Cairo. Egypt. November 7-8, 2022

MENAPS 2022

MIDDLE EAST AND NORTH AFRICA PERFORATING SYMPOSIUM

Selective Wire Line Perforation Optimization in Rig Operations

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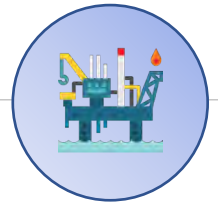
AGENDA

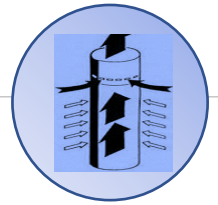
Planning Phase



The Case

Gupco Operation Limitations

Well Data



Perforation Options

Selective Perforation

Execution Phase

Job Execution

Evaluation

Lesson Learned

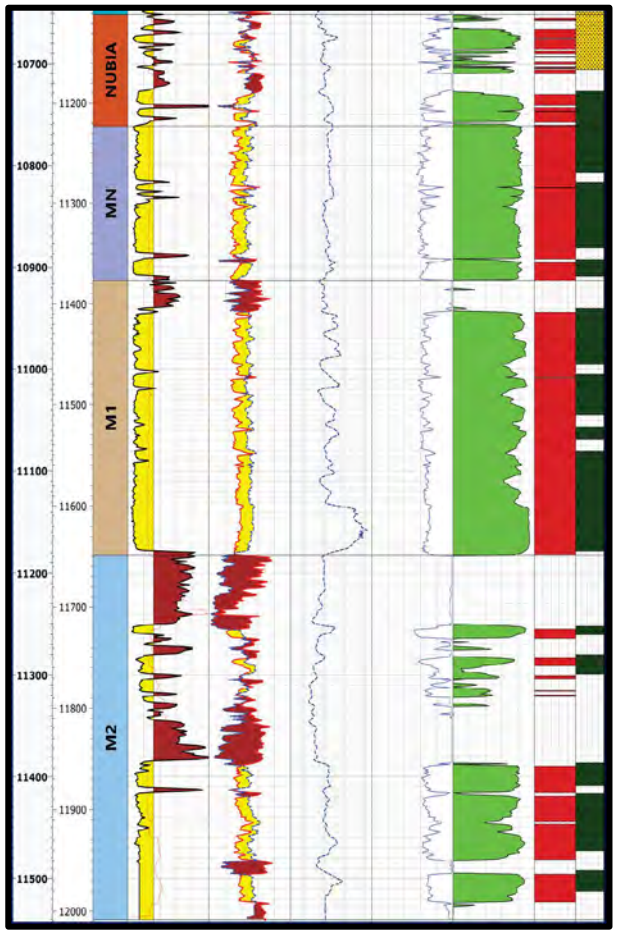
Results

Evaluation Phase

The Case

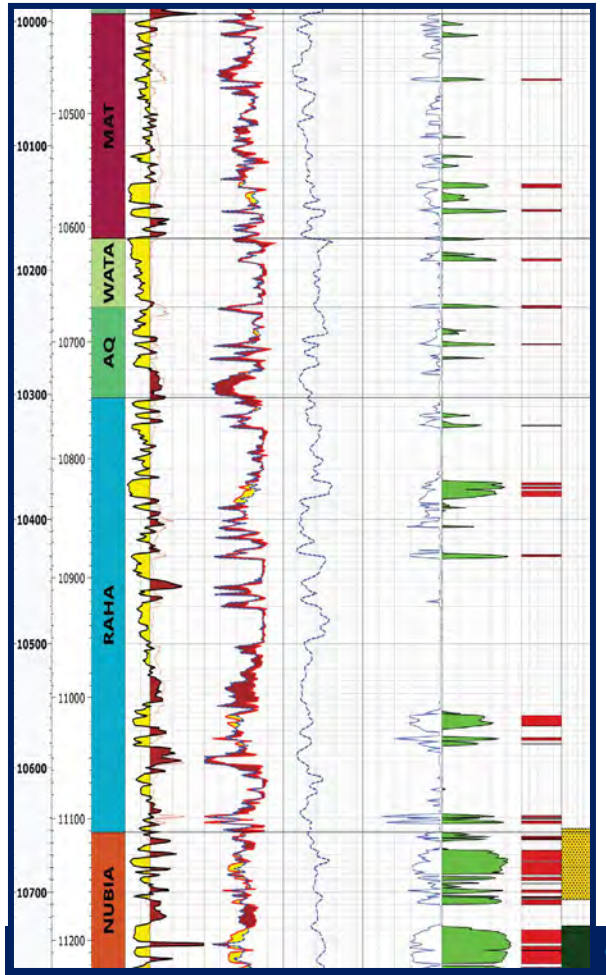
- Four perforation jobs were planned in Upper Cretaceous formations
- The reservoir is characterized as thin sand streaks.

