ESTABLISHMENT OF COMMUNICATION BETWEEN PLC AND SCADA THROUGH MODBUS FOR GREASE PUMP OPERATION IN SPECIALIZED MINING EQUIPMENT

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Abstract—Steam Turbine Protection System is designed with today technology to operate the thermal power plants in safe and reliable manner. **The protection system operates only when any of the control system set point parameter is exceeded, and the steam turbine will damaged if it continues to operate. This paper presents overview of the steam turbine protection logics of lube of system and implementation for smooth automatic operation by using SIMATIC S7 PLC programming along with monitoring SCADA SYSTEM by using WinCC software.**

Keywords: SiemensPLC Software, WINCC SCADA, Protection logics,Controlling schemes.

I. INTRODUCTION

Demand for high quality, greater efficiency and an automated machine has increased day by day in the industrial sector as well as power plants.[1] Power plants require continuous monitoring and inspection at frequent intervals. There are possibilities of errors at measuring and various stages involved with human workers and also the lack of few features of microcontrollers. Thus this paper takes a sincere attempt to explain the advantages that will be obtained by implementing automation system. The turbine lube oil system control which is the most important part of any power plant, and its automation is the precise effort of this paper. In order to automate a power plant and minimize human intervention, there is a need to develop PLC based system along with monitoring SCADA system that monitors the plant and helps reduce the errors caused by humans [2].The internal storage of instruction of PLC is used for implementing function to control various types of machines and processes through digital or analog input/ output modules. PLC systems are used to monitor and control a plant or equipment in industries such as power plants, energy, oil and gas refining and transportation .

II. LUBE OIL SYSTEM

1. **Purpose of Lubrication System**

   Turbine lube-oil systems have many missions among the most important are following

ξ To reduce the wear and tear of the rotating element

ξ To maintain the temperature of the bearing.

ξ Provide a medium hydraulically operating the governor gear and controlling the steam.

ξ Provides for hydrogen cooled generators a sealing medium to prevent hydrogen leaking out along the shaft.[3]

2. **Lube oil System components**

   Main and Auxiliary Lube Oil Pump:

   Motor driven auxiliary oil pumps are provided for continuous turbine operation including starting or shutting down, barring operation or when lube oil header pressure is low or control oil pressure is low. They are directly driven by Electric motor (AC Supply) and combined unit is mounted on the Lube oil skid.[4]

   MOP and AOP START/STOP CONDITIONS:

   Start Permissive

ξ Drive remote selected

ξ MOP feeder healthy OR AOP feeder healthy

Manual Start

ξ Through Pushbutton when drive in manual mode

Auto Start

ξ Lube oil header pressure low(Set point >= 2.5)

ξ Control oil pressure (Set point >= 9 kg/cm2)*OR* ξ Standby drive is tripped (AOP feeder not healthy) OR Standby drive is (AOP) is not running & vice versa.

Auto Trip

ξ MOP OR AOP feeder unhealthy.

Emergency Lube Oil Pump:

Emergency oil pump driven by DC Motor is provided. When all sources of oil supply fail the Emergency oil pump ensures supply to bearings during coasting down period. This is the reason why these pump are connected to the bearing oil circuit without passing through oil cooler and filter to ensure positive supply of oil to the bearing[5]

Manual Start

ξ Through Pushbutton when drive in manual mode

Manual Stop

ξ Through Pushbutton when drive in manual mode AND

ξ Lube oil header pressure not LOW LOW (Set point> 1.2kg/cm2)

Auto Start

ξ Lube oil header pressure LOW LOW AND turbine speed = > 20rpm.

ξ EOP can automatically start and cannot e stopped until the pressure becomes normal or turbine speed come to standstill

Oil Vapor Extractor (OVE) Fans:

During Turbine operation when either of the MOP or AOP or EOP is supplying lube oil to all the bearings. Due to the oil circulation and heat taken away by the oil from bearing, vapors formation is occurred inside the lube oil tank. This creates a positive pressure above the oil level, which may cause restrictions for the proper oil circulation. As it is necessary to remove the vapour from tank and create slight negative pressure oil vapour extractor fan is provided. This also prevents leakages from the bearings baffle rings.[6]

Start Permissive

ξ Drive remote selected.

Manual Start\STOP

ξ Through Pushbutton when drive in manual mode.

