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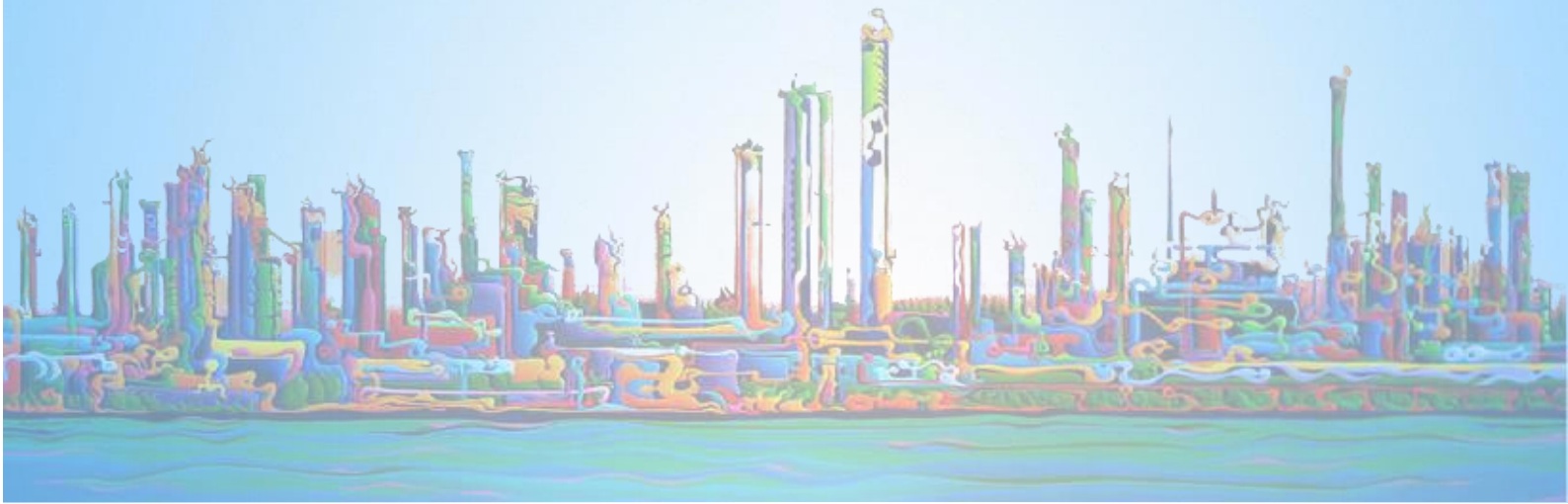
RETROFITTING IS OUR EXPERIENCE



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INTRODUCTION

Automating valve operation throughout a facility or in key strategic areas within the plant can offer substantial cost savings and improvements in efficiency and safety.

Today, the new generation of valve actuators and bus loop communication systems provide an easy way for virtually any large or small to cost-effectively retrofit their manually operated valves with automated systems. Most importantly, the retrofit often can be accomplished quickly without the need for major plant reconstruction or complicated reengineering.

Technology has made advances in almost every field over the last few years, but the advances in microprocessors and computer technology have been far greater than many other technologies. For that reason, we see many processes in the oil and gas, municipal water treatment and power generation, and industries advancing, but often not as rapidly as the technological advancements in the control and supervisory systems that run these plants. The advent of miniaturization and the effects of cost-reduction have made the application of control systems more powerful and less expensive.

Throughout the industrialized world, there are a vast number of installations that could benefit from increased productivity by the application of modern control and monitoring technology.

By applying new controls to old plants, many benefits can be accrued. This is the essence of retrofit.

SUSTECH wants to explore the application of modern valve actuators and control technology to existing installations and to offer insights on how it might benefit your situation.

BENEFITS OF RETROFIT

The overall benefit of performing a comprehensive retrofit on a plant accrued from the ability to operate the plant more efficiently. Specifically, when we retrofit, we are replacing manually operated valves or old-technology valve operators with modern valve control equipment.

One of the major advances of valve actuator technology that helps make retrofitting a practical reality is that the presence of moisture, dirt, and extremes of temperature do not affect the operation of today's generation of automated valves. For example, most of electric valve actuators are designed with proven "double-sealed" capacity, which prevents the ingress of moisture or dirt. It also provides non-intrusive operation such that the electric

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covers do not have to be removed during configuration, commissioning, and resetting. Furthermore, there are smart capabilities built into the actuator that provide for superior levels of around-the-clock monitoring and control.

