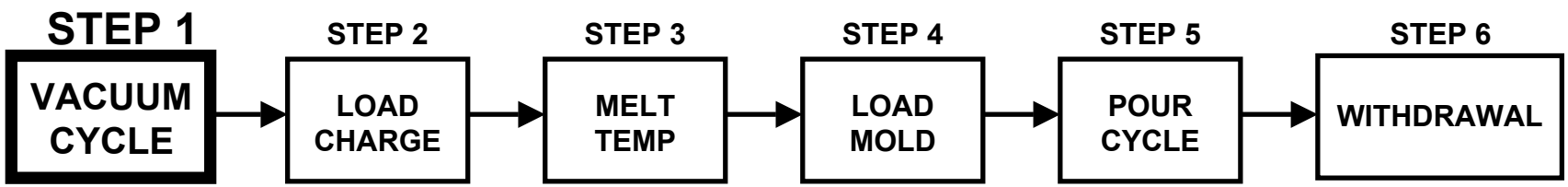
The Equiax Process: Vacuum Cycle Step



Vacuum System Quiz I

- What Does the Melt Vacuum Pump Do?
- What Does the Mold Vacuum Pump Do?
- Where are Vent Valves Located and What is Their Purpose ?
- What is the Diffusion Pump & What Does it Do?

Vacuum System Quiz II

- Where is the Poppet Valve and What Does it Do?
- Where is the Load Valve & What Does it Do?
- What Does the Flapper Valve Do?

Vacuum System Concepts I

- Roughing and the Roughing Valve
- The Foreline and the Foreline Valve
- Low Vacuum
- High Vacuum

Vacuum System Concepts II

- Valve Open/Close Requests
- Pirani Gauges
- The Penning Gauge
- Vacuum Setpoints
  - Vacuum Setpoint I
  - Vacuum Setpoint II

Vacuum Map Screen on the Operator's Console

Valve OPENED

Valve CLOSED

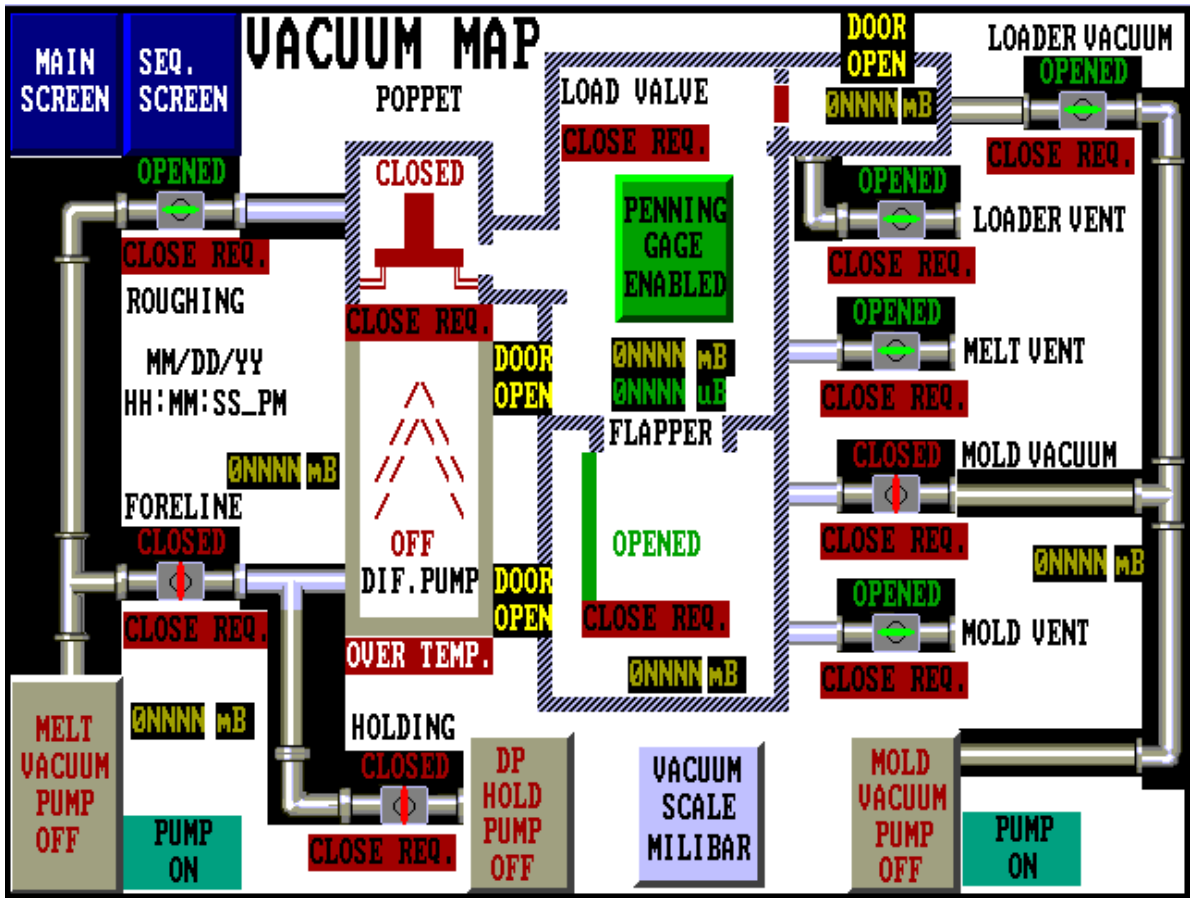
Pending request for valve state

Pressure in millibar (Pirani gauge)

Pressure in microbar (Penning gauge)

Bar Feeder, Melt Chamber or Mold Chamber door state

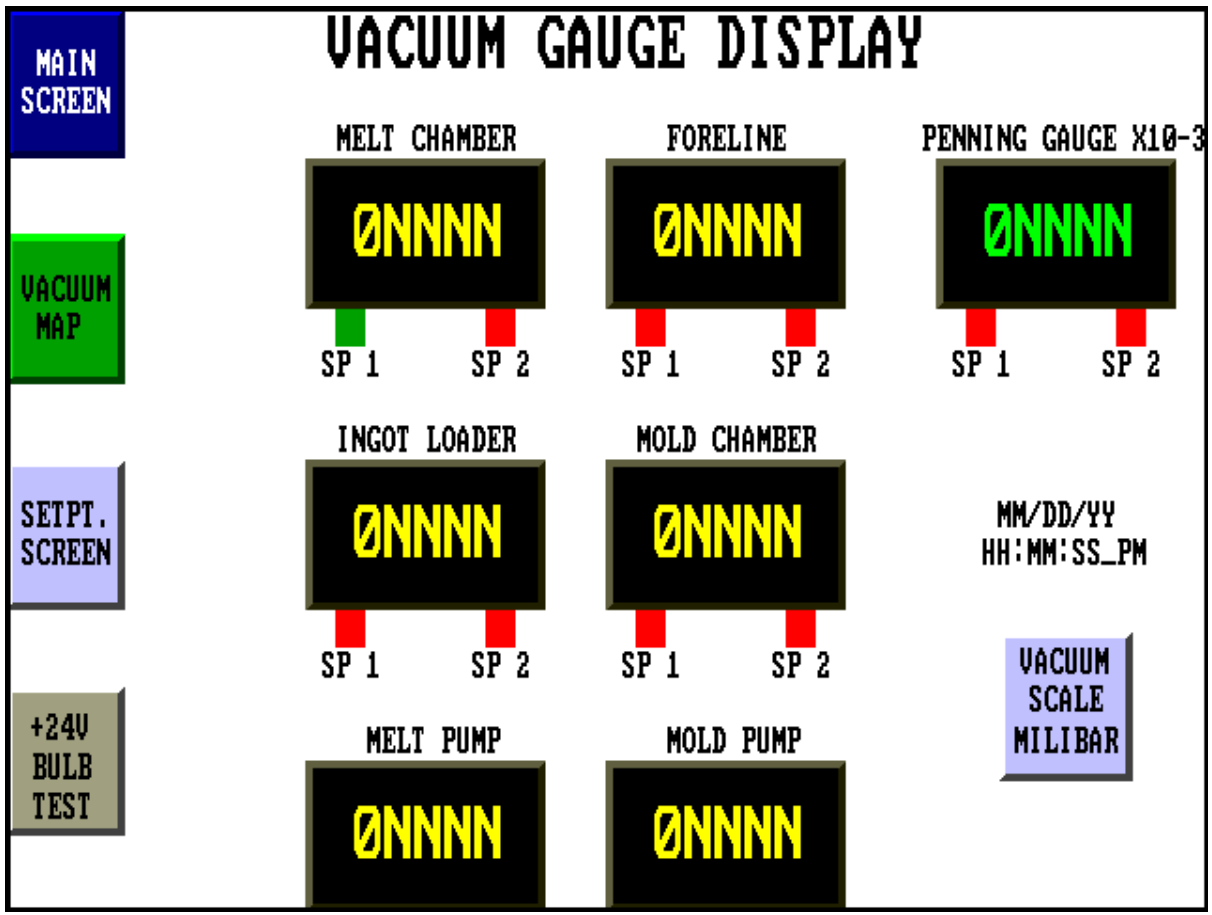
Current state of Melt or Mold Vacuum Pump. Can be any of the following:
PUMP ON: Vacuum Pump is on.
PUMP OFF: Vacuum Pump is off.
OT WARNING: Vacuum Pump is hotter than normal.
PUMP OVERTEMP: Vacuum Pump has overheated and been shut off. It cannot be started until it is cool.



