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Developing the Future

DC low voltage valve actuator White Paper - 10th March 2014

White Paper

Choosing DC valve actuators with the lowest energy consumption

Modular Design Electric Valve Actuators

Choosing DC valve actuators with the lowest energy consumption

Sector: Water, Environment, Irrigation
Category: Electric Actuators
Products: Centork

Introduction

Around the world there is a growing need for automated valve control in remote locations where mains electrical power is not available. For example, effective water management demands efficient and responsive flow control for applications such as groundwater remediation, irrigation and flood prevention. With perceived climate changes introducing more extremes of rainfall or drought conditions, remote valve and penstock installations are often in the front line of defence against environmental calamities when performing flow control duties.
Using DC powered electrical equipment to operate remote valve and penstock installations offers a number of advantages over other stored energy solutions. Stored energy in the form of batteries requires little maintenance to ensure that it is always available when operation is required. Reliability is further enhanced by the use of solar panels and wind turbines to maintain the battery charge. Electric valve actuators are available with DC motors, enabling a direct connection to the power supply and simplifying the overall installation.

Electric valve actuators also deliver a very high degree of functionality, providing regulating or isolating control and facilitating a direct interface with SCADA and telemetry systems. Similarly, a local HMI is provided by the actuator's local controls and indication window; in other words, the electric actuator can provide everything that is required for local and remote control and indication within a single, fully sealed package that only needs to be connected to the DC electrical supply.

Low voltage DC issues and solutions

Using a low voltage 24 Volt DC power supply offers many advantages in terms of system simplification, economy, safety and reliability. For these reasons it is preferred by many end-users. However, one problem is the relationship between the output torque and thrust available from a DC powered actuator in relation to the current that it draws at low voltage.

For example, the 24 Volt DC version of a conventional multi-turn actuator can require a maximum operating current approaching 200 amps and a starting current of 230 amps in order to produce a torque output of 500 Nm at 22 rpm. In many cases this high current demand can rule out the use of low voltage DC supplies for everything other than small scale, low torque applications. For this reason some actuator manufacturers will only offer the smallest models in their electric actuator ranges with a 24 Volt DC option.

One manufacturer, however, is able to reduce the equivalent figures to only 18% of the operating current (34 amps) and 23% of the starting current (64 amps) for a 24 Volt DC actuator producing a torque output of 500 Nm at 17 rpm. Similar scale of reduced power consumption is available throughout the complete range of Centork actuator models which, with a wide range of standard output speeds, enables actuators to accurately match the majority of valve sizes and applications.

Central to the achievement of this low power requirement is an innovative mechanical gear train design, known as the Planetary Torque Control System (PTCS). By replacing the worm and wheel gear train design employed by virtually all other valve actuator manufacturers the PTCS provides a compact planetary gear module which increases the mechanical efficiency from around 35% to over 90%. Consequently, the input power required to produce a given output torque is reduced by a similarly considerable margin. The PTCS is a very compact module which contributes to the overall compact dimensions of the complete actuator. Added to this, the reduced motor power requirement offers the benefit of considerably reduced motor size and weight, resulting in an actuator that is both compact and lightweight.

The highly efficient planetary gear train enables the same amount of torque to be applied by an actuator that is smaller and more lightweight than a conventional worm and wheel equivalent, whilst also permanently protecting the valve from over-torque damage, even at high speeds. The torque limiter can be set to between 60% and 100% of the actuator rated torque and when this preset value is reached the output drive is immediately diverted from the valve stem to the planetary wheel. The use of disc springs in the sensing mechanism maintains reliability and prevents the set point from drifting. The system is fool-proof and will protect the valve from any control failure including non-functioning limit and torque switches, contactors or any other fault that could otherwise expose the valve to the full stall torque of the motor. As a result, it is not necessary to size the valves to account for excessive torque, or design the pipework to support heavy loads, facilitating increased overall economy and efficiency in the design of the entire installation.

