Controlling Induced Draft Fan of Power Plant using Labview

R. M. Potdar, Anup Mishra, Soma Kala Sammidi, Akula Nagesh

Abstract:- In this proposed work, design and development of controlling induced Draft fan in a power plant which is presently working on DCS technique has been accomplished by using high computing software Lab VIEW and results has been shown with suitable examples. The goal of this work is to control the Induced Draft Fan in a different way. A set of six interlock conditions were provided for this purpose. The objective was to design and implement the controlling of ID Fan in Lab VIEW that will control the ID Fan similar to the DCS technique. Since DCS is applicable only for big system not less than 5000 input and output but this is costly. It consists of separate server, processor and computers where as Lab VIEW does not require a separate processor, no workstation, no operator station here directly connect interfacing card with computer itself. Proposed system can cost less than two hundred times than a DCS.

Index Terms:- Induced Draft Fan; LAB VIEW,Power Plant (WHRB), Software Control.

I. INTRODUCTION

Induced Draft Fan is one of the rotating equipment in a Power plant. It maintains the pressure in the Boiler as per process requirement. The gases generated in the Boiler to be sucked by Induced Draft fan to maintain required pressure inside Boiler.

In the JSPL, Raigarh Plant one of the power production route is through Waste Heat Recovery Boilers. In detail, the function of the Boiler in a power plant is convert water into steam. In thermal power plant the Coal is used as a fuel for this operation. In WHRB boilers, the fuel to convert water into steam is Waste gases or Flue gases generated by process like DRI, Blast Furnace and Coke Oven etc. By adjusting the inlet guide vanes and inlet damper, sucking capacity of Induced draft fan can be altered to maintain the required Operational pressure inside the Boiler or Kilns. Inlet guide vanes are equipped with Fan to adjust the direction of flow for maintaining pressure inside the boiler or Kiln. And Inlet damper is a simple valve in the suction line of Induced draft fan to adjust the quantity of Gas. Induced draft fan used in thermal power plant as well as Waste Heat recovery Boilers.

Manuscript received on April 14, 2012.

Mr.R M Potdar,Sr. Associate Professor, Department of Electronics & Telecommunication, Bhilai Institute of Technology,Durg, Chattisgarh,India (E-mail:ravi_potdar@rediffmail.com)

Dr.Anup Mishra, Professor & Head, Department of Electrical & Electronics, Bhilai Institute of Technology, Durg, Chattisgarh, India. (E-mail:anupmishrabit@yahoo.co.in)

Ms.Soma Kala Sammidi, Department of Electronics & Telecommunication, Bhilai Institute of Technology, Durg, Chattisgarh, India. (E-mail:sammidisomakala@yahoo.com)

Mr. Akula Nagesh, Deputy General Manager, Power Plant (Instrumentation), Jindal Steel & Power Limited, Raigarh,Chattisgarh, India. (E-mail:anagesh@jsp.com).

II. INDUCED DRAFT FAN OPERATIONAL PROCEDURE

In Brief, DRI is a process to produce Sponge Iron in solid state which is used as raw material in Electric Arc Furnace to produce Steel. In this DRI process, excess gases generated will be discharged at high temperature (650°C). This heat energy of these gases is recovered in WHRB to convert Water as Steam.

