IDC Mechanical

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Mechanical Narrative

Our HVAC system is based on cogeneration in collaboration with a water source heat pump. It uses a Black Hawk helicopter turbine engine as the boiler. It is a self-contained unit. The excess heat from the super-heated exhaust is transferred through a tube to a heating coil into water. The water runs through the building to the heat pumps. The water then makes its way back to the chiller from the heat pumps. The process is repeated since it is a closed system. The air conditioning is run using steam from the heat exchanger located in the thermal mass. According to Matthew Setzekorn, the Mechanical Engineer, our cogeneration system allows us to decrease the size of our Mechanical Rooms in the building.

Biodiesel Collection, Production & Use:

The turbine engine is fueled by biodiesel converted from waste cooking grease from local restaurants. The waste grease is collected from several local sources within a mile radius, including the Washington Nationals Ballpark. The waste grease is brought back to the Boeing Building. It is fed up through a 2 hour fire-rated pipe system leading from the service area to the 2 hour fire rated storage tank room via an enclosed 2 hour fire-rated chase. The pipe system will need boosters in order to get the grease to the roof. The storage tank room is climate controlled due the biodiesel's nature to gel at 61° F. Climate control prevents gelling and the clogging of fuel filters and fuel injectors. Climate control also prevents condensation. Water in the biodiesel can cause serious mechanical problems for the turbine engine. The storage tank room has also been equipped with four louvers to provide adequate ventilation for the space.

There are five 4,000 gallon storage tanks in the room. Three tanks are dedicated to biodiesel fuel storage. The remaining two are for holdings and processing grease. The tanks have been sized based on calculations of projected daily grease collection. Baseball season significantly impacts the weekly grease collection. The grease intake tank is directly connected to the piping from the chase. Grease is processed there then transferred to the biodiesel tanks. The B100 pure biodiesel is what is produced in this process. The biodiesel is then fed directly to the turbine engine above the storage tank room on Level 8. The fuel then enters the combustion chamber via fuel injection. Biodiesel is like diesel in that it needs to be compressed rather than ignited like jet fuel.

There will be no odor from the biodiesel combustion like there is in a vehicle. Because the exhaust is super-heated, it is hot enough to burn any trace of odor emitting from the engine. This also means that no noxious odors will enter the building. Biodiesel is also safe to handle and transport because it is as biodegradable as sugar, 10 times less toxic than table salt, and has a high flash point of about 300° F compared to petroleum diesel fuel, which has a flash point of 125° F. This is a significant fact that will aid in determining fire ratings of the pipe chase and storage tanks. We used 2 hour fire-ratings to be on the cautious side.

Turbine Engine:

The Black Hawk turbine engine can be broken down into two sections. The cold section is where the air flow intake is occurring. The hot section is where combustion occurs and the exhaust exits the engine. The air intake in the engine can be separate into two air flows. The hot blow-off comes through the first set of compressors as cool air, into the combustion chamber, through another set of compressors and exits as super-heated exhaust. The cool blow-off goes through the engine in an interstitial like space between the inner housing and exterior housing. The hot blow-off from the super heated exhaust is what is funneled into the boiler with the heating coils.

Some modifications may need to be made due to the use of B100 – pure biodiesel. This relates to seals and gaskets for the most part because of certain chemical properties biodiesel lacks. Because it is a helicopter turbine engine, it will not produce a whistling sound that a jet turbine engine produces. Any sound production will be minimal because of biodiesel. We do not have to worry about the exhaust getting into the building and causing any noxious gases and fumes because of the HVAC arrangement. Exhaust eventually is kept to a minimum by going through a thermal mass/boiler and exit ing upward through the flue. The exhaust is almost a moot point because biodiesel is nearly carbon neutral.

Biodiesel Savings:
We are collecting grease from approximately 50 restaurants within a mile radius of site B. It costs $250.00 to empty a 1000 gallon grease receptacle every six months. We are collecting weekly, but will be charging customers $150.00 every six months except the Washington Nationals. The Washington Nationals Organization will be charged on a pro-rated amount. An estimate would be 2140 gallons per game amounting to $321.00 per game. Our annual profit from grease collection based on these figures is $38,001.00. This figure could increase or decrease based on the Nationals yearly performance. If they are doing well, surrounding businesses will be doing well also because of increased attendance.

he amount of biodiesel necessary to fuel our helicopter turbine engine in annually is 695,290 gallons. Our calculations show that our annual collection and production of biodiesel is 253,786 gallons. This leaves us with a 253,786 gallon surplus. The current cost per gallon in the East Coast – Central Atlantic region of the United States is $4.046. We stand to make a $1,026,818.16 profit annually. This could potentially be even more due to our conservative calculations and other socioeconomic factors that are not able to be accounted for without highly detailed research.

Cost of Maintenance:
The cost of maintaining the helicopter turbine engine is difficult to calculate. The turbine engine runs 24 hours a day, 7 days a week. This will cause wear and tear to occur at an accelerated rate compared to a turbine engine in actual use on a Black Hawk helicopter. Our aeronautics specialist, Dave Aston, said it may be difficult for him to even gauge what the maintenance cost would be given that we are using it for something other than its intended purpose.

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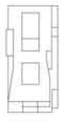
Key Plan



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