CONCEPTUAL DESIGNING 20 MW DIESEL ENGINE POWER PLANT FOR A REMOTE AREA

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DECLARATION

"I admit this report is done all by myself except statement that I have already stated on each one of them"

Signature : .....

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This work is dedicated to all my family especially my parent, brothers and sisters. You all very important in my life...

Also to my project supervisor, all lecturers and all my friends. This project success because of your support...

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ABSTRAK

Projek ini menerangkan tentang konsep janakuasa yang mengunakan enjin diesel sebagai pengeraknya. Sistem janakuasa ini melibatkan kuasa keluaran 20Mw bertujuan untuk kegunaan bangunan di kawasan pendalaman. Di dalam projek ini, bab-bab banyak berkisar tentang sistem dan komponen-komponen terlibat dalam menyediakan janakuasa di kawasan tersebut. Selain itu, ada juga ditekankan tentang cara berfungsinya sesebuah janakuasa serta contoh-contoh janakuasa yang telah wujud yang menggunakan enjin diesel. Projek ini juga dapat membantu untuk mendalami sistem janakuasa dengan lebih mendalam.

ABSTRACT

This project explain about the power plant concept which is use the diesel engine as the prime mover. This power plant needs the output electrical energy around 20Mw and use in remote area. In this project, the chapter are explain about the system and component that relates with the designing the power plant. Besides, there is the chapter explaining the function of the several component or system and also the existing modern diesel engine power plant.

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CHAPTER 1

INTRODUCTION

The project of "Conceptual Designing 20 Mw Diesel Engine Power Plant for A Remote Area" is about the power plant that supplied to the remote area in stated energy. The project mention about the electrical distribution and the systems or sub-systems that involve in order to build the power plant. This power plant is located in remote area and by using the diesel engine as the prime mover. There are also several items or components had been study due to the important to the power plant.

1.1 Objectives

1. The main objective of this project is to develop the concept in designing the 20MW diesel engine power plant for a remote area.

2. The power plant engine must run at efficiencies approximate 42%.

3. To identifying the main components and developing their detailed specifications about the diesel engine power plant.

4. The auxiliaries components are :
    a. Cooling system
    b. Fuel oil system
    c. Lubricating oil system
    d. Starting system

1.2 Scope Of Project

This project can be defined as the developing the design concept to ensure the power plant manage to reach the certain objective such as run at efficiencies approximate 42%. In order to get the 42% of efficiency, the engine should have some addition component. The addition needed to ensure the engine steady, reliable and safe to use.

1.3 Overview of Diesel Engine

The diesel engine is a type of internal combustion engine, more specifically a compression ignition engine, in which the fuel is ignited by the high temperature of a compresed gas, rather than a separate source of energy.

In the diesel engine need gas to be compressed which is will rise its temperature – Charles's Law. This property is the basic to ignite the fuel. The air is drawn into the cylinder and compressed by the rising piston. At the top of the piston stroke, diesel fuel is injected into the combustion chamber at high pressure, through an atomising nozzle, mixing with hot, high pressure air. This phenomenon will make the mixture ignites and burns very rapidly. The explosion causes gas in the chamber to expand, driving the piston down with considerable force and creating power in vertical direction. The connecting rod transmits this motion to the crackshaft which is forced to turn, delivering rotary power at the output end of the crankshaft. Scavenging of the engine is done either by ports or valves. Usage of the turbocharger to compress the intake air will fully realize the capabilities of diesel engine. An aftercooler/intercooler used to coom the intake air after compression by the turbocharger will increases efficiency.

1.4 Problem Statement

Even though in Malaysia there is rarely power plant using the diesel engine as their prime mover except in Sabah, this thesis is about to discover the conceptual design of the diesel engine power plant. Due to the literature review, the little bit information and knowledges gained.

