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**SERVICE AND OPERATIONAL MANUAL**

# PRELIMINARY AND NOT AUDITED

**NMPSolvent Recovery Unit**

Client: MOBIUS, INC.

SRS Reference number: SR-NMP-MNL-001.doc

| Action | Name | Date | Initials |
|---|---|---|---|
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# 1. GENERAL

## 1.1 Introduction

Dear customer,
We wish to thank you for choosing SRS Engineering, Corp.
In order to maximize the use of your solvent recovery system, it is important to read and understand this manual before attempting any distillation.

The contents of this manual should be read in its entire prior to installation and operation. Failure to do so may cause unnecessary delays, omissions of fail-safe devices, or specifications that may result in the cancellation of your warranty. The manuals intentions are to assist you during the installation and safe operation of the system in part or as a whole. All safety devices associated with the equipment must be installed and additional safeties may be added by the customer, but must be verified by the manufacturer before they can be added to the control system.

The microprocessor controlled NMP system was designed to offer you the ultimate in control and monitoring without compromise to safety. This manual will allow you to understand some of the basic principles of distillation. As you proceed through the instructions to follow you will understand some of the technology behind this system that makes it unique to the industry.

These systems are available in different sizes. The systems and options will be defined throughout the manual allowing you to configure each option as it applies to your particular system.

## 1.2 Brief Description

This system is designed for the separation of NMP from Saturation Air Stream. Chilled water, Compressed Air Supply should be ensured before starting the system. During startup when operator enables “Master Control” from SCADA -Master Screen, Nitrogen purging starts for the set time entered from SCADA.

Remove all the alarms to operate the system in auto mode. To start particular loop ensure all the conditions to start the loop in auto mode are satisfied. The Feed loop will be started in auto mode. The liquid feed stream from VRS-T-101 Bottom Discharge Pump (VRS-PU-102) will be feed to Packed Bed. The feed mixture fed to the feed section of the VRS-SEC-101. The Feed consisting of Pure NMP Only .During operation the saturated air stream flows from bottom of Packed bed & the air fed to the feed

suction of column(VRS-SEC-101). NMP feed & distribute within packing from top of packed bed , Feed consists of pure NMP which will strip out miscible NMP in saturated Air from bottom .During operation Air removes at the top of Packed bed and vented to atmosphere.

The system operates on a principle of single stage absorption which separates a mixture of gases by absorption with individual components/ Solvent. The system consists of a flash still vessel, Packed Bed , Refrigeration Unit, (heat exchanger), transfer pumps and associated instruments like temperature indicators, pressure gauges, pressure indicators, flow transmitters, level transmitters, temperature transmitters, control valves, solenoid valves etc.

The NMP recovery process is started at the microprocessor in the control panel. Operator attention required is minimum, but **must never be left unattended**. NMP recovery process has been automated with a programmable logic controller (PLC). The PLC continuously monitors and controls each step of the operation.

The basic system comes with a *PLC* controlled panel, which **must be placed in a non-hazardous location**. The PLC runs the program, does a self-diagnostic check and tests all temperature signals. If a Resistance Temperature Detector (RTD) becomes faulty or is disconnected accidentally the PLC will receive a broken wire fault and shut down the system. In short, all systems are controlled by one source. Any Default of any monitoring device will stop the process offering you the ultimate in safety.

### 1.3 Site location

**MOBIUS**

### 1.4 Abbreviations

SRS SRS Engineering, Corp.

MP MOBIUS PROJECT

### 1.5 Instrument Identification

For Complete instrumentation list, which includes part numbers and manufacturer's names refer to the parts list and spare parts list. Fig. 1.1 illustrates ID tags

*Fig 1.1*

## 2. INSTALLATION

### 2.1 General

On receipt of your system, it is important to inspect for physical damages that may have occurred during shipment. It is possible that due to vibration and handling some components can loosen and sometimes break. Notify "SRS" prior to correcting these problems so we may assist you and provide the necessary replacement parts.

### 2.2 Rigging Instructions

It is recommended that the Owner use professional millwrights or sometimes referred to as riggers to handle the NMP System. It is recommended that extreme caution and care is to be used when handling the NMP system. When transporting the NMP System the operator must use his professional experience to avoid bending, scratching and denting. When being transported it is recommended that the NMP System be placed on a pallet and stabilized with tie down straps or any other method which will secure the machine. If the NMP System must be elevated a fork lift is recommended to raise in front of the front side, but not from the left or right side. The forks must also be adjusted so no harm is done to any of the cylinders or other components.

