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SESA Mill View System

ANALYSIS SOFTWARE FOR SHAPE STRUCTURAL & BAR MILLS

1. Introduction

The SMVS software package is an analytical tool that highlights specific mill process parameters using colorful graphic displays and allows examining of the setup data for each billet rolled. Mill operators and rollers can assess causes of cobbles, improve mill setup practices (compare existing setups to actual), and predict equipment deterioration.

2. SMVS software structure

Figure 1 shows the configuration diagram of the SMVS software structure.

The OPC based interface

collects real time data (Process data) from the mill control PLC every 100 ms. This data is processed and displayed on mill view screens including mill overview, tension display and R factor display.

In addition to the real time displays described above, data is stored in a relational database on a billet by billet basis.

The mill performance application can retrieve the stored parameters for further analysis in preformatted reports and charts. Changes between mill setup and actual parameters can be viewed by selecting either a single billet in a campaign, or by selecting up to 20 billets. Averages, minimum and maximum values can be compiled for a group of selected billets
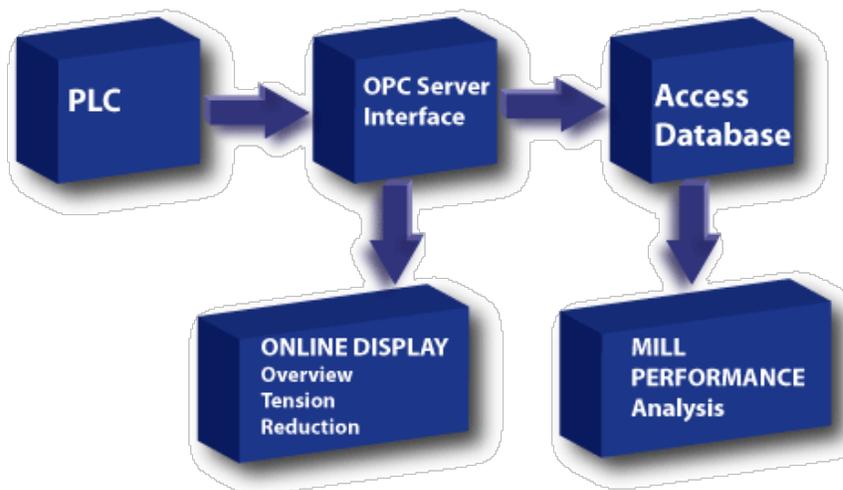

Figure 1 SMVS software structure diagram

3.2   SMVS Bar Mill Tension Screen

The bar mill tension screen allows the operator or roller to monitor tension status in the mill. The concept of monitoring load using traditional bar graphs has been expanded. The screen is designed to indicate actual load, average load plus sampled load. Four specific indicators (floats or bars) per stand are used. A float is used to memorize the last value as the bar leaves the stand.

The screen is developed and configured to simultaneously display the entire mill where the tension zones display loads and the looping zones show loop heights.   For mills with more than 10 stands, two displays are used.

Mill Stand loads are displayed below each stand graph. Also the difference between sampled and actual is displayed above each graph. In addition stand loaded indicators are provided.
Once the bar threads into the mill stand

load is sensed. Samples are taken and averaged.   This averaged or sampled value is then frozen and does not change for the remaining portion of the billet. This value becomes the front end sample. This sample is further averaged over multiple billets to provide an indicator that does not fluctuate and is less susceptible to sampling errors.

As the bar threads into the next or downstream stand, load changes. By comparing this load to the sampled load, we can establish whether there exists interstand tension or compression.

For stand zones that are configured as looping the reference signal or front end sample is replaced with the loop height reference and the dynamic load graphs are replaced with the actual loop height feedback graphs.

The dual bar graph system shown in fig 3.2a displays the sampled and averaged loads

3.3   SMVS Bar Mill Reduction Screen

The bar mill reduction screen allows the operator or roller to monitor changes in reduction in the mill. The screen is designed to indicate and compare actual reduction, and scheduled reduction. Three floating indicators (per stand) are used.

The screen is developed and configured to simultaneously display the entire mill. For mills with more than 10 stands, two displays are used.
Mill Stand set reductions are displayed below each stand graph. Also the difference between set and scheduled is displayed above each graph.   In addition, stand loaded indicators are provided.

