

# ROLE OF AUTOMATION IN SUGAR INDUSTRY A PRACTICAL APPROACH

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## INDUSTRIAL SITUATION

### Sugar Industry in Pakistan

- ❖ Economic condition
- ❖ Increased cost of raw material
- ❖ High rate of inflation leading to escalating cost of maintenance and operation
- ❖ Low sugar prices and less capacity utilization of plants

## HOW TO REMAIN COMPETITIVE IN MARKET

- ❖ To run sugar Industry in cost effective way
- ❖ Maximize process efficiencies
- ❖ Use of Latest Technologies

## WAY TO MAXIMIZE EFFICIENCIES

- ❖ Set high goals
- ❖ To achieve these goals
- ❖ Follow the best practices
- ❖ Major difference between leading Sugar Industry of the World and Pakistan Sugar Industry Use of Latest Technology to get maximum efficiencies
- ❖ Use of Latest Technology to get maximum efficiencies

## USE OF LATEST TECHNOLOGY

Automation is one of the most important technology to adopt

## EXPENSIVE AUTOMATION?

- ❖ Can be produced profitably without Automation
- ❖ Highly Skilled Technical Staff is available with affordable cost
- ❖ Hesitate to experiment themselves, Waiting for fruitful results from others experiences

## **BENEFITS OF AUTOMATION**

- ❖ Improve Efficiencies
- ❖ Removal of Human Error
- ❖ Reduces Downtime
- ❖ Cut short Wastages
- ❖ Helps in Troubleshooting
- ❖ Safe working conditions
- ❖ Less chances of machinery failure
- ❖ Low cost of maintenance
- ❖ Standardization of Product
- ❖ Repeatability of Desired Results
- ❖ Lowering HR Costs
- ❖ Trustable monitoring
- ❖ Recording and Trending of Process Parameters for Future Planning
- ❖ Losses became apparent after automation and then can be eliminated
- ❖ Helping to get desired results
- ❖ Efficient Control of Processes

## **WHY AUTOMATION FAILS?**

- ❖ Less involvement of operators
- ❖ Complex Control Strategy
- ❖ Wrong Selection and Installation of Field Instruments
- ❖ Non Availability of Spare Parts
- ❖ Process which cannot controlled manually, it cannot be automated

## **WHAT TO DO?**

- ❖ Involve operators in design process
- ❖ Staff Training
- ❖ Keep it Simple
- ❖ No flooding of information
- ❖ Amend process to meet your requirements
- ❖ Modular Approach

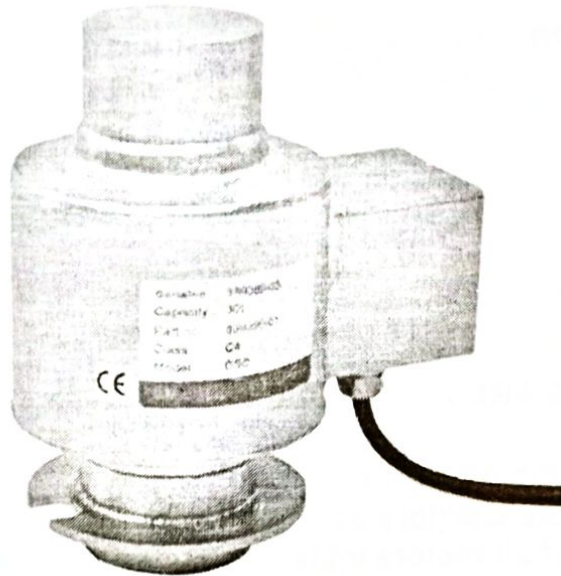
## **AUTOMATION & SHAKARGANG MILLS LIMITED**

- ❖ Pioneer in adopting automation for process control in Pakistan.
- ❖ Shakarganj wants to share its decade long experience
- ❖ The most of the automation systems are being employed at Shakarganj Mills Limited
- ❖ Some of the automation plans are described for awareness and benefits of the participant

