

The latest technologies for new concept "UEC-LSJ" engine

October 12 2018

10th CIMAC CASCADES in Kobe, Japan

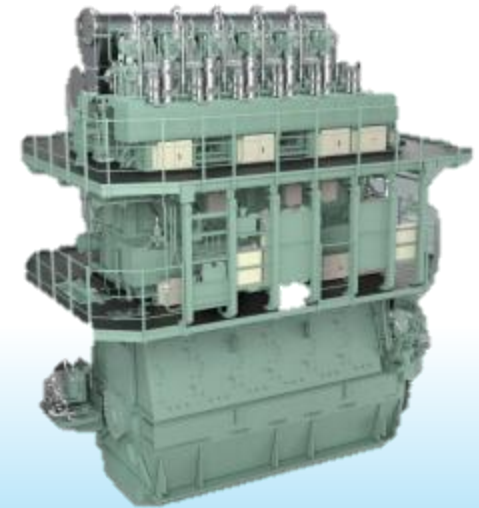
Chikara Matsuda

WMS-F440

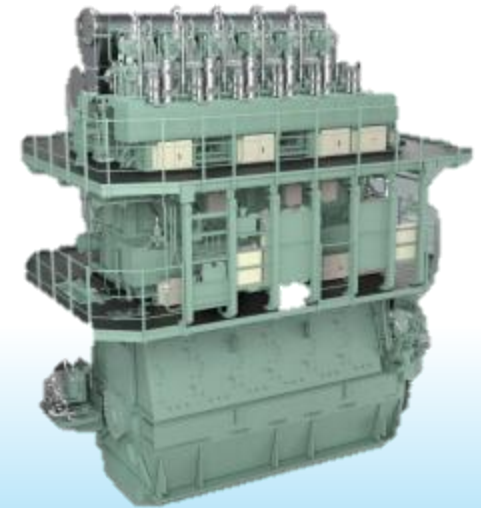
Japan Engine Corporation

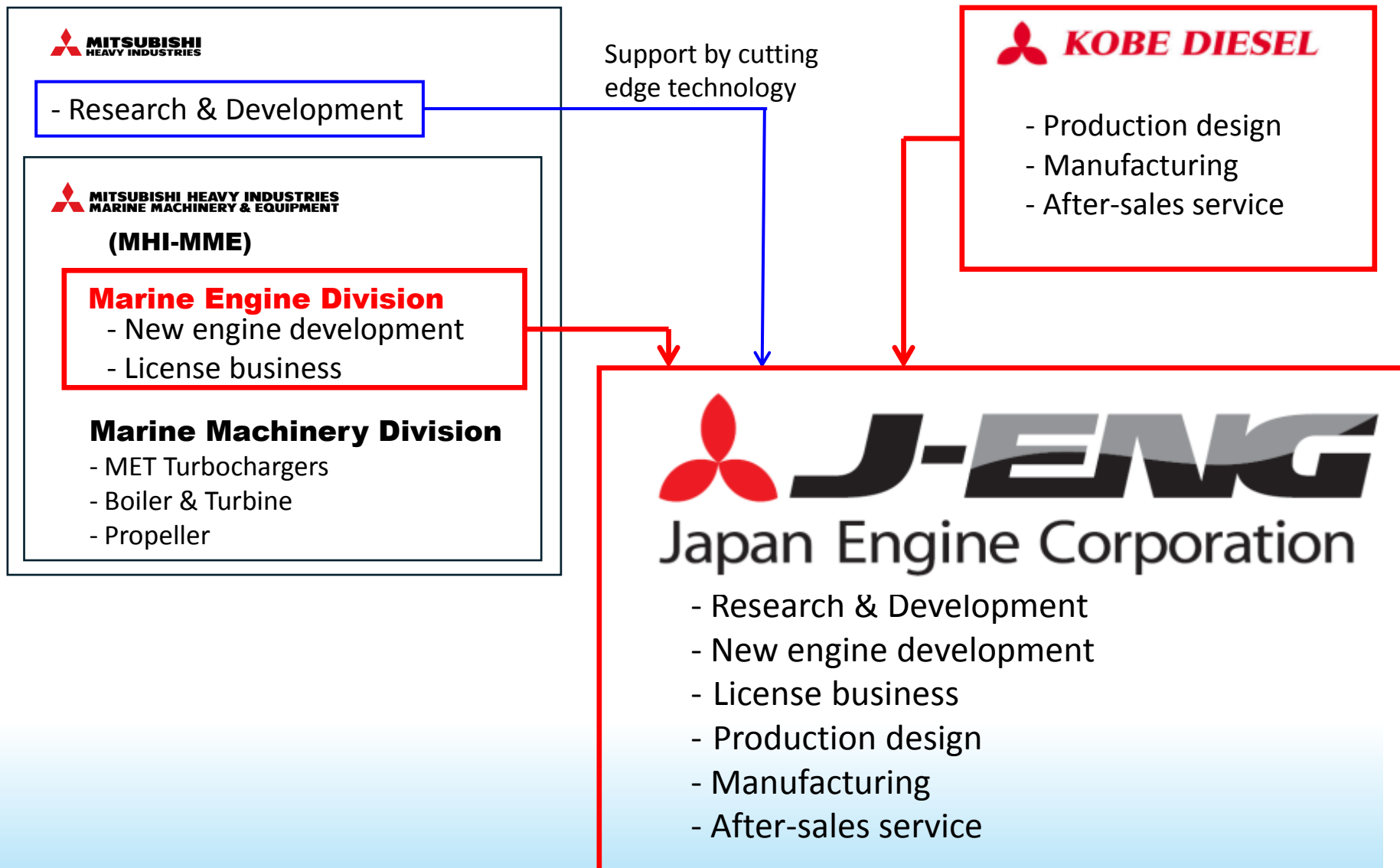


- 1. Overview of Japan Engine Corporation and UE engine**
- 2. Solution for IMO-SOx regulation**
- 3. Concept of “UEC-LSJ”**
- 4. Technical features and development phase**
- 5. Conclusion**



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Developing history of UE engine

