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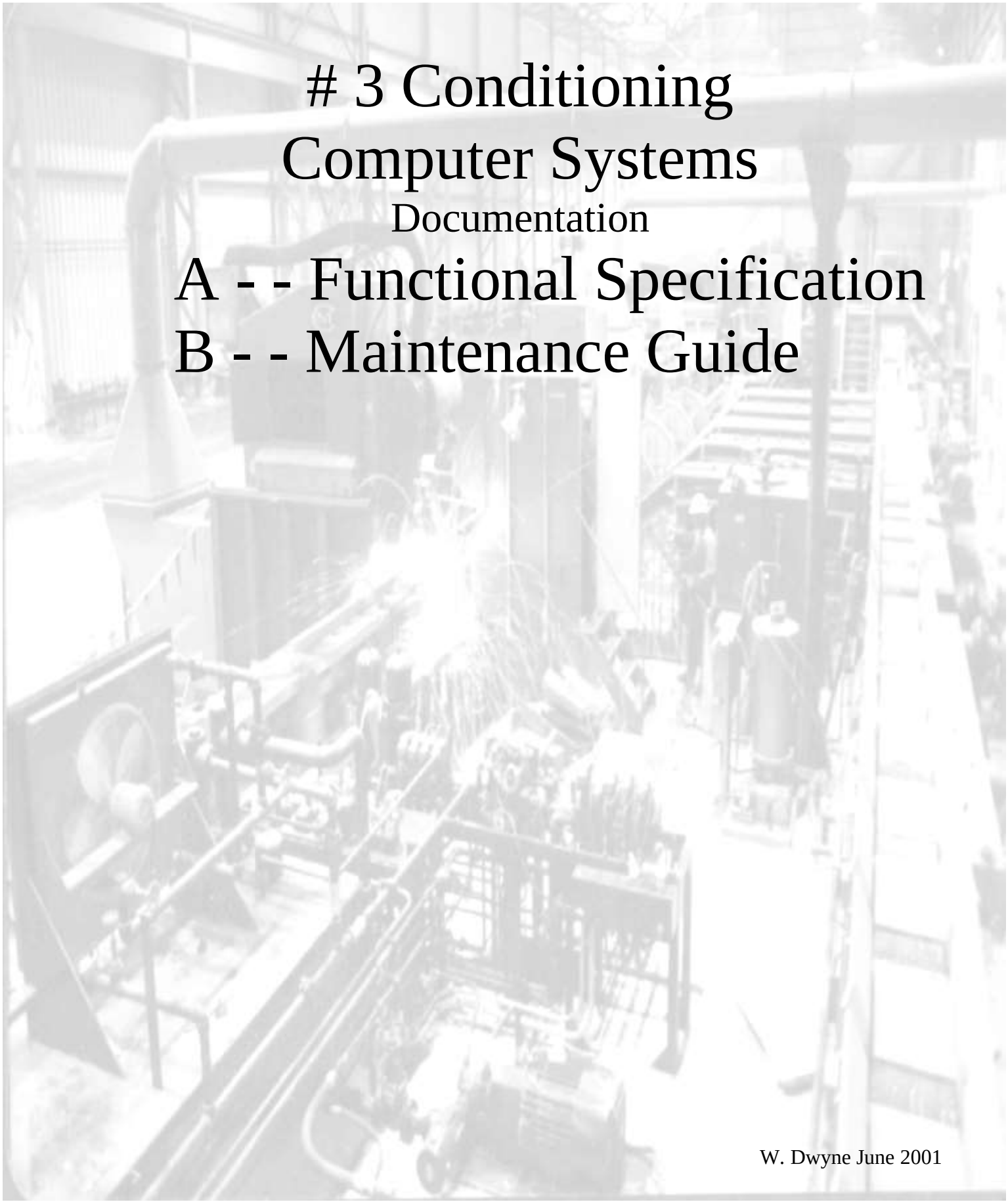

3 Conditioning Computer Systems

Documentation

A - - Functional Specification

B - - Maintenance Guide

W. Dwyne June 2001

Functional Specification
Stelco # 3 Conditioning Mill

Grinder and roller line. View is from magnaflux.

W. Dwyne June 2001

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Functional Specification
Stelco # 3 Conditioning Mill

1. Description of facilities

The facility inspects billets (a steel bar 4-7" in section and 31.5 max in length) for defects, classifies the billets and removes defects.

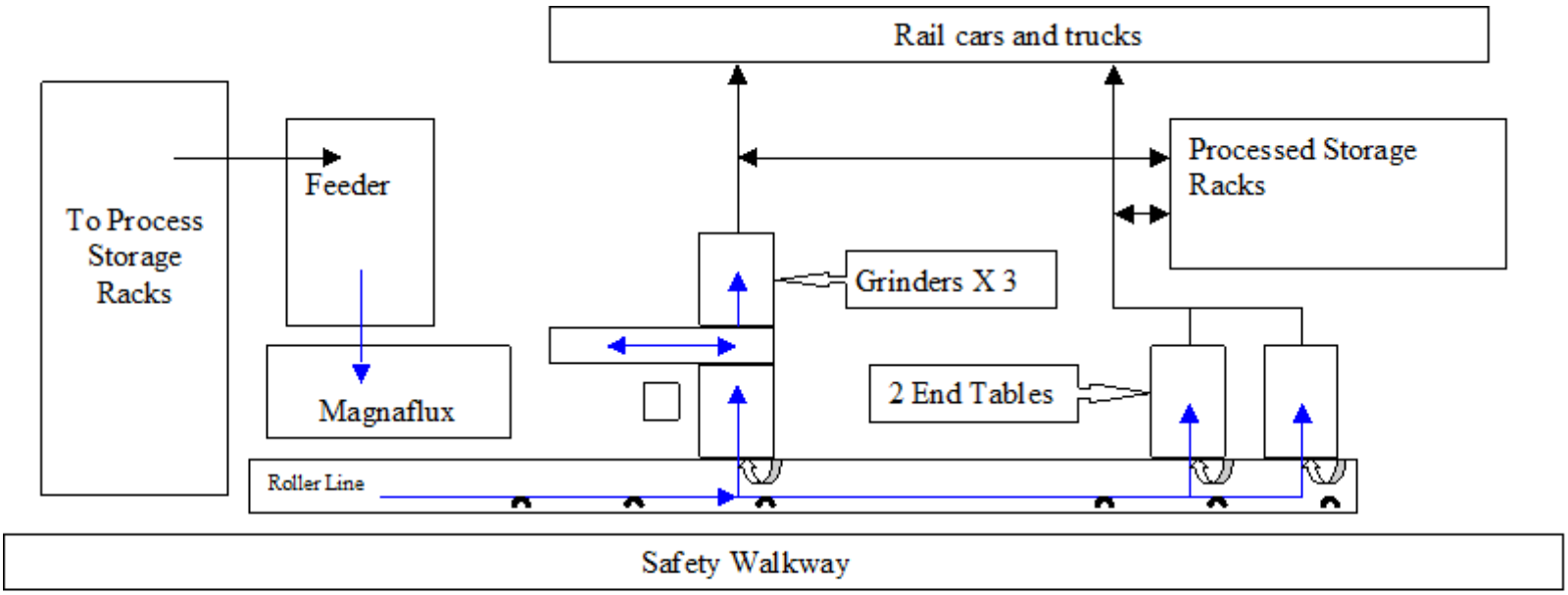
The machinery consists of an automated magnaflux machine that identifies defects in the product, three grinding machines for the removal of defects and two tables for material that is not destined for a grinder (the tables occasionally receive material that will subsequently go to a grinder). A roller line connects all of the equipment. Two overhead cranes are used to load and remove billets at the head and tail end of the process.

The grinding units are normally integrated into the process. They can also be operated independently of the magnaflux and roller line. Grinders can handle product that exceeds the size limitations of the magnaflux. This independent operation is also controlled by the process system.

The mill has a computer (process) system that provides operator data, control and product tracking.

2. Drawing of Mill

The drawing only shows grinder one. The other two are located between grinder one and the two tables.



3. Two Minute Tour

Billets are shipped to # 3 Conditioning via the buggy from the # 3 Bloom and Billet Mill (3B&B) and occasionally by rail or truck. After rolling in # 3 Bloom and Billet, data detailing the steels identification and the number of pieces is transmitted to the process system. This data is used to produce the 3B&B floor inventory report.

As billets are received the Co-ordinator checks the identity and count. He then uses the store program to indicate to the computer system that the material has been received and placed in a specific location in the pre-process inventory. The store program also allows for manual entry of data. Material is stored by location, heat number and a system generated sequence number. The purpose of the sequence number is to allow the same heat (or parts of) to be processed as often as required.

Using a line-up and the pre-process inventory report the Co-ordinator selects a sequence for the magnaglo. This process informs the computer system which sequence is being processed and what is next.

As billets are processed through the magnaglo the process systems orders the correct charge, checks the length of each billet and determines the destination of the billet being processed. To determine the destination, the computer evaluates the markers vote stations, which are Prime, Grind (defect removal required), Reclass, or Scrap. Then, based on the vote, availability of grinders, end tables and the operating foreman's preferences, the systems assigns a destination to the billet, enables the magnaglo release and updates the operators screen (19.2). Normally a prime billet will go to the end tables and a grind billet to a grinder. The computer can send any type (Prime, Grind, Reclass or Scrap) to any destination and provide the appropriate tracking, identification and reporting.

Using sensors on the roller line the billet is tracked to its destination. Upon arrival the appropriate stop block is raised and the kick-off is armed. The computer continuously monitors the status of the roller line and will shut it down if a failure is detected. Line diagnostics are provided for operating and electrical.

When the billet is discharged on to the grinder table the operator's screen (19.3) is updated. After defect removal, the operator via his panel indicates whether the billet is Prime, Grind, Reclass or Scrap. The computer system then counts, enables the release and updates the operator's screen (19.3).