Cretaceous



N/G≈ 70%

Upper Cretaceous



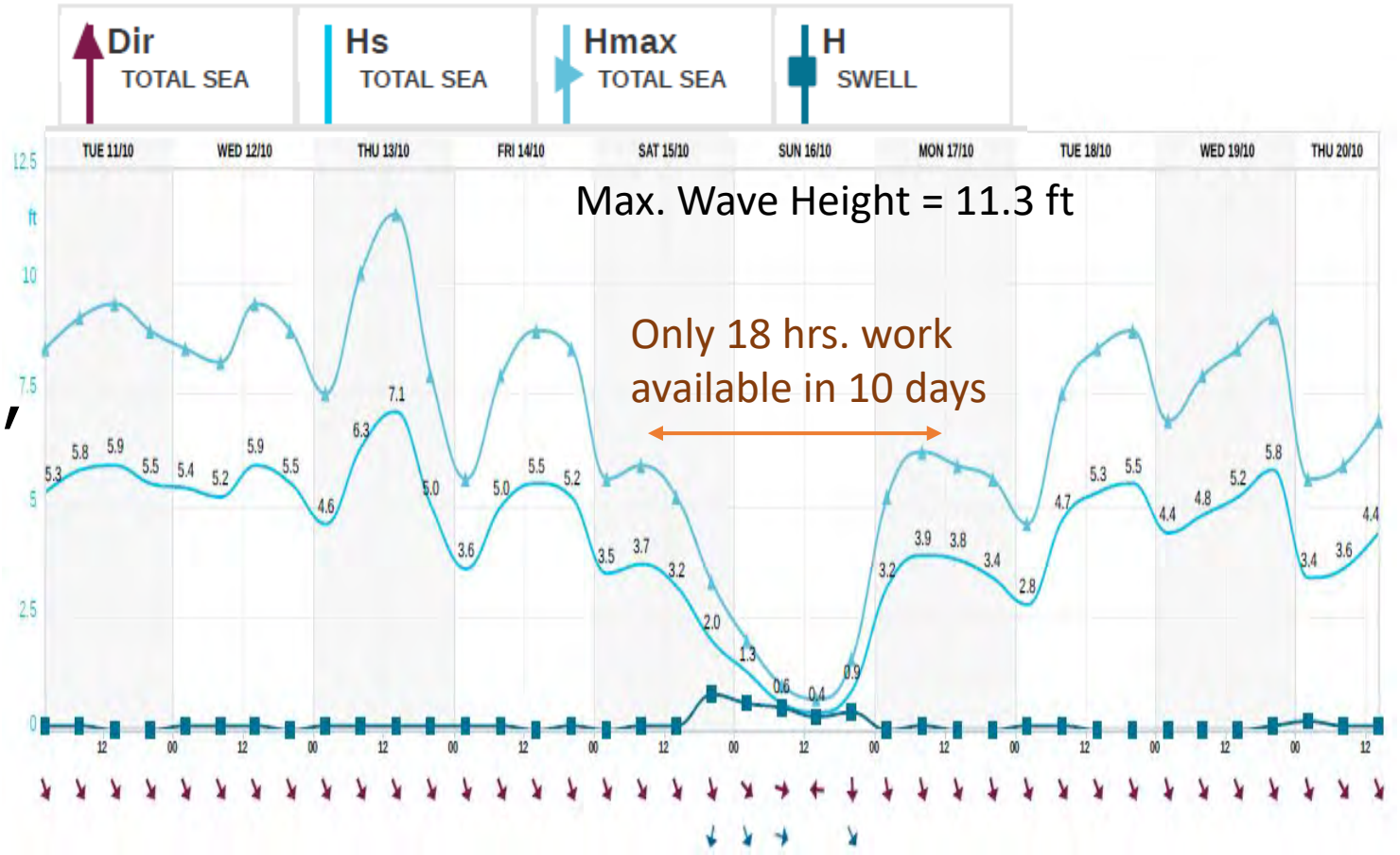
N/G ≈ 23%

Why time is a critical factor in GUPCO ?

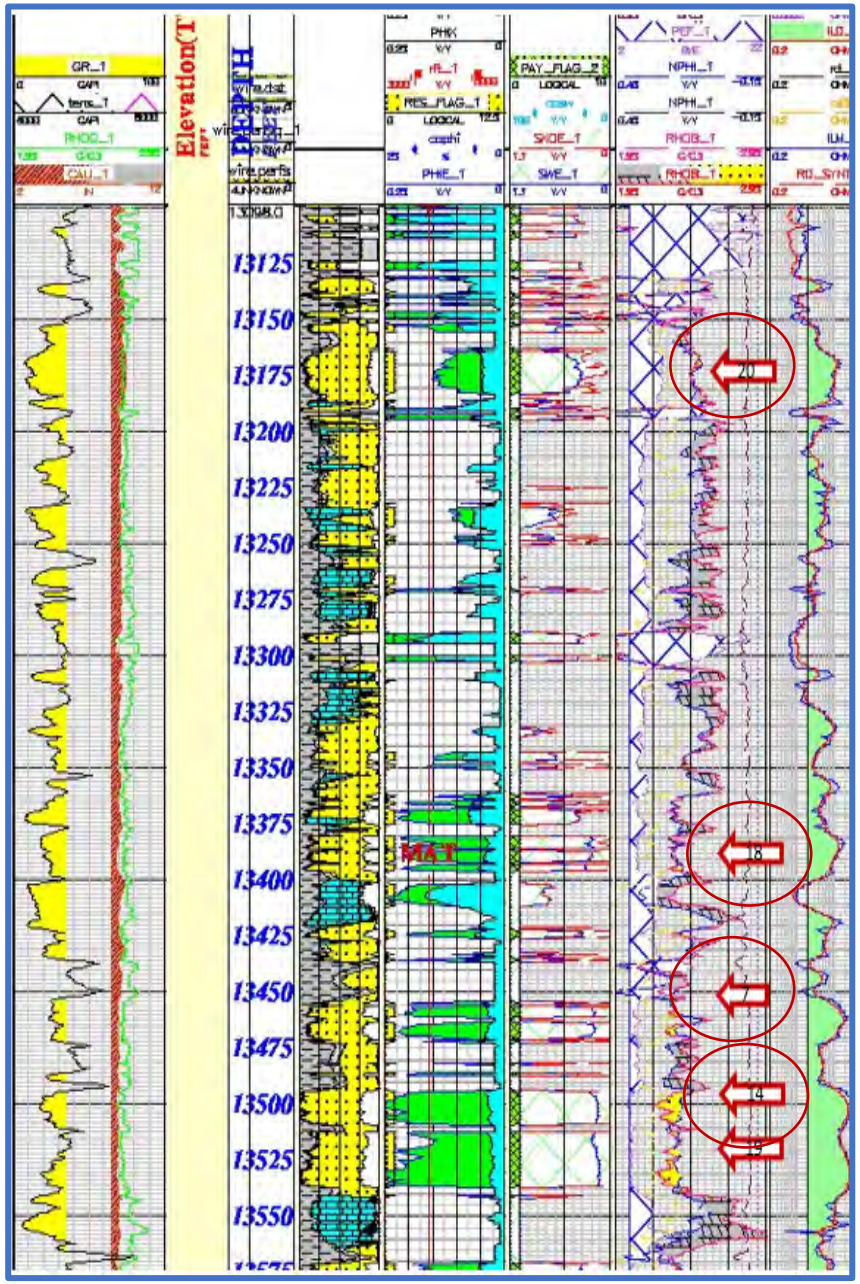
- GUPCO produces from more than six mature offshore oil fields

Operation Limitation in Offshore

- Weather condition
- Limited logistics (vessels, equipment mobilization)
- Daylight working hours



Well-C (Log & WBS)