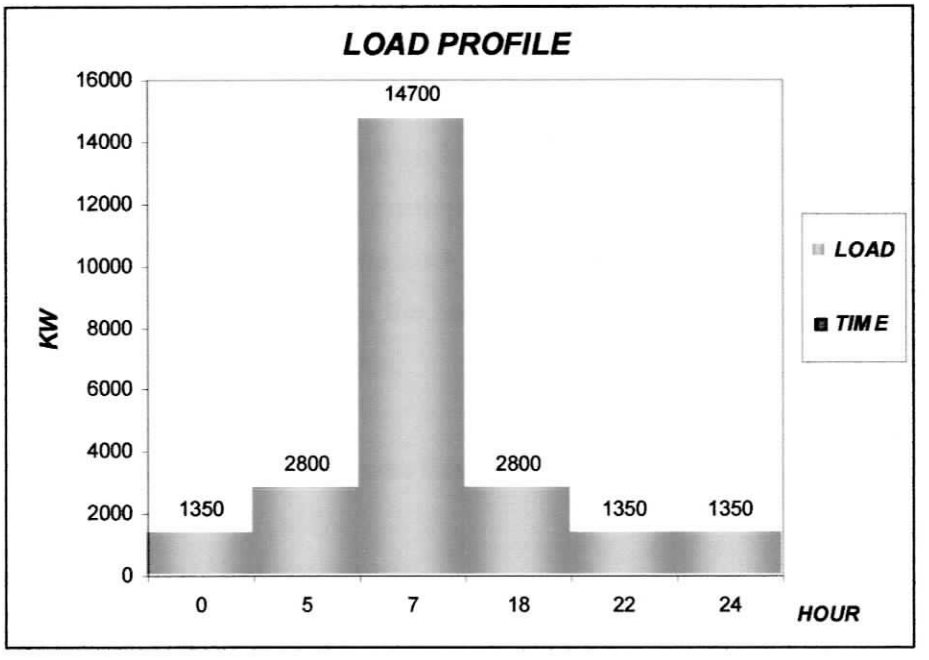
The power plant that using the diesel engine as the prime mover in the world normally faces a lot of challenge and problem. One of the problem is pollution or emissions of CO_2. In other hand, diesel engine itself has some problem such as the engine not working really proper when the cylinder are cold. Basically, there is a lot of problem occur by using the diesel engine.

A lot of development is run due to this problem and author will try to discover the solution of the problem based on the concept has been used. For example, the pollution problem can be reduced by using the emissions control-Exhaust Gas Recirculation (EGR) and Humid Air Motor (HAM) or Selective Catalytic Reduction (SCR) techniques.

For the problem such as engine not working properly due to the cylinder temperature, the usage of glow plug (use to warm the cylinders prior to starting) needed. There is a lot of solution author have to discover to ensure the design of the diesel engine power plant get the best specification with addition following the problem stated:

1. The engine that will be design suppose to be assume as working at the remote region.
2. It should have high reliability.
3. Periods between overhauls should be as long as possible.
4. It should be fuel efficient (lowest amount of fuel per kWh).
5. Able to use least expensive fuel.
6. Supply of water is limited.
7. Nearest fuel point is 200 miles away.
8. Plant is stand alone and not connected to any grid.

9. The normal temperature available : 40 °C
10. Expected load profile is as below.



Graph 1 : Electrical Load Profile by a day

So, the little bit solution of the problem:

a) As water supply being limited, cooling of the plant should be with a cooling pond and a cooling tower.

b) The cooling water is expected to be available at a maximum temperature of 35°C from the cooling pond.

c) Temperature rise in the cooling water is limited to 5°C.

d) It is expected that the wet bulb temperature at the maximum temperature of 40°C will be less than 35°C.

e) The plant should be capable of using the least expensive oil (least Heavy Fuel Oil).

f) Fuel is brought from the fuel supply point in trucks.

1.5 Methodology

Based on the title 'Conceptual Design 20 MW Diesel Engine Power Plant for a remote area', author sure there is a lots of component or area must be discover. Firstly, the exploration to the engine. Generally, engine is divide into two types. It is two-stroke and four stroke. Then, we go into the speed of the engine. The speed of engine based on 3 types. It is slow, medium and high, refer to the crank shaft speed. The engine also some consideration such as the numbers of engine to use, bore diameter, the stroke of the cylinder, the horse power occupied etc. which is all this part will be as the engine specification.

