



WIN G&D

Winterthur Gas & Diesel

Tier III programme

Status and Outlook

Dominik Schneider

**Licensees'
Conference 2015**

Interact. Inspire. Innovate.

**INTERLAKEN
6-9 SEPT 2015**

Agenda

1 *Regulations & Markets*

2 *Selective Catalytic Reduction (SCR)*

3 *Exhaust Gas Recirculation (EGR)*

4 *Conclusion*

IMO/MARPOL Summary

International Convention for the Prevention of Pollution from Ships

SO_x
Acid rain

3.5% (2012)
ECA 0.1% (2015)
0.5% (2020-25)

Regulation 14

NO_x
Acid rain

Tier II (2011)
Tier III (2016)

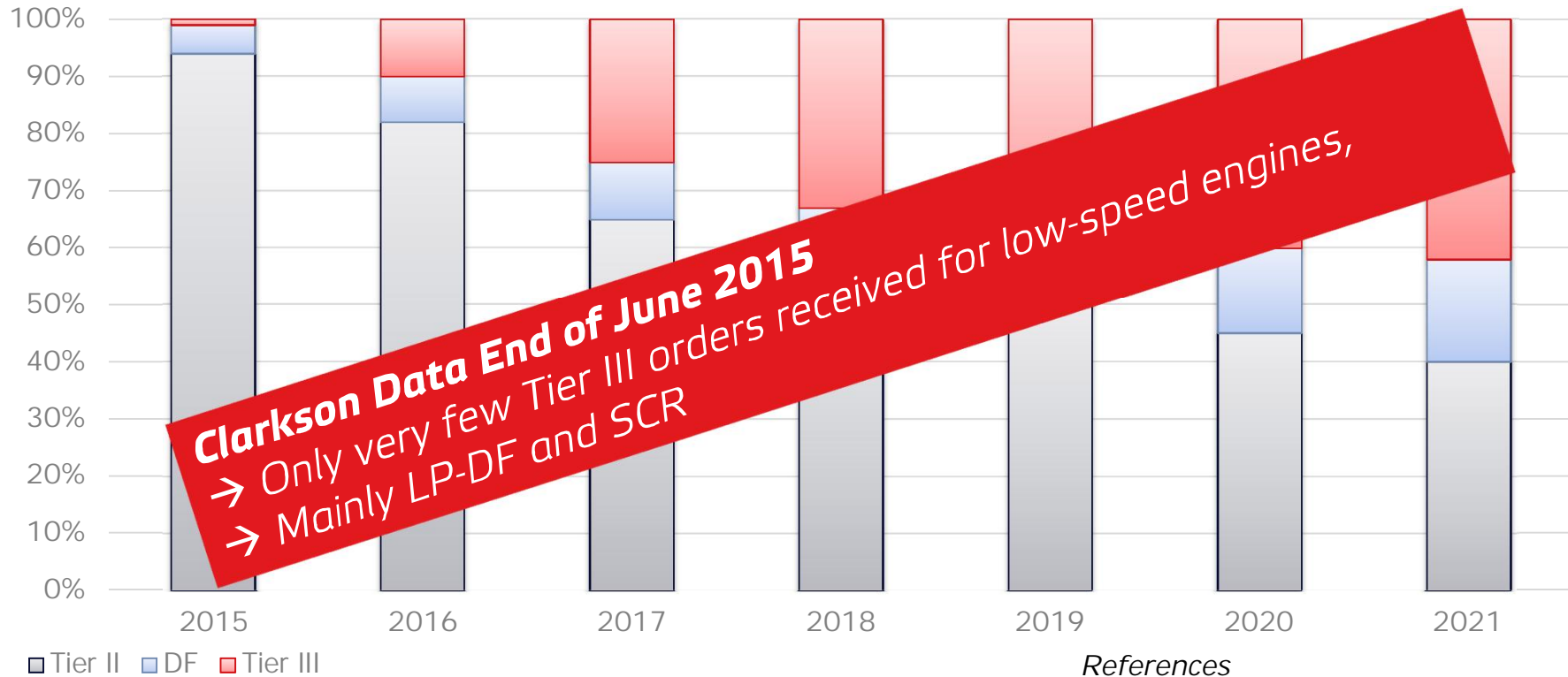
Regulation 13

CO₂
Greenhouse gas

EEDI
by IMO

Markets

Estimated Tier III engine deliveries over time



