



# ROLE OF AUTOMATION IN DEVELOPMENT OF SUGAR INDUSTRIES

Hamid Mubeen Khan (DGM Instrumentation & Control)

**SHEIKHOO SUGAR MILLS PVT. LTD.**

Patti Naich Anwarabad, Kot Addu.



# Abstract

- This paper reflects the areas of automation of sugar processes and benefits achieved by the Sheikho Sugar Mills. In the past few years of advancements at Sheikho Sugar made us the industry leader in supplying highest grades of Sugar Crystals to most of the industry leaders in Food and Beverages sectors.
- Sheikho Sugar Mills always searching for the optimum solutions to the process problems whether it is process modification or the advancement in process control. All Concerned departments play vital role to bring the process of sugar production at the level where operation, maintenance and troubleshooting are at height of ease.



## Introduction

- The Sheikhoo Sugar Mills Pvt. Limited is the Pioneer and leading producer of refined sugar in Pakistan. Its produce several grades of quality sugar. The company comprises of two divisions i.e. Sugar & Steel division. The Sugar division has a crushing capacity of 23,000 TCD of sugarcane.



# Introduction

- The Sugar division enabled with advance sugar technologies to produce high quality sugar to meet the needs of our clients. The whole plant equipped with latest machinery and automated from cane feeding to packaging through Mill House & Process House. In Sugar Mill two different DCS (Honeywell & Rockwell) installed for plant automation.



# Automation & Control Layout

- **Level 0**

This level contains the field devices such as flow and temperature sensors, and final control elements, such as control valves.

- **Level 1**

This level contains the marshalling cabinets where the field termination takes place. Also for safety relays, Terminal blocks, Isolators are also used.



# Automation & Control Layout

- **Level 2**

This level contains the system cabinet which is designed to accommodate power supply, controller and I/O Modules. The field signals will be digitally processed by the I/O Modules and sent to the controller for further digital processing.

- **Level 3**

This level consists of visual display unit HMI Engineering Station Operator Station & Servers. It is production control level, which directly control the process. Plant operational schematics are displayed. Alarm and interlock cause and effect diagrams are displayed in different pages.



# Areas of Process Automation:

- MILL HOUSE
- FFE
- TALO & DBF
- REFINE PAN
- C CONTINUOUS PANS
- R1 REFINE MACHINES AIR JET SYSTEM



# MILL HOUSE AUTOMATION

- The purpose of Mill house Automation is sated below;
- Safety of Cane Feeding and Milling Equipment.
- Prevention of Overloading of Feeding.
- Prevention of Jams and Choking in Cane Feeding and Milling
- Continuous smooth operation.
- Reduction stoppages due to Human Error.
- Maintaining the Steam and Power Demand over entire Milling and Cane Feeding.





# Controls

- Automatic Cane Feeding Control.
- Automatic Mill Speed Control.
- Automatic Imbibition Water Control.
- Automatic Juice Flow Control.
- Bearing Temperatures of all Mills.
- Hydraulic Pressure of all Mills.
- CMD Gear Control.



# Key benefits

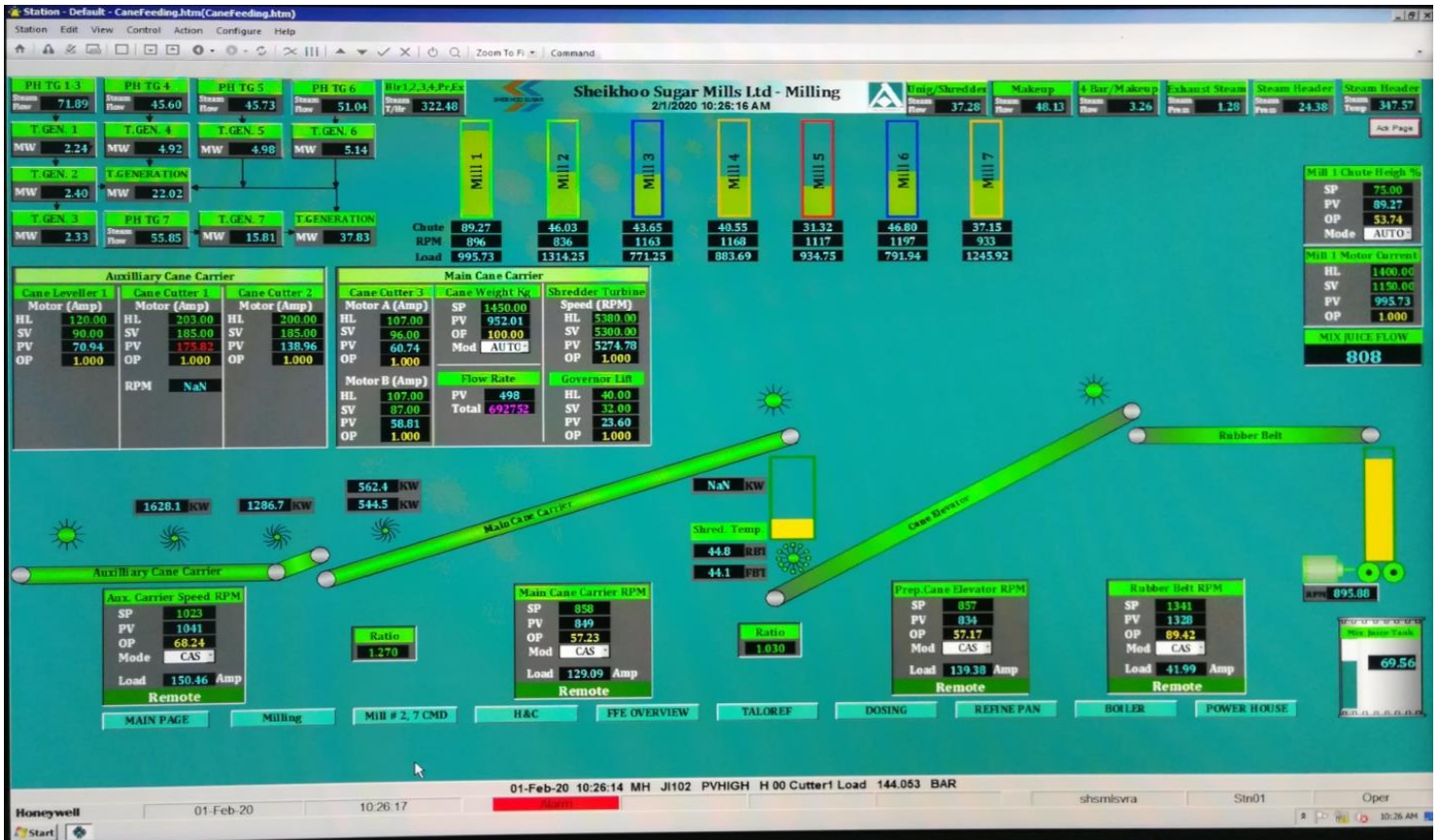
- Abnormal variation and torque of cutters, shredder controlled and leads to smooth operation of power house
- Crushing capacity increased due to smooth operation.
- Milling results improved, bagasse pol, moisture reduced due adequate loading of donley chute of mills.
- Life of equipment increased due to smooth operation.
- Saving in manpower
- Intelligent control
- Root cause analysis becomes easy in case of any breakdown



