

SET^o

Introduction

SETCON[®]

variable-speed gearbox



SETCON[®]

SET GmbH

Combining mechanical,
electrical and automation
capabilities

> 35 years experience
in drive technology

Technology leader and
pioneer in EMDS*



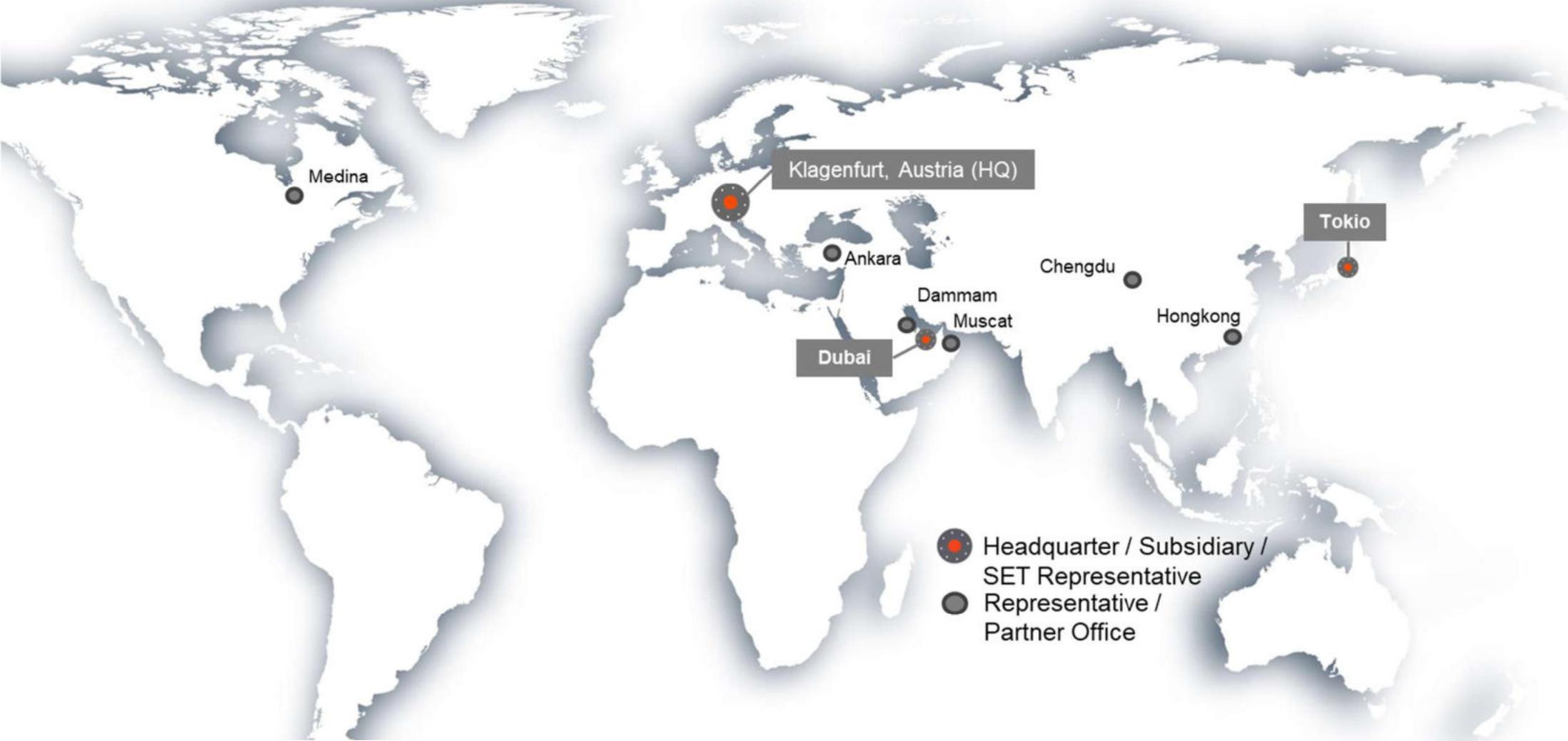
> 30 patent families for
EMDS

Based in the
heart of
Europe



*EMDS = electro-mechanical differential system (SETCON®)

SET Representative Offices



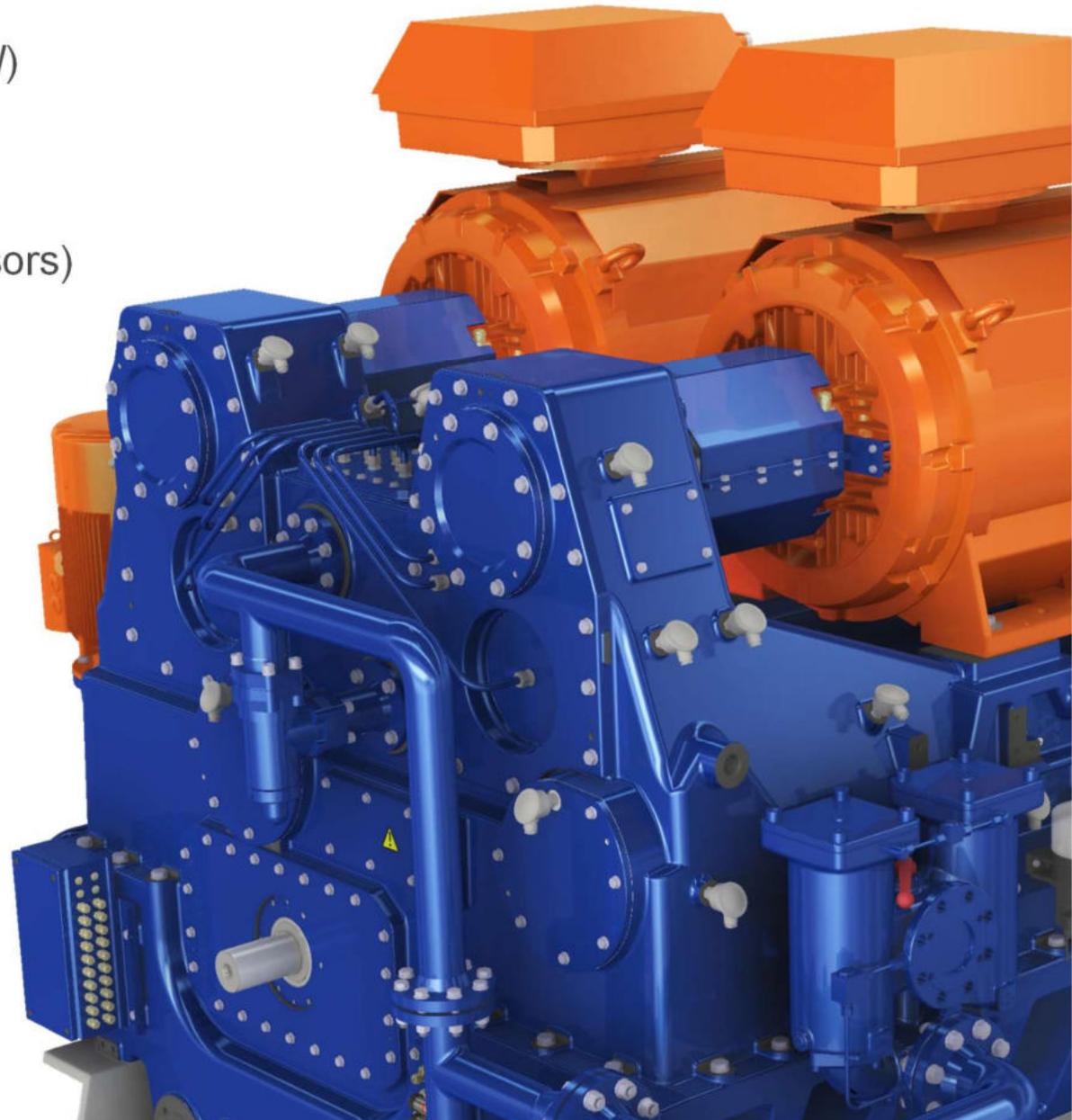
Vendor Registered at (among others):



