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Engineering Work Station as a Tool For a Process Control Design and Implementation

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Abstract This paper describes the total role of a PC based Engineering Work Station (EWS) in designing and implementing the control functions for a plant The plant is controlled, monitored, and managed by a microprocessor based distributed control system which interfaces with EWS The steps and procedures of the work is described from control design to the plant start up During the design and implementation phase EWS was also used as a personal computer and many off line calculations were performed The plant for the work was a chiller system which is part of the power house supplying the steam and chilled water into the chemical and polymer processing plant as well as buildings for heating and cooling The role of EWS as a significant control design and implementation tool, which received wide acceptance and user's appeal, has been demonstrated The main advantages of EWS have been (i) the ability to configure and edit all control system configurations before installation is complete, (ii) to have on site permanent drawings of control logics at any time, (iii) to integrate various control symbols and load them onto control modules by operator friendly softwares, (iv) to monitor the process operation for diagnosis and troubleshooting as a support to the user

Keywords Computer aided control design, computer graphics, process control, distributed control, engineering work station

INTRODUCTION

There have been significant changes in the operation of control system suppliers due to the impact of microprocessors in process industry The role of control designer, instrument technician, process control engineer and maintenance procedures etc , are all affected Control system suppliers had to adopt new efficient procedures The development of the Engineering Work Station (EWS) is the result of such efforts to be used for in house only

Then, the product proved to be so flexible that many are now used by end users The software packages have been developed which contain powerful programs specifically designed for engineering and maintaining distributed control systems It is also used as a limited operator and/or supervisor console This devise was also located remote from the job site EWS was developed to meet the basic needs of reducing the elapsed time between defining the control system and the customer acceptance at the plant site It has been reported that (Browngart, 1987) a work requiring 165 days of elasped time is reduced to 110 days by using a PC and it was reduced to less than 60 days by using EWS

There are several steps that should be accomplished Personal Computers such as EWS plays a key role in this process (Browngart, 1987) Personal computers can use graphic symbols to describe the control requirements of the process After the definition is completed, hard copies can be made via output devices While these features are not revolutionary in terms of typical CAD (Computer Aided Drafting) features the translation of the "control picture" to that of functional algorithms in the process control hardware can also be done automatically via communication links to the actual process control hardware The use of personal computers results in large engineering cost savings provides uniform and easy to change documentation, permits on line monitoring and control tuning and eliminates translation errors when going from the 'drawing board' to the process hardware

Also EWS plays an important role in communicating between user and supplier, providing remote diagnostics, even trouble shooting and tuning the control remotely (Lazar, 1985) In this work, the role of EWS will be described as applied into a given project

PLANT AND CONTROL SYSTEM DESCRITPION

The total plant considered here can be divided into three parts (i) power house (ii) process, (iii) supply and distribution lines, and facilities The powerhouse has major units as boilers turbines for in plant electric generation, and chillers Specific details of the procedures are worked out for the chillers supplying the chilled water for process plant and buildings There are 4 chillers in parallel, each of which is driven by an electric motor There are 4 parallel feed (outside loops) pumps, and 4 circulation (inside loops) pumps The chiller plant has a fixed chilled water flow of approximately 11 000 gpm Chilled water is supplied to two main users It should be emphasized that the control system is totally integrated covering the complete plant

The Control System including the Engineering Work Station connection is shown in Fig 1 EWS can interact with the total distributed control system through the computer interface unit by connecting to the plant loop (Fig 1) Also a local EWS can connect to Process Control Unit (PCU) through the Serial Port Module (SPM) The EWS connecting the plant loop can communicate with all Process Control Units (PCU) within the distributed control system That is the functions of EWS are carried out for the control system of boilers, turbines chillers process etc