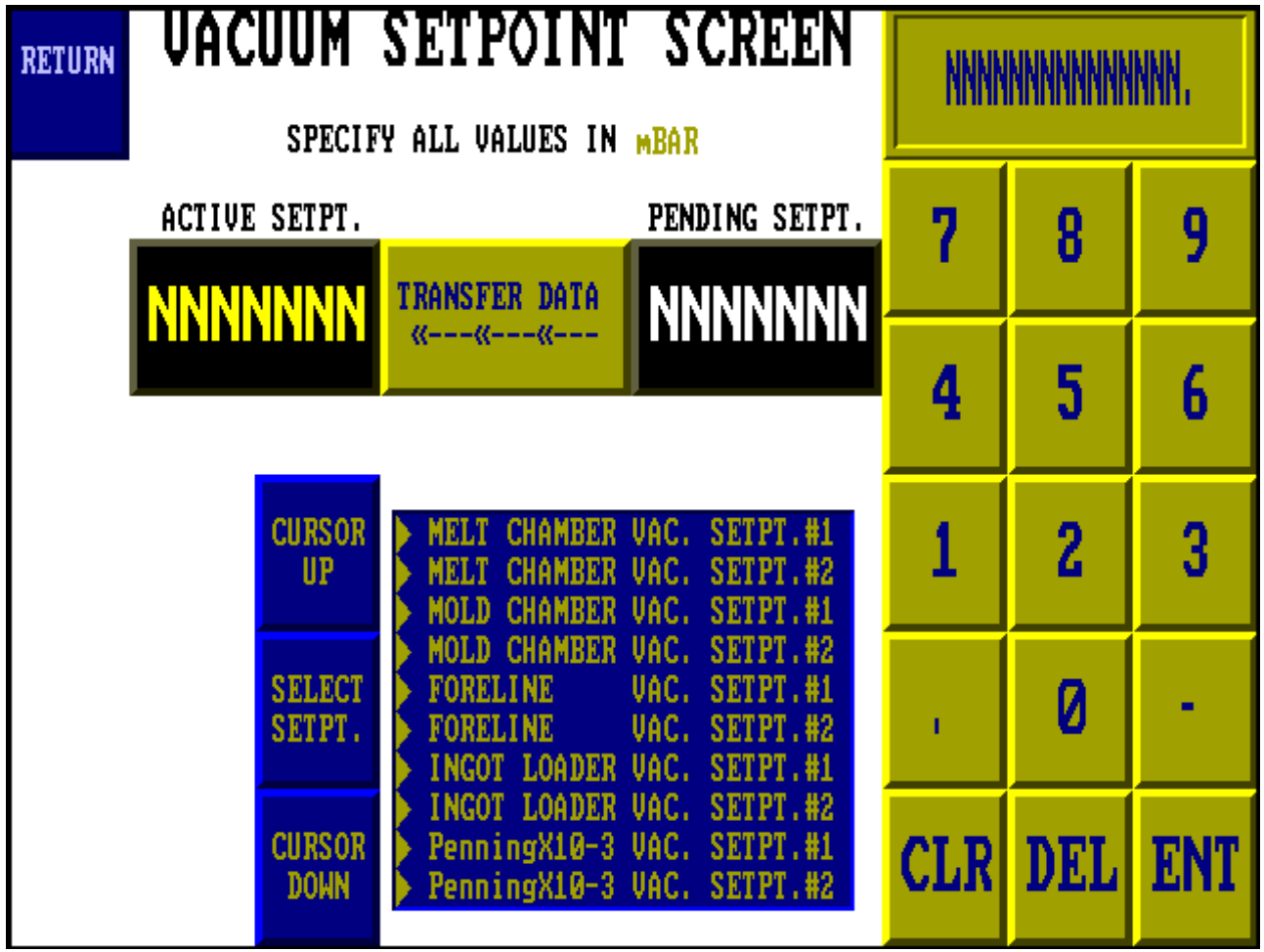
Vacuum Gauge Display on the Operator's Console

SP 1 — Vacuum setpoint one has been reached.

