



sorensen governor
A wholly owned subsidiary of
THG Corporation

Water-to-Wire Turbine-Governor and Valve-Actuator Systems Integrator

Sorensen Governor Products

- Turbine-generator operating systems
- Electro-hydraulic governors and positioners
- Electric gate and valve positioners
- Gate and valve operating systems
- Self-contained actuator systems
- Conversion Systems
- Valve and valve operating systems
- AWWA butterfly valves
- AWWA ball valves
- Fixed cone valves
- Explosion-proof actuator systems
- Submersible actuator systems
- Hydraulic and electric operating systems

Sorensen Systems LLC
70 Bearfoot Road
Northborough MA 01532
Tel: 508-393-7660
www.SorensenSystems.com

Sorensen Governor Specializes in Design, Procurement, Manufacture and Project Management for Water-to-Wire Turbine-Generator and Valve-Actuator Systems Worldwide

Sorensen Governor has over 50 years experience with new installations, refurbishment projects and station automation for the hydroelectric, power generation, water and waste water industries.

Sorensen Governor is a leader in the design and manufacture of electro-hydraulic governors, gate operating systems, and hydraulic lubrication and bearing cooling units for the power generation, municipal and waste water industries.

Sorensen Governor's experience includes applications ranging from turbine speed control to water level management:

- High and low pressure electro-hydraulic control systems
- Remote gate positioning systems
- Ball valve, butterfly valve and fixed cone operating assemblies and systems



Sorensen Governor provided turbine rehabilitation, governor conversion and station automation for the MWRA facility to monitor and control the flow of water for the City of Boston.

- Turbine lubrication and cooling systems
- Crest, slide and roller gate control systems
- Gas/steam turbine combined cycle diverter systems
- Electro-hydraulic governor control systems

Sorensen Governor Systems Solves Water Challenges Throughout the World

Whether the challenge is waste-water disposal in New York City, desalinization of sea water in Jordan or flood protection in Texas, Sorensen Governor has the expertise and experience to provide solutions.

According to Mark Ferland, President of Sorensen Systems, LLC, the 50 year legacy of innovation continues at Sorensen Governor with projects on behalf of the public drinking water for Boston, Atlanta, Los Angeles and San Francisco.



Sorensen Governor designed and built this valve control system for the California Water Resources Authority at its 60,000 sq ft, ISO 9001:2000 certified fabrication facility in Massachusetts.

"It's always a challenge to design and build a custom control system for the various installations," said Ferland. "But, there is great satisfaction in seeing our contribution to these public works when they come on line," he added.

Over the years, Sorensen Governor has designed, built and installed systems throughout the world including Egypt, India, United Arab Emirates (UAE), Korea, Jordan and throughout North America including Mexico and Canada.



sorensen systems
Single-Source System Provider

Sorensen Systems Takes the Lead Toward Renewable Energy and Power Generation

Sorensen Systems LLC is a privately-held company, which is one of three subsidiaries of THG Corporation, a Massachusetts corporation founded in 1933. Today, the Sorensen Systems company operates as the engineering and manufacturing arm of THG Corporation and its other two subsidiaries, The Hope Group LLC and Hope Air Systems LLC. It focuses on the water and waste water industry, the power generation industry and the motion and control and machine control systems marketplace. Its staff of design engineers, technicians and project managers operates from its 60,000 sq ft office and manufacturing location in Northborough, MA. Sorensen Systems was founded 25 years ago with the acquisition of the Sorensen Governor brand and immediately became focused on the hydroelectric power industry in New England and for certain applications throughout the world. Today, with representation in the US and Canada, the company continues its expansion into the power generation marketplace.



The Sorensen Systems office and manufacturing facility is located in Northborough, MA near the intersection of Rt-290 and Rt-495 40 miles west of Boston.

System Solutions Philosophy Drives Sorensen's Design/Build Capabilities

Operating as the engineering and fabrication arm of THG Corporation, Sorensen Systems has an exclusive focus on system design/build. It does not inventory parts, replace or repair components or otherwise operate in the traditional MRO role, which is handled by its associated company, The Hope Group. Rather, it serves as a provider of design/build services to The Hope Group and Hope Air Systems as needed and takes its services directly to the market for the thermal and hydro power generation market, water and waste water distribution market and general motion and control systems for defense, semiconductor, life science and other industrial markets.



