ETN

Exhaust Systems Project

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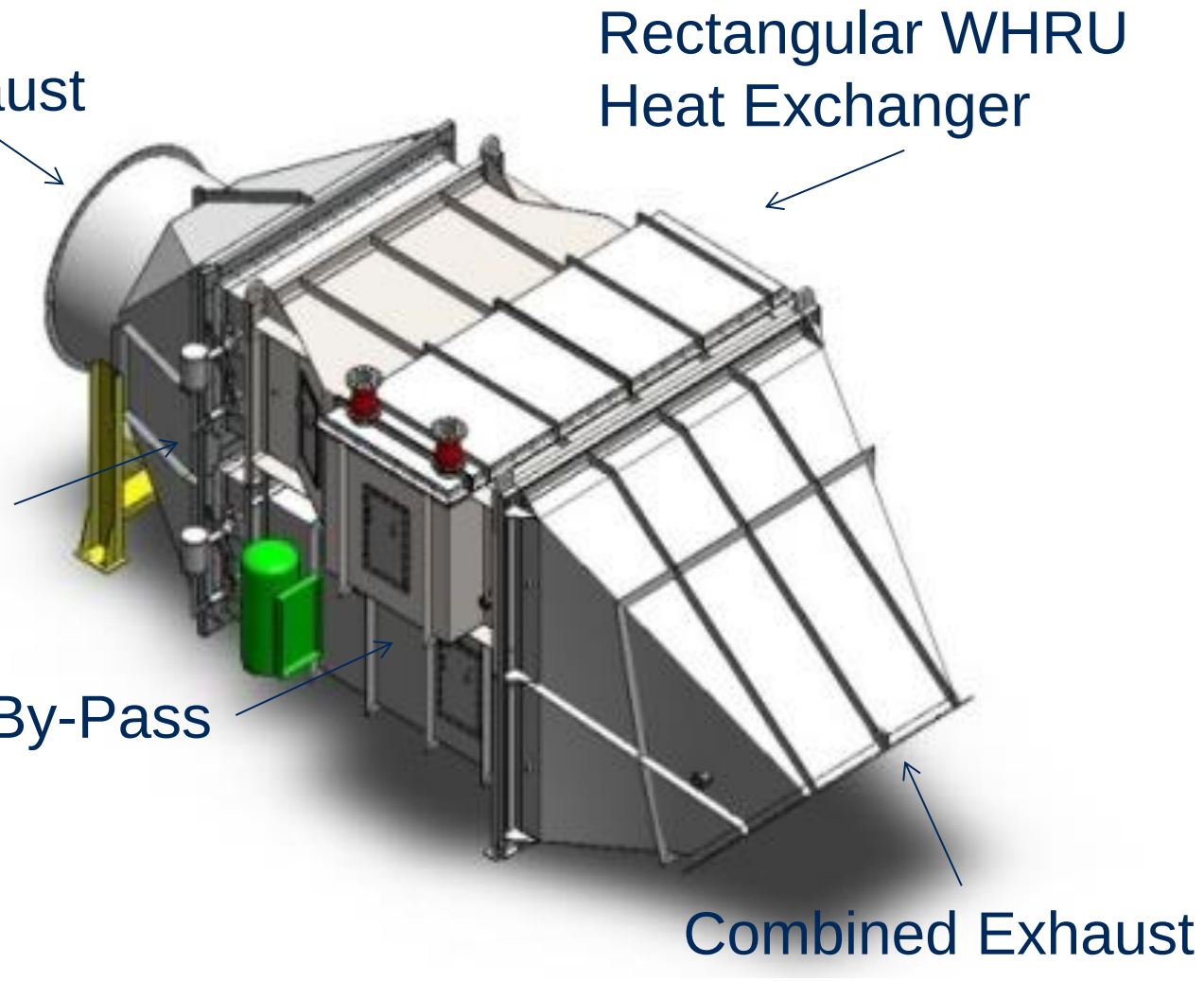
Gas Turbine Exhaust Systems Project Two Activities

