



The Challenge



- Ask an engineer how to improve an application, and they will likely say, "give me a way to see MORE DATA". Surveillance engineers may analyze output from a dozen or more sensors in the same visualization.
- Line charts are the default choice for this workflow, but they are cumbersome, especially if the data streams have different scaling and units. And as IIoT becomes pervasive at the wellsite, this problem will only grow.
- Show us how to do it better!
- Deliver a web application to display/query/analyze time-series data from downhole equipment in innovative ways.

Development Environment

Deliver a web application to display/query/analyze time-series data from downhole equipment in innovative ways.

A web application template

- Backend: Flask
- Frontend: Angular

Development Tools

- Git
- Node.js, npm
- Angular CLI

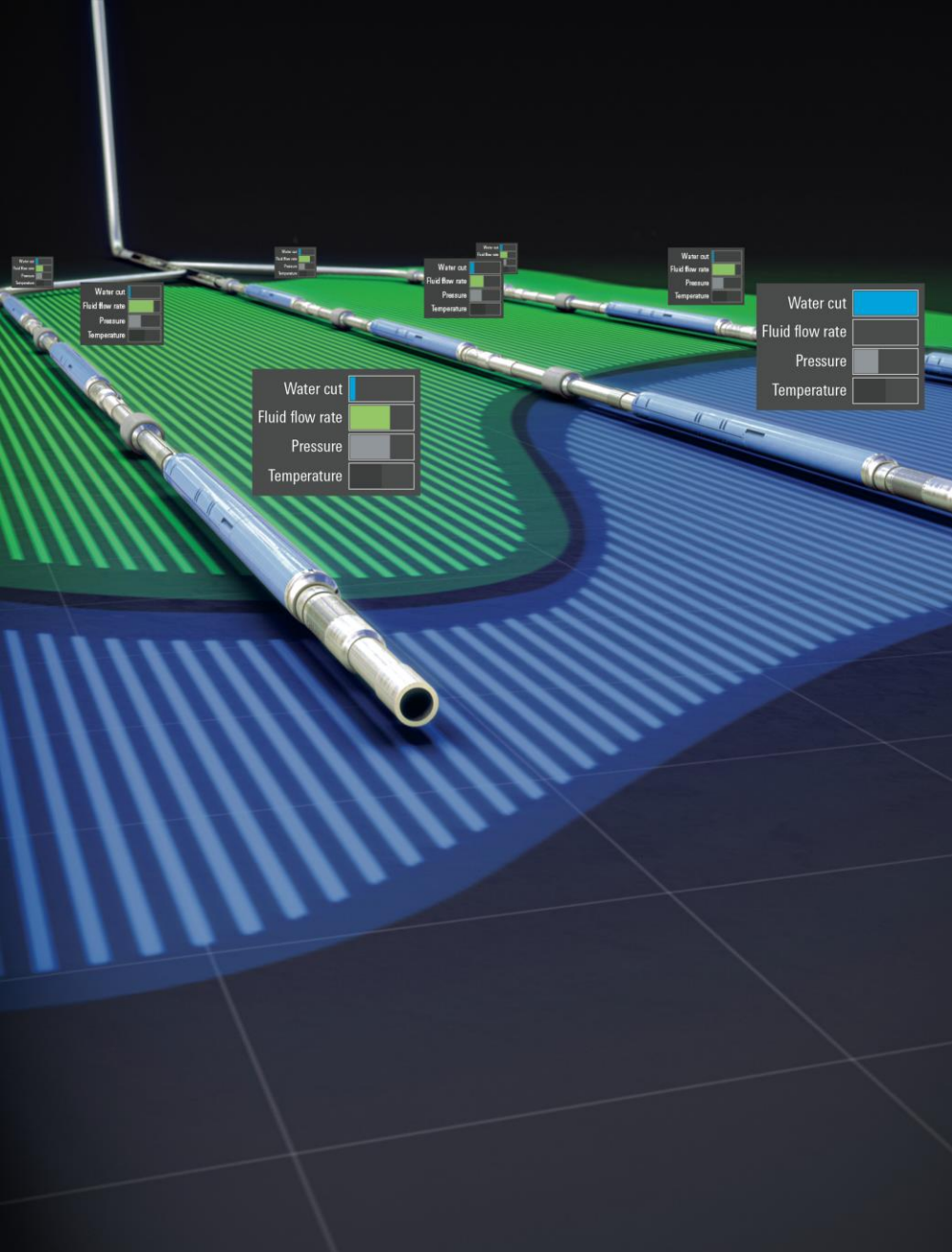
Hackers can use the template or not. It's not a mandatory requirement for the deliverable.

