Power Study and Tailored Solution for High H_2S Environment Extends ESP Run Life in Douglas Field in the Irish Sea

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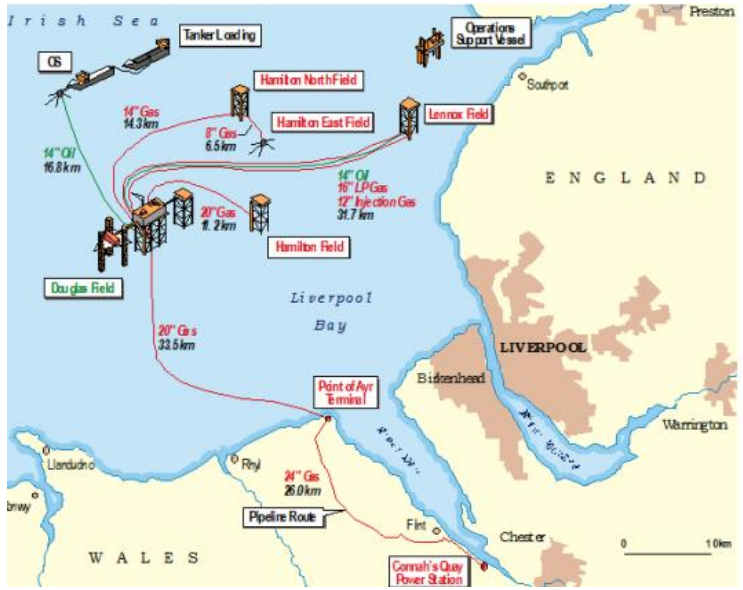
Introduction

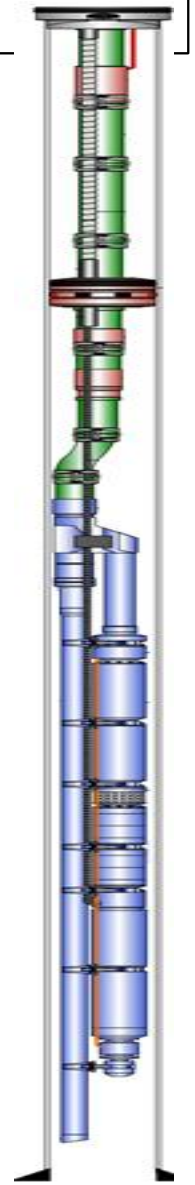
Douglas Field

- Located in the Irish Sea, 23 Km from North Wales and England coastlines.
- Discovered in 1990, production started in 1996.
- Triassic sandstone reservoir at 2,400ft TVD.
  - Low abrasives and temperatures.



Completion details

- ESP was selected as the Artificial Lift method.
- Target run life was set at 2-3 years.
- Upper completion installed with bypass system.