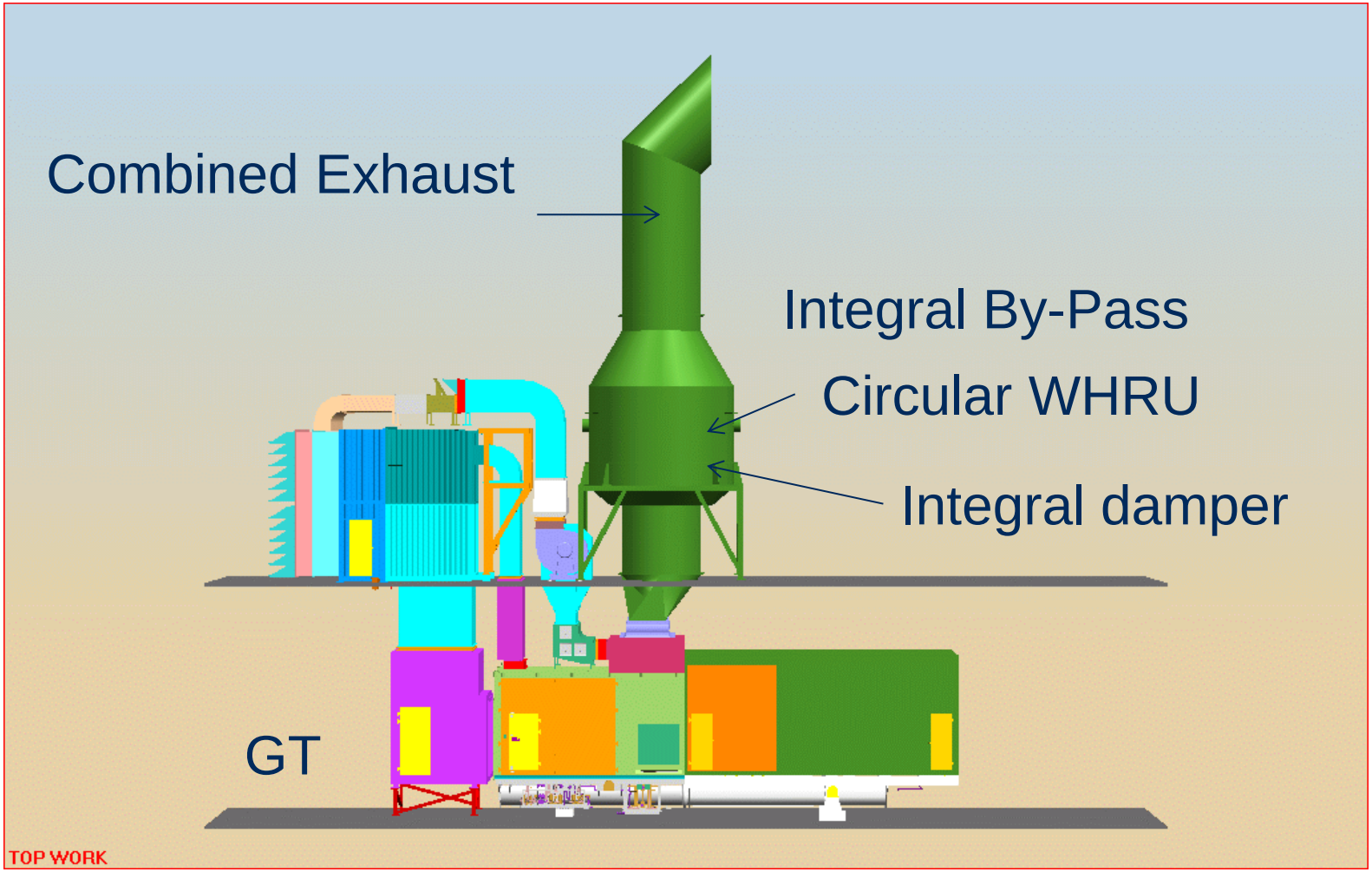
- Technical Standards
  - Preparation of separate EU / ISO Technical Standards for both WHRU and HRSG Exhaust Systems
  - The WHRU Standard first with HRSG Standard to follow

- CFD Benchmark Testing
  - Development and Implementation of Live Tests on a Gas Turbine / WHRU Installation to gather data and used to undertake Benchmark CFD Modelling

