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Virtual Design and Simulation in two-stroke marine Engine Development

Cimac congress paper 173, Helsinki 2016, A. Brueckl, M. Sichler, U. Balsiger

Introduction

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	W-X52
Bore [mm]	520
Stroke [mm]	2315
Cylinder number	4 – 8

Mechanical and plant engineering

Engineering tools landscape

Consolidation of information

Seamless project execution

Release and dispatch of documentation

Time-to-market

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Introduction

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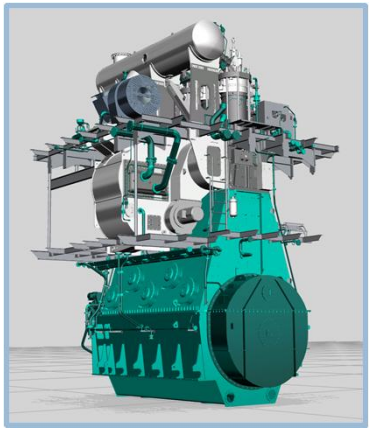
System Definition
- Inputs needed
- Tools in use
- Actions & output

Development of Piping Diagrams
- Inputs needed
- Tools in use
- Actions & output

Validation of Concepts
- Inputs needed
- Tools in use
- Actions & output



1st stop

2nd stop

3rd stop

4th stop

5th stop

6th stop

Terminal stop

Determination of flow requirements
- Inputs needed
- Tools in use
- Actions & output

Development of 3D Engine Model
- Inputs needed
- Tools in use
- Actions & output

Preparation of drawing set
- Inputs needed
- Tools in use
- Actions & output

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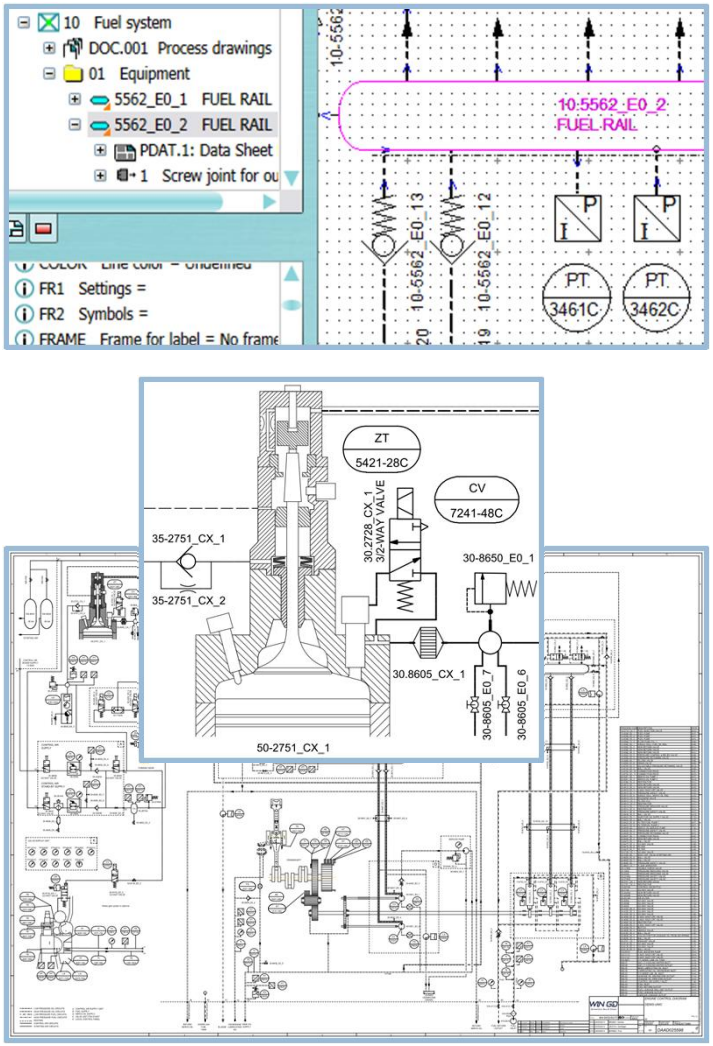
Development of System Layout

System Definition

*Start of two-stroke engineering activities with **E**ngine **C**ontrol **D**iagram (ECD)*