A major manufacturer had a requirement for an integrated control system that required the design and assembly of a structural aluminum machine frame, pneumatic and automation assemblies, hose and stainless steel fittings and a PLC driven control system.



sorensen
INTEGRATED SYSTEMS

- Power Station automation
- Design/Build services
- Project Management
- Turbine-Governor-Valve integrator
- Equipment procurement/fabrication



sorensen
GOVERNOR SYSTEMS

- Electro-hydraulic governors
- Digital governor conversion
- Gate and valve operating systems
- Self-contained actuator systems



sorensen
ENGINEERED SYSTEMS

- Design/Build services
- Turnkey motion control systems
- Mechanical, hydraulic, pneumatic
- UL, CE, ISO 9001:2008 certified
- 60,000 sq ft fabrication facility



sorensen
POWER GENERATION

- Combustion Turbine
- Combined Cycle
- Fossil Fuel
- Hydroelectric
- Nuclear

SORENSEN SYSTEMS
Subsidiary of THG Corporation

70 Bearfoot Road
Northborough, MA 01532
Tel: 508-393-7660
Fax: 508-393-6042

www.SorensenSystems.com

Sorensen Engineered Systems

PRODUCTS

- Air Compressors
- Electrical Panels
- Flood Protection
- Gate Operating
- Hydraulic Manifolds
- Hydraulic Power
- Lock and Dam
- Positioning Tables
- Power Take Off
- Process Controls
- Reservoir Levels
- Waste Water

Sorensen Systems

70 Bearfoot Road, Northborough, MA 01532
Tel: 508-393-7660 • Fax: 508-393-6042
www.SorensenSystems.com

Turn-Key Fluid Power Systems From Design/Build Specialists

Sorensen Systems is a designer and manufacturer of turnkey fluid power and electrical control systems required to meet the stringent motion and control requirements of today's industrial OEM's. The company has established a strong reputation for accomplishment through the capabilities of its engineering, technical and fabrication talent. Its in-house capability for designing, manufacturing, and testing hydraulic, pneumatic, automation, and electrical control packages, including skid-mounted packaged compressed air and nitrogen generator systems makes it a leading engineered system provider in New England.



Sorensen Systems designed and built three hydraulic power units and a PLC driven control system to remotely operate the gates from the passenger embarkation station on the San Antonio River Walk tourist attraction.

Sorensen Systems has built its reputation on successfully designing and building CE & CSA compliant hydraulic power units, pneumatic panels, equipment sound attenuation enclosures, lubrication systems, hydraulic and pneumatic filtration systems, proportional and directional control valves, hose and tubing assemblies.

Engineered Solution Solves Gas Distribution Challenge

The community of Keene NH relied on engineering design fabrication from Sorensen Systems for an upgrade to its municipal propane gas distribution system. The solution was a custom sequenced blower package that provided a stabilized pressure source. The design incorporated four rotary-lobe blowers linked together to provide the required controlled pressure and internal back-up.



The goal was to use four rotary blowers to upgrade from the existing gravity-fed system to a controlled pressurized distribution system.

A pressure and flow controller package integrated the existing digital controls for the system. A new pressure sensor was mounted on the existing line, which mixes the propane, to provide the correct ratios and proportioning to meet varying demands. Sorensen Systems engineers developed the software programming that permits the blowers to work in sequence.

Sorensen Governor Systems

PRODUCTS

- Turbine-generator operating systems
- Electro-hydraulic governors and positioners
- Electric gate and valve positioners
- Gate and valve operating systems
- Self-contained actuator systems
- Conversion systems
- Valve and valve operating systems
- AWWA butterfly valves
- AWWA ball valves
- Fixed cone valves
- Explosion-proof actuator systems
- Submersible actuator systems
- Hydraulic and electric operating systems

Sorensen Systems

70 Bearfoot Road, Northborough, MA 01532
Tel: 508-393-7660 • Fax: 508-393-6042
www.SorensenSystems.com

Water-to-Wire Governor and Valve-Actuator Systems

Sorensen Governor has over 50 years experience with new installations, refurbishment projects and station automation for the hydroelectric, power generation, water and waste-water industries.

