UKAS INSPECTION
331

Aberdeen
Significant Error Review
ITE Investigation Status

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Presentation Content

- Brief introduction to the “key” events of the SMER
- Description of the methodology adopted
- Current status

Site Layout

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Orifice Fitting

Orifice Fitting Counter

SMER Timeline

Investigations to date would indicate (subject to additional review) that;

- The initial cause of the SMER was as a result of the incorrect positioning of a replacement orifice plate within a “Senior” type fitting following an annual validation visit to site (counter reading 99984/99985).
- This activity was completed on **21st July 2009** and the site was introduced back on-line accordingly.
- During the next annual validation visit to site on **27th July 2010** the orifice plate was replaced and the orifice plate installed incorrectly again but to a different position than that previously (counter reading 99950).
- On the **10th August 2010** the site was visited (responding to a raised fault log) and the incorrect positioning of the orifice plate was subsequently discovered and reset (counter reading 00000).

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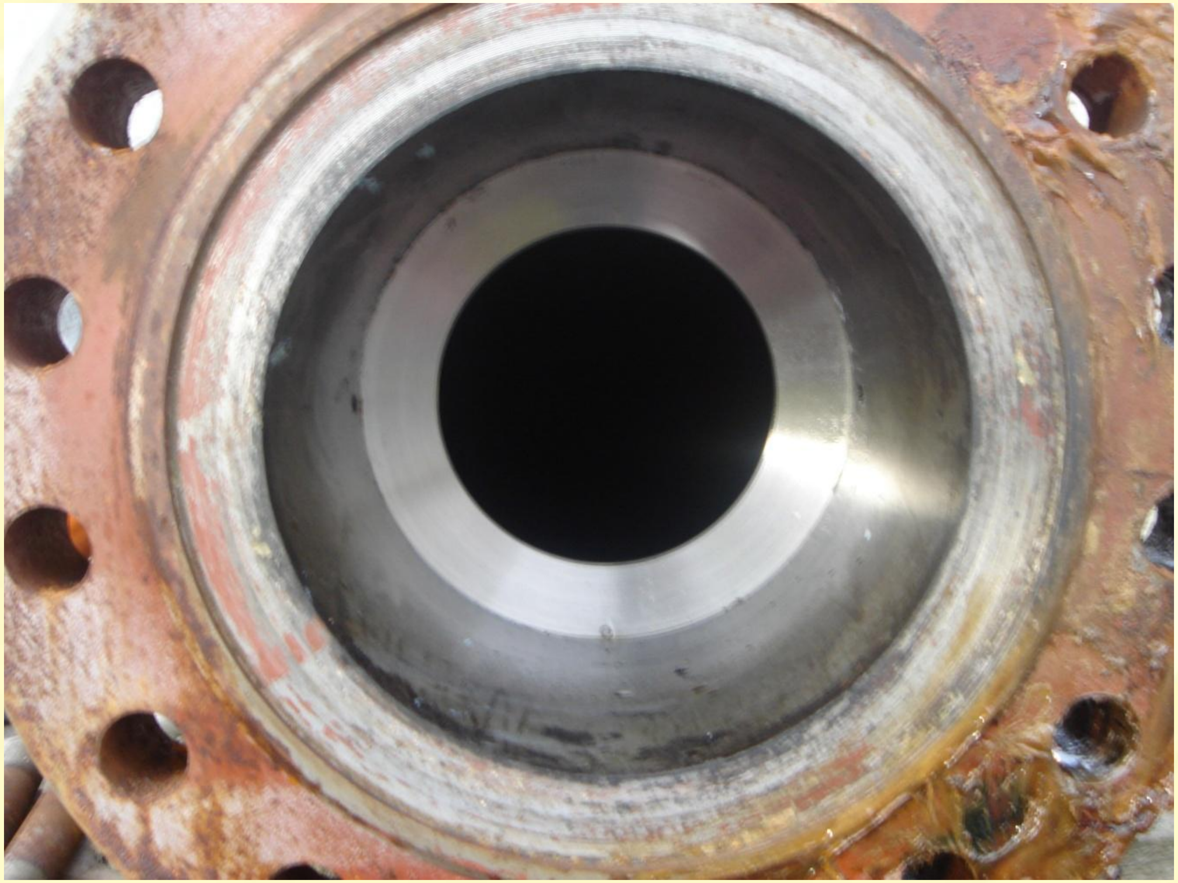
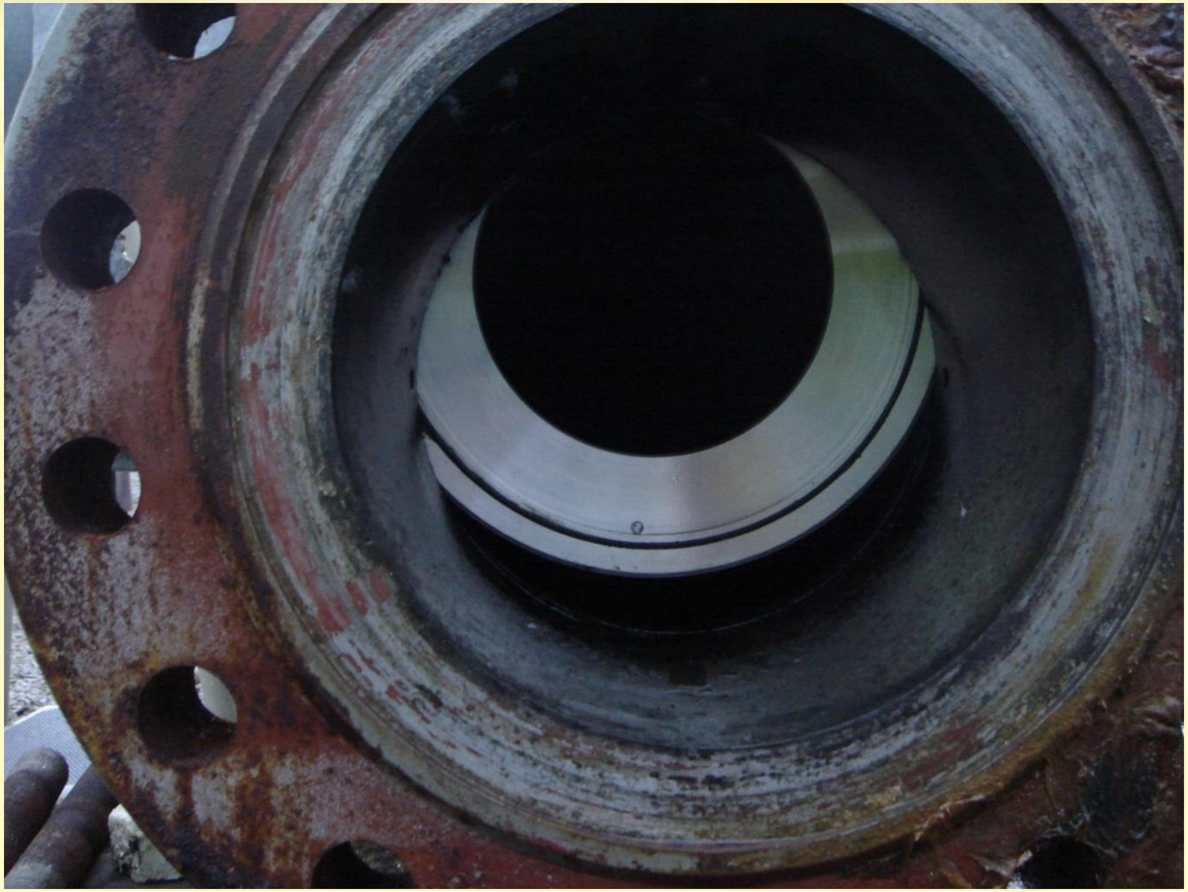
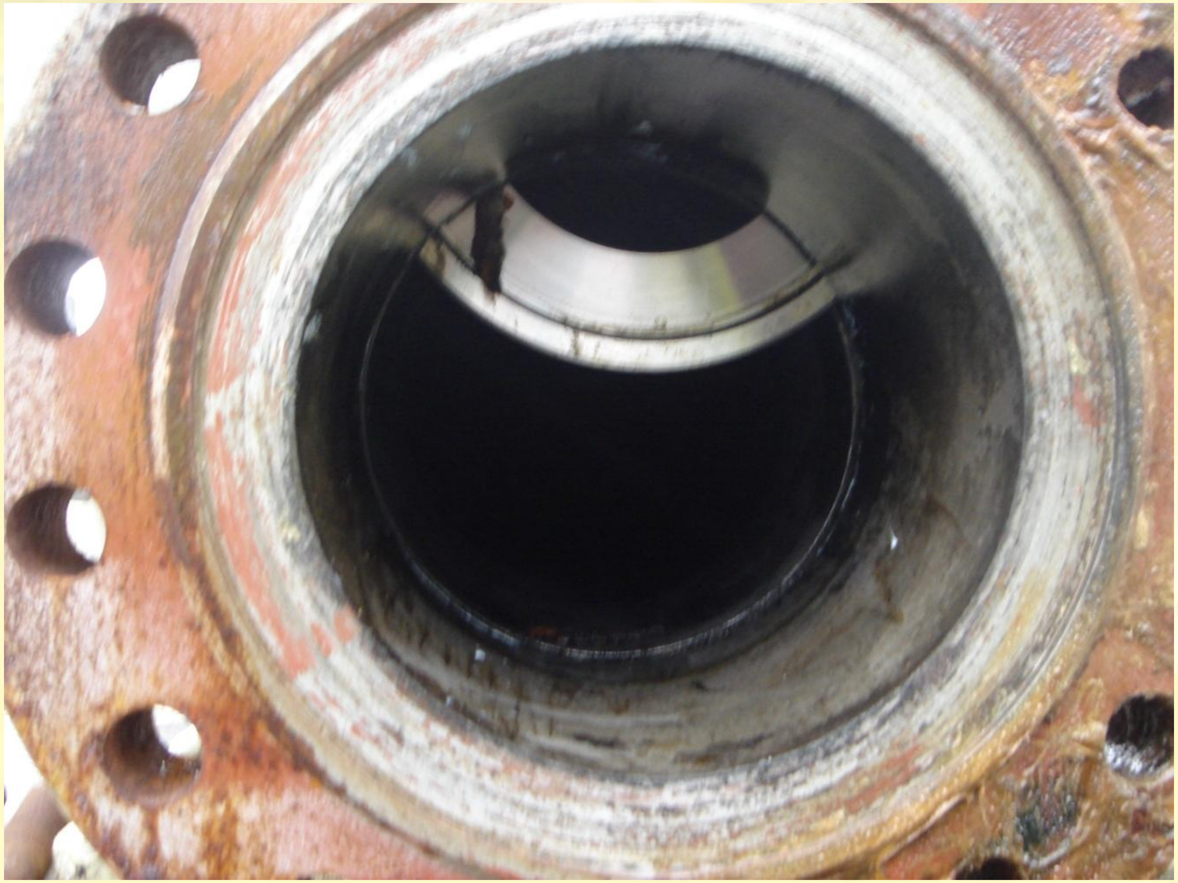
Counter Reading 00000