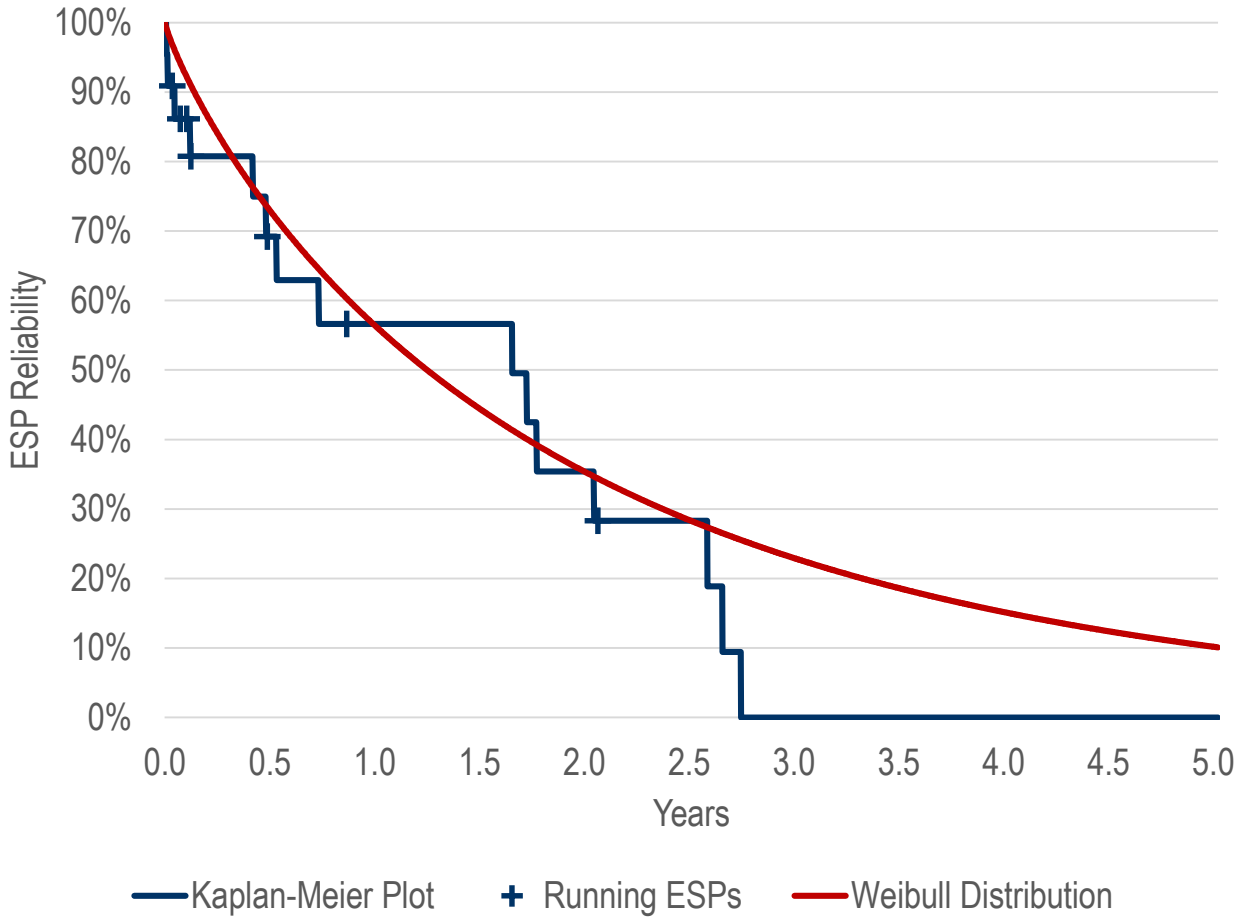
Initial ESP Performance

1995-1999 Performance

- First ESP installed in July 1995.
- First ESP started in December 1995.

- 15 ESP failures between 1996-1999.
- ESPs in Douglas initially struggled to achieve the 2-3 target run life.

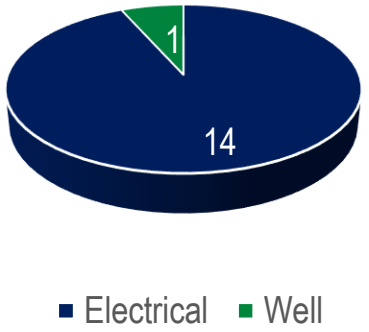
- Failure analysis and action was required to improve ESP run life.