## NORMAL PRACTICE

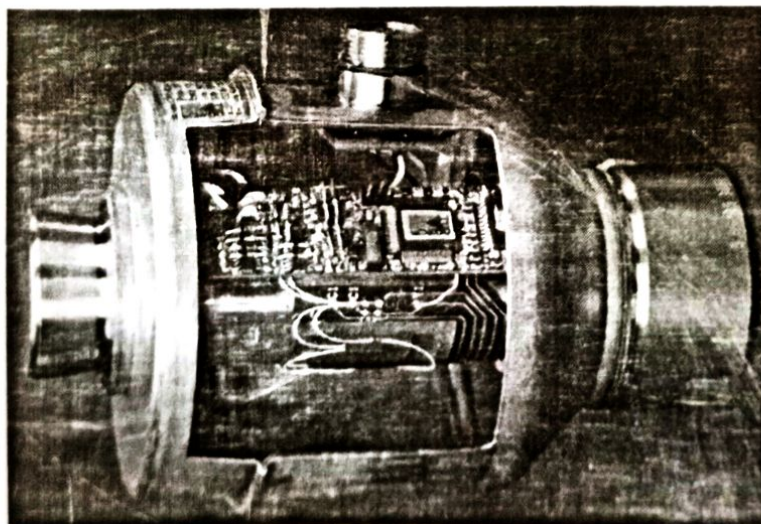
- ❖ Weighing Bridge
- ❖ Platform hangs on Analog Load Cells
- ❖ Problem
  - Calibration
  - Cornering Error

## ANALOG LOAD CELL



## DIGITAL LOAD CELL

- ❖ New Technology - Digital Load Cell.
- ❖ Easy s to trouble shoot each load cell
- ❖ Easy calibration of weighing bridge and load cell
- ❖ No Corning Error
- ❖ Need perfect alignment of platform



At Shakaganj both types of load cells are in operation. There is no cornering problem faced where digital weighing system is in use

## **MILL HOUSE AUTOMATION**

### **Mill House**

Mill House is heart of any sugar industry. The good performance of milling is required for better boiler and process house working. The mill house automation can be divided into two sections:

#### **Cane Preparation section**

- ❖ Good Results

#### **Milling Section**

- ❖ Satisfactory Results

## **FOLLOWING CONTROLS ARE AVAILABLE**

- ❖ Speed Control of Damping Carrier through VFD
- ❖ Speed Control of Cane Carriers using VFD
- ❖ Current Monitoring of all motors installed on cane carriers
- ❖ Nozzle Pressure of all the steam turbines
- ❖ RPM of all Steam Turbines
- ❖ Level of all chutes
- ❖ Close Circuit Televisions
- ❖ Imbibition Flow Control

## **New Types of Sensor can be used for effective Mill Control**

- ❖ Cane Blanket Level Sensing and Transmission Systems.
- ❖ Top Roller Lift Sensing and Transmission Systems.

