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PLAINS TALK

WPE WEST PLAINS ENGINEERING, INC.

ACEC MEMBER
PEER REVIEWED COMPANY

U.S. GREEN BUILDING COUNCIL MEMBER

Did You Know?

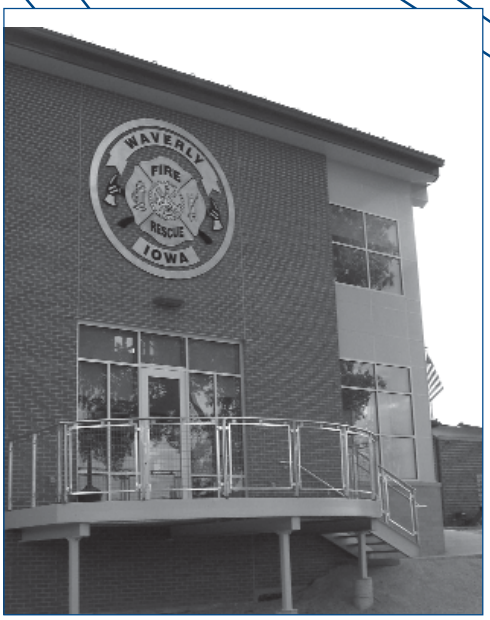
• The SDSU Natatorium Ventilation Upgrade project received an **Honorable Mention in the 2006 Engineering Excellence Awards Competition**, sponsored by the American Council of Engineering Companies of South Dakota.

See the back page of this issue for more on the SDSU Natatorium project.

Plains Talk is a quarterly publication of West Plains Engineering, Inc. in which we highlight a few of our most interesting projects. Your comments are welcome at any of our locations listed on the back cover of this newsletter.

Cedar Rapids WPE: Waverly Fire Station, Waverly IA

• The City of Waverly needed a new fire station. The existing fire station was a converted car dealership that was built in the 1950's. It had become too small for the fire department's needs and was also showing its age. The city decided it was time to construct a new, larger facility and demolish the existing fire station. The project was financed entirely with local option sales tax funds. Gardner Architecture, LLC served as the project architect and West Plains Engineering provided mechanical/electrical design services. Holland Contracting of Forest City, Iowa was the successful bidding contractor.



A view of the east side of the building which faces the river.

The building construction is unique and it could be termed as a "hybrid" steel building. The two-story portion of the building was constructed using a conventional steel structure. The apparatus bay portion of the building is a pre-engineered steel structure. Both structures utilize tilt-up precast panels for the exterior walls and together they form one seamless building. The facility is 18,750 square foot in size with spaces for the fire department trucks, a wash bay, an exercise room, meeting rooms, training rooms, a kitchen, and a few offices.

From the outside, the mix of brick and glass make this a very striking building. On the east and west sides of the building, two 10 foot diameter Waverly Fire Department logos constructed of stainless steel panels are set against the brick walls. Color changing light emitting diode (LED) flood lights were used to illuminate these logos. They are programmed to change color every few seconds for a very dynamic approach of highlighting the building.

On the inside, the two-story lobby is home to a brass fire pole, although it is not intended for use by the

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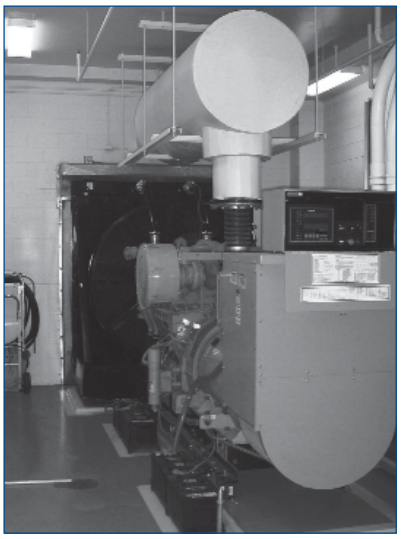
Rapid City WPE: Reliable Electrical Power For Your Critical Loads

• As our society continues on its course of becoming a more digital society, we have become accustomed to relying not only on quick access to everything (our work, information, money, kids, etc.), but we demand "immediate" access as well. Waiting does not seem to be a viable option. Loss of our ability to connect has become paralyzing.

One critical part of maintaining our connections in all that we do is the reliability of the electrical power source behind them. This includes everything from the battery in the cell phone to the back up power source for the large data centers that are processing our everyday activities.