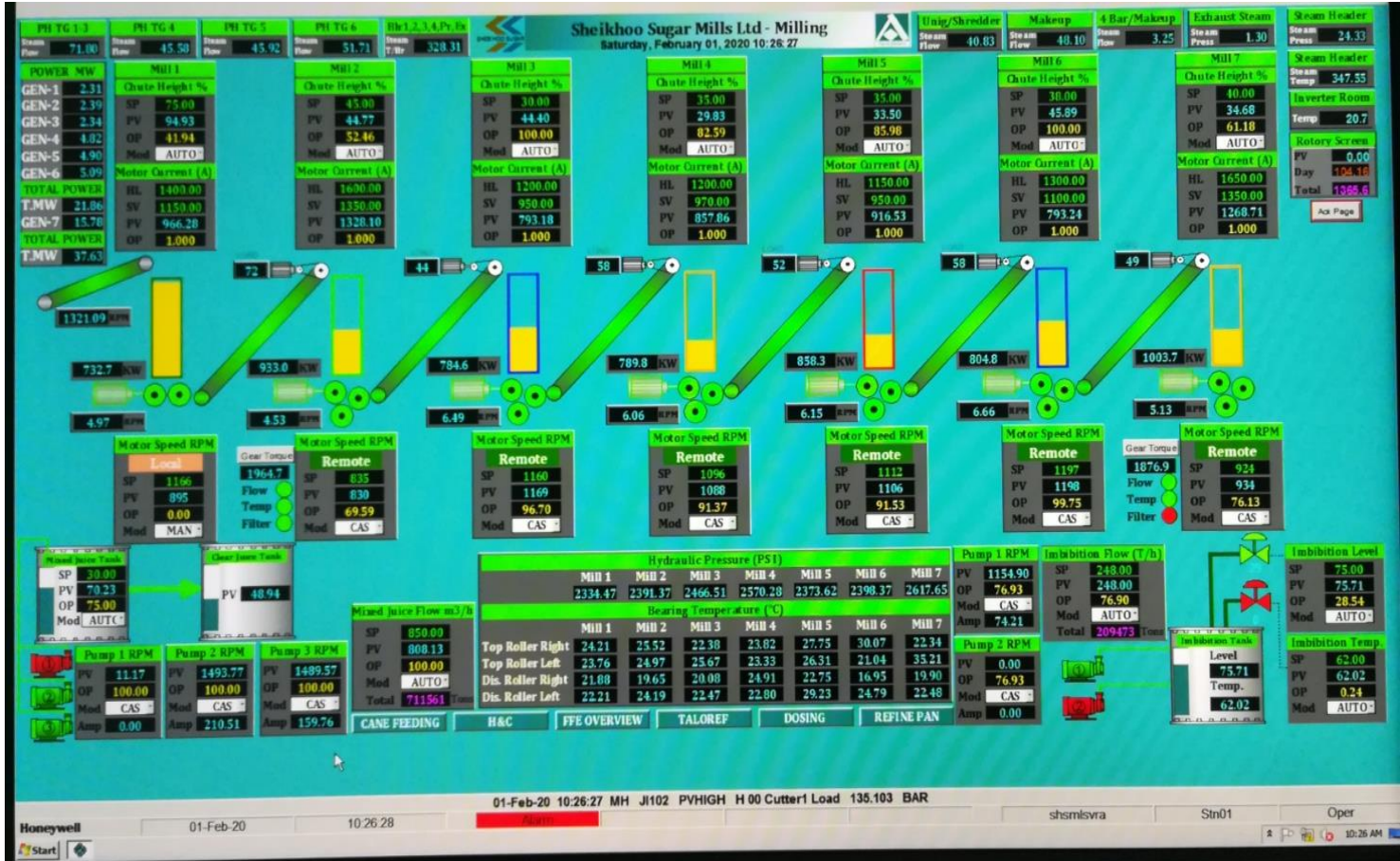
# Achievements

- Dry Bagasse to the Boilers.
- Bagasse Pol 1.5%
- Bagasse Moisture 50.5%
- Maintained Juice to Imbibition Water Ratio increases Evaporation Efficiency
- Constant Juice Flow to Process better boiling house efficiency.
- Levels in Chutes ensured positive feeding at all times and also result in power saving & Constant Load on Mills also results in Lesser Mechanical Wear & Tear.