Simply stated, the old school of thought that valves in hostile or challenging environments must be manually operated is outdated and can reduce a plant's efficiency and productivity.

Specifically, valves that are large and take a long time or a lot of force to operate manually can now be operated rapidly and reliably utilizing the retrofitted actuator. The speed of operation of any particular valve can now be selected without the constraint of space or the limitations associated with how many workers can stand around and operate a hand wheel.

Quite often, valves are located high up in buildings or deep in sumps or pits where it is difficult and impractical for personnel to reach them. Sometimes they are located in hostile areas where there are noxious fumes or liquids, making it physically distressing to operate the valve manually. The manual operation of valves is a common cause of worker injury, particularly where there are old valves that require excessive amounts of force to operate.

When valves are operated manually, plant operations are dependent on the human operator to ensure that the valve is in the correct position. This information has to be transmitted back to the control room, which, in the past, was done by word of mouth – sometimes an unreliable method. By retrofitting a valve actuator, the integral position indicating mechanisms of the actuator enable both local and remote indication of the position of the valve. In this way, confirmation of valve closure can be transmitted instantaneously to control the room.

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Once a plant or a section of a plant has been retrofitted with valve actuators, then centralized control can be affected, increasing the throughput of the plant and reducing the work hours spent manually operating valves. Retrofitted plants can run for an increased number of hours per day, further increasing return in investment and efficiency.

There is another substantial benefit to retrofitting that addresses the world's increased concern about fugitive emissions, contaminations from spills, and other environmental issues. That is, automated equipment can open or close valves in emergencies, thereby avoiding spills and other accidents. Logic controllers can be used to analyze the status of flow control elements and make the selection of which valve to actuate to prevent accidents. The advanced monitoring capability of state-of-the-art Modbus loop master station ensures that the motor-operated valves are constantly checked for availability to react to emergency circumstances.

Most importantly, retrofitting is now affordable and convenient. No longer is it necessary for old plants to engage in a major physical renovation or reengineering of their existing processes to upgrade to automated valve operation.

With the coupling of modern electric and fluid power actuators to digital control systems, the cost of retrofitting is now affordable to large and small facilities alike.

MOST FACILITIES CAN BENEFIT FROM RETROFIT

Almost every type of plant can accrue some benefit from retrofit program.

- Refinery Tank Farms

The inlet and outlet valves on a tank are located adjacent to the tanks themselves. Tanks are generally spread over a large acreage, therefore operating these valves requires a considerable amount of time for an operator to travel to each valve and then manually open or close them. Once the appropriate valves have been set to the required position, then pumps can be started to move the products from one area to another.

These installations are ideal for retrofit because of the distances involved, and also the catastrophic consequences of co-mingling or spillage. By using electric valve actuators linked by Modbus loop communication to a central control room, fingertip control of each valve can be achieved with positive verification of the position of each valve.

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- ## Water Treatment Plants

Many water treatment plants around the world have been in constant operation for many years. Some utilize automatic valves while others use manual valves. The older automatic valves are often powered by water hydraulics or compressed air. Because of the age of this equipment, a considerable amount of maintenance is required due to wear and the corrosive effects of the moisture and/or chlorine in the atmosphere.

The new generation of fluid power and electric operators can reduce maintenance requirements and streamline the backwash operations by preprogramming them in a Modbus loop master station.

- ## Wastewater Treatment Plants

As environmental concerns increase around the world, the emphasis on clean water sets more demands on wastewater facilities. Many wastewater facilities can benefit from the automation of sections of their plants, both large and small. Where operations have to continue around the clock, the demands on personnel can be reduced by having processes automated, substantially reducing the need for personnel to be present.

- ## Power Plants

Power plants are an example of an extremely high capital cost plant. But, even where the mainstream circuits and generating equipment still function well, important benefits can result from strategic retrofitting in the plant. That is, modern control equipment can significantly reduce manning levels and increase plant efficiency. Also, in old plants, space for additional motor controls may not be available. Here the integrated motor starters of the OUR actuator can give great benefits for retrofitting feed water valves, boiler trim valves, and many other applications on a power plant without the need for an additional motor control center. Furthermore, load fluctuations can be more easily accommodated by using digital two-wire communication technology to piggyback automated valve controls into existing DCS systems.