## **BENEFITS**

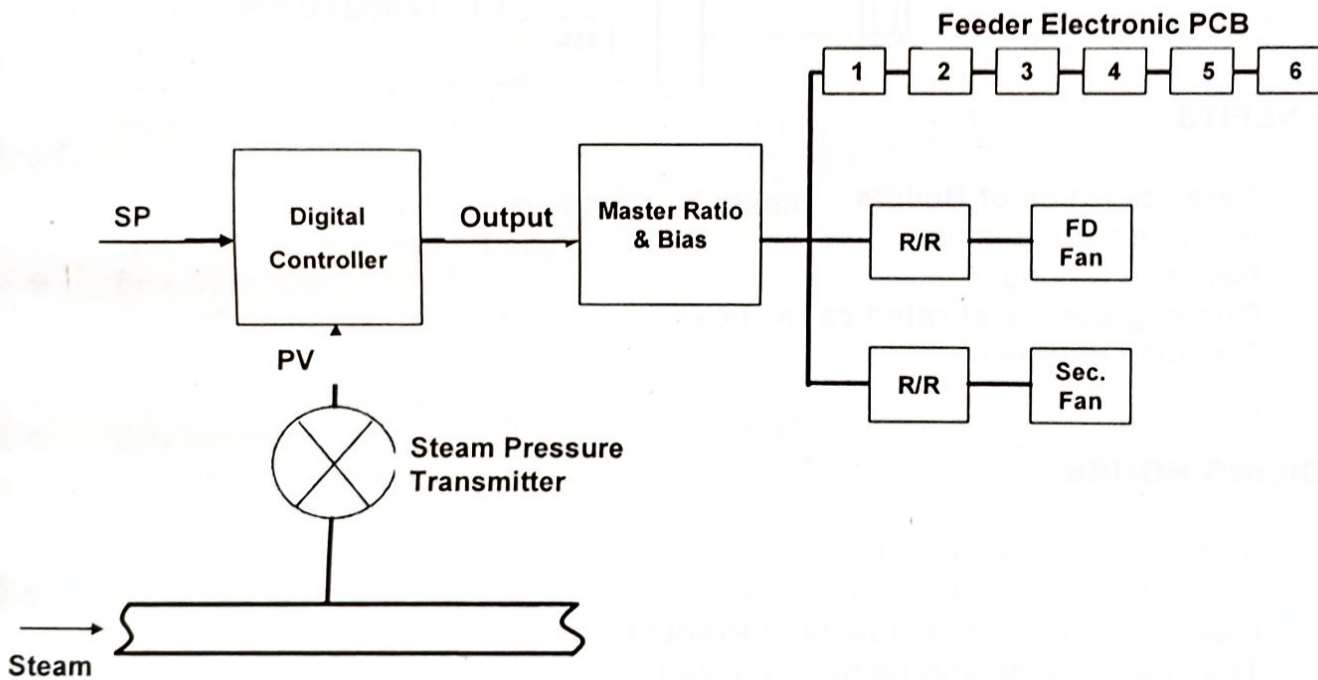
- ❖ Stability of Mill Operation
- ❖ Reducing down time with avoiding choke on carriers due to jams
- ❖ Maintain a smooth crushing rate
- ❖ Better extraction due to even loading of Mills
- ❖ Safe operations of costly equipment
- ❖ Better Boiler Operation