References

BCG 2015: 5-27% DF

in 2020

IHS 2014: 60% T3 in

2021

DNV-GL 2014: 40% T3 in 2020

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SCR

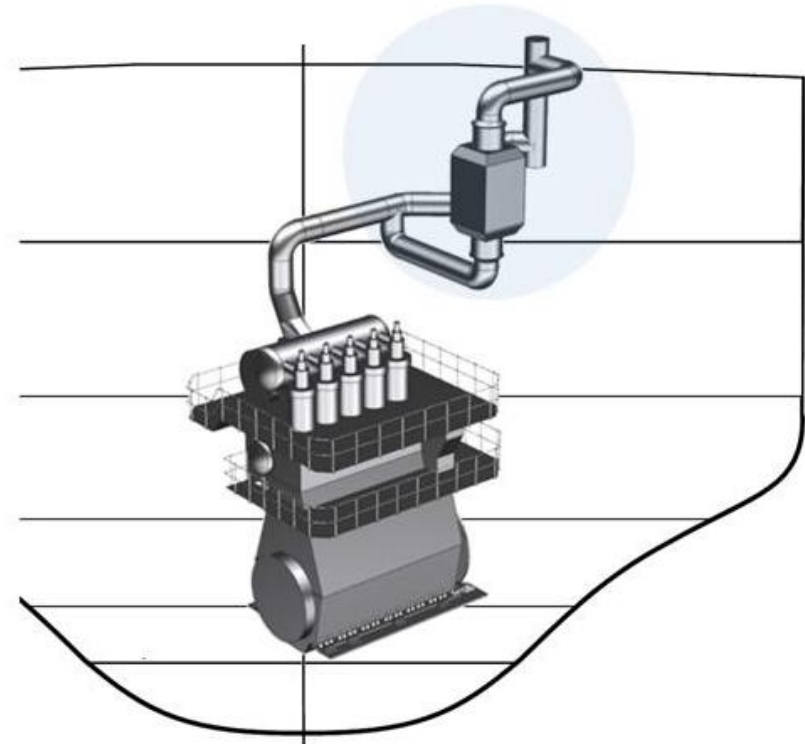
(Selective Catalytic Reduction)

Low-Pressure SCR

- The SCR system is placed on the **low-pressure side, after the TC turbine**, giving high flexibility to arrange the SCR system anywhere in a vessel.
- **No engine modification is required**

WinGD provides interface specifications

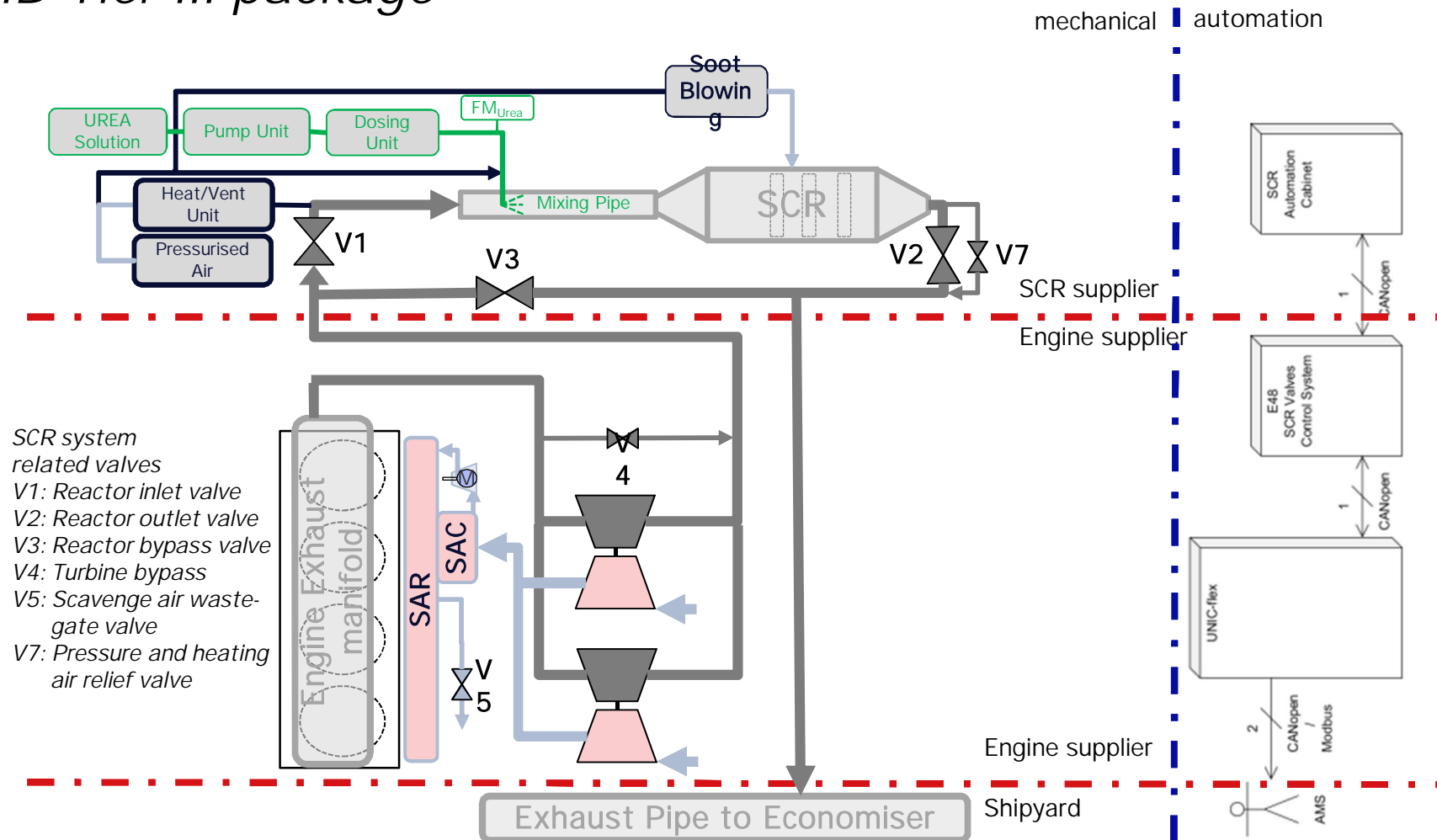
- Integration of LP-SCR control interface.
- Released for the entire engine portfolio.
- Published engine performance data (GTD data).