Referring to Fig 1 one or more of the PCU cabinets can control the chiller plant PCU cabinets are hardwired to the process which in this case are the instruments (transmitters and positioners etc) of the plant The plant loop EWS is used to do all necessary operations concerning the PCU's of chiller plant as well as the other PCU s The structure of distributed system allows to use the PCU's to interact with and control the plant equipment through their instruments The remote multipliers (remote I/O) are also used for process interfacing which performs the data acquisition and control functions

REVIEW OF FEATURES OF EWS

The EWS has paved the way for new ideas to implement process control system design There are many engineering work stations available today from desk top models to large central computer based systems It is not the intent of this paper to compare such systems but only to show what has been accomplished using the more traditional "PC" approach One of such hardware selection are shown in Fig 2 (Bailey, 1987)

The software for the Personal Computer engineering Work Station is a major item which varies from vendor to vendor These packages represent a major investment in creating a personal computer process control system user orientated work station In addition to the personal computer's operating system software, the following packages may be included with Engineering Work Station (Bailey, 1987)

CAD	Computer Assisted Drawing) Use Color graphic displays to design, monitor, and implement control sytems
TEXT	Modify and verify configurations and monitor the system from a menu driven program
LADDER	Design logic control systems using ladder logic and selected Function Codes
TOOL KIT	Review and save data, view data in a graphic format or download to a spreadsheet program
DATA SHEET	Feed current process data directly into a SYMPHONY™ spreadsheet

The capabilities of EWS software are briefly shown in Fig 3 More information on each function is given in literature (Bailey, 1987) The milestones accomplished by using EWS will be listed in the next section

PROCEDURES OF CONTROL DESIGN AND IMPLEMENTATION

The design implementation of a process control system (from defining process control requirements to actually having a customer accepted system) usually involves a series of work tasks Many of these tasks have been made easier through the use of the personal computers These tasks are listed as below (Browngart 1987)

1 Process logic definition

2 Develop detailed schematics and external drawings

3 Translate schematics to wire lists configuration lists program listings, etc

4 Input wire lists configuration lists etc into process control hardware

5 Factory check out

6 Set any tunable parameters for anticipated process dynamics Complete factory documentation

7 Verify factory adjustments at site prior to commissioning

8 Final adjustment of tunable parameters and site configuration changes to deal with actuality

9 Update system schematic documentation

It was essential to use the EWS to reduce the elapsed time in carrying out these tasks

The operation and management of the chillers from the control room, including the constraints are specified The subjects addressed were related to interfacing the control equipment, start/stop and sequencing plant master and its interface with individual chillers and chiller demand control A summary of the specifics is listed as follows

1 Conditions to start a compressor keeping the compressor operation within safe limits

2 Chiller plant master setting the chilled water supply temperature as necessary by various options

3 Optimum load allocation allocating the chiller load by setting the chilled water exit temperature from each chiller under constant flows

4 Peak loading adjusting chilled water temperature of each chiller to match the peak cooling demand profile

5 Chiller demand control limiting the maximum current that each chiller can draw

6 Current ramping increasing the current drawn by the compressor at a specified rate

7 Total demand limiting the maximum current that the chiller plant can draw

The operational and safety conditions were taken into account in designing the control logics Plant displays and reporting of status, instructions trends and diagnosis are integral part of system

The conditions to start the compressor and keeping it within the safe limits (Item #1 of the specs) were translated into a logic diagram as shown in Fig 4, which is generated as a document by EWS However it was possible to enter a ladder diagram (provided by user) into EWS and generate the same results by the software LADDER This was done in other cases

The control logic for individual chillers diagrammed in SAMA standards (Fig 5 was entered into EWS and a drawing (Fig 6) was generated by using CAD and TEXT softwares All the tasks were performed by using EWS for which the details are omitted The specific milestones accomplished are as follows

1 Modulating controls (such as PID), alarms safety interlocks, etc are configured by EWS according to the control philosopy described in the contract The diagrams for the chillers safety and start up etc are supplied by manufacturer The softwares CAD TEXT, and LADDER have been used for the work The EWS integrated the modulating, programmable logic and the sequential controls in a single system