- *Engine specification and potential engine configurations*
- *Object oriented software allowing data to be used downstream the development process*
- *Visualization of engine systems and interconnections in a schematic layout*
- ***Benefit:** Overview of engine systems in early project phase*



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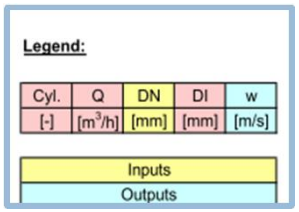
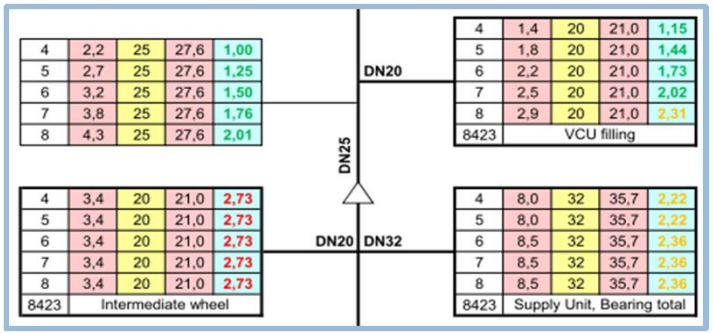
Development of System Layout

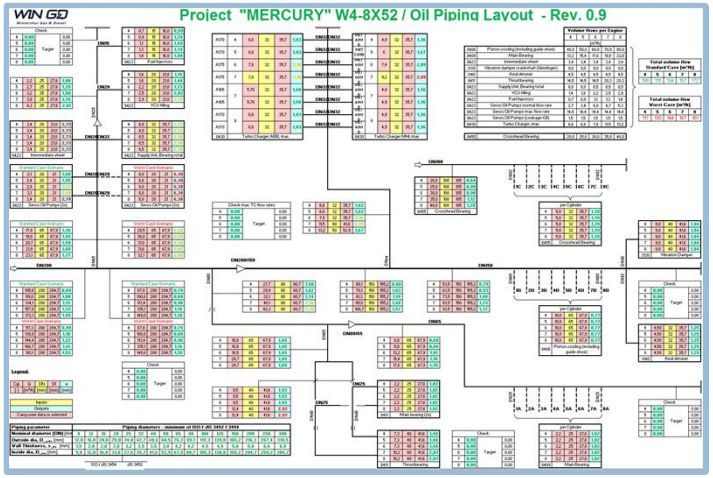
Determination of Flow Requirements

Definition of pipe sizes for verification of fluid velocities

- *System flow rates*
- *Automated excel based calculations with all consumers and their flow quantities*
- *Calculation of fluid velocities based on flow rate and pipe diameter*
- *Overview of system data resulting from technical and economical evaluation*
- ***Benefit:** Parametrised system flow overview*