Res. Press. = 2,160 psi

Formation= Sandstone

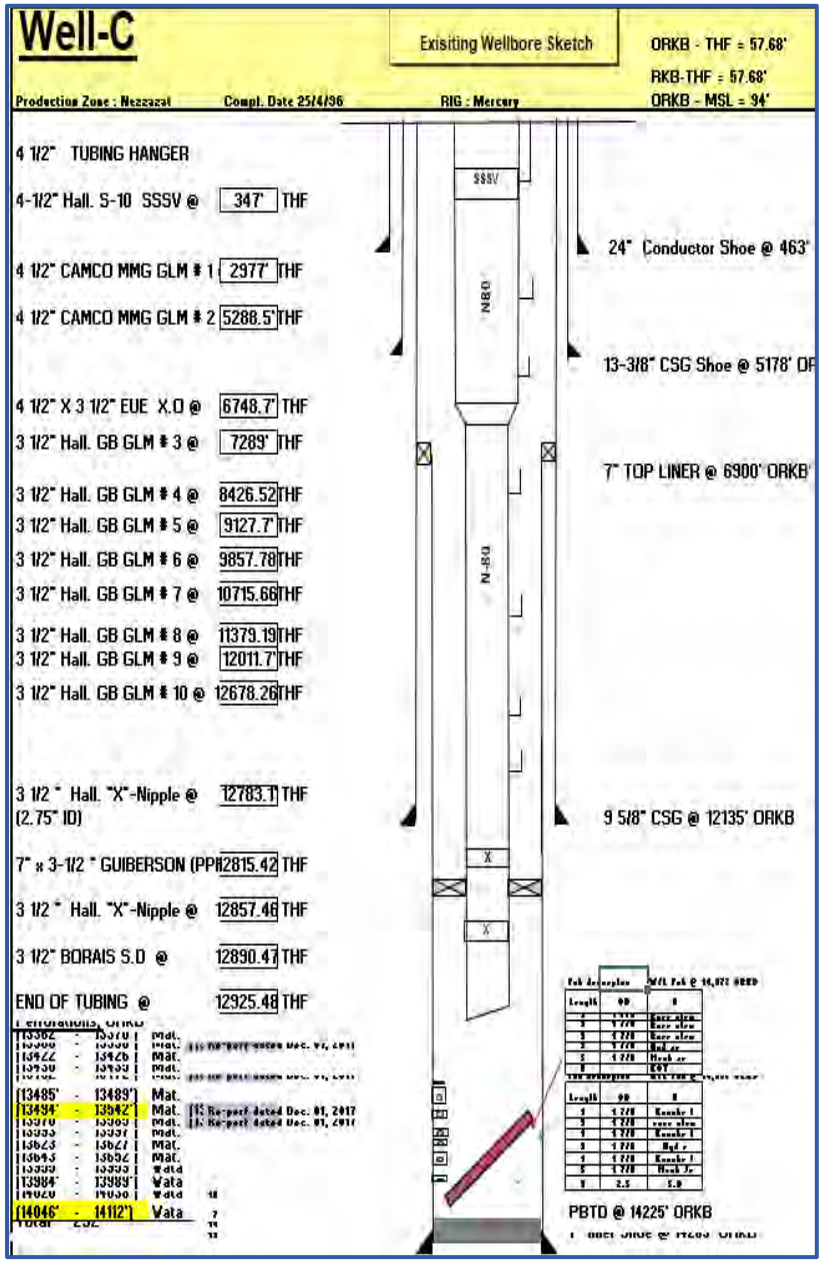
MAX. Deviation=54.8°

MAX. Depth=14,100 ORKB

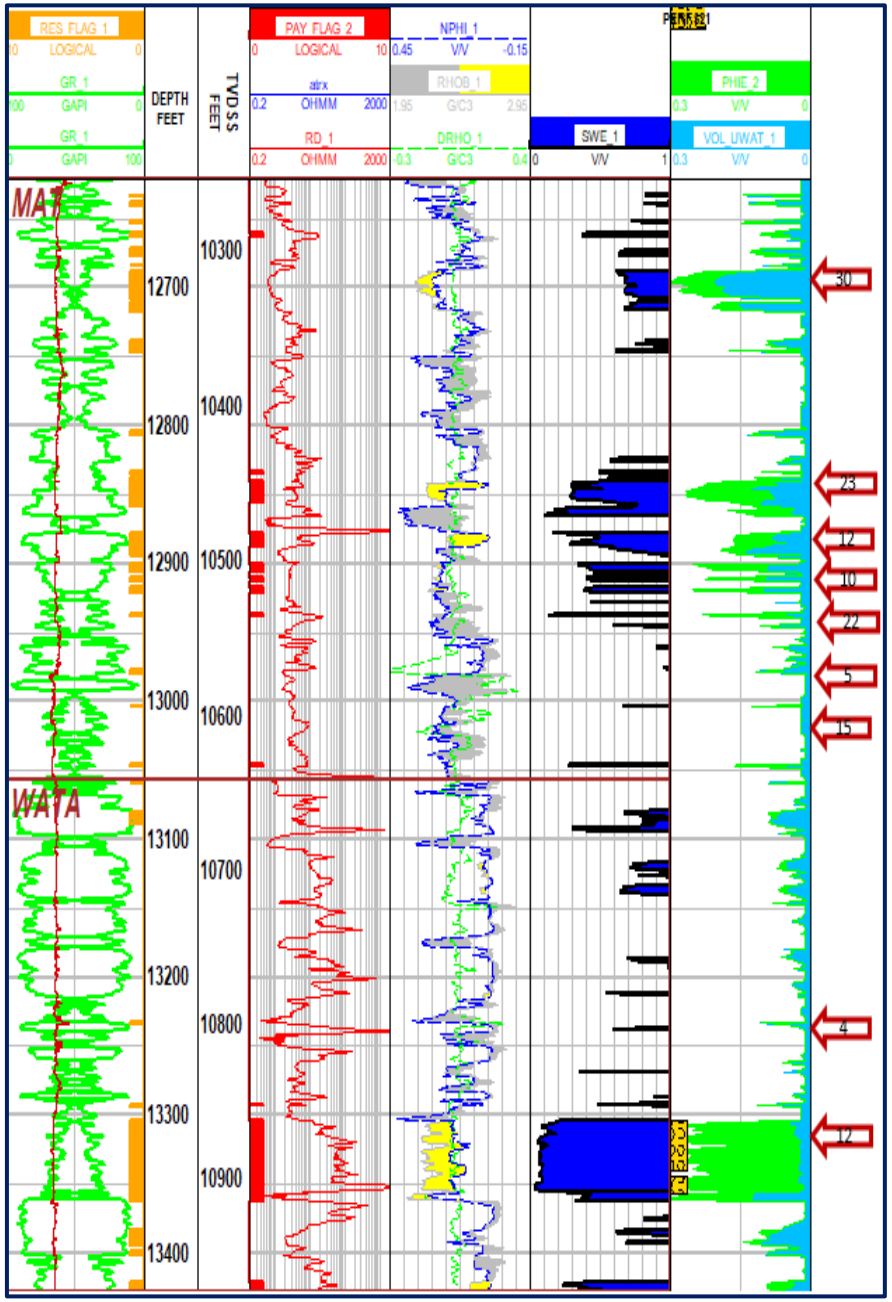
Min. ID = 2.75" ID @X-Nipple

Scale type

- Wax & Asphaltene
- Calcium Carbonate



Well-D (Log & WBS)



