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Alpensee Water District
Director Mr. Don Skotty
PO Box 2204
Frisco, CO 80443

Dear Don,

I was asked to review two proposals for installation of a backup generator system diesel or Natural Gas (NG). The scope is to run One 5hp (Jockey) pump and One fire pump 100hp, plus the associated control and lighting for the building. I have proposals from Triangle Electric and Master Electrical Contractor's Inc.

First let us say, the logical controller should drop out the 5 hp pump on any fire event; IE; when the any of the 3 fire pumps are on the Jockey pump is automatically interlocked off. This is the best practice and should already in the logical programing.

Why is this generator option being considered? We need the end state or what we are trying to accomplish upfront every time a modification or review is done.

100hp=74.6kW, 5hp=3.7kW, lighting and control = 2kW, Total = Total load= 80.3kW. The district motors are poor quality by today's standards. The motor efficiency looked like 65%. In industry, in the USA we generally require >95% efficient motors. It was difficult for me to see the motor labels. So 80.3/65%= 123.5kW.

Triangles design is for 80kW and MEC is for 150KW. If the running kW design demands are the same for the two suppliers, the estimated costs would likely be a lot closer. Please note MEC analysis shows the running KW demand as 122.5kW, based on what they were told; which I would say is accurate.

Fire pump rating is 1250gpm at lot 27, the highest point, or the worst case. The maintenance pressure is 180psig or 390ft of head. According to Crane, B-9, this is 50.53hp per 500 gpm. We need 2.5 times this for full fire rating or 126.3hp = 94.2kW. So you can see the design is two fire pumps must be one to deliver water at lot 27. Since one fire pump can be broken or under repair, there are three fire pumps. For a full load event we then need 94.2kW/65% = 145kW running load, please note MEC's design is for 150kW running load.

We do not have any report of requirement from the fire department. Other nearby communities are serviced with a small tanker of 8000gallons; which only provides 6.4 minutes of fire fighting at 1250gpm. With one pump you will get at least ½ half of the tested rate or 650gpm for as long as the electrical power stays on or the water reserve lasts.

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It is very important to know what you are getting for the money you spend. You should also know that the easiest fix is the most expensive over the long run. The pump house was modified because the motor efficiency was low and put out excessive heat and likely ozone. So panels were added for ventilation when the fire pumps were on. The district keeps trying to fix poor quality low initial cost with add on fixes. Each add-on fix represents an additional failure mode; which must be brought into the total analysis of safety and reliability.

Adding a new generator to come on when the electrical power supplied by the utility company fails, does not mean you and have improved system for the district. If you are not careful, the potential hazard for the district as well as the operating costs can go up.

NEW HAZARDS FOR BACK-UP POWER

When backup power is installed additional hazards are brought to the district are increased and must be mitigated. You weigh these issues against the hazard you trying to mitigate with the back-up power. The new hazards include:

A. Fuel Storage for Diesel unit. We need about 100gallons of storage to fight a 3-hour event. The consumption is 12gallon per hour. But the tank is not always full and we cannot be sure the event will only be 3 hours. We then have to worry about the diesel leaking into the ground and contaminating the districts water supply. The supply line is often the over-looked item.
B. The diesel supply is fire risk. So storage must be located at specific distance from the pump house or firewalls must be constructed.
C. The diesel engine will have exhaust, which must be vented in such as way as not to cause additional risk to the nearby occupants. This is commonly over looked. The NG unit is going to be far more clean and less of an issue.
D. Noise of the new operation must be mitigated, even though the operation is minimal.
E. New enclosures or building will be required for the motor/generator and fuel storage.
F. The NG generator set will have no fuel storage, but will require auto shut-off to mitigate the gas line possible rupture. This is quite normal and every lot in the PUD has one.
G. The NG installation will require more review, because the county is less confident in their understanding and less confident in the skill of the local providers.
H. In all cases we have the typical engine maintenance hazards; spilled service fluids etc. These are not trivial. Poor planning and procedure can result in water supply contamination; which is why electric motors were selected for the pump house.