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2 As the configuration was done the function blocks are checked on CRT for verification After editing the configurations and retuning of the controls are completed by EWS, drawings and diskettes were generated

3 The configuration diskettes were loaded onto control modules of distributed control system (NETWORK 90®) The control system was put to work and its performance was observed by the OIU displays of distributed control system and moni tored by EWS TOOL KIT and DATA SHEET Software packages resident in EWS were utilized to save the data and view in graphic and spreadsheet format

4 As the plant started the performance of the control system was remotely monitored via modem's The plant performance was analyzed and further modifications were done The modifications were loaded onto diskettes and new drawings were generated

During the operation of the plant the managerial staff could interface with the distr buted control system via EWS and monitor the plant performance The choice of what is to be monitored was decided by the people The communication with the distributed system was either by hardwire cable (10 meter) or by modem Typical sample displays by EWS are shown in Fig 7 and self explanatory

SUMMARY AND CONCLUSIONS

The role of EWS has been described in this paper including the limited demonstration of the results accomplished The recent trend is that more and more functional features are added to EWS to make it operate as an expert system, interface with smart transmitters, perform diagnostics etc

In conclusion there are many benef ts of using personal computers to design and implement the process control systems Because of that, the use of personal computers with the appropriate software packages are increasing at an explosive rate Those benefits are

1 Process definition, automatic translation from design to hardware, to change and update documentation in the field is easy

2 Personal computer can be used to monitor process and tune adjustable parameters while process is on line

3 Reverse compiler function available to document field systems to base format

4 Documentation transportable via communication

5 Major cost savings involving system design, translation from the drawing format to controller hardware, documentation and its changes and maintenance, reduced time of control system delivery

6 Availability of personal computer for normal "PC" type functions

There is no doubt that EWS is a valuable tool for the control system engineer

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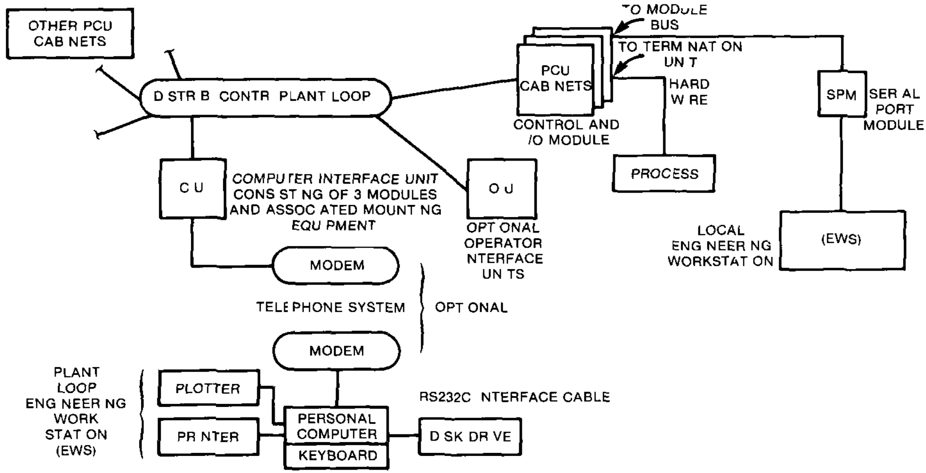
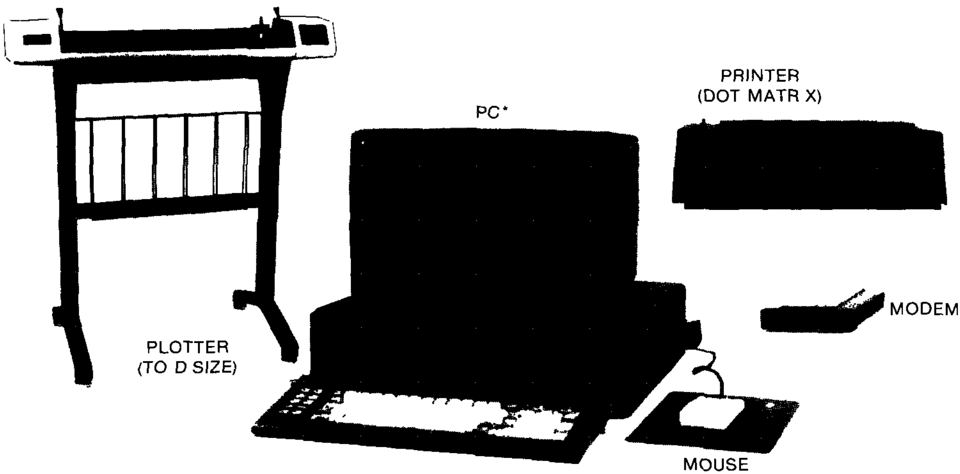