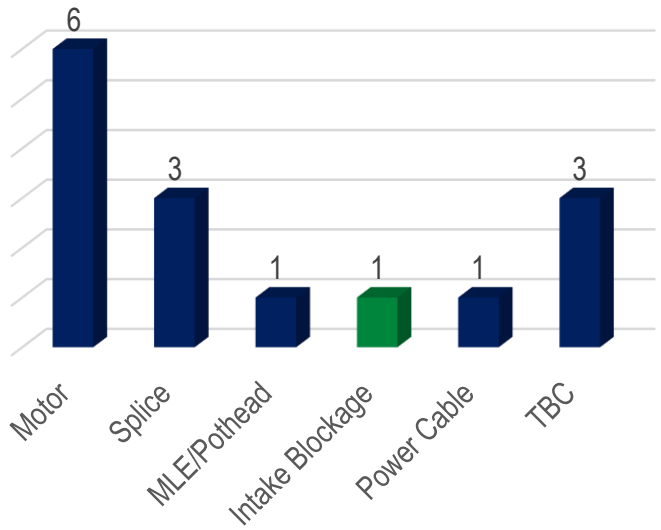


Failure Analysis

Failures Before 1999

- A majority of failures were electrical related, distributed among different components.
- Clean oil found with no signs of well fluid contamination.
- Signs of arcing found on the motor stator and rotor.
- H_2S intrusion found inside motors and protectors.

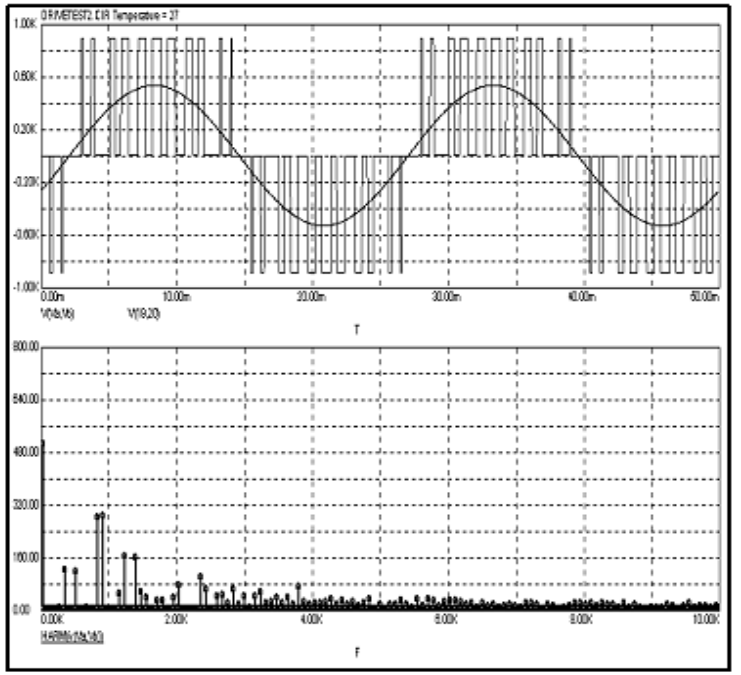


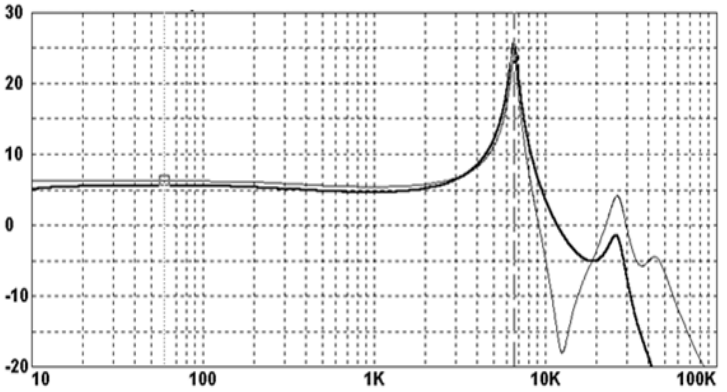


Power Quality Study Performed in Douglas

Electrical Analysis

- Analyze the total harmonic distortion generated by the PWM VSDs in the load side.
- System frequency response test conducted to check for excessive voltage levels.
- Check total harmonic distortion at the line side.