github.com/Schlumberger/hackathon





Intelligent Completions (IC)



Intelligent completions incorporate permanent downhole sensors and surface-controlled downhole flow control valves, enabling you to monitor, evaluate, and actively manage production (or injection) in real time.

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A little more about Intelligent Completion data...

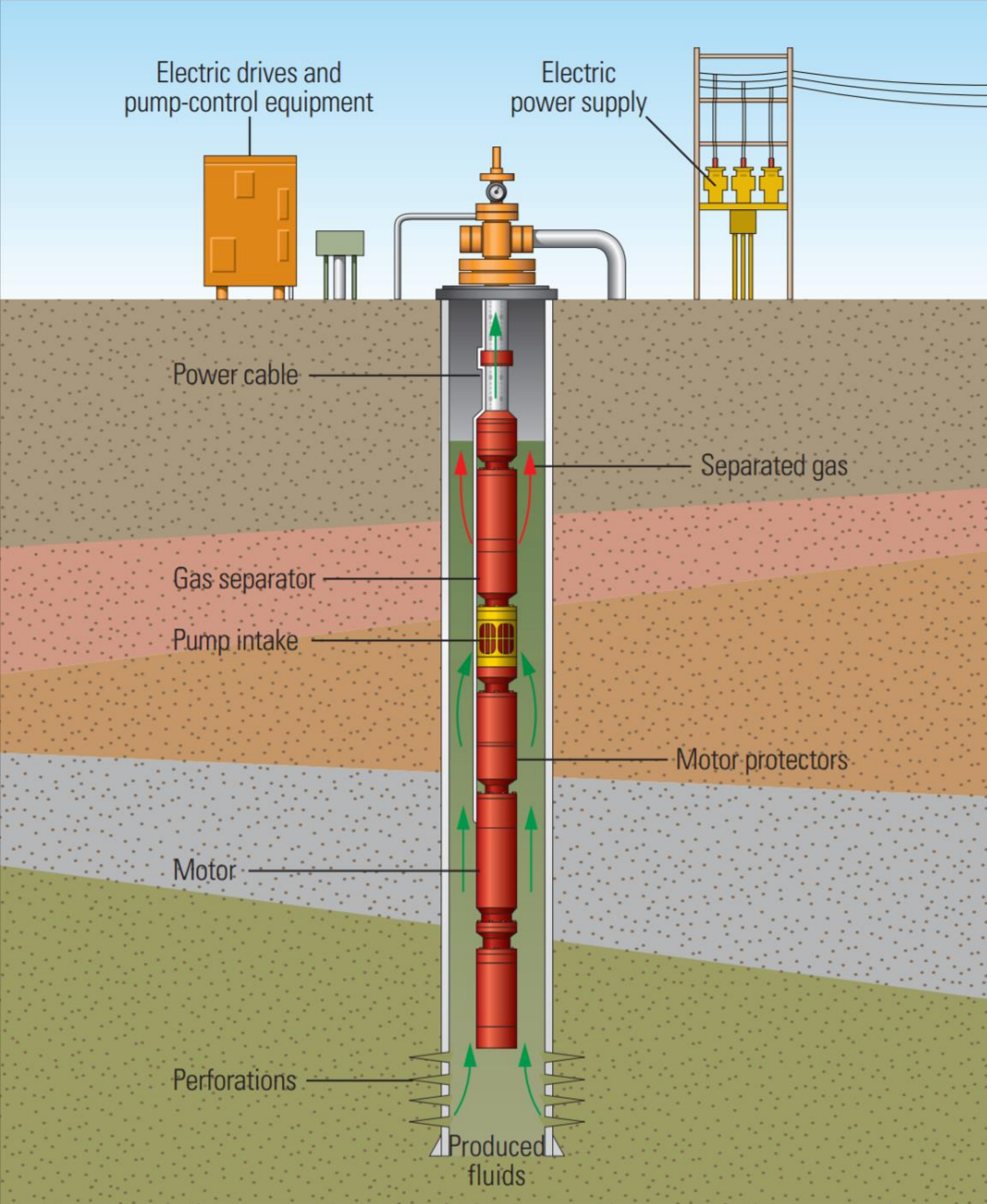


- **Choke Position (%)** – FVC (Flow Control Valve) regulates the flow or pressure of the fluid (closed = 0%).
- **Pressure1/Pressure2 (psia)** – Measure downhole pressure. Delta pressure ($P1 - P2$) is used to calculate the Liquid Rate (Venturi flow meter).
- **Temperature (°F)** – Measure downhole temperature.
