Operations Manual

UWM CSI - Vial Fill Test Bed
Connected Smart Manufacturing (CSM)
APT Manufacturing Solutions

September 16, 2020
Version 1.0

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1 Introduction

1.1 Scope and Purpose

UWM CSI Vial Filling Connected Smart Manufacturing (CSM) System

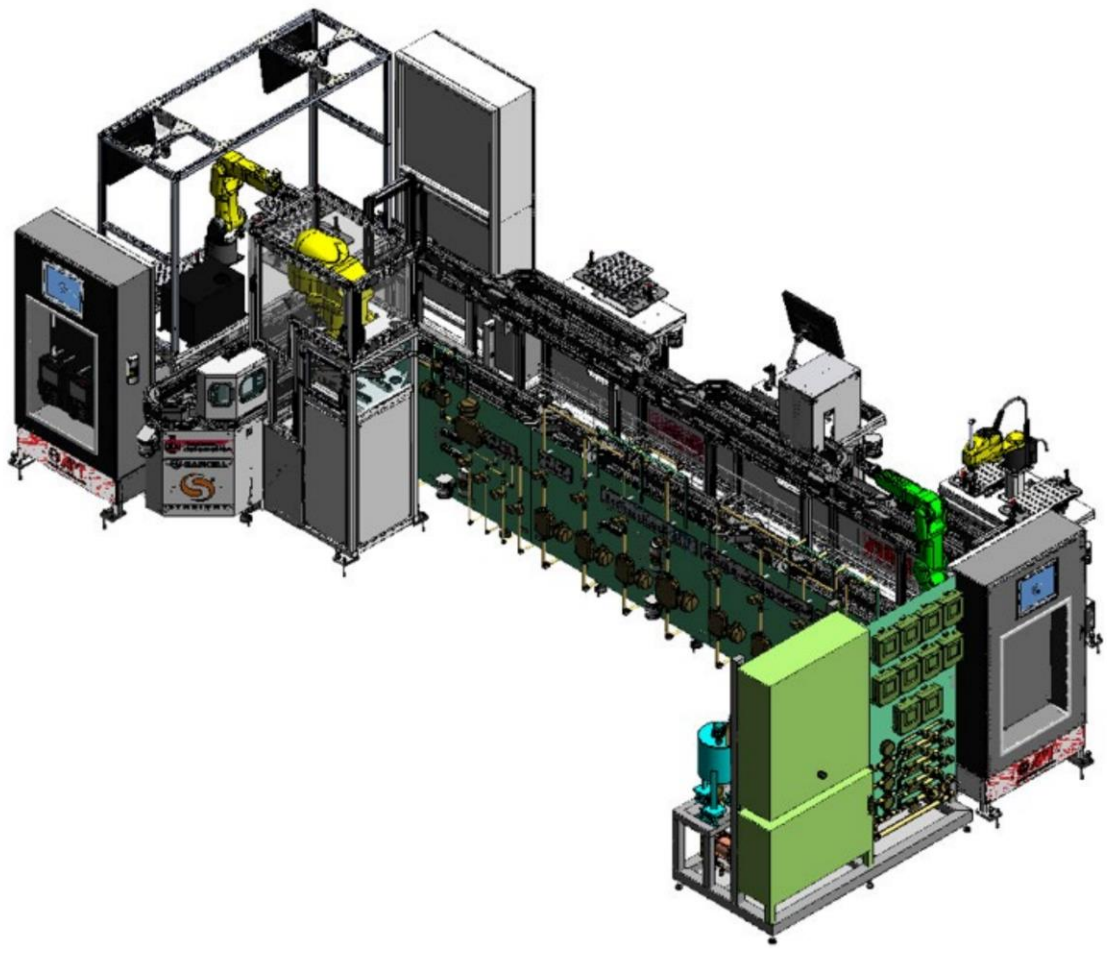

Figure 1-1 Vial Fill CSM System

The UWM CSI Vial Filling CSM System is an intelligent manufacturing system using the latest Industry 4.0 connected advanced manufacturing equipment and techniques to produce vials filled with varying product using a variety of filling methods and capturing process data that can be used for data analysis and system optimization.

The Vial Filling CSM System is a platform that university faculty and students will use for both education and research to further the advancement of a connected enterprise. The CAM components are integrated seamlessly within a fully integrated architecture and connected enterprise using cutting-edge smart-data devices at all layers.

The image (Figure 1-1) depicts a detailed 3D model of a Vial Fill CSM (Continuous Sterilization Module) System. This system is likely used in pharmaceutical manufacturing for the automated filling and sterilization of vials. The model includes various components such as robotic arms, conveyor belts, control panels, and other machinery parts essential for the vial filling process. The system appears to be designed for high efficiency and precision in a controlled environment, ensuring the sterility and accuracy of the vial filling operation.

1.2 Process Overview

The process overview detailed in this section describes in general how the Vial Filling Connected Smart Manufacturing system functions as a complete system processing component. Operational steps and slight variances in the process may differ from what is described here depending on the configuration parameters or using the stations in a dry cycle mode.

The Vial Filling CSM utilizes localized system configuration setting within the machine as well as process data requirements and parameters to determine how to process the product and which stations and inspections are required to complete the production job. When running under MES Production Center control, the process requirements and parameters are received from the MES system as to where and how to process and inspect the vials produced by the system.

1.2.1 Station1 – Load / Unload

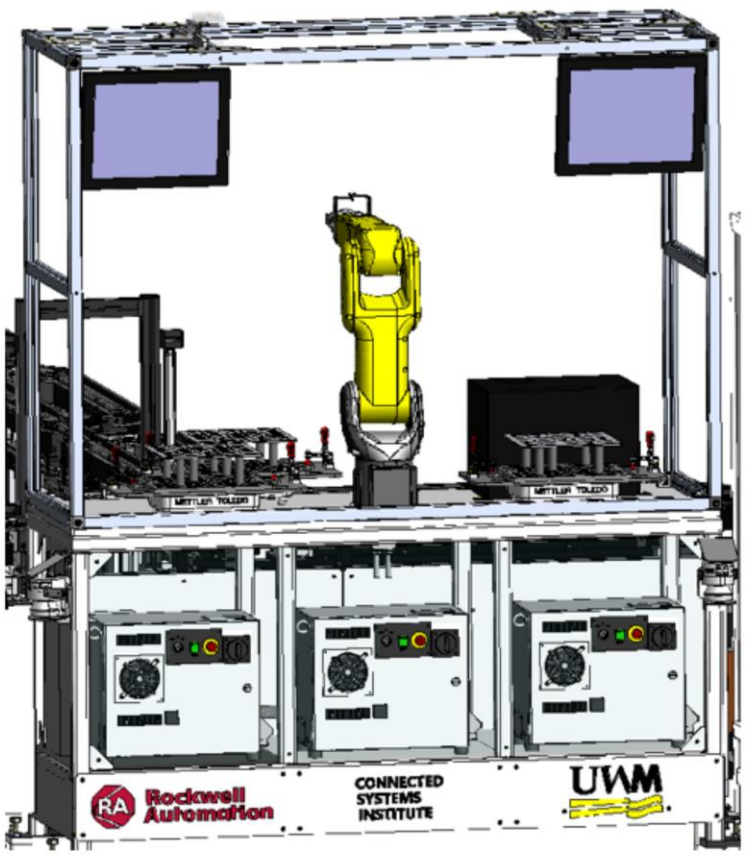

Figure 1-2 Station1 Load / Unload

Station1 is the start of system; Vial Inspect / Load Station. Empty vials are loaded to the system on an array template that sits atop a scale to determine empty vial weight. Once an order is received to process through the MES Production Center, the next available empty vial is retrieved by the FANUC LRMate 200iD 7L robot and then processed through a vision

The image (Figure 1-2) depicts an industrial automation station labeled "Station 1 Load / Unload." The station features a robotic arm in the center, which is likely used for handling materials or components. The setup includes various control panels and equipment, with three main control units at the bottom. The station is enclosed in a frame with two display screens at the top. The logos of Rockwell Automation, Connected Systems Institute, and UWM (University of Wisconsin-Milwaukee) are visible on the lower part of the station, indicating collaboration or sponsorship. The station appears to be designed for automated loading and unloading tasks in a manufacturing or research environment.

inspection process as determined by the system configuration. The vial inspection consists of: inspecting the vials for damage or cleanliness by rotating the vial 360 degrees across three different sections of the vial; scanning and associating the vial's 2d bar code data to the scheduled production job. Once the vial inspection process has been completed, the vial is either loaded to the MagneMotion transport system or rejected to the reject parts tray.

Once a good vial is placed to the MagneMotion transport carrier, the production process parameters for that particular vial are loaded into the system's part tracking and traceability logic. These parameters are used and production data is updated as the vial is processed through the system.

Station 1 also received all finished product and stores them to one of two separate array templates. One array template for finished products that has met all process data and inspection criteria and are considered "Good Parts". The other array template for finished products that have failed to meet all process data parameters and inspection criteria and are considered "Bad Parts".

1.2.2 Station2 – Dry Fill

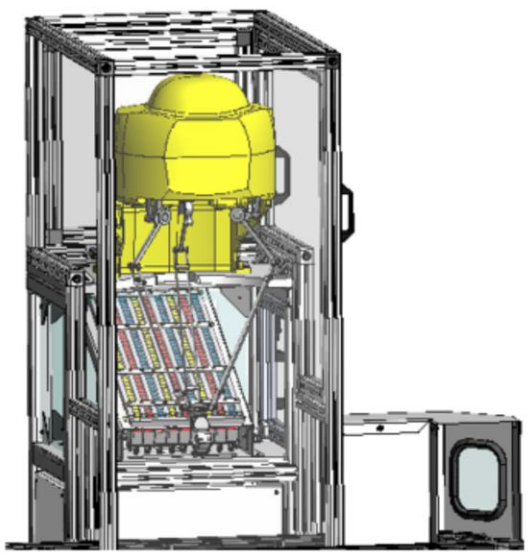

Figure 1-3 Station2 Dry Fill

The Dry Fill station consists of a gravity tray loaded with product of three varying-colored cubes. Each lane of product contains a color sensor to determine the appropriate color product is loaded into each channel. An M1iA robot is used to pick the colored product according to the process parameters.

An empty vial will arrive at this station on the MagneMotion transport system from the load station. The robot will receive the process parameters from the system's part tracking and traceability logic and picks the appropriate quantity in the appropriate order and places them to the vial at the station. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station.

The image depicts a technical illustration labeled "Figure 1-3 Station2 Dry Fill." It shows a piece of industrial equipment, likely used in a manufacturing or processing environment. The equipment is housed within a frame structure, and there is a prominent yellow component at the top, which appears to be a hopper or container. Below this, there are various mechanical and electronic components, including what looks like a conveyor or filling mechanism. The setup suggests that this station is used for the dry filling of materials, possibly powders or granules, into containers or packages. The overall design indicates a focus on automation and precision in the filling process.

1.2.3 Station3 – Wet Fill (Single Nozzle Sequential)

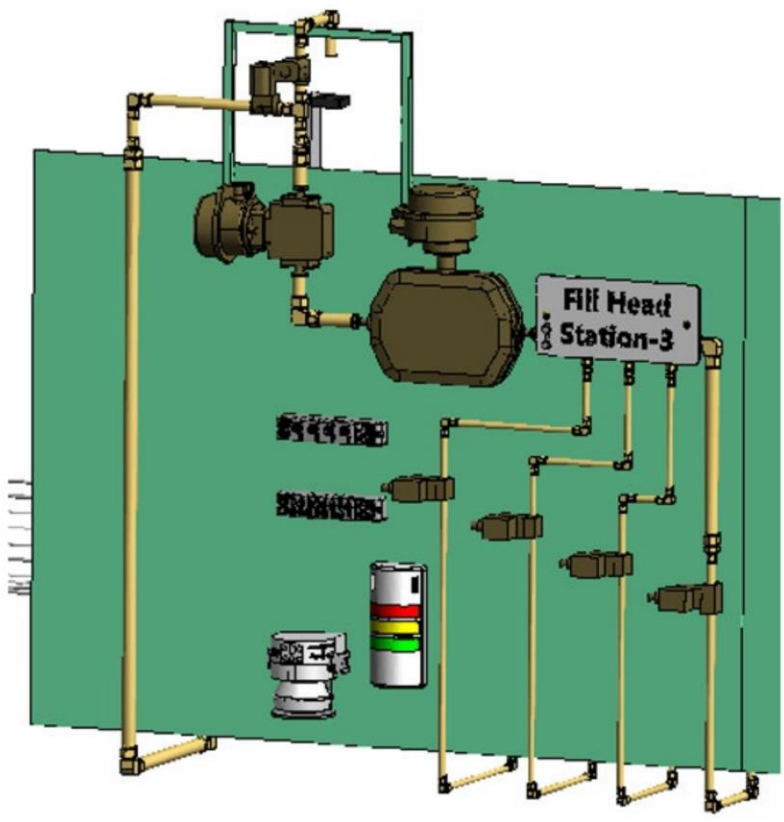

Figure 1-4 Wet Fill Single (Sequential)

The first Wet Fill station consists of a single nozzle used to dispense specified quantities of four different fluids sequentially into the vial located at the station on the MagneMotion carrier. The liquid fill parameters and resulting data are passed between the system PLC and the fluid delivery system PLC.

A vial will arrive at this station on the MagneMotion transport system from the load station or previous processing station. The station will receive the process parameters from the system's part tracking and traceability logic and dispenses the appropriate liquid in the appropriate order into the vial located at the station. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station.

The image (Figure 1-4) depicts a schematic diagram of a "Wet Fill Single (Sequential)" system, specifically labeled as "Fill Head Station-3." The system appears to be a part of an industrial or manufacturing setup, likely used for filling operations.

Key components visible in the diagram include:

1. Piping and Valves: Various pipes and valves are shown, indicating the flow paths and control points for the fluid being handled.

2. Fill Head: The central component labeled "Fill Head Station-3" is likely the main filling mechanism.

3. Control Units: There are several control units or sensors attached to the piping, which may be used for monitoring and controlling the filling process.

4. Pressure Gauge or Indicator: A cylindrical component with colored bands (red, yellow, green) is present, which might be a pressure gauge or level indicator.

5. Connection Points: There are multiple connection points, possibly for attaching hoses or other equipment.

The system is designed to operate in a sequential manner, meaning the filling process occurs in a specific order or sequence.

1.2.4 Station4 – Wet Fill (Single Nozzle Mixed)

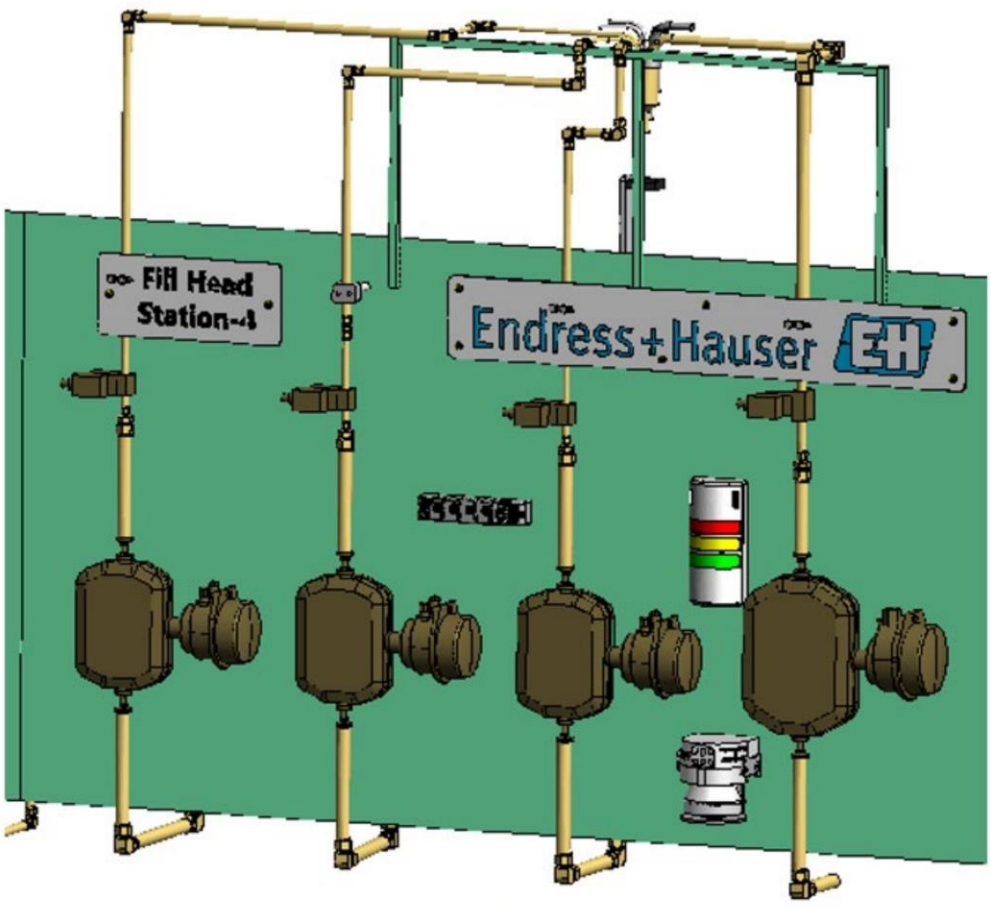

Figure 1-5 Wet Fill Single (Mixed)

The Second Wet Fill station consists of a single nozzle used to dispense specified quantities of four different fluids simultaneously into the vial located at the station on the MagneMotion carrier. The liquid fill parameters and resulting data are passed between the system PLC and the fluid delivery system PLC.

A vial will arrive at this station on the MagneMotion transport system from the load station or previous processing station. The station will receive the process parameters from the system's part tracking and traceability logic and dispenses the appropriate liquid in into the vial located at the station. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station.

The image depicts a schematic diagram of a wet fill single (mixed) system, labeled as "Figure 1-5 Wet Fill Single (Mixed)." The system appears to be part of an industrial setup, likely for fluid handling or processing.

Key components and features in the image include:

1. Fill Head Station-4: This label indicates the specific station within the system.

2. Endress+Hauser: The logo and name of the company, which is known for providing measurement instrumentation, services, and solutions for industrial process engineering.

3. Piping and Valves: Several pipes and valves are shown, which are likely used for controlling the flow of fluids within the system.

4. Flow Meters or Sensors: The brown-colored components could be flow meters or sensors used to measure the flow rate of the fluid.

5. Indicator Lights: A vertical stack of indicator lights (red, yellow, green) is present, which might be used to show the status of the system (e.g., operational, warning, or error states).

6. Additional Components: There are other components such as connectors and possibly a pressure gauge or another type of sensor.

The setup is mounted on a green panel, which serves as the background for the various components. The system is likely used in a process where precise control and measurement of fluid flow are critical.

1.2.5 Station5 – Wet Fill (Individual)

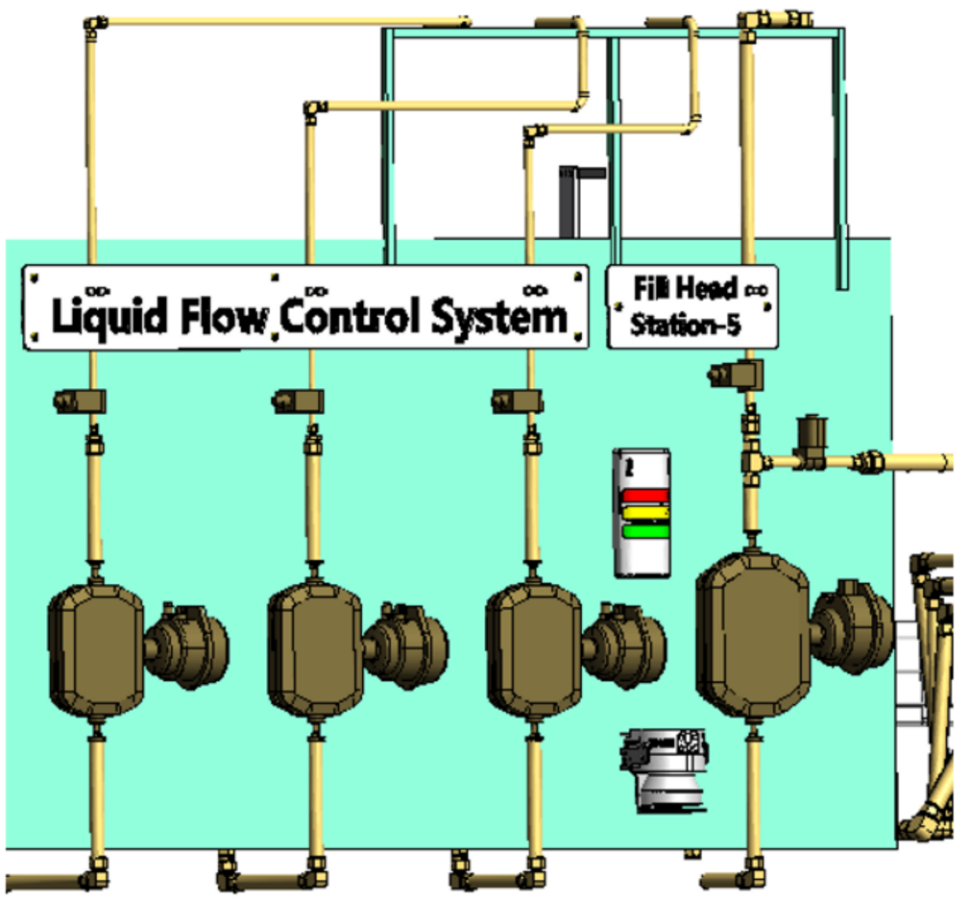

Figure 1-6 Wet Fill Individual (Seuqential)

The third Wet Fill station consists of four separate nozzles used to dispense specified quantities of four different fluids sequentially into the vial located at the station on the MagneMotion carrier. The liquid fill parameters and resulting data are passed between the system PLC and the fluid delivery system PLC.

A vial will arrive at this station on the MagneMotion transport system from the load station or previous processing station. The station will receive the process parameters from the system's part tracking and traceability logic and dispenses the appropriate liquid in the appropriate order into the vial located at the station. This process will repeat through the three other station nozzle positions. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station.

The image depicts a schematic diagram of a "Liquid Flow Control System" for a "Fill Head Station-5." The system appears to be designed for a wet fill process, likely used in industrial or manufacturing settings for filling containers with liquid.

Key components visible in the diagram include:

1. Flow Control Valves: There are five flow control valves aligned horizontally, each connected to a vertical pipe. These valves are likely used to regulate the flow of liquid into the containers.

2. Piping System: The diagram shows a network of pipes connected to the flow control valves, indicating the path through which the liquid flows.

3. Control Panel: There is a control panel with indicator lights (green, yellow, and red) suggesting the operational status of the system. Green typically indicates normal operation, yellow may indicate a warning or caution, and red usually signifies an error or stop condition.

4. Labels: The system is labeled as "Liquid Flow Control System" and "Fill Head Station-5," providing context for the specific station and its function.

5. Additional Components: There are other components such as connectors, fittings, and possibly sensors or actuators that are part of the system to ensure proper operation and control.

The diagram is labeled as "Figure 1-6 Wet Fill Individual (Sequential)," indicating that this is part of a series of figures in a larger document or manual, and it represents a sequential process in the wet fill operation.

1.2.6 Station6 – Capping

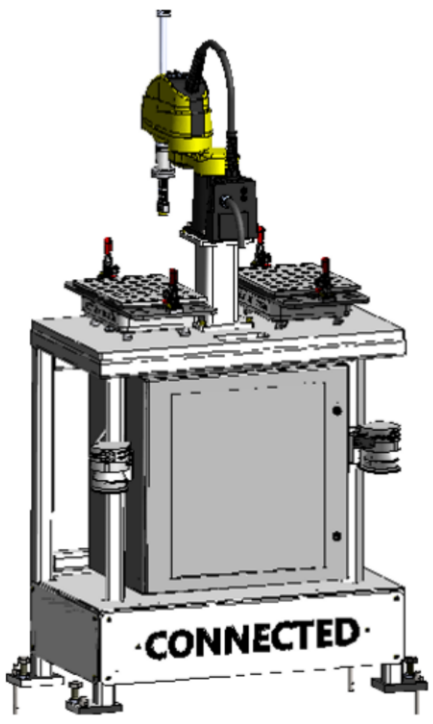

Figure 1-7 Capping Station

The capping station places caps onto the vials as determined by the process parameters for that vial. Caps are loaded to the system onto two array templates that sits atop a scale to determine cap weight. An SR3iA SCARA robot is used to pick the next available cap and place it to the vial loaded on the MagneMotion transport carrier. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station.

The image depicts a capping station, which is a piece of industrial equipment used in manufacturing processes to place and secure caps onto containers. The station features a mechanical arm or capping head, which is likely automated, positioned above a work surface where containers are placed. The base of the station is labeled "CONNECTED," indicating it may be part of a larger automated or networked system. The station appears to have fixtures to hold containers in place during the capping process. The image is labeled "Figure 1-7 Capping Station."

1.2.7 Station7 – Vision Inspection

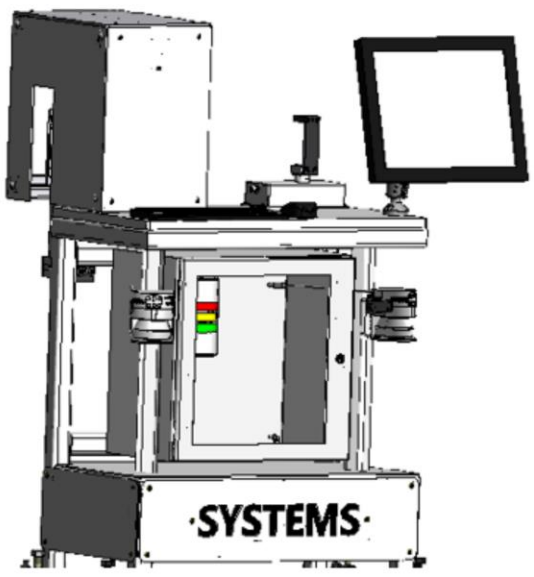

Figure 1-8 Vision Inspection Station

The vision inspection station is used to verify the contents of each vial that it inspects. Depending on the product that is to be inspected, the vision system loads one of two inspection programs. For liquid fill vials, the camera program evaluates the vial and returns RGB values (Red / Greed / Blue) of the inspection area. The resultant data is compared against MES provided process parameters to determine that the vial has the correct or incorrect color. For vials with dry fill contents, the vision system loads an inspection program that retrieved the RGB values for the seven different dry fill positions and compares them to the system's dry fill color setup parameters. The station determines if the vial is loaded with the correct color of dry fill cubes and that they are in the correct order as defined by the MES provided process parameters for that particular vial. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station.

The image depicts a Vision Inspection Station, which is a type of automated system used for quality control and inspection in manufacturing processes. The station includes a camera or vision system mounted above a work area, a monitor for displaying the inspection results, and various controls and indicators. The system is likely used to inspect products for defects, measure dimensions, or verify assembly accuracy. The label "SYSTEMS" is visible on the front of the station, and there are indicator lights on the side of the inspection area. The figure is labeled as "Figure 1-8 Vision Inspection Station."

1.2.8 Station8 – Weigh Check

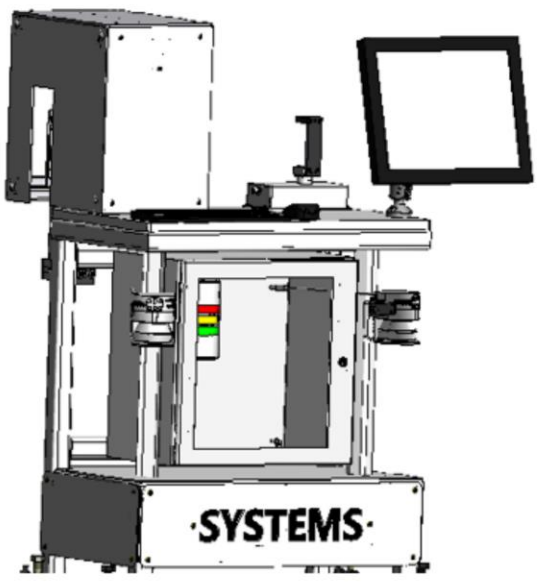

Figure 1-9 Weight Check Station

The weight check station is used to verify weight of the contents of each vial that it inspects against MES provided process parameters. Once a vial arrives at the station on a MagneMotion carrier, the Cr7 Robot retrieves the vial from the MagneMotion carrier and places it to the precision weigh scale. After a brief settling period, the station record the weight and compares the results to the MES parameters to determine to pass or fail the vial. Once completed, the CR7 robot picks the vial from the scale and places it back to the MagneMotion carrier. Upon completion, the station updates the system's part tracking and traceability database and then sends the vehicle on to the next processing station. and send it to the next processing station.

The image (Figure 1-9) depicts a weight check station, which is a piece of equipment used to measure and verify the weight of items. The station includes a platform for placing items, a display screen for showing measurements, and various controls for operation. The label "SYSTEMS" is prominently displayed on the front of the station. The setup also includes a computer monitor mounted on an adjustable arm, likely for interfacing with the system and displaying data. The station appears to be designed for industrial or laboratory use, where precise weight measurements are critical.

1.2.9 Station9 – Inspect / Repair

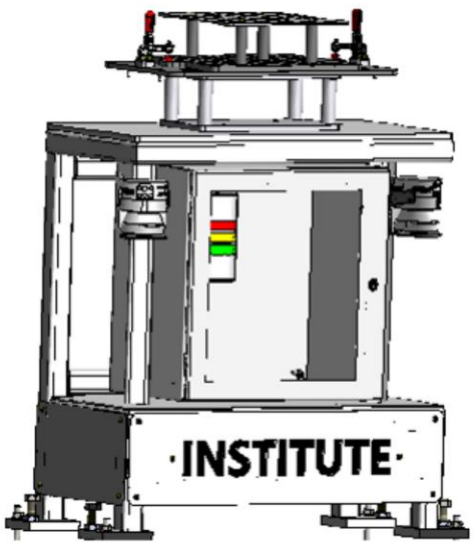

Figure 1-10 Inspect and Repair Station

The intent of the inspect and repair station is for product to be staged for inspection and possible repair by operating personnel. The demonstration program provided with the cell send vials whose process parameters were slightly outside the required specifications to the inspect and repair station. This station is designed for the end-user to develop their own processing and repair criteria and utilize it according to their processes.

Once a vial arrives at the station on a MagneMotion carrier, the Cr7 Robot retrieves the vial from the MagneMotion carrier and places it to the vial array.

The image depicts a piece of industrial equipment labeled "INSTITUTE" on its base. The equipment appears to be an "Inspect and Repair Station," as indicated by the caption "Figure 1-10 Inspect and Repair Station" below the image. The station has a rectangular structure with a door on the front, which likely provides access to the internal components. There are indicator lights on the door, possibly for status monitoring. The top of the station has a platform with clamps or fixtures, which might be used to hold items in place during inspection or repair. The overall design suggests it is used in a manufacturing or industrial setting for maintenance purposes.

1.2.10 MagneMotion Independent Cart Transport System

Figure 1-11 MagneMotion

The MagneMotion Independent Cart Transport system utilizes linear motor technology and magnetic carriers to transport vials throughout the CSI vial filling cell. The system is configured with 17 Nodes (locating positions) on 23 paths. Transport carriers flow through the system stopping at the required process stations or using bypass paths to continue moving throughout the system.

The MagneMotion node controller receives commands from the system's process PLC and in turn monitors and controls the direct motion of the independent cart trafficking, positioning and motion profiles. The system is designed for the end-user to build upon the basic programming provided and take advantage of the technology to develop and test varying delivery system configurations.

The image depicts a complex conveyor system, likely used in an industrial or manufacturing setting. The system consists of multiple interconnected conveyor belts arranged in a zigzag pattern, supported by a series of metal frames and legs. The conveyors are positioned at different heights and angles, suggesting a design optimized for efficient material handling and transport. The caption below the image reads "Figure 1-11 MagneMotion," indicating that this is a figure from a document or manual related to MagneMotion, a company known for its advanced conveyor and transport systems.

2 Safety

2.1 Follow Safety Instructions

Carefully read all safety messages in this manual and on the machine safety signs as depicted in Figure 2.1.

Keep safety signs in good condition. Replace missing or damaged safety signs.

Learn how to operate the machine and how to use controls properly. Do **NOT** let anyone operate the machine without instruction.

Keep the machine in proper working condition. Unauthorized modifications to the machine may impair its function and/or safety and affect the machine's life.

Figure 2-1 Follow Safety Instructions

Whenever encountering the caution symbol in the manual (Fig. 2.2). Carefully read the message text that accompanies the symbol. This caution symbol signals that failure to follow the accompanying message can lead to injury or death to personnel or damage to the

Figure 2-2 Caution Symbol

2.2 Residual Risks

The assembly cell is provided with fixed guarding along with a category 3 performance level d rated safety system. The safety system is meant to prevent the operator from coming into contact with any hazards. However, those hazards still exist. Those hazards are:

- Electrical shock hazard from the cabinet(s) and cable routing
- Pinch point crush hazard from robot(s) and mechanical motion
- Pinch points and trapping hazards from transport system
- Strobing lights from vision systems
- Sharp edges of machines parts
- Chemical / fluid exposure to liquid filling system
- Magnetic hazard from independent cart system
- Wet or slippery surfaces from liquid filling fluid.

2.3 Foreseeable Misuse

- This equipment is not for use within a residential area

The image is a blue circular icon featuring a white silhouette of a person holding and reading a book or manual. Below the icon, there is a caption that reads "Figure 2-1 Follow Safety Instructions." This icon typically indicates the importance of reading and following safety instructions or guidelines.

The image shows a caution symbol. It is a yellow equilateral triangle with a black border. Inside the triangle, there is a black exclamation mark. Below the triangle, there is a caption that reads "Figure 2-2 Caution Symbol." This symbol is commonly used to indicate a warning or to draw attention to potential hazards.

- This equipment is designed for indoor use only
- This equipment is not designed for use within a potentially explosive environment
- This equipment is not designed for underground use
- Equipment is designed for educational use only simulating an assembly line with automation and robotics. Do not process any other material apart from that which the machine is designed to process
- Ensure that the correct LOTO is in place prior to any cleaning, repair or maintenance routines
- This equipment is not designed for use with personnel climbing over, on, or into the robot or conveyor and processing stations or maintenance area without following proper control of hazardous energy procedures.

2.4 Safety Precautions

The precautions outlined in this section are not intended to cover all hazards that may exist in a school or on this machine. Usage of safety equipment without common sense will not prevent accidents, nor will it reduce the severity of those accidents which do occur. It requires the constant attention of all personnel within the vicinity of this or any manufacturing operation to maintain a safe operation and work environment. A school and its equipment are only as safe as its faculty and students are safety conscious. Properly trained faculty and students, plus a well-maintained machine will contribute as much toward the overall safety program as any number of mechanical guards and safety devices.

1. Study the operating instructions thoroughly before attempting to install, operate, or maintain this machine.
2. Do **NOT** operate this machine unless all guards are in place and all safety devices are functioning properly. Check all devices before starting this machine.
3. Avoid wearing loose-fitting clothing and jewelry while working on or near moving components.
4. Never leave a running machine unattended. Shut down the machine before leaving the work area.
5. Keep the work area clean and free of grease, oil, water, or obstacles that could cause you to slip or trip and fall.
6. Always perform the safety lockout procedures listed on a LOTO Developed by the end user before performing any maintenance on this machine.