## BOILER HOUSE AUTOMATION

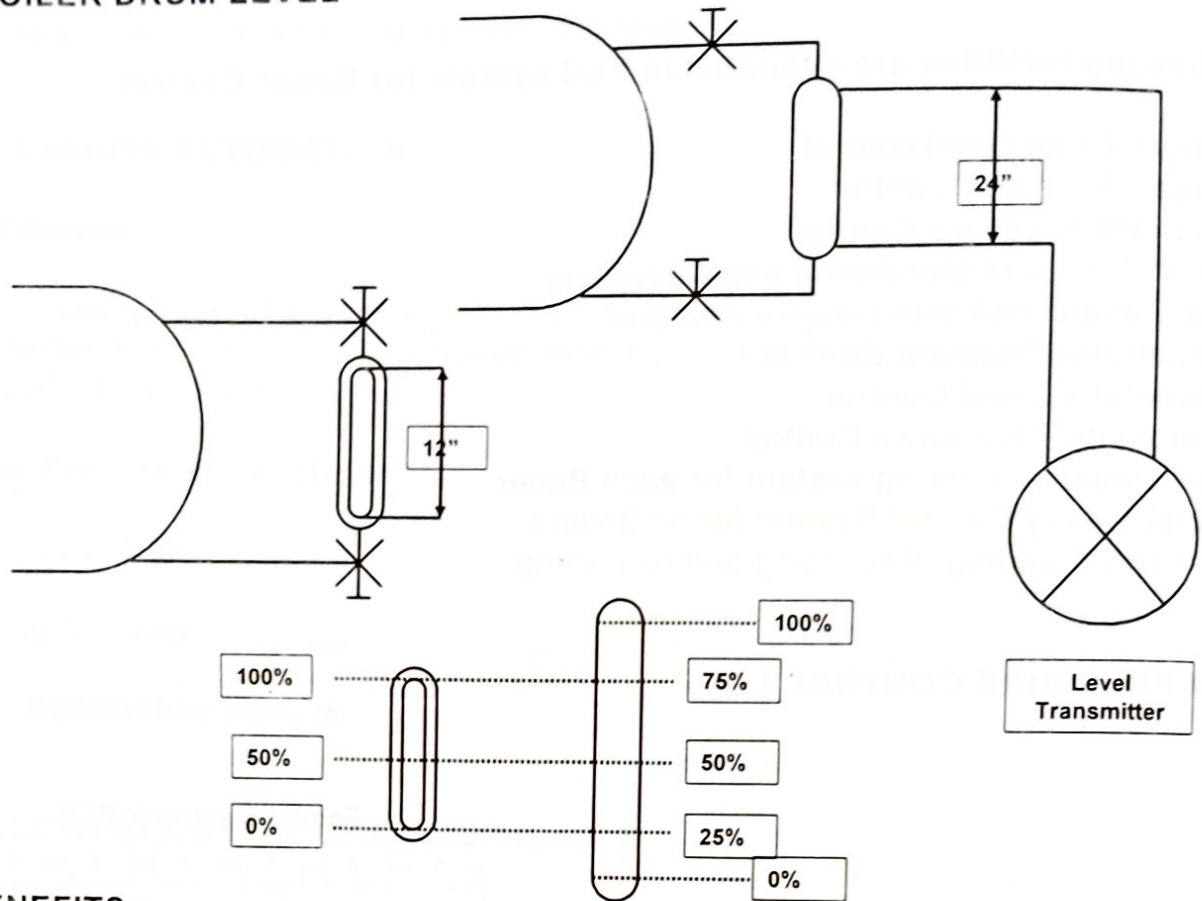
The following facilities are available in PLC system for Boiler Control

- ❖ Steam Drum Level control
- ❖ Steam Pressure Control
- ❖ Furnace Pressure Control
- ❖ Draft Pressure Monitoring and Recording
- ❖ Air Combustion with Oxygen Analyzer
- ❖ Deaerator Pressure Control
- ❖ Deaerator Level Control
- ❖ Automatic Blow down Control
- ❖ Individual Monitoring system for each Boiler
- ❖ Supervisory Control System for all Boilers
- ❖ On line Trending, Recording and Reporting

### STEAM PRESSURE CONTROL LOOP



## BOILER DRUM LEVEL



## BENEFITS

- ❖ Safe operation of Boilers
- ❖ Improved Efficiencies
- ❖ Bagasse Saving
- ❖ Running Boilers at rated capacities
- ❖ Smooth Operation

## BOILING HOUSE

- ❖ 60 % of overall steam consumption
- ❖ 70 % of Losses in Boiling House
- ❖ Color Formation and Quality of Product
- ❖ The sugar house should be optimized

## JUICE FLOW STABILIZATION

- ❖ Raw Juice Flow Measurement
- ❖ Raw Juice Tank Level
- ❖ Heater Temperature Monitoring
- ❖ pH of Clarifiers
- ❖ Speed Regulation of chemicals at Clarifier
- ❖ Milk of Lime Flow Control at Defecation
- ❖ pH of Defecated Juice

## BENEFITS

- ❖ Uniform Raw Juice Flow
- ❖ Stable operation of Clarifier
- ❖ Smooth Chemical dosing
- ❖ Effective heating of Juice in heaters
- ❖ Better setting at clarifier leading to improved quality of clear juice
- ❖ Reduction of losses by minimizing recirculation juice in form of filtrate
- ❖ Low brix of MOL cause more water to be evaporated at Evaporator Station so steam usage will be increased.
- ❖ Smooth and Reduced Chemical Consumption