The auxiliary component or subsystems that also have to be considered are:

1. Cooling Water Heat Exchangers
    a) Type of design.
    b) Capacity in m^3.
2. Cooling Water Pumps
    a) Types Of Pumps used.
    b) Number of pumps needed.
    c) The Flow Rate (Kg/Sec) in the system
    d) Head Dimension (m)
    e) Drive Motor Rating In Kw (Each)
3. Fuel Oil Storage Tanks
    a) No Of Tank Needed for supply to the whole system.
    b) Capacity Of Each Tank In m^3
    c) Perimeter (m) of the tank.
    d) Height (m) of the tank.
4. Diesel Oil Storage
    a) No of tanks needed for the system
    b) Capacity (m^3)
    c) Diameter (m)
    d) Height (m)

5. Fuel Oil Setting Tanks
    a) No Of Tanks required.
    b) Capacity (m^3) of the tanks.
    c) Size Length (m), Width(m), High(m)
6. Fuel Oil Day Tanks
    a) No Of Tanks required.
    b) Capacity (m^3) of the tanks.
    c) Size Length (m), Width(m), High(m)
7. Diesel Oil Setting / Day Tanks
    a) No Of Tanks
    b) Capacity (m^3)
    c) Dimensions Length (m), Width(m), High(m)
8. Fuel Oil Transfer Pumps
    a) Types Of Pumps
    b) Capacity (M^3)
    c) Drive Motor Setting (Kw)
9. Fuel Oil Separators
    a) Types Of Separators
    b) No Of Units
    c) Capacity (M^3/ H)
10. Diesel Oil Transfer Pumps
    a) Types Of Pumps
    b) Capacity
    c) Types Of Motor
11. Diesel Oil Separators
    a) Type Of Separators
    b) Capacity
12. Starting Compressor
    a) Type Of Compressor
    b) Capacity
    c) Drive Motor Setting (Kw)

CHAPTER 2

LITERATURE REVIEW

2.1 History Of Diesel Engine

1862 - Internal combustion engine was introduced by Beau de Roches.

- Otto(Germany) , made the first practical application of Beau de Roches's theory in an actual working model.

-Otto's engine was practicable and fairly reliable compared to other earlier attempts. It employed a 4-stroke cycle of operation using gas as a fuel. Thus, the 4-stroke cycle of a gas engine became popularly known as an *Otto* cycle.

1872 - George Brayton, an American, introduced a new principle of fuel injection.

- He demonstrated that prolonging the combustion phase of the cycle, by injecting fuel at a controlled rate, produced more power per unit of fuel consumed.

- However, much of the efficiency gained by this method was lost due to the lack of an adequate method of compressing the fuel mixture prior to ignition.

- Later, Hornsby-Ackroyd engine produced. The first early designed engines that used a liquid fuel derived from crude oil.

1893 - Rudolf Diesel (18 Mac 1858 – 30 Sept 1913), a German inventor, patented a design for an internal combustion engine which was termed a Diesel engine.

1897 - Building a functional prototype while working at the MAN plant at Augsburg.

PICTURE 1 :Rudolf Diesel (18 Mac 1858 – 30 Sept 1913)

2.2 Classification Of Diesel Engine

Generally, all diesel engines can be classified as follows:

1. By means of realization of working cycle:
    a. Four-stroke diesel engines if working cycle requires four piston strokes
    b. Two-stroke diesel engines if working cycle requires two piston strokes

2. By means of application:
    a. Ship diesel engines (main and auxiliary)
    b. Industrial and stationary diesel engines (diesel generators, diesel compressor etc.
    c. Locomotives diesel engines
    d. On-road (trucks) and off-road (tractors) diesel engines

3. By charging cylinder with air:
    a. Naturally aspirated diesel engines in which piston is sucking the fresh intake air into the cylinder during its downward motion