GL Noble Denton

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Issue: 1.0
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Response to Questions from Graham Wood of British Gas received on 24th August 2012

1. A claim was made that flow before and after could not be determined, maybe this needs to be looked at a longer time period. Flow was 20 mmscf/d before plate returned to its correct position then 40 mmscf/d afterward, how much of the flow is due to transient demand at the time?
   During the plate change on 27th July 2010 the site was under transient flow conditions and so a comparison of flow rates before and after could not be made. For July 2009 and August 2010 the valve position and flow rates were held constant therefore the step change is due to the incorrect position of the orifice plate. During on site testing some instability was seen over the duration of each test (approximately 1 hour). At 1 Mscm/d and 3 Mscm/d the instability was up to 4 %. At 4.5 Mscm/d the instability was around 10 %. The instability was due to the change in downstream pressure as the flow rate did not match demand (~2 Mscm/d). On the days where the orifice plate was changed the site would have been operating to demand and therefore the instability would have been significantly less.

2. No spread or uncertainty has been stated for derivation of error, we would be interested in your view on this.
   I will calculate the uncertainty of the differential pressure measurement as part of the analysis to determine whether the experimental results are within the uncertainty range.

3. We are mindful that there is the potential that additional site tests may be required, what is your view on this? We are clear that such a requirement should not be discounted on grounds of cost or inconvenience, due to the value of the error. If further site tests are required then this should be clearly recommended by the ITE.
   I agree and have already stated in the methodology that further tests may be required depending on the outcome of the CFD modelling.

4. How were the counter readings verified? This is a critical aspect to establish the exact location of the plate.
   Measurements of the physical plate location against counter reading were made by an independent party and witnessed by both ITEs. The measurements were made with the downstream spool removed to provide access to the orifice plate inside the pipe. The vertical and horizontal offsets were recorded at various points of removal and insertion and repeated multiple times with very good repeatability.

5. The name plate included a hard to read counter reference and the counters first and last digits were also "clouded" / easily mis-read. So, while in on a scale of 1-100 how confident are you that the "perceived" plate position while in correctly positioned, was what you have presumed: Case 1? Case2?
   99950 – July 2010 to August 2010: Witness statements have been taken and corroborated as evidence for this counter reading.
   99985 – July 2009 to July 2010: I am 100% confident that the name plate states 99885 in two locations with photographic and physical evidence to support this. Regarding the counter reading for this case, initial estimations prior to on site testing produced a counter reading of 99984, however 99985 was considered to be a more plausible reading for the counter to have been left at because of the values stated on the name plate. Without experimental data to support this, it is not possible to put much confidence in this counter reading.
   The errors from the experimental data will be compared with the step changes in flow on the days of the orifice plate changes in July 2009 and August 2010. If they are within the uncertainty range then I will have more confidence in the counter readings.

6. The CFD model is questionable in terms of how it is used. We would expect it to be very close to the standard ISO 5167 calculation as this is well defined. However when the plate is not in the correct position it is outside of ISO 5167 so there are no rules or guidance for the calculation. It may therefore need another independent calculation as a check for the first once?

As I understand it the CFD model does not calculate the mass flow rate in accordance with ISO 5167, but predicts the differential pressure at the tapping points based on the geometry and various input parameters. Various guidance exists on the most accurate and appropriate model to use for different applications. Guidance exists based on ISO 5167 compliant orifice plate metering systems which is expected to predict the 'normal' differential pressure very accurately. However as suggested this may not be the most appropriate guidance to use for the 'abnormal' or non-compliant case and other models may be explored.

7. Is the CFD expert subject to ISO 9001, to include peer review and who was doing that review?
   The CFD expert is an independent contractor working alone and therefore the review of his work will be down to the ITEs.

8. As the CFD results for the "test" point have been unsuccessful so far, how many attempts are you going to give the expert, before this is seen as a "lucky" answer and this line of enquiry no longer progressed?
   As there is little experience of using CFD modelling for this 'abnormal' orifice plate application a certain amount of validation is to be expected. The data used in the validation of the model will not be taken from any of the data sets that are expected to be used in the calculation of the error (i.e. not the 99985 or 99950 counter reading tests). Once I am satisfied with the model it will be expected to produce results for the final data sets and it is these results that will be compared to the experimental data.

9. Do the test flows and line conditions match that of the meter run at the time, especially in a cold winter (2010)?
   The test flows and pressures were designed to cover the operational ranges over the period of the error. They in fact cover over 80 % of the operational pressures and over 70 % of the operational flows. The ground temperature (and metering temperature) varies very little over the year and typical ranges from 10 to 15 °C.

10. As the pressure loss is far less than expected for the flow rate how is the upstream temperature determined? With ISO 5167 this is clearly defined, but with the plate not in place is can only be assumed, this has an impact as the lack of valid temperature correction will affect the calculated gas density as the upstream temperature has to be determined from an known model with an inconsistent flow profile in the meter run.
    The downstream temperature was monitored during the test runs and no change in temperature was noted so the temperature drop was also assumed to be constant.
    The assumption of an isenthalpic downstream to upstream temperature correction will be examined in the analysis. The uncertainty of this measurement will be taken into account.

11. The orifice plates removed may also provide evidence but we have not yet seen any photos, are there any that can be shared?
    Photographs of the upstream and downstream faces of the orifice plate removed in 2010 have been examined. They will form part of the final report however the downstream party may choose to share these beforehand if formally requested to do so.

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