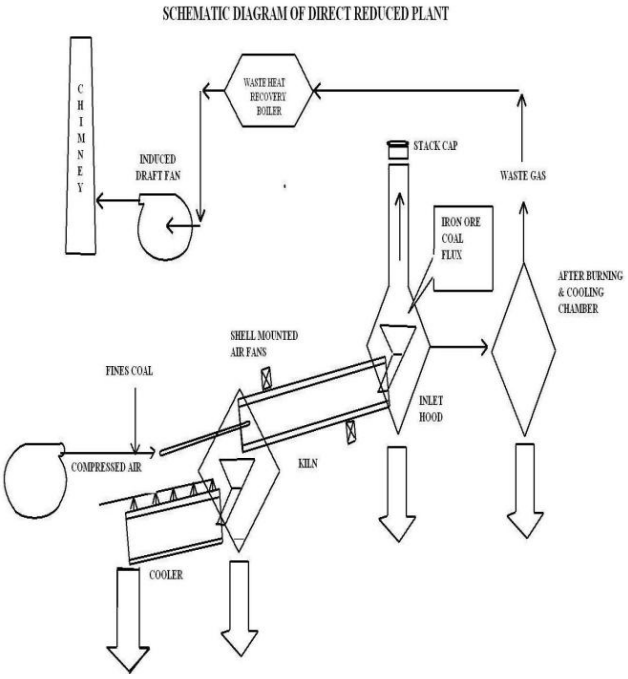

Fig-1 As shown in Fig-1 the above figure ID fan sucks the gases inside the Kiln to maintain required operational pressure.

III. METHODOLOGY

Hardware Description:

There are 3 main parts with which the Hardware part is constructed.

A. The power supply Card:

The purpose of using power supply card is to supply the power required for the circuit. A nominal AC 230V input is fed to this card and +24V DC and +15V DC output Voltages are delivered by this card. The Measurement card and the Converter cards will operate with 24V DC. +15V DC is used to control external device (if connected) through the relays.

B. Measurement Card:

All the signal levels (Like: Inlet Damper, IGV, Fan Bearing, Fan winding, Motor Winding and Motor Bearing) are measured by the measurement card. The measurement card will process these signals and provides its output in CAN (Controlled Area Network) format.

C. Converter Card:

The output of the measurement card will be fed to the converter card. The Converter card will convert these CAN data in to Ethernet format in order to interface with the PC. The converter card will be used as the gateway for interface the hardware with the PC.

Fig-2 Hardware Components

D. The LOGIC:

The Logic for the FAN ID to be in ON and STACK CAP should be in CLOSE position is as mentioned below.

INTLET DAMPER and IGV should be in CLOSED position. (i.e. for project simulation we consider CLOSE position as High Voltage i.e. 18V to 30V). The moment these two are in CLOSE position the operator should be able to turn ON the system by clicking 'Click to STRAT' button. If either one or both (Inlet damper and IGV) are in OPEN position, 'Click to START' button will not appear on the screen. Hence the operator cannot click the button.

The temperature of ID FAN bearing, ID FAN winding, ID FAN MOTOR bearing and ID FAN MOTOR winding should be in low level. (i.e. for project simulation we consider -5 to 5V is Low level) During the operation, if any of the above mentioned 6 conditions goes out of the limit the ID FAN should go OFF and STACK CAP should be in Open position.

IV. LAB VIEW SOFTWARE CONTROL SYSTEM

Lab VIEW is a graphical programming language - G language, in different from other programming languages such as VC, VB and other text-based type program code, Lab VIEW use graphical block diagram model to build a program code. Using Lab VIEW developed applications is known as the VI (Virtual Instrument).

A. Block Diagram

The use of virtual instrument technology, through the Lab VIEW software to achieve control of Induced Draft Fan, the block diagram of control system is shown in Figure Fig 3 & 4