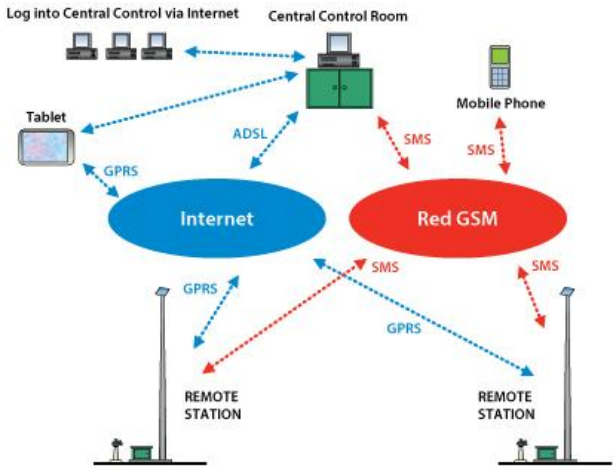
Centork actuators are designed on a modular principle, enabling various control and mechanical options to be applied with the maximum flexibility. On the control side, options range from basic units requiring external controls to units with Centronik non-intrusive integral digital control. The terminal compartment can be double-sealed to ensure the integrity of the internal electrical components during site wiring and is available with plug-and-socket connectors. Digital fieldbus compatibility includes Profibus-DP and Modbus.

Usability is further enhanced by the availability of actuators for isolating and modulating duties. Actuators can be directly fitted to multi-turn valves with non-rising stems and, in combination with secondary gearboxes, to valves of all multi-turn, part-turn, linear and lever-operated configurations.

Remote, automated real-time control

Typical solar powered remote penstock installations equipped with 24VDC Centork actuators (Courtesy of Riegosalz)

The use of Centork actuators in remote locations can therefore enhance the convenience, economy and versatility of a low voltage DC power supply. In addition to delivering enough muscle to operate the valve or penstock, the Centork actuator also introduces a simplified means of interfacing with sophisticated SCADA systems.
For example, the actuators have been successfully incorporated in systems that have adopted remote telemetry using the GSM (Global System for Mobile Communication) and GPRS (General Packet Radio Service). Automatic communication between the remote site and a central control room via GPRS or to the operator's mobile phone via voice or SMS text messaging is permanently available. In real-time, the operator can check on the condition of his installations, receive alarms, send instructions to open or close the sluice and receive confirmation of actions.



Schematic of the real-time telephone and internet communication channels utilised by the Riegosa system to facilitate permanent monitoring and control of solar powered remote penstock installations incorporating Centork low power DC actuators.

The Riegosa system is designed specifically for the latest GSM and GPRS technologies and low power DC installations utilising renewable energy sources. An internal modem provides access to the internet and the mobile phone network, supporting permanent and rapid connection between site and control room. Central to the system, a microprocessor monitors and controls the installation, initiating complex procedures, responding to alarms and communicating to the operator. An EEPROM

memory stores historical activity which is available for diagnostic and analysis activity. The system is able to accept digital and analogue signals from external sensors for the control of level, flow, temperature, water quality or virtually any required operating parameter. In many cases ultrasonic level and flow sensors provide a reliable, low power and non-intrusive solution to common operating requirements. Solar power is the preferred energy source, backed up by 24VDC batteries to provide power for the energy efficient Centork actuator and control system. In many cases the system has been retrofitted to provide automatic operation of existing installations, the Centork actuator providing a proven means of motorising a wide range of penstock sizes.
The system owes its success to its adaptability, enabling it to meet the diverse requirements of many remotely sited applications, whilst providing permanent and secure automation. It is designed to meet the following fundamental criteria in addition to the specific duties of each installation.

- Rugged, weatherproof and vandalproof protection for all component parts (control cabinet, actuator, battery pack, solar panels etc) with the ability to withstand long periods of inactivity, corrosive environments and changeable ambient conditions with no impact on reliability.
- A high level of mechanical performance from a low power source, provided by the Centork actuator.
- Very low maintenance requirement.
- Emergency manual override facility, provided by the actuator handwheel.
- Precise control of penstock position and protection from damage caused by over-torque, again provided by the design of the Centork actuator.

A retrofitted solar powered low voltage installation, with a Centork DC actuator fitted to an existing penstock, replacing the original handwheel awaiting disposal in the new control cabinet.

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