



I-VIGILANT



National Engineering
Laboratory

ITE SUMMARY REPORT

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INDEPENDENT TECHNICAL EXPERT 1
TÜV SÜD NATIONAL ENGINEERING
LABORATORY

INDEPENDENT TECHNICAL EXPERT 2
I-VIGILANT TECHNOLOGIES LIMITED

SUMMARY OF APPROACHES TAKEN

ITE 1 - NEL

- Measurement error calculated from CFD
- Plate Geometry established from laser scanning
- CFD Modelling
 - Ansys Fluent
 - 3 Reynolds Numbers for each orifice
 - Forward and reverse orientation
 - 12 cases in total
 - k- ϵ turbulence model
 - Validated against ISO 5167 forward
 - Validated against SwRI published data in reverse

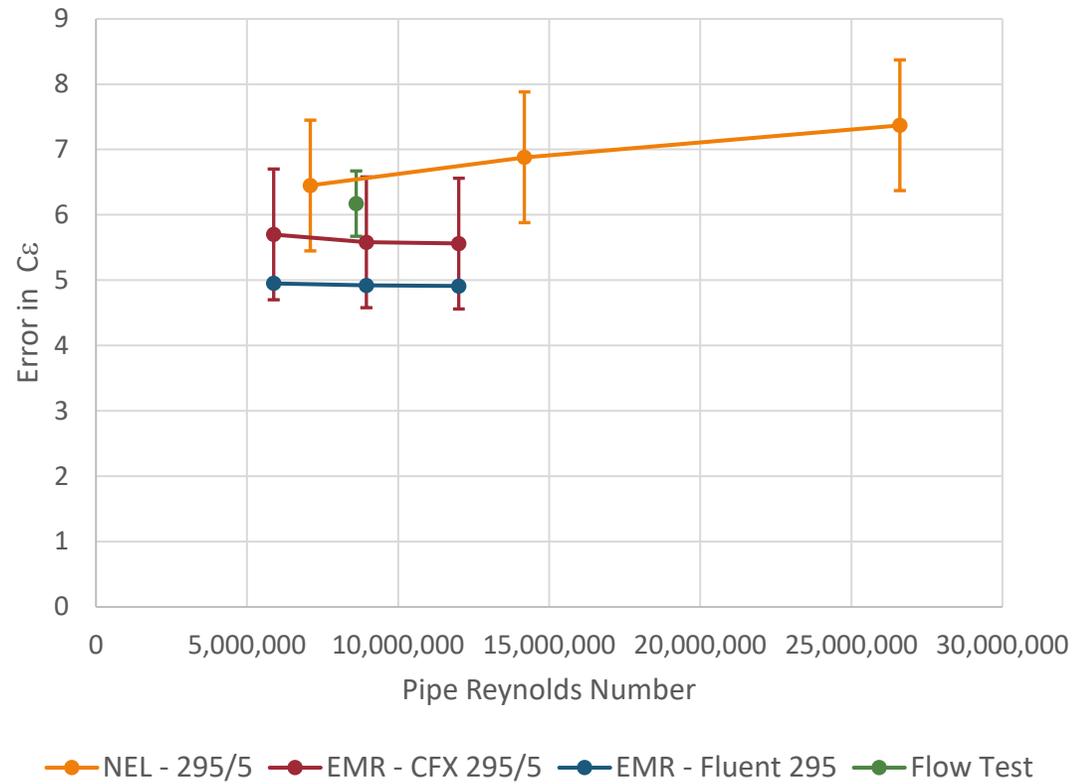
ITE 2 – i-Vigilant

- Error calculated from CFD and Flow Test
- Plate Geometry established from calibration certificates
- CFD Modelling
 - Ansys Fluent, Ansys CFX
 - 3 Reynolds Numbers for each orifice (24 cases)
 - k- ω SST turbulence model
 - Validated against 5167 forward
- Flow Testing
 - 4 flow tests over 4 days
 - Each plate forward and reverse