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FIRST STEPS IN THE RETROFIT DECISION PROCESS

Almost every facility can benefit from automation. The scale of a retrofit can vary enormously with the type and size of the plant.

SUSTECH knows how valve actuators have been used to automate the level control on a reservoir utilizing just two valves; they have also been used to automate hundreds of valves on large tank farm automation upgrades. However, in both cases, the retrofit elements can be broken down into a few discrete steps.

First, there is the selection of the particular type of valve actuator. This selection is dependent on many external factors, including the available power source, the required mode of operation, the environment, and so forth.

Then the valve actuator has to be controlled by some means. This could range from manual push-button controls at the actuator to sophisticated general communications linked to a host computer some distance away.

These two elements, the actuator, and its control method, dictate how to proceed with the retrofit. Regardless of whether it is one valve or a thousand valves, the decisions made and the information required are the same.

Plant owners or their consulting engineers usually have decided on the type of power source to be applied to the automated valve, and the type of control required, such as on/off, modulating, or fail-safe. For users who have not made that preselection, the available power sources for valve actuators usually include three-phase or single-phase electricity, shop air supply (usually around 80 psi), line gas for gas pipeline applications, or water pressure in water treatment plants. If any of those power supplies are readily available, then this may dictate the selection of actuator type.

To remotely control valve actuators, there needs to be some source of control power that emanates either from the host controller, the actuator itself, or a backup or auxiliary power supply, such as solar energy. Once the power supply has been determined and the control philosophy has been defined, then actuator type selection can be made.

By definition, retrofitting means the installation of a valve actuator onto an existing valve.

Valve selection, therefore, is not a criterion we need to be concerned about; however, we are most concerned about the type of valve that needs to be automated. From an actuator manufacturer's point of view, valves can be segregated into two types: (1) multi-turn and (2) quarter-turn.

Multi-turn valves include gate valves, globe valves, and sluice gates. Quarter-turn valves include ball valves, plug valves, and butterfly valves as well as louver and butterfly dampers.

Having selected the of actuator, the next step is to size the correct actuator to the corresponding valve. Different valves require different torque inputs because of varying size, pressure class, and mechanism. There is a wealth of detailed engineering information on how to size valves (contact S **SUSTECH** for more details).

The category of valve determines the sizing procedure. For quarter-turn valves, the torque information has to be gathered from the valve maker or from a reference database at the actuator manufacturer. The torque for multi-turn valves, however, can often be calculated using tried and proven calculation methods available at the actuator manufacturer.

Because the power delivered by an actuator is a function of both torque and speed, sizing cannot be completed until the required speed of operation is known. In most instances, gate valves are required to operate at the rate of 12 inches per minute. For quarter-turn valves, a similar rule of thumb suggests valve operation at a rate of 60 seconds for every 12 inches of valve diameter. Hence, a 24-inch gate valve would operate in two minutes and an 18-inch ball valve in 90 seconds.

Differing applications may, of course, require higher or lower speeds, and this will affect the size of the actuator.

Every plant has different parameters; however, to do a successful retrofit, the two fundamental stages of powering the valve and then controlling the valve can be broken down to give you a road map on how to proceed with your retrofit.

1. POWERING THE VALVE

- *Choosing the Power Source.*

The most common sources of power for an automated valve are electricity and fluid power. If electric power is selected, a three-phase supply is required for large valves (usually on pipes 18 inches and above); however, for small valves (on pipes below 18 inches), a single-phase supply may be sufficient.

Usually, an electric valve actuator can accommodate any of the common voltages. Occasionally, such as with power plants, a 24-volt DC supply is available and sometimes preferred for emergency operating or black start operation. **SUSTECH** is capable of providing DC-powered actuators.

The variations in fluid power are much greater. First, there are varieties of fluid mediums, such as compressed air, nitrogen, hydraulic fluid, or natural gas to consider. Then, there are the variations in the available pressure of that medium. With **SUSTECH** solutions line of fluid power products, almost all of the variations can be considered.

The higher the applied pressure of the fluid medium, the smaller the required cylinder. Typically, smaller cylinders are less expensive for any given fluid medium.