# Cane Feeding



# Milling





# Falling Film Evaporators

- Falling Film Evaporators is modification of conventional evaporation system by modifying the evaporation design. FFEs have long tubes and are most suitable for low temperature. In falling film evaporators uniform distribution of liquid in each tube is the most important feature for its efficiency



# Purpose of Automation

- Safety of Juice and Evaporative Equipment.
- Prevention of Downtimes for Process.
- Highest Evaporation Rate
- Continuous smooth operation
- Reduction of Time for Startup and Shutdown for Process
- Maintaining the Steam Demand through 1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> Vapors.



# Controls

- Juice level control
- Juice Recirculation flow control.
- Emergency hot water control.
- Exhaust steam Pressure Control
- Pressure & Temperature of vapors.
- Transfer tank level and flow control
- Steam Condensate and Vapor  
Condensate Control

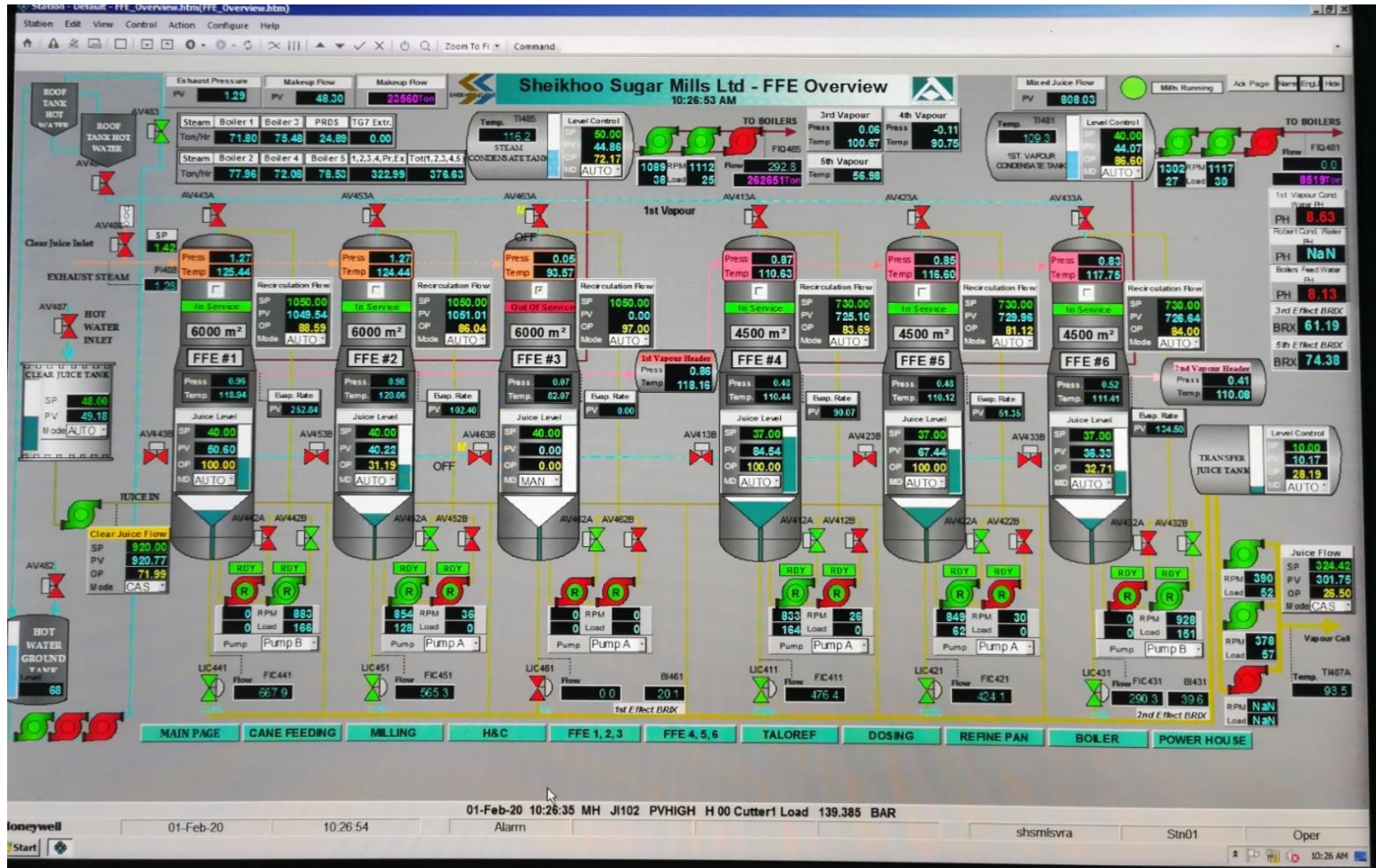




# Achievements

- Reduced Steam Consumption and achieved Highest Evaporation Rates
- Reduced Evaporation Time
- Maintained Backpressure for Turbines and Steam Demand for further Processes
- Reduced Process Downtime
- Reduced startup and shutdown time for the Evaporation Process
- Easy to operate and minimized Man Hours for Repair and Maintenance

# Falling Film Evaporators





# TALO REFINERY & DBF

- Talo consist of the most critical stations for processing of Juice to Liquor with maintained pH, Liquor Color, Liquor Temperature and Liquor Brix and Lastly Filtration of Liquor Using Deep bed Filters.
- There are 12 no. Deep Bed Filters are used for separating the suspended impurities from the clarified liquor. The pressure of the Liquor entering the filter, crossing over pre-specified pressure indicates that the filter is getting choked and that Filter put into backwash and regeneration process to be in service once again.