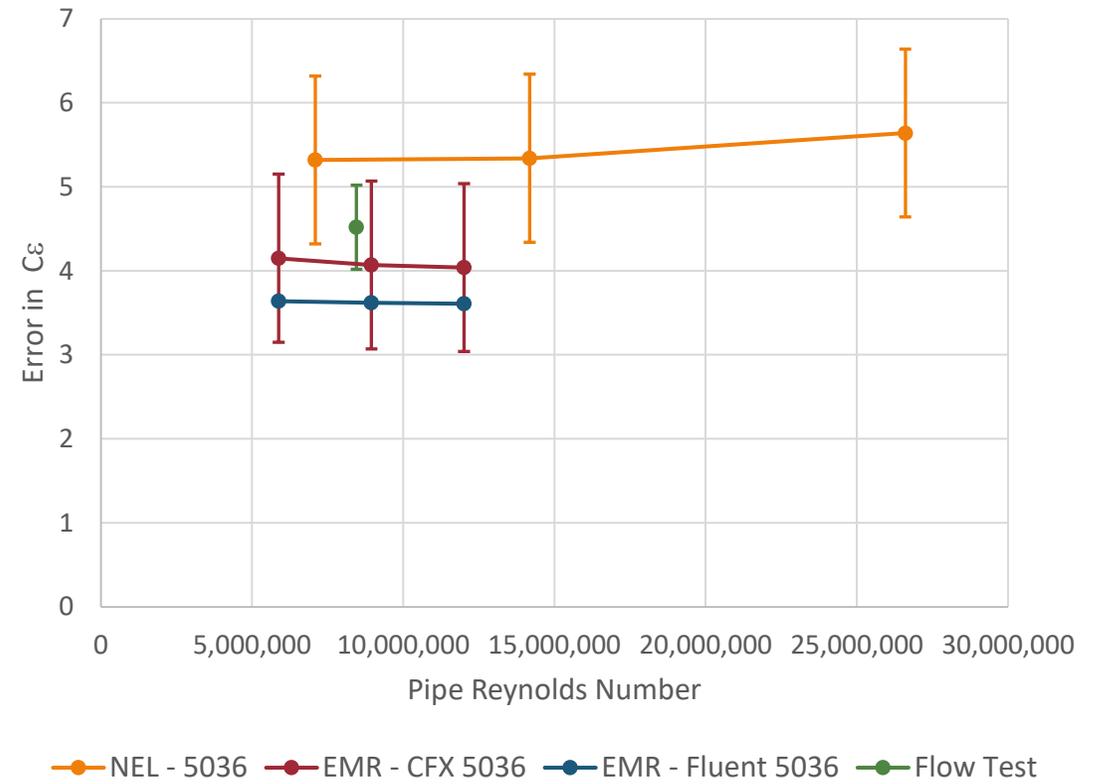
**BOTH ITE'S PERFORMED CFD OVER 3 REYNOLDS NUMBERS
VERY SIMILAR INPUT CONDITIONS – ITE 1 COVERED WIDER RED RANGE**

SUMMARY OF RESULTS

Orifice 295/5



Orifice ARLE 5036



ERROR BARS

CFD 1%, FLOW TESTS 0.5%

THE MAIN DIFFERENCES

- Both CFD results are similar in magnitude (within approx 1%)
- Flow tests results between NEL CFD and EMR CFX
- Main differences in SMER
 - Small differences in uncorrected quantities
 - Less than 0.2%. ITE-1 used 12-12 for day, ITE-2 5am.
 - Agreement: Original Data taken from 5am closing total.
 - Difference in linearity with respect to ReD
 - ITE-1 CFD done over wider range of ReD and showed dependence – ReD dependent correction implemented. ITE-2 smaller range of ReD and a smaller gradient.
 - Agreement: Due to small ReD range - ReD dependence can be neglected.
 - Differences in CFD solvers/turbulence models
 - Small differences in plate geometries and input conditions
 - Difference in turbulence models, and model setup (cell shapes and mesh sizes)
 - Generally good agreement and within uncertainty envelopes
 - Requires knowledge and experience – will always be some subjectivity in configuration and execution