- **Liquid Rate (bbl/d)** – Volume flow rate of total liquids produced.
- **Water cut (%)** – The ratio of water produced compared to the volume of total liquids produced.
- **Water Rate (bbl/d)** – Volume flow rate of water produced (Liquid Rate * Water Cut).
- **Oil Rate (bbl/d)** – Volume flow rate of oil produced (Liquid Rate - Water Rate).

Why measure such data?

- Provide real-time zonal downhole monitoring of pressures and temperatures.
- Enable surface-controlled production from each zone or lateral to optimize production and reservoir management.
- Reduce production of undesirable water or gas.
- Increase recovery and extend the economic life of the well.





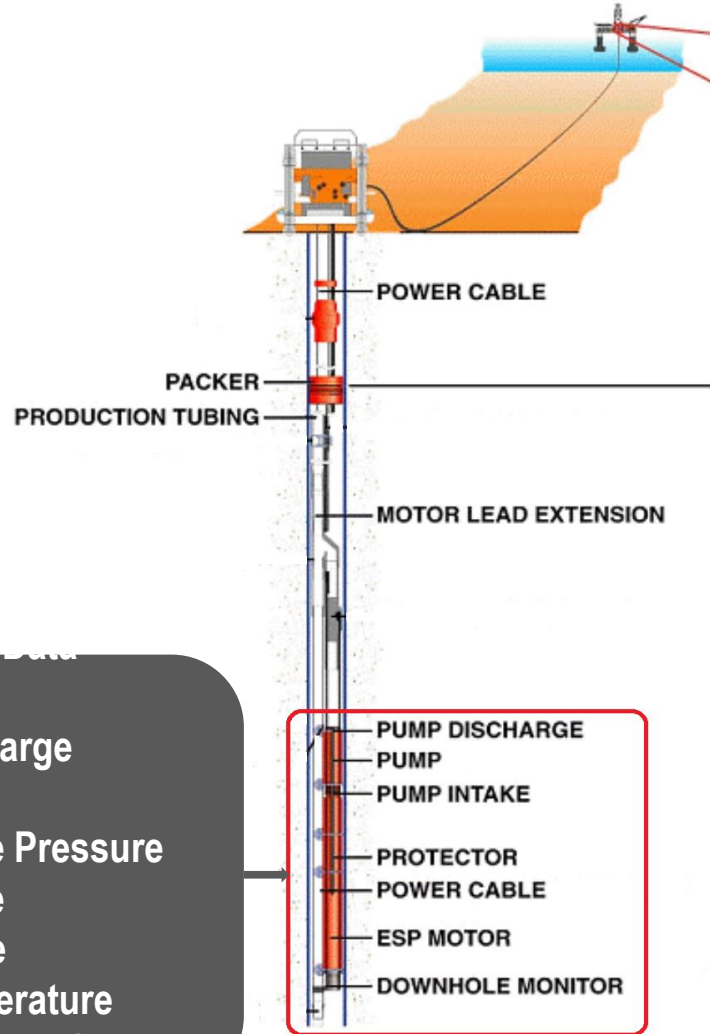
Electric Submersible Pump (ESP)