### 2.3 Securing

A bolt and anchor device may be used to secure the skid. There are 4 holes at the bottom of the tank base. Fasten 4 bolts through holes to the floor. Skid must be level to avoid improper weight distribution, when distillation is filled with product.

***Fig 2.1***

## 2.4 Electrical

Electrical power must be provided to the main control panel **(MCP-1), 460Volts, 3Phase, 60Hz.** See Electrical Schematics. Connect the unit per the electrical control panel schematics. Refer to Appendix B for details. Check for correct rotation on all motors, pumps and drives. A separate ground conductor is recommended, connected to the unit's frame. Grounding is essential to ensure a zero resistance to ground, avoiding electrical shock. Proper grounding minimizes the risk to personal. Electrical must meet national electric code (**NEC) Class 1, Division 1 regulations.** All electrical components are UL or FM listed.

The electrical components other than the control panel **are NEMA 7X** rated for use in a **CLASS 1, DIV. 1** location. The control panel is **NEMA 4** rated for installation in dusty and wet environments, and must be either purged to meet Class 1, Div. 1 or installed in an unclassified room.

**NOTE**: Optional purge controls are available for the main control panel, which will comply with regulations for usage in a CLASS 1, DIV. 1 locations.

## 2.5 Process piping

All fittings and flanges are provided on the equipment for attachment of piping. Maintain sizes of piping provided per the fitting or flange, reference P&ID. Always install a union or flange for connection and disconnection purposes and for servicing components. Shut off valves are also recommended and are to be tagged to indicate their normal operating position. Piping is schedule 40, 304 stainless steel. All fittings must be rated at a minimum of 150 lbs, when threaded always use Teflon tape and Teflon paste to ensure proper sealing and resistance to chemicals - if flexible connections are desired use metal hoses or metal with Teflon lining to ensure compatibility to chemicals. Heating media must be installed prior to first

start up. Fig. 2.2 illustrates process piping.

***Fig* 2.2**

## 2.6 Utility connections

All Utility connections are described as being the termination points where NMP System will terminate their piping to the Skid End Point. Each utility connection is labeled with letters and tagged per specifications on the unit. If detailed connections are required, refer to Appendix B. All utility connection prerequisites must be met before operation of equipment. Ensure that all prerequisites include adequate: Air and steam pressures, electrical connections, Insertion of heat transfer fluid. For exact utility location and requirements refer to Utility connections drawing located in Appendix B. See Fig 2.3 as an example.

***Fig* 2.3**

## 2.7 Materials of Construction

- **Frame constructed of SQ. Tube (4”x 4” x 1/4”) material C.S.**
- **All piping used for process fluids are SS304 schedule 40**
- **Level and Temperature sensors 316L Stainless Steel**
- **Pneumatic lines are schedule 40 galvanized with flexible reinforced nylon lines to the actuated valves.**

## 2.8 Machine Assembly

The NMP System will be shipped and received in single large pieces. In most cases the unit is crated to ensure maximum protection during shipping. Because the unit is shipped in minimum pieces to less assembly is required. If the NMP Skid is crated it is important to disassemble the crate with precaution to ensure no damage is caused to the unit. We strongly recommend the use of a professional equipment movers or contractors to avoid damage of equipment or injury to personnel.

**NOTE: Only trained and certified personnel may proceed with this installation.**

## 2.9 Location

All SRS compactors when Class 1, Div 1 rated properly installed meet all “National Electrical Code Section 500 (ANSI/NFPA 70)” requirements to be rated fully “Explosion Proof”, and therefore can be safely installed in most environments, including those with Class I, Division I, Group D conditions.

For Maximum safety, the NMP System and its optional systems should be installed following the standards of the NFPA 30 and 70 codes.

To find the proper location site for this machine please reference the utility connections or if requested Equipment layout drawing.