Never alter, by-pass, or otherwise deter the operation of any safety guard or other safety devices on this machine.

2.5 Robot Protective Safety Boundaries, Joint Limits, Force Monitoring

Each Fanuc Robot utilizing Advanced DCS is equipped with motion limiting features as an additional measure to protect personnel. Joint limitations and safety boundaries have been programmed specifically for the work envelope and function of each robot. Any modification to these safety features shall only be performed by qualified personnel and shall require the complete validation and certification of the system safety performance to be completed, then approved of by the end user safety engineer.

Joint limits restrict the individual robot axis to a pre-specified range of motion. Figure 2.3 depicts an example the allowable joint limitations and safety boundaries for the robot.

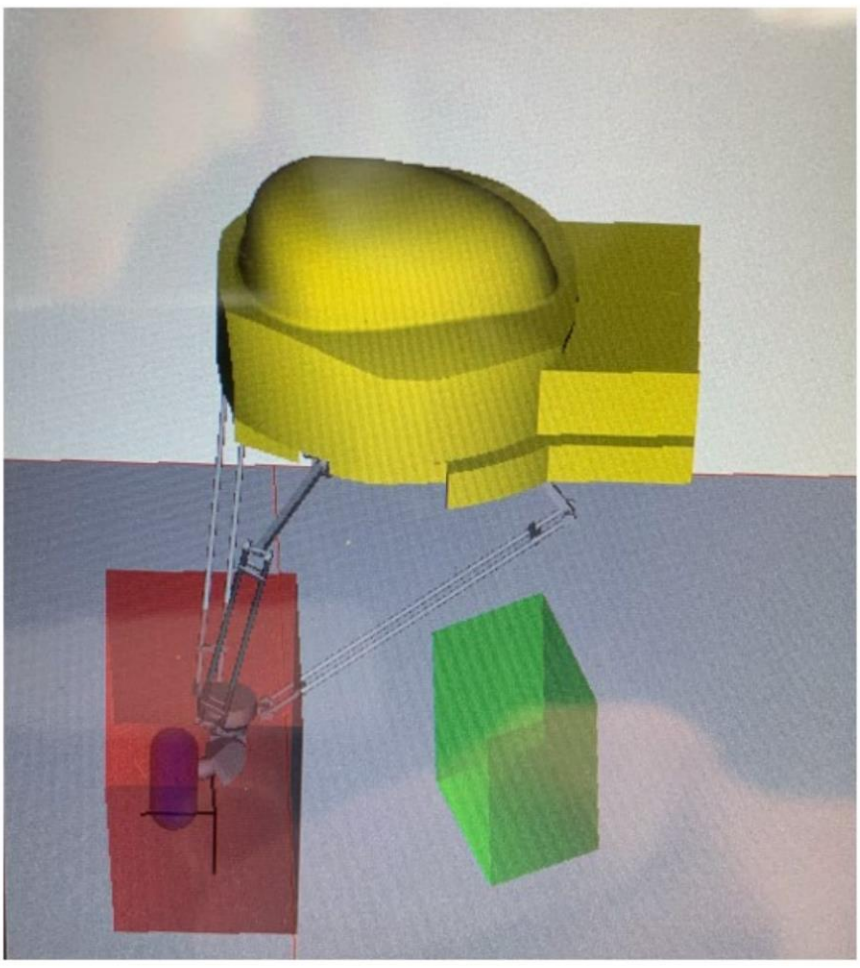

Figure 2-3 DCS Protective Zones

The image appears to be a 3D model illustrating the protective zones of a DCS (Distributed Control System). The model includes several colored zones and components:

- A large yellow structure, possibly representing a protective enclosure or a critical area.

- A red zone, which might indicate a restricted or hazardous area.

- A green zone, likely representing a safe or monitored area.

- A mechanical arm or robotic component, shown in grey, which seems to be interacting with the different zones.

The image is labeled "Figure 2-3 DCS Protective Zones," suggesting it is part of a technical document or manual explaining the safety and operational boundaries within a DCS environment.

2.6 Robot Teach / Manual Mode

QUALIFIED INDIVIDUAL IS REQUIRED
FOR THE FOLLOWING PROCEDURE

Always use extreme caution while performing this procedure. Only a single person should ever be within the hazard area at any given time.

The machine is equipped with a teach mode to allow for robot adjustment through the use of the teach pendant while personnel are within the robot work envelope. It is beyond the scope of this operations manual to setup and teach the robot. This manual is not intended to replace the robot manufacturer's training or equipment manuals. Please refer to the manufacture's documentation and training for detailed procedures for working with and configuring the robot.

Figure 2-4 Teach Pendant / Teach Mode

2.7 Safety System

The Vial Fill Test Bed is equipped with a dedicated Allen Bradley L8 series GuardLogix programmable safety controller to monitor and control the safety of the entire system through control reliable means. The safety system for the cell consists of four dual channel emergency-stop push button with reset functionality, nine dual channel area scanners with warning and stop zones, two dual channel light curtains, a single dual channel solenoid locking door interlock, and four Fanuc robot controller with advanced DCS functionality and ethernet safety. The Fanuc robots are connected as a child to the system safety controller (e.g., an assembly cell emergency stop will emergency stop the robot). Activations of the robot controller and pendant emergency stop will also stop the assembly cell.

Figure 2-5 – System Safety Controller

The image shows a close-up of a switch labeled "OFF" and "ON" with a key inserted into it. The key is turned to the "ON" position. Below the switch, there are additional indicators, including a battery symbol and a hand symbol. The caption below the image reads "Figure 2-4 Teach Pendant / Teach Mode." This suggests that the switch is part of a teach pendant, a device used to control and program industrial robots.

The image shows a system safety controller setup, typically used in industrial automation and control systems. The setup includes various modules and components mounted on a rack. The components are connected with numerous wires, indicating a complex configuration. The modules are likely programmable logic controllers (PLCs) and safety relays, which are essential for ensuring the safe operation of machinery and processes. The caption below the image reads "Figure 2-5 – System Safety Controller."

2.8 Emergency Stop Circuit

The system is equipped with dual channel emergency stop push buttons. Upon activation, all hazardous electrical outputs are disabled by the monitoring safety controller and the robots are issued a stop category zero (emergency stop).

Figure 2-6 Robot E-Stops

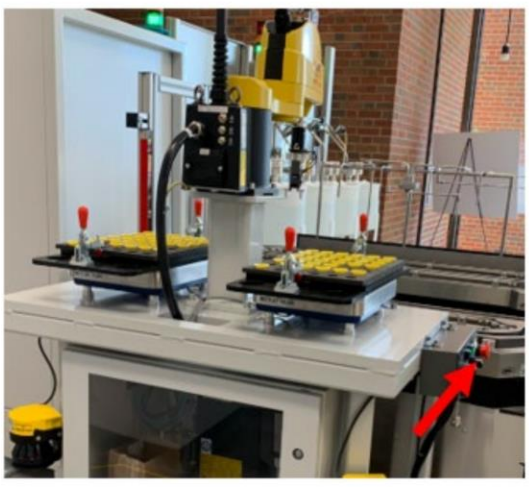

Figure 2-10 SR3iA E-Stop

Figure 2-9 Process Panel E-Stop

Figure 2-8 Robot & Power Panel E-Stop

Figure 2-7 Safety Panel E-Stop

The image shows a robotic workstation with several emergency stop (E-Stop) buttons highlighted by red arrows. The E-Stop buttons are located at various points on the workstation, including:
1. On the front panel of the control cabinet.
2. On the side of the control cabinet.
3. On the lower part of the workstation, near the base of the robot.
4. On the side of the workstation, near the base of the robot.
The robot is a yellow industrial robotic arm, and the workstation appears to be part of a laboratory or manufacturing setup. The E-Stop buttons are safety features designed to immediately halt the operation of the robot in case of an emergency. The image is labeled "Figure 2-6 Robot E-Stops."

The image shows a safety panel with an emergency stop (E-Stop) button. The panel includes a screen displaying some data or controls, and below the screen, there are various electronic components and wiring visible through a transparent section. The E-Stop button is highlighted with a red arrow, indicating its location on the panel. The E-Stop button is typically used to immediately halt operations in case of an emergency. The caption below the image reads "Figure 2-7 Safety Panel E-Stop."

The image shows a control panel, labeled as "Figure 2-8 Robot & Power Panel E-Stop." The panel is a tall, white cabinet with various controls and displays.
Key features include:
- A large screen or display in the upper section.
- A smaller screen or control interface below the larger display.
- Several buttons and switches, including an emergency stop button (E-Stop) highlighted by a red arrow.
- A key switch and other control elements are also visible on the panel.
The emergency stop button is prominently marked and is likely used to quickly shut down the system in case of an emergency. The panel appears to be part of a robotic or automated system, given the reference to "Robot & Power Panel."

The image shows a process panel with an emergency stop (E-Stop) button. The panel has a touchscreen display at the top, which appears to be showing some operational data or controls. There are three red arrows pointing to components inside the panel, which are visible through a transparent section. The emergency stop button is highlighted with a red arrow and is located to the left of the touchscreen. The panel is labeled with the text "APT" at the bottom. The caption below the image reads "Figure 2-9 Process Panel E-Stop."

The image shows a piece of industrial equipment with two workstations, each holding a tray with yellow components. The equipment appears to be part of a manufacturing or assembly process. There is a red arrow pointing to a red emergency stop button (E-Stop) on the right side of the machine. The emergency stop button is a safety feature used to immediately halt the operation of the machine in case of an emergency. The caption below the image reads "Figure 2-10 SR3iA E-Stop."

2.9 Area Scanner

The area in front of each station is protected by an array of safety area scanner that has both a warning and stop zone.

When an obstruction is detected within the warning zone (depicted in yellow) the scanner sends dual signals to the safety PLC which in turns signals the robot controller initiating slow-down mode of the robot via CIP safety over ethernet protocols.

When an obstruction is detected within the protective stop zone (depicted in red), the area scanner and safety system controller initiate a safe stop of the machine and robot. When the areas scanner stop is activated, all hazardous electrical outputs are disabled, and the robot initiates zero speed and position monitoring preventing the robot from autonomous cycling. Robot I/O controlled through the robot controller are not affected by the area scanner stop.

Figure 2-11 Area Scanners

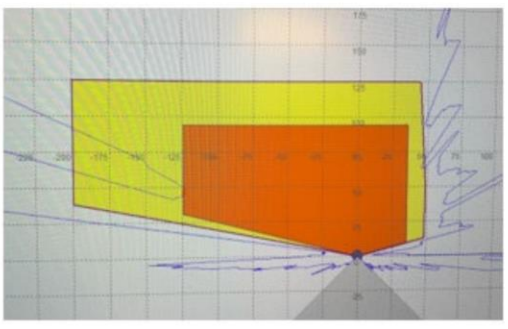

Figure 2-12 Area Scanner Zones

Figure 2-13 Area Scanner Zones

The image shows a laboratory or industrial setting with several pieces of automated equipment. The equipment includes robotic arms and conveyor systems, likely used for manufacturing or assembly processes. The red arrows in the image point to yellow devices mounted on the sides of the equipment, which are identified as area scanners. These scanners are likely used for safety purposes, to detect the presence of objects or people in their vicinity and prevent accidents. The equipment is branded with logos from Rockwell Automation and FANUC, indicating that these companies are the manufacturers or suppliers of the automation technology. The caption under the image reads "Figure 2-11 Area Scanners."

The image shows a graphical representation of area scanner zones, labeled as "Figure 2-12 Area Scanner Zones." The diagram features two distinct zones:

1. Yellow Zone: This is the outer zone, which likely represents a warning or caution area. It is a larger rectangular area that encompasses the inner zone.

2. Orange Zone: This is the inner zone, which is smaller and likely represents a more critical or immediate action area. It is a rectangular area within the yellow zone.

The background consists of a grid, which may be used for precise measurement or mapping purposes. The zones are likely used to indicate different levels of alert or action required when an object or person enters these areas.

The image (Figure 2-13) shows a section of an industrial or laboratory setting with various machinery and equipment. There are two colored lines on the floor, marked with arrows:

1. A yellow arrow pointing to a yellow line.

2. A red arrow pointing to a red line.

These lines likely indicate different zones for an area scanner, which is used for safety or operational purposes. The yellow and red lines might represent different levels of access or safety zones around the machinery. The yellow zone could be a caution area, while the red zone might indicate a restricted or danger area. The machinery includes various components, such as a robotic arm and control panels, and is situated in a clean, well-lit environment.

QUALIFIED INDIVIDUAL IS REQUIRED
FOR THE FOLLOWING PROCEDURE

Only qualified personnel should setup or modify the protective fields of the safety area scanner. Full functionality check and validation of the safety system shall be completed upon any modification the system setup and area scanner protective fields.

The area scanner protective fields have been set to the proper location and distance corresponding to the system layout and stop time distance calculated for the system robot speed at time of shipping. At time of shipping, robots have been restricted to a maximum override speed through the advanced DCS functions of the robot controller while in the slow zone. It is not recommended to modify the maximum speed as it will adversely affect the stop time distance and zone layout of the area scanners.

The Vial Fill Cell stations have integrated the safety area scanners as its primary mode of protection of perimeter guarding. To aide is the openness and ease of use for training, the system has incorporated an automatic reset functionality once the area scanner protection zones have been cleared of obstruction. This is accomplished by the Safety PLC monitoring and sending the slow down and stop signals to the system. While this feature is incorporated into the system, the end users should not rely solely on this feature and shall ensure good safety practices are in place when working and training on the system.

2.10 Light Curtains

The CR7 Rail Robot incorporates a seventh axis which is NOT collaborative in nature. In conjunction with the system area scanners, two sets of dual channel light curtains are used to prevent the rail from moving while the safety system is impeded. The combination of light curtains and area scanners allow the robot to function as long as no objects are detected within the safety detection zones. The Light curtains only become relevant to the safety function if the area scanners detect an obstruction and can be thought of as a secondary safety system or alternate safety system.

Figure 2-14 Light Curtains Receivers

Figure 2-15 Light Curtain Transmitters

The image (Figure 2-14) shows a manufacturing or automation setup with various pieces of equipment. The red arrow is pointing to a component labeled as "Light Curtains Receivers." Light curtains are safety devices used to protect personnel from injury by creating an invisible barrier around hazardous areas. If the barrier is broken, the machine will stop operating to prevent accidents. The setup includes machinery from Rockwell Automation and FANUC, indicating the use of advanced automation and robotics technology. The environment appears to be a modern industrial or educational facility with various workstations and control panels.

The image (Figure 2-15) shows a section of an industrial or laboratory setup with a conveyor system. The setup includes light curtain transmitters, which are indicated by red arrows. These light curtain transmitters are mounted vertically on either side of the conveyor. Light curtains are safety devices used to detect the presence of objects or people and are commonly used to prevent accidents in automated environments. The setup also includes a tray with multiple slots, likely for holding test tubes or similar cylindrical objects. The environment appears to be clean and organized, typical of a laboratory or manufacturing setting.

3 Mode Status

The following modes are available on the individual stations. A brief description of each mode is provided for general information.

3.1 Control Power ON/OFF

Primarily a hard-wired interface that allows controls functions to be turned on and off. Alternately, an HMI based interface that allows for controls functions to be turned on and off. No Motions (Auto or Manual) shall occur if control power is not in an on state.

3.2 Manual Mode

Station motions are only allowed through manual interaction. Any fault condition shall place station into this mode of operation.

3.3 Auto Mode

Station is ready for automatic operation, but auto sequence is not started or processing. No manual functions can be performed.

3.4 Auto Cycle

Station's Auto Sequence is processing and repeating under normal conditions

3.4.1 Cycle Starting

Delay in auto cycle sequence start as needed based on application.

3.4.2 Cycle Stopping

Current Auto Cycle sequence continues until completed; Once completed station then drops out of Auto Cycle but remains in Auto Mode.

3.5 Dry Cycle

Emulation of Auto Cycle generally without parts or pallets. Simulates or ignores input sensors and inspection conditions to allow Auto Sequence to function. Primarily used for maintenance or troubleshooting.

3.6 Faulted

System has experienced a fault condition. Any fault condition shall drop the station out of automatic operation and place it into Manual Mode.

3.7 Idle

Station is in Auto Mode and Auto Cycle with the Cycle Started but is idle due to waiting on parts or operator input to continue processing the Auto Sequence.

Additional application specific modes may be added as needed. Any addition of mode types shall be approved during the design review process.

4 System Reset Types

The following four reset types are available on the individual stations. A brief description of each reset function is provided below for general information. Certain reset types may also include reset functions provided by other reset types.

4.1 Safety Reset

Used to reset the safety system of the machine when safety devices require a manual reset. This reset shall be of the trailing edge type. All safety devices must be physically ok to reset for the safety reset to complete.

4.2 Robot Reset

Used to reset the robot fault via UI[5]. Robot fault is cleared, servo power is turned on, but the paused program will not resume.

4.3 Reset

Used as a general system reset. Primarily thought of as a retry of the system state when the system fault occurred. After a general reset the system should start back up on its current process step and continue once placed back into auto mode and the cycle is started. In general, no manipulation of parts or machine functions should be needed when using the general reset function. However, there may be unique situation which may require intervention to have the system resume operations once restarted. System faults along with external device faults are cleared. The general system reset shall also invoke the Safety Reset and Robot Reset as applicable.

4.4 Master Reset

The Master Reset is the same functionality general system reset with the addition of resetting all sequence routines back to their initial starting points. This type of reset is used when the machine is to begin back at an initial configuration upon being placed back into auto cycle. This initial state a Master Reset induces requires that all parts and pallets be removed or put back to starting position.

5 Visual Indicators

5.1 Stack Light Indicators

The following are the status indicator definitions as provided with the default system programs.

Figure 5-1 Stack Light

5.1.1 Red – Flashing

System Faulted

5.1.2 Amber – Flashing

Attention Required

5.1.3 Green – Solid

System in Auto Mode and Running Auto Cycle

5.1.4 Green – Flashing

Cycle Stopping – Waiting Completion of Current Cycle to Stop Auto Cycling

5.2 Area Scanner Indicators

The following are the status indicator definitions which indicate the status of area scanner(s) for each cell station.

Figure 5-2 Area Scanner Indicator

5.2.1 Green

Area Scanner(s) Warning and Stop Zone(s)s are Cleared.

5.2.2 Yellow

Area Scanner(s) Warning Zone(s) Detect an Obstruction.

5.2.3 Red

Area Scanner(s) Stop Zone(s) Detect and Obstruction.

The image shows a stack light, which is a type of signal light used in industrial settings to indicate the status of a machine or process. The stack light in the image has three colored segments: red at the top, amber (orange) in the middle, and green at the bottom. The green segment is illuminated, while the red and amber segments are not. The stack light is mounted on a surface, and the background appears to be an indoor setting with a ceiling and some fixtures visible. The caption below the image reads "Figure 5-1 Stack Light."

The image shows an area scanner indicator setup. The area scanner, which is yellow and black, is mounted on a structure. Next to it, there is a vertical indicator light panel with three lights: red, yellow, and green. The red light is illuminated, indicating a specific status or condition. An arrow points from the scanner to the indicator lights, suggesting a relationship between the two devices. The caption below the image reads "Figure 5-2 Area Scanner Indicator."

6 HMI General Information

6.1 Splash Screen

The splash screen is by default the initial screen the system displays on startup. Touching anywhere on the screen shall navigate to the main operations screen. Splash screen images may vary based on the application.

Figure 6-1 Splash Screen

The image is a splash screen for a project titled "Vial Fill Machine" associated with the University of Wisconsin-Milwaukee. The screen features logos and text indicating collaboration with Rockwell Automation, APT Manufacturing Solutions, and FANUC. The background has a geometric pattern with a central yellow section highlighting the main text. Below the image, there is a caption that reads "Figure 6-1 Splash Screen."

6.2 Navigation Screens

Tabs configured through global objects located at the top of every screen are used for general navigation through the HMI program. The exception to this requirement is the startup splash screens and small pop-up screens. While the content of a few of the tabs may change based on applications specifics; the System, Operation, and Production Tabs are universal to all projects. Tabs may be added or removed based on the application.

Figure 6-2 Navigation Screens

6.3 General Information Indicators

General information used by the application is to be located at the bottom of HMI application screens. Examples of this are: system date and time; robot indicators and alarms.

Figure 6-3 General Information Indicators

The image shows a navigation bar with several buttons, each labeled with different functions. From left to right, the buttons are:

1. A bell icon

2. A left arrow

3. A right arrow

4. SYSTEM (blue)

5. OPERATION (gray)

6. MAGNEMOTION (purple)

7. ROBOT (yellow)

8. IO (brown)

9. PRODUCTION (gray)

To the far right, there is a digital clock displaying the time as 08:30 PM and the date as 1/1/1971. Below the navigation bar, there is a caption that reads "Figure 6-2 Navigation Screens."

The image (Figure 6-3) shows a user interface for a robot control system, specifically from APT Manufacturing Solutions. The interface includes several indicators and information displays:

1. Current Robot Alarm: This section is highlighted in yellow and indicates the current alarm status of the robot. The text appears to be a placeholder or corrupted, showing repeated "s" characters.

2. Company Logos: The center of the interface displays logos for APT Manufacturing Solutions and FANUC Robotics.

3. Date and Time: The top right corner shows the current date and time, which is 8:56:20 PM on December 9, 2018.

4. Status Indicators: There are several status indicators with different colors:

- Busy: Gray
- Running: Green
- Hold: Yellow
- Fault: Red
- Battery: Red
- TP Disabled: Yellow
- At Perch: Green

These indicators provide quick visual feedback on the robot's operational status, battery condition, and other critical parameters.

6.4 System Screens

System screens are used for general machine setup and utilitarian operations. A majority of the functions available on the systems should screen more than likely should have security privileges associated with them. If the Security levels are not met, those functions should be not visible. Examples of system functions on the System HMI screens are: VFD frequency setup; Recipe Management System, Inspection Limits, IO Tests, Login, and Security Settings, Global Startup and Stopping Commands

Vial Fill System specific system screens and their uses shall be described in further detail in later section of this manual.

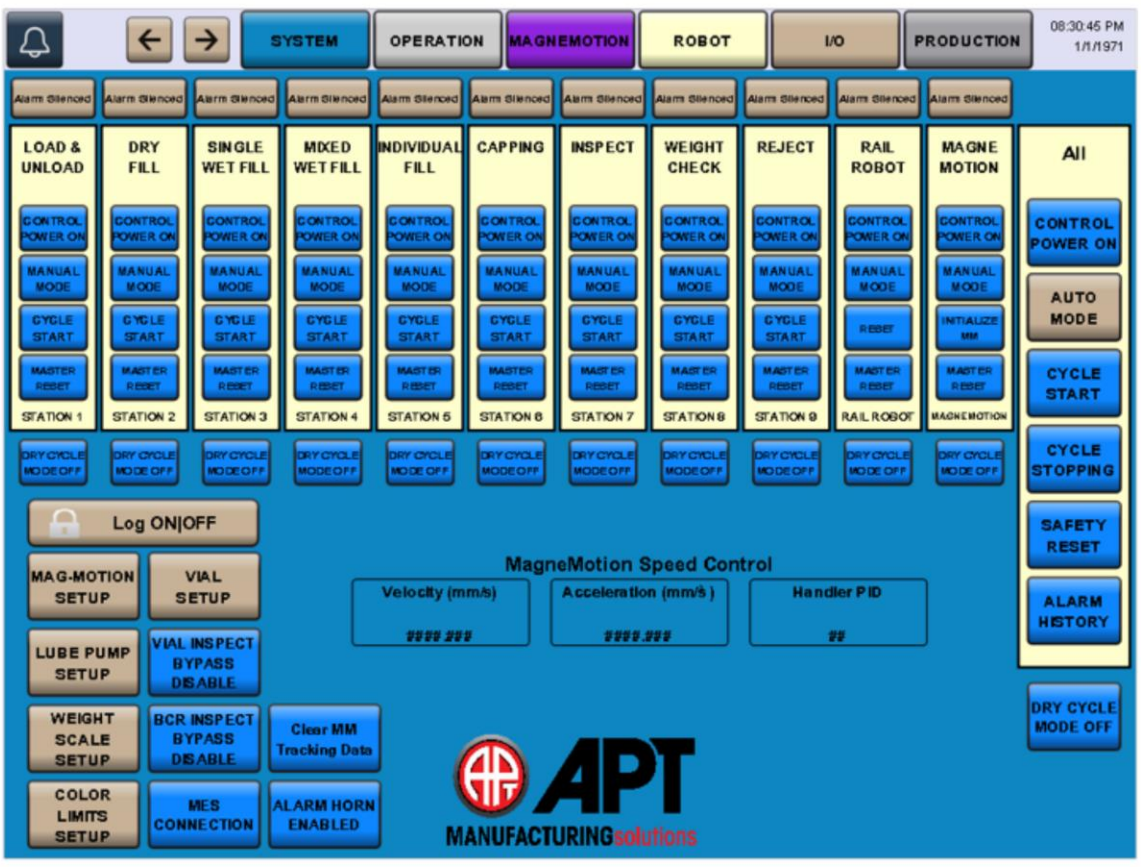

Figure 6-4 System Screen Example

The image (Figure 6-4) is a screenshot of a system control interface from APT Manufacturing Solutions. The interface is divided into several sections, each with its own set of controls and indicators. Here is a detailed description of the various sections and their functions:

1. Top Navigation Bar:
   - Contains buttons for different system modes: SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION.
   - A clock displaying the time and date (08:30:45 PM, 1/1/1971).
2. Alarm Indicators:
   - A row of "Alarm Silence" buttons at the top of each section.
3. Station Controls:
   - Each station (LOAD & UNLOAD, DRY FILL, SINGLE WET FILL, MIXED WET FILL, INDIVIDUAL FILL, CAPPING, INSPECT, WEIGHT CHECK, REJECT, RAIL ROBOT, MAGNE MOTION) has its own set of controls:
     - CONTROL POWER ON
     - MANUAL MODE
     - CYCLE START
     - HMI STATION (numbered from 1 to 9, and RAIL ROBOT)
     - DRY CYCLE MODE ON/OFF
4. General Controls:
   - Located on the right side:
     - CONTROL POWER ON
     - AUTO MODE
     - CYCLE START
     - CYCLE STOPPING
     - SAFETY RESET
     - ALARM HISTORY
     - DRY CYCLE MODE OFF
5. Login and Setup:
   - Log ON/OFF button.
   - Various setup buttons: MAG-MOTION SETUP, VIAL SETUP, LUBE PUMP SETUP, WEIGHT SCALE SETUP, COLOR LIMITS SETUP.
6. Bypass and Data Management:
   - VIAL INSPECT BYPASS ENABLE/DISABLE
   - BCR INSPECT BYPASS ENABLE/DISABLE
   - Clear MM Tracking Data
   - ALARM HORN ENABLED
7. MagnaMotion Speed Control:
   - Controls for Velocity (mm/s), Acceleration (mm/s^2), and Handler PID.
8. Company Logo:
   - APT Manufacturing Solutions logo at the bottom center.

The interface is designed for managing and monitoring various stages of a manufacturing process, with specific controls for each station and general system controls for overall operation.

6.5 Operation Screens

Operation screens are used for general machine operation and functionality. Use of 3d model images are used wherever possible to aid with the intuitiveness and ease of use. Sensor indicators are located as close to the actual position of the input device as represented on the 3d image. In addition, the following are incorporated into the operations screen:

- Mode operators for machine control (Global Functions)
- Additional operation screen navigation
- Local messages to display current operational sequence step number and description
- Fault banner on top of the screen indicating current active alarms
- Manual functions and indicator of the function
    - E.g. Button, Output State, Sensor Input of manual function

Vial Fill System specific operation screens and their uses shall be described in further detail in later section of this manual.

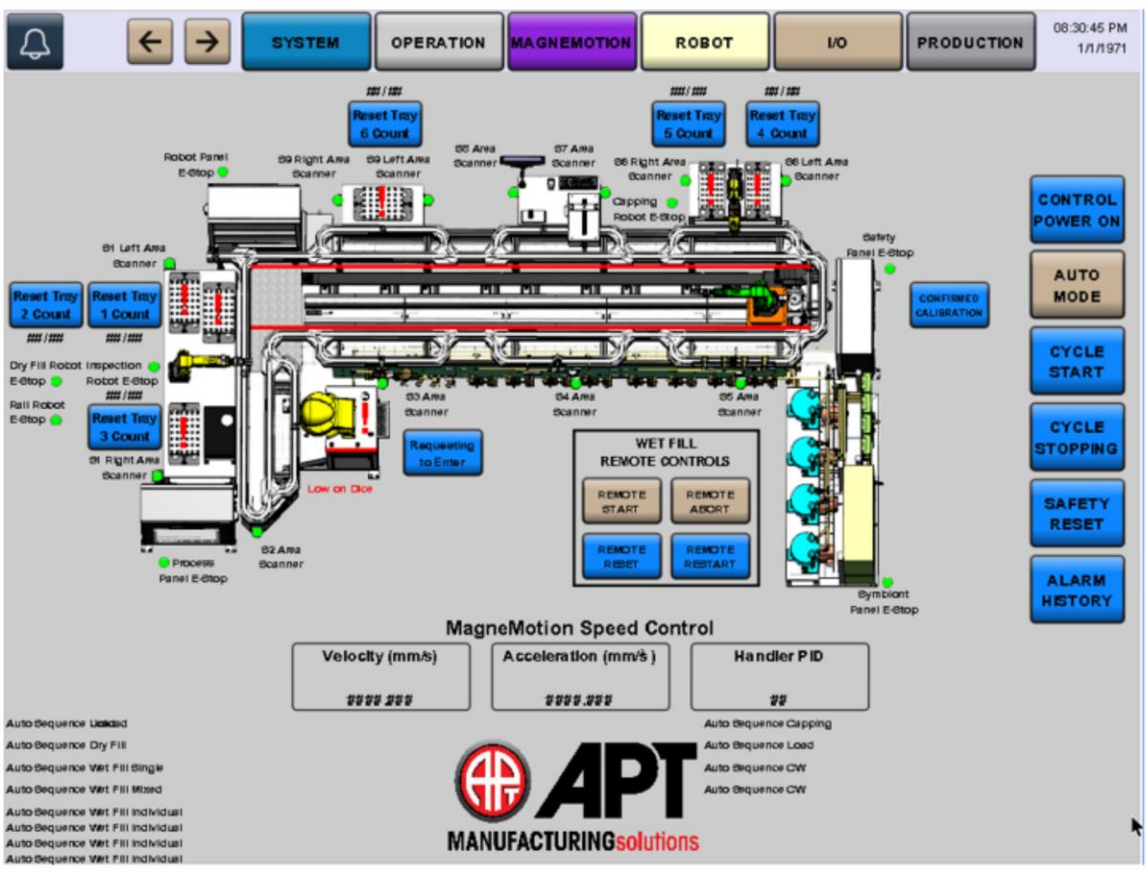

Figure 6-5 Operation Screen Example

The image (Figure 6-5) depicts an operation screen example from a manufacturing system, specifically from APT Manufacturing Solutions. The screen is divided into several sections, each with distinct functions and controls.

Key Elements:

1. Top Navigation Bar:
  - Contains buttons for different sections: SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION.
  - Displays the current time and date (08:30:45 PM, 1/1/1971).

2. Main Diagram:
  - Shows a detailed layout of the manufacturing process, including various stations and components.
  - Labels such as "Reset Tray 2 Count," "Robot Panel E-stop," "Low On Oil," and "Requesting To Enter" indicate different statuses and controls.
  - Includes areas for "Dry Fill Robot Inspection," "Wet Fill Remote Controls," and "MagneMotion Speed Control."

3. Control Buttons (Right Side):
  - CONTROL POWER ON
  - AUTO MODE
  - CYCLE START
  - CYCLE STOPPING
  - SAFETY RESET
  - ALARM HISTORY

4. MagneMotion Speed Control:
  - Displays parameters like Velocity (mm/s), Acceleration (mm/s^2), and Handler PID.

5. APT Manufacturing Solutions Logo:
  - Located at the bottom center of the screen.

6. Status Indicators (Left Side):
  - Auto Sequence Loaded
  - Auto Sequence Dry Fill
  - Auto Sequence Wet Fill
  - Auto Sequence Fill Single
  - Auto Sequence Fill Individual
  - Auto Sequence Wet Fill Individual
  - Auto Sequence Capping
  - Auto Sequence Load
  - Auto Sequence CW

Functionality:
The screen is designed to provide a comprehensive overview of the manufacturing process, allowing operators to monitor and control various aspects of the system. The buttons and indicators facilitate quick actions and status checks, ensuring efficient and safe operation.

6.6 Robot Screens

Robot screens are used to view and manipulate the robot functions, I/O, and parameters. Manual control of the robot shall also be located on these screens. This includes pick, place, and go to operations along with manual control of the robot controlled I/O functions such as gripper open and close.

All I/O and interface signals should be displayed on the robot screens to aide in maintenance and troubleshooting efforts. This includes but not limited to digital I/O, Universal I/O, and Group I/O.

As with all manual functions, actions that may cause damage to the equipment or product should be interlocked through the PLC program or not allowed to be selected via the HMI. Modification of the HMI operator though "visibility" options is the preferred method.

Vial Fill System specific robot screens and their uses shall be described in further detail in later section of this manual.