After processing, material is placed in the processed storage racks or directly on to rail cars or trucks.

The loader enters the identification and count of the material being shipped. The system checks the data and counts, prints a tally and transmits the data.

During the shift the process system provides the operating supervisor with reports that detail the amount of production and delays. Reports detailing any possible discrepancies are produced hourly.

4. Purpose organisation and presumptions of this document

- To describe the current configuration and process at the # 3 Conditioning Mill with an emphasis on the control functions. The document follows the flow of the product.

- Multiple units are described as one (i.e. there are three grinders but only one is described).

- The process system does not depend on any other (VAX) system. Everything described is local to the process system.

- Each section contains a hardware and software specification. Any reference to hardware is not meant to specify a type or manufacturer. Software specifications are only meant to describe requirements and the logic/rules required. There is no attempt to indicate where the functions belong.

- The term SEQUENCE is used to describe the requirement to process and track by a unit less than a heat lot, to maintain the separate identity of the lot and to relate these lots back to the heat. A sequence contains 1-180+ billets. A sequence can only be processed by the magnaflux once (any subsequent processing receives a new sequence number). Billets from a magnaflux sequence retain the same sequence ID on the grinders and may be processed several times.

- A PRIME billet from the magnaflux is one that does not require grinding. A PRIME billet from a grinder was a GRIND from the magnaflux that has had the defects removed.

- The term " TO PROCESS" describes material that is to be processed.

- The terms CRT & MMI are used interchangeably.

- The vote stations and operators panels contain backlit switches or LED's. These are used to prompt the operator, or to indicate to the operator that a switch press is recognised. This document presumes that the panels are controlled by the process system, lighting switches or multiple switches as required (I am not detailing every panel light).

- STOP or "is stopped" in reference to the magnaflux or grinders means:
  - Inhibit the unit from releasing a billet.
  - Provide an explanation on the operators MMI
  - Activate the operators message acknowledge panel function and light.
  - Allow the process to continue when the operator acknowledges.

5. General Requirements

- All requirements on a CRT that provide status or are used to control or monitor will be available on all CRT's in the mill as required. Some require password protection.

- All CRT's that display product identification will display the data in a standard format - - being Sequence Number, Heat Number, Grade, Conditioning Level, Size, Weight, Destination.

- All events recorded by the process system and its order of processing will be recorded against the sequence. A sample Sequence Log is in the reports section (20.).

- All error messages will be recorded in a log file.

- A small database of to process and finished material will be available.

- Only the level of reporting required to support day to day operations and the tracking of material will be available. All other reporting will be provided by higher level systems.

6. Operating Database

- All of the data described in this document resides on the current system.

- The process system is capable of operating the mill independently with no external connections. Incoming data is received from #3B&B, processing data, shipping etc is output to other systems.

- Operating require a small database that tracks product within the mill. This database may be local or remote and contains the heat identification, counts, location and other data applied during processing. Most of the data will be received from other systems or applied at time of processing by the control system. The operators require the ability to enter and/or change all of the data.

- The tracking of the physical product is accompanied by the data that describes it. This data must be part of (or instantly accessible by) the control functions.

7. Operating Supervisor (Foreman)

7.1. Hardware Required

- CRT and printer

7.2. ***Software Required***

- Current shift production and delay status for magnaflux and grinders.
- Detailed daily shift production reports (20.3).
- Ability to input and/or correct all production data.
- Ability to control availability and flow to grinders and or tables for the current sequence and lined up sequences.
- Ability to force (software) a last billet at the magnaflux and grinders.
- Auto updating mill status screen (sample attached section 19.1)
- Mill diagnostics to provide
  - Line/sensor monitoring
  - Continuous monitoring of roller line.
  - Magnaglo status (ready to cycle)
  - Emergency stops
  - Position of stop blocks
  - Status of hydraulics
  - Position of safety arms
  - Status of billet to close sensors.
  - Status of almost full and empty sensors on all tables.

8. Metallurgical

No metallurgical functions should be performed.

8.1. Hardware Required

- None

8.2. Software Required

- Ability to override any met holds in the local database. Function to be password protected, only to be used in emergencies. All changes to be logged against the individual sequence.

9. Selection of Product

General

Operating require the ability to line-up sequences for processing at the magnaflux. The lined up sequences are referred to as the Magnaflux or "in process" sequence and six(6) following sequences. The "SELECTED" sequences are already in the operating database. The selection can be product that has not been processed, product that has already been processed, or product that is already lined up or in process.

9.1. Hardware Required

- CRT (2) at feeder and buggy

9.2. Software Required

9.2.1. Software functions required to SELECT a sequence

- Display and check that the operator entered sequence identification is correct.
- Check for metallurgical hold, if found stop.
- Request operator input to determine if material is:
  - Reprocess (Material being processed again for quality reasons *)
  - Random Reprocess (A quality test bundle +)
  - Remag (Material being processed again for other reasons #)
  - Audit (An audit $)
  - Then mark last character in grade code with symbol.
  - Note:
    - *, +, etc are added to last position of grade code.
    - *, +, # can only come from an already processed sequence. i.e. can not select reprocess from a reprocess sequence.
  - No entry indicates that the billets are being processed for the first time.
- If the current in process sequence is over the selected count or if less than 4 remain then stop.
- Request the count (number of billets). Ensure that there is sufficient available (less is ok).
- Determine if the request exactly matches the in process or any lined up sequences. If it does then use the input data to adjust (+-) the counts only.
- Allow operator to request a new sequence number. If requested allow operator to change grade descriptor and conditioning level only.
- Allow operator to indicate material is to be held (@) in grade code. This just flags shipping.
- Allow operator to indicate "ALL TO ONE DESTINATION" for small lots (<34).The preferred destination is a grinder.

- Has the sequence been run before. If it has apply a new sequence number.
- Adjust the inventory count for the number selected.
- If there is no in process sequence at the magnaflux calculate the average length for the billet, provide the required amperage and update all mill screens (section 19.).
- If there is no next sequence at the magnaflux up date all mill screens (19.). Note: Must provide some of the functions of a "last billet" if no in process sequence.
- Provide the ability to remove or flip the lined up sequences.
- Provide the operating supervisor with the ability to force the sequences through the process without having to cycle the magnaflux.

10. Magnaflux

Hardware and I/O Required & brief description of functions.

10.1. To measure length (PLC)
10.2. To set amperage (PLC)
10.3. One central CRT to display the current and following sequence data. Screen is detailed in *screen* section (19.2). This CRT has a slave display in the computer room and feeders pulpit
10.4. Three vote stations that provide 4 input/output each.

- Allows operators to vote Prime, Grind, Reclass, or Scrap
- When all votes are in:
  - Determines lowest vote
  - If scrap turns on "Message Acknowledge", requests a scrap code, requests operators to paint both ends (to ID scrap)
  - Start billet assignment function.

10.5. The centre operators' panel is used by the system to prompt the operator and by the operator to control various functions of the control system. The following is a list of the functions available.

10.5.1. Last Billet
- System or operator initiated.
- Informs system that this is the last billet of the in process sequence.
- Detailed in section (14.)- - "Last Billet tracking and Sequence separation"

10.5.2. Count Check
- System initiated.
- Operator acknowledged. Indicates intention to run over the selected count. Cancels system initiated "Last Billet"

10.5.3. Magnaflux available
- Turns Magnaflux available panel light on and unavailable light off.
- Clears Magnaflux down status.
- Activate billet release.

10.5.4. Magnaflux Down
- Turns magnaflux unavailable panel light on and available light off.
- Sets magnaflux down status.
  Note: The above are used by the reports and grinders.

10.5.5. Zone Tables (Multifunction dependant on values in thumbwheel)
- 9 clears zone tables (tells system line is clear)
- 8 Message Acknowledge
- 7 Conveyor restart
  - 7&8 just provide an alternative (panel problems)
- +1+2+3+4 Adds to P, G, R or Scrap count
- 101, 102, 103, 104 decrements count
- All count corrections to be time stamped and recorded against sequence.

10.5.6. Delay Entry. System initiated.
- Allows for the entry of Operator, Electrical and Mechanical delays. Not detailed in this document.

10.5.7. Delay Correct.
- Operator initiated. Allows for the correction of delays. Not detailed in this document.

10.5.8. Message Acknowledge

- System initiated.
- Flashes panel button.
- Stops magnaflux release
- When activated removes magnaflux stop.

10.5.9. Magnaflux Check

- Not used.

10.5.10. Conveyor reset.

- Operator initiated function.
- System checks all line sections, blocks, destinations etc and reports status to operators screen (19.2).

10.5.11. Billet Release

- System or operator initiated.
- Releases a billet or reports failure

10.6. Computer Mode. This selector switch is used to remove the process system from the electrical control system. Used for troubleshooting.

10.7. Ready to cycle. This signal informs the process system that the electrical/mechanical process of movement and charging of a billet is complete

11. Software functions Required to process, assign a destination and release one billet from Magnaflux.

Assigning a destination to the billet that is in the lower position of the ferris wheel and releasing to roller line.

11.1. Amperage will be set prior to charge based on product grade code and or conditioning level.
- Requested and actual amperage displayed. Magnaflux cycle is not complete if charge fails.
- Note: There is a conditioning level that calls for no charge (visual inspection).
- When a billet is entering the magnaflux its length will be measured at the charging position.

11.2. Ability to set length when processing the test billet (a billet of known length).

11.3. Length for both positions of the ferris wheel displayed to operator.

11.4. When billet is in bottom of ferris wheel its type (Prime Grind Reclass or Scrap) is determined from the vote stations. If the billet requires burn back (due to length) amount is displayed and magnaflux is stopped.

