

## Objectives

- Integration of SCR (Selective Catalytic Reduction) with the existing strong Miller cycle 4-stroke diesel engine and combining it with particulate emission (PM) abatement technology would enable to achieve more than 80% NOx emission reduction and 25% reduction in PM. Also a combination of integrated SCR and EGR (Exhaust Gas Recirculation) is to be developed. Feasible solutions of combining the above mentioned technologies having as a target the near zero emission engine are also studied.
- Integrating methane and ethane abatement technology into lean burn 4-stroke gas engines will enable compact solutions to reduce methane and ethane slip. The objective is a catalytic system working with the engine and optimization of the engine performance. Also the knowledge on deactivation & regeneration strategies for integrated catalyst solutions and methane formation and location in the engine exhaust system should increase. Target is a greenhouse gas emission decrease up to 15% and fuel savings up to 5%.

WP Leader: Jukka Leinonen



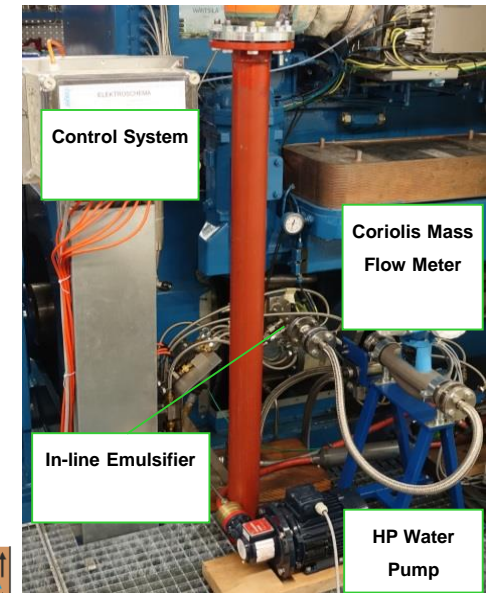
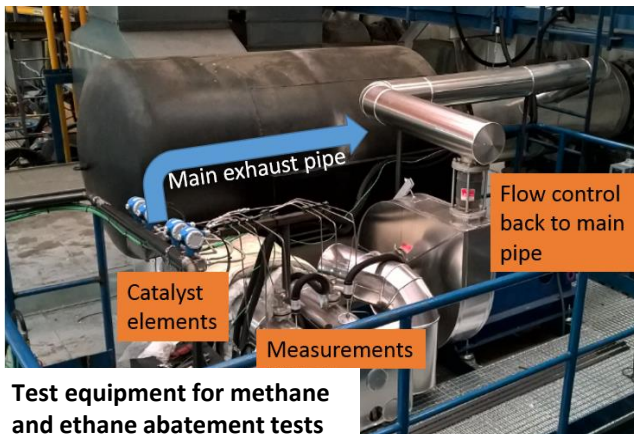
Partners:  WÄRTSILÄ  VTT  Vaasan yliopisto  
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### Subprojects

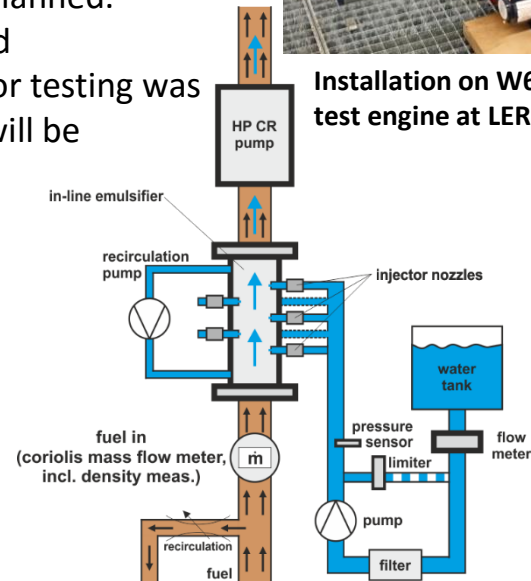
- 7.1 Combined on-engine aftertreatment solutions for 4-stroke diesel engines
- 7.2 SCR reduction agent injection solutions
- 7.3 Integration of methane and ethane abatement technology with gas engines
- 7.4 Emission measurement systems for integrated after treatment technologies