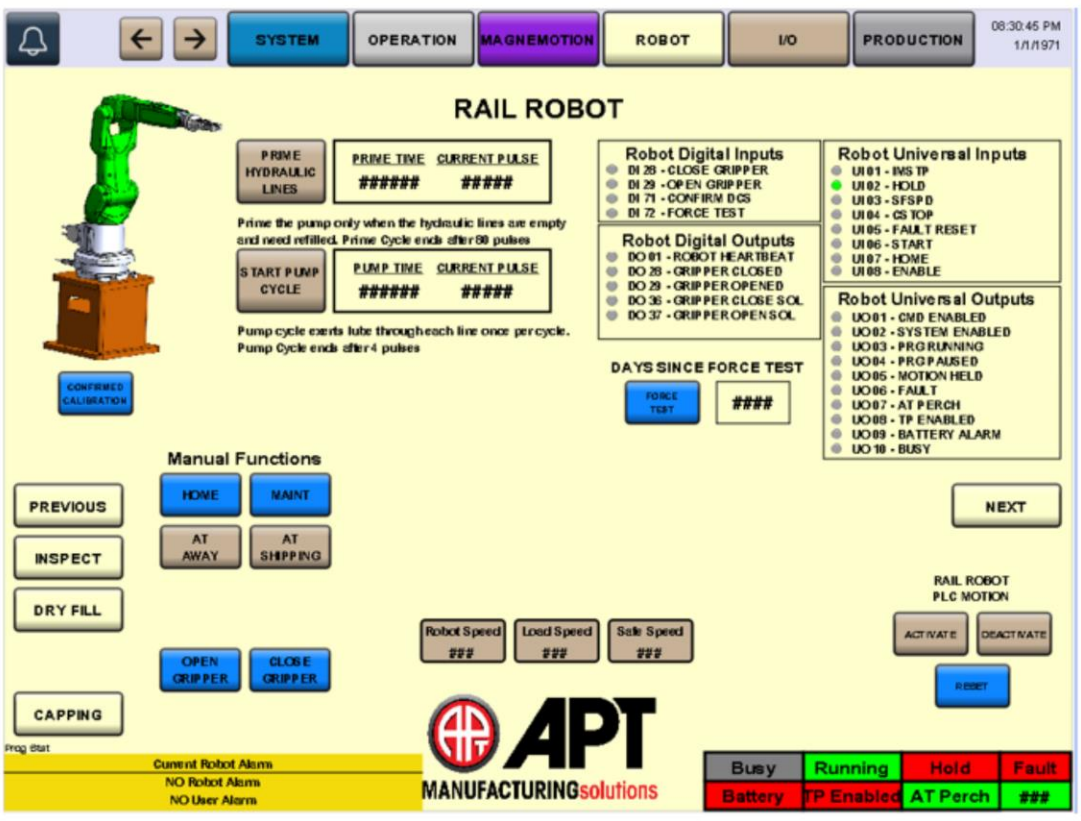

Figure 6-6 Robot Screen Example

The image (Figure 6-6) shows a control screen interface for a rail robot, provided by APT Manufacturing Solutions. The interface includes various sections and buttons for controlling and monitoring the robot's functions. Here is a detailed description of the screen:
Top Section:
- Tabs: SYSTEM, OPERATION, MAGNETOM, ROBOT, I/O, PRODUCTION
- Time and Date: Displayed at the top right corner (08:30:45 PM, 1/1/97)
Main Section:
- Title: RAIL ROBOT
- Robot Image: A green robotic arm is depicted on the left side.
- Prime Time and Pump Time: Prime Hydraulic Lines, Start Pump Cycle, and Both sections have fields for PRIME TIME and CURRENT PULSE.
- Robot Digital Inputs: DI 28 - CLOSE GRIPPER, DI 29 - OPEN GRIPPER, DI 30 - CONFIRM DSG, and DI 72 - FORCE TEST
- Robot Digital Outputs: DO 28 - ROBOT AT READY, DO 29 - GRIPPER CLOSED, DO 30 - GRIPPER OPEN, DO 31 - GRIPPER CLOSE SOL, and DO 32 - GRIPPER OPEN SOL.
- Robot Universal Inputs: U101 - MS IP, U102 – HOLD, U103 – SSPD, U104 - FAULT RESET, U105 - AT PERCH, U106 – HOME, and U107 – ENABLE.
- Robot Universal Outputs: U001 - SYSTEM ENABLED, U002 - SYSTEM READY, U003 - SYSTEM FAULT, U004 - MOTION ENABLED, U005 - MOTION HELD, U006 - TP ENABLED, U007 - FAULT RESET, U008 - BATTERY ALARM, U009 - TP ENABLED, and U010 – BUSY.
- Days Since Force Test: FORCE TEST button and (placeholder for days)

Manual Functions:
- Buttons:
  - PREVIOUS
  - HOME
  - MANT (Maintenance)
  - INSPECT
  - DRY FILL
  - AT AWAY
  - AT SHIPPING
  - CAPPING
  - OPEN GRIPPER
  - CLOSE GRIPPER

Robot Speed Controls:
- Robot Speed: Adjustable
- Load Speed: Adjustable
- Safe Speed: Adjustable
Bottom Section:
- APT Manufacturing Solutions Logo
- Current Robot Alarms:
  - NO Robot Alarm
  - NO User Alarm
- Status Indicators:
  - Busy
  - Running
  - Hold
  - Fault
  - Battery
  - TP Enabled
  - AT Perch
Right Section:
- RAIL ROBOT PLC MOTION:
  - ACTIVATE
  - DEACTIVATE
- NEXT button
This interface is designed to provide comprehensive control and monitoring of the rail robot, including manual functions, speed adjustments, and status indicators.

6.7 I/O Screens

I/O screens include all I/O integrated into the system to aide in maintenance and troubleshooting efforts. Should faceplate pop-up screens be used, they shall be called from an I/O main screen.

Vial Fill System specific I/O screens and their uses shall be described in further detail in later section of this manual.

Figure 6-7 I/O Screen Example

The image (Figure 6-7) shows a screenshot of a Local Safety Input Module interface, specifically for Slot 3. The interface displays the status of various safety inputs, all of which are currently marked as "ON" with green indicators. The inputs are listed as follows:

1. 3:I.Pt00 - Safety Panel E-Stop Ch. A
2. 3:I.Pt01 - Safety Panel E-Stop Ch. B
3. 3:I.Pt02 - Process Panel E-Stop Ch. A
4. 3:I.Pt03 - Process Panel E-Stop Ch. B
5. 3:I.Pt04 - Robot Panel E-Stop Ch. A
6. 3:I.Pt05 - Robot Panel E-Stop Ch. B
7. 3:I.Pt06 - Symbiont Panel E-Stop Ch. A
8. 3:I.Pt07 - Symbiont Panel E-Stop Ch. B
9. 3:I.Pt08 - Guard Door Interlock OSSD1
10. 3:I.Pt09 - Guard Door Interlock OSSD2
11. 3:I.Pt10 - Guard Door Locked
12. 3:I.Pt11 - Safety Panel Control Power Reset
13. 3:I.Pt12 - Process Panel Control Power Reset
14. 3:I.Pt13 - Robot Panel Control Power Reset
15. 3:I.Pt14 - E-Stop Power Safety EDM
16. 3:I.Pt15 - E-Stop Control Safety EDM

The interface includes navigation buttons at the top for SYSTEM, OPERATION, MAGNETOM, ROBOT, I/O, and PRODUCTION. There are also "PREVIOUS" and "NEXT" buttons at the bottom for navigating through the screens. The time and date are displayed in the top right corner.

6.8 Production Data Screen

Production data screens display the relevant information collected from the machine. A number of data points are automatically collected within the program provided.

Vial Fill System specific production screens and their uses shall be described in further detail in later section of this manual.

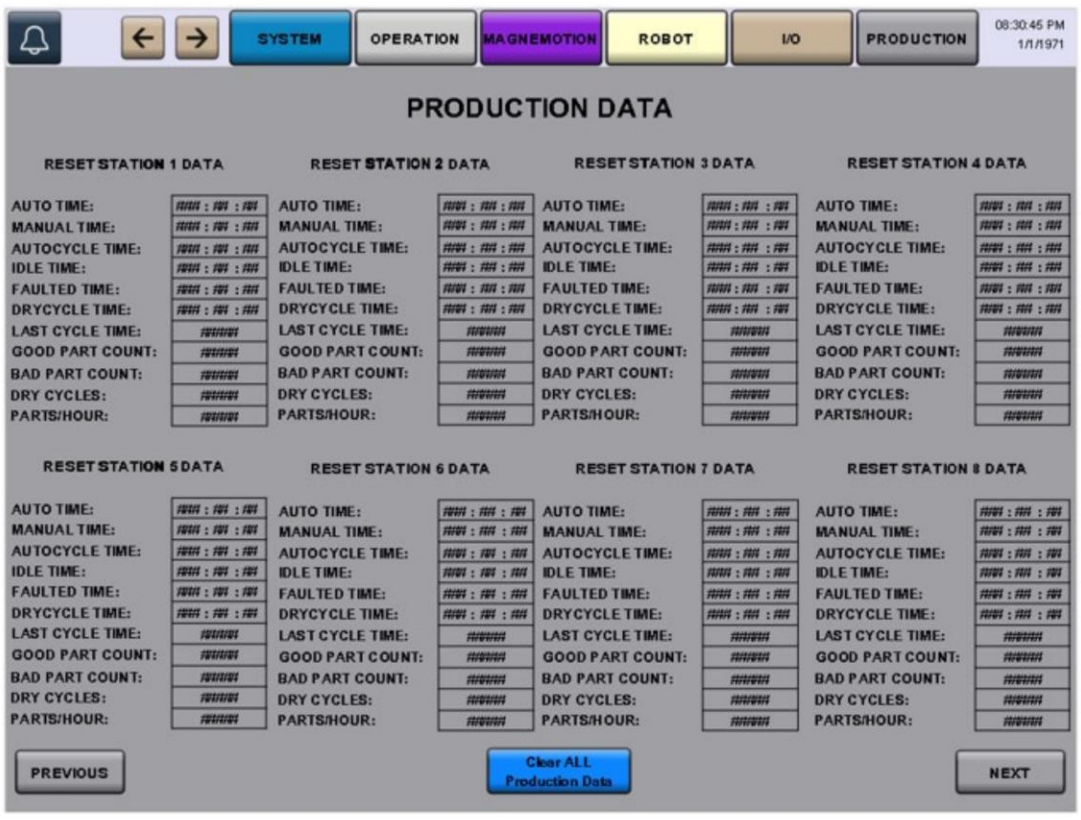

Figure 6-8 Production Data Screen Example

The image shows a "Production Data" screen from an industrial control system interface. The screen is divided into sections for different reset stations, each displaying various metrics related to production data. The sections are labeled "RESET STATION 1 DATA" through "RESET STATION 7 DATA." Each section includes the following metrics:

- AUTO TIME

- MANUAL TIME

- AUTOCYCLE TIME

- IDLE TIME

- FAULTED TIME

- DRYCYCLE TIME

- LAST CYCLE TIME

- GOOD PART COUNT

- BAD PART COUNT

- DRY CYCLES

- PARTS/HOUR

The data fields for each metric are currently filled with placeholder symbols (###), indicating that no specific data is displayed at the moment.

At the bottom of the screen, there are buttons labeled "PREVIOUS," "Clear ALL Production Data," and "NEXT." The top of the screen has navigation buttons labeled "SYSTEM," "OPERATION," "MAGNETOM," "ROBOT," "I/O," and "PRODUCTION." The current time and date are displayed in the top right corner as "08:30:45 PM" and "1/1/1971."

Below the image, there is a caption that reads "Figure 6-8 Production Data Screen Example."

6.9 MagneMotion Screen

MagneMotion screens are used to view and manipulate the MagneMotion transport system's functions, I/O, and parameters.

Vial Fill System specific MagneMotion screens and their uses shall be described in further detail in later section of this manual.

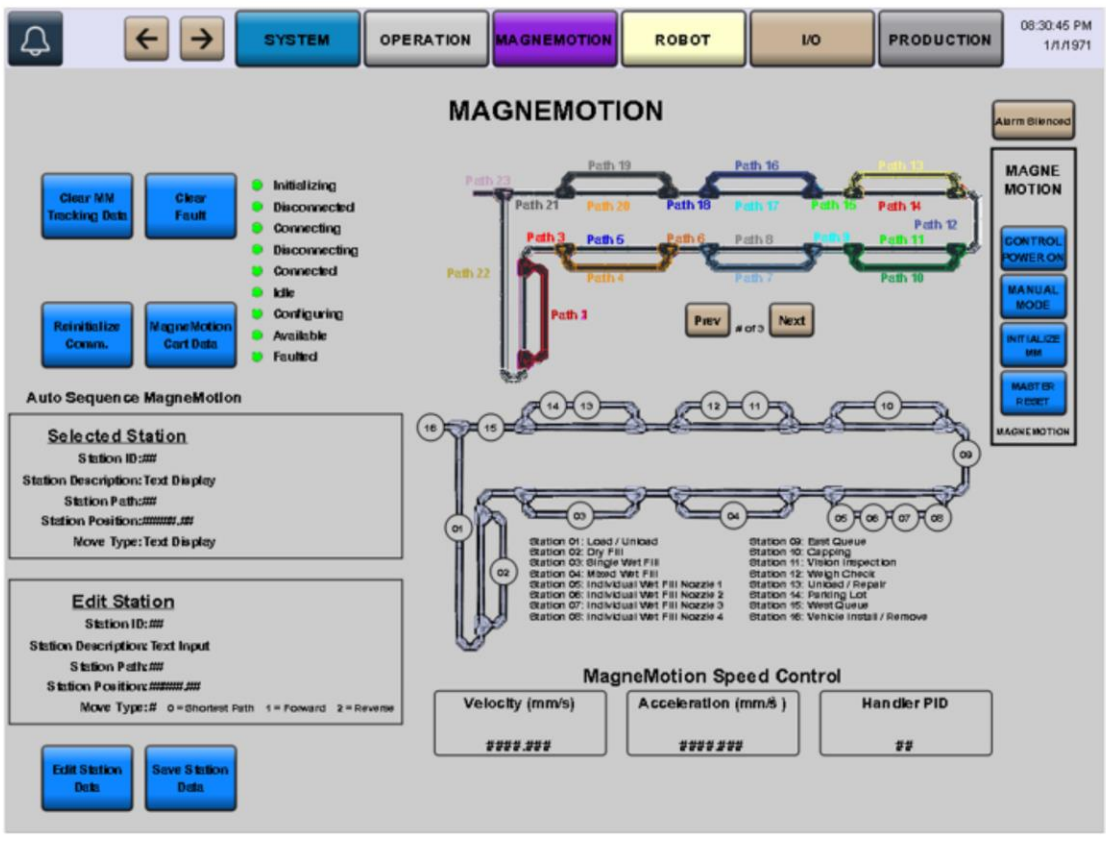

Figure 6-9 MagneMotion Screen Example

The image (Figure 6-9) is a screenshot of a control interface for a MagneMotion system, which is used for automated material handling. Here is a detailed description of the various sections and elements in the interface:

1. Top Navigation Bar:
  - Contains buttons for different sections: SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, PRODUCTION.
  - There are also back and home buttons on the left side.

2. Main Display Area:
  - MagneMotion Path Map: A visual representation of the paths (Path 1, Path 2, etc.) and stations (S01, S02, etc.) in the system.
  - Path Navigation: Buttons labeled "Prev" and "Next" to navigate through different paths.
  - Status Indicators: Lights indicating the status of the system (Initializing, Disconnected, Connecting, Connected, Idle, Configuring, Available, Faulted).

3. Control Buttons:
  - Clear NM Tracking Data
  - Clear Fault
  - Reinitialize Comm.
  - MagneMotion Cart Data

4. Auto Sequence MagneMotion:
  - Selected Station: Displays information about the selected station, including Station ID, Description, Position, and Type.
  - Edit Station: Allows editing of station information, including Station ID, Description, Path, and Position.

5. MagneMotion Speed Control:
  - Controls for setting the Velocity (mm/s), Acceleration (mm/s^2), and Handler PID.

6. Right Sidebar:
  - Alarm Silence
  - MagneMotion Controls: Buttons for Control Power On, Manual Mode, Initialize, Main Reset, and MagneMotion.

7. Bottom Buttons:
  - Edit Station Data
  - Save Station Data

The interface is designed to provide comprehensive control and monitoring of the MagneMotion system, allowing operators to manage paths, stations, and system parameters effectively.

7 HMI Security

Typical application and HMI Security shall utilize the built-in security features of the HMI. Only applications that need to interface with plant systems for security authorizations shall use PLC based security functionality.

Unless otherwise provided by the customer at the time of Purchase Order and Project Kick-Off meeting, the following security levels and passwords have been used.

Security:

User	Password
APT	801
SUP	see
MAINT	fix
ENG	idea

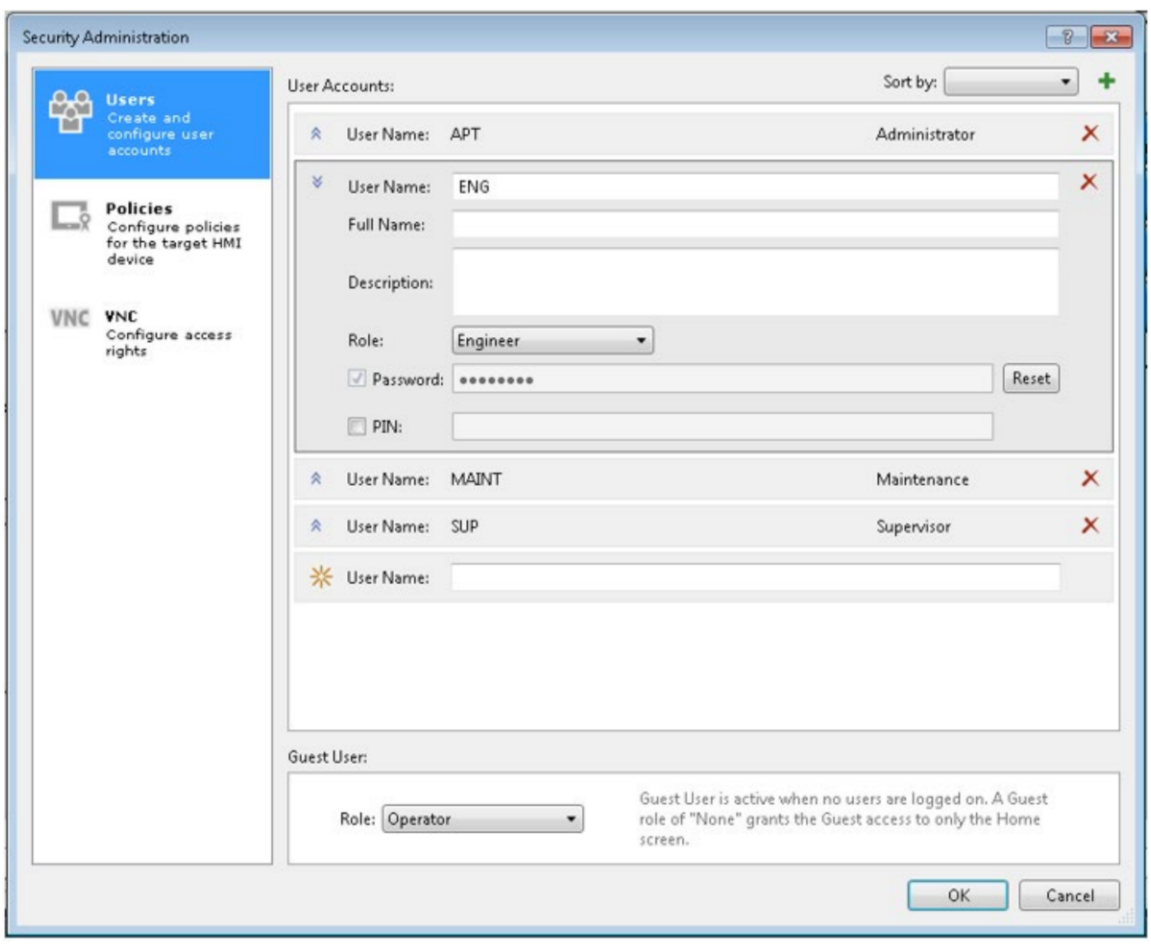

Figure 7-1 HMI Security Administration

The image shows a screenshot of the "Security Administration" window from an HMI (Human-Machine Interface) system. The window is used to manage user accounts and their roles. Here is a detailed description of the elements in the image:

1. Left Panel:

- Users: Create and configure user accounts.

- Policies: Configure policies for the target HMI device.

- VNC: Configure access rights.

2. User Accounts Section:

- User Name: APT (Role: Administrator)

- User Name: ENG (Role: Engineer)

- Fields for Full Name, Description, Password, and PIN.

- User Name: MAINT (Role: Maintenance)

- User Name: SUP (Role: Supervisor)

- An empty field for adding a new user name.

3. Guest User Section:

- Role: Operator (Dropdown menu to select the role for the guest user)

- Note: "Guest User is active when no users are logged on. A Guest role of 'None' grants the Guest access to only the Home screen."

4. Buttons:

- OK and Cancel buttons at the bottom right corner.

The image is labeled as "Figure 7-1 HMI Security Administration" at the bottom.

8 Passwords

APT makes all efforts to use the default passwords provided with the hardware. However, it is common for the hardware manufacture to require changing of the default passwords. Unless otherwise provided by the customer at the time of Purchase Order and Project Kick-Off meeting, the following passwords shall be used.

Standard Password:	APTmfg801
Password Requiring Special Character:	APTmfg801!
Numeric Only Password:	801
Numeric and Special Character:	801!
Studio 5000 VNC Password:	APTmfg

**HMI equipment with VNC server installed will be configured with read and control access set to the numeric password listed in the table above. VNC hardware requiring special characters will use the numeric and special character password listed in the table above.

9 Vial Fill Machine Setup

9.1 Station Setup

This section provides a brief description of how to navigate and configure the stations through the HMI system setup screens. Some setup configurations are only accessible under security accounts.

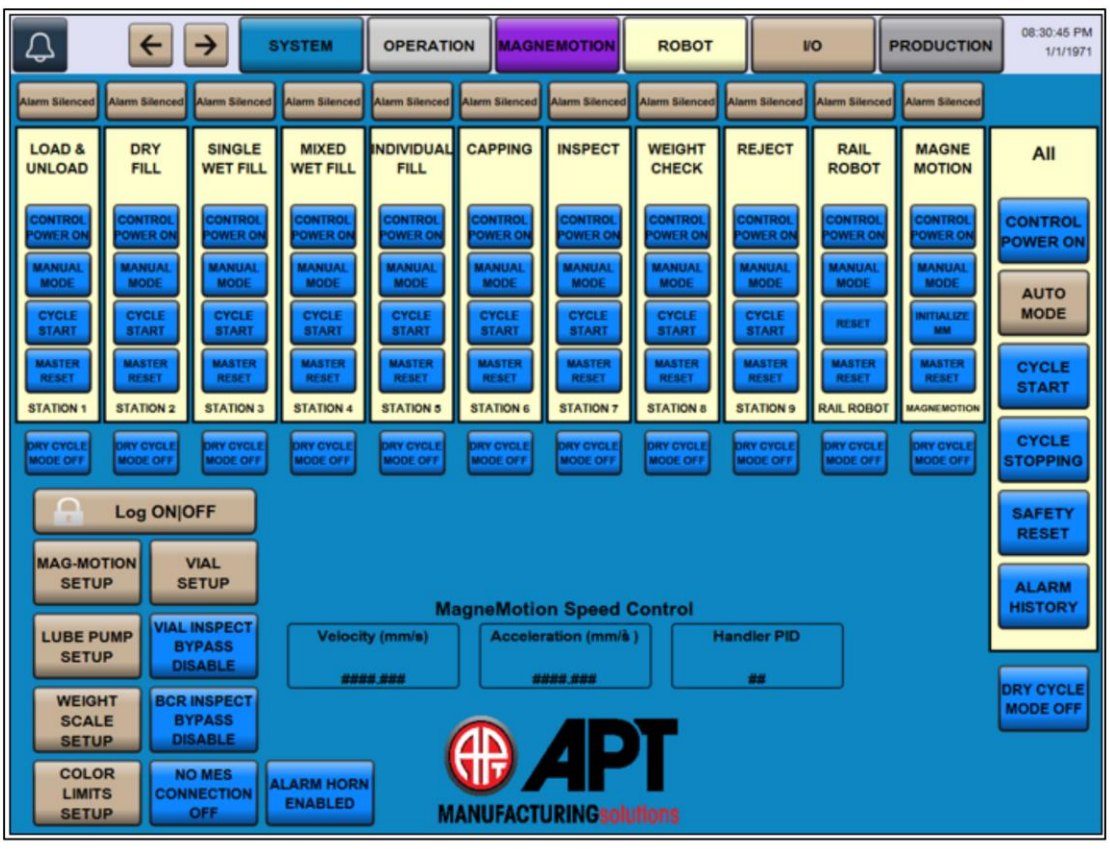

Figure 9-1 System Setup Main Screen

The image shows a system setup main screen for a manufacturing process, specifically from APT Manufacturing Solutions. The screen is divided into several sections, each representing different stages of the manufacturing process. Here is a detailed description of the screen:

Top Navigation Bar:
- Buttons: SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, PRODUCTION
- Time and Date: Displayed on the top right corner (08:30:45 PM, 1/1/1971)

Main Sections:
1. Load & Unload
2. Dry Fill
3. Single Wet Fill
4. Mixed Wet Fill
5. Individual Fill
6. Capping
7. Inspect
8. Weight Check
9. Reject
10. Rail Robot
11. Magne Motion

Each section has the following controls:
- Control Power On
- Manual Mode
- Cycle Start
- Master Reset
- Station Number

Right Side Controls:
- All: Control Power On, Auto Mode, Cycle Start, Cycle Stopping, Safety Reset, Alarm History, Dry Cycle Mode Off

Bottom Section:
- Log ON/OFF
- Mag-Motion Setup
- Vial Setup
- Lube Pump Setup
- Vial Inspect Bypass Disable
- Weight Scale Setup
- BCR Inspect Bypass Disable
- Color Limits Setup
- No MES Connection Off
- Alarm Horn Enabled

MagneMotion Speed Control:
- Velocity (mm/s)
- Acceleration (mm/s^2)
- Handler PID

Branding:
- APT Manufacturing Solutions Logo

Figure Caption:
- Figure 9-1 System Setup Main Screen

This screen is likely used for monitoring and controlling various stages of a manufacturing process, providing operators with the ability to manage and troubleshoot different aspects of the system.

9.1.1 Login / Logout

The system login screen is where different security accounts can be entered or exited to access different functions of the HMI. The display shows the current user logged in. By selecting the login button, a pop-up will allow for entry of a user and password. Selecting the logout button, the system will log out to the "Default" user security profile. User accounts and passwords are only editable via the View Designer Application development software.

Figure 9-2 Login Screen PopUp

The image shows a login screen pop-up window with the title "Logon." The window has the following elements:

1. User Name: A text field labeled "User Name:" with the value "eng" entered.

2. Password: A password field labeled "Password:" with three asterisks (***), indicating that a password has been entered.

3. Log on: A button labeled "Log on" next to the password field.

4. Logged on: A section labeled "Logged on:" with the value "ENG" displayed.

5. Log off: A button labeled "Log off" below the "Logged on" section.

At the bottom of the image, there is a caption that reads "Figure 9-2 Login Screen Pop Up."

9.1.2 Dry Cycle Mode

When Dry Cycle Mode On is selected, the station will emulate an auto sequence once the system is started ignoring part presence indicators. For Dry Cycle to function, no parts can be in the system. Each time the system is started up in Dry Cycle mode, the Dry Cycle count is reset.

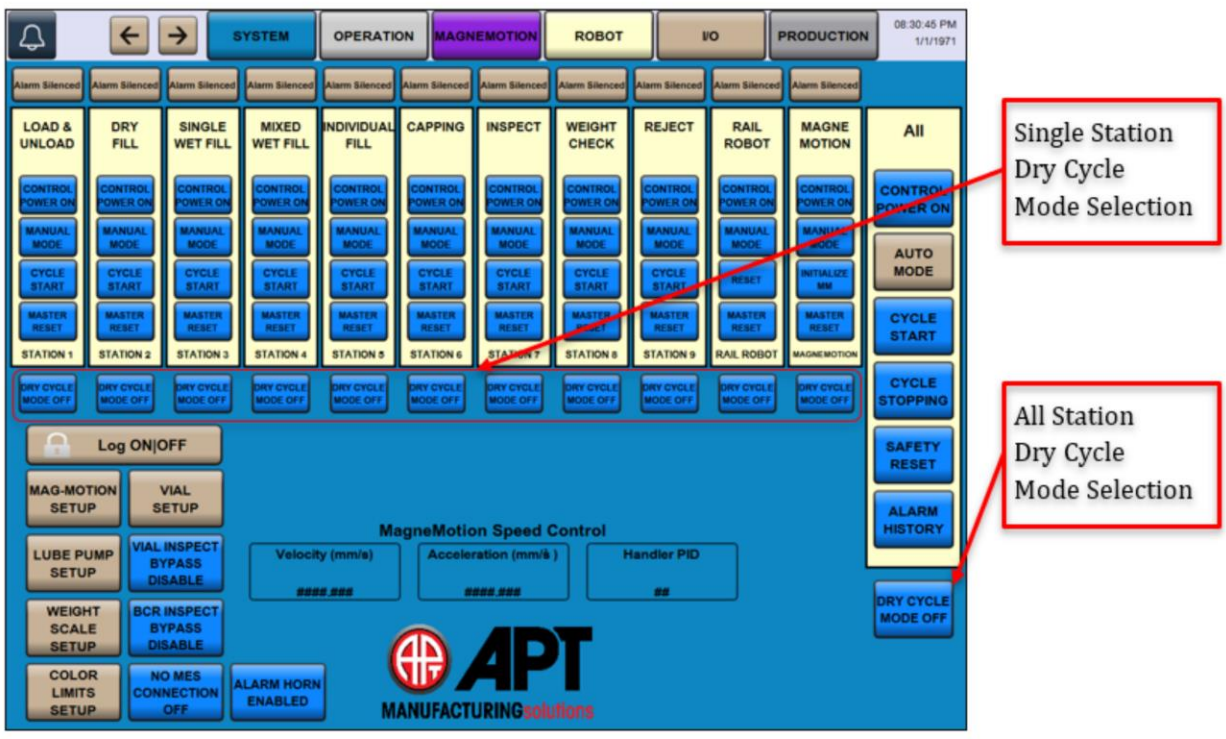

Figure 9-3 Dry Cycle Mode Selection

The image shows a control panel interface for a manufacturing system, specifically for selecting dry cycle modes. The interface is divided into several sections, each with different functions and controls.

Key elements of the interface include:

1. Tabs at the Top: These tabs allow navigation between different sections of the system, such as SYSTEM, OPERATION, MAGNETMOTION, ROBOT, I/O, and PRODUCTION.

2. Alarm Controls: There are multiple "Alarm Silenced" buttons at the top, indicating the ability to silence alarms for different stations or processes.

3. Station Controls: The main section of the interface is divided into columns for different stations and processes, such as LOAD & UNLOAD, DRY FILL, SINGLE WET FILL, MIXED WET FILL, INDIVIDUAL FILL, CAPPING, INSPECT, WEIGHT, REJECT, RAIL MOTION, and ALL. Each column has buttons for controlling the conveyor, cycle start, master start, and other specific functions.

4. Dry Cycle Mode Selection:
- Single Station Dry Cycle Mode Selection: This is indicated by a red arrow pointing to the "DRY CYCLE MODE" button in the "ALL" column.
- All Station Dry Cycle Mode Selection: This is indicated by another red arrow pointing to the "DRY CYCLE MODE OFF" button at the bottom right of the interface.

5. Log ON/OFF: A section for logging in and out of the system.

6. Setup Options: Various setup options for MagneMotion, Vial, Lube Pump, Weight Scale, Color Limits, and more.

7. MagneMotion Speed Control: A section for controlling the speed of the MagneMotion system, with fields for velocity, acceleration, and handler PID.

8. Safety and Alarm Controls: Buttons for safety reset and alarm history.

The interface is branded with the logo of APT Manufacturing Solutions, and the figure is labeled as "Figure 9-3 Dry Cycle Mode Selection."

9.1.3 Robot Speeds

Robot general override speeds are linked and controlled by the system PLC and are configurable through the HMI robot screens. Three override speeds are available for modification.

The general robot speed sets the speed of the robot for all general movements.

The robot load speed configuration controls the speed of the robot while the robot has a part on the end of arm tool (EOAT).

The robot safe speed configuration controls the speed of the robot during safe move functions such as performing a safe home routine, or when an obstruction is detected in the area scanner warning zone.

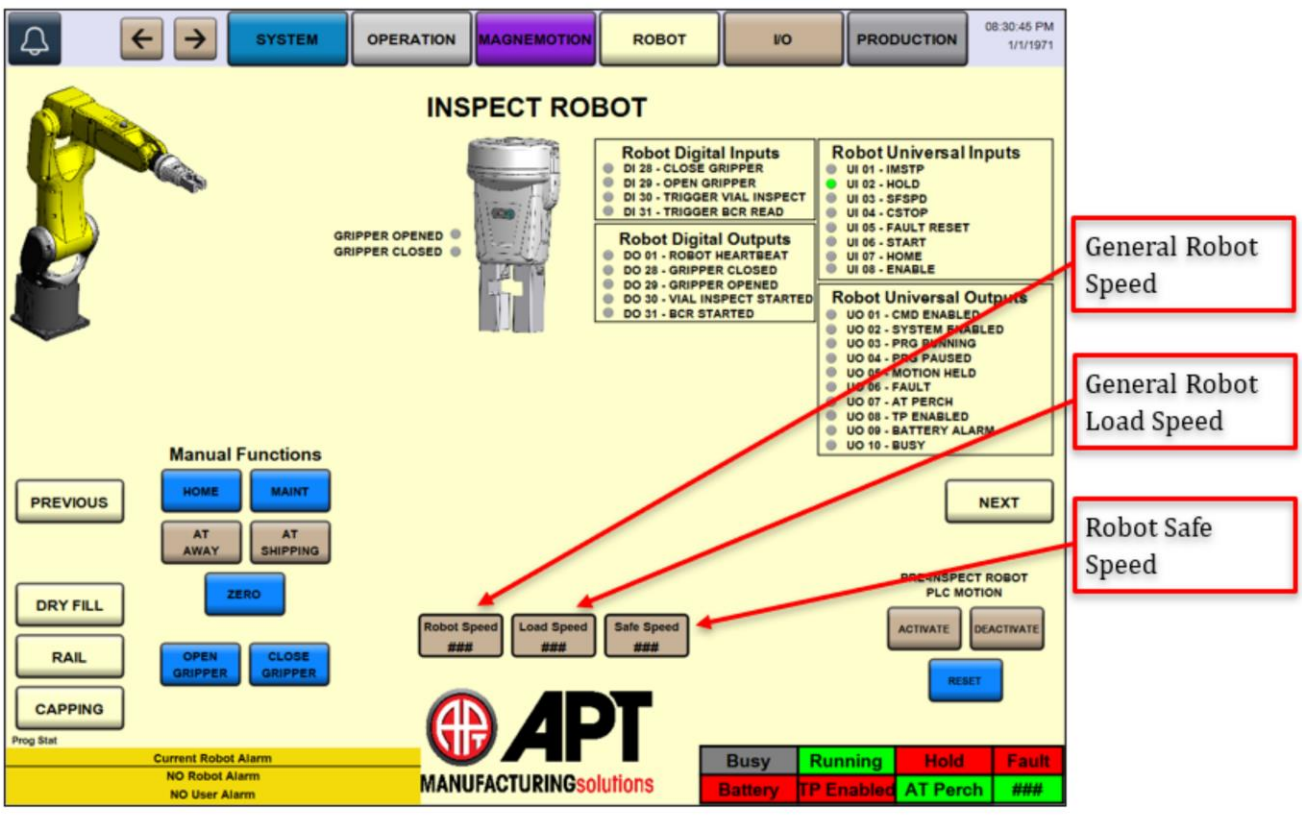

Figure 9-4 Robot Speed Configuration

The image (Figure 9-4) is a screenshot of a control interface for an inspection robot, specifically from APT Manufacturing Solutions. The interface includes various buttons, indicators, and information related to the robot's operation. Here are the key elements:

1. Tabs at the Top:
   - SYSTEM
   - OPERATION
   - MAGNETOMOTION
   - ROBOT
   - I/O
   - PRODUCTION

2. Robot Image:
   - A visual representation of the robot is shown on the left side.

3. Robot Digital Inputs and Outputs:
   - Lists of digital inputs and outputs for the robot are displayed in the center-right section.

4. Manual Functions:
   - Buttons for various manual functions such as HOME, MAINT, AT AWAY, AT SHIPPING, DRY FILL, RAIL, CAPPING, OPEN GRIPPER, and CLOSE GRIPPER.