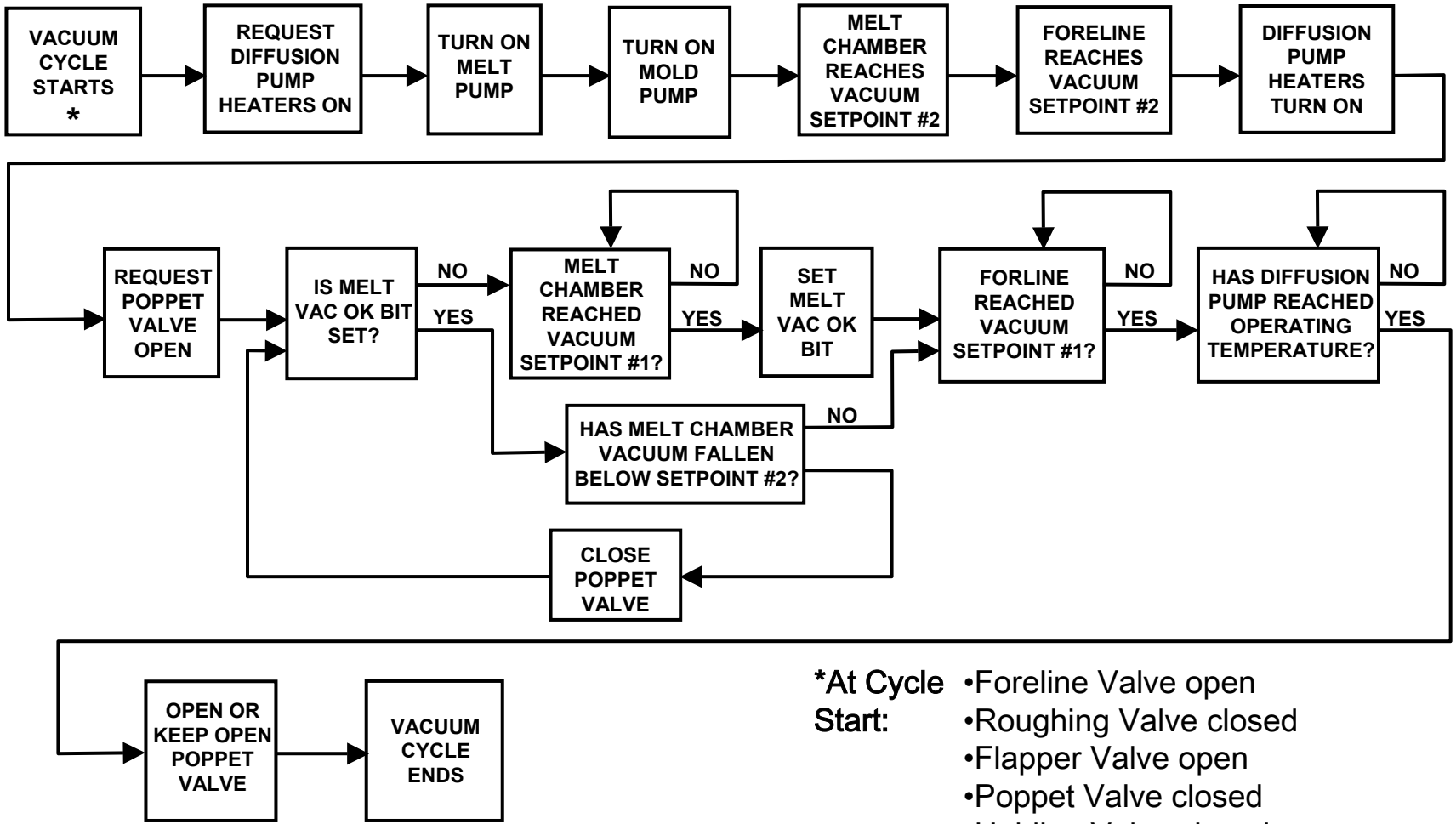
SP 1 — Vacuum setpoint one has not been reached.



Vacuum Setpoint Screen on the Operator's Console



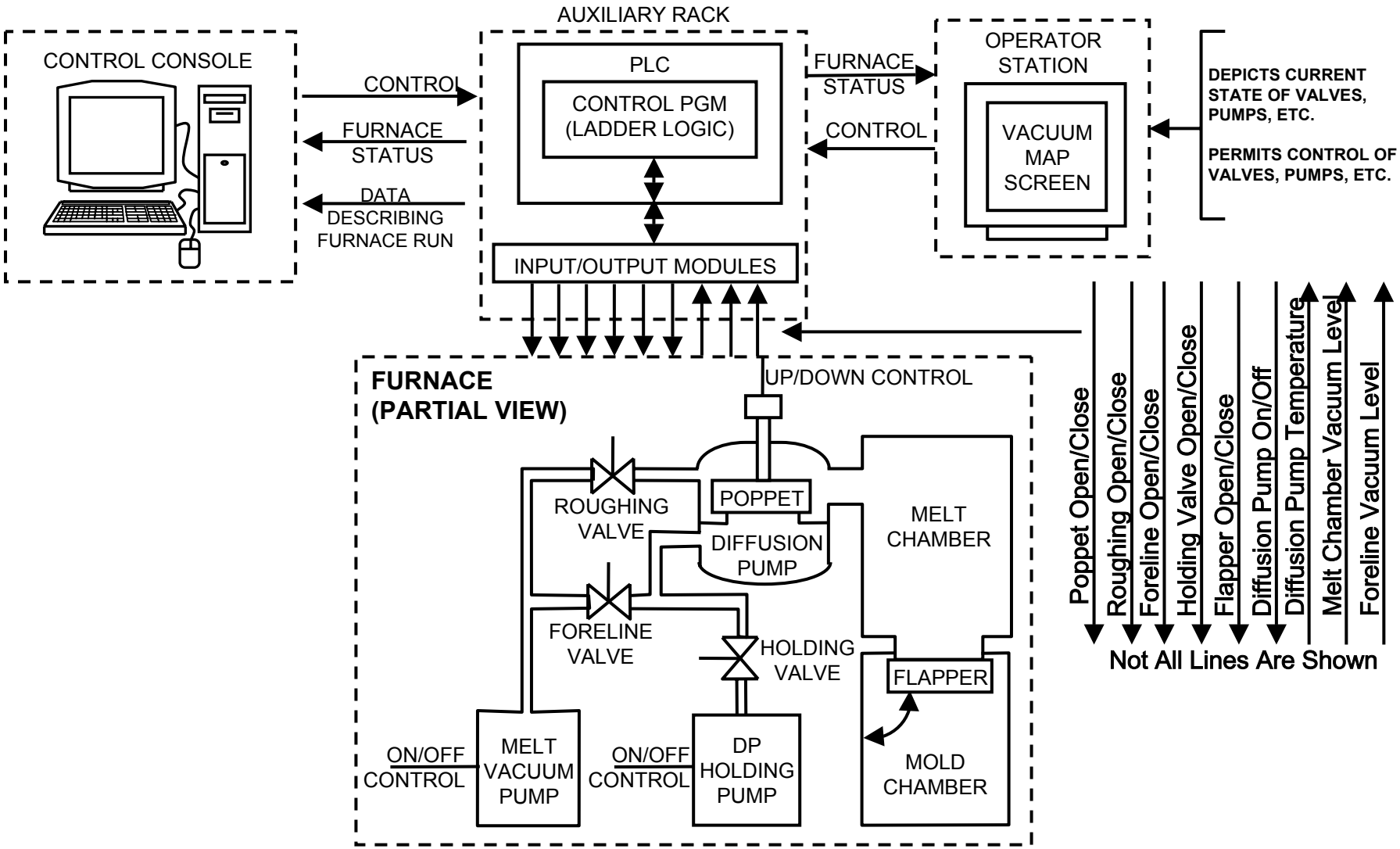
Anatomy of a Vacuum Sub-Cycle



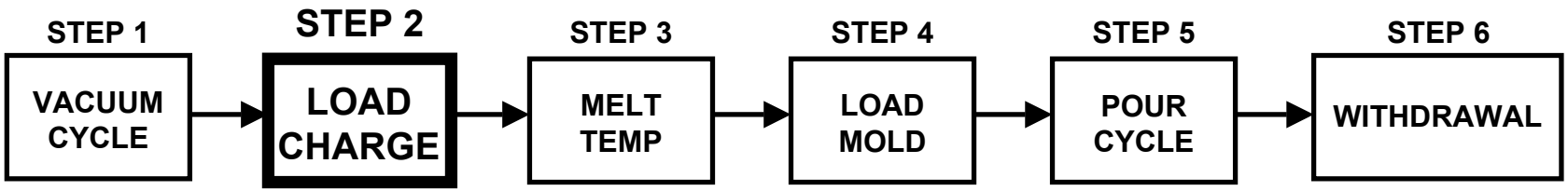
*At Cycle Start:

- Foreline Valve open
- Roughing Valve closed
- Flapper Valve open
- Poppet Valve closed
- Holding Valve closed
- Melt Chamber Door closed
- Mold Chamber Door closed
- Diffusion Pump off

Furnace Control During a Vacuum Sub-Cycle



The Equiax Process: The Load Charge Step



Charge Loading Quiz I

- What Does the Sliding Scoop Do & in What Mode is it Used?
- What Does the Rotating Spoon Do & in What Mode is it Used?
- What Does the Bar Feeder Pendant Do ?