Changes in pass can be viewed. Also set reductions and speed ratios can be compared to scheduled. These changes indicate worn passes or differences between the rolling setup reduction ratios and scheduled reduction ratios. Once the difference exceeds five percent, the scheduled reduction indicator changes color from green to red.
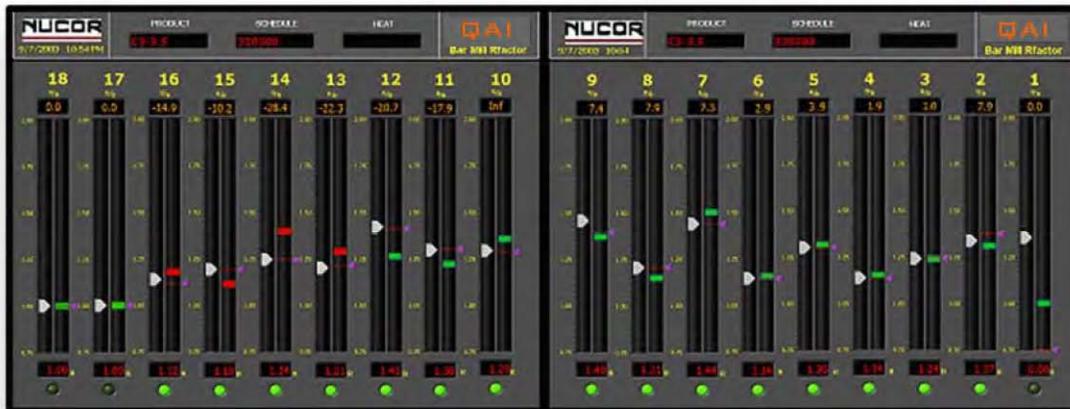

Fig 3.3a SMVS Online Display - Mill Reduction

4. Mill Performance Analysis of Schedule and Process Parameters

Process parameters are gathered and stored in the SMVS relational data-base. This data is organized by product ID on a billet by billet basis, to allow comparison of multiple billets. Setup and actual data is stored for all stands and shears. A VBA application (designed using MS-Access2000) has been developed to parse the data stored in this database, generate setup reports, and compare actual and scheduled parameters. This application can retrieve the stored parameters based on specific search criteria including date rolled, product ID or Heat #, and allow the operator or roller to print the data in preformatted reports and charts. Changes between mill setup and actual parameters can be viewed by selecting either a single billet in a campaign, or by selecting up to 20 billets. Averages, minimum and maximum values can be compiled for a group of selected billets. The SMVS mill performance and analysis application consists of three main screens: Search, Report and Analysis described below. These screens can be accessed from the application startup or Main screen shown in fig 4.0a.

Figure 4.0a Mill Performance Analysis Main - Startup Screen
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4.1 SMVS Mill Performance - Search Screen

The mill performance search screen allows users to parse the data in the database and display a list of a group of billets based on the search criteria. Once the list is displayed the operator can pick a specific billet in a campaign for generating the setup report. By selecting more than one or multiple billets he can compare speeds and tension changes from billet to billet.

The search screen contains a list box of search results (displayed on the right hand side). Once the search criteria have been selected then clicking on the find button will populate the list with the result of the query. If no search criteria are selected, clicking on the Find button will populate the list with all the billets contained in the data. Scroll buttons will help navigate through the list.

If more than one billet is selected than the Analysis button below the search list results becomes active. If only one billet is selected, then the Report button is active while the Analysis is grayed-out. Clicking the Analysis button would open the Analysis screen, displaying the results with the selected billets. Similarly with only one billet selected, clicking the Report button would open the Report screen, described below.
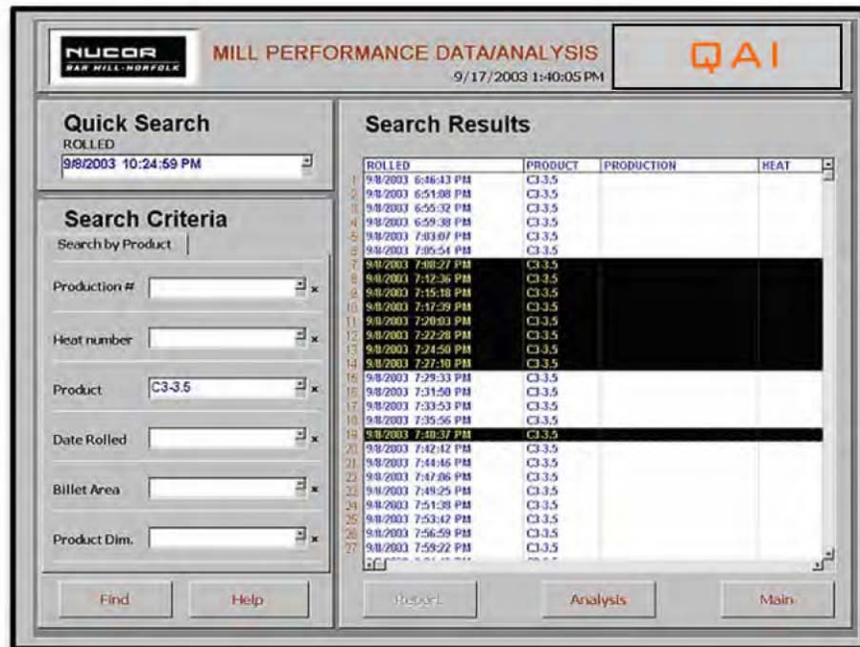