Sorensen Governor is a leader in the design and manufacture of electro-hydraulic governors, gate operating systems, and hydraulic lubrication and bearing cooling units for the power generation, municipal and waste-water industries.

Sorensen Governor's experience includes applications ranging from turbine speed control to water level management:

- High and low pressure electro-hydraulic conversion systems
- Remote gate positioning systems
- Ball valve, butterfly valve and fixed cone operating assemblies and systems
- Turbine lubrication and cooling systems
- Crest, slide and roller gate control systems
- Gas/stream turbine combined cycle diverter systems
- Electro-hydraulic governor control systems



Sorensen Governor provided turbine rehabilitation, governor conversion and station automation for the MWRA facility to monitor and control the flow of water for the City of Boston.

Sorensen Governor Systems Solves Water Challenges Around the World

Whether the challenge is waste-water disposal in New York City, or flood protection in Texas, Sorensen Governor has the expertise and experience to provide solutions. The 50 year legacy of innovation at Sorensen Governor continues with projects on behalf of the public drinking water for Boston, Atlanta, Los Angeles and San Francisco.

Mark Ferland, President of Sorensen Systems LLC, said, "It's always a



Sorensen Governor designed and built this valve control system for the California Water Resources Authority at its 60,000 sq ft, ISO 9001:2008 certified fabrication facility in Massachusetts.

challenge to design and build a custom control system for the various installations. But, there is great satisfaction in seeing our contribution to these public works when they come on line," he added.

Over the years, Sorensen Governor has designed, built and installed systems throughout the world, including Egypt, United Arab Emirates (UAE), Korea, Jordan and throughout North America including Mexico and Canada.

Sorensen Integrated Systems

PRODUCTS

- Design/Build
- Directional Control Valves
- Equipment Procurement
- Lubrication Systems
- Machine Fabrication
- Pneumatic Filtration
- Project Management
- Power Station Automation
- Proportional Control Valves
- Sound Attenuation Enclosures
- Tubing Assemblies
- Turbine-Governor Integration

Sorensen Systems

70 Bearfoot Road, Northborough, MA 01532
Tel: 508-393-7660 • Fax: 508-393-6042
www.SorensenSystems.com

Hydraulic, Pneumatic and Electrical Control Systems for Industry

Sorensen Systems is a premier designer and manufacturer of hydraulic, pneumatic and electrical control systems for the water, waste-water, power generation, industrial motion control, and process control industries. It has built its reputation on successfully designing and building CE & CSA compliant hydraulic power units, pneumatic panels, equipment sound attenuation enclosures, lubrication systems, hydraulic and pneumatic filtration systems, proportional and directional control valves, hose and tubing assemblies.



A major manufacturer had a requirement for an integrated control system that required the design and assembly of a structural aluminum machine frame, pneumatic and automation assemblies, hose and stainless steel fittings and a PLC driven control system.

All completed systems are fully tested at its 60,000 square foot manufacturing facility in Massachusetts and provided with complete documentation packages at time of shipment. Use of non-proprietary equipment from leading manufacturers assures world-wide support for warranty and support services. When working with clients on an integrated system design, our commitment extends from initial concept through commissioning and extended in-the-field follow-up services.

Integrated Solution Keeps the Oil Flowing in Egypt

An interesting challenge requiring an integrated design solution was a requirement to build four skid-based oil pumping stations for a crude oil field in Cairo, Egypt. Part of the solution was the integration of multiple pumps on a single 40-foot skid-based platform.

Two pumps were required to meet the boost requirement, while the third in the series served as a back-up during



The compact design of the skid accommodated three pump/motor combinations working in parallel, each pump drawing oil from a common supply and discharge header, and each pump/motor has its own electrical controls and protective devices.

routine maintenance and any unexpected downtime. The use of multiple pump/motor combinations provided an economical means of transferring the crude oil between various locations. Each pump was of a compact design allowing for reduced horse power electric motors. Each skid contained motorized screw pumps, lubrication systems, large diameter piping, electronic control cabinets and complete instrumentation.