Counter Reading 99984



Counter Reading 99950



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Investigation Methodology

For a SMER "kick-off" meeting with SGN on 18th July 2011, the following methodology was tabled by the ITE;

- **Understand the events of the SMER -** A detailed SGN presentation is required to initially introduce the SMER so that the Independent Expert understands the basic issue(s).

- **Define the SMER period -** The period of the SMER must be determined beyond all reasonable doubt. This must be supported as a minimum by operational event recordings, look book entries and personnel interviews. Evidence from as many "other sources" (which are not considered commercially sensitive and can be incorporated openly for discussion within the Joint Office forum) will also be required to support the SMER period. Preferred evidence would be from other "Sources" outside of the SGN derived information chain.

- **Define the Operating conditions seen during the SMER;**
  - Define the minimum & maximum instantaneous flow rates that were recorded during the SMER to provide a "flow band" to replicate during the site tests.
  - Define the minimum & maximum operating pressure that was recorded during the SMER to provide a "pressure band" to replicate during the site tests.
  - Define the minimum & maximum operating temperature that was recorded during the SMER to provide a "temperature band" to replicate during the site tests.

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Investigation Methodology

- Define the minimum & maximum operating density that was recorded during the SMER to provide a “density band” to replicate during the site tests.
- Review flow computer configuration to ensure key parameters (“d”, “D” & field devices ranges etc.) are still representative of the SMER period.

- **Benchmark the Measurement System -** A site visit will be required to benchmark the metering installation. An internal inspection of the Orifice Fitting (as it is installed within the pipeline) and the ability to catalogue (in photographic form) the relationship between Orifice Plate position and the displayed Orifice Carrier Counter value is required.

- **Define the technical methodology to derive a robust evaluation of the magnitude of the SMER;**
  - Formulate several (to be determined) flowing scenarios that provide as accurate as can reasonably be achieved a “representative” cross section of the operating conditions observed during the SMER period.
  - Provision to record in “real time” (in electronic form) the outputs of the following measured variables;
    - Low ΔP
    - High (Duty) ΔP
    - High (Standby) ΔP
    - Pressure
    - Temperature
    - Density
    - Instantaneous Flow (Standard Volume)

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Investigation Methodology

- For each of the tabulated flow scenarios, replicate the operating conditions on the flow metering stream with the metering stream "set" for normal operation (Orifice Plate "fully racked" within the closed position – achieved by Counter Value determined from internal inspection).

- Once a flow scenario has been replicated & established, the following actions will be required to be implemented;

  - Ensure all measured variables must be recording satisfactorily and stable. Ensure a "date & time stamp" is incorporated.

  - "Wind out" the Orifice Plate (in steps to include the range of Counter Values – final steps to be determined at site).

  - For each change in Orifice Plate position, ensure (allowing time for stabilisation) the recorded values have appropriately responded and identify on the recording device the "implemented Orifice Plate position change".

  - Repeat the above for all selected flow scenarios.

  - Collate all records on completion of testing.

- **Supportive Tests -** It is envisaged that additional supportive (independent of the site testing methodology) testing will be required. This maybe in the form of Computational Fluid Dynamics (CFD) provided by an accredited organisation such as the National Engineering Laboratory (NEL).

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Actual Site Test Parameters

Following review of the operational data seen during the SMER period, the following was established;

- Pressure Range 55 – 65 BarG (Site actual 58, 61.5 and 64 BarG)
- Temperature Range 9 – 14 °C (Site typical 10°C)
- Flow Range 1 – 4.6 MMCM/D (Site actual 1, 3 and 4.6 MMCM/D)

Site Visit Dates

Site visits were attended on the following dates;

- **30th November 2011 –** orifice plate positional checks
  - Difference in Winding in/out positional differences noted!
- **15-17th February 2012 –** medium pressure test achieved only
- **18-19th April 2012 –** remaining low & high pressure tests completed

Counter Reading Checks

ABERDEEN SMER FLOW TESTS

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TEST NUMBER:

Date:	Test Stability:
Time Start:	Time Finish:
Pressure Start:	Pressure Finish:
Temperature Start:	Temperature Finish:
Density Start:	Density Finish:
RD Start:	RD Finish:
Flow Rate Start:	Flow Rate Finish:

