

Puvurnaq Power Company Wind Heat Smart Grid Design

Kongiganak, Alaska
April 2010



**INTELLIGENT
ENERGY SYSTEMS**

SAKATAengineering

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Wind Heat Smart Grid Design



Puvurnaq Power Company Wind Heat Smart Grid Design

The project consists of implementing a high penetration wind diesel system in Kongiganak using five Windmatic 17s wind turbines, a power electronics grid interface to maintain grid voltage, distributed load control to manage system frequency, and electronically fuel injected diesel generators to provide real energy support.

Design phase objectives include:

- Project narrative describing the operating requirements of the wind diesel system components
- Supporting engineering drawings and component specifications
- Site map and permitting documents

System Overview

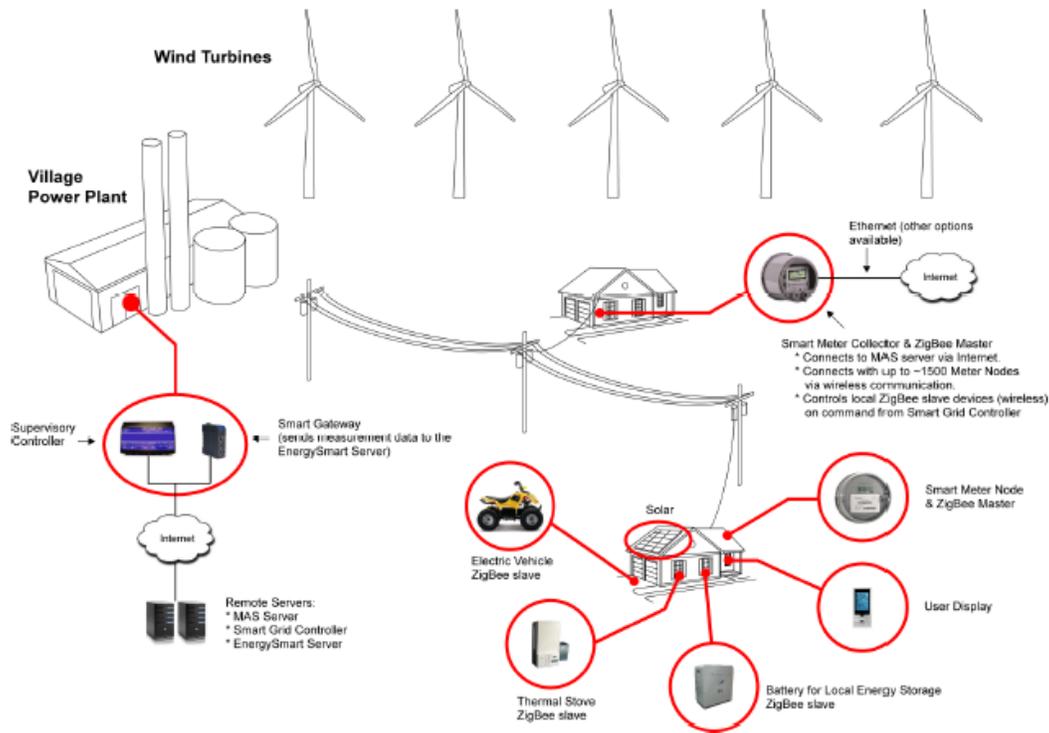
The Puvurnaq Power Company serves the community of Kongiganak, a traditional Yup'ik Eskimo village of 445 permanent residents. Kongiganak is located on the western shore of Kuskokwim Bay, 70 miles southwest of Bethel, and 450 miles northwest of Anchorage. The community includes a school, washeteria, community center, clinic, store, lighted 2000-foot runway, a bulk fuel storage facility, a small local store and 135 residences. The economy is based primarily on a fishing and subsistence lifestyle. Local employment includes work at the school, limited commercial fishing and seasonal construction.

The population and electrical load are increasing each year. Recent oil price volatility has resulted in a tripling of fuel prices. The community is entirely dependent on diesel fuel for heating and power generation, and recognizes the importance of reducing dependency on diesel fuel for the economic stability of the community. In the lower Kuskokwim region, there is an abundant wind resource. Wind diesel systems hold promise for lowering power costs and reducing diesel fuel usage for this and many communities in rural Alaska.

The Puvurnaq Wind Heat Smart Grid System is a high penetration wind diesel system in which excess wind turbine capacity has been installed. The intention is to generate electricity in excess of the power generation needs and use this energy to displace heating fuel.

A graphic depicting the general conceptual design is presented below. It provides an overall perspective of the components of the wind diesel power system and how they relate to the individual residential customer, now and in the future.

Figure 1: System Architecture



The system components are as follows:

1. Two new electronically fuel injected diesel generator sets, rated at 260 kW.
2. 5 Windmatic 17-S wind turbines, remanufactured, (395 kW nominal, expected peak, 600 kW).
3. A fast acting controllable 300 kW electric boiler with a power electronics interface connected into the power system heating loop.
4. 200 kW of supplemental controllable electric thermal storage in a community building.
5. 200 kW of distributed electric thermal storage (twenty one 9.6 kW individual thermal storage devices located in residential homes).
6. A smart metering system to account for the changes in system operation.

The wind system architecture for this project has been based on the use of proven industrial components, e.g. newer diesel engines, electric boiler, off the shelf power electronics, proven wind diesel controls, electric thermal storage devices, robust wind turbines, and advanced automated metering systems. These components have been demonstrated to be reliable and when combined, make maximum use of the existing power generation and distribution equipment.

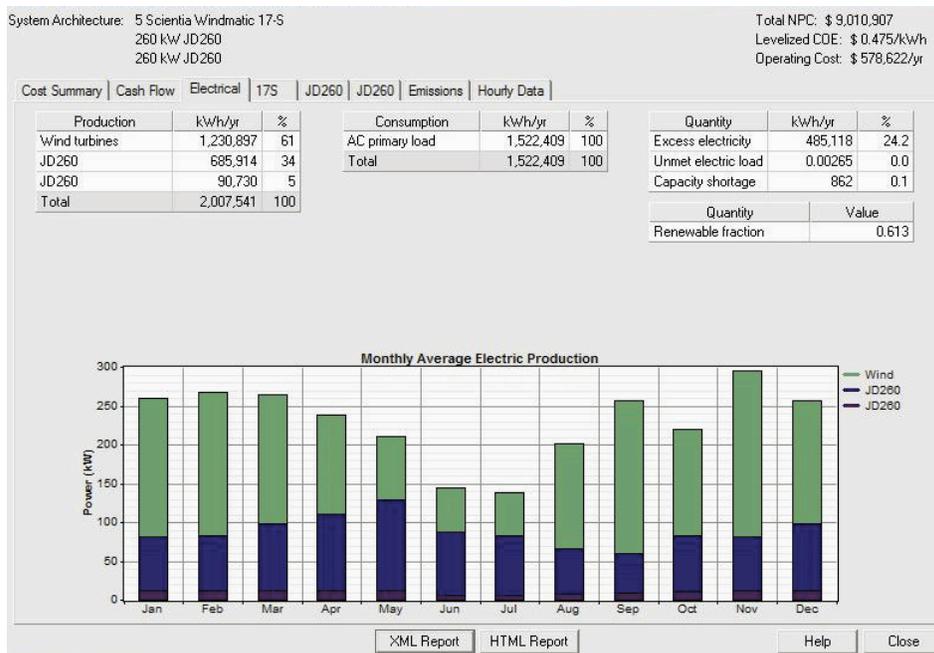
In support of this objective, several years of historical weather data for Kongiganak and Bethel area were collected and analyzed. Consulting

meteorologists were asked to examine aerial photographs and maps and suggest potential wind sites, and estimate wind turbine output. One year of monitoring data was collected and several models were run to estimate the potential fuel savings.

Wind for Heat

One of the first tasks in designing a wind diesel system for a remote community, like Kongiganak, was to analyze the amount of fuel available for displacement, and correlate that information with the potential for wind generation. While the primary purpose of the wind diesel system was to displace diesel fuel used for power generation, survey information indicated that over twice as much diesel fuel was used for heating than power generation. It is estimated that the average homeowner consumes 766 gallons of heating fuel at a cost of over \$6.24 per gallon. In some circumstances this makes up more than 25% of a household budget. It was estimated that excess wind energy could be sold for \$.10 to \$.15/kWhr. This would represent a significant cost savings to the average consumer, while increasing revenues to the local utility. There are multiple locations for wind energy to displace heating fuel throughout the village of Kongiganak and throughout rural Alaska.

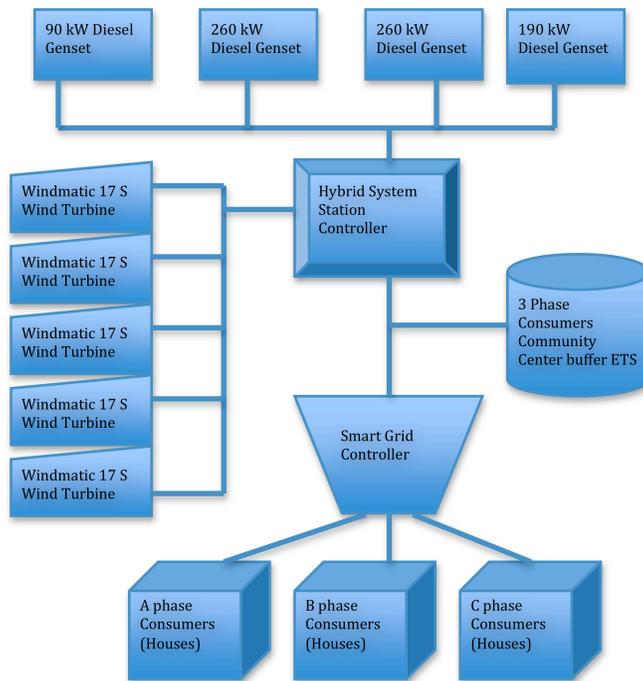
Figure 2: Wind production and penetration by month



The initial design envisioned a very high penetration wind system and recognized the requirement for a storage device such as a flywheel, which could rapidly inject and absorb energy to stabilize the power system as the wind power fluctuated.

Since funds are not available for a complete flywheel system, a lower cost solution using a power electronics driven electric boiler in combination with a diesel generator will be used. The system configuration is described in Figure 3.

Figure 3: Principle Wind Diesel System Components



Two diesel gen-sets, both of which are capable of prolonged efficient operation at low load will be installed in the Puvurna power system. These units will be interfaced to the power electronics driven electric boiler. The control system, diesel gen-sets, and special boiler work together, switching excess wind energy into and out of an electric boiler at such a rate that the voltage and frequency on the grid become stable despite variable turbine output due to wind gusts. The power electronics interface provides voltage support by maintaining the balance between real and reactive power. The electric boiler is connected into the heat recovery system in the power plant and provides makeup heat for that which is lost as diesel output is diminished. Excess heat from the boiler is distributed through insulated piping to the community washeteria.

The low load diesel/power electronics boiler operation is similar to that of a flywheel, except that excess wind energy is being stored as heat into a boiler instead of the rotating mass of the flywheel. Rather than extracting electrical energy from a flywheel connected to a generator, energy is extracted by withdrawing it from the heating system. The primary drawbacks of the diesel boiler system versus the flywheel system are that the diesel boiler system is not

as flexible in terms of wind operational modes, the overall system requires a significantly greater spinning reserve on the diesel system, and the greater cost savings available from the option of diesel off operations does not exist.

Community Heating

Since there is a good match between the available wind power and the heating needs of the community, the project was expanded from three 15S Windmatic turbines (65 kW) to five 17S Windmatic (75 kW) machines. The project took advantage of heavy equipment, which was mobilized for turbine installation to add wind capacity. This excess capacity can generate electrical energy over and above that required to meet the electrical load requirements of the community. At modest to high wind speeds, the excess will be captured and stored in electric thermal storage (ETS) units. The ETS units capture electrical energy by heating ceramic bricks, which can be accessed later for room heat, thus displacing heating fuel. At lower wind speeds the excess capacity expands the fuel displacement envelope at the power plant. Electric thermal storage represented a low cost, low maintenance method of energy storage.

Fuel and Cost Savings: Available wind and electric load data were analyzed using the HOMER modeling software to estimate fuel savings, power produced and excess kWhrs available for heating. A base year of 2015 was used in which the load is expected to be 1,500,000 kWhrs. HOMER does not take into account system stability issues and The HOMER model is an energy flow model that estimates energy production for each hour of the year, and sums these to provide a general estimate of power production for each turbine.

Table 1 – Projected Fuel Savings in Kongiganak 2015

System Description	Overall System		Power Plant		Heating Fuel Estimated	
	Fuel Consumption (gal/yr)	Fuel Savings (%)	Fuel Consumption (gal/yr)	Fuel Savings (%)	Fuel Consumption (gal/yr)	Fuel Savings (%)
Diesel Only	135,750	n/a	90,750	n/a	45000	n/a
Wind diesel			54,690	39.7		20,0
Fuel Displaced	45000		36,060		9000	

Windmatic Wind Turbines:

The wind turbine selected for this project is the Windmatic 17s. The Windmatic is of classic Danish design, and has been proven to be a reliable workhorse wherever it has been installed. The Windmatic 17s (17 meter rotor diameter) wind turbine is a three bladed, stall regulated upwind wind turbine with a nominal rating of 75 kW. These turbines use induction generators, which require

excitation from the power line to generate power and consequently operate at the line voltage and frequency. Each turbine is equipped with two generators, a 20 kW for low wind speeds and a 95 kW generator for high wind speeds. At zero power the large generator's reactive power demand is approximately 22 kVAR, which increases to as much as 45 kVAR at full power. The reactive power demanded by each wind turbine is reduced by power factor correction capacitors that are wired into the generator controllers.

The Windmatic operates between 4 m/s and 25 m/s, achieving rated power at 15 m/s. Above rated wind speed, and during periods of cold dense air the wind turbine's power could easily exceed the rated power for short periods without causing the wind turbine to cut out. The Windmatic turbine can operate from 0 to 125% of full rated load (95kW). The gust power of the turbine is estimated to be 120 kW and has been observed in other locations. The maximum gust power of 5 machines defined the total capacity required for all thermal storage banks.

The Windmatic wind turbines are of a simple, rugged, fixed pitch design. The turbines use induction generators, which rely on external excitation from the power grid to generate electricity and for frequency and voltage control.

When generating power, each wind generator draws reactive power (VARs) from the power grid. At zero power, the generators' reactive power is approximately 20 kVAR and increases to 40 kVAR at full power. The reactive power needed by the wind turbines is reduced by power factor capacitors that are wired into individual wind turbine controllers. Turbine auxiliary equipment includes: heated anemometers, low temperature lubricants, and Stay Clean blade coatings to prevent ice build up.

Grid stability:

The output of these turbines changes quickly as wind speed varies. The instantaneous total VAR demand can fluctuate quickly and sometimes exceed the capacity of the power system. Therefore a 300-kVAR static VAR compensation device (SVC) is installed at the point of contact of the wind farm to the power line to provide some or all of the reactive power demanded by the load and the wind turbines. The SVC is a four-quadrant, bi-directional inverter. The device provides simple low maintenance, long life operation with high efficiency particularly at low loads. The SVC is proven technology previously available only in highly complex and expensive transmission systems.

It is anticipated that a flywheel system will be added in the future. The flywheel system will be able to symmetrically absorb and inject large amounts of real or reactive power. The flywheel will increase the penetration and generation of wind energy across all wind speed conditions and do so with fewer system losses and lower spinning reserve margins.

The five-turbine configuration is estimated to produce over 480,000 kWhrs of

excess electricity, which is equivalent to 14,700 gallons of heating fuel (13690 Btu/gal in an 80% efficient appliance). Electric thermal storage (ETS) stoves will be used to capture and store this energy. In the Kongiganak wind diesel system there are three types of thermal energy storage capacity:

- The power plant heating loop
- Community facilities, which include the community center, and head start classrooms
- Residential heating

While the actual savings resulting from the use of excess wind energy will depend on several variables, such as the availability of the wind, customer decisions and price. Electricity sold for \$.09/kWhr, would be equivalent to \$3.00 per gallon heating fuel. Since current heating fuel prices exceed \$6.00 per gallon, this excess wind energy represents a potential fuel savings of 50%. Annual average residential fuel usage is 760 gallons per household. The target for this project would be to displace 200 gallons of heating fuel in each of the 21 homes fitted with an ETS unit. These homes will be monitored and metered separately for fuel usage, and the price of excess wind energy adjusted to encourage usage. The additional revenue from the sale of excess electricity will increase revenues to the local utility, further stabilizing the local economy.

Table 2: Fuel Comparison

Diesel #2	Gallon Cost	Cost/MMBTU	Appliance Conversion Efficiency:	Actual Cost/MMBTU
138690 BTU/gallon			78%	
	\$3.00	21.63		27.73
	\$4.00	28.84		36.98
	\$5.00	36.05		46.22
	\$6.00	43.96		55.46
	\$6.24	44.99		57.68
	\$7.00	50.47		64.71
	\$8.00	57.68		73.95
<hr/>				
Electricity	Cost per KW/hr	Cost/MMBTU	Avg App Conversion Efficiency	Actual Cost/MMBTU
3412 BTW/KW			98%	
	0.05	\$14.65		\$14.65
	0.075	\$21.96		\$22.43
	0.08	\$23.45		\$23.93
	0.09	\$26.38		\$26.92
	0.1	\$29.31		\$29.91

	0.125	\$36.64		\$37.38
	0.15	\$43.96		\$44.86
	0.175	\$51.29		\$52.39
	0.2	\$58.62		\$67.29

The Wind Diesel Smart Grid Control System:

A critical part of the Puvurnaq wind diesel system is the automated power system control. High penetration wind diesel systems require sophisticated control systems to dispatch the generation resources reliably and to maintain system voltage and frequency during periods of wind operation. The control system is designed to optimize and balance the heating and electrical loads against the available wind power and the diesel generator output. In general, the diesel power plant supervisory controller is integrated with the wind turbine and demand managed device control to create a Hybrid System Supervisory Controller (HSSC). The HSSC automates the combined operation of the wind diesel system package and features high-resolution data recording, full remote control operation and redundant levels of control to assure reliable power system operation. The Smart Grid Controller manages the use and metering of the excess wind energy through the individual meters in the homes. The primary subcomponent controllers are the diesel generator or gen-set controllers, the wind turbine controllers, and demand managed or thermal device controllers. The control system is broken down into several levels of operation:

- Hybrid System Supervisory Controller (HSSC): The HSSC schedules each of the lower units (diesel gen-sets, wind turbines, other devices), and performs remote control, visualization, trending and data logging functions.
- Diesel Generator (Gen-set) Controller (DGC): Each engine generator is monitored and controlled by an individual controller, which provides generator protection, load sharing and data collection.
- Managed Device Controller (MDC): The demand controller is routine in the HSSC that monitors the amount of excess energy, whether excess wind or diesel capacity, and schedules load control devices, which in this instance is the thermal electric furnace in the community building.
- Feeder Monitor (FM): The feeder monitor monitors feeder operating parameters.
- Wind Turbine Controller (WTC): Each wind turbine has an autonomous controller that performs dispatch and control functions.
- Smart Grid Controller (SGC): The SGC is an automated controller that collects, communicates and stores operational information of the overall village power system, and based on that information controls customer devices through the automated meters. The SGC updates energy pricing and communicates with the individual meters to operate demand managed and dynamic pricing programs.
- Electric Thermal Storage Device Controller (ETSDC): Each electric thermal storage device has an individual controller which monitors outdoor temperature, state of charge and responds to automatic pricing signals and manual control.

The control system is a structured hierarchy providing a high degree of resilient power control with minimal loss of control in the event that an individual component or controller fails. Each diesel generator has its own controller, which is independent of the HSSC. The failure of one generator controller does not affect the operation of any other generator controller, or the operation of the station controller. The protection functions and the load sharing functions of the remaining generator controller will function as normal and the HSSC will simply modify its scheduling table to take into account the missing generator. If the HSSC controller fails, except for remote functions and automated scheduling, all generators are available for manual operation, with load sharing and automatic synchronization. This control architecture ensures that the diesel plant stays on line.

The Hybrid System Supervisory Controller (HSSC):

The HSSC is an industrial automation controller running on a secure platform with custom designed software. The software is modular, allowing insertion of certain control tasks, such as addition of wind or photovoltaic battery storage or other operational routines that extend the capabilities beyond basic diesel generation. The operation of the software is controlled by a large number of parameters, allowing simple configuration of the wind diesel system operations. The HSSC is responsible for automated scheduling and black start of diesel generators. Failed generator sets are locked out of operation and not re-scheduled for operation until the operator resets the various alarms.

Diesel Generator (Gen-set) Controllers (DGC):

The control of diesel generator sets will be through the use of digital generator set controllers provide by Woodward. These generator controllers offer a number of advantages over conventional systems, most notably a reduction in the number of components and reduced cost. Each Gen-set controller perform synchronizing and load sharing functions as well as provide all protective functions (over/under voltage, over/under frequency, phase imbalance, etc.), while continuously monitoring the operation of the generator and the engine. The Gen-set controller's ability to communicate via Ethernet and/or CANbus with other segments of the control system provides a rapid update on the status of the system and a pathway for rapid diagnostics. The Puvurnaq Power System has Woodward Model GCP 31 Gen-set Controllers.

Low Load Diesel Operation:

The HSSC has a special mode of operation for utilization of the low load capabilities of the diesel generator sets for operation with a power electronics driven boiler. When a generator set is operating in low load mode, the HSSC re-establishes a new spinning reserve and low load operational set point every 2 seconds. The new set point prevents over-fueling due to power fluctuations and

keeps spinning reserve to a minimum. Low load diesel operations will require careful maintenance of all systems including: turbo chargers, fuel systems, exhaust, cooling, engine heating systems as well as oil reservoir size, gaskets, bearings, connecting rods, starters and station batteries. These systems must be regularly maintained and fully operational for effective performance.

Managed Device Controller: (MDC)

The HSSC control programming is capable of communicating with and incorporating a limited number of auxiliary devices into wind diesel operating modes. The HSSC controller schedules and dispatches large loads in order to increase wind penetration, as well as increasing grid stability. The HSSC sends information about the type and level of spinning reserve in the system. The HSSC can identify the amounts of each type of spinning reserve (diesel or wind) and uses a predictive algorithm for short-term (2 to 15 minute) forecasts to schedule the device operation.

In doing so, the HSSC is taking into account a number of parameters including the temperature set point of the power plant heating loop, and the desired set point of the 200 kW of electric thermal storage at the community center. The MDC routines in the HSSC can also control any other large devices, which could significantly affect consumer demand. The set point of the ETS units is set by the MDC so that they only receive energy when excess wind is available. If sufficient capacity is available the load controller asserts a ready signal, and the community center ETS unit is immediately started.

Wind Turbine Controller (WTC):

Control operations and protection for each wind turbine is carried out through a wind turbine controller located at the base of each tower. The WTC is a stand-alone controller that is designed to monitor and control the Windmatic 17S subsystems and to safely start and stop the wind turbine. During start up, the wind turbine is not connected to the grid. However the rotor is allowed to free wheel. As the anemometers detect an increase in wind speed the turbine yaw drive is activated and orients the turbine into the wind. When the generator reaches approximately 1155 rpm, the power factor correction capacitors are connected. As the generator speed continues to climb at approximately 1198 rpm, the generator is connected to the grid. This sequence means that the synchronous generator is not required to motor the generator up to its operational speed, and is assisted in exciting the generator through power factor correction capacitors, which are connected before the wind turbine generator is connected.

To be effective in a wind diesel system, each wind turbine must be controlled in a coordinated manner with the wind diesel supervisory controller to optimize system operation. To do this, each wind turbine controller must communicate

with the wind diesel system controller so that it can be regulated and its operating status can be known. The Windmatic controller has an imbedded web server and event recorder for remote diagnosis and reset of alarm events. Communication to the wind turbine from the wind diesel plant supervisory controller can be through fiber optic or wireless link. The controller is set up to carry out shutdown on any of the following events:

- Rotor overspeed/underspeed
- Excessive vibration
- Winding over temperature
- Over/under voltage
- Over/under frequency

Smart Grid Controller (SGC):

The SGC is a supervisory controller and data collection gateway that monitors and can control the consumer load on the power system through the automated metering system. The SGC communicates with the load controllers in each of the ETS units. The 21 residential thermal storage devices represent a set of controlled loads distributed across each phase of the distribution system. These loads can be used by the SGC to capture the excess wind energy as usable heat and to keep the network loading within range.

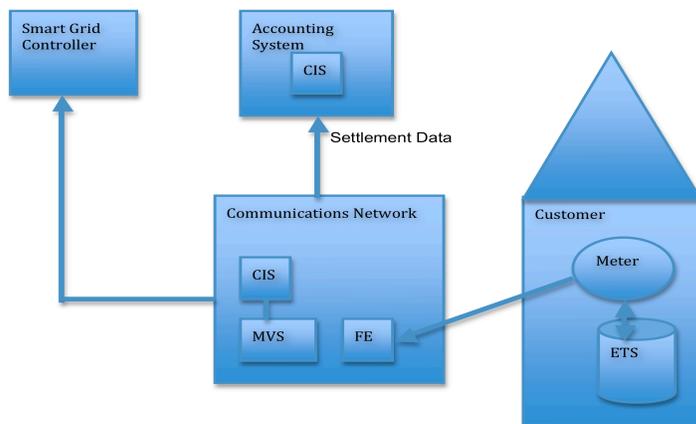
At all times the SGC is monitoring the amount of available excess wind energy signals provided by the HSSC and polling the status of each residential ETS unit through the electrical meters. When additional wind generation is available the HSSC send signals to the SGC. At the end of a prescribed time period, which is based on the cycle times of controllers, communications delays, and forecasted level of energy supply, the SGC sends a signal through the metering system to connect or disconnect each ETS device. The time delays enable reconfiguration of the power system spinning reserve set point and the amount and which ETS units to operate.

At the end of a running period of any residential ETS device, the SGC will signal the HSSC. At this time the HSSC will shift load between ETS devices and reconfigure any of the other power system components as appropriate. This reconfiguration could include changing the diesel lineup, operating demand managed load devices, and curtailing wind turbine operation.

Each ETS unit contains an under frequency relay to ensure that the power system is stable for connection and automatically disconnects itself during a frequency excursion, i.e. if there is a sudden increase in consumer load. If a communications failure occurs, the ETS units default to under frequency mode. Ongoing work indicates that distributed autonomous load control and two-way communications with the SGC through the metering system could provide a method of system stability at very low cost.

Figure 4 below describes the relationship of the SGC to the Meter Control and Management System (MCMS). The MCMS manages meter status and energy usage, and communicates through the SGC to each meter. The SGC is directly connected to a central collector meter. This collector meter communicates with all other meters through a wireless mesh network. Individual customer meters are equipped with a short range Zigbee wireless transceiver that can operate the slave devices on a home area network (HAN). Each ETS unit controller receives signals on this home network. The meters can also communicate other signals to devices on the HAN. One such device is a user interface in each home, which displays energy usage and pricing information. The MCMS is a server based software program, which is able to remotely manage meter data and execute various HAN control programs. The community of Kongiganak and Puvurna Power Company have requested that the metering system be operated as a prepay system. The MCMS is automated for prepay and to connect and disconnect customers in the event of non-payment. However there are a number of safeguards built into this system, such as real time customer usage information via the Internet as well as in home display, and a specified daily disconnect time. In an emergency, a residential customer may operate their ETS unit; however the customer will be billed at the full retail rate for electricity consumed.

Figure 4. Meter Control and Management.



Power System Remote Monitoring:

High-resolution data recording by the HSSC is taken up to 10 times per second to accurately record the sequence of events during a fault condition. This data is concentrated through the SGC, which is then archived in a historical database for trending and visualization. The SGC collects and stores data from the HSSC, the electric meters on each home, as well as environmental data, such as outside temperature, wind speed and wind direction. A remote operator can view exactly what the local operator can see

using the built in web server in the SGC and the HSSC. In addition, trending analysis can also be done remotely.

The SGC is the principle data collection and monitoring device in the system. Data in excess of 250 operating parameters is stored on the SGC and archived daily to a secure database, which can store this information indefinitely. Operating parameters include:

- Voltages (phase to phase, phase to neutral)
- Currents
- Real power
- Reactive power
- Power factor
- Wind speed
- Wind direction
- Outdoor temperatures
- Internal station controller variables and registers
- Status registers
- Alarm registers

Remote monitoring and control of the plant is also available, using any of the following communications methods:

- Telephone
- ISDN (digital)
- Cellular phone (GSM or CDMA)
- Other Internet connection

Power System Stability at High Penetration:

Stability becomes an important issue in wind diesel installations, especially in a system where the wind turbine output frequently is greater than community electric load. Under low penetration scenarios, when wind energy output is less than 50% of rated diesel capacity, the gen-set governors and voltage regulators provide good load following capabilities and fast response to load changes. Unlike a diesel generator set, a wind turbine's energy source is the constantly changing wind.

Sometimes, there will be too much wind and a few seconds later the wind speed may be insufficient to produce power. As the instantaneous proportion of wind energy on the grid increases, special measures must be taken not only to stabilize the amount of power in the grid but the balance between real and reactive power. This balance is reflected in the stability of the frequency and voltage on the system. The frequency is controlled through active load management and voltage is stabilized using power electronics. The integration/stabilization components consist of the control system and diesel generator sets as described above. The power electronics and heat loads that adjust energy flows are

described below.

The first use of the excess energy is to reduce diesel loading. The second use of the excess energy will be into an electronic boiler that is connected into the large thermal mass of the heat recovery system where it can be stored or released as energy fluctuations occur, while maintaining the temperature of the buildings and generators. To control the flow of energy into the diesel plant heating loop, a power electronics driven electrical boiler will be used. This equipment is based on available power electronic technology and sits between the station power grid and the electric boilers. It uses specialized software to monitor the power system and respond within 250 milliseconds to changes in the balance of generation and load. A single 300 kW power electronics driven boiler will be located in the powerhouse. This boiler will be connected in the power plant heating loop and operate in conjunction with the electronically controlled 260 kWe John Deere engine generators.

Primary grid stability necessary for wind-diesel operations is provided by the electronically fuel injected diesel engine driven generators. The throttles on the units are electronically controlled and are able to rapidly respond to changes in electrical demand. A power electronics driven electric boiler is installed between the power plant buss and the power plant heating loop. This device serves three important functions: rapid capture and release control energy in a complementary manner with the variations in the wind, as a buffer for diesel step changes, and reactive power balance. The boiler controller uses specialized software to monitor the power system and respond within 10 milliseconds to changes in the balance of generation and load.

At the power plant an electric boiler and power electronics controlled interface will be connected into the power plant heat recovery loop. The power electronics controlled boiler (PCB) uses the electric boiler elements, and a variable load inverter system to provide very fast frequency, voltage and power factor correction and capture of excess wind energy. This PCB power demand would be controlled and used to respond to balance the power system during times of collapsing wind power generation. In this instance the boiler captures the first 25 kW of wind energy and uses this for spinning reserve. The boiler is sized to capture energy to follow the load very closely, balancing the energy generation to the demand through direct frequency control. The boiler is able to absorb up to 300 kW of energy on a continuous basis, which enables it to rapidly absorb longer bursts of energy, on a much smaller scale.

The PCB is plumbed directly into the existing power plant heat recovery system. The electric boiler in the plant is regulated as part of the heating system in the washeteria, which receives heat from the hydronic loop, using the same heat exchangers and thermostatic controls.

Additional excess wind energy needed to maintain a load balance will be captured in a large commercial ETS unit located in the community center.

The community center represents a large interruptible energy sink that represents a balancing load for the energy system. The community center's ETS unit will require separate metering and a service panel, including cables and breakers. The system would use the existing temperature controls and act as a demand managed device controlled through the HSSC. The method of communication proposed is via Ethernet connection.

Major community buildings with large heating requirements, such as the school, city offices, clinic, city shop, and water and sewer treatment facilities represent potential customers with large heat demand that could also benefit from excess energy produced by an expanded wind plant.

Reactive Power Compensation and Voltage Control

Windmatic 17s turbines are equipped with induction generators. This implies that the reactive power requirement of the wind turbines change with changes in power output. During periods of high wind penetration the diesel generators at the power plant may be unable to meet these requirements. Without support, voltage could decrease and an outage could result. Therefore the SVC is installed at the point of common connection of the wind turbines to the power system distribution feeder. This device has the flexibility to efficiently meet reactive power requirements across the full range of fluctuating load conditions. The SVC is designed to make corrections within a single cycle. A filter is included to reduce harmonic resonances within the network. The principal advantages of the SVC over a rotary synchronous compensator are the higher conversion efficiencies, simplified installation and operation, and elimination of mechanical maintenance required for rotating machinery. The SVC is readily scalable to increases in wind energy capacity through the addition of modules.

The SVC unit is an inverter-based reactive compensation system, which is integrated with inductors and reactive banks for steady-state voltage regulation, power factor correction and low voltage ride-through capability. The SVC system monitors the voltage and current at the point of interconnect and adjusts its output depending on the compensation required. The SVC alleviates fluctuating voltage and VAR requirements. The SVC package includes the automatically switched shunt capacitors and reactors for additional steady state or dynamic compensation as needed. The SVC system makes use of this available reactive capability of the power factor correction capacitors of the turbine. The SVC will be located on a small deck at the base of the power pole where the wind farm is connected to the distribution line. To eliminate harmonic currents between the grid and the wind turbines, a harmonic filtering system is included. The SVC unit will rely on the ground fault protection of the distribution grid. Additional ground fault protection is provided at the machine and at each transformer.

Electric Thermal Storage

An average home in Kongiganak uses over 760 gallons of heating fuel annually. During a windy week in the winter, a single home can consume an entire 55-gallon drum of heating fuel. This project proposes to capture the wind and use it to heat homes year-round using Electric Thermal Storage (ETS). ETS is the method of capturing excess wind generated electricity as heat and storing it for use at a later time. An ETS unit is an insulated metal box, about the same size as a Toyo Stove, which contains electric heating elements that lie within special, high-density ceramic bricks. These bricks are capable of storing vast amounts of heat for extended periods of time. During periods of excess wind energy, a signal from the power plant supervisory controller is sent to the metering system. The meters then enable the relays, which turn on elements that heat the bricks. Operation of the system is completely automatic. A sensor monitors the outdoor temperature to regulate the amount of heat the system stores in the bricks. A thermostat regulates the delivery of the heat to the room. Each unit has a built in microprocessor that allows the owner to configure the operation for their needs. There are over 100,000 of these units in operation in the mid-west United States and off-peak heating is common in Europe. The system provides a lower cost, low maintenance method of home heating.

The ETS units will be charged on dynamic schedules, charging in periods of high wind. The residential ETS units are sized to provide a maximum heat production of 30,000 Btu/hr. Heating surveys indicate that average hourly living room heat for a residence in Kongiganak is 14,000 Btu/hr. Each ETS unit can both produce and store up enough energy depending on the charge schedule to output 20,000 Btu/ per hour per unit, 24 hours a day. This is similar in size and energy output to a Toyo Stove. The pictures below present an exterior and interior view of a room unit. The dimensions are 58 inches in length, 24.5 inches in height, and 10.5 inches in depth, and when filled with heat charge bricks each unit weighs 690 lbs.



The room units (shown above) are non-ducted and are designed to heat the room or area where they are placed. These heaters can be used in new construction applications or as a retrofit or supplement to an existing heating system, and only require an electrical connection to operate.



A fan inside the unit circulates stored heat evenly and quietly as the room thermostat calls for heat. Individual units are easy to operate and require very little maintenance. The amount of heat stored in the brick core of the heater is regulated (either manually or automatically) according to seasonal weather conditions using an outdoor temperature sensor and an onboard microprocessor.

The Smart metering system enables the ETS to charge and allocates the costs differently between excess wind and diesel only generation. The metering system working with control signals from the diesel plant insures that customers are only charged the reduced excess wind rate for heating.

Community Center Electric Thermal Storage:

The Wind Diesel Smart Grid Controller measures the consumer load on the system and compares this amount to the amount of generation available. When excess wind energy is available, the HSSC sends a signal to the load controller to the 160 kW electric thermal storage (ETS) unit located in the community building. Any excess power is first switched into the ETS units in the community center, which is connected into the building's heating system through an air-to-air heat exchanger. The excess energy is stored in the heated bricks and drawn upon as needed.

Commercial ETS units operate at 480 Volt, 3 phase, and will be located in the community center, and can be placed at other locations throughout the community. Each commercial ETS unit is configured with fifteen separate 10.6 kW resistive heating elements, five per phase. These elements are controlled through silicon-controlled rectifiers (SCRs), which rapidly modulate average power flow from 0 to 100% energy absorption. This capability allows the device to be used for frequency control on the grid. The ETS load controller accomplishes this by measuring frequency and adjusts its energy consumption in response to grid frequency. During frequency excursions, i.e. if there is a sudden increase in consumer load, the device will disconnect itself. This configuration gives refined load control and additional frequency stability.

The residential ETS units each have a peak power rating of 9.6 kW and are 240 Volt, single phase. Each residential ETS unit is also equipped with a controller that can adjust consumption in response to signals from the power plant through the electric meter on each household. Additionally each ETS unit will automatically disconnect itself in under frequency conditions.

Demand Management for Thermal Stove Activation

Large ETS units placed in community facilities will be controlled by the demand managed device control algorithms in the Smart Grid Controller. Communications from the SGC in the power plant will be provided by a wireless connection.

