New Smart Regulation Station
WP3-31_Filip

Summary

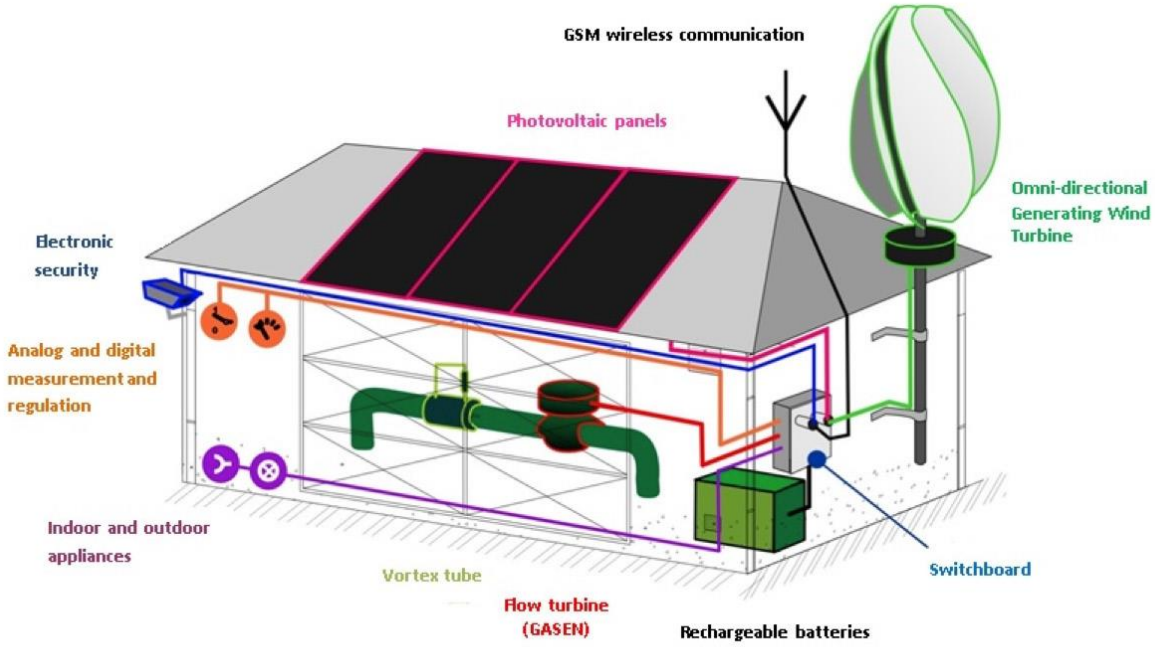
New Smart Regulation Station

1 Introduction

RWE GasNet, s.r.o. initiative was formed in 2012. It is aimed at finding solutions enabling operation of gas regulating stations independently from external energy supplies, thus increasing their energy security. Basic problems to be solved comprise energy related risk in case of grid power supply outage at the regulating station and costs relating to energy consumption during classical method of gas preheating.

1.1 New Smart Regulation Station

…and technology will be the key to the future business model for gas growth.



Create new Regulation station using new technological components and operational approaches in order to reduce own consumption.

- Implement alternative power supply solution using renewable sources and alternative physical principles in order to reduce the cost for power supply and power line operation and maintenance.
- Implement new core and insulation materials in order to reduce the risk of fittings / armatures condensation and freezing due to the gas pressure regulation station operation without gas / power preheating.

Goals/benefits

- New concept of gas pressure regulation station is focused on renewable sources and shall consist on several newly tested equipment (photovoltaic, wind, storage, …) – w/o external power supply
- Implement alternative power supply solution using renewable sources and alternative physical principles in order to reduce the cost for power supply and power line operation and maintenance

Background/Rationale

- New concept of gas pressure regulation station is focused on renewable sources and shall consist on several newly tested equipment (photovoltaic, wind, storage …).