# Purpose of Automation

- Maintaining Liquor pH
- Maintaining Liquor Color
- Maintaining Liquor Temperature
- Maintaining Liquor Temperature
- Reduction of errors in Chemical Dosing
- Increasing filtration
- Reduction of Downtimes due to Human Error.
- Reduction of Process Preparation Time



# Controls

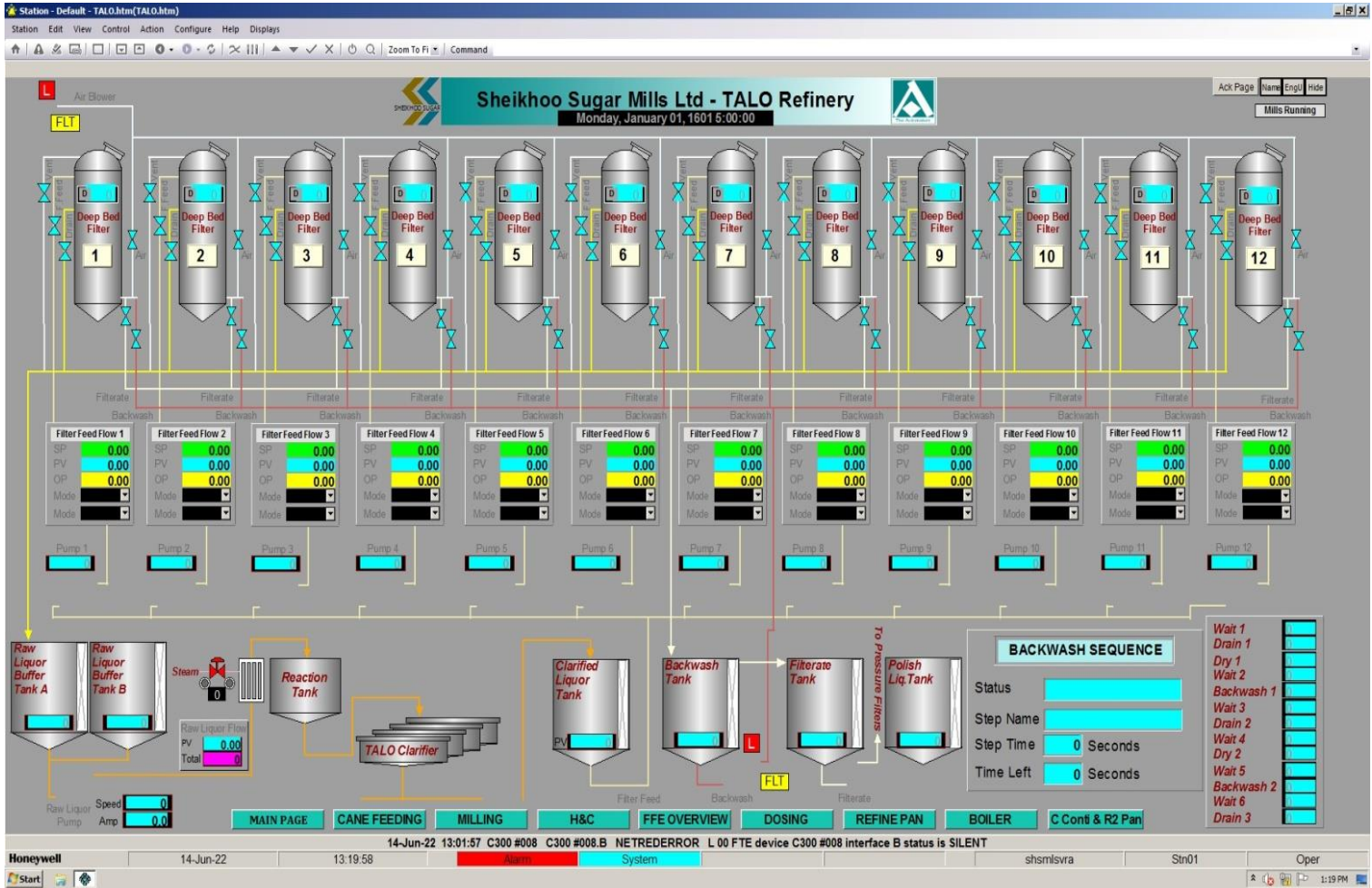
- Remelter Brix Control
- Remelter Temperature Control
- Raw Liquor Flow Control
- Raw Liquor Temperature Control
- Raw Liquor Dosing and pH Control
- DBF Start and Stop Control
- Filter Feed Flow and Backwash Control