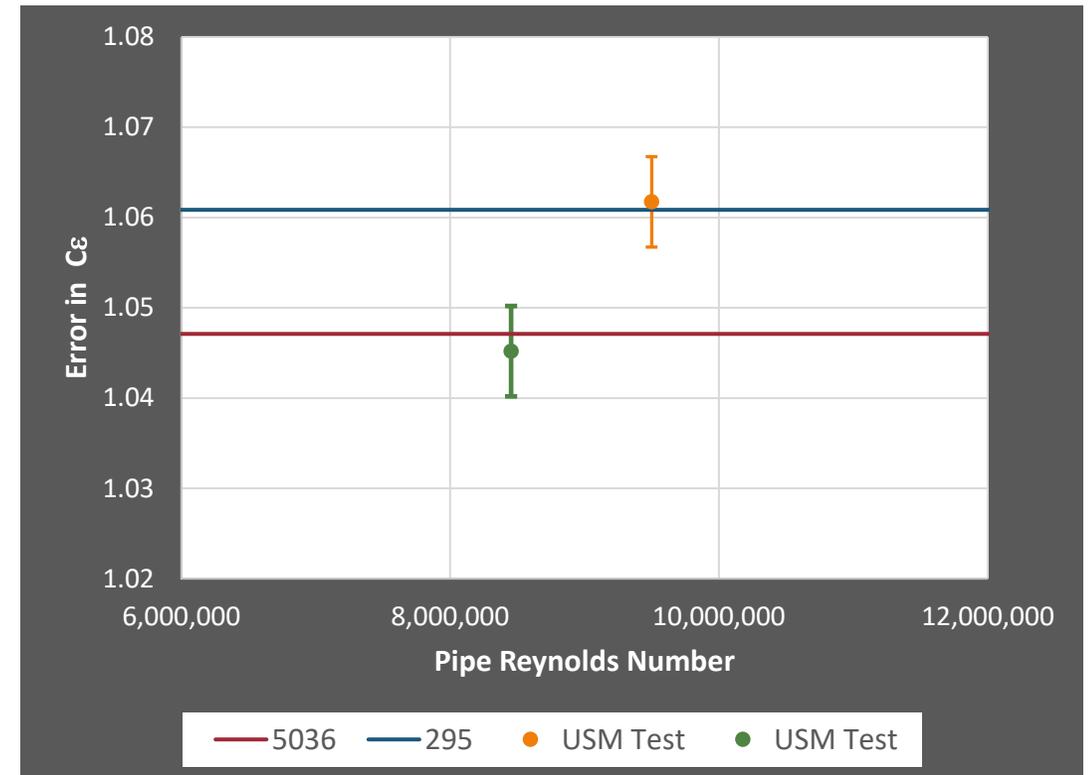
BOTH CFD SIMULATIONS CLOSE TO ONE ANOTHER
FLOW TEST RESULTS CLOSE TO MIDDLE OF CFD DATA

FINAL CORRECTION FACTORS

- Average of ITE1 CFD and ITE2 (CFX) CFD
- Correction
 - Plate 295/5: 1.06084
 - Plate ARLE 5036: 1.04709

- Final Correction and Flow Test Result

	ITE-1	ITE-2	Final
Correction for period: GWh	867.09	776.10	782.4
Correction for period: Msm ³	79.44	71.11	71.69
% of Total over Period	6.01%	5.39%	5.43%



SUMMARY

- Both ITE's completed separate assessments
- Some minor differences were observed
- Mutually agreeable, single conclusion established
- Correction factor for plate 295/5: **1.06084**
- Correction factor for plate ALRE5036: **1.04709**
- Total Production over period
 - 14,547 GWh
 - 1,333.2 MSm³
- Total undermeasurement of
 - 782.4 GWh
 - 71.69 MSm³