Project Objectives

- Create new Regulation station using new technological components and operational approaches in order to reduce own consumption
- Concept design is split into 2 phases - 1st phase is R&D oriented (studies, analyses, design and proof of selected technologies), 2nd phase is focused on the prototype construction and field test.

Implementation target/ demo version

- Implement alternative power supply solution using renewable sources and alternative physical principles in order to reduce the cost for power supply and power line operation and maintenance
- Implement new core and insulation materials in order to reduce the risk of fittings / armatures condensation and freezing due to the gas pressure regulation station operation without gas / power preheating

Project Challenges & Risks

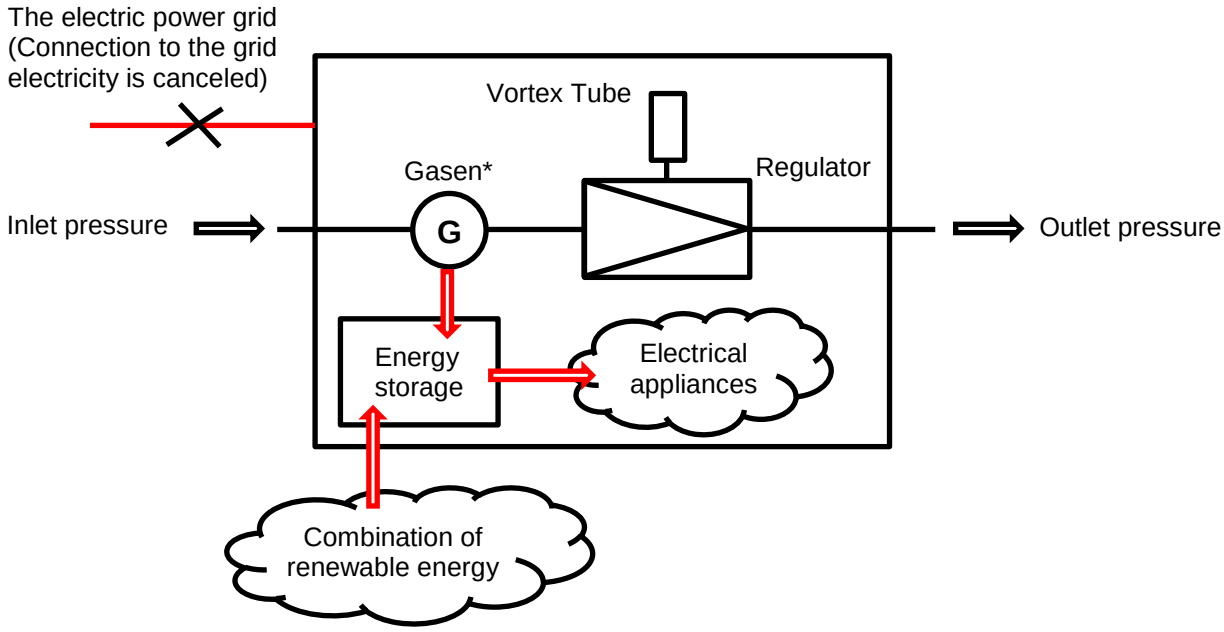
- EU legislation drive the topic energy efficiency
- Intelligent components with active energy management shall decrease own technological consumption
- Some locations (Regulation station) are not applicable due to different solar and windy conditions

Status/ next steps

- 1st Phase – finalization of feasibility study - done
- 2nd Phase – installation of new technology (photovoltaic, wind turbine, batteries, vortex tube) for field test – Regulation station Nehvizdy – done
- Field test - Data collection and optimalization of parameters (dimensioning) - ongoing
- Searching for GASEN technology (small gas turbine for electricity production for battery – ongoing

2 Technical description

2.1 New SMART Regulation Station – design



* Gasen - uses the energy of flowing gas for power generation.

2.2 Main aspects of the solution

- Vortex tube as a replacement of classic preheating method.
- Replacement of LV connection by an island electricity generation and supply system.
  - Photovoltaic panels.
  - Wind turbine.
  - Electricity generator using the gas stream energy (GASEN).
  - Battery set.
  - Control electronics.

