SMARTSim - Gas Quality Tracking in Distribution Grids

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content

1. Overview SmartSim.

2. Prestudy results of grid “Lund”
   • Input data and integration of SmartSim
   • Simulation results
   • Conclusions and outlook
Target:
Selective billing of end customers
In case of multi-point injection

Solution:
Determine CVs by flow simulation

Costly propane admixture can be avoided in case of biomethane injection
SmartSim Software
Grafical User Interface with Integrated Calculation Kernel

- GIS / control system
  - grid topology
  - valve positions

- billing (energy)
  - load profile customer (SLP)
  - measured volume customer
  - calorific values (CV)

- measured values (e.g. cluster controller)
  - required data
    - calorific value (CV)
    - volume
    - pressure

- data handling

- data acquisition

- SmartSim graphical user interface (GUI)
  - Kernel
    - volume correction
    - hydraulic simulation
    - CV tracking (back propagation)
  - visualisation and reporting
Project Implementation

prestudy
- grid simulation (e.g. for 1 year period)
- evaluation of results

validation
- field test
- uncertainty evaluation

implementation
- automated interface to billing system
- operation/billing
topology – simplification of lund city grid

- sections that have to be simplified are selected by polygons
• All elements within the polygon are deleted
• A new exit node with total demand of all customers is generated
• To obtain the grid volume – volumes of all deleted pipes are assigned to pipe 1
• To match transit times through a reduced section – length and diameter of pipe 2 correspond to path with lowest pressure loss (here drawn in yellow)
• simplified topology contains finally 165 nodes, 164 pipes and 2 controller
• therefore are 4 entry and 51 exit points
Simulation scenario: virtual biogas plant Dalby

Assumptions
- biogas plant in Dalby with around 60 GWh per year
- constant injection of 600 m³/h biogas
- constant calorific value of 10.7 kWh/m³
- injection to 10 bar grid
- in regard to energy balance - injection of Nöbbelöv is reduced

Upcoming questions
- How is the biogas distribution in the grid?
- How can we ensure a correct energy billing?
SmartSim – the simulation tool
typical supply situation in summer 2012 (June)
typical flow situation in summer 2012 (June)
example exit point Dalby (Dal 1) – eastern grid
example exit point Gas. / Vip. – western grid
example exit point Maskinvägen (Ra 2) – western grid
example exit point Tulpanvägen (Mö 2) – western grid
typical supply situation in Winter 2012 (December)
typical flow situation in winter 2012 (December)

Tuesday, 11. December 2012
14:00
example exit point Dalby (Dal 1) – eastern grid
example exit point Gas. / Vip. – western grid
Example exit point Södra verket – western grid
example exit point Tulpanvägen (Mö 2) – western grid
Conclusions and outlook

- Input data and topology are prepared for use with SmartSim for 2012.
- The gas grid of Lund is successfully simulated for this period.
- A virtual biogas plant with 60 GWh per year is assumed injecting in the 10 bar grid section near Dalby.
- A Calorific value for each exit point is determined as monthly average.

- Gas quality tracking with SmartSim makes it possible to avoid cost intensive propane admixture of biogas in future.
- This also reduces the CO$_2$ fingerprint of the biogas plant and makes the gas “greener”

- In a next project phase simulation results should be verified by measurements . . .