Concept of JUMP

Solution to three environmental issues of NOx, SOx, EEDI(CO₂) simultaneously



6UEC35LSE-Eco



6UEC50LSH-Eco

35LSJ

50LSJ

50LSH-Eco

33LSE

80LSE-Eco

35LSE

Eco

45LSE

Eco

50LSE

Eco

60LSE

Eco

68LSE

52LSE

Eco



6UEC50LSE



8UEC60LSII-Eco

LSII Type

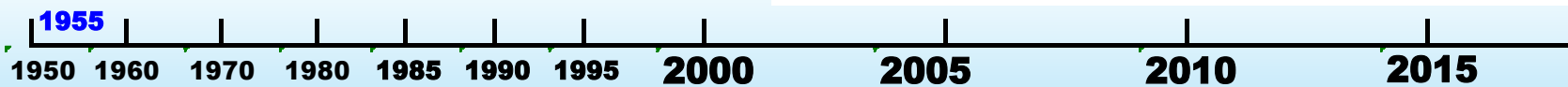
Eco

L/LA/LS Type

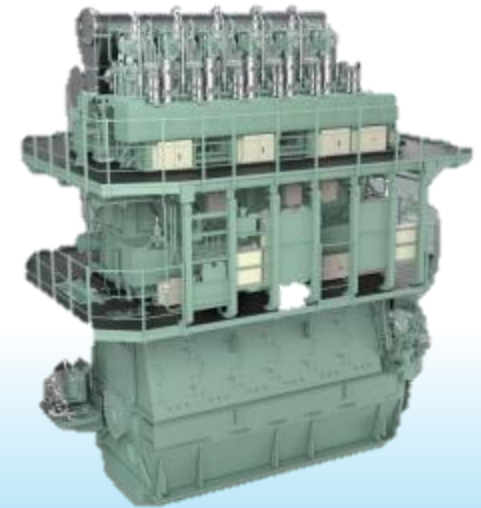
H/HA Type

A/B/C/D/E Type

Eco: Electronically controlled engine



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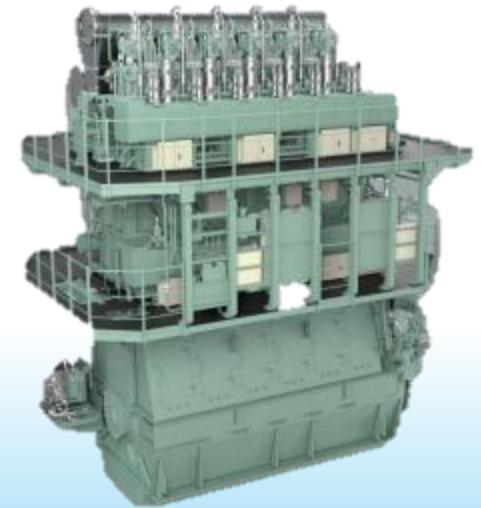
	HFO	MGO	LS-HFO	LNG
Price	Base	Higher	Higher	Closed to HFO
Availability	Now >Good Future >?	Promising	Promising	Limited
Heating	Necessary	Unnecessary	Necessary	Unnecessary
System	Expensive and complicated by Scrubber	Simple without heat trace and EGE	Same as current system	Expensive and complicated

Solution for IMO-SOx regulation



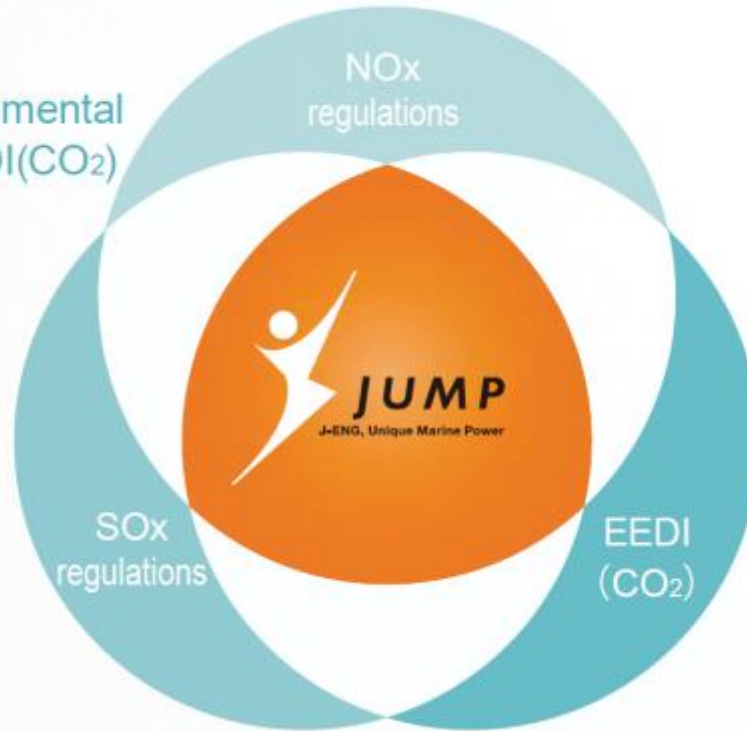
	HFO(Scrubber)	MGO	LS-HFO	LNG(DF-Engine)
Pros.	<ul style="list-style-type: none"> Available cheap HFO FO system unchanged 	<ul style="list-style-type: none"> Unnecessary of heating Without chemical products Available globally even now Easy handling by crew Expect less maintenance cost and higher reliability for engine room equipment Less burden for crew 	<ul style="list-style-type: none"> Slightly cheaper than MGO FO system unchanged 	<ul style="list-style-type: none"> Clear SOx, PM, CO2, (NOx) regulations simultaneously
Cons.	<ul style="list-style-type: none"> Space problem (cargo capacity might be reduced) Increase electric power consumption For open loop, discharged water regulations in future are unknown For closed loop, huge amount of caustic soda is necessary (Availability of caustic soda also must be checked.) Production capacity of scrubber and number of repair dock is limited. 	<ul style="list-style-type: none"> Higher FO price 	<ul style="list-style-type: none"> Unexpected trouble by mixture of different FO Uncertain FO specification (Fix at MEPC74 in autumn, 2019) Different property according to region or port. 	<ul style="list-style-type: none"> Reduction of cargo capacity due to large FO tank Limited bunkering port Higher CAPEX High level crew must be secured Risk of methane slip, knocking

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Concept of JUMP J-ENG Unique Marine Power

Solution to three environmental issues of NOx, SOx, EEDI(CO₂) simultaneously



Also, contribute to reduce EEDI at the same time
with **MGO mono-fuel engine**

UEC-LSJ is specific option of environmental solution “JUMP”

In March 2018 **MGO mono-fuel Engine**



was adopted as the subsidy program of new development of **THE NIPPON FOUNDATION**



Supported by
 日本
財団
**THE NIPPON
FOUNDATION**

Benefits for all stake-holders

Operator

- **Low fuel oil consumption** (during operation and at port) ⇒ $\Delta 5\%$ less than the conventional engine
- Reduction of risk for demurrage
- Enhancement of CSR due to environmental friendliness

Shipowner

- **Enhancement of reliability of engine**
- Reduction of risk for demurrage
- **Less maintenance cost**

Crew

- **Easy operation**
- **Less maintenance work**

Maintenance interval will be 2 times longer than the conventional engine.