2.3 Regulation station Nehvizdy – test polygon

High pressure regulating station at Nehvizdy is one of the recent generation of regulating stations. It was constructed within the premises of previous obsolete station. Part of the underground gas pipeline was relocated during its construction. This is the first regulating station operated by RWE GasNet, s.r.o., where pilot operation of the regulating station in island mode was officially started in the half of February 2014.
Vortex tube, set of photovoltaic panels, wind turbine, intelligent SMART Regulation station control system, and battery set for surplus electricity storage were installed.
The island system will be extended by GASEN generator in the future. The generator will be installed as soon as its development is finished.
Regulation station Nehvizdy serves as the test polygon for identifying the most suitable combination of energy sources and for resolution of technical problems with regard to natural conditions and course of natural gas development during individual seasons in the Czech Republic.

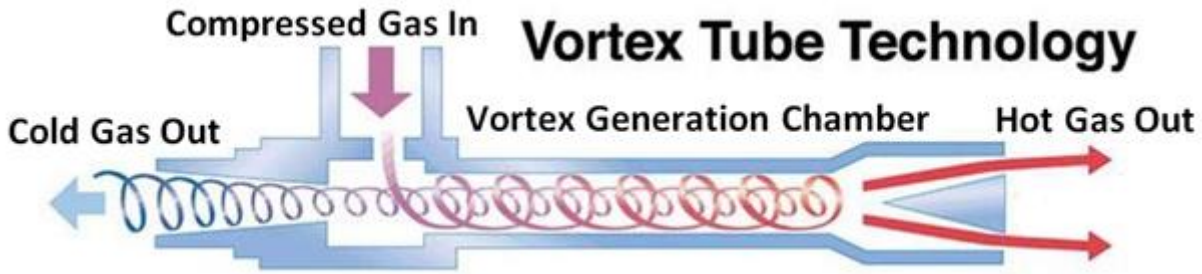
2.3.1 Vortex tube as a replacement of classic preheating method.

The vortex tube offers solution to thousands of industrial problems involving cooling of heating with compressed fluid as the source of power. The vortex tube splits the compressed fluid into two flows - one hot and the other cold. The vortex tubes are capable of producing heat or cold with no moving parts, no electricity, and no Freon.

2.3.1.1 Functional description

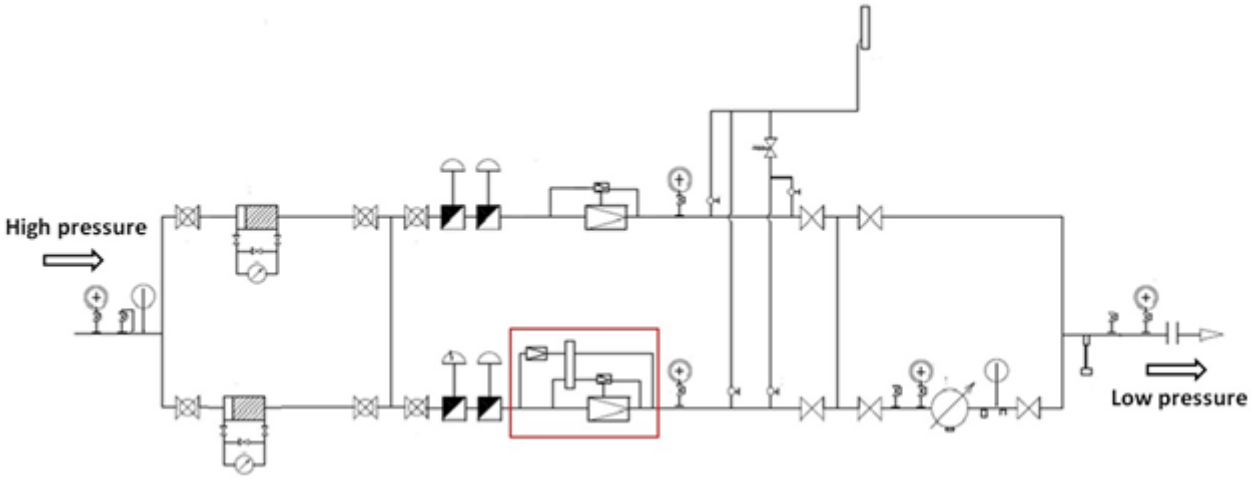
Compressed fluid (natural gas in our case) enters stationary generator with tangential boring, which forces the gas to rotate through the tube along its internal wall towards the hot outlet.

