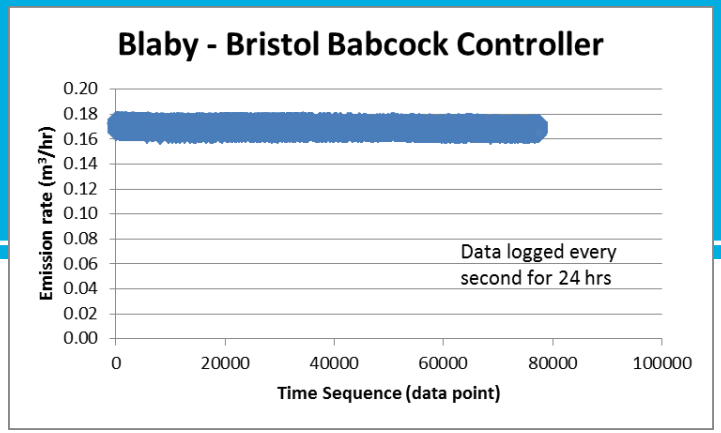
Venting Controllers/Positioners – understanding natural gas emission rates at AGIs



Background

- Emissions of natural gas from gas networks originate from a number of sources including:
  - Infrastructure failure
  - Operational/process venting
  - Fugitive leakage from pipeline infrastructure

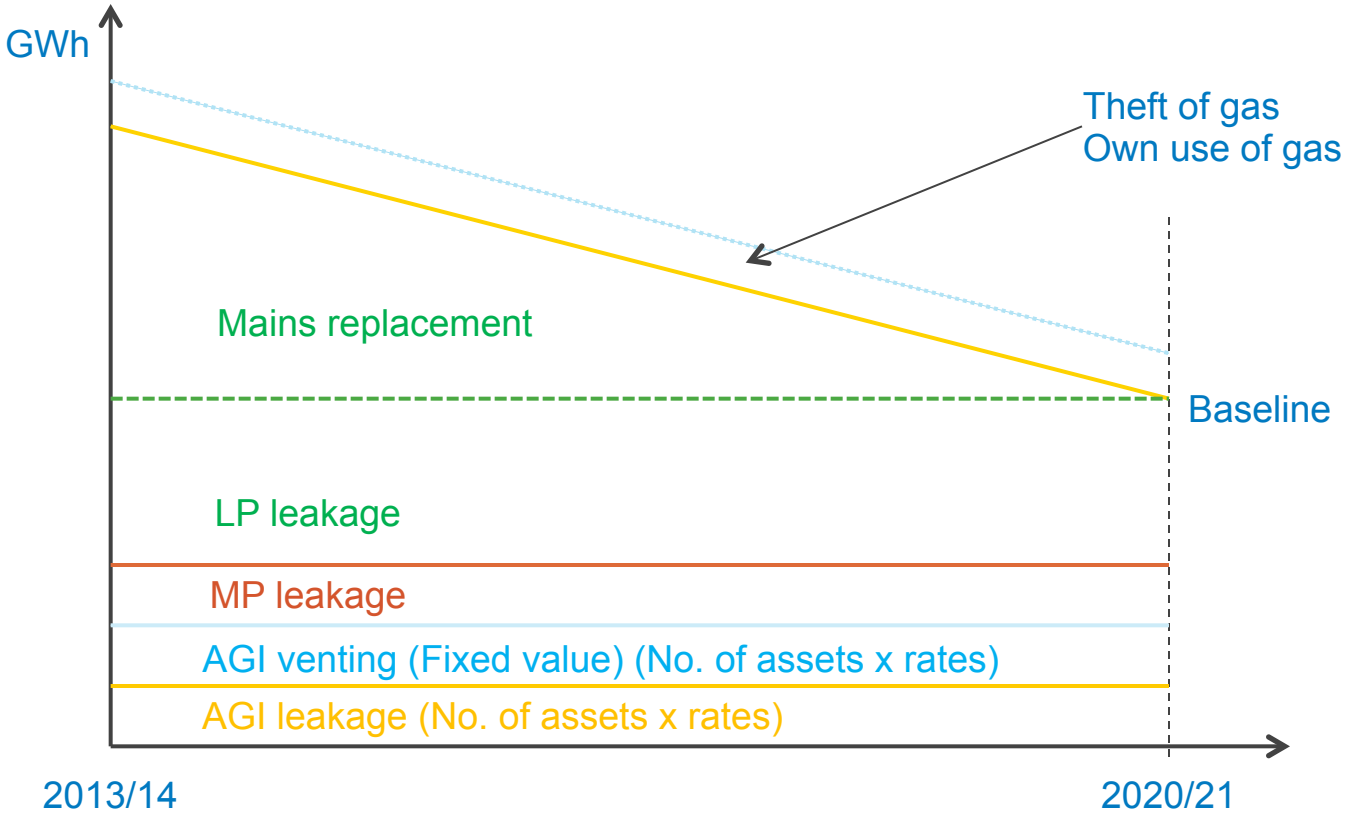
- Fugitive leakage can be a significant, continuous emission
  - Valves, flanges, connectors, pressure relief devices, PIG trap doors and filters have been identified as major fugitive emission sources.