5. Speed Configuration:
   - Three buttons labeled "Robot Speed," "Load Speed," and "Safe Speed" are highlighted with red arrows and text indicating their functions:
     - General Robot Speed
     - General Robot Load Speed
     - Robot Safe Speed

6. APT Manufacturing Solutions Logo:
   - The logo is displayed prominently in the lower center of the interface.

7. Status Indicators:
   - Indicators for the robot's status, such as Busy, Running, Hold, Fault, Battery, TP Enabled, AT Perch, and a numerical display.

8. Current Robot Alarm:
   - A section at the bottom left indicating the current robot alarm status, showing "No Robot Alarm" and "No User Alarm."

9. Activate/Deactivate and Reset Buttons:
   - Buttons for activating, deactivating, and resetting the robot are located on the right side.

The interface is designed to provide comprehensive control and monitoring of the inspection robot, allowing operators to manage its functions and speeds effectively.

9.1.4 Inspection Bypass

The vial inspect bypass will accept vials with pass conditions while enabled.

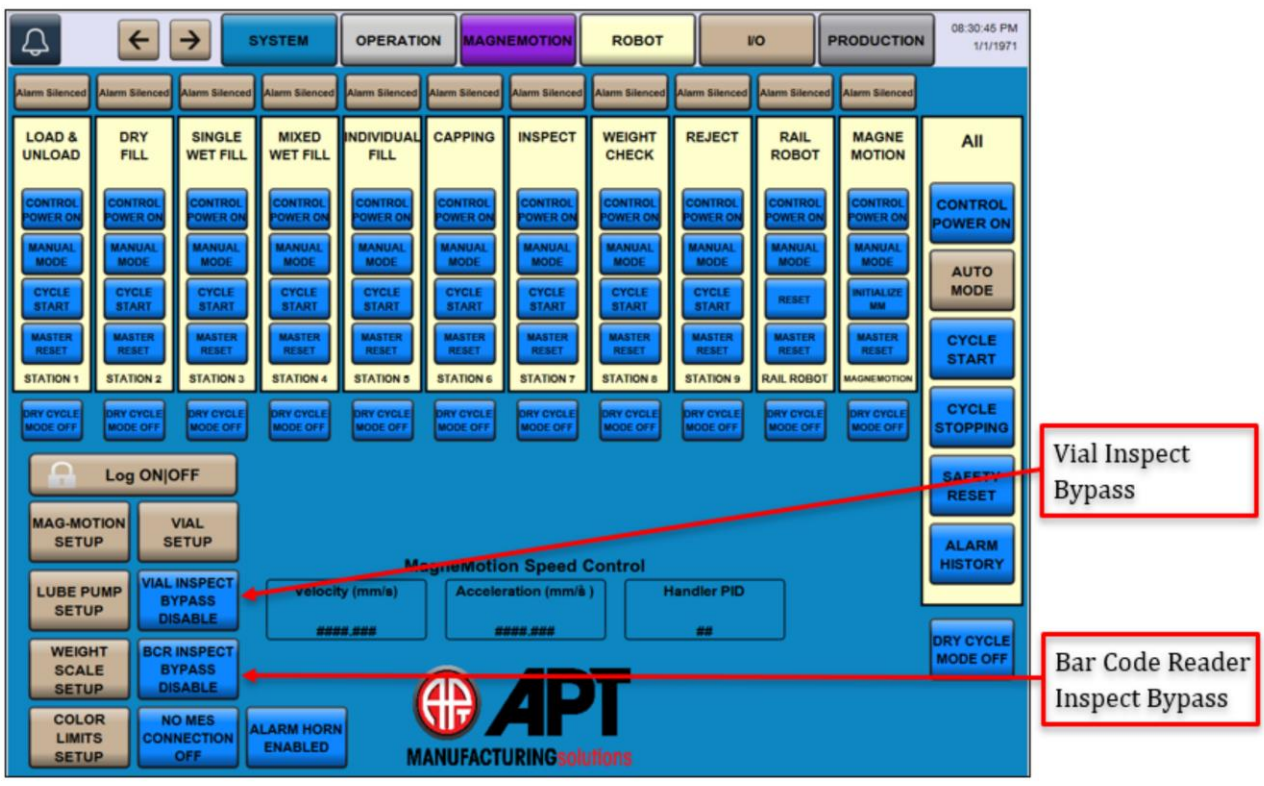

Figure 9-5 Stack Light Test Feature

The image shows a control panel interface for a manufacturing system, specifically for a machine that appears to handle various stages of vial processing. The interface is divided into several sections, each with its own set of controls and indicators. Here is a detailed description of the interface:

Top Section:

- Alarm Silence Buttons: There are multiple "Alarm Silence" buttons at the top, likely used to mute alarms for different stations or processes.
- Tabs: The interface has several tabs labeled "SYSTEM," "OPERATION," "MAGNEMOTION," "ROBOT," "I/O," and "PRODUCTION," indicating different views or control panels for various aspects of the system.
- Time and Date: The top right corner displays the current time and date.

Main Control Area:

- Process Stages: The main area is divided into columns representing different stages of the vial processing:
  - LOAD & UNLOAD
  - DRY FILL
  - SINGLE WET FILL
  - MIXED WET FILL
  - INDIVIDUAL FILL
  - CAPPING
  - INSPECT
  - WEIGHT CHECK
  - REJECT
  - RAIL ROBOT
  - MAGNE MOTION
  - ALL

Each stage has buttons for "CONTROL POWER ON," "MANUAL MODE," "AUTO MODE," "START," and "STOP," along with station numbers.

Right Section:

- Control Buttons: On the right side, there are buttons for "CONTROL POWER ON," "AUTO MODE," "CYCLE START," "CYCLE STOPPING," "SAFETY RESET," "ALARM HISTORY," and "DRY CYCLE MODE OFF."

Left Section:

- Log ON/OFF: A button for logging in or out of the system.
- Setup Buttons: Buttons for various setups:
  - MAG-MOTION SETUP
  - VIAL SETUP
  - LUBE PUMP SETUP
  - WEIGHT SCALE SETUP
  - COLOR LIMITS SETUP
  - NO MES CONNECTION OFF

Bypass Controls:

- VIAL INSPECT BYPASS DISABLE: A button to disable the bypass for vial inspection.
- BCR INSPECT BYPASS DISABLE: A button to disable the bypass for bar code reader inspection.

Speed Control:

- Magnemotion Speed Control: Fields for setting or displaying "Velocity (mm/s)," "Acceleration (mm/s^2)," and "Handler PID."

Branding:

- APT Manufacturing Solutions: The logo and name of the company are displayed at the bottom center of the interface.

Figure Label:

- Figure 9-5 Stack Light Test Feature: A label at the bottom of the image indicating that this is Figure 9-5, related to the stack light test feature.

This control panel interface is designed to manage and monitor various stages of a vial processing system, providing comprehensive control and setup options for operators.

9.1.5 No Mes Connection

Randomly populates process data into the production queue.

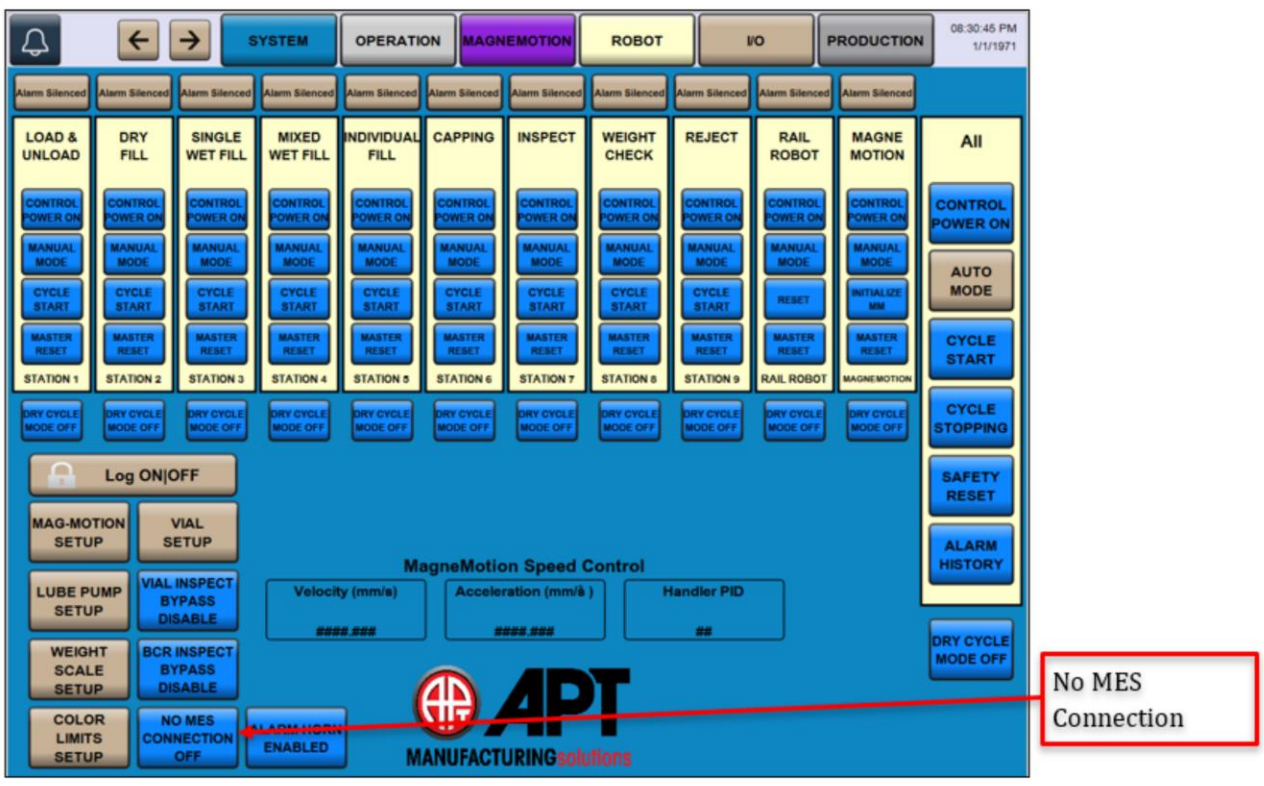

Figure 9-6 No MES Connection Setting

The image shows a control panel interface for a manufacturing system, specifically from APT Manufacturing Solutions. The interface is divided into several sections, each with various buttons and controls for different functions.

Key sections and features include:

1. Top Navigation Bar: Contains tabs for different sections such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. There is also a timestamp in the top right corner.
2. Alarm Silence Buttons: Located at the top of each column, these buttons are labeled "Alarm Silence."
3. Station Controls: Each station (1 through 7, Rail Robot, and MagneMotion) has its own set of controls, including:
   - CONTROL POWER ON
   - MANUAL MODE
   - MASTER START
   - MASTER RESET
   - CYCLE STOPPING
   - DRY CYCLE MODE OFF
4. General Controls: On the right side, there are general controls for the entire system, including:
   - CONTROL POWER ON
   - AUTO MODE
   - CYCLE START
   - CYCLE STOPPING
   - SAFETY RESET
   - ALARM HISTORY
   - DRY CYCLE MODE OFF
5. Settings and Setup: On the left side, there are buttons for various setups and settings, such as:
   - Log ON/OFF
   - MAG-MOTION SETUP
   - VIAL SETUP
   - LUBE PUMP SETUP
   - WEIGHT SCALE SETUP
   - COLOR LIMITS SETUP
   - VIAL INSPECT BYPASS DISABLE
   - BCR INSPECT BYPASS DISABLE
6. MagneMotion Speed Control: In the center, there are controls for adjusting the speed of the MagneMotion system, including:
   - Velocity (mm/s)
   - Acceleration (mm/s^2)
   - Handler PID
7. No MES Connection: At the bottom, there is a highlighted section indicating "No MES Connection," suggesting that the Manufacturing Execution System (MES) is not connected.

The image is labeled "Figure 9-6 No MES Connection Setting," indicating that it is part of a larger document or manual.

9.1.6 Alarm Horn

Disables the alarm from emitting noise when a system fault is triggered. Horn will still trigger when cycle starting the cell.

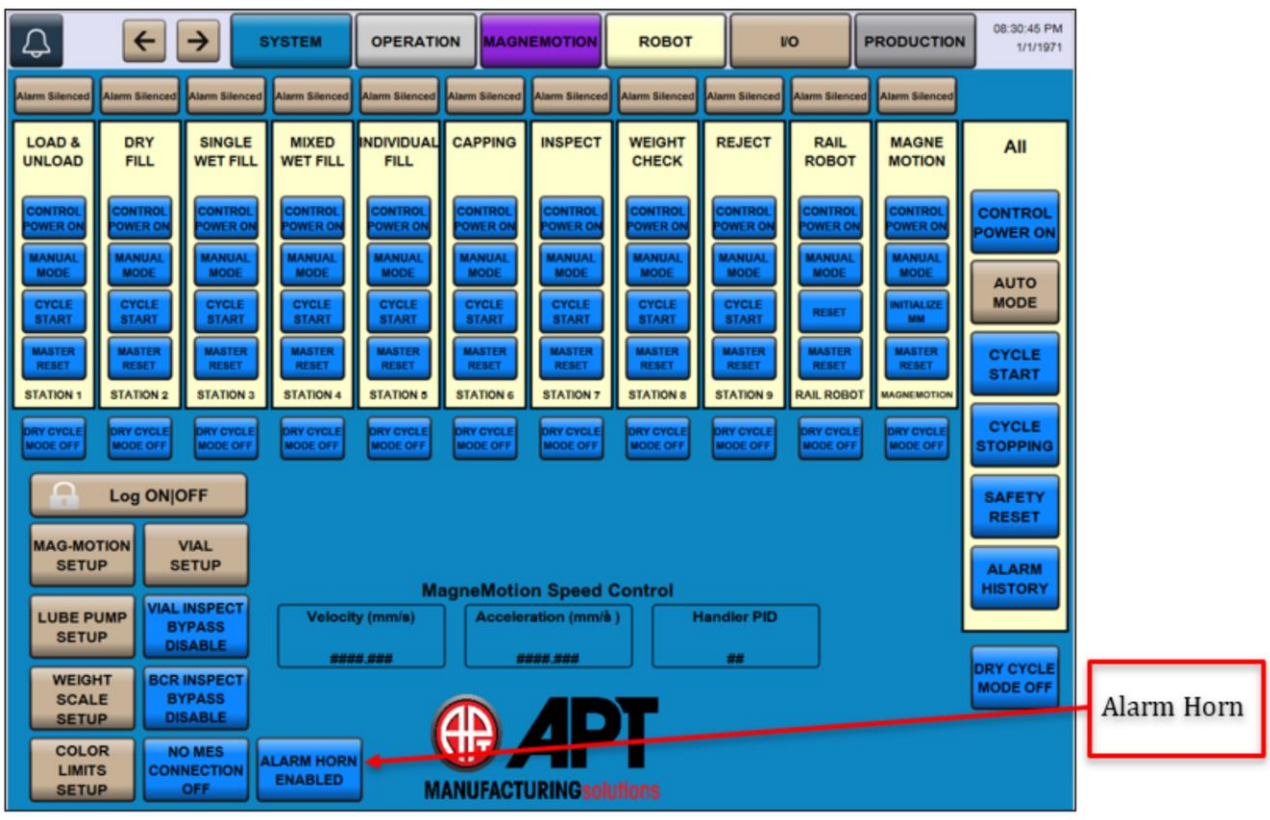

Figure 9-7 Alarm Horn Control

The image (Figure 9-7) shows a control panel interface for a manufacturing system, specifically highlighting the "Alarm Horn Control" section. The interface includes various buttons and indicators for different operations and settings.

Key elements of the interface include:

1. System Tabs: At the top, there are tabs for different sections such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION.
2. Operation Buttons: Below the tabs, there are buttons for different operations like LOAD & UNLOAD, DRY FILL, SINGLE WET FILL, MIXED WET FILL, INDIVIDUAL FILL, CAPPING, INSPECT, WEIGHT CHECK, REJECT, RAIL ROBOT, and MAGNE MOTION.
3. Control Buttons: Each operation has associated control buttons such as CONTROL POWER ON, MANUAL MODE, CYCLE START, RESET, and DRY CYCLE MODE OFF.
4. General Controls: On the right side, there are general control buttons like CONTROL POWER ON, AUTO MODE, CYCLE START, CYCLE STOPPING, SAFETY RESET, ALARM HISTORY, and DRY CYCLE MODE OFF.
5. Settings and Setup: On the left side, there are buttons for settings and setup like Log ON/OFF, MAG-MOTION SETUP, VIAL SETUP, LUBE PUMP SETUP, WEIGHT SCALE SETUP, COLOR LIMITS SETUP, and others.
6. MagneMotion Speed Control: In the center, there is a section for MagneMotion Speed Control with fields for Velocity, Acceleration, and Handler PID.
7. Alarm Horn Control: At the bottom left, there is a button labeled "ALARM HORN ENABLED," which is highlighted and pointed out as the "Alarm Horn Control."

The interface is designed to manage and control various aspects of a manufacturing process, with a specific focus on enabling or disabling the alarm horn.

9.2 Sequence of Operations

PLC logic provided with the demonstration program uses sequence-based logic otherwise known as step logic. The following section details the sequence of operations for all stations in the logic. This information is also provided on the HMI as the station steps though its sequence.

9.2.1 Station 1 Load Auto Sequence

Station 1 Step 10: Pick Empty Vial from Tray 3
Station 1 Step 20: Waiting for Vial to be Picked from Tray 3
Station 1 Step 30: Inspect Vial Position 1
Station 1 Step 40: Waiting for Vial Inspection Position 1 to Complete
Station 1 Step 50: Checking Position 1 Inspection Results
Station 1 Step 60: Inspect Vial Position 2
Station 1 Step 70: Waiting for Vial Inspection Position 2 to Complete
Station 1 Step 80: Checking Position 2 Inspection Results
Station 1 Step 90: Inspect Vial Position 3
Station 1 Step 100: Waiting for Vial Inspection Position 3 to Complete
Station 1 Step 110: Checking Position 3 Inspection Results
Station 1 Step 115: Checking for BCR Bypass
Station 1 Step 120: Inspect Vial Bar Code Reader
Station 1 Step 130: Waiting for Vial Bar Code Reader to Complete
Station 1 Step 140: Checking Bar Code Reader Results
Station 1 Step 150: Merge Current Vial Data with Scheduler Data
Station 1 Step 160: Wait for MagneMotion Vehicle Present
Station 1 Step 170: Load Vial to MagneMotion
Station 1 Step 180: Waiting for Vial to be Loaded onto MagneMotion
Station 1 Step 190: Transfer Vial Data to MagneMotion Vehicle
Station 1 Step 200: Updating Production Data / End of Cycle
Station 1 Step 300: Load Vial to Tray 1 Reject
Station 1 Step 310: Waiting for Vial to be Loaded to Reject Tray
Station 1 Step 320: Transferring Vial Data from Robot to Reject Tray

9.2.2 Station 1 Unload Auto Sequence

Station 1 Step 10: Pick Vial from MagneMotion
Station 1 Step 20: Waiting for Vial to be Picked from MagneMotion
Station 1 Step 30: Transfer Part Tracking Data to Robot
Station 1 Step 40: Evaluating Tracking Data
Station 1 Step 50: Place Bad Vial to Reject Tray (Tray 1)
Station 1 Step 60: Waiting for Vial to be Placed to Reject Tray (Tray 1)
Station 1 Step 70: Transfer Part Tracking Data to Reject Tray (Tray 1)
Station 1 Step 80: Increment Reject Tray Count
Station 1 Step 90: Place Good Vial to Finished Tray (Tray 2)
Station 1 Step 100: Waiting for Vial to be Placed to Finished Tray (Tray 2)
Station 1 Step 110: Transfer Part Tracking Data to Finished Tray (Tray 2)
Station 1 Step 120: Update Production Data / End of Cycle

9.2.3 Station 2 Auto Sequence

Station 2 Step 10: Sending Process Data to Robot
Station 2 Step 20: Trigger Dry Fill Robot to Run
Station 2 Step 30: Waiting for Robot to Run (PNS 100)
Station 2 Step 40: Waiting for Robot Program to Finish (PNS 100)
Station 2 Step 50: Update Tracking Data
Station 2 Step 60: Updating Production Data / End of Cycle

9.2.4 M1iA Robot PNS Sequence of Operations

Step 00: Waiting for Sequence Start
Step 10: Set PNS Program Number
Step 20: Strobe PNS and Wait for Acknowledgement
Step 30: Send Production Start
Step 40: Wait for Robot to Run

9.2.5 Station 3 Auto Sequence

Station 3 Step 10: Sending Required Data to Symbiont
Station 3 Step 20: Triggering WetFill
Station 3 Step 30: Waiting for WetFill to Complete Process
Station 3 Step 40: Spare
Station 3 Step 50: Updating Tracking Data
Station 3 Step 60: Updating Production Data / End of Cycle

9.2.6 Station 4 Auto Sequence

Station 4 Step 10: Sending Required Data to Symbiont
Station 4 Step 20: Triggering Mixed WetFill
Station 4 Step 30: Waiting for Mixed WetFill to Complete Process
Station 4 Step 40: Spare
Station 4 Step 50: Updating Tracking Data

9.2.7 Station 5 Auto Sequence

9.2.7.1 Wet Fill Individual A Auto Sequence

Station 5 Wetfill A Step 10: Sending Required Data to Symbiont
Station 5 Wetfill A Step 20: Triggering WetFill
Station 5 Wetfill A Step 30: Waiting for WetFill to Complete Process
Station 5 Wetfill A Step 40: Waiting for Robot Program to Finish (PNS 100)
Station 5 Wetfill A Step 50: Updating Tracking Data
Station 5 Wetfill A Step 60: Updating Production Data / End of Cycle

9.2.7.2 Wet Fill Individual B Auto Sequence

Station 5 Wetfill B Step 10: Sending Required Data to Symbiont
Station 5 Wetfill B Step 20: Triggering WetFill
Station 5 Wetfill B Step 30: Waiting for WetFill to Complete Process
Station 5 Wetfill B Step 40: Waiting for Robot Program to Finish (PNS 100)
Station 5 Wetfill B Step 50: Updating Tracking Data
Station 5 Wetfill B Step 60: Updating Production Data / End of Cycle

9.2.7.3 Wet Fill Individual C Auto Sequence

Station 5 Wetfill C Step 10: Sending Required Data to Symbiont
Station 5 Wetfill C Step 20: Triggering WetFill
Station 5 Wetfill C Step 30: Waiting for WetFill to Complete Process
Station 5 Wetfill C Step 40: Waiting for Robot Program to Finish (PNS 100)
Station 5 Wetfill C Step 50: Updating Tracking Data
Station 5 Wetfill C Step 60: Updating Production Data / End of Cycle

9.2.7.4 Wet Fill Individual D Auto Sequence

Station 5 Wetfill D Step 10: Sending Required Data to Symbiont
Station 5 Wetfill D Step 20: Triggering WetFill
Station 5 Wetfill D Step 30: Waiting for WetFill to Complete Process
Station 5 Wetfill D Step 40: Waiting for Robot Program to Finish (PNS 100)
Station 5 Wetfill D Step 50: Updating Tracking Data
Station 5 Wetfill D Step 60: Updating Production Data / End of Cycle

9.2.8 Station 6 Auto Sequence

Station 6 Step 10: Pick Vial Cap
Station 6 Step 20: Waiting for Robot to Pick Vial Cap
Station 6 Step 30: Place Cap onto Vial
Station 6 Step 40: Waiting for Cap to be Placed on Vial
Station 6 Step 50: Transfer Vial Data to MagneMotion
Station 6 Step 60: Updating Production Data / End of Cycle

9.2.9 Station 7 Auto Sequence

Station 7 Step 00: Waiting for Load Request
Station 7 Step 10: Sending Required Process Data to Camera
Station 7 Step 20: Triggering Vision Inspect
Station 7 Step 30: Waiting for Inspect to Complete
Station 7 Step 40: Evaluating Inspect Results
Station 7 Step 50: Updating Tracking Data
Station 7 Step 60: Updating Production Data / End of Cycle

9.2.10 Station 8 Auto Sequence

Station 8 Step 10: Waiting for Rail Robot to be Available
Station 8 Step 20: Pick Vial From MagneMotion
Station 8 Step 30: Waiting for Robot to Pick Vial From MagneMotion
Station 8 Step 40: Transferring Vial Data to Robot
Station 8 Step 50: Place Vial to Check Weight
Station 8 Step 60: Waiting for Vial to be Placed in Check Weigh Station
Station 8 Step 70: Transferring Vial Data to Check Weigh Station
Station 8 Step 80: Evaluating Vial Weight
Station 8 Step 90: Waiting for Rail Robot to be Available
Station 8 Step 100: Pick Vial from CW
Station 8 Step 110: Waiting for Vial to be Picked from CW
Station 8 Step 120: Transfer Vial Data to Robot
Station 8 Step 130: Place Vial to MagneMotion
Station 8 Step 140: Waiting for Vial to be Placed into MagneMotion Cart
Station 8 Step 150: Transferring Vial Data to MagneMotion Cart
Station 8 Step 160: Production Data / End of Cycle

9.2.11 Station 9 Auto Sequence

Station 9 Step 10: Waiting for Rail Robot to be Available
Station 9 Step 20: Picking Vial From MagneMotion
Station 9 Step 30: Waiting for Robot to Pick Vial From MagneMotion
Station 9 Step 40: Transferring Vial Data to Robot
Station 9 Step 50: Place Vial to Reject Tray
Station 9 Step 60: Waiting for Vial to be Placed in Reject Tray
Station 9 Step 70: Transferring Vial Data to Reject Tray
Station 9 Step 80: Updating Tray Count
Station 9 Step 90: Production Data / End of Cycle

9.3 Mode Selection / Station Reset

Mode selection is accomplished through operators on the station HMI. The operators will be display different values and control based on the current state of the machine. Depress the operator to toggle between the modes.

1. Auto / Manual Mode
2. Cycle Start / Reset
3. Cycle Stop / Master Reset
4. Safety Reset

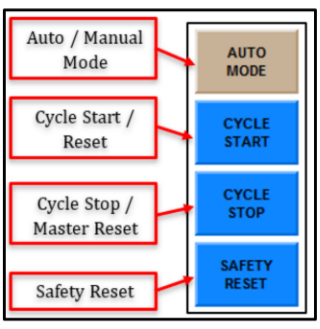

Figure 9-8 Mode Operators

The station has three types of reset functionality:

1. Reset – Resets current faults conditions, send the robot to its safe home position, and readies the station to resume operation from where it left off at the time of fault or disruption. Best thought of as a "resume or retry" operation. Once the Station is placed back into Auto Mode and Cycle Start, the system resumes its previous sequence step.
2. Master Reset – Resets current faults conditions, send the robot to its safe home position, resets the stations sequence of operation back to 0 (starting step number), and readies the station to begin operations as if not parts are in that station. This reset functionality is best thought of as a "give up and start over". Parts or Pallets may need to be removed from the station or robot in the event a Master Reset is induced.
3. Safety Reset – Resets the safety controller and enables the systems hazardous functions controlled by the safety system. This reset is identical to depressing the reset push button on the station electrical enclosure.

Station reset is accomplished through operators on the station HMI. Depress the appropriate operator based on the need to reset the station.

The image is a diagram labeled "Figure 9-8 Mode Operators." It shows a set of buttons used for controlling a machine or system. The buttons are organized into four categories, each with a corresponding label and function:

1. Auto / Manual Mode
  - Button: AUTO MODE (colored in brown)

2. Cycle Start / Reset
  - Button: CYCLE START (colored in blue)

3. Cycle Stop / Master Reset
  - Button: CYCLE STOP (colored in blue)

4. Safety Reset
  - Button: SAFETY RESET (colored in blue)

Each category is connected to its respective button with a red arrow, indicating the function associated with each button.

9.4 Manual Functions

While the station is in Manual Mode, the operator may manually manipulate motions for the station through operators on the HMI. Manual operators may only be visible or function while in manual mode. Manual operators that are displayed while in Auto mode provide an indication of their status only.

Improper movement of motions manually may result in damage to product, pallets, conveyor systems or station components.

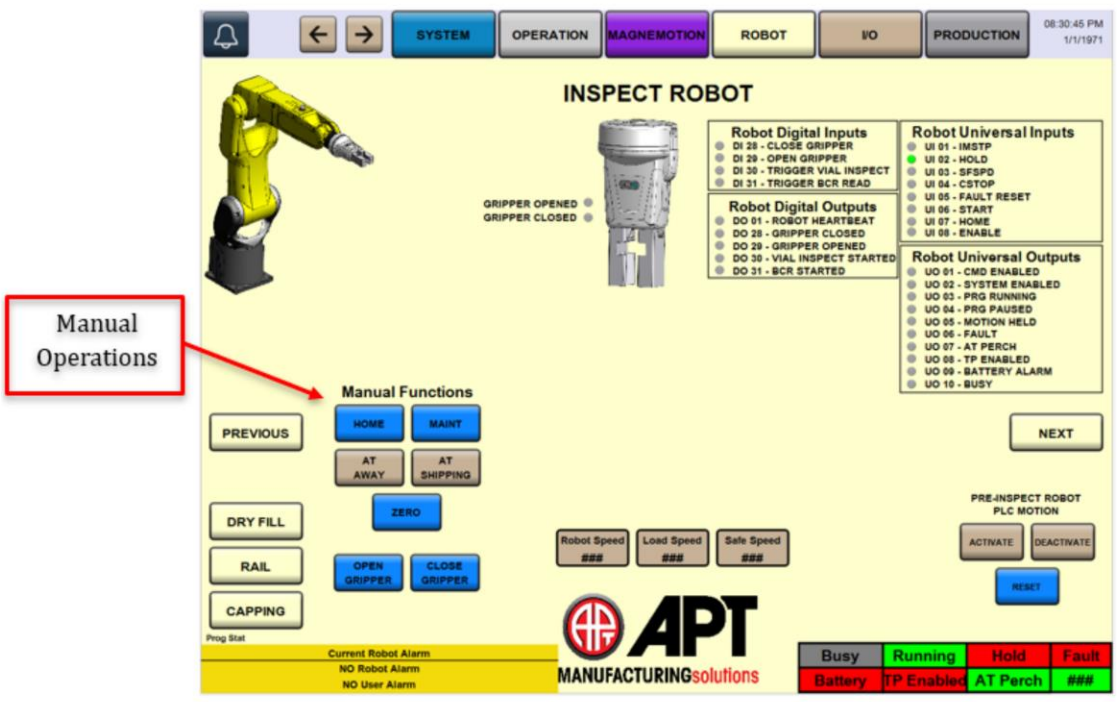

Figure 9-9 Manual Mode Operators

The image is a screenshot of a user interface for controlling a robot in manual mode, specifically for inspecting the robot. The interface is divided into several sections:

1. Top Navigation Bar: Contains buttons for different sections such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION.

2. Main Display Area:
- Inspect Robot: Shows a visual representation of the robot and its gripper status (opened or closed).
- Robot Digital Inputs: Lists various digital inputs with their corresponding statuses.
- Robot Universal Inputs: Lists universal inputs with their corresponding statuses.
- Robot Digital Outputs: Lists digital outputs with their corresponding statuses.
- Robot Universal Outputs: Lists universal outputs with their corresponding statuses.

3. Manual Functions: Contains buttons for various manual operations:
- HOME
- MAINT (Maintenance)
- AT ARRAY
- AT SHIPPING
- DRY FILL
- RAIL
- CAPPING
- ZERO
- OPEN GRIPPERS
- CLOSE GRIPPERS

4. Robot Speed and Load: Displays the robot speed, load speed, and safe speed.

5. Pre-Inspect Robot PLC Information: Contains buttons for activating and deactivating the robot.

6. Status Indicators: Shows the current status of the robot with indicators for Busy, Running, Hold, Fault, Battery, TP Enable, and AT Perch.

7. Current Robot Alarm: Displays the current robot alarm status, indicating "NO Robot Alarm" and "NO User Alarm."

8. APT Manufacturing Solutions: The logo and name of the company providing the interface.

The image is labeled as "Figure 9-9 Manual Mode Operators," indicating it is part of a manual or instructional document.

9.5 Automatic Operation

Automatic operation continually cycles through the sequence of operations defined in section 9.3. To enter automatic operation from initial startup: system control power must be on; the station must be clear of any fault conditions (Reset); Station sequence of operation should be on Step 0 (Master Reset); Place the station in Auto Mode by depressing the "Manual Mode" HMI operator; once in Auto Mode, depress the Cycle Start HMI Operator after holding it for 5 seconds. The station will now begin Automatic Operation.

To safely shut down the station at the end of a cycle, depress the cycle stop HMI operator. The station will continue processing through its current sequence of operations and once that cycle is complete the station will take itself out of Auto Cycle but stay in Auto Mode.

In the even a fault condition occurs during automatic operation, the station will display the appropriate fault message and place itself in manual mode with the cycle stopped. Once the fault condition is resolved, the operator should attempt to retry the operation by the following sequence of HMI interface: Reset; Auto Mode, Cycle Start. The station will resume its previous sequence of operation.

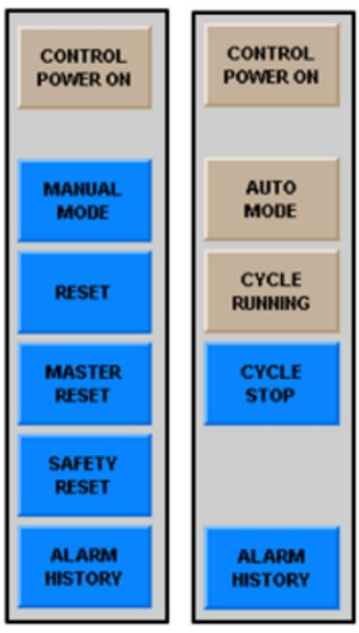

Figure 9-10 Startup & Shutdown Operators

The image shows a diagram labeled "Figure 9-10 Startup & Shutdown Operators." It consists of two vertical panels, each containing a series of buttons and indicators.

Left Panel:
- Top Indicator:
  - "CONTROL POWER ON" (highlighted in beige)
- Buttons (from top to bottom):
  - "MANUAL MODE" (blue)
  - "RESET" (blue)
  - "MASTER RESET" (blue)
  - "SAFETY RESET" (blue)
  - "ALARM HISTORY" (blue)

Right Panel:
- Top Indicator:
  - "CONTROL POWER ON" (highlighted in beige)
- Buttons and Indicators (from top to bottom):
  - "AUTO MODE" (beige)
  - "CYCLE RUNNING" (beige)
  - "CYCLE STOP" (blue)
  - "ALARM HISTORY" (blue)

The left panel appears to be for manual control and reset functions, while the right panel is for automatic mode and cycle control functions. Both panels have an "ALARM HISTORY" button at the bottom.

