



I-VIGILANT



National Engineering  
Laboratory

# ITE SUMMARY REPORT

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INDEPENDENT TECHNICAL EXPERT 2  
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# 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- $\epsilon$  turbulence model
  - Validated against ISO 5167 forward
  - Validated against SwRI published data in reverse

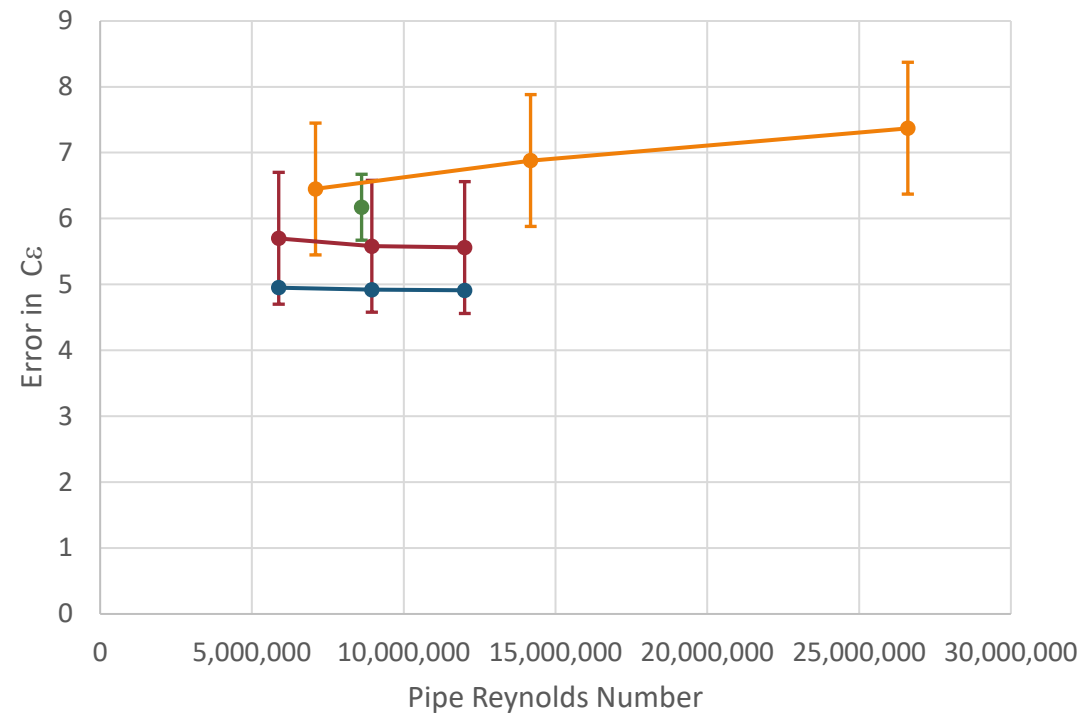
## ITE 2 – i-Vigilant

- 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- $\omega$  SST turbulence model
  - Validated against 5167 forward
- Flow Testing
  - 4 flow tests over 4 days
  - Each plate forward and reverse

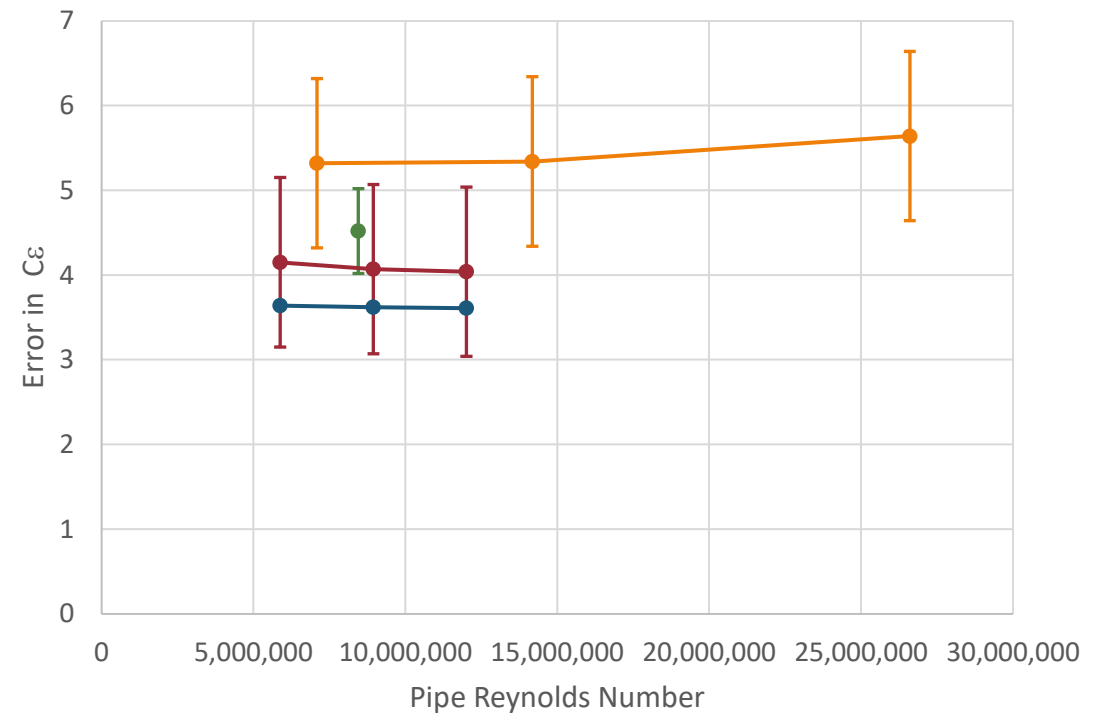
**BOTH ITE'S PERFORMED CFD OVER 3 REYNOLDS NUMBERS  
VERY SIMILAR INPUT CONDITIONS – ITE 1 COVERED WIDER RED RANGE**