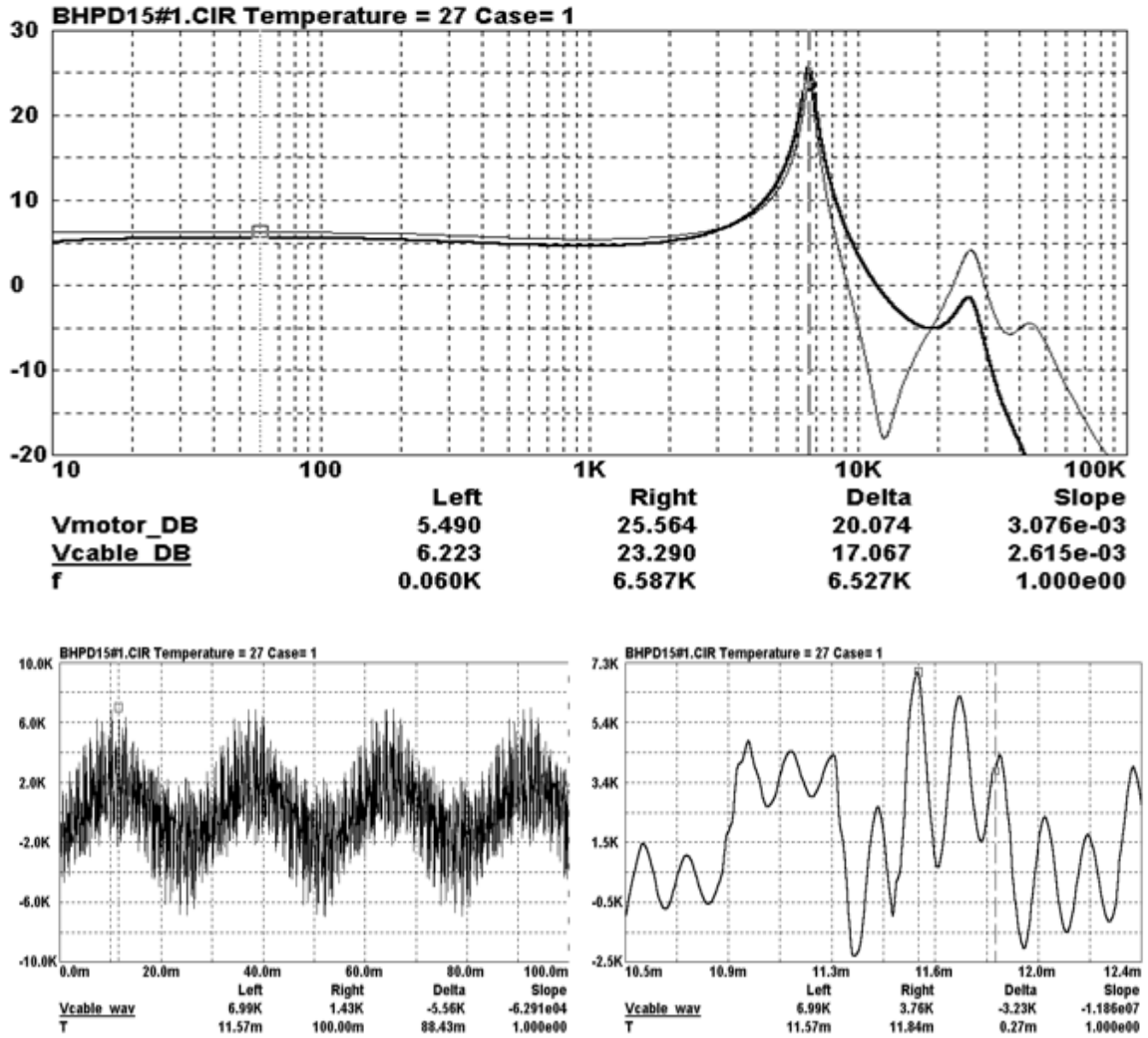




Power Quality Study Performed in Douglas

Challenges Identified

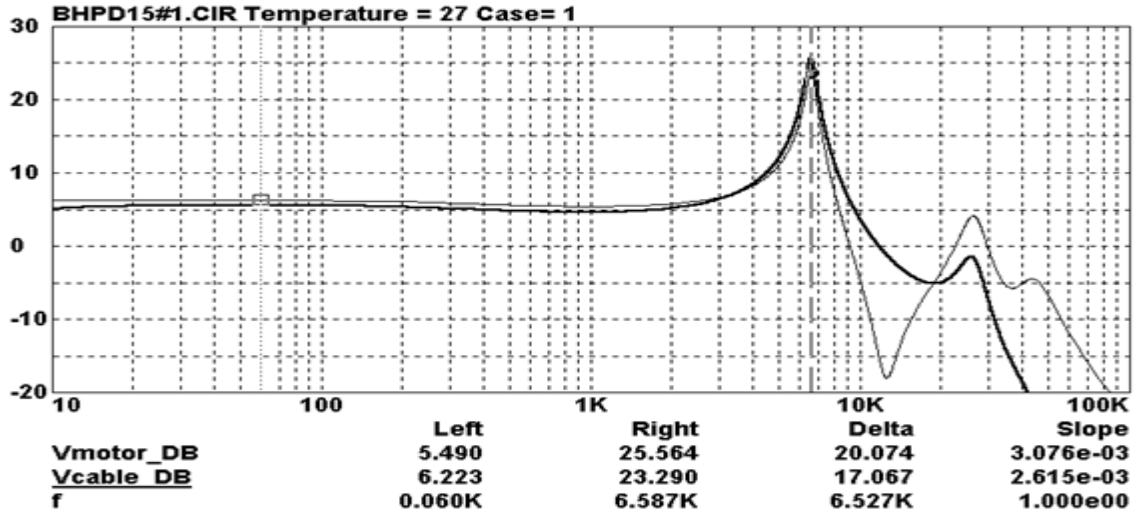
- Harmonic peaks detected around multiples of the carrier frequency. Harmonics in the band from 2 to 9 kHz are amplified.
- Frequency response analysis confirmed a natural resonance in all wells in Douglas between 5.7 and 6.8 kHz.
- A gain of 17 dB (7.1 times amplification) was noted in the resonant frequency. Voltage overshoot equals to 6.99kV.