1200KW Diesel Fueled Emergency Generator

West Plains Engineering and its employees have been involved in designing reliable sources of power for many of our clients. These facilities include those for credit card processing, telecommunications switching/networking, cable TV broadcasting, banking, military security systems, research/teaching, dispatching/command centers, and other power critical functions we encounter every day.

POWER SUPPLY

In this article I would like to discuss options for the installations with large power needs. The most common pieces of equipment for supplying power to critical loads consist of on-site emergency engine-generators and battery backed-up Uninterruptible Power Supply (UPS) Systems.

On-site power generation will normally consist of an emergency engine-generator set with an on-site stored fuel source, such as diesel fuel or gasoline. Sometimes, but not often, an off-site source can be considered, such as natural gas, if the reliability of this source is deemed adequate for the application. Engine-generators are typically very reliable when adequately maintained. Their disadvantage when considered as a backup power source is their delay of several seconds to start up, reach running speed, and assume load.

UPS systems are available in several configurations, but all have one thing in common: a source of stored energy. Rotary flywheel UPS's rely on the inertial energy of a flywheel while Battery UPS's rely on the chemical processes within the battery to provide backup power to the critical loads. The most common of these configurations is the Battery UPS with a rectifier converting normal AC power to DC, and an associated inverter converting the DC power back to AC utilization power. Under normal power situations the rectifier is the normal source of power for the inverter. If the normal power fails, the batteries become the backup source of power for the inverter. The advantage of a UPS is the continuous "uninterrupted" power it is capable of providing. The disadvantage of the UPS is its inherent aspect of energy storage. Flywheels have relatively limited ability to store large amounts of energy, while batteries require a large amount of space to store significant amounts of energy. Batteries also have limited life span and require periodic maintenance and replacement.

By using an emergency engine-generator set in conjunction with a UPS, the system's reliability is increased. Normally, utility power can feed the critical loads through the UPS. If utility power fails, the UPS's stored energy is only required to provide power to critical loads during the time it takes the generator to start and be transferred to the UPS as its source of power. Some clients prefer to have additional battery (stored energy) capacity to allow their critical loads to operate for longer time periods should the emergency engine-generator fail.

POWER DISTRIBUTION

To maintain reliability, in addition to a reliable source of power, we must also have a reliable method of delivering the power to our critical loads. We design to minimize (or eliminate) single points of failure within the system. This is accomplished by providing redundancy within the electrical distribution. An example of redundancy would be to provide an additional emergency generator or UPS such that the removal of one of these backup devices (due to failure, scheduled maintenance, etc.) does not create a failure of the entire system. The system continues to function reliably with complete backup capability. This is typically known as "N+1" in the trade jargon. Some extremely critical loads requiring even greater reliability may go to an "N+2" design scheme.

Providing dual routes in the distribution system for power to reach critical loads will also increase reliability. The use of "static switches" can feed continuous and uninterrupted power to distribution points from two separate sources of power simultaneously. Computing equipment is also readily available with dual power cords, allowing it to be connected to dual sources of power at the same time.

In future articles, we will discuss requirements of operating and maintaining the support systems for these critical power systems (air conditioning, fire suppression, etc.).

About the Author:
Bob Thompson *P.E. is a Principal/Electrical Engineer in the Rapid City Office. He has been with WPE for over 22 years.*

Cedar Rapids WPE: Waverly Fire Station, Waverly IA, continued

department. The two-story meeting room is situated on the east side of the building and overlooks the river. Its vast amount of windows lets in a tremendous amount of natural light and provides a great view of the river.

The HVAC system is a well source geothermal "pump and dump" type. Water is pumped from a well near the river, circulated through water-to-water heat pumps in the building, and is then discharged into the river. Air-to-water heat pumps are located throughout the two-story portion of the building to provide heating/cooling for all areas except the apparatus bays. The apparatus bays are heated with a radiant in-floor heating system served from the same geothermal system. There is also a geothermal in-slab snowmelt system to keep the truck approaches free of snow in the winter months.

Electrically, the entire building is backed-up with a diesel generator. Not only does this allow the station to remain operational during a power outage, it also allows the building to serve as an emergency shelter if need arises.

A view of the front entrance. Just left of the fire department logo is the intersection of the conventional steel structure and pre-engineered steel structure.

