



Simcenter[™] Nordic Conference Sven Olmes 03. - 04. May 2018

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Agenda

- Introduction
- Whole Engine Modelling
- Use of Simcenter for WEM
- Conclusion



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Introduction



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ANSALDO ENERGIA Ansaldo Energia Whole Engine Modelling (WEM) Introduction

Ansaldo Energia Gas Turbine Portfolio

MODEL		ISO POWER [MW]	FREQUENCY [Hz]
GT36-S5	the state	538	50
GT36-S6	and the second	369	60
GT26		370	50
AE94.3A	A Contraction	340	50
AE94.2	J.S.	190	50
AE64.3A		80	50/60
GT36		AE94.3A	



Whole Engine Modelling



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• Thermo-Mechanical modelling:

§ Prediction of metal temperatures and displacements at each point in time for the entire gas turbine (Whole Engine Modelling – WEM)



• Main customers:

- § Mechanical Integrity for lifetime of components & clearance prediction as well as for optimization purposes
- § Performance & Secondary Air Flow for internal cooling air heat pick up

• Requirements:

- § Real geometry representation of engine
- § Transient thermodynamic key parameters (engine operation)
- § Heat transfer mechanisms / mass flow distribution







Thermo-mechanical modelling



ANSALDO ENERGIA Ansaldo Energia Whole Engine Modelling (WEM) Selection of NX

- Legacy tool not available any more (Primary driver)
- Multiphysics environment required (Thermo-Mechanical)
 - o Transient FE Heat transfer Flow network / Fluid Flow



- Heat storage & release in the FE part is essential for the engine heat up and cool down of the simulation
- o Flow networks (simple & fully hydraulic ones) are required to distribute the heat accordingly
 - § Clearances determine in reverse the massflow acting
- Powerful GUI to support boundary condition management (~3500 BC's)
- o Flexibility with respect to include own codes / subroutines as well as parametrization of inputs



Use of Simcenter 12 for Thermo-mechanical WEM



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Rebuilding detailed functionality within a new tool without the option of crosschecking the individual features against the legacy tool

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ENERGIA2D WEM Thermo-Mechanical AnalysisSimcenter Implementation - Legacy model import

- o Python scripting to translate legacy models into Simcenter functionality
- o Semi-Automatic process established for model recreation (not just an import)
- o Expression Extension via C++ Plug-Ins / Fully parametrized boundary conditions
- Geometry Materials User Parameters Loads Transient Mission Cycle

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Fully functional model utilizing NX capabilities (Link Geometry Heater Boundary Conditions)

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- Baselining to legacy models completed: demonstrating overall a very good match to legacy tool
- Steady State and transient matching criteria were fulfilled





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ENERGIA2D WEM Thermo-Mechanical AnalysisDirect Temperature Validation – GT36 Test Plant Birr (Switzerland)

• Real engine testing confirms local quality of modelling approach

Time [s]



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Time [s]

Time [s]

ANSALDO ENERGIA Indirect Validation – AE94.3 Field Measurements

- Indirect validation of overall mechanical behaviour via stress level of centre tie-rod
- Confirmation of accumulated accuracy of modelling approach





- Computational time is crucial to succeed within the productive environment as well as for proceeding towards the digital twin
- Starting release (NX10) with too high computational times (>80hrs!)
- During the application Simcenter improved significantly
 - *Remarkable* speed up of the thermal solver from over 80hrs down to 2.5hrs (same model)



ANSALDO ENERGIA Improvement Proposal: Conditions Sequence / Mission Cycles

- Transient Mission Cycle to prescribe the engine operation
- Within design process about **50** non-standard mission cycles per engine design are evaluated
 - o Clearance behaviour (pinch points, critical engine operation)
 - Lifetime prediction utilization of part lifetime with respect to freedom of engine operation
 - o Unfortunately: Simcenter only manages ONE condition sequence per model up to now





Conclusions



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- Full productive tool set for 2D & 3D thermo-mechanical modelling available within NX12
- Thanks to dedicated support from Siemens and Maya HTT WEM within NX was successful
- Simcenter fulfils the requirements and is enabling all required functionality for the next steps