Ship yard

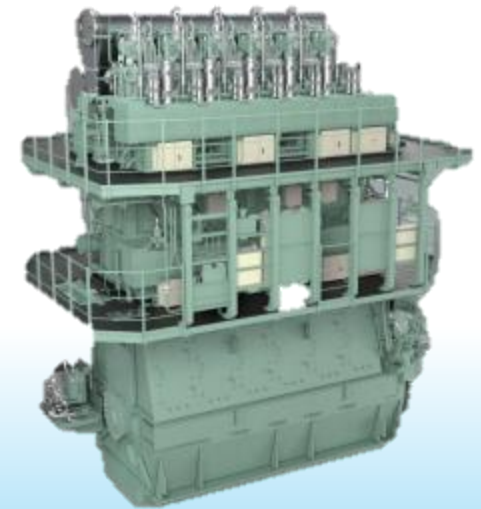
- Unnecessary of SOx scrubber
- **Simplified engine room** without heat trace

Typical modification of MGO mono-fuel vessel



Conventional vessel		MGO mono-fuel vessel
MDO or MGO and HFO tank	➡	MGO FO tank
Purifier for MDO or MGO and HFO	➡	Purifier for MGO
FO heating and relevant piping	➡	No heating line
Exhaust gas economizer	➡	Down size
MDO or MGO and HFO line	➡	MGO line
Water supply system for cooling and accommodation etc.	➡	Additional line for supplying water to water injection system
Fresh water generator	➡	Increase capacity

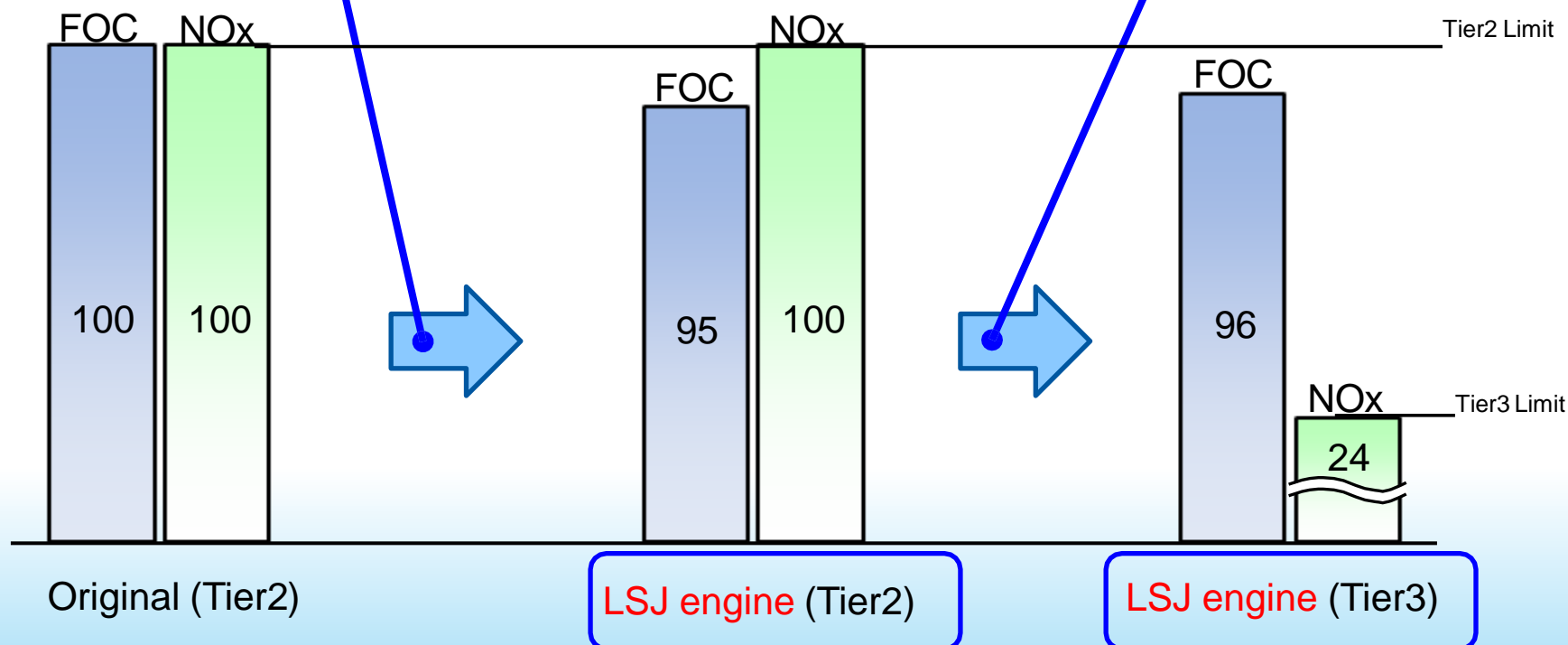
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Realize **low FOC** meeting with NOx regulations by **comprehensive UE engine technology** and mixture of **existing technology**

- ❑ Ultimate low FOC
 - **Combustion tuning** to prioritize low FOC
- ❑ Reduction of NOx
 - Application of **water injection** system

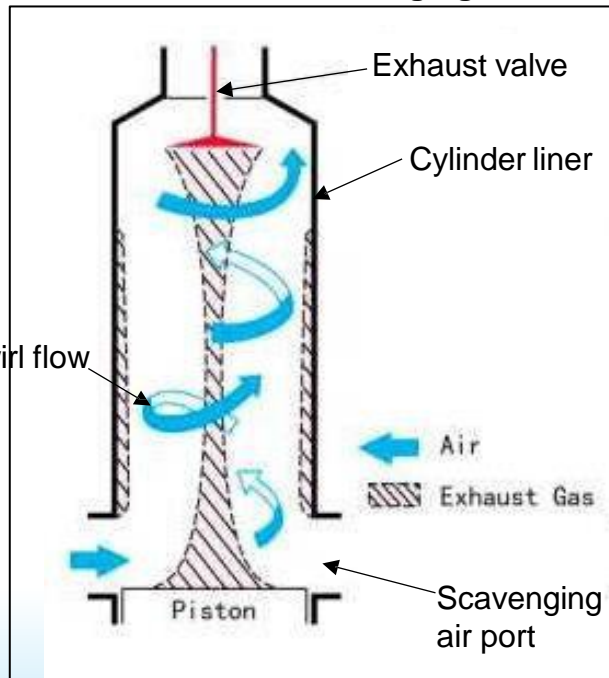
- ❑ Compliance with Tier3 LP-EGR or LP-SCR