Figure 4.1a Mill Performance Analysis Search Screen

4.2 SMVS Mill Performance – Setup Analysis screen

The mill performance report allows users to display either the actual or scheduled data, and compare the difference between these values. This report displays the setup analysis stored for the selected billet. The report displays scheduled shear configuration and lengths, and stand configuration and setup. The Stand configuration and setup values include

A. Stand Selected
B. Groove In
C. Reduction Ratio
D. Speed Fpm
E. Stand RPM
F. Area In2
G. Tension PSI
H. Loop Height In.
I. Load (%)

By selecting Actual the actual values for the above variables are displayed. By selecting Setup the scheduled values are displayed. Difference calculates the absolute difference between the two and highlights the fields in cyan
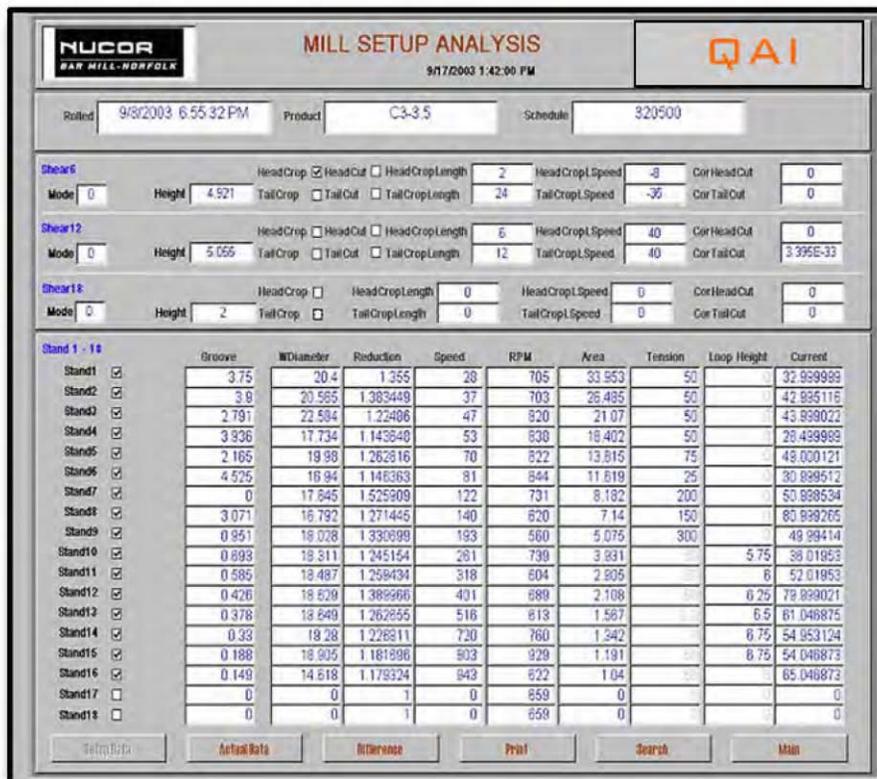

Figure 4.2a Mill Performance Setup Analysis Report Screen

4.3 SMVS Mill Performance -Data Analysis Screen

The mill performance data analysis allows users to display either the actual or scheduled data, by process variable for the selected billets. Data for up to 20 billets can be displayed. The data is populated in columns by stand number and in rows by the selected billet. Trends or changes in process variables during a campaign can be highlighted and printed. The average and min-max and difference values are displayed at the bottom of the form. These are tabulated for each stand. The variables that can be displayed are

A. Speed FPM
B. RPM
C. Reduction Ratio
D. Area in2
E. Tension PSI
F. Height In
G. Gap In
H. Roll Diameter In.
I. Work Roll Diameter In.
J. Stand Load %