The Back-up Generator suppliers provided no reliability data. Yes, the suggested units can provide power to run a fire pump, which would do a good job putting out a fire in the district. But, what makes us sure that the generator will even start? Usually bad events take place in bad weather. Here are items that need to be considered:

1. Will the diesel fuel gel or be unserviceable do to storage or temperature?

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2. Will the NG gas pressure be sufficient to supply enough gas? Is the NG gas system more reliable than the electrical system? Or are they linked in this case? No electrical power = no gas pressure?
3. How much burden will the county inflict on the project? Are the estimates even close after unskilled labor inflates the scope do the fear of the unknown?

CONCLUSIONS AND OPINIONS:

1. It appears MEC is more skilled and prepared for this project based on what documentation is supplied. But we can be easily fooled. No detailed design basis was provided. So these suppliers provided what detail they could to get potential business and neither should be dropped from consideration at this time.
2. The cost to install a generator of approximately 150kW is $105,000.00USD +/-50%. These should be considered budget estimates with final costs that may be as much as 50 to 100% higher based on things the two contractors do not provide.
3. The running demand for the case provided is 123kW. The power must be supplied by either a diesel engine or a NG fueled engine. The district elevation is about 9100 feet or a 22% drop in typical engine power. The drop in power is because the in-take is designed for near sea level. The density of air at the district elevation is substantially lower, less oxygen per cubic foot of air. So the engine's power is lower. The generator requirement is exactly the same. Do not confuse the generator limits with motor limits. Inflation comes when the engine is not paired with the correct generator. A larger engine is selected to give the correct horse-power at altitude. Since the typical unit is matched for service at low altitude, the result is usually an over sized generator, which can never provide the electrical power it is designed for. The inflation begins because the electrical components and supporting equipment are then selected based on the generators rating when the unit is at sea level.
4. What is the reliability of the supply grid the district is using now? How many outages of more than 6.4 minutes are there per year? Where did we get the 6.4 minutes? That is how long is takes to empty the Fire Department Tanker at the response rate for fire suppression of 1250gpm in our test report.
5. What rate can the Fire Department actually put on a typical house fire? I am sure they can pull equipment from everywhere, but what is real in first responder case?
6. The District may want to look at replacing motors on the fire pumps with >95% efficient motors. If this is corrected, then the running load would drop to 80.3/95%= 84.5kW. Based on what was provided it would appear the generator set could be 31% smaller and cost at least $20,000USD less. The new high efficiency motor should be much cheaper than $20,000.
7. If the fire pump motors were increased in efficiency to >95%, then the running kW demand for fire suppression would then be 94.2/95%= 99.2kW. This is even smaller than the current case. This would mean buying 3 motors for the 3 fire pumps and a smaller generator than specified by MEC; which likely could be done for the same cost basis as MEC

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has outlined. Then the district would have its back-up fire water rate. The issues would then be reliability of the system selected. Please note; the generator running demand is based on what the pumps lift and not the name-plate of the electrical motors. The electrical motors only consume the power required to turn the shaft. In the design requirement presented to the contractor, the motor name-plate demand was given and not the correct power demand for single pump. This is because you actually need a pressure and flow rate of the water to get the actual service demand. The contractors selected do not know how to calculate this and were not supplied the base data to do the calculations.

8. Now that District has the base cost for the installation, they need to ask the utility for the service reliability data for the past 5 years. How many outages >6.4 minutes per year? Then ask the generator suppliers for actual reported reliability data. What is the percent time it takes more 10 minutes to get up and running? Or any other reasonable probability data. The cost risk analysis can then be done.
9. If the district is looking for support in the form of a grant. The project will have to be engineered and have phases. The design phase and analysis budget would be no less than $20,000USD. The purchase and install would be no less than $200,000USD. The total project with the burden of red tape and government methods will be 2.2 to 2.5 times what is estimated here.

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