11.5. Based on the vote, a destination will be assigned to the billet using the following criteria:
- Modify vote type based on length (i.e. if too short change to scrap, Prime to Grind if burn back req'd
- Maintain a count of all forced or changed votes.
- If any units are unable to accept billets of this length (based on ordered size and weight) make them unavailable for the sequence.
- What sections of the roller line are available? Can't get there - unit is unavailable.
- Check status of hydraulics. If not running make unit unavailable.
- What units are available?
  - Foreman's request to keep unit unavailable Y/N? Y = unit unavailable.
  - Operators request to make unit unavailable Y/N? Y = unit unavailable
  - Grinder up or down Y/N? N = unit unavailable.
  - End tables available Y/N? Are they full Y/N. Are the safety arms UP Y/N? Any N means table is not available.
  - Last billet involvement Y/N? Y = unit is unavailable

  Note: FULL Y/N is when the table full sensor is picked up. There is enough room for any billets that are on the line.

11.6. Destination assignment rules and order (for units that are available)

11.6.1. General Rules

- Small lot that is required to be kept together? Then all billets P G R or S are sent to one unit. The preferred destination is a grinder, use rotation to determine first destination only. Only use a table if no grinders available. Only switch if unit becomes unavailable.
- Foreman's request for:
  - All GRIND to grinders or stop.

- All PRIME to tables or stop.
- Both of the above.

The default delivery is any type of billet (Prime, Grind, Reclass, or Scrap) can go to any Grinder or Table. Grinders have preference for Grind, Tables have preference for Prime, Reclass or Scrap. If this is not possible deliver any type anywhere

11.6.2. *Grinders*

- Foreman's rotation for delivery to grinders if present. If no rotation calculate one:
  - Give preference to grinders that have same sequence.
  - Give preference to grinders with the most room, greatest delay and least production.
  - Calculate expected number of grind pieces remaining. If it appears to be possible to keep all on one grinder do not switch or just select one. If not, send balanced load to two grinders. Only go to third grinder as last resort.

11.6.3. Tables

- Table available with same sequence and type(P,G,R,S)? Yes = use it.
- Table available, but no sequence and type is correct? Yes = use it.
- Table available but no sequence and wrong type? Yes = change type, update table operators screen (19.4), annunciator panel and use it.

11.6.4. Destination determined Y/N?

- ***YES***
  - Display the destination to operators CRT (screen section 19.2).
  - If non grind going to grinder request operators to mark billet (they physically mark it Prime, Reclass etc), and wait for acknowledge from operators panel.
  - Enable billet release.

- ***NO***
  - Display appropriate message to operators screen (19.2) i.e. No destinations available. Cancel all votes.

Note: The assign function on the existing system is 1650 lines of code.

11.7. Billet Release

This function is both operator(panel) and system initiated. It should always cause a billet to be released or display the current reason for failure to the operators screen (19.2).

11.7.1. Check that:

- the Magnaflux is in computer mode, available and ready to cycle. If not display message, cancel votes and assignment.
- the gap time is sufficient. If not just call billet release again. (15s tail to head needs to be variable)
- the message acknowledge light is not on. If on, message acknowledge function reinitiates billet release.
- the last billet and/or count check function is not active. If on, the function reinitiates billet release.
- the billet has an assignment (destination). If not display message and cancel vote.
- the line is (still) running. If not display message, cancel votes and assignment.
- the last billet identification function is complete. If not display message, cancel votes and assignment

- the line clearing function (line problems) is complete. If not display message, cancel votes and assignment
- there is a sequence to process. If not display message, cancel votes and assignment.
- Admit that you do not know the reason - display appropriate message - wait for call.

11.7.2. Check that destination is still available and reachable. If not cancel votes, inform operator and start again. This must be checked immediately before allowing a billet release. Delays in the process can allow units to become unavailable between the assignment of a destination and the release of the billet.

- Enable the release.
- Cancel the votes.
- Place the sequence at the grinder or table that it is going to. Update screen (19.2)
- Note: A billet must have a destination before release and the destination must know that the billet
  is coming.
- If the release was not possible cancel vote and display reason to operators screen (19.2).

  Notes: "ready to cycle" is the electrical/mechanical process of charging and moving a billet though the magnaflux process.

12. Roller Line

12.1. Roller Line Tracking

General description

The roller line is divided into a series of software and hardware zones. Billets are cascaded through the zones as roller line sensors are activated. The line tracking function does not require any sequence identification. Billets are identified by billet number within the sequence, their destination, last billet status and current location. All input from the roller line requires the ability to determine if the signal is expected (timeliness) or just erroneous input (i.e. eliminate signals caused by rattle/vibration/loose sensors or switches).

12.2. Tracking one billet to # 2 grinder & # 4 Table

12.2.1. Magnaflux exit sensor.

- Was a billet expected (i.e. was the billet release activated)? If not report and exit.
- Read PLC for next length and send the required amperage for next billet. The amperage may be
  for the next sequence to be processed. If no data is available default to high setting
- Determine the counts, percentages etc for magnaflux screen and update. Sample screen attached. (section 19.2)
- Update the grinder operator screens. Sample screen attached (section19.3).
- Update the table operator's display. Sample screen attached (section 19.4).
- Record counts and decrement any rotation values.
- Check for last billet:
- If this is the last billet activate the last billet procedures.
- If the next billet is the last billet then activate the last billet and count check procedure. Magnaflux to be stopped until operator indicates that this is the last billet or that they intend on going over the selected count.
- If this release terminates a delay record the delay and prompt the operator for an explanation.
- Start recording elapsed time for next release (delay timer)
- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 1? No it is not.
- Move billet to next software zone.

12.2.2. Grinder 1 approach sensor.

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 1? No it is not.
- Move billet to next software zone

12.2.3. Grinder 1 kick-off sensor.

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 1? No it is not.
- Move billet to next software zone.

12.2.4. Grinder 2 approach sensor.

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 2? Yes it is. Raise the block for # 2 grinder and arm the kick off. If the block up signal is not received within 8 seconds shut down the roller line. The block may already be up.
- Move billet to next software zone.

12.2.5. Grinder 2 kick-off sensor.

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 2? Yes it is. If the kick off up signal is not received within 8 seconds shut down the roller line. Put the block down unless billets on the roller line are going to this destination or a previous destination. (Leave block up to save mechanical wear and tear)
- Update the grinder operators screen (19.3).

Now presume the billet is going to # 4 Table

12.2.6. Grinder 3 approach sensor.

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 3? No it is not.
- Move billet to next software zone.

12.2.7. Grinder 3 kick-off & Table 2 approach sensor. (Same physical sensor)

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to grinder # 3? No it is not.
- Is the billet going to table # 2? No it is not.
- Move billet to next software zone.

12.2.8. Table 2 kick-off sensor & Table 4 approach sensor. (Same physical sensor)

- If there is a billet in the next zone shut down the line. The reason is JAMUP.
- Is the billet going to # 4 table? Yes it is. Fixed block at # 4 no need to raise. Check position of safety arms, if up shut down the line, if down arm the kick off.
- Move billet to next software zone.

12.2.9. Table 4 kick-off sensor.

- There is no next zone.
- Is the billet going to table # 4? Yes it is. Check position of safety arms, if up shut down the line, if down arm the kick off. Kick-off armed? YES. If the kick off up signal is not received within 8 seconds shut down the roller line.

12.3. Line Shut Down

- The process system monitors the roller line via:
  - A run/stop input from each section of the line
  - A series of "Billet too Close" inputs.
  - Input from the mill electric's that indicate electrical shut downs
  - By timing and monitoring the raising of stop blocks and kick-offs.
- There are several reasons for line shutdowns:
  - Problems with the tracking system and or stop blocks and kick-offs.
  - Electrical sensing of jam-ups.
  - Operator initiated.
  - Emergency stops.
- All shut downs are to be reported to the magnaflux operators, end table operators screens (19.2 19.4) and to the system log file. These messages are to be time stamped, indicate their source, and the reason.
  i.e.

13:34 Electrical line failure TABLES 16-17 @ T2	(Note: TABLES X-Y represent a section of roller line, not the end tables
14:26 Kick-off timer shutoff line at kick-off 3	Kick-off failed. Presumably billet is still on line.
23:11 Billet not expected at Grinder # 3.	Unknown billet or billet passed it's intended destination has been detected.

- If lost, unexpected or unknown billets are detected the lost billet alarm at the tables is to be activated (currently this does not work).

- The magnaflux billet release will be inhibited after all line stoppages. The inhibit will be maintained until the line is clear (empty).

13. Kick-offs & Blocks

General

Each unit has a set of kick-off arms and a block. The process system raises blocks and arms the kick-offs as required. The kick-offs are activated (if armed) by the kick-off sensor in the roller line. A billet is presumed to have kicked off when the kick-off upper limit signal is received. The following describes the functions that occur when the kick-off up signal is received.

13.1. Grinders

- Each grinder can have 3 sequences on its to process bed. These sequences are referred to as the:
  PRESENT sequence being delivered from the magnaflux.
  NEXT (or middle) sequence to be processed by grinder
  CURRENT sequence being processed by grinder.

- If there is a PRESENT sequence then just add to the PRESENT.
- If there is no PRESENT and no NEXT then add to the CURRENT
- If the PRESENT is equal to the NEXT or there is no PRESENT then add to the NEXT.
- If the PRESENT is the same as CURRENT and the NEXT is empty then add to current.
- Reduce the available room on the grinder.
- Update operators screen (19.3) as required.

- An Example. If the magnaflux is running a large sequence, billets will be kicking off into the PRESENT and the grinder will be working on the CURRENT which is exactly the same as the PRESENT. Or. The magnaflux may be running small lots. Billets will kick-off as PRESENT but NEXT and CURRENT are different sequences.
- This process is further complicated by the grinders manipulation of the sequences on the to process bed.

13.2. Tables

- The tables are much simpler than the grinders as they can only have one sequence.
- Add to the count.
- Update operators screen (19.4).
  Note: Empty and full status is determine by the billet assignment function.