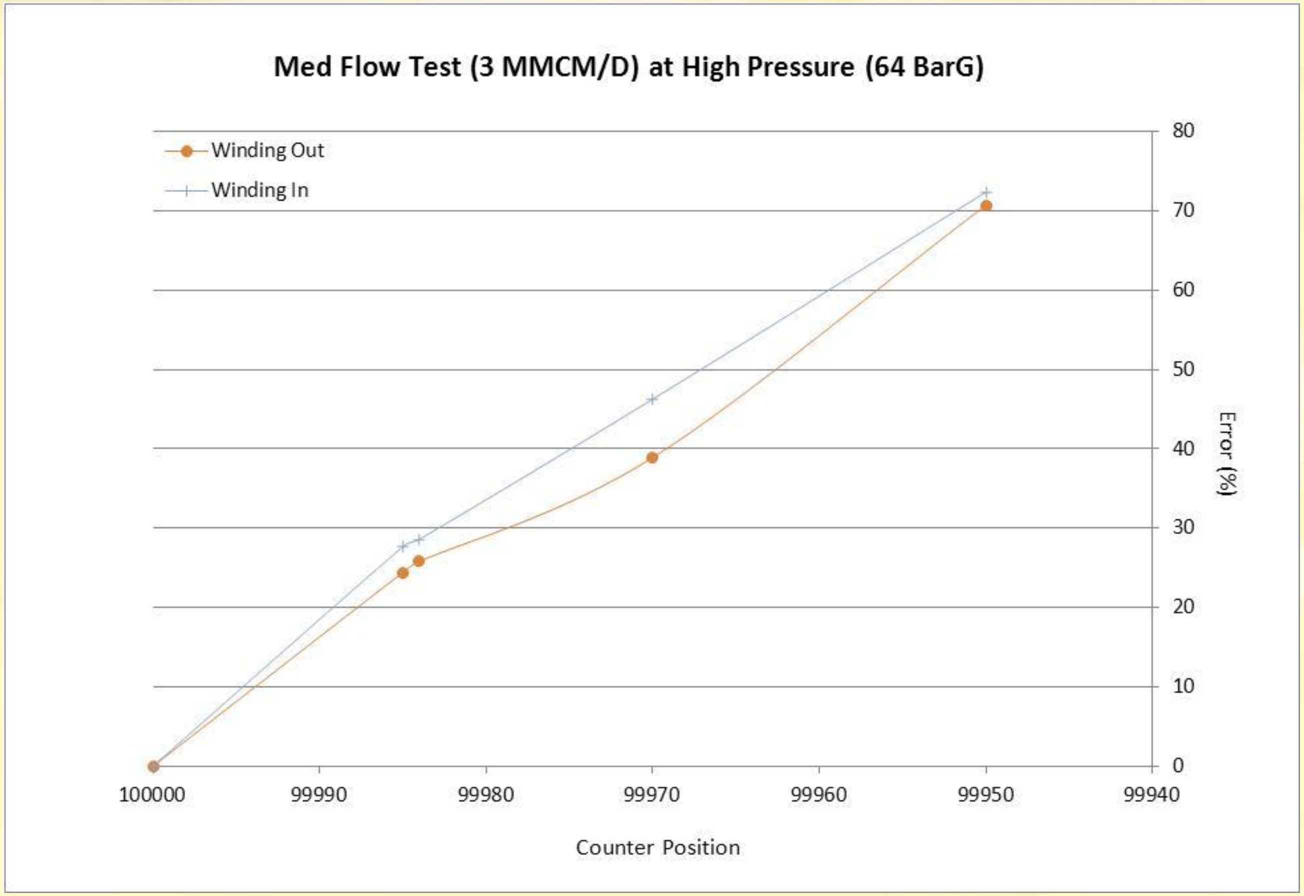
Counter Position	Pressure	Temperature	ΔP	Flow Rate	Difference (%)
00000					
99985					
99984					
99970					
99950					
Fully Out					
99950					
99970					
99984					
99985					
00000					