Communication between devices will be as follows:

1. Request to run – digital input from thermal device controller
2. Okay to run – digital output from the Supervisory Demand Managed Device Controller to the thermal devices or via the Smart Grid Controller

Controls and indicators on Community Center 160 kW electric thermal storage device will include:

1. Auto/Manual switch – in automatic mode the “Okay to run” signal will be issued when the “Request to run” input is asserted and the HSSC reports sufficient spinning reserve to activate the ETS unit as an energy balancing load.
2. Okay to run lamp – lights in response to the ETS device returning an “Okay to run” signal to the HSSC.
3. Communications Failure lamp – illuminates when there is no communication with the HSSC for more than one minute.
4. Communications Failure output – voltage free contact that closes for 10 seconds after a communications failure is declared. This is to attach to an external alarm device to ensure that plant operation is uninterrupted.

Operation of the ETS units:

1. The ETS unit is always on and responds to changes in frequency.
2. The HSSC communicates with the ETS device assuring the “Okay to run” signal. If it is not on, it will be started immediately or an alarm will be raised.
3. Other wind turbines will not be allowed to start for the following ten minutes (this is a configurable time delay parameter based on communication round-trip times with the HSSC, ETS and WTC controllers) allowing the HSSC to ascertain whether enough spinning reserve, reactive power support exists on the power system.
4. As the ETS unit approaches full capacity, the HSSC will hold a request for spinning reserve for a period of 10 minutes (time delay is a parameter, before readjusting the spinning reserve request to zero and allowing the diesel plant to return to standard levels of spinning reserve).

5. If a communications failure occurs, the ETS unit will enable all other residential ETS units to start, and provide a price signal to the metering system. If all ETS devices are at capacity and if additional wind power is still available, the HSSC will reconfigure the power system components and curtail wind power as required. Units that are running will be allowed to keep running until they stop.

Power Electronics Boiler System (PEB):

The PEB has three distinct roles:

1. To provide a demand managed device capable of delivering heat to a heating loop in a complimentary manner to the availability of renewable power.
2. To provide frequency stabilization through the high speed frequency monitoring and the rapid adjustment of load from the boiler grid interface.
3. To provide a fully adjustable load with small 100W steps and an adjustable power factor without inducing damaging harmonics into the power system.

Operation

The temperature controller in the power electronics controller monitors the temperature of the heating loop and makes requests to the HSSC controller for power to maintain the temperature. The HSSC sends back a power set point, which the PEB is to maintain a power set point for a specific period of time (2 minutes, fully configurable). This number is based on the amount of uncommitted renewable power available on the system.

If the frequency of the grid moves outside of acceptable limits, the PEB will automatically adjust the amount of power it is drawing based on a sliding linear scale in an attempt to maintain control over the frequency. Once the frequency is back within acceptable limits, the PEB returns to its original power set point. If the frequency does not return within acceptable limits over a period of approximately 2 seconds, the HSSC will take additional action (such as modifying the power demand of the community ETS unit, starting additional generator sets or disconnecting any controlled devices) to rectify the situation.

Method Of Power Control

The PEB uses IGBT technology to create the following competing goals:

1. Fully adjustable 0-100% load control in steps of approximately 0.025%.
2. Fast response time, 0-100% in less than 1/180th of a second.
3. Exceptional power quality, with the option to actively improve the voltage waveform at the expense of maximum load sizing.

The IGBT based technology offers smooth and fast power control due to its ability to modify the current draw at any point in the cycle. This feature also allows the IGBT based PEB to draw or stop drawing current at a pre-specified power factor. This feature will help the generators support voltage at the power plant.

Metering system

Wind/thermal storage requires a method of notifying the ETS units of the availability of low energy and a way to account for the difference in rates. This is done through new meters, which will be placed on each home. The proposed metering platform uses the Itron open way platform, to create a wireless, fully automated, intelligent two-way communications link between the power plant and each meter. The advanced meters offer many additional features that will allow the utility to be managed more effectively, and optimize diesel station operation.

The metering system will consist of a single collector meter and 135 customer meters. These meters will communicate wirelessly using a mesh network. The meters are designed for plug and go capability. This eliminates programming and simplifies installation. The Alaska Village Electric Cooperative is using a similar metering system as a best practice management tool.

Three important features of the metering system are:

1. Demand control signals injected into the power grid through the metering system. The meter provides a method of 2-way communication, which allows the utility to control ETS units and other devices remotely. Thermal stoves will be enabled for green energy pricing only when a signal from the utility indicates that an excess of wind energy is available. The meter contains a transceiver, which activates a relay in each ETS unit. This signal is adjusted according to the amount of excess wind energy available. The meters can also control other electrical devices such as water heaters and/or controlling lighting or thermostats.
2. User interface - the meters come with an in-home display device that can be used to inform the customer about their cost and energy usage. In the future they can be enabled to enter credit card information to pay bills directly.
3. Pre payment option - the proposed meters can be configured with a prepay option, which requires consumers to pay in advance of use. This feature is requested by small utilities, because it mitigates the financial risks associated with power sales and reduces embarrassing utility disconnects, billing disputes and damage to local relationships. When coupled with the associated user display in each home, the system improves financial management for both the utility and the customer. The in-home display allows utility customers to self manage

energy use through real-time, informed decisions about consumption. When combined with the user interface, most customers are typically very satisfied.

Through smart metering, the utility will:

- Enable time of use and green energy management rate structures
- Activate thermal storage devices when wind is available
- Understand load profiles and enable demand control schemes
- Fairly and more accurately allocate costs of utility service according to actual consumption
- Encourage conservation of electricity
- Detect system problems and imbalances
- Lower the cost of utility service to improve profitability
- Recover related costs of utility service to improve revenues

Smart Grid Controller/ETS Interface

The central SGC measures the consumer load on the system and compares this to the amount of wind spinning reserve available. When additional generation is available the HSSC send signals to the SGC to enable residential ETS units. Each residential ETS unit has an embedded transceiver, which operates the load controller and measures the state of charge of each ETS unit. Like the larger ETS units, the residential ETS controllers measure frequency and disconnect themselves during a frequency excursion.

During this time the load controlled boiler and 21 residential thermal storage devices will represent a set of controlled loads, which are used to capture the excess wind energy as usable heat. These devices are used to keep the network loading within range. In this way, blackouts are avoided while the load controllers only operate on connected loads when wind power is available.

Initially, load controlled ETS units will be installed evenly across the community distribution feeders. Communications with the residential energy storage devices will be through the metering system.

It is not anticipated that the residential ETS loads will be capable of controlling frequency until much more is learned about the systems. The characteristics of the AVR, the PEB and the larger ETS units will be responsible for frequency control. However, it is expected that as more is learned about the characteristics of the power system, the residential ETS units can be used as small controlled loads, which can be switched to maintain the frequency and voltage. At this time, frequency regulation is not provided by residential load control. However, it is envisioned that using two-way communication distributed load control and distributed energy storage could increase the amount of wind energy that can be utilized.

The metering system has three major components:

- Information Management System (IMS): The IMS is a client/server software application running on a wide area network (WAN) computer system that makes it possible to automatically read and report on the metering functions. Through the IMS, energy usage and meter location are linked. This information can be manipulated in many ways to provide valuable reports, visualize conservation efforts, and improve customer service.
- Communications Network: This consists of the wireless meter reading system and an Internet based modem to the collector meter.
- Digital Meter: The digital meter replaces the consumer's conventional meter and contains a microprocessor to enable communication with other meters, collector meters, telephone or other communication system and the IMS. The meter housing can also be purchased with an automatic connect-disconnect feature that opens or closes as instructed.

These three components create a network of automatically read electric meters, which will be used to create a management system. When combined with load, power production, and environmental data, the metering data will provide a way of measuring performance through electrical demand, energy budget, and conservation program impacts. The meter management and smart grid data servers will provide accurate and easily accessible usage data, which can be collected, communicated and managed very effectively. This network, once established, will become a source of the system evaluation and monitoring information for the operators, managers and customers alike.

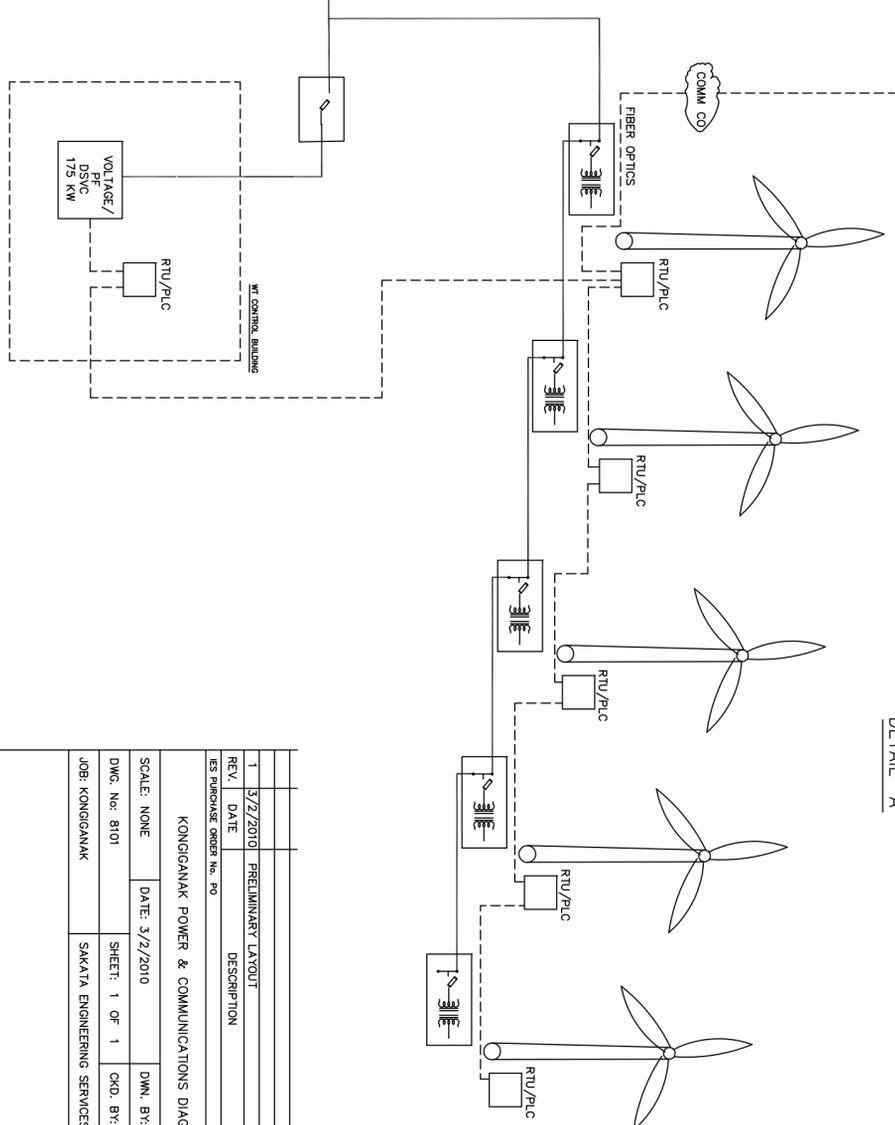
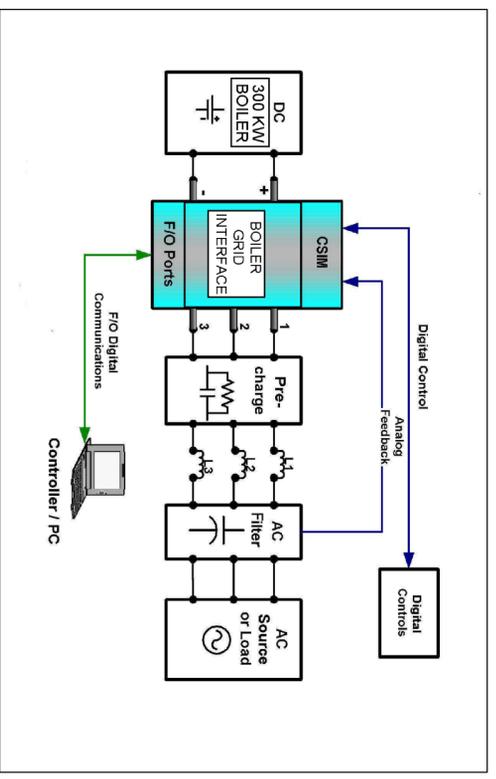
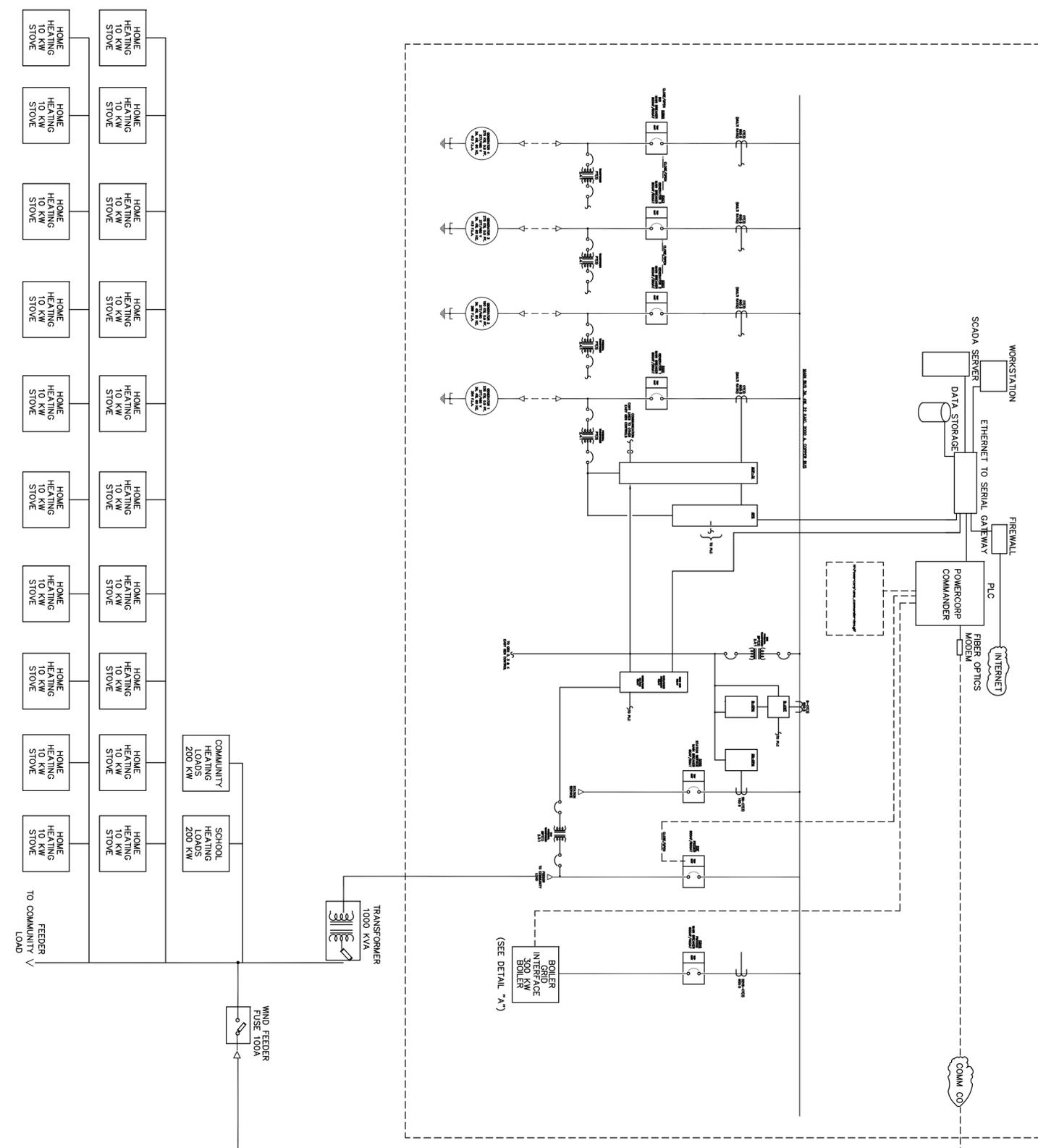
The metering system serves as a data collection and communication backbone for each customer. The collector meters poll individual facility meters and transfer the information wirelessly to the collector meter, which is transferred to a web-based server via Internet connection. Through the meter management system, all meters would be read daily for system checks and revenue protection, and customer data collected from customized schedules. For higher resolution analysis the meters can be read at one-minute intervals.

Automated metering provides the following functionality:

- Identifies opportunities to conserve energy and save money
- Accurately allocates costs
- Collects data to understand usage levels and adjust time of usage charges
- Improves and insures customer service quality
- Uses the internet to provide 24/7 access
- Makes systems hybrid ready with two-way reading, for photovoltaic, wind or other net metering
- Provides a method of customer management, pre-payment remote meter reads, off-cycle reads, turn-on/turn-off, load limiting set points
- Enables prepaid functionality with energy usage reports for management and budget reporting system, for better cash management

- Integrates energy usage with location
- Web-based management reports and billing, custom usage reports

POWER PLANT BUILDING



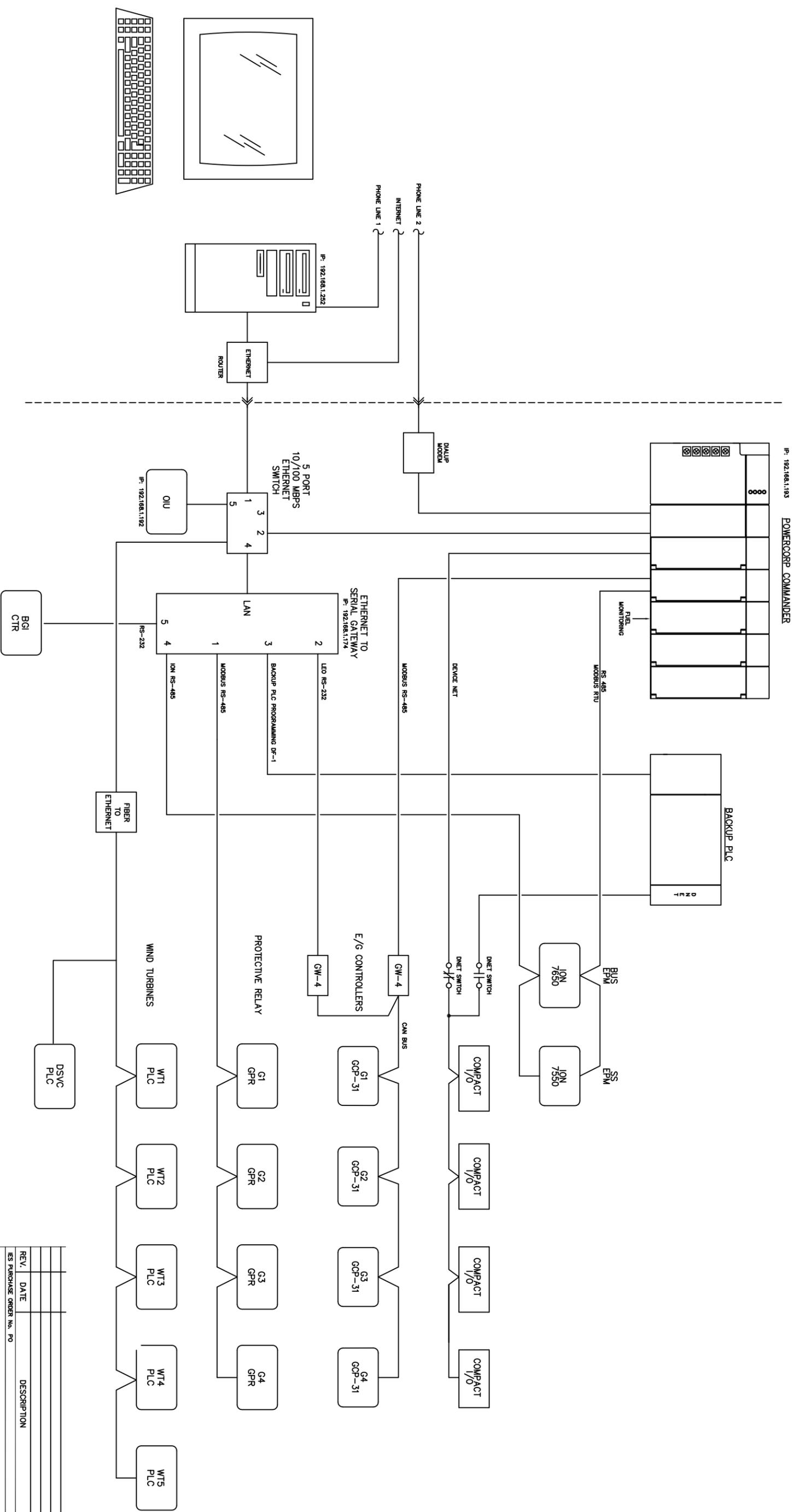
REV.	DATE	DESCRIPTION	BY
1	3/2/2010	PRELIMINARY LAYOUT	ATS

ES PURCHASE ORDER No. PO

KONGIGANAK POWER & COMMUNICATIONS DIAGRAM

SCALE: NONE	DATE: 3/2/2010	DMN. BY: ATS
DWG. No: 8101	SHEET: 1 OF 1	CRD. BY:
JOB: KONGIGANAK	SAKATA ENGINEERING SERVICES	

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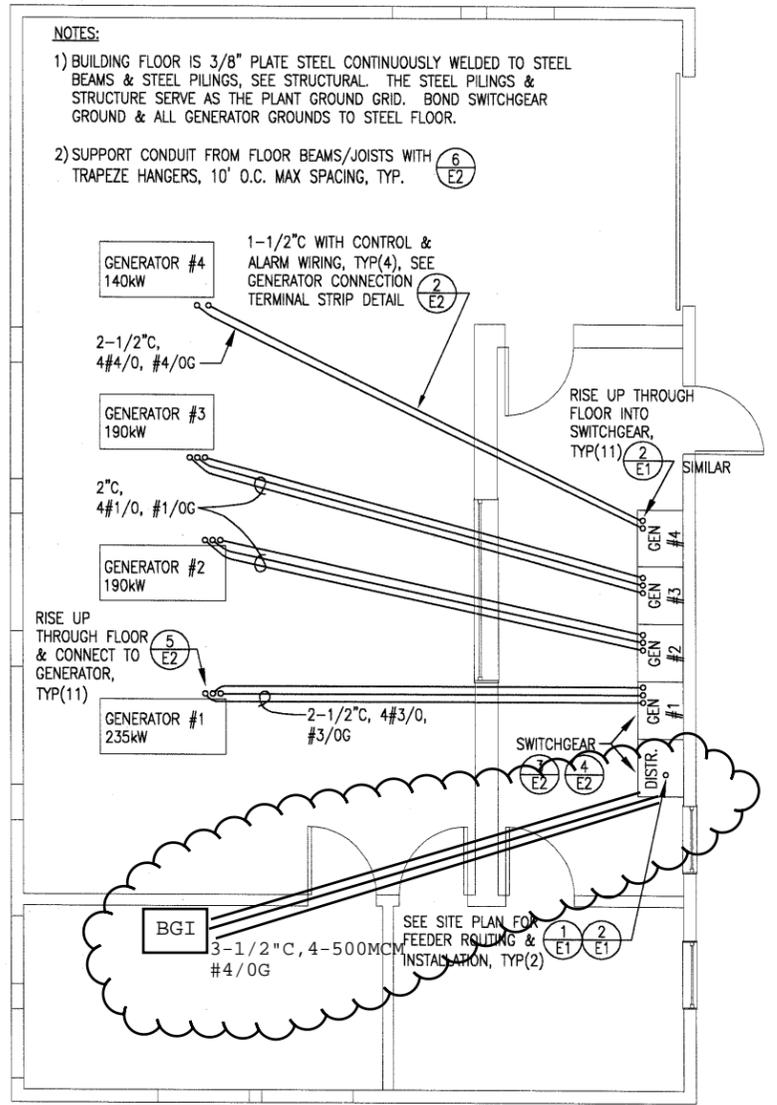


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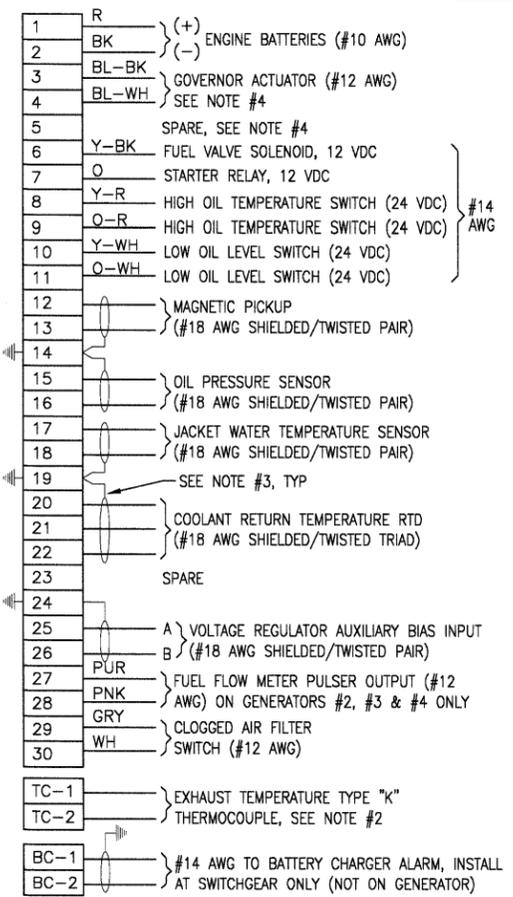
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COMMUNICATIONS-NETWORK-DIAGRAM

SCALE: NONE	DATE: 03-31-10	DWL BY: ATS
DWG No: 5601	SHEET: 1 OF 1	OKD BY: ATS
JOB No: KONGIGANAK	SAKATA ENGINEERING SERVICES	

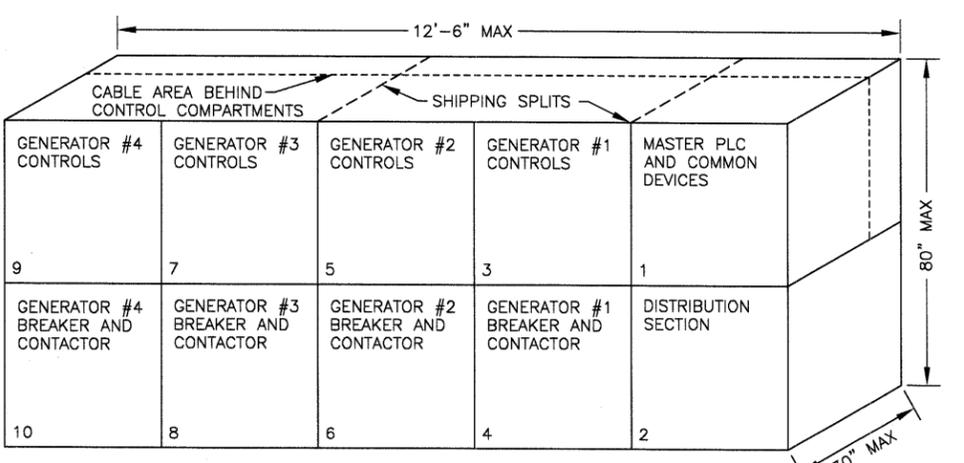


1 POWER PLANT UNDERFLOOR PLAN
1/4"=1'-0"

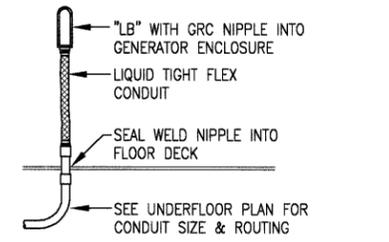


- NOTES:**
- PROVIDE IDENTICAL TERMINAL STRIPS IN EACH GENERATOR & EACH CORRESPONDING SECTION OF SWITCHGEAR. LAY OUT & NUMBER TERMINALS EXACTLY AS SHOWN. USE WIRE GAUGES & COLOR CODE INDICATED FOR FIELD INTERCONNECTION.
 - PROVIDE TYPE "K" THERMOCOUPLE TERMINAL BLOCKS & EXTENSION WIRE.
 - IN ADDITION TO TERMINAL BLOCKS SHOWN PROVIDE 2 EACH 30A GROUNDING LUGS IN GENERATOR ENCLOSURE BONDED TO GENERATOR FRAME. TERMINATE DRAIN WIRES FOR ALL SHIELDS ON GROUND LUGS AT GENERATOR END ONLY.
 - TYPICAL MECHANICAL GOVERNOR CONNECTION SHOWN. ON EFI UNIT (GEN #1) CONNECT #18 SHIELDED TRIAD TO TERMINALS 3, 4, & 5. #3=911 SENSOR POWER (+5VDC), #4=414/914 SENSOR RETURN (-), & #5=915 SENSING (0.25-4.75VDC). IN ADDITION INSTALL 2 PAIR CANBUS CABLE FOR ECU MONITORING.

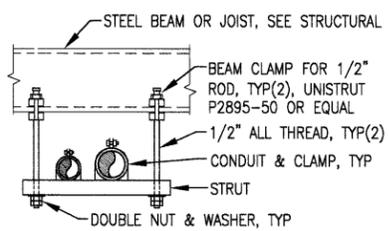
2 TYPICAL GENERATOR CONNECTION DETAILS
NO SCALE



4 SWITCHGEAR ENCLOSURE LAYOUT
NO SCALE

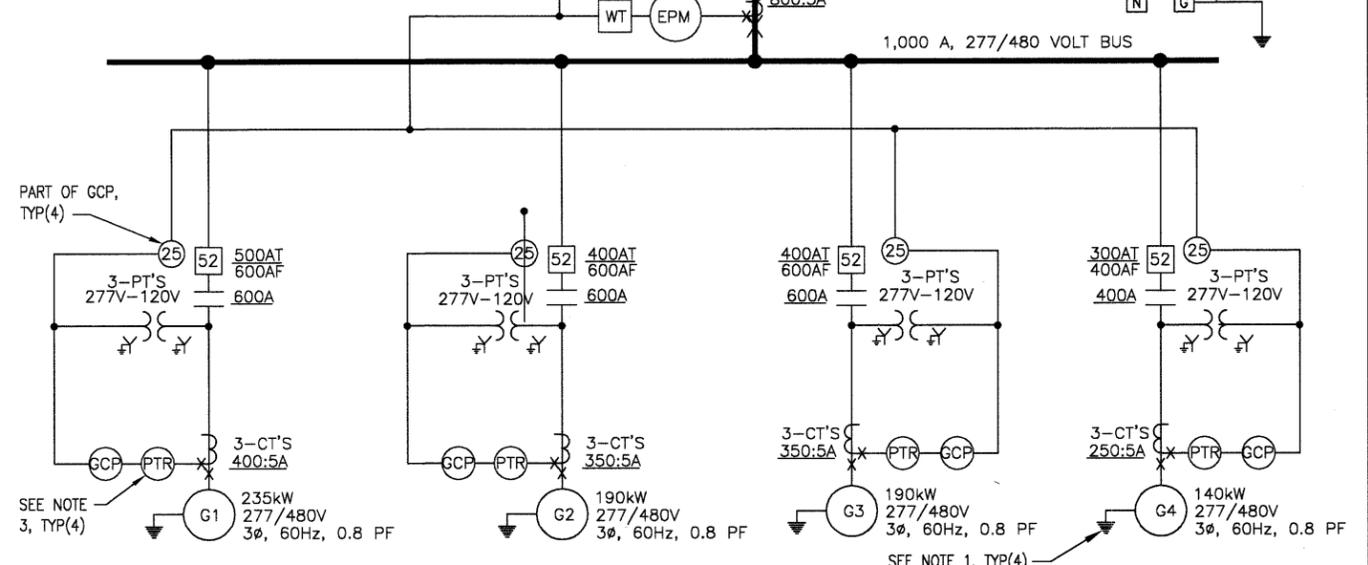


5 GENERATOR CONNECTION
NO SCALE



6 TRAPEZE HANGER
NO SCALE

- NOTES:**
- ISOLATE EACH GENERATOR NEUTRAL FROM MOUNTING SKID & GENERATOR FRAME. CONNECT NEUTRAL TO THE NEUTRAL BUS AT THE PARALLELING SWITCHGEAR. INDEPENDENTLY GROUND EACH GENERATOR FRAME TO SWITCHGEAR GROUND BUS & PROVIDE SECOND GROUND DIRECTLY TO PLANT FLOOR. DO NOT BOND SWITCHGEAR NEUTRAL BUS TO THE SWITCHGEAR GROUND BUS, GROUND NEUTRAL AT THE STEP UP TRANSFORMER BANK ONLY.
 - PROVIDE THE FOLLOWING FEATURES ON MICROPROCESSOR BASED METERS (EPM):
V_{AB}, V_{BC}, V_{CA}, I_A, I_B, I_C
WATTS, VARS, PF, F, DEMAND WATTS, WATT HOURS
 - PROVIDE THE FOLLOWING FEATURES ON PROTECTIVE TRIP RELAY (PTR):
27-UNDERVOLTAGE ELEMENT
32-REVERSE POWER ELEMENT
47-UNBALANCE ELEMENT
810-OVERFREQUENCY ELEMENT
51V-VOLTAGE RESTRAINED OVERCURRENT ELEMENT
40-LOSS OF EXCITATION ELEMENT
59-OVERVOLTAGE ELEMENT
81U UNDEFREQUENCY ELEMENT
 - ALL FIELD INSTALLED POWER CONDUCTORS 150°C CABLE. FEEDERS TO STATION SERVICE OVERSIZED FOR TERMINATION ON 75°C RATED LUGS. ON GENERATOR LEADS AND COMMUNITY DISTRIBUTION FEEDER TERMINATE WITH COPPER COMPRESSION LUGS RATED FOR THE FULL AMPACITY OF THE CABLE.



3 SWITCHGEAR ONE-LINE DIAGRAM
NO SCALE
SEE NEW ONE-LINE DIAGRAM

(G)	DIESEL GENERATOR	(WT)	WATT TRANSDUCER
(52)	80AT 250AF CIRCUIT BREAKER AT=AMP TRIP RATING AF=AMP FRAME RATING	(25)	SYNCHRONIZING EQUIPMENT
()	250A CONTACTOR WITH AMPERE RATING	(PTR)	MICROPROCESSOR-BASED PROTECTIVE TRIP RELAY
(C)	CURRENT TRANSFORMER M.R. - INDICATES MULTIRATIO CT'S RATING FACTOR RF=2.0	(25/59)	VOLTAGE RELAY OVER/UNDER
(Y)	POTENTIAL TRANSFORMER	(81/6/U)	FREQUENCY RELAY OVER/UNDER
(Y)	WYE CONNECTION	(DBR)	DEAD BUS RELAY
(Δ)	DELTA CONNECTION	(EPM)	MICROPROCESSOR-BASED METERING UNIT
(EPM)	MICROPROCESSOR-BASED METERING UNIT	(GCP)	GENSET CONTROL PACKAGE WOODWARD GCP-31

RECORD DRAWING
THESE DRAWINGS HAVE BEEN PREPARED FROM A FIELD OBSERVATION BY THE UNDERSIGNED ENGINEER. THERE IS NO GUARANTEE AS TO THE ACCURACY OR COMPLETENESS OF THE INFORMATION CONTAINED HEREIN.
Neil C. ...
DATE: 4/17/06

REDUCED PLOT - HALF SCALE

State of Alaska
Department of Community and Economic Development
AIDEA/AEA
Rural Energy Group
813 West Northern Lights Blvd.
Anchorage, Alaska 99503

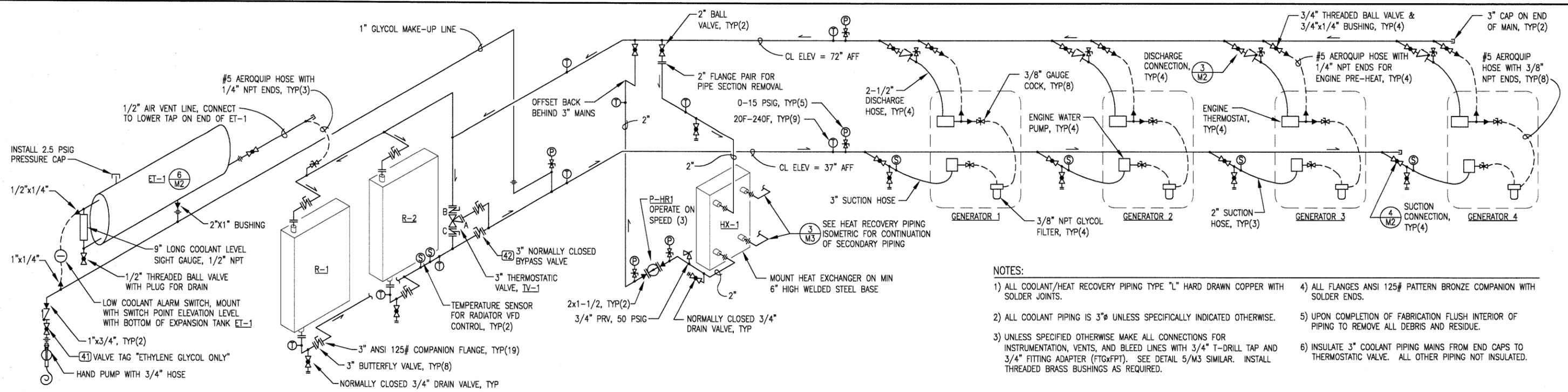
ALASKA ENERGY AUTHORITY

PROJECT: **KONGIGINAK POWER SYSTEM UPGRADE**

TITLE: **GENERATION POWER & CONTROL PLANS & DETAILS**

ALASKA ENERGY AND ENGINEERING, INC
P.O. BOX 111405 ANCHORAGE, ALASKA 99511-1405 PHONE (907) 349-0100

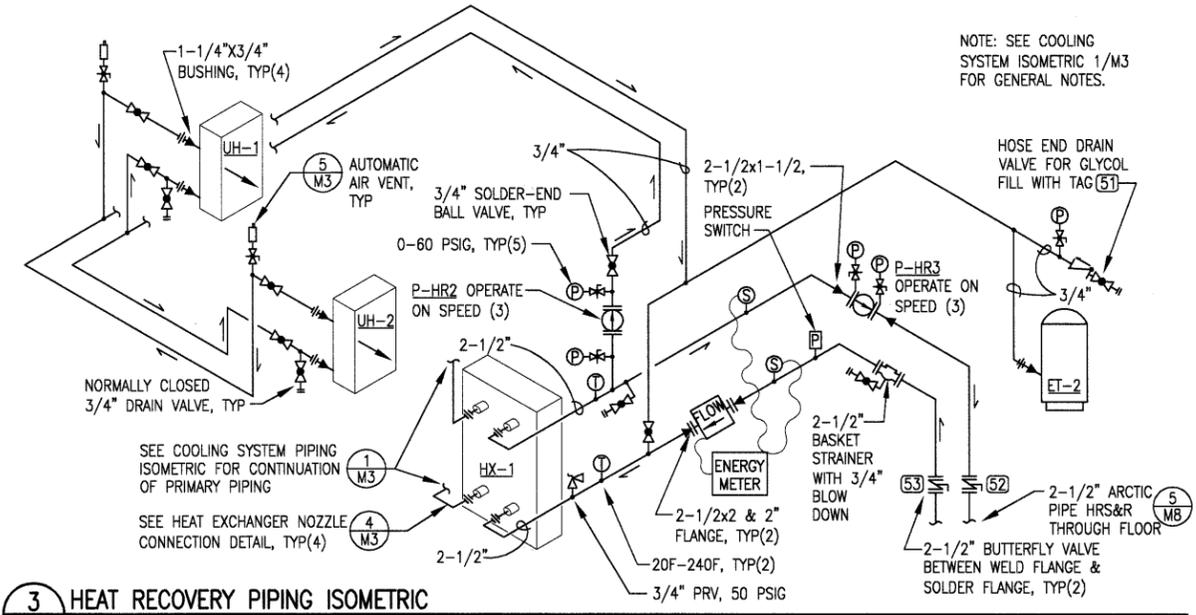
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DESIGNED BY: CWV/BCG DATE: 2/19/04 PROJECT NUMBER: 03-03-9559



- NOTES:
- 1) ALL COOLANT/HEAT RECOVERY PIPING TYPE "L" HARD DRAWN COPPER WITH SOLDER JOINTS.
 - 2) ALL COOLANT PIPING IS 3"Ø UNLESS SPECIFICALLY INDICATED OTHERWISE.
 - 3) UNLESS SPECIFIED OTHERWISE MAKE ALL CONNECTIONS FOR INSTRUMENTATION, VENTS, AND BLEED LINES WITH 3/4" T-DRILL TAP AND 3/4" FITTING ADAPTER (FTG&FPT). SEE DETAIL 5/M3 SIMILAR. INSTALL THREADED BRASS BUSHINGS AS REQUIRED.
 - 4) ALL FLANGES ANSI 125# PATTERN BRONZE COMPANION WITH SOLDER ENDS.
 - 5) UPON COMPLETION OF FABRICATION FLUSH INTERIOR OF PIPING TO REMOVE ALL DEBRIS AND RESIDUE.
 - 6) INSULATE 3" COOLANT PIPING MAINS FROM END CAPS TO THERMOSTATIC VALVE. ALL OTHER PIPING NOT INSULATED.