Auto Start

ξ Any of the oil pump is running OR

ξ Standby drive is tripped.

ξ Standby drive is not running.

Auto Trip

ξ Feeder Fault

III.HARDWARE AND SOFTWARE DESCRIPTION

STEP 7 is standard software for creating programmable logic control program in Ladder logic, Function Block Diagram or Statement List for SIMATIC S7-300/400 stations. Basic Tasks when you create an automation solution with STEP 7, there are a series of basic tasks projects and assigns them to a basic procedure as shown below Fig.1.[7]

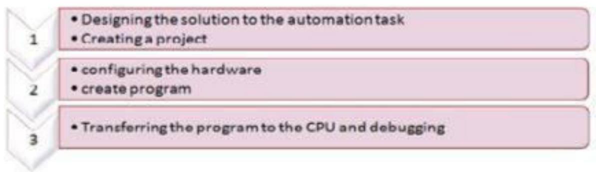


Fig.1 Basic Procedure for STEP7

Using the STEP 7 software, you can create your S7 program within a project programmable controller consists of a power supply unit, a CPU, and input and output modules (I/O modules). The programmable logic controller (PLC) monitors and controls the machine with the S7 program. The I/O modules are addressed in the S7 program via address. The SIMATIC Manager is the central window which becomes active when STEP7 is started is shown below.

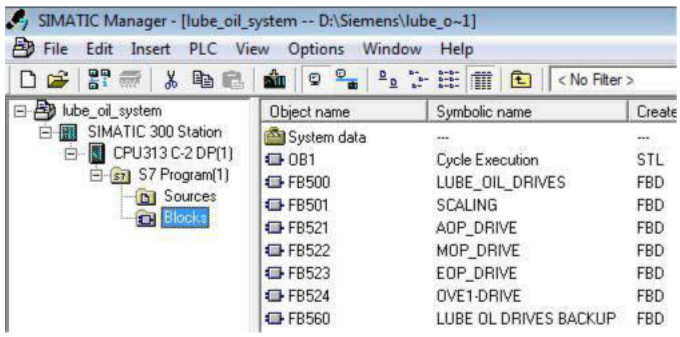


Fig.2 SIMATIC Manger Project Structure

To create the project in STEP 7 Software here some basic steps are mention. That step is taken from reference .

CPU (Central Processing Unit)

ξ Name:CPU313-2DP(1)

ξ ORDER NO: 6ES7 313-6CF03-0AB0

Digital and Analog Input/output

ξ DI16/DO16

ξ AI18/AO18

Power Supply Module

ξ Name: PS 307, 5A

ξ Order No: 6ES7307-1EA01-0AA0

Technical Specification : Output current 5 A; Output voltage 24 VDC; short circuit proof, open circuit-proof Connection to single phase AC mains(rated input voltage120/230V, 50/60 HZ)

Hardware Configuration:

The hardware config editor is reached from SIMATIC manager. This is where engineer the engineers set up entire hardware network, concerning everything from what kind of PLC to use to the type media interconnection between nodes and where the OS and ES stations should be connected in the automatic control system network.[8]

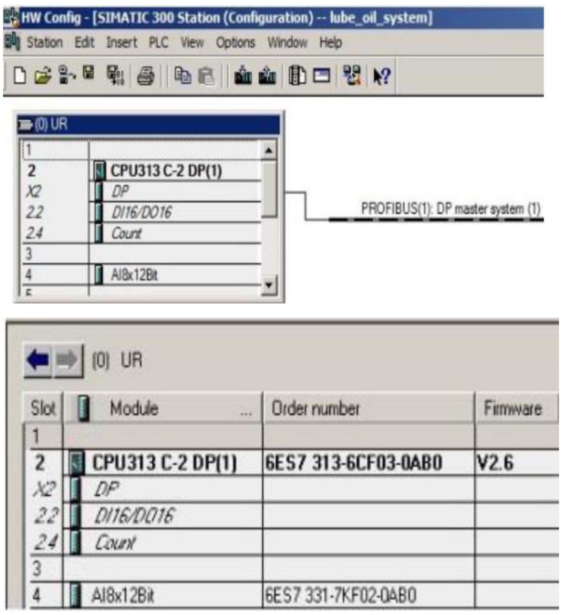
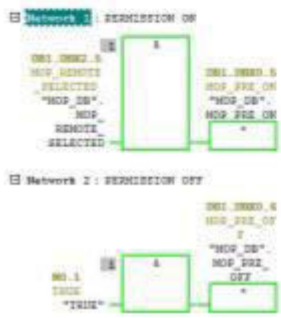