If you have a choice of power supply, **SUSTECH** can provide budgetary figures comparing electric motor operators with fluid power operators, so a cost-based decision can be made.

- *Examining the Valve Type*

At the inception of the retrofit project, the valve type needs to be known so that the correct type of actuator can be selected. As we mentioned, some valves need multi-turn inputs whereas others need quarter-turn. This has a great impact on the type of actuator selected

and, when considered with the power supply available, a rational selection of actuator type can be made.

In general terms, multi-turn fluid power actuators are a more expensive solution than multi-turn electric actuators; however, for rising non-rotating stem valves, a linear fluid power actuator may be the suitable selection.

A definitive selection cannot be made until the power requirements of the valve are determined. After that decision has been made, then consider the criteria below.

- *Calculating the Torque Required by the Valve*

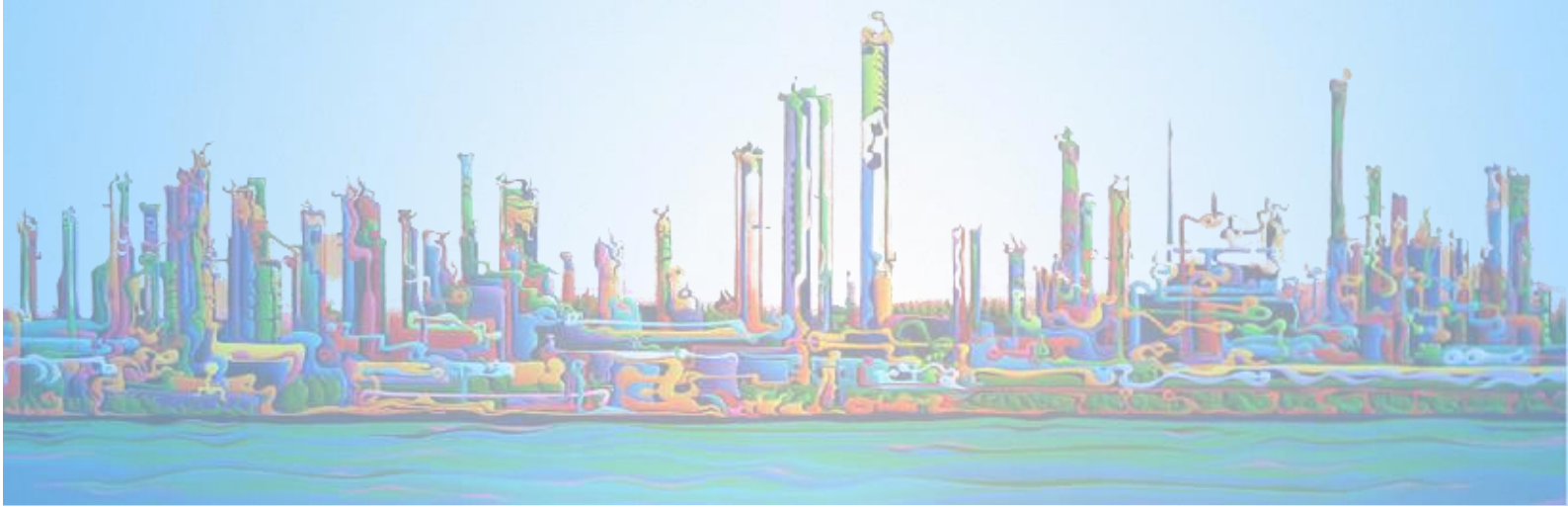
For quarter-turn valves, the best way of determining the torque required is by obtaining the valve maker's torque testing data. Most valve makers have measured the torque required to operate their valves over the 90 degrees of operation and make this information available to customers. In addition, **SUSTECH** maintains its own database of torque data for many manufacturers and can size actuators accordingly.

However, the situation for multi-turn valves is different. Multi-turn valves can be broken down into several groups:

- Rising rotating stem valves (most globe valves)
- Rising non-rotating stem valves (most gate valves)
- Non-rising rotating stem valves (some waterworks' gate valves)

In each of these cases, the measurement of the stem diameter together with the lead and pitch of the valve stem thread is required to size the valve. This information coupled with the size of the valve and the differential pressure across the valve can be used to calculate the torque demand.