9.6 HMI Screens & Operations

9.6.1 System Screen

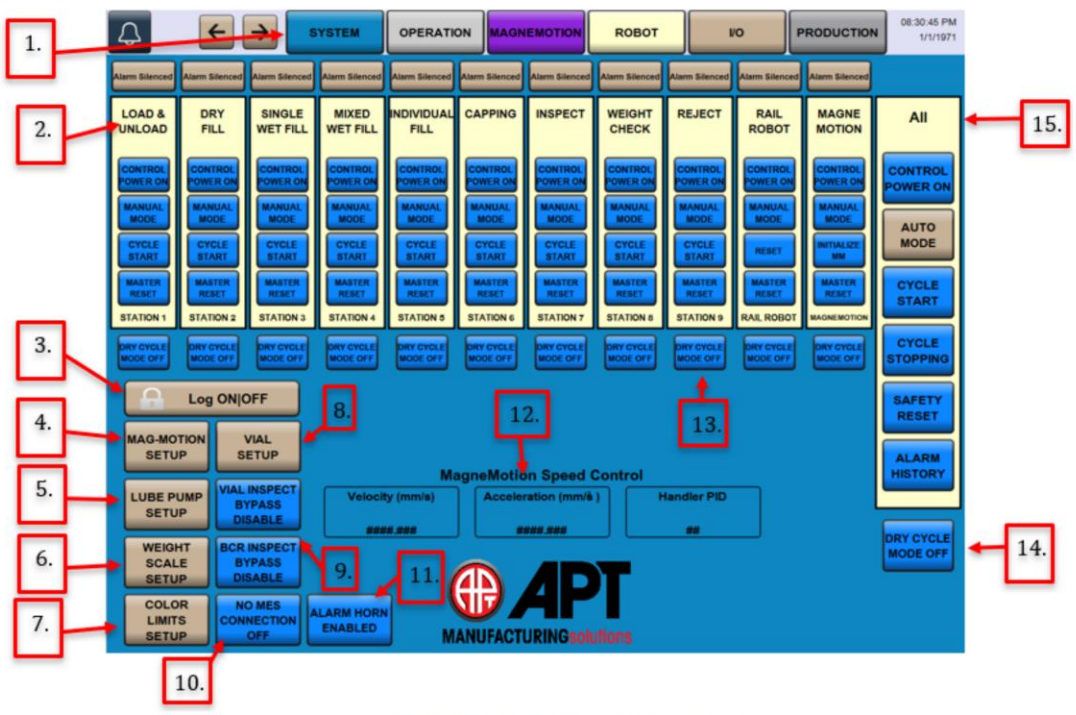

Figure 9-11 System Main Screen

1) Screen Navigation Tabs – Used to navigate to different functions of the HMI.
2) Individual Station Modes – Touch Text to navigate to the station operation screen
3) Login / Logout button
4) Navigate to MagneMotion Setup Screen
5) Navigate to Lube Pump Setup Screen
6) Navigate to Weight Scale Setup Screen
7) Navigate to Color Limits Setup Screen
8) Navigate to Vial Setup Screen
9) Inspect Bypasses – Determines whether the BCR and Vial Inspects are enabled
10) Toggle MES Connection – Determines whether Process Data is randomly generated
11) Toggle Alarm Horn
12) MagneMotion Speed Controls
13) Toggle Individual Dry Cycle Mode
14) Toggle All Dry Cycle Mode
15) All Station Mode Operators

This image (Figure 9-11) is a screenshot of a system main screen from a manufacturing control interface. The screen is divided into several sections, each labeled with a number. Here is a description of each labeled section:

1. Navigation Buttons: Buttons for navigating between different sections of the system (SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, PRODUCTION).

2. Process Stages: Buttons for different stages of the manufacturing process (LOAD & UNLOAD, DRY FILL, SINGLE WET FILL, MIXED WET FILL, INDIVIDUAL FILL, CAPPING, INSPECT, WEIGHT CHECK, REJECT, RAIL ROBOT, MAGNE MOTION).

3. Log ON/OFF: Button to log in or out of the system.

4. MAG-MOTION SETUP: Button to access the setup for MagneMotion.

5. LUBE PUMP SETUP: Button to access the setup for the lube pump.

6. WEIGHT SCALE SETUP: Button to access the setup for the weight scale.

7. COLORS LIMIT SETUP: Button to access the setup for color limits.

8. VIAL SETUP: Button to access the setup for vials.

9. VIAL INSPECT BYPASS ENABLE: Button to enable or disable the bypass for vial inspection.

10. NO MES CONNECTION: Indicator showing the status of the MES connection.

11. ALARM HORN ENABLED: Indicator showing the status of the alarm horn.

12. MagneMotion Speed Control: Section for controlling the speed of the MagneMotion system, including settings for velocity, acceleration, and handler PID.

13. Handler PID: Section for controlling the PID settings for the handler.

14. Control Buttons: Buttons for various control functions (CONTROL POWER ON, AUTO MODE, CYCLE START, CYCLE STOPPING, SAFETY RESET, ALARM HISTORY, DRY CYCLE MODE OFF).

15. Alarm Indicators: Indicators showing the status of various alarms

9.6.1.1 System Lube Pump Screen

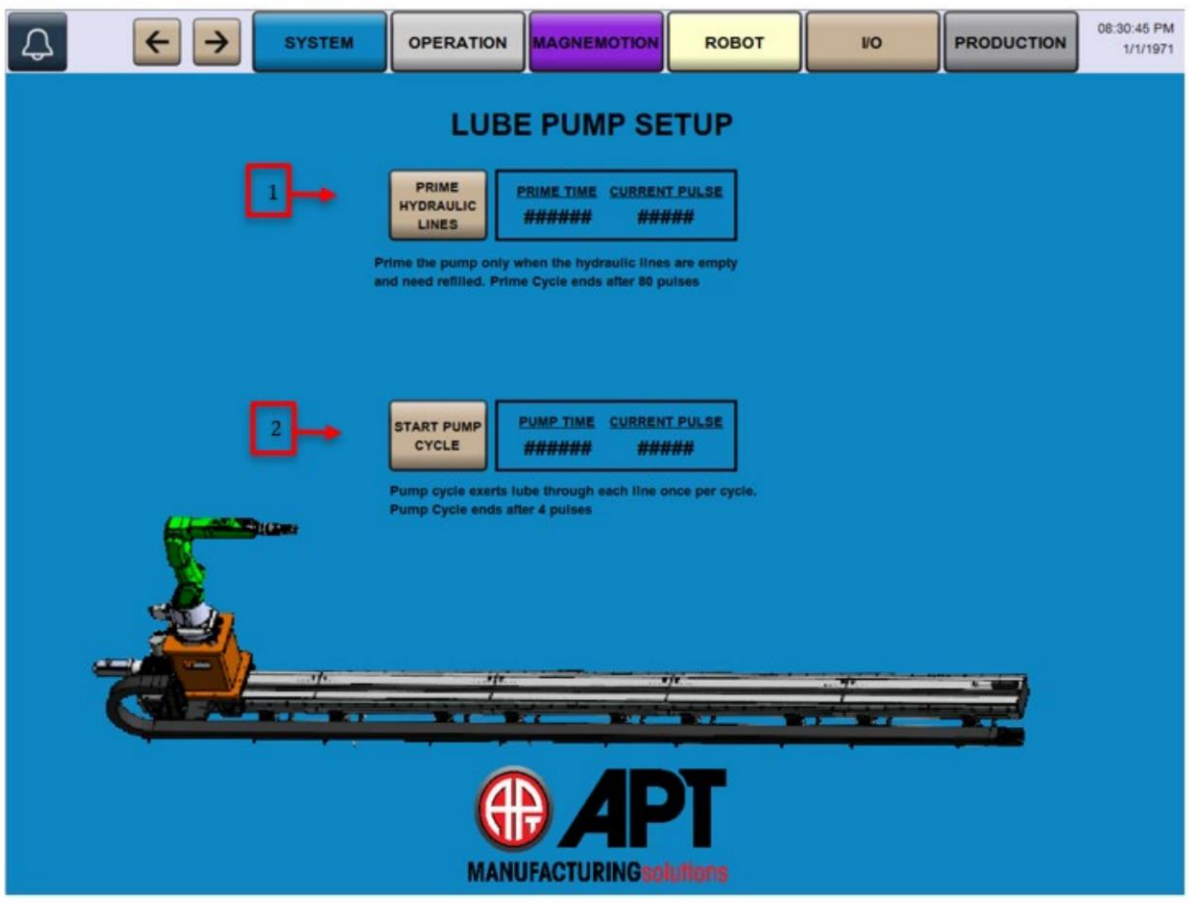

Figure 9-12 Lube Pump Screen

1) Prime Hydraulic Lines – Primes the Lube Lines
2) Start Pump Cycle – excretes one pump of Lube out of each line

The image (Figure 9-12) shows a "Lube Pump Setup" screen from a control system interface, likely for an industrial robot or machinery. The screen is divided into two main sections, each with a corresponding button and description:

1. Prime Hydraulic Lines:

- Button: Labeled with the number 1 and the text "PRIME HYDRAULIC LINES".

- Prime Time and Current Pulse: Display fields for "PRIME TIME" and "CURRENT PULSE".

- Description: "Prime the pump only when the hydraulic lines are empty and need refilled. Prime Cycle ends after 80 pulses."

2. Start Pump Cycle:

- Button: Labeled with the number 2 and the text "START PUMP CYCLE".

- Pump Time and Current Pulse: Display fields for "PUMP TIME" and "CURRENT PULSE".

- Description: "Pump cycle exerts lube through each line once per cycle. Pump Cycle ends after 4 pulses."

At the bottom of the screen, there is an illustration of a robotic arm on a track, and the logo of "APT Manufacturing Solutions" is prominently displayed.

The top of the screen contains navigation buttons for different sections of the control system interface, including SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The current time and date are displayed in the top right corner.

9.6.1.2 Weight Scale Setup Screen

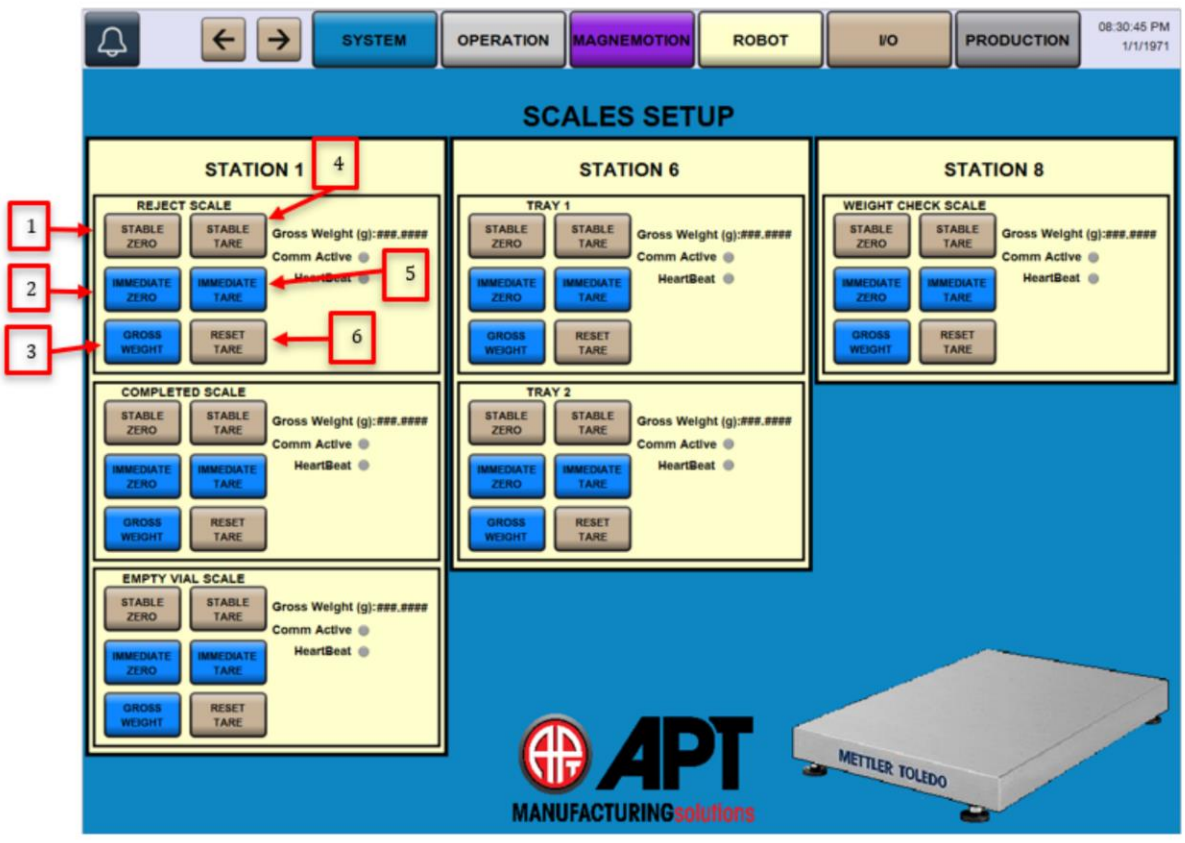

Figure 9-13 Weight Scale Setup

1) Stable Zero Scale
2) Immediate Zero Scale
3) Toggle Gross/Net Weight
4) Stable Tare
5) Immediate Tare
6) Reset Tare

The image (Figure 9-13) is a screenshot of a "Scales Setup" interface from a weight scale system, specifically from APT Manufacturing Solutions. The interface is divided into different sections for various stations and scales. Here is a detailed description of the labeled elements:

1. Reject Scale: This section is part of Station 1 and includes buttons for "Stable Zero," "Immediate Zero," "Gross Weight," and "Reset Tare." It also displays the gross weight and communication status.

2. Completed Scale: This section is also part of Station 1 and includes similar buttons as the Reject Scale: "Stable Zero," "Immediate Zero," "Gross Weight," and "Reset Tare." It also displays the gross weight and communication status.

3. Empty Vial Scale: This section is part of Station 1 and includes buttons for "Stable Zero," "Immediate Zero," "Gross Weight," and "Reset Tare." It also displays the gross weight and communication status.

4. Station 1: This label indicates the section of the interface dedicated to Station 1, which includes the Reject Scale, Completed Scale, and Empty Vial Scale.

5. Station 6: This label indicates the section of the interface dedicated to Station 6, which includes Tray 1 and Tray 2. Each tray has buttons for "Stable Zero," "Immediate Zero," "Gross Weight," and "Reset Tare," along with displays for gross weight and communication status.

6. Station 8: This label indicates the section of the interface dedicated to Station 8, which includes the Weight Check Scale. This scale has buttons for "Stable Zero," "Immediate Zero," "Gross Weight," and "Reset Tare," along with displays for gross weight and communication status.

The interface also includes navigation buttons at the top for different system functions such as "System," "Operation," "Magnetomotion," "Robot," "I/O," and "Production." The time and date are displayed in the top right corner. The bottom of the image features the APT Manufacturing Solutions logo and a Mettler Toledo scale image.

9.6.1.3 Camera Dice Color Limits Setup Screen

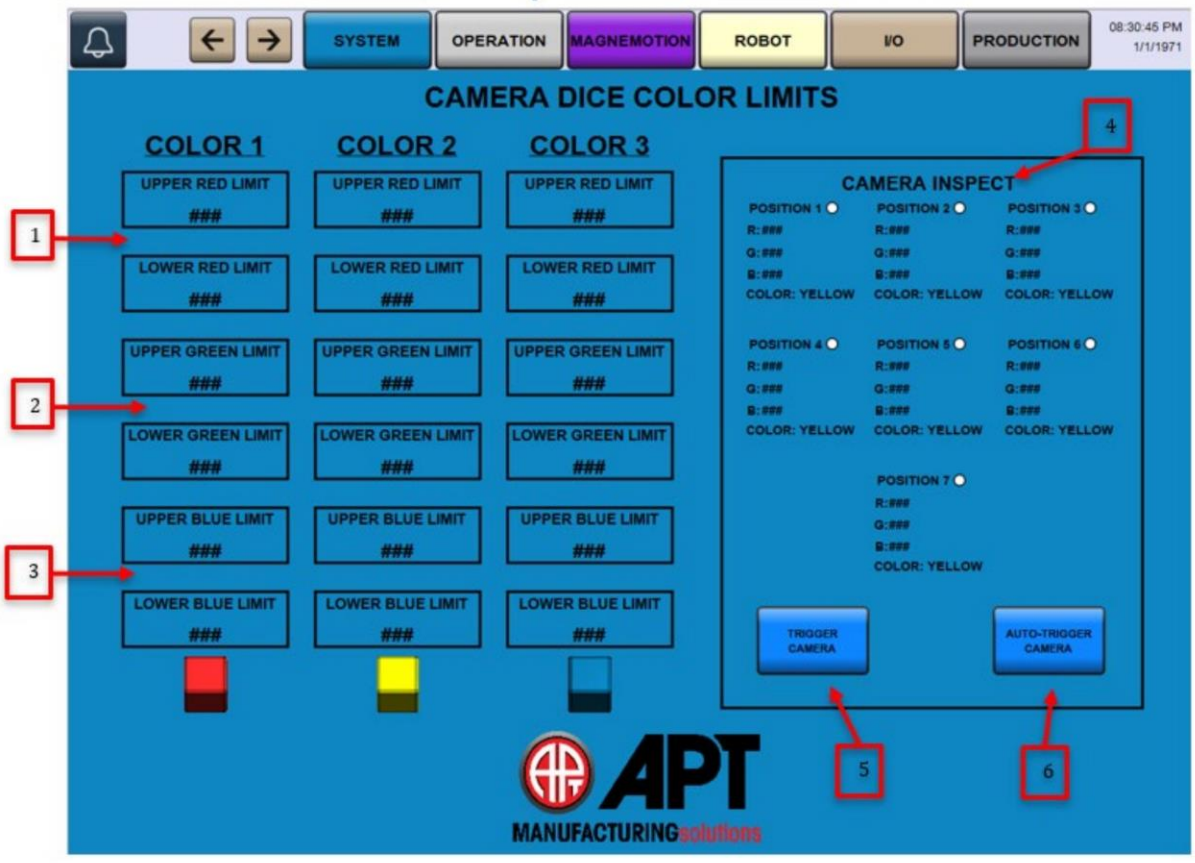

Figure 9-14 Stack Light Setup

1) Adjust Upper and Lower Red Limits
2) Adjust Upper and Lower Green Limits
3) Adjust Upper and Lower Blue Limits
4) Displays last triggered camera inspect
5) Trigger camera once
6) Trigger camera repeatedly

The image is a screenshot of a user interface for setting up stack light colors in a manufacturing system. The interface is labeled "CAMERA DICE COLOR LIMITS" and is divided into several sections. Here is a detailed description of the labeled elements:

1. Upper and Lower Red Limits:

- This section allows the user to set the upper and lower red color limits for three different colors (Color 1, Color 2, and Color 3).

2. Upper and Lower Green Limits:

- This section allows the user to set the upper and lower green color limits for the same three colors.

3. Upper and Lower Blue Limits:

- This section allows the user to set the upper and lower blue color limits for the three colors.

4. Camera Inspect:

- This section provides options to inspect the camera positions (Position 0 to Position 6) and displays the RGB values and the detected color (Yellow in this case).

5. Trigger Camera Button:

- This button is used to manually trigger the camera.

6. Auto-Trigger Camera Button:

- This button is used to set the camera to auto-trigger mode.

The interface also includes navigation buttons at the top for different sections such as System, Operation, Magnemotion, Robot, I/O, and Production. The time and date are displayed in the top right corner. The bottom of the interface features the logo and name of the company, "APT Manufacturing Solutions."

The figure is labeled "Figure 9-14 Stack Light Setup" at the bottom.

9.6.1.4 Camera Dice Color Limits Setup Screen

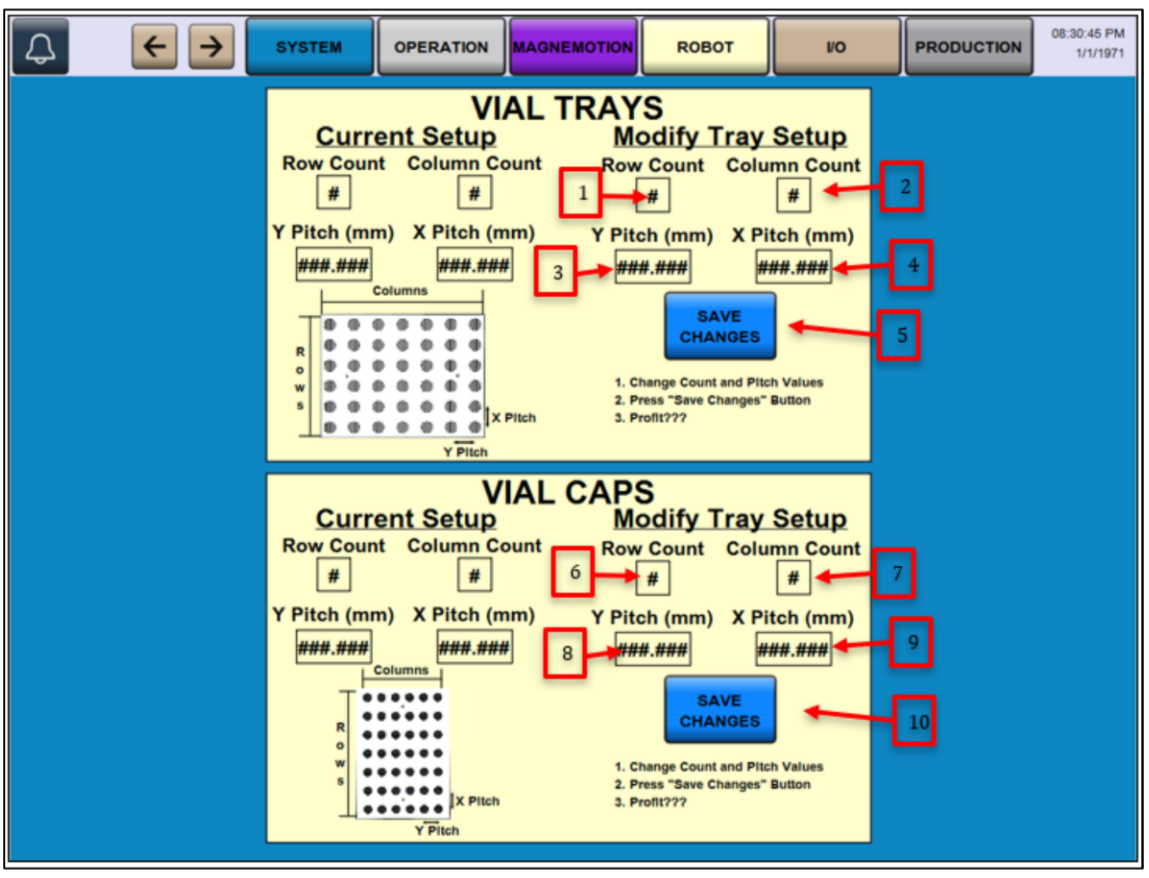

Figure 9-15 Stack Light Setup

1) Adjust Vial Tray Row Count
2) Adjust Vial Tray Column Count
3) Adjust Vial Tray Y Pitch
4) Adjust Vial Tray X Pitch
5) Save Vial Tray Changes
6) Adjust Cap Tray Row Count
7) Adjust Cap Tray Column Count
8) Adjust Cap Tray Y Pitch
9) Adjust Cap Tray X Pitch
10) Save Cap Tray Changes

The image shows a user interface for setting up vial trays and vial caps, with sections for "VIAL TRAYS" and "VIAL CAPS." Each section has a "Current Setup" and a "Modify Tray Setup" area. The interface allows the user to modify the row count, column count, Y pitch, and X pitch for both vial trays and vial caps. The image is labeled "Figure 9-15 Stack Light Setup."

Here are the numbered elements in the image:

1. Input field for modifying the row count of vial trays.

2. Input field for modifying the column count of vial trays.

3. Input field for modifying the Y pitch (mm) of vial trays.

4. Input field for modifying the X pitch (mm) of vial trays.

5. "SAVE CHANGES" button for vial trays.

6. Input field for modifying the row count of vial caps.

7. Input field for modifying the column count of vial caps.

8. Input field for modifying the Y pitch (mm) of vial caps.

9. Input field for modifying the X pitch (mm) of vial caps.

10. "SAVE CHANGES" button for vial caps.

The interface also includes a graphical representation of the vial tray and vial cap layouts, showing rows and columns. The top menu has buttons for "SYSTEM," "OPERATION," "MAGNEMOTION," "ROBOT," "I/O," and "PRODUCTION." The date and time are displayed in the top right corner.

9.6.2 Operations Screen

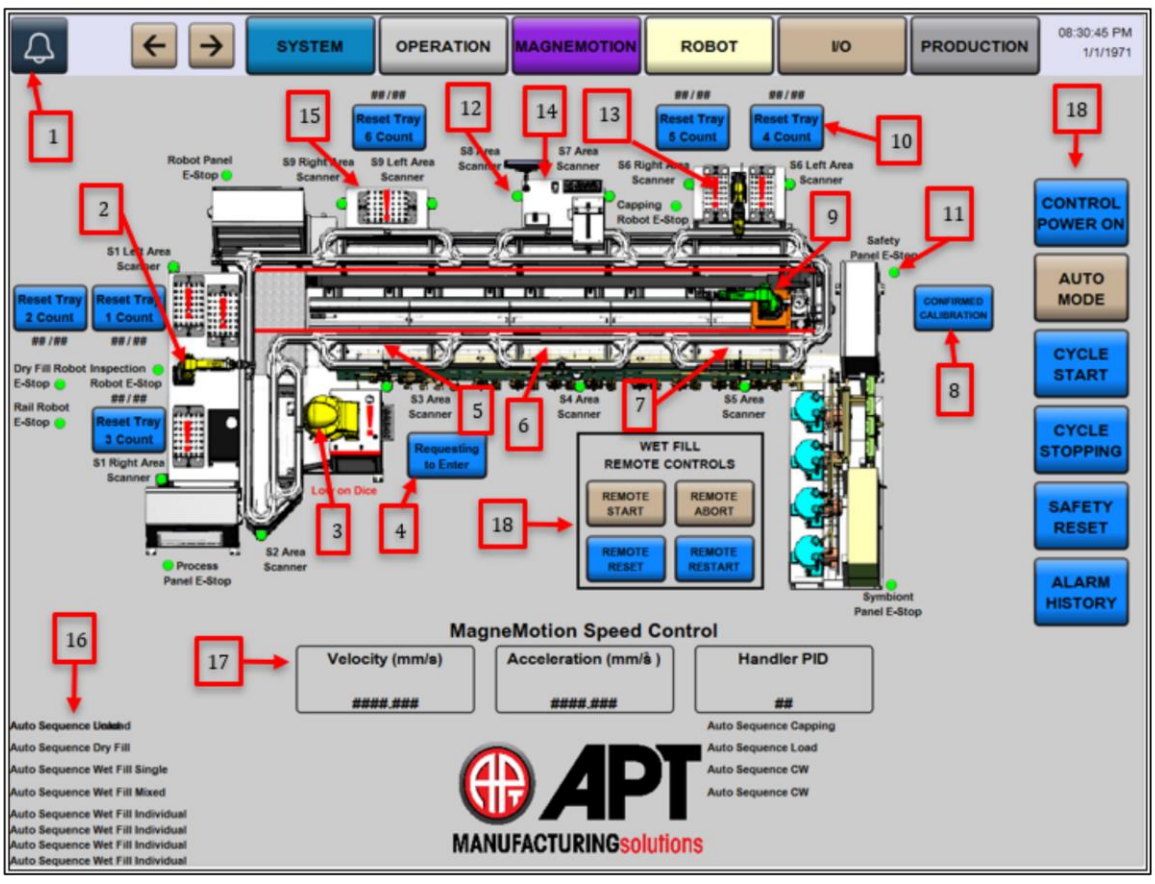

Figure 9-16 Main Operation Screen

1) Display of Current System Fault
2) Navigate to Station 1 Operation Screen
3) Navigate to Station 2 Operation Screen
4) Request to Enter Dice Cell
5) Navigate to Station 3 Operation Screen
6) Navigate to Station 4 Operation Screen
7) Navigate to Station 5 Operation Screen
8) Confirm Collaborative Robot Calibration
9) Navigate to Rail Robot Operation Screen
10) Reset Tray Count
11) Emergency Stop Status
12) Area Scanner Status (Green-Clear; Yellow-Warning Zone; Red-Stop Zone)
13) Navigate to Station 6 Operation Screen
14) Navigate to Station 7 & 8 Operation Screen
15) Navigate to Station 9 Operation Screen
16) Auto Sequence Display and Description for every Station
17) MangeMotion Speed Controls
18) Remote WetFill Controls
19) All Stations Mode Operators

The image (Figure 9-16) is a screenshot of the main operation screen for a manufacturing system, specifically from APT Manufacturing Solutions. The screen is divided into several sections, each with specific controls and indicators. Here is a detailed description of the elements:

1. Bell Icon: Likely for notifications or alerts.

2. Reset Tray 1 Count: Button to reset the count for Tray 1.

3. Reset Tray 2 Count: Button to reset the count for Tray 2.

4. S1 Area Scanner: Indicates the status of the S1 area scanner.

5. S2 Area Scanner: Indicates the status of the S2 area scanner.

6. S3 Right Area Scanner: Indicates the status of the S3 right area scanner.

7. S3 Left Area Scanner: Indicates the status of the S3 left area scanner.

8. S4 Area Scanner: Indicates the status of the S4 area scanner.

9. S5 Right Area Scanner: Indicates the status of the S5 right area scanner.

10. S5 Left Area Scanner: Indicates the status of the S5 left area scanner.

11. S6 Area Scanner: Indicates the status of the S6 area scanner.

12. S7 Area Scanner: Indicates the status of the S7 area scanner.

13. S8 Area Scanner: Indicates the status of the S8 area scanner.

14. S9 Right Area Scanner: Indicates the status of the S9 right area scanner.

15. S9 Left Area Scanner: Indicates the status of the S9 left area scanner.

16. Auto Sequence Loaded: Indicates if the auto sequence is loaded.

17. Auto Sequence Wet Fill: Indicates if the auto sequence for wet fill is active.

18. Various Buttons: Includes buttons for control power on, auto mode, cycle start, cycle stopping, safety reset, and alarm history.

The central part of the screen shows a detailed layout of the manufacturing process, including various scanners, robots, and control panels. The bottom section includes controls for MagneMotion Speed Control, with fields for velocity, acceleration, and handler PID.

The screen also includes a timestamp in the top right corner, showing the date and time as 06:30:45 PM on 1/1/1971.

9.6.2.1 Station 1 Operation Screen

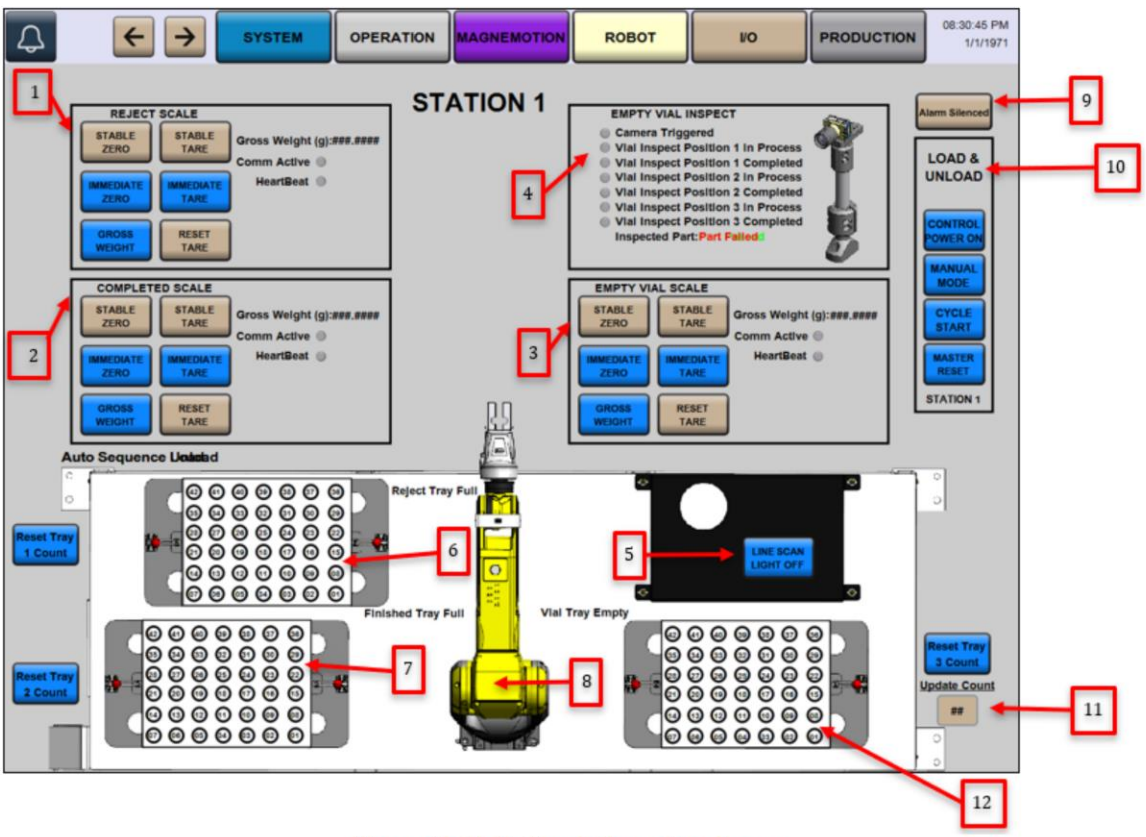

Figure 9-17 Station 1 Operation Screen

1) Tray 1 Scale
2) Tray 2 Scale
3) Tray 3 Scale
4) Current Vial Inspect
5) Toggle Line Scan Light
6) Navigate to Tray 1 Vial Inspect Operation Screen / Current Tray Count
7) Navigate to Tray 2 Vial Inspect Operation Screen / Current Tray Count
8) Navigate to LR-Mate Robot Screen
9) Station Alarm Silence
10) Station Mode Operators
11) Manually Update Tray Count
12) Empty Vial Tray Count

The image (Figure 9-17) is a screenshot of an operation screen for Station 1 in an automated system. The screen includes various controls, indicators, and sections for monitoring and managing the station's operations. Here is a detailed description of the labeled components:

1. Reject Scale: This section displays the status and controls for the reject scale, including options to stabilize, zero, and tare the scale, as well as showing the gross weight, communication status, and heartbeat.

2. Completed Scale: Similar to the reject scale, this section shows the status and controls for the completed scale, with options for stabilizing, zeroing, and taring the scale, and displaying the gross weight, communication status, and heartbeat.

3. Empty Vial Scale: This section provides the status and controls for the empty vial scale, including stabilizing, zeroing, and taring options, and displaying the gross weight, communication status, and heartbeat.

4. Empty Vial Inspect: This section shows the status of the empty vial inspection process, including the camera trigger and the status of various inspection positions. It also indicates if a part has failed inspection.

5. Line Scan Light Off: This button likely controls the line scan light, allowing the operator to turn it off.

6. Reject Tray Full: This indicator shows the status of the reject tray, indicating whether it is full.

7. Finished Tray Full: This indicator shows the status of the finished tray, indicating whether it is full.

8. Vial Tray Empty: This indicator shows the status of the vial tray, indicating whether it is empty.

9. Alarm Silence: This button allows the operator to silence any active alarms.

10. Load & Unload: This section includes controls for loading and unloading, with options for control power, manual mode, cycle start, and master reset.

