PNEUMATIC / INSTRUMENTATION SUPPLY GAS PROVIDED BY SOLAR POWER AIR COMPRESSION

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ABSTRACT
Advances in technology and innovation have allowed for development of solar powered devices and machinery of all types; solar power prevalence has been well established in the oil and gas industry in the last 2 or 3 decades in devices such as flow computers, plunger lift systems, SCADA systems, etc. Stricter environmental and emissions laws, along with an industry-wide focus on efficiency of operations, have led to the development of solar powered air compression equipment for many different applications. Today's presentation will address a few of the guidelines with which this technology may be implemented in the field.

DISCUSSION

The solar powered air compressor design we'll discuss today was designed to be implemented with pneumatic loads which require a reliable 100+ PSIG supply gas source but have limited consumption, such as pneumatic well safety shutdown systems, intermittent duty chemical injection systems, and automated gas well soaping equipment. The technology and components used in this particular unit have been assembled from several industries, including industrial automation, automotive, marine, military, and the oil and gas industry. Special emphasis has been placed upon efficiency, simplicity of design, ease of use, reliability, and minimal maintenance.

Compressed air offers several advantages over produced methane for instrument supply, including better sales proceeds, improved life and reliability of pneumatic components, and elimination of hazardous areas formed by introducing methane supply gas into otherwise non-hazardous areas. The use of compressed nitrogen cylinders has been met with limited success due to the finite quantity of gas available at any given time, and the inevitable loss of supply gas when a cylinder is depleted.

Sizing of the solar compressor unit should be performed using maximum allowable load versus solar power available during wintertime minimums, which will ensure reliable year-round operation. In this case, for the West Texas area, maximum load should not exceed 15 minutes if runtime per day, about 1% duty, or about 1 SCF of compressed air per day consumption. This assumes an average of 4 hours per day of full solar output, a good estimate for winter in this area.

Installation of the solar air compressor will rely on proper positioning (solar panel facing due south, at an angle from horizontal of latitude + 15 deg, no obstructions between the unit and the sun's arc), as well as proximity to the pneumatic load. Other installation concerns will be exposure to hazard classified areas and corrosive compounds, as well as likelihood of physical damage to the solar array from adjacent operations. Additionally, special precautions should be taken to ensure that all lines and connections to the pneumatic load are free of leaks.

Once the unit is set and connected to the pneumatic load, turning on the power switch will place it into service. The unit will pressurize the onboard storage tank to 125 PSIG, then turn the compressor off until consumption causes the tank pressure drops to 100 PSIG, at which point it will cycle to 125 PSIG again. The on-board storage tank allows for instantaneous high consumption levels such as pressuring a large manumatic valve or pneumatic cylinder.

The heart of the unit is an oilless automotive/military grade 12 volt miniature air compressor. Regular maintenance only includes cleaning the foam inlet filter. This maintenance item will vary widely based on duty cycle and operating environment. A good starting point will be to clean it every 3 months. Another regular maintenance item is for the operator to purge any condensation from the storage tank using the bleed valve. The on-board storage tank is monitored via a sealed stainless steel analog pressure transmitter, inverted to keep the element dry and accurate in below freezing temperatures.

The unit is controlled by a micro PLC device using function block programming. It has a non-volatile memory and therefore holds it's programming during extended periods of being powered down. The controller also has menus through which the operator can monitor battery state of charge, runtimes, operating mode, and tank pressure. In addition to compressor control and runtime logging, the controller also manages battery charging and "floating" operations. Special circuitry has been implemented to allow functioning of the controller and battery charging when the power switch is turned off if solar power is available, even though zero battery power is used when the power switch is off. Deep discharge of the battery, which can significantly reduce battery life, is prevented by a low battery shutdown function, which includes an external visual indicator to alert the operator to this condition. This alarm can also be linked to on-site SCADA systems for remote alarming.

Pressure setpoints for compressor ON/OFF cycling can be accessed and changed at the operator's discretion. Other functions include contrast adjustment and a calendar / clock with leap year capabilities.

The compressor is controlled using a heavy duty (80 Amp) continuous duty solenoid actuated relay. The unit is equipped with a 90 AH (Ampere-Hour) maintenance free AGM (Absorbent Glass Mat) non-spillable battery. Typical runtime draw is 40-45 Amps DC. Under normal operating conditions, approximately 9 days of reserve power is available during cloudy weather. Operators should expect 3-5 years battery life under normal operating conditions.

Additional solar and battery power may be added through the installation of one or more companion solar / battery power units, which effectively increase runtime capability for larger loads. This option can also be helpful when running the unit in cold climates, which decrease reserve capacity of batteries and lowers efficiency.