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Integrating Efficiency And Safety Of Power Plant By Changing D.C.S Into P.L.C Without Changing Input And Output Modules

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Abstract

Integration, reuse, flexibility, safety and optimization are demanded to adapt to a rapidly changing and competitive market in industry sector. This Paper is based on the ***live*** *project in a power plant of an industry, older version of Controller (i.e. SIEMENS D.C.S) is converted into newer latest version of Controller (i.e. SIEMENS P.L.C) without changing the Analog and Digital modules of D.C.S. Older D.C.S was redundant controller but was not behaving as like redundant controller and sometimes malfunction of signals occurred due to that the power plant suffered Trip condition and high production loss occurred many times and safety of man and machine too was the issue. So to get rid of uneven tripping and safety issues we have used more reliable advanced version of SIEMENS P.L.C using SIMATIC-S7 software for logic development and WinCC for graphics designing, we used Siemens P.L.C only so that we don't need any analog or digital modules only redundant controllers are changed.*

Keyword: ***Programmable Logic Controller, Ladder Diagram Functional Block Diagram, Transformation Methodology***

"1 . Introduction"

This project is a **Live** project of a power plant, Main aim is to improve the efficiency of power plant by saving it from malfunction of existing Controller (Siemens DCS), So as to save the plant from tripping we have to implement a more reliable controller so that Plant don't suffer from abrupt tripping and huge losses due to this kind of tripping is needed to be stopped. From the point of view of getting most effective, reliable and cost beneficially. I searched an option of converting SIEMENS DCS into SIEMENS PLC so that we can use the Analog and Digital modules of existing DCS only we need is a new P.L.C as a hardware part. So before starting the work we should understand what is PLC and what is DCS, what software they use and what kind of language is being used to build logic in PLC.

For logic building we can use any of the languages written below.

1. Ladder Diagram (LD)
2. STL (Statement Logic)
3. FBD (Function Block Diagram)
4. Instruction list (IL).

For the current project we have used Ladder logic when ladder logic is completed it is converted into FBD.

LLD models the actual combination of relay contacts. A relay contact or a step in LLD is either (a) Normally closed (NC) or (b) Normally open (NC).

"2.Programmable Logic Controller"

PLC is a specialized computer used for the control and operation of manufacturing process and machinery. The PLC is a robust industrial computer, which accepts input data, both digital and analogue, from switches and sensors and controls outputs to drive devices such as motors, pneumatic devices, and indicators. PLCs are used in almost every aspect of industry to expand and enhance production. Where older automated systems would use hundreds or thousands of electromechanical relays, a single PLC can be programmed as an efficient replacement. The functionality of the PLCs has evolved over the years to include capabilities beyond typical relay control.

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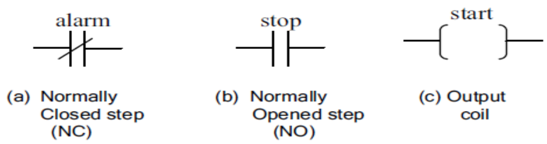
2.1 Ladder Diagram:

It is based on graphical symbols laid out in networks in a similar way to a rung of relay of a ladder logic diagram. A network represents the flow of the power between two rails (from the left to the right); in the same manner as in an electromechanical relay system. The elements contained by a network are contacts and coils of relays, as well as blocks and other elements. It is specially oriented to applications which use Boolean signals



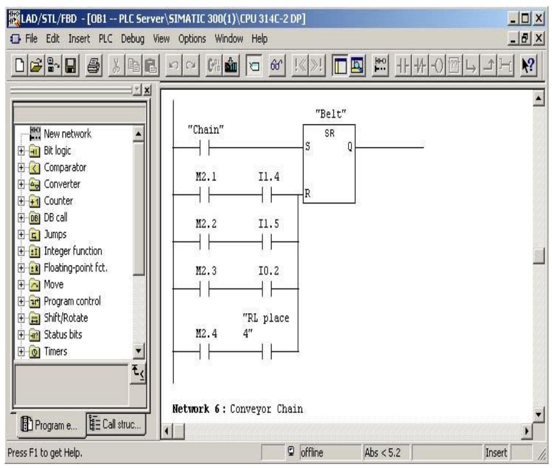


Fig 1: Siemens PLC programming tool in LD.