Spartanburg SC Water Treatment Plant Provides Clean Water and Hydropower

Since 1926 the Simms Water Treatment Plant in Spartanburg SC has been powered in part by energy generated through the release of water – hydroelectric power. In recent years the hydro generation equipment experienced various maintenance issues and fell out of service. The plant owners made a commitment to reactivate energy recovery through refurbishment and upgrading of the water treatment facility. In 2010 the plant broke ground on a \$30million improvement project and as part of that plan engaged Sorensen Systems for a significant aspect of the project associated with energy recovery.

Sorensen Systems engineered and supplied the complete Unit Control System (UCS) in support of the major hydroelectric overhaul allowing Spartanburg Water to utilize the valuable infrastructure for power generation. The scope of supply included hydraulic power units, hydraulic cylinder actuators for turbine wicket gate control Basler digital excitation and rectifying system, turbine control panel, balance of plant control panel, and system programming with field start-up services.

The Spartanburg improvement project is designed to ensure the sufficient long-term water supply essential to supporting quality of life and the local economy. The facility serves 200,000 people as principal and wholesale water supplier for Spartanburg and surrounding counties. By offsetting costs, hydropower generation complements

Spartanburg Water's mission of providing safe drinking water and environmentally sound wastewater treatment while being a responsible steward of ratepayer assets.

Spartanburg Water System's original water plant, Chinquapin Filter Plant, was established in 1887 at 250 Whitney Road in Spartanburg. Privately owned, it went into receivership in 1898. A year later it was purchased by some businessmen with familiar names in the Spartanburg community: John H. Montgomery, Ralph Carson, D. E. Converse, Jesse Franklin Cleveland, and John Bomar Cleveland. They named the business the Home Water Supply Company. On March 25, 1907, a fire started in a house on Forest Street that quickly spread and destroyed over 70 buildings and homes in the Spartan Mills area.

After this "Big Fire" there was great interest among the citizens within the city of Spartanburg to acquire ownership of the water company. In June 1907, after a local referendum, the city of Spartanburg purchased the company. The first Commissioners of Public Works were elected in the spring of 1908. In 1910, Samuel A. Bush was appointed the first General Manager of Spartanburg Water Works. The facility has undergone previous refurbishment work, the last about 40 years ago. The recent improvements will serve the community for many years to come.



Sorensen Systems designed and built turbine control panels and balance of plant control panels as part of the Spartanburg Water Treatment improvement project.



The Spartanburg Water Treatment plant operates two 500 kW turbine generators providing water treatment and power generation to 200,000 consumers including neighboring counties.



The refurbishment included new PLC based unit control systems, one per generator, which were programmed and tested at the Sorensen Systems fabrication facility.



Energy Recovery is the Goal From Water-to-Wire System

The engineers and technicians at Sorensen Systems recently built and installed a renewable energy system in Keene, NH, that transforms excess pipe pressure and flow into clean “green” power. This Water-to-Wire energy recovery project provides 480 VAC (volts alternating current) power from water flow exiting the treatment plant.

The system includes a 22 kW and 40 kW dual-turbine generators. The electricity generated from the system is sent to the power grid, which offsets the amount of electricity the plant uses. According to officials from the Keene, NH, Public Works Department, this is the first installation of its kind in New Hampshire and represents an opportunity for gravity-fed water system deploying regulator valves.

In addition to the two turbine generators, control cabinets were designed and built at Sorensen Systems with controls and status indicators that can be used to monitor the operation of the turbine generators while they are being operated under remote control, or as a means for operating the turbine generators locally for diagnostic purposes. The control cabinet for the system is dual-bay; the left-hand side includes the controls specific to the 22 kW turbine generator, and the right-hand side includes the controls specific to the 40 kW turbine generator.