## REMELTER AUTOMATION

- ❖ Remelter Brix Control
- ❖ Remelter Temperature Control
- ❖ Level Indications

## EVAPORATOR AUTOMATION

- ❖ Temperature of vapor space and calandrias
- ❖ Pressure / Vacuum of bodies and calandrias
- ❖ Vacuum in the last body
- ❖ Pressure and temperature of exhaust steam
- ❖ Level of Juice in each body
- ❖ Brix of syrup
- ❖ Flow of condensates from calandrias
- ❖ Regulated feed to each vessel
- ❖ Maintain level in bodies
- ❖ Brix control
- ❖ Consistent high syrup brix
- ❖ Less scale formation due to even juice level
- ❖ Degree of superheat does not exceed 25 – 30C
- ❖ Superheated steam has poor heat transfer rate

### Level in Evaporator bodies

Vessel 1	35 – 40 %
Vessel 2	25 %
Vessel 3 & 4	20 %

- ❖ In case low or high juice levels, the circulation is affected and rate of evaporation lowered and chance of entrainment increases
- ❖ Vacuum in last body less than 625 – 650 mm

## REFINE MELT CLARIFICATION

- ❖ Deep Bed Filters
- ❖ Talo Clarifier
- ❖ Benefits
  - Better Color Removal
  - Efficient Use of Chemicals
  - Consistent Results

## CONDENSING SYSTEM AUTOMATION

- ❖ Conventional System
- ❖ In case of variable Load :
  - Huge quantity of water circulation
  - High Electricity Consumption
  - Large number of equipment installation( Pumps, Motors)
- ❖ Modern Condensing System
  - Economical use of water
  - Energy reduction without effecting efficiency of condenser ( i.e. almost 50 %)
- ❖ Two Types
  - Nozzle Governing System
  - High Pressure Water controls Nozzle Operations
- ❖ Single Entry Condensers
  - Nozzles being controlled by pneumatic pressure
  - No need of Spray Pumps

## WHY BATCH PAN AUTOMATION?

- ❖ The boiling of Masecuite in Batch Pan is very critical operation.
- ❖ Because the super saturation of boiling liquid inside the pan should be maintained within a very narrow range.
- ❖ Ineffectiveness of operator to do so will leads to extra water drink to dissolve false grain.

## BATCH PAN AUTOMATION

- ❖ This will increase steam/vapor requirements
- ❖ The curing time will also increased
- ❖ For energy conservation such a laxity is not affordable.
- ❖ The Automation of batch pan is inevitable to :
- ❖ To maintain masecuite inside the Boiling Pan at a super saturation, in matastable zone.
- ❖ The measurement of brix of pan
- ❖ Level of masecuite inside the pan monitored continuously
- ❖ Feed liquor is controlled automatically.
- ❖ Clalendria steam pressure is monitored and steam flow to pan is regulated.



- ❖ The operations like:
  - Selection of feed liquor,
  - Seed slurry feeding,
  - Control of Vacuum,
  - Vacuum breaking,
  - Pan washing, Opening and closing of discharge valve can also be automated.
- ❖ Disturbances like
  - No juice available
  - Mingler is full
  - Vacuum Breakdown
  - Can be handled well in automation
  - Leave 51 steps use one step automation

## BENEFITS

- |  |           |
|--|-----------|
| ❖ Reduction of boiling time                  | 20 – 30 % |
| ❖ Reduction of energy(steam, vacuum)         | 20 - 30 % |
| ❖ Strikes without opening the water valve    |           |
| ❖ Reduction of sucrose in final molasses     | 1 – 2 %   |
| ❖ Maximum amount of desired grain            |           |
| ❖ Minimum contents of fine grain             |           |
| ❖ Narrow range of crystal size               |           |
| ❖ Easy operation even by untrained operators |           |