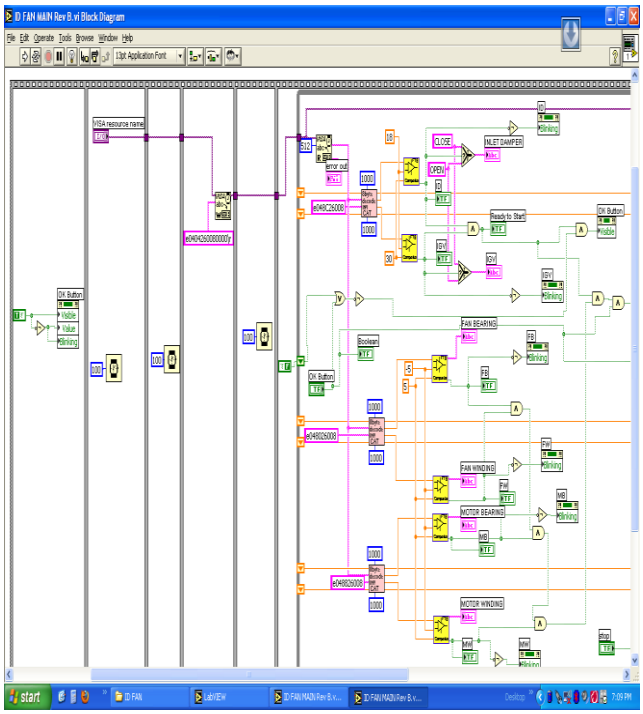

Fig-3(a) ID Fan Main programme

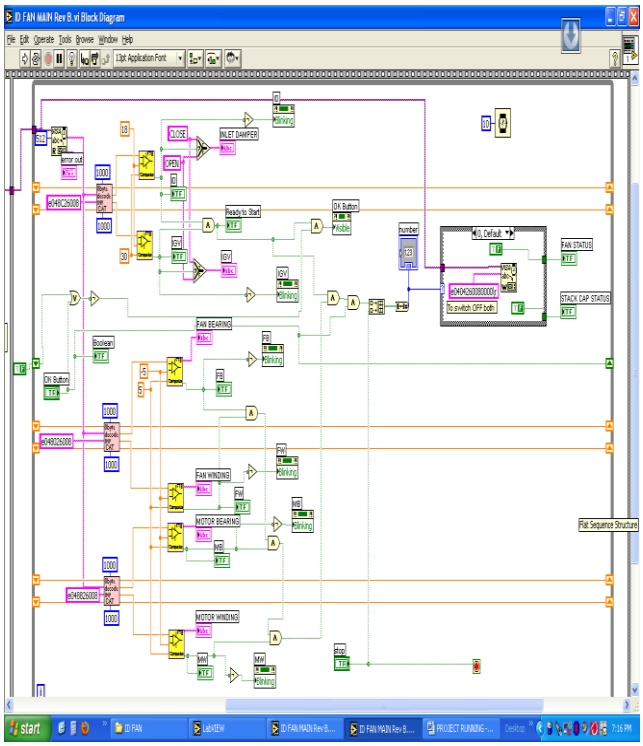

Fig-3(b) ID Fan main programme

B. Induced Draft Fan Control Panel

Control front panel as shown in Figure 4.

Fig- 4 Front Panel

C. Induced Draft Fan control flow process:

Induced Draft Fan control system software control flow diagram is as follows:

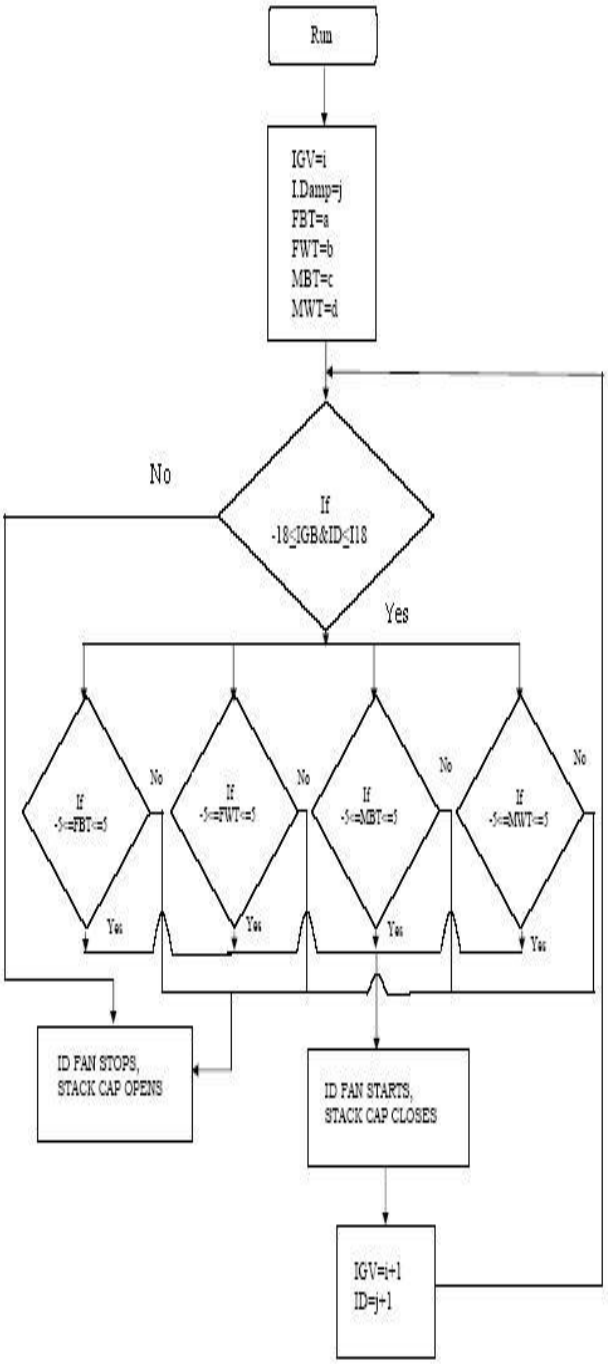

Fig- 5 Flow Chart of Programme

V. RESULTS

a) When RUN condition (Execution) is given, Click to start button will appears in Red Color
as shown in below Figure.

Fig-6 ID Executed ID Fan front panel

b) If one of the Start permissive Inlet Damper is open, then ID fan will not start, so the Inlet damper signal glows as faulty as shown in below figure.

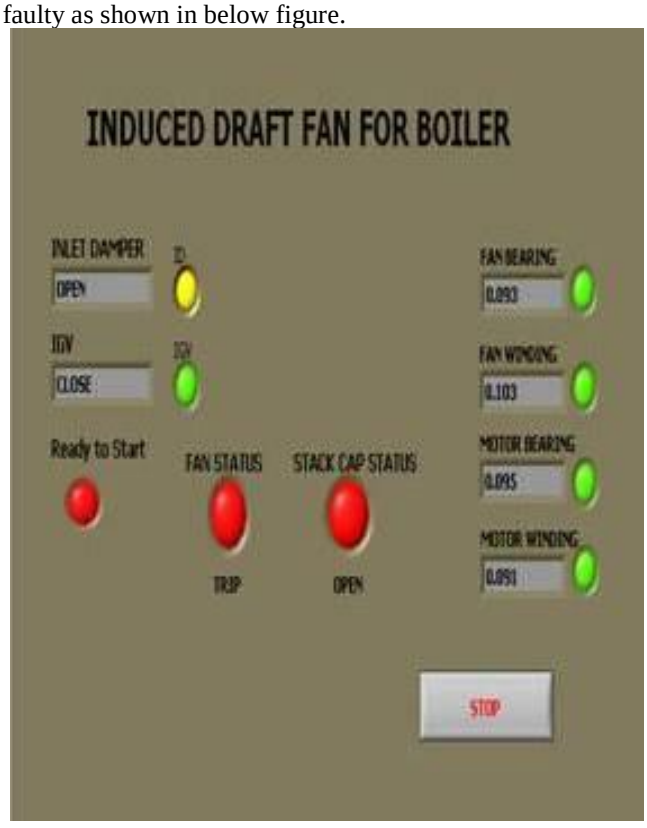

Fig-7 Inlet Damper Open Condition

c) If the Second start permissive of ID FAN Inlet Guide Vanes is Open, then also the ID FAN will not start, so signal of IGV glows as faulty

Fig-8 IGV Open Condition

d) During Running of FAN, if any Inter lock like Fan Bearing temperature exceeds the limit value, then Fan will trips and Stack Cap will also Open to send out the Flue gases to maintain a desired pressure in the Boiler So Fan Bearing signal shows as faulty as below