The PLC (programmable logic controller), used to control all operating features for both turbine generators, is located in the left-hand bay of this control cabinet. It is an Allen-Bradley Compact

Logix platform that communicates with the SCADA (supervisory control and data acquisition) system via EtherNet. A mains disconnect circuit breaker is located under the central pillar on the front of the control cabinet; this device is used to isolate the entire control cabinet from the mains AC line and to shut off power to all circuitry within this control cabinet.

Each turbine generator has its own touch-screen. These HMI's are used to monitor all operational parameters for each turbine generator. They are also used to control the operation of the turbine generators if local control is selected and as a means for diagnosing fault conditions within the turbine generator controls. Each turbine generator has a key-lock switch on the control front panels. These switches have three positions: Local, Remote, and Off. These switches are used to determine the source for the on/off control signals for the turbine generators, or to lock out the turbine generator from operation.

Each turbine generator has its own HMI screen that is used to control its operation and to display status information. These HMI's when they are turned on, default to the main status screen, which is called the Turbine System State. This screen displays the status information for its turbine generator while it is running. This screen has two distinct functions: numerical displays for turbine data and pushbuttons used to select further display for the generator. The touch-screens on this system are the primary means whereby a machine

operator can monitor and control the operation of the turbines locally. There are five screens that the HMI's display. They are 1) Turbine Systems State, 2) Intertie Status, 3) Turbine Status, 4) Turbine Maintenance Controls, and 5) Turbine Local Start Controls.

The power necessary for running these controls is derived from the 480 VAC power grids to which this control cabinet is connected. However, once the turbines are on-line and generating power, the power source for this cabinet is the turbine-generators that it is controlling.



Sorensen Systems engineers and technicians recently built and installed a renewable energy system for the Keene, NH community at its Water Treatment plant.



According to officials from the Keene, NH, Public Works Department, this is the first installation of this kind in New Hampshire and represents an opportunity for gravity-fed water system deploying regulator valves.



Sorensen Provides Station Automation, Governor Conversion & Turbine Rebuild

When the Massachusetts Water Resources Authority (MWRA) determined that turbine generators at its Clinton MA location along the Wachusett Reservoir needed upgrading and refurbishment, Sorensen Systems was awarded the contract for the project. The two vertically oriented, full Kaplan type 1,600 KW generators with six adjustable runner blades and two 2,240 HP turbines had been in operation since 1969. The upgrade was necessary to integrate the turbine operation with newly configured water supply system.

The hydroelectric facility, locally referred to as the Cosgrove Intake, regulates the flow of water from the Wachusett Reservoir into the Cosgrove Aqueduct, which is an important transmission leg in the supply of water to the Boston Metropolitan area. There are two sections, the North and South intakes, and both intakes include a hydraulic turbine and two bypass lines. Each intake has three channels with traveling water screens. Each intake also has an upper intake sluice gate and lower intake sluice gate that allow operational flexibility to draw water from different levels of the reservoir.

Hydroelectric Refurbishment

Sorensen Systems provided the design, manufacturing, installation supervision, commissioning and training for the entire project, which included the disassembly and refurbishment of the existing turbine generators, new static excitation systems, new turbine bearing cooling water systems, refurbished switchgear panels, new digital governor heads with the refurbished governor hydraulic pumping units and new station battery charging system.

Sorensen Systems has over 50 years experience with new installations, refurbishment projects and station automation for the hydroelectric, power generation, water and waste-water industries. It has established a reputation as a leader in the design and manufacture of electro-hydraulic governors, gate-operating systems, and hydraulic lubrication and bearing cooling units.

Sorensen Systems Design/Build

Its in-house staff of engineers and design technicians have extensive experience with applications ranging from turbine speed control to water level management. System design, fabrication, installation, start-up and field maintenance are provided for:

- High and low pressure electro-hydraulic conversion systems
- Remote gate positioning systems
- Ball valve, butterfly valve and fixed cone operating assemblies and systems
- Turbine lubrication and cooling systems
- Crest, slide and roller gate control systems
- Gas/steam turbine combined cycle diverter systems
- Electro-hydraulic governor control systems