- Venting from some process control equipment can also be significant and continuous:
  - This work focuses on emissions from valve controllers and positioners. These equipment may have continuous emission which, although at a relatively low flow rate, still comprises a significant amount when considered over a full year.

Drivers for action on gas venting and leakage

- UK legislation and targets
- Improve environmental performance
- Reduce carbon footprint of business
- Take the UK gas industry lead, in demonstrating awareness and action with regard to emissions reduction
- OFGEM structures in RIIO:
  - Shrinkage
  - Environmental Emissions Incentive
  - Business Carbon Footprint

Targets for leakage reduction



Venting Controller Project - Aims

- The key aims from this study include:
  - Quantify the vent emission rate from selected controllers and positioners
  - Study how the vent rate varies as a function of site operation (looking at time and seasonal dependence)
  - Determine if there is a link between the emission rate and site operation
  - Couple site infrastructure information with measured emissions to quantify overall emission inventory and produce robust values.
- Future projects:
  - Identify controllers and positioners that give better (ie. lower) emission performance
  - Evaluate potential emissions reductions through retro-fit of different controllers and positioners.

Venting Controller project phases

- R&D lab-based studies to quantify leakage rates
  - Parametric study
  - Different equipment types and installation pressures

Completed

- Selected site studies
  - Site tests to confirm lab studies
  - Site tests to check emission rates as a function of time
    - daily swings in system pressures, flows and site use
    - Seasonal swings in system pressures, flows and site use

Completed

- Inventory surveys (National Grid regions)
  - Equipment type
  - Equipment installation factors
  - Equipment pressures