Technical Data

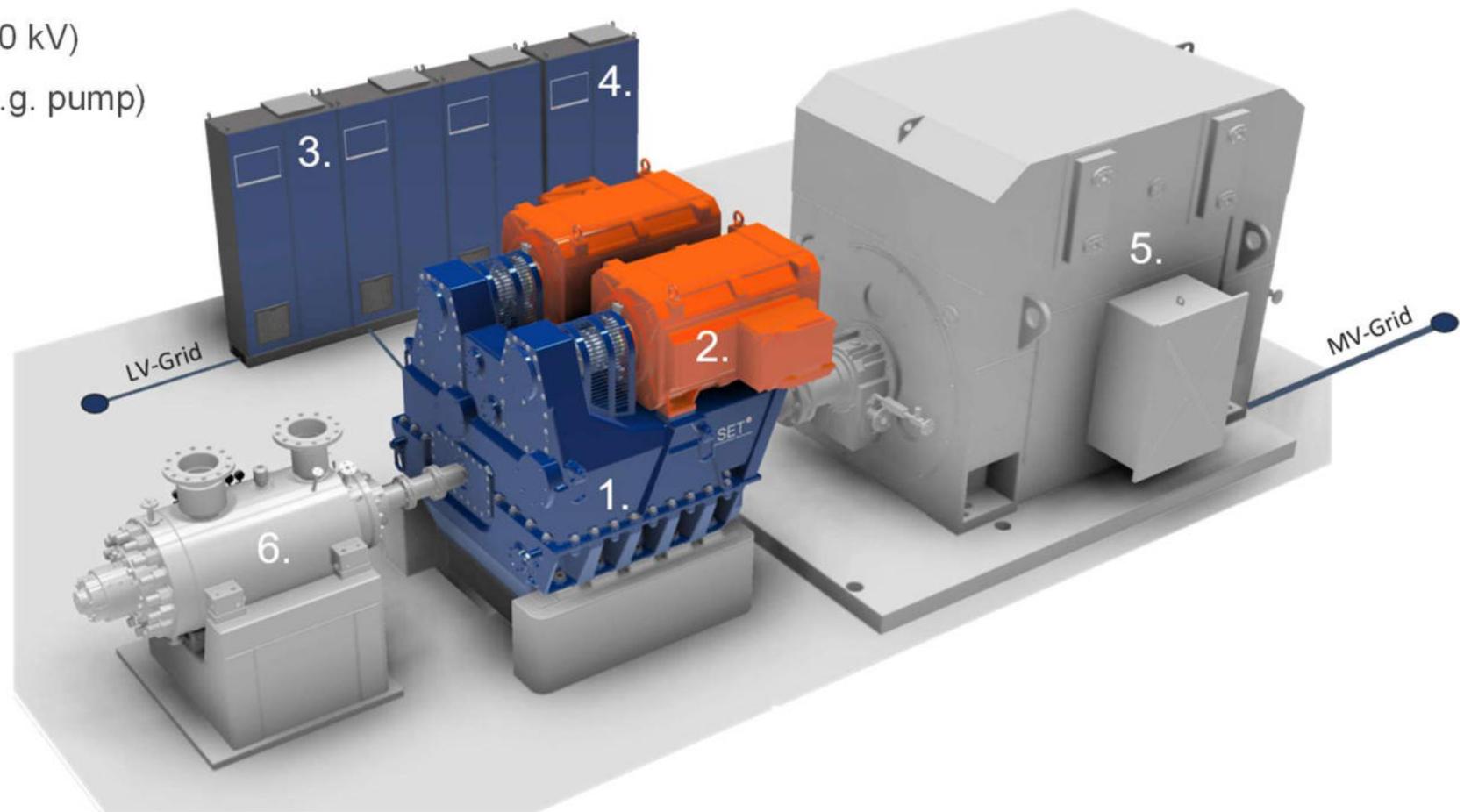
SETCON[®]

Rated power:	1 MW – 15 MW (18 MW)
Input shaft:	1 500 rpm / 1 800 rpm
Output shaft:	up to 15 000 rpm
Variable speed range:	50 % – 100 % (Pumps) 70% - 105% (Compressors)
Area classification:	Non-Ex, Ex
Energy efficiency:	up to 97 %
Integrated LOS:	SET Std. / API 614
MPS:	SET Std. / API 670
Soft Start Main Motor:	yes, integrated

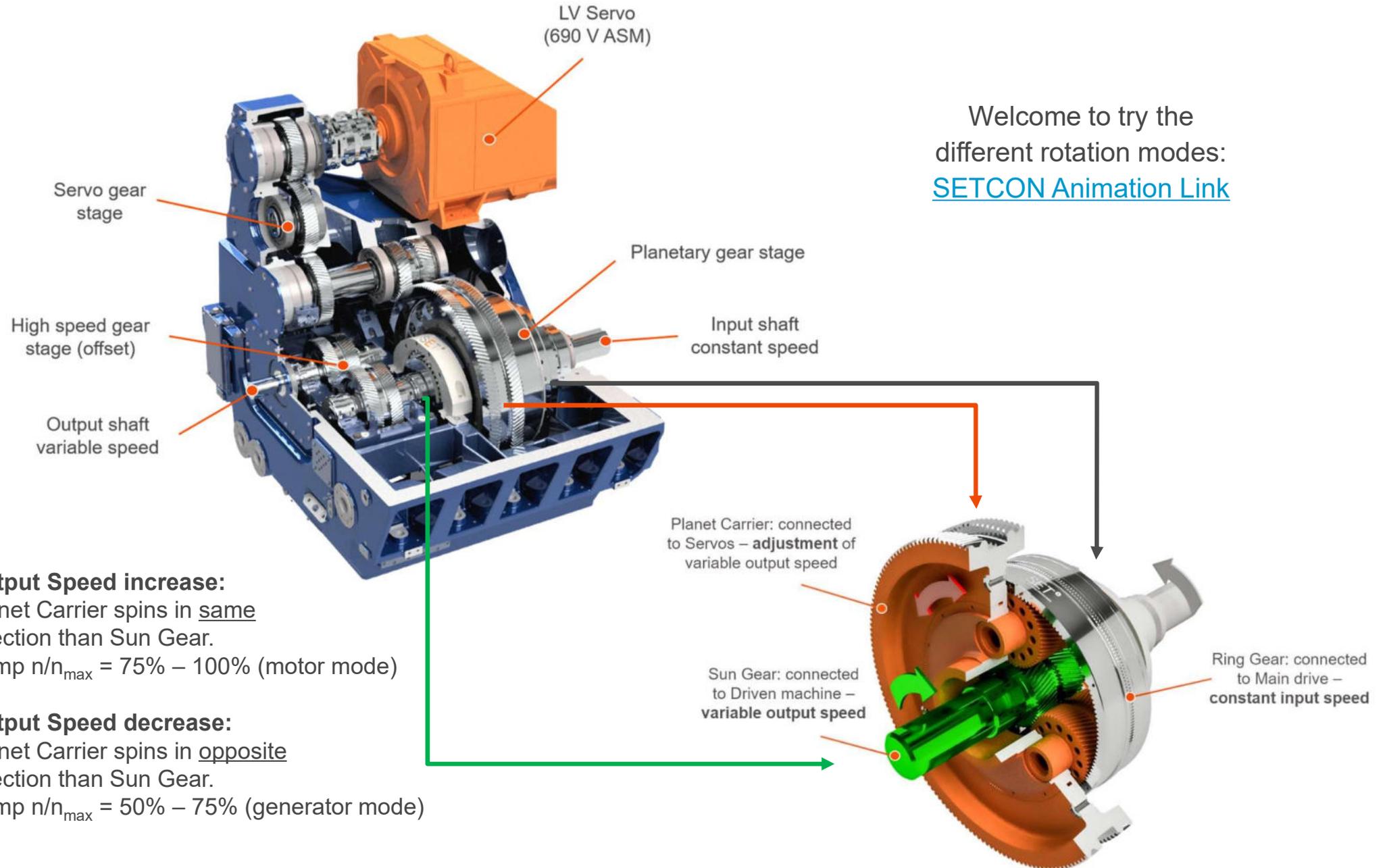


SETCON[®] set-up

1. Gearbox incl. lubrication unit
2. Servos (ASM)
3. 4Q LV- Frequency Converter (e.g. 690 V)
4. Control Unit incl. PLC
5. Main Motor (e.g. 10 kV)
6. Driven Machine (e.g. pump)



Gearbox Arrangement



Welcome to try the different rotation modes:
[SETCON Animation Link](#)

Output Speed increase:

Planet Carrier spins in same direction than Sun Gear.