11. Reset Tray 3 Count: This button resets the count for tray 3.

12. Update Count: This button likely updates the count of vials or items processed.

The central part of the screen shows a robotic arm and the layout of the trays, providing a visual representation of the station's operation.

9.6.2.2 Station 2 Operation Screen

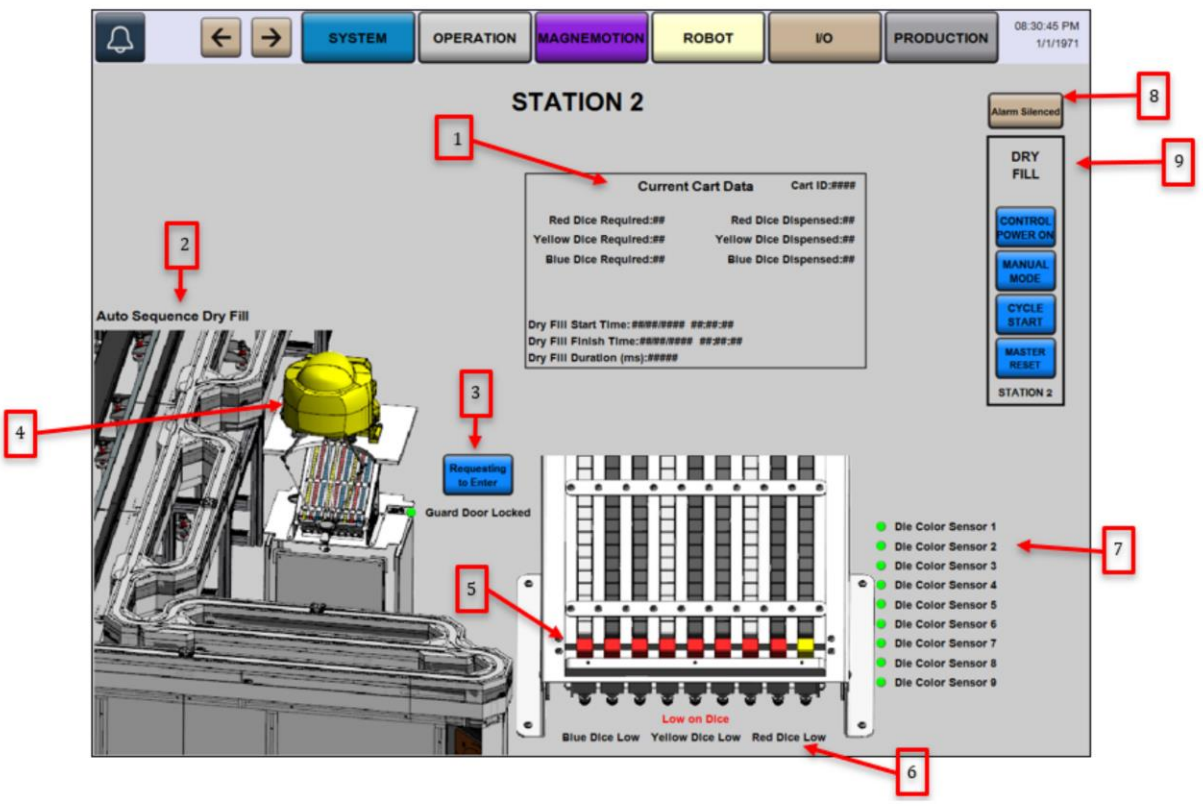

Figure 9-18 Station 2 Operation Screen

1) Station 2 Current Cart Data / Navigate to MagneMotion Information Screen
2) Station 2 Auto Sequence Steps
3) Request to Enter Dice Cell
4) Navigate to M1iA Robot Screen
5) Current Dice Color
6) Dice Tray Low on Dice Indicators
7) Die Sensor Indicators
8) Station Alarm Silence
9) Station Mode Operators

The image (Figure 9-18) is a screenshot of the Station 2 Operation Screen from an industrial control system. Here is a detailed description of the labeled components:

1. Current Cart Data: This section displays the data related to the current cart, including the required and dispensed quantities of red, yellow, and blue dice, as well as the start and finish times for the dry fill process and its duration.

2. Auto Sequence Dry Fill: This label indicates that the system is in the automatic sequence mode for the dry fill process.

3. Guard Door Locked: This indicates the status of the guard door, which is currently locked. There is also a "Requesting to Enter" message, likely indicating a request to unlock the door.

4. Image of the Station: This part of the screen shows a visual representation of Station 2, including the machinery and components involved in the dry fill process.

5. Dice Dispensers: This section shows the dispensers for the dice, with indicators for the levels of red, yellow, and blue dice.

6. Low on Dice Indicators: This section indicates the status of the dice levels. The labels "Blue Dice Low," "Yellow Dice Low," and "Red Dice Low" suggest that the system will alert the operator if the dice levels are low.

7. Die Color Sensors: This section lists the sensors for detecting the color of the dice, with indicators for each sensor (1 through 6).

8. Alarm Silenced: This button likely allows the operator to silence any active alarms.

9. Control Buttons: This section includes various control buttons for the dry fill process, such as "CONTROL POWER ON," "MANUAL MODE," "CYCLE START," "MASTER RESET," and "STATION 2."

The screen provides a comprehensive overview of the status and control options for Station 2 in the dry fill process, ensuring that the operator can monitor and manage the system effectively.

9.6.2.3 Station 3 Operation Screen

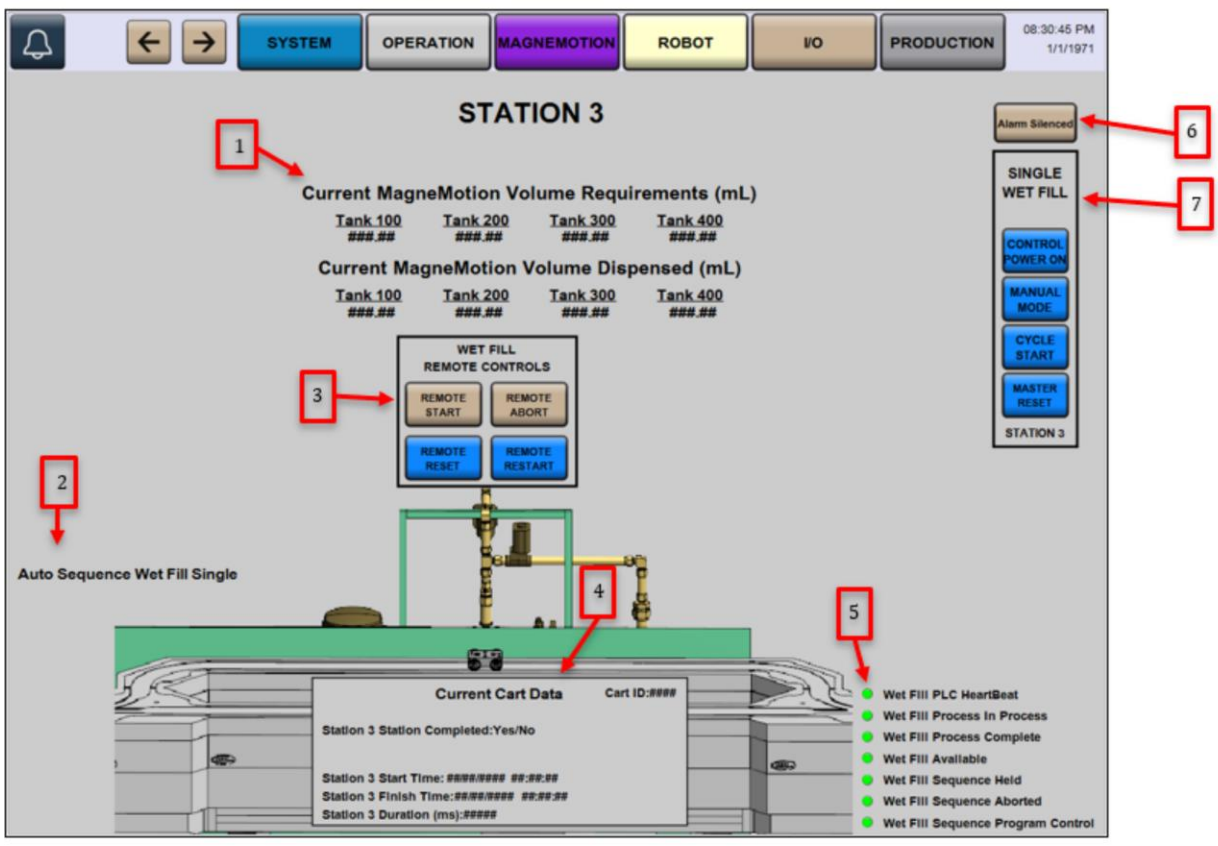

Figure 9-19 Station 3 Operation Screen

1) Station 3 Current Wetfill Volume Required / Dispensed values
2) Station 3 Auto Sequence Steps
3) Remote Wetfill Controls
4) Station 3 Current Cart Data / Navigate to MagneMotion Information Screen
5) Wetfill Station 3 Status Indicators
6) Station Alarm Silence
7) Station Mode Operators

The image (Figure 9-19) provided is a screenshot of the Station 3 Operation Screen from a control system interface. Here is a detailed description of the various elements labeled in the image:
1. Current MagneMotion Volume Requirements (mL): This section displays the required volume for each tank (Tank 100, Tank 200, Tank 300, Tank 400).
2. Auto Sequence Wet Fill Single: This label indicates the mode of operation for the wet fill process.
3. Remote Controls: This section includes buttons for controlling the wet fill process remotely:
- Remote Start
- Remote Abort
- Remote Reset
- Remote Restart
4. Wet Fill Equipment: This part of the screen shows a diagram of the wet fill equipment, including valves and pipes.
5. Current Cart Data: This section provides data about the current cart being processed:
- Station 3 Completed: Yes/No
- Station 3 Start Time
- Station 3 Finish Time
- Station 3 Duration (ms)
6. Alarm Silenced: This indicator shows whether the alarm has been silenced.
7. Single Wet Fill Controls: This section includes buttons for controlling the single wet fill process:
- Control Power On
- Manual Mode
- Cycle Start
- Manual Reset
- Station 3
Additionally, there are status indicators on the right side of the screen showing the status of various processes:
- Wet Fill PLC HeartBeat
- Wet Fill Process In Process
- Wet Fill Process Complete
- Wet Fill Sequence Held
- Wet Fill Sequence Aborted
- Wet Fill Sequence Program Control
Each status indicator is represented by a green dot, which likely indicates that the process is functioning correctly.

9.6.2.4 Station 4 Operation Screen

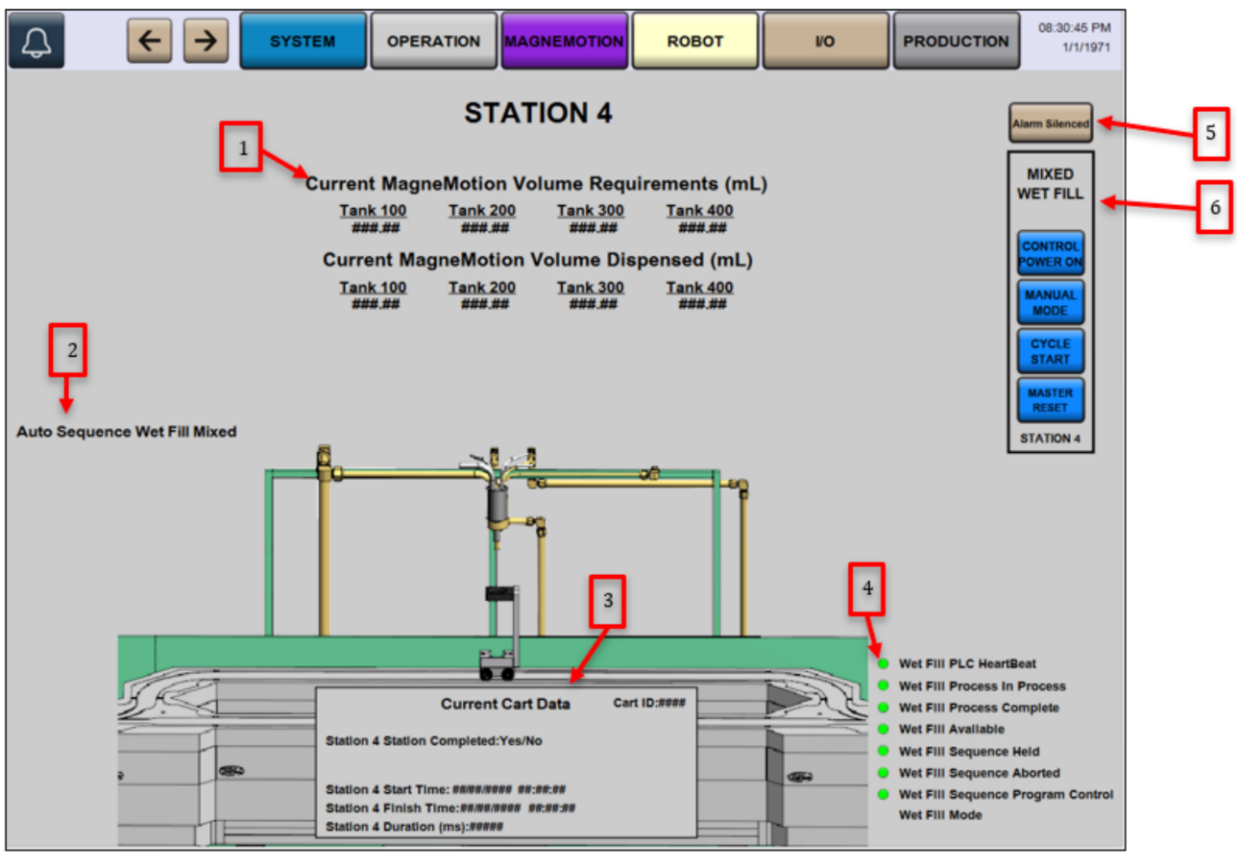

Figure 9-20 Station 4 Operation Screen

1) Station 4 Current Wetfill Volume Required / Dispensed values
2) Station 4 Auto Sequence Steps
3) Station 4 Current Cart Data / Navigate to MagneMotion Information Screen
4) Wetfill Station 4 Status Indicators
5) Station Alarm Silence
6) Station Mode Operators

The image (Figure 9-20) is a screenshot of the Station 4 Operation Screen from a control system interface. Here is a detailed description of the various elements labeled in the image:

1. Current MagneMotion Volume Requirements and Dispensed (mL):
   - Displays the volume requirements and the volume dispensed for four tanks (Tank 100, Tank 200, Tank 300, Tank 400).
2. Auto Sequence Wet Fill Mixed:
   - Indicates that the system is in auto sequence mode for wet fill mixed operations.
3. Current Cart Data:
   - Shows data related to the current cart, including:
     - Cart ID
     - Station 4 completion status
     - Start time
     - Finish time
     - Duration
4. Status Indicators:
   - A series of status indicators with green lights showing various states such as:
     - Wet Fill PLC HeartBeat
     - Wet Fill Process In Process
     - Wet Fill Process Complete
     - Wet Fill Available
     - Wet Fill Sequence Aborted
     - Wet Fill Sequence Abort
     - Wet Fill Mode
5. Alarm Silenced:
   - Indicates whether the alarm is silenced.
6. Control Buttons:
   - A set of control buttons for various operations:
     - CONTROL POWER ON
     - MANUAL MODE
     - CYCLE START
     - MASTER RESET
     - STATION 4

The top of the screen has navigation buttons for different sections of the system, including SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The current date and time are displayed at the top right corner.

9.6.2.5 Station 5 Operation Screen

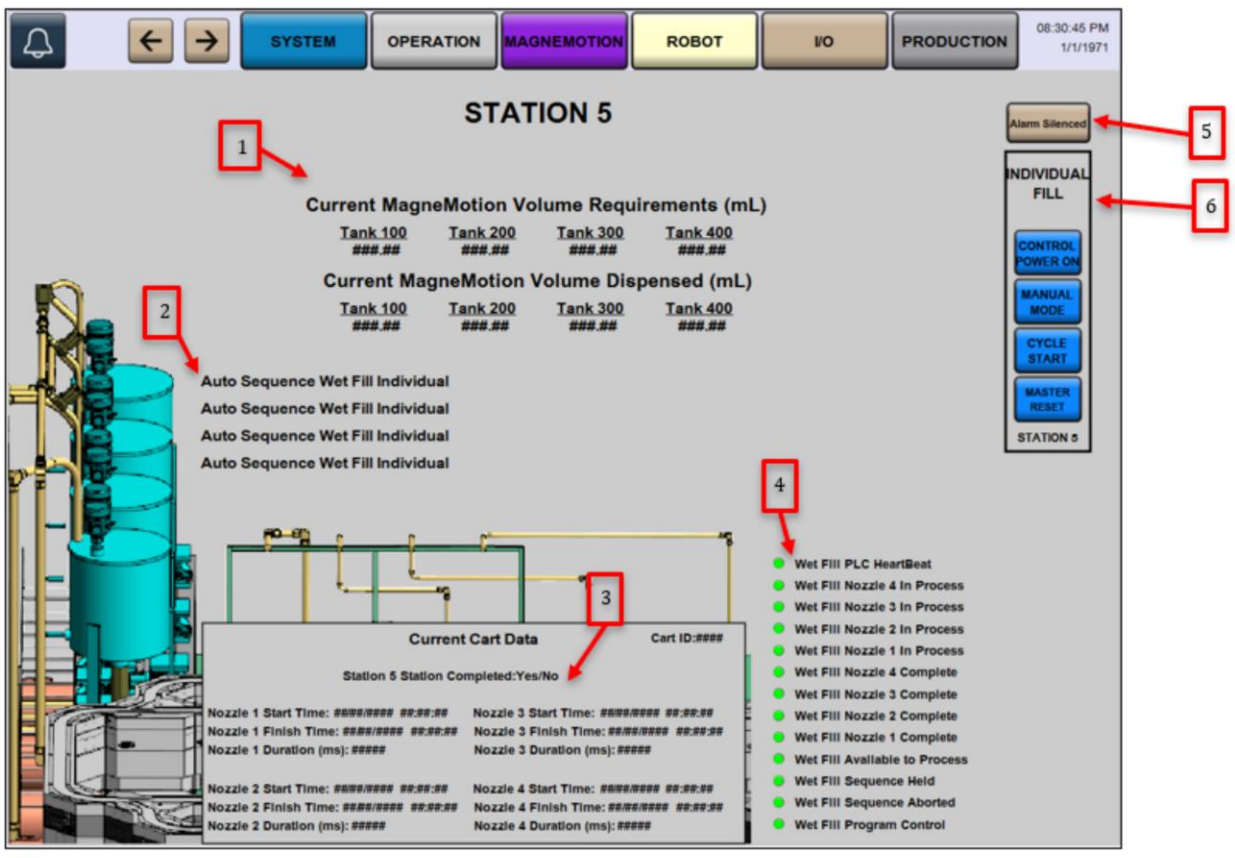

Figure 9-21 Station 5 Operation Screen

1) Station 5 Current Wetfill Volume Required / Dispensed values
2) Station 5 Auto Sequence Steps
3) Station 5 Current Cart Data / Navigate to MagneMotion Information Screen
4) Wetfill Station 5 Status Indicators
5) Station Alarm Silence
6) Station Mode Operators

The image (Figure 9-21) shows the Station 5 Operation Screen of a control system interface. Here is a detailed description of the various elements labeled in the image:

1. Station 5 Header: This section displays the title "STATION 5" and includes information about the current MagneMotion volume requirements and volumes dispensed for different tanks (Tank 100, Tank 200, Tank 300, Tank 400).

2. System Diagram: This area shows a graphical representation of the system, likely depicting the physical setup of the tanks and associated equipment.

3. Current Cart Data: This section provides detailed information about the current cart, including the cart ID and various timestamps for nozzle operations (start time, finish time, and duration for each nozzle).

4. Status Indicators: This area contains a list of status indicators for various processes, such as "Wet Fill PLC HeartBeat," "Wet Fill Nozzle 1 In Process," "Wet Fill Nozzle 1 Complete," etc. Each status is accompanied by a green light, indicating the current state of each process.

5. Alarm Silenced Indicator: This section shows whether the alarm is silenced.

6. Control Buttons: This panel includes several control buttons for operating the system:
- "CONTROL POWER ON"
- "MANUAL MODE"
- "CYCLE START"
- "MASTER RESET"
- "STATION 5"

The screen also includes navigation buttons at the top for different sections of the system, such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The date and time are displayed in the top right corner.

9.6.2.6 Station 6 Operation Screen

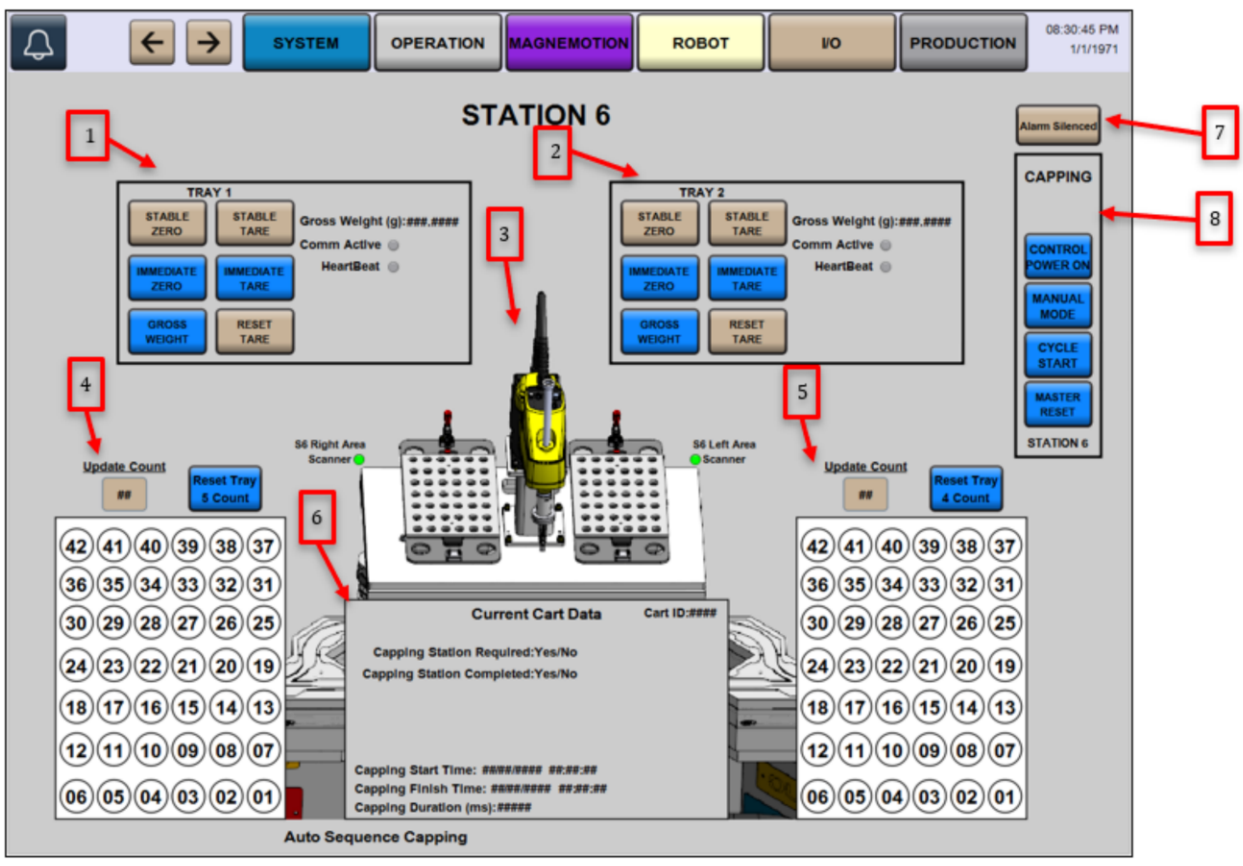

Figure 9-22 Station 6 Operation Screen

1) Station 6 Tray 1 Scale
2) Station 6 Tray 2 Scale
3) Navigate to Scara Robot Screen
4) Manually Update Tray 2 Count
5) Manually Update Tray 1 Count
6) Station 6 Current Cart Data / Navigate to MagneMotion Information Screen
7) Station Alarm Silence
8) Station Mode Operators

The image (Figure 9-22) is a screenshot of the Station 6 Operation Screen from an industrial control system. The screen is divided into several sections, each labeled with a number for reference. Here is a detailed description of each labeled section:

1. Tray 1 Controls:
   - Contains buttons for stabilizing and resetting the tare weight.
   - Displays the gross weight in grams.
   - Shows communication status and heartbeat indicator.
   - Buttons include "IMMEDIATE ZERO," "GROSS WEIGHT," and "RESET TARE."

2. Tray 2 Controls:
   - Similar to Tray 1, it has buttons for stabilizing and resetting the tare weight.
   - Displays the gross weight in grams.
   - Shows communication status and heartbeat indicator.
   - Buttons include "IMMEDIATE ZERO," "GROSS WEIGHT," and "RESET TARE."

3. Central Robot:
   - Depicts a robotic arm or device situated between Tray 1 and Tray 2.
   - Likely used for handling or processing items on the trays.

4. Left Tray Count:
   - Displays a grid of numbers representing tray positions or counts.
   - Includes an "Update Count" button and a "Reset Tray & Count" button.

5. Right Tray Count:
   - Similar to the Left Tray Count, it displays a grid of numbers for tray positions or counts.
   - Includes an "Update Count" button and a "Reset Tray & Count" button.

6. Current Cart Data:
   - Shows information about the current cart being processed.
   - Includes fields for Cart ID, whether capping is required or completed, and timestamps for capping start, completion, and duration.

7. Alarm Silenced Indicator:
   - Indicates whether the alarm has been silenced.

8. Capping Controls:
   - Contains buttons for controlling the capping process.
   - Buttons include "CONTROL POWER ON," "MANUAL MODE," "CYCLE START," "MASTER RESET," and "STATION 6."

The screen also has navigation buttons at the top for different sections such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The current time and date are displayed in the top right corner.

9.6.2.7 Station 7 & 8 Operation Screen

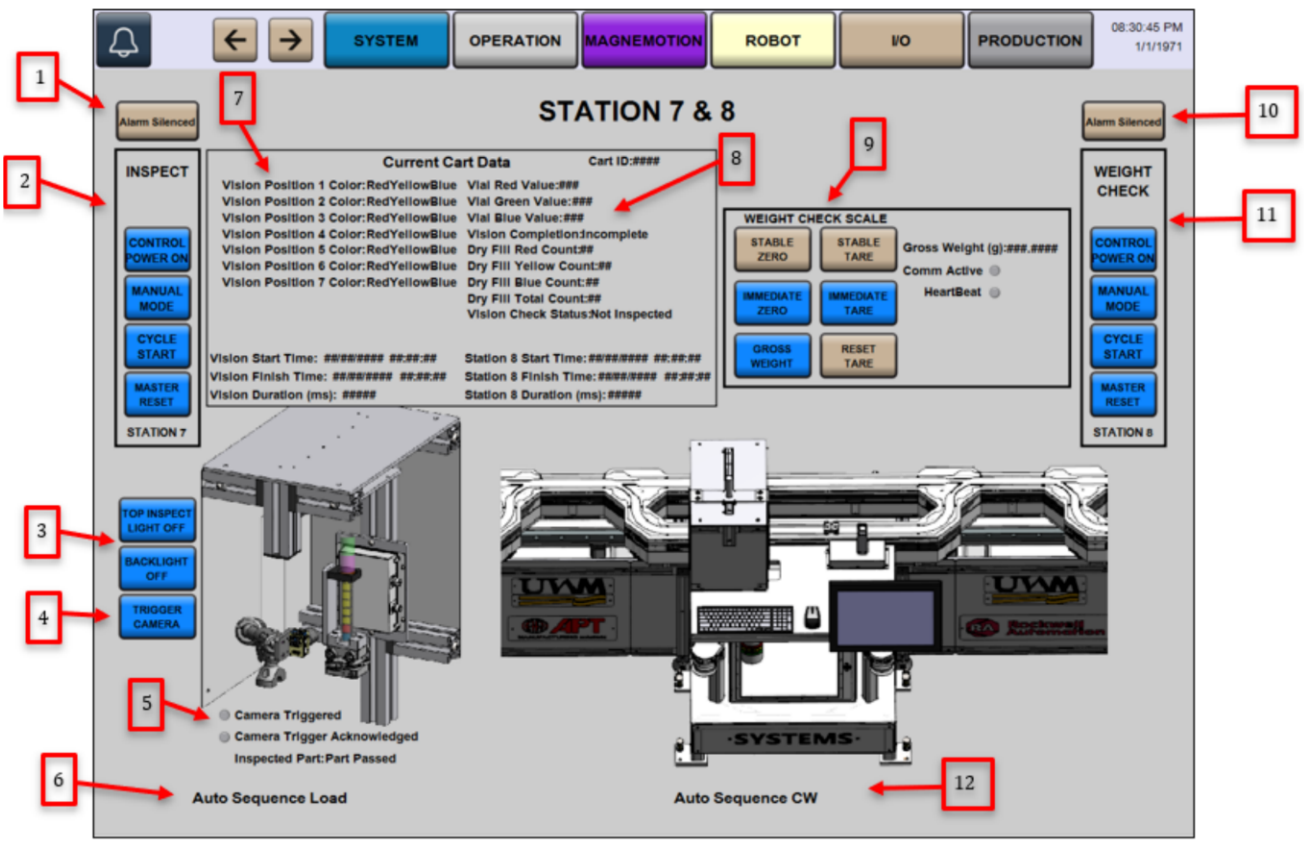

Figure 9-23 Station 7 & 8 Operation Screen

1) Station 7 Alarm Silence
2) Station 7 Mode Operators
3) Toggle Camera Inspect Lights
4) Trigger Camera
5) Camera Result Indicators
6) Station 7 Auto Sequence Steps
7) Station 7 Current Cart Data / Navigate to MagneMotion Information Screen
8) Station 8 Current Cart Data / Navigate to MagneMotion Information Screen
9) Station 8 Scale
10) Station 8 Alarm Silence
11) Station 8 Mode Operators
12) Station 8 Auto Sequence Steps

This image (Figure 9-23) is a labeled diagram of the "Station 7 & 8 Operation Screen" from a control system interface. Here is a description of each labeled part:

1. Alarm Silence: Button to silence the alarm.
2. INSPECT Section: Contains controls and indicators related to the inspection process.
3. TOP INSPECT LIGHT OFF: Button to turn off the top inspection light.
4. BACKLIGHT OFF: Button to turn off the backlight.
5. Camera Triggered: Indicator showing the camera has been triggered.
6. Auto Sequence Load: Button to start the auto sequence load.
7. Current Cart Data: Displays current data related to the cart being processed.
8. Cart ID: Displays the ID of the current cart.
9. Weight Check Scale: Section displaying weight check information and controls.
10. Alarm Silence: Another button to silence the alarm.
11. WEIGHT CHECK Section: Contains controls and indicators related to the weight check process.
12. Auto Sequence CW: Button to start the auto sequence in a clockwise direction.

The screen also includes various buttons for system navigation at the top, such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The time and date are displayed in the top right corner.

9.6.2.8 Station 9 Operation Screen

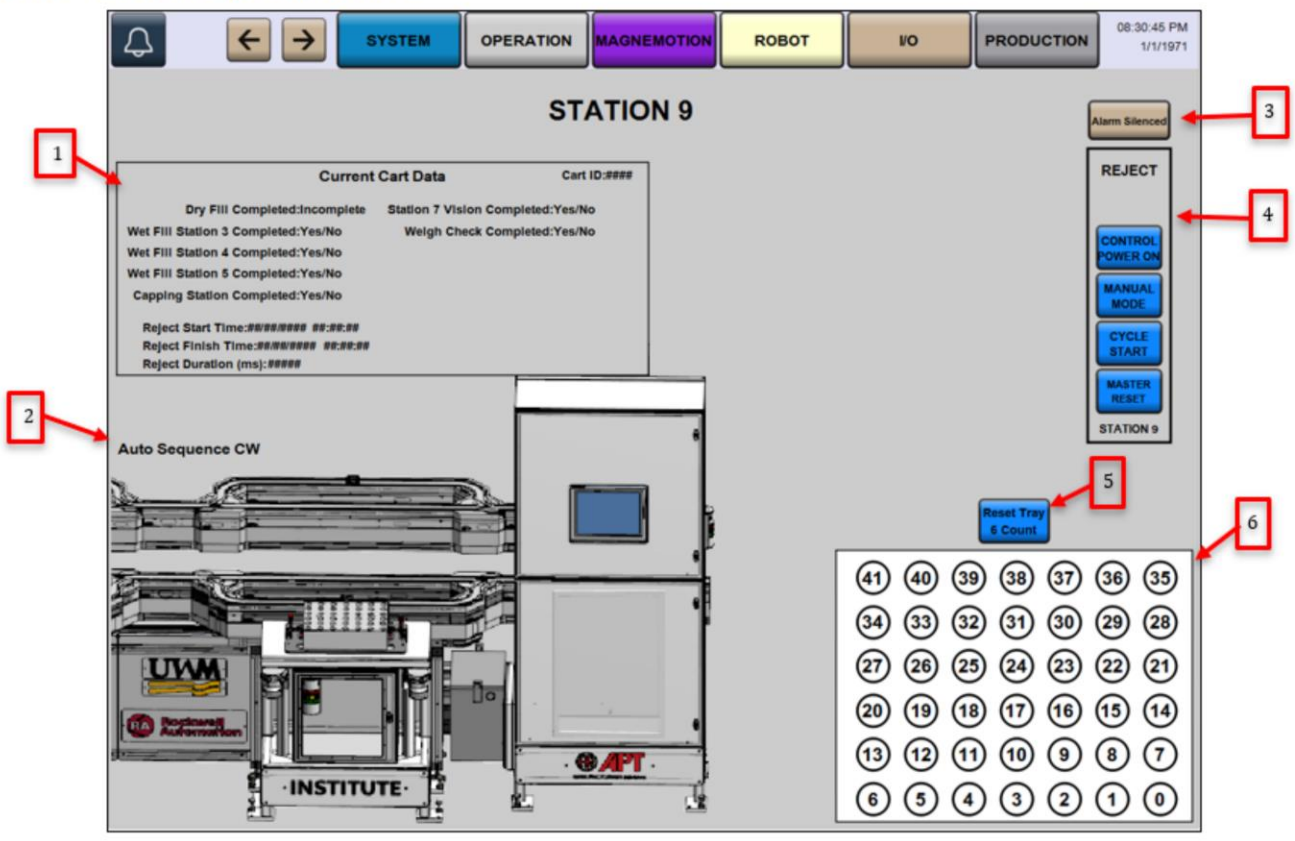

Figure 9-24 Station 9 Operation Screen

1) Station 9 Current Cart Data / Navigate to MagneMotion Information Screen
2) Station 9 Auto Sequence Steps
3) Station 9 Alarm Silence
4) Station 9 Mode Operators
5) Reset Station 9 Tray Count
6) Reject Tray Count Indicators / Navigate to Reject Tray Vial Information

The image (Figure 9-24) provided is a screenshot of the Station 9 Operation Screen, which appears to be part of an industrial or manufacturing control system. The screen is divided into several sections, each labeled with numbers for reference. Here is a detailed description of each labeled section:

1. Current Cart Data:
  - This section displays the status of various operations for the current cart. It includes:
    - Dry Fill Completed: incomplete
    - Wet Fill Station 3 Completed: Yes/No
    - Wet Fill Station 4 Completed: Yes/No
    - Wet Fill Station 5 Completed: Yes/No
    - Capping Station Completed: Yes/No
    - Station 7 Vision Completed: Yes/No
    - Weigh Check Completed: Yes/No
  - It also shows the Cart ID and reject information such as Reject Start Time, Reject Finish Time, and Reject Duration.