Two regions completed. Two underway and one to start

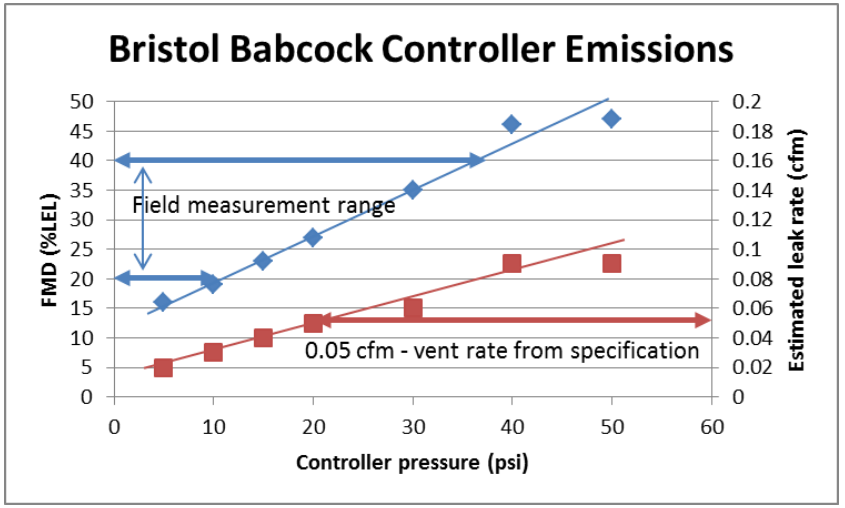
Venting Controller Project – outline

- Identify and quantify the gas venting from selected controllers and positioners
  - Develop a robust test methodology
  - Identify the controller types and suitable sites for test work
  - Perform lab tests on selected controllers and positioners to understand the impact of supply pressure on vent rate
- Study the venting at a number of sites to get a representative range of controller types and operation
  - Measure the vent emission rates using a high flow sampling technique, for short term measurements – time averaged data
- Study how the vent rate varies as a function of controller operation (by studying the vent rate as a function of time over a 24hr period)
  - Install suitable flow meters on selected vents – to establish time-dependence of vent rate
  - Compare the vent rate profiles with site operational parameters to determine if there is any correlation
- Undertake two or three measurement campaigns at different times of the year to check whether system operation factors influence the emission rate
- Survey all above 7 bar AGIs (in five National Grid regions) to collect suitable inventory to enable an overall emission rate to be established for controllers and positioners

Impact of supply pressure (Bristol Babcock controllers)

- Operating manual proposes a controller pressure of 20psi
- Site observations suggest controller pressure may be higher
  - 70psi reported on one site
  - Between 20 – 40psi observed on the initial 20 site surveys.
- Linear relationship of emission rate with controller pressure (lab study)
- Emission rate of 0.05cfm at 20psi, but up to around 0.09cfm at 40psi

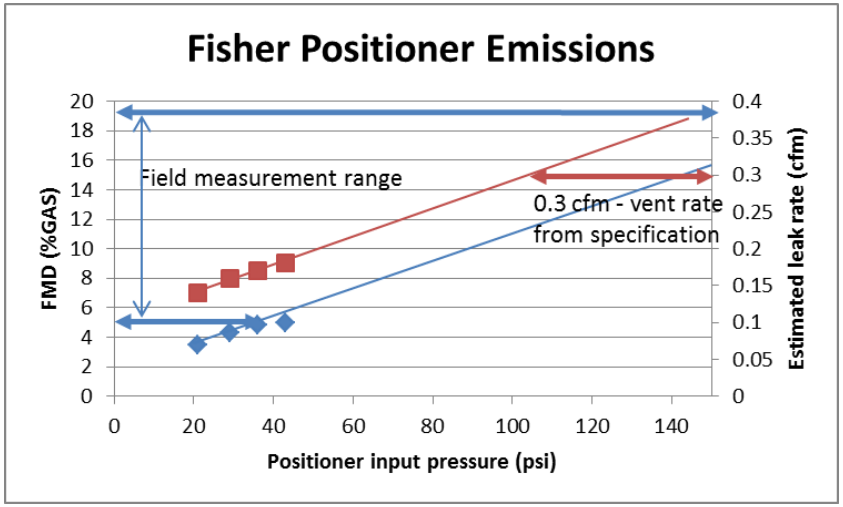
  [0.05cfm ≈ 0.085 m^3/h (≈ 0.5 t/a per controller)]



Impact of supply pressure (Fisher Positioners)

- Operating manual proposes a positioner pressure of 100psi
- Site observations suggest positioner pressure may be between 40 – 150psi
- Linear relationship of emission rate with controller pressure (*limited range of lab tests*)
- Extrapolation of lab tests confirms manufacturer quoted discharge rate of 0.3cfm
- If average positioner pressure is 100psi then vent emission rate will be around 0.5 m^3/h

  [≈ 3 t/a per positioner]