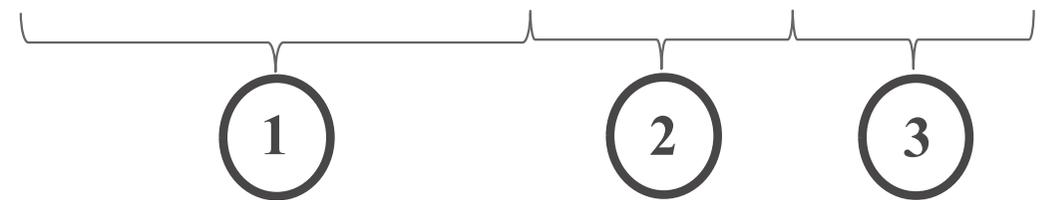
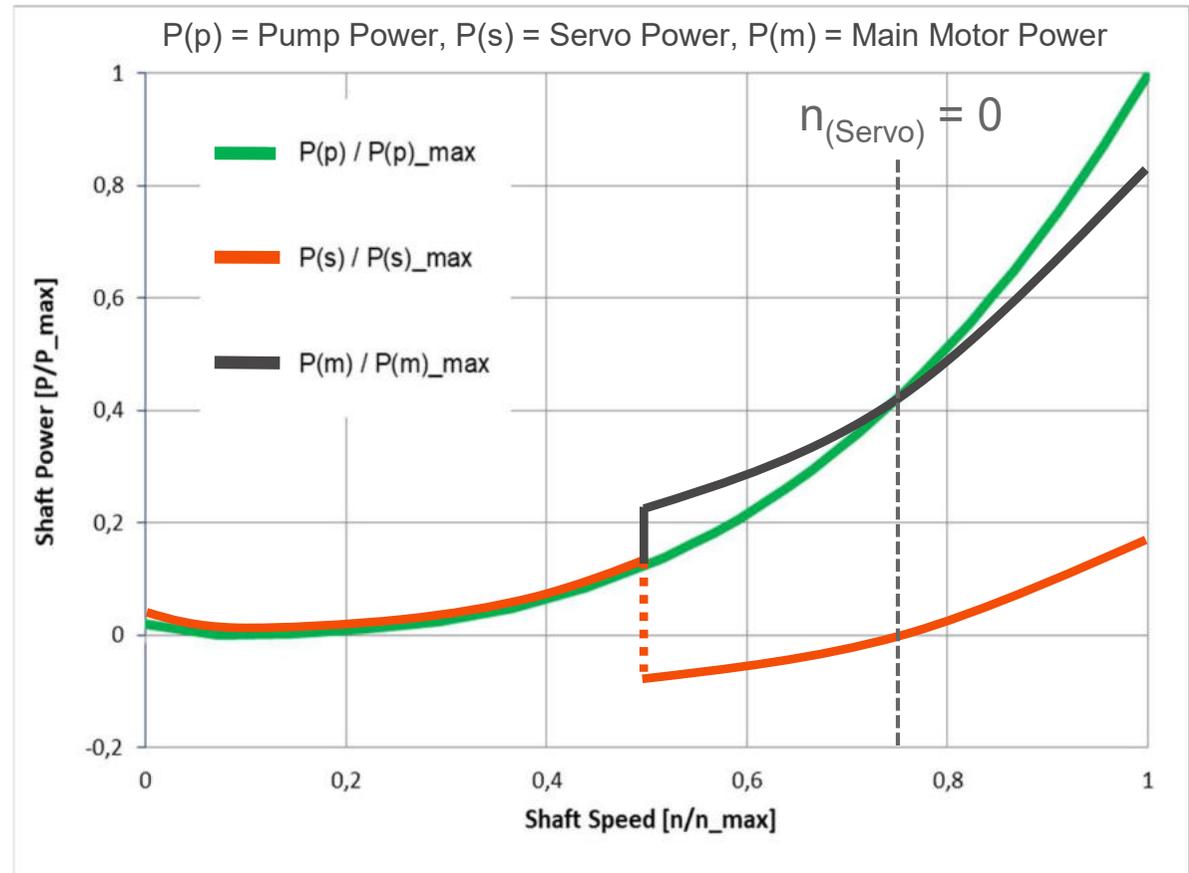
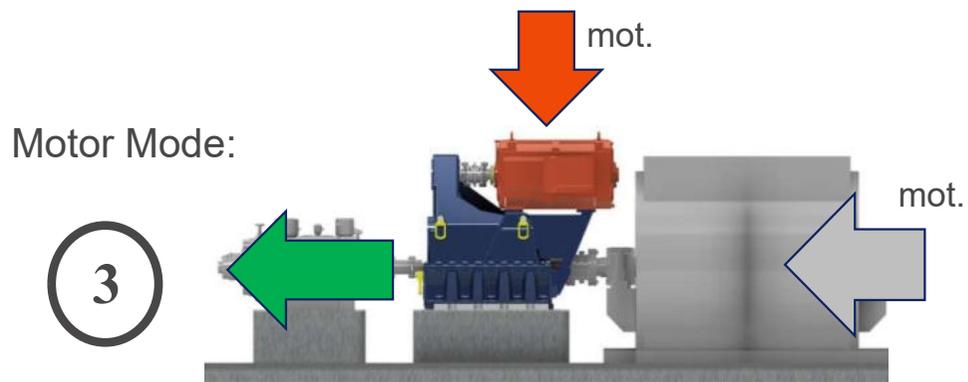
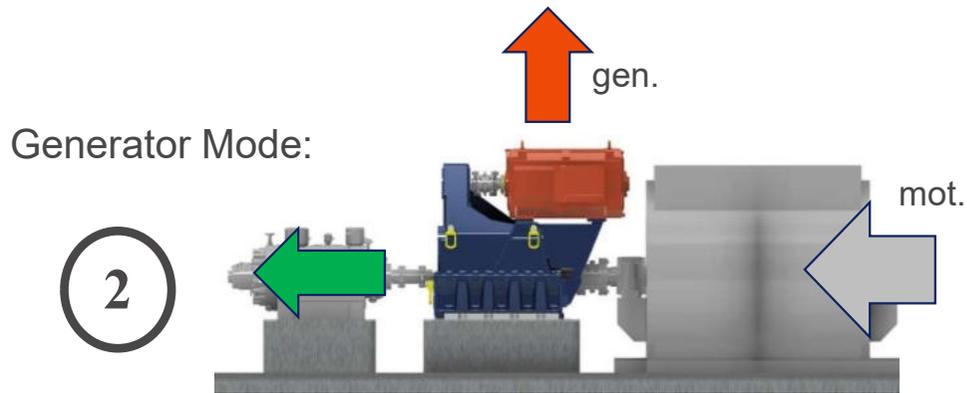
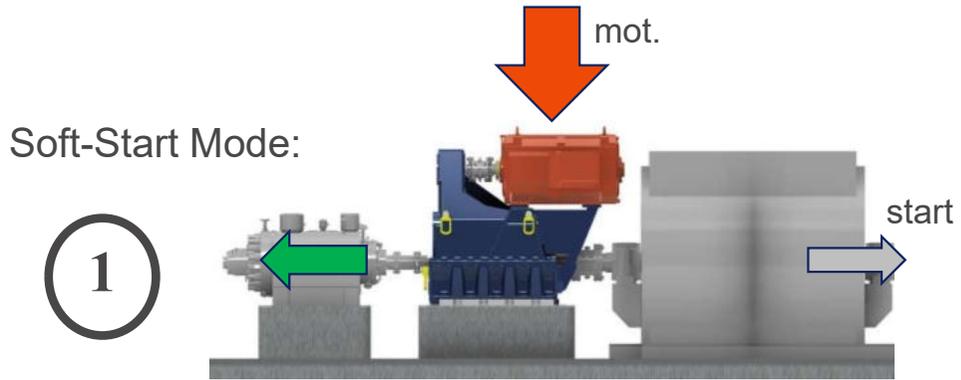
Pump $n/n_{max} = 75\% - 100\%$ (motor mode)

Output Speed decrease:

Planet Carrier spins in opposite direction than Sun Gear.

Pump $n/n_{max} = 50\% - 75\%$ (generator mode)

SETCON[®] operation modes



SETCON Reliability

Why SETCON Is One of the Most Reliable VSD Systems?



Standard low-voltage Motors (+ VFDs)
from leading manufacturers

Passive Overspeed
Protection (SSL)

MPS acc. API 670

Simple Gearbox
Design

Safety Factors > Standard

Integrated LOS acc. API 614

✓ Key Reliability Features of SETCON

✓ Mechanical Simplicity & Robustness

Fewer components and reduced complexity—built for demanding applications. Features a standard planetary gear stage for main power transmission.

Side Note: Complete gearbox assembly < 10 days

✓ Conservative Design with High Safety Factors

Gearbox design exceeds ISO, API, and AGMA safety standards to ensure long-term reliability and operational security.

✓ Standard low-voltage Motors and VFDs

Equipped with low-voltage Motors and VFDs from top-tier manufacturers, backed by thousands of global references.

✓ Patented SETCON Safety Lock (SSL)

Passive, self-activating overspeed protection for Motors, Bearings, and Gears — no active braking systems required.

✓ Redundancy “One-Servo Mode”

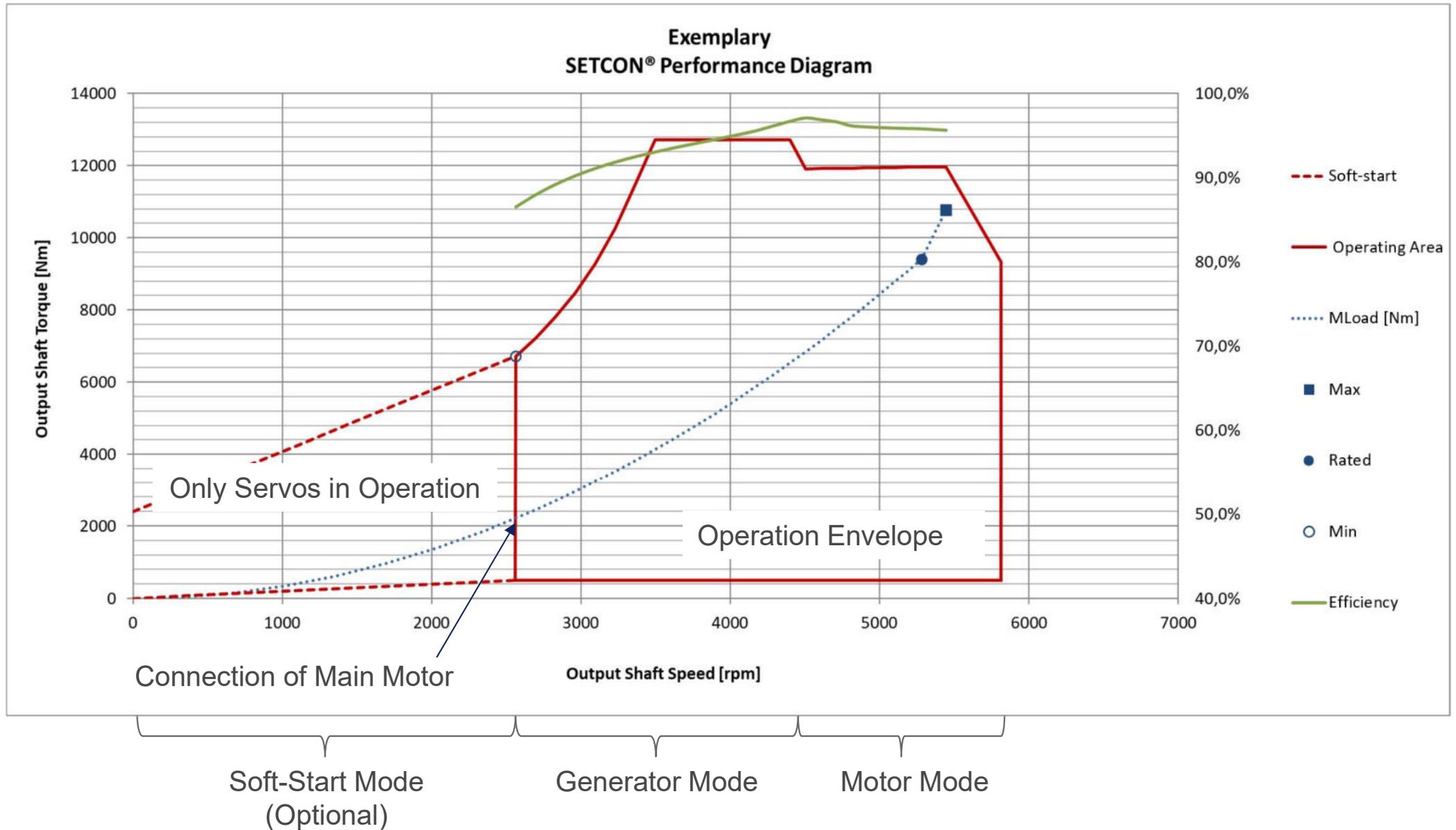
SETCON can be operated only with one Servo/VFD string under reduced load, sufficient for most operations.