**OSHA REQUIRES: At least 3’ of space between equipment and walls.**

## 2.10 Pneumatic Piping

Pneumatic Piping requirements must match minimum size provided at the point of connection. Maximum air pressure of 120 P.S.I (min. 90 P.S.I.) will ensure the safety and design criteria of all components. Galvanized piping schedule 40 is recommended. Provide only clean, dry air for maximum performance and wear life of pneumatically operated components.

Maintain lubricant levels in all lubricators to prevent excessive wear and stalling. Install Air Dumps with lockouts for additional safety. See Fig 2.4.

***Fig 2.4***

PERSONNEL SAFETY PRECAUTIONS

When working with high-pressure equipments, you must wear approved safety glasses or face shields. Do not direct high-pressure air against the deck, workbench, or other equipments. Low-pressure air may be used for certain specified maintenance-related cleaning or drying tasks. Always obtain permission to use low-pressure air for these purposes. Never direct any pressurized air jet toward your (or another persons) body.

During any equipment operation, keep all parts of the body clear of any component that moves as a result of pneumatic or hydraulic pressure.

Safety precautions must be observed and common sense used all the time. Do not think that once you have learned all the applicable safety rules you can sit back and relax. Review them periodically, particularly for those jobs seldom performed. Try to improve upon any rules in effect. Safety is everyone's responsibility, not just those who drew up the regulations. Many accidents are caused by personnel who are so familiar with their jobs they think they can take shortcuts. Personnel who do not know the applicable safety precautions often are the cause of accidents. We also cannot forget the many tragic accidents caused by practical jokers. However, in the majority of instances, plain carelessness is the biggest threat, Stay alert!

### 2.11 Adequate Ventilation

Enclosed areas where Class I liquids are processed in the machine must be ventilated at a rate of not less than 1 cubic foot of air per minute for each square foot of solid floor area.

**CAUTION**: Most Class II and III liquids will become Class I liquids when heated to their distillation temperatures.

When processing liquids other than those rated at Class I, the unit should be place in an area that has a regular and steady exchange of air that exceeds the vapor production capability of the machine and the solvent being reclaimed by a factor of five, so that if vapors should escape from the unit they can not build up to dangerous levels.

Solvent vapors are heavier-than-air, so vents should be provided at floor level so that if any vapors should escape from the machine they will not build up to hazardous levels.

Local air-quality standards and codes should be checked for the proper treatment or containment of any vapors or fumes that may be released from ventilation of the area where the machine is located.

## 3. PRINCIPLE OF OPERATION

### 3.1 Description

This system is designed for the separation of NMP from Saturation Air Stream. Chilled water, Compressed Air Supply should be ensured before starting the system. During startup when operator enables “Master Control” from SCADA -Master Screen, Nitrogen purging starts for the set time entered from SCADA.

Remove all the alarms to operate the system in auto mode. To start particular loop ensure all the conditions to start the loop in auto mode are satisfied. The Feed loop will be started in auto mode. The liquid feed stream from VRS-T-101 Bottom Discharge Pump (VRS-PU-102) will be feed to Packed Bed. The feed mixture fed to the feed section of the VRS-SEC-101. The Feed consisting of Pure NMP Only .During operation the saturated air stream flows from bottom of Packed bed & the air fed to the feed suction of column(VRS-SEC-101). NMP feed & distribute within packing from top of packed bed , Feed consists of pure NMP which will strip out miscible NMP in saturated Air from bottom .During operation Air removes at the top of Packed bed and vented to atmosphere.

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### 3.2 Operating Recommendations

After the plant has been commissioned as per the instructions in the installation procedures, the processor will continually monitor all safeties, temperatures and fill sequences from the PLC processor. It is advisable to periodically check the center lines of the physical gauge on the top of the flash still, column and the temperatures located on the operating screen of the SCADA. The pressure should not exceed 20 PSIA. If pressure exceeds 21.7 PSIA, the Pressure Relief Valve will open relieving the system of any additional increase in pressure. Normal operating condition is within 0 to 14.7 PSIA

**To maximize recovery rates:**

1. Continuous operation is required

2. Avoid switching from manual to automatic.

3. Promote "Good Housekeeping".

4. Do not interrupt the normal operating cycle unless absolutely necessary. The result may be one or a combination of the symptoms mentioned above.

5. Periodic inspection of the level control. Clean the sensors and ensure smooth operation to prevent false activation of the mechanism, which could result in overflow. If an electronic level sensor is used remove built up materials, which may cause a sensitivity problem resulting in higher than normal levels. SRS recommends cleaning of sensors after every 3 months.