14. Last Billet tracking and Sequence separation.

NOTE: This is the magnaflux "Last Billet", it describes a last billet at the magnaflux and the tracking of the last billet to its destination. The grinders can have multiple last sequences on their bed (up to 3 one for each sequence). The Grinders also have a "Last Billet" function (when they finish grinding a sequence) that is described in the grinder section (15.).

General

The importance of mixed steel prevention cannot be over emphasised. If you only get one thing right make sure it's this one. While most billets are stamped and the end may be colour coded there is no identification readily visible to the operators.

When a "Last Billet" is declared at the magnaflux all billets on the roller line are declared to be possible last billets. Any unit that has any billets from the sequence is declared to be unavailable due to "Last Billet". The "Real Last Billet" may be on the unit or on the line. If the "Last Billet" is on the unit, it is handled by the magnaflux last billet function. If the "Last Billet(s)" are on the roller line they are handled by the kick-off function. This separation is a safety requirement. We do not want to request the operator to mark the "Last Billet" when there is the possibility of another billet kicking off.

14.1. Magnaflux

- The system will notify the operator when the last billet is in the bottom position of the ferris wheel.
- The magnaflux operator will indicate that this is the:
  - last billet by activating the "Last Billet" function (he physically marks the billet LAST).
  - or that he intends on running over the selected count ("Count Check") and will notify when the last billet is in the bottom position of the ferris wheel.
- Presuming this is a last billet.
- Inhibit magnaflux release and the selection process until sequence separation is complete.
- Record all billets on the roller line as being a "last billet"
- Make all destinations that are receiving or have a "last billet" as unavailable.
- Cancel all rotation values used for this sequence.
- Clear the magnaflux in process sequence, recording counts, lengths etc.
- The next selected sequence will now be the in process sequence.
- Enable the magnaflux release

14.2. For each Grinder that has a 'Last Billet" on its bed

Note: This section details the last billet from the current magnaflux sequence. After grinding there is a "Grinder Last Billet" which is detailed in the grinder section (15.).

- For each grinder that will be receiving a "last billet"

- Reject operator attempts to make unit unavailable. Notify operator.
- Combine the PRESENT, NEXT and CURRENT as required (see KICK-OFF)
- If the grinder has 3 sequences put the grinder down for 3 sequences
- If there are no "last billets" on the line
  - turn on the grinder "Mark Last Billet" light/alarm.
  - turn on the "Message Acknowledge" panel button.
  - write message to CRT (19.3) "Mark LAST BILLET from mag" (operator physically goes and out marks it).
  - Make grinder unavailable for heat separation (also called MarkLast) the grinder will remain unavailable until the operators "Mark(ed) Last Billet" function is activated.

14.3. For each Table that has a 'Last Billet" on its bed

- If there are last billets on the line just flash and exit.
- Light the clear table light on the operators panel and on the annunciator panel.

14.4. Additional for each Grinder that has a "Last Billet" on the line.

- Check for addition last billets. If found exit.
- If this is the real last billet.
  - turn on the grinder "Last Billet" light/alarm.
  - turn on the "Message Acknowledge" panel button.
  - write message to CRT (19.3) "Mark LAST BILLET from mag" (operator physically goes and out marks it).
  - Make grinder unavailable for heat separation (also called MarkLast) the grinder will remain unavailable until the operators "Mark(ed) Last Billet" function is activated.

14.5. Additional for each Table that has a "Last Billet" on the line.

- Check for additional last billets. If found exit.
- If this is the real last billet.
  - Light the clear table light on the operators panel and on the annunciator panel.
  - Update operators screen (19.3)

14.6. Grinder "Last Billet" is in the GRINDER section (15.).

15. Grinders

General

Usually the grinders are an integral part of the process.

The grinders receive billets on the grinder bed (from roller line or overhead crane) and discharge their processed billets on to the grinder table. A very high percentage will be Prime. Occasionally Grind will be discharged if the machine needs to be cleared for repairs/maintenance, these billets will be stored for later processing. If Scrap or Reject are discharged the operator will mark and segregate on table.

Occasionally the grinders will be used as independent units and may process material that is outside of the size restrictions of the magnaflux. When operating independently the grinder will not be available to receive steel from the magnaflux, it will be loaded by overhead crane. The material may or may not have been previously processed by the magnaflux. The operators will (from a CRT) inform the control system of the ID of the material, the control system will then track, control and report this material against the sequence number. Operating call this procedure "Direct Grind".

15.1. Hardware Required & brief description of functions.

- One central CRT to display the previous, current and following sequence data. Display is detailed in *screen* section (19.3).

- One operators panel/MMI. The operators' panel is used by the system to prompt the operator and by the operator to control various functions of the control system. The following is a list of the functions available.

    - Select Prime Grind Reclass or Scrap (4 inputs)
        - Operator initiated to indicate type (Prime, Grind, Reclass, or Scrap)
        - No release if table full.
        - Prevent more than one sequence on table.
        - If scrap, prompt for valid scrap code.
        - Enable release (allows table over horizontal).
    - Grinder up
        - Operator initiated to make grinder available (to delivery system).
        - Reject if hydraulics are off.
    - Grinder Down
        - Operator initiated to make grinder unavailable (to delivery system)
        - Reject if billets on line (flash and message). Stop any additional billets from being assigned to grinder.
    - Count Correct
        - Operator initiated to correct counts for current sequence.
        - Warn if correcting zero count.
        - Prime, Grind, Reclass or Scrap plus or minus comes from thumbwheel.
        - Recalculate room on bed.
        - Update screen (19.3).
        - All changes to be recorded against sequence data.
    - Maintenance

        - Not used.
    - Delay Entry Operator, Electrical or Mechanical (3 inputs)
        - System initiated:
        - Allows for the input of delays.
        - Not detailed in this document.
    - Delay Correct
        - Operator initiated.
        - Allows correction of last delay.
        - Not detailed in this document
    - Message Acknowledge
        - System initiated.
        - Stops grinder billet release.
        - Flashes panel button.
        - When acknowledged removes grinder release stop.
    - Last Billet
        - System or operator initiated.
        - Informs system that this is the last billet of current sequence.
        - Detailed in section (14.)- - "Last Billet tracking and Sequence separation"
    - Count Check
        - System initiated.
        - Operator acknowledge indicates intention to run over the delivered count
        - Cancels system initiated "Last Billet"
    - Last billet marked
        - System initiated, operator acknowledged.
        - Check for more last billets on the line. If found reject and inform operator.
        - Remove grinder "last billet" status.
        - Activate magnaflux billet release
        - Turn off "last billet light" and annunciator.
        - Turn off message acknowledge.
- Input from grinder table indicating:
    - That there are billets on the table (Table Almost Full)
    - That the table is empty (Table Empty)
- Input to indicate that there is a "Billet on the Grinder Car".
- Input that indicates the status of the hydraulics
- Output (Computer Selection Made) that indicates that the billet has been ground and assigned a type (Prime, Grind, Reclass or Scrap). This output allows the table to go over horizontal.
- Input that indicates that the table has gone over horizontal (upper limit). This signal plus a previous "Billet on Car" indicates that a billet has actually been processed.

15.2. Software functions required to process one billet on a Grinder.

- The grinder bed can contain 1 to 3 sequences. These sequences are
    - PRESENT sequence being delivered from the magnaflux.
    - NEXT (or middle) sequence to be processed by grinder
    - CURRENT sequence being processed by grinder.
      Note: There is additional information in the KICKOFF section (13.)
- Only the CURRENT sequence can be processed, but the current may be the same as the PRESENT or NEXT.

- The operator moves billets across the grinder bed, into the crotch, then onto the unload arms, then on to the grinder car table. A series of limit switches in this process provides the process system with a "Billet on Car" signal.
  - When "Billet on Car" is received increase the room available on the grinder bed.
- The operator proceeds to remove defects from the billet.
- When complete, the operator, via his panel indicates if the billet is Prime, Grind, Reclass, or Scrap.
  - Turn off selection and then back on to indicate that selection is accepted.
  - Check for "Billet on Car" if not present inform operator, cancel selection and exit.
  - Check the table status. If full inform operator and reject selection and exit.
  - If this is first billet of sequence and there is material on grinder table, inform operator, reject selection and exit. Only one sequence allowed on grinder discharge table.
  - Enable billet release. (Allows table to go over horizontal)
    This is referred to as "Computer Selection Made"
- Operator discharges billet. System is informed by upper limit on car.
  - If this release terminates a delay record the delay and prompt the operator for an explanation.
  - Start recording elapsed time for next release (delay timer)
  - If the billet is Scrap request and record the scrap code.
  - Update counts and the operators screen (19.3).
  - If this is the last billet on the sequence activate the "Last Billet" and "Count Check"
  - Cancel the vote.
- Last Billet is detailed

15.3. Last Billet on Grinder.

- System will light the "Last Billet" and "Count Check" when it determines a last billet.
- Operator will:
  - Press "Last Billet" to indicate that this is really the last
  - Press "Count Check" to indicate his intentions to go over the delivered count and will press "Last Billet" when the actual last billet has been processed.
- Record all of the counts that apply to the sequence.
- Manipulate the (up to) 3 sequences on the grinder bed as required.
- If possible remove the down for 3 sequences status.
- Update operators screen (19.3)

16. End Tables

General

The end tables consist of tables that receive billets from the roller line. Operating often refer to these tables as "Prime Tables", this description is misleading, the tables can and do accept Grind, Reclass, Scrap and Prime billets.
Each table has a set of safety arms that are monitored by the control system. The purpose of the arms is to prevent injury to the operator. The control system monitors the position of the arms and takes appropriate action. I.E. If the arms are up and billet going to destination disarm kick-offs and shut down the line.

16.1. Hardware Required & brief description of functions

- One CRT to allow operator input functions. Also used to run line diagnostic software.

- One operators display CRT (screen section 19.4) to display the
  - current magnaflux sequence,
  - the sequence on, and the status of each table including the position of the safety arms.
  - any following sequence at the magnaflux.
  - Display is detailed in *screen* section (19.4).

