

# ULTRA SLIM HIGH SPEED ESP



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# Agenda

1. Challenges
2. Opportunities
3. Evolution of the PMM and the high-speed ESP
4. Case study

# Challenges And Opportunities

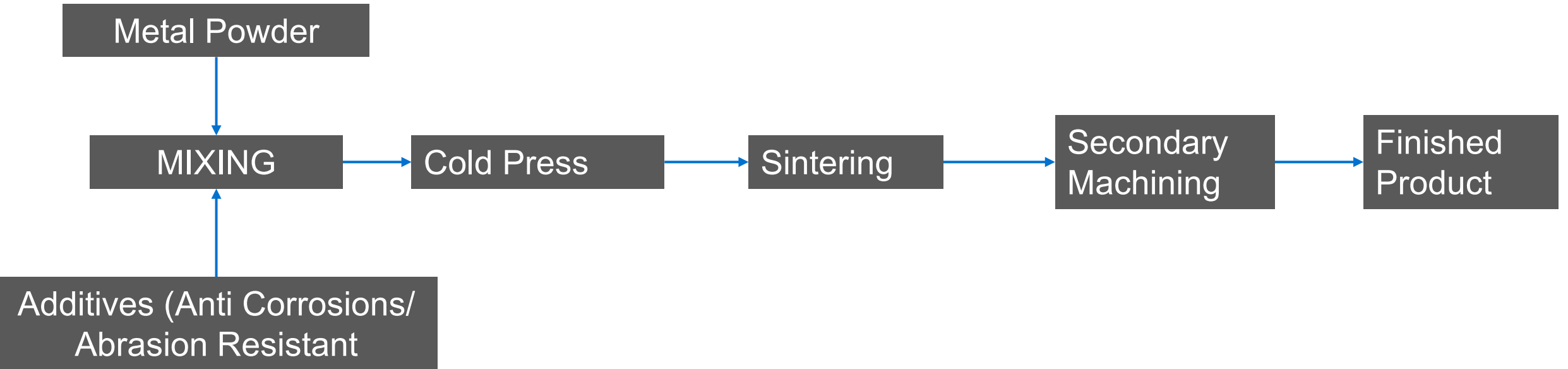
1. Old wells with Casing Recompleted.
  - a) Around 7000 wells in Asia and ME with 5" & 4.5" Casing
2. Casings < 7" Needing special completions
  - a) Y tool with 2 7/8" bypass
  - b) Dual ESP systems/ Dual Y tool Dual ESP
3. Operator Desire to reduce Drilling Cost
  - a) 2000 BFPD thru 4.5" casing
  - b) 4000 BFPD thru 5" casing
  - c) 6000 BFPD thru 7" casing
4. Gas well Dewatering
  - a) Most of the Gas wells are 4.5" and 5" casing
5. Thru Tubing ESP for 2-7/8" Tubing.