FIGURE 1 Engineering Work Station and Distributed Microprocessor System Configuration



*PC 640K RAM 10 MB HD DSK COLOR D SPLAY
TWO SERIAL PORTS TWO PARALLEL PORTS

FIGURE 2 EWS Hardware

Program	Des gn	Conf gure	Mon tor	On L ne Tune	Trend	Save	Translate	Ca cu ate	Pr nt Conf g	Pr nt Output	Ver fy	Off L ne Ed t	Down oad	P ot	Comp e
	FUNCT ONS														
CAD	x	x	x	x		x			x			x		x	x
TEXT		x	x	x					x		x		x		x
LADDER	x	x	x	x					x			x	x	x	x
TOOL K T			x		x	x	x			x					
DATA SHEET			x		x	x		x		x					

X Suppo ted

FIGURE 3 Capabilities of Software of EWS

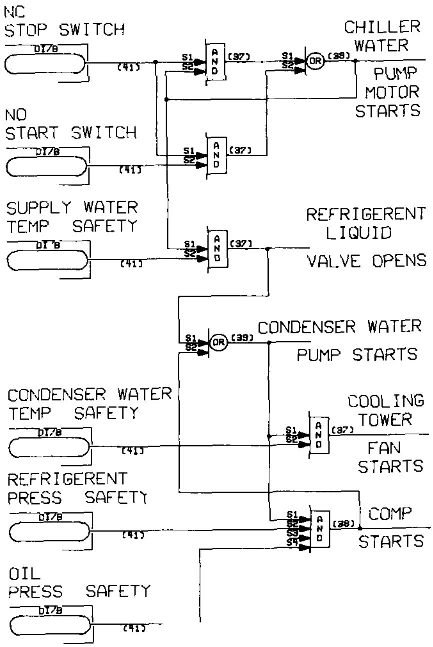


FIGURE 4 Chiller Start Up and Stop Down Logic

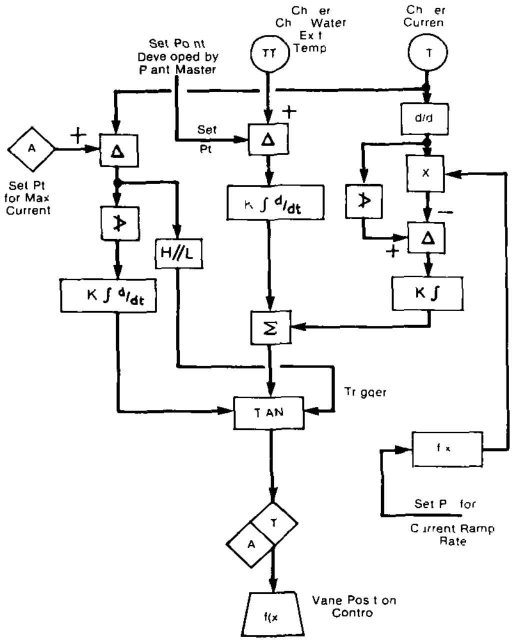


FIGURE 5 Chiller Chilled Water Exit Temperature Control (For Chiller #1)