2. Auto Sequence CW:
  - This section likely shows a visual representation or diagram of the machinery or process flow at Station 9. It includes logos of various organizations and companies involved, such as UWM, the Institute, and APT.

3. Alarm Silenced:
  - This indicator shows whether the alarm has been silenced.

4. Control Buttons:
  - This section contains several control buttons for operating the station:
    - CONTROL POWER ON
    - MANUAL MODE
    - CYCLE START
    - MASTER RESET
    - STATION 9

5. Reset Tray & Count:
  - This button is used to reset the tray and count.

6. Numbered Circles:
  - This section contains a grid of numbered circles, possibly representing different trays, slots, or positions within the station. The numbers range from 1 to 41.

The top of the screen has navigation buttons for different sections of the system, such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The current date and time are displayed in the top right corner.

9.6.2.9 MagneMotion Operation Screen

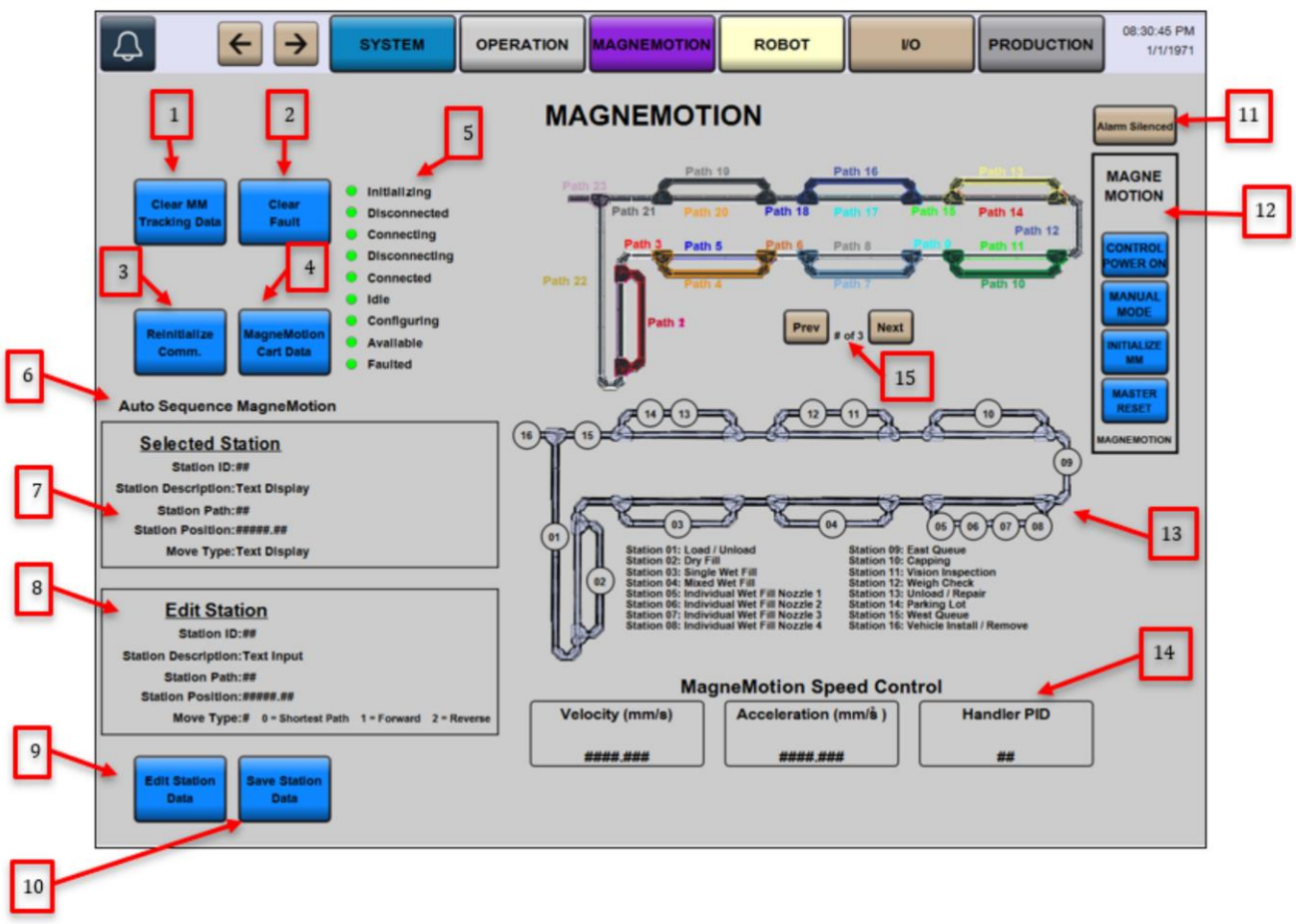

Figure 9-25 MagneMotion Operation Screen

1) Clear MagneMotion Tracking Data
2) Clear MagneMotion Faults
3) Reinitialize MagneMotion Communication
4) Navigate to MagneMotion Information Screen
5) MagneMotion Status Indicators
6) MagneMotion Auto Sequence Steps
7) Current selected MagneMotion station data – Shows MagneMotion data on selected cart station
8) Edit selected MagneMotion station data – edit selected cart station and save to store values
9) Edit Station Data – Allows user to edit the selected station
10) Save Station Data – Stores the Data in the edited station into the current selected station
11) Silence MagneMotion Station Alarm
12) MagneMotion Mode Operators
13) MagneMotion cart at Station Indicators (Green when present) – Tap to show Selected Station Data
14) MagneMotion Speed Controls

This image (Figure 9-25) is a screenshot of a MagneMotion Operation Screen, which appears to be part of a control interface for an automated system. The screen is divided into several sections, each labeled with a number. Here is a description of each labeled section:

1. Clear MM Tracking Data: A button to clear the MagneMotion tracking data.
2. Clear Fault: A button to clear any faults in the system.
3. Reinitialize Comm.: A button to reinitialize communication.
4. MagneMotion Cart Data: A button related to MagneMotion cart data.
5. Status Indicators: A list of status indicators showing the current state of the system (e.g., Initializing, Disconnected, Connecting, etc.).
6. Auto Sequence MagneMotion: A section for auto-sequencing MagneMotion.
7. Selected Station: Displays information about the selected station, including Station ID, Description, Position, and Move Type.
8. Edit Station: Allows editing of station information, including Station ID, Description, Path, Position, and Move Type.
9. Edit Station Data: A button to edit station data.
10. Save Station Data: A button to save station data.
11. Alarm Silence: A button to silence alarms.
12. MagneMotion Control Panel: Contains buttons for various controls such as Control Power On, Manual Mode, Initialize MM, and Master Reset.
13. Station Map: A map showing the layout of the stations and paths in the system.
14. MagneMotion Speed Control: Controls for adjusting the speed of the MagneMotion system, including Velocity, Acceleration, and Handler PID.
15. Path Navigation: Buttons to navigate between different paths (Prev and Next).

The screen provides a comprehensive interface for monitoring and controlling the MagneMotion system, allowing operators to manage station data, handle faults, and adjust system parameters.

9.6.2.10 Tray Vial Information Operation Screen

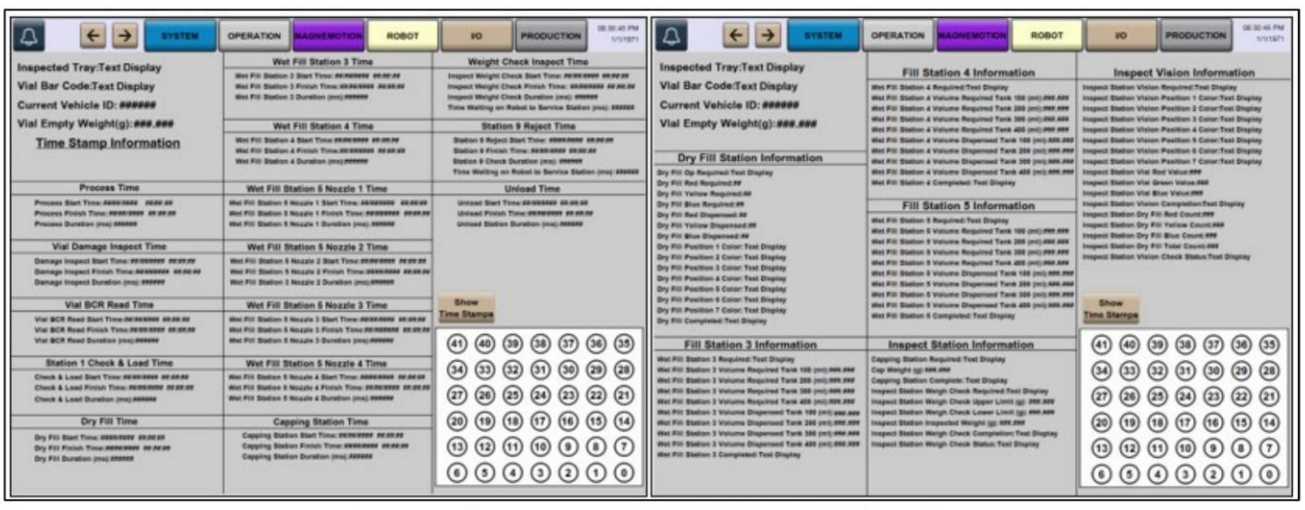

Figure 9-26 Vial Tray Information Operation Screen

This screen shows all the process data that is sent throughout all the stations during Auto Cycle and gets stored into the Inspected Tray's process data. Vial indicators are green when a vial is present and touching a vial indicator displays the vial process data.

9.6.2.11 MagneMotion Cart Information Operation Screen

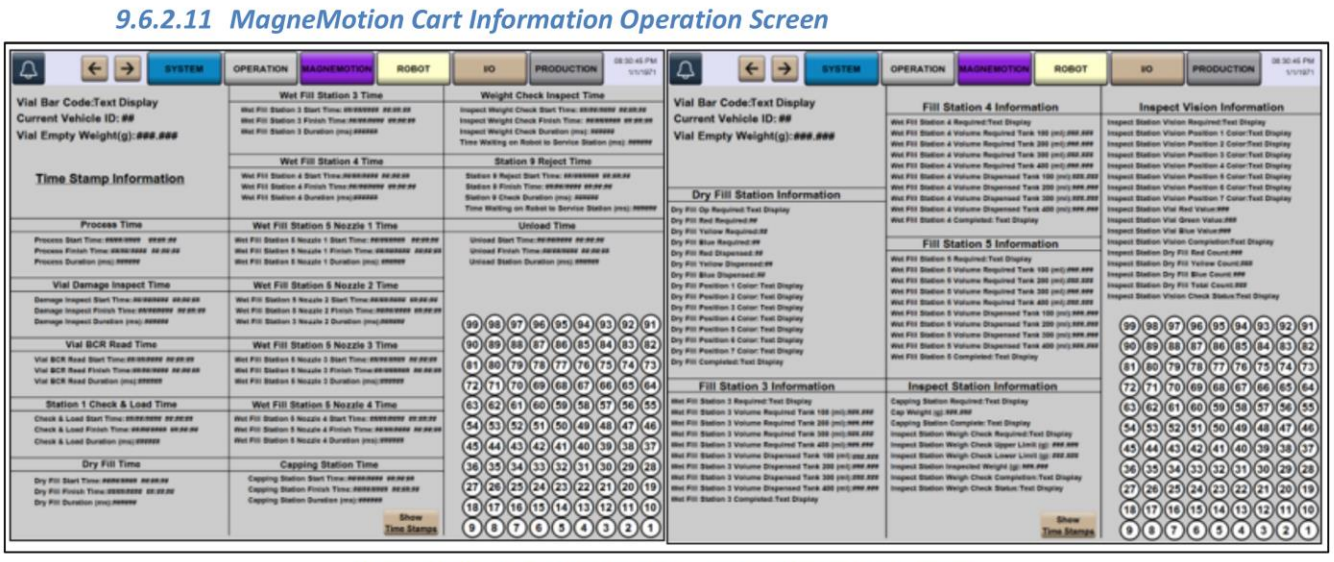

Figure 9-27 MagneMotion Information Operation Screen

This screen shows all the process data that is sent throughout all the stations during Auto Cycle and gets stored into the Inspected MagneMotion cart process data. Cart indicators are green when a cart is active (cart vehicle ID between 1 – 99) and touching a cart indicator displays the process data.

The image shows a Vial Tray Information Operation Screen, labeled as Figure 9-26. The screen is divided into several sections, each providing specific information related to the vial processing system. Here is a breakdown of the sections:

1. Top Navigation Bar:
   - Contains buttons for different system functions: SYSTEM, OPERATION, ADMINISTRATION, ROBOT, I/O, and PRODUCTION.
2. Inspected Tray/Test Display:
   - Displays the inspected tray and test information.
   - Shows the Vial Bar Code/Test Display, Current Vehicle ID, Vial Empty Weight, and Time Stamp Information.
3. Process Time:
   - Displays the process time for various stages.
4. Vial Damage Inspect Time:
   - Shows the time taken for vial damage inspection.
5. Vial BCR Read Time:
   - Displays the time taken for the Vial BCR (Bar Code Reader) to read.
6. Vial Check & Load Time:
   - Shows the time taken for vial check and load.
7. Dry Fill Time:
   - Displays the time taken for the dry fill process.
8. Wet Fill Station Information:
   - Information for Wet Fill Station 1, 2, and 3, including the time taken for each station.
9. Capping Station Time:
   - Shows the time taken for the capping station.
10. Weight Check Inspect Time:
   - Displays the time taken for weight check inspection.
11. Untested Time:
   - Shows the untested time.
12. Fill Station Information:
   - Information for Fill Station 4 and 5, including the time taken for each station.
13. Inspect Vision Information:
   - Displays the inspect vision information for various stages.
14. Circular Indicators:
   - There are circular indicators at the bottom of the screen, possibly representing the status of different vials or stations.

The screen provides a comprehensive overview of the vial processing stages, including inspection, filling, capping, and weight checking, along with the respective times taken for each process.

The image (Figure 9-27) shows a screenshot of a software interface titled "ManeMotion Information Operation Screen." The interface is divided into two main sections, each containing various panels and information fields.

Left Section:

- Top Panel:"Vial Bar Code/Text Display","Current Vehicle ID:", and "Vial Empty Weighing:"
- Time Stamp Information: Process Time, Dry Fill Station Information, Wet Fill Station Information, and Inspect Vision Information

9.6.3 Robot Screens

9.6.3.1 LR-Mate Robot Screen

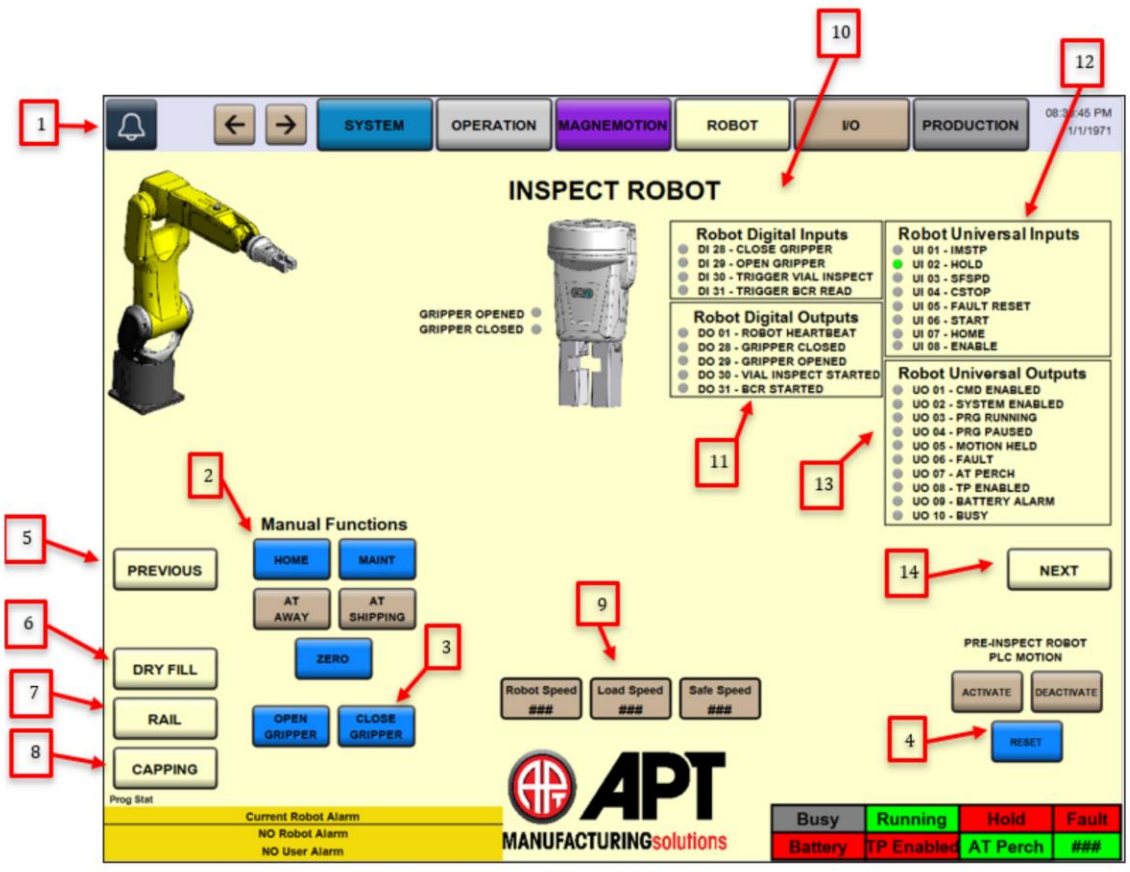

Figure 9-28 LR-Mate Robot Screen

1) Display Current Faults
2) Manual Function Operators and Indication of State; Select Button to Move Robot to the Desired Position.
3) End of Arm Tooling Manual Function and Status Indicators
4) Robot UOP Commands and Indicators
5) Navigate to Previous Robot Screen
6) Navigate to M1iA Robot Screen
7) Navigate to CR7 Robot Screen
8) Navigate to Scara Robot Screen
9) Robot Speed Control
10) Robot Digital Input Signals from Process PLC
11) Robot Digital Output Signals to Process PLC
12) Robot UI Signal Indicators to Process PLC
13) Robot UO Signal Indicators to Process PLC
14) Navigate to Next Robot Screen

This image (Figure 9-28) is a screenshot of the LR-Mate Robot Screen from APT Manufacturing Solutions. The screen is used to control and monitor a robotic system. Here is a detailed description of the various elements labeled in the image:

1. Bell Icon: Likely used for notifications or alerts.
2. Manual Functions: Buttons for manual control of the robot, including:
   - HOME: Move the robot to the home position.
   - MANT: Maintenance position.
   - AT AWAY: Move the robot to the away position.
   - AT SHIPPING: Move the robot to the shipping position.
3. Gripper Control: Buttons to open and close the gripper.
4. RESET: Button to reset the system.
5. PREVIOUS: Button to navigate to the previous screen or step.
6. DRY FILL: Likely a function related to the robot's task.
7. RAIL: Another function related to the robot's task.
8. CAPPING: Another function related to the robot's task.
9. Speed Controls: Buttons to adjust the robot's speed:
   - Robot Speed: Overall speed of the robot.
   - Load Speed: Speed when the robot is carrying a load.
   - Speed: General speed control.
10. Navigation Tabs: Tabs to navigate between different sections of the control system:
   - SYSTEM
   - OPERATION
   - MAGNETOMON
   - ROBOT
   - I/O
   - PRODUCTION
11. Robot Digital Inputs: Indicators for the robot's digital inputs.
12. Time and Date: Display of the current time and date.
13. Robot Universal Inputs and Outputs: Indicators for the robot's universal inputs and outputs.
14. NEXT: Button to navigate to the next screen or step.

The screen also includes a visual representation of the robot and its gripper status (opened or closed), as well as the current status of the system (e.g., Busy, Running, Hold, Fault, Battery, TP Enabled, AT Perch).

9.6.3.2 M1iA Robot Screen

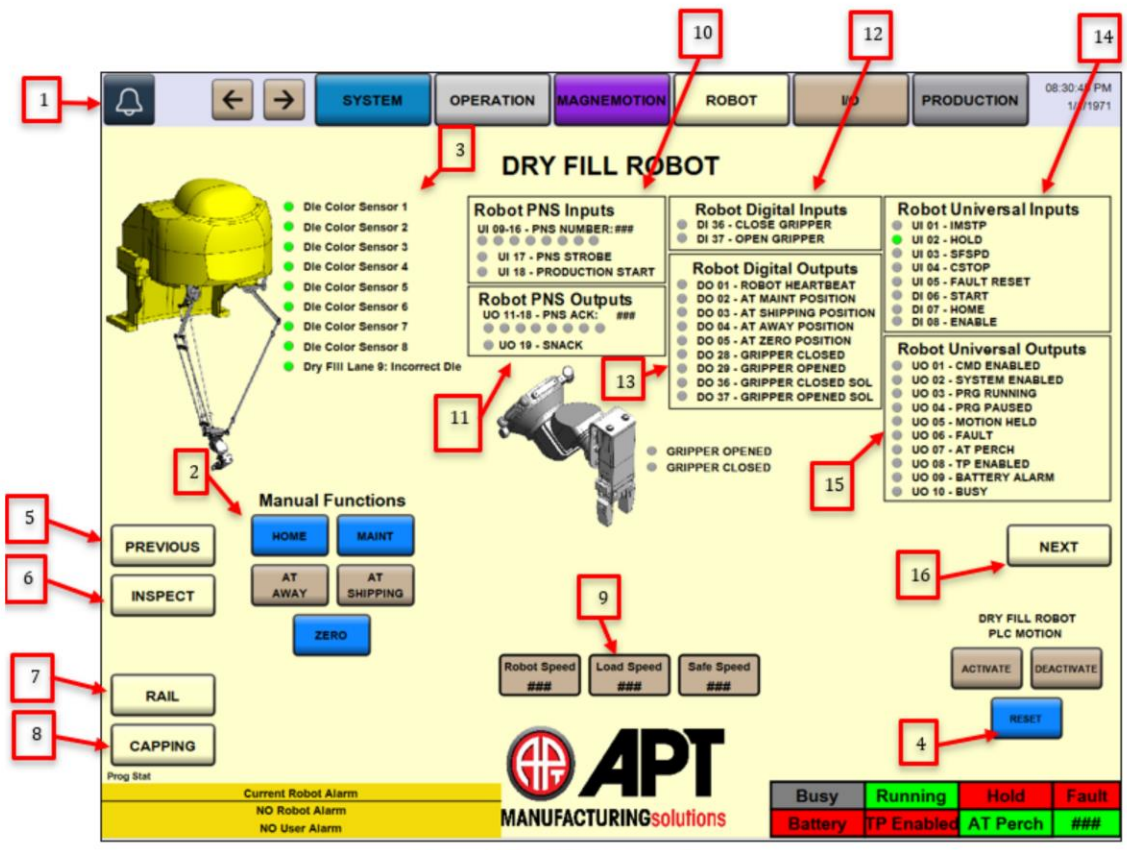

Figure 9-29 M1iA Robot Screen

1) Display Current Faults
2) Manual Function Operators and Indication of State; Select Button to Move Robot to the Desired Position.
3) Dice Tray Color Sensor Status Indicators
4) Robot UOP Commands and Indicators
5) Navigate to Previous Robot Screen
6) Navigate to LR-Mate Robot Screen
7) Navigate to CR7 Robot Screen
8) Navigate to Scara Robot Screen
9) Robot Speed Control
10) PNS Input Data to the Robot from the Process PLC
11) PNS Output Data Echoed Back from Robot to the Process PLC
12) Robot Digital Input Signals from Process PLC
13) Robot Digital Output Signals to Process PLC
14) Robot UI Signal Indicators to Process PLC
15) Robot UO Signal Indicators to Process PLC
16) Navigate to Next Robot Screen

This image (Figure 9-29) is a screenshot of the M1iA Robot Screen from APT Manufacturing Solutions. The screen is labeled "DRY FILL ROBOT" and contains various buttons, indicators, and sections for controlling and monitoring the robot. Here is a detailed description of the labeled elements:

1. Bell Icon: Likely an alarm or notification indicator.
2. Robot Image: A visual representation of the robot with labeled die color sensors.
3. Tab Navigation: Tabs for navigating between different sections such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, and PRODUCTION.
4. RESET Button: A button to reset the system.
5. PREVIOUS Button: Likely used to navigate to the previous screen or step.
6. INSPECT Button: Possibly used to initiate an inspection process.
7. RAIL Button: Likely related to rail functions.
8. CAPPING Button: Likely related to capping functions.
9. Speed Indicators: Displays for Robot Speed, Load Speed, and Safe Speed.
10. Robot PNS Inputs: Lists inputs for the robot, such as PNS NUMBER, PNS STORE, and PRODUCTION START.
11. Manual Functions: Buttons for HOME, MAINT (maintenance), AT AWAY, AT SHIPPING, and ZERO.
12. Robot Digital Inputs: Lists digital inputs for the robot, such as CLOSE GRIPPER and OPEN GRIPPER.
13. Robot PNS Outputs: Lists outputs for the robot, such as PNS ACK and SNACK.
14. Robot Universal Inputs: Lists universal inputs for the robot, such as INP, HOLD, and SSFD.
15. Robot Digital Outputs: Lists digital outputs for the robot, such as ROBOT HEARTBEAT, AT AWAY POSITION, and GRIPPER OPENED SOL.
16. NEXT Button: Likely used to navigate to the next screen or step.

Additional elements include:
- Manual Functions Section: Contains buttons for various manual operations.
- APT Manufacturing Solutions Logo: Located at the bottom center.
- Status Indicators: At the bottom, indicating the current robot alarm status and user alarm status.
- Activation/Deactivation Buttons: For activating or deactivating the robot's PLC motion.

This screen provides a comprehensive interface for controlling and monitoring the dry fill robot, with various inputs, outputs, and manual functions clearly labeled for ease of use.

9.6.3.3 CR7 Robot Screen

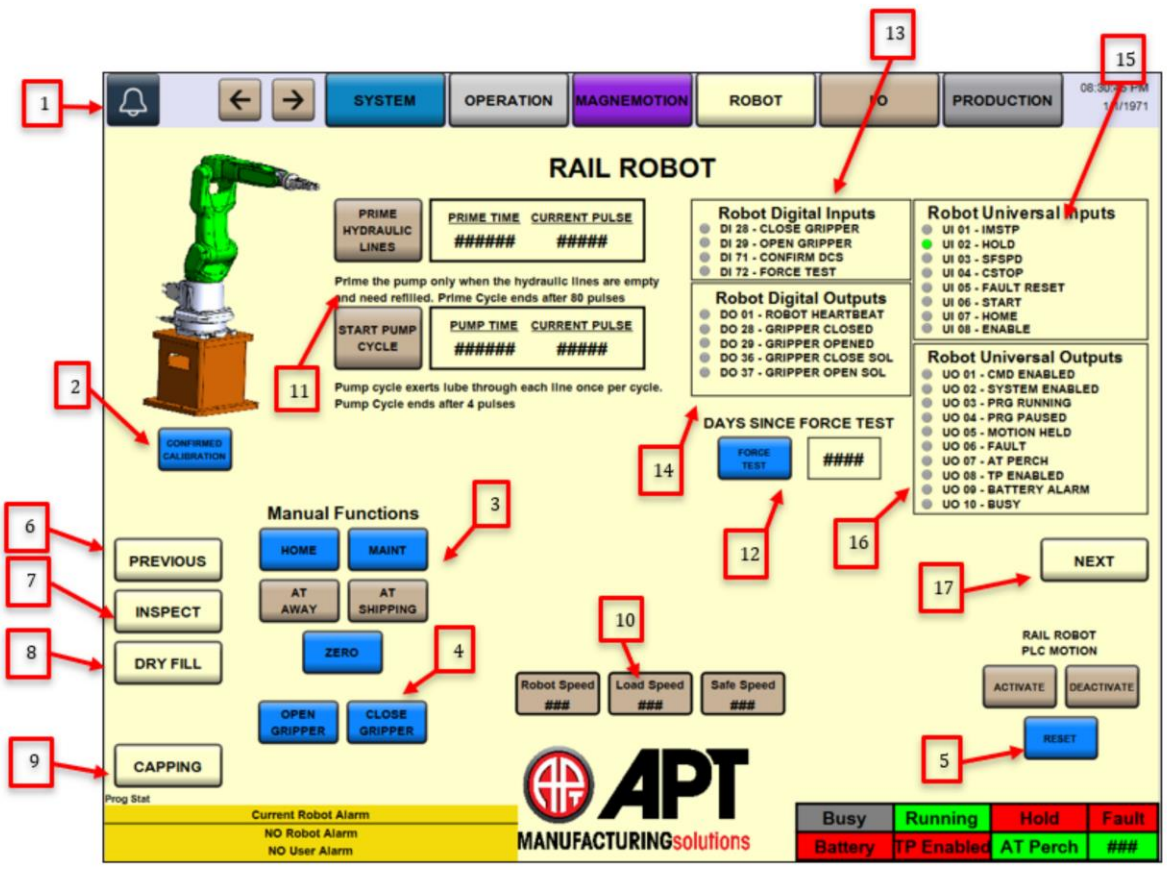

Figure 9-30 CR7 Robot Screen

1) Display Current Faults
2) Confirm CR7 Collaboration – Ensure no one is touching the Robot
3) Manual Function Operators and Indication of State; Select Button to Move Robot to the Desired Position.
4) End of Arm Tooling Manual Function and Status Indicators
5) Robot UOP Commands and Indicators
6) Navigate to Previous Robot Screen
7) Navigate to CR7 Robot Screen
8) Navigate to M1iA Robot Screen
9) Navigate to Scara Robot Screen
10) Robot Speed Control
11) Lube Pump Controls
12) Force Test Controls
13) Robot Digital Input Signals from Process PLC
14) Robot Digital Output Signals to Process PLC
15) Robot UI Signal Indicators to Process PLC
16) Robot UO Signal Indicators to Process PLC
17) Navigate to Next Robot Screen

The image (Figure 9-30) is a screenshot of a control interface for a rail robot, specifically the CR7 Robot Screen from APT Manufacturing Solutions. Below is a detailed description of the various elements and their functions as labeled in the image:

1. Bell Icon: Likely used for notifications or alerts.
2. Robot Image: Visual representation of the robot.
3. Manual Functions: Buttons for manual control of the robot, including:
   - HOME
   - MAINT (Maintenance)
   - AT AWAY
   - AT SHIPPING
   - OPEN GRIPPER
   - CLOSE GRIPPER
   - ZERO
4. Prime Hydraulic Lines: Section for priming the hydraulic lines with options for PRIME TIME and CURRENT PULSE.
5. Reset Button: Used to reset the system.
6. Previous Button: Likely used to navigate to the previous screen or step.
7. Inspect Button: Used to initiate an inspection process.
8. Dry Fill Button: Used to start a dry fill process.
9. Capping Button: Used to start the capping process.
10. Robot Speed, Load Speed, Safe Speed: Displays for different speed settings of the robot.
11. Start Pump Cycle: Section for starting the pump cycle with options for PUMP TIME and CURRENT PULSE.
12. Force Test Button: Used to initiate a force test.
13. Navigation Tabs: Tabs for navigating between different sections of the control interface:
   - SYSTEM
   - OPERATION
   - MAGNEMOTION
   - ROBOT
   - PRODUCTION
14. Days Since Force Test: Display showing the number of days since the last force test.
15. Date and Time: Display showing the current date and time.
16. Robot Digital Inputs and Outputs: Lists showing the status of various digital inputs and outputs for the robot.
17. Robot Universal Inputs and Outputs: Lists showing the status of various universal inputs and outputs for the robot.

The bottom section of the screen shows the current status of the robot, including:
- Current Robot Alarm
- No Robot Alarm
- No User Alarm

Additionally, there are indicators for the robot's status:
- Busy
- Running
- Hold
- Fault
- Battery
- TP Enabled
- AT Perch

The interface is designed to provide comprehensive control and monitoring of the rail robot, allowing operators to manage various functions and view the status of the robot in real-time.

