Universal Vortex, Inc. offers technology for non-freeze decompression of non-preheated CNG. The core of the technology is the proprietary Vortex Self-Heating Pressure Reducer (VPR) — a device with no moving parts.

The non-preheated CNG introduced into the VPR through a tangential orifice of a fixed size undergoes pressure reduction and subsequent energy division in the highly rotating low-pressure gas (vortex phenomenon). The originated vortex cold and vortex hot flows coexist in the VPR low pressure chamber and then exit the VPR through a single discharge orifice. Prior to exiting the VPR, the hottest portion of the hot flow is directed to internally warm up the unit’s inlet orifice (self-heating provision), thus preventing the inlet depressurized flow freeze up.

The vortex cold and the hot flows mixing at the VPR discharge negates their temperature differences. Therefore, the temperature of the combined flow at the VPR discharge reflects only Joule-Thomson temperature drop in the expanded gas.

Besides the VPR, other major components of the Vortex PRS-CNG configuration are “on/off” solenoid valves, an air source or any low grade medium heat exchanger, an inter stage receiver accumulating the pressure reduced gas and a fine tune pressure regulator to maintain the desirable delivery pressure and flow.

Universal Vortex designs the Vortex PRS-CNG to satisfy either the gas desirable discharge time (variable flow) or to maintain a constant flow of the depressurized gas.

The control logic of the VPRS-CNG decompression provides for gradual increase of the total VPR inlet cross section to maintain a steady delivered gas flow upon tank pressure decrease. Since the VPR is a device with a fixed inlet orifice (no moving parts!), this is achieved by designating a number of working pressure ranges and by interconnecting the available VPR in a way, that each tank pressure range is served by a combination of the VPR with a specified total inlet cross section area.

Generally, the number of VPR needed for an application ranges from 2-4 units.

The conceptual flow diagram on the reverse side also illustrates a case where CNG accumulated in the tank at 204 bar is to be delivered at 10 bar with a constant flow rate of 900 sm³/Hr.

VPRS-CNG sequence of operations:
- High pressure gas from the CNG tank passes the “on/off” solenoid valve and undergoes non-freeze pressure reduction in the VPR down to the current pressure in the inter stage receiver.
- Prior to entering the receiver the pressure reduced gas chilled due to Joule-Thomson temperature drop is warmed up by heat exchanging with ambient air.
- The VPR ‘A’ is sized to deliver 900 nm³/Hr at 136 bar and, therefore, will be in service in the tank pressure range of 204 bar to 136 bar.
- The VPR ‘B’ is sized to deliver 900 nm³/Hr at 91 bar and, therefore, will be in service in the tank pressure range of 136 bar to 91 bar.
- The VPR ‘A’ and VPR ‘B’ are together deliver 900 nm³/Hr at 60.5 bar and, therefore, will be in service in the tank pressure range of 91 bar to 60.5 bar.
- The VPR ‘C’ is sized to deliver 900 nm³/Hr at 40.5 bar and, therefore, will be in service in the tank pressure range of 60.5 bar to 40.5 bar.
- The VPR ‘B’ and ‘C’ are sized to deliver 900 nm³/Hr at 27 bar and, therefore, will be in service in the tank pressure range of 40.5 bar to 27 bar.
- At the tank pressure below 27 bar the CNG pressure regulation takes place in a conventional pressure regulator.

Tel  +1-609-586-3702
Fax  +1-609-586-0002
info@universal-vortex.com
17A Marlen Drive  Hamilton, NJ 08691  USA
NON-FREEZE PRESSURE REDUCTION OF NON-PREHEATED CNG

An inter stage receiver (ISR) in the VPRS-CNG installation further provides for overcoming the inconvenience of the VPR’s single, non-changeable orifice.

Since the VPR capacity will at all times equal or exceed the delivery flow rate, an ISR is utilized to balance supply and demand. The gas pressure in the ISR raises until the receiver is at the high pressure set point, whereupon flow is stopped and not started until the receiver is depleted to the low set point. The high pressure set point for the above application is 18 bar; this pressure allows for favorable ratio of the VPR inlet and outlet pressures to secure the VPR high thermal efficiency. The low pressure set point is 11 bar.

Optimization of the VPR-CNG conceptual process diagram can be achieved by considering the following design options:
- Dual Ambient Air Heat Exchanger (AAHE)
- Defrost of AAHE
- Make up heater
- Manual or automated control

The UVI Vortex Self Heating Pressure Reducer (VPR) Dual Stream technology (not shown in the flow diagram) allows farther increasing the delivery gas temperature – to comply with its specified value.

An air source heat exchanger at the VPR discharge.

VPR-CNG installation with two VPR runs, and fine tune PR.