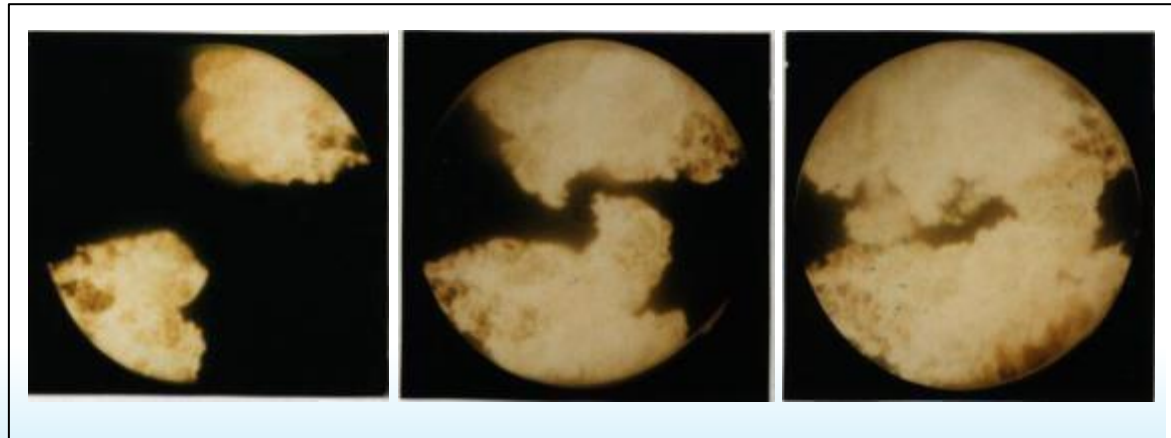
Sufficient mixture of fuel oil and scavenging air for higher combustion efficiency can be realized by

- Appropriate swirl flow of scavenging air port arrangement of cylinder liner, etc.
- Optimization of atomizer design for fuel injection valve, fuel injection pressure, etc.

Swirl flow of scavenging air



Flame in combustion chamber

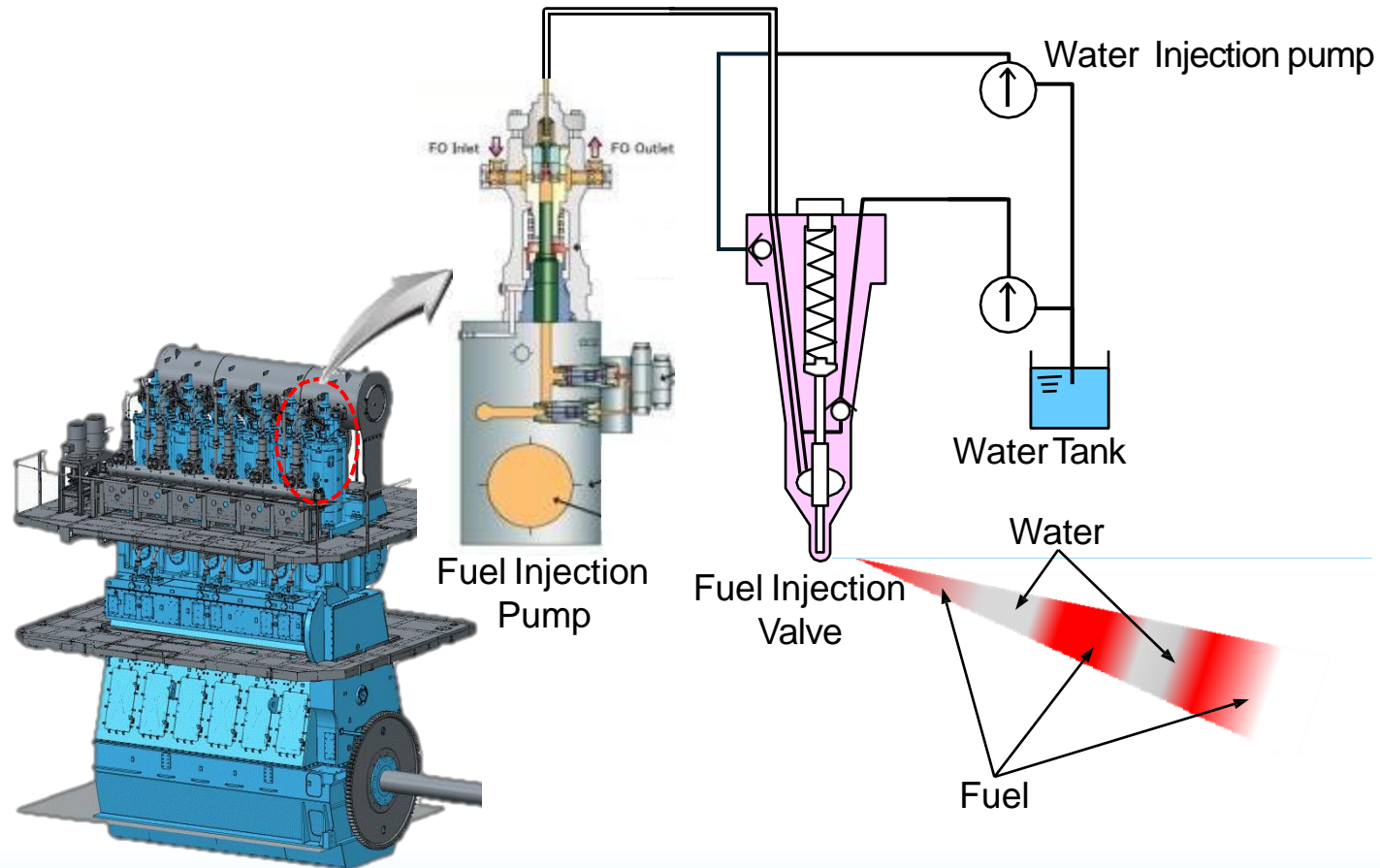


Less NOx emission due to lower maximum combustion temperature by water injection to flame

Better mixing of fuel oil and air due to increase of kinetic momentum by water
⇒ Lower FOC