Fig.3 Hardware Configuration

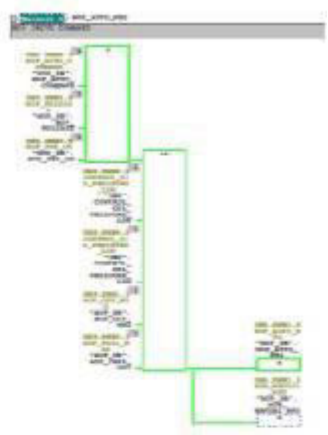
In Fig.3 hardware setup can be seen as defined by the hardware configuration editor.

The programming has been done using FBD language for the PLC and protections interlock logics for lube oil system has been done in the Step 7 software as shown in Fig. 4.[9]

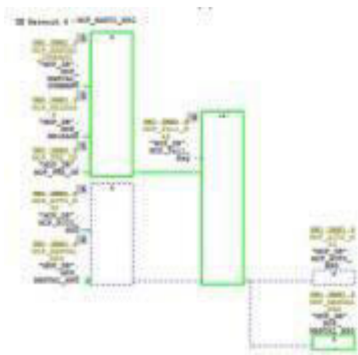
Start Permissive:



Auto Mode:



Manual Mode:



Anlog Input Scaling

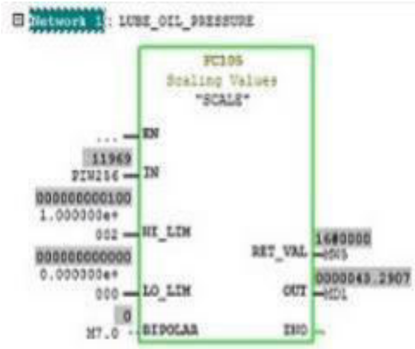


Fig.4 Developed Program for MOP drive in SIMATIC manager

In this way all lube oil system logic has been developed in SIMATIC Manger.

SIMATIC WinCC Flexible:

SCADA system offers maximum functionality and a user-friendly user interface.[10] With this configurable and scalable system, you have the advantage of absolute openness to both the office environment and to production. An integrated process database and Plant Intelligence, for example, ensure transparency in production. Numerous options and add-ons extend and expand the scope of performance. [11]

WinCC is a powerful HMI system. HMI stands for "Human Machine Interface", i.e. the interface between the person and the machine. WinCC or Windows Control Centre, is the program where the operator picture are built, allows the operation and observance of the processes that run in a machine.[12] The communication between WinCC and the machine takes place via an automation system.as shown in Fig.5.

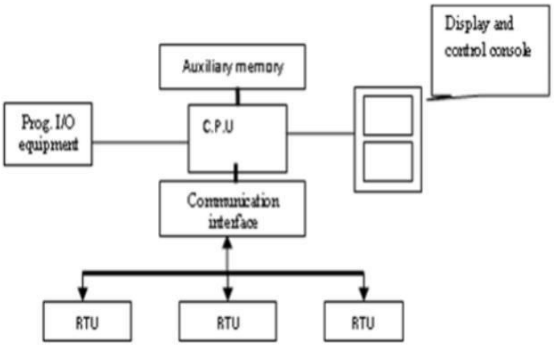


Fig.5 SCADA System with Single Computer

Configuration steps in the WinCC Explorer are mention below:

ξ Project Name: Lube Oil System.

ξ Connection Parameters: The connection from WinCC to the AS is established as shown in Fig.6.