### 3.3 Operation Sequence

**Start Up Procedure:**

1. Pre-checks
    - Ensure Packed Bed (VRS-SEC-101) is operating.
    - Ensure all set points for level, temperature, flow, pressure & PID are correct.
    - Ensure that all Manual valves are at correct position.
    - Ensure Air supply pressure is > 110 psig.
    - All PID loops are in manual mode.
    - Ensure that proper electric supply voltage is connected as specified in Electrical drawing and on equipment name plate.
    - Ensure that all pumps rotational directions are set as required.
    - Ensure all the alarms have been removed.
    - Ensure Chilled Water, Nitrogen supply

2. When operator powers up the Panel (i.e. PLC & SCADA), the system defaults in Manual Mode and Master Mode is disabled. All PID Controllers & loops are in Manual Mode.

3. Operator shall enter or confirm the all necessary System & Alarm set point for various loop below.

| Sr.No. | Tag | Description | Setting | Set Point Range |
|---|---|---|---|---|
| 1 | VRS-AV-101 | VRS-T-101 Bottom Set Point | 10% | 10 to 20 % |
| 2 | VRS-AV-102 | VRS-SEC-101 Bottom Set Point | 10 % | 10 to 20 % |
| 3 | VRS-AV-103 | NMP Bottom (VRS-T-101) Set Point | 20 % | 10 to 30% |
| 4 | VRS-AV-104 | NMP Feed to VRS-T-101 Stop Level Set Point | 50 % | 30 to 70% |

Alarm Set Points:

| Sr.No. | Tag | Description | Setting | Set Point Range |
|---|---|---|---|---|
| 1 | VRS-TE-105 | VRS-SEC-101 Bottom Alarm Set Point | 166 ˚ F | 100 to 200 ˚ F |
| 2 | VRS-TE-101 | Saturated Air Stream Set Point | 300 ˚ F | 200 to 450 ˚ F |
| 3 | VRS-TE-102 | VRS-SEC-101 Feed alarm set point | 13˚ F | 25 to 100 ˚ F |
| 4 | VRS-TE-111 | NMP Feed Set Point (VRS-T-101) | 13˚ F | 50 to 100 ˚ F |
| 5 | VRS-TE-107 | Refrigerant supply alarm set point | 46˚ F | 25 to 100 ˚ F |
| 7 | VRS-TE-112 | VRS-SEC-101 Top Alarm Set Point | 75 ˚ F | 80 to 200 ˚ F |

## Auto Mode of Operation

The system will run in AUTO mode when all PID controllers & routine will be in AUTO mode. The detail description of each routine is described in previous sections. The SCADA screen indicates on/off status of pumps, valves, % opening of valves & process parameters such as level, temperature & pressure. In the event a fault occurs during a cycle the message flashes and the system stops. On correction of this fault the Fractionation System may be re-started. Operator shall press “ACK” button to acknowledge the fault. The message can only be cleared if the fault condition is cleared and by pressing the “RESET” button on the operator terminal. Review fault messages first. If a fault condition occurs the operator terminal screen will display the alarm banner, so the operator can quickly identify and correct the fault. System parameters and values can be changed in any mode of operation. The register values formerly used are maintained until changed by the operator.

- **Shut Down Procedure:**

  - When operator wants to shut down the system, operator shall go to the Manual screen & change the mode of routines from Auto to Manual mode and turn off the pumps & valves in respective mode in following sequence.

    a. Packed Bed Feed Routine
    b. Packed Bed Feed Temperature Routine
    c. Packed Bed Liquid Transfer Routine
    d. Packed Bed Bottom Discharge Routine

- **Maintenance Procedure:**

1. In order to do the trouble shooting or maintenance, the pump & valve of respective routine can be operated manually by transferring the control from Auto to Manual mode for the respective routine.
2. It is recommended to transfer the control to Auto mode after the maintenance is done.

## 4. Start up Check List

### 4.1 Motor Rotation

Ensure correct Rotation of pumps and motors by reviewing the pictures below. All pumps and motors have been tested at correct rotation. Initially Confirm Feed pump motor, Discharge Pump motor & Recirculation pump motor direction is in maintenance mode. Confirm Electrical Supply connection point that all 3 phases are placed in correct order, Ex: L1, L2, L3 are clearly marked on connection point. Always jog motors to confirm correct fan rotation. See Fig. 4.1. Pump might not be typical in appearance.

