Solar & UPS Power for Remote

What You Need to Know about Powering These Systems

Valve actuators are a common necessity along vast stretches of pipeline infrastructure. Out in the middle of nowhere, line power can be less than dependable, costly to install on site, or is simply not available. Solar powered systems and line powered UPS systems can provide both the power and reliability to remotely operate a valve when the need arises.

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Energy Reserves & Back-Up.

In reviewing energy requirements first, a typical remote valve actuator site will have some sort of communication, whether it's licensed radio, cellular, or satellite. This same site will likely have a small PLC or SCADA system. In the event of a power failure, several days of UPS backup power is desirable — enough time to get a person in a truck to the site.

In the case of a solar powered system, five days or more of backup time (autonomy) is required for proper system function during bad weather. Assuming a 40-Watt load for PLC, SCADA and communications, operating at 24 Volts DC, a system requires 200 Amp-hours of battery capacity. This value increases to 313 Amp-hours when the battery is properly de-rated for Depth-of-Discharge and End-of-Life. The energy requirements will vary, but even the smallest systems will likely have 100 Amp-hours of battery capacity.

A 100 Amp-hour Battery is More Than Enough to Power a Typical Valve Actuator

The instantaneous power required by a valve actuator depends on the application. Electric motors from less than 1 horsepower to several 10's of horsepower are common. While the power requirements vary wildly, what is common across the spectrum is the relatively small amount of energy required to operate a valve. By comparison, a 10 horsepower actuator operating over a 2-minute cycle requires about 333 Watt-hours of energy. Converting this value to Amp-hours in a 24 Volt DC battery, about 14 Amp-hours are required to close a large valve in a hurry. At Solarcraft, we consider this a "relatively small amount of energy" because typically batteries used for remote power are 100 Amp-hours or larger.

Bottom line: The size of the actuator has small bearing on the energy requirements of the system as a whole.

The primary load in remote systems is nearly always the electronic equipment – not the actuator. Often, a small solar array or for that matter 120 Volt single-phase line power (brown and dirty) is all that is needed to satisfy the energy requirements of a system. This is mostly due to the fact that actuators are generally operated very infrequently, and even though they require relatively large amounts of power to work, the sum of the consumed energy over a period of time is very small.

Consider a remote installation comprised of a small PLC with a flow meter, a radio modem and a DC powered actuator requiring 20A @ 24V to run once a day for 15 minutes. (For adding up the total energy requirement one can mostly disregard the short but high start-up power requirement). During one day, the PLC, flow meter and radio will consume a total of say 20Ah, while the actuator will only burn 5Ah. If the actuator fills a close-on-fail role, however, only operating once in a blue moon, it is clear that the power budget is almost entirely spent on the electronic equipment.

Power is wasted without controls

In the case of AC powered actuators in remote locations, a little more care needs to be taken when configuring the power supplies, especially if the energy needs to be generated on site. Inverters have an often overlooked quiescent power draw of roughly 2% of their nameplate power rating, and can very easily be the largest drain on the power supply if not managed properly.

Extending the example above, if the same remote station was fitted with a 3-phase actuator drawing 4A at 480V, the power supply will have to drive a 9kW inverter, which in turn will require 180W of power just to stay on and ready. If line power is available this might not sound like much, but it can be awfully expensive to generate this small amount of power on site from available resources. For perspective, should this installation be somewhere in West Texas, it would require a 2.5kW solar array (about 200 ft²) with almost the entire energy production spent on keeping the inverter running while not in use.

This waste can be negated by programming the local PLC to only turn on the inverter when it is required to power the actuator. For a close on fail application, this brings the energy budget back to an easier-to-digest ±20W consumed continually, which can be addressed with one or two solar panels easily mounted to the back of the power supply enclosure.

Inverter Sizing Is Critical

The power requirements of a remote actuator system are an entirely different matter; especially where standard AC motors drive the actuator. AC motors, whether single phase or 3- phase, require an inverter that can supply the majority of the published locked-rotor current of the motor. Locked-rotor current can simply be considered the "starting" current of the motor, usually somewhere between 4 to 10 times the "running" current. Because actuators may sit for extended periods between operating cycles, static friction in the mechanism becomes a factor in starting. Ensuring that sufficient current is available to start the locked rotor and overcome the friction is vital.

Supplying the entire locked-rotor current rating of the actuator motor is not necessary. Experience has taught that the maximum current capability of the inverter should be around 5 times the running current of the

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motor. Inverters installed in Solarcraft systems are capable of delivering 2 times their rated output for 3 seconds; this is sufficient to overcome the demand for starting current. Therefore, a good rule-of-thumb is to provide 3-kiloWatts of inverter power for each horsepower of actuator motor. For example, an 8 horsepower motor requires a 24-kiloWatt inverter. The inverters are modular and can be configured for power output, single, split and 3-phase operation. However, these inverters are a major component of the overall system cost.

Alternatives to Consider When Specifying an Actuator

Depending on the size of the valve and the stroke time required, there are alternatives to consider. Several manufacturers of actuators offer 24/48 Volt DC powered versions. These eliminate the need for an inverter altogether because system batteries are more than capable of supplying starting currents. A 24/48 Volt DC actuator offers substantial cost advantages and should be considered whenever a smaller actuator is required. 110 Volt DC versions are also available but should be avoided for solar powered systems. Switchgear, fusing and product availability become vexing issues when designing systems beyond 48 Volts DC.

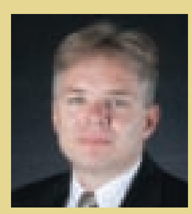
Depending on the actuator size (2-3 horsepower or less), a single-phase motor can be chosen over a 3-phase. While the single-phase motor is somewhat more costly, the inverter to power it is less complicated. This more than offsets the increase in motor cost.

Rethinking Motor Voltage

The voltage of the actuator motor is also an issue. The industry habit is to specify 480 Volt 3-phase motors. In the case of Solarcraft's inverter, 120/240 single/split phase and 208 3-phase are the only options for output voltage. Voltages can be stepped up with transformers if needed. This is often done where an existing actuator is being upgraded.
In the case of new installations, 208 Volt motors simplify the system; and all but the very largest actuators are available in 208 Volt models.

To recap powering remote valve actuators, remember the following:
•Energy requirements for a system are dictated by the system electronics, not necessarily the actuator.

- Small solar power systems and weak line power UPS systems can power large actuators.
- Power capability of the inverter will be directly proportional to the actuator size and speed. Opt for a slower stroke speed when possible.
- Inverters and batteries can create 3-phase actuator power when only single-phase line power is present.
- Opt for a 24/48 Volt DC motor when possible.
- Opt for a single-phase motor when possible.
- When a 3-phase motor becomes a necessity, opt for a 208 Volt version.
- If you still need to power a 20 HP 480 VAC 3-phase actuator, Solarcraft can engineer the proper system. Contact us directly for more information.



About the author

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