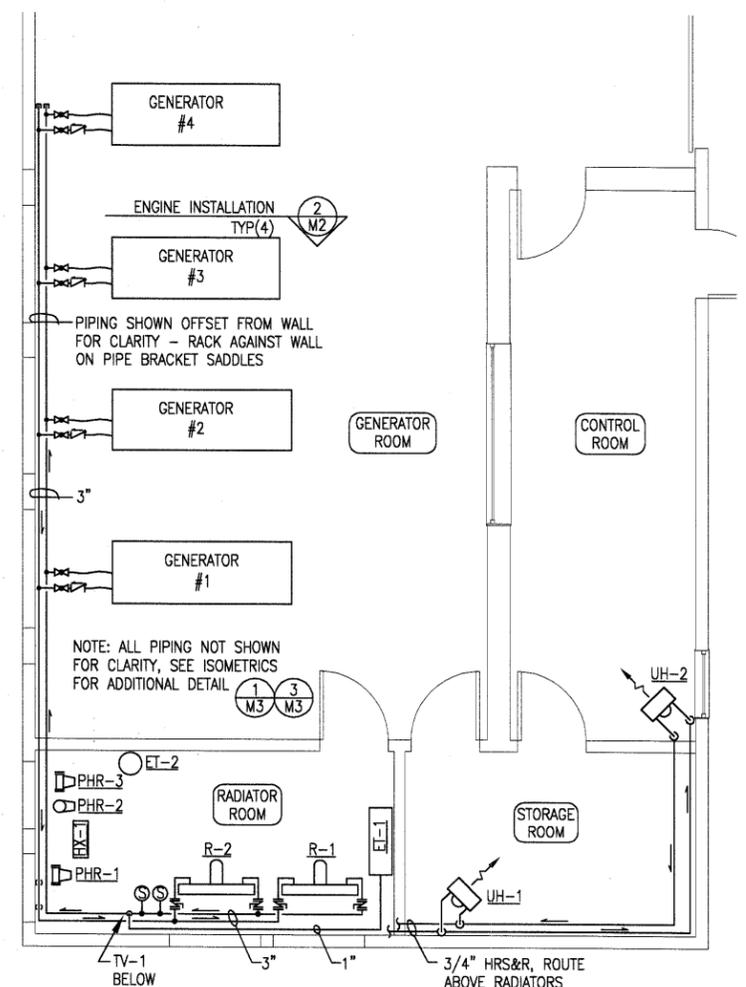
1 COOLING SYSTEM PIPING ISOMETRIC
NO SCALE

COOLANT/HEAT RECOVERY EQUIPMENT SCHEDULE		
R-1 R-2	REMOTE RADIATOR	FLAT-ROUND MECHANICAL BOND VERTICAL CORE, COPPER FINNS, BRASS TUBES, TEFC MOTOR. 95 BTU/MIN-°F MINIMUM CAPACITY FACTOR, 5 HP, 208 V, 3 PHASE. YOUNG MWC-66FRD5-1P, NO SUBSTITUTES.
HX-1 HX-2	POWER PLANT HEAT EXCHANGER	316 STAINLESS STEEL PLATES, ALL BRAZED CONSTRUCTION, 2-1/2" NPT PORTS, 350 MBH MIN CAPACITY. AMERIDEX SL140TL-LL-80 OR EQUAL. PRIMARY: 50 GPM 190F EWT (50% ETHYLENE GLYCOL) 0.9 PSI MAX WPD SECONDARY: 50 GPM 180F LWT (50% PROPYL. GLYCOL) 1.0 PSI MAX WPD
TV-1	THERMOSTATIC VALVE	3" ANSI 125# FLAT FACED FLANGES, CAST IRON BODY, FACTORY SET NON-ADJUSTABLE FIELD REPLACEABLE THERMOSTATIC ELEMENTS - 185F NOMINAL TEMPERATURE, FPE #A3010-185, NO SUBSTITUTES.
ET-1 ET-2	COOLANT EXP. TANK	24 GALLON CAPACITY STEEL TANK FABRICATED IN ACCORDANCE WITH AEA STANDARD POWER PLANT TANK FABRICATION DETAILS.
UH-1 UH-2	STOR/CONTROL ROOM HEAT EXCHANGER	HORIZONTAL DISCHARGE HOT WATER UNIT HEATER, 29 MBH AT 3 GPM 200F EWT AND 60F EAT, 1/12HP, 120V, 1Ø. MODINE HS-47 NO SUBSTITUTES.
P-HR1 P-HR2 P-HR3	COOLANT CIRC. PUMP	50 GPM AT 7' TDH, 1/3HP, 115V, 1Ø. GRUNDFOS UPS40-40, SPEED 3, NO SUBST, WITH 1-1/2" NPT COMPANION FLANGES, GASKETS, AND BOLTS.
	POWER PLANT CIRC. PUMP	4 GPM AT 14' TDH, 1/25HP, 115V, 1Ø. GRUNDFOS UPS15-42F, SPD 3, NO SUBST, WITH 3/4" NPT COMPANION FLANGES, GASKETS, & BOLTS.
	WATER PLANT CIRC. PUMP	45 GPM AT 19' TDH, 1/2HP, 115V, 1Ø. GRUNDFOS UPS40-80/4, SPD 3, NO SUBST, WITH 1-1/2" NPT COMPANION FLANGES, GASKETS, AND BOLTS.



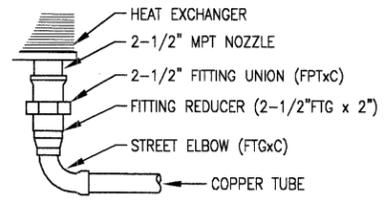
NOTE: SEE COOLING SYSTEM ISOMETRIC 1/M3 FOR GENERAL NOTES.

3 HEAT RECOVERY PIPING ISOMETRIC
NO SCALE

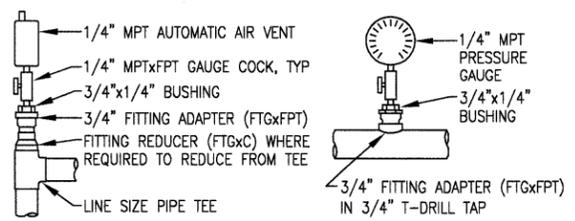


NOTE: REDUCE TO 2" TUBE ON PRIMARY (ENGINE) SIDE OF HX-1 ONLY. INSTALL 2-1/2" TUBE ON SECONDARY SIDE OF HX-1 AND BOTH SIDES OF HX-2.

NOTE: CLOSE GAUGE COCKS ON AIR VENTS AFTER BLEEDING SYSTEM OF AIR. LEAVE GAUGE COCKS OPEN ON PRESSURE GAUGES.



4 TYPICAL HX PIPING CONNECTION
NO SCALE



5 TYPICAL AIR VENT & PRESSURE GAUGE INSTALLATION
NO SCALE

2 COOLANT/HEAT RECOVERY PIPING PLAN
1/4"=1'-0"

REDUCED PLOT - HALF SCALE

State of Alaska
Department of Community and Economic Development
AIDEA/AEA
Rural Energy Group
813 West Northern Lights Blvd.
Anchorage, Alaska 99503

ALASKA ENERGY AUTHORITY

PROJECT: KONGIGINAK POWER SYSTEM UPGRADE

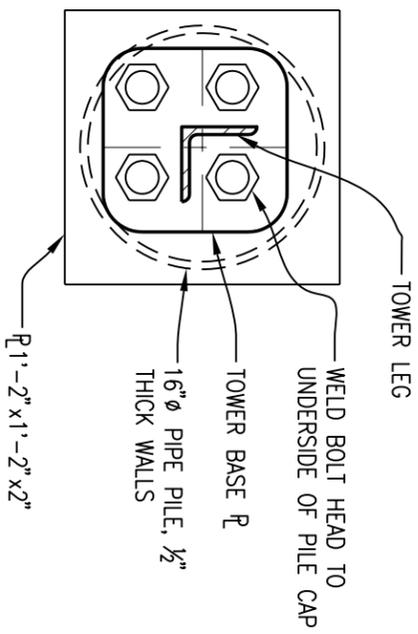
TITLE: COOLANT/HEAT RECOVERY PIPING PLAN, ISOMETRICS, DETAILS, & EQUIPMENT SCHEDULE

ALASKA ENERGY AND ENGINEERING, INC
P.O. BOX 111405 ANCHORAGE, ALASKA 99511-1405 PHONE (907) 349-0100

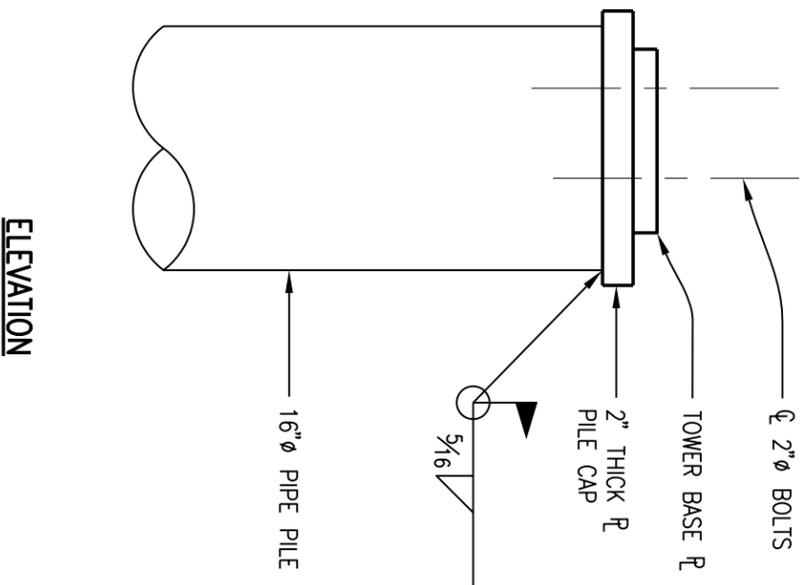
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DESIGNED BY: BCG SCALE: AS NOTED FILE NAME: KONGPP-M3A SHEET: M3 OF 8

KONGIGANAK

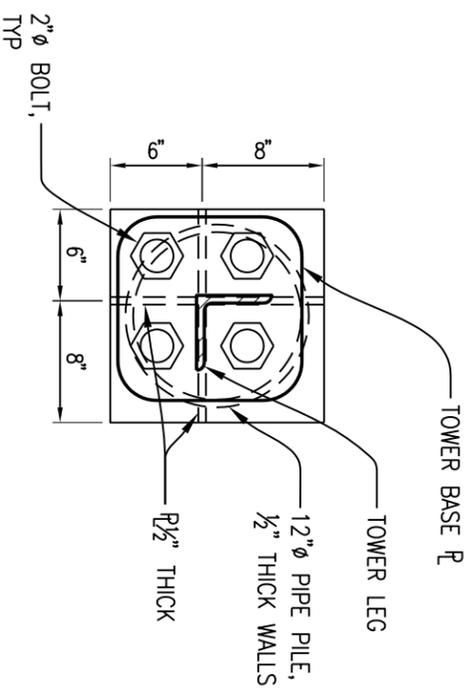


PLAN VIEW

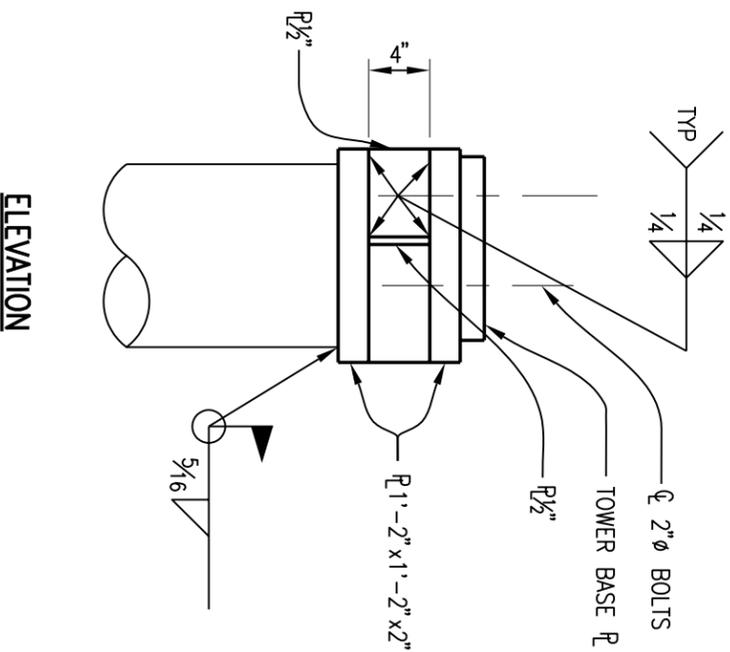


ELEVATION

KIPNUK



PLAN VIEW



ELEVATION

GENERAL STRUCTURAL NOTES

THE CONTRACTOR SHALL VERIFY AND COORDINATE ALL DIMENSIONS AMONG THE DRAWINGS BEFORE STARTING ANY WORK OR FABRICATION. ANY DISCREPANCIES FOUND AMONG THE DRAWINGS, SITE CONDITIONS, SPECIFICATIONS AND THESE NOTES SHALL BE REPORTED TO THE ENGINEER AT ONCE. ALL CONSTRUCTION SHALL COMPLY WITH THE INTERNATIONAL BUILDING CODE 2006. SAFETY - THE CONTRACTOR IS RESPONSIBLE FOR MEETING ALL FEDERAL, STATE AND LOCAL SAFETY STANDARDS. THE CONTRACTOR IS IN CHARGE OF ALL SAFETY MATTERS ON AND AROUND THE JOB SITE.

STRUCTURAL DESIGN DATA

STRUCTURAL DESIGN IS IN ACCORDANCE WITH THE INTERNATIONAL BUILDING CODE 2006. STRUCTURES HAVE BEEN DESIGNED FOR THE FOLLOWING OPERATIONAL LOADS ON THE COMPLETED STRUCTURES. CONTRACTOR IS RESPONSIBLE FOR TEMPORARY SHORING AND BRACING DURING CONSTRUCTION. LIVE LOADS: WIND LOADS: BASIC WIND SPEED (3-SECOND GUST) = 130 MPH, EXPOSURE D, IW = 1.0. ICE LOADS: 1 INCH ICE BUILDUP ON ALL SUPERSTRUCTURE ELEMENTS TOWER DESIGN HAS NOT BEEN CHECKED. TOWER MATERIAL PROPERTIES AND DESIGN ARE THE OWNERS RESPONSIBILITY. THIS DESIGN IS ONLY FOR FOUNDATION LOADS AND ADEQUACY.

SPECIAL INSPECTION

THE OWNER OR OWNER'S REPRESENTATIVE SHALL RETAIN A QUALIFIED SPECIAL INSPECTOR TO PROVIDE INSPECTIONS AS LISTED IN SECTION 1704 OF THE 2006 IBC. COPIES OF INSPECTION REPORTS SHALL BE AVAILABLE AT THE CONSTRUCTION SITE FOR REVIEW BY THE ENGINEER. MATERIALS THAT REQUIRE SPECIAL INSPECTION ARE:
STRUCTURAL STEEL WELDING

FOUNDATIONS

FOUNDATIONS ARE DESIGNED IN ACCORDANCE WITH IBC 2006, CHAPTER 18, AND THE PROJECT GEOTECHNICAL INVESTIGATION REPORTS BY DUANE MILLER ASSOCIATES, LLC.

PIPES	ASTM A 53, GRADE B
BOLTS	ASTM A 307
NUTS	AS RECOMMENDED IN BOLT SPECIFICATION
WELD	FILLER METAL
	MINIMUM TENSILE STRENGTH
	MINIMUM YIELD STRENGTH
	CVN TOUGHNESS
	ELONGATION
	GALVANIZING
	70 KSI
	58 KSI
	20 FT-LBS @ -20F AND 40 FT-LBS @ 50F
	22% MINIMUM
	ASTM A 385

STEEL CONSTRUCTION SHALL CONFORM TO AISC CODE OF STANDARD PRACTICE FOR STEEL BUILDINGS AND BRIDGES AND AISC SPECIFICATION FOR STRUCTURAL JOINTS USING ASTM A325 OR A490 BOLTS. ALL WELDING SHALL CONFORM TO THE AWS D1.1, STRUCTURAL WELDING CODE - STEEL, LATEST EDITION

LIMIT OF APPLICABILITY

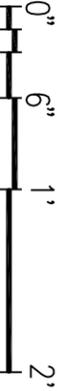
THESE DESIGNS ARE ONLY VALID FOR THE KONGIGANAK, ALASKA AND KIPNUK, ALASKA LOCATIONS RESPECTIVELY AS NOTED IN THE GEOTECHNICAL REPORTS. THEY ARE NOT VALID FOR INSTALLATION ANYWHERE ELSE. THE CONTRACTOR ASSUMES ALL LIABILITY FOR INSTALLATION OF THESE FOUNDATIONS IN ANY LOCATION OTHER THAN THOSE SPECIFIED ABOVE.

ONLY LOADS ON THE FOUNDATIONS WERE CONSIDERED. THE PROPRIETARY TOWER'S ADEQUACY FOR THESE LOCATIONS AND FOR THE DESIGN LOADS OF THE AREAS WHERE THE TOWERS ARE TO BE INSTALLED IS ENTIRELY THE CONTRACTOR'S RESPONSIBILITY.

FOUNDATION DETAILS

1

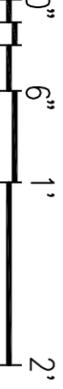
SCALE 1" = 1'-0"



FOUNDATION DETAILS

2

SCALE 1" = 1'-0"



4300 B ST., Suite 302
Anchorage, AK 99503
Phone: 907 562-3439
Fax: 907 561-5319
www.reidmiddleton.com

IES TOWER FOUNDATIONS
ELEVATIONS AND PLAN VIEWS

SCALE AS NOTED	SHEET NO.
DESIGNER: PG	DATE: 08/26/08
CHECKER: CSB	NO. 04-80-059
DATE: 08/26/08	
SCALE: S1.0	



KONG WIND TURBINES



REPLY TO
ATTENTION OF:

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
REGULATORY DIVISION
P.O. BOX 6898
ELMENDORF AFB, ALASKA 99506-0898

AUG 07 2009

Regulatory Division
POA-2009-835

Intelligent Energy Systems, LLC
Attention: Mr. Dennis Meiners
1960 Wildwood Lane
Anchorage, Alaska 99517

Dear Mr. Meiners:

This is in response to your request for a Department of the Army (DA) jurisdictional determination for your proposal to install five wind turbines. The project site is located within Section 33, T. 3 S., R. 18 W., Seward Meridian, USGS Quad Map Kuskokwim Bay D-4, Latitude 59.9621° N., Longitude 162.8683° W., in Kongiganak, Alaska. The file has been assigned number POA-2009-835, Kuskokwim Bay, which should be referred to in all correspondence with us.

Based on our review of the information you provided and resources available to our office, we have determined that although the project site appears to contain waters of the United States (U.S.), your proposed project would not involve an activity we regulate. Therefore, a DA permit is not required. However, a permit may be required if you alter the method, scope, or location of your proposed work; you should contact us if you make changes to your project.

Section 404 of the Clean Water Act requires that a DA permit be obtained for the placement or discharge of dredged and/or fill material into waters of the U.S., including jurisdictional wetlands (33 U.S.C. 1344). The Corps defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

Nothing in this letter excuses you from compliance with other Federal, State, or local statutes, ordinances, or regulations.

Thank you for your cooperation with the Corps of Engineer's Regulatory Program. If you have any questions, please contact me via email at jack.j.hewitt@usace.army.mil, or in writing at the letterhead address, by phone at (907) 753-2708 or by FAX at (907) 753-5567. For additional information about our regulatory program, visit our web site at <http://www.pos.usace.army.mil/reg>.

Sincerely,


Jack Hewitt
Project Manager



Issued Date: 08/07/2009

Ona Brause
Intelligent Energy Systems, LLC
PO Box 91978
Anchorage, AK 99519

**** DETERMINATION OF NO HAZARD TO AIR NAVIGATION ****

The Federal Aviation Administration has conducted an aeronautical study under the provisions of 49 U.S.C., Section 44718 and if applicable Title 14 of the Code of Federal Regulations, part 77, concerning:

Structure: Wind Turbine Kongiganak Wind System
Location: Kongiganak, AK
Latitude: 59-57-47.90N NAD 83
Longitude: 162-51-57.70W
Heights: 110 feet above ground level (AGL)
160 feet above mean sea level (AMSL)

This aeronautical study revealed that the structure does not exceed obstruction standards and would not be a hazard to air navigation provided the following condition(s), if any, is(are) met:

Based on this evaluation, marking and lighting are not necessary for aviation safety. However, if marking and/or lighting are accomplished on a voluntary basis, we recommend it be installed and maintained in accordance with FAA Advisory circular 70/7460-1 K Change 2.

This determination expires on 08/07/2011 unless:

- (a) extended, revised or terminated by the issuing office.
- (b) the construction is subject to the licensing authority of the Federal Communications Commission (FCC) and an application for a construction permit has been filed, as required by the FCC, within 6 months of the date of this determination. In such case, the determination expires on the date prescribed by the FCC for completion of construction, or the date the FCC denies the application.

NOTE: REQUEST FOR EXTENSION OF THE EFFECTIVE PERIOD OF THIS DETERMINATION MUST BE POSTMARKED OR DELIVERED TO THIS OFFICE AT LEAST 15 DAYS PRIOR TO THE EXPIRATION DATE.

Additional wind turbines or met towers proposed in the future may cause a cumulative effect on the national airspace system. This determination is based, in part, on the foregoing description which includes specific coordinates and heights. Any changes in coordinates will void this determination. Any future construction or alteration requires separate notice to the FAA.

This determination does include temporary construction equipment such as cranes, derricks, etc., which may be used during actual construction of the structure. However, this equipment shall not exceed the overall heights as indicated above. Equipment which has a height greater than the studied structure requires separate notice to the FAA.

This determination concerns the effect of this structure on the safe and efficient use of navigable airspace by aircraft and does not relieve the sponsor of compliance responsibilities relating to any law, ordinance, or regulation of any Federal, State, or local government body.

If we can be of further assistance, please contact our office at (404) 305-7082. On any future correspondence concerning this matter, please refer to Aeronautical Study Number 2009-WTW-4240-OE.

Signature Control No: 641783-117587511

(DNE -WT)

Earl Newalu
Specialist

STATE OF ALASKA

SARAH PALIN, GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF COASTAL AND OCEAN MANAGEMENT
<http://www.alaskacoast.state.ak.us>

SOUTHCENTRAL REGIONAL OFFICE
550 W 7th AVENUE SUITE 705
ANCHORAGE, ALASKA 99501
PH: (907) 269-7470 FAX: (907) 269-3981

CENTRAL OFFICE
P.O. Box 111030
JUNEAU, ALASKA 99811-1030
PH: (907) 465-3562 FAX: (907) 465-3075

PIPELINE COORDINATOR'S OFFICE
411 WEST 4TH AVENUE, SUITE 2C
ANCHORAGE, ALASKA 99501
PH: (907) 2857-1351 FAX: (907) 272-3829

July 24, 2009

Intelligent Energy Systems
P.O. Box 91978
Anchorage, Alaska 99509

for

Puvurna Power Company
P.O. Box 5009
Kongiganak, Alaska 99559

SUBJECT: **ACMP REVIEW NOT REQUIRED AT THIS TIME**
Kongiganak wind turbines
ID2009-0718AA

To whom it may concern:

The Division of Coastal & Ocean Management (DCOM) has reviewed the Coastal Project Questionnaire (CPQ) and other pertinent information regarding the above referenced project. Based upon the information you have supplied, your proposed project does not require a State review for consistency with the Alaska Coastal Management Program (ACMP), because it does not require permits subject to the ACMP.

You are not relieved from obtaining required permits and approvals from state, federal or local agencies before you begin the proposed work. Nothing in this letter excuses you from compliance with other statutes, ordinances, or regulations that may affect any proposed work.

This decision is ONLY for the proposed project as described. If there are any changes to the proposed project, including its intended use, prior to or during its siting, construction, or operation, contact this office immediately to determine if further review and approval of the revised project is necessary.

"Develop, Conserve, and Enhance Natural Resources for Present and Future Alaskans."

Thank you for your cooperation with the ACMP.

Sincerely,

Handwritten signature of Ashley Reed Kalli in black ink.

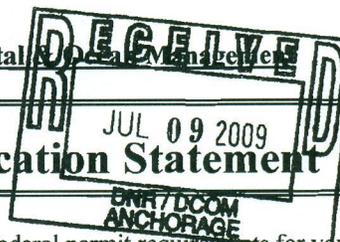
Ashley Reed Kalli
Project Review Coordinator

Encl.: CPQ pages 1-2

cc:

Adele Lee, DNR/DMLW Land
Carl Andrew, CRSA Board Chair-Coastal District
Ellen Simpson, ADFG
Fran Roche, DEC - JNU
Kellie Westphal, DNR/DMLW Water
Mike Daigneault, ADFG/Habitat
Sean Palmer, DEC - ANC
Shauna McMahon, DNR/DCOM
DNR/SHPO
USACE Regulatory Branch
Clayton McDowell, Coastal District Coordinator

2009-0718AA



Coastal Project Questionnaire and Certification Statement

The Coastal Project Questionnaire (CPQ) is a diagnostic tool that will identify the state and federal permit requirements for your project that are subject to a consistency review. You must answer all questions. If you answer "Yes" to any of the questions, please call that specific department for further instructions to avoid delay in processing your application. You can find an agency contact list online at <http://alaskacoast.state.ak.us/Contacts/PRCregcont.html>.

A complete project packet includes accurate maps and plan drawings at scales large enough to show details, copies of your state and federal permit applications, your answers to this questionnaire, and a complete consistency evaluation. DCOM will notify you within 21 days of receipt if the packet is incomplete and what information is still required.

For additional information or assistance, you may call or email the Juneau Project Review at (907) 465-2142, or the Anchorage Project Review at (907) 269-7478. This CPQ document contains numerous hyperlinks (underlined text that has a connection to an internet web page) and is best viewed on-line. Additional instructions are available at <http://www.alaskacoast.state.ak.us/Projects/pcpq.html>

■ APPLICANT INFORMATION

1. Puvurna Power Company

Name of Applicant
 PO Box 5009
 Address
 Kongiganak, AK 99559
 City/State/Zip
 907-557-5616
 Daytime Phone
 557-5614
 Fax Number E-mail Address

2. Intelligent Energy Systems

Agent (or responsible party if other than applicant)
 PO Box 91978
 Address
 Anchorage, AK 99509
 City/State/Zip
 907-770-6367
 Daytime Phone
 677-1886 dennis@iesconnect.net
 Fax Number E-mail Address

■ PROJECT INFORMATION

Yes No

1. This activity is a: new project modification or addition to an existing project
2. If this is a modification or an addition, do you currently have any State, federal or local approvals for this activity?

NOTE: Approval means any form of authorization. If "yes," please list below:

Approval Type	Approval #	Issuance Date	Expiration Date

3. If this is a modification, was this original project reviewed for consistency with the Alaska Coastal Management Program?
- Previous ACMP I.D. Number: _____ (example: AK 0706-05AA or ID2004-0505JJ)
- Previous Project Name: _____ Previous Project Applicant: _____

■ PROJECT DESCRIPTION

Attach a complete and detailed narrative description of your new project or of your modification/addition including ALL associated facilities and changes to the current land or water use (if not already attached as part of an agency application). Clearly delineate the project boundaries and all property owners, including owners of adjacent land, on the site plan. The scale of the maps and plan drawings must be large enough to show pertinent details. Identify your proposed footprint or

State of Alaska, Department of Natural Resources, Division of Coastal & Ocean Management

disturbed area. If this project is a modification to an approved project, identify existing facilities and proposed changes on the site plan.

Proposed starting date for project: July 2008 Proposed ending date for project: Dec. 2011

PROJECT LOCATION and LAND OWNERSHIP

Yes No

4. Describe/identify the project location on a map (Including nearest community, the name of the nearest land feature or body of water, and other legal description such as a survey or lot number.).

Township 2 South Range 79 West Section 33 Meridian Seward

Latitude/Longitude _____ / _____ (specify Decimal Degrees or Degrees, Minutes, Seconds)

USGS Quad Map Kuskokwim Bay D3

5. The project is located on: State land or water* Federal land Private land Municipal land
(Check all that apply) Mental Health Trust land University of Alaska land

Contact the applicable landowner(s) to obtain necessary authorization. State land ownership can be verified using Alaska Mapper. *State land can be uplands, tidelands or submerged lands to 3 miles offshore.

6. Is the project within or associated with the Trans Alaska Pipeline corridor? Yes No

COASTAL DISTRICT

Yes No

7. Is the project located in a coastal district? Yes No

If yes, identify the applicable coastal district(s) CENALIURIIT CRSA and contact them to ensure your project conforms with district policies and zoning requirements. Coastal districts are a municipality or borough, home rule or first class city, second class municipality with planning powers, or coastal resource service area. A coastal district is a participant in the State's consistency review process. Early interaction with the district can benefit you significantly; please contact the district representative listed on the contact list at <http://www.alaskacoast.state.ak.us/Contacts/PRCregcont.html>

DEPARTMENT OF NATURAL RESOURCES (DNR) APPROVALS

DNR DIVISION OF MINING, LAND & WATER- LAND SECTION

Yes No

1. Is the proposed project on State-owned land or water or will you need to cross State-owned land for access? (NOTE: State land includes the land below the ordinary high water line of navigable streams, rivers and lakes, and in marine waters, below the mean high tide line seaward for three miles. State land does not include Alaska Mental Health Trust Land or University of Alaska Land.) Yes No

2. If you answered yes to the question above, indicate the person you contacted at the appropriate Division of Mining, Land and Water regional office for information.

a) Name/date of Contact: _____

b) Is an application required for the proposed activity? Yes No

c) If "YES" then submit a signed copy of the completed application to the DCOM. If "No", explain why an application isn't required. Explanation: _____

DNR DIVISION OF MINING, LAND & WATER- MATERIALS SECTION

Yes No

3. Do you plan to dredge or otherwise excavate or remove materials such as rock, sand, gravel, peat, or overburden from any land regardless of ownership? Yes No

a) Location of excavation site if different than the project site: _____

Township _____ Range _____ Section _____ Meridian _____

4. At any one site (regardless of land ownership), do you plan any of the following? Yes No

Excavate five or more acres over a year's time

Excavate 50,000 cubic yards or more of materials (rock, sand, gravel, soil, peat, overburden, etc.) over a year's time

Have a cumulative, un-reclaimed, excavated area of five or more acres

5. Do you plan to place fill or excavated material on State-owned land? Yes No

a) Location of fill or material disposal site if different than the project site: _____

Township _____ Range _____ Section _____ Meridian _____

6. If you answered yes to any question above, indicate the person you contacted at the appropriate Division of Mining,

Land Status Report
Wind Turbine Project
Kongiganak, Alaska

Background

By email dated February 24, 2009, you requested that I provide recommendations for site control for wind turbines sites in Kongiganak. A map was attached depicting the approximate location of the sites.

Land Status Report

Land records were researched at the Bureau of Land Management (BLM), the State Department of Commerce, Community and Economic Development, and the State Recording Office. All research was conducted on line. All of the sites appear to be located within Section 33, Township 2 South, Range 79 West, Seward Meridian.

The surface estate of this section was conveyed to Qemirtalek Coast Corporation, the Native Village Corporation, for the village of Kongiganak on November 20, 1981, by Interim Conveyance No. 451. A copy of the recorded document is attached. The conveyance is subject to the requirements of Section 14(c) of the Alaska Native Claims Settlement Act (ANCSA). The subsurface estate was conveyed to Calista Corporation by Interim Conveyance No. 452.

Corrected Interim Conveyance No. 1899 was issued to Qemirtalek Coast Corporation on December 24, 2005. This document was issued for the limited purpose of excluding additional Native allotment parcels from the lands transferred by Interim Conveyance No. 451. In Section 33, Township 2 South, Range 79 West, SM, U.S. Survey No. 10172 and U.S. Survey No. 10463 were excluded from the conveyance. However, from the community profile maps, neither of these surveys appear to be in the area of the proposed wind turbine sites. A copy of the recorded interim conveyance is attached.

Recommendations

From the above cited transactions, it appears that the Qemirtalek Coast Corporation is the owner of the surface estate of the land where the proposed wind turbines are to be located. The owner of the wind turbines should obtain either a long term lease or fee conveyance from Qemirtalek Coast Corporation. A fee conveyance would require a subdivision survey. The entities should make sure none of the proposed facilities sites conflict with any possible future claims under ANCSA 14(c). There was nothing observed in a review of the community profile maps which would indicate any type of structural conflict.

Disclaimer:

This report does not purport to insure, warrant or certify title. This opinion is not a legal opinion. The research of the Bethel Recording Office records was limited to a review of the computerized files. This report is the result of a limited research effort as described above.

Prepared by

Rick Elliott
Land Consultant
June 25, 2009

Attachments: a/s

Qemirtalek Coast Corporation
#9 Frontway, P.O. Box 5070
Kongiganak, Alaska 99545
907-557-5529, (email) qccstore@msn.com

February 1, 2007

To whom it may concern:

We, the Qemirtalek Coast Corporation Directors and Land Committee, recognize the importance of wind-diesel technology and support Puvurnaq Power Company and Powercorp Alaska, LLC with their endeavor.

In recognition of this support Qemirtalek Coast Corporation will contribute a parcel of land appropriate in size for the wind turbine construction within the Village of Kongiganak.