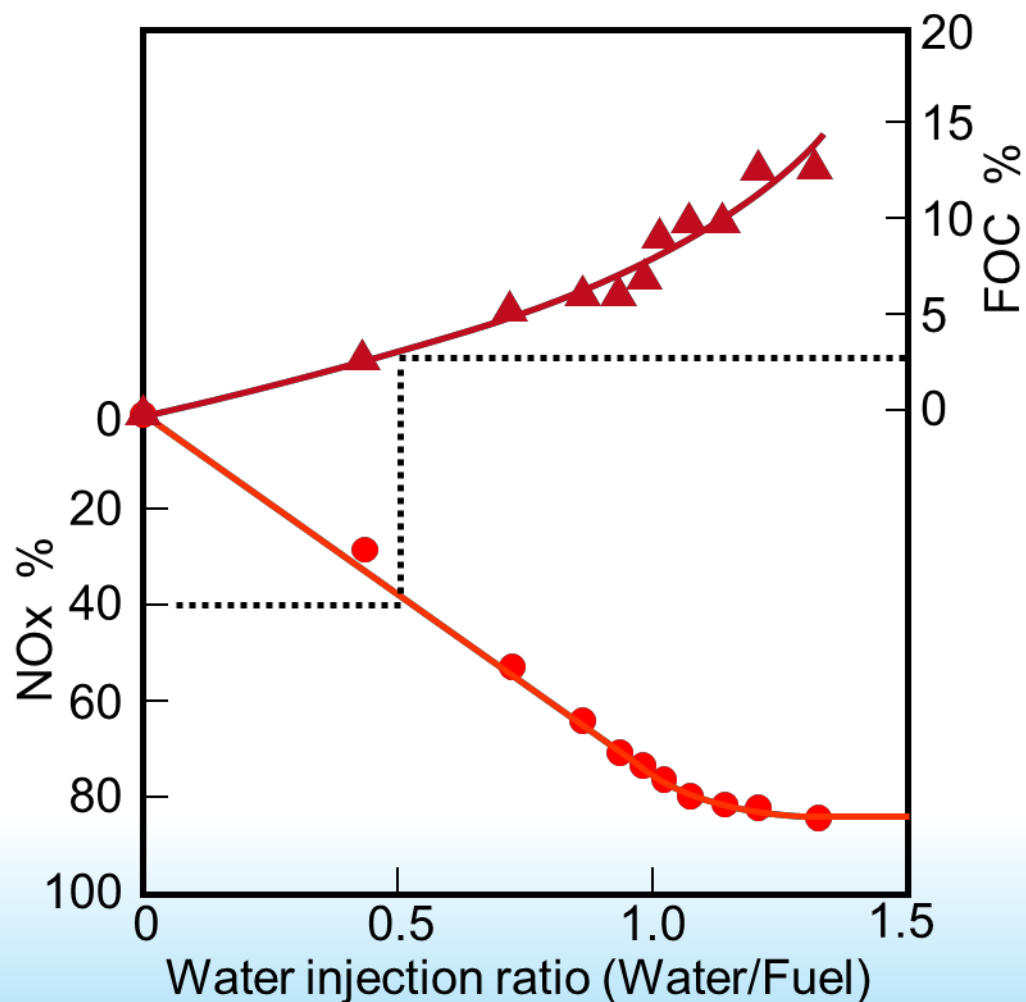
⇒ Improvement of trade-off between FOC and NOx

System outline of water injection system



- Insert water in fuel injection valve during standstill period of injection at each cycle
- Fuel and water can be injected by layers according to actuation of fuel pump

Test result of water injection



Reference of water injection system

	Ship / Plant	Engine Model	Year in service	Running hour of water injection
1	Ginga Maru	6UEC52/105D	1994 (On-board test)	Approx. 2,000h
2	Company “S”	16KU30A	1995 – 2004	Approx. 16,000h
3	Company “S”	16KU30A	1995 – 2004	Approx. 16,000h
4	Company “T”	18KU34	1996 – 2006	Approx. 12,000h

- 1 set for 2 stroke engine
- 3 sets for 4 stroke engine
- 4 sets in total



鯨河丸及び主機関
6UEC52/105D



Overview of MGO engine



Water injection pump

EGR unit for Tier3

Controller for
water injection

Increase capacity of
electric pump for water
injection

Accumulator block and
mechanical hydraulic
pump for exhaust valve
control

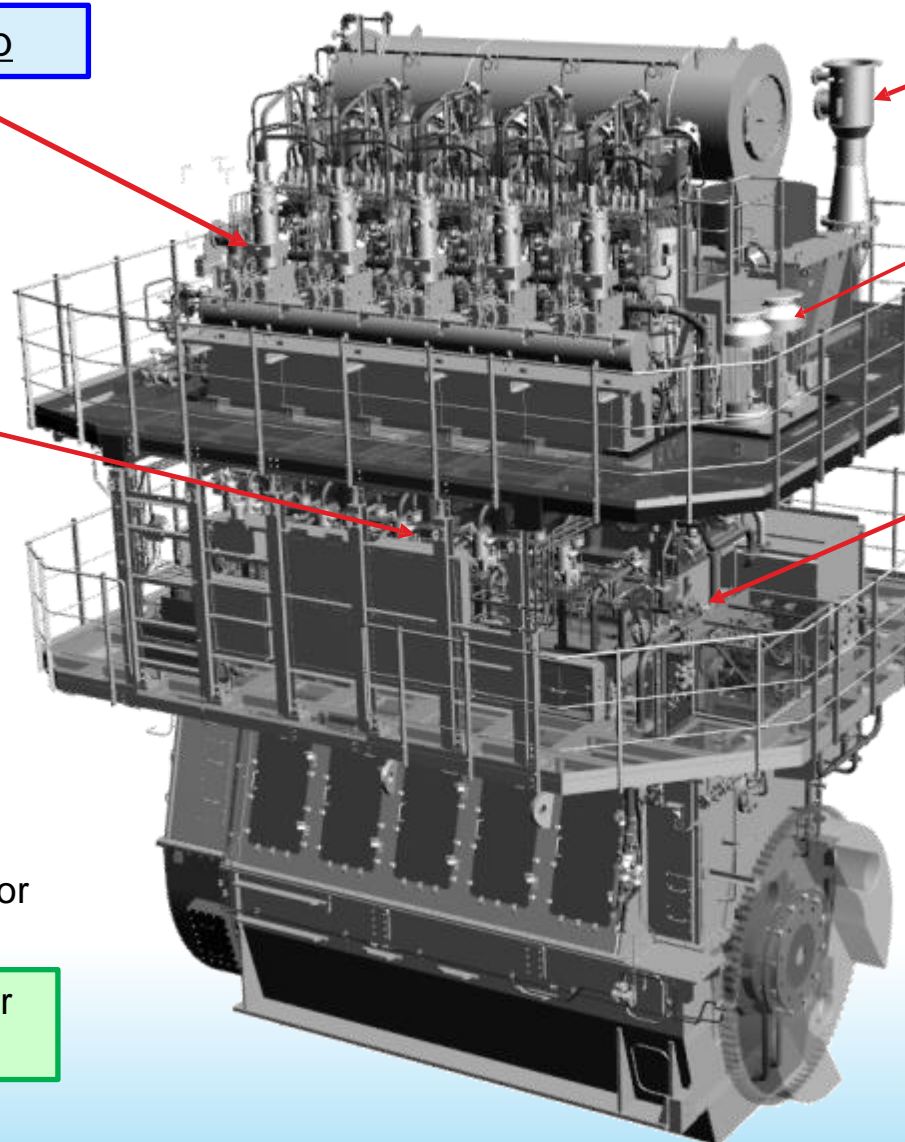
-> According to application
of full electronically control
system including exh. cam
driving for 50LSH