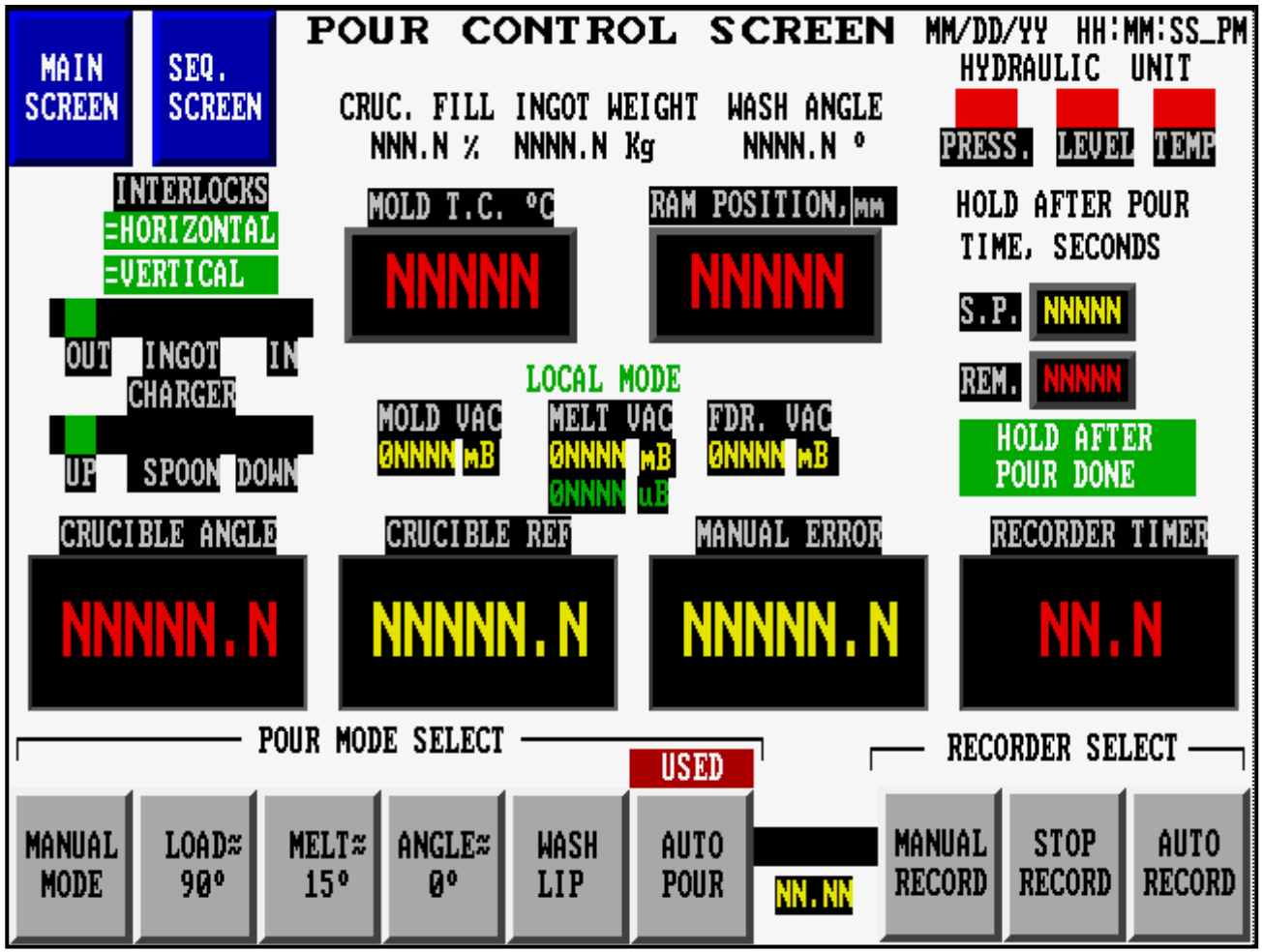
Charge Loading Quiz II

- What is the Bottle Brush and How is it Used?
- The Bar Feeder Extends Until . . . ?
- The Bar Feeder Pendant Buttons are Active in What Furnace Mode?

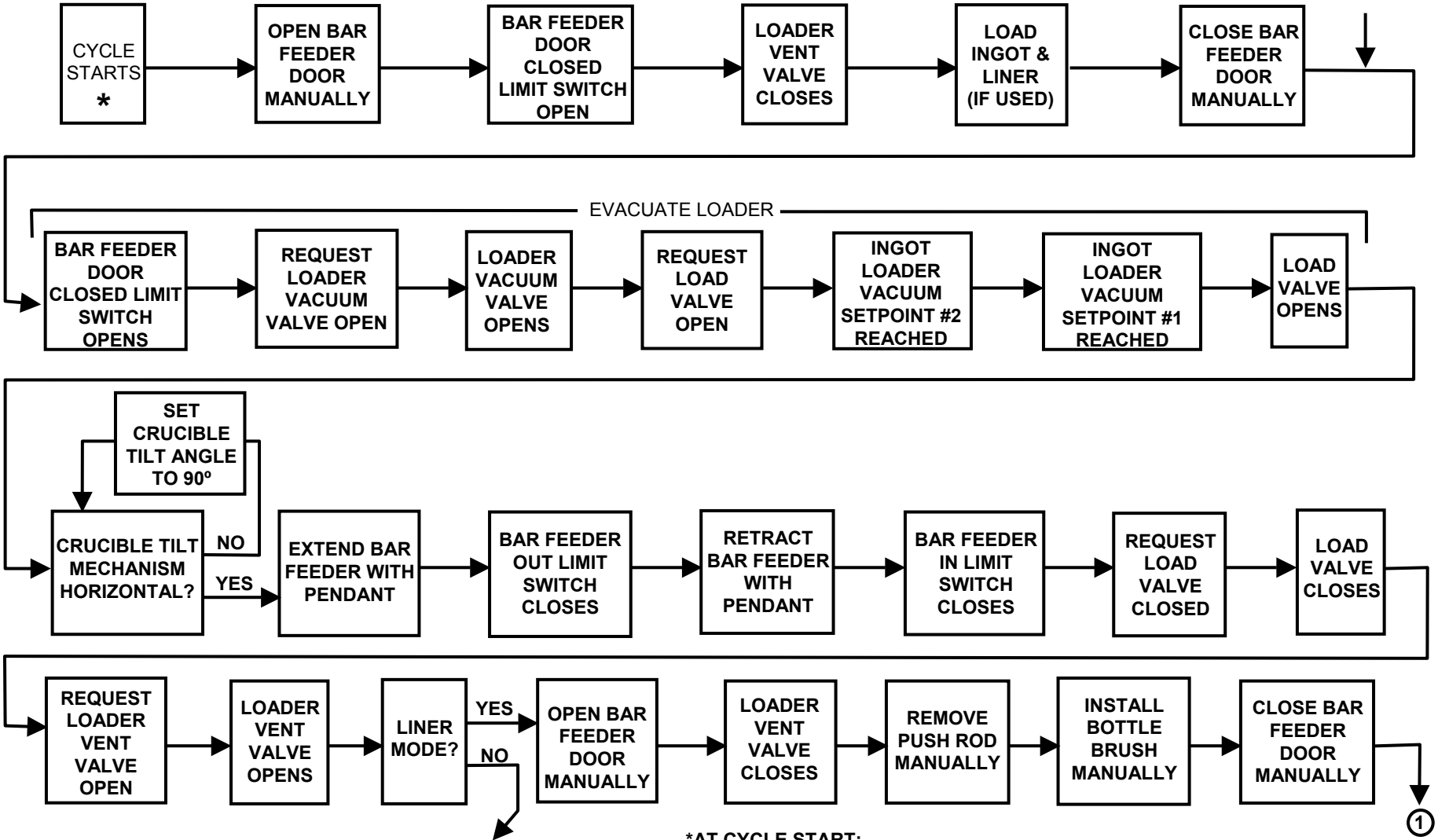
Charge Loading Concepts

- Interlocks and Bar Feeder Extension
- Interlocks and Crucible Tilt Rotation
- Interlocks and Load Valve Opening

