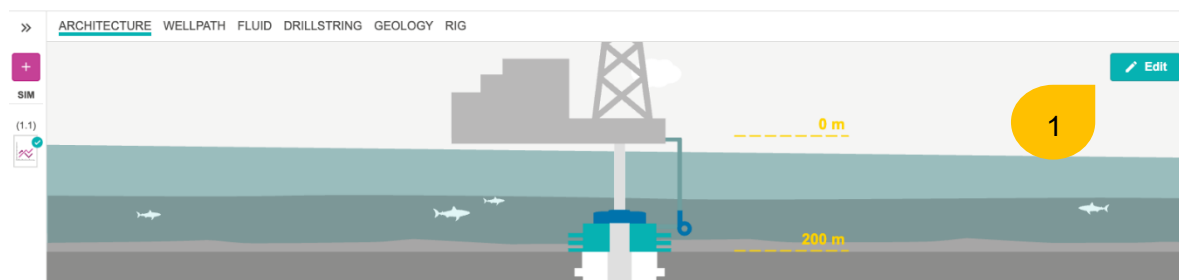
3.2 Edit a Configuration

A configuration is divided into different parts or categories as seen in the following image.

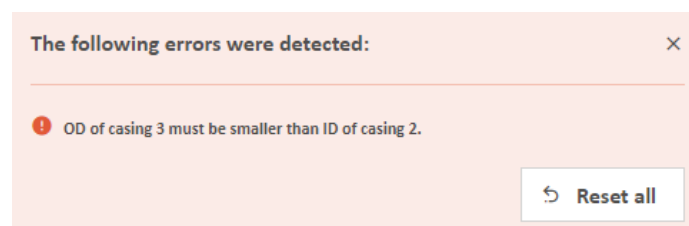


This will be described in detailed in the next chapter with each category available in the configuration mode.

A configuration item can be edited by clicking the “Edit” button (1) that is in the right corner.



When editing a configuration, a set of validation rules will automatically be applied to secure that the configuration is still valid for the computer model to initialize and run. If one or several of the input parameters are outside the acceptable range, a warning will be given as the following



The message will guide to the locations where the input parameters need to be corrected.

Be aware that if your configuration has already been used to create a simulation, any changes to the configuration will create a new version. Previous configurations along with corresponding simulations are stored and can be viewed in the Configuration sidebar, which can be expanded by clicking the » symbol.

3.3 Categories

In order to have a real like simulation, the configuration is divided into six different categories of the rig. Each one can be edited to its desire parameters.

3.3.1 Architecture

In the Architecture editor, it can be select the drilling method, edit the lengths and diameters of the flow lines, riser, casings, liners, and open hole section as seen in the image below. It is not possible to import any data for this editor.

This editor automatically checks the inputs and warns if any change creates an invalid setup, either within this editor or in other affected parts of the configuration

Drilling method ⓘ ✕ Close

Conventional ▾

BOP position ⓘ

200 m

Riser and flow lines ■ DELETE

Type	From depth (m)	To depth (m)	OD (in)	ID (in)
Riser	0	200	21	19

[+ Add choke line](#) [+ Add kill line](#) [+ Add riser booster line](#)

Casings ■ DELETE

#	Type	Hanger depth (m)	Shoe depth (m)	OD (in)	ID (in)	
1	Casing	200	400	32	30 3/4	<input type="checkbox"/>
2	Casing	200	465	26	25	<input type="checkbox"/>
3	Casing	200	1055	20	18 23/32	<input type="checkbox"/>
4	Casing	200	1616	13 3/8	12 13/32	<input type="checkbox"/>
5	Casing	200	2000	10 3/4	9 15/16	<input type="checkbox"/>
6	Casing (liner)	1995	2200	9 7/8	9	<input type="checkbox"/>

[+ Add](#)

Open hole

Type	From length (m)	To length (m)	Length (m)	Open hole diameter (in)
Open hole	2200	2500	300	8 1/2

⏪ SHOW ADVANCED

There are several drilling methods that have its own characteristics, where choke, kill lines, and riser booster can be added in almost every drilling method. The following list of drilling methods defines the process and also the possible additions that can be done.

- Conventional: Additions as the choke line, kill line and riser booster line can be made.