**ULTRA SLIM  
INNOVATION**

# STAGE MANUFACTURING INNOVATION

## POWDER METALLURGY



# STAGE MANUFACTURING INNOVATION

1. METAL POWDER AND ADDITIVES MIXING



2. COLD PRESS TO FORM



3. ASSEMBLY FOR SINTERING



4. SINTERING



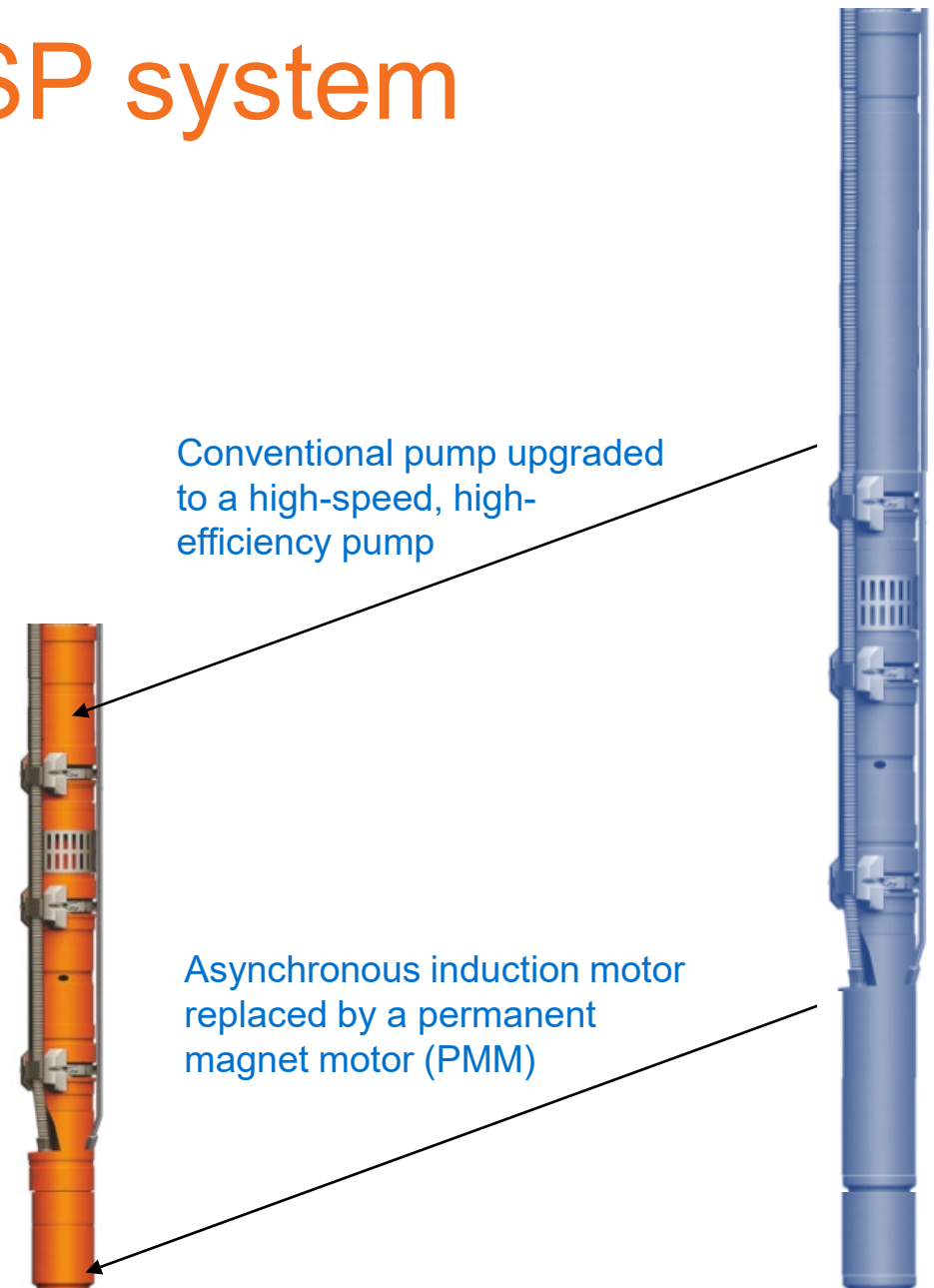
5. MACHINING



# Evolution of the high-speed ESP system

## Reduced ESP footprint

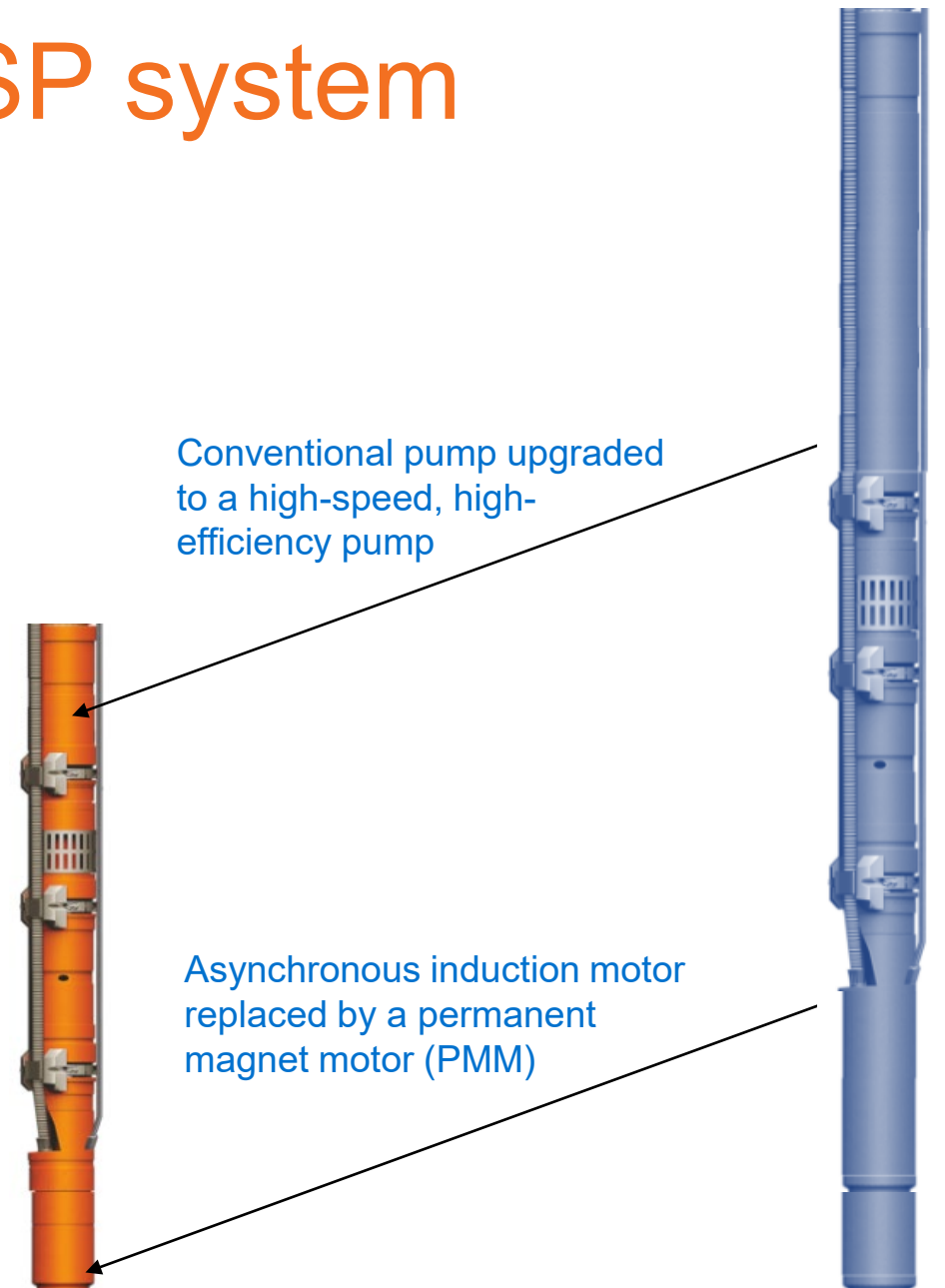
- a) High-speed 8500-RPM PMM
- b) Reduced number of stages by 50%