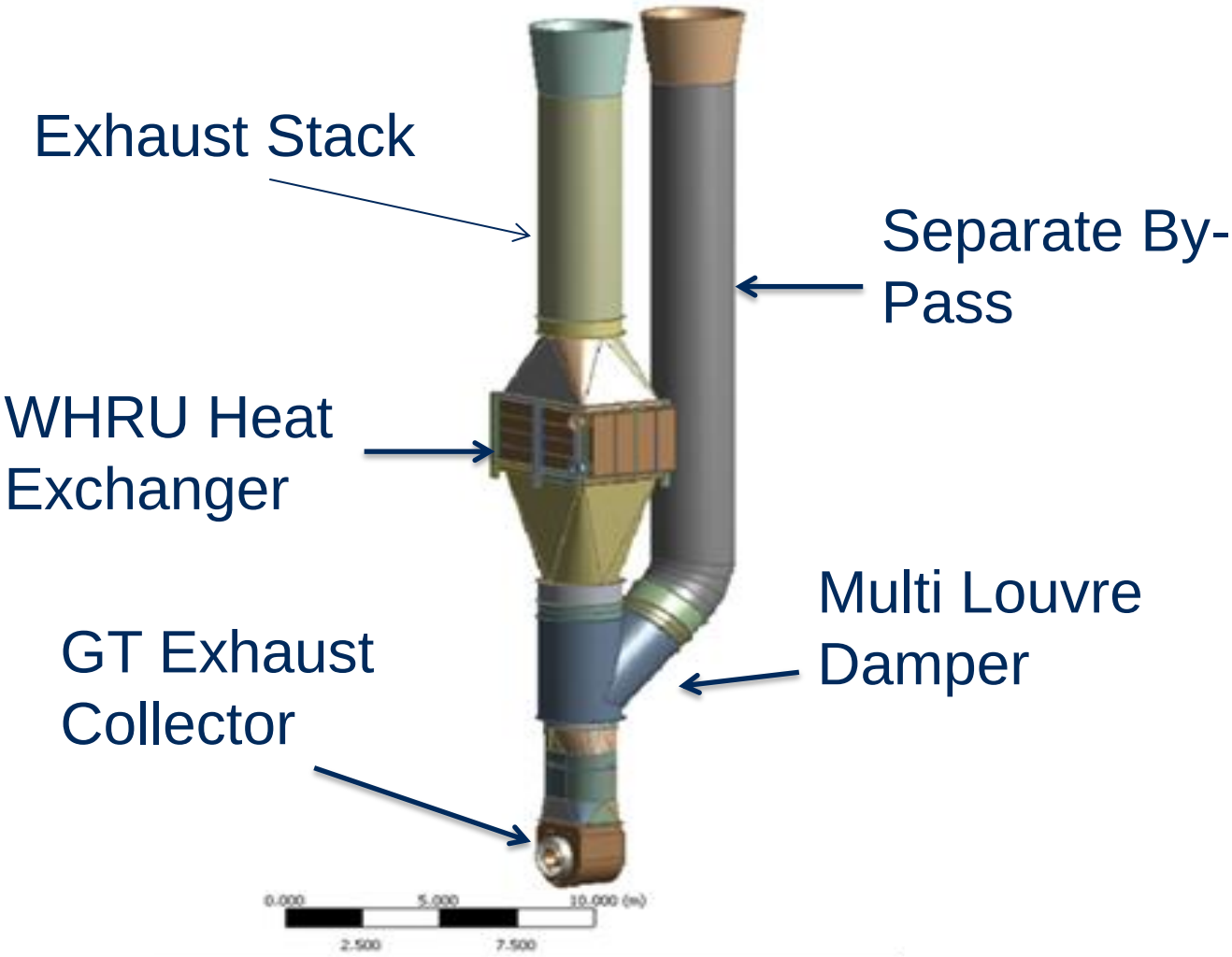
Horizontal Waste Heat Recovery Unit



Vertical Waste Heat Recovery System



Vertical Waste Heat Recovery System



Typical HRSG Installation

Current Standards

- There is no published Technical Standard specific to GT WHRU Systems - HRSG's are included as a section of a wider API 534 Standard
- The Industry uses various and differing extracts and references from other Codes, Client and Vendor standards
- There is significant market for these WHRU and HRSG products – both onshore and off-shore (oil and gas applications)
- There has been 'mixed' experience from applications in the field – and some repetitive defects noted with very serious down-time consequences

Benefits of the Standard Project

- The ‘industry’ will benefit from the availability of Technical Standards which, whilst not being restrictive to innovation, would :-
  - Identify the necessary input data to enable proper design to be undertaken – supported by effective CFD tools
  - Guide the ‘purchaser / specifier’ (regardless of specific expertise) in best practise and acceptable technical solution options – allowing bidding and evaluation on ‘like for like’ bases
  - Guide the vendor in best practice and acceptable design options & deter non-compliance