- One operators panel/MMI. The operators' panel is used by the system to prompt the operator and by the operator to control various functions of the control system. The following is a list of the functions available.
  - Clear Table. This function is both operator and system(usually) initiated. CLCR
    - Check for billets on the line. If found inform operator and wait.
    - Make table unavailable
    - Update operators screen (19.4)
  - Table available. Operator initiated.
    - Check for billets on table, if found inform operator and exit.
    - Check that the safety arms have been cycled and are in the down position.
    - Make table available to the system when all billets have been removed and the safety arms have been put up and down.
    - Also changes the table assignment (usually done by system).
    - Update operators screen (19.4)
  - Message acknowledge. System initiated, operator acknowledged.
    - Flash to inform operator of message.
    - When operator initiated cancels the "Lost Billet Alarm".
  - Conveyor restart. Operator initiated.
    - Check the status of all roller line sections. Used if a section of line has been down.
- Annunciator panel (on the west wall viewable by crane operator) that displays, for each table
  - the status
  - assignment (P, G, R, or Scrap)
    Note: Essentially mirrors operators panel.
- Input from each table indicating:
  - That there are billets on the table (Table Almost Full)
  - That the table is empty (Table Empty)
- Input to indicate that the safety arms are UP or DOWN

- Input that indicates the status of the hydraulics

16.2. Software functions required to clear a table.

- Operator or system initiated.
  - Operator initiated
    - Flash to acknowledge
    - Check line for more billets to this table. If found inform and exit.
    - Light clear table button and annunciator panel
    - Update operators screen (19.4)
    - Wait for safety arm activation.
  - System initiated
    - Flash clear light and annunciator panel.
    - Check line for additional billets (kick-offs also do this) for this table.
    - Light clear table button and annunciator panel when last has arrived.
    - Update operators screen (19.4)
    - Wait for safety arm activation
- Operator raises safety arms.
  - Check line for billets to this table. If found shut down line, and inform operator.
  - Record up signal.
  - Update operators screen (19.4)
- Operator ID's billets
- Operator lowers safety arms.
  - Check for previous UP. If not found inform operator and exit.
  - Make table available to system.
  - Update operators screen (19.4) and annunciator panel.

17. Additional I/O

General

This sections describes I/O that is not covered elsewhere.

- Server Interlock
  - Forces Terminal Servers to fully reset during system initialisation by cycling power.

- Computer room Over Temperature
  - Monitors environment (voltage and temperature). If activated warns operators of the problem. For temperature starts the shutdown timer which will power off the system in 15 minutes.

- Computer room Bypass
  - In Bypass mode the system will not report environment problems to the mill screens.

- Emergency Stop
  - Magnaflux
  - Manually Operated Position (MOP)
  - Tables
    - The Emergency Stops remove power from Magnaflux, roller line, and Tables when activated. The process system only monitors and reports the status of the emergency stops.

18. Shipping

Shipping is not a part of the control system. However shipping does use the data that is captured by the control system. Shipping can occur while a sequence is in process. Process counts are used to verify the amount shipped.

19. Screens

19.1. Foreman's Mill Status

Foreman's mill status display, refreshes every 30 seconds.
Normal font and style on VT100 compatible.

Description

```
(# 3 Conditioning  Mag destinations >T2p )          Comp 9:59
```

Computer mode, system time

```
                                                   Charge 2000/ 2137
```

Requested/actual

```
Mag Seq  2290 Heat 554942 Grade C5160HT@ O Size 6.00 3313  Dst 15 Selected  96
```

Magnaflux data

```
P= 14 G=  3 R=    S=     Tot = 17  ( 79 Left)          27ft  0in
```

ft, in based on size wt for seq

```
82%  18%    %    %       18%  82%                      Rep> 67 B:C 11-SEP-2000
```

Crew and Stelco date

```
All Grind Reclass & Scrap to grinder or stop.
```

Foreman's request

```
G1  Seq     Heat       Grade          Size          Dst     0 Done Dela13
Tbl Prm  Grd  Rec  Scr   Bed                                    |      |        | UP
Cnt                                                             |      |    20 | 120"
```

Grinder data

```
G2  Seq  2290 Heat 554942 Grade C5160HT@ O Size 6.00 3313  Dst 15  0 Done Dela13
Tbl Prm  Grd  Rec  Scr   Bed  2290       2290                    |      |       | UP
Cnt    3                                   3                    |      |   17 | 102"
```

Another message line

Grinder data

```
G3  Seq  2986 Heat 454988  Grade C5160HT@  O Size 4.30 1741 Dst 15  9 Done
Tbl Prm  Grd  Rec  Scr   Bed                                  |Mag But | Hyd OFF| Down
Cnt    9                                                     | Operator|     20 | 120"
( 14)  57
```

Another message line

Grinder data

Unit is Down 120"on bed can 2 accept 20 pieces
(14 = estimate for 14 more grind)
room for 57 more on grinders.

```
Op d{ 7} Grinder rotation =  0  2  0  ~  6  6  6  ~  6  6  6  ~  6  6  6  ~
```

Grinder rotation, entered by Operator (Op) d{7} is system default.

Tables & Roller line

```
Tables 2 =  2290                |4 =  2290                Line  MG G1 G2  G3 T2 T4   PLC
HydOn  Av PR  1 Not Empty  |Un PR 10 Not Empty   0/  0  ^     ^   ^   ^    ^  ^   On
```

0/ 0 indicates stops this seq/shift
^ indicates line section is up

Next Sequences (up to four)

```
1> 554942 C5160H+  6.00 O 15 Grd   6
```

19.2. Operators screen in magnaflux.

Duplicate screen in unscrambler and computer room.
Screen uses double width & double height characters.

Description

Seq# Heat# Grade Size Wt. Cl To Cnt
229 554942 C5160HT@ 6.00 3313 O 15 96 — In process sequence

Time 11:16 Count Percent Standard Upper Limit Lower Limit
PRIME 57 70% 45.0 61.0 35.0 — Count % by class

GRIND 24 30% 55.0 71.0 44.0

Top length = 123.4 xxx.x — Length of the top billet

RECLASS 0 % 0.0 0.0 0.0

Bottom length = 567.8 xxx.x — Length of the bottom billet

SCRAP 0 % 0.0 0.0 0.0

2000/1992 left assigning UP> G1 G2 T4 — Amps call+actual. Units that are available.

TOTAL 81 (15) #16 to Grinder 2 — Next billet goes to G2

287 554942 C5160H+ 6.00 3313 O 15 6 — Next sequence

Messages — Scrolling region for messages

19.3. Grinder operators display

- Screen uses double width & double height characters.

Description

PREVIOUS SEQUENCE G2 Time 11:13 Room 84

Time & room updated every minute.

Seq# Heat# Grade Size Wt. Cl Ds Cnt
3011 557584 C1038TRW 6.00 3218 O 15 12

The previous seq data and count

UP> G1 G2 T4 Done Left

Available units. # done, togo

CURRENT SEQUENCE 2 4

Count for current seq

Seq# Heat# Grade Size Wt. Cl Ds Cnt
3024 557584 C1038T+W 6.00 3218 O 15 6

Sequence ID. Count is the delivered count from mag

Prime Grind Reclass Scrap
2 0 0 0

Breakdown by type for current sequence.

NEXT SEQUENCES
No sequence

Lists next and present sequences at this grinder.

MAG SEQUENCES
3012 455093 C1038TRW 6.00 3211 O 15 96

In process mag sequence

Next sequence not selected

Next magnaflux sequence

Messages

Scrolling region

The screen has been updated by a foreman's request.

System message

19.4. Table operators screen.

- Screen uses double width & double height characters.

Description

Seq# Heat# Grade Siz Wt. Cl Ds Cnt
2962 557485 CB10B22@ 4.30 1915 O 16 56

Current mag seq. Updated by mag release.

Table Seq# Cnt Available Class Safety Arms To Rack
2 2962 23 YES Prime Down

T2 available to receive billets. Updated by kick-offs

Table Seq# Cnt Available Class Safety Arms To Rack
4 2962 0 No Grind Up

T4 unavailable - - being cleared Updated by kick-offs

Next Sequences

2976 557485 CB10B2+ 4.30 1915 0 16 GRD 9

RANDOM all to one grinder

2974 557376 C5160AMS 6.0 3200 0 15 ALL 16
2959 557482 C5160HT@ 6.0 3230 0 15 ALL 96

HELD material to all

2977 557482 C5160+ 6.0 3230 0 15 GRD 6
2984 557489 C5160+ 6.0 3230 0 15 GRD 6

Maintained by the programs that control the lineup

Messages (4 lines scrolling region)

General and line stop messages.

20. Reports

Note: This partial set of reports is included to show the type and detail of data that is collected.