## CONTINUOUS VACUUM PAN AUTOMATION

- ❖ To monitor conductivity in each compartment
- ❖ To control liquor feed into each compartment.
- ❖ To monitor and control total liquor feed rate to the pan
- ❖ To control the seed magma feed to the pan
- ❖ To monitor calandria pressure
- ❖ To control steam flow to the pan
- ❖ To control masecuite discharge w.r.t. level in last compartment.
- ❖ Brix Control
- ❖ Vacuum Control
- ❖ Steam Pressure Control
- ❖ Masecuite Flow Control
- ❖ Seed Flow Control
- ❖ Purity Control

## BENEFITS

- ❖ Pan Floor capacity enhancement
- ❖ Steam Economy
- ❖ Sugar Quality

## VARIABLE SPEED DRIVES

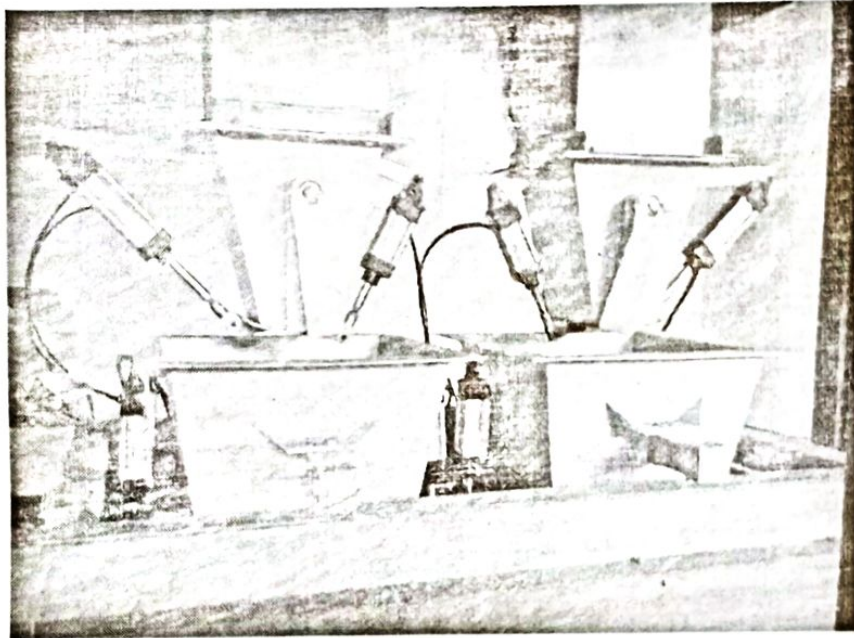
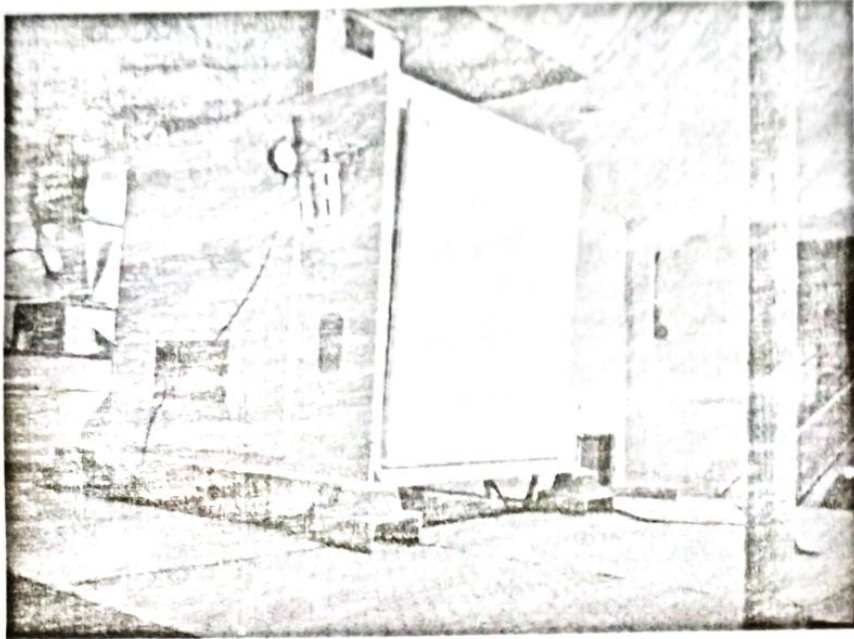
- ❖ Eddy current Drives have 60 % efficiency at 80 speed.
- ❖ Pumps runs on reduced capacities by throttling the valves.
- ❖ VFD can reduces electrical energy consumption at least by 30%