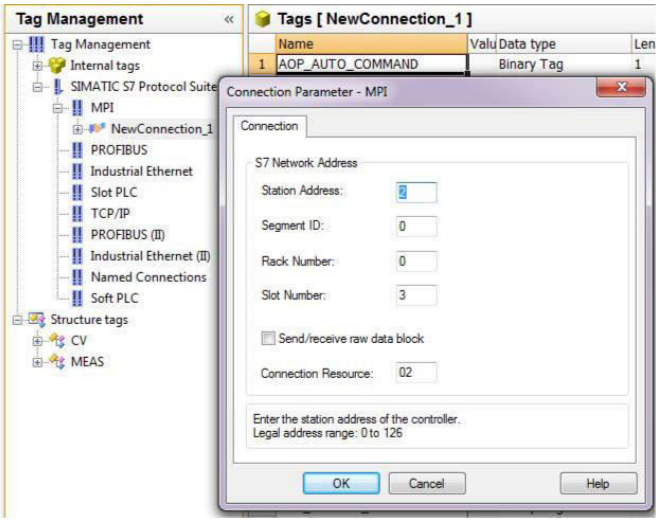


Fig.6 Connection between WinCC and AS *(Automation System) using MPI*

ξ Tag Management:

Tags [MOP_DRIVE]

	Name	Data type	Leng	Group	Address
1	MOP_AUTO_COMMAND	Binary Tag	1	MOP_DRIVE	DB1,D0.7
2	MOP_AUTO_MSG	Binary Tag	1	MOP_DRIVE	DB1,D1.0
3	MOP_Fail_Msg	Binary Tag	1	MOP_DRIVE	DB1,D1.4
4	MOP_LOCAL_MSG	Binary Tag	1	MOP_DRIVE	DB1,D0.0
5	MOP_MANUAL_COMMANI	Binary Tag	1	MOP_DRIVE	DB1,D1.1
6	MOP_MANUAL_MSG	Binary Tag	1	MOP_DRIVE	DB1,D1.2
7	MOP_OFF_CMD	Binary Tag	1	MOP_DRIVE	DB1,D0.3
8	MOP_OFF_CMD_WINCC	Binary Tag	1	MOP_DRIVE	DB1,D2.0
9	MOP_OFF_MSG	Binary Tag	1	MOP_DRIVE	DB1,D0.4
10	MOP_ON_CMD	Binary Tag	1	MOP_DRIVE	DB1,D0.1
11	MOP_ON_CMD_WINCC	Binary Tag	1	MOP_DRIVE	DB1,D1.7
12	MOP_ON_MSG	Binary Tag	1	MOP_DRIVE	DB1,D0.2
13	MOP_PRE_OFF	Binary Tag	1	MOP_DRIVE	DB1,D0.6
14	MOP_PRE_ON	Binary Tag	1	MOP_DRIVE	DB1,D0.5
15	MOP_Protection_off	Binary Tag	1	MOP_DRIVE	DB1,D1.6
16	MOP_Protection_on	Binary Tag	1	MOP_DRIVE	DB1,D1.5
17	MOP_RELEASE	Binary Tag	1	MOP_DRIVE	DB1,D1.3

Fig.7 List of variable tagged in SCADA

Graphic Design:

Faceplate: Faceplate is a user-defined object; we can define the properties which are permanently saved in the Properties window for an IO field.

Faceplates can be used for creating and changing elements on of process values is also possible.[13]

The different states of MOP drive can be described with 11 individual tags are following:

ξ Fail State.

ξ Local Selected State.

ξ On Command.

ξ Off Command.

ξ On Protection.

ξ Off Protection

ξ On Permission

ξ Off Permission

ξ Automatic Mode

ξ Manual Mode

ξ Release Mode

Drive ON Conditions: If Auto Mode OR Manual Mode AND Permission On AND Release Mode AND no Fail msg.

Drive OFF Conditions: If Manual Mode And Release Mode AND Permission Off OR Fail msg OR Off command.

Basic steps to configure faceplate properties:

Right Click on automatic button and select object properties.

After selecting object properties then select events, in events select the option of mouse as shown in FIG.8

If we press left on mouse then direct connection through a constant and assign the tag name.

In this way all the states are assign in faceplate.