Res. Press. = 2,180 psi

Formation= Sandstone

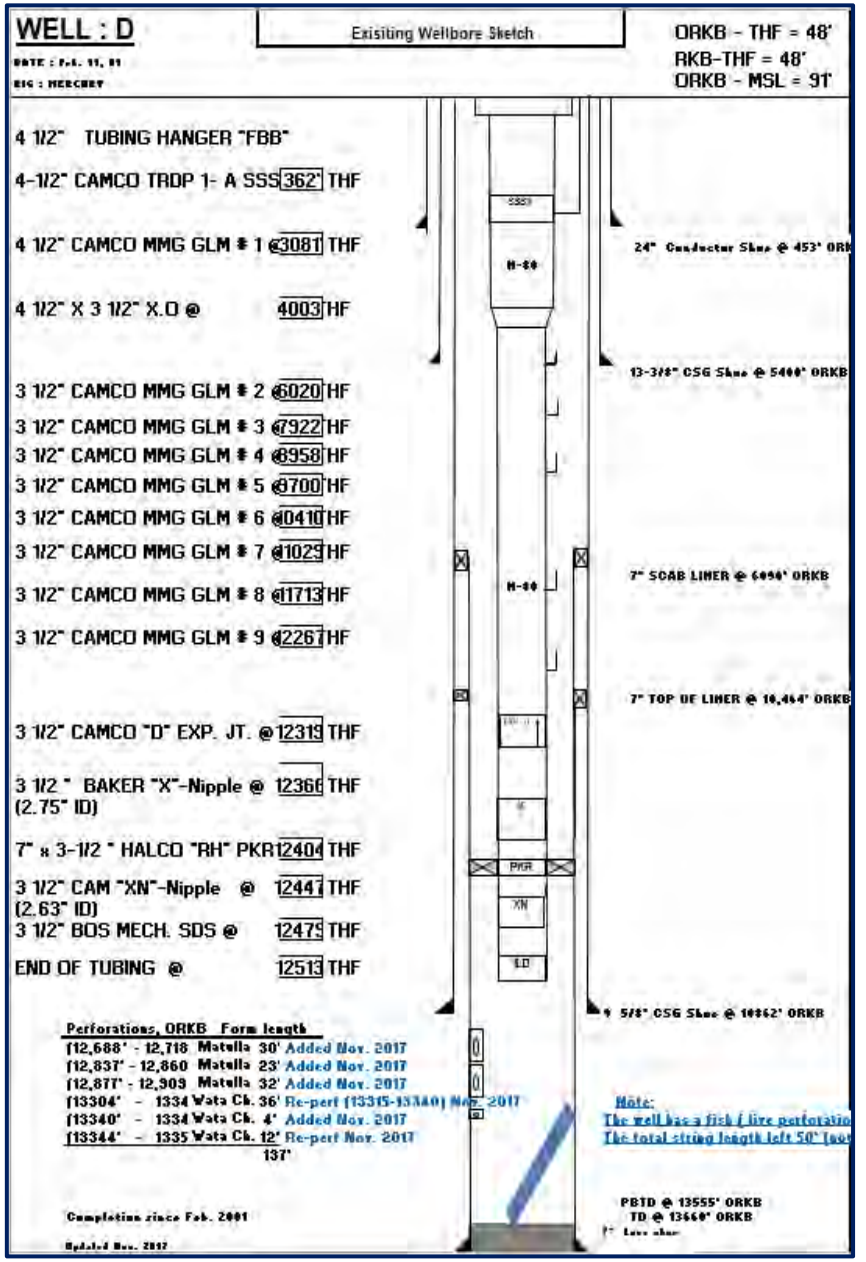
MAX. Deviation=44.9°

MAX. Depth=13,460 ORKB

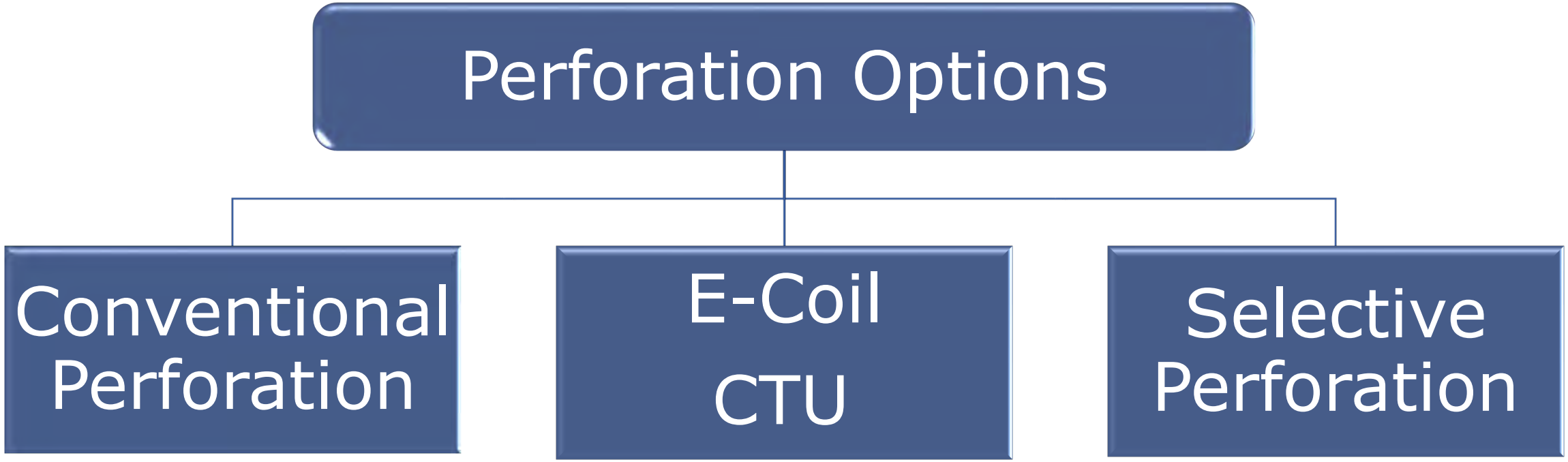
Min. ID = 2.63" ID

Scale type

- wax & asphaltene



Perforation Options



Perforation Options

Advantages

Conventional Perforation

- Simplest operation
- Least preparation time
- Less running time than E-Coil

CTU (E-Coil)

- Increase gun length
- Decrease runs fairly
- push it into the hole rather than relying on gravity

Selective Perforation

- Less number of runs.
- Least rig time
- Less intervention risk
- Most economical option

Perforation Options

Disadvantages

Conventional Perforation

- Limit gun length to 40 ft
- Largest number of runs
- Highest intervention risk

CTU (E-Coil)

- Large number of runs
- More time for each run
- More time between runs
- Most expensive option (not economical)

Selective Perforation

- Complex operation
- Not Familiar
- Risk of misfire

Perforation Options

	 Conventional Perforation	 E-Coil CTU	 Selective Perforation
Number of Runs	28	20	14
Intervention Risk	High	Low	Low
Familiarity	V. High	High	Low
Preparation Time	Low	V. High	Moderate
Cost	Intermediate	V. High	Low