Picture Doosan

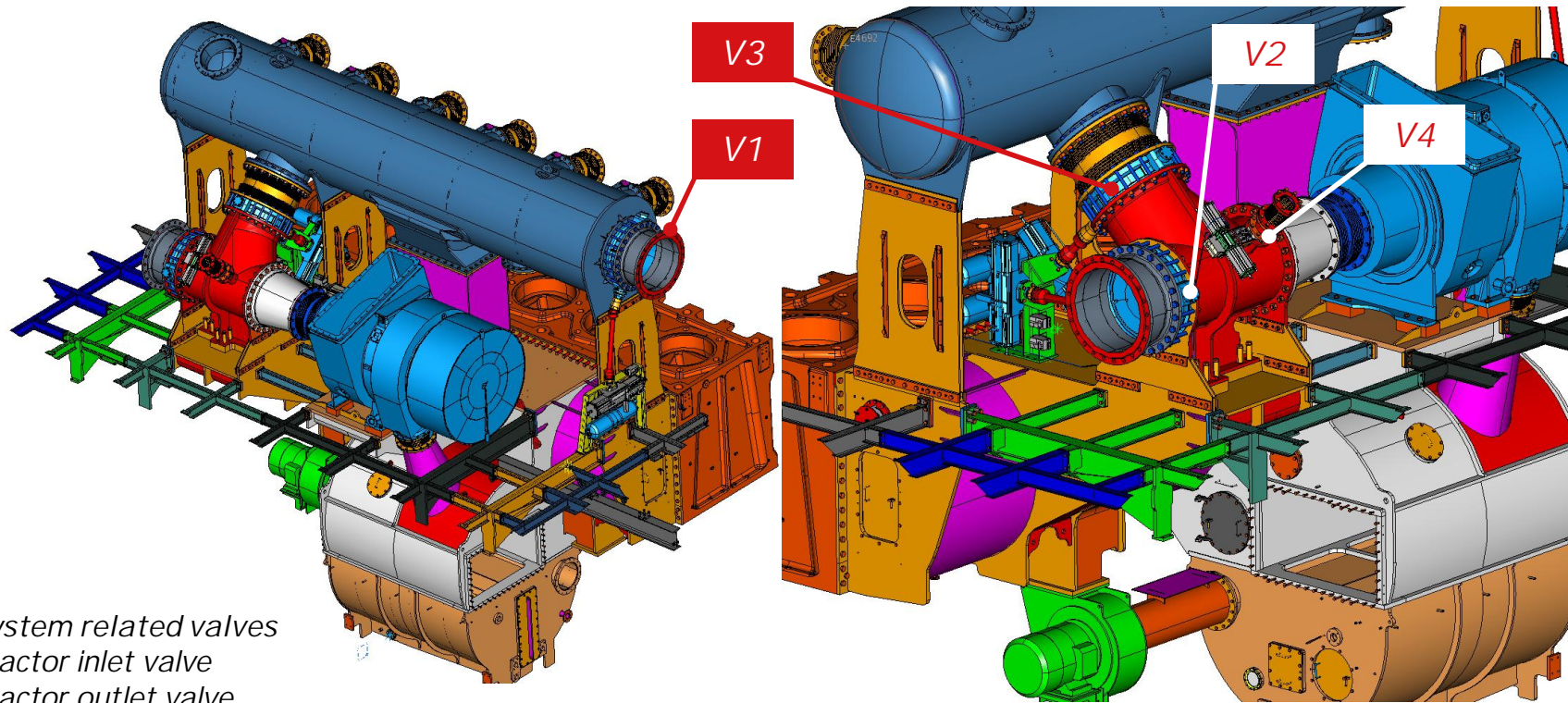
LP-SCR

PID Tier III package



High-Pressure SCR

Example W6X72, single TC



SCR system related valves

V1: Reactor inlet valve

V2: Reactor outlet valve

V3: Reactor bypass valve