20.1. Foreman's hourly report

CD0024 Crew: B #3 Conditioning Hourly Report 10:00:51 03-MAY-2001 Page 1

P E R F O R M A N C E B Y UN I T

	Magnaglow		Grinder 1		Grinder 2		Grinder 3		
	Billets	Delay	Billets	Delay	Billets	Delay	Billets	Delay	
Hour >	55	33	14	36	12	17	16	21	<Hour
Shift>	157	98	44	86	27	82	44	70	<Shift
Av/Hr>	52		14		9		14		<Av/Hr
Prime>			44 100%		27 100%		44 100%		<Prime
Grind>	157 100%								<Grind

M A G N A G L O B Y S I ZE

	Tons	Bar Mill		Rod Mill	Other		Total	
		4"	6"	4"	4"	6"	Count	
Hour >	54			55			55	<Hour
Shift>	155			157			157	<Shift
Av/Hr>	51						52	<Av/Hr

20.2. Delay Summary

3 C O N D I T IO N I N G

CD0027 12 Hour DELAY SUMMARY 21-APR-2001 19:00:01

MAGNAGLO

Type	Reason	Time	Min
OPER	Headstock	07:05:	7
OPER	Break	09:01:	36
OPER	Kick-off failure	09:19:	2
OPER	Break	11:01:	37
OPER	Sequence change	11:19:	3
OPER	Crane Delay	11:21:	2
ELEC	Alignment table	11:29:	8
OPER	Tables full	11:43:	3
OPER	No steel	13:01:	37
OPER	Break	14:59:	35
OPER	Miscellaneous	15:34:	3

D E L A Y I N P R O G R E S S 201 MIN

TOTAL DELAY TIME 6 HRS 14 MINS 51.9 %

TOTAL RUN TIME 5 HRS 46 MINS 48.1 %

1 Line stops occurred this shift

GRINDER #1			GRINDER #2			GRINDER #3		
TYPE DELAY REASON	TIME	DURATION	TYPE DELAY REASON	TIME	DURATION	TYPE DELAY REASON	TIME	DURATION
OPER No Steel	07:37:	42	OPER No Steel	07:40:	45	OPER No Steel	07:05:	10
OPER Break	09:09:	54	OPER Break	08:14:	19	OPER Clean Up	07:42:	7

OPER Wheel change 10:21: 23	OPER Dump Boxes 09:12: 40	OPER Heavy Grind 08:13: 12
OPER Break 11:14: 45	MECH Grinder Car 09:49: 19	OPER Break 09:09: 33
ELEC Grinder Car 11:46: 26	OPER No Steel 13:08: 153	OPER NO CODE 09:44: 6
OPER No Steel 14:05: 102	OPER Break 14:18: 55	OPER Break 11:14: 85
OPER Break 15:17: 58	ELEC Tilt Arms 15:12: 40	MECH Grinder Unit 13:21: 96
OPER Heavy Grind 15:30: 6		
OPER Crane Delay 16:36: 27		
DELAY IN PROGRESS 121 MIN	DELAY IN PROGRESS 153 MIN	DELAY IN PROGRESS 297 MIN
DELAY TIME 8 HR 24 MIN 70.0%	DELAY TIME 8 HR 44 MIN 72.8%	DELAY TIME 9 HR 6 MIN 75.8%
RUN TIME 3 HR 36 MIN 30.0%	RUN TIME 3 HR 16 MIN 27.2%	RUN TIME 2 HR 54 MIN 24.2%

TOTAL DELAY TIME 26 HRS 14 MINS 54.7 %
TOTAL RUN TIME 21 HRS 46 MINS 45.3 %

20.3. 12 Hour Production Reports

CD0011 Crew: B #3 Conditioning 12 HOUR PRODUCTION REPORT 19:00:14 02-MAY-2001 Page- 1

MAGNAGLO reporting 4 Sequences. This shift operated > MG G1 G2 G3

																		< Destination of MAG output >									
* SEQ#	HEAT#	GRADE CODE	CL	DST	SIZ	WGHT	* 3BB CNT	CHG CNT	TOTAL TO-DATE	* Actual this shift * TOT	PRM	GRD	REC	SCP	* CNT COR	DEL TOT	* GRINDERS * 1	2	3	* TABLES * TOT	PRM	GRD	REC	SCP
3214	455442	CB57SPG	G	16	4.3	1980		176	170	66	3	63				66	31	9	23	3	3			
3218	557798	CB1541	O	16	4.3	1794		175	175	175	150	25			-1	176	16	9		151	151			
3209	557885	1060	G	16	4.3	1850		180	180	180		180				180	75	47	58					
3211	455445	1060	G	16	4.3	1980		150		79		79				79	27	36	16					

1 GRINDER reporting 4 Sequences. This shift operated > MG G1 G2 G3

* SEQ#	HEAT#	GRADE CODE	CL	DST	SIZ	WGHT	* DIRGND	FROM MAG PRM	GRD	REC	SCP	DEL TOT	* ACTUAL THIS SHIFT * TOT	PRM	GRD	REC	SCP	CNT COR	
3214	455442	CB57SPG	G	16	4.3	1980		61				61	54			54			(Balance on previous shift)
3218	557798	CB1541	O	16	4.3	1794		16				16	16			16			
3209	557885	1060	G	16	4.3	1850		75				75	75			75			
3211	455445	1060	G	16	4.3	1980	32	27				59	13			13			(in process at end of shift)

20.4. 24 Hour Production Summary

Note: The 12 hour production summary is the same.

CD0013 #3 Conditioning 24 HOUR PRODUCTION SUMMAY 07:00:20 30-APR-2001

PERFORMANCE SUMMARY

Output = 267.7 Tons Repro = 9.9 Tons

O-R = 257.8 Tons

MAGNAGLO

	TONS	PCS	%
PRIME	166.9	101.0	60.1
GRIND	110.7	67.0	39.9
RECLASS	0.0	0.0	0.0
SCRAP	0.0	0.0	0.0(0.To Short)
TOTAL	277.6	168.0	100.0

COMBINED GRINDERS

	TONS	PCS	%
PRIME	125.6	76.0	100.0
RECLASS	0.0	0.0	0.0
SCRAP	0.0	0.0	0.0
SUB TOT	125.6	76.0	100.0
BENT	0.0	0.0	
TOTAL	125.6	76.0	

	OPER HOURS	TONS / HR	STD %
GRINDER 1	1.37	57.9	26.3
GRINDER 2	0.00	0.0	0.0
GRINDER 3	1.58	29.3	11.9
COMBINED GRINDERS	3.35	37.5	9.6
MAGNAGLO	1.42	195.5	15.0

	GRINDER 1			GRINDER 2			GRINDER 3		
	TONS	PCS	%	TONS	PCS	%	TONS	PCS	%
PRIME	79.3	48.0	100.0	0.0	0.0	0.0	46.3	28.0	100.0
RECLASS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SCRAP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	79.3	48.0	100.0	0.0	0.0	0.0	46.3	28.0	100.0
BENT	0.0	0.0		0.0	0.0		0.0	0.0	

Tons Prime + Reclass + Scrap Delivered to Grinders from Mag = 24.8

CD0013 CD0013 #3 Conditioning 24 HOUR PRODUCTION SUMMAY 07:00:20 30-APR-2001

	MAGNAGLO			COMBINED GRINDERS			GRINDER 1			GRINDER 2			GRINDER 3		
	TONS	PCS	%	TONS	PCS	%	TONS	PCS	%	TONS	PCS	%	TONS	PCS	%
4"															
6"	277.6	168.0	100.0	125.6	76.0	100.0	79.3	48.0	100.0	0 0	0.0	0.0	46.3	28.0	100.0
5"															
6">															
7">															

0.0 Total Tons L Level. 0.0 Total Tons G Level (all sizes at mag).

0. Billets scrap, to short. 3. Billets to be cut back. 169. Billets measured.

OUTPUT = tons prime + tons reclass + tons scrap + combined grinder total tons - P G R delivered from mag

CD0014 # 3 Conditioning 30-APR-2001

REPROCESS REPORT

SEQ#	HEAT#	GRADE	CLV	DST	SIZE	WGHT	PCS	TONS
3205	123456	TESTBA+	B	ST	6.0	3308	0	0.0
3207	455335	C5160 +	O	15	6.0	3305	6	9.9
		TOTALS					6	9.9

CD0015 #3 Conditioning 07:00:20 30-APR-2001

PERFORMANCE SUMMARY

<<<<<< MAGNAGLO >>>>>>>>>>>> COMBINED GRINDERS >>>>>>OUTPUT<<REPROCESS>

DAY	OP HR	TOT PCS	TOT TONS	TONS PRIME	% PRIME	TONS GRIND	TONS RECL	TONS SCRAP	OP HR	TOT PCS	ACTUAL PCS	TOT TONS	ACTUAL TONS	TONS PRIME	TONS GRIND	TONS RECL	TONS SCRAP	PCS REPRO	TONS REPRO
1	2.	263.	291.	242.	83.1	49.	0.	0.	2.	42.	42.	50.	50.	50.	0.	0.	0.	277.	6.	10.
2	1.	98.	78.	52.	66.3	26.	0.	0.	2.	82.	82.	70.	70.	70.	0.	0.	0.	81.	9.	7.
3	7.	572.	898.	613.	68.3	281.	0.	4.	8.	234.	234.	361.	361.	352.	0.	0.	10.	875.	24.	39.
30	2.	168.	278.	167.	60.1	111.	0.	0.	4.	76.	76.	126.	126.	126.	0.	0.	0.	268.	6.	10.

TOTALS MONTH TODATE

110.	13174.	67.9	0.	157.	3697.	5002.	13.	30.	422.										
9901.	8942.	4213.	18.	3711.	5015.	4972.	0.	13036.	577.										