2.2 The Function Block Diagram (FBD):

It is used for programming complex procedures with graphical objects or blocks which represent functions, function blocks or programs, like in electronic circuit diagrams. These diagrams consist of some networks containing blocks interconnected by lines which depict the signal flow. Lines go from the output side of a block to the input side of another one. This language is widely used in the process industry.

```
FUNCTION InRange: BOOL
VAR_INPUT
    Value: INT ;
    Maximum:INT ;
    Minimum: INT ;
END_VAR
```

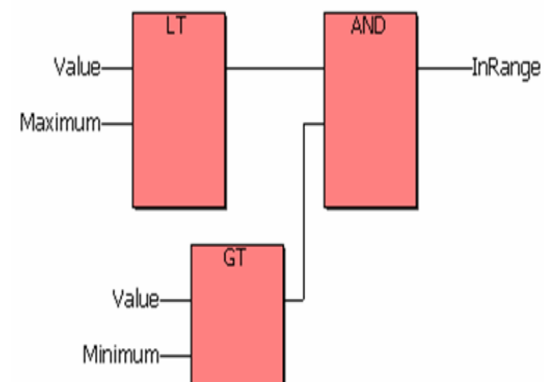


Fig 2: Example of FBD.

"3.Tranformation Methodology:"

The section proposes steps to be followed for transferring DCS into PLC for this kind of project are.

(i) Input and output signals making according to PLC acceptable form.
(ii) SIMATIC software uploading in computer for logic building and WinCC software uploading for graphics designing.
(iii) Communication of PLC rack with computer.
(iv) Logic generation in PLC and its output testing.
(v) Simulation of analog signal via hardware simulator to PLC and its display in computer.
(vi) Graphics designing in computer according to the previous graphics of DCS, and display changes in the value according to the logic.

Mainly in automation process there is two categories of Signals.

1. Analog
2. Digital

In Siemens PLC the signals are defined as:

Digital Input - I0.0 to I 0.7 than I 1.0 to I 1.7 ...
Digital Output- Q 0.0 to Q 0.7 than Q 1.0 to Q 1.7 ...
Analog Input- piw 512 , piw 514 ....
Analog Output – pqw 512,pqw514....

So we changed each an every signal in PLC acceptable form as shown above also called as tag

making. Than for logic making in SIMATIC software, first we configured hardware configuration according to the previously commissioned input output modules in SIMATIC software so that current system accepts the same hardware configuration.
Second step is logic making.
i. For all DOL & RDOL.
ii.PID making and tuning for all Control valve.
iii. Boiler logic making.
iv. Turbine boiler logic.
v. Modified logic for ash handling system.

After logic completion work Graphics designing and tagging is done in WinCC software.
Last step is Testing of both Graphics and logic through simulator.
Testing also include downloading of logic in PLC and testing the complete loop throughout the field for this basic knowledge of electrical network is very important.
After testing all the field analog and digital signals we are ready to start the plant and are ready to give clearance from instrument point of view to operation department.
For safety purpose at the starting of the PLC system in real-time we kept the old system DCS too for the initial starting procedure, that can be viewed in below photograph. But PLC project was successfully started and is working normally without giving malfunction signal and successfully working in redundant mode.

"4. Conclusion"

After implementing the PLC uneven tripping of power plant is reduced to zero and hence resulting in improvement of power plant efficiency.

1. Problem of malfunction and Redundancy is solved and giving improved efficiency .
2. New logic for Energy saving has been modified in ash handling system (Probe Mode).
3. Safety of Man and machine is increased.

Fig. 3. Actual view of both the controllers, Above two are New Programmed PLC and Below two are DCS.

"5. Future Scope:"

The similar problem of uneven tripping due to malfunction of controllers is observed in two other Power plant in same industry having the similar version of DCS , The two units of power plant DCS is also proposed to be changed with SIMATIC S7 PLC to increase the efficiency of Power plant. This would result in saving huge generation loss and thus saving huge cost.
The similar type of problem of any process plant where analog and digital modules can be used can be rectified and thus will integrate the Efficiency and safety of plant.
Good results have been achieved, but there is still much work to do. From the author's point of view future work for better system should be concentrated to.

- Refine the diagnostic knowledge acquisition methods and reasoning algorithms, so as to improve the efficiency of diagnostic system .
- Define an Embedded diagnosis system approach which will integrate the diagnostic models in the PLC's, so that fault can be diagnosed in real time.

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