Well Testing and Pressure Transient Analysis

After flowing an oil and gas well over a stable period via a flow meter, closing the well with a surface or downhole valve for a finite time interval defines a well test.

For a producer, pressure builds up during a shut-in: This is called a Pressure Build-Up (PBU) test.

For an injector, pressure falls off during a shut-in: This is called a Pressure Fall-Off (PFO) test.
Pressure Transient Analysis

A well test provides information on well productivity and reservoir performance over a large radius of investigation (permeability, connected volume, reservoir pressure, well damage, etc...).

Pressure Transient Analysis (also called Well Test Analysis or Well Test Interpretation) is a process of recovering this information by exploring the pressure data with special tools and techniques.

Geological, geophysical and petrophysical views would help to reduce the range of possible solutions.
Exploration and Appraisal Well Testing

Hydrocarbon is produced for the first time and flared via a temporary facilities (platform rig at sea) to evaluate the potential and reserves of an oil and gas field. This involves tens of millions of dollars per operations, with high safety and environmental risks.
Why testing in Exploration and Appraisal?

- Confirm oil/gas reservoir discovery
- Define well productivity
- Spot field heterogeneities and boundaries
- Detect sand production
- No other alternative to obtain the well damage, acquire representative fluid samples and assess connectivity over large volumes (compartmentalization, oil and gas reserves)

A poorly performed well test could lead to a disastrous field development and huge financial losses up to hundreds of millions of dollars.
Standard Exploration and Appraisal Well Test

Bottom hole Pressure

Clean-up
1st PBU
Main flow
2nd PBU

Rate

100%
90-95%

Time

TestWells
Best Practices in Exploration and Appraisal

- Well Test Design and Peer Review
- Multiple gauges with specific depths
- Downhole shut-in
- Real-time Well Testing to quality check the data and optimize the test
- Review data from all the gauges
- Interpret the data using the latest well testing tools and techniques
- Integrate the results with other sources of subsurface information
Other types of tests in Exploration and Appraisal

- RFT/MDT
- Slug test
- Impulse test (surge test, closed chamber test)
- Harmonic test
- Mini-DST

- DFIT, also called ACA or mini fall-off
- Water injection test

short radius of investigation, limited connectivity and small fluid samples

Unconventional resources
Production Well Testing

Initial **baseline PBU/PFO** tests are performed in the first two weeks of production to obtain the initial reservoir pressure, the permeability and initial skin.

Opportunistic shut-ins will help to monitor the well and reservoir performance over time and understand the causes of performance deviation.
PBU analysis on producers could help to:

- Quality control the rate measurement and allocation,
- Assess the oil and gas recovery mechanism,
- Diagnose production problem before becoming irreversible (gas breakout)
- Detect waterfront, predict water breakthrough and support relative permeability curves,
- Assess a well intervention with pre and post PBU tests.

PFO analysis on water injectors could help to:

- Monitor frac size and injectivity over time,
- Detect thermally induced fractures,
- Ensure no excessive frac growth and safe operations,
- Detect oil/water front and assess the impact of cold water front,
- Assess the impact of water quality on performance and understand performance deviation.