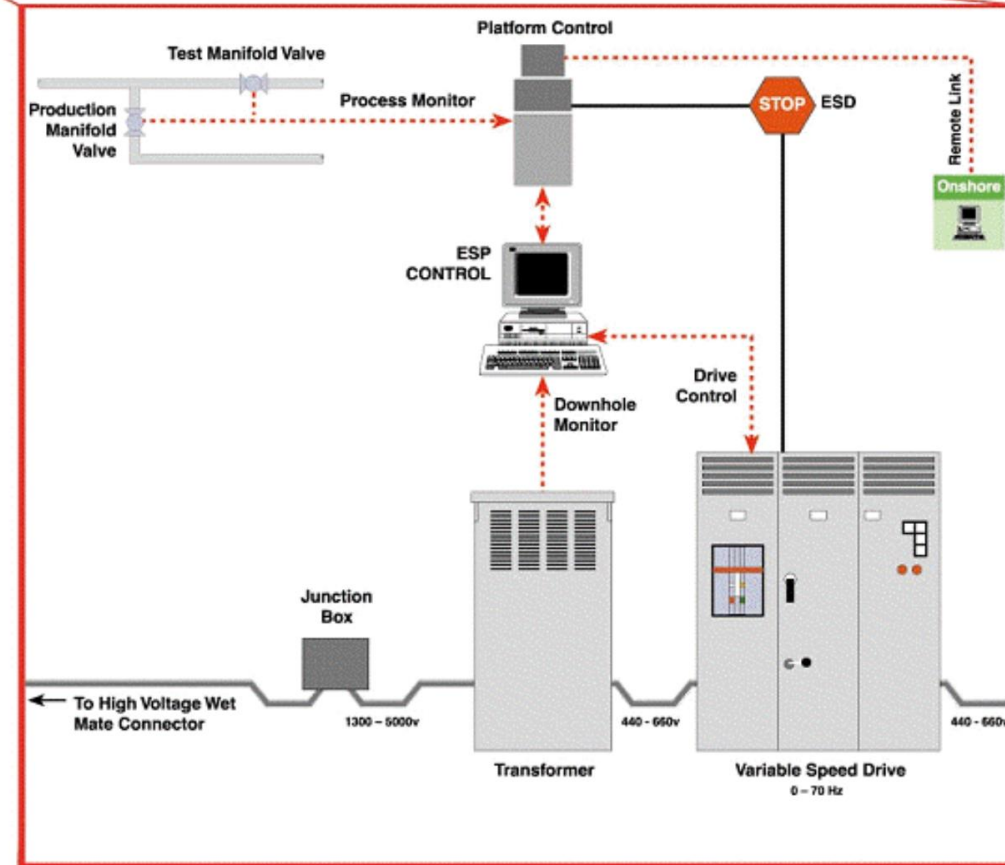
Equipment used in wells deeper than 12000 feet to increase flow of liquids when reservoirs no longer has sufficient energy to naturally produce.

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What are we measuring?



Pump Discharge Pressure
Pump Intake Pressure
Pump Intake Temperature
Motor Temperature
VSD Frequency Out



A little more about ESP data ...



Pump – helps in liquid/gas flow

- Discharge Pressure(psia) – measure of the pressure of the discharge head of the pump.
- Pump Intake Pressure(psia)/Temperature(K) – measure of the pressure and temperature of the pump component through which liquid/gas enter the pump.

Motor – running at a approx. speed of 3500rev/min in 60Hz, helps to operate the pump.

- Motor Temperature(K) – used to measure the thermal performance of the motor so that pump works efficiently for longer. Approx Range - 470 – 525K

Variable Speed Driver (VSD) – helps to control motor speed so that its not overloaded.

- VSD Frequency Out(Hz) – measuring the output frequency of the motor.
- VSD Motor Amps(A) – measuring the current of the motor.

Why measure such data?



- Equipment like ESP pumps are very costly to install and maintain.
- It is monitored continuously to maintain the longevity of the equipment. E.g. ensure you are not overheating the motor.
- If something goes wrong, results can be catastrophic and oil companies may incur huge losses.

Data summary



Equipment/devices:

- Intelligent Completion
 - Sensors/Measurements: Pressure, Temperature, Choke Position, Water Cut, Volume Rates (Liquid, Oil, Rater).
- ESP (Electric Submersible Pump)
 - Sensors/Measurements: Pump Discharge Pressure, Pump Intake Pressure, Pump Intake Temperature, Motor Temperature, VSD Frequency Out, VSD Motor Amps