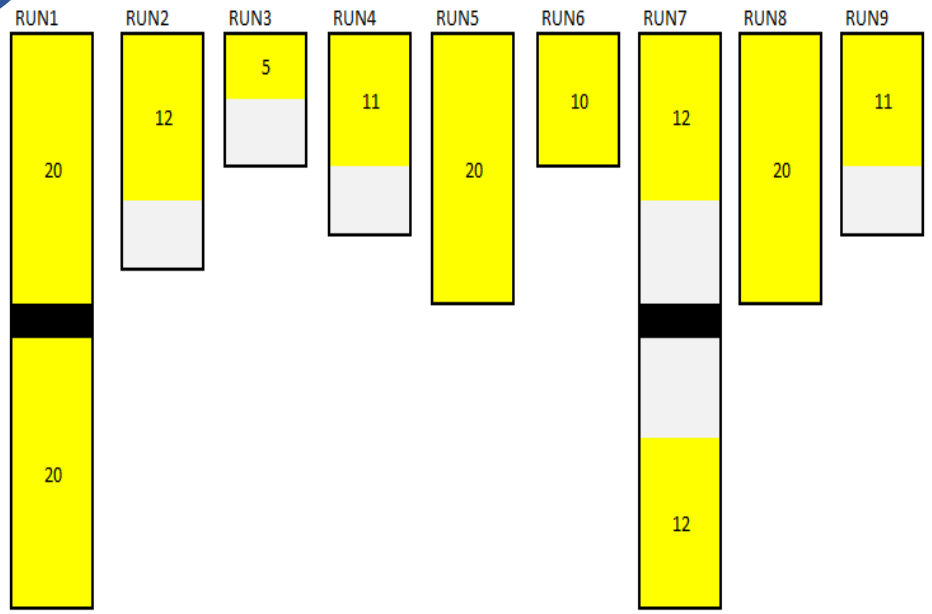
D-Well

Selective

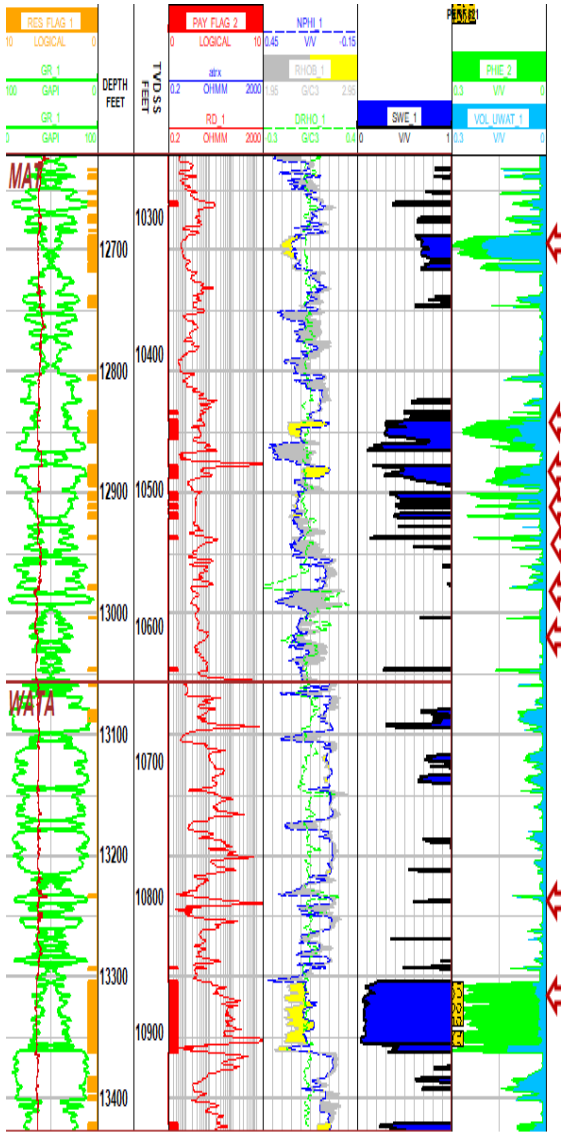
VS

Conventional

5 RUNS



9 RUNS

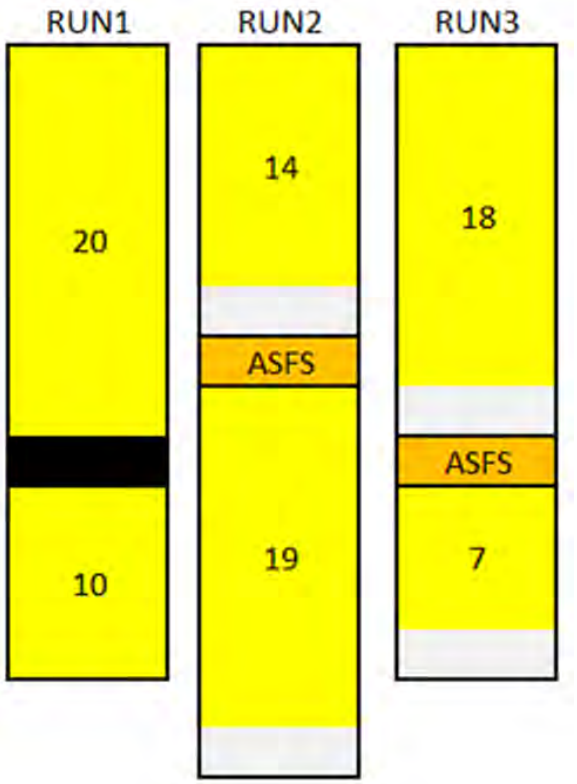


C-Well

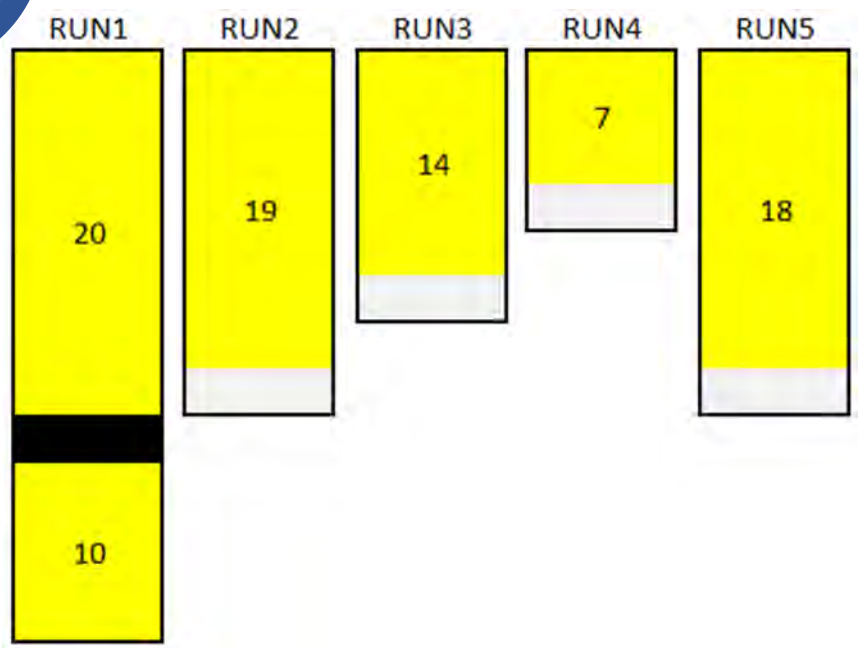
Selective

VS

