Technical Requirements for the Development of the Certification Test Software

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Technical Steering Group

- Membership
  - **Halloran, CO-LaN contractor**
  - **Oliver Koch, Linde**
  - **Mark Stijnman, Shell**
  - **Laurent Testard, HALIAS**
  - **Jasper van Baten, AmsterCHEM**
  - **Malcolm Woodman, M R Woodman Consulting**

- Work Process
  - **6 phone conferences**
  - **Documentation of the outcomes and preparing additional material for future discussion**

Overview

- Some underlying technical decisions
- Scope of testing
- Methodology of testing
- Proposed order of creation of test suite
- Future updates to the test suite
- Development of test suite
- Next steps

Underlying Technical Decisions

- **Open-source**
  - **Improves trust in the software**
  - **Source code is available to explain how tests are done**
  - **Allows vendors to challenge or add to the tests, changes can be submitted**
  - **CO-LaN is still the owner of the official code**
    - **But need to keep a strong control on the code base**

- **Based on the new COBIA middleware**
  - **Future-proof**
  - **Supports the strategic direction determined by the Management Board**

Implications of COBIA

- **Must allow the testing of COM interfaces**
    - **This however will be possible via COMBIA**
- **COM specific testing can still be tested via a COBIA-based reference application**
    - **E.g. testing whether software that implements apartment threading is thread safe**
- **M&T should consider allowing a conditional compile of COMBIA, to make COMBIA more pedantic**
    - **Production use would still use less pedantic compile, to ensure necessary speed and leniency**
- **Error messages will be interpreted by COMBIA, rather than displaying the original COM error**
- **It will not be possible to test arrays of arrays or arrays of mixed data types in COM, as these are not supported by COBIA**
    - **But no commercial implementations?**
- **COBIA and COMBIA currently only implements common interfaces, UNIT & THERMO**
    - **No numeric solvers or Sequential Flowsheeting tools**
    - **Additional interfaces need to be ported to COBIA when there is a business case and extend test software at same time**
    - **New features not currently in the standard (e.g. Flowsheet Monitoring) added bit-by-bit**

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Scope of Testing

- Compliance
  - All required interfaces exist
    - And are executed in the correct (documented) order
  - Interfaces behave as expected
    - No crashes occur when they are exercised
    - Types of arguments are correct
  - Errors are trapped and reported
  - Values can be retrieved for each available property or flash type:
    - Correct types
    - Correct dimensions
    - Test derivatives by numerical perturbation
    - Rotate component list, check that values also rotate
    - Reduced component list
    - Not a check that the values themselves are correct

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Scope of Testing

- Compliance
- Best practice
  - Things that are not currently included in the standard
  - For example, a PMC that assumes if an argument is not "mole" than it must be "mass". Best practice would be to test for both and throw an error if neither is passed
  - Not currently defined anywhere!

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Scope of Testing

- Compliance
- Best practice
- Interoperability
  - Which flash types are required / available
  - Which properties are required / available
  - Easy to check what is available for a PMC
  - Much more difficult to check what is required for a PME
    - Unit operation specific
    - PME may include work-arounds if something is not available

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Methodology of Testing - PMC

Test software will be a test harness that acts as a PME. Test Harness will:

☐ Carry out all the steps required for the PMC to be successfully instantiated and executed, in the appropriate order

☐ Provide a Material Object (MO) for testing purposes

☐ Create a time-stamped test report which documents the results of all tests carried out

☐ Differentiate between THERMO and UNIT PMCs, performing the appropriate tests for each

Test Harness will be completely automatic

Testing of UNIT PMC will require availability of suitable thermodynamics package

Test Suite will provide:

- **An ideal thermodynamics package**
  - **as a reference standard thermo**
- **An interface to an external CO Property package**
  - **The actual property package used must have previously been certified**

Methodology of Testing – PME

- ☐ **Each PME is unique**
  - ■ **CO-LaN cannot provide automated test software**
  - ■ **Up to each vendor to automate as approriate**