9.6.3.4 Scara Robot Screen

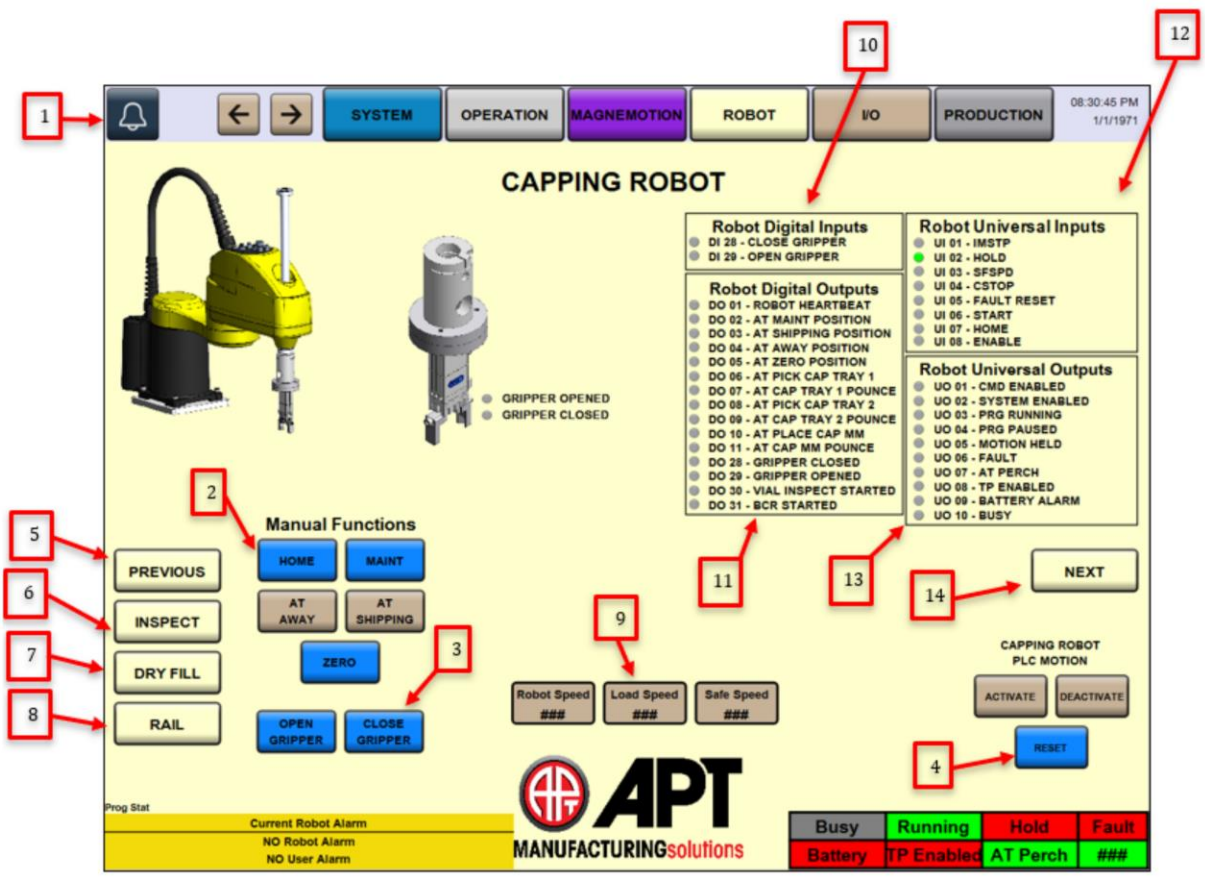

Figure 9-31 Scara Robot Screen

1) Display Current Faults
2) Manual Function Operators and Indication of State; Select Button to Move Robot to the Desired Position.
3) End of Arm Tooling Manual Function and Status Indicators
4) Robot UOP Commands and Indicators
5) Navigate to Previous Robot Screen
6) Navigate to LR-Mate Robot Screen
7) Navigate to M1iA Robot Screen
8) Navigate to CR7 Robot Screen
9) Robot Speed Control
10) Robot Digital Input Signals from Process PLC
11) Robot Digital Output Signals to Process PLC
12) Robot UI Signal Indicators to Process PLC
13) Robot UO Signal Indicators to Process PLC
14) Navigate to Next Robot Screen

This image (Figure 9-31) is a screenshot of a SCADA (Supervisory Control and Data Acquisition) system interface for a capping robot. The interface provides various controls and indicators for operating and monitoring the robot. Here is a detailed description of the elements in the image:

1. Bell Icon: Likely an alarm or notification indicator.
2. Manual Functions: Buttons for manual control of the robot, including:
   - HOME
   - MAINT (Maintenance)
   - AT AWAY
   - AT SHIPPING
   - ZERO
   - OPEN GRIPPER
   - CLOSE GRIPPER
3. RESET Button: Used to reset the system.
4. APT Manufacturing Solutions Logo: The company logo.
5. PREVIOUS Button: Likely used to navigate to the previous screen or step.
6. INSPECT Button: Used to initiate an inspection process.
7. DRY FILL Button: Likely used to start a dry fill process.
8. RAIL Button: Possibly used to control the rail system.
9. Speed Settings: Indicators for different speed settings of the robot:
   - Robot Speed
   - Load Speed
   - Safe Speed
10. Navigation Tabs: Tabs for navigating different sections of the interface:
   - SYSTEM
   - OPERATION
   - MAGNEMOTION
   - ROBOT
   - I/O
   - PRODUCTION
11. Robot Digital Inputs and Outputs: Lists of digital inputs and outputs for the robot, indicating various states and commands.
12. Date and Time: Displays the current date and time.
13. Robot Universal Inputs and Outputs: Lists of universal inputs and outputs for the robot, indicating various states and commands.
14. NEXT Button: Likely used to navigate to the next screen or step.

The bottom section of the screen shows the current status of the robot, including alarms and user status. The status indicators at the bottom right show various states such as Busy, Running, Hold, Fault, Battery, TP Enabled, AT Perch, and others.

9.6.4 I/O Screens

1) Status Indicator of I/O
2) Navigate to I/O Master Block #1
3) Navigate to I/O Master Block #2

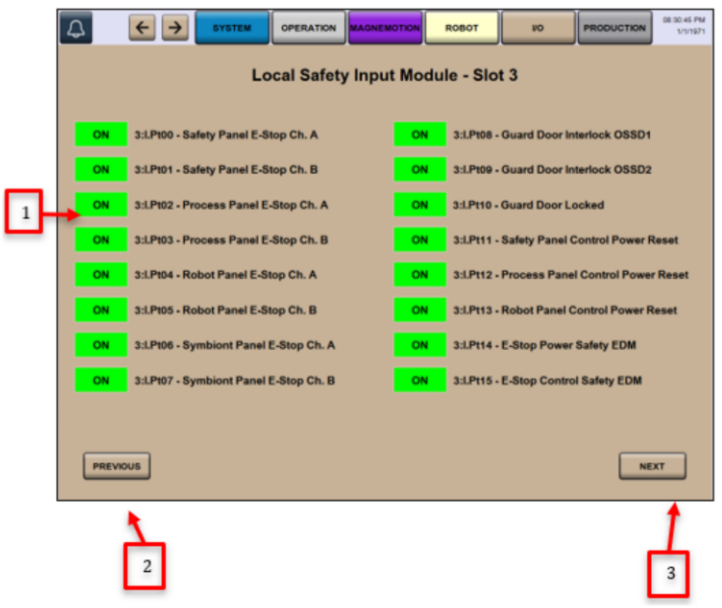

Figure 9-32 Safety I/O Screen Slot 3

Figure 9-34 Safety I/O Screen Slot 4

Figure 9-33 Safety I/O Screen Slot 5

The image (Figure 9-32) shows a screenshot of a Local Safety Input Module interface, specifically Slot 3. The interface is divided into three main sections, each highlighted with red arrows and numbers for reference:
1. Section 1 (Left Column):
 - This section lists various safety inputs, each with a corresponding status indicator.
 - All the indicators in this column are green and labeled "ON."
 - The inputs listed include: 3:1P00 - Safety Panel E-Stop Ch. A; 3:1P01 - Safety Panel E-Stop Ch. B; 3:1P02 - Process Panel E-Stop Ch. A; 3:1P03 - Process Panel E-Stop Ch. B; 3:1P04 - Process Panel E-Stop Ch. A; 3:1P05 - Process Panel E-Stop Ch. B; 3:1P06 - Robot Panel E-Stop Ch. A; and 3:1P07 - Symbiont Panel E-Stop Ch. A.
2. Section 2 (Bottom Left):
 - This section contains a "PREVIOUS" button, likely used for navigation to the previous screen or set of inputs.
3. Section 3 (Right Column):
 - This section also lists various safety inputs, each with a corresponding status indicator.
 - All the indicators in this column are green and labeled "ON."
 - The inputs listed include: 3:1P08 - Guard Door Interlock OSSD1; 3:1P09 - Guard Door Interlock OSSD2; 3:1P10 - Guard Door Locked; 3:1P11 - Safety Panel Control Power Reset; 3:1P12 - Process Panel Control Power Reset; 3:1P13 - Robot Panel Control Power Reset; 3:1P14 - E-Stop Power Safety EDM; and 3:1P15 - E-Stop Control Safety EDM.
4. Section 4 (Bottom Right):
 - This section contains a "NEXT" button, likely used for navigation to the next screen or set of inputs.
The top of the screen has a navigation bar with tabs labeled SYSTEM, OPERATION, MAINTENANCE, ROBOT, I/O, and PRODUCTION, indicating different sections of the interface for various functions.

The image (Figure 9-33) shows a screen from a control system interface, specifically the "Local Safety Input Module - Slot 5." The screen displays the status of various safety inputs, each labeled with a specific identifier and description. The status of each input is indicated by a green box with the word "ON" inside it.
Here is a breakdown of the inputs and their statuses: S1LP00 - Station 4 Stop OSSD1: ON; S1LP01 - Station 4 Stop OSSD2: ON; S1LP02 - Station 4 Warning OSSD1: ON; S1LP03 - Station 4 Warning OSSD2: ON; S1LP04 - Station 5 Stop OSSD1: ON; S1LP05 - Station 5 Stop OSSD2: ON; S1LP06 - Station 5 Warning OSSD1: ON; S1LP07 - Station 5 Warning OSSD2: ON; S1LP08 - Station 6 Left Stop OSSD1: ON; S1LP09 - Station 6 Left Stop OSSD2: ON; S1LP10 - Station 6 Left Warning OSSD1: ON; S1LP11 - Station 6 Left Warning OSSD2: ON; S1LP12 - Station 6 Right Stop OSSD1: ON; S1LP13 - Station 6 Right Stop OSSD2: ON; S1LP14 - Station 6 Right Warning OSSD1: ON; and S1LP15 - Station 6 Right Warning OSSD2: ON.
The screen also has navigation buttons labeled "PREVIOUS" and "NEXT" at the bottom, and a series of tabs at the top for different sections of the control system: SYSTEM, OPERATION, MAGNETOM, ROBOT, I/O, and PRODUCTION. The current time and date are displayed in the upper right corner.

The image (Figure 9-34) shows a screen from a control system interface labeled "Local Safety Input Module - Slot 4." The screen displays the status of various safety inputs for different stations. Each input is labeled with a unique identifier and a description, and the status of each input is indicated by a green box with the word "ON" inside it.
Here is a breakdown of the inputs and their statuses: 4.1.P0.0 - Station 1 Left Stop OSSD1: ON; 4.1.P0.1 - Station 1 Left Stop OSSD2: ON; 4.1.P0.2 - Station 1 Left Warning OSSD1: ON; 4.1.P0.3 - Station 1 Left Warning OSSD2: ON; 4.1.P0.4 - Station 1 Right Stop OSSD1: ON; 4.1.P0.5 - Station 1 Right Stop OSSD2: ON; 4.1.P0.6 - Station 1 Right Warning OSSD1: ON; 4.1.P0.7 - Station 1 Right Warning OSSD2: ON; 4.1.P1.0 - Station 2 Stop OSSD1: ON; 4.1.P1.1 - Station 2 Stop OSSD2: ON; 4.1.P1.2 - Station 2 Warning OSSD1: ON; 4.1.P1.3 - Station 2 Warning OSSD2: ON; 4.1.P1.4 - Station 3 Stop OSSD1: ON; 4.1.P1.5 - Station 3 Stop OSSD2: ON; 4.1.P1.6 - Station 3 Warning OSSD1: ON; and 4.1.P1.7 - Station 3 Warning OSSD2: ON
The screen also has navigation buttons labeled "PREVIOUS" and "NEXT" at the bottom, and there are tabs at the top for different sections of the control system, including SYSTEM, OPERATION, MAGNETMOTION, ROBOT, I/O, and PRODUCTION. The time and date are displayed in the upper right corner.

Figure 9-38 Safety I/O Screen Slot 6

Figure 9-37 Safety I/O Screen Slot 7

Figure 9-36 Safety I/O Screen Slot 11

Figure 9-35 I/O Screen Slot 16

The image shows a screen from a control system interface, specifically the "Local Output Module - Slot 15." The screen displays the status of various outputs, all of which are currently turned on, as indicated by the green "ON" labels next to each output.
The outputs are listed with their respective identifiers and descriptions: 15.0.PB0 - Alarm Horn Stacklight; 15.0.PB1 - Alarm Active Stacklight (Red); 15.0.PB2 - Attention Stacklight (Amber); 15.0.PB3 - Machine Running Stacklight (Green); 15.0.PB4 - Safety Panel Control Power Light; 15.0.PB5 - Process Panel Control Power Light; 15.0.PB6 - Robot Panel Control Power Light; 15.0.PB7 - Guard Door Lock Solenoid; 15.0.PB8 - Station 1 Area Scanner Warning Light; 15.0.PB9 - Station 2 Area Scanner Warning Light;15.0.PB10 - Station 3 Area Scanner Warning Light; 15.0.PB11 - Station 1 Area Scanner Clear Light; 15.0.PB12 - Station 2 Area Scanner Clear Light; 15.0.PB13 - Station 3 Area Scanner Clear Light; 15.0.PB14 - Station 1 Area Scanner Stop Light; and 15.0.PB15 - Station 2 Area Scanner Stop Light.
The screen also includes navigation buttons at the top for different sections of the system: SYSTEM, OPERATION, MAGNETOM, ROBOT, I/O, and PRODUCTION. There are "PREVIOUS" and "NEXT" buttons at the bottom for navigating through different slots or screens. The figure is labeled as "Figure 9-35 I/O Screen Slot 16."

The image (Figure 9-36) shows a screen from a control system interface, specifically the "Local Safety Output Module - Slot 11." The screen displays the status of various safety outputs, with each output labeled and its status indicated as "ON" or "OFF."
Here are the details of the outputs: 11.0.P00 - E-Stop Power Safety Relay A (ON); 11.0.P01 - E-Stop Power Safety Relay B (ON); 11.0.P02 - E-Stop Control Safety Relay A (ON); 11.0.P03 - E-Stop Control Safety Relay B (ON); 11.0.P04 - Spare (ON); 11.0.P05 - Spare (ON); 11.0.P06 - Spare (ON); and 11.0.P07 - Guard Door Lock Solenoid (ON).
The screen also includes navigation buttons labeled "PREVIOUS" and "NEXT" at the bottom, and a series of tabs at the top for different sections of the system: SYSTEM, OPERATION, MAGNETOM, ROBOT, I/O, and PRODUCTION. The time and date are displayed in the upper right corner, showing 08:36:42 PM on 5/13/17.

The image (Figure 9-37) shows a screen from a control system interface, specifically the "Local Safety Input Module - Slot 7." The screen displays the status of various inputs, with each input labeled and its status indicated as "ON" or "OFF."
Here is a breakdown of the inputs and their statuses: 7.1-Pb00 - South Light Curtain OSSD1: ON; 7.1-Pb01 - South Light Curtain OSSD2: ON; 7.1-Pb02 - North Light Curtain OSSD1: ON; 7.1-Pb03 - North Light Curtain OSSD2: ON; 7.1-Pb04 - Spare: ON; 7.1-Pb05 - Spare: ON; 7.1-Pb06 - Spare: ON; 7.1-Pb07 - Spare: ON; 7.1-Pb08 - Spare: ON; 7.1-Pb09 - Spare: ON; 7.1-Pb10 - Spare: ON; 7.1-Pb11 - Spare: ON; 7.1-Pb12 - Spare: ON; 7.1-Pb13 - Spare: ON; 7.1-Pb14 - Spare: ON; and 7.1-Pb15 - Spare: ON.
The screen also includes navigation buttons labeled "PREVIOUS" and "NEXT" at the bottom, and a series of tabs at the top labeled "SYSTEM," "OPERATION," "MAGNETOSYN," "ROBOT," "IO," and "PRODUCTION." The current time is displayed in the top right corner.

The image (Figure 9-38) shows a screen from a control system interface, specifically the "Local Safety Input Module - Slot 6." The screen displays the status of various safety inputs for different stations. Each input is labeled with an identifier and a description, and the status of each input is indicated by a green box with the word "ON."
Here is a breakdown of the inputs and their statuses: 6:I.P00 - Station 7 Left Stop OSSD1: ON; 6:I.P01 - Station 7 Left Stop OSSD2: ON; 6:I.P02 - Station 7 Left Warning OSSD1: ON; 6:I.P03 - Station 7 Left Warning OSSD2: ON; 6:I.P04 - Station 7 Right Stop OSSD1: ON; 6:I.P05 - Station 7 Right Stop OSSD2: ON; 6:I.P06 - Station 7 Right Warning OSSD1: ON; 6:I.P07 - Station 7 Right Warning OSSD2: ON; 6:I.P08 - Station 8 Left Stop OSSD1: ON; 6:I.P09 - Station 8 Left Stop OSSD2: ON; 6:I.P10 - Station 8 Left Warning OSSD1: ON; 6:I.P11 - Station 8 Left Warning OSSD2: ON; 6:I.P12 - Station 8 Right Stop OSSD1: ON; 6:I.P13 - Station 8 Right Stop OSSD2: ON; 6:I.P14 - Station 8 Right Warning OSSD1: ON; and 6:I.P15 - Station 8 Right Warning OSSD2: ON.
The interface also includes navigation buttons at the bottom labeled "PREVIOUS" and "NEXT," and a set of tabs at the top for different sections of the system: SYSTEM, OPERATION, MAINTENANCE, ROBOT, I/O, and PRODUCTION. The current time and date are displayed in the upper right corner.

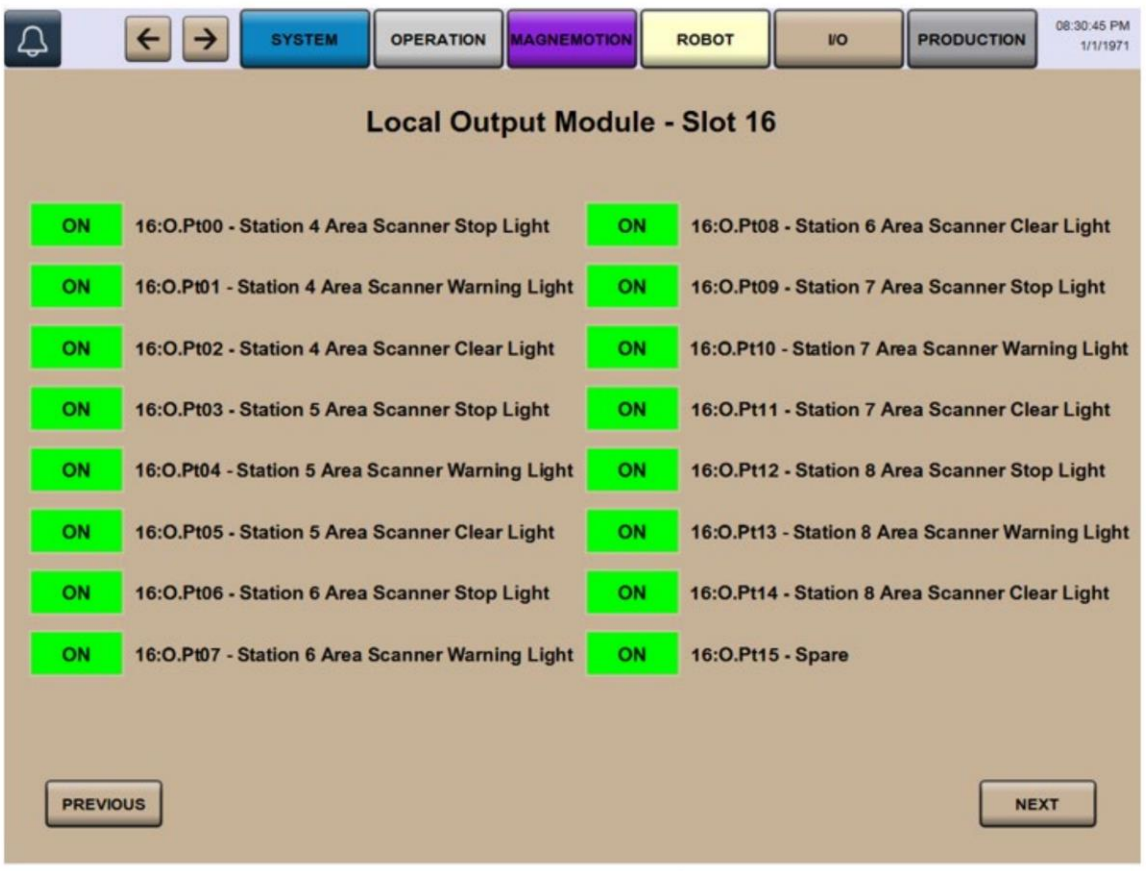

Figure 9-39 I/O Screen Slot 16

The image (Figure 9-39) shows a control panel interface for a Local Output Module in Slot 16. The interface displays the status of various area scanner lights for different stations. Each entry includes an identifier, a description, and a status indicator. All the status indicators are currently set to "ON" and are highlighted in green.

Here is a detailed breakdown of the entries:

1. 16:O.Pt00 - Station 4 Area Scanner Stop Light - ON
2. 16:O.Pt01 - Station 4 Area Scanner Warning Light - ON
3. 16:O.Pt02 - Station 4 Area Scanner Clear Light - ON
4. 16:O.Pt03 - Station 5 Area Scanner Stop Light - ON
5. 16:O.Pt04 - Station 5 Area Scanner Warning Light - ON
6. 16:O.Pt05 - Station 5 Area Scanner Clear Light - ON
7. 16:O.Pt06 - Station 6 Area Scanner Stop Light - ON
8. 16:O.Pt07 - Station 6 Area Scanner Warning Light - ON
9. 16:O.Pt08 - Station 6 Area Scanner Clear Light - ON
10. 16:O.Pt09 - Station 7 Area Scanner Stop Light - ON
11. 16:O.Pt10 - Station 7 Area Scanner Warning Light - ON
12. 16:O.Pt11 - Station 7 Area Scanner Clear Light - ON
13. 16:O.Pt12 - Station 8 Area Scanner Stop Light - ON
14. 16:O.Pt13 - Station 8 Area Scanner Warning Light - ON
15. 16:O.Pt14 - Station 8 Area Scanner Clear Light - ON
16. 16:O.Pt15 - Spare - ON

The interface also includes navigation buttons at the bottom labeled "PREVIOUS" and "NEXT," and tabs at the top for different sections such as SYSTEM, OPERATION, MAGNEMOTION, ROBOT, I/O, and PRODUCTION. The timestamp in the top right corner shows "08:30:45 PM 1/1/1971."

9.6.5 Production Data Screen

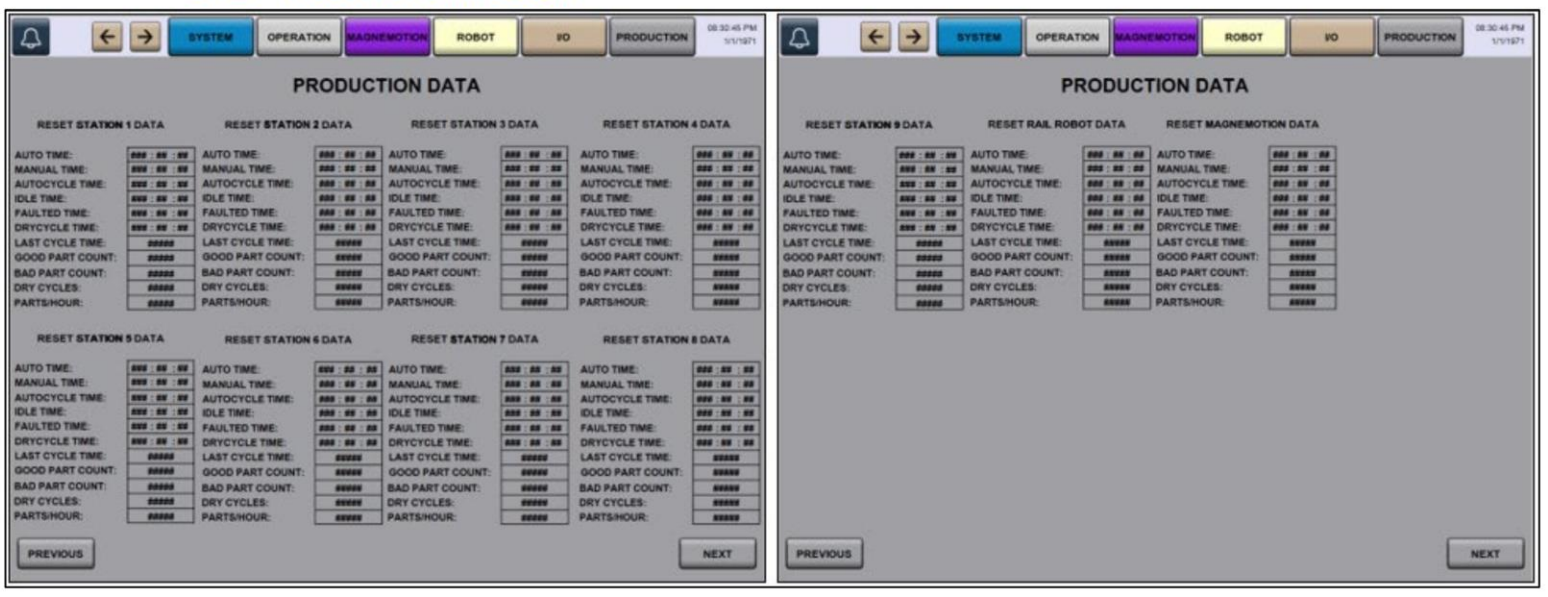

Figure 9-40 Production Data Screen

The image (Figure 9-40) shows a "Production Data" screen from a control system interface. The screen is divided into two sections, each displaying data for different stations and components.
Left Section:
- Title: PRODUCTION DATA
- Tabs at the Top: SYSTEM, OPERATION, MAGNE MOTION, ROBOT, I/O, PRODUCTION
- Data for Stations 1 to 5:
  - Metrics Displayed:
    - AUTO TIME
    - MANUAL TIME
    - AUTOCYCLE TIME
    - IDLE TIME
    - FAULT TIME
    - CYCLE TIME
    - LAST CYCLE TIME
    - GOOD PART COUNT
    - BAD PART COUNT
    - PARTS/ HOUR
- Navigation Buttons: PREVIOUS, NEXT

Right Section:
- Title: PRODUCTION DATA
- Tabs at the Top: SYSTEM, OPERATION, MAGNE MOTION, ROBOT, I/O, PRODUCTION
- Data for Stations 6 to 9, Rail Robot, and MagneMotion:
  - Metrics Displayed:
    - AUTO TIME
    - MANUAL TIME
    - AUTOCYCLE TIME
    - IDLE TIME
    - FAULT TIME
    - CYCLE TIME
    - LAST CYCLE TIME
    - GOOD PART COUNT
    - BAD PART COUNT
    - PARTS/ HOUR
- Navigation Buttons: PREVIOUS, NEXT

General Observations:
- The interface is designed to monitor and display production data for various stations and components.
- Each station/component has a set of metrics that are tracked and displayed.
- The interface allows navigation between different screens using the "PREVIOUS" and "NEXT" buttons.
- The tabs at the top suggest that the system can switch between different operational views or modules.

This screen is likely part of a larger system used for monitoring and managing production processes in an industrial setting.

9.7 Fault Listings

9.7.1 Station 1 Faults

Alarm 01: LRMate7L Robot HeartBeat Fault – Check Robot Controller
Alarm 02: Station 1 Tray 1 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 03: Station 1 Tray 2 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 04: Station 1 Tray 3 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 05: Station 1 Robot Faulted – See Teach Pendent for Details

9.7.2 Station 2 Faults

Alarm 01: Spare
Alarm 02: Spare
Alarm 03: Spare
Alarm 04: Spare
Alarm 05: Station 2 Robot Faulted – See Teach Pendent for Details

9.7.3 Station 3 Faults

Alarm 01: Wet Fill PLC Heartbeat Fault – Check Filler Panel & Controller
Alarm 02: Spare
Alarm 03: Spare
Alarm 04: Spare
Alarm 05: Spare

9.7.4 Station 4 Faults

Alarm 01: Wet Fill PLC Heartbeat Fault – Check Filler Panel & Controller
Alarm 02: Spare
Alarm 03: Spare
Alarm 04: Spare
Alarm 05: Spare

9.7.5 Station 5 Faults

Alarm 01: Wet Fill PLC Heartbeat Fault – Check Filler Panel & Controller
Alarm 02: Spare
Alarm 03: Spare
Alarm 04: Spare
Alarm 05: Spare

9.7.6 Station 6 Faults

Alarm 01: SR3iA SCARA Robot Heartbeat Fault – Check Robot Controller
Alarm 02: Station 6 Tray 1 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 03: Station 6 Tray 2 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 04: Spare
Alarm 05: Scara Robot Faulted – See Teach Pendent for Details

9.7.7 Station 8 Faults

Alarm 01: Spare
Alarm 02: Station 8 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 03: Station 6 Tray 2 Scale Heartbeat Fault – Check Scale ACT350 Controller
Alarm 04: Spare
Alarm 05: Spare

9.7.8 CR7 Faults

Alarm 01: CR7 Rail Robot Heartbeat Fault – Check Robot Controller
Alarm 02: Spare
Alarm 03: Spare
Alarm 04: Spare
Alarm 05: CR7 Rail Robot Faulted – See Teach Pendent for Details

9.7.9 Safety Faults

Alarm 00: Safety Panel Emergency Stop Activated
Alarm 01: Safety Panel Emergency Stop Faulted – Check for Wire Break or Short
Alarm 02: Process Panel Emergency Stop Activated
Alarm 03: Process Panel Emergency Stop Faulted – Check for Wire Break or Short
Alarm 04: Robot Panel Emergency Stop Activated
Alarm 05: Robot Panel Emergency Stop Faulted – Check for Wire Break or Short
Alarm 06: Symbiont Panel Emergency Stop Activated
Alarm 07: Symbiont Panel Emergency Stop Faulted – Check for Wire Break or Short
Alarm 08: Robot Rail North Light Curtain Faulted – Check for Wire Break or Short
Alarm 09: Robot Rail South Light Curtain Faulted – Check for Wire Break or Short
Alarm 10: Station 1 Area Scanner Left Stop Zone Faulted – Check for Wire Break or Short
Alarm 11: Station 1 Area Scanner Left Warning Zone Faulted – Check for Wire Break or Short
Alarm 12: Station 1 Area Scanner Right Stop Zone Faulted – Check for Wire Break or Short
Alarm 13: Station 1 Area Scanner Right Warning Zone Faulted – Check for Wire Break or Short
Alarm 14: Station 2 Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 15: Station 2 Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 16: Station 3 Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 17: Station 3 Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 18: Station 4 Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 19: Station 4 Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 20: Station 5 Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 21: Station 5 Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 22: Station 6 Left Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 23: Station 6 Left Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 24: Station 6 Right Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 25: Station 6 Right Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 26: Station 7 Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 27: Station 7 Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 28: Station 8 Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 29: Station 8 Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 30: Station 9 Left Area Scanner Stop Zone Faulted – Check for Wire Break or Short

Alarm 31: Station 9 Left Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 32: Station 9 Right Area Scanner Stop Zone Faulted – Check for Wire Break or Short
Alarm 33: Station 9 Right Area Scanner Warning Zone Faulted – Check for Wire Break or Short
Alarm 34: Guard Door Lock Faulted – Check for Wire Break or Short
Alarm 35: Safety Relay Output Control Faulted – Check for Wire Break, Short or EDM Feedback
Alarm 36: Safety Relay Output Power Faulted – Check for Wire break, Short or EDM Feedback
Alarm 37: Fanuc LR-Mate 7L Emergency Stop Activated
Alarm 38: Fanuc LR-Mate 7L Emergency Stop Safety Instruction Faulted – Check Robot Communication
Alarm 39: Fanuc CR7 Emergency Stop Activated
Alarm 40: Fanuc CR7 Emergency Stop Safety Instruction Faulted – Check Robot Communication
Alarm 41: Fanuc SR3iA Emergency Stop Activated
Alarm 42: Fanuc SR3iA Emergency Stop Safety Instruction Faulted - Check Robot Communication
Alarm 43: Fanuc M1iA Emergency Stop Activated
Alarm 44: Fanuc M1iA Emergency Stop Safety Instruction Faulted - Check Robot Communication
Alarm 45: Safety Input Card Slot 3 Faulted
Alarm 46: Safety Input Card Slot 4 Faulted
Alarm 47: Safety Input Card Slot 5 Faulted
Alarm 48: Safety Input Card Slot 6 Faulted
Alarm 49: Safety Input Card Slot 7 Faulted
Alarm 50: Safety Output Card Slot 11 Faulted
Alarm 51: Safety Input Connection Faulted Fanuc LR-Mate
Alarm 52: Safety Input Connection Faulted Fanuc CR7
Alarm 53: Safety Input Connection Faulted Fanuc SR39A
Alarm 54: Safety Input Connection Faulted Fanuc M1iA
Alarm 55: System Safety Mismatch, Please Verify System Safety has not been Tampered with

10 Appendix A – Equipment / Process Flow

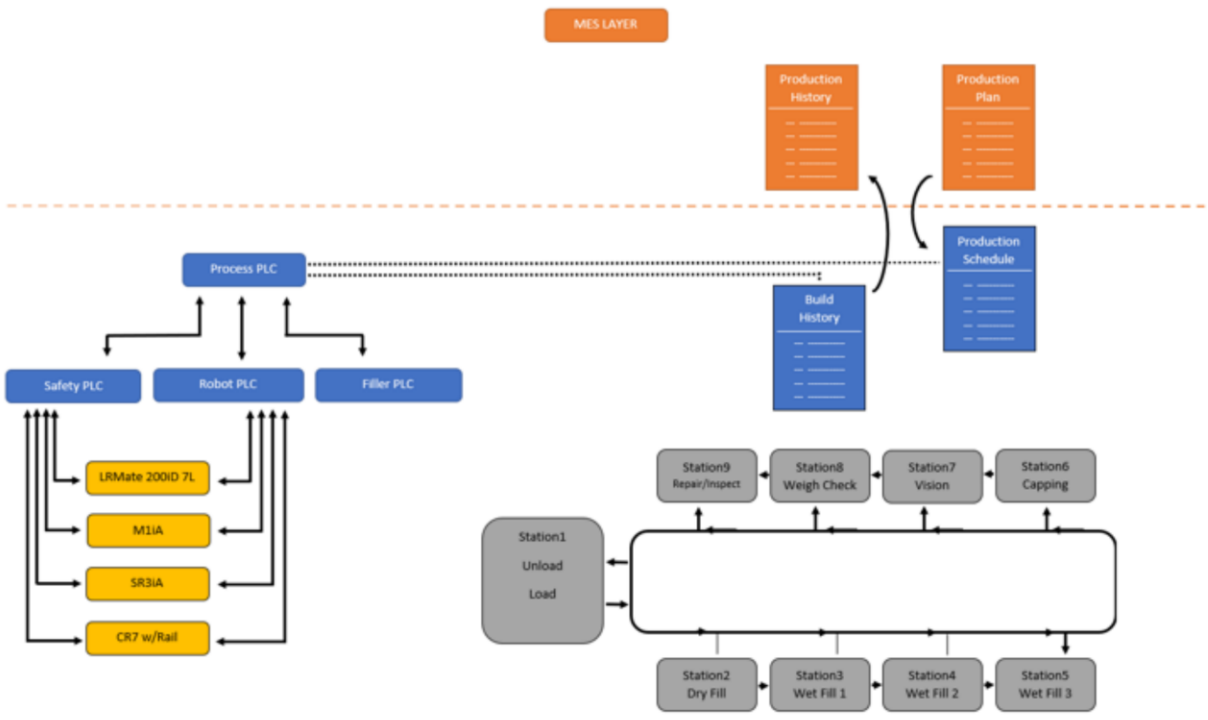

Figure 10-1 Equipment / Process Flow Diagram

The image is a process flow diagram labeled "Figure 10-1 Equipment / Process Flow Diagram." It illustrates the interaction between various components in a manufacturing execution system (MES) layer and the equipment/process flow.

MES Layer:
- Production History
- Production Plan
- Production Schedule
- Build History

Process PLC:
- Safety PLC
- Robot PLC
- Filler PLC

Robots:
- LRMate 200iD 7L
- M1iA
- SR3iA
- CR7 w/Rail

Stations:
1. Station 1: Unload/Load
2. Station 2: Dry Fill
3. Station 3: Wet Fill 1
4. Station 4: Wet Fill 2
5. Station 5: Wet Fill 3
6. Station 6: Capping
7. Station 7: Vision
8. Station 8: Weight Check
9. Station 9: Repair/Inspect

The diagram shows the flow of information and control between the MES layer and the process PLCs, which in turn control various robots and stations involved in the manufacturing process. The stations are arranged in a loop, indicating a continuous or cyclical process flow.