The lighting design for the building did not include any high intensity discharge type lighting and their problems with cool down and restrike time. Fluorescent high bay fixtures, using four 80 watt biax type light fixtures, were used to illuminate the 20 foot high apparatus bay. Cold weather fluorescent downlights and decorative wall fixtures were used to illuminate the building exterior. And, of course, the wall fixtures were painted "fire engine red"!

The Waverly Fire Station is a great addition to the beautiful riverfront in the heart of downtown Waverly. West Plains Engineering, Inc. is happy to have had the privilege to work closely with the architect and fire department on this project.

About the Author:
Jeff Reinhart *is the Office Manager and Electrical Engineer in the Cedar Rapids Office. Jeff has been with West Plains Engineering for four years.*

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NEW EMPLOYEE — RAPID CITY

• **David Dowling** joined the Rapid City Office in February as a CAD Operator/Mechanical Designer. He is a December 2006 graduate from the South Dakota School of Mines and Technology with a Bachelors Degree in Mechanical Engineering. He enjoys spending his spare time with his fiancé and is planning on getting married in October.

NEW EMPLOYEE — CASPER

• **Scott Isennock** joined the Casper office in April to serve as mechanical engineer/project manager. He received his BS in Architectural Engineering from the Univ of WY in 1998. He is licensed in NE & WY and is a LEED® and Accredited Professional. Scott, his wife Marci, daughter Ryan, and son Ash have recently moved to back to Wyoming after spending the last 9 years in Omaha, NE. They are happy to be near family again and look forward to their new adventure.

NEW EMPLOYEE — CEDAR RAPIDS

• **Blake Pauls** joined WPE of Cedar Rapids in May 2007. Graduated from Hamilton Tech in Davenport in 2006 with a degree in AutoCAD. Blake is from Maquoketa, IA. In his spare time he enjoys playing golf, basketball, pick up football games, and movies. He also enjoys racing Subaru's in his '81 Honda.

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Sioux Falls WPE: SDSU Natatorium Increases Comfort, Decreases Expenses

• The Natatorium at South Dakota State University has served the Health, Physical Education and Recreation Department well for over thirty years. This facility continues to be a vital part of the campus and the community. Last year, when the heating and ventilation system for this facility was reaching the end of its useful life, the University decided to upgrade it with a more capable and economical system.

Pool facilities require precise control of both temperature and humidity, both for the comfort of the occupants and to minimize operating costs. Maintaining a proper temperature not only limits the chill effect on swimmers but reduces pool water evaporation rates. Excessive evaporation can lead to increased pool chemical demand, make-up water demand and energy demand for heating the make-up water. Even more significant energy costs for these facilities are related to the large ventilation requirements. As air is exhausted from the interior space, it must be replaced with outside air, conditioned to the proper temperature.

West Plains Engineering, Inc. evaluated this situation for the University and devised a solution for upgrading the system and saving substantial energy costs well into the future. They designed a heat recovery system, which preconditions incoming outside air with the inside air, before it is exhausted from the building. This is difficult to accomplish with humid air from a pool area, due to frosting issues, which lead to decreased efficiencies. However, the system designed uses Reverse Flow heat recovery, a technology trademarked by bkm Energy & Environmental Products. This technology eliminates the frosting issues and provides heat recovery efficiencies of 80 to 90 percent.

The new system was installed by Tessier's Inc. of Mitchell, with the help of Midwestern Mechanical, Johnson Controls, Bob's Electric and Mills Construction. RISE, Inc. provided structural engineering and analysis, and Holman & Associates, Inc. provided the architectural design for mechanical room renovations.

It is anticipated that the new heating, ventilating and air conditioning system will save nearly $60,000 per year in energy costs, compared to those of a conventional equipment replacement. In this application, the premium cost for the heat recovery system, over that of the conventional system, was around $127,000. Therefore, this system is expected to pay itself back in just over two years and provide substantial cost savings well into the future.

West Plains Engineering, Inc. is proud to be a part of a team effort, in which the design team worked closely with the Owner and contractors to create a cost effective solution for a facility that is vital to the community and the State. This project is an example of South Dakota State University's commitment to advancements in sustainable building technologies and maintaining state of the art facilities at a leading institution of higher education.

About the Authors:

Mark Grebner, *Principal and Sioux Falls Office Manager, was the Project Manager for the SDSU Natatorium Ventilation Upgrade project.*

Jeff Eidsness *prepared the official entry notebook on this project for submission into the South Dakota Engineering Excellence Awards Competition.*