Sincerely,

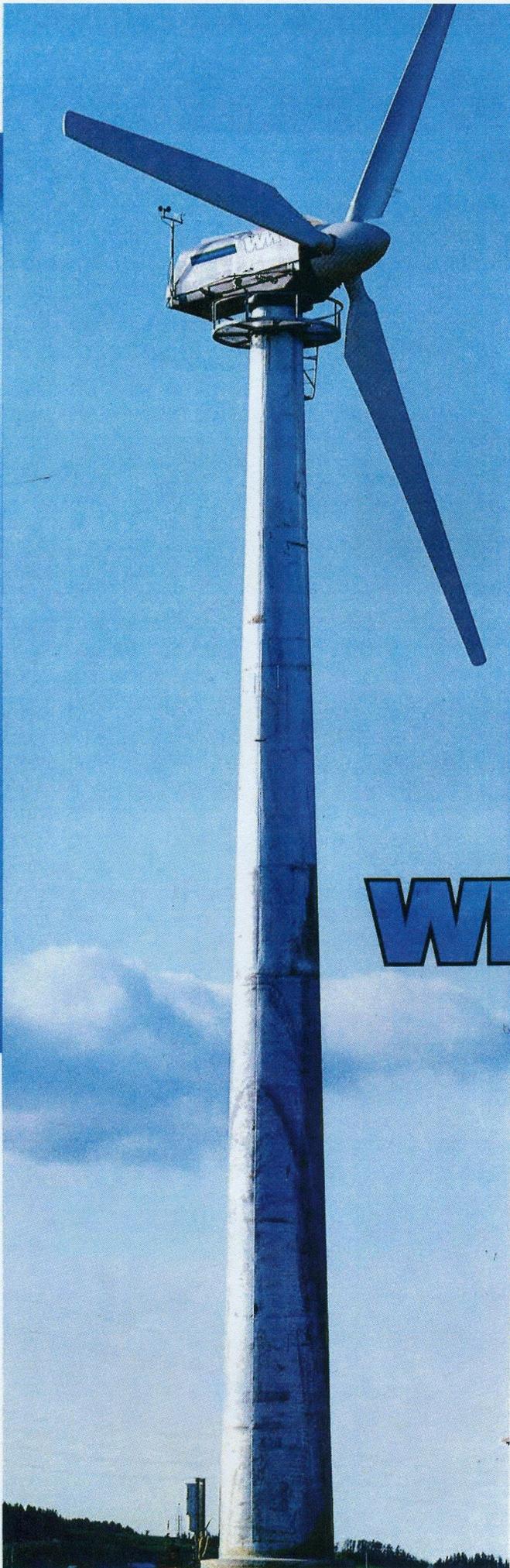


Ralph Kiunya, Sr., Vice-Chairman
Board of Directors
Qemirtalek Coast Corporation



Evon Azean, Sr., Chairman
Land Committee
Qemirtalek Coast Corporation

Cc; files
Kongiganak Traditional Council
Puvurnaq Power Company
Powercorp Alaska, LLC ✓



wm17S

WM[®]
DENMARK

wind matic[®]

Money's in the air

The forces of nature are far beyond human control, however, some of them we are able to control and transform into energy. From natural sources we derive, among other things, lighting and heating, and those are the factors which keep the whole economy working.

In some states water power forms the basis for natural energy. In other states, like California for instance, wind power is the natural energy source.

Actually, the California wind means that millions of kilowatt hours are floating about in the air, so really, it is only a question

of harnessing them.

The advanced Wind Matic windmill renders this possible through an investment which is not only financially profitable, but also an extremely solid way to save energy money. In areas which are particularly wind-swept it would be almost unwise not to utilize the wind energy.

Wind Matic WM 17 S means a safe investment in the future

Here are some facts which speak for investing in windmills

Wind power: The investment. It would be an understatement to say that wind power represents a favorable investment opportunity. In fact, thanks to several factors, wind power is one of the most attractive investment opportunities ever offered to the private investor.

Wind power is »pre-sold«. Federal and state law require utility companies to pur-

chase all the power that wind generation can produce. That means that every single watt of wind-produced electricity is guaranteed a market! Better still, the utility companies are required to purchase wind-generated power at the »highest avoided cost« – that is, the maximum rate they would have to pay for conventionally-produced power.

Here are some facts which speak for investing in Wind Matic

Wind Matic A/S has more than 10 years experience in development and production of windmills and is the Danish company which has the best knowledge in this field. The Wind Matic windmill occupies a prominent position because of

the advanced technology and design of the windmill and because the components used are of high quality. All factors which ensure a reliable, effective operation and a very long life, including very little maintenance.

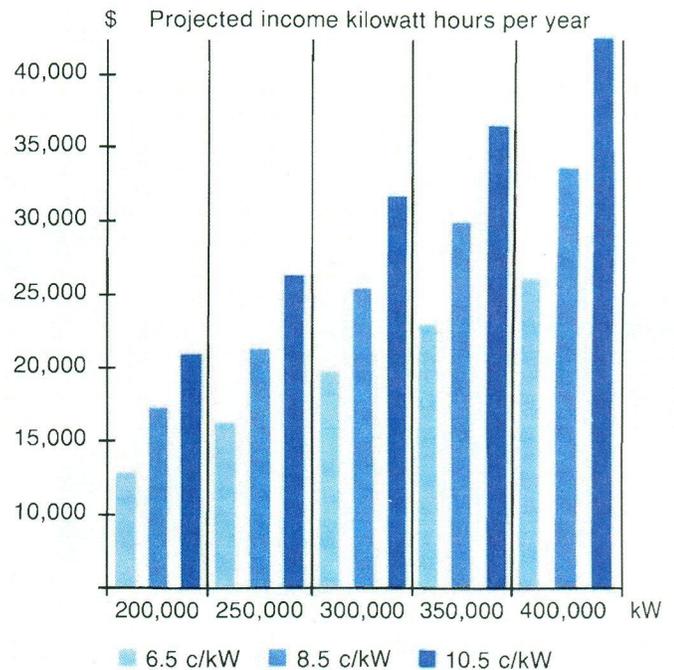
wm17S The result of many years of research and development

The Wind Matic 17 S has been developed on the basis of the WM 15 S.

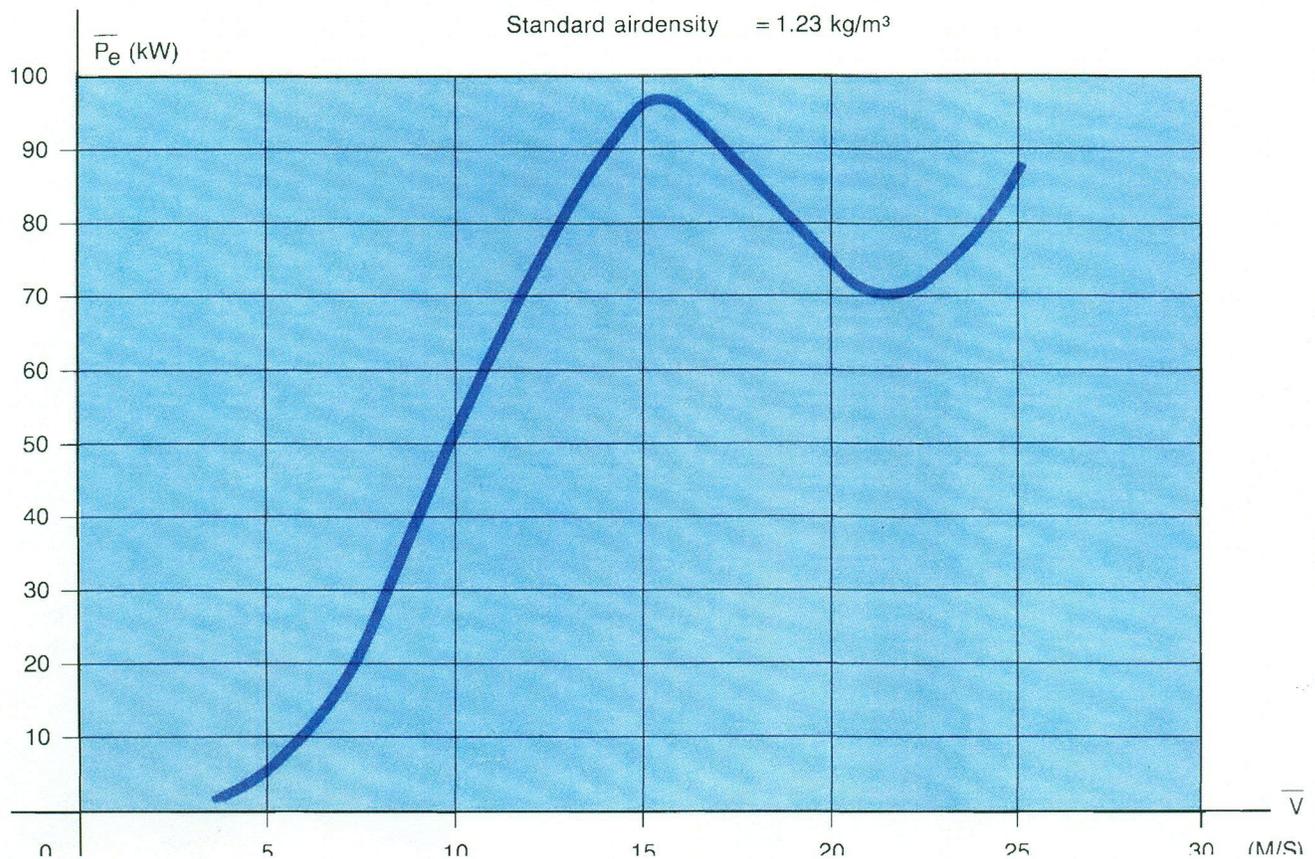
The Wind Matic 17 S is the latest development in our S-series and thus it is constructed with the purpose of obtaining a higher power output. The WM 17 S is equipped with advanced computer steering, based on micro-processor technology.

The annual energy yield of the windmill is dependent on the wind conditions of the site in question and of course the placing of the windmill.

The power of the WM 17 S can be read from the power curve below. (Power curve measured by an impartial authority »Test Plant for Smaller Windmills, Riso«).

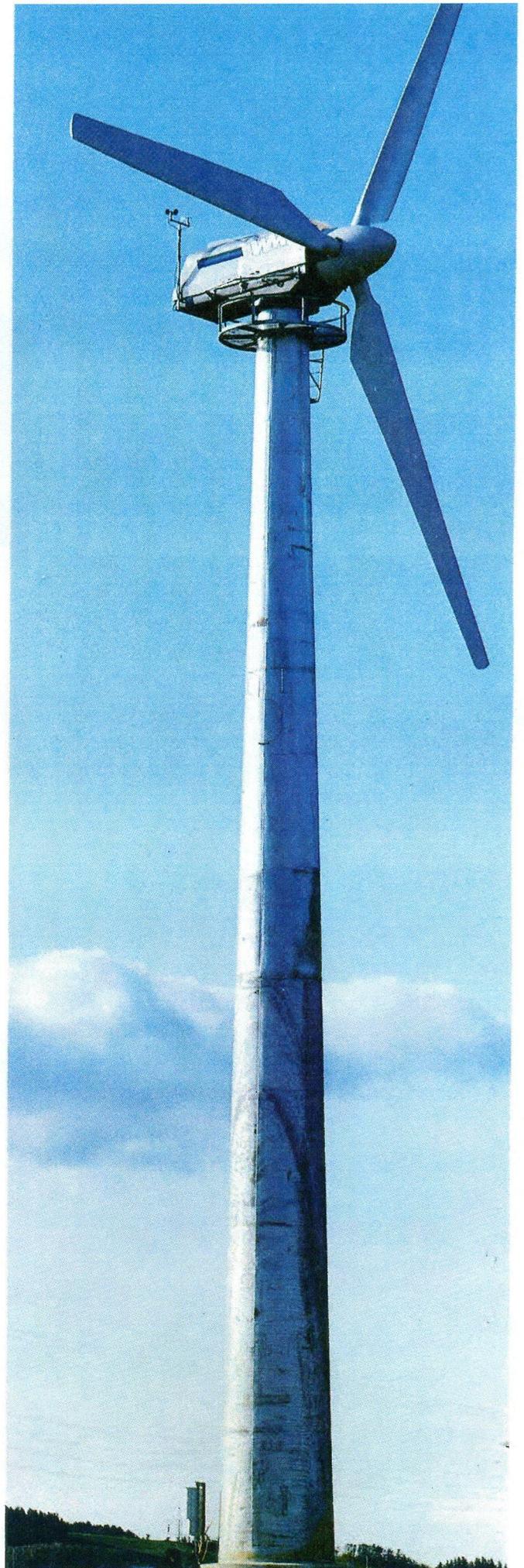


Power Curve WM 17 S USA



Strong and reliable

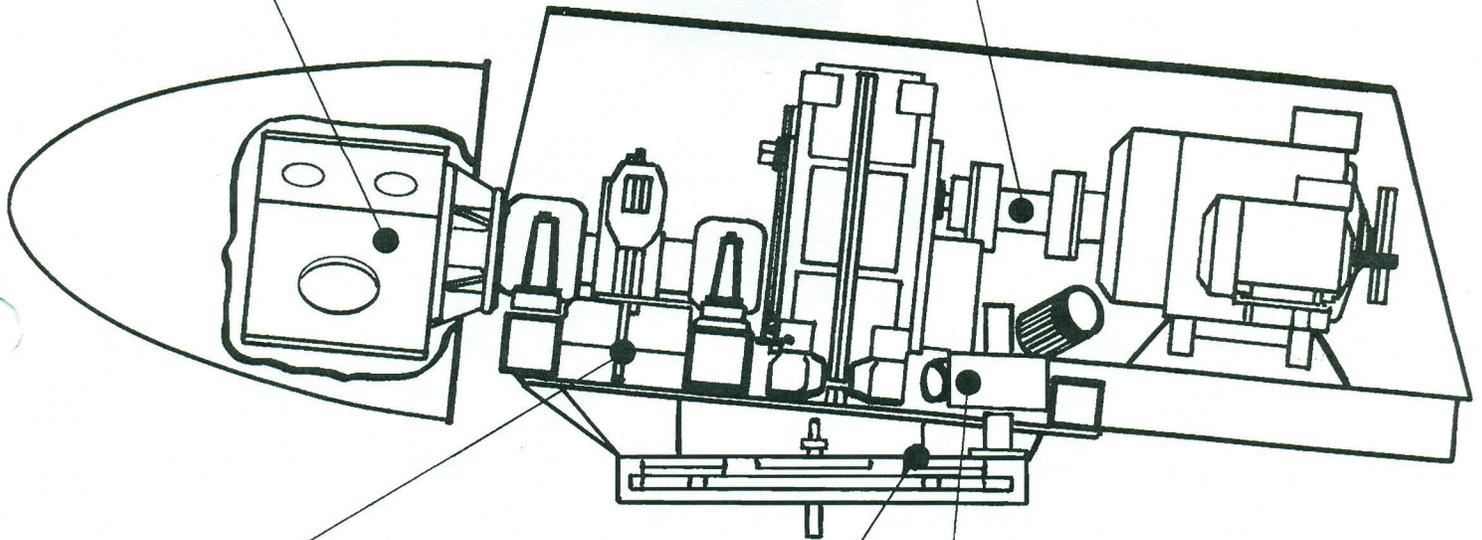
- 1) The turbine has been constructed in a way which provides you with the possibility of fine adjustment of the tip angle in accordance with the conditions. The turbine is mounted on a forged shaft, supported by two heavy-duty, spherical roller bearings.
- 2) When designing the aerofoil emphasis was placed on obtaining a higher power output. The blades are made of fiberglass reinforced Polyester, built up around a reinforced main beam with an imbedded root of heat-treated SG-iron.
- 3) Each blade is equipped with a spoiler type independent aerodynamic brake, providing a secondary braking system.



Sturdy quality down to details

The hub is a welded, heavy-duty construction, bolted to the flange on the main shaft.

Between the gearbox and the generator a flexible coupling, free of maintenance, is mounted.



The windmill is equipped with an operation brake on the slowrevolving shaft. A fact which means that the gearbox will not be exposed to large mechanical loads when breaking.

The yawing system functions by means of a yaw motor and a yaw gear which keeps the windmill oriented to the wind direction. The yaw motor is controlled by means of wind vane signals.

The nacelle rotates on four self-greasing Oilon blocks, mounted between the cabin and the yaw gear wheel.

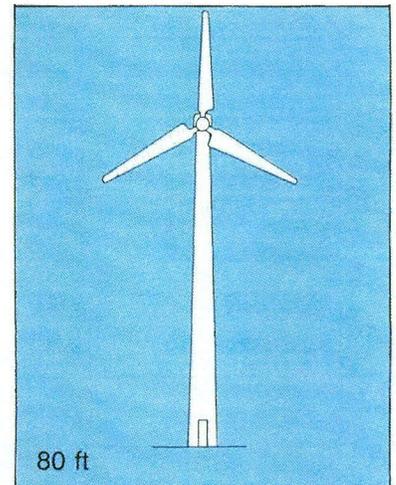
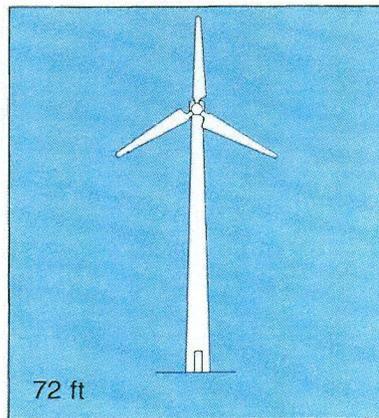
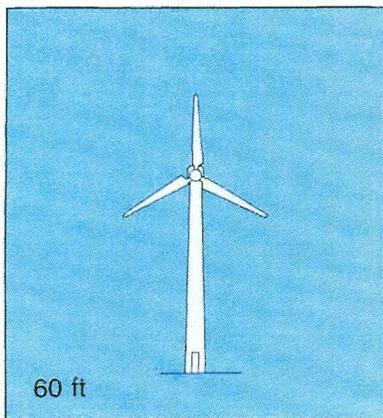
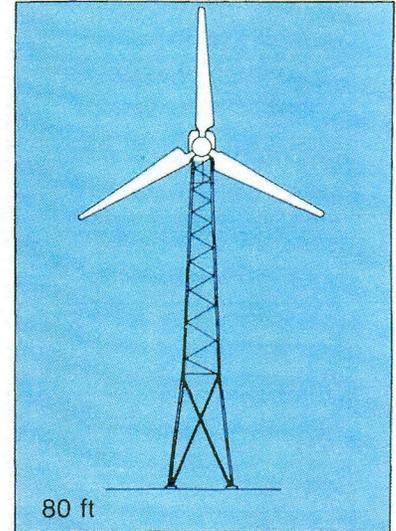
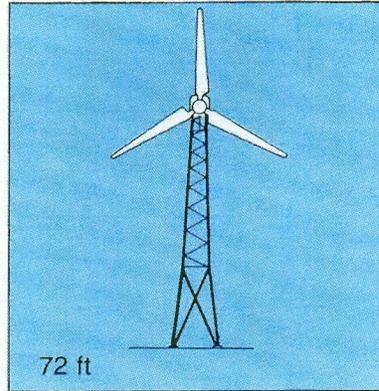
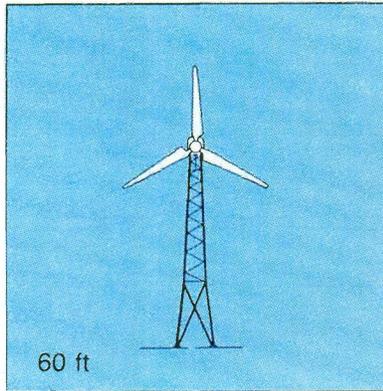
wm17S

Six various types of towers

You can choose between a steel lattice tower or a tube tower and each of these types gives you the choice between three different heights – 60, 72 or 80 ft.

Which height of tower chosen depends on the conditions of the site in question.

The steel lattice tower is solidly constructed of hot dip galvanized round iron and the tube tower is hot dip galvanized milled tank plates.



There is always a Wind Matic windmill which fits

Irrespective of energy needs there is always a Wind Matic windmill which fits – and remember, the Wind Matic windmills are all fully developed products from the

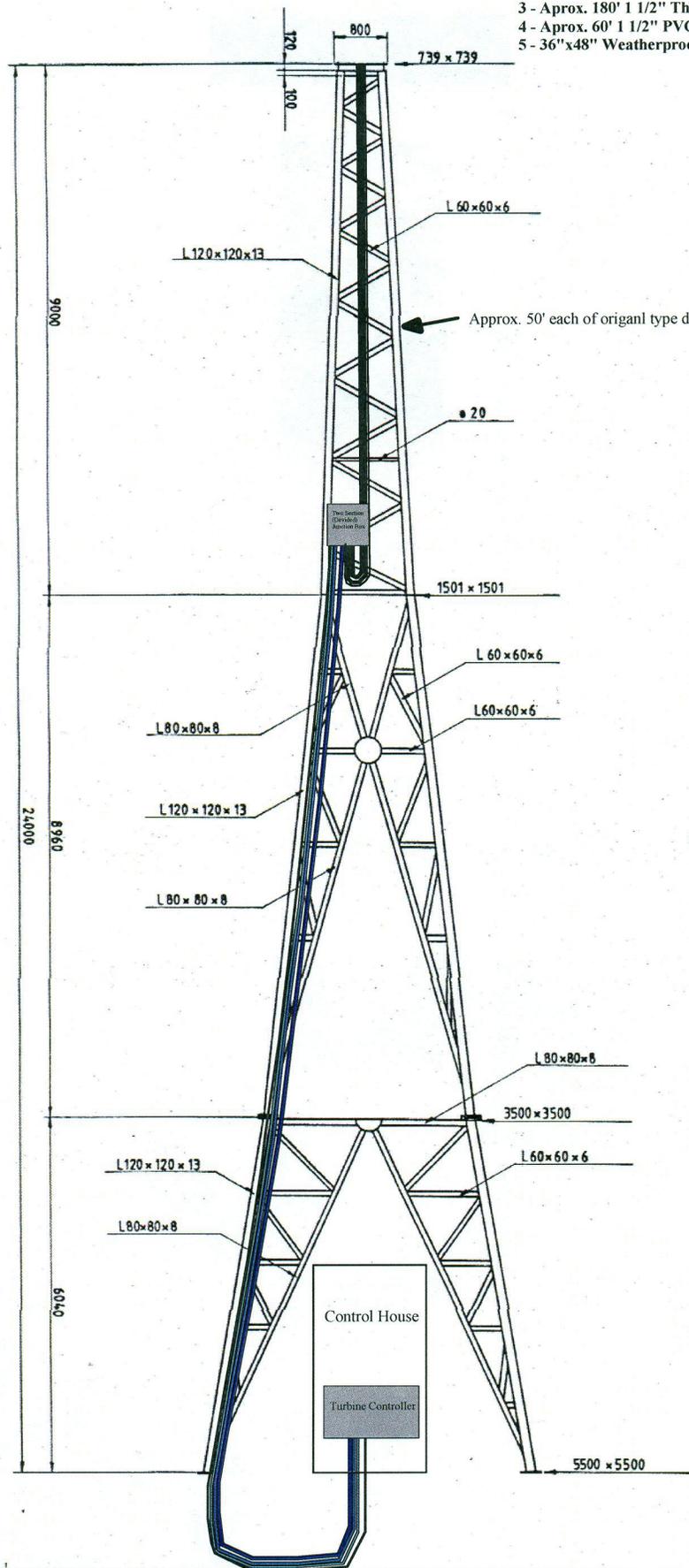
professional Danish Windmill Company.
– You can depend on the Wind Matic windmill.

It shall not be construed to
 constitute a contract or other
 legal document.

Must not be shown
 given to or used by
 person without our
 written consent.

Turbine Controller to Nacelle Electrical Conduit Addition

- 1 - Aprox. 60' 2" Thinwall Conduit
- 2 - Aprox. 20' 2" PVC Conduit
- 3 - Aprox. 180' 1 1/2" Thinwall Conduit
- 4 - Aprox. 60' 1 1/2" PVC Conduit
- 5 - 36" x 48" Weatherproof (two section) Junction Box



AIRPACIFIC CORPORATION
 PROPRIETARY INFORMATION
 DO NOT REPRODUCE WITHOUT PERMISSION

REV	DATE	DESCRIPTION

PROJECT	WM 17 S
DESCRIPTION	Wind mill
DATE	2/11/84
BY	GH
CHECKED	
DATE	
SCALE	1:50
PROJECT NO.	270 831
CLIENT	24m tower for USA

COMMANDER SOFTWARE

The Commander System

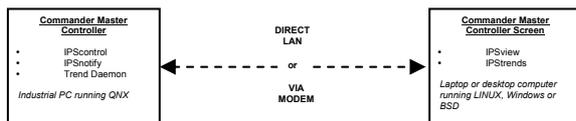
The Commander control system is based on a modular design, enabling it to offer flexible solutions using the very best in automation technology. Components of the Commander control system are:

- Commander Master Controller
- Commander Software
- Commander Communications
- Generator Controller
- Feeder Controller

The central focus of the Commander control system is a comprehensive data pool that is formulated using data collected from the Commander Master Controller, Generator Controller and Feeder Controller. The values contained in the data pool can be visualised via the IPSview software and can be accessed locally in the power station or remotely via a dial up connection.

The values in the data pool are sampled on a priority basis, ensuring that all activities and actions are managed in a safe and efficient manner within the power station. The data pool is a key element of the software architecture and as such provides visual representation, alarm reporting and plant information in a high speed environment, aiding accurate data analysis and trending of data.

General Description

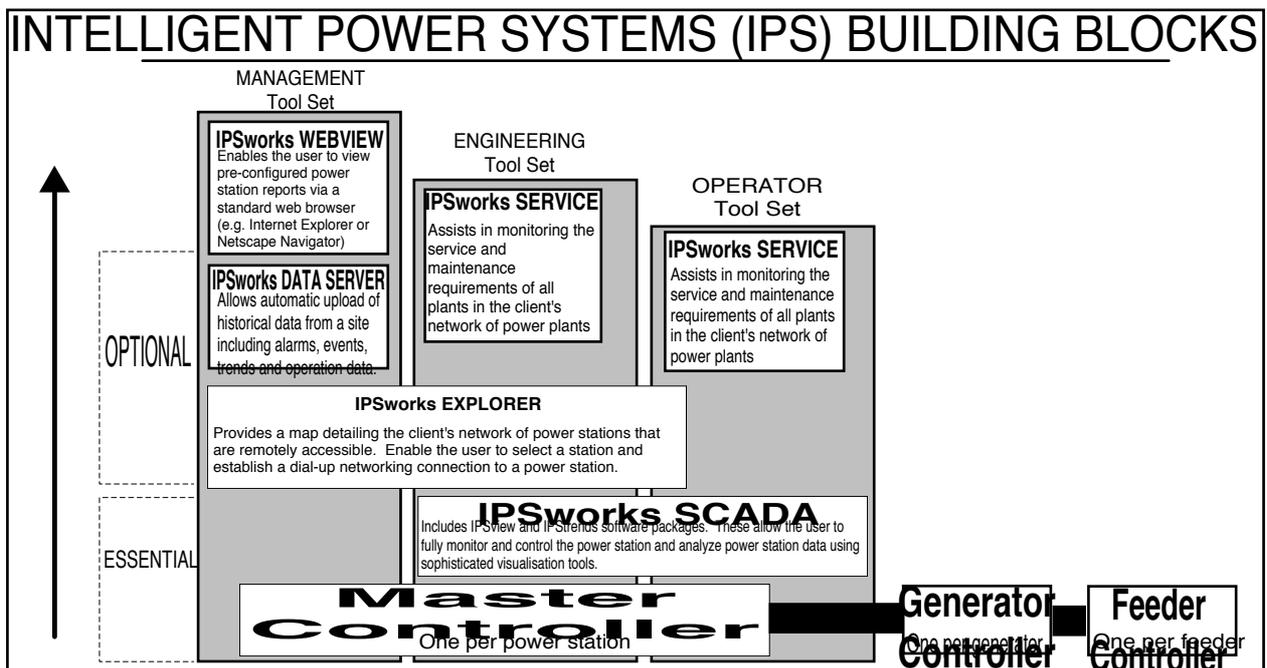


(Location of software elements in the Commander control system)

The software elements of the Commander control system exist as separate modules and programs. Some of the modules are essential for successful power station operation and others are available separately as add-ons, where the user requires increased functionality.

The Commander is a bundle of software modules that has been put together to provide the core control and monitoring functions for a power station. The Commander bundle includes:

- **IPScntrol** Key software module providing all the control functions for the Commander Master Controller.
- **IPStotify** External alarm notification via sending of power station alarm information to designated telephone and facsimile numbers.
- **IPView** Graphical operator interface providing clear visualisation of the sophisticated operations that are undertaken by the Commander Master Controller. Can be used locally in the power station and remotely.
- **IPStrends** User-friendly graphing package that enables visualisation, evaluation and printing of power station trends.



IPScontrol

FEATURES

- Code is written in C++, universal programming language.
- Code runs on a QNX real-time operating system.
- Parameter driven operation allowing a high degree of customisation by the user.

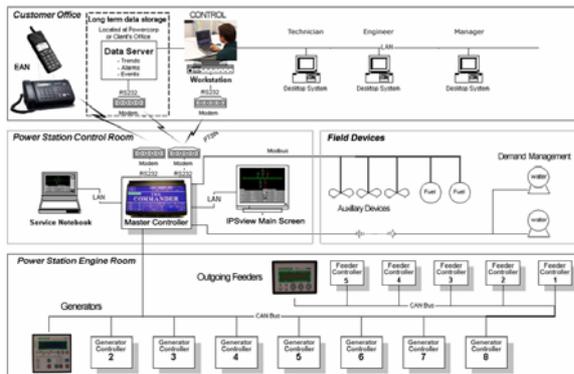
FUNCTIONS

Control

- Generator manual / operator / auto control for up to 8 generators.
- Feeder manual / operator / auto control for up to 6 HV or LV feeders.
- Station automatic black start.
- Generator configuration management for automatic call-up of generators.
- Automatic call-up of replacement gensets before an alarm shutdown.
- Automatic connection and disconnection of consumer feeders (load shedding).

Monitoring

- Station data monitoring, recording and trending.
- Generator data monitoring, recording and trending.
- Feeder data monitoring, recording and trending.
- Fuel farm monitoring.
- Remote control and monitoring access.
- Monitoring of station batteries and battery charger.
- Alarm/event reporting, trending, remote control and external alarm notification via voice, or fax.



(Commander System Architecture)

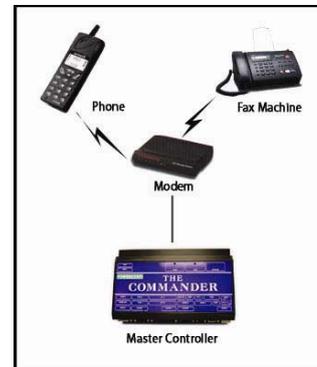
IPSnotify

FEATURES

- Code is written in C++, universal programming language.
- Code runs on a QNX real-time operating system.
- Parameter driven operation allowing a high degree of customisation by the user.

FUNCTIONS

- External alarm notification using voice and fax.
- Voice messaging of alarms to multiple telephone numbers.
- Fax messaging of alarms to multiple facsimile numbers.
- Alarm filtering to send highest priority alarms first.
- Messages identify station, alarm and time.



(Example of the external alarm notification)



(Alarm monitor parameters)

IPView

FEATURES

- Source code written in JAVA, as opposed to a proprietary language.
- High degree of look-and-feel configurability by the user.
- Operating system independent. Can run on Linux, Windows, BSD etc.
- Screen update rate 2s.
- Reliable; no locking up or losing of communication sockets.
- Trend resolution 200ms.
- First error detection possible due to 200ms data resolution.
- Remote access update rate 2s – 4s due to intelligent data packaging.

FUNCTIONS

- Real-time visualisation of the power station.
- Access to semi-automatic (operator) control of generators.
- Access to semi-automatic (operator) control of feeders
- Viewing of trending/data recording information.
- Password protection.
- Access to parameters for system commissioning and setup.
- Alarm reporting.
- Remote dial in access.

DESIGN CONCEPTS

Three key visualisation concepts have been incorporated in the design of IPView:

• Horizontal Screen Navigation

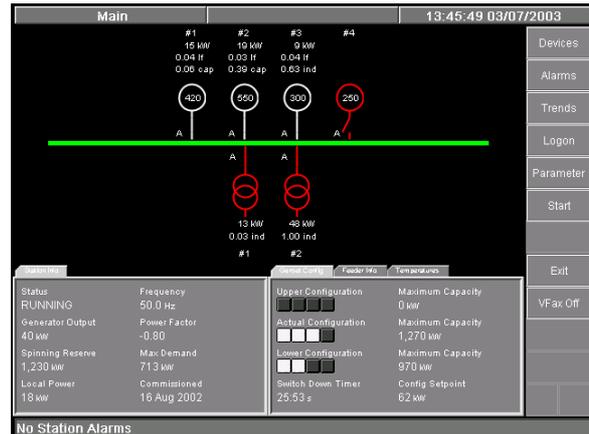
The user can traverse most screens horizontally, to avoid having to go back to the top of one branch of screens to get down into another branch of screens. Comparison of information (for example, the water temperature of each generator) is therefore much quicker.

• Information Using Colour

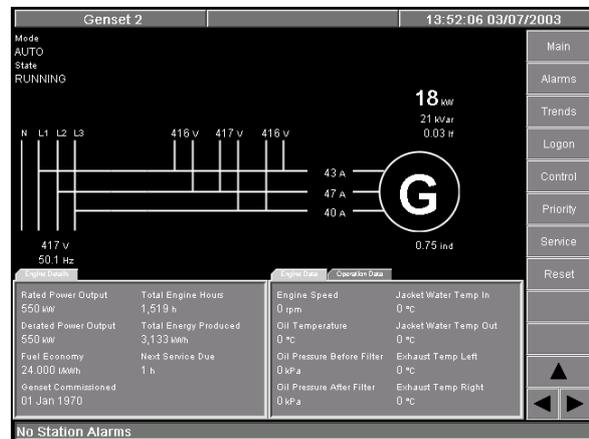
Where possible, icons are colour-coded to represent the different states that a device can hold. This helps the operator to gain an immediate impression of the power station at a glance, without having to read the state of each device.

• Display Relevant Information Only

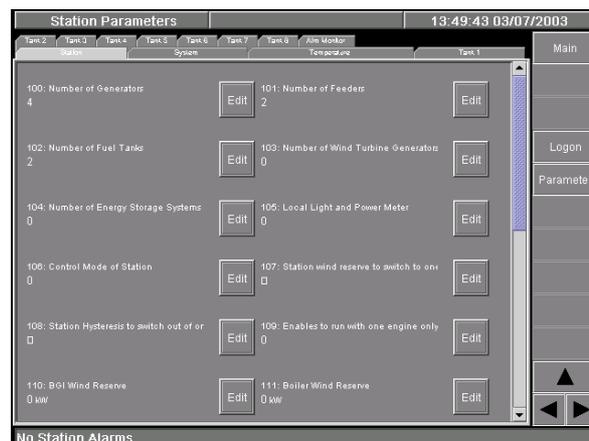
If the information is not relevant, it is not displayed in IPView. For example, if a generator is not running, IPView will NOT show that the set is delivering zero kilowatts at a power factor of zero. Rather, it will leave the information blank in order to make the screen less cluttered and to help the operator to gain an immediate impression of the status of the generator at a glance.



(IPView - Main screen)



(IPView - Generator screen)

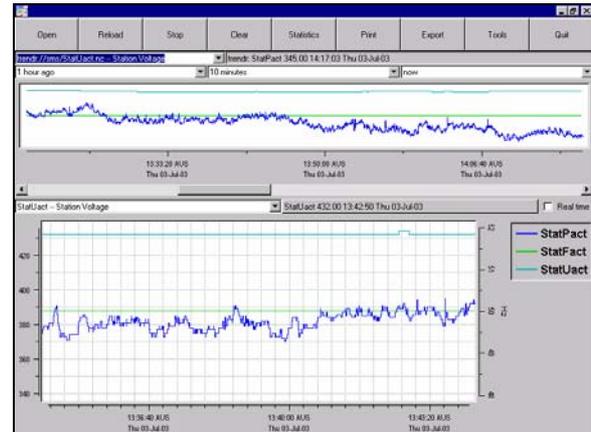


(IPView - Parameter screen)

IPStrends

FEATURES

- IPStrends can be installed as a separate program or as a part of IPSview. Trend files can be automatically joined together, for instance on a monthly basis. This means the user can scroll through time without interruptions or having to jump from files to file.
- IPStrends generates time sequenced trend files which are stored in files for each site and alarm triggered trend files. Alarm triggered trend files contain data with a higher resolution of data recorded at the time of the alarm. New files from the daily download are automatically joined to existing monthly files.
- The Commander Master Controller records the data of every power system quantity that is displayed on IPSview. The data is recorded at roughly 200ms time intervals.
- IPStrends is a smart data management and trending software package. It utilises a system of only storing differences in data values. This significantly reduces the amount of data with a 200ms time base that can be stored in the Commander Master Controller.
- The data is stored in the Commander Master Controller for a period of months before it begins to be overwritten. Most of the data is used for troubleshooting purposes, such as tracking down the cause of blackouts. The Commander Master Controller also records data for administration purposes, such as providing a load profile so that load growth can be predicted for a power station.



(IPStrends screen)

FUNCTIONS

- User configurable trend pages with individual data pens and time resolutions.
- Station data recording and trending.
- Consumer feeder data recording and trending.
- Generator data recording and trending.
- Selectable viewable trend resolution (1 minute to 1 hour).
- Transient data recording using high speed resolution (100ms to 1s).