20.5. Final Sequence Log

Sample Final Sequence Log - - Shows the data that is collected by the control system.

```
                                                                                                                                3012  455093
CD0023 (SCINDEX  H9445)   # 3 Conditioning FINAL SEQUENCE LOG        for sequence 3012                as of 07:00: C 17-APR-2001
                                        Discrepancy: MAG TOT - SHIP+INV

      HEAT#    SEQ#  Original SEQ# = 3012   Line stops =  0
      455093   3012                                                  REQUIRED      RECEIVED (STORE TIME)      MAGNAGLOW PRODUCTION
                          GRADE   CLV  DST SIZ  WGHT  PRODUCT#        DATE          DATE       TIME             DATE       TIME
                          C1038TRW O   15  6.0  3211  89369060     04-APR-01     07-APR-01    11:37: A       09-APR-01   19:04:B
PRODUCTION                                Reclass to >00000000
         #3B&B  CHG     MAGNAGLO OUTPUT       CNT
          CNT   CNT     TOT  PRM GRD REC SCP  COR
           96    96      96   66  30   0   0    0

                        DELIVERED   FROM MAG                                 TOTAL
                        TOT  PRM GRD REC SCP    DELIVERED BY DIRGND     DELIVERD     GRINDER OUTPUT        CNT
          TABLES         66   66   0   0   0     DATE  SHIFT  CNT      TO GRINDER    TOT  PRM GRD REC SCP  COR     DATE     TIME

         GRINDER 1       12    0  12   0   0                   0          12         12   12   0   0   0   0   09-APR-01  20:02:B

         GRINDER 2       12    0  12   0   0                   0          12         12   12   0   0   0   0   09-APR-01  22:15:B

         GRINDER 3        6    0   6   0   0                   0           6          6    6   0   0   0   0   09-APR-01  19:59:B

          TOTAL          96   66  30   0   0                              30         30   30   0   0   0   0

SHIPPING STATUS (    6 Billets were selected from this sequence. )
                        PRIME                                GRIND                              RECLASS
                DATE  SHIFT  CAR #  CNT            DATE  SHIFT  CAR #  CNT            DATE  SHIFT  CAR #  CNT
               09-APR  NGHT   0239   26
               09-APR  NGHT   0235   64
                           TOTAL   90                       TOTAL    0                        TOTAL    0
              Total ship + sel =   96
       SQV rating:  2  Heat OK.                                  ( 1 1 1 1 1 0 1 0 0 0 0)
          Cracks: LIGHT  1" - 3",   1 - 3 per side,       most on 1 side.        25 % of seq involved.
           Seams: None.                          Slivers: Light, little to no effect.            Lap: None
Roll/Guide marks: None                             Swarf: None                        Broken corners: None
         Comment: HEAT OK

              Average Length =   3090 Min Length =   3077 Max Length =   3131 Total Length =  296682.  PLC status = On
     0 Billets scrapped ( to short ).     0 Billets cut back.     Amount cut off =      0      Valid lengths =   96 out of  96
                       Prime to Grind =   0   Prime to Scrap =   0  Grind to Scrap =   0   Reclass to Scrap =   0
```

```
                                        I N D I V I D U A L   L E N G T H S       windows > (2700-3220)  (3480-3580)
    3092  3090  3092  3093  3095  3090  3091  3093  3096  3079  3091  3091  3098  3087  3092  3092  3092  3081  3092  3094
    3097  3081  3090  3092  3092  3088  3092  3090  3092  3092  3093  3090  3085  3090  3091  3089  3097  3089  3090  3091
    3094  3085  3092  3093  3090  3087  3093  3090  3094  3087  3090  3092  3092  3088  3085  3077  3091  3090  3088  3087
    3087  3093  3093  3093  3089  3085  3092  3089  3091  3090  3085  3090  3088  3088  3087  3131  3093  3090  3087  3090
    3090  3090  3093  3079  3091  3095  3092  3087  3090  3088  3086  3090  3090  3092  3090  3091
c = Cut  i = Invalid  s = Scrap
```

20.6. Management Report

CD0030

3 Conditioning
Daily update for 02-MAY-2001

Delta Prime: -33.6% Overall Prime: 29.4%

Processed: 6" Pieces: 0. 4" Pieces: 500. Total: 500. Tons: 467.
(BM> 0 RM> 500)

Below standard heats
455442 CB57SPG G 4.3" 4% Prime 95% Grind 0% Scrap SQV = 3 Heat OK.
Roll Marks - Heavy, removal + repro reqd.

557885 1060 G 4.3" 0% Prime100% Grind 0% Scrap SQV = 3 Heat OK.
Roll Marks - Heavy, removal + repro req'd.

Audits processed: 0 MTD: 0
Audits failed: 0 MTD: 0
Cracks: 0 MTD: 0
Mill Defects: 0 MTD: 0

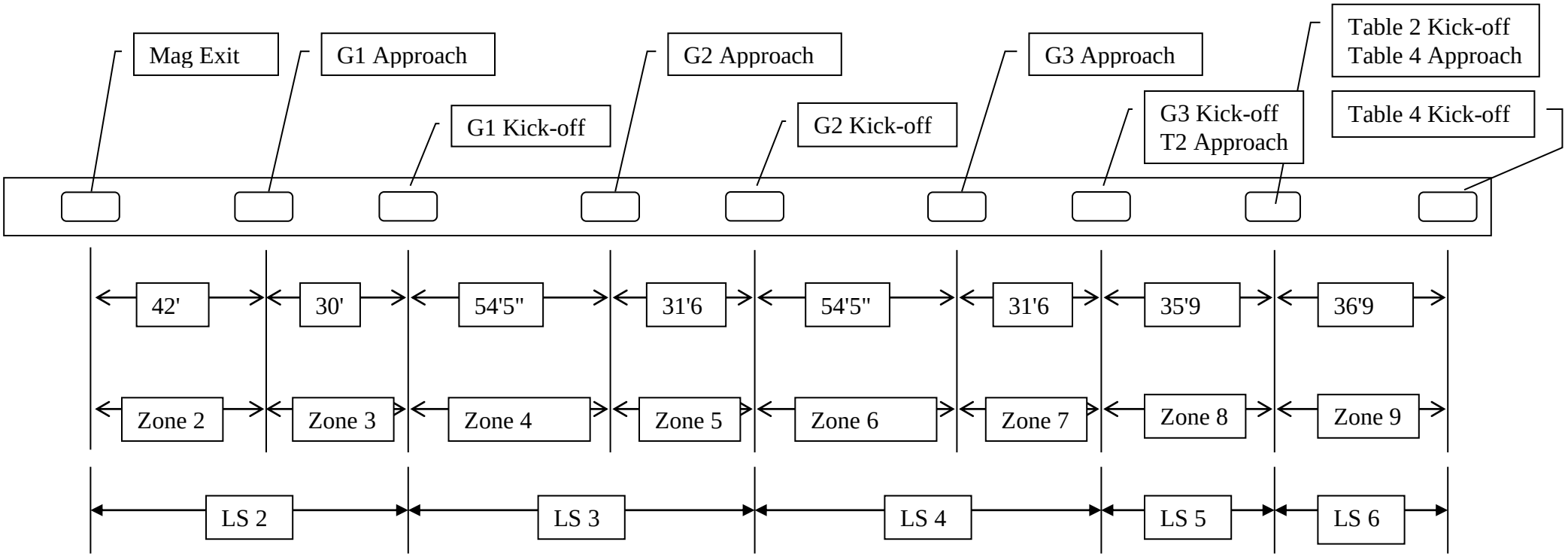
Billet Inventory

	6" Bar Mill	4" Bar Mill	4" Rod Mill	Total
Bloom Mill:	705.	0.	0.	705.
Cond:	45.	0.	831.	876.

Total:	750.	0.	831.	1581.

Report produced on 03-MAY-2001 07:00:

21. Diagram of Roller Line



Notes:
Zone > The process systems software tracking zones.
Zone 1 is under the magnaflux.
LS > Electrical Line Section
Line Section 1 is under the magnaflux

22. I/O points for current system

22.1. Interrupts

- Mag
  - Billet release — Operator initiated billet release. Also software initiated.
  - Ready to Cycle ON — The magnaflux process is complete.
  - Ready to Cycle OFF — The magnaflux process is NOT complete.
  - Magnaflux tables Running — Line under magnaflux is running.
  - Magnaflux Tables Stopped — line under magnaflux is stopped.
  - Main Insp P.B. Matrix — Centre magnaflux markers panel activated.
  - Main Insp Vote Matrix — Centre magnaflux markers vote station active. X3
  - Run Mode Comp ON — Computer is in RUN mode
  - Run Mode Comp OFF — Computer is switched out of process
- Grinder
  - Stop Block UP — Stop block upper limit made.
  - Kick Off UP — Kick-off upper limit made.
  - Billet on Car — The process of placing a billet on grinder car has completed.
  - Table Above Horiz — Grinder table above horizontal limit made (billet discharge)
  - Last Billet Marked — Last billet from magnaflux has been marked
  - P. B. Matrix — Operators panel active
  - Tables 1 - 5 Stopped — Roller line at this section stopped. Grinder 1
  - Tables 6 -10 Stopped — Grinder 2
  - Tables 11-15 Stopped — Grinder 3
  - Tables 16-17 Stopped — Table2
  - Tables 18-19 Stopped — Table 4
- Miscellaneous
  - A/C Low Voltage — Power supply low
  - Table Stop Elect to close — Mill electric's have detected a problem
  - Comp Room Over Temp — Room to hot. Activate shutdown timer
  - Comp Shut Down Bypass — Shut down timer in bypass mode
- Table
  - Kick Off UP — Kick-off upper limit made.
  - P. B. Matrix — Operators panel active

- Safety Arms UP — Upper limit made
- Safety Arms Down — Lower limit made

22.2. Digital Sense

- Magnaflux
  - Inspector Prime — Operators vote *3 operators
  - Grind
  - Reclass
  - Scrap
  -
  - panel PB # 1 — Operators panel active
  - panel PB # 2
  - panel PB # 4
  - panel PB # 8
- Grinder
  - panel PB # 1 — Operators panel active. Panel driver determines button.
  - panel PB # 2
  - panel PB # 4
  - panel PB # 8
  - Table almost full — Table is almost full, stop discharge.
  - Table empty — Table is empty and may be reused.
  - Discharge in Process — Grinder discharging billet
  - Hydraulics ON
  - Billet to close
  - Table
  - panel PB # 1 — Operators panel active. Panel driver determines button.
  - panel PB # 2
  - panel PB # 4
  - panel PB # 8
  - hydraulics ON
  - Table almost full — Table is almost full, assign no more billets.
  - Table Empty — Table is empty and may be reused.
  - Billet to close
  - Miscellaneous
  - Emergency Stop — Emergency stop activated at Magnaflux.
  - Emergency Stop — (manually operated position) MOP
  - Emergency Stop — Tables
  - Thumbwheels 1 — Least significant digit