Pour Control Screen on the Operator's Console



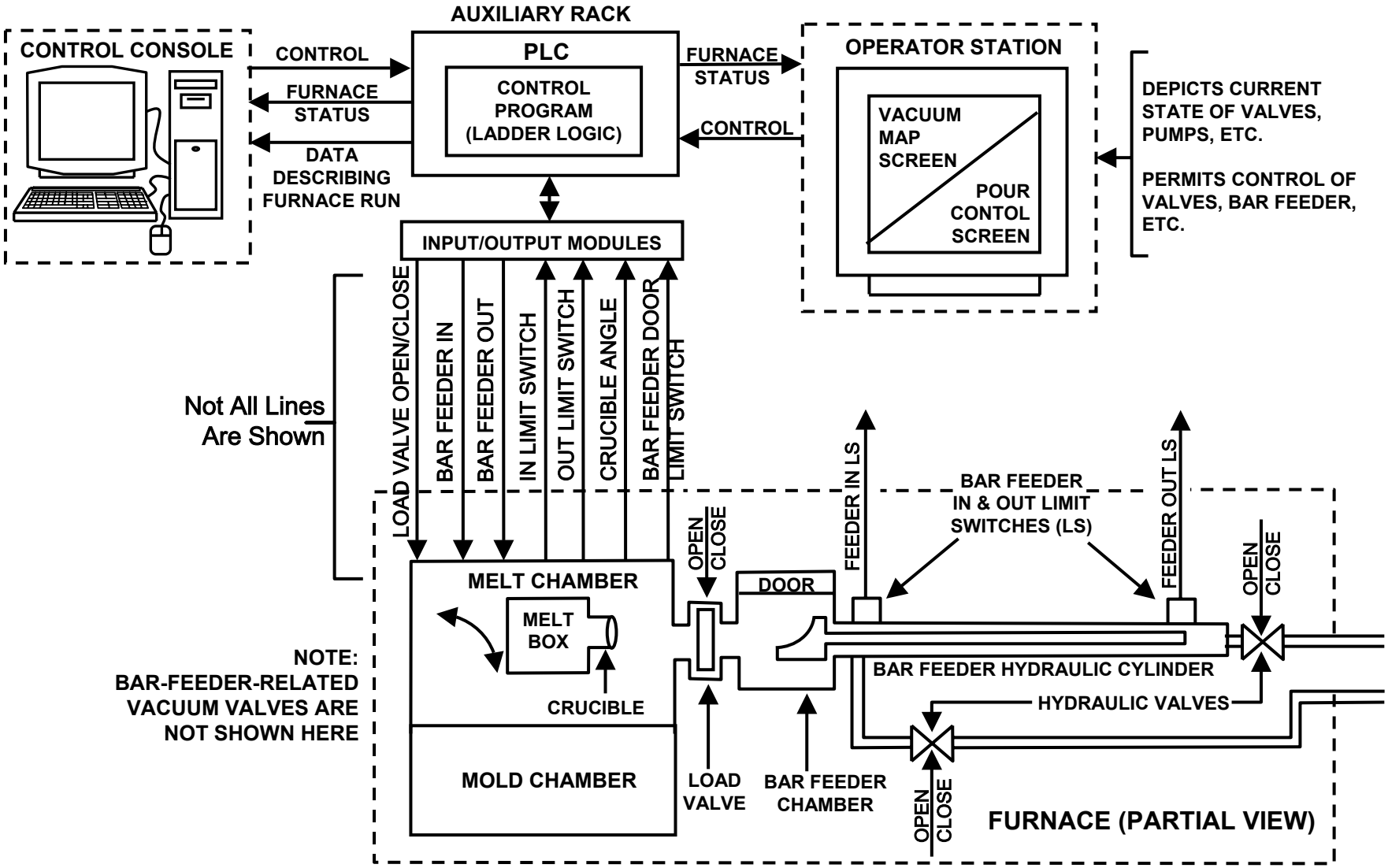
Anatomy of a Load Charge Sub-Cycle



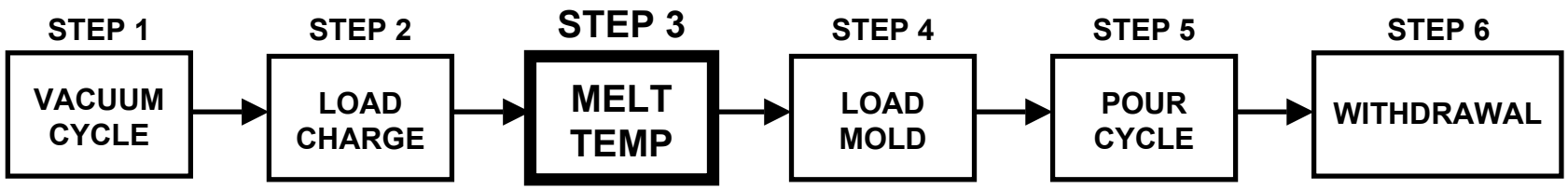
NOTE:
FLOW DIAGRAM ABOVE ASSUMES FURNACE IN LINER-MODE

*AT CYCLE START:
- BAR FEEDER CHAMBER VENTED TO ATMOSPHERE
- SLIDING SPOON AND PUSH ROD INSTALLED ON BAR FEEDER

Overview of Furnace Control During a Load Charge Sub-Cycle



The Equiax Process: The Melt Temp Step



Melt Step Concepts I

- Closed Loop Temperature Control
  - PLC Controls Alloy Temp Automatically by Controlling Melt Power Supply Output
  - Alloy Temp Feedback from Optical Pyrometer Required for Operation
- Profile Mode
  - Melt PS Output Set by Predefined Profile of Power Versus Time
  - Used During Melting as No Alloy Temperature Feedback Available so no Closed Loop Control
  - Use VBPower to Create Profiles on Control Console