Benefits

- Remote control and monitoring
- Reduced fuel consumption
- Reduced operation and maintenance costs
- Easy asset management
- Better genset efficiencies
- Reduced need for on-site staff

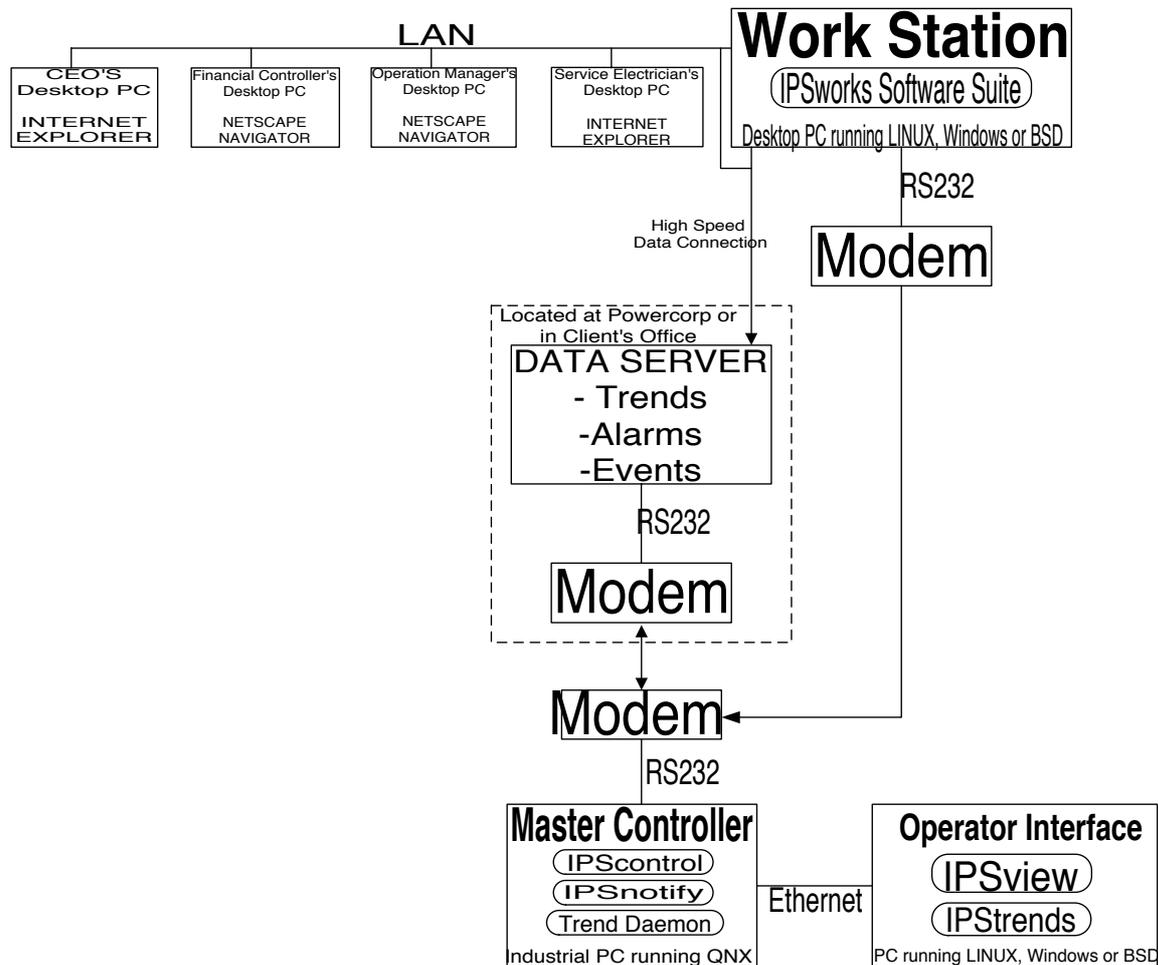
Applications

- Mining operations
- Telecommunication sites
- Defence applications
- Remote or island communities
- Hotel and tourist resorts
- Individual towns or villages
- Industrial estates
- Emergency services and disaster relief
- Construction sites

Unique Features

- User friendly, parameter driven interface.
- Fax or voice annunciations for automotive alarms.
- Optional performance reporting based on Web access to a Data Server.
- Ethernet service interface.
- User configurable trending of all power station readings.
- Mission critical control (i.e. load shedding) achieved via CAN bus.
- Ability to interface to diesel and/or gas generators.
- High flexibility for future changes to the power station configuration.
- Compatibility to most prime mover types.
- Distributed architecture of the control system minimises the risk of outages from a single hardware failure.

Typical Application



Future Features for Commander

The following table contains a list of features that are currently under development. These features will be included in future releases of the Commander Software.

Feature	Description
Commander Master Controller Time Synchronisation	The time in the Commander Master Controller is set during the manufacturing process. Currently it cannot be changed, although the time zone to adjust the clock to your local time can be changed. In the next release of the Commander Master Controller, the time will be automatically adjusted to synchronise with the computer that IPSview is installed on.
IPSview Multiple Users Access	More than one user can access the Commander Master Controller using IPSview. However, the Commander Master Controller can currently only administer one user. This means that when more than one user is connected, they both share the same access level. Future upgrades will allow user names and passwords for multiple users.

Commander Package

The Commander package includes the following items:

- Commander Master Controller
- Generator Controller
- Feeder Controller
- IPSview software
- Folder with manuals
- RJ-45 Communication crossover cable
- Commander Master Controller 24VDC power supply plug
- Power pack 100-240Vac/50-60Hz/50W, 24dc
- Modem
- Modem RS232 cable
- CAN bus termination plug
- RS232/485 converter

Other Commander Product Specifications Available

- Commander Master Controller Product Specification
- Generator Controller Product Specification
- Feeder Controller Product Specification
- Commander Communications Product Specification

More Information

For more information or queries about Commander please contact us direct or visit our website. We look forward to hearing from you!

www.pcorp.com.au

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COMMANDER COMMUNICATIONS

The Commander System

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- Commander Master Controller
- Commander Software
- Commander Communications
- Generator Controller
- Feeder Controller

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The values in the data pool are sampled on a priority basis, ensuring that all activities and actions are managed in a safe and efficient manner within the power station. The data pool is a key element of the software architecture and as such provides visual representation, alarm reporting and plant information in a high speed environment, aiding accurate data analysis and trending of data.

General Description & Function

The Commander control system includes a number of communications interfaces. Some of the interfaces are essential for successful power station operation and others are used to provide increased functionality to the user.

COMMUNICATION FEATURES

- Robust, remote access via landline and satellite phone.
- Industry standard protocol for CAN bus and Modbus.
- Supports Modbus TCP over the Internet for WAN SCADA access.
- Security features eg: data encryption, security access.
- FTP (File Transfer Protocol) for software update and maintenance.
- Embedded web server for device configuration.
- Connection to corporate LAN.
- Broadband ready.

PROTOCOLS & LAYERS

- Physical layers
 1. CAN bus
 2. Ethernet 10baseT
 3. Serial RS-232 point-to-point link
 4. Serial RS-422/RS-485
- Communications protocols
 1. Can 2.0 Part A
 2. TCP/IP
 3. Modbus/TCP and Modbus RTU

COMMUNICATION INTERFACES

CAN bus

The CAN bus is a serial bus designed for high speed data transmission over distances less than 200m. The CAN bus is used to transport data between the Commander Master Controller, Generator Controller and Feeder Controller components of the Commander control system.

COM1 Remote Access

Modem connection RS-232. COM1 is used to connect a modem to the Commander Master Controller in order to achieve remote connectivity. This enables a user to dial up to a site and have control and monitoring capabilities from a remote location.

COM2 Alarm Monitor

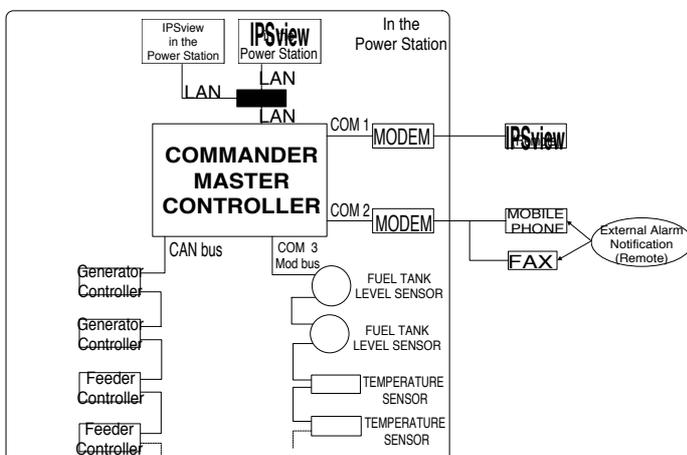
Modem connection RS-232. COM2 is used to connect a modem to the Commander Master Controller for the purpose of sending voice or fax alarm messages using External Alarm Notification.

COM3 Modbus Remote I/O

COM3 is used to connect remote I/O such as bulk fuel storage tank level sensors and engine room temperature sensors to the Commander Master Controller using the Modbus RTU protocol.

LAN Ethernet

The Ethernet connection is used to connect the Commander Master Controller to a computer running IPSview. This can be achieved via a direct connection or over a Local Area Network (LAN).



(Communications Architecture Diagram)

CAN bus

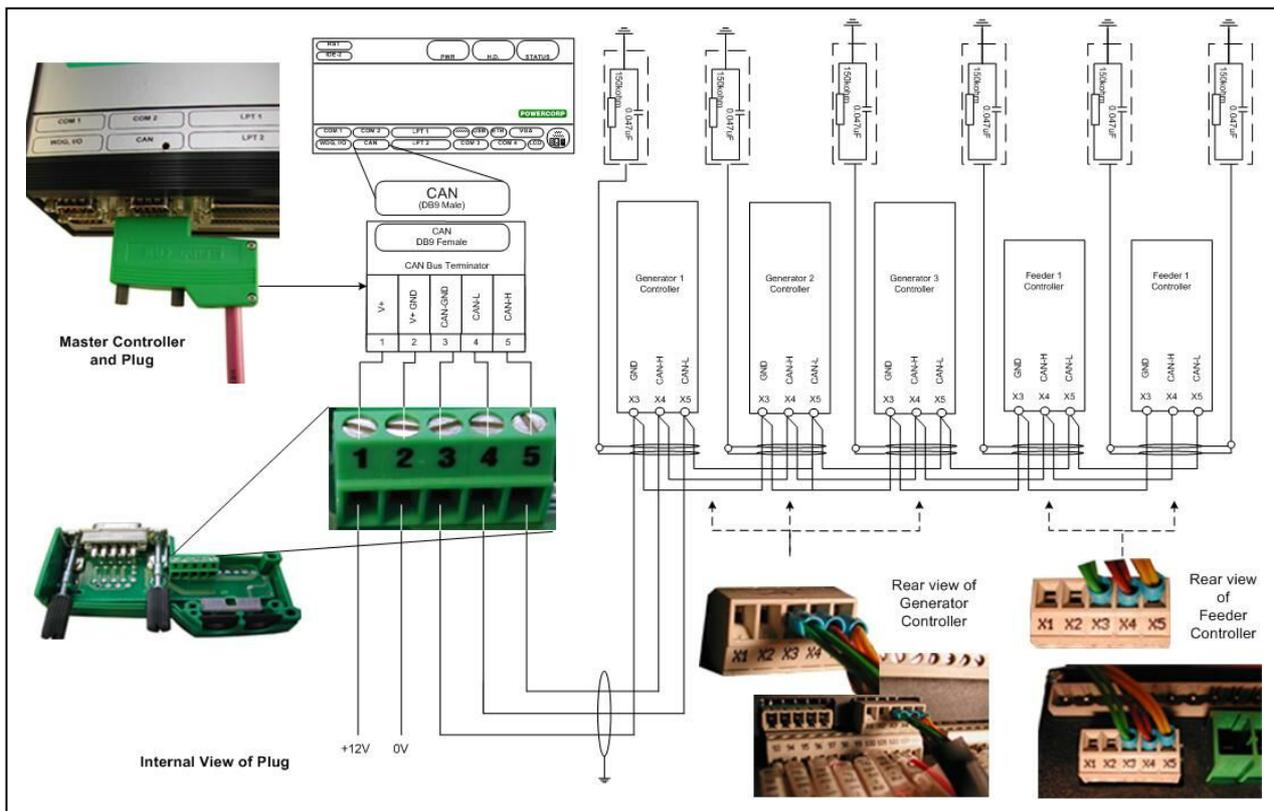
GENERAL

The order in which the Generator Controller and Feeder Controller devices are connected on the CAN bus is not relevant. Each device must, however, have an exclusive ID number. (This number is part of the parameters for the device and is set up during commissioning).

The CAN bus is a fieldbus that enables the devices in the Commander control system to talk to one another. It is the primary method for collecting data from the generators and feeders for use in the data pool in the Commander Master Controller.

SPECIFICATIONS

- Data cable shielded twisted pair, 120 ohm characteristic impedance.
- Termination 120 ohm at both ends.
- Common mode range -7V to +12Vdc.
- Power supply 12Vdc or 24Vdc.
- Opto-galvanically isolated (500Vac rms).



(CAN bus connection between Commander control system components)

COM1 Remote Access

GENERAL

Remote access enables a user to dial in to a site and undertake control and monitoring functions as if on site.

Remote Access Features

- Allows remote generator start/stop.
- Remote programming of parameters.
- Remote control of the power station.
- Remote monitoring of the power station.
- Remote alarm reset.
- Remote access to trending information.

SPECIFICATIONS

- Direct connection to the Commander Master Controller via a standard serial cable to the Commander Master Controller RS-232 port.
- Compatibility with several modems (eg: Sixnet VT, Westimo TD-328).
- **NOT** galvanically isolated – it is recommended that additional surge protection be installed on the incoming telephone line.



(DB9 connection to COM1)

COM2 Alarm Monitor

GENERAL

The Alarm Monitor is an optional module that can be used to send alarm messages from the Commander Master Controller to a remote telephone or facsimile.

Alarm Monitor Features

- External alarm notification using voice and fax.
- Voice messaging of alarms to multiple telephone numbers.
- Fax messaging of alarms to multiple facsimile numbers.
- Alarm filtering to send highest priority alarms first.

SPECIFICATIONS

- Direct connection to the Commander Master Controller via a standard serial cable to the Commander Master Controller RS-232 port.
- Compatibility with several modems (eg: Sixnet VT, Westimo TD-328).



(External alarm notification parameters)

COM3 Modbus Remote I/O

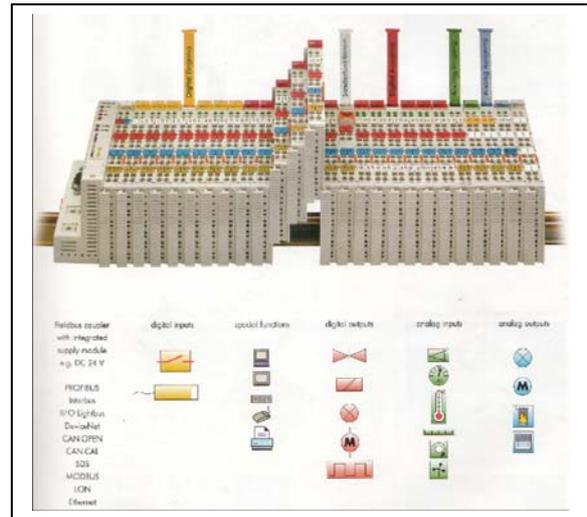
GENERAL

Temperature and fuel level sensors can be connected to the Commander Master Controller via this interface. Additional digital I/O can also be connected (for example, station emergency stop, fire alarm or intruder alert). The Commander Master Controller acts as a Modbus RTU master station. Each connected device is then a Modbus RTU slave.

An RS-232 to RS-485 converter must be installed to connect more than one device to the Commander Master Controller.

SPECIFICATIONS

- Direct connection of RS-232/485 converter to the Commander Master Controller via a standard DB9 serial cable to the Commander Master Controller RS-232 port.
- Protocol Modbus RTU over RS-485, as documented by Schneider Automation/Modicon.
- Compatible with several Modbus RTU devices (eg: Gantor, Procon, WAGO).
- NOT galvanically isolated.



(Sample remote I/O)

CAN Ethernet

GENERAL

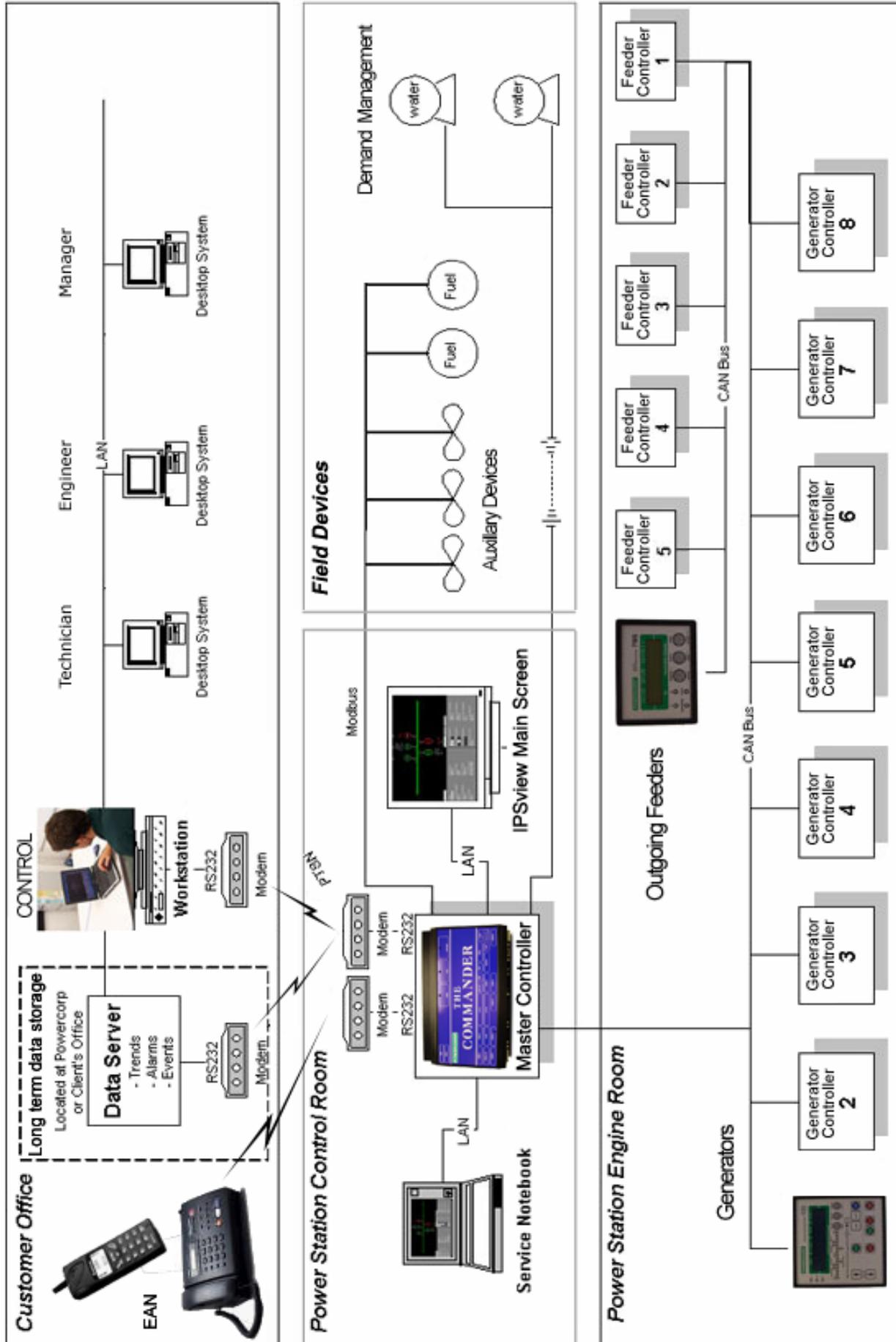
The Ethernet port on the Commander Master Controller enables the user to plug in a desktop or laptop PC running the IPSview software. IPSview is a tool that provides a window to the control and monitoring functions of the Commander Master Controller.

SPECIFICATIONS

- CAT5 cable with separate transmit and receive pairs for proper operation with 100BaseT.
- Modbus TCP/IP at 10Mb/s.
- Galvanically isolated (500Vac rms).



(Service laptop connected to the Commander Master Controller)



Benefits

- Remote control and monitoring
- Reduced fuel consumption
- Reduced operation and maintenance costs
- Easy asset management
- Better genset efficiencies
- Reduced need for on-site staff

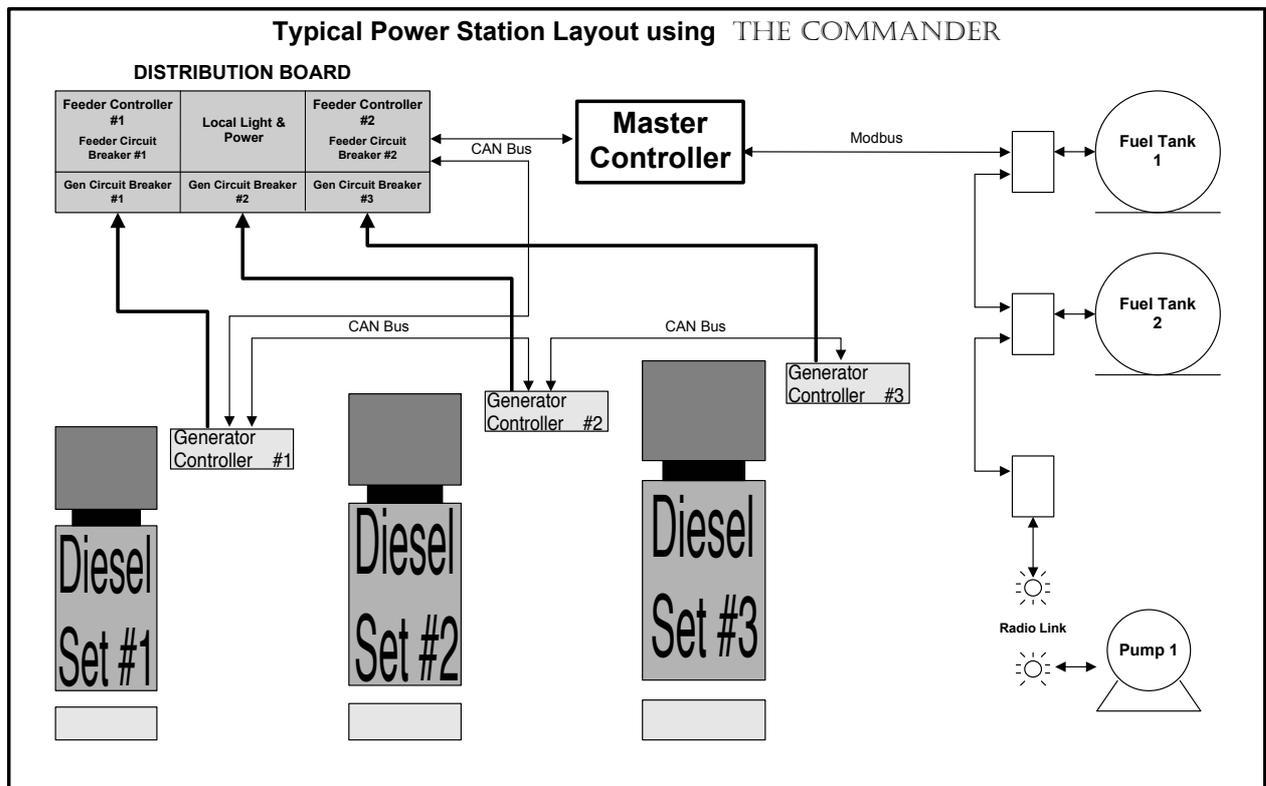
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- Generator Controller Product Specification
- Feeder Controller System Product Specification
- Communications Product Specification

More Information

For more information or queries about Commander please contact us direct or visit our website. We look forward to hearing from you!

www.pcorp.com.au

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GENERATOR CONTROLLER

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General Description & Function

OVERVIEW

The Generator Controller is primarily a microprocessor based control unit capable of controlling, monitoring and displaying all aspects of diesel or gas generator set operation. The genset may be used for isolated or standby applications or for operations in parallel with the mains.

The Generator Controller is designed to provide total control for medium sized to big applications with multiple gensets.

Unlike traditional installations of engine and power station control systems, the Powercorp Generator Controller units are shipped with quick-connect installation cables. This innovation reduces the expensive on-site labour required to strip, number, terminate and test every core of the control system interface. Instead sensor, power supply, control and communication cables come with industrial IP65 connectors that simply plug into the side of the Generator Controller. Testing and calibration is therefore reduced to a minimum, contributing to a significant reduction in installation costs.

Up to 8 Generator Controller units can be operated in parallel on the same field-bus.

BASIC FEATURES

- Complete engine, generator, and mains protection and controller into one unit.
- True RMS sensing.
- Synchronisation for one breaker.
- Load/var sharing
- Counters for kWh, engine starts, operating hours, maintenance call.
- Freely configurable discrete and analog alarm inputs.
- Freely configurable relay and analog outputs.
- PC and front panel configurable.
- CAN bus based communication.
- UL/cJUL Listed.



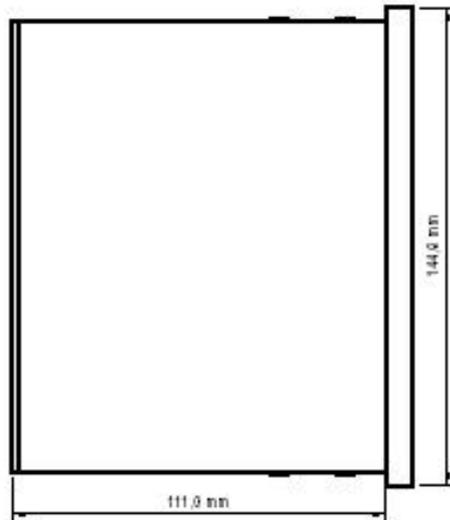
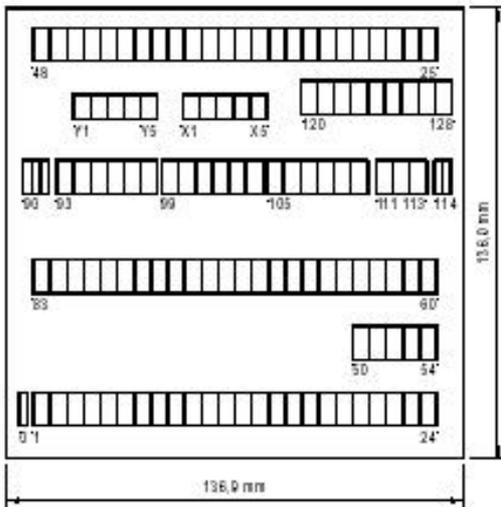
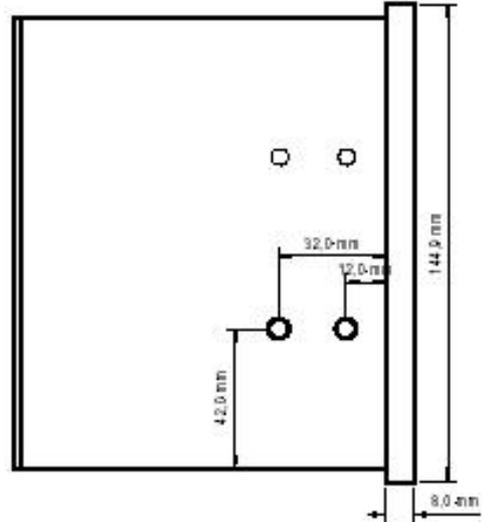
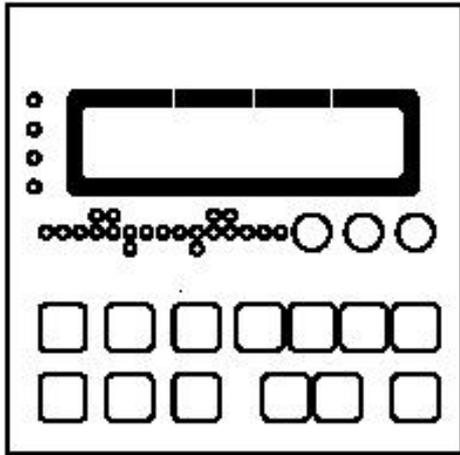
FEATURES

- True RMS 6x voltage (gen/bus)
- True RMS 3x current (gen)
- Start/stop logic for diesel/gas engines
- Engine pre-glow or purge control
- Battery voltage monitoring
- Speed control with overspeed monitoring
- kWh/oper.hours/start/maintenance counter
- Configurable trip/control set points
- Configurable delays for each protection
- Magnetic/switching Pickup input
- 16 configurable discrete alarm inputs
- 5 configurable/programmable relays
- Two-line LC display
- Synchroscope
- Push-buttons for direct control
- CAN bus communication
- Multi level password protection

Accuracy..... Class 1
 Power supply..... 24 Vdc (9.5..32 Vdc)
 Intrinsic consumptionmax. 15 W
 Ambient temperature..... -20..70 °C
 Ambient humidity..... 95 %, non-condensing
Voltage Rated: [1] 57/100(120) Vac or [4] 230/400 Vac
 UL: [1] max. 150 Vac or [4] max. 300 Vac
 Setting range: [1] 50..125 Vac or [4] 200..440 Vac
 Measuring frequency..... 50/60 Hz (40..70 Hz)
 Linear measuring range up to 1.3×Un
 Input resistance..... [1] 0.21 MΩ, [4] 0.7 MΩ
 Max. power consumption per path < 0.15 W
Current# [../1] ..1 A or [../5] ..5 A
 Current-carrying capacity Igen = 3.0×In
 Imains = 1.5×In
 Load < 0.15 VA
 Rated short-time current (1 s) [../1] 50×In, [../5] 10×In
Discrete inputs metallicity separated
 Input range 12/24 Vdc (4..40 Vdc)
 Input resistance..... approx. 6.7 kΩ
Relay outputs..... metallicity separated
 Contact material AgCdO

Load (GP)..... 24 Vdc@2 Adc, 250 Vac@2 Aac
 Pilot duty (PD) 24 Vdc@1 Adc
Analog input# freely scaleable
 Type 0/4..20 mA, Pt100, VDO
 Resolution 10 Bit
Analog output metallicity separated
 Type 0/4..20 mA, freely scaleable
 Resolution 8/12 Bit (depending on model)
 Max. load 0/4..20 mA 500 Ω
 Insulating voltage 3,000 Vdc
Housing..... Type APRANORM DIN 43 700
 Dimensions..... 144×144×118 mm
 Front cutout 138×136 mm
 Connection screw/plug terminals depending
 on connector 1.5 mm² or 2.5 mm²
 Front insulating surface
 Protection system..... IP 21
 Weight depending on version, approx. 1,000 g
Disturbance test (CE)..... tested according to
 applicable EN guidelines
Listings..... UL/cUL listed (voltages up to 300 Vac)
 for ordinary loc., file E212970

DIMENSIONS



Benefits

- Remote control and monitoring
- Reduced fuel consumption
- Reduced operation and maintenance costs
- Easy asset management
- Better genset efficiencies
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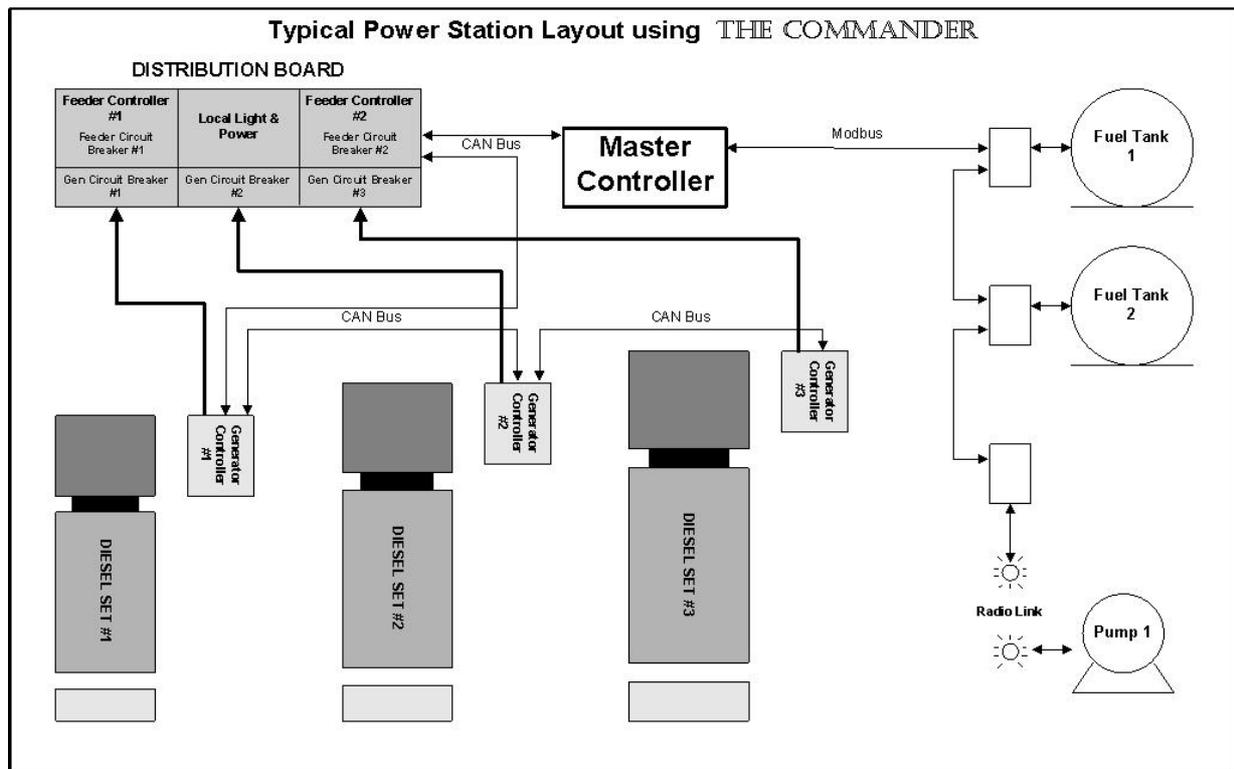
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- Telecommunication sites
- Defence applications
- Remote or island communities
- Hotel and tourist resorts
- Individual towns or villages
- Industrial estates
- Emergency services and disaster relief
- Construction sites

Unique Features

- User friendly, parameter driven interface.
- Fax or voice annunciations for automotive alarms.
- Optional performance reporting based on Web access to a Data Server.
- Ethernet service interface.
- User configurable trending of all power station readings.
- Mission critical control (i.e. load shedding) achieved via CAN bus.
- Ability to interface to diesel and/or gas generators.
- High flexibility for future changes to the power station configuration.
- Compatibility to most prime mover types.
- Distributed architecture of the control system minimises the risk of outages from a single hardware failure.

Typical Application for the Generator Controller



Power Station Layout.vsd

Future Features for Commander

The following table contains a list of features that are currently under development. These features will be included in future releases of the Commander software.

Feature	Description
Commander Master Controller Time Synchronisation	The time in the Commander Master Controller is set during the manufacturing process. Currently it cannot be changed, although the time zone to adjust the clock to your local time can be changed. In the next release of the Commander Master Controller, the time will be automatically adjusted to synchronise with the computer that IPSview is installed on.
IPSview Multiple Users Access	More than one user can access the Commander Master Controller using IPSview. However, the Commander Master Controller can currently only administer one user. This means that when more than one user is connected, they both share the same access level. Future upgrades will allow user names and passwords for multiple users.

Commander Package

The Commander package includes the following items:

- Commander Master Controller
- Generator Controller
- Feeder Controller
- IPSview software
- Folder with manuals
- RJ-45 Communication crossover cable
- Commander Master Controller 24VDC power supply plug
- Power pack 100-240Vac/50-60Hz/50W, 24dc
- Modem
- Modem RS232 cable
- CAN bus termination plug
- RS232/485 converter

Other Commander Product Specifications Available

- Commander Master Controller Product Specification
- Feeder Controller System Product Specification
- Commander Communications Product Specification
- Commander Software Product Specification

More Information

For more information or queries about Commander please contact us direct or visit our website. We look forward to hearing from you!

www.pcorp.com.au

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FEEDER CONTROLLER

The Commander System

The Commander control system is based on a modular design, enabling it to offer flexible solutions using the very best in automation technology. Components of the Commander control system are:

- Commander Master Controller
- Commander Software
- Commander Communications
- Generator Controller
- Feeder Controller

The central focus of The Commander control system is a comprehensive data pool that is formulated using data collected from the Commander Master Controller, Generator Controller and Feeder Controller. The values contained in the data pool can be visualised via the IPSview software and can be accessed locally in the power station or remotely via a dial up connection.

The values in the data pool are sampled on a priority basis, ensuring that all activities and actions are managed in a safe and efficient manner within the power station. The data pool is a key element of the software architecture and as such provides visual representation, alarm reporting and plant information in a high speed environment, aiding accurate data analysis and trending of data.

General Description & Function

The Feeder Controller is a microprocessor based controller unit capable of monitoring and displaying all aspects of feeder operation.

The unit is capable of displaying:

- Three-phase measurement of the rms value of phase-to-neutral and phase-to-phase voltages;
- Three-phase measurement of the rms value of current;
- Three-phase measurement of the rms value of active power through real-time multiplication of instantaneous values of phase-to-neutral voltage and line current;
- Three-phase measurement of reactive power, calculated by means of apparent power and active power and;
- Time measurement between filtered measured values of voltage U1N and current I1 to calculate power factor.