# Evolution of the high-speed ESP system

## Reduced power consumption by 25%

- a) PMM with high-efficiency pumps
- b) Lower current requirement for PMM reduced size of the power cable

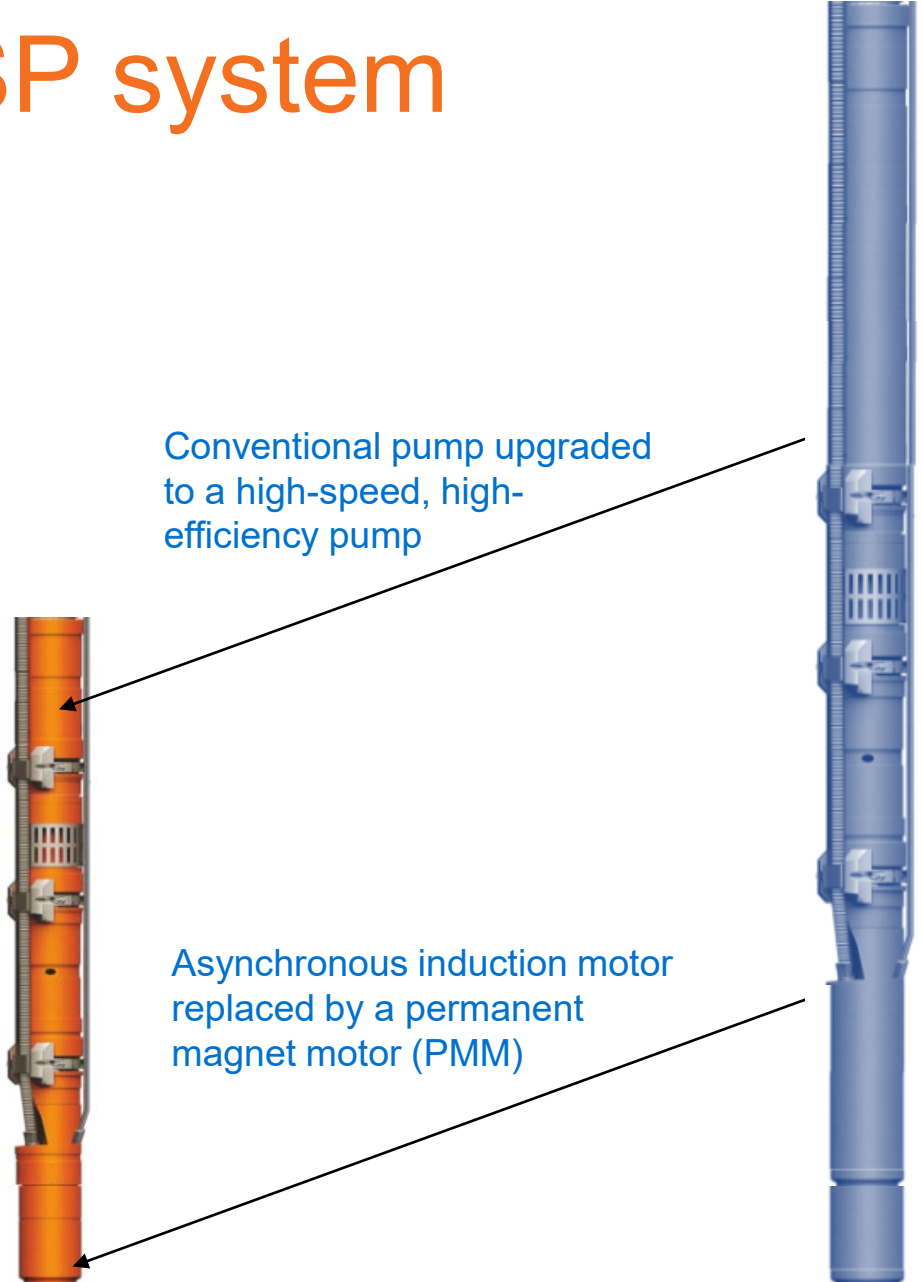




# Evolution of the high-speed ESP system

## Reduced OD of the ESP

a) Smallest OD—2.17 in. (55 mm)



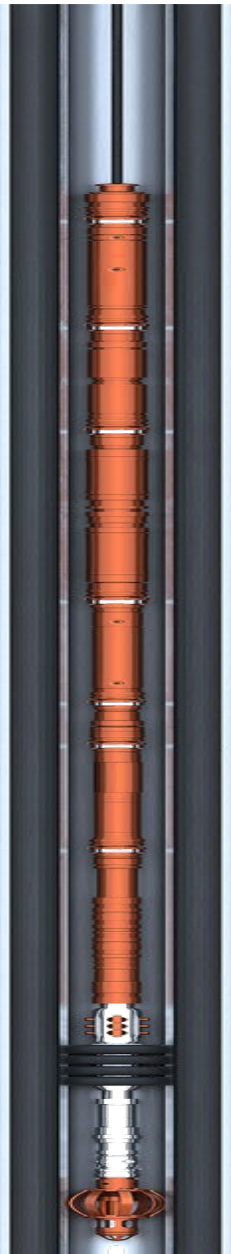
Conventional pump upgraded to a high-speed, high-efficiency pump

Asynchronous induction motor replaced by a permanent magnet motor (PMM)

# ULTRA SLIM

RIG DEPLOYED					
Pump Series	Pump OD	Motor Series	Motor OD	RPM	Max ESP System OD with MLE Guard
272	2.72	319	3.19	6500	3.23
319	3.19	319	3.19	6500	3.74
338	3.38	378	3.78	3600	4.2
362	3.62	406	4.06	3600	4.53

RIG LESS DEPLOYED					
Pump Series	Pump OD	Motor Series	Motor OD	RPM	Max ESP System OD
217	2.17	2.17	2.17	8500	2.17
272	2.72	319	3.19	8500	3.19
319	3.19	319	3.19	8500	3.19



# CASE STUDIES

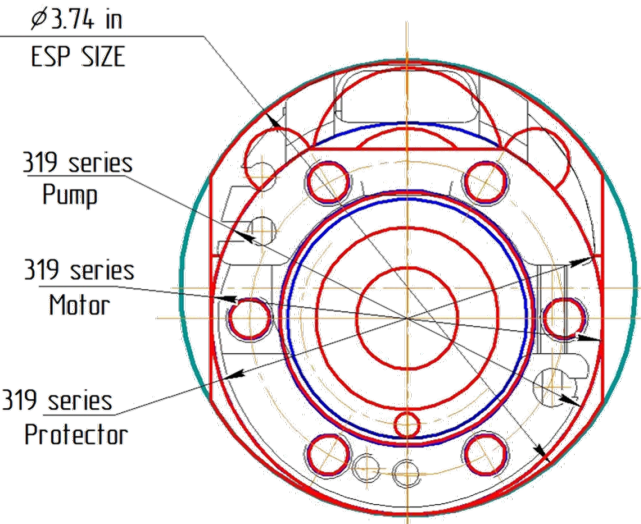
# Case Studies -1 Middle East Offshore

What was done

1. 5" #15 ppf , Drift ID -4.408". Tbg 2 3/8"
2. Original ESP completion – 338 Series Pump ( 3.75" Motor)
3. Inverted ESP system
4. Surface System
  - a) Standard Induction Motor VSD. Maximum Frequency 120Hz
  - b) No Sine Wave Output Filter required for PMM
5. Maximum Production – 1500 BFPD