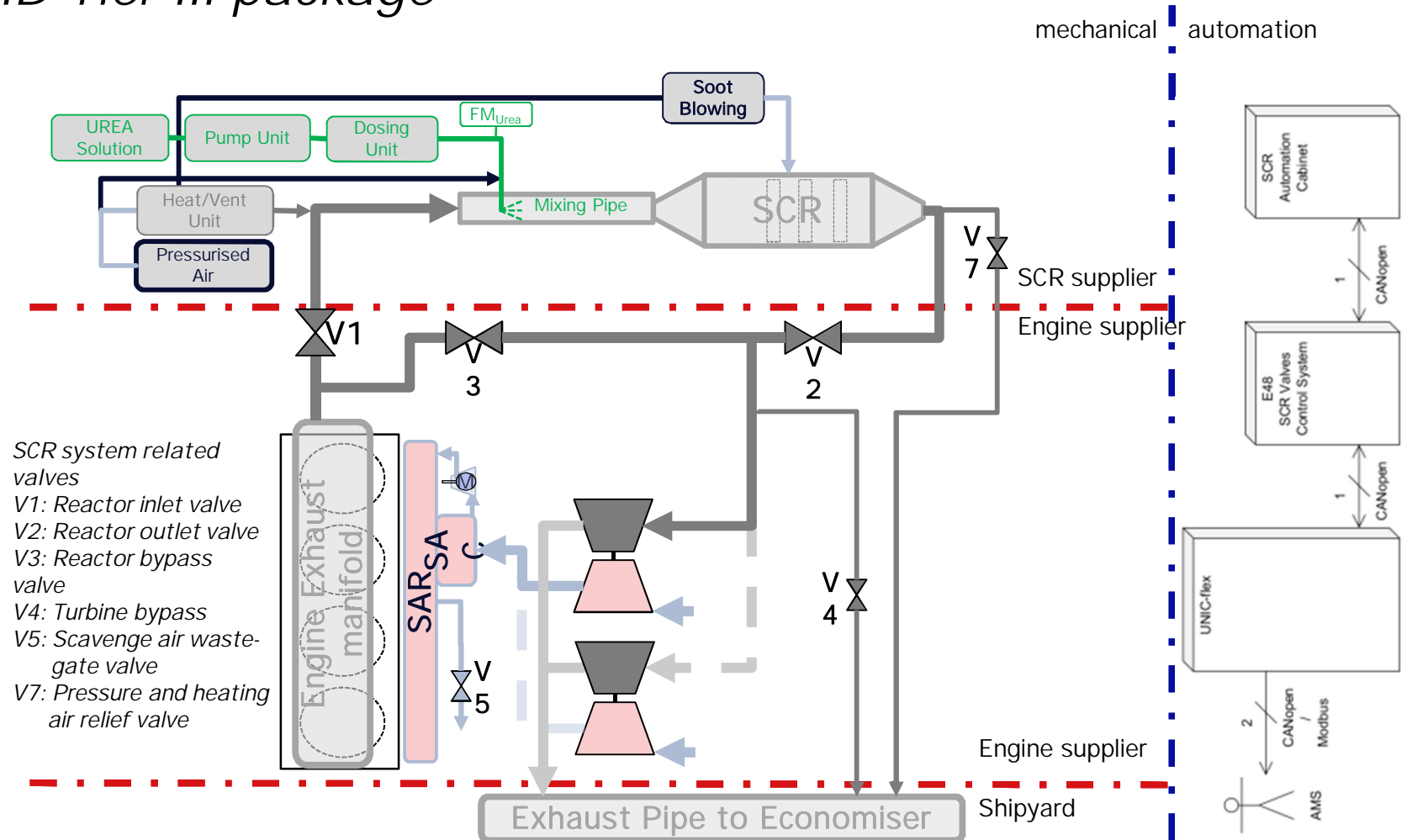
V4: Turbine bypass

V5: Scavenge air waste gate valve (not shown)

V7: Pressure and heating air relief valve (not shown)

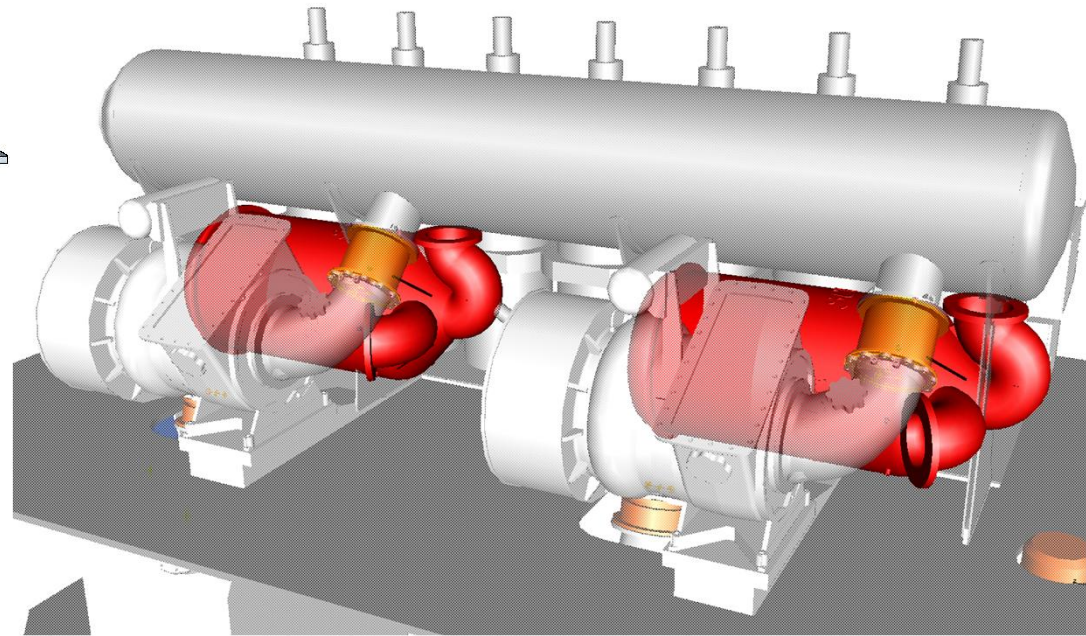
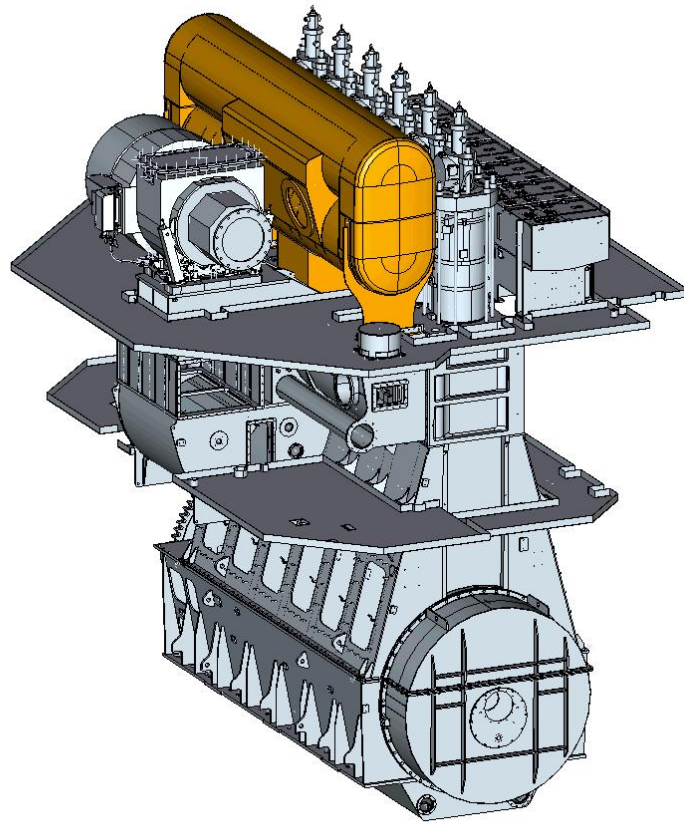
HP-SCR