Selecting Setup or Actual toggles between the Scheduled Data or actual data. Once the billet results are tabulated for the chosen variable, they can be displayed in the form of a graph. Clicking the graph button opens the analysis graph report screen, described below.
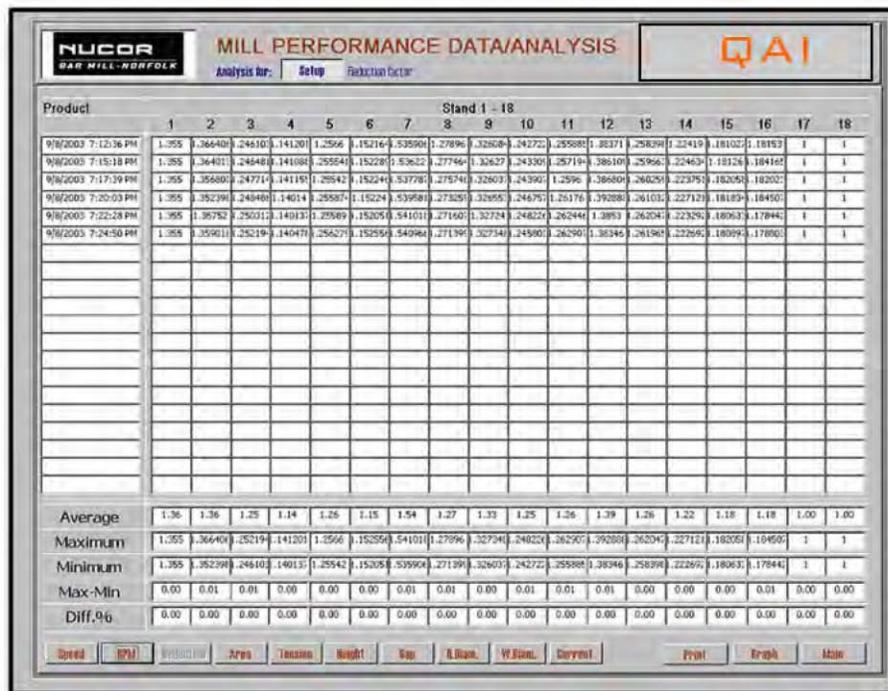

Figure 4.3a Mill Performance Data Analysis Report Screen

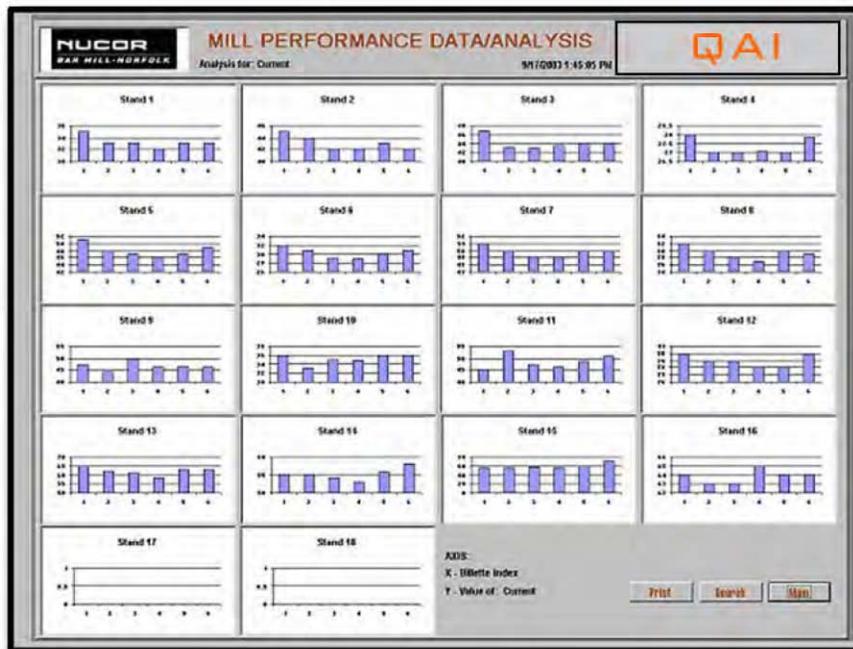## 4.4 SMVS Mill Performance - Data Analysis Graph Screen

The mill performance data graphs display the data in the form of bar graphs. The variables that can be plotted are either scheduled or actual and are selected in the Analysis screen. They are as follows

A. Speed FPM
B. RPM
C. Reduction Ratio
D. Area in2
E. Tension PSI
F. Height In
G. Gap In

H. Roll Diameter In.
I. Work Roll Diameter In.
J. Stand Load %

Changing trends in current or reduction factors can be attributed to problems. Also variations in Loop height and tension can be plotted.

Individual graphs are displayed for each stand, with the X axis representing each selected billet, and the Y axis the magnitude. In the graph below we can see the decreasing change or trend in Load of Stand 1 and Stand 2 for the 6 selected Billets. In the case where the mill is stable, this may be attributed to change in furnace temperature.

4.4a Mill Performance Data Analysis Report Screen