Operator Compromise – Well Production Capability was 4000 BFPD plus

# Case Studies -1 Middle East Offshore

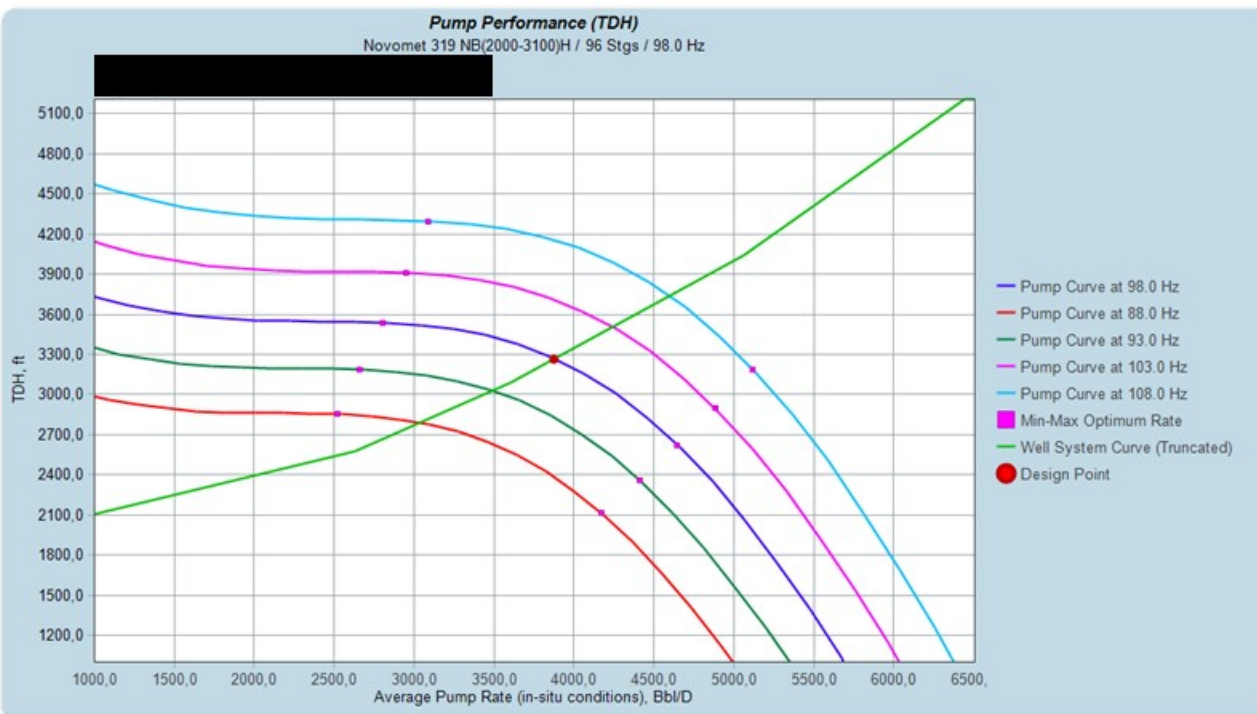


## GAIN OF 2300 BFPD

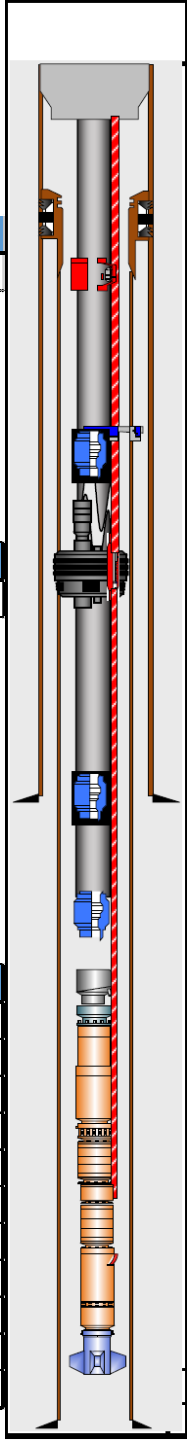
1. Motor RPM – 5880RPM
2. VSD Frequency – 196Hz
3. Surface Flow Rate – 3800BFPD
4. Operating since 360 days

Casing	Size	Weight	Drift ID
Casing	5"	15.00	4.408"

Description of Item	OD
ESP Packer	4.249



Description of Item	OD
DISCHARGE PRESSURE SUB 2-3/8"-8RD	2.375
BOH 2 3/8" 319SERIES	2.375
PUMP NB(2000-3100)H CMP AR1:1 CR2C FJT S14	3.190
PUMP NB(2000-3100)H CMP AR1:1 CR2C FJT S14	3.190
INTAKE N319I 319H/319B CR1 0.67" S14	3.190
PROTECTOR N319MP BSB 319H/319B CR2C UHT HL	3.190
ADAPTER PROT MP319/MP319 SS	3.190
PROTECTOR N319MP BSB 319H/319B CR2C UHT HL	3.190
MOTOR N319PM120 1620V 6.0RPM UT CR2C HT	3.190
SENSOR NDS2 319 DES2 5800PSI CR2 MOD0 HT M1	3.190
CENTRALIZER 5" 2-3/8"-10RD NUE CR0 MOD0	4.150