PID Tier III package



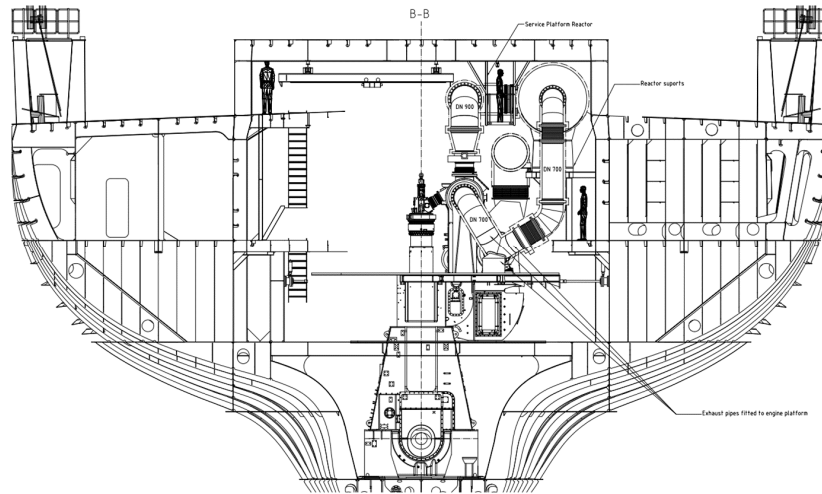
HP-SCR

Integrated on-engine package



HP-SCR

Single TC pilot



- 5RT-flex58T-D
- 22,000 DWT MPV
- CMCR 10,000 kW at 105rpm
- Shipyard: Ouhua Shipyard
- Class Society: LR
- Owner: China Navigation