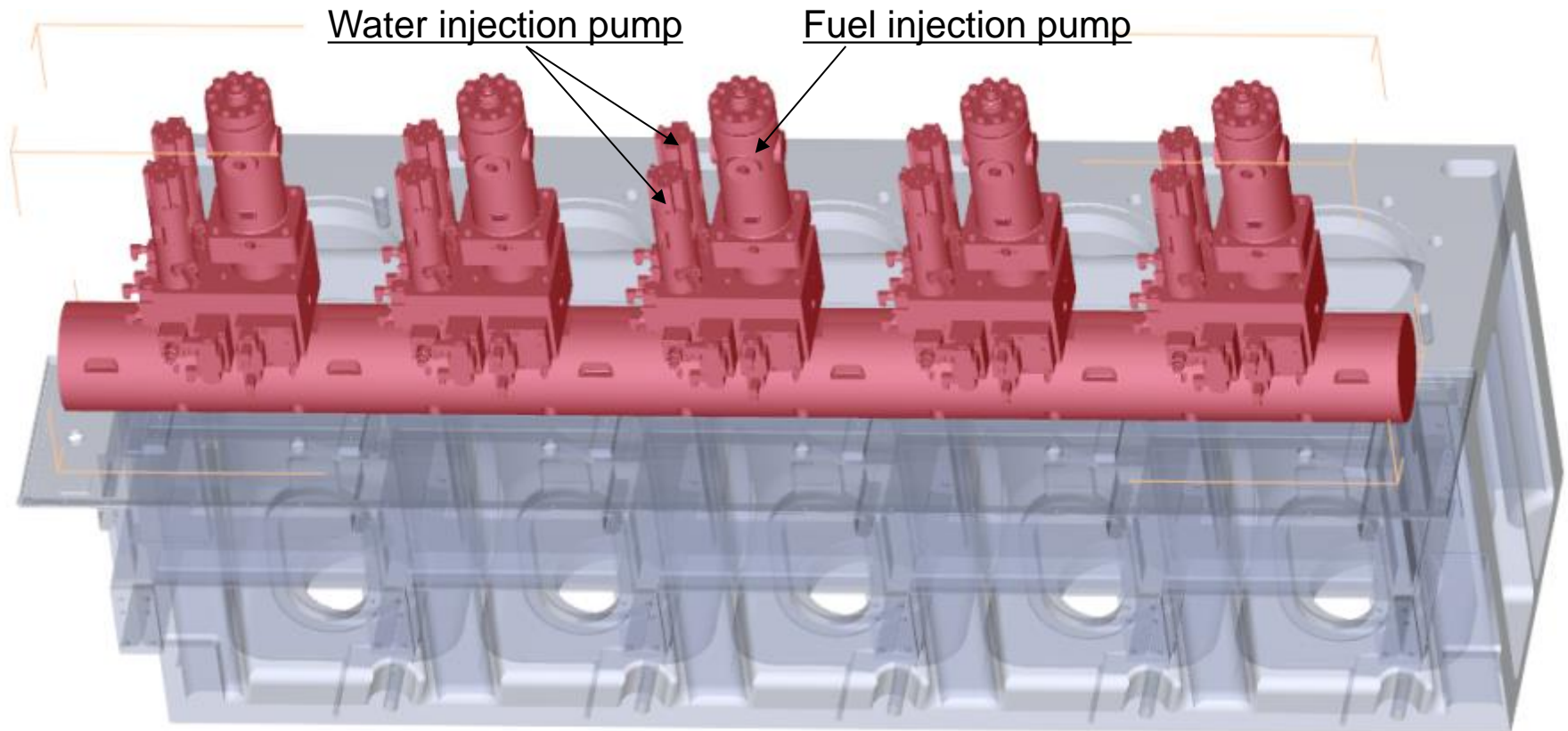
Additional equipment for
MGO engine

Removal equipment for
MGO engine

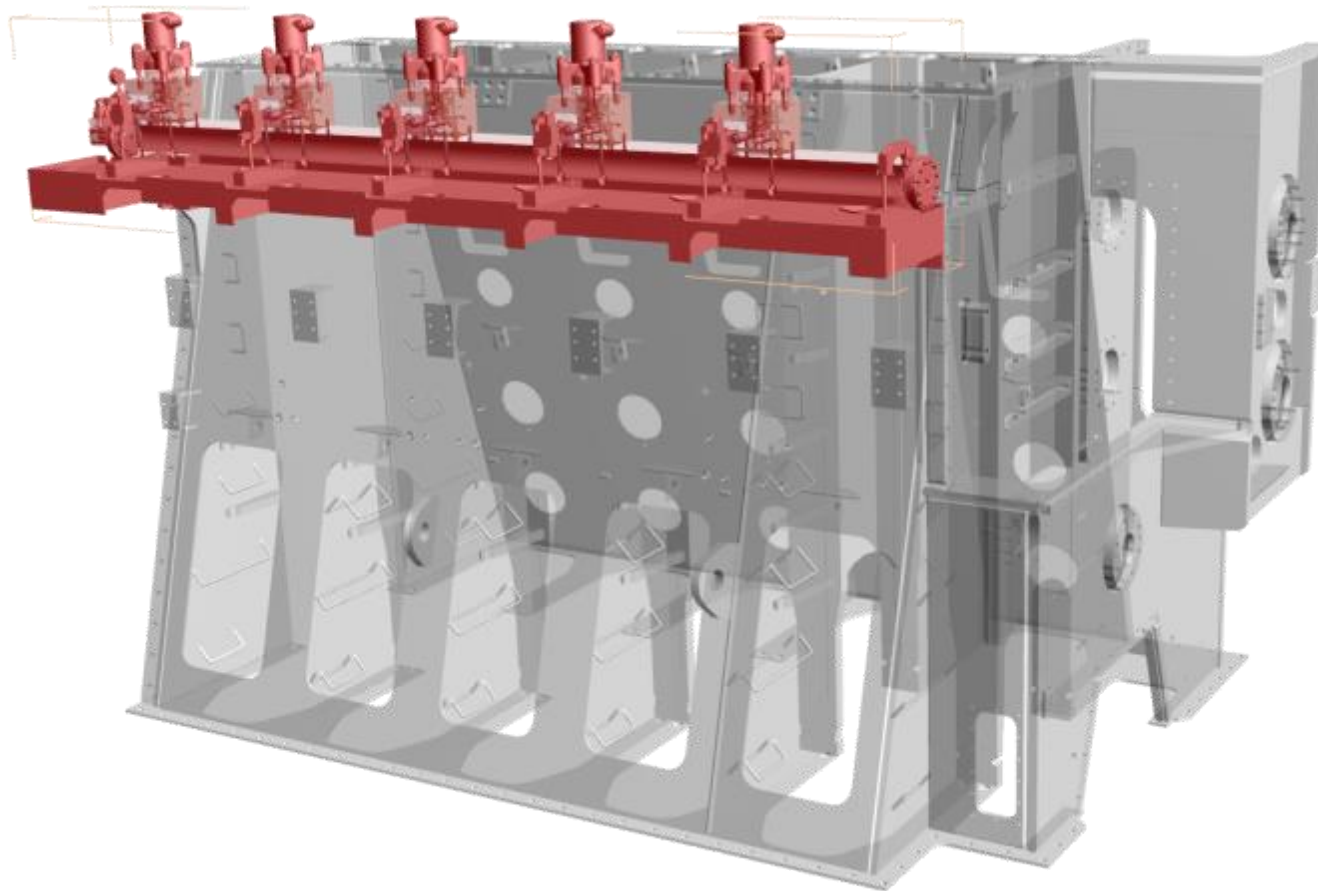
Camshaft due to
electronically control for
50LSH

Heat trace for FO line