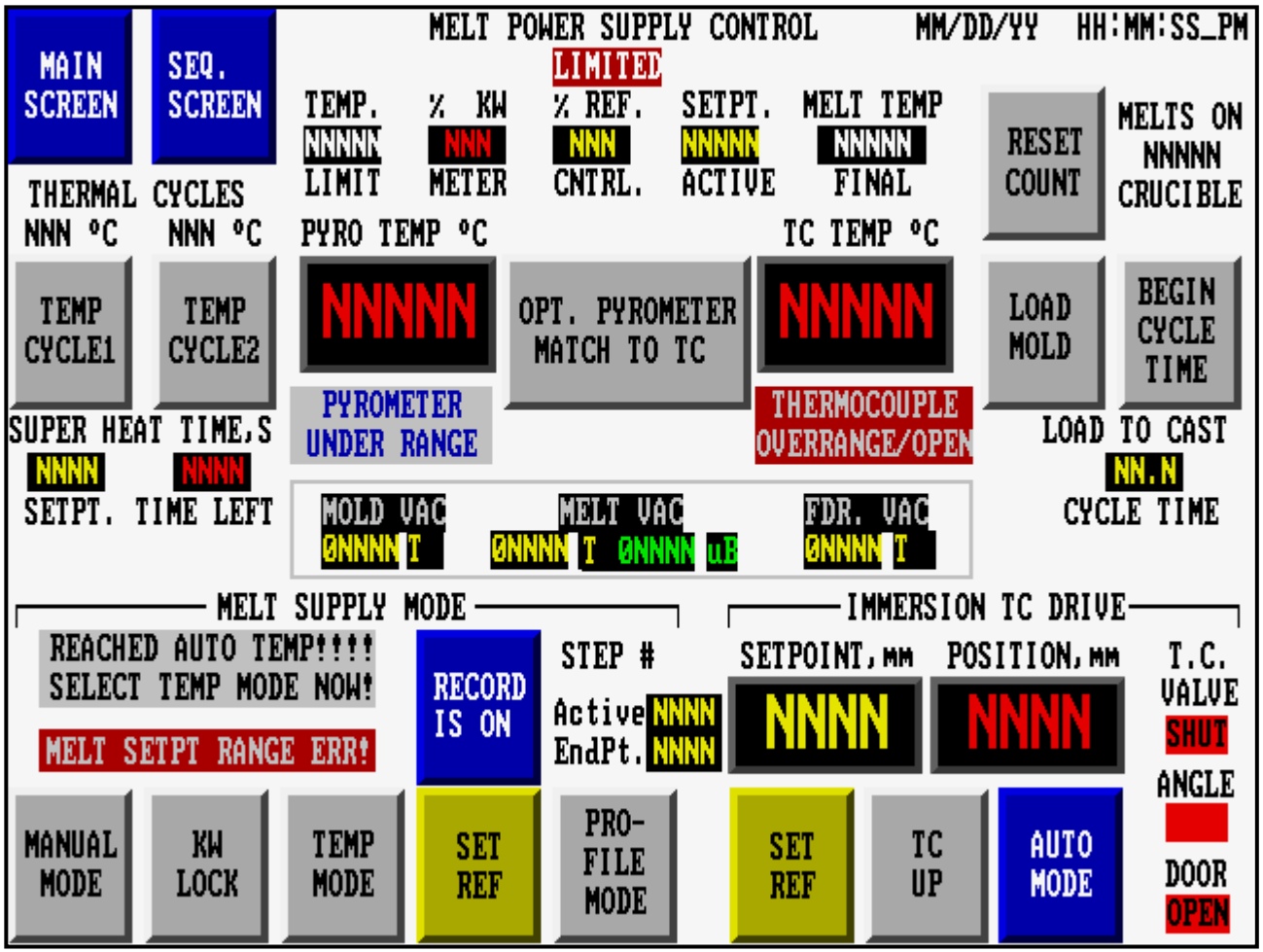
Melt Step Concepts II

- Super Heating Cycle
  - Raise Alloy Temp Above Casting Temperature, Hold for Predefined Time, Return to Casting Temperature
  - Zero to Three Permitted per Furnace Cycle
- OPT. MATCH TO PYROMETER Button
  - Add or Remove Offset to Pyrometer Output
  - Toggle Switch; Push Once for On, Again for Off

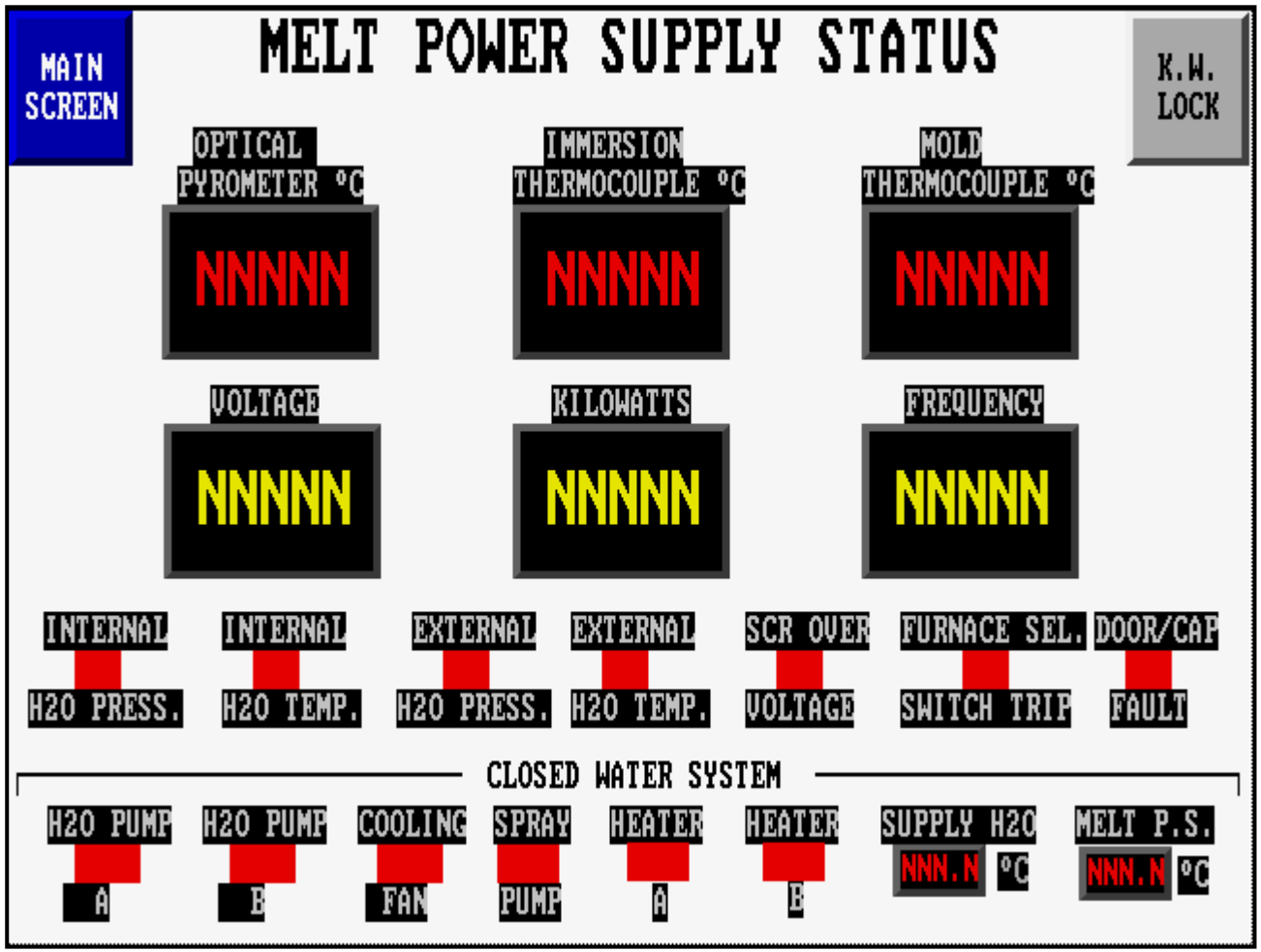
Melt Step Concepts III

- The Power Limit Potentiometer
  - Limit PS Output in Furnace Auto & Temp Modes
  - Set PS Output in Furnace Manual Mode
- LIMITED Indicator on Melt PS Control Screen
  - Illuminated When Melt Power Supply Output Throttled Due to Power Limit Potentiometer Setting
- KW Lock Temperature Mode
  - Hold Melt PS Output at Level Existing When Button Was Pushed