***Fig 4.1***

### 4.2 Daily Startup Inspection CHECKLIST

**INSPECTOR:** _____ **DATE:** _____

| ITEM | ITEM INSPECTED | (Y/N) | COMMENTS |
|---|---|---|---|
| 1. | Check Clean Solvent liquid level | | |
| 2. | Check adequate refrigerant available | | |
| 3. | Check Air Pressure, must be above 90 P.S.I | | |
| 4. | Check steam | | |
| 5. | Check set points in setup menu | | |
| 6. | Check pressure gauges | | |
| 7. | Check Main Screen on (HMI): Confirm that there are no Alarms. If so reset each | | |

**COMMENTS:** _____

## 5. AUTOMATIC CONTROL FEATURES

### 5.1 Operation & Control Description:

**Operation Sequence**

**Filling Cycle:**

The system will automatically run as per below, when it is in Auto Mode:

To start the system operator need to press MASTER on master screen on Filling Overview.

.

1. To start the cycle, Operator presses "START" button from HMI on Filling Overview.
2. Auto filling enables, open the valve (VRS-AV-104) after delay of 3 Seconds the valve (VRS-AV-104) open, after delay of 2 sec the pump (VRS-PU-102) will start. After level reaches up to the level switch (VRS-LSL-010), filling timer (0-300 sec) start.
3. Once filling timer done, filling cycle done with master disable.

**NMP Recovery Cycle:**

In this cycle, there are 2 modes for NMP discharge selection.

**A) NMP discharge ON Mode:**

1. To start the system operator need to press MASTER on master screen from NMP overview Screen.
2. To start the cycle, Operator presses "START" button from HMI on NMP Overview.
3. NMP recovery cycle start, open the valves (VRS-AV-101) and (VRS-AV-102) and after delay of 2 sec Pumps (VRS=PU-101) and (VRS=PU-102) ON. (This is NMP feed and recirculation Loop).
4. Once (VRS-TI-105) temp reached greater than or equal to vapor unit start temp, then Remote output Signal (O: 0/7) ON to start vapor unit at remote location. After start vapor unit PLC receive feedback signal from vapor unit (I: 0/9). If this signal drops then system go in standby mode.
5. When high level (VRS-LSH-101) and (VRS-LSH-102) reached in column and Tank, Discharge settable timer ON and the valve open (VRS-AV-103) after delay of 2 sec pump (VRS-PU-103) ON once level below 50 % in VRS-T-101 or Discharge timer done NMP Discharge Loop stop. (VRS-AV-103 and VRS-PU-103 close)

**B) NMP discharge OFF Mode:**

1. To start the system operator need to press MASTER on master screen from NMP overview Screen.

2. To start the cycle, Operator presses "START" button from HMI on NMP Overview.

3. NMP recovery cycle start, open the valves (VRS-AV-101) and (VRS-AV-102) and after delay of 2 sec Pumps (VRS=PU-101) and (VRS=PU-102) ON. (This is NMP feed and recirculation Loop).

4. Once (VRS-TI-105) temp Reached greater than or equal to vapor unit start temp, then Remote output Signal (O: 0/7) ON to start vapor unit at remote location. After start vapor unit PLC receive feedback signal from vapor unit (I: 0/9). If this signal drops then system go in standby mode.

5. When high level (VRS-LSH-101) and (VRS-LSH-102) reached in column and Tank, shutdown settable timer ON and the valve (VRS-AV-103) & pump (VRS-PU-103) can be open by operator manually by pressing Discharge switch (Dead man s/w). Once level below 50 % in VRS-T-101 or shutdown timer done NMP Discharge Loop disable.