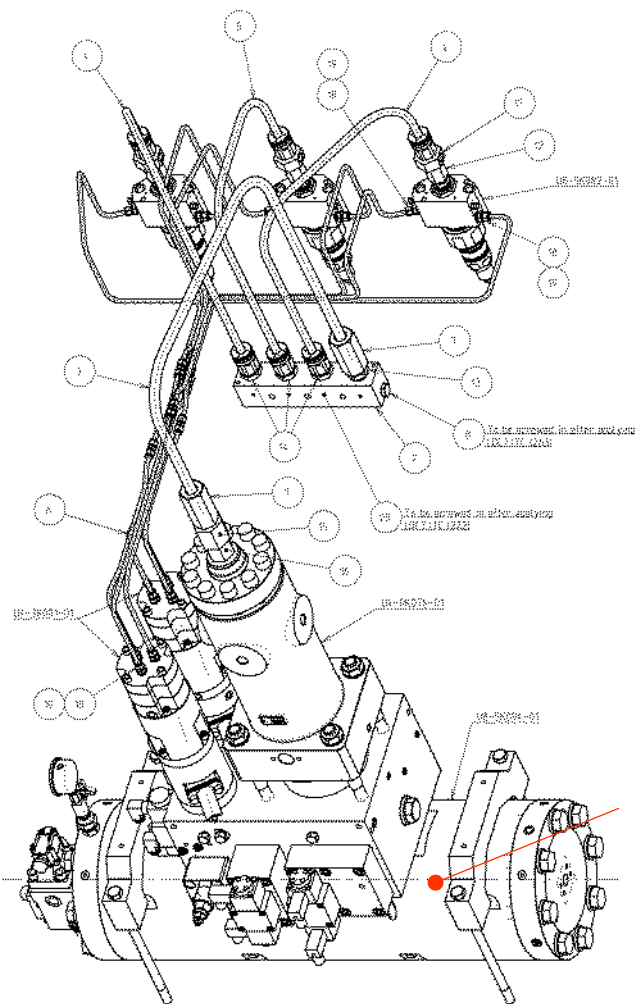


- Eco hydraulic system located on upper floor is provided for fuel and water injection.



- Eco hydraulic system located on middle floor is provided for exhaust valve actuation.