Once we have the power supply defined, the type of valve, and the torque demand of the valve, then we can look at the available products that can automate that particular valve. You can find a matrix that can assist you in making that selection please contact **SUSTECH** to assist you in getting The available products together with their torque range and power requirements.



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- *Sizing the Actuator*

Once the actuator type has been selected and the torque requirement of the valve has been determined, then we can size the actuator using one of many available tools.

For fluid power actuators, we match the fluid pressure with the torque demand and read off the actuator size from the torque tables in **SUSTECH** sizing guide (which is available by contacting **SUSTECH**).

Usually for fluid power operators, the speed of operation is not a critical issue, since the normal speed operation of the actuator is fast enough for most applications. If necessary, fluid power actuators' speed of operation can be increased by using high-speed (large capacity) control valves and piping. Conversely, it can be reduced by using the standard controls with the addition of flow control valving.

The speed of operation for an electric actuator, however, is critical to the sizing selection. On the **SUSTECH** sizing table, the actuator model number is a function of valve torque demand and output speed of the actuator.

Perhaps the easiest way to size an electric actuator is to use the **SUSTECH** CD catalog (which is available free of charge by contacting **SUSTECH**). The interactive CD allows actuator

selection by range and then sizes the actuator based on valve torque demand. It also checks to ensure that the actuator can accept the valve stem.

Once the actuator has been selected, the CD will allow dimensional drawings and wiring diagrams to be automatically selected and printed out for reference. There is also an actuator order form, which can be faxed to **SUSTECH** to place an order.

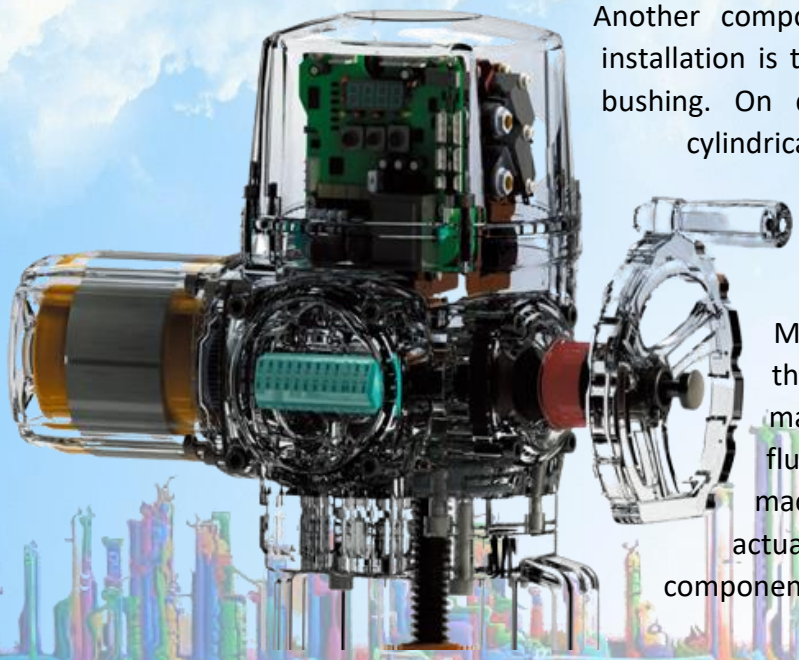
- *Adapting the Actuator to the Valve*

Having defined the actuator, we now have to consider how that actuator will be physically mounted onto the valve when it arrives from the factory. For this, we need to design appropriate mounting bracketry so that the weight and the torque reaction of the actuator is absorbed or supported by the valve.

First, the valve topworks need to be carefully examined and measured. There may already be some kind of mounting flange in existence that previously supported an old actuator or gearbox. This could be utilized to bolt an adaptation piece between the existing valve topworks and the actuator mounting base. Such an adapter can take many forms, such as a single or double plate adapter, a spool piece, or a piece of rectangular hollow section.

The bracket not only must be able to support the weight of the actuator, but it must also be robust enough to take the torque reaction and the thrust reaction of the valve. The valve topworks themselves must also be robust enough to support these forces. Needless to say, extensive experience is a benefit that comes into play in the design of the bracketry, which often is critical to the success of the retrofit.

Some valves have no flange at all onto which the actuator can be mounted. In those circumstances, a plate has to be utilized, such as a saddle bracket.