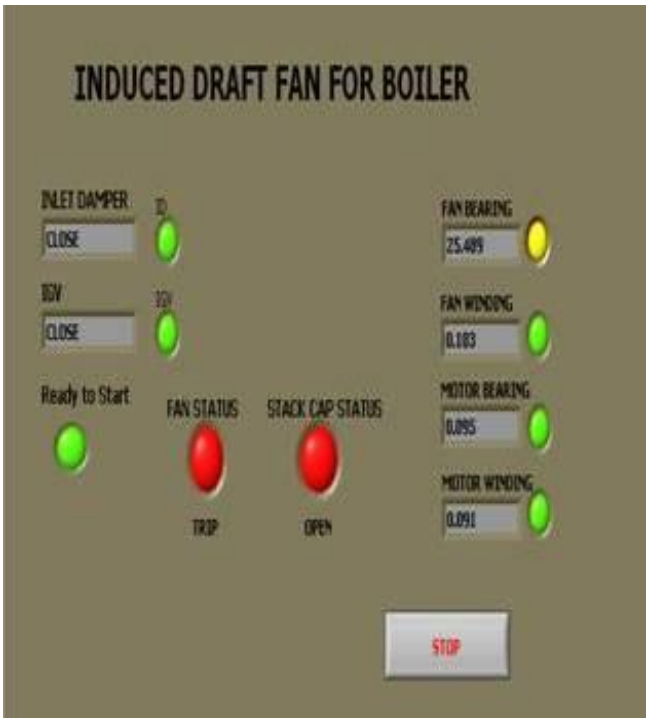

Fig-9 Fan Bearing Temperature. Beyond limit

e) During Running of FAN, if any Inter lock like Fan Winding temperature exceeds the limit value, then Fan will trips and Stack Cap will also open to send out the Flue gases to maintain a desired pressure in the Boiler So Fan Bearing signal shows as faulty as below

Fig-10 Fan Winding Temperature beyond limit

f) During Running of FAN, if any Inter lock like Motor Bearing temperature exceeds the limit value, then Fan will trips and Stack Cap will also open to send out the Flue gases to maintain a desired pressure in the Boiler So Fan Bearing signal shows as faulty as below

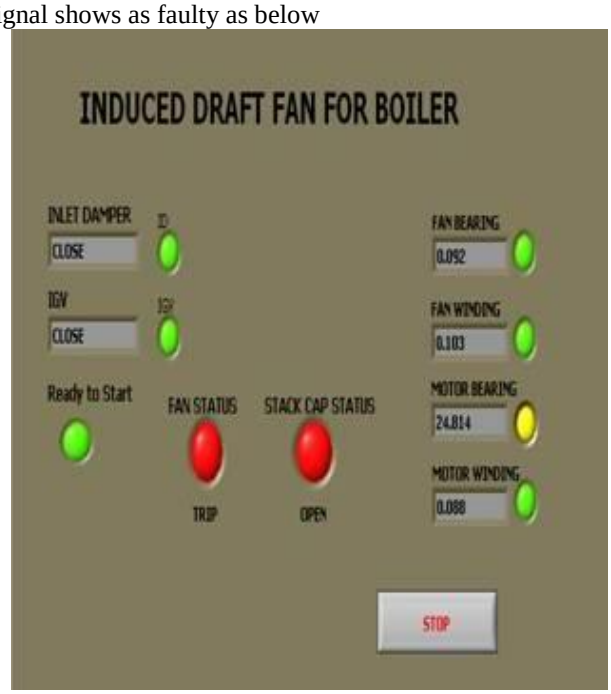

Fig-11 Motor Bearing Temperature beyond limit

g) During Running of FAN, if any Inter lock like Motor winding temperature exceeds the limit value, then Fan will trips and Stack Cap will also open to send out the Flue gases to maintain a desired pressure in the Boiler So Fan Bearing signal shows as faulty as below

Fig-12 Motor Winding Temperature beyond limit

h) After re-setting, all indications will show OK condition and fan will runs as shown in blow

Fig-13 All conditions satisfied

VI. CONCLUSION

Based on the graphical programming language and the data stream operating mode, the software instead of apparatus, the use of virtual instrument technology has opened up our new field of control. Compared to the traditional control it has obvious advantages. Programming is simple by the graphical programming language.