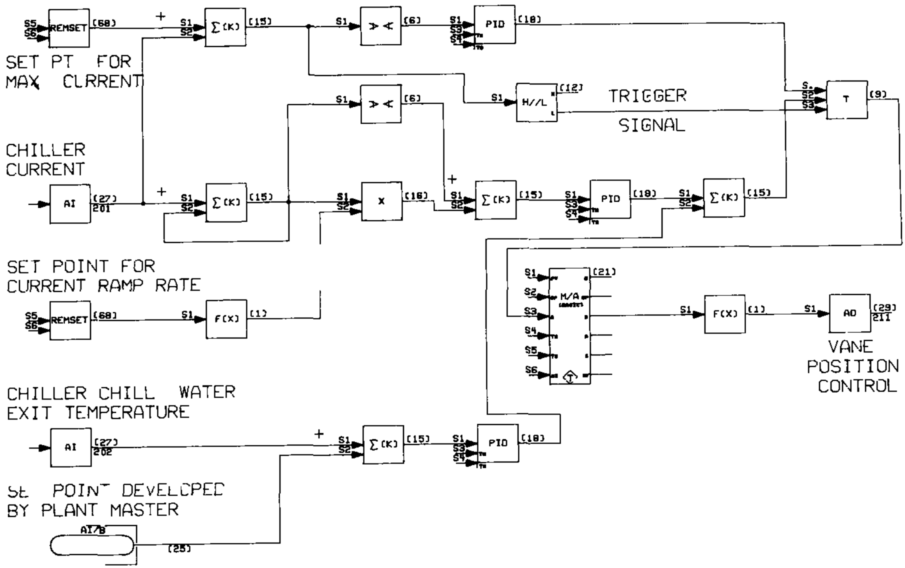
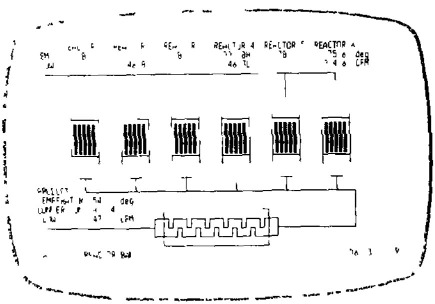
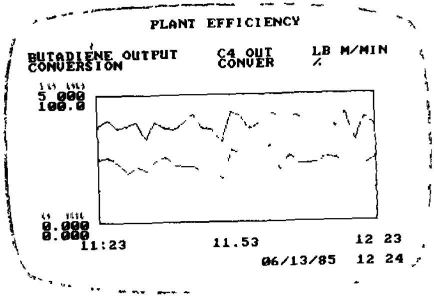


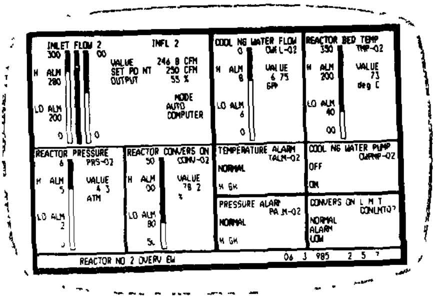
FIGURE 6 Chilled Water Temperature Control



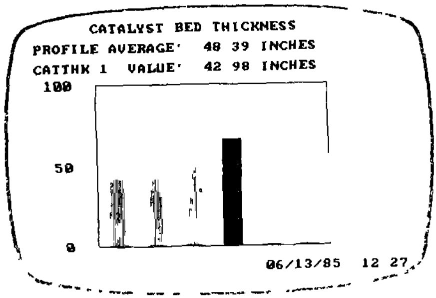
Reactor Bank Sample Graphic Display



Trend Display



Control System Group Display



Bar Graph Display

FIGURE 7 *Typical Displays of Plant by EWS*

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