Another component that is essential to a successful installation is the torque transmission element, or drive bushing. On quarter-turn actuators, this is often a cylindrical intermediate piece between the valve stem and the actuator such that a keyway transmits the drive from the drive bushing to the valve stem.

Most electric quarter-turn actuators have their blank drive bushing available for machining to suit the valve stem; however, fluid power actuators usually have a custom-machined drive bushing made to suit the actuator and valve stem. In either case, this component can be provided by **SUSTECH**.

For threaded valve stems, such as gate valves, the drive bushing is usually made of an aluminum bronze material that needs to be threaded to the valve stem.

- *Mounting the Actuator onto the Valve*

In the mounting operation, the valve, actuator, and mounting adaptation come together to make the automated valve assembly. The physical mounting actuator on the valve requires the stem bushing to be mated with the valve stem while the actuator is lowered onto the mounting hardware. Once in position, the actuator can be secured by bolts to the mounting hardware and hence to the valve itself.

Once the actuator is physically in position on the valve, then the power supply can be connected to the actuator. On electric actuators, this requires conduit to be connected to the terminal compartment of the actuator, and the wires to be connected to the appropriate terminals in the separately sealed terminal compartment. Fluid power actuators require tubing containing the fluid power medium to be connected to the control valve associated with the fluid power actuator.

Once the power supply has been connected, the limits of travel and other parameters can be set on the actuator.

For electric actuators, the setup has been dramatically simplified with the advent of the OUR non-intrusive setting feature. This allows the limits of travel, torque setting, direction of rotation, and other parameters to be set using an infrared setting tool to communicate with the actuator. During the setup, procedure, no covers need to be removed, and hence no moisture or dirt can ingress into the electrical enclosure of the actuator.

Limits of travel on the AQ and Q quarter-turn electric actuators also can be achieved by adjusting the external mechanical travel stops located on the outside of the actuator. The same is true for fluid power quarter-turn valve actuators.

Details of setup procedures can be found in **SUSTECH** partner technical manuals supplied with the actuator.

- *Testing and Commissioning*

Once the actuator has been mounted and the travel limits have been set, then, utilizing the local controls and a power supply, the operation of the valve can be tested locally.

The normal procedure for testing an electric operator is to move the valve into the “Mid” position, then press the “Open” position until it reaches the end-of-travel and then stop.

However, if the actuator is connected to a three-phase supply and the phases are reversed, there is a danger that a conventional actuator would move in the opposite direction because of phase reversal. This is an extremely bad situation. It means the torque and position

switches are in the wring control circuit, and the valve could run to the end-of-travel and go into a stall condition causing damage to the stem or the valve seat.

Fortunately, this will not occur with a new **SUSTECH** partner actuator due to the inherent safeguard provided by Synchrophasing, a feature that automatically selects the correct contactor to energize. Therefore, the motor will always run in the correct direction. The protection switches are always in effect and no damage can occur to the valve.

After the motor operator has run the valve in the “Open” and “Close” directions confirming correct seating of the valve and functionality of the automated valve package, then commissioning is completed, and we can turn our thoughts to remote operation.

CONTROL AND MONITOR THE VALVE

- *Bus Communication Systems*

The previously described controls function perfectly well, but because of the length of cabling required to connect actuators to the control room, the cost of cabling, conduit, and labor can be astronomical. A simpler method of connecting actuators to the control room uses **SUSTECH** Principal Master station technology which consists of a signal-generating master station that communicates over Modbus Loop.

The master station through Modbus communication which are mapping to each actuator, so each or every actuator can be commanded to “Open”, “Close”, or go to any position. Over the same serial modbus cable , actuator position can be reported back to the master station for each of the actuators.

Modbus Loop control can perform all of the functions of the standard hard-wire control and enables the examination and communication of additional information in each actuator For example, the status of the following can all be brought back over modbus loop:

- Torque Switch
- Limit Switch
- Thermostat
- Local/Remote Controls
- Contactors
- Power Supply

In addition, the master station can check every actuator every few seconds to ensure its availability for operation. This is the scanning part of the master station system.

Should a break occur in the Modbus loop, then the master station immediately detects the fault and configures the loop into two branches. This gives the Master station system single fault tolerance.

The master station connects to the host main control room via an RS-485 or RS-232 Modbus RTU link. This enables the programmer to have a proven interface between main control room and Master Station systems have been successfully interfaced with all of the major international DCS and PLC manufacturers.

