Automatic Fuel Filling of Diesel Generator Tank Using BMS System

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Abstract- *In this venture, another control approach for ongoing automatic fuel filling technique in an effective and efficient way is given. The control technique is to make the fuel filling more reliable and without manual interference. In this technique the fuel filling is done by using pneumatic rack and pinion actuators with solenoid valve and BMS software. In industries many techniques are used for diesel generator fuel filling such as PLC based system or manual filling. Diesel generator plays and important role at the time of MSEB power shut down. So at power shut down condition quick operation of diesel generator is required. Other wise it will badly affect the production of industry. Fuel filling using PLC is uneconomical. Manual fuel filling is also not efficient , reliable and economical. There is a chance of manual error can decrease efficiency of the system. So a system including Sensors, pneumatic rack and pinion actuators with solenoid valve and BMS system is used for diesel generator fuel filling.*

I. INTRODUCTION

There are mostly diesel generators are used in industries as a backup at the time of power shut down. The fundamental issue is to always keep the diesel generator in a condition required for its operation. The main requirement is availability of fuel in the tank.

To overcome this problem a system with level sensors, pneumatic rack and pinion actuators with solenoid valve ,DDC panel, BMS software and other required accessories. In the system a level sensor senses the level in fuel tank. Then according to the level it gives analog signal to DDC panel. The DDC panel converts analog signal to digital signal and sends it to BMS system. Then according to the logic saved in a controller it generates an output signal. This digital output signal is given to DDC panel it converts the signal in analog and sends it to the pneumatic rack and pinion actuators. So accordingly the valve opens or closes. So with help of this system fuel tank is filled according to requirement.

II. NEED OF AUTOMATIC FUEL FILLING

In industries diesel generator plays a vital role at the time of power shut down. So for quick operation of DG operation it is compulsorily required that it provided with a diesel tank which is completely filled with fuel as per requirement. So for this monitoring and control of level of diesel tank is required. The control and monitoring should be reliable, efficient and economic. For all of this requirements automatic fuel filling is essential.

III. METHODOLOGY

Hardware and software used

1. Level sensors
2. DDC panel
3. Solenoid valve
4. Diesel generator
5. Diesel tank
6. Pneumatic rack and pinion actuator
7. BMS software
8. Air filter regulator
9. Limit switch
10. Manual override

1. Level sensors-

Float type level transmitter Construction

Float Operated Liquid Level Transmitter consists of non magnetic sealed stem containing series of reed switches and resistors, float carrying magnet, mounting adaptor (or flange) and enclosure containing electronics.

Operating Principle

Stem carrying series of reed switches and resistors forms a "Potentiometer" circuit which extends to the full indicating length of the transmitter. The reed switches are tapped at regular intervals and this tap off point is connected to electronics in enclosure. As the float travels through the indicating distance, the magnet located within it tap off the reed switches there by varying the resistance fed to the

electronics(as shown in figure below), which in turn converts the change in resistance to industry standard analog output.

Technical Data

- Overall Length: 300mm to 5000mm
- Measuring Error: 0.25 % of Span
- Output Temperature Co-efficient : 0.007% / C
- Resolution: 5mm / 10mm
- Ambient Temperature: - 40 C to 60 C
- Liquid Temp. Range: - 40 C to 120 C
- Liquid Min. Density: 0.8 gm/cc
- Max. Pressure2: 10 Kg/cm

2. DDC Panel

Direct Digital Control (DDC) involves the connection of microprocessor-based controllers to field level sensors and actuators. The signals received from field level instrumentation are converted from analogue to digital format so that the data can be used in software logic. Control signals are determined by software logic and they are converted from digital to analogue format so that the final control elements can be adjusted.

I/P card – 4to20mA
O/P card -0to24V DC

3. Solenoid valve

A solenoid valve is an electromechanically operated valve to control flow of liquid. The valve is controlled by an electric current flow through a solenoid coil in the case of a two-port valve the flow is switched on or off in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold. Solenoid valves are the most frequently used elements in control of fuel flow. Their tasks are to shut off, release, distribute. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

4. Diesel generator

Operating principle

In four-stroke cycle engines there are four strokes completing two revolutions of the crankshaft. These are respectively, the suction, compression, power and exhaust strokes.