The compact size and multiple functions of the Feeder Controller helps to simplify switch-gear design. The digital display offers a user friendly interface to setup the unit as well as monitor the operation and display any of the alarms.



(Feeder Controller)

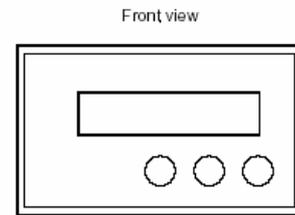
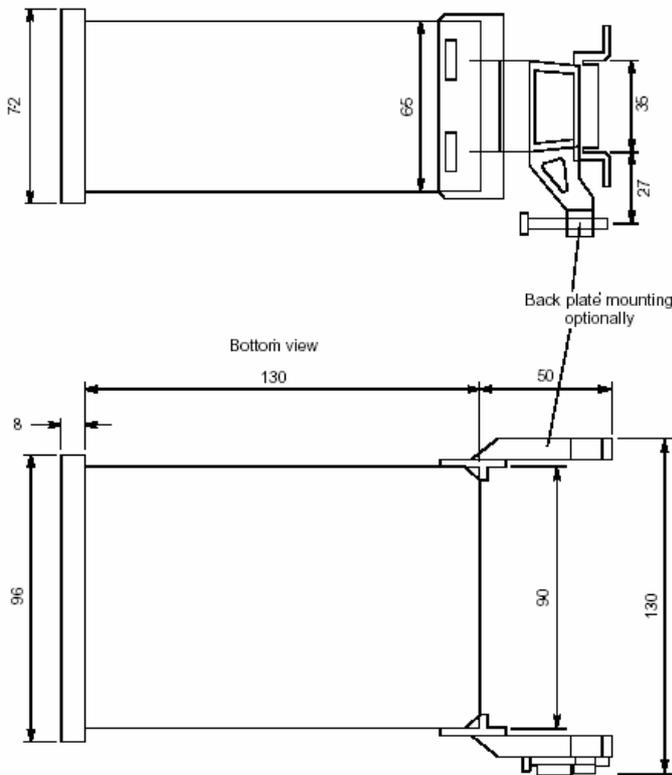
BASIC FEATURES & FUNCTIONS

- True RMS voltage (generator)
- True RMS current (generator)
- True RMS sensing
- Two-line LC display
- Complete feeder protection in one unit.
- PC and front panel configurable
- Microprocessor technology for accurate, repeatable and reliable operation.
- UL/cUL Listed
- GL Approval
- Three relay outputs (changeover contacts) for ACB close, open and reset.
- Encoding function (software).
- Five digital inputs to interface with the feeder circuit breaker.

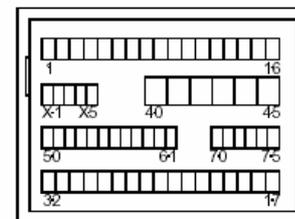
Accuracy.....Class 1
 Power supply 24 Vdc (18..32 Vdc)
 Intrinsic consumptionmax. 12 W
 Ambient temperature-20..70 °C
 Ambient humidity 95 %, non-condensing
Voltage Rated: [1] 57/100(120) Vac or [4] 230/400 Vac
 UL: [1] max. 150 Vac or [4] max. 300 Vac
 Setting range: [1] 50..125 Vac or [4] 200..440 Vac
 Measuring frequency 50/60 Hz (40..70 Hz)
 Linear measuring range up to 1.3×Vn
 Input resistance [1] 0.21 MΩ, [4] 0.7 MΩ
 Max. power consumption per path < 0.15 W
Current..... [./1] ..1 A or [./5] ..15 A
 Current-carrying capacity 3.0×In
 Load < 0.15 VA
 Rated short-time cur. (1 s) [./1] 50.0×In, [./5] 10.0×In
Discrete inputs..... metalically separated
 Input range 18..250 Vac or dc
 Input resistance approx. 68 kΩ

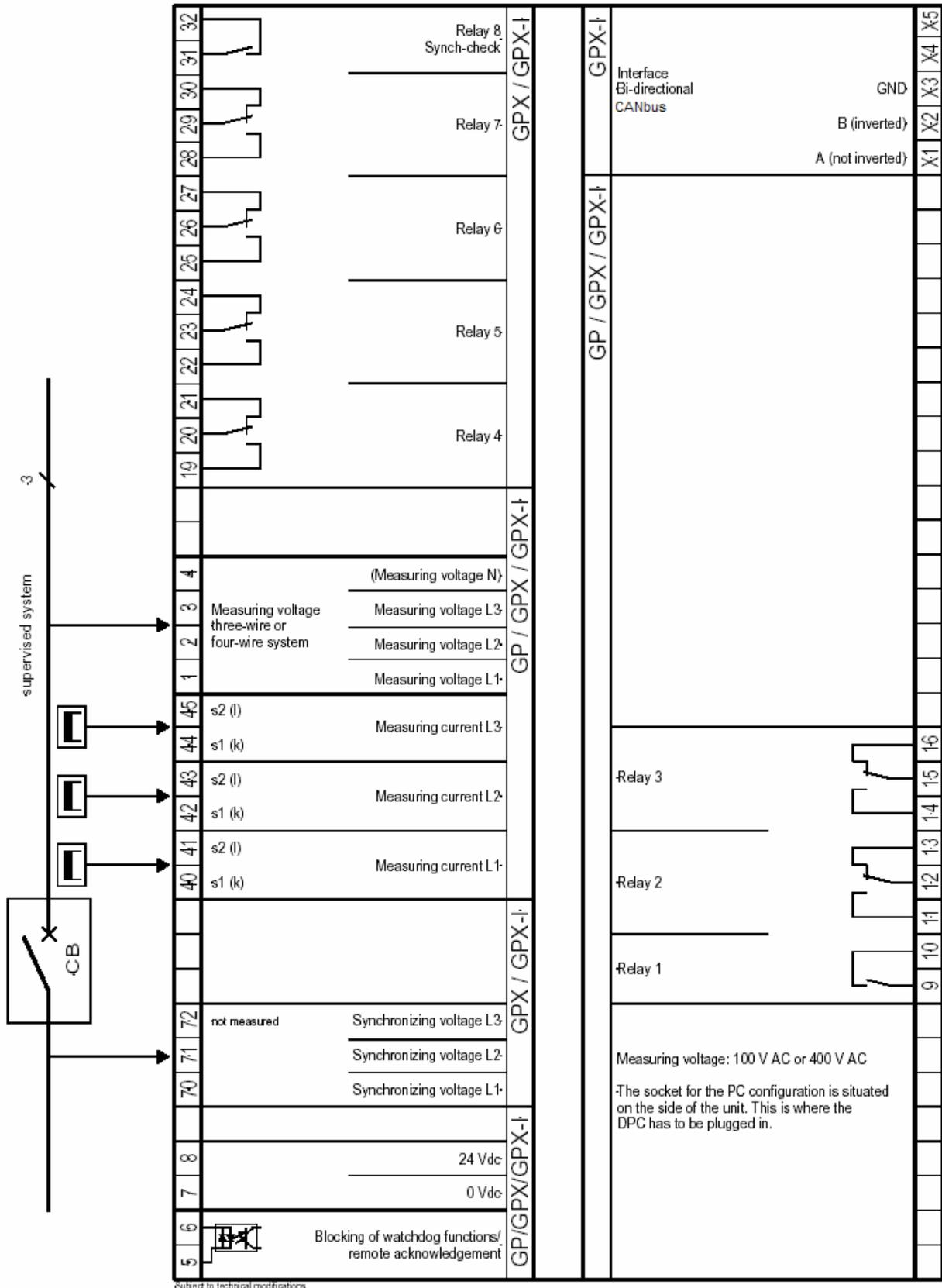
Relay outputs..... metalically separated
 Contact material AgCdO
 Load (GP)..... 24 Vdc@2 Adc, 250 Vac@2 Aac
 Pilot duty (PD) 24 Vdc@1 Adc
Housing..... Type APRANORM DIN 43 700
 Dimensions..... 96×72×130 mm
 Front cutout 91×67 mm
 Connection screw/plug terminals depending on connector 1.5 mm², 2.5 mm² or 4mm²
 Front..... insulating surface
 Protection system IP 21
 Weight..... depending on version, approx. 800 g
Disturbance test (CE) tested according to applicable EN guidelines
Listings UL/cUL listed (note: max. voltages apply) for ordinary loc., file E212970
Approvals..... GL (Germanischer Lloyd)

DIMENSIONS



Back view with connecting terminals





Benefits

- Remote control and monitoring
- Reduced fuel consumption
- Reduced operation and maintenance costs
- Easy asset management
- Better genset efficiencies
- Reduced need for on-site staff

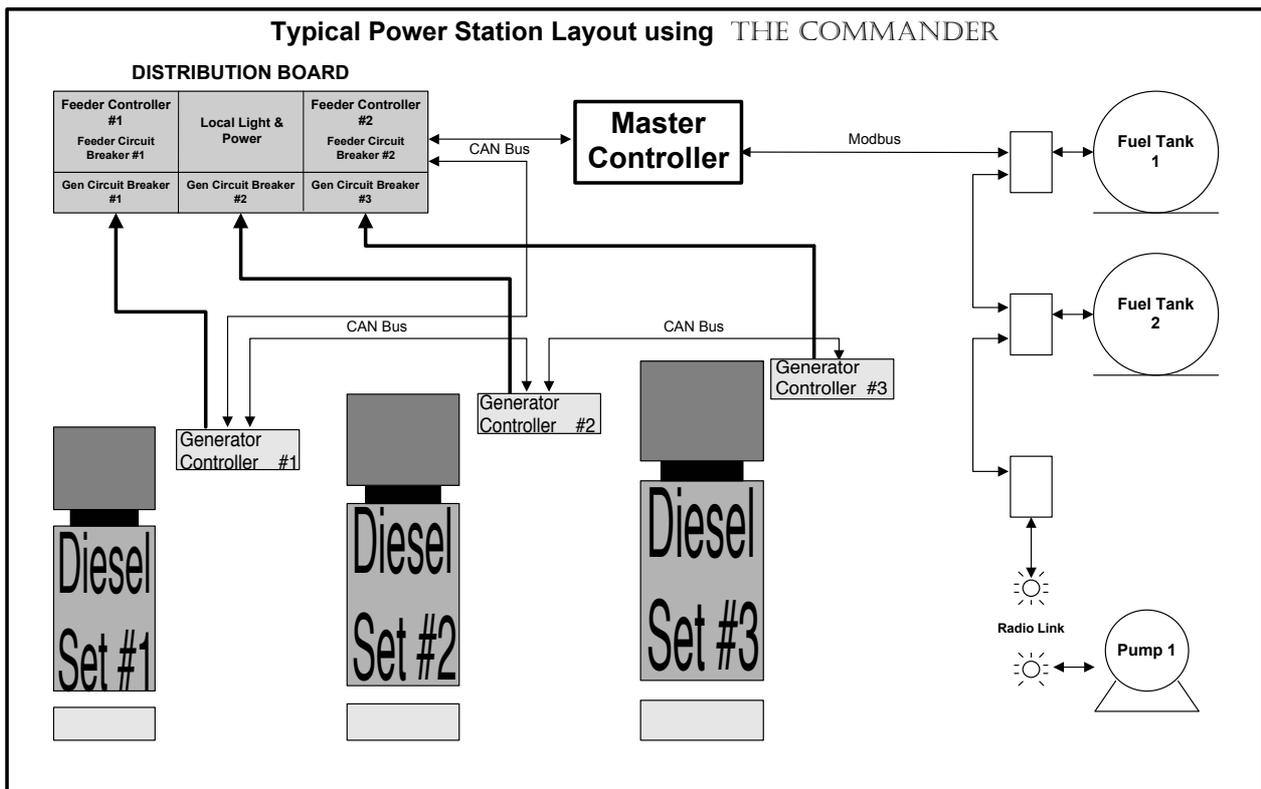
Applications

- Mining operations
- Telecommunication sites
- Defence applications
- Remote or island communities
- Hotel and tourist resorts
- Individual towns or villages
- Industrial estates
- Emergency services and disaster relief
- Construction sites

Unique Features

- User friendly, parameter driven interface.
- Fax or voice annunciations for automotive alarms.
- Optional performance reporting based on Web access to a Data Server.
- Ethernet service interface.
- User configurable trending of all power station readings.
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- Ability to interface to diesel and/or gas generators.
- High flexibility for future changes to the power station configuration.
- Compatibility to most prime mover types.
- Distributed architecture of the control system minimises the risk of outages from a single hardware failure.

Typical Application for the Feeder Controller



Future Features for Commander

The following table contains a list of features that are currently under development. These features will be included in future releases of the Commander software.

Feature	Description
Commander Master Controller Time Synchronisation	The time in the Commander Master Controller is set during the manufacturing process. Currently it cannot be changed, although the time zone to adjust the clock to your local time can be changed. In the next release of the Commander Master Controller, the time will be automatically adjusted to synchronise with the computer that IPSview is installed on.
IPSview Multiple Users Access	More than one user can access the Commander Master Controller using IPSview. However, the Commander Master Controller can currently only administer one user. This means that when more than one user is connected, they both share the same access level. Future upgrades will allow user names and passwords for multiple users.

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- Modem
- Modem RS232 cable
- CAN bus termination plug
- RS232/485 converter

Other Commander Product Specifications Available

- Commander Master Controller Product Specification
- Generator Controller Product Specification
- Commander Communications Product Specification
- Commander Software Product Specification

More Information

For more information or queries about Commander please contact us direct or visit our website. We look forward to hearing from you!

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COMMANDER MASTER CONTROLLER

The Commander System

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- Commander Master Controller
- Commander Software
- Commander Communications
- Generator Controller
- Feeder Controller

The central focus of the Commander control system is a comprehensive data pool that is formulated using data collected from the Commander Master Controller, Generator Controller, Feeder Controller. The values contained in the data pool can be visualised via the IPSview software and can be accessed locally in the power station or remotely via a dial up connection.

The values in the data pool are sampled on a priority basis, ensuring that all activities and actions are managed in a safe and efficient manner within the power station. The data pool is a key element of the software architecture and as such provides visual representation, alarm reporting and plant information in a high-speed environment, aiding accurate data analysis and trending of data.

General Description & Function

The Commander system enables a power station to operate automatically without human intervention, except for monitoring, maintenance of plant and fuel supplies.

The controllers used in the Commander control system are:

- Commander Master Controller
- Generator Controller
- Feeder Controller

The Commander Master Controller automatically controls and monitors all diesel and/or gas generator sets, consumer feeders and fuel tanks in a power station. It provides alarm/event reporting, trending, remote access and external alarm notification.

Depending on system load conditions, the Commander Master Controller starts and stops generators to optimise station fuel efficiency. The Commander Master Controller maintains optimum loading and spinning reserve on all in-service generator sets. The Commander Master Controller power management continuously monitors the feeder load and matches the most economical configuration of the generator sets to the demand. By doing so it ensures that the following criteria are met:

- Maintaining the required spinning reserve
- Optimising the loading of generator sets
- Preventing low loading of generator sets

The Commander Master Controller is based on an open controller hardware architecture. Embedded industrial PC hardware is used with distributed I/O to achieve mission critical and highly reliable power station control. The Commander Master Controller is specifically designed for power station applications and can withstand temperatures between -40°C and +50°C.

Communications between the Commander Master Controller, the generator sets and the consumer feeder circuit breakers takes place via fieldbus using the CAN protocol.



(Commander Master Controller)

The Commander Master Controller enables fuel savings due to better loading of generator sets and fewer operation and maintenance costs due to much improved management of plant assets.

The Commander Master Controller is able to control and monitor:

- Up to 8 Generator Controllers.
- Up to 6 Feeder Controllers.
- An additional 1 Feeder Controller for use as a Local Light and Power Meter.
- Up to 12 Bulk Fuel Storage Tanks.
- Up to 3 Temperature Measurement Inputs.

Standard Features

CONTROL

- Diesel and/or gas generator manual / operator / auto control for up to 8 generators.
- Feeder manual / operator / auto control for up to 6 HV or LV feeders.
- Station automatic black start.
- Configuration management for automatic call-up of generators.
- Automatic call-up of replacement gensets before an alarm shutdown.
- Automatic connection and disconnection of consumer feeders (load shedding).

MONITORING

- Station data monitoring, recording and trending.
- Generator data monitoring, recording and trending.
- Feeder data monitoring, recording and trending.
- Fuel farm monitoring.
- Remote control and monitoring access.
- Monitoring of station batteries and battery charger.
- Alarm/event reporting, trending, remote control and external alarm notification via voice, or fax.

OTHER

- Automatic upload of data records and trends to a central remote database (eg a head office).
- Parameter driven operation.
- Up and download facility of parameter sets.
- RS232 service interface.
- The Commander Master Controller meets UL and CE approval requirements .

Hardware Features

The Commander Master Controller hardware is based on an industrial PC platform, especially designed for rugged industrial environments.

- Dimensions (W x D x H)..... 228 x 143 x 92mm
- Weight..... 2 kg
- Fan..... Operates without fan
- Nominal supply voltage range..... 10 to 30Vdc
- Max. power consumption at rated voltage.....Maximum 13.2W
- Ambient humidity.....5% - 90% at +40°C
Non-condensating
- Operating temperature..... 0°C to 50°C
- Storage temperature..... -40°C to +50°C
- Flammability..... 94V-0
- Vibration..... TBD G @ 5 to TBD Hz
- Incorporated CAN bus for direct connection to Generator Controller and Feeder Controller
- Additional Modbus interface for connection with auxiliary devices
- Service laptop interface via Ethernet 10BaseT
- Warranty..... 12 months
- Standards:
 - UL approval E214940
 - CE compliant, EN 50082-2 (immunity) and EN50081-2/55022 (emission)
- Optional extended temperature range of -40°C to +50°C

Software Features

Please refer to the Commander Software Product Specification for more details.

- Full automatic operation of power station plant.
- Real-time visualisation of the power station.
- Visualisation of individual generators and feeders via data on CAN bus.
- Secured access to all parameters including those in the Generator Controller.
- Customisable via user configurable files.
- Trending of all power station data including generators and feeders.

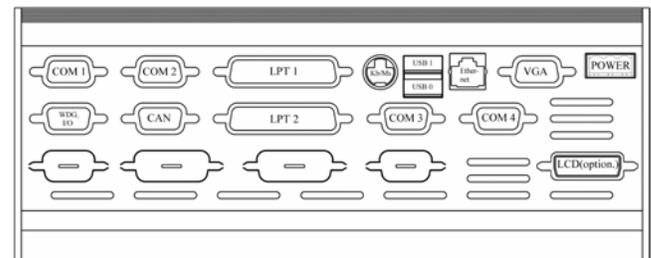
Communication Features

Please refer to the Commander Communications Product Specification for more details

- Interfacing to the diesel generators, feeders and fuel tanks is realised via fieldbus – using CAN bus and Modbus.
- Physical Layers:
 - CAN bus
 - Ethernet 10baseT
 - Serial RS232 point-to-point link
 - Serial RS-422/RS-485
- Communication protocols:
 - CAN 2.0 Part A
 - TCP/IP
 - Modbus/TCP and Modbus RTU



(Front: The Commander facia)



(Bottom: The Commander Interface Connections)

Control Functions

Station Automatic Control

- Automatic station black start.
- Spinning reserve management.
- Station overload feeder load shedding.
- Station under frequency feeder load shedding.

Generator Control

- Semi-automatic (operator) control of each generator.
- Automatic generator starting and stopping based on engine priorities.
- Automatic call-up of replacement generators before alarm shutdown.
- Fuel consumption recording.

Feeder Control

- Semi-automatic (operator) control of each feeder.
- Automatic feeder closing during black start.
- Automatic feeder load shedding based on station overload.
- Automatic feeder load shedding based on station under frequency.
- Automatic feeder rotation in case of lack of generation capacity.
- Priority based feeder connection and disconnection.

Monitoring Functions

Bulk Fuel Storage Tanks

- Tank alarm reporting for low levels.
- Individual size volume calculations.
- Supervision of the Commander Master Controller to tank level sensor communication system.

Temperature Measurement Inputs

- Analogue temperature measurement (for example, engine hall temperature).
- Supervision of the Commander Master Controller to temperature sensor communication system.

Alarm Monitor

- External alarm notification using voice and fax.
- Voice messaging of alarms to multiple telephone numbers.
- Fax messaging of alarms to multiple facsimile numbers.
- Alarm filtering to send highest priority alarms first.

Data Recording

- Station load, frequency, voltage etc.
- Station number of blackouts, total station outage time etc.
- Generator power, temperatures, currents.
- Generator kWh, engine hours, fuel consumptions etc.
- Feeder power, frequency, voltage
- Feeder kWh, number of open/close cycles, total feeder outage time etc
- Tank levels, tank volume
- Temperatures

Other Functions

Operator Interface

- Real-time visualisation of the power station.
- Access to semi-automatic (operator) control of generators.
- Access to semi-automatic (operator) control of feeders.
- Viewing of trending/graphic information.
- Password protection.
- Access to parameters for system commissioning and setup.

Remote Access

- Remote control of the power station.
- Remote monitoring of the power station.
- Remote alarm reset.
- Remote access to trending information.
- Remote access to parameters.

Operation Modes

Each device (generator sets, feeders) controlled by the Commander Master Controller can operate in one of three modes:

- **Operation Mode – MANUAL**

If a sub-system is in manual operation, all commands from the Commander Master Controller are isolated from the manual control system. This means that the Commander Master Controller has no control over the dedicated device. In manual operation, interference of operations via the SCADA system or the Commander Master Controller is impossible. The Commander Master Controller continues to log alarms recorded on the devices, as well as to monitor device status but no control functions take place.

- **Operation Mode – AUTOMATIC**

If a sub-system is in automatic operation it is automatically controlled by the Commander Master Controller. Manual controls are overridden by the Commander Master Controller commands. In this operation mode manual controls at the device switchboards are disabled.

- **Operation Mode – OPERATOR**

In operator mode each device can be started via the on-site or remote SCADA system. In this operation mode manual controls at the device switchboards are disabled.

The Commander Master Controller monitors the status of each device in the power station. Every time an event occurs that has been customised to trigger an alarm, an alarm is logged for that device. Alarms can be viewed on the Operator Interface using the IPSview software.

Types of alarms:

- **SYSTEM ALARM (SA)**

The Commander Master Controller monitors and check the status of the communication to all devices. If an abnormal situation occurs, the Commander Master Controller raises a system alarm. System alarms are generated by the Commander Master Controller, not individual device controllers. System alarms reset automatically once the alarm condition has been rectified.

- **WARNING ALARM (WA)**

The operation of the power station is uninterrupted and the device continues to function normally. The operator should investigate the cause of the warning alarm in due course. The warning alarm will be reset when the alarm condition has been rectified.

- **NON-CRITICAL ALARM (NCA)**

Non-critical alarms only occur on the generators. The operation of the power station is uninterrupted but the Commander Master Controller starts replacement generators and takes the generator with the non-critical alarm off line when sufficient replacement capacity is online. The operator should investigate the cause of the non-critical alarm immediately. The non-critical alarm will be reset when the alarm condition has been rectified and the operator has acknowledged the alarm.

- **CRITICAL ALARM (CA)**

The operation of the power station may be interrupted, potentially causing a blackout. The Commander Master Controller attempts to stabilise the power system and restore grid voltage and frequency. The operator should investigate the cause of the critical alarm immediately. The critical alarm will be reset when the alarm condition has been rectified and the operator has acknowledged the alarm.

Station Alarms

Defines the various alarms that can occur in the power station.

- Station Black Alarm.
- Station No Generators Alarm.
- Station No Feeders Alarm.
- Station Power Supply Failed Alarm.
- Station Fire Alarm.
- Station Battery Charger Failed Alarm.
- Station Under Frequency Alarm.
- Station Over Load Alarm.
- Station Intruder Alarm.
- Station Lack of Capacity Alarm.
- Station Temperature Communications Alarm.
- Station LLP (Local Light & Power) Power Monitor Alarm.
- System CPU Over Temperature Alarm.
- System CMOS Battery Low Alarm.
- System CPU Watchdog Alarm.
- System Parameter Write Alarm.
- System Operation Data Lost Alarm.
- System Reboot Alarm.
- System Fatal Alarm.
- Station Emergency Stop Alarm.

Tank Alarms

Defines the various alarms that can occur on each fuel tank

- Tank Empty Alarm.
- Tank Low Alarm.
- Tank I/O Alarm.
- Tank Communications Alarm.

Generator Alarms

The Commander Master Controller logs these general alarms for each generator. Specific generator alarms (like under voltage or loss of coolant) are monitored at the Generator Controller level and can be viewed on the front panel of the Generator Controller or using the IPSview software.

- Generator Warning Alarm.
- Generator Non-Critical Alarm.
- Generator Critical Alarm.
- Generator Fail to Open Alarm.
- Generator Fail to Start Alarm.
- Generator Fail to Stop Alarm.
- Fail to Synchronise Alarm.
- Generator Power Monitor Alarm.
- Generator Digital I/O Alarm.

Feeder Alarms

Defines the various alarms that can occur on an individual feeder

- Feeder Trip Alarm.
- Feeder Fail to Close Alarm.
- Feeder Fail to Open Alarm.
- Feeder Sensitive Earth Fault (HV) Alarm.
- Feeder Earth Fault (LV) Alarm.
- Feeder Over Current Alarm.
- Feeder Power Monitor Alarm.
- Feeder Digital IO Alarm.

The Commander Master Controller monitors changes in the state of each device in the power station. Every time a change occurs, an event is logged for that device. The operator does not need to action events. Events can be viewed on the Operator Interface using the IPSview software.

Station Events

- Station Initialisation State.
- Station Stop State.
- Station Power-up State.
- Station Run State.
- Station Shutdown State.

Generator Events

Generator Commands

The Commander Master Controller can issue the following commands to a Generator Controller:

- Online command.
- Offline command.
- Operator command.
- Automatic command.
- Alarm reset command.
- Service done command.
- Clear start command.
- First start command.
- Last start command.
- Start command.
- Close command.
- Open command.
- Unload command.
- Stop command.

Generator States

The Commander Master Controller receives the following feedback information from a Generator Controller:

- Stop state.
- Run state.
- Circuit breaker open state.
- Circuit breaker closed state.
- Temperature derating state.
- Starting state.
- Stopping state.
- Black bus state.
- Pre-glow state.
- Warm up state.
- Synchronization state.
- Unload state.
- Cool down state.
- Healthy state.
- Alarm state.

Generator Modes

A generator can operate in the following modes:

- Manual mode.
- Operator mode.
- Auto mode.
- First start mode.
- Last start mode.

Feeder Events

Feeder Commands

The Commander Master Controller can issue the following commands to a Feeder Controller:

- Close command.
- Open command.
- Operator command.
- Automatic command.
- Alarm reset command.

Feeder States

The Commander Master Controller receives the following feedback information from a Feeder Controller:

- Open state.
- Closed state.
- Closing state.
- Opening state.
- Black Bus state.
- Healthy state.
- Alarm state.

Feeder Modes

A feeder can operate in the following modes:

- Manual mode.
- Operator mode.
- Automatic mode.

Parameter Overview

The following lists contain the parameters that can be changed using the IPSview software. The parameters can be changed locally or via remote control. The parameters are protected by a series of security levels as follows:

- Level 0: Read only level.
- Level 1: Operator password level is required to change the parameter.
- Level 2: Maintenance password is required to change the parameter.
- Level 3: Engineer password is required to change the parameter.
- Level 4: Commissioning password is required to change parameter.

Station Manager Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Station local light and power demand	kW	0	100	3
Station averaging time for generated power	sec	0	100	3
Station minimum long-term spinning reserve	kW	0	1000	3
Station minimum short-term spinning reserve	kW	0	1000	3
Station spinning reserve	kW	0	1000	3
Station averaging time for the long-term	min	1	60	3
Station averaging time for the short-term	sec	1	600	3
Station number of black start attempts	-	0	5	3
Station commissioned date	-	01/01/1970	31/12/2039	4
Station control mode	-	0	1	5
Station local light and power meter	-	0	1	4
Station number of demand managed devices	-	0	12	5
Station number of feeders	-	0	6	5
Station number of generators	-	0	8	5
Station number of fuel tanks	-	0	12	5

System Parameters

Parameter Name	Unit	Minimum	Maximum	Password
System IP address	-	0	FFF FFF FFF FFF	5
System netmask address	-	0	FFF FFF FFF FFF	5
System engineering password	-	0	0	5
System ID	-	0	99999999	3
System I/O Configuration of the CPU	-	0	0xFFFF	5
System maintenance password	-	0	99999999	5
System operator password	-	0	99999999	5
System commissioning password	-	0	99999999	5

System I/O Parameters

Parameter Name	Unit	Minimum	Maximum	Password
System CAN Bus Timeout	sec	0	9999999	4
Control room temperature normalisation high boundary	degC	-1000.00	1000.00	5
Control room temperature normalisation low boundary	degC	-1000.00	1000.00	5
Control room temperature sensor high boundary	-	-32767	32768	5
Control room temperature sensor low boundary	-	-32767	32768	5
Engine room temperature normalisation high boundary	degC	-1000.00	1000.00	5
Engine room temperature normalisation low boundary	degC	-1000.00	1000.00	5
Engine room temperature sensor high boundary	-	-32767	32768	5
Engine room temperature sensor low boundary	-	-32767	32768	5
Outside ambient temperature normalisation high boundary	degC	-1000.00	1000.00	5
Outside ambient temperature normalisation low boundary	degC	-1000.00	1000.00	5
Outside ambient temperature sensor high boundary	-	-32767	32768	5
Outside ambient temperature sensor low boundary	-	-32767	32768	5
Control room temperature register address	-	0	6	5
Control room temperature slave address	-	0	255	5
Engine room temperature register address	-	0	6	5
Engine room temperature slave address	-	0	255	3
Outside ambient temperature register address	-	0	6	5
Outside ambient temperature slave address	-	0	255	5

Generator Manager Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Generator configuration table	-	0x0	0xE0FF	2
Generator configuration priorities	-	0x0	0xFFFFFFFF	2
Generator kilowatt hysteresis	kW	0	500	3
Generator percentage hysteresis	-	0	100	3
Generator actual power smoothing	sec	0	100	3
Generator power configuration setpoint smoothing	sec	0	100	3
Generator reset minimum load long-term	kW	0	100	3
Generator configuration minimum run time	min	0.0	180.0	2
Generator off separation time	sec	10	900	3
Generator black start configuration	-	0	255	-
Generator call-up strategy	-	1	3	2

Generator Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Generator # fuel pulse scaling	Litres/pulse	0.0000	99.0000	5
Generator # maximum derating percentage	-	0.0	100.0	2
Generator # optimum operating range lower limit	-	0.0	100.0	2
Generator # optimum operating range upper limit	-	0.0	100.0	2
Generator # prime power rating	kW	0	2000	2
Generator # temperature derating lower limit	degC	0.0	120.0	2
Generator # temperature derating upper limit	degC	0.0	120.0	2
Generator # minimum run time	min	0.00	180.00	2
Generator # open timer	sec	0	900	3
Generator # start timer	sec	0	900	3
Generator # stop timer	sec	0	900	3
Generator # synchronisation timer	sec	0	900	3
Generator # control type	-	0	341	5
Generator # fuel economy update counter	kWh	0	200	3
Generator # manager type	-	1	3	3

Feeder Manager Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Feeder overload	-	0.00	150.00	3
Feeder averaging time for the power demand	sec	0.01	750.00	3
Feeder time close next	sec	0.00	600.00	3
Feeder overload delay time	sec	0.00	3600.00	3
Feeder tie shed next	sec	0.01	20.00	3
Feeder underfrequency delay time	sec	0.00	10.00	3
Feeder underfrequency	Hz	0.00	60.00	3
Feeder close strategy	-	0	2	3

Feeder Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Feeder # minimum power demand	kW	0.00	2000.00	3
Feeder # power demand safety factor	-	0	200	2
Feeder # closing time	sec	0.00	900.00	2
Feeder # opening time	sec	0.00	900.00	3
Feeder # maximum outage time	min	0.00	180.00	2
Feeder # reconnection delay time	min	0.00	180.00	3
Feeder # extended open time	sec	0.0	60.0	2
Feeder # control type	-	0	117	3
Feeder # priority	-	0	6	2

Tank Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Tank # capacity	litres	0	99999	5
Tank # diameter	mm	0	99999	5
Tank # empty level	litres	0	999999	4
Tank # length	mm	0	99999	5
Tank # low level	-	0	100.00	4
Tank # fuel level normalisation low boundary	litres	-99999.00	99999.00	5
Tank # fuel level normalisation low boundary	litres	-99999.00	99999.00	5
Tank # fuel level sensor high boundary	-	-32767	32768	5
Tank # fuel level sensor low boundary	-	-32767	32768	5
Tank # fuel level register address	-	0	6	5
Tank # fuel level slave address	-	0	255	5

Alarm Notification Parameters

Parameter Name	Unit	Minimum	Maximum	Password
Alarm monitor time off	sec	2	1800	-
Alarm monitor communications port	-	0	6	-
Alarm monitor fax configuration	-	0	100	-
Alarm monitor fax minimum retries	-	0	9	-
Alarm monitor fax time before redial	sec	2	1800	-
Alarm monitor phone configuration	-	0	15	-
Alarm monitor phone maximum retries	-	0	9	-
Alarm monitor phone time before redial	sec	2	1800	-
Alarm monitor time delay	sec	0	1800	-

Benefits

- Remote control and monitoring
- Reduced fuel consumption
- Reduced operation and maintenance costs
- Easy asset management
- Better genset efficiencies
- Reduced need for on-site staff

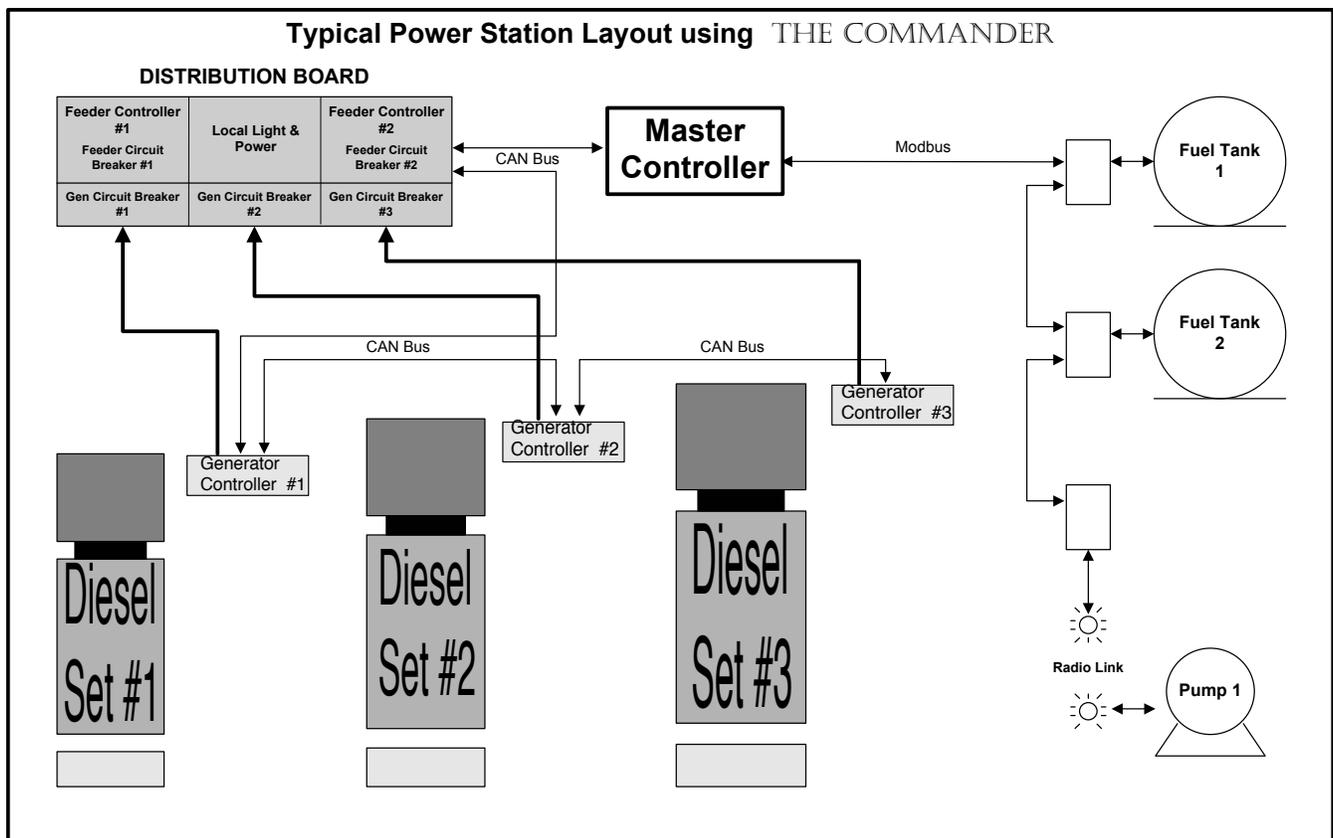
Applications

- Mining operations
- Telecommunication sites
- Defence applications
- Remote or island communities
- Hotel and tourist resorts
- Individual towns or villages
- Industrial estates
- Emergency services and disaster relief
- Construction sites

Unique Features

- User friendly, parameter driven interface.
- Fax or voice annunciations for automotive alarms.
- Optional performance reporting based on Web access to a Data Server.
- Ethernet service interface.
- User configurable trending of all power station readings.
- Mission critical control (i.e. load shedding) achieved via CAN bus.
- Ability to interface to diesel and/or gas generators.
- High flexibility for future changes to the power station configuration.
- Compatibility to most prime mover types.
- Distributed architecture of the control system minimises the risk of outages from a single hardware failure.