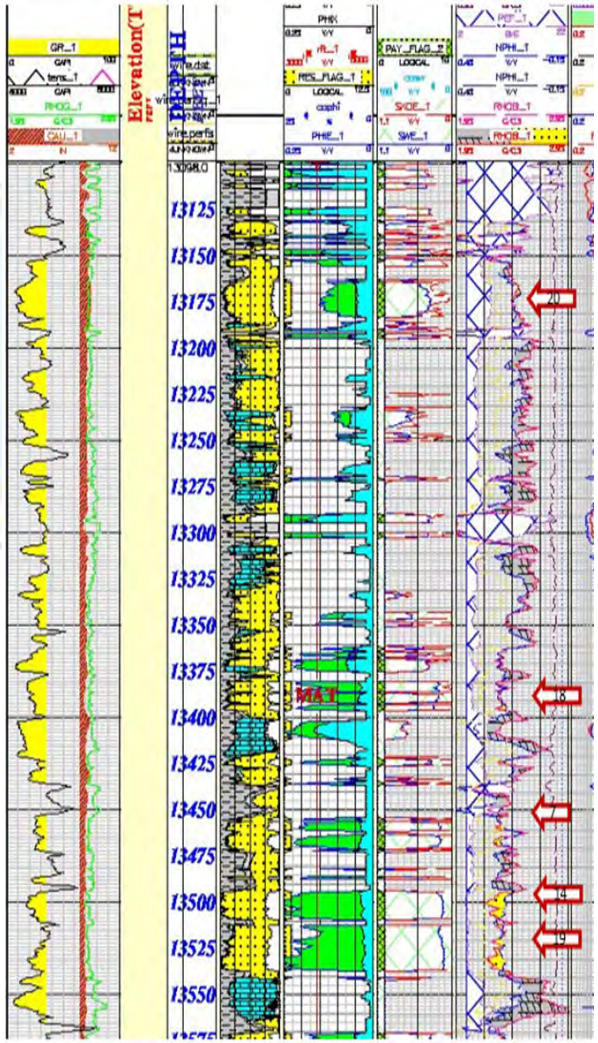
Conventional



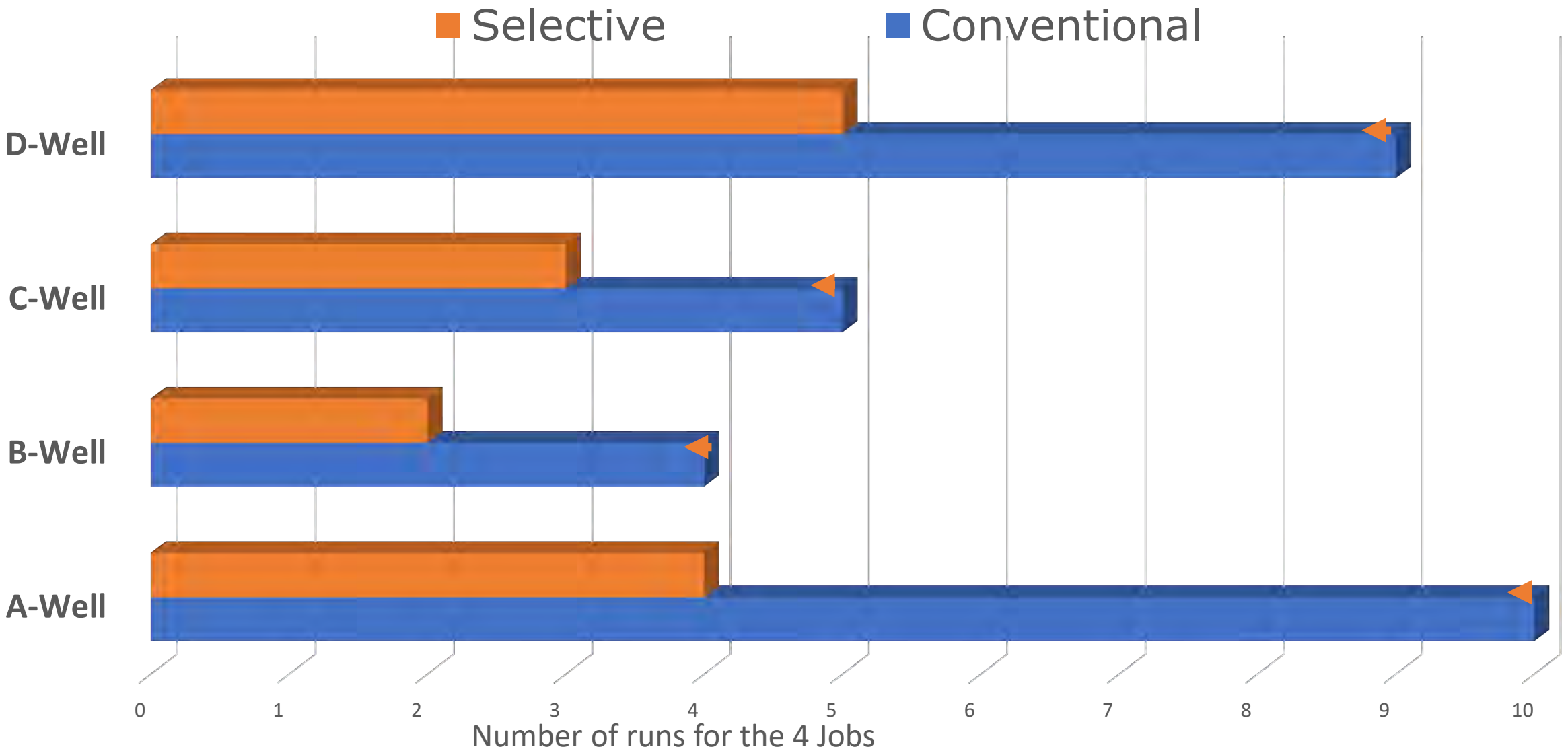
3 RUNS



5 RUNS



Number of Runs Saved



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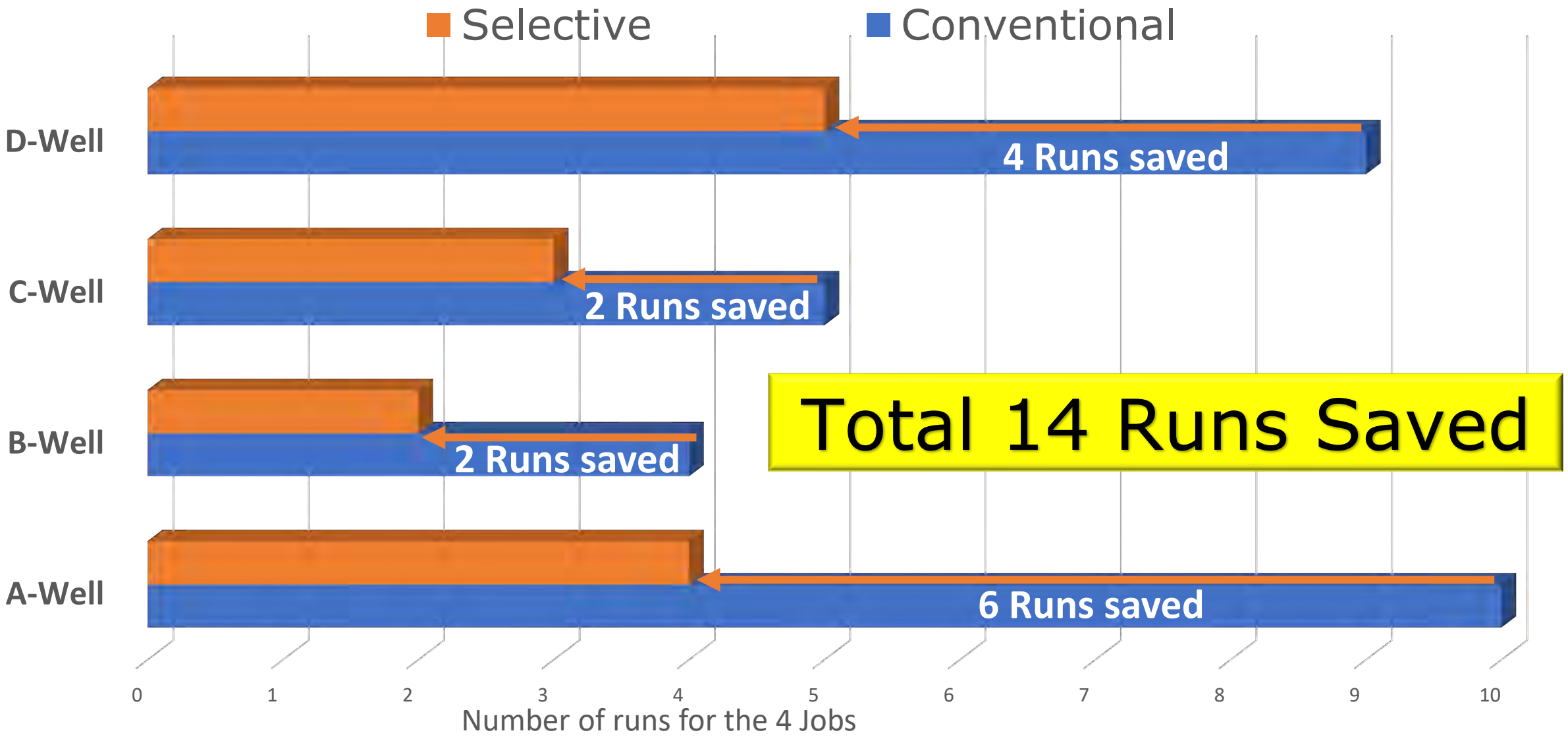
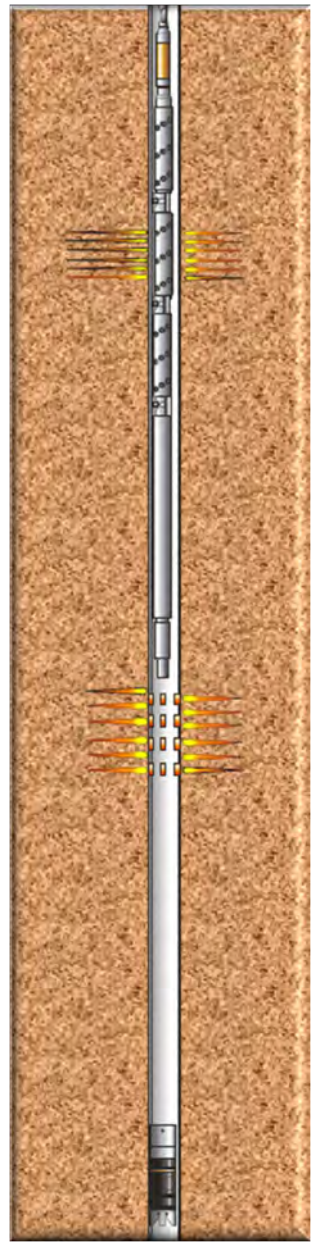