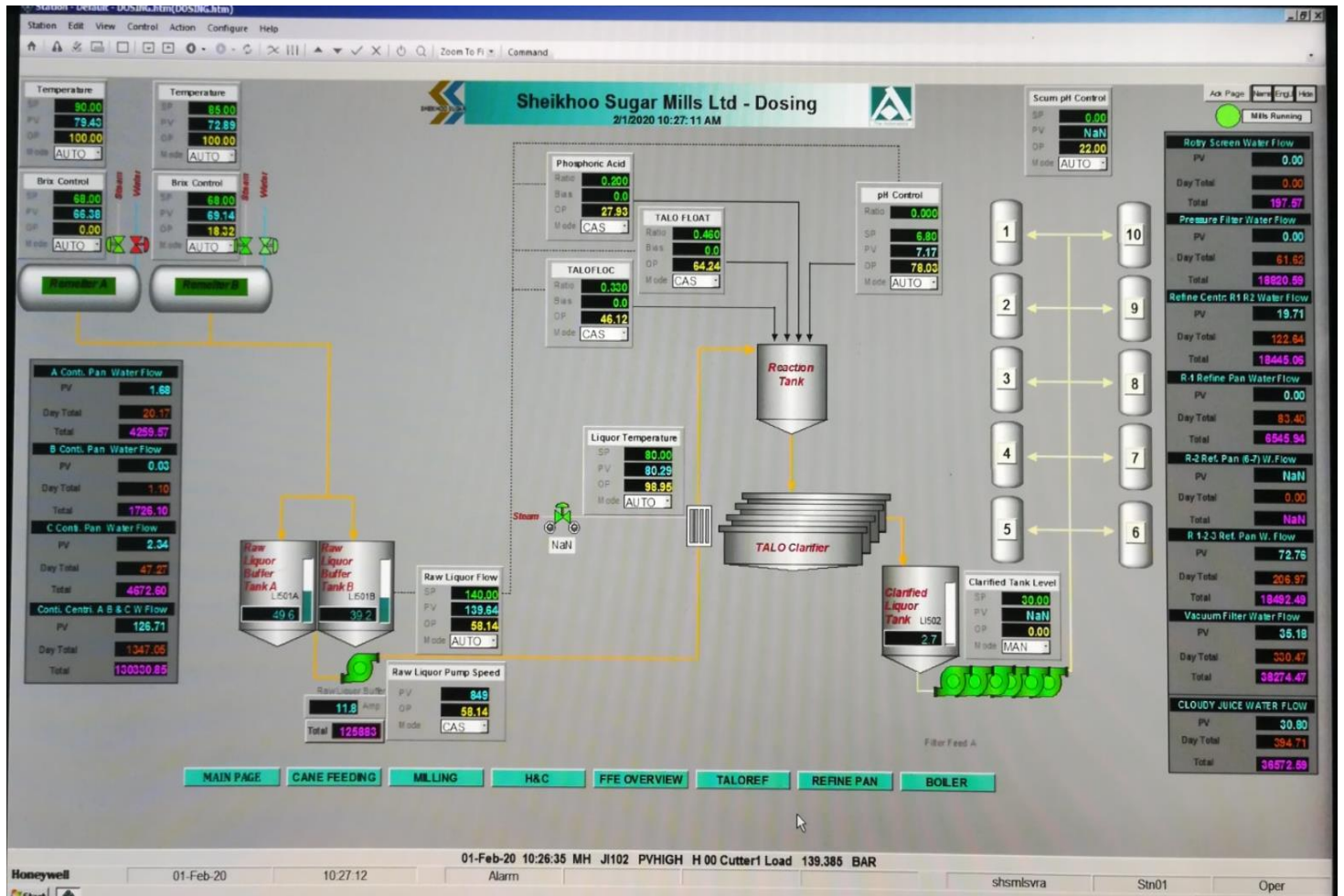
# Achievements

- Maintained pH level for Liquor throughout the season
- Maintained Temperature and Brix
- Maintained and Accurate Chemical dosing at Talo Stations
- Highest Filtration achieved and Clearest Liquor free from any suspended particles
- Reduced Process Downtime
- Reduced startup and shutdown time for the Talo Processes
- Easy to operate and minimized Man Hours for Repair and Maintenance

# DBF



# TALO







# REFINE PAN

- There are 04 No. pans for R 1 Refine sugar crystallization, each having 90 tons/strike capacity, 02 No. pans for R 2 Refine sugar crystallization, each having 90 tons/strike & 03 No. pans for R 3 Refine sugar crystallization, each having 75 tons/strike capacity. Pan automation optimizes the pan process. It handles the whole strike from evacuation to discharge.



# Purpose of Automation

- Maintaining Pan Brix
- Reduction of False Grain
- Reduction of Water Usage for Crystal Washing
- Optimization of Energy Consumption
- Reduction of Strike Time
- Reduction of Downtimes due to Human Error.
- Reduction of Process Preparation Time



# Controls

- Refine Pan Brix Control
- Refine Pan Level and Liquor Feed Control
- Pan Temperature Control
- Pan Massecuite Circulation Control
- Pan Vacuum Control
- Pan Cutover and Discharge Control



# Achievements

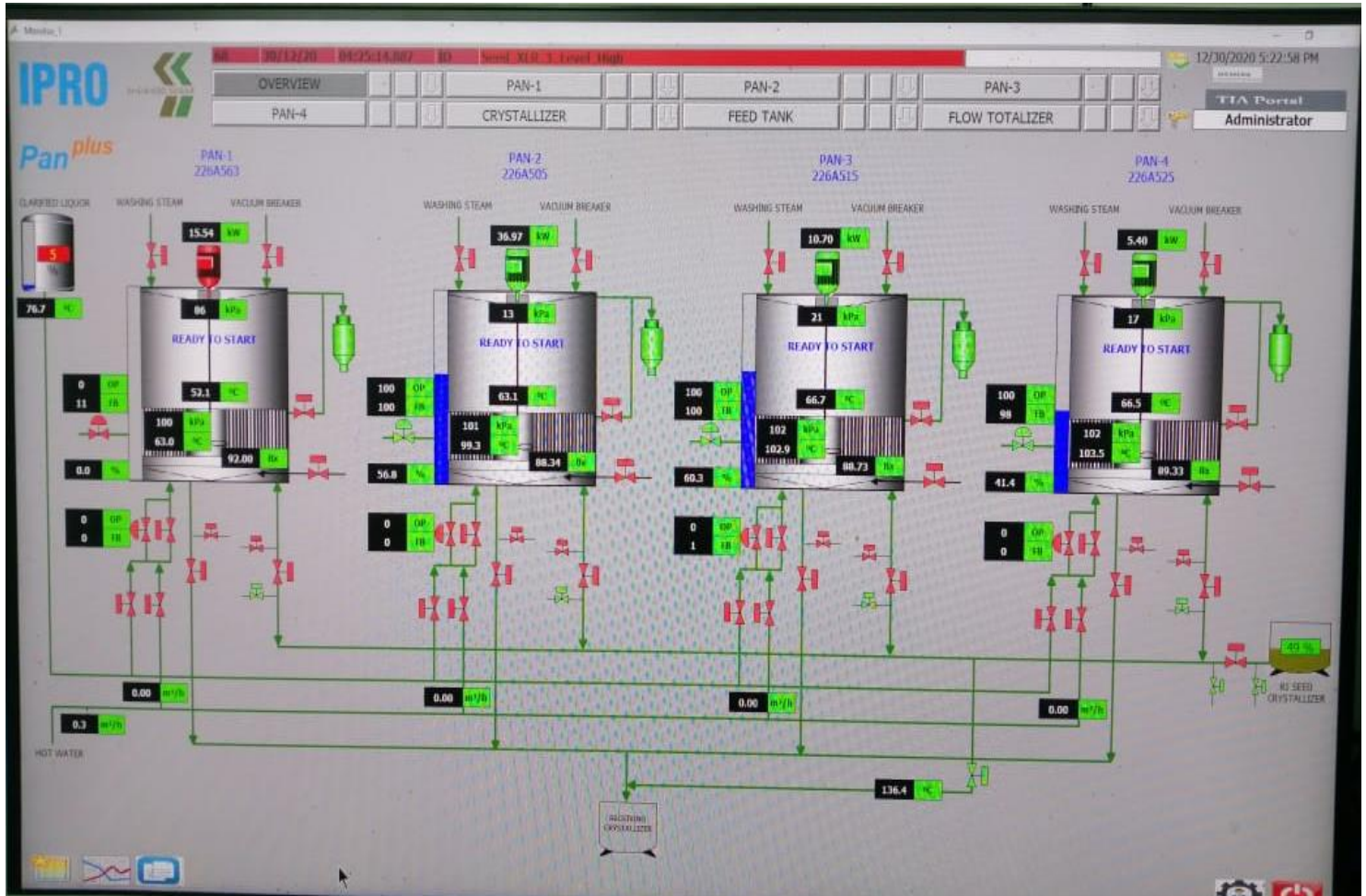
- Reduced of Pan Strike Time due to Optimized Pan Control massecuite reaches required level and brix set points in less time. Approx. 20-25 min each strike time reduced thus increasing pan capacity per day.
- Maintained Temperature and Brix of Massecuite Throughout the Strike
- Maintained Vacuum through Condenser Control
- Reduced Time for Vacuum producing and breaking of Vacuum at strike completion
- Uniform Crystal Sizes and minimized False Grain
- Reduced approx. 60% of water to wash False Grains
- Reduced Vapor Consumption due to maintained Temperature, Vacuum and Circulation
- Reduced Strike Cutover and Discharge time thus increasing
- Reduced startup and shutdown time for the Refine Pan
- Easy to operate and minimized Man Hours for Repair and Maintenance