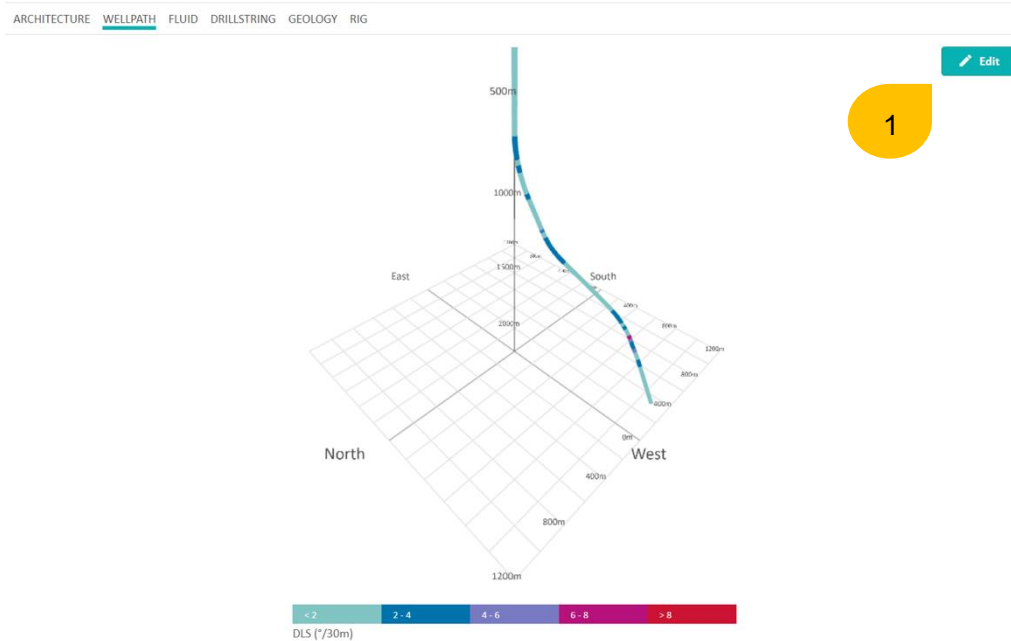
- [Back Pressure MPD](#) : A back pressure pump can also be applied as the choke line and the kill line.
- [Controlled Mud Level](#): The connection point between the open water riser and the annulus is determined by the number in the ‘To depth’ column for the open water riser. Additions as the choke line, kill line and riser booster line can be made.
- [Riser Lift Pump](#): The position of the riser lift pump is determined by the number in the ‘To depth’ column for the open water riser. Choke lines, Kill line and riser booster lines can be added.
- [External Riser Lift Pump](#): To be able to simulate such a configuration we also need a casing (riser) element in the casing table which connects the riser to the casing(s). A riser booster line can be only added to the architecture.
- [Open Water Drilling](#): For this configuration it is also possible to enable the use of an additional lift pump called mid-water lift pump by using a checkbox in the rig configuration page and selecting the position of the pump.

It is also possible to specify the horizontal offset which is the horizontal distance between the lift pump and the connection point between the annulus and the open water riser in the rig page.

- [Reversed Circulation](#). No additions can be made to this configuration as only changes in the depth or distance in the casing and the BOP
- [Riserless Drilling](#): The riserless drilling is like the open water configuration except that there is no RCD and no conventional riser. Additional choke lines, kill lines and riser booster lines can be made.

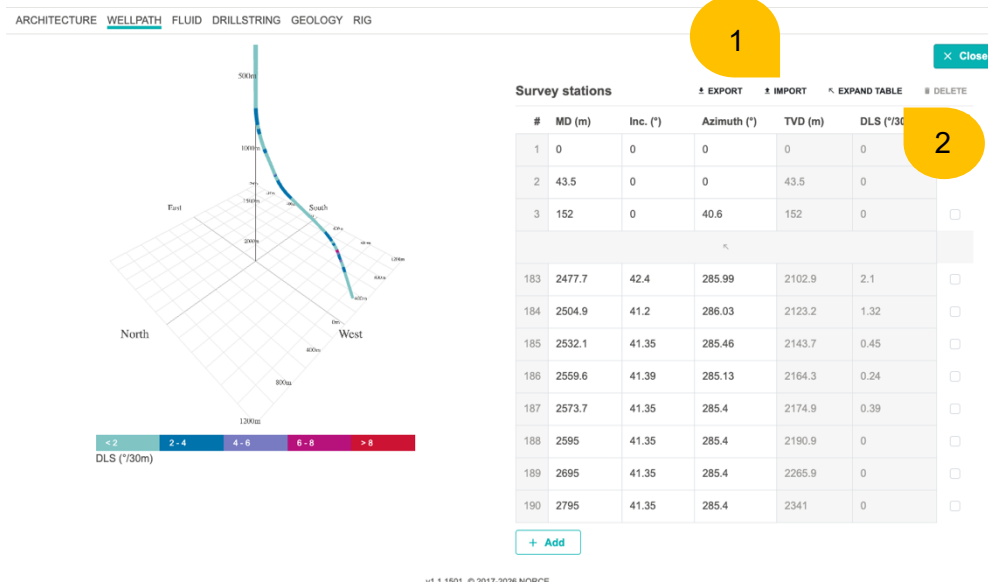
3.3.2 Wellpath

The front page of the Wellpath editor shows the trajectory of the well as seen in the picture below. The different colors on the trajectory refer to the dog leg severity (DLS). To edit the Wellpath, push the Edit button (1).