Full Service Project Engineering

From its 60,000 square foot engineering and manufacturing headquarters in Massachusetts, Sorensen Systems works closely with its customers and with any globally recognized hydraulic and electrical component manufacturer to provide full service project engineering from initial concept through commissioning. Its team of mechanical,

electrical, hydraulic, electro-mechanical, and pneumatic engineers, support customers in the following ways:

- We provide complete design documentation
- We follow a compressed turn-around design-to-production schedule
- We offer worldwide field assistance for on-site engineering of special applications reducing installation and commissioning costs
- We offer customized testing procedures at our facility allowing the customer to put their equipment to work sooner



Sorensen Systems upgraded and refurbished the two 1.6 MW generators at the MWRA Cosgrove Intake facility in Massachusetts.



Sorensen Systems built two new digital excitation control systems as part of refurbishment.



Sorensen Systems Designs/Builds/Installs Innovative Hydroelectric Plant for MWRA

With each glass of fresh, clean water drawn from a water tap in Boston, consumers are helping to generate electricity that goes back into the grid at a rate that will power the energy needs of over 100 homes. As the water flows from reservoirs in the western part of the state, a unique hydraulic turbine and hydroelectric generator combine to generate enough electricity to operate an MWRA storage facility, with left-over electricity sent back into the grid.

This Micro electric power generator is one of many innovative installations being installed around the state to meet the goal of getting at least 15 percent of its annual electricity requirements from renewable sources by 2012. According to an article in the Boston Globe, Frederick Laskey, executive director of the water agency said, "It basically helps get us off the roller coaster of utility bills. The more we can self-generate, the less vulnerable we are to the peaks and valleys of the energy commodities market," he added.

Gravity sends the water to Boston from the Quabbin Reservoir and the Wachusett Reservoir, which becomes pressurized as it travels via aqueducts to a treatment plant about 30 miles west of Boston. From there it travels to a network of tanks that depressurize and store the drinkable water before it is distributed to Boston and other communities. It's here at the storage facility that the magic happens.

At the Loring Road facility in Massachusetts, the potable water now moves through the recently installed hydroelectric turbine, which reduces the gravity-fed pressure from the water and converts it to electric energy. By by-passing

the pressure reducing valves with a 200 kW turbine-generator unit, instead of dissipating the energy with the sleeve valves, it is converted into electricity. The compact horizontal Francis turbine with wicket gates will generate an average annual 1.2 million kWh.

The storage tanks at the Loring Road facility were constructed to protect and store treated drinking water in compliance with the Federal Safe Drinking Water Act. The storage tanks replaced a 100 year old system of open reservoirs. The covered tanks protect drinking water from potential contamination. The two reservoirs that feed into the Loring Road facility supply an average of 200 million gallons per day to consumers.

The Sorensen Systems company designed and built the turbine-generator systems used at the Loring Road facility by the MWRA. The purpose of the project was to meet the requirement by the MWRA to recover the energy previously lost through the power reducing sleeve valves. The water passes through the turbine the pressure is reduced and the energy is transferred into electric power via the induction generator connected to the turbine water wheel, or runner. The electric power generated through this process is used to power the equipment in the vault, with the balance exported back to the utility for revenue.

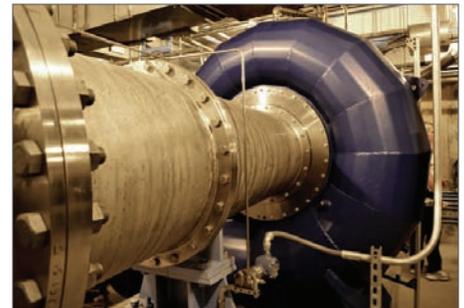
Sorensen Systems design engineers and technicians were responsible for overall project management to include the turbine generator, the hydraulic power unit, the turbine circuit breaker, the turbine control panel, the Francis turbine unit, the induction motor and the large butterfly valves and piping.



The custom built Turbine Control Panel used Allen-Bradley SLC500 PLC and Panelview Plus HMI.



The 200 kW, 480 VAC, 3PH, 60 Hz, 727 rpm induction generator was manufactured by Marelli Motori.



The Francis turbine with wicket gates will generate an average of 1.2 million kWh per year.