Unit test of water injection system



Accumulator block



Over view



Accumulator block

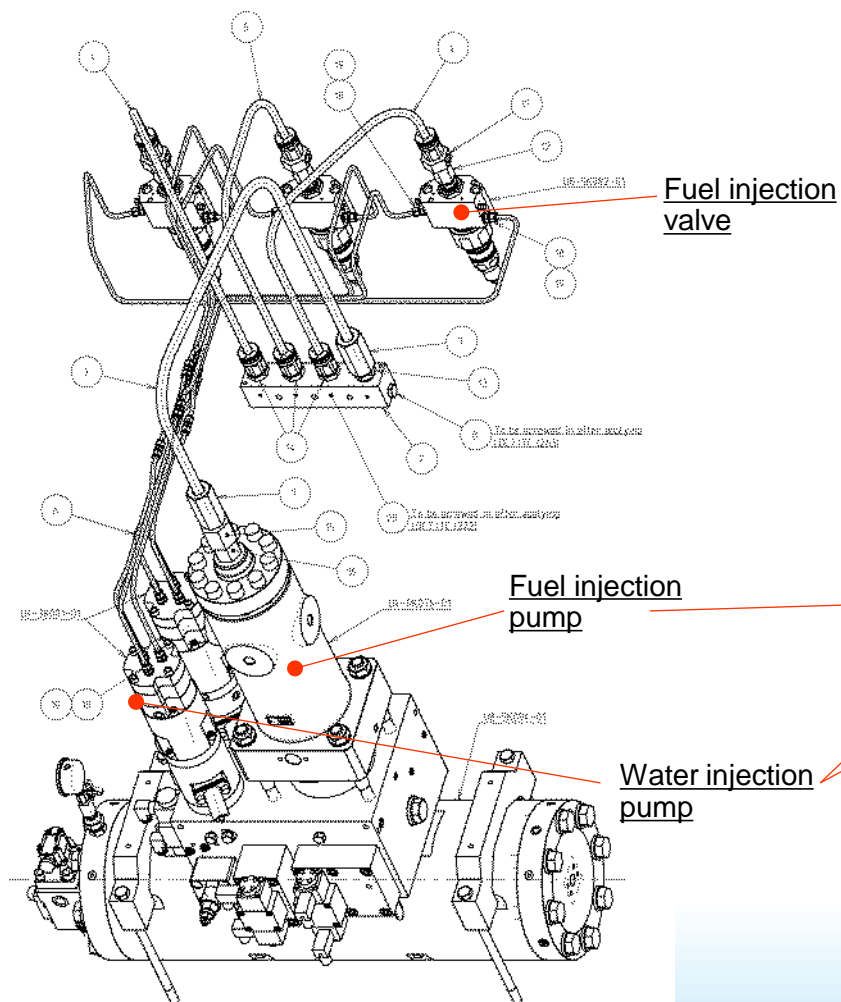


Electric hydraulic pump

Unit test of water injection system

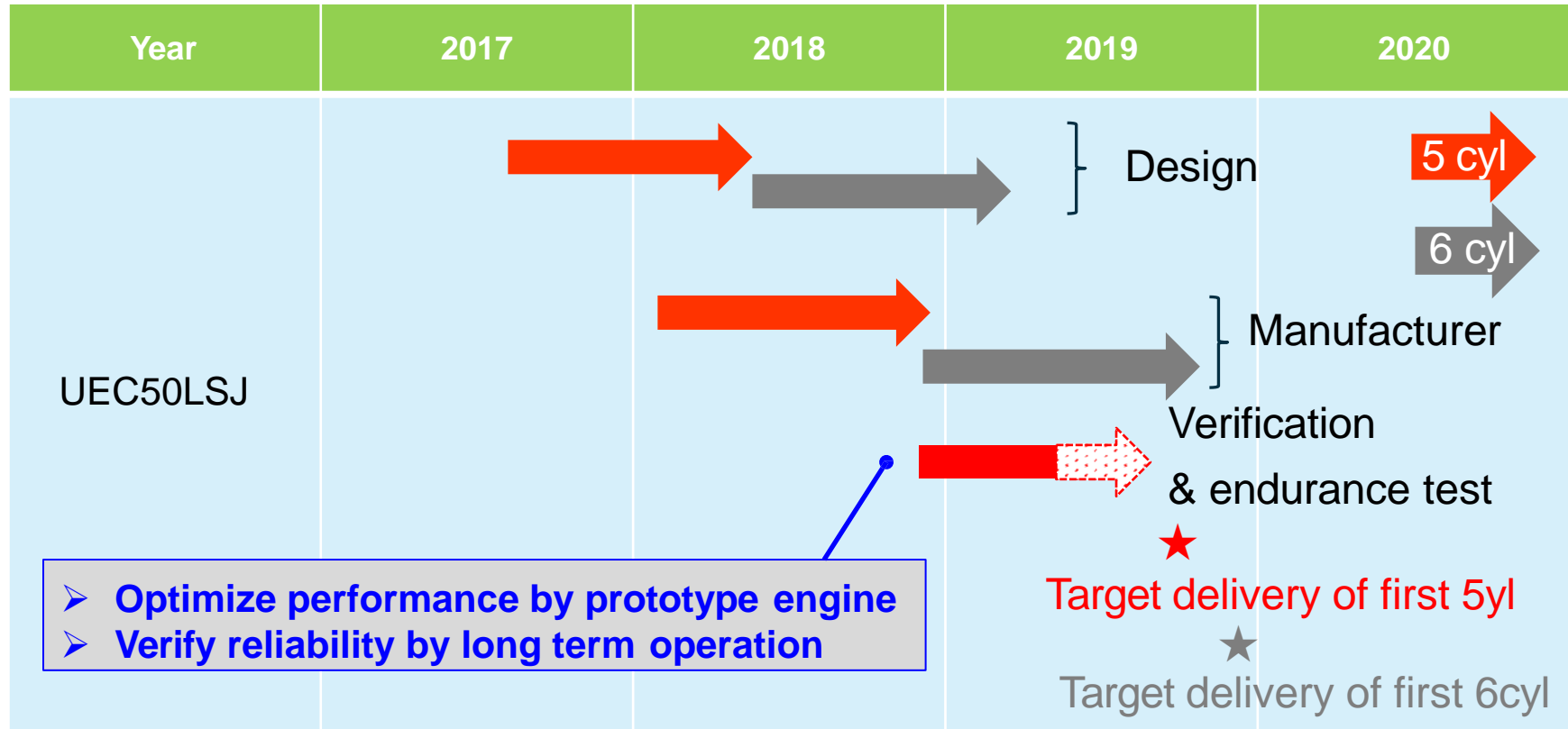


Fuel injection valve(with water injection line)

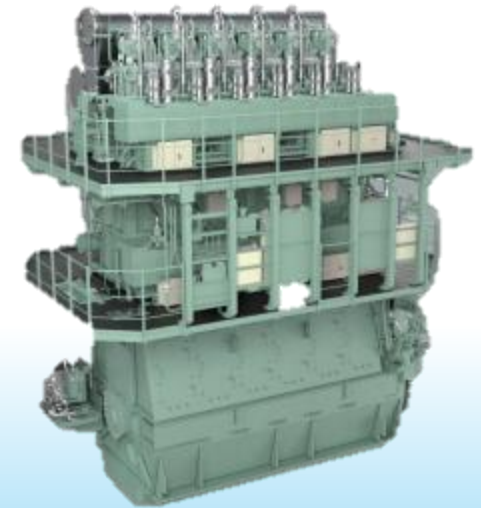


Fuel injection pump / Water injection pump

Running surface
condition is normal
after running of
 3.9×10^6 cycle (equal to
600hrs)



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- New concept engine “UEC-LSJ” can achieve extreme low fuel oil consumption complying with both NOx and SOx regulations with “JUMP” technology.
- “JUMP” technology includes high efficiency combustion technology and stratified water injection technology that were compiled as J-ENG’s genuine technology.
- “JUMP” technology makes all stakeholders have advantages.
- The first “UEC-LSJ” will be manufactured in December 2018 and tested and launched soon.

Thank you!