## Progress update

- PSI, Feasibility and demonstration of NO<sub>x</sub> and particulate reduction with tests on test engine was started and work has gone as planned and will continue due to plan.
- WFI, Activities are ongoing within schedule. PM measurement test equipment was commissioned and test was started ahead of original schedule.
- WSP, Needed test equipment for feasibility and demonstration of integrated methane and ethane abatement with gas engine was procured and commissioned. Testing started and tests will continue as planned.
- UV, Literature reviews regarding particulate abatement including particulate filter and SCR integration with engine was started as planned. First deliverable regarding literature reviews will be ready as planned.
- VTT, Investigation about available NH<sub>3</sub> sensors were made and procurement for sensors were made and initial plans for sensor testing was made. Also PM emission testing plans was made and testing will be completed at the end of the first year of the project.



**Installation on W6L20CR test engine at LERF**



**Schematic of in-line water fuel emulsifier**

### Deliverables and Plan for future work

- Literature review regarding SCR engine integration and particulate abatement.
- Emission measurement systems for SO<sub>3</sub>, NH<sub>3</sub> and PM emissions to support integrated after-treatment technologies
- Experimental assessment of integration of methane and ethane abatement technology into gas engine structure
- Experimental assessment of SCR reduction agent injection systems with sensors for feedback control



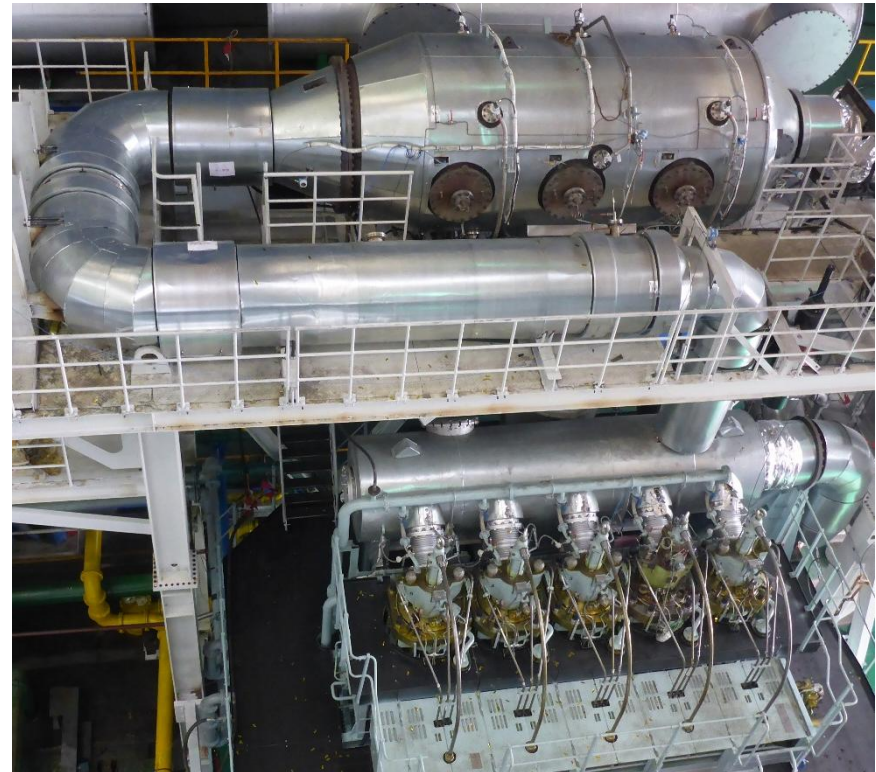
## Objectives of Work Package

Development of key technology for integration of the currently separated SCR aftertreatment into existing 2-stroke engine structure, which enables widespread installation of SCR systems on all ship types and additionally increase overall NO<sub>x</sub> removal efficiency above 80%, reduce overall hydrocarbon emissions (HCs) by 50% or more, reduce PM emissions and lead to potential fuel savings of up to 5%.