Photographs of a sample of installations

Venting Controller Project – Initial output

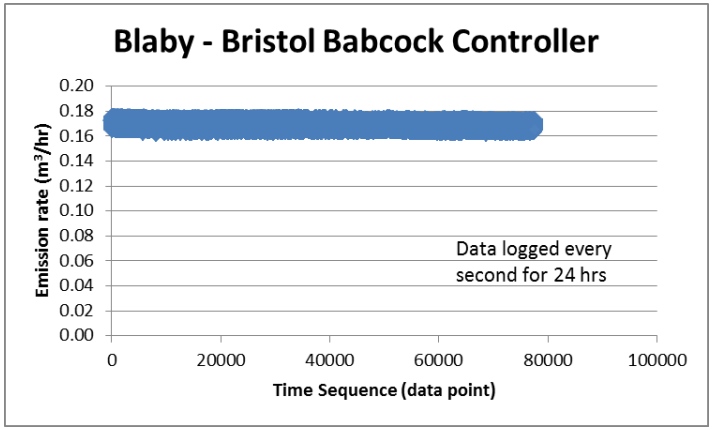
- Site survey controller emission rates.
  - AGI sites surveyed and vent emission rates measured using high flow sampling system – "Snap shot" measurements taken on an "as found" basis
  - Emission rates measured for Bristol Babcock, Fisher, Neles, Taylor, Mokveld, ABB, Watson & Smith and Becker (pneumatic valve controllers and positioners)
  - 3 sites selected for longer term testing (Blaby, Coleshill and Hedgerley).
- Measurements made show wide range of emissions dependent on equipment type and function.
  - The positioners all give relatively high readings, with the highest recorded value on a Fisher positioner with an emission rate of 2.6 m^3/hr (or 1.8 cfm)
  - The Bristol Babcock controllers appear to have an emission rate between 0.04 and 0.08 m^3/hr (0.03 – 0.06 cfm)
  - The Becker low emission controllers appear to fall into two classifications:
    - Override units have zero emission
    - Variable Set-point controllers have emission rates similar to Bristol Babcock units

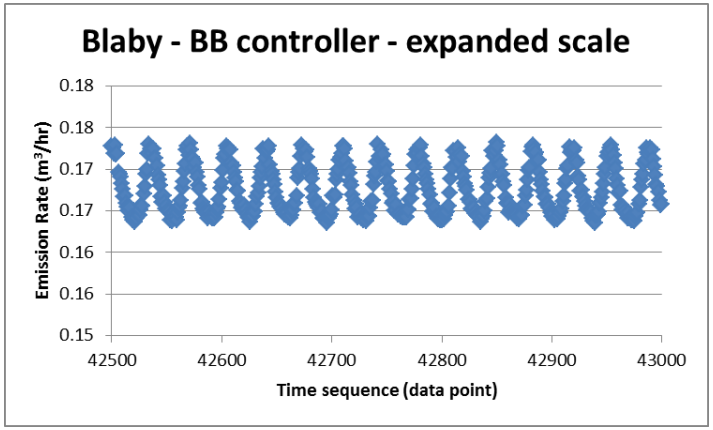
Venting Controller Project – longer term site tests

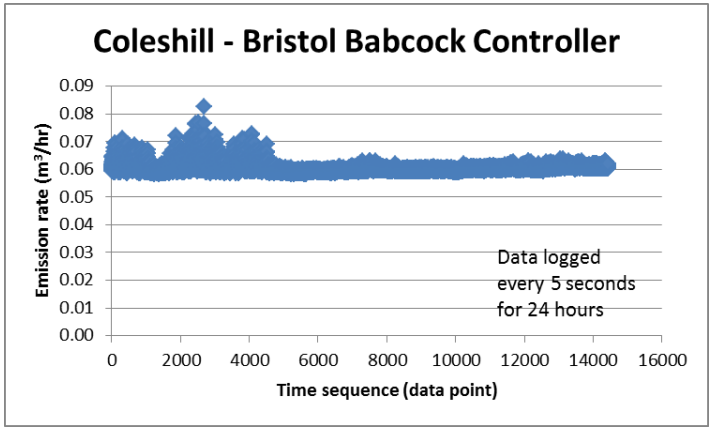
- Longer-term emission test campaign
  - Campaigns at Blaby, Coleshill and Hedgerley tests completed
  - Flow meter data obtained from Bristol Babcock controllers, Becker controllers and Fisher positioners.
- Trends in logged data show some interesting characteristics
  - Bristol Babcock controller and Fisher positioner units generally show steady emissions
  - Becker controller and some Bristol Babcock over-rides appear to have more variation.