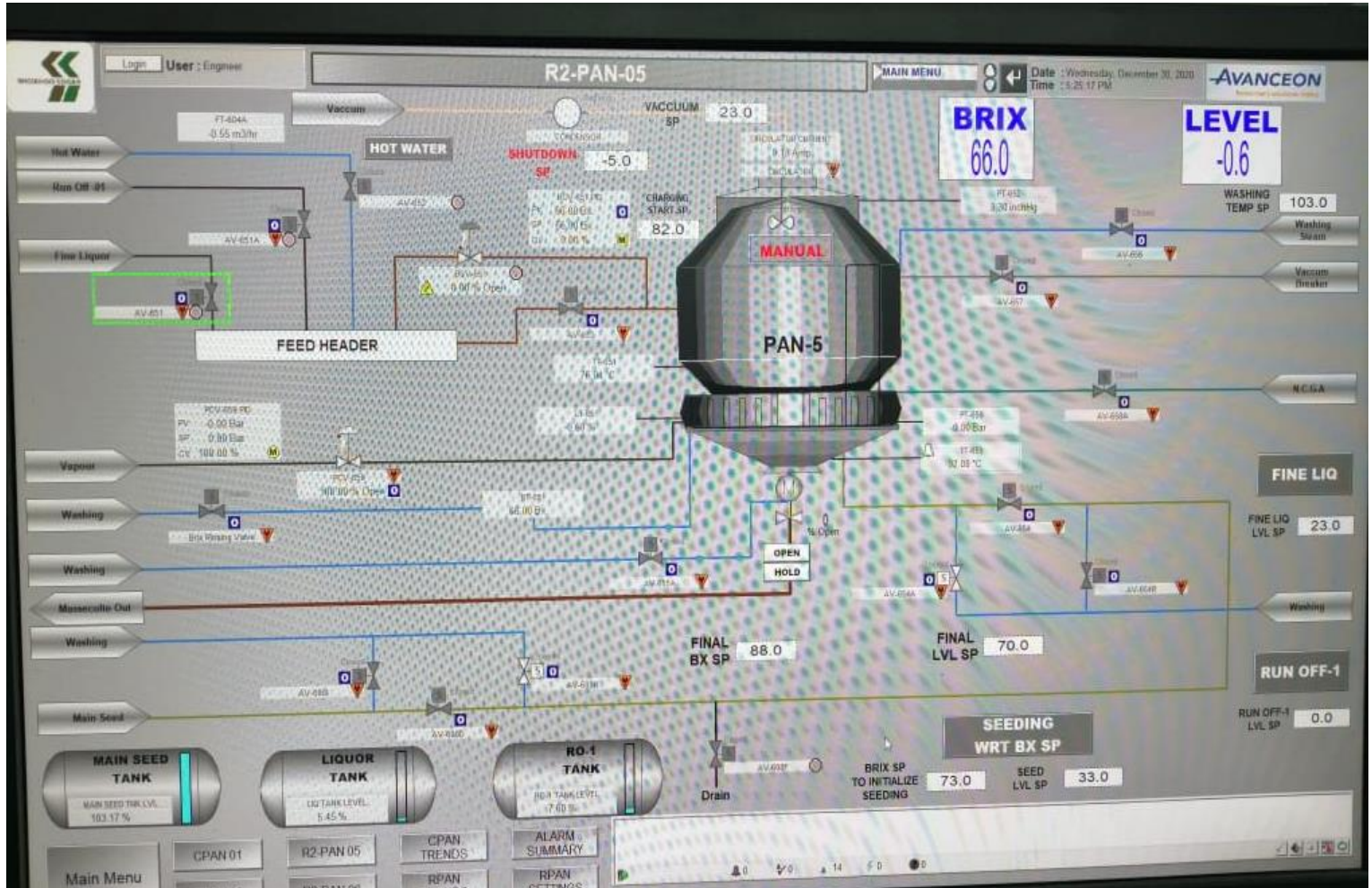
## Achievements

- Average water consumption of refine pan at approx. 23000TCD is 26 Tons
- With Pan Automation we saved approx 60% of water =15.6 Tons
- 16 Ton water= 8 Ton Exhaust Steam which means 4 ton of Baggasse/hr.
- Appox. 1.5% Steam on Cane saving.