# Case Studies -1 Middle East Offshore

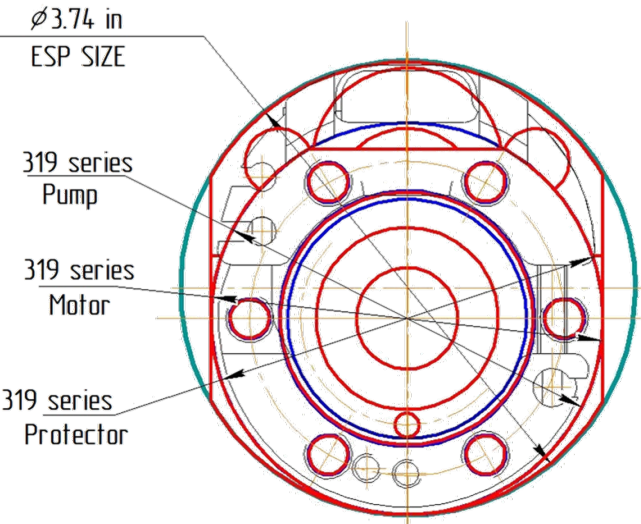
1. VSD Existing Output Hz 10 to 120 Hz
  - a) Modified to 0 to 283 Hz
2. Acceleration time 2 to 200sec
  - a) Modified to 2 to 6000 Sec
3. Operating mode was Standard Maximum Torque start
  - a) Modified to include Magnet Rotor Synchronization
4. VSD output 6 pulse Step Output
  - a) Modified to Sine wave Output
5. Scada was Standard RS 485
  - a) Modified to RS 485 with Wi Fi for Remote access (Android and Window)

# Case Studies -2 Middle East Onshore

## The Challenge

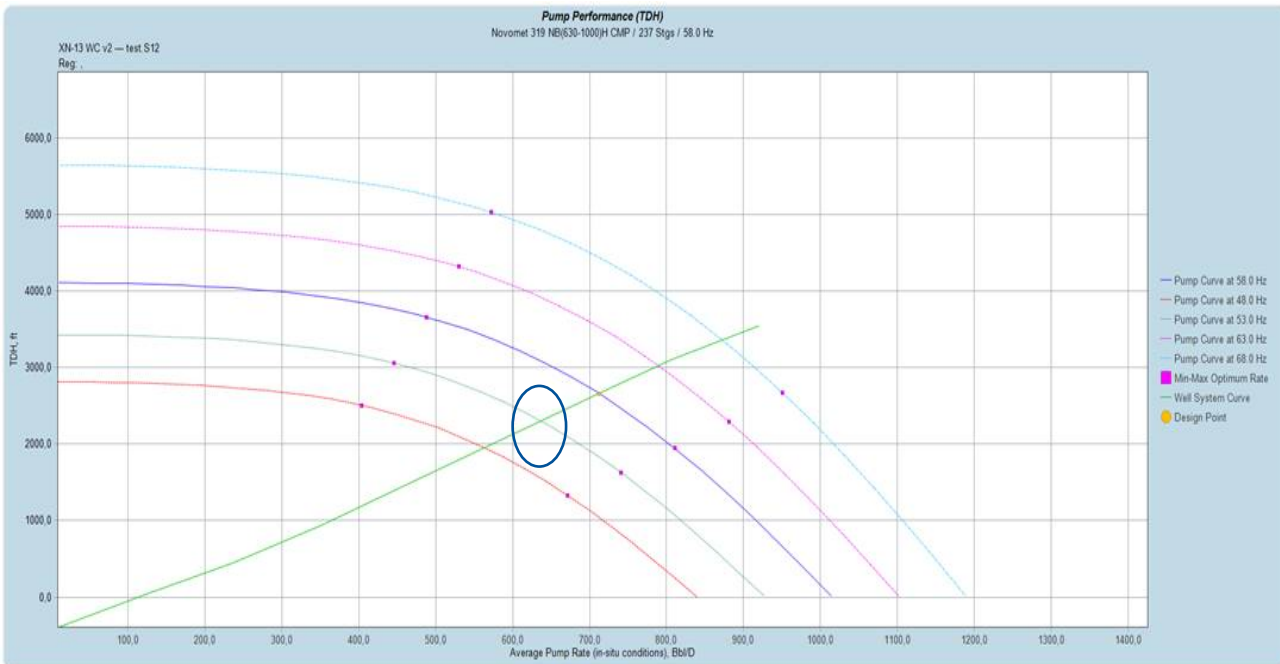
1. 4-1/2" #12.6ppf , Drift ID -3.833". Tbg 2 3/8"
2. Multiple Gas Well stopped producing due to water level increase.
3. Existing ESP sizes were not suitable.
4. Well, was shut in after Natural flow stopped.
5. Operator lost the Gas Production.