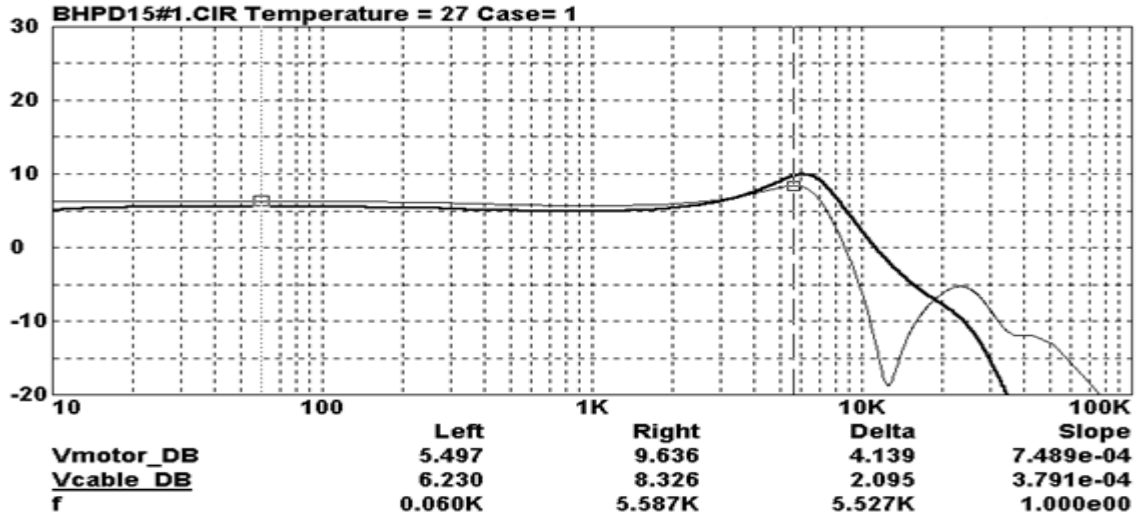


Solution Proposed

Power Study Results

- Challenge – The VSDs used in Douglas do not allow increasing carrier frequency. During testing, limited benefits were obtained by changing the operating frequencies.
- Solution – apply load filters to change the resonant frequency and adjust gain by including dampening resistors.
- Result – Gain at the motor terminals reduced to 4dB. Voltage overshoot reduced to 4.64kV.