✓ Proven Track Record

Global references, including units in continuous operation for over 5 years without downtime. SET is a registered vendor with ARAMCO, PDO, Sulzer, and others.



SETCON[®] Performance

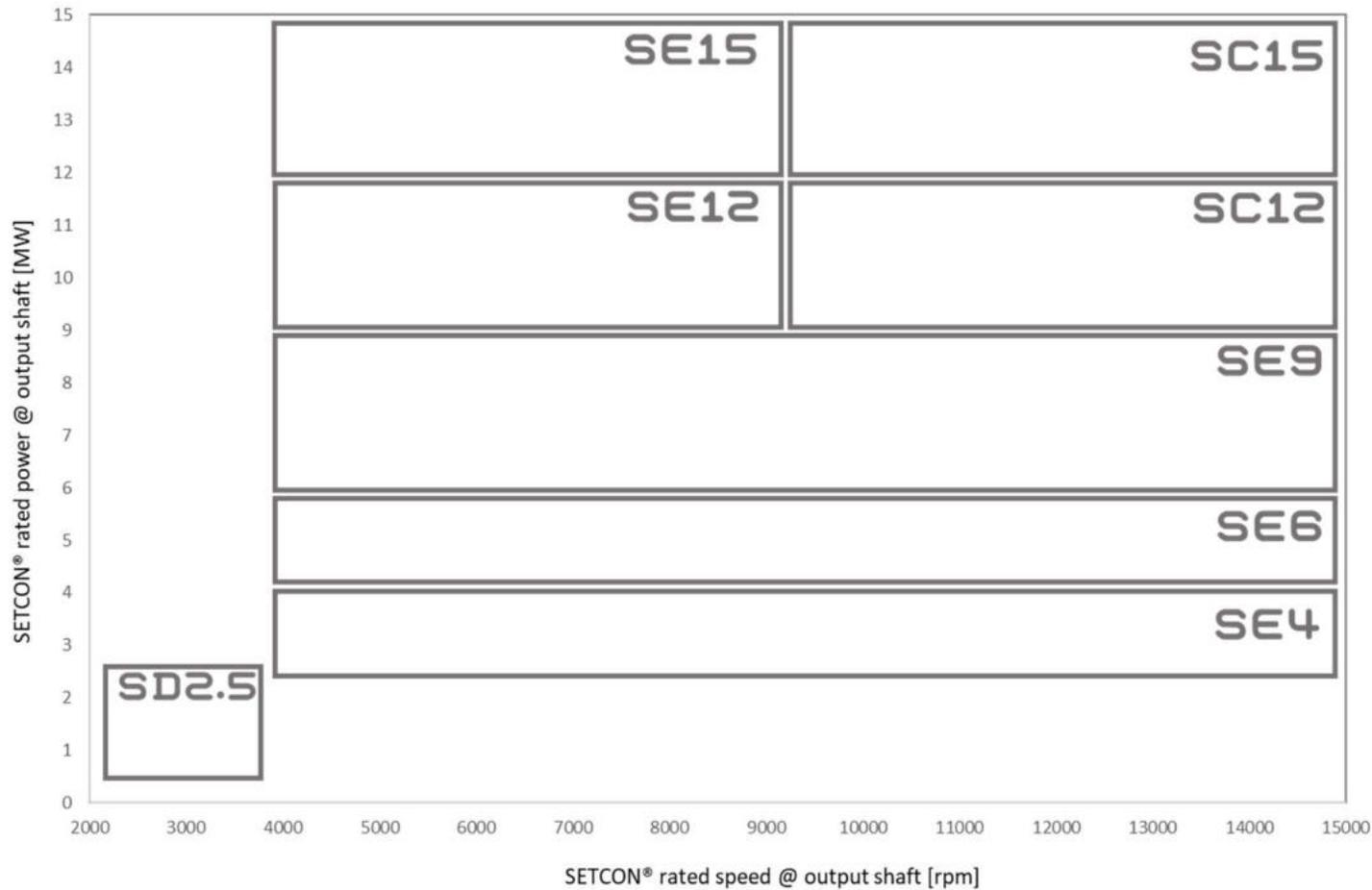


SETCON[®]

Gearbox Platform Standard Design



SETCON[®] Gearbox Platform



Gearbox Platform Topology:

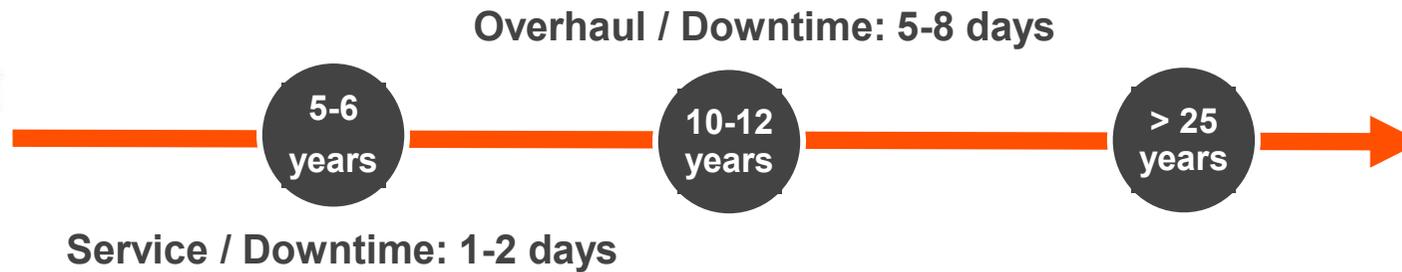
SE6AR



SETCON Maintenance

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Continuous On-line SETCON Monitoring: vibrations, temperatures, pressure and oil level.



5 tons max. weight for overhaul (based on SETCON SE9)



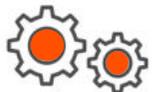
horizontal split casing for easy and quick runner access



service and overhaul on-site (lower housing remains on skid)



no special tools required



excellent spare part availability due to low-voltage electronics and standardized gearbox design (multiple sourcing!)

Areas of Application

Areas of Application: Pumps, Compressors, Blowers, Fans

Power Generation:

- Boiler feed pumps
- Fan drives
- Cooling and condensate pumps

Oil & Gas:

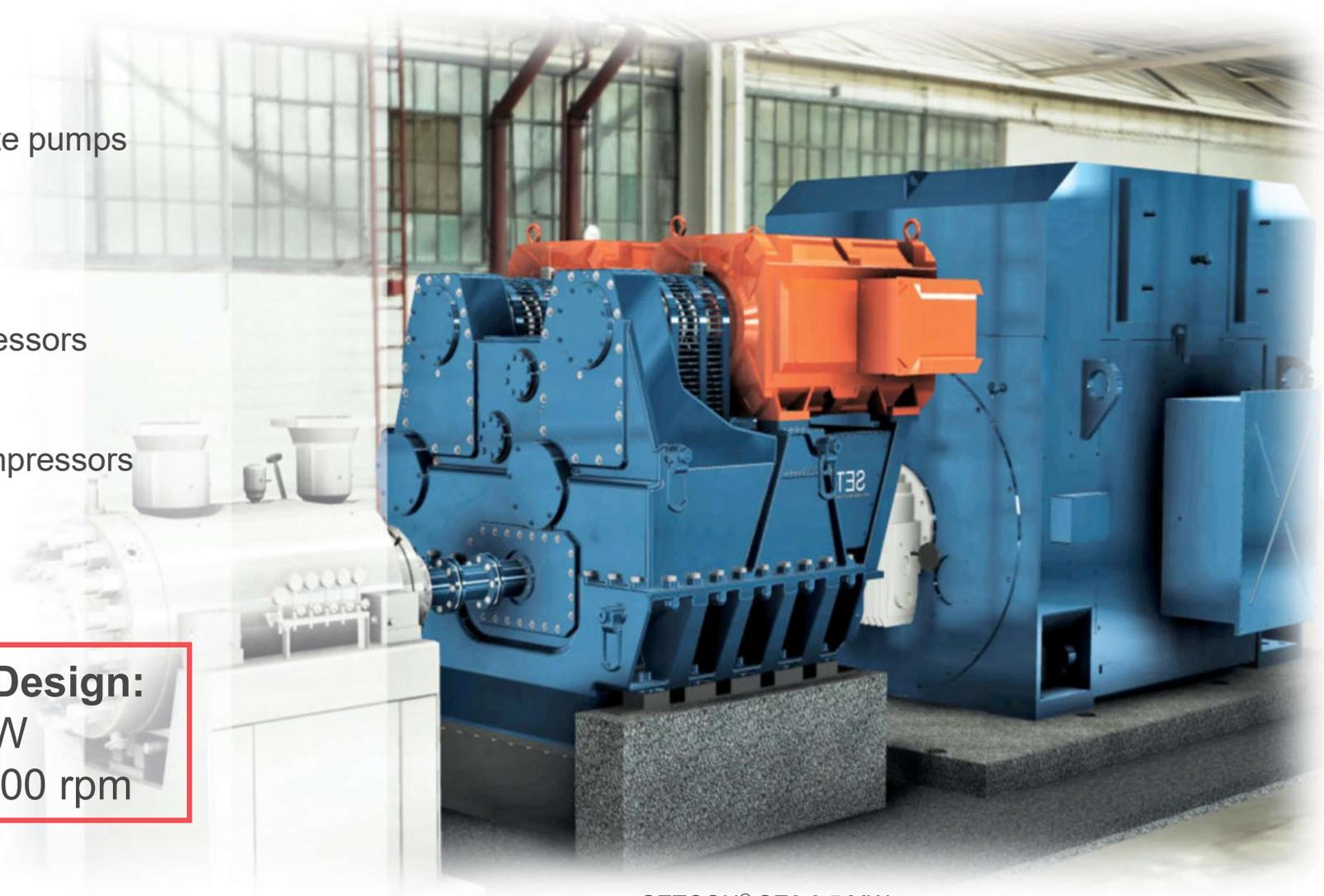
- Water injection pumps
- Crude oil pumps
- Pipeline pumps / compressors
- Gas lift compressors
- Process compressors
- LNG fuel / flash gas compressors

and many more.

Preferred SETCON Design:

Power: ≥ 1 MW

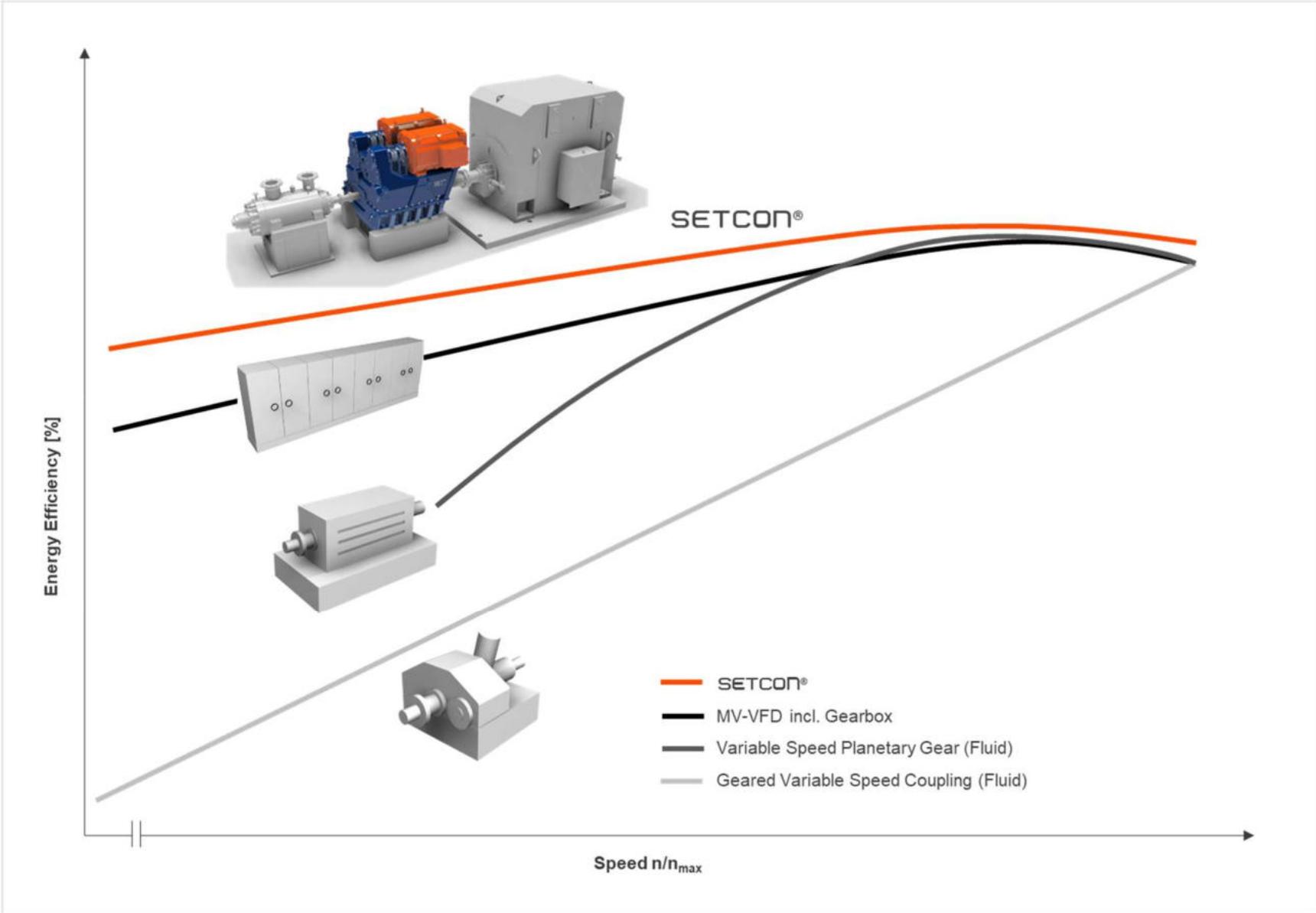
Output Speed: ≥ 3000 rpm



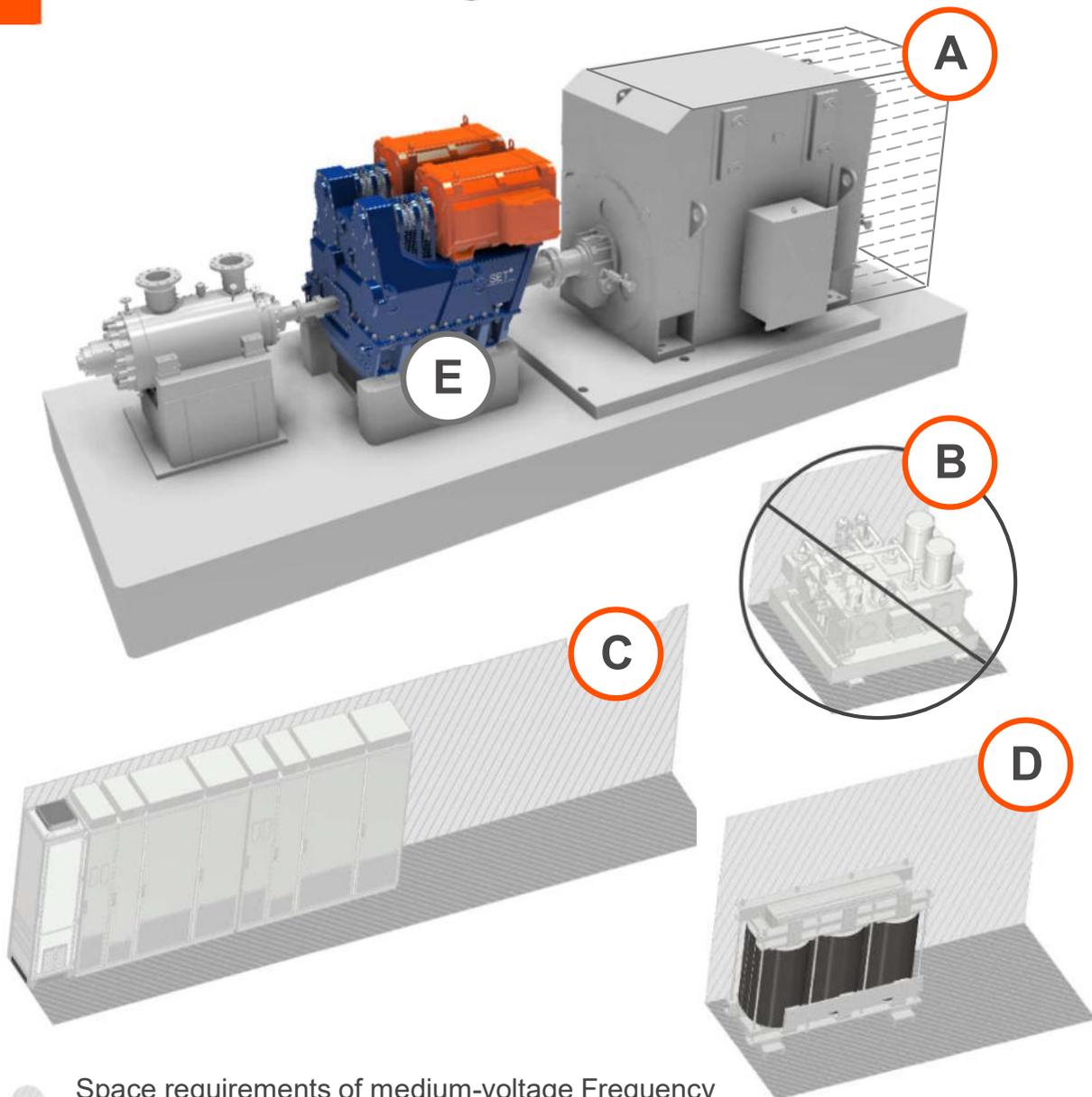
SETCON[®] SE6 6.5 MW

Energy Efficiency Comparison

incl. Main Motor, excl. Pump



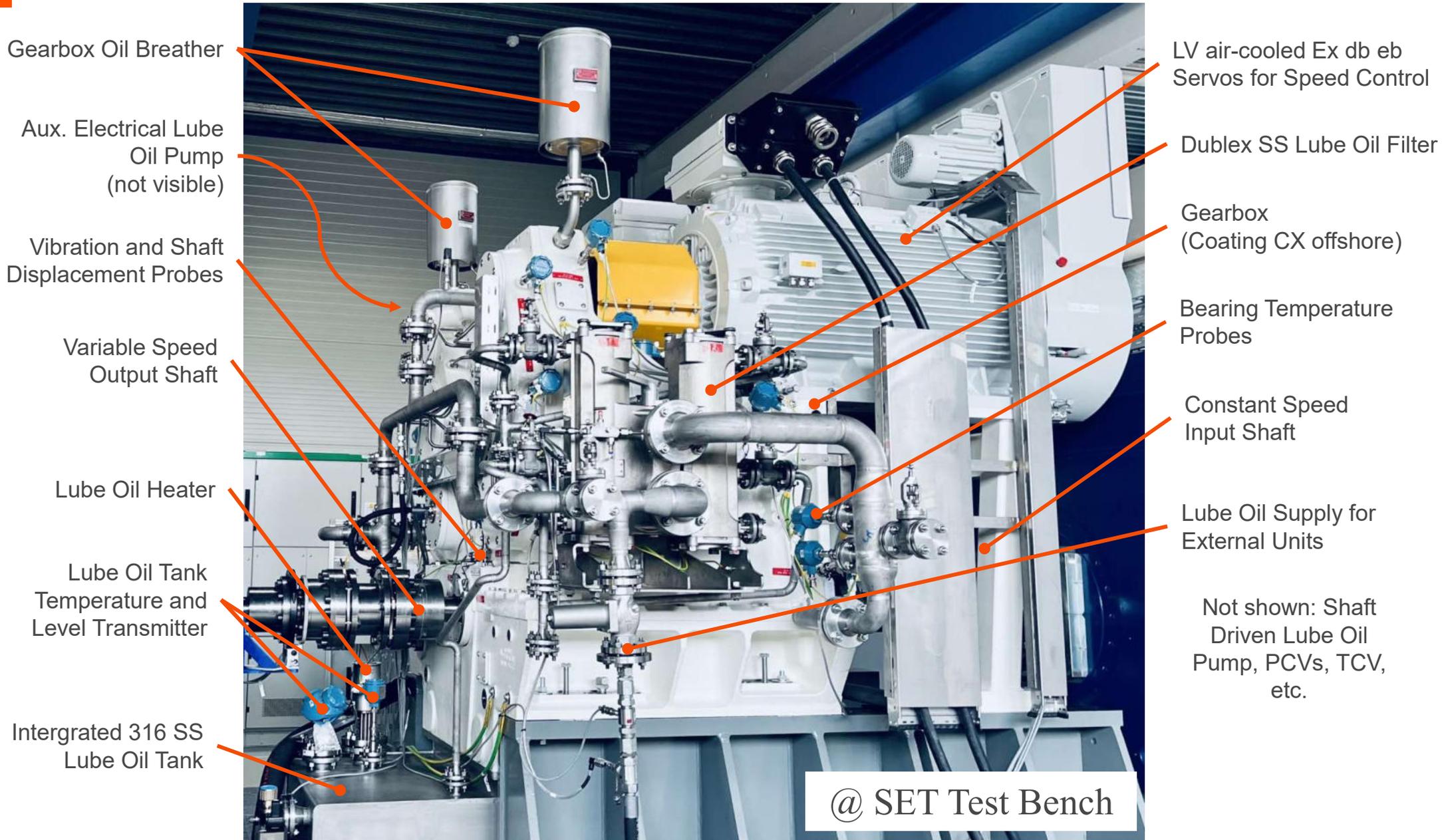
SETCON advantages compared to MV-VFD incl. gearbox



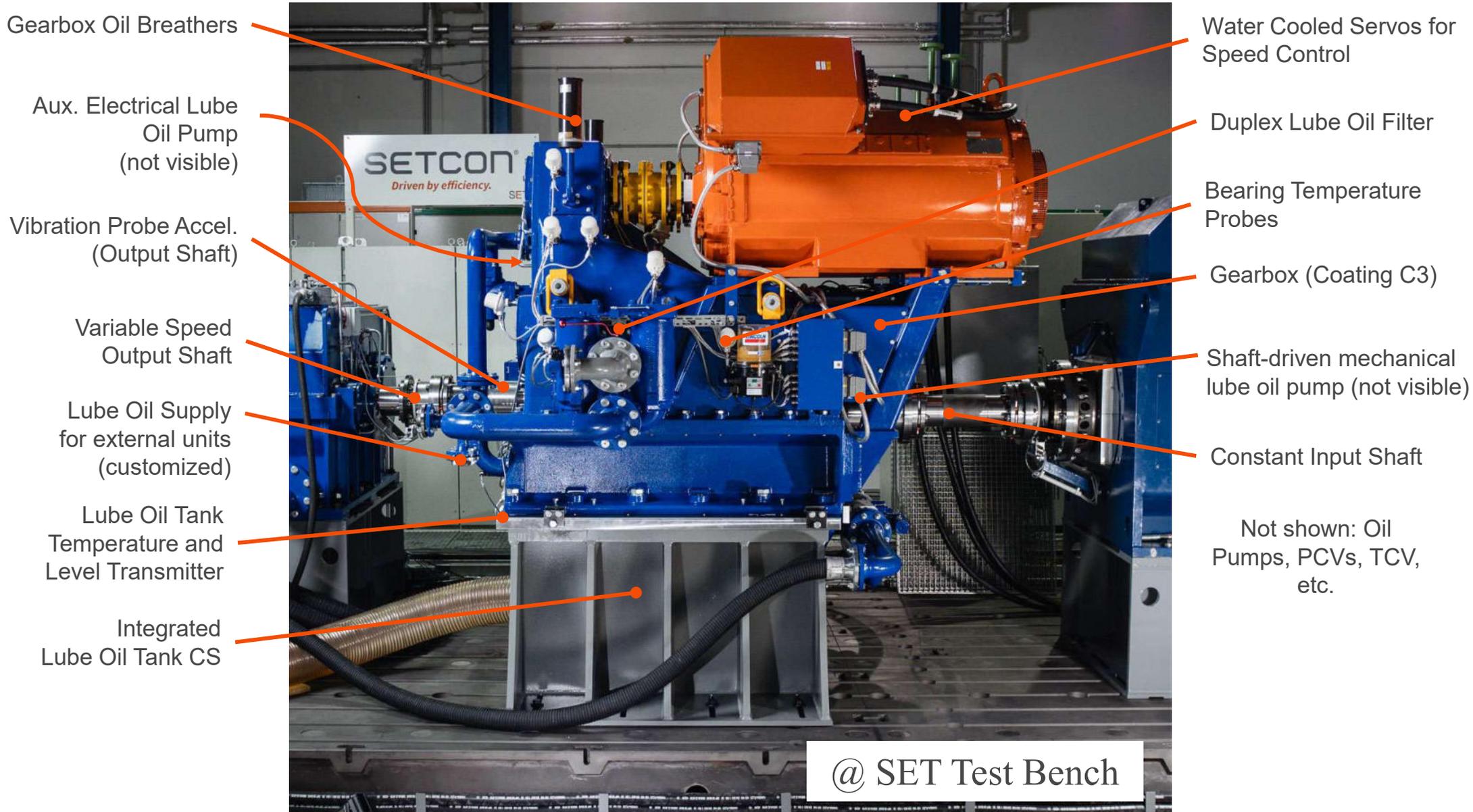
- !** On average, 2–10% **higher energy efficiency** across the entire speed range
- !** Reduced complexity through low-voltage VFDs, resulting in higher reliability and easier maintenance
- A** Minus **20%** Main Motor Power compared to MV-VFD
- B** **Integrated Lube Oil System** with oil supply to external units. **No Stand Alone Lube Oil Console** required
- C** Max. **20%** of Frequency Converter Power (of total driven power)
- D** Max. **20%** of Transformer Power (of total driven power)
- E** Plus **15% in length (DBSE)** compared to parallel shaft gearbox

Space requirements of medium-voltage Frequency Converter (MV-VFD) and Auxiliaries

SETCON[®] gearbox design Oil&Gas



SETCON[®] gearbox design Power Plants



SE4R (2 MW - 4 MW)