- ☐ **Test suite will consist of:**
  - ■ **One or more reference PMEs, acting as either a UNIT or a THERMO PMC**
    - • **Creates a time-stamped test report, documenting**
      - – **The order in which the various interfaces are executed**
      - – **The results from the execution of each interface**
  - ■ **A test scenario, which**
    - • **Documents the series of steps that need to be carried out within the PME user interface**
      - – **Software tool that allows tracking of successful completion of each step in the scenario?**
    - • **The PME vendor can then follow using their user interface**

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Methodology of Testing – Log file

- Risk that the time-stamped log file could be tampered with
  - thus invalidating the certification process
- Risk is low?
  - No action at this time
  - Implement a signing mechanism (or equivalent) in the future?

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Order of Creation of Test Suite

- **Thermo PMC**
    - **Test Harness**
    - **Material Object**
- **Unit PMC using standard thermo**
    - **Test Harness**
    - **Material Object**
    - **Reference ideal thermodynamics package**
- **Unit PMC using external CO property package**
    - **Test Harness**
    - **Material Object**
    - **Interface to an external CO Property Package**
        - **Allows use of any previously certified CO Thermo PMC**
- **Thermo PME**
    - **Reference Thermo PMC**
    - **Test scenario**
- **Unit PME**
    - **Reference Unit PMC**
    - **Test scenario**

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Future updates to the Test Suite

- **Open Source software allows a vendor to create new versions of the test suite**
    - **Report issues with the test suite to CO-LaN**
    - **Certification can only be granted for tests conducted with the official released version of the test software**
- **Vendor reports issue (missing feature or bug) to CO-LaN**
    - **Vendor can modify local version of test suite to fix issue**
    - **Modification invalidates test report to get Certificate**
    - **Certification will therefore require update to the official test suite**
- **A future "Certification SIG" manages the process to improve test suite**
    - **With input from relevant CO-LAN SIGs**
- **It is the interest of the vendor to provide access to the relevant software being tested**
    - **either through supplying the software itself to the CCO**
    - **or through remote desktop sessions**
- **Certification SIG will have final responsibility for publishing an updated version of the test suite**
    - **Against which the vendor will re-test their software and obtain certification**

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Implication of Updates to Test Suite

- **An existing certificate will remain valid**
  - But the CO-LaN compliance repository will record which version of the test software has been used for certification
- **Best practice will be for vendor to re-test when a new version of the test suite is available**
  - But not mandatory
- **CO-LaN should inform all existing certificate holders when an updated version of the test suite is available**
- **CO-LaN will need to maintain a public change log for the test suite**

Future version of Test Software will need to support multiple versions

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Development of Test Suite

- SoR developed by Technical Steering Group
- 1st category of requirement: What the software should do
  - Architecture
  - The way the user interacts with the testing application
    - Includes options, switches, configuration, user interface
    - Ability to run single tests or subsets
  - Organisation of tests – groups / severity
    - Simple vs advanced
    - Nominal tests vs. error handling
  - How to report the outcome of the testing
  - Reporting of feature logging

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Development of Test Suite

- ☐ **SoR developed by Technical Steering Group**
- ☐ **1st category of requirement: What the software should do**
- ☐ **2nd category of requirement: What steps should be tested**
  - ▪ **Which interfaces**
    - • **Initially base on use cases in standard (if available)**
    - • **Ensure that test suite captures all existing know bugs**
  - ▪ **Issue of confidentiality of known bugs**
  - ▪ **Sequence of operation to be followed**
  - ▪ **Coverage testing (every interface called at least one)**
  - ▪ **Error handling & reporting by PMC / PME**
  - ▪ **How to test features**

Next Steps

- **Identify suitable developer**
    - **Insufficient resource currently available**
- **Write SoR for test suite for Thermo PMC**
    - **Technical Steering Group**
    - **Developer**
- **Estimate cost of work and budgetary approval**
    - **Developer**
    - **Management Board**

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Thank You!

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