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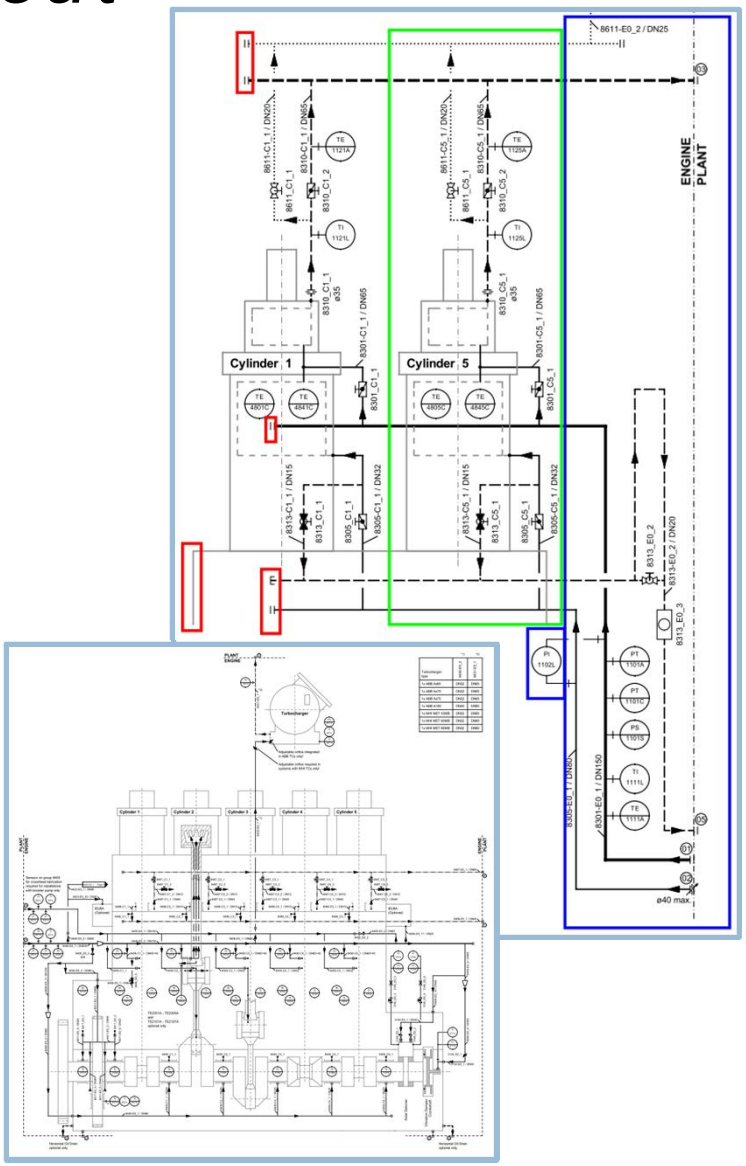
Development of System Layout

Development of Piping Diagrams

Centralisation of system data in schematic engine layout

- *System overview (ECD) and fluid systems*
- *Signal list and indicator positions*
- *Object oriented software*
- *Configuration of piping diagrams from modular elements*
- *Complete diagram set for specific engine configuration*
- ***Benefit:** Full functional layout description*



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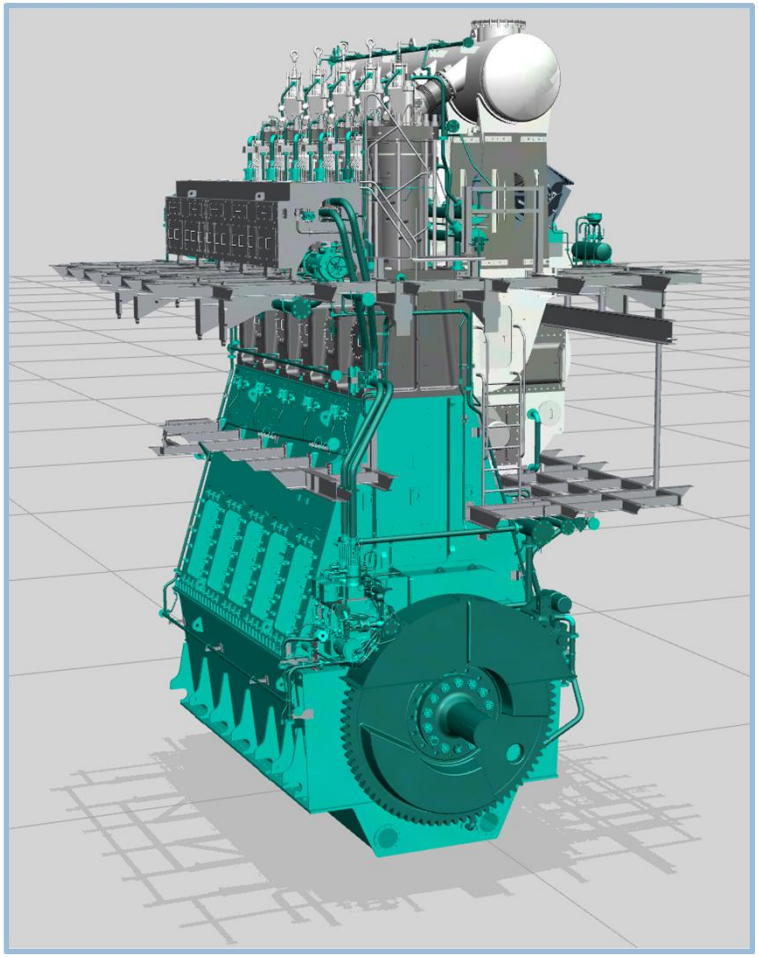
Conceptual Design