H_2S Production

Tailored H_2S Solution

- Signs of H_2S intrusion was noticed during equipment dismantle. The decision was made to customize the ESP equipment to increase reliability in sour services.

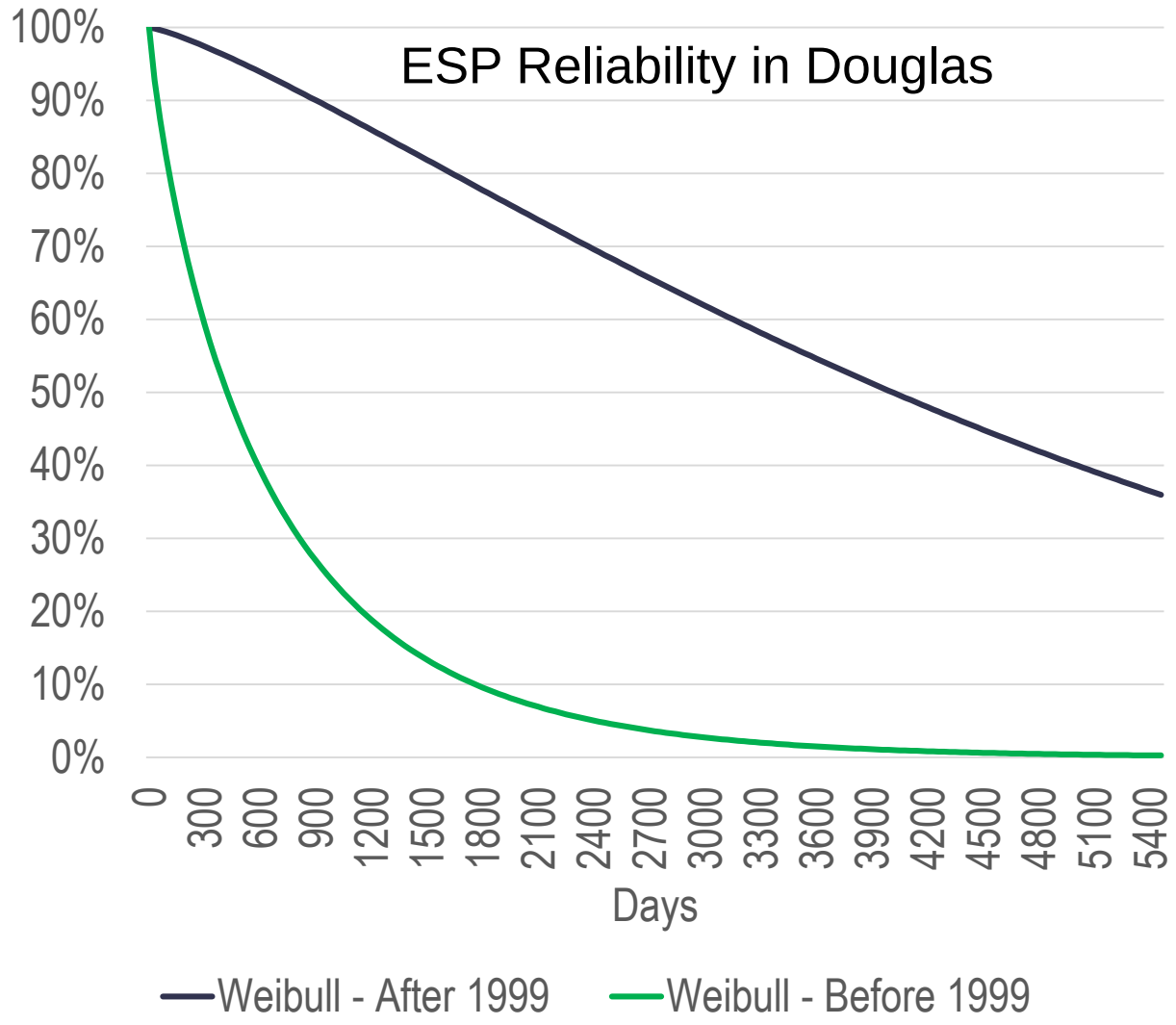
- Metallurgy improvement:
  - Elastomers upgraded from HSN to AFLAS.
  - Trim upgraded to Monel and Inconel.