Generator set specifications

- Model CP1500 D5 P
- Prime Power Rating kVA 1500
- Output Voltage and Frequency 415 Volts, 50 Hz
- Power Factor 0.8 (lag)
- No. of phases 3 phase

Engine specifications

- Make Cummins
- Model KTA 50 G8-I
- No. of cylinders 16 ‘Vee’
- Aspiration Turbocharged- Aftercooled
- Bore x Stroke 159 mm x 159 mm
- Displacement 50.3 ltrs
- Output - Prime 1735 bhp (1294 kWm)
- Fuel consumption @ 75% load with Radiator & Fan 231 ltr/hr
- Fuel consumption @ 100% load 301.7 ltr/hr
- Typical oil consumption @ 100% load 0.35 ltr/hr
- Total wet weight (engine + radiator) 7205 kg
- Length x Width x Height (engine) 2978 x 2080 x 1780 mm
- Compression Ratio 14.9:1
- Piston Speed 7.95 m/s
- Governor / Class Electronic / A1
- Lubricating oil system capacity 177 ltrs
- Coolant capacity (engine + radiator) 510 ltrs
- Combustion air intake @ 100% load (+/- 5%) 95.5 m3/min
- Fan air flow across radiator 28400 ltrs/sec
- Exhaust Temperature 481 oC

Alternator specifications

- Make Stamford

- Frame size / Model No. PI734C
- Voltage Regulation + 0.5%
- Insulation Class H
- Standard Enclosure IP 23
- Winding Pitch 2 / 3 Pitch
- Stator Winding Double layer lap
- Rotor Dynamically balanced
- Wave form distortion No load < 1.8 %, non distorting balanced linear load < 5 %
- Telephone Interference Factor Better than 50
- Total Harmonic Better than 2%

5. Diesel tank

A 990 liters diesel tank is provided for each diesel generator.

6. Pneumatic rack and pinion actuator

Operating Principle (Standard Mode)

- Double Acting

Both ports A and B are used as inlet ports. When air is supplied to Port A, the pistons are moved away from each other, and the pinion is rotated CCW. When air is supplied through Port B, the pistons come closer and return to their home position, rotating the pinion CW.

- Spring Return – Fail Cw

Port A is used as inlet. When air is supplied to Port A, the pistons are moved away from each other, the springs are compressed, and the pinion is rotated anticlockwise. When the air is exhausted through Port A, the springs return the pistons to the home position, rotating the pinion clockwise.

Operating Medium

- Air or non-corrosive gas compatible with the internal materials of construction.
- Dry or lubricated.
- Gas must be clean and filtered to minimum 100 micron level.

7. BMS Software

METASYS@Site Management Portal, Version-9.0.0.4256

Metasys System

The Metasys system is a web-based building automation system that allows day-to-day building operators to access the system's user interface (UI). The Metasys system user experience is a portal into a site that you can tailor to fit the need so fall potential system users. The user experience provided by the Metasys system can evolve and scale to match the needs of any single facility or campus of multiple buildings. Two variations of the user interface are available: Metasys UI and Site Management Portal.

Metasys System Capabilities

- Site Director
- Time Management
- System Navigation
- Monitoring and Command

8. Air filter regulator

This is protective to ensure that the air supply into the actuator is free of dust and moisture. It has also regulator and a pressure gauge to regulate/measure the actual line pressure near the actuator.

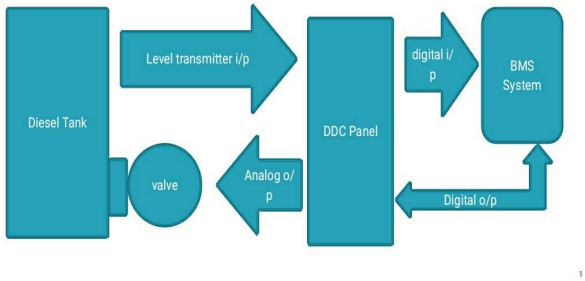
9. Limit switch

This is used in control circuits where mechanical position of valve/actuator has to be translated into electrical single for remote operation of another equipment . These switches could also be used for Visual indication of open & close position of Valve & Actuators.

10. Manual override

In case of non availability of air pressure a Manual override could be provided by fitting a suitable gear unit at the bottom of the actuator. The pinion of the actuator is coupled to the gear unit which in turn gets connected to the valve stem. Lever arrangements in the manual override facilitate engaging the actuator pinion with gear unit wherever it is required to operate manually. By simultaneously pulling a plunger knob and rotating the leaver downwards in clockwise direction by 90 the manual override is engaged. The lever position at this position is horizontal. Similarly when the lever moved upwards in anticlockwise direction the MOR is disengaged. The lever position as this position is vertical.

IV. BLOCK DIAGRAM



Working

The level transmitter provided at the top of the diesel tank senses the level of the diesel and accordingly gives the signal of low level or high level to the DDC Panel. The signal is an analog signal the DDC panel converts the analog signal to digital value accordingly. This value is given to the BMS system. Then according to the logic saved in BMS system it generates an output signal. This signal is in the digital form the DDC panel converts the digital signal to the analog signal accordingly. Then the DDC panel accordingly provides 24V DC to the solenoid valve. And the solenoid valve opens or closes accordingly. Hence the fuel filled in the diesel tank automatically according to the requirement.

V. CONCLUSION

Thus we concluded that by using BMS system we can make the fuel filling of diesel generator tank automatic. This method is more efficient and effective. As we are using BMS system for this method it is more economic.

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