Selective Perforation

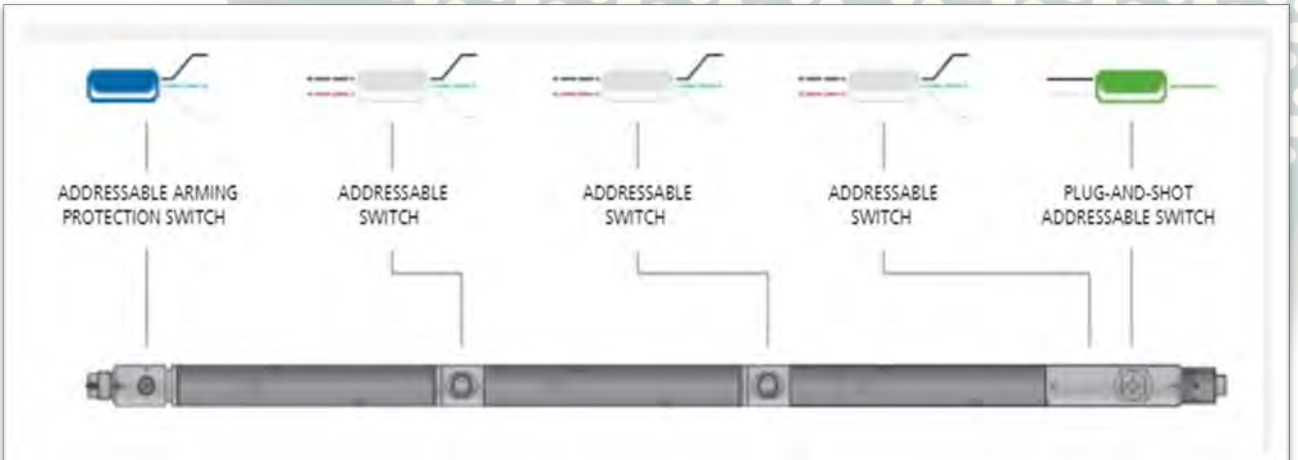
What is Selective Perforation?

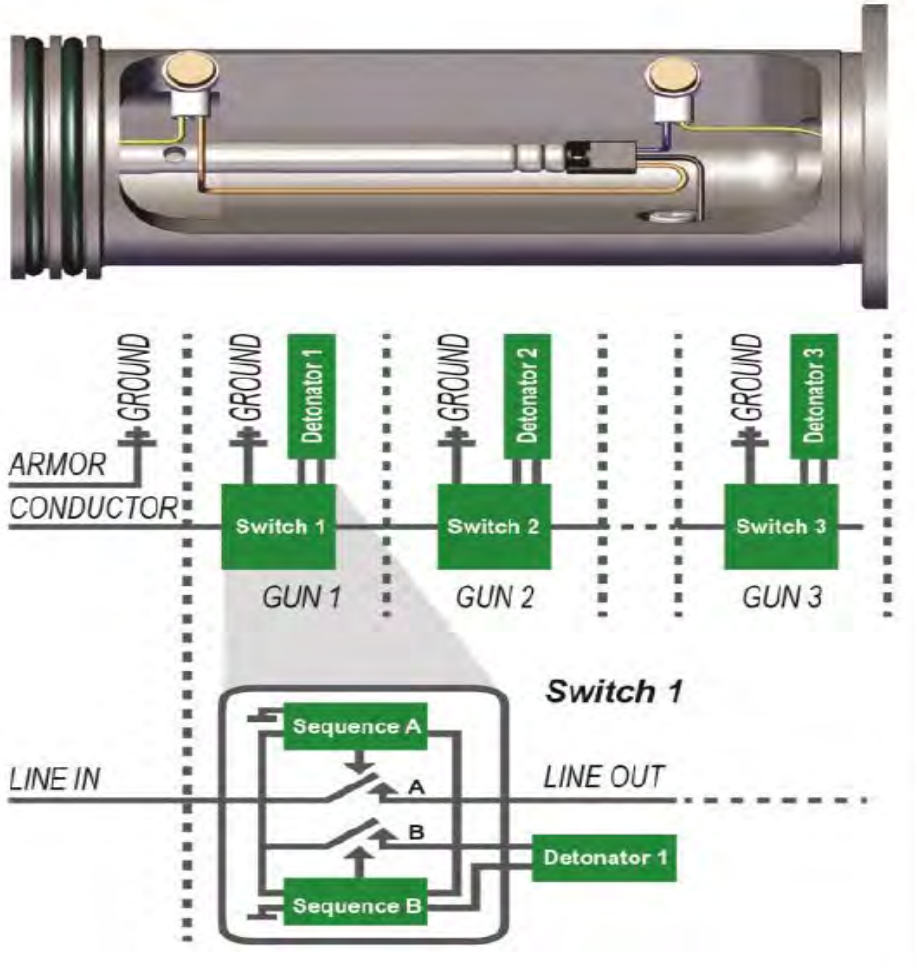
- Allows multiple, independently fired, perforating guns separated from each other in a single trip.
- In between each interval, the gun is moved and correlated against the next interval to be perforated
- Up to 40 guns can be connected in single run



What is Addressable Switch Firing System (ASFS)?

- series of microprocessors attached to the initiators.
- Each microprocessor has a unique address to individually identify the associated explosive device.