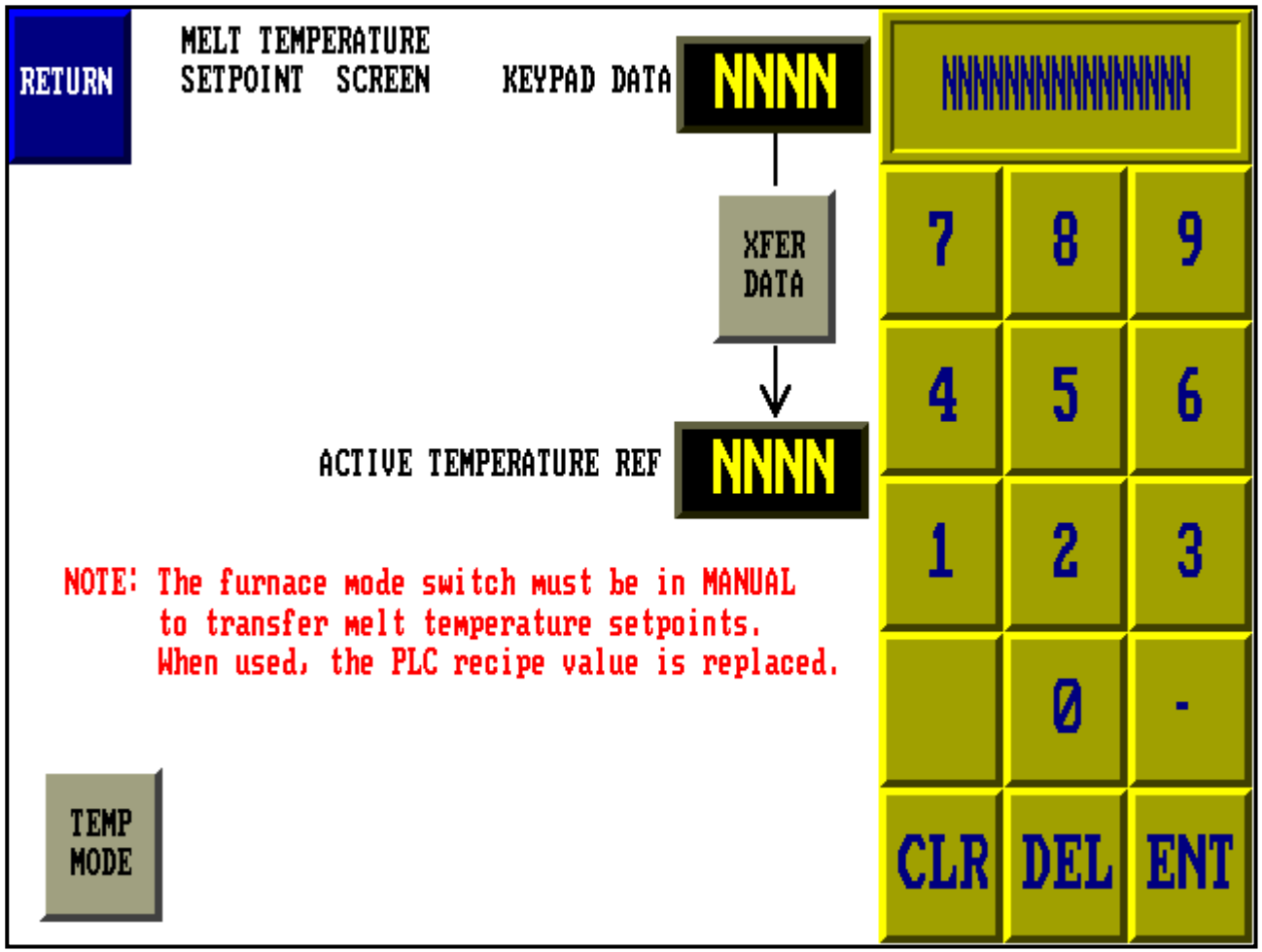
Melt Power Supply Control Screen on the Operator's Console



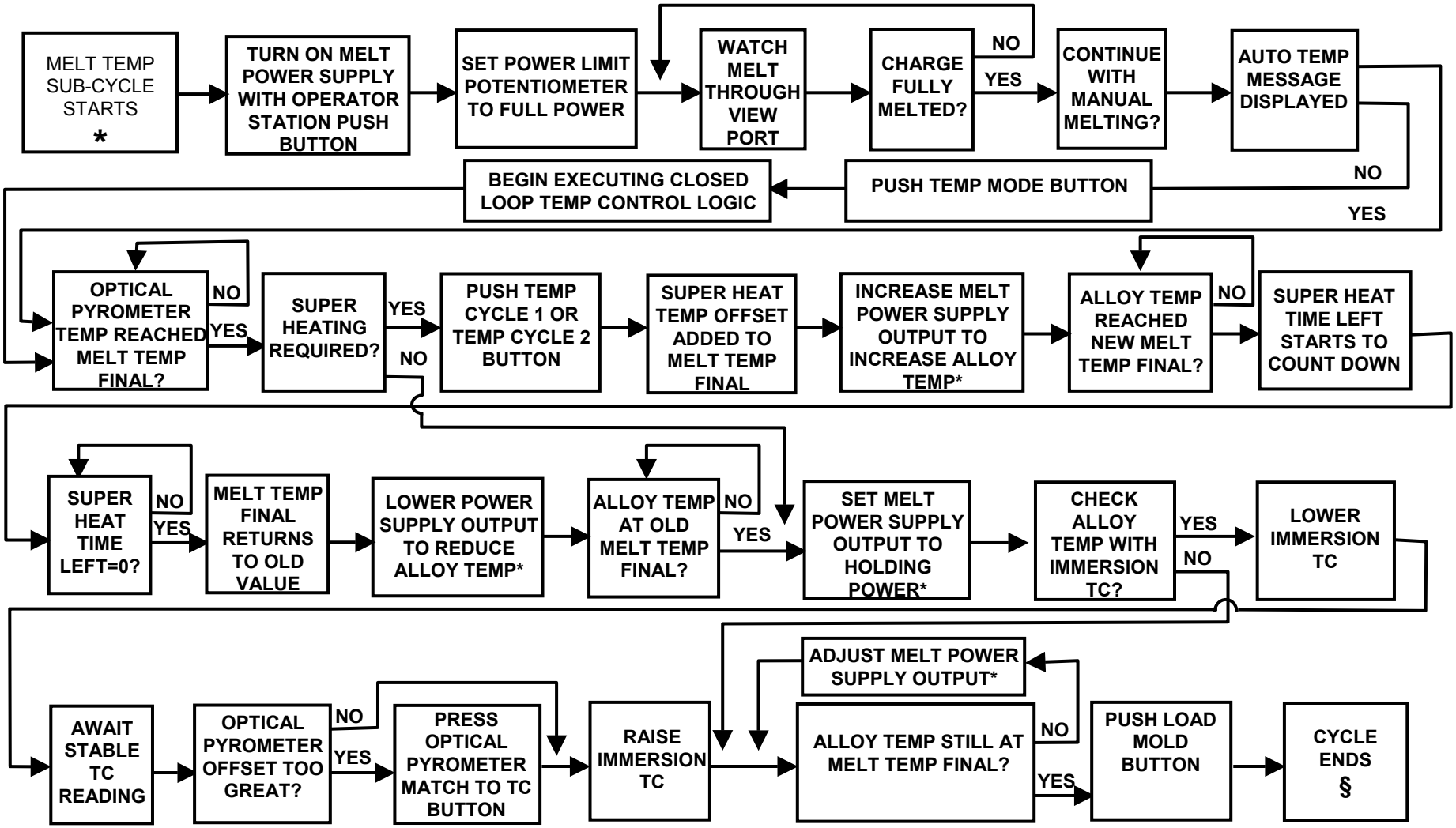
Melt Power Supply Status Screen on the Operator's Console