For the Wellpath editor, there is the possibility to import the survey points from a CSV file (1). It can also be manually edited, however there are limitations on the dog leg severity (an error message will appear if the DLS is too high). To see all the stations, click the expand table button (2)

3.3.3 Fluid



In the Fluid editor, two fluids are available for changes, the Main Fluid and the Reserve Fluid. Both fluids are based on templates. The density of the mud can also be changed during simulations, but the value you enter in the Fluid editor is your default value. Press the Edit button (1) to modify the properties.

MAIN FLUID RESERVE FLUID Edit

Drilling fluid type

Generic OBM 1

Mass fractions

- Oil: 27.3 %
- Water: 11.4 %
- Barite: 61.4 %

Drilling fluid density (50 °C)

1.65 s.g.

Volume fractions

- Oil: 56.9 %
- Water: 19 %
- Barite: 24.1 %

Rheology

Robertson-Stiff model: $f(\tau) = a (\tau + c)^b$, where $a = 0.1039$, $b = 0.8438$ and $c = 60.8558$

Shear rate (rpm)	Shear stress (lb/100ft ²)
0	0
50	15
100	22
200	35
300	48
600	80

Data cannot be imported from a CVS file.

MAIN FLUID RESERVE FLUID Close

Drilling fluid type

Generic obm 1

Gel strength 10 s.

6 Pa

Oil/water ratio

60 / 40

Mass fractions

- Oil: 27 %
- Water: 22.5 %
- Barite: 50.5 %

Drilling fluid density (50 °C)

1.45 s.g.

Gel strength 10 min.

9 Pa

Volume fractions

- Oil: 49.5 %
- Water: 33 %
- Barite: 17.4 %

Rheology SHOW GRAPH

Fann shear stress measurements in lb/100ft² at 50 °C and 1 bar vs. shear rate

3 rpm	6 rpm	30 rpm	60 rpm	100 rpm	200 rpm	300 rpm	600 rpm
5	6	10.8	16.2	23	37	50.8	85

Specific heat **Conductivity**

1774 J/kg·K 0.44 W/m·K

Base-oil-pvt (s.g.) COLLAPSE TABLE

	4°C	20°C	50°C	75°C	100°C	125°C	150°C	175°C	200°C
1 bar	0.819	0.809	0.79	0.775	0.758	0.744	0.727	0.712	0.696
200 bar	0.829	0.82	0.805	0.788	0.775	0.761	0.746	0.733	0.718
400 bar	0.838	0.83	0.815	0.803	0.789	0.776	0.765	0.751	0.738
600 bar	0.847	0.84	0.826	0.815	0.803	0.791	0.779	0.767	0.754
800 bar	0.856	0.848	0.836	0.825	0.815	0.803	0.793	0.782	0.77
1000 bar	0.864	0.856	0.845	0.835	0.824	0.814	0.803	0.793	0.782
1200 bar	0.87	0.864	0.852	0.842	0.832	0.822	0.812	0.802	0.791

3.3.4 Drillstring

The drillstring, bottom hole assembly (BHA) and bit can be edited by clicking on each row (1)(2)(3)(4) or on the Edit button.

Some elements in the BHA and drillstring have some additional parameters that can be found by expanding the drop-down arrow in the lower right corner of its respective table row. This editor is also likely to give validation messages when it being edited.

To add along-string measurement nodes to the drill string, it can be done by entering the + button and choose ASM among the components.

The screenshot shows a software interface for editing a wellbore configuration. On the left is a vertical wellbore diagram with a rig at the top. Four yellow callout circles are placed around the diagram: '1' is on the upper drillpipe, '2' is on the MWD tool, '3' is on the float sub, and '4' is on the bit. On the right are three tables: 'Drillpipe', 'Bottom hole assembly', and 'Bit'. Each table has a '+', 'EXPORT', 'IMPORT', and 'DELETE' button. The 'Drillpipe' table has two rows. The 'Bottom hole assembly' table has six rows. The 'Bit' table has one row. A 'Close' button is in the top right of the interface.

Type	Length (m)	OD (in)	ID (in)	Lin. weight (kg/m)	Cum. length (m)
Drillpipe	3585	5	4 1/2	33	4196
Drillpipe	500	5	4 1/2	33	611

Type	Length (m)	OD (in)	ID (in)	Lin. weight (kg/m)	Cum. length (m)
HW drillpipe	54	5	3	76	111
Jar	9.4	6 1/2	2 1/2	139.7	57
Drill collar	28.8	6 1/2	2 3/16	145.7	47.6
MWD	7.9	6 3/4	3	139.6	18.8
Drill collar	2	5 1/2	3	84.5	10.9
Float sub	1	6 3/4	3	146	9
Steerable rotary tool	7.7	6 3/4	3	148	8

Type	Length (m)	OD (in)	TFA (cm²)	Mass (kg)	Cum. length (m)
Bit	0.3	8 1/2	6.3	50	0.3