Selective Perforation

Features

1. Switches can be checked before and during the wireline run
2. Employs two-way communications
3. Detonator cannot be accidentally fired
4. Provides a unique address for each addressable switch
5. Can Skip a gun if one fails

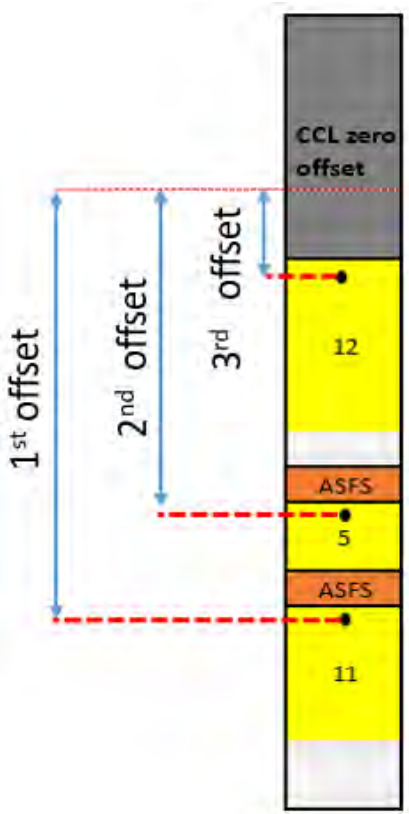
Risks

1. Mistakes while crimping connections
2. Possibility of pinch wire
3. Time-consuming operation
4. Manual handling

Job Execution

Before ASFS Run

- Slick-line Gauging
- Dummy run to tag bottom



Pre-Run checks

- Identify unique digital address for each gun
- Switches are polled with a test panel
- Measure top shot – CCL offset lengths

Perforation Run

- Check each switch every 2000 ft
- Correlate depth
- Open the well for underbalance
- Run one shooting pass,
- Close well & POOH

WHY one day was lost ?

Well-A

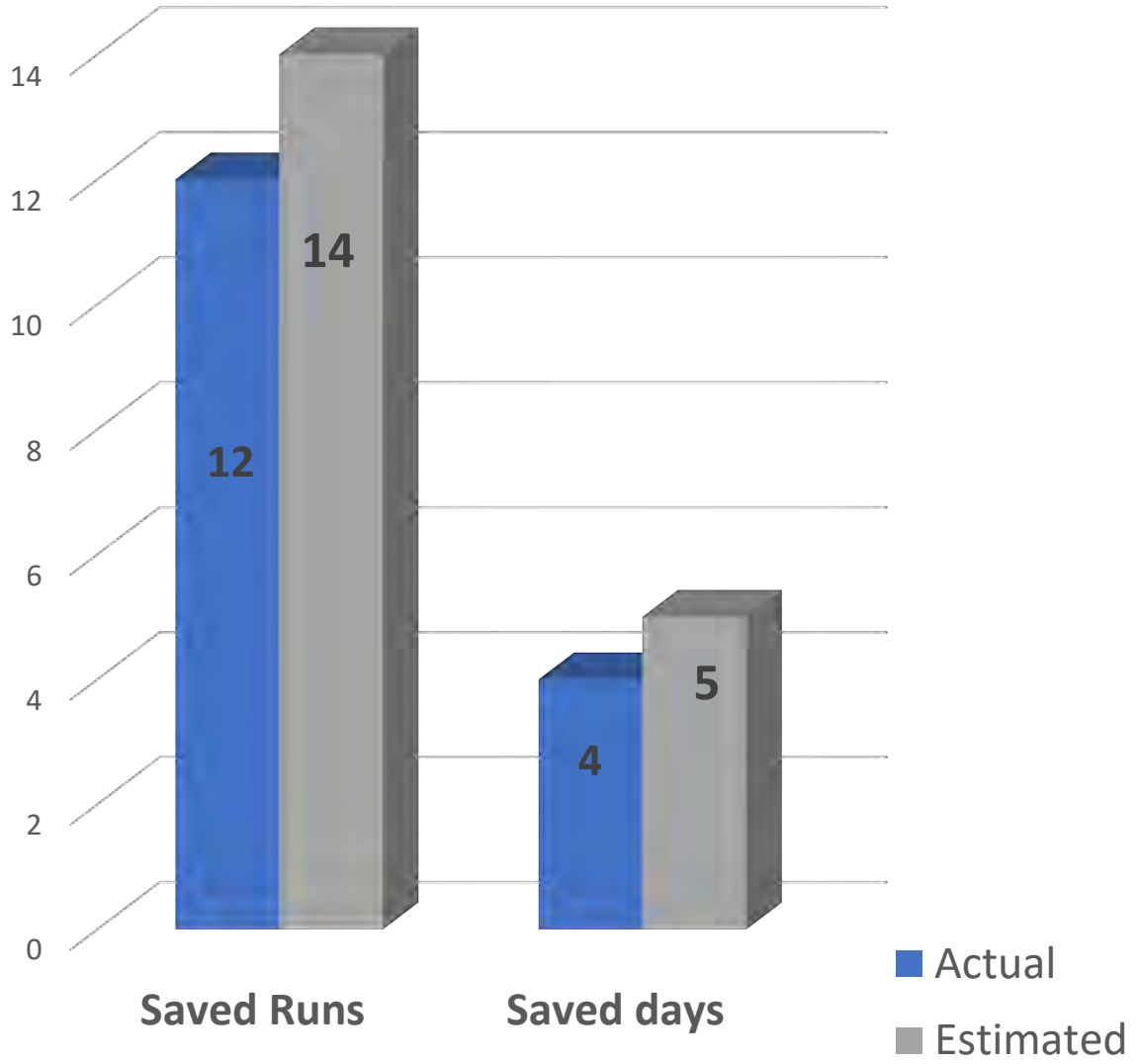
Switches failed to read for the three guns after tagging the bottom

Well-D

Two switches failed to connect at 4000 ft

One switch only connected

Estimated vs Actual



Lesson learned

D-well Problem

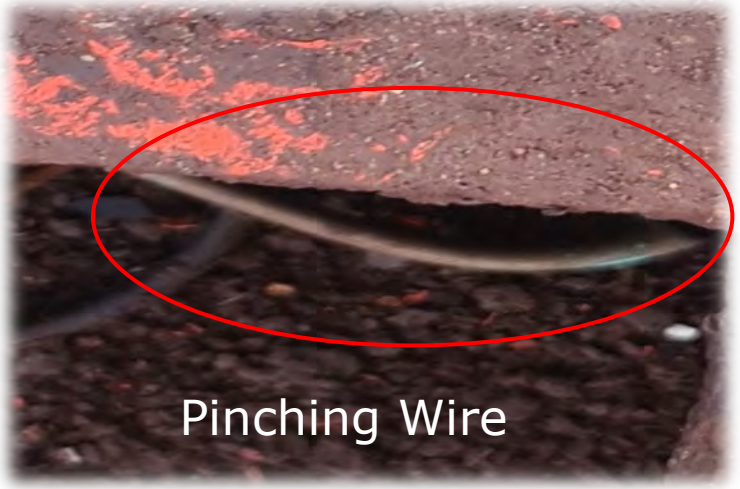
- Before RIH switches connected and tested
- First check downhole showed all switches were connected and properly functioning
- Second check downhole showed only first switch was connected and other two switches were not.

Investigation

- After disassembly the gun, connection pinching was found
- It is believed that pinching occur during lifting the total string (53 ft.) from pipe deck to the rig floor

Action

- Pre-run checks are to be done as usual on pipe deck
- Guns should be lifted as three pieces at rig floor and connected then.



Results

2,000

BOPD

Gain achieved from four successful perforation jobs

12

Risky run

Avoid 12 risky runs in aggressive well environment

4

Days

RIG time saved

Equipment rental

$250,000

USD

Save Rig rental cost only

Not include Vessel's cost

E-line cost

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Q&A

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