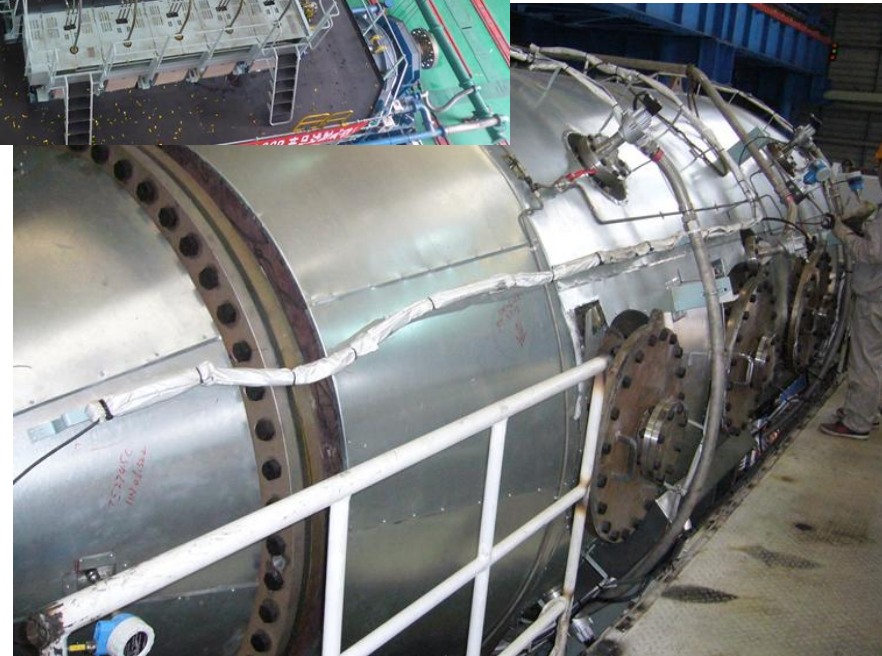


HP-SCR

Single TC pilot



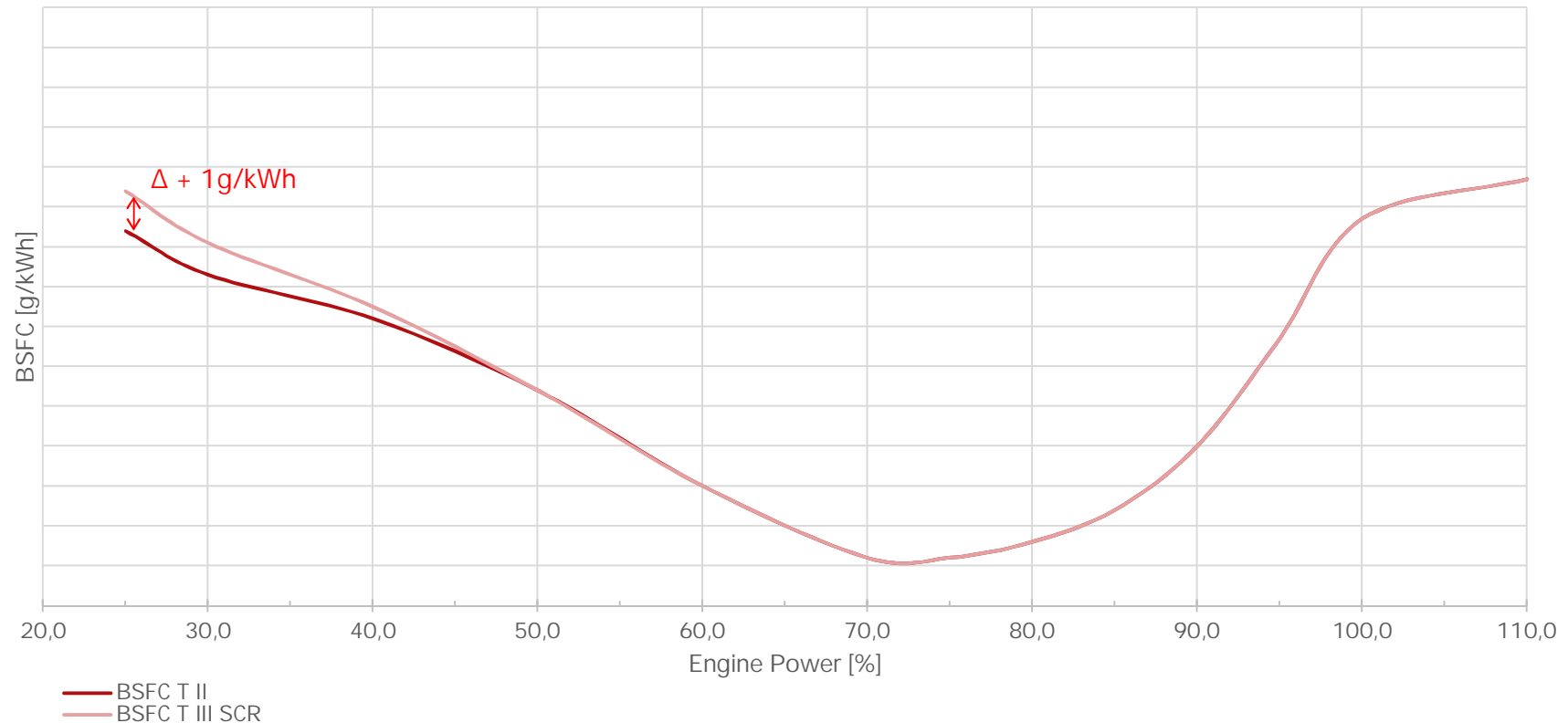
- *Successful FAT in January 2015*
- *Successful sea-trial in July 2015*
- *Start of operation in August 2015*



Optimised BSFC with HP SCR

Indicative fuel consumption increase for SCR operation in Tier III mode
(example W6X72 Low Load Tuning → engine and rating dependent)

W6X72, 17430 kW at 82 rpm



HP-SCR references

Delivered or under construction

RTA52U

- 3x RoRo (Wagenborg, SWE),
since 1999

RTX-5

- 1x 6RT-flex50 research engine
(Wärtsilä, Trieste)