## RECOMMEND DRIVES

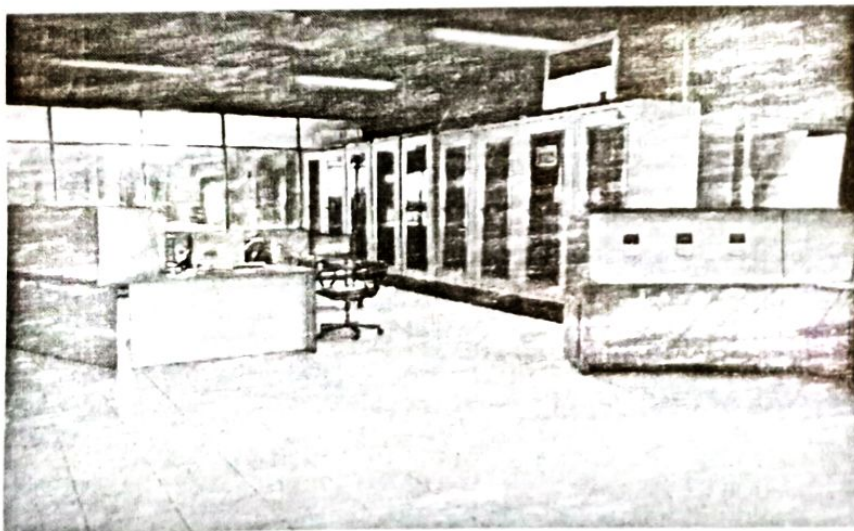
- ❖ Raw Juice Pumping
- ❖ Air compressors
- ❖ Sulfur Burner Air Compressors
- ❖ Muddy Juice and Filtrate Pumps
- ❖ Clear Juice Pumps
- ❖ A Centrifugal Drives
- ❖ Hot and Cold Air Blowers
- ❖ Dust Catcher blowers
- ❖ Sugar Elevators
- ❖ Vacuum Filter Condenser water pumps
- ❖ Defecated Juice Pumps

## AUTO BAGGING MACHINE

- ❖ Gravity Flow Measurement Technique
- ❖ Sugar Bin Level
- ❖ Speed of Bagging
- ❖ Accuracy of Weighing
- ❖ Single Chute Bagging Machine
  - Speed Problem
  - Accuracy Problem
  - Durability
- ❖ Double Chute Bagging Machine
  - Speed 16 – 18 bags per minute
  - Accuracy 20 gram
  - Standby Arrangement



CENTRAL CONTROL ROOM



## CONCLUSION

- ❖ Use of Automation is always beneficial
- ❖ Shakarganj Mills Limited Jhang expanded from 1,400 TCD to 13,000 TCD.
- ❖ Without automation and instrumentation, it would have been difficult to run such a complex plant at good efficiencies.
- ❖ The new plant installed at Bhone has excellent performance record
- ❖ Sugar Production
  - All sugar color less than 56 ICUMSA with 80% Industrial sugar (< 40 ICUMSA)
- ❖ Steam Consumption                      45% at rated capacity
- Electricity Load                        5500 kWh at 8000 TCD
- ❖ Sugar Industry can maintain and grow its profit margins with use of Automation Techniques