Site Tests Performed

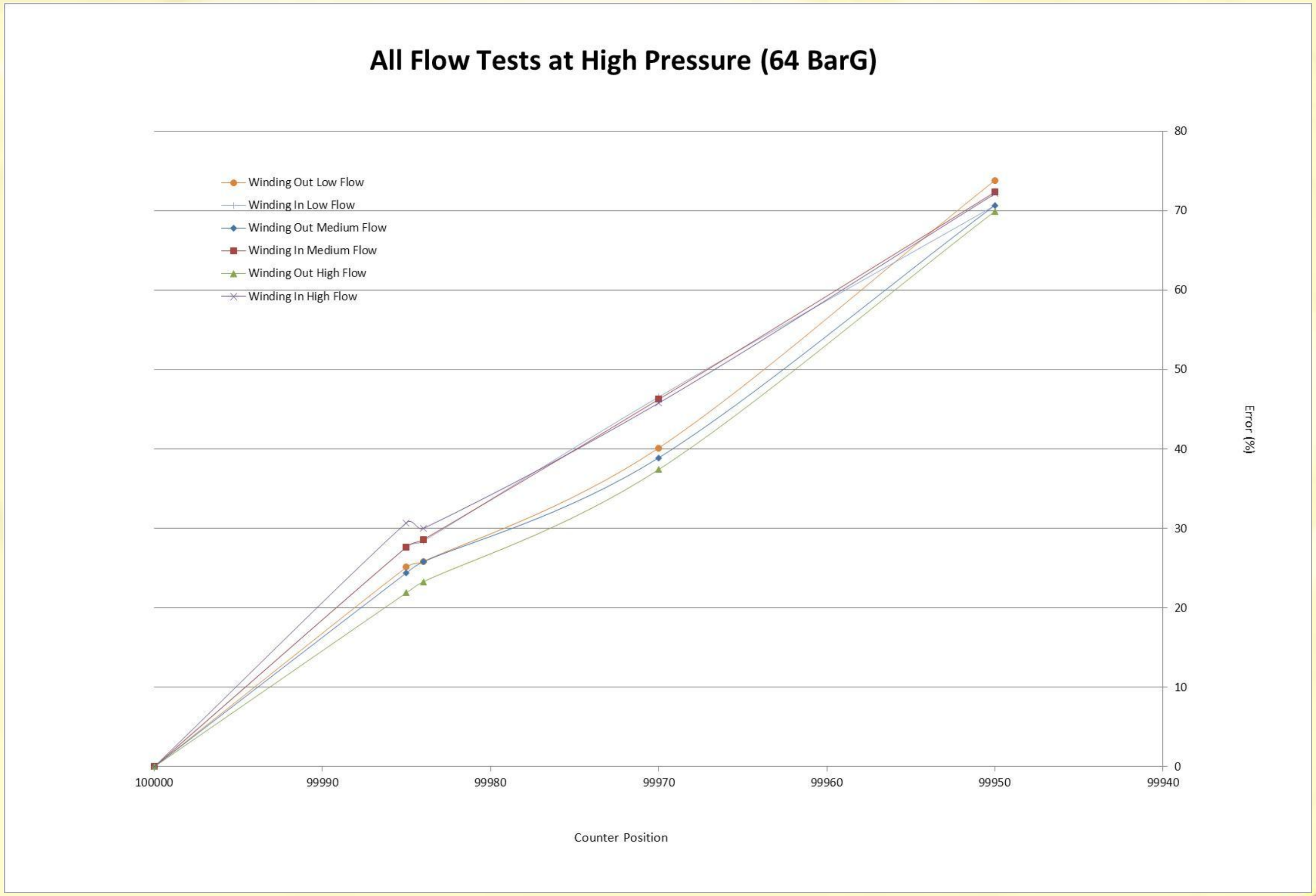
A total of 10 flow tests were performed;

- **Low, med & high flows at high pressure**
- **Low, med & high flows at mid pressure**
- **Low, med & high flows at low pressure**
  - Additional second run at low flow to verify the first (lower trend observed to others)

Results


Med Flow Test (3 MMCM/D) at High Pressure (64 BarG)
Winding Out
Winding In
80
70
60
50
40
30
20
10
0
Error (%)
100000
99990
99980
99970
99960
99950
99940
Counter Position