# Case Studies -2 Middle East Offshore

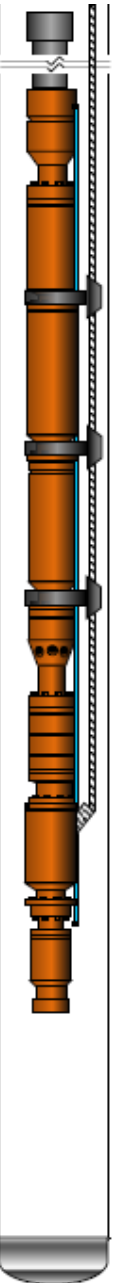


**GAIN OF 2500 scf/d gas**

1. Motor RPM – 3600RPM
2. VSD Frequency – 120Hz
3. Dewatering – 500 BFPD



Description of Item	OD
DISCHARGE PRESSURE SUB 2-3/8"-8RD	2.375
BOH 2 3/8" 319SERIES	2.375
PUMP NB(630-1000)H CMP AR2 CR2S 79STG	3.190
PUMP NB(630-1000)H CMP AR2 CR2S 79STG	3.190
MULTI PHASE PUMP NP319MPP1050 15 STG	3.190
PROTECTOR N319TMP BPB - SBPB CRM HT HL	3.190
MOTOR N319PM105 1440V 6.0RPM UHT	3.190
SENSOR NDS2 319 DES2 5800PSI CR2 MOD0 HT M1	3.190





# Case Study 3 – South East Asia Offshore

## Operator Difficulty

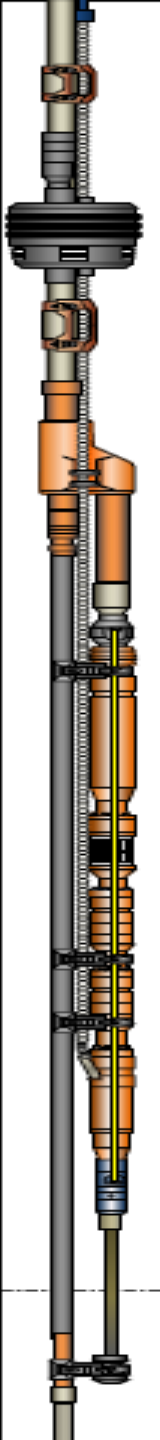
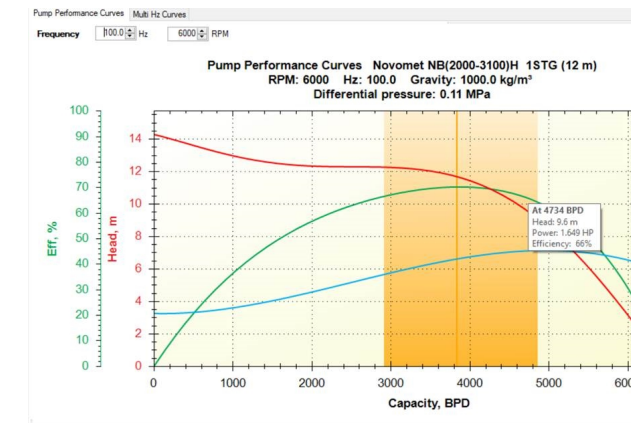
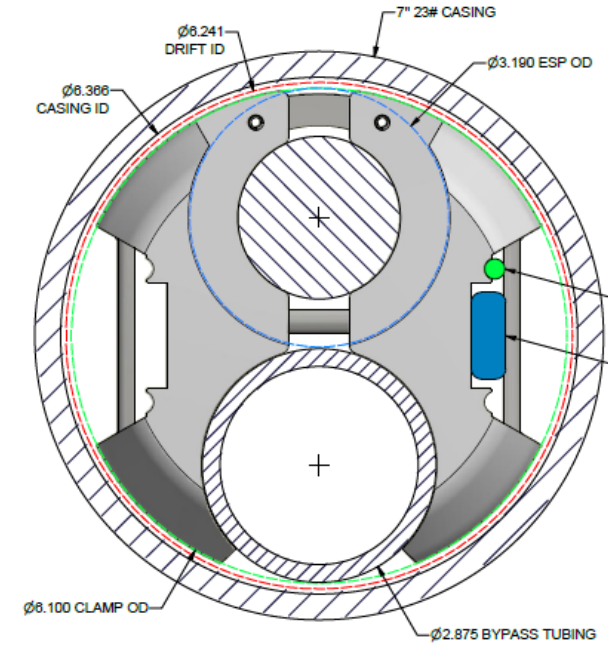
1. 7" #23 ppf Casing. Drift ID 6.36"
2. Current ESP OD 3.8 inch
3. Y tool Completion with Bypass of 23/8"
4. Operator Challenge
  - a) Due to use of 23/8" bypass Operator had to use CT services for down hole logging.
  - b) Flow rate was restricted due to limitation on standard Slim Line ESP.