R17K...M
R16K...M
R15K...M
R14K...M

SE6R (4 MW – 6 MW)

R18K...M
R17K...M
R16K...M
R15K...M
R14K...M
R16/17 KGS

SE9R (6 MW – 9 MW)

R19K...M
R18K...M
R17K...M
R16K...M
R15K...M
R16 - 19 KGS

SE12R (9 MW – 12 MW)

R19K...M
R18K...M
R17K...M
R16K...M
R 18/19 KGS

SE15R (12 MW – 15 MW)

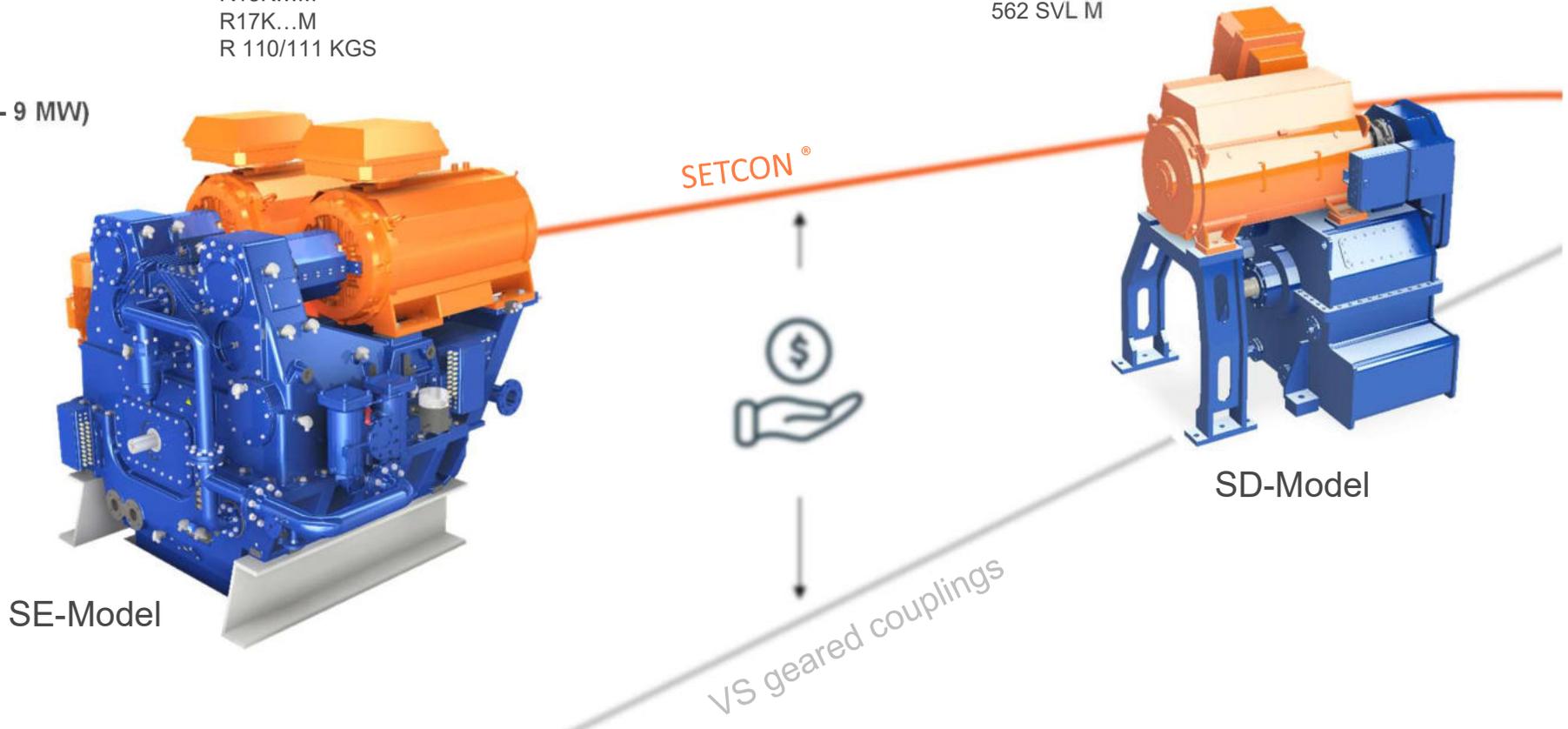
R100 K 630
R19K...M
R18K...M
R17K...M
R 110/111 KGS

SD2.5 (1 MW – 2.5 MW)

487 SVTL HP
562 SVTL 12.1
562 SVTL HP
562 SVTL 33
562 SVTL 33 HP

SD2.5A (1 MW – 2.5 MW)

464 SVL M
510 SVL M
562 SVL M



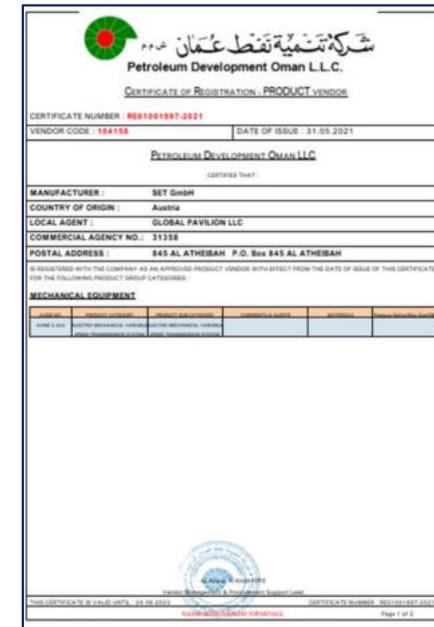
Vendor Registered at (among others):



Vendor ID: 10112049 / Plant ID: 30014623
#9com: 600000722 variable speed gearbox



Vendor ID: 104158 / AVME 2.20 A

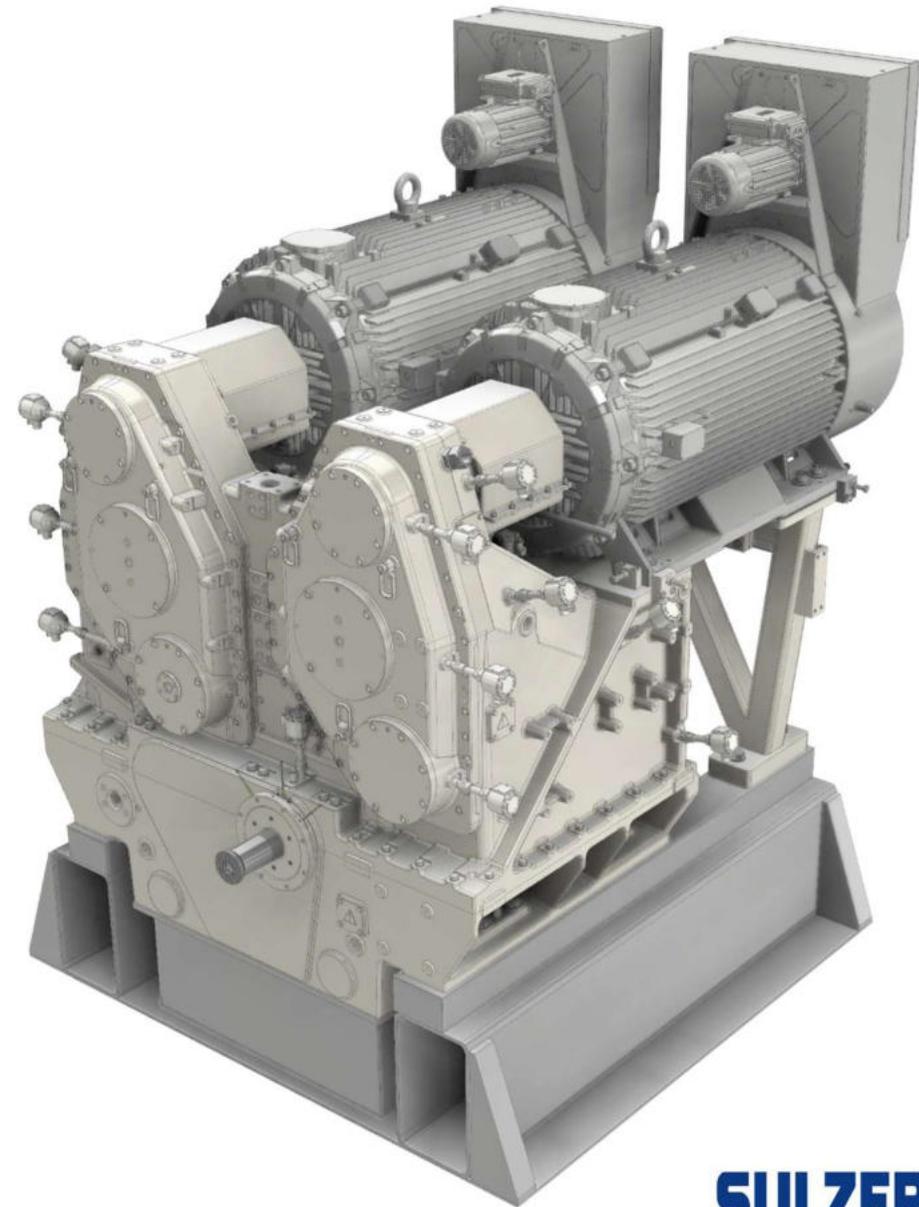


New Business Oil&Gas

PDO (Oman) – New Business

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4 MW SETCON – Oil&Gas application, 2023
Customer: PDO LLC / Sulzer Pumps
Location: Oman
Project name: Nahada Additional Booster Pump
Project type: new business, outdoor
Model: SETCON SC4A
Ambient temperatures: 5° C – 60° C
Area classification: Zone 2, Group IIB, T4
Design Power: app. 4 200 kW
Design Speed: app. 4 800 rpm
Speed range: 50% – 100%
Soft-Start: yes
Delivery date: Q3 2024
Commissioning Date: ~ Q4 2025
Energy Savings: app. **600 kW** compared to geared variable speed coupling (estimated)