- Thumbwheels 2
- Thumbwheels 4
- Thumbwheels 8
- Thumbwheels 10
- Thumbwheels 20
- Thumbwheels 40
- Thumbwheels 80
- Thumbwheels 100
- Thumbwheels 200
- Thumbwheels 400
- Thumbwheels 800

Most significant digit

Note: All Thumbwheels read through same points

22.3. Output

- Magnaflux
  - Strobe Thumb Whee1 — Voltage on before read
  - Release PB red — No release from mag
  - Rel PB green — Turn green Ok to release
  - Billet release enable — Process system OK to release
  - Inspector — Prime — Acknowledge operators vote *3
  - Grind
  - Reclass
  - Scrap
  - Magnaflux Last Billet — Acknowledge or activate last billet.
  - Magnaflux Count Check — Acknowledge or activate count check.
  - Magnaglo available — Magnaflux is available to process system.
  - Magnaglo down — Magnaflux is unavailable to process system.
  - Clear zone table — Acknowledge operators request to clear zone tables
  - Operator delay — Indicate and acknowledge delay in progress
  - Magnaflux Electrical delay — Operator will press appropriate button
  - Magnaflux Mechanical delay
  - Delay correct — Acknowledge request for (previous) delay correct.
  - Computer on — Useless (the operators know first)
  - Message acknowledge — Acknowledge operators acknowledge of active message acknowledge.
  - Conveyor restart — Respond to operators request to check conveyor. (Note: No Acknowledge)

- Grinder *3
  - Strobe Thumb Wheel — Voltage on before read.
  - Operator selects — Prime Respond to operators selection
  - Grind
  - Reclass
  - Scrap
  - Grinder Available — Operator has made grinder available to process system.
  - Grinder Down — Operator has made grinder is unavailable to process system.
  - Count Correct — Operator requested count correct
  - Delay — Operator — Process system has initiated delay, operator

- Electrical — responds by pressing appropriate button
- Mechanic
- Delay Correct — Operator has requested delay correct
- Computer On
- Message Acknowledge — Acknowledge operators acknowledge of active message acknowledge.
- Last Billet — System has detected last billet, or operator has initiated last billet function.
- Count Check — Acknowledge or activate count check
- Comp Selection Made — Allows table over horizontal
- Kick-off Enable — Raise stop block and arm kick-off.
- Grinder Mark Last Billet — Light mark last billet, mess ack and stop release.

- Tables *2
  - Strobe thumbwheel — Voltage on before read
  - Table Prime — Indicate on operators panel and annunciator board that table is assigned to this type.
    - Grind
    - Reclass
    - Scrap
  - Clear table — Indicates or respond to request to clear table
  - Computer On
  - Message acknowledge — Acknowledge operators acknowledge of active Message acknowledge.
  - Conveyor restart — Respond to operators request to check conveyor.
  - Kick Off Enable — Raise stop block and arm kick-off.
  - Miscellaneous
  - Server power interlock — Cycle power to force servers to start clear (boot procedure)
  - Tables Enable — Process system permissive to start/stop roller line
  - Lost Billet Alarm — Process system has detected a lost/unknown billet
    (Does not work - - kept waking operator up)

23. Alternatives and Suggestions

NOTE: Most of these suggestions are not mine. They have been discussed by many for many years. The suggestions also presume a reconfiguration of the mill for 34-ft billets.

- ***Magnaflux***
  - The need for 3 markers and an unscrambler has been questionable for years. There are a number of solutions both high and low tech.
    - Automatic sensing and marking of defects.
    - Camera and controls to allow unscrambler functions to be provided/controlled by the magnaflux markers.
    - One marker on a motorised/track chair/platform.
    - Combine markers and grinder operators. Six jobs to five and use based on quality of steel.

- ***Grinders***
  - Investigate the availability of automated "In Line" grinder units.

- ***Table operator.***
  - If a grinder is re-established south of the tables combine the table operators and grinders job.

- ***General***
  - If the number of grinders are reduced to two, configure two units of a grinder and an end table (so the grind from a sequence is delivered to the grinder and the prime is delivered to its prime table. The operator looking after both).

  - Take a hard look at billet dimensions. The magnaflux will accept a billet up to 31' 6". A 6.2 x 6.2 x 31'6" weighs 4116 lb.

24. Glossary

3 B&B	Number 3 Bloom and Billet Mill. The mill that rolls blooms to billets.
Audit	A small portion of a heat. The "Audit" is brought into Conditioning for evaluation.
Auto/Manual Mode	Computer system is switched out of the process. Used for testing and the clearing of problems on the line. Also see Computer Mode.
Bed	Billets from the roller line kick off onto the grinder bed. Grinders discharge ground billets onto the grinder table. Operating use the term table and bed interchangeably.
Billet	A 4-6in. bar of steel about 30ft long. Operating use billet and bar interchangeably.
Billet-On-Car	Term to describe that the process of moving a billet across the grinder bed, into the crotch, up to the tilt arms and onto the grinder car is complete
Block	A pneumatically controlled disappearing stop block. There are 4 in the roller line.
Buggy	Transfer car. Brings in billets from #3 B&B.
Charge	When billets are pulled into (chain drive) the magnaflux they are lifted, washed with a solution of water and magnaflux powder and charged with 1500-2000 amps.
Clear Zone Tables	The operating process of telling the process system that they have cleared all billets from the roller line.
Computer Mode.	The normal mode of operation. The computer is switched into the process. Also see Auto/Manual mode.
Conditioning Level	A requirement for charge (amperage) level that determines the defects that the Magnaflux process will reveal
Co-ordinator	Job title. The individual that receives billets and lines up sequences for the Magnaflux.
Count Check	The operators are indicating that they intend to go over the selected or computer count of billets.
Current Sequence	When referring to a grinder this is the sequence that is being ground. Also see Next and Present Sequence.

Destination	Magnaflux - - the unit that a billet has been assigned to. General - - the next mill destination (i.e. Bar Mill, #2 Rod Mill)
Direct Grind	Operating procedure and terminology for placing billets on to a grinder with a crane. The material may have been previously magnafluxed or may just require visual inspection and defect removal by the operator.
Ferris Wheel	The large shaft and wheels in the magnaflux. The operators can see two sides of each billet in each position. In the top position they mark top and face, when the wheel turns they see the other two surfaces.
Final Sequence Log	Hard copy of all processing, events etc. that apply to the sequence.
GRD	Operating terminology for the process of entering a grinder delivery rotation. Also see grinder rotation.
GRIND	A billet that requires grinding to remove unacceptable defects. Most of these "GRIND" will become "PRIME" after grinding. Also see Prime, Reclass and Scrap
Grinder UP/Down	Grinder is or is not available to receive billets from the roller line.
Grinder Rotation	The order that the grinders will be used in and the number of billets within the order. i.e. 0 0 12 - - 0 12 12 - will send 12 to #3 first then 12 to #2, then 12 to #3. Entered by foreman or calculated by process system.
In Process Sequence "In process"	The sequence that is currently being processed at the magnaflux.
Ingot	Old terminology for a small lot. (An ingot use to be about 32 billets)
Kick-Off	A series of hydraulically operated arms under the roller line that lift or kick-off a billet on to a grinder or table.
Last Billet	Magnaflux. The process of identifying and tracking the last billet(s) on the in Process Sequence and the updating of the selected sequences. Grinder The process of separating and updating the sequences at a grinder when the current sequence is complete.
Line-Up	A priority list provided by Production Planning
Magnaflux Magnaglo Mag	The defect inspection machine.
Mag Sequence	The sequence that is "in process" at the magnaflux.
Mark Last Billet "Mark Last"	The request to and the operators procedure for identifying the last billet of the current magnaflux sequence on the grinder.

Message Acknowledge	A button on each panel that stops the process at the unit when the process system has displayed an information message on the operators screen.
Met Hold	An indicator in the process system that prevents the material from being processed.
MOP	Manually Operated Position. Seldom used. Allows, with additional personnel the roller line, blocks etc to be operated manually.
Next Sequence	When referring to a grinder this is the sequence that is the middle sequence. Also see Current and Present Sequence
Present Sequence	When referring to a grinder this is the sequence that is being delivered from the magnaflux. Also see Current and Next Sequence
PRIME	Magnaflux - - A billet that has no or an acceptable level of defects. Grinders - - A billet (Grind) that has had defects removed and now meets the requirements of Prime. Also see Grind, Reclass and Scrap
Prime Tables	The end tables. Operating refer to these tables as Prime Tables, in reality they can also receive Grind, Reclass or Scrap.
Ready-To-Cycle	The magnaflux has completed it's charging and loading cycle and is ready to release a billet onto the roller line.
RECLASS	A billet that has defects that can not be removed and is to be RECLASSED to another grade classification. Also see Prime, Grind, and Scrap
Remag	Billets that, for operating reasons (problem with charge?) must be processed again.
Reprocess	Material that, for quality or metallurgical reasons must be processed again
Safety Arms	Located at the tables. Physical steel arms that prevent a billet from kicking off on to the tables.
SCRAP	A billet that due to defects or length is of no use. Also see Prime. Grind and Reclass
SELECT	Operating's procedure for selecting or lining up the in process or following sequences at the magnaflux.
Sequence Seq	A heat or part of a heat.
SQV	Surface Quality Value. A metallurgical determination of the overall quality. Not part of the process system.

Stop-Block	A disappearing stop in the roller line. When up stops billet at requested location.
Table (End)	Billets that are not going to a grinder (Bed) will go to the End Tables.
Table (Grinders)	Billets that have been ground are discharged onto the grinder table. Billets from the roller line kick off onto the grinder bed. Operating use the term table and bed interchangeably.
Table Almost Full	Indicates that the TABLE cannot receive any additional billets.
Table Empty	There is no steel on the table. It can be used and/or reassigned as required.
To Process	Material that is in inventory that has not been or requires additional processing.
Zone Tables	Divisions of the roller line within the process system.

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