# Case Study 3 – South East Asia Offshore

Description of Item	ID	OD
Y BLOCK	2.441	6.000
BY PASS	2.441	2.875

Description of Item	OD
DISCHARGE PRESSURE SUB 2-3/8"-8RD	3.190
BOH 2 3/8" 319SERIES	3.190
PUMP NB(1500-2500)H CMP AR2 CR2S 79STG	3.190
INTAKE	3.190
PROTECTOR N319TMP BPB - SBPB CRM HT HL	3.190
MOTOR N319PM105 1440V 6.0RPM UHT	3.190
SENSOR NDS2 319 DES2 5800PSI CR2 MOD0 HT M1	3.190

Not Yet Installed



# Case 4 Middle East Onshore

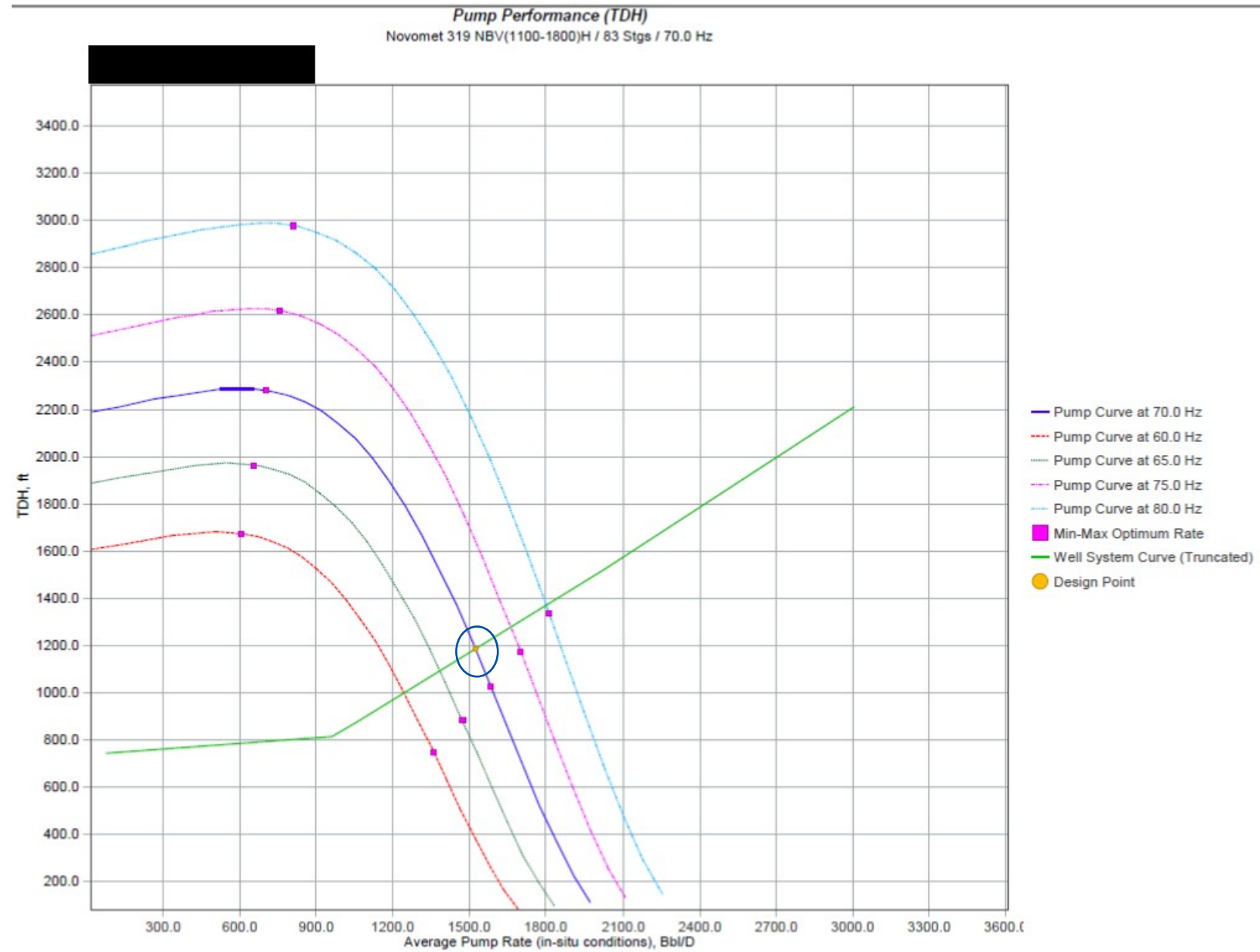
1. Multiple Old wells with 5" , Drift ID 4.408"
2. Wells were shut in as loss in Natural Flow pressures.
3. Conventional Slim Line ESP (338/375) Not feasible
4. Operator loss –between 4000 – 1800 BFPD per well.
5. 5 of the Slim wells were put back to production providing a gain of 1 M BO per year.

# Case Studies -4 Middle East Onshore

## Solution

1. 319 Series High Speed ESP ( 6000 RPM)
2. Operating at 140 Hz ( 4800 RPM)
3. Operating Days – 614

Gain of 1 M BO per year – 5 wells





# THANK YOU

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