Typical Application



Future Features for Commander

The following table contains a list of features that are currently under development. These features will be included in future releases of the Commander Master Controller software.

Feature	Description
Commander Master Controller Time Synchronisation	The time in the Commander Master Controller is set during the manufacturing process. Currently it cannot be changed, although the time zone to adjust the clock to your local time can be changed. In the next release of the Commander Master Controller, the time will be automatically adjusted to synchronise with the computer that IPSview is installed on.
IPSview Multiple Users Access	More than one user can access the Commander Master Controller using IPSview. However, the Commander Master Controller can currently only administer one user. This means that when more than one user is connected, they both share the same access level. Future upgrades will allow user names and passwords for multiple users.

Commander Package

The Commander package includes the following items:

- Commander Master Controller
- Generator Controller
- Feeder Controller
- IPSview software
- Folder with manuals
- RJ-45 Communication crossover cable
- Commander Master Controller 24VDC power supply plug
- Power pack 100-240Vac/50-60Hz/50W, 24dc
- Modem
- Modem RS232 cable
- CAN bus termination plug
- RS232/485 converter

Other Commander Product Specifications Available

- Generator Controller Product Specification
- Feeder Controller Product Specification
- Communications Product Specification
- Commander Software Product Specification

More Information

For more information or queries about Commander please contact us direct or visit our website. We look forward to hearing from you!

www.pcorp.com.au

The Powercorp Group

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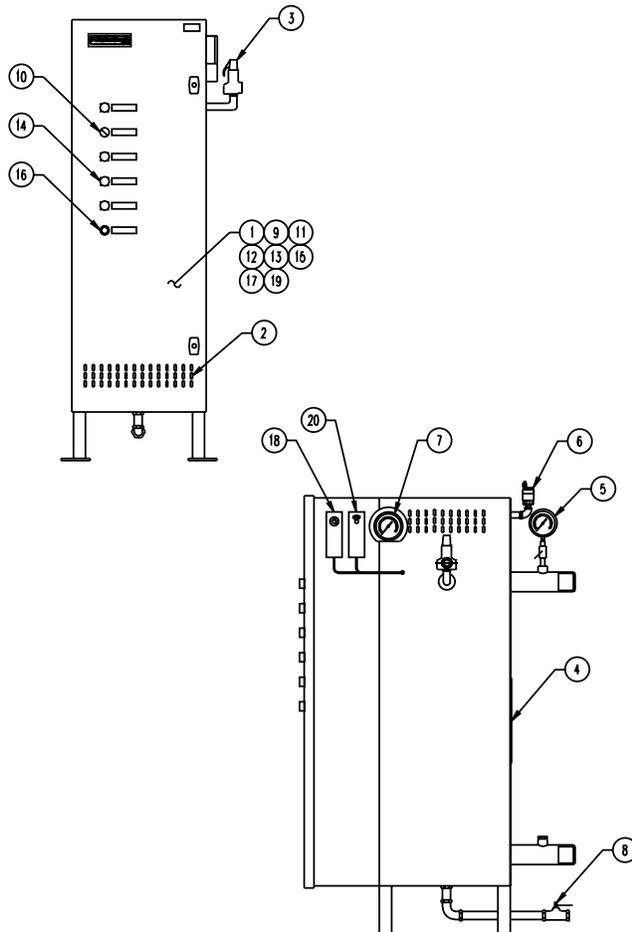
Postal: PMB 88, Berrimah, Northern Territory, Australia, 0828

Packaged Hot water Boilers DESCRIPTION

Caloritech™ electric hot water boilers are recommended for applications where a clean, safe, quiet and reliable source of hot water is required. Caloritech™ electric hot water boilers may be used as the sole source of heat or in standby applications such as summer periods when operation of larger boilers may prove uneconomical. The Caloritech™ boiler is ideally suited for use in dual energy systems; electric-oil or electric-gas. Low water volume assures quick response. Caloritech™ boilers are 100% efficient with over 98% of the energy consumed transferred directly to the water.

TYPICAL USES

- process heating
- heat transfer loops
- comfort heating: institutional and commercial
- freeze protection
- industrial and commercial standby equipment
- commercial dishwashers
- radiant floor heating
- commercial swimming pools
- domestic hot water
- car washes
- laundromats



FEATURES

- space saving vertical vessels and top mounted vertically positioned flange heaters (VWB only) to minimize scaling, conserve floor space and simplify maintenance.
- clean and odorless; venting not required.
- quiet operation.
- fully packaged to minimize electrical and plumbing installation costs.
- incoloy sheathed heating elements silver brazed to mounting flange.
- designed and built to the latest edition of the ASME Code
- compliant to SELO standards.
- capacities up to 4950 kW and pressure ratings to 2500 PSIG are available.

STAGING

Heating circuits are staged generally in compliance with the following table:

BOILER AMPS	NO. OF STAGES (MIN.)
45	1
90	2
270	3
360	4
450	5
540	6
600	5
720	6

For each additional 120 amps after 720, add an additional stage. For example, for boiler amps of 960, the number of stages is 8.

STANDARD BOILER ACCESSORIES

Det. No.	Description
1	Insulated ASME designed pressure vessel
2	Vented control cabinet
3	Pressure relief valve
4	Inspection and cleanout holes
5	Pressure gauge c/w isolating stopcock (not shown)
6	Air vent
7	Temperature gauge
8	Drain blowdown valve
9	Flanged heaters c/w low watt density elements
10	Control circuit on/off switch
11	Control circuit transformer (fused)
12	HRC power fusing
13	Magnetic contactors
14	Indicating pilot lights
15	Electronic low water control
16	Push to test button for low water simulation
17	On/off staging up to 95 amps
18	Proportional temperature controller for units over 95 amps
19	Staging controller with detail no. 18
20	High temperature controller

Packaged Hot Water Boilers

PHYSICAL DIMENSIONS, OPENING SIZES, VOLUMES, AND LINE CURRENTS

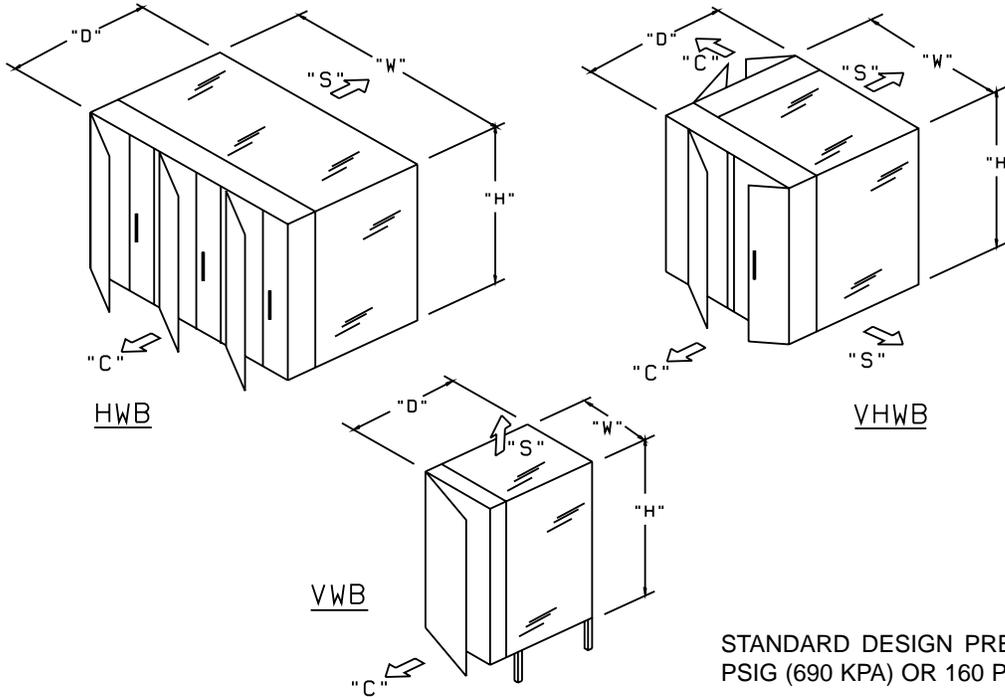
Listed below is a summary of the **approximate** minimum clearance requirements, piping sizes and volumes for the various standard boiler types and sizes.

If these dimensions are unsuitable to your intended installation, you may consider two smaller boilers working in tandem or requesting a quote on a customized unit.

To calculate boiler line current, use the following basic equations.

$$\text{One phase: AMPS} = \frac{\text{BOILER WATTAGE}}{\text{VOLTAGE}}$$

$$\text{Three phase: AMPS} = \frac{\text{BOILER WATTAGE}}{1.73 \times \text{VOLTAGE}}$$



STANDARD DESIGN PRESSURE IS 100 PSIG (690 KPA) OR 160 PSIG (1104 KPA)

TABLE 1 - HOT WATER BOILER GENERAL SPECIFICATIONS

MODEL NO.	MAX. kW	DIMENSIONS IN (MM)					VESSEL OPENINGS (NPT)*		NORMAL WATER VOLUME IMP. GALLONS (LITRES)
		H	W†	D	C	S	INLET/ OUTLET	DRAIN VALVE	
VWB-10	150	54 (1372)	16 (406)	24 (610)	16 (406)	36 (914)	2	3/4	11.3 (51.4)
VWB-20	585	64 (1626)	26 (660)	36 (914)	26 (660)	36 (914)	4	1 1/4	46.5 (212)
VWB-30	1080	66 (1676)	42 (1067)	47 (1194)	38 (965)	36 (914)	4	1 1/2	105 (478)
VWB-42	1890	90 (2286)	72 (1829)	62 (1575)	48 (1219)	36 (914)	8	1 1/2	206 (936)
VHWB-42	3240	96 (2438)	72 (1829)	72 (1829)	48 (1219)	36 (914)	8	2	328 (1500)
VHWB-48	3735	108 (2743)	84 (2134)	84 (2134)	48 (1219)	48 (1219)	8	2	470 (2140)
HWB-54	4995	92 (2337)	163 (4140)	82 (2083)	48 (1219)	48 (1219)	8 1/2	2 1/2	1400 (6370)

* INLET AND OUTLET FLANGED ABOVE 3" NPT

† WIDTH 'W' MAY BE 8" (200 MM) MORE FOR HIGHER AMPERAGE UNITS

Packaged Hot Water Boilers

Caloritech™ VWB packaged hot water boilers have proven their superiority in thousands of installations. The VWB boiler features a space saving vertical vessel with vertically positioned flange heaters which minimize scaling while simplifying maintenance. Standard units have a design pressure of 160 PSIG with the relief valve set at 125 PSIG.

Three choices of inner shell material coatings allow the VWB to meet most applications:

TYPE VWBF - The VWBF boiler has an uncoated steel shell. The boiler is suitable for use in comfort heating, domestic water heating, freeze protection, process heating, etc. where water purity is not an important issue.

TYPE VWBC - The VWBC boiler has a sprayed copper inner shell lining for use in water heating applications where a higher purity water is required and a galvanized vessel is unsuitable.

TYPE VWBG - The VWBG boiler has a dipped galvanized steel shell. Besides covering all uses of the VWBF, the boiler is also suitable for heating water in commercial dishwashers, for heating consumable water for showers and sinks, and for heating swimming pools.



SHOWN WITH OPTIONAL FEATURES

TO ORDER: Specify quantity, catalog no., voltage, phase, kW rating, intended use, optional features, operating pressure, ultimate owner's name and address, and installation address.

TABLE 1 - TYPE VWBF, VWBC, AND VWBG WATER BOILERS (10")

KILOWATTS NOM'L (ACT'L)	HEATERS NO. (kW)	STANDARD VOLTAGES 1Ø & 3Ø	CATALOG NUMBER			WEIGHT LBS (KG)
			UNCOATED STEEL	COPPER COATED	GALVANIZED	
12	1(12)	208, 240, 380, 416, 480, 600	VWBF-10-12	VWBC-10-12	VWBG-10-12	350 (159)
15	1(15)	"	VWBF-10-15	VWBC-10-15	VWBG-10-15	350 (159)
18*	1(18)	"	VWBF-10-18	VWBC-10-18	VWBG-10-18	350 (159)
24	2(12)	"	VWBF-10-24	VWBC-10-24	VWBG-10-24	360 (163)
30	2(15)	"	VWBF-10-30	VWBC-10-30	VWBG-10-30	360 (163)
36*	2(18)	"	VWBF-10-36	VWBC-10-36	VWBG-10-36	360 (163)
42	1(12) + 2(15)	"	VWBF-10-42	VWBC-10-42	VWBG-10-42	370 (168)
50 (48)	4(12) OR 2(24)	"	VWBF-10-50	VWBC-10-50	VWBG-10-50	380 (172)
60	5(12) OR 4(15)	"	VWBF-10-60	VWBC-10-60	VWBG-10-60	390 (177)
72	1(12) + 4(15) OR 4(18) OR 3(24)	"	VWBF-10-72	VWBC-10-72	VWBG-10-72	390 (177)
84	2(12) + 4(15)	"	VWBF-10-84	VWBC-10-84	VWBG-10-84	400 (181)
90	6(15) OR 5(18) OR 4(22 1/2)	"	VWBF-10-90	VWBC-10-90	VWBG-10-90	400 (181)
96*	2(12) + 4(18) OR 4(24)	"	VWBF-10-96	VWBC-10-96	VWBG-10-96	400 (181)
100* (102)	1(12) + 5(18) OR 1(12) + 4(22 1/2)	"	VWBF-10-100	VWBC-10-100	VWBG-10-100	400 (181)
108*	1(12) + 4(24) OR 6(18)	"	VWBF-10-108	VWBC-10-108	VWBG-10-108	400 (181)
3Ø ONLY						
120	1(12) + 6(18) OR 8(15)	208, 240, 380, 416, 480, 600	VWBF-10-120	VWBC-10-120	VWBG-10-120	410 (186)
135	3(15) + 5(18)	"	VWBF-10-135	VWBC-10-135	VWBG-10-135	420 (191)
150*	4(15) + 5(18)	"	VWBF-10-150	VWBC-10-150	VWBG-10-150	430 (195)

* CONTACTORS IN THIS UNIT NOT DERATED FOR 208V, 3Ø

Packaged Hot Water Boilers

(continued)

TYPE VWBF - The VWBF boiler has an uncoated steel shell. The boiler is suitable for use in comfort heating, domestic water heating, freeze protection, process heating, etc. where water purity is not an important issue.

TYPE VWBC - The VWBC boiler has a sprayed copper inner shell lining for use in water heating applications where a higher purity water is required and a galvanized vessel is unsuitable.

TYPE VWBG - The VWBG boiler has a dipped galvanized steel shell. Besides covering all uses of the VWBF, the boiler is also suitable for heating water in commercial dishwashers, for heating consumable water for showers and sinks, and for heating swimming pools.



SHOWN WITH
OPTIONAL FEATURES

TABLE 1 - TYPE VWBF, VWBC, AND VWBG WATER BOILERS (20")

KILOWATTS NOM'L (ACT'L)	HEATERS NO. (kW)	STANDARD VOLTAGES 3Ø ONLY	CATALOG NUMBER			WEIGHT LBS (KG)
			UNCOATED STEEL	COPPER COATED	GALVANIZED	
165	11(15) OR 5(15) + 5(18)	208, 240, 380, 416, 480, 600	VWBF-20-165	VWBC-20-165	VWBG-20-165	1120 (508)
180	12(15) OR 10(18)	"	VWBF-20-180	VWBC-20-180	VWBG-20-180	1130 (513)
200 (195)	13(15) OR 1(15) + 10(18)	"	VWBF-20-200	VWBC-20-200	VWBG-20-200	1130 (513)
210	14(15) OR 2(15) + 10(18)	"	VWBF-20-210	VWBC-20-210	VWBG-20-210	1140 (517)
240	16(15) OR 4(15) + 10(18)	"	VWBF-20-240	VWBC-20-240	VWBG-20-240	1160 (526)
250 (247, 252, 255)	17(15) OR 14(18) OR 11(22 1/2)	"	VWBF-20-250	VWBC-20-250	VWBG-20-250	1170 (531)
270	18(15) OR 15(18)	"	VWBF-20-270	VWBC-20-270	VWBG-20-270	1180 (535)
300	20(15) OR 2(15) + 15(18) OR 2(15) + 12(22 1/2)	"	VWBF-20-300	VWBC-20-300	VWBG-20-300	1200 (544)
360	24(15) OR 20(18) OR 16(22 1/2)	"	VWBF-20-360	VWBC-20-360	VWBG-20-360	1230 (558)
400* (396, 405)	22(18) OR 18(22 1/2)	"	VWBF-20-400	VWBC-20-400	VWBG-20-400	1230 (558)
450	25(18) OR 20(22 1/2)	240, 380, 416, 480, 600	VWBF-20-450	VWBC-20-450	VWBG-20-450	1240 (562)
500 (510)	2(15) + 20(24) OR 1(15) + 22(22 1/2)	380, 416, 480, 600	VWBF-20-500	VWBC-20-500	VWBG-20-500	1240 (562)
585	26(22 1/2)	600	VWBF-20-585	VWBC-20-585	VWBG-20-585	1250 (567)

* CONTACTORS IN THIS UNIT NOT DERATED FOR 208V, 3Ø

TABLE 2 - TYPE VWB WATER BOILERS (30" AND 42")

NOMINAL KW	ACTUAL kW AT STANDARD AVAILABLE 3Ø VOLTAGES				CATALOG NUMBER	WEIGHT LBS (KG)
	208V, 240V	380V, 416V	480V	600V		
450	450	450	468	450	VWB-30-450	1640 (745)
500	495	510	504	495	VWB-30-500	
550	555	540	540	540	VWB-30-550	
600	600	600	612	585	VWB-30-600	
650	—	648	648	630	VWB-30-650	1640 (745)
700	—	684	684	720	VWB-30-700	1750 (795)
750	—	756	756	765	VWB-30-750	1750 (795)
800	—	792	792	810	VWB-30-800	1750 (795)
900	—	—	900	900	VWB-30-900	1860 (845)
1000	—	—	990	990	VWB-30-1000	1970 (895)
1100	—	—	1080	1080	VWB-30-1100	1970 (895)
650	645	—	—	—	VWB-42-650	2700 (1225)
700	705	—	—	—	VWB-42-700	2800 (1270)
750	750	—	—	—	VWB-42-750	2800 (1270)
800	795	—	—	—	VWB-42-800	2900 (1320)
900	900	900	—	—	VWB-42-900	2900 (1320)
1000	1005	990	—	—	VWB-42-1000	3000 (1365)
1050	1050	1050	—	—	VWB-42-1050	3000 (1365)
1100	CHECK FACTORY	1110	1116	1080	VWB-42-1100	3100 (1410)
1200	FACTORY	1200	1188	1215	VWB-42-1200	3100 (1410)
1300	"	1290	1296	1305	VWB-42-1300	3200 (1455)
1400	"	1410	1404	1395	VWB-42-1400	3300 (1500)
1500	"	1500	1512	1485	VWB-42-1500	3300 (1500)
1750	"	1740	1755	1755	VWB-42-1750	3460 (1570)
1900	"	1890	1890	1890	VWB-42-1900	3460 (1570)

TABLE 3 - TYPE VHWB WATER BOILERS (42" & 48")

NOMINAL KW	ACTUAL kW AT STANDARD AVAILABLE 3Ø VOLTAGES				CATALOG NUMBER	WEIGHT LBS (KG)
	208V, 240V	380V, 416V	480V	600V		
2000	—	2010	1980	1980	VHWB-42-2000	4100 (1860)
2250	—	2250	2268	2250	VHWB-42-2250	4260 (1930)
2500	—	2490	2484	2520	VHWB-42-2500	4410 (2000)
2750	—	2730	2745	2745	VHWB-42-2750	4560 (2070)
3000	—	3000	2970	2970	VHWB-42-3000	4560 (2070)
3250	—	3240	3240	3240	VHWB-42-3250	4710 (2135)
3500	—	3510	3510	3510	VHWB-48-3500	4860 (2205)
3750	—	3750	3735	3735	VHWB-48-3750	5010 (2275)

TABLE 4 - TYPE HWB WATER BOILERS (54")

NOMINAL KW	ACTUAL kW AT STANDARD AVAILABLE 3Ø VOLTAGES				CATALOG NUMBER	WEIGHT LBS (KG)
	208V, 240V	380V, 416V	480V	600V		
4000	—	3990	3996	4005	HWB-54-4000	5160 (2340)
4250	—	4260	4230	4230	HWB-54-4250	5310 (2410)
4500	—	4500	4500	4500	HWB-54-4500	5460 (2475)
4750	—	4740	4770	4770	HWB-54-4750	5610 (2545)
5000	—	4980	4995	4995	HWB-54-5000	5760 (2615)

TO ORDER: Specify quantity, catalog no., voltage, phase, kW rating, intended use, optional features, operating pressure, ultimate owner's name and address, and installation address.

Options for Packaged Hot Water Boilers

These are many of the most frequently supplied optional items.

- Inlet and outlet valves (gate)
- Auxiliary low water cutoff
- High temperature alarm
- Low temperature alarm
- Audible alarm c/w reset
- Pilot light per heating stage
- Manual OFF/AUTO switch per heating stage
- Voltmeter c/w three position selector switch
- Ammeter c/w three position selector switch
- kW hour meter
- Main power disconnect switch
- Main power automatic breaker
- Safety door interlock switch
- Proportional temperature controller (std over 95 amps/)
- Electronic progressive sequencer
- Circulating pump
- Motor starter
- Ground fault indicator
- Spare components
- Higher kW capacities
- Non-listed voltages
- Single phase
- Higher pressure rating
- Lined vessels (check factory)
- Dual energy system interface
- Indoor/outdoor temperature reset controller
- Auxiliary high temperature cutoff
- High or low pressure cutoff
- Flow switch

SOME BOILER FACTS

1. Most boilers require jurisdictional registration. Very large boilers may require an operating engineer on staff.
2. Registered boilers must be fitted with registered flange heaters.
3. The operating pressure on boilers should not normally exceed 90% of the relief valve setting.
4. 1 Boiler horsepower (B.H.P.) = 10 kW.
5. 1 Therm hour = 2.99 B.H.P. = 100,000 BTU/hour.
6. Some waters contain a high concentration of solids and may require water treatment. We recommend you consult a water treatment specialist in your area for advice prior to placing the boiler in operation.

dSVC™ Pad-Mounted SVC for Distribution Systems

Benefits:

- Increase quality of service
- Eliminate “blips,” sags or equipment dropout
- Improve feeder power factor and voltage profile
- Serve large loads faster and at lower cost
- Increase real power flow
- Easy to install and service

The American Superconductor (AMSC) dSVC solution is a completely self-contained, semi-custom, pad-mounted static VAR compensator (SVC) suitable for use on underground distribution circuits. The dSVC technology brings capabilities to distribution systems previously available only in highly complex and expensive transmission level SVCs.

The dSVC solution can address many systems issues including:

- Boosting the quality of service on a distribution circuit by eliminating minor voltage sags and reducing major voltage sags.
- Reduces the number of capacitor banks required to improve feeder operations.
- Isolating the effects of voltage flicker caused by one or more customers from the surrounding distribution circuit.
- Optimizing feeder power factors to high levels in real-time, reducing reactive power losses and maximizing circuit capacity at all times.



AMSC dSVC solution shown at far right with existing circuit equipment

Proven Technology

The dSVC technology is fully solid-state and provides transient-free switching. It connects directly to medium voltage distribution systems without the need for step-up transformers. These characteristics allow the system to be set to switch as quickly, and as often, as needed without wear-and-tear concerns.

The AMSC dSVC solution shares the same technology as AMSC's traditional turnkey SVCs. AMSC SVCs are used for applications ranging from wide area transmission voltage stability applications to correcting troublesome loads in industrial facilities such as metal shredders, crushers, pumps and pipelines.

Multiple Siting Options

The dSVC is completely contained within a large pad-mount enclosure. This compact footprint permits a variety of installation options:

- Distribution substations,
- Along distribution circuits, or
- Adjacent to customers causing voltage instabilities that affect thousands of customers sharing the same circuit

In addition to raising the quality of service by eliminating customer-induced problems, the dSVC solution also improves the quality of electrical service when problems occur elsewhere on the grid (e.g., sags and “blips”). With only a one-cycle response rate and rated capacity, the dSVC solution effectively insulates customers on a distribution circuit.

Advanced Control Options

The dSVC solution offers three standard control modes:

- **Capacitor Emulation:** Voltage, VAR and current control, with adjustable time-of-day standard. No restriction on frequency of switch/re-switch operations
- **Power Quality:** Adjustable one- and three-phase flicker and sag control
- **Full SVC Mode:** Emulation of a transmission SVC with slow voltage regulation within adjustable limits (nominal operation) combined with one-cycle voltage correction when limits are exceeded



The control is field-adjustable and fully capable of single- and three-phase VAR and voltage control in response to both load- and utility-induced voltage changes. The control can also control and coordinate the operation of multiple conventional switched capacitor banks on the same feeder or bus.

An integrated data logger and analyzer provides regular information on circuit and dSVC equipment performance, transmitting automatic alerts to user personnel in case of alarms, and provides high speed current, voltage and harmonic records for all distribution system excursions.

Scalable, Easy to Site and Install

The dSVC technology provides a highly scalable distribution voltage solution that is designed for placement on new or existing circuits. The dSVC can be specified, supplied and installed quickly to solve voltage sag and flicker problems.

Specifications:

Reactive power rating:	Up to 6 MVAR @ 15 kV, 3 MVAR @ 5 kV
Voltage rating range:	Up to 15 kV, 50 or 60 Hz
Step-up transformer:	None required, direct connection at system voltage
Response time:	Adjustable; down to one cycle
Standard Control options:	Capacitor Control Emulation: Voltage, VAR, and current control, with adjustable time-of-day standard. No time delay required between switching operations. Power Quality: Adjustable one-and-three phase flicker and sag control. Full SVC Mode: Emulation of a transmission SVC with slow voltage regulation within adjustable limits (nominal operation) combined with one-cycle voltage correction when adjustable limits exceeded.
Control Programming:	Custom algorithms may be included in control
Communication protocols:	DNP3.0, Modbus (optional)



REVOLUTIONIZING THE WAY THE WORLD USES ELECTRICITY®

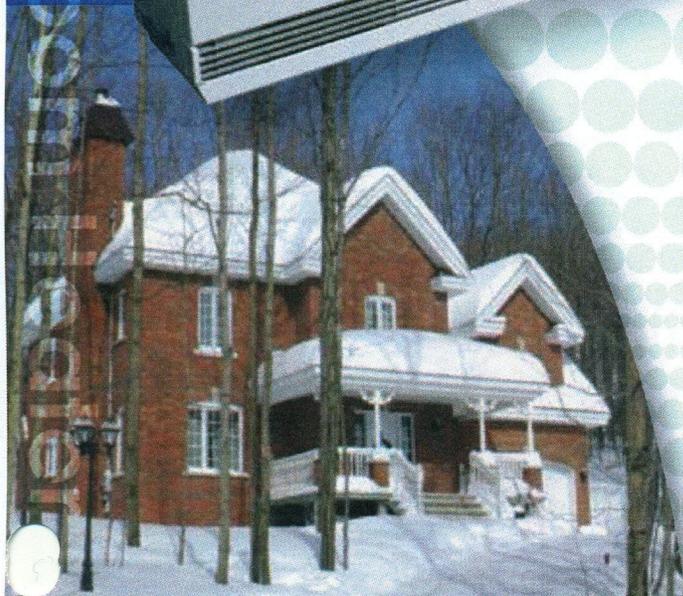
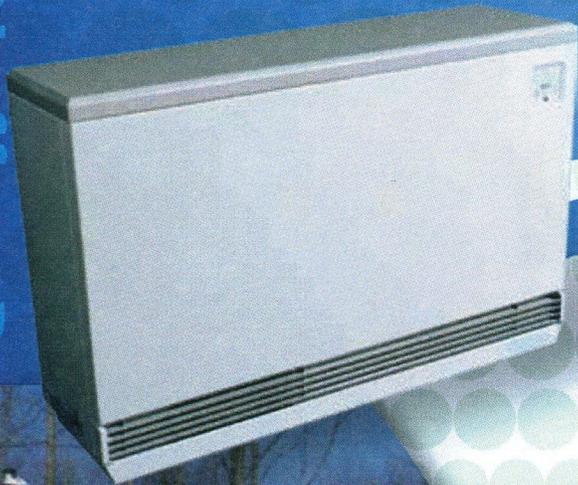
Visit our website at www.amsc.com

Sales Offices:

South Hills Industrial Park
1200 Lebanon Road
West Mifflin, PA 15122 USA
ph +1 412 464 1295
fx +1 412 464 1229

8401 Murphy Drive
Middleton, WI 53562-2550
USA
ph +1 608 828 9103
fx +1 608 831 5793

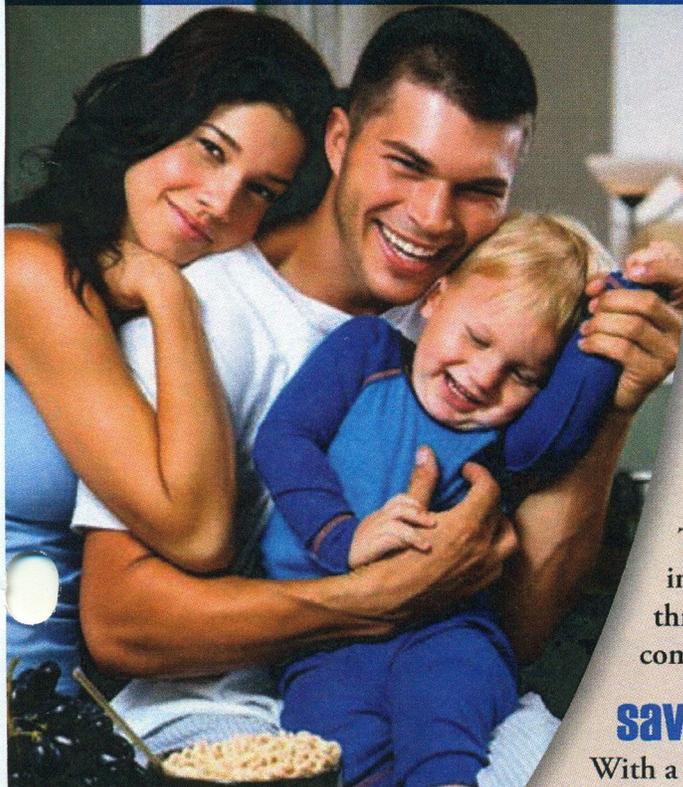
Steffes Room Heaters



Save up to 70% on your home heating costs with a Steffes Room Heater

Many people are taking advantage of low cost electricity rates from their local power company known as off-peak rates and saving hundreds, even thousands of dollars on their home heating bills. If you are looking for great comfort and relief from high propane, fuel oil or natural gas costs, now's the time for a Steffes Room Heater.

STEFFES
Heating Systems



Get the "Off-Peak Advantage!"

Electricity is more expensive during the day – when we use a lot of it. Dishwashers, washers and dryers, water heaters, computers... it's a long list. Power companies charge lower rates at times when less electricity is used. These lower rates are called "off-peak rates."

how it Works

The Steffes Room Heater stores low cost, off-peak electricity as heat in its specially designed, ceramic bricks. The amount of heat stored regulated automatically based on the heating needs of your home and outdoor temperatures.

The heater's built-in room thermostat and fan deliver the stored heat into your home when needed to provide comfortable, even temperature throughout the house. It's quiet, easy to use, and can satisfy your desired comfort 24 hours a day.

save money!

With a Steffes Room Heater, many homeowners are cutting their annual

Steffes Room Heater

- Safe, Clean, Comfortable Heat
No Smoke, No Fumes, No Mess
- Easy To Operate
- No Routine Maintenance
- 100% Efficient
- Manufactured In North America
- 5-Year Limited Manufacturer's Warranty

Unique Features

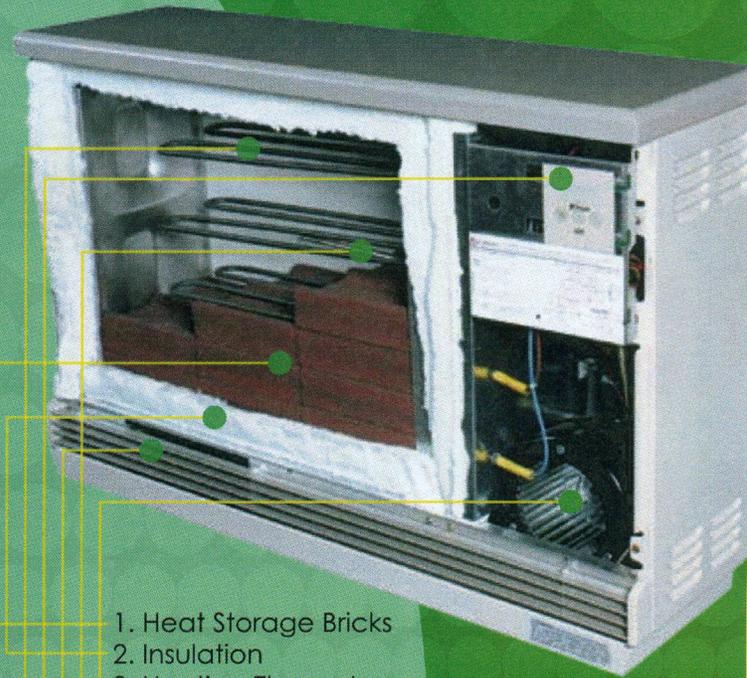
- Microprocessor Technology
- Low Cost Automatic Charge Control
- Heater Operation Display Lights
- Built-in Digital Room Temperature Thermostat
- Brick Core and Air Discharge Temperature Safety Controls
- Variable Speed Blower
- Built-in Controls to Reduce Installation Time & Costs
- Microprocessor Based Time Clock Module (Optional)

Any Application

- Electrically Heated Homes
- Fossil Fuel System Replacement
- Wood Stove Replacement
- Boiler Replacement
- Supplement to any Existing Heat Source

Perfect For

- Primary Residence
- Weekend Home or Cabin
- Manufactured Home
- Apartments or Condominiums
- Churches
- Hotels/Motels
- Schools/Offices
- Warehouses



1. Heat Storage Bricks
2. Insulation
3. Heating Element
4. Temperature Control and Display Panel
5. Warm Discharge Air
6. Brick Core Temperature Sensor
7. Fan



Specifications

Standard voltage on all systems is 240VAC. Charging input voltages of 208 and 277 are also available.

MODEL	Charging Inputs (kW) Available (See Note 1)	Approximate Installed Weight (lbs)	Dimensions (Inches)		
			Length	Height	Depth
2102 (See Note 2)	2.4, 3.0, 3.6	267	30	24.5	10
2103	3.6, 4.5, 5.4	376	37	24.5	10
2104	4.8, 6.0, 7.2	478	44	24.5	10
2105	6.0, 7.5, 9.0	585	51	24.5	10
2106	7.2, 9.0, 10.8	692	58	24.5	10

NOTE 1: kW input must be specified at time of order. The appropriate model and kW input for your application will depend on heat loss of the area intended to be heated and the number of power company off-peak hours available. Contact your local power company, a contractor or Steffes Corporation for assistance in selecting an appropriately sized system.

NOTE 2: Model 2102 also available in a 1.32kW input with a 120V plug-in cord.

NOTE 3: A clearance of 12" is recommended on the right side of heater to ensure accurate room temperature sensing and for servicing purposes. If less than 12" is available, an optional remote room temperature sensor is available.

MINIMUM CLEARANCE REQUIREMENTS	
Top	4"
Front	15"
Sides (See Note 3)	2"
Back	1.5"

STEFFES
Heating Systems

701-483-5400

E-Mail: offpeak@steffes.com

Web: www.steffes.com

For More Information Contact:

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ETS : Residential Systems : Room Units Overview : Room Unit Specifications

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- Green Heating Solutions
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- Choosing The Right System
- How We Save You Money
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- How Power Companies Benefit
- Become a Dealer or Distributor
- Service & Support
- Contact Us - Off Peak Heating

Room Unit Specifications

Model

	2102	2102	2103	2104	2105	2106
	(plug-in)					
Charging Inputs (kw)	1.32	2.4 3.0 3.6	3.6 4.5 5.4	4.8 6.0 7.2	6.0 7.5 9.0	7.2 9.0 10.8
Approximate Installed Weight	281 lbs	267 lbs	376 lbs	478 lbs	585 lbs	692 lbs
Storage Capacity						
kWh rating	13.5	13.5	20.25	27	33.75	40
BTU rating	46,602	46,602	69,093	92,124	115,155	136,480
Element Voltage	120V			240V (Standard)		
Blower/Controls Voltage	120V			240V (Standard)		
Variable Speed Blower						
Minimum Wattage				30 Watts		
Maximum Wattage				120 Watts		

Notes:

- 2102 Plug In (PI) model is not available in all markets.
- Standard voltage on all room heaters is 240VAC. 208V and 277V charging inputs also available as special factory orders. Standard 240V units can be connected to 208V; however, the heater will operate at 75% of its 240V rated input kW.
- Blower/controls voltage also available in 120V or 208V as special factory order.