- *Startup and Commissioning of Control Systems*

The first step in commissioning a remote control system for the **SUSTECH** actuators is to locally commission the actuator to ensure correct functionality at the automated valve. Only then should remote control commissioning take place.

For conventional hardwired systems, the functionality of each control and position feedback should be checked sequentially, preferably with a technician at the valve and a technician in the control room to initiate and confirm control commands. In the event of a problem, the continuity of the wiring and wiring connections should be systematically checked, as well as the functioning of control and indicating switches.

Commissioning a Master station fortunately is significantly less complex. After the commissioning of each valve locally, the continuity of the Modbus loop should be checked.

- *Applying predictive maintenance for the Actuator and valve*

As we **SUSTECH** have extensive experience in applying and giving solutions for IIOT, we **SUSTECH** can give cost-effective solutions to monitor all remote area valves and we can give SAS (software as a service) for predictive maintenance.

- *Remote monitoring of the manual valves*

Our partner manufacturing devices for IIOT applications can communicate with the cloud and then send massage by mobile or email or directly to the control room to monitor the manual valves if it is open or closed.

In such monitoring, you avoid workman failure

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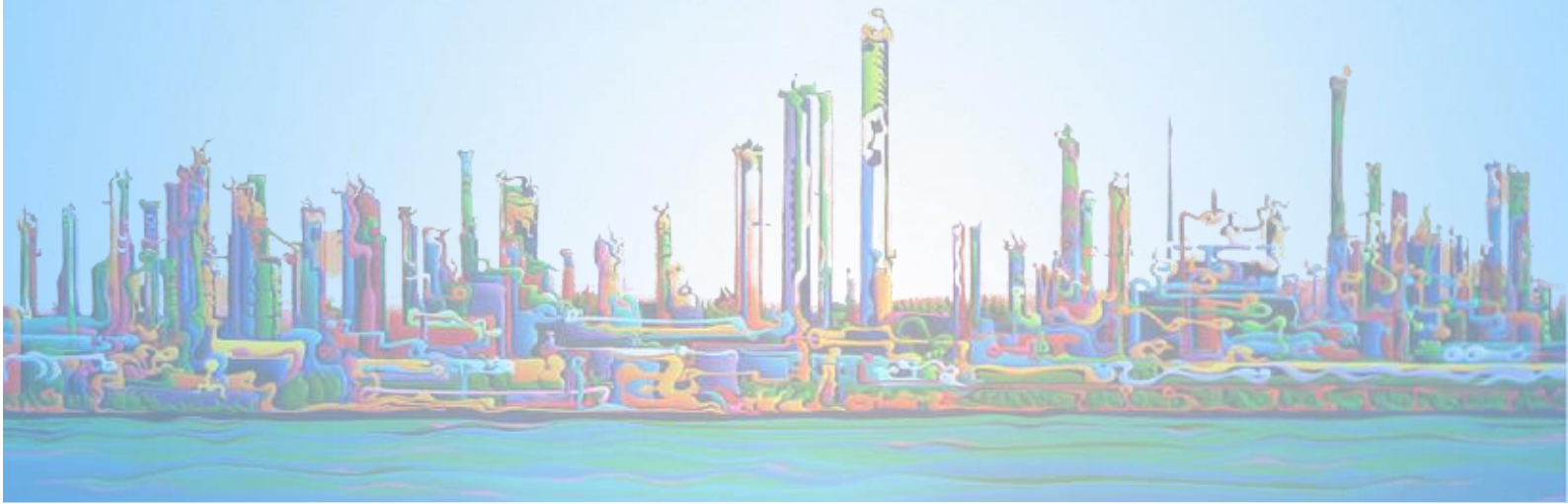
SUMMARY

Today's automated valve actuator systems can be cost-effectively installed and retrofitted in virtually any type of facility. Automated valve operation provides an array of important benefits, including:

- Increased plant efficiency
- Decreased labor costs
- Improved safety
- More effective control
- The flexibility to add additional monitors and alarms
- Less chance of operator error
- Less risk of injury to personnel
- Increased environmental protection, and more.

Most importantly, even very old and small plants can enjoy these benefits by retrofitting.

Today's valve actuator technology is so affordable and dependable that manual operation is fast becoming outdated and is relevant for only a few types of applications.



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