# SUMMARY OF RESULTS

## Orifice 295/5



## Orifice ARLE 5036



—●— NEL - 295/5 
 —●— EMR - CFX 295/5 
 —●— EMR - Fluent 295 
 —●— Flow Test

—●— NEL - 5036 
 —●— EMR - CFX 5036 
 —●— EMR - Fluent 5036 
 —●— Flow Test

**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

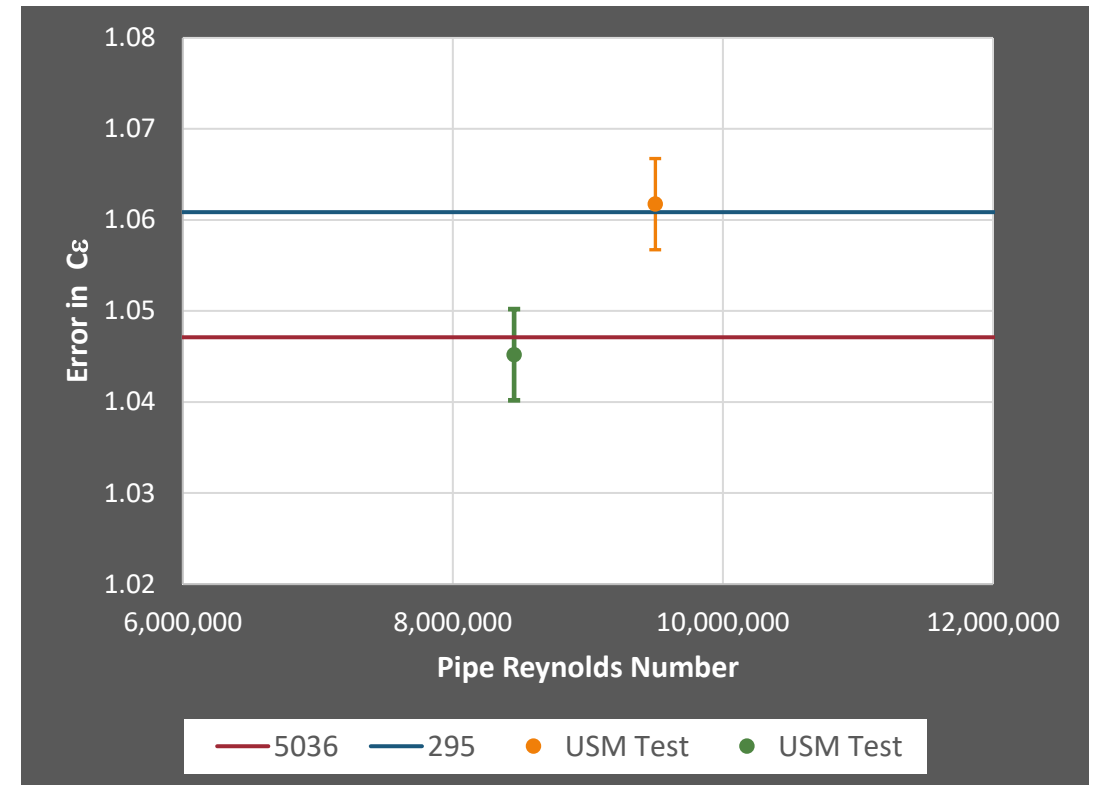
**BOTH CFD SIMULATIONS CLOSE TO ONE ANOTHER  
FLOW TEST RESULTS CLOSE TO MIDDLE OF CFD DATA**

# FINAL CORRECTION FACTORS

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

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

- Final Correction and Flow Test Result



# 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 MSm<sup>3</sup>
- Total undermeasurement of
  - 782.4 GWh
  - 71.69 MSm<sup>3</sup>