Development of 3D engine layout

Configuration of total assembly (TOA)

- *Basic engine outline*
- *Yard connections*
- *3D volume modelling software*
- *Creation of 3D layout of engine with all components, systems and sub-systems*
- ***Benefit:** Master model for interdisciplinary cooperation*



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Concept Validation

Calculation and Simulation

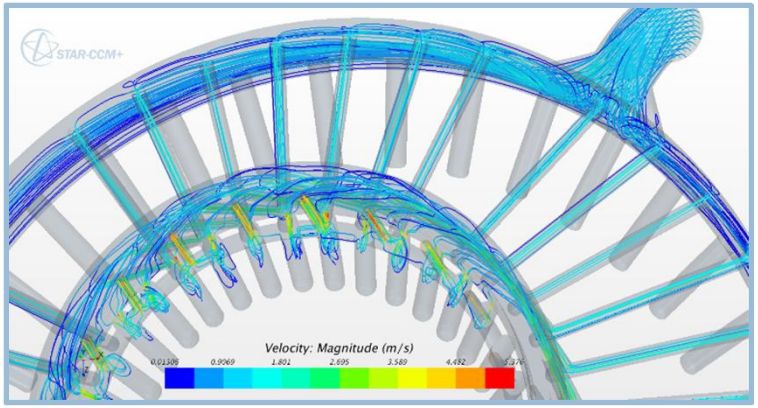
Verification of concepts

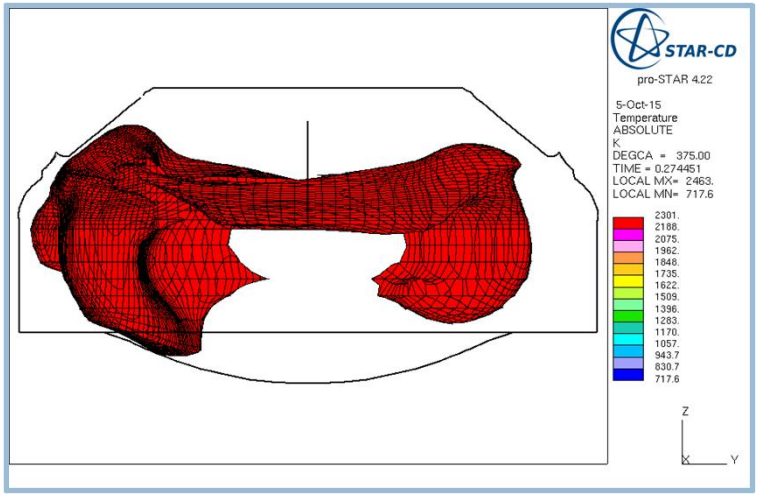
– *3D models, performance targets, design limits, standards, regulations*

– *Computational **F**luid **D**ynamics (CFD), **F**inite **E**lement **M**ethod (FEM) and in house developed software*

– *Simulation of flow speed in cooling bores*

– *Simulation of temperature isocontours*





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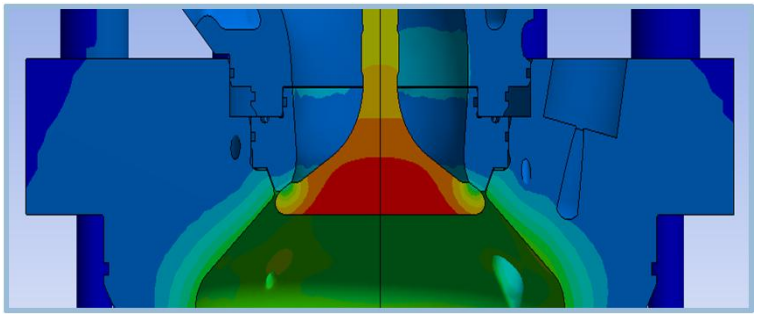