Note: All VFD's pump speed controlled set point is feed manually in set point screen from 0 -100 %

**Set points:**
Temp set points:

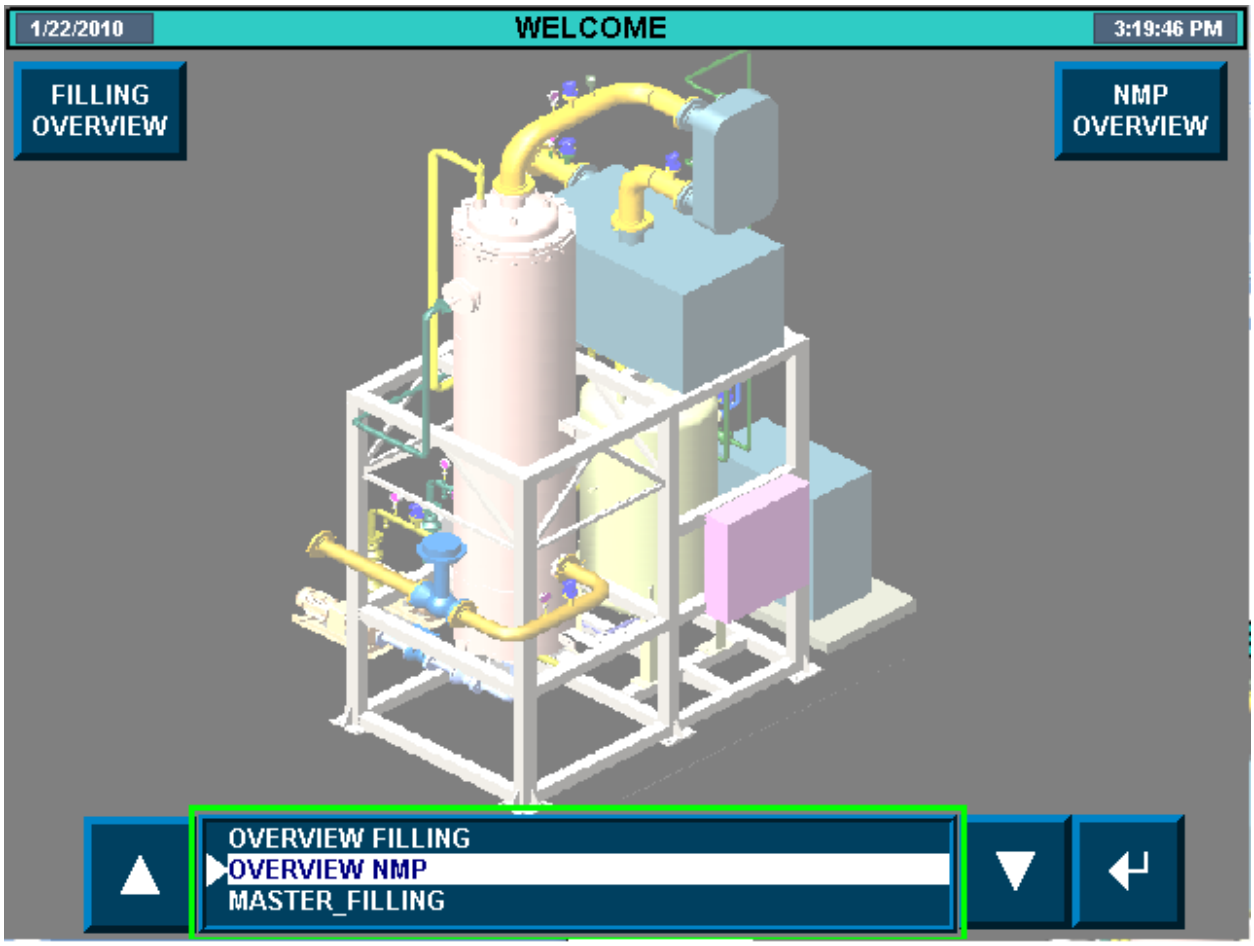
1. Vapor Unit Start Temp.(-20°F -150 °F
2. Filling Timer Set point-( 0 sec -600 sec)
3. Discharge Timer Set point-( 0 sec -300 sec)
4. Shutdown Timer Set point-( 0 sec -1000 sec)
5. VRS-PU-101 Speed Control set point-(0%-100%)
6. VRS-PU-102 Speed Control set point-(0%-100%)
7. VRS-PU-103 Speed Control set point-(0%-100%)