# R1 Refine Pan



# R2 Refine Pan





## C-CONTINUOUS PAN

- There are 02 No. pans for C-Continuous sugar crystallization, where massecuite final brix is one of the critical control elements. It contains 12 compartments where in the 1<sup>st</sup> compartment seed taken and last 12<sup>th</sup> compartment final prepared massecuite discharges. Brix Probes, Water control valves and Molasses control valves are installed at each compartment.





# Purpose of Automation

- Maintaining Pan Brix
- Reduction of Water Usage
- Optimization of Energy Consumption
- Reduction of Final Molasses Values
- Reduction of Downtimes due to Human Error.
- Reduction of Process Preparation Time.



# Controls

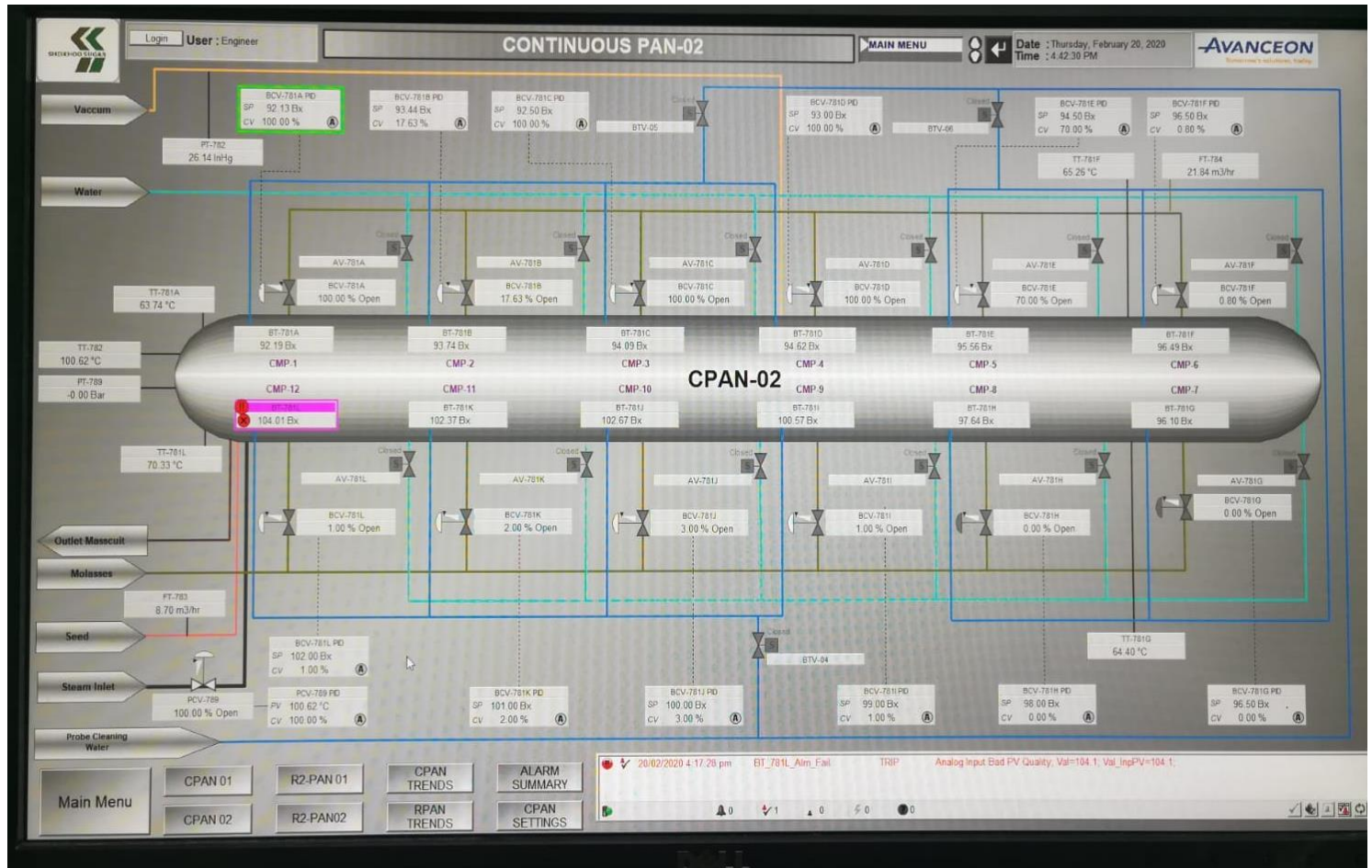
- C-Continuous Pan Brix Control at Each compartment
- C-Continuous Pan Water and Molasses Feed Control at Each Compartment
- Brix Probes washing Control
- Pan Temperature Control
- Pan Vacuum Control