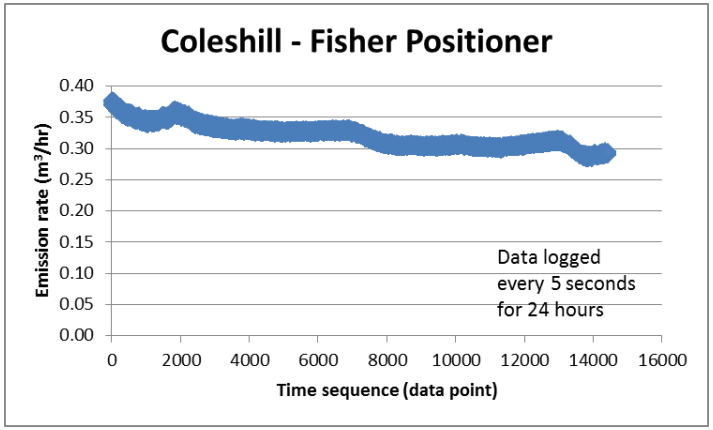
Venting Controller Project – Example Results (1)

- Examples of time series results:



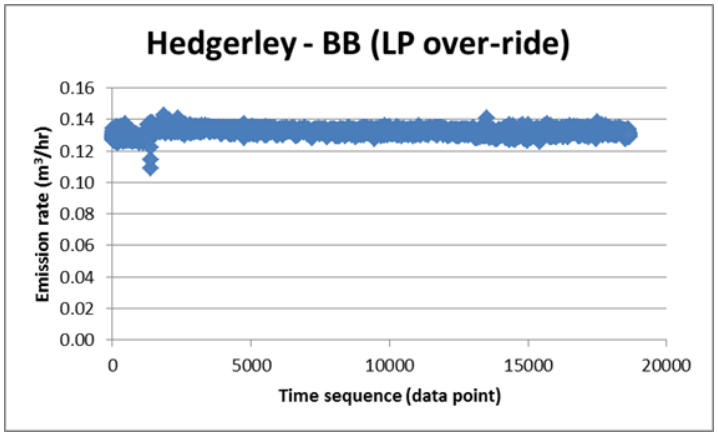


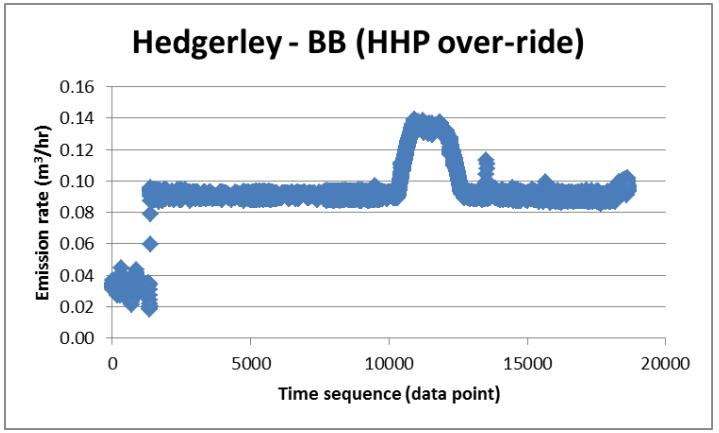


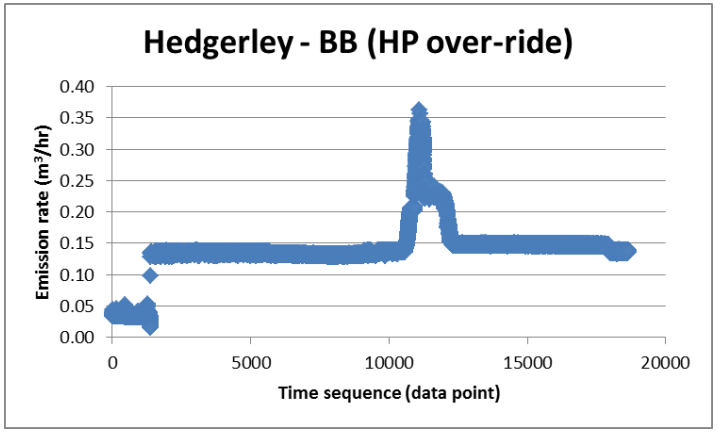


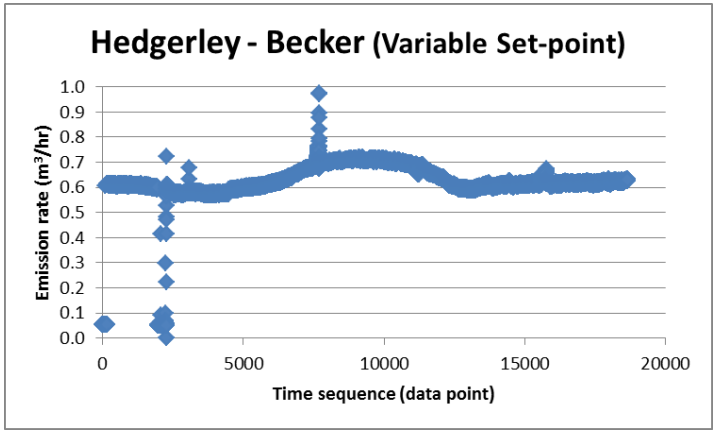
Venting Controller Project – Example Results (2)

- Examples of time series results:









Summary of Surveys (West Midlands)

- West Midlands region
  - 123 sites surveyed

Inventory for West Midlands Region

WM	Controller Name							
Inventory	Bristol Babcock (20 psi)	Bristol Babcock (30 psi)	Bristol Babcock (35 psi)	Becker	ABB TZID	Watson-Smith (422)	Watson-Smith (MGPC)	Total Number
Number	29	0	0	1	2	25	107	164

WM	Positioner Name					
Region	Fisher	Becker	Neles	Bailey	Mokveld	Total number
Number	8	0	0	0	7	15

Vent Emissions

Total from inventory	25.73	m^3/hr
Annual emission volume	225395	m^3/yr
Annual mass emission	171.3	tonnes/yr (tpa)
Annual energy emission	2.46	GWh/yr

Summary of Surveys (North West)

- North West region
  - 122 sites surveyed

Inventory for North West Region

NW Inventory	Controller Name: Bristol Babcock (20 psi)	Bristol Babcock (30 psi)	Bristol Babcock (35 psi)	Becker	ABB TZID	Watson-Smith (422)	Watson-Smith (MGPC)	Total Number
Number	84	24	35	6	0	5	40	194

NW Region	Positioner Name: Fisher	Becker	Neles	Bailey	Mokveld	Total number
Number	17	5	0	4	0	26

Vent Emissions

Total from inventory	43.17	m^3/hr
Annual emission volume	378169	m^3/yr
Annual mass emission	287.4	tonnes/yr (tpa)
Annual energy emission	4.1	GWh/yr

Project Conclusions and next steps

- Lab work on variation of emissions with equipment type and pressure completed
- Site work on variation of emissions with site operation, pressure, diurnal swings, etc completed
- Inventory and equipment pressure checks completed for WM and NW regions
- Inventory and equipment pressure checks in EA and NL regions underway (Target date for completion: March 2016)
- Inventory and equipment pressure checks to begin in EM region soon (Target date for completion: April 2016)
- Report on emissions totals for all five regions to be completed (Target date: May 2016)

Thank you for your attention

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