Project Working Group Members

Project Group Members

- **Total SA – Chair / Mjorud as – Deputy Chair**
- **USERS**
  - Statoil as
  - Shell BV
- **OEM's**
  - GE oil and Gas (CFD Benchmark activity only)
  - Dresser Rand
- **ACADEMIA**
  - RWTH Aachen University

Project Group Members (Continued)

- **EQUIPMENT SUPPLIERS**
  - AAF
  - Aarding Thermal Acoustics
  - Alstom
  - Camfil Farr
  - BIHL
  - Kanfa-Tec
  - Oxsensis (CFD Benchmark activity only)
  - TechPart AS
- **CFD SERVICES SUPPLIER**
  - Frazer-Nash Consultancy

Methodology for Writing the Standards

- Sections of the Standard allocated to pairs of organisations / individuals to draft
- Working Group review remotely and then in Workshop sessions until Section texts agreed
- ETN secretariat prepares / updates the documents
- This process is by definition laborious and time consuming
- But shares out the speculative efforts of all the Working Group Members

Objectives / Status of the Standards Project - 2013

- Complete the draft ‘text’ of the WHRU Standard to be issued to ETN Working Group Members for comment
  - Well advanced – to complete

- Investigate the route, requirements and costing to develop the WHRU and HRSG documents into properly formatted ETN Best Practise and then ISO Standards
  - Started – to progress

Objectives / Status of the Standards Project – 2013 (Continued)

- Identify source/s of funding for the final drafting and publishing preparations and identify means of exploitation
  - Commercial issues addressed - to progress
- Initiate proper formatting of WHRU standard
  - To progress once funding source/s identified and in place
- Progress preparation of the separate Heat Recovery Steam Generator (HRSG) version of the WHRU Standard, expanding the scope as required
  - Started, to progress – partial ‘copy / paste’ exercise

Objectives of the Standards Project - 2014

- Complete the draft WHRU standard into an ETN Best Practise – advertise as then commercially available to both members and non members
- Complete the draft HRSG Standard for review within ETN and properly format same into an ETN Best Practise – promote / exploit as for WHRU standard
- Data from the CFD Benchmark Activity to be incorporated if available
- Establish both WHRU and then HRSG ETN documents into ISO Standards and exploit

Current Scope & Status of the WHRU Standard

- Information to be Provided by Purchaser - Section substantially completed
- Contents / Scope of the Standard
  - Scope
  - Definitions and Abbreviations
  - Design and Engineering
    - Process Design
    - Mechanical / Pressure Part / Supports
    - Insulation and Lining

Current Scope & Status of the WHRU Standard (Cont'd)

- Exhaust Gas System
  - Ducting / Expansion Joints / Supports
  - Silencer
  - Stacks
- Dampers
  - Types and Function
  - Performance
  - Actuation
  - Isolation

Current Scope & Status of the WHRU Standard (Cont'd)

- Fabrication
- Control and Instrumentation
- Inspection and Testing
- Documentation
- Installation and Commissioning
- Performance Testing
- **In Summary the document can be seen to cover a wide scope**
- The document is reasonably well advanced in draft format

Objectives / Status of the CFD Benchmark Activity - 2013

- Identify a ‘user’ partner and GT plant for Tests
  - Discussions with possible partners in progress
- Identify format to disseminate results
  - Incorporate in Standards, possibly as Appendix
- Develop input data requirements for turbine exhaust gas CFD modelling
  - Generally complete

Objectives / Status of the CFD Benchmark Activity – 2013 (Cont'd)

- Develop generic instrumentation requirements for data measurement and customise for specific installation
  - Generic details complete – final customisation dependent on the specific installation selected
- Identify costing / funding and schedule for undertaking the testing and CFD modelling
  - Outline costs and program completed – to finalise with selected partner/s

Objectives of the CFD Benchmark Activity - 2014

- Subject to Funding and Partner/s - Undertake the testing and CFD Benchmark modelling, formulate results and incorporate into the Technical Standards

Benefits of the CFD Benchmark Activity

- Successful Benchmark Tests and CFD models validated against the test results will provide confidence that proper CFD modelling techniques can be :-
  - An effective tool in designing and predicting the performance of GT exhaust heat recovery systems
  - Subject of course to properly certified input data from OEM's or other sources
- Well designed and constructed Exhaust Systems will provide more reliable operation and performance

Gas Turbine Exhaust Systems Project Group

- **THANK YOU FOR YOUR ATTENTION**
- **PAUL SETCHFIELD – MJORUD AS**