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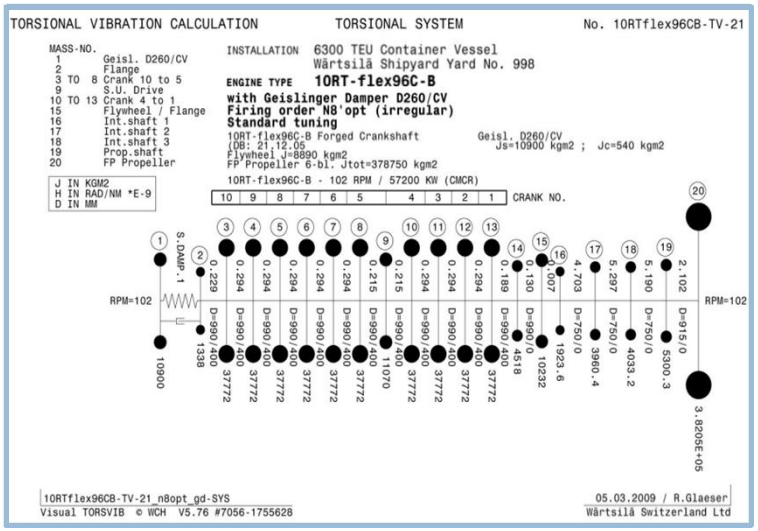

– *Calculation of component temperatures*

– *Analysis of torsional vibration*

– ***Benefit:** High efficiency for individual investigations*

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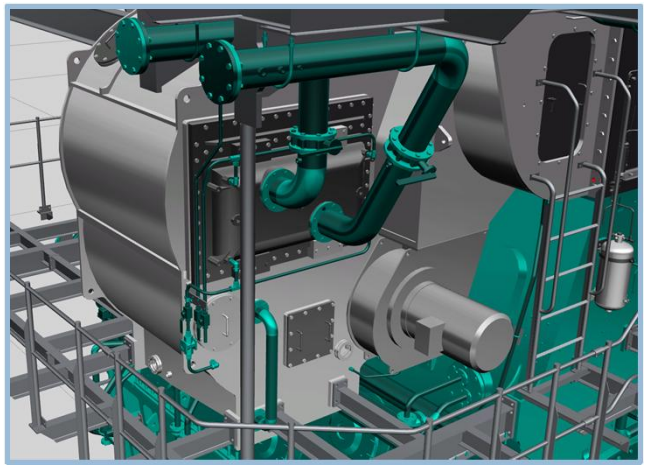
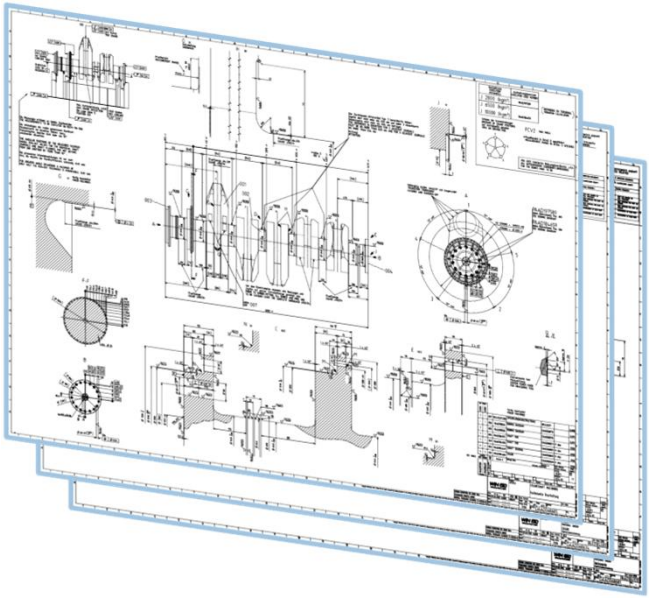
Detailed Design

Preparation of technical 2D drawing set

Finalization of engine design

- *Validated design models from previous phases*
- *Computer **A**ided **D**esign (CAD) system*
- *Detailing of 3D volume models*
- *Collision analysis*
- *Creation of engine drawing package*
- ***Benefit:** Built-in routines for consistency checks*





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Conclusion

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– *Outlook:*

  – *Concentration of engine information around 3D engine data model*

  – *Integration of tools to streamline development process for*

    – *Fast and simple delivery of intermediate and final results*

    – *Centralised management of engineering data*

Requirements ⇨ ***Product***

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Thank you!

Questions and answers

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