Heating Systems

- [Room Units](#)
- [Residential Forced Air Furnaces](#)
- [Residential Hydronic Furnaces](#)
- [Load Management Controls](#)
- [Commercial Furnaces](#)
- [Calculator](#)
- [Dealer Locator](#)

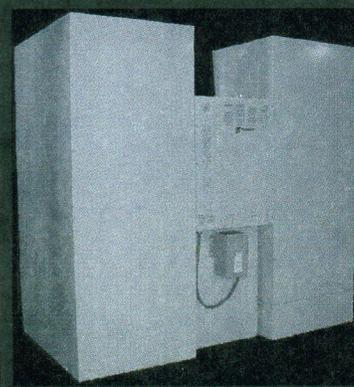
Room Unit Information

- [Overview](#)
- [Advantages & Features](#)
- [Spec Chart](#)
- [Dimensions & Clearances](#)
- [Room Unit Downloads](#)
- [Sizing](#)
- [Contact Us](#)

"...the heat is distributed throughout the entire house with incredible evenness. Another feature of the ETS units we have found to be better than we expected is the ability to heat up the house fast. When we leave for a day or two we turn the heat down knowing that within 15-20 minutes after we get back home we can have the house toasty again. It's great!"

Durango, Colorado

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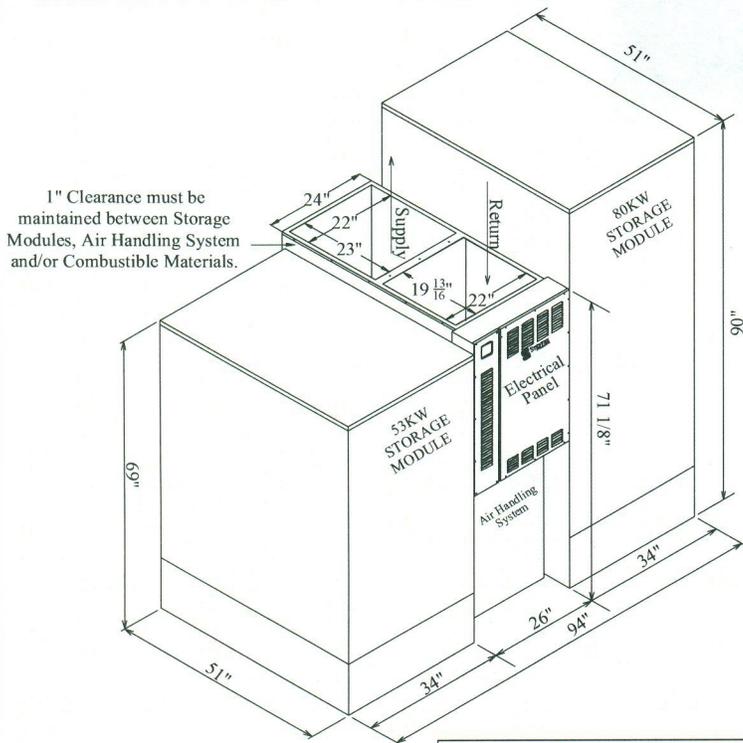
Technical Data Sheet



Electric Thermal Storage Heating System

Models 8150, 8155, 8180, 8185, 8188

Clearances and Dimensions



Storage Module (53kW and 80kW)

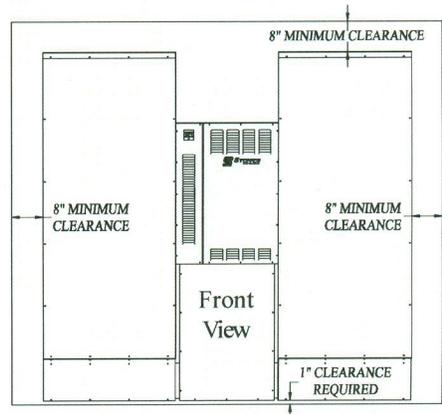
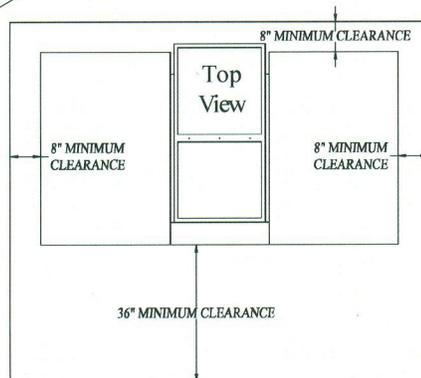
- ◆ Back = 8 inches
- ◆ Bottom = 1 inch (from combustible material)
- ◆ Sides = 8 inches
- ◆ Top = 8 inches (from combustible material)
- ◆ Front = 36 inches (for ease in servicing)

Air Handler (2000 and 3000 CFM)

- ◆ Back = 1 inch clearance
- ◆ Bottom = 1 inch (from combustible material)
- ◆ Sides = 1 inch clearance
- ◆ Top = 0 inches (from combustible material)
- ◆ Front = 36 inches (for ease in servicing)



Some electrical codes may require a greater front clearance depending on operating voltages and other factors.



Placement

The minimum area required for the installation of the system is 100 square feet per Storage Module. This area must remain free of debris and room air should be maintained at less than 85° Fahrenheit / 29° Celsius. Ventilation **MUST** be provided if the system is being installed in an area with less than 600 square feet. It is the responsibility of the installer and system designer to provide this ventilation.

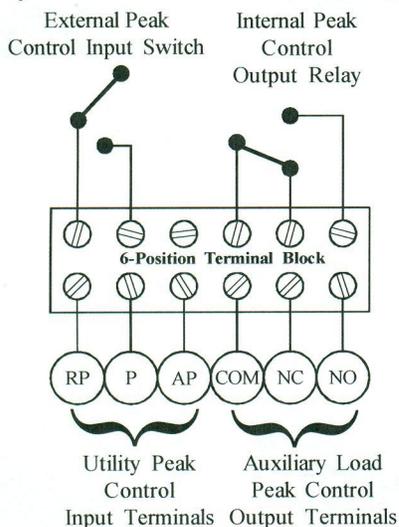
Load Management

The ThermElect is a commercial Electric Thermal Storage (ETS) heating system. It uses Demand Free, Off-Peak electricity to provide a low cost heating solution for commercial, industrial, and large residential applications. ETS equipment is designed to store electricity, as heat, during hours when energy costs are lower and kW demand charges are not incurred. The ThermElect's thermal mass consists of a high-density ceramic brick capable of vast heat storage.

The ThermElect system is designed to operate under any one of three load control strategies.

- 1. On-Peak/Off-Peak Signal:** ThermElect responds to external load control device (contact closure) and charges during off-peak periods. Auxillary contact is provided on the ThermElect for controlling external loads. If using the optional Steffes Power Line Carrier Transmitter (208/240V systems only) or Steffes Time Clock Module for peak control, the direct wiring shown here is not necessary.
- 2. 4-20 Milli-Amp (1-5 Volt DC):** ThermElect responds to external load management device and monitors energy usage so as not to exceed the maximum allowable rate of consumption (kW).
- 3. Pulse Monitoring:** ThermElect monitors pulse inputs from the power company's electric meter and proportionally charges when demand free power is available. Optional load management control modules (Order Item #1908410) are available for control of up to 16 external loads.

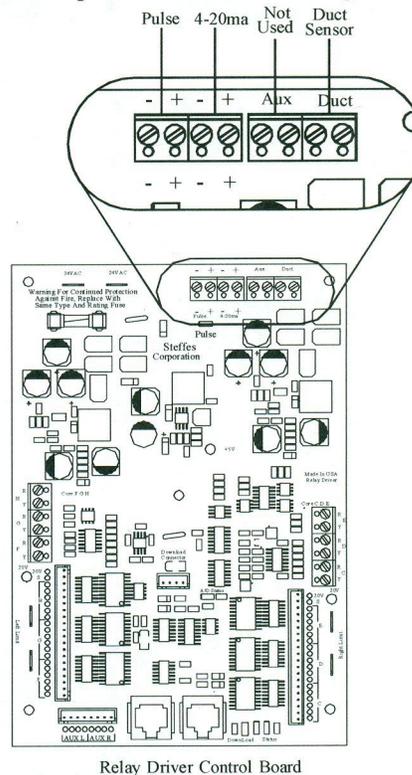
Utility On-Peak/Off-Peak Connections



Terminal Block Code Designations

- RP = Peak Control Input Common
- P = Peak Control Input
- AP = Anticipated Peak (Pre-Peak) Control Input
- COM = Peak Control Output Common
- NC = Peak Control Output (Normally Closed)
- NO = Peak Control Output (Normally Open)

4-20 Milli-Amp or Pulse Monitoring Connections



Supply Air Blower Speed Data

For air delivery, the system is equipped with a 2000 CFM (3000 CFM optional) Air Handler containing a 3-speed supply air blower. The system is factory wired to operate in medium speed for "heating" and in high speed for "cooling" or a "fan only" thermostat setting.

Supply Air Blower Speed	(External static pressure should not exceed .75 inches water column for all models)					
	.25"		.50"		.75"	
	2000	3000*	2000	3000*	2000	3000*
High (CFM)	2050	2950	1900	2490	1540	2160
Medium High (CFM)	1990	2850	1890	2350	1535	1980
Medium Low (CFM)	1870	2520	1670	2270	1450	N/A
Low (CFM)	N/A	1920	N/A	N/A	N/A	N/A

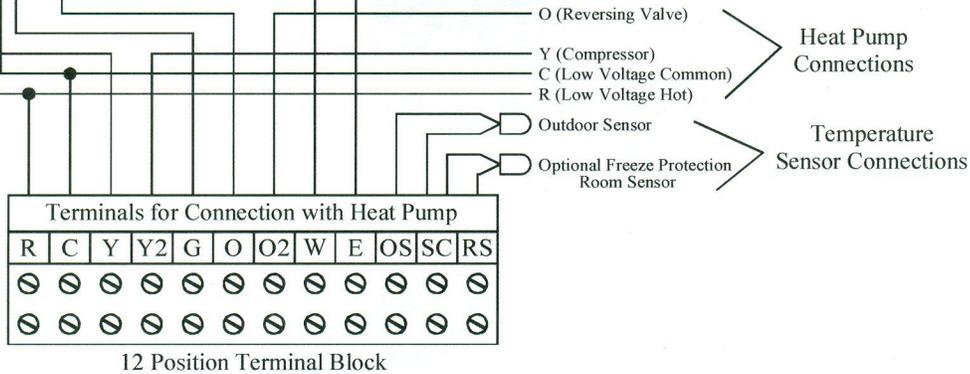
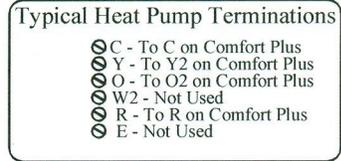
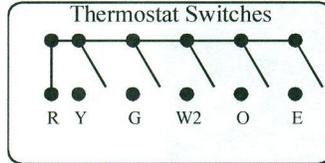
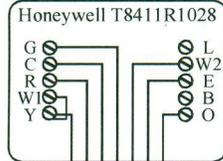
*The 3000 CFM Air Handler is optional. It is equipped with two 4-speed supply air blowers.

Low Voltage Wall Thermostat, Sensor, and Compressor Connections

- 24 VAC wall thermostat must be used. Honeywell brands are shown in schematics and recommended.
- A digital wall thermostat is recommended for use with the systems. If utilizing a mechanical wall thermostat, it may be necessary to add a load resistor (250 ohm, 5 watt) due to the low current draw (.01 amp) on the heat call input circuit.
- An outdoor sensor is included with the system to provide outdoor temperatures for automatic charge control (regulation of stored heat).

Heat Pump Application

A Two Stage Heating and Single Stage Cooling Heat Pump Room Thermostat

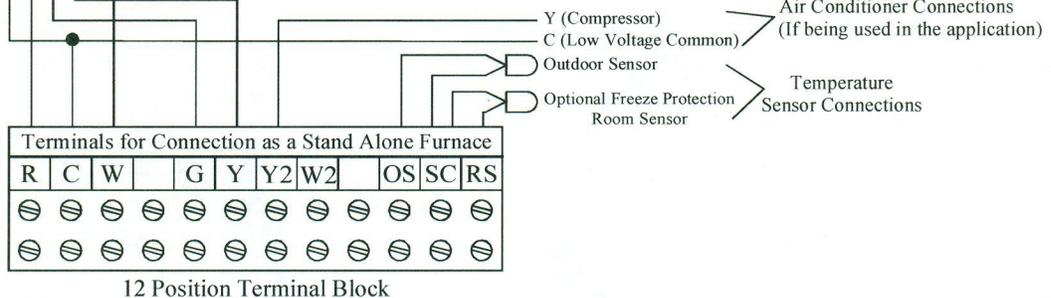
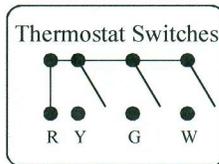
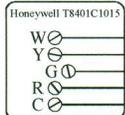


Terminal Block Code Designations

- | | |
|----------------------------------|--|
| R = Low Voltage Hot | O = Reversing Valve Input |
| C = Low Voltage Common | O2 = Reversing Valve Output |
| Y = Compressor/Stage 1 Heat Call | E = Emergency Heat |
| W = Stage 2 Heat Call | OS = Outdoor Temperature Sensor |
| W2 = Not Used | SC = Temperature Sensor Common |
| Y2 = Compressor Output | RS = Freeze Protection Room Temperature Sensor |
| G = Fan Call | |

Stand Alone Furnace Application

A Single Stage Heating and Cool Room Thermostat



Specifications

MODEL 8150 (1 - 53kW Storage Module)

Input Voltage	240	120/208	120/240	277/480	347/600
Phase	1	3	3	3	3
Number of Wires	2	3	3	4	4
Charging Input (kW)	53.3	48.0	53.3	50.4	53.3
Elements - Quantity	12	12	12	12	12
Elements - Watts Each	4,444	4,000	4,444	4,200	4,444
Amps – Core Charging	222.20	133.39	128.44	60.65	51.23
Max. Core & Blower Load (AMPS)	3.0	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	281.50	175.99	169.80	78.69	67.78
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh	320				
Storage Capacity - BTU	1,091,840				
Approximate Storage Module Weight (lbs)	770				
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	330 (utilizing 2000 CFM Air Handler)*				
Approximate Brick Weight (lbs)	3,440				
Approximate Installed Weight (lbs)	4,540 (add approx. 500 lbs to arrive at shipping weight)				
Number of Brick	192				

MODEL 8155 (2 – 53kW Storage Modules)

Input Voltage	240	120/208	120/240	277/480	347/600
Phase	1	3	3	3	3
Number of Wires	2	3	3	4	4
Charging Input (kW)	106.6	96.0	106.6	100.8	106.6
Elements - Quantity	24	24	24	24	24
Elements - Watts Each	4,444	4,000	4,444	4,200	4,444
Amps – Core Charging	444.40	266.79	256.88	121.30	102.46
Max. Core & Blower Load (AMPS)	3.0	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	559.25	342.73	330.35	154.50	131.82
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh	640				
Storage Capacity - BTU	2,183,680				
Approximate Storage Module Weight (lbs)	770 per module = 1,540 Total				
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	610 (utilizing 2000 CFM Air Handler)*				
Approximate Brick Weight (lbs)	3,440 per module = 6,880 Total				
Approximate Installed Weight (lbs)	9,030 (add approx. 600 lbs to arrive at shipping weight)				
Number of Brick	192 per module = 384 Total				

MODEL 8180 (1 – 80kW Storage Module)

Input Voltage	240	120/208	120/240	277/480	347/600
Phase	1	3	3	3	3
Number of Wires	2	3	3	4	4
Charging Input (kW)	80.0	72.0	80.0	75.6	80.0
Elements - Quantity	18	18	18	18	18
Elements - Watts Each	4,444	4,000	4,444	4,200	4,444
Amps – Core Charging	333.30	200.09	192.66	90.97	76.84
Max. Core & Blower Load (AMPS)	7.4	7.4	3.0	2.3	3.0
Minimum Circuit Ampacity	420.38	259.36	250.07	116.59	99.80
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh	480				
Storage Capacity - BTU	1,637,760				
Approximate Storage Module Weight (lbs)	840				
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	400 (utilizing 2000 CFM Air Handler)*				
Approximate Brick Weight (lbs)	5,160				
Approximate Installed Weight (lbs)	6,400 (add approx. 600 lbs to arrive at shipping weight)				
Number of Brick	288				

* Optional 3000 CFM Air Handler increases approximate installed weight by 40 pounds.

Specifications continued...

MODEL 8185 (1 – 53kW and 1 – 80kW Storage Module)

Voltage	120/208	120/240	277/480	347/600
Phase	3	3	3	3
Number of Wires	3	3	4	4
Charging Input (kW)	120.0	133.3	126.0	133.3
Elements - Quantity	30	30	30	30
Elements - Watts Each	4,000	4,444	4,200	4,444
Amps – Core Charging	333.48	321.10	151.62	128.07
Max. Core & Blower Load (AMPS)	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	426.10	410.62	192.41	163.84
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh	800			
Storage Capacity - BTU	2,729,600			
Approximate Storage Module Weight (lbs)	770 (53kW) + 840 (80kW) = 1,610 Total			
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	730 (utilizing 2000 CFM Air Handler)*			
Approximate Brick Weight (lbs)	8,600			
Approximate Installed Weight (lbs)	10,940 (add approx. 650 lbs to arrive at shipping weight)			
Number of Brick	192 (53kW) + 288 (80kW) = 480 Total			

MODEL 8188 (2 – 80kW Storage Modules)

Input Voltage	120/208	120/240	277/480	347/600
Phase	3	3	3	3
Number of Wires	3	3	4	4
Charging Input (kW)	144.0	159.9	151.2	159.9
Elements - Quantity	36	36	36	36
Elements - Watts Each	4,000	4,444	4,200	4,444
Amps – Core Charging	400.18	385.32	181.95	153.68
Max. Core & Blower Load (AMPS)	7.4	7.4	2.3	3.0
Minimum Circuit Ampacity	509.47	490.90	230.31	195.85
Blowers/System Control Voltage	240V/208V	240V/208V	240V/208V	240V/208V
Storage Capacity - kWh	960			
Storage Capacity - BTU	3,275,520			
Approximate Storage Module Weight (lbs)	840 per module = 1,680 total			
Approximate Insulation Block, Air Handler, Elements & Other Weight (lbs)	760 (utilizing 2000 CFM Air Handler)*			
Approximate Brick Weight (lbs)	10,320 Total			
Approximate Installed Weight (lbs)	12,760 (add approx. 700 lbs to arrive at shipping weight)			
Number of Brick	288 per module = 576 Total			

* Optional 3000 CFM Air Handler increases approximate installed weight by 40 pounds.

Temperature Rise

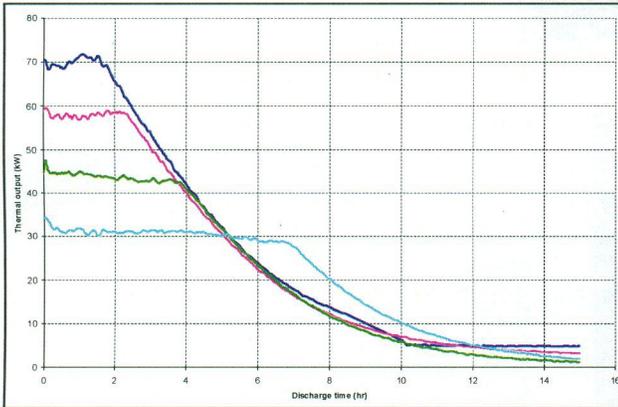
Maximum discharge air temperature of the ThermElect unit is 150°F/66°C. Actual system output is based on the difference between the inlet air temperature and the outlet temperature. Use this matrix and the performance graphs to determine maximum temperature rise and actual system output.

kW	2000 CFM	3000 CFM
30	55°F / 12.8°C	37°F / 2.8°C
35	64°F / 17.8°C	43°F / 6.1°C
40	74°F / 23.3°C	49°F / 9.4°C
45	83°F / 28.3°C	55°F / 12.8°C
50	92°F / 33.3°C	62°F / 16.7°C
55	101°F / 38.3°C	68°F / 20°C
60	110°F / 43.3°C	74°F / 23.3°C
65	120°F / 48.9°C	80°F / 26.7°C
70	129°F / 53.9°C	86°F / 30°C
75	138°F / 58.9°C	93°F / 33.3°C
80	147°F / 63.9°C	98°F / 36.7°C
85	156°F / 68.9°C	105°F / 40.6°C

Load Profile Graphs

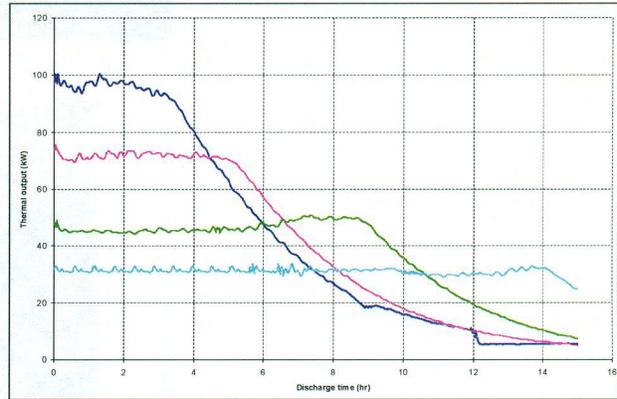
MODEL 8150

(1 - 53kW Storage Module)



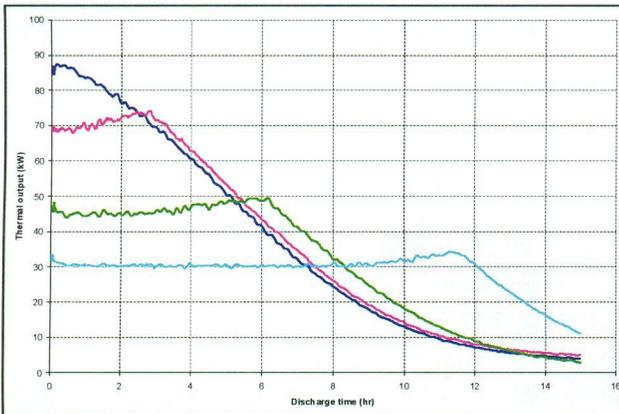
MODEL 8155

(2 - 53kW Storage Modules)



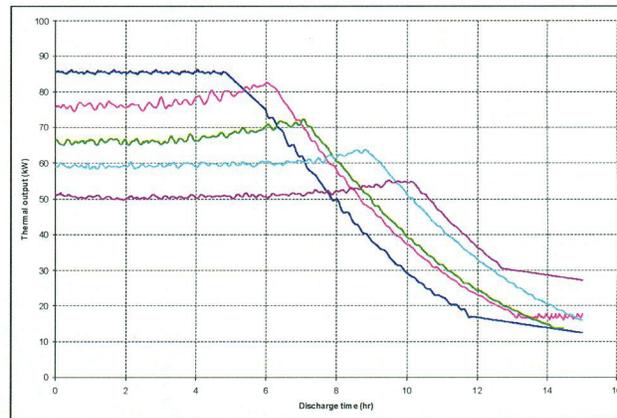
MODEL 8180

(1 - 80kW Storage Module)



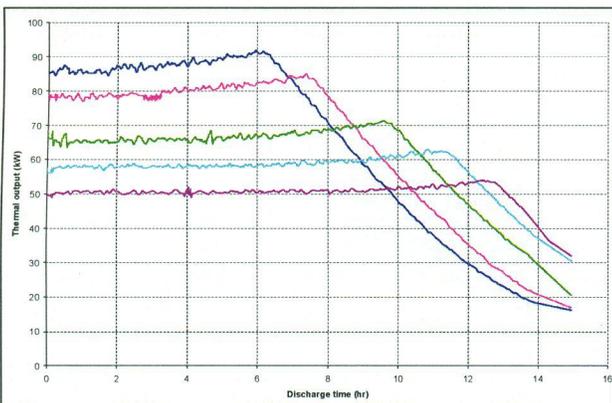
MODEL 8185

(1 - 53kW and 1 - 80kW Storage Module)



MODEL 8188

(2 - 80kW Storage Modules)



IMPORTANT

Please refer to the
Temperature Rise Chart
on the previous page.

Kongiganak Traditional Council

Puvurna Power Company
 P.O. Box 5009
 Kongiganak, AK 99559
 Ph. (907) 557-5616 Fax: (907) 557-5614

I: Homeowner Information

Homeowner Address: _____

Physical Address: _____

Mailing Address: Box 5072

Day Phone Number: (907) 557-5209

Homeowner: (please print) Nora & Roland Andrew

Homeowner Signature: Nora J Andrew

PLEASE COMPLETE SURVEY FULLY

II: Home Condition

	No	Yes	
Have you had an energy audit in the past 5 years?	<input checked="" type="checkbox"/>	<input type="checkbox"/>	When? _____
Has your house been weatherized in the past 5 years?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	When? <u>2006</u>
Is the ceiling insulated?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	R- _____
Is the floor insulated?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	R- _____
Are the exterior walls insulated?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	R- _____
What is the exterior wall thickness?	2x4 _____	2x6 _____	Other: <u>2x8</u>

Windows:

Dimensions (inches)	# of Panes	Leaks:	Nothing	Wind	Water	Opens/Closes
<u>35x31</u>	<u>2</u>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> N
<u>35x30</u>	<u>2</u>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N
						Y/N

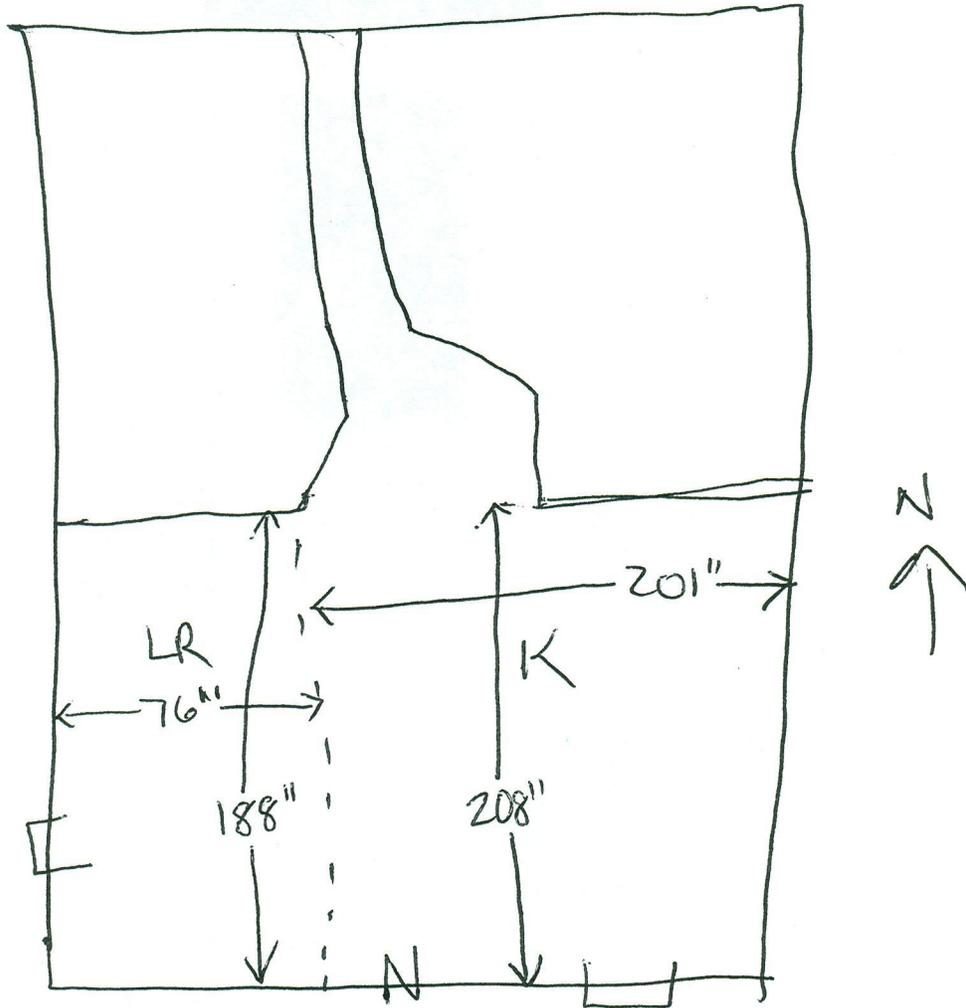
Doors:

	Dimensions	Wood or Steel	Leaks:	Yes	No
Entry	<u>80" x 36"</u>	<u>Steel</u>	<u>AIR</u>	<input checked="" type="checkbox"/>	
Porch					

III: House Dimensions

Make a sketch of your house's floor plan below.

Please include: Dimensions of the main living area (living room and kitchen), location of electric meter, location of furnace/primary heating source, window and door locations in main living area, indicate where stove should be located, and please indicate which direction is North.



IV: Computer Information

Do you have a computer? No Yes _____ How many? _____
Do you have internet access? No Yes _____

V: Heating Costs

Annual Heating Costs _____ Actual Estimated

How much did you spend on heating fuel last year? \$ 2560

How many drums/gallons of fuel did you use last year?
Drums: 8 Gallons: 440

Did you supplement this by heating your house with a wood stove? Yes _____ No

VI: Transportation

4-Wheeler	Snowmachine	Outboard	Year/Make/Model/Horsepower or cc	Runs
	1			Y/N
				Y/N

Annual Transportation Costs: _____ Actual Estimated

How much did you spend on fuel for transportation last year? \$ N/A

4-Wheeler _____ gallons
 Snowmachines _____ gallons
 Boats _____ gallons

VII: Food Storage

Freezer(s): No _____ Yes How many? 1

Make/Model/Year	Cubic Ft.	Door Seal	
		Good	Bad
		<input checked="" type="checkbox"/>	

Refrigerator(s): No Yes _____ How many? _____

Make/Model/Year	Cubic Ft.	Door Seal	
		Good	Bad

VIII: Miscellaneous:

	No	Yes	Quantity	Make/Model/Btu
Main fuel heating system		✓	1	MONITOR 441
Wood Stove	✓			
Portable Electric Heater	✗			Watts:
Fire Place	✗			

	No	Yes	Quantity	Make/Model/Wattage
Electric Range Stove		✗	1	
Oil Stove	✗			
Gas Stove	✗			
Microwave		✗	1	

	No	Yes	Make/Model/Wattage
Slow Cooker	✗		
Toaster Oven	✗		
Coffee Maker		✗	
Toaster		✗	
Blender	✗		
Dishwasher	✗		
Trash Compactor	✗		
Food Disposal	✗		

	# of Bulbs	Wattages (list and add to total wattage)	Total Wattage
Incandescent Lights (Regular Bulbs)			
Fluorescent Lights (Energy Savers)			

skip

	No	Yes	Make/Model/Wattage
Washer	_____	✗	_____
Dryer	✗	_____	_____

<u>Entertainment</u>	No	Yes	How Many?
Radio	✗	_____	_____
Television	_____	✗	1
Video Game System	✗	_____	_____
DVD/VCR Player	_____	✗	1
Printer	✗	_____	_____

Home Tools	No	Yes	How Many?
Drill	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	1
Electric Saw	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Battery Charger	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Cordless Drill w/ charger	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1
Sewing Machine	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Vacuum Cleaner	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Water Transfer Pumps	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
Welder	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

We are interested in your comments and ideas about what our community can do to lower energy costs of improve efficiency; please comment in the space below:

Lowering costs important

High cost is a problem when you can't afford it.

Thank you for completing this survey. The Chaninik Wind Group is very interested in alternative energy and needs your support in finding solutions to lower your energy costs. This survey will be used to measure the benefits of our wind power generators once alternative energy systems are in place. Thank you for your cooperation.

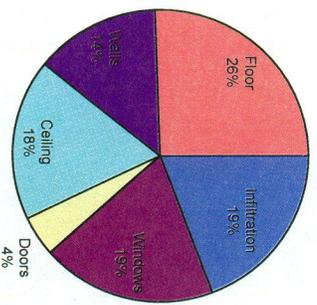
Heat Loss Calculation Worksheet (Whole House Concept)

CUSTOMER NAME AND ADDRESS: Roland and Nora Andrew, PO Box 5072, Kong, 907-557-5209
OUTSIDE DESIGN TEMP: -27
ROOM TEMP MAINTAINED: 65
GARAGE TEMP MAINTAINED: n/a

ROOM or AREA NAME	LENGTH WIDTH HEIGHT	AREA SQ. FT.	LOSS	LIVING AREA						TOTALS	GARAGE		TOTAL LOSS Living Area & Garage
				Room/Area	Room/Area	Room/Area	Room/Area	Room/Area	Room/Area		Room/Area	Room/Area	
INFILTRATION RATE (AIR CHANGES/HOUR)	24.00	24.00	9.66667	12.17	10.50	15.33	7.33	7.33	0.00	0.00	0.00	TOTAL LOSS	24,926
	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00		
INFILTRATION LOSS	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	TOTAL HEAT LOSS (WATTS)	11,456
	3.328	3.328	3.328	3.328	3.328	3.328	3.328	3.328	3.328	3.328	3.328		
WINDOWS	1.01	15.57	415.63	7.79	207.81	7.79	207.81	7.79	207.81	7.79	207.81	TOTAL HEAT LOSS (BTU/hr)	3,44
	Type 1	0.00	0	0	0	0	0	0	0	0	0		
Type 2	0.00	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	3,44	
Glass Doors (Sliding or French)	0.00	0	0	0	0	0	0	0	0	0			TOTAL HEAT LOSS (BTU/hr)
DOORS	2.13	21.11	267.17	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	
	Type 1	0.00	0	0	0	0	0	0	0	0	0		TOTAL HEAT LOSS (BTU/hr)
Type 2	0.00	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	3,44	
Leading into Unheated Area	0.00	0	0	0	0	0	0	0	0	0			TOTAL HEAT LOSS (BTU/hr)
EXTERIOR WALLS	20.00	119.32	160.81	89.55	120.69	153.55	206.95	192.21	259.07	54.17	73.01	TOTAL HEAT LOSS (BTU/hr)	
	Main	0.00	0	0	0	0	0	0	0	0	0		TOTAL HEAT LOSS (BTU/hr)
Main (shared w/ unheated area)	20.00	46	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	
Basement - Above Grade	0.00	0	0	0	0	0	0	0	0	0	0		TOTAL HEAT LOSS (BTU/hr)
Basement - Below Grade	0.00	0	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	
CEILING	21.00	416	534	118	151	102	130	148	190	54	69		TOTAL HEAT LOSS (BTU/hr)
	Type 1	0.00	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	
Type 2	0.00	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)		3,44
Under Unheated Area	0.00	0	0	0	0	0	0	0	0	0		0	
FLOOR	14.70	416	783	118	216	102	186	148	272	54	99	TOTAL HEAT LOSS (BTU/hr)	3,44
	Over Open Crawl Space	0.00	0	0	0	0	0	0	0	0	0		
Over Unheated Area or Enclosed Crawl Space	0.00	0	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	3,44
Basement Floor	0.00	0	0	0	0	0	0	0	0	0	0		
Edge Loss (slab on grade)	5.00	0	0	0	0	0	0	0	0	0	0	TOTAL HEAT LOSS (BTU/hr)	3,44
TOTAL HEAT LOSS (WATTS)			3,357		1,039		1,028		1,363		518		
TOTAL HEAT LOSS (BTU/hr)			11,456		3,546		3,508		4,549		1,767	TOTALS	24,926
Heat Loss (BTU/hr/Cubic Foot)			3.44		3.77		4.32		3.92		4.11	TOTALS	3.72

Heat Loss Summary

- Infiltration 1,159 Watts
- Windows 1,159 Watts
- Doors 267 Watts
- Ceiling 1,075 Watts
- Walls 821 Watts
- Floor 1,535 Watts



Hydronic Heating Notes:
 1. If installing hydronic in-floor systems, the surface below the floor must be insulated for optimum performance and efficiency.
 2. If installing the Stiefes hydronic furnace (5100 Series) in an unheated area, provisions to sizing of the furnace must be made to account the heat the system loses statically through its outer surface panels.

Disclaimer: Stiefes performed this heat loss calculation to the best of their ability using information provided and making assumptions where information provided was unclear or not available. Please review this calculation for accuracy and completeness as Stiefes nor any representative of Stiefes assumes any liability in this regard.

Heat Loss Calculation conducted by: Calen Brooks
 Date: July 27, 2009
 Revision Date (if revised): _____

"Warm Room" Concept Heat Loss Calculation

Customer Name and Address: Roland and Nora Andrew, Kong, PO Box 5072, 907-557-5209

Area for which this Heat Loss Calculation is being completed: Entire house as one room

<u>General Information</u>	
Outside Design Temp.	-27
Desired Room Temp.	65
Room Length (ft)	40
Room Width (ft)	24
Room Height (ft)	8
Infiltration Rate	0.75
Floor Structure	Crawl

(Enter "Basement", "Slab", "Crawl" or "Heated")
Basement = Unheated Basement or Enclosed Crawl Space
Slab = Concrete floor on dirt grade
Crawl = Open Crawl Space
Heated = Area under floor is heated

<u>Construction Information</u>				
	R-Value	Length	Width	Height
Outside Wall #1	20.00	80		
Outside Wall #2	20.00	48		
Window #1	1.01		11	4
Window #2	0.00		0	0
Door #1	2.13		3.16666667	
Door #2	0.00		0	0
Ceiling	21.00	40	24	
Floor	14.70	40	24	

<u>Heat Loss Information</u>		
	ΔT	Heat Loss
Infiltration		2809
Outside Wall(s)	92	1380
Window(s)	92	1174
Door(s)	92	0
Ceiling	92	1232
Floor	92	1760
Total Heat Loss (Watts)		6,595
Total Heat Loss (BTU/hr)		22,503