Part of this gas exits this part as hot gas. Remaining gas is pushed back through the center of the flow where it continues to swirl and moves at lower speed while performing simple (natural) heat exchange. The inner slow moving gas column passes its heat to the outer rapidly moving gas column. When the slower inner gas column passes through the center of stationary generator and exits through cold exhaust, it can achieve relatively extremely low temperature.

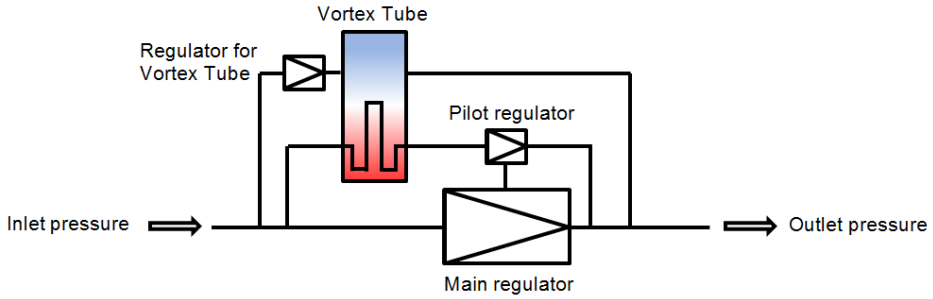


2.3.1.2 Connection scheme

Connection of the Vortex Tube in the mechanical equipment of Nehvizdy regulating station (without preheating).



2.3.1.3 Details of integration vortex tube (schema)



2.3.2 Replacement of LV connection by an island electricity generation and supply system.

2.3.2.1 Photovoltaic panels.

- Three installed photovoltaic panels with the total output of 690 Wp have their active surface oriented towards the south with inclination of 35° towards the Earth surface. This position is optimal for static panels in the Czech Republic and enables maximum utilization of sun rays throughout the year.

2.3.2.2 Wind turbine.

- A low-speed vertical wind turbine Poweregia 300W is characterized mainly by its ability to start and operate at low wind speeds over 3 m/s and by independence from wind direction. It is designed on a unique six-blade head with vertical rotating axis thanks to which the turbine is omnidirectional. Low rotating speed makes the turbine safe equipment with minimum noise level.
- Basic parameters:
    - Electric power output: max. 320 W
    - Rotating speed: up to 80 rpm
    - Dimensions without support stand 2x1.2 m
    - Automatic braking by internal generator

2.3.2.3 GASEN

- Electricity generator using the gas stream energy (development).

2.3.2.4 Battery set

- All generated and immediately unused energy from the photovoltaic panels and wind turbine is stored in batteries and used later at times when electricity generation is unavailable or when peak consumption needs to be covered. When the sun shines, wind does not blow, and vice versa.
- The battery set consists of 12 traction batteries with the total capacity of 1000Ah and 24V DC rating.

Switching between energy sources:
New electricity sources currently supply power to the station telemetry. This is the crucial equipment of the entire station and the power supply will be thus backed up by public grid connection for the period of pilot operation. Possible switching among the energy sources is ensured by the electronics which also controls the energy sources and charging of the batteries.

2.3.2.5 Control electronics (SWITCHBOARD)

- Attached to the panels' structure, it acts as the brain of the entire power supply system. It processes energy flows from individual sources, controls charging of the batteries, and checks all operating data. It communicates over GSM modem with an application available through the Internet.