## Subproject

7.5 Robust catalysts for pre-turbo SCR

WP deputy: Daniel Peitz



WinGD pre-turbocharger SCR system

Partners:

**WIN GD**  
Winterthur Gas & Diesel

**dINEX**  
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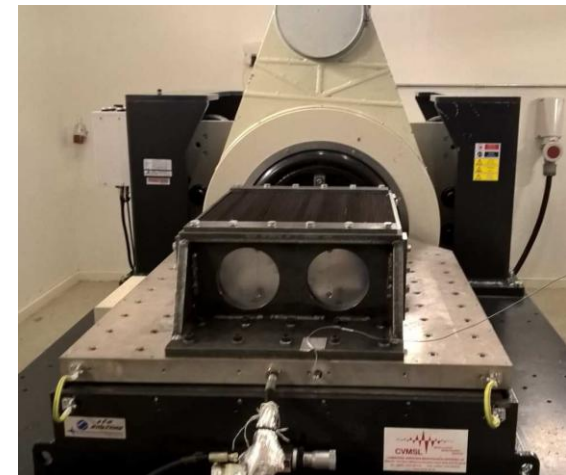
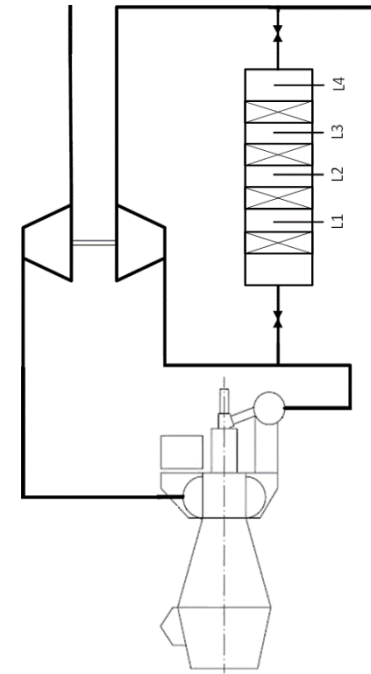
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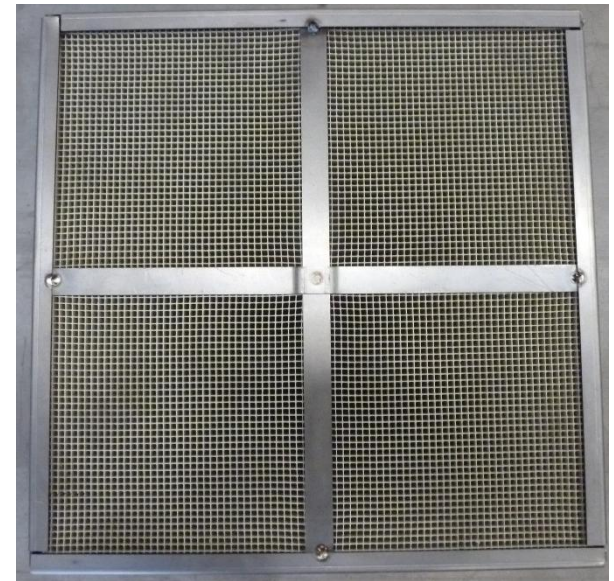
### Main results achieved during 1<sup>st</sup> year

- vibration test cycle specification for SCR components in future 2-stroke marine diesel engine SCR applications
- SCR catalyst durability against ammonium bisulphate (ABS) deactivation from high sulphur fuels investigated
- Prototype vibration resistant catalyst modules containing extruded SCR catalysts and metallic supports for SCR catalysts were designed, produced and tested on vibration test benches



### Problems / delays (if any)

- delay of around 1 month for testing of prototype catalyst modules on vibration test benches due to delay in manufacturing.  
(Testing in field not anticipated to be delayed.)



### Deliverables and Plan for future work

- Finalize vibration testing according to supplied test cycle.
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- Laboratory testing of catalyst performance and catalyst deactivation assessment.
- Vibration testing of prototype SCR catalysts on engines operating in the field.