- Introduction of tandem protectors, with H_2S Scavenger protector:
  - Sacrificial parts to delay H_2S attack at the magnet wires.
  - PEEK coated high load bearings.
  - Replacement of elastomer shaft seal with metal bellow shaft seals.

Results

ESP Reliability Comparison

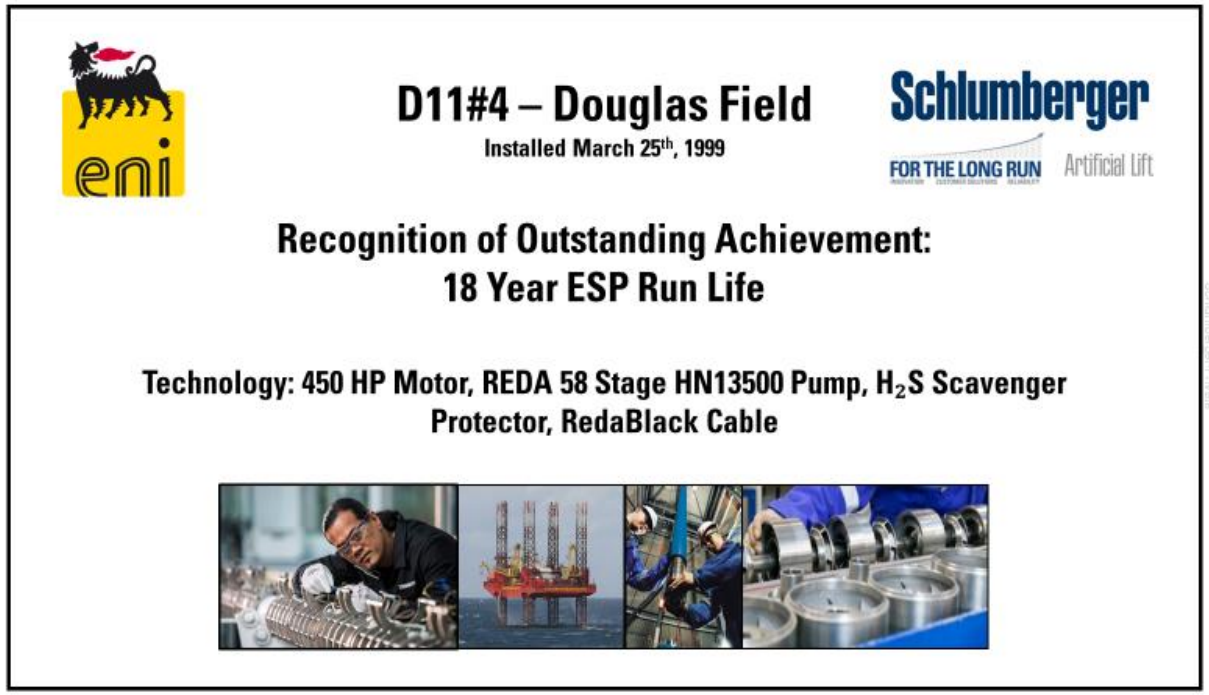
- ESP performance increased considerably after the introduction of the load filter and severe service protectors.
- 18 ESP systems failed in the field between 1999 and 2018. 14 electrical, 2 mechanical, 2 reservoir.
- Douglas field is now seeing wear-out failures instead of premature failures.



Conclusion

18 Year ESP Run Life Achieved

- ESPs initially struggled to reach the target run life of 2-3 years.
- Load filter installations eliminated the premature electrical failures. Scavenger protector for H_2S production increased intrinsic reliability of the ESP system.
- Strong partnership between operator and ESP supplier allowed outstanding ESP run lives to be achieved in Douglas field.



Acknowledgements / Thank You

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