Melt Temperature Setpoint Screen on the Operator's Console



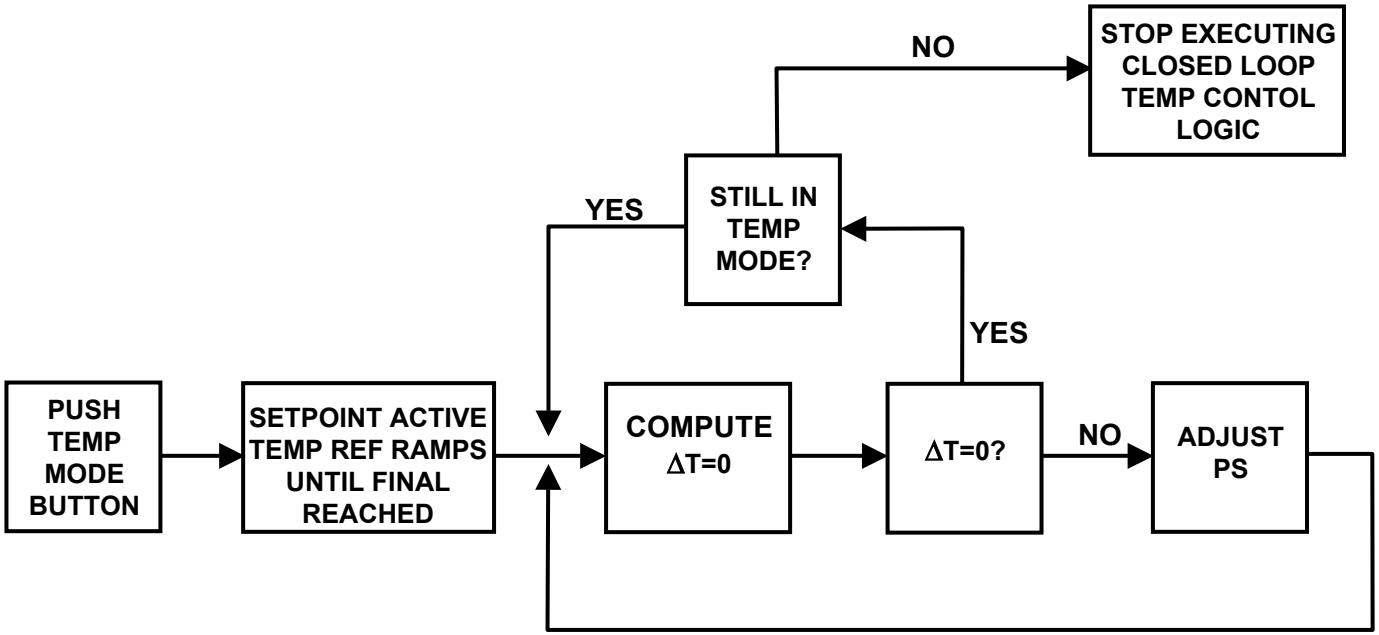
Anatomy of the Melt Temp Process Step

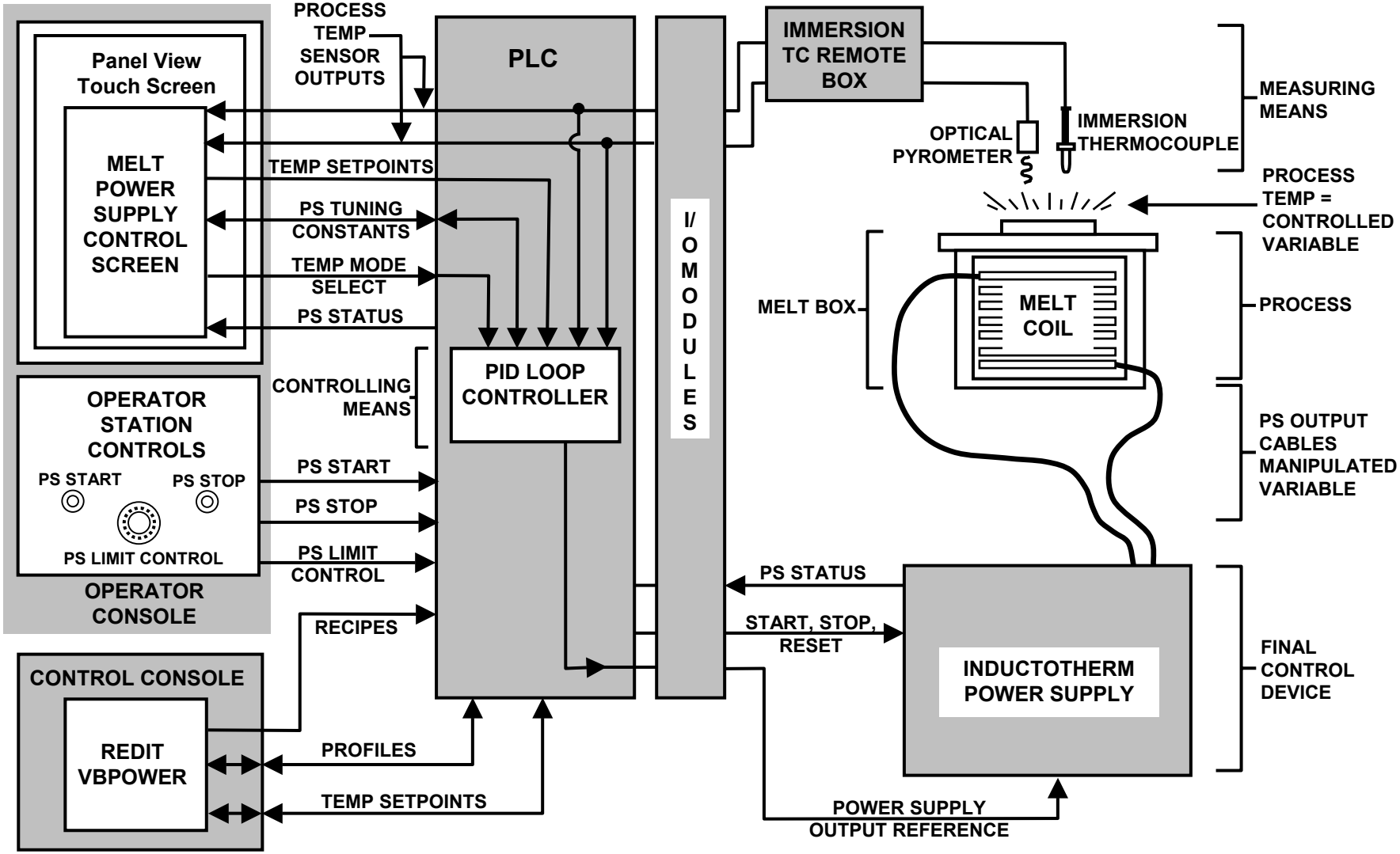


*THIS STEP DONE MANUALLY WITH POWER LIMIT POTENTIOMETER OUTSIDE TEMP MODE OR AUTOMATICALLY BY PLC IN TEMP MODE

§ IF STILL IN TEMP MODE WHEN MELT TEMP CYCLE ENDS, OPERATOR MUST EXPLICITLY DEPART THIS MODE JUST PRIOR TO POURING THE MOLTEN ALLOY INTO THE MOLD

Closed Loop Temperature Control Logic



NOTE: ONCE STARTED, THE STEPS OUTLINED ABOVE EXECUTE UNTIL THIS LOOP IS EXPLICITLY TERMINATED. EXECUTION CONTINUES EVEN WHILE OTHER TASKS ARE OCCURRING ON THE FURNACE UNDER PLC CONTROL.

Closed Loop Temperature Control Block Diagram