A panel of LabVIEW personalizes button design and layout, with the virtual knobs and switches to struct the friendly human, intuitive control interface makes vivid, so that the operators are involved in the operation easier to control the process and results at a glance. The main advantage of controlling Induced draft fan by using LAB View is lesser cost as compared to DCS technique, since the interfacing of inputs and outputs are directly given to the PC (which works as work station i.e. block panel and operator station i.e. front panel) .This paper was made in a Coal Based Thermal power plant at JSPL, Raigarh Plant as the existing is running on DCS system.

REFERENCES

1. Gregory K. McMillan, Douglas M. Considine (Ed), Process/Industrial Instruments and Controls Handbook Fifth Edition, McGraw-Hill, 1999 ISBN 0-07-012582-1 Section 3 Controllers
2. Li, Nan; Teng, Fei *System Design Electro-motor Rotational Speed Control Based on of Lab VIEW* . Computer Measurement & Control, p794-799. 2006. 14(6).
3. Prime, J.B. Valdes, J.G., *"use of ladder diagram in discrete system of PLC",* IEEE Transaction, Vol. PAS-100, pp-143-153, January 1989.
4. *IEEE Guide for AC Motor Protection* IEEE, Std C37.96-2000 (Revision of IEEE Std C37.96-1988)
5. National Instruments Corporation. *Getting started with LabVIEW* [Z]. Part No.323427A-01. April 2003 Edition.
6. Peter A. Blume: *The LabVIEW Style Book*, February 27, 2007, Prentice Hall. Part of the National Instruments Virtual Instrumentation Series series. ISBN 0-13-145835-3
7. Jeffrey Travis, Jim Kring: *LabVIEW for Everyone: Graphical Programming Made Easy and Fun, 3rd Edition*, July 27, 2006, Prentice Hall. Part of the National Instruments Virtual Instrumentation Series. ISBN 0-13-185672-3.

Abbreviations:

1. Lab VIEW: Laboratory Virtual Instrumention Engineering Workbench.
2. DCS: Distributed Control Systems.
3. ID : Induced Draft
4. WHRB: Waste Heat Recovery Boiler.
5. DRI: Direct Reduced Iron
6. IGV: Inlet Guide Vanes
7. JSPL: Jindal Steel & Power Limited

AUTHORS PROFILE

Sr. Associate Professor Mr. R. M. Potdar received B.E. Electronics, M.Tech. (Hons) Instrumentation & Control. He is having a total teaching experience of 14 years and industrial experiences of 5 years. His interests are in Image Processing, Neural Network & Fuzzy Logic System Design. His specialization subjects are Adaptive Control System, Optimal Control System, Control System Design, Satellite communication and Optical Communication. He has published the papers in 6 international journals and 2 national journals and also attended 1 international conference and 11 national conferences. Also he is having Life Membership of Indian Society of Technical Education, India (ISTE).

Dr Anup Mishra, Professor& Head Electrical & Electronics Department Bhilai Institute of Technology, Durg, Chhattisgarh. He Has 15 Years of teaching experience, his area of specialization is Network Analysis, Digital Electronics, Power Electronics, Signals & Systems, and Material Science. He has published two national and two papers in international journals.

Ms. Soma Kala Sammidi received M.Sc. Electronics from GITAM Engineering College, Visakhapatnam & pursuing M.Tech. Instrumentation & Control from Bhilai Institute of Technology (BIT), Durg, Chhattisgarh, India. Her interests are in Biomedical Instrumentation, Digital electronics, Satellite Communication, Signals & Systems.

Mr. Akula Nagesh did his Bsc. Engg. In electronics & telecom. MBA (HR) and at Present Pursuing his MCA 5th sem. from SMU. At present he is working as DGM (Head Instrumentation, Power Plant) at JSPL Raigarh. He has been associated with this organization since last 18 years. His areas of interest are Analog & Digital Electronics, Power plant Automation, and Solar & wind energy.