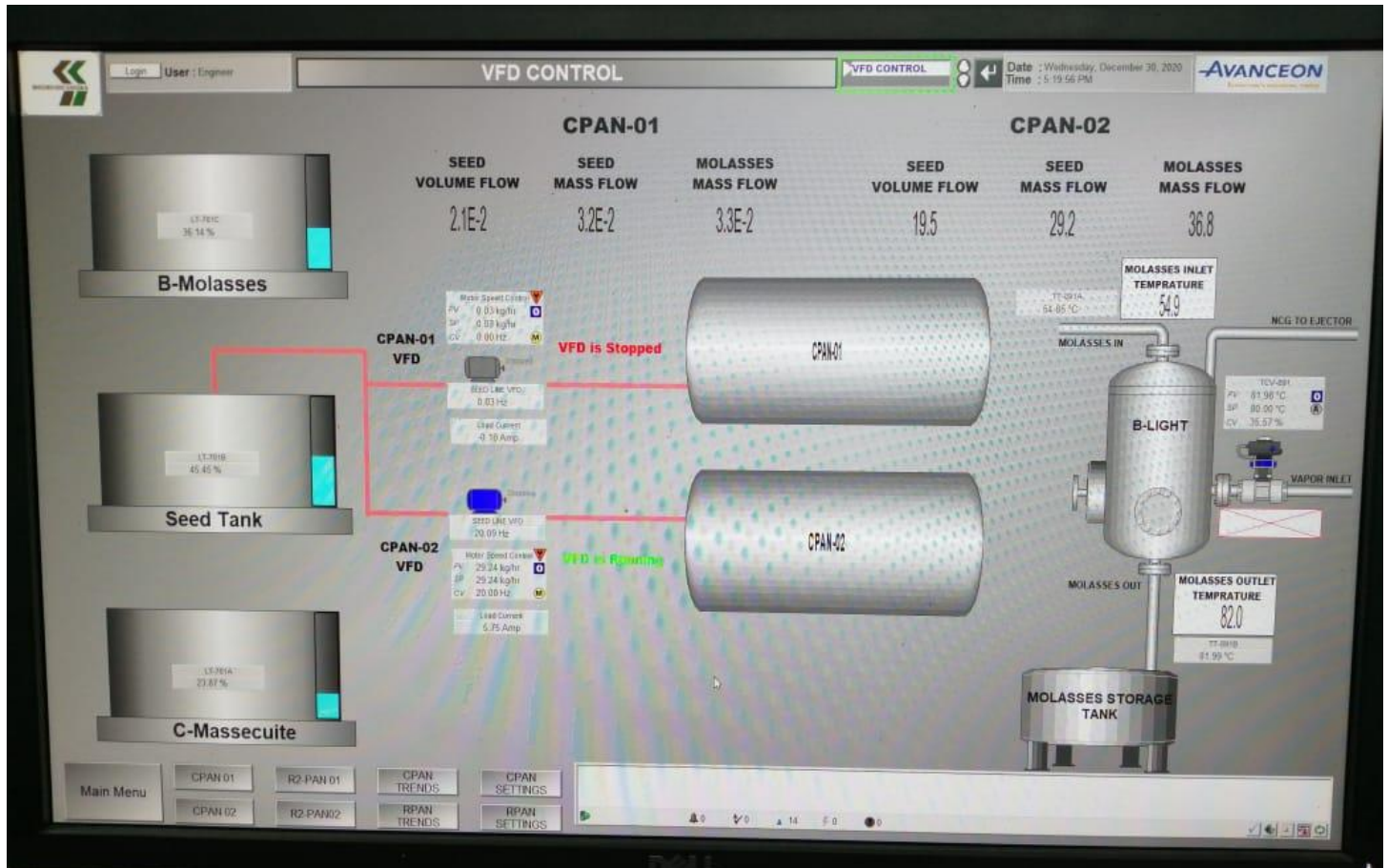
# Achievements

- Maintained Temperature and Brix of Masecuite Throughout the Chambers
- Maintained Vacuum through Condenser Control
- Reduced Time for Vacuum producing and breaking of Vacuum
- Reduced Final Molasses Values
- Reduced Water to control Elevated Brix usage due to Advance Brix Control
- Reduced Vapor Consumption due to maintained Temperature, Vacuum and Circulation
- Reduced startup and shutdown time for the C-Continuous Pan
- Easy to operate and minimized Man Hours for Repair and Maintenance

# C-CONTINUOUS PAN



# C-CONTINUOUS PAN





# R1 REFINE MACHINES AIR JET SYSTEM

- For Refine Machines Scrappers are used to scrap-out the sugar from Machine Basket during discharge cycle and then Steam and Hot Water used to clean the basket filter screen holes as some of sugar crystal layer sticks at Basket filter screen. This caused the sugar to mixed with hot water form molasses and we need to reprocess this molasses to reduce water content in it and use it back in the crystallization process.
- This Recycle process required good amount of steam vapors to evaporate the water in this molasses. To reduce this steam vapor consumption and sugar wastage (Already Prepared sugar crystals washed with hot water during machine cleaning cycle) Air Jet system was installed last year which uses the compressed air to scrap out the sugar during discharge cycle.



# Purpose of Air Jet System

- Reduction of Steam-Water usage for cleaning of Filter Screen Before Next Cycle Start
- Reduction of Wastage of Sugar Crystal
- Optimization of Energy Consumption
- Reduction of Cycle Time
- Reduction of Downtimes due to Human Error.
- Reduction of Process Preparation Time



## Controls

- Compressed Air Pressure control for each machine separately
- Compressed Air Filtration and germs Control
- Air Jet Nozzles Control





# Achievements

- More Cleaned Basket Filter Screen
- No Filter Screen Damages
- Reduces Steam Water Consumption about 20%
- Optimized Energy Saving
- Reduced Cycle Time due to Steam-Water washing not required after discharge and before starting next Cycle.
- Reduced Sugar wastage
- Reduced Downtimes
- Easy to operate and minimized Man Hours for Repair and Maintenance

# R1 REFINE MACHINES AIR JET SYSTEM



# R1 REFINE MACHINES AIR JET SYSTEM





# Conclusions

- In the above scenario Shekhoo Sugar achieved Energy Optimization, Reduced Downtimes, Reduced Equipment and Machines Breakdowns and Reduced Man Hours for Repair/Maintenance Works. All in all, we achieved highest efficiencies with reduced operating costs through state-of-the-art control systems and equipments.
- We encourage our different department to research on process optimization techniques, and we are doing our best to set Shekhoo sugar as one of the highest per day sugar crusher, as presently we are achieving 23,000 TCD with single Tandem Milling House Setup. Automation for each process gives you tight monitoring of process and reduced human errors.



# Conclusions

- We believe in near future sugar industry would be in the main line industries where automation is at their peak. We believe that we will have more competent resources in the market due to implementation new control strategies and advance process optimization technologies.
- We wish good luck to all sugar manufacturers to bring latest technologies in Pakistan.



Thanx

You are Welcome for Questions