شركة تنمية نفط عُمان
Petroleum Development Oman

SULZER 

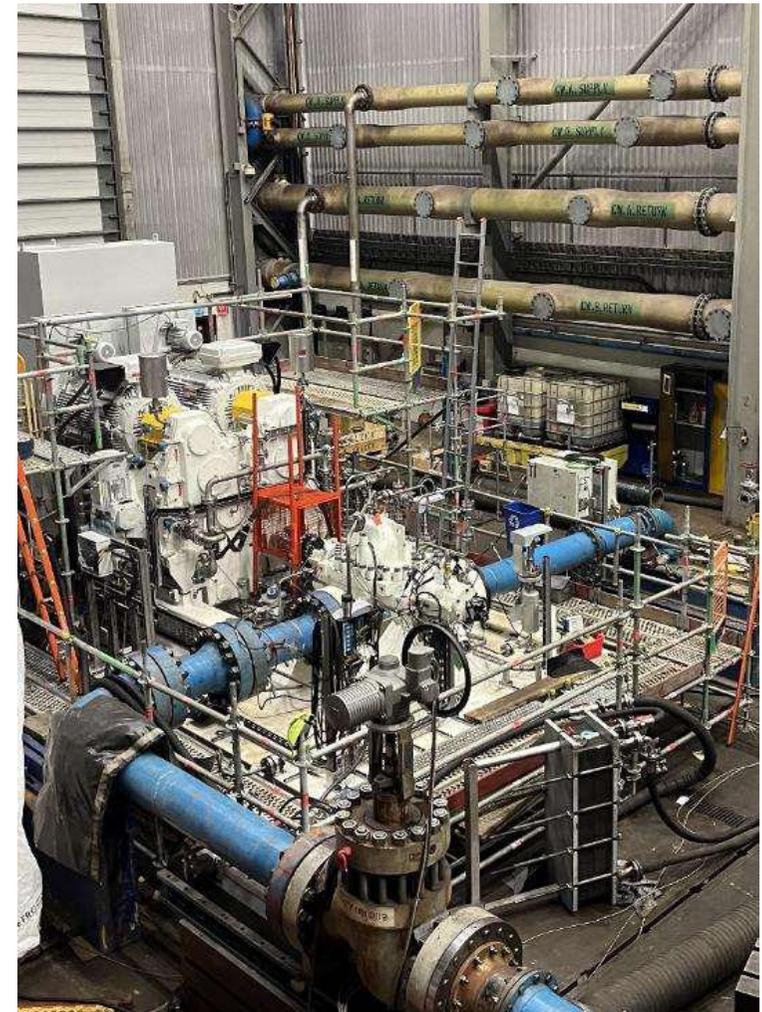
Nahada Additional Booster Pump – FAT at SET and Sulzer (UK)



Partial-load FAT at SET in May 2024

Proof of:

- ✓ Functionality (Soft-start, etc.)
- ✓ Energy Efficiency (highest among common variable speed systems)
- ✓ Values within range (temp., pressure, vibrations)



Full-load FAT at Sulzer Leeds in October 2024 with complete string

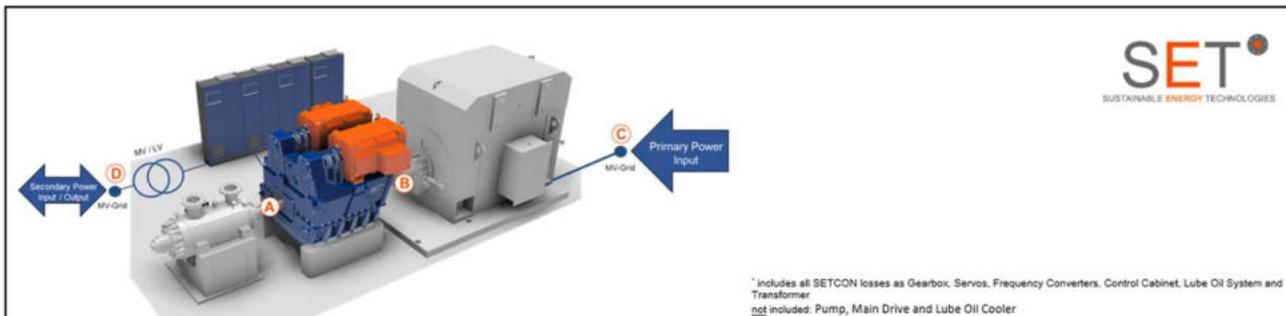
FAT Test Results at Sulzer

Full Load Performance Tests in October 2024



Measured values over entire speed range (54%-111%):

- **System Efficiency: 87.7% - 95.8% (96.5%)**
- Gearbox Housing Vibrations / Servo vibrations: < 1.5 mm/s
- Shaft Displacement Output Shaft: < 45 μm
- Bearing Temperatures and Oil Pressure: all within expected values
- Noise Level: max. 87 dB(A) (measured by 3rd party)



Pump Input				Primary Power			Secondary Power		Efficiency			Losses	
Operation Points	Gearbox Output Power	Gearbox Output Speed	Output Speed Range	SETCON primary mech. Power Input	Main Drive Efficiency	Main Drive electrical Power Input	SETCON secondary electr. Power Input / Output	Mode Servos	Total Input electr. Power	Total Efficiency Drive Train w/o Pump	Efficiency SETCON*	Losses Main Drive	Losses SETCON*
-	A	A	A	B	-	C	D	-	C + D	-	-	-	-
-	[kW]	[rpm]	[ninmax]	[kW]	[%]	[kW]	[kW]	-	[kW]	[%]	[%]	[kW]	[kW]
Max Condition	3778	4730	111%	3253	95.8%	3396	690	mot Mode	4086	92.4%	95.8%	143	165
Rated Condition	2924	4258	100%	2787	95.6%	2916	245	mot Mode	3161	92.5%	96.4%	130	108
Normal Condition	2702	4126	97%	2671	95.5%	2798	130	mot Mode	2928	92.3%	96.5%	127	99
Low Flow Cond.1	1438	3912	92%	1525	93.4%	1634	-4	gen Mode	1630	88.2%	94.5%	109	84
Low Flow Cond.2	921	3378	79%	1120	91.2%	1228	-132	gen Mode	1096	84.0%	93.2%	108	67
MIN	439	2300	54%	785	88.0%	892	-284	gen Mode	608	72.3%	87.7%	107	61
Max EOC	4336	4730	111%	3709	95.7%	3875	790	mot Mode	4665	92.9%	96.4%	167	163
Low Flow 2 EOC	1585	3378	79%	1924	94.5%	2037	-248	gen Mode	1789	88.6%	94.5%	113	92

SULZER
Pumps Equipment
Sulzer Pumps (UK) Ltd

Performance Test Data Summary

Date: 11.10.2024
Client: Overseas Projects + Equipment Co LLC
Project: Oil Refinery - Additional Booster
Pump Service: Crude Oil Booster
End User: Petroleum Development Oman LLC
Client's Order No.: 480718324
Tag No.: P-8516
Pump No.: 1
Pump Type: MSD 12x12x150/24g
Manufacturer's Order No.: 10854349-010

Quotation Code: API 610 11th Edition
Test Engineer: Anas Tsamir
Connected Data Units: Metric

Pump Performance

Flow	Head	Power	Efficiency
+5	+3	+4	N/A
-5	0%		N/A
1160	973.0	3719.0	83.0
1164	991.5	3786.0	82.90

Mechanical Performance - Pump Vibration at 4732rpm

Region	Rated		ADR	
	Limit	4.50	5.00	5.00
Peak OE Housing Velocity	1.98	1.16	1.59	3.39
Peak MDE Housing Velocity	2.00	1.84	2.23	3.84
Peak OE Shaft Displacement	33.20		33.30	41.10
Peak MDE Shaft Displacement	16.4	12.5	23.6	13.9
	15.6	12.6	17.9	14.1

Mechanical Performance - Bearing Temperatures

Lubrication Type: Lube Oil System
Oil Grade: VG46

Pump OE Journal T8.3		Mechanical seal leakage collected in
Pump MDE Journal T6.3		control pan* See
Pump Inboard Thrust T2.1		
Pump Outboard Thrust B8.9		
Misc OE Journal B6.4		
Misc MDE Journal B7.8		

Test Review and Acceptance

Please note that the test was conducted over two days. 10th October being Mechanical run-1 11th October being performance NPSH/Aux flow switch test. Please refer to the test report and a process run-up and run-down for extra information for commissioning activities. The results compared with the test and the Acceptance Criteria detailed above and have been reviewed and accepted by:

Test Engineer: Sulzer Project UK LTD
Reviewed/Approved: REVIEWED/ACCEPTED
Date: 16.10.24 Witnessed: _____



Smart technology
for our Environment and
your benefit

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