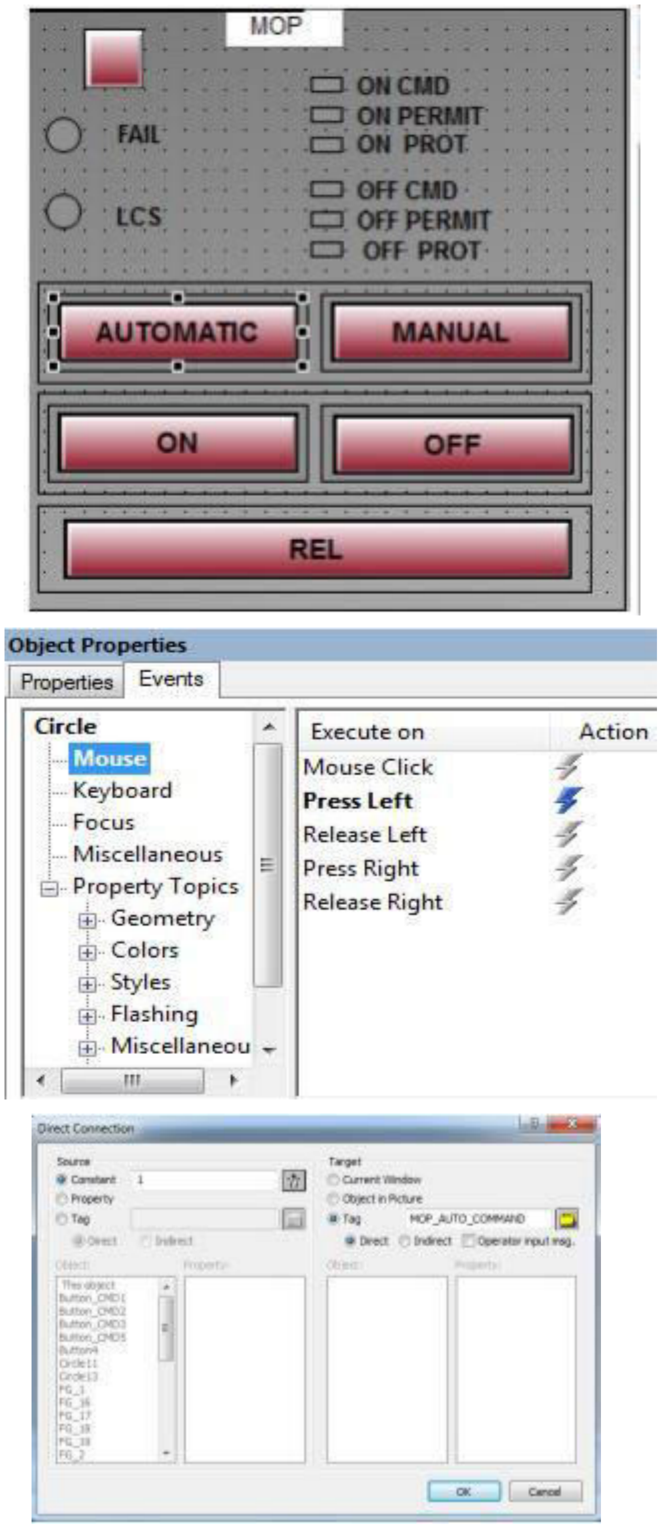


Fig.8 Faceplate Description

HMI is developed to read the values numerically as well as graphically in WinCC flexible as shown in Fig. 9. Simatic WinCC flexible is HMI software provided by Siemens Company. It provides easy implementation with wide variety of graphics for industry applications.[14]

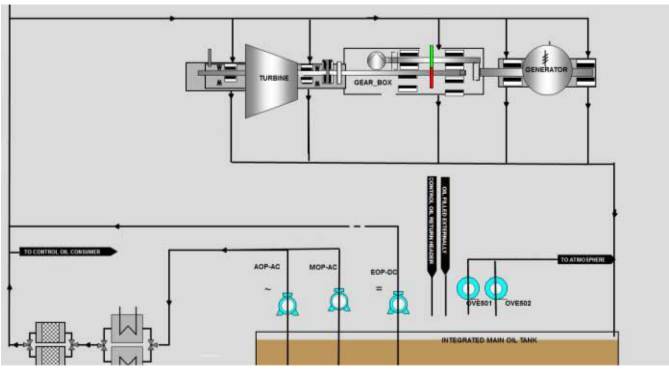


Fig.9 HMI developed for Lube Oil system in WinCC Flexible

VI. CONCLUSION

The automation of Lube Oil System was implemented successfully using FBD language along with monitoring SCADA System by using WinCC software. The turbine was thus automatically protected when any fault condition occurred through interlock protection logics of lube oil system has been developed in SIMATIC Manger.

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