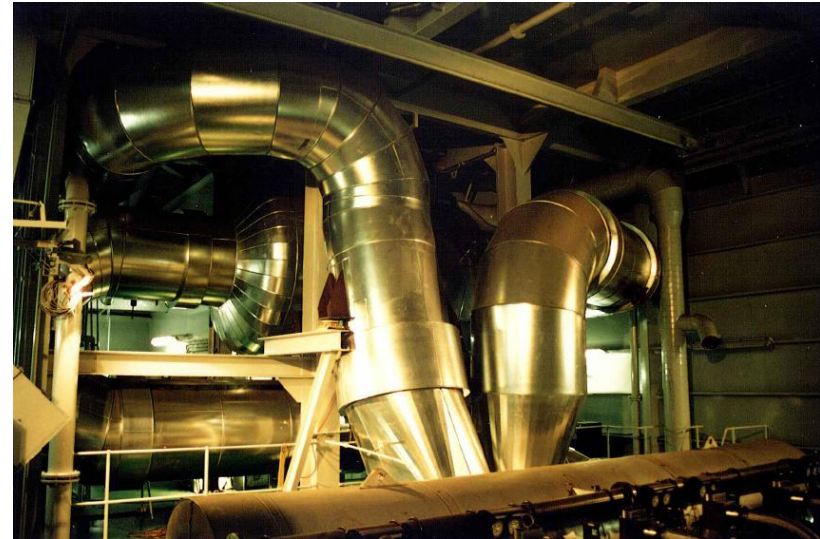
RT-flex58T

- 1x 22.1 kDWT MPP
(China Navigation, Singapore)

W-X72

- 2 Suezmax Tankers
(AMPTC, EG)

Total: 7 engines



EGR

(Exhaust Gas Recirculation)

High-Pressure EGR

Validated Tier III solution

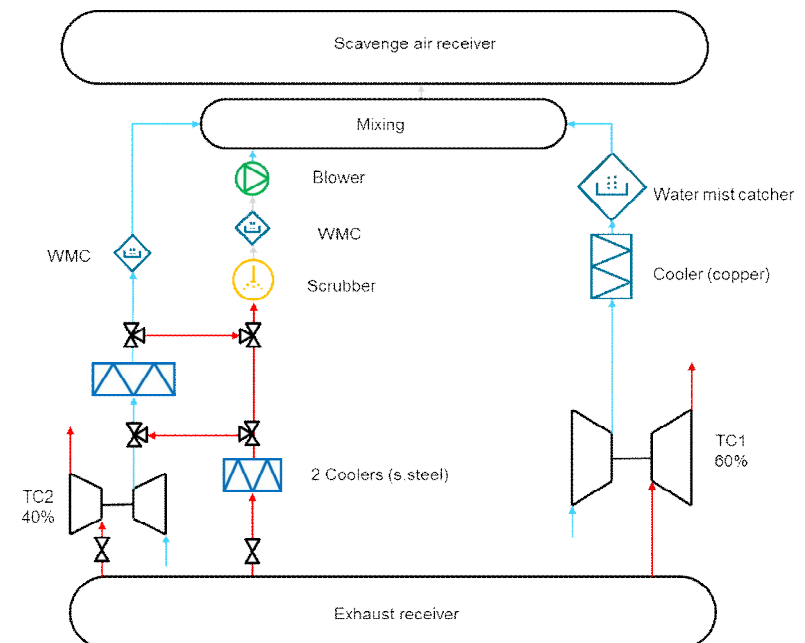
Function

- HP-EGR; Approx. 40% exhaust gas is recirculated **outside the cylinder**.

Characteristics

- Engine internal approach, compact solution.
- Requires more complex ancillary systems than SCR.
- Comes with a considerable fuel penalty in Tier III mode
- In case of scrubber failures, engine cylinder components are subject to fast degradation.
- Scrubber waste water treatment requires caustic soda and generates sludge.
- Exhaust cooling absorbs heat energy which is lost.
- Upper engine structure requires reinforcement

WinGD pilot test planned in 2017



Internal EGR

Contributing technology

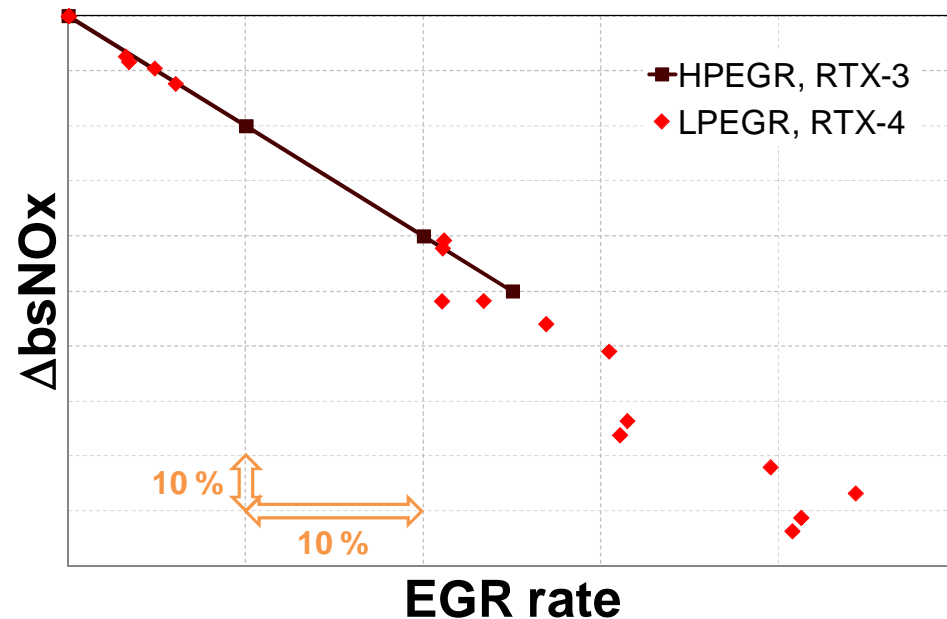
Function

- Internal EGR; exhaust gas is retained in the cylinder during scavenging.
- Not able to attain Tier III NO_x level by itself.