**Alarms:**

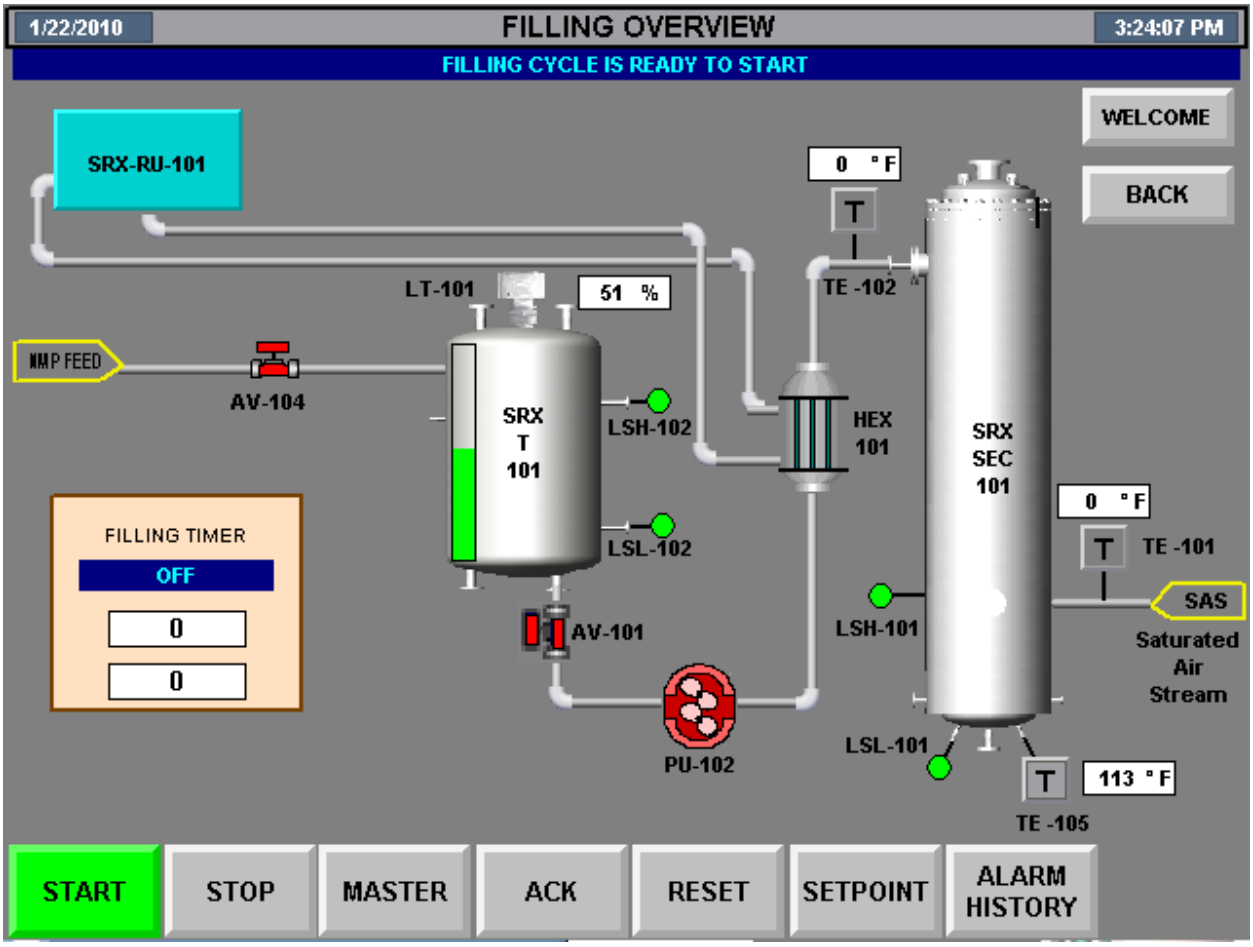
1. VRS-PU-101 Pump Overload Alarm.
2. VRS-PU-102 Pump Overload Alarm.
3. VRS-PU-103 Pump Overload Alarm.
4. Air Pressure Low Alarm.
5. TE-101 RTD Wire Break Alarm.
6. TE-102 RTD Wire Break Alarm.
7. TE-105 RTD Wire Break Alarm.
8. TE-107 RTD Wire Break Alarm.
9. TE-111 RTD Wire Break Alarm.
10. LT-101 Level Wire Break Alarm
11. High Level In NMP Tank

**5.2 Interface Screen:**