Results



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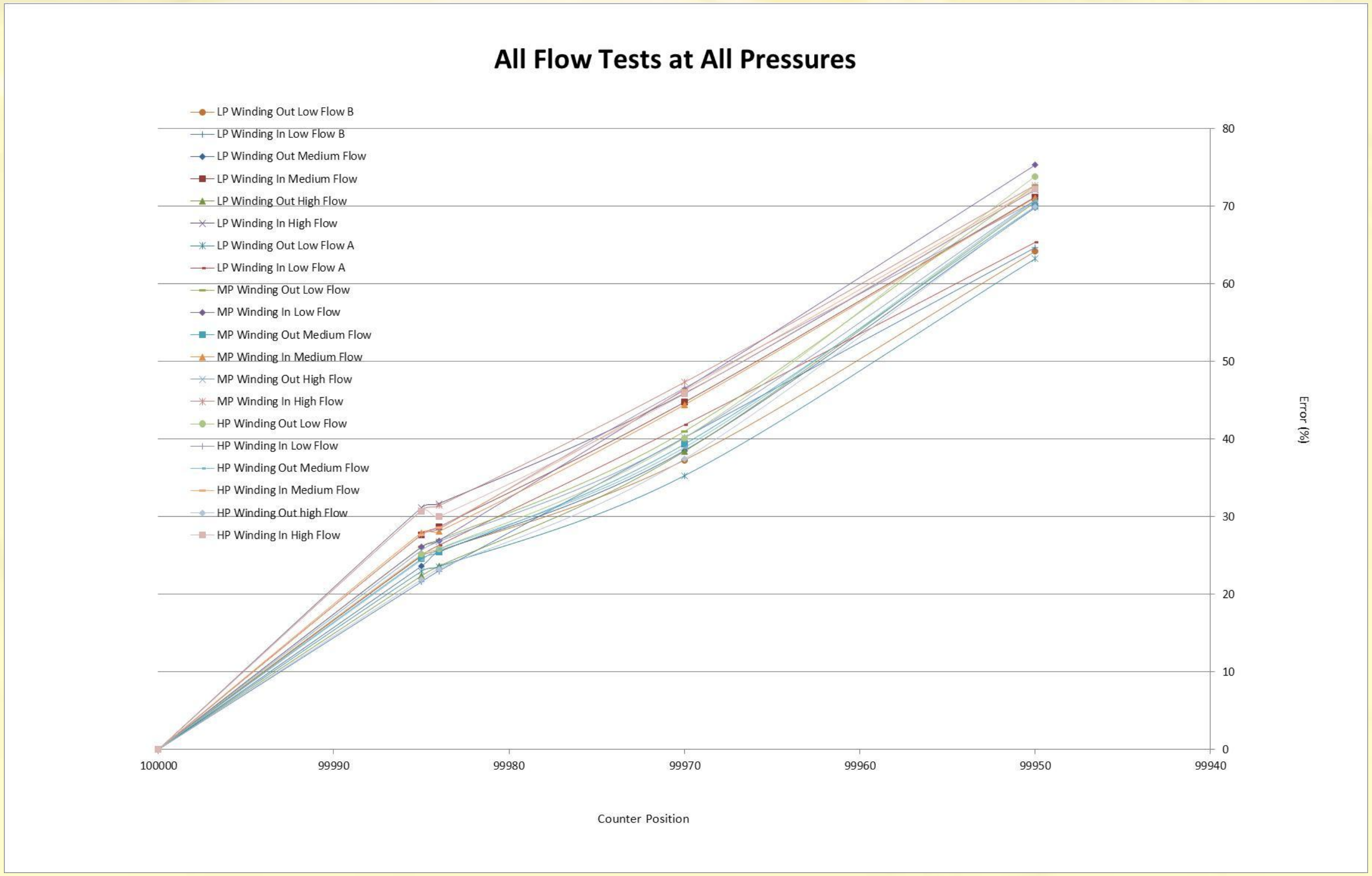
Results



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Preliminary Error Values

- **For the period 21/07/2009 to 27/07/2010**
  - in the region of **25 – 31%**
- **For the period 28/07/2010 to 10/08/2010**
  - in the region of **70 – 75%**

The review of results to date has not indicated that there is an identifiable bias associated with different flow rates or pressures. However, the low flow at low pressure appears to be "outside" the general trend of the other results (requires further investigation).

Computational Fluid Dynamics

Due to the "spread" of site test results, a CFD analysis model (as initially identified by the ITE within the methodology procedure) is currently being constructed by;

Professor W Malalasekera

Professor of Computational Fluid Flow & Heat Transfer

Loughborough University

The idea being that the "independent" (to the site flow tests) evaluation of the CFD results can be used to "closely" indicate an error value within the spread of results obtained from the site tests.

Further Review

- **Await the results of the CFD Analysis**
  - To provide (hopefully) some more precision of error value(s)
- **Finalise the SMER period**
  - Provision of definitive support data
- **Establish the final correction factor(s)**