Characteristics

- High boost pressure combined with Miller timing compensates temperature level in the cylinder.
- Of all the EGR approaches, internal EGR has the lowest number of components exposed to the exhaust gases.
- No additional ancillary systems needed.
- No exhaust gas cleaning needed.

Internal EGR is standard on WinGD Tier II low speed engines.



Conclusion

Conclusion

WinGD is currently...

LP-SCR

- *Providing a control interface specification.*
- *Open for any LP-SCR provider.*

HP-SCR

- *Providing an engine interface specification.*
- *Having a single TC field test vessel.*
- *Planning a multiple TC field test.*
- *Designing an on-engine concept.*

LP-EGR

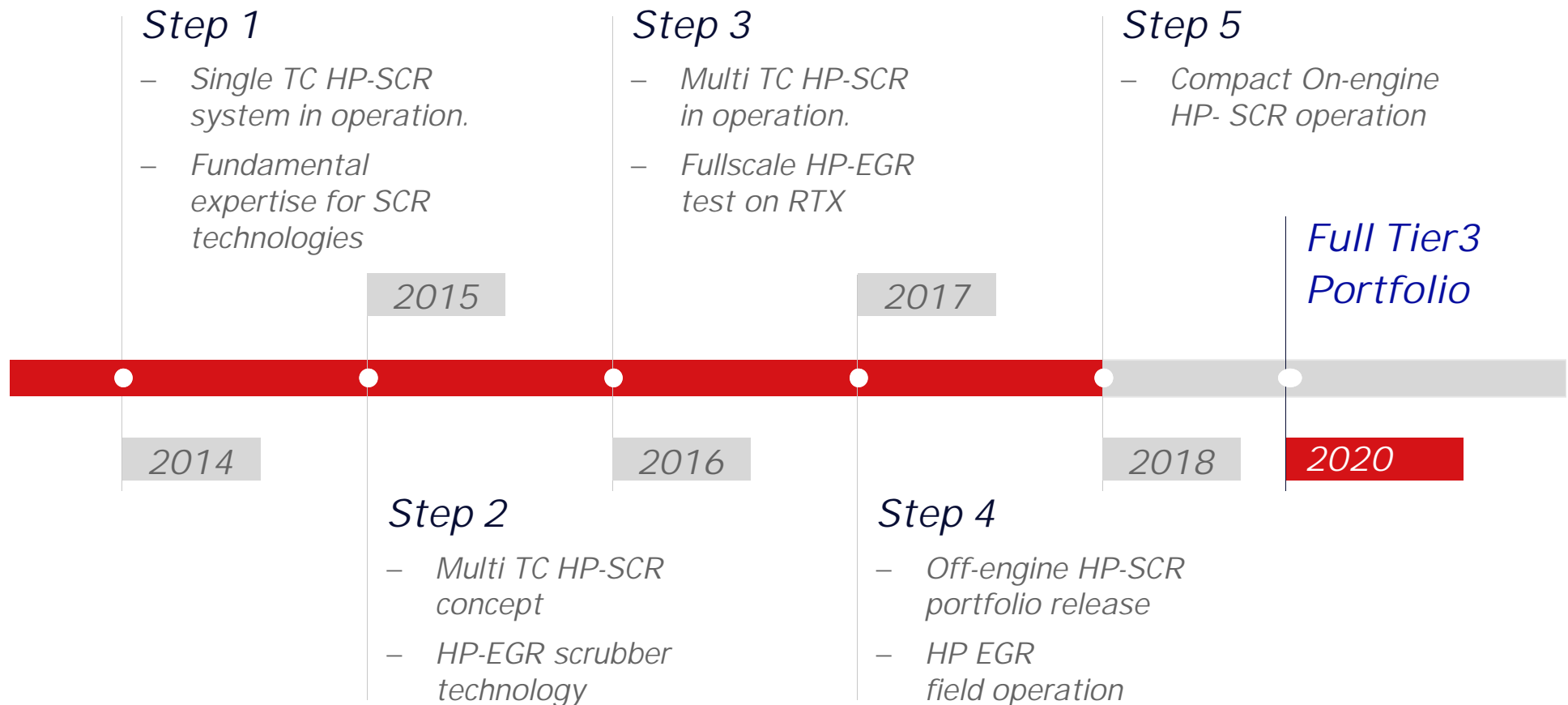
- *Having own experience with testing.*
- *Open for testing third party proposals.*

HP-EGR

- *Optimising scrubber technologies.*
- *Planning a full scale RTX HP-EGR test.*
- *Planning an HP-EGR field test*

Development Roadmap

Tier III NO_x abatement technologies



WinGD Summary

Where do we go...?

HP-SCR

First Choice

- *Technology Leadership*
- *1st step off-engine*
- *2nd step on-engine*
- *GTD data*
- *Performance optimised*

LP-SCR

Fully Supported

- *Third party supply*
- *Control integration*
- *Engine limitations*
- *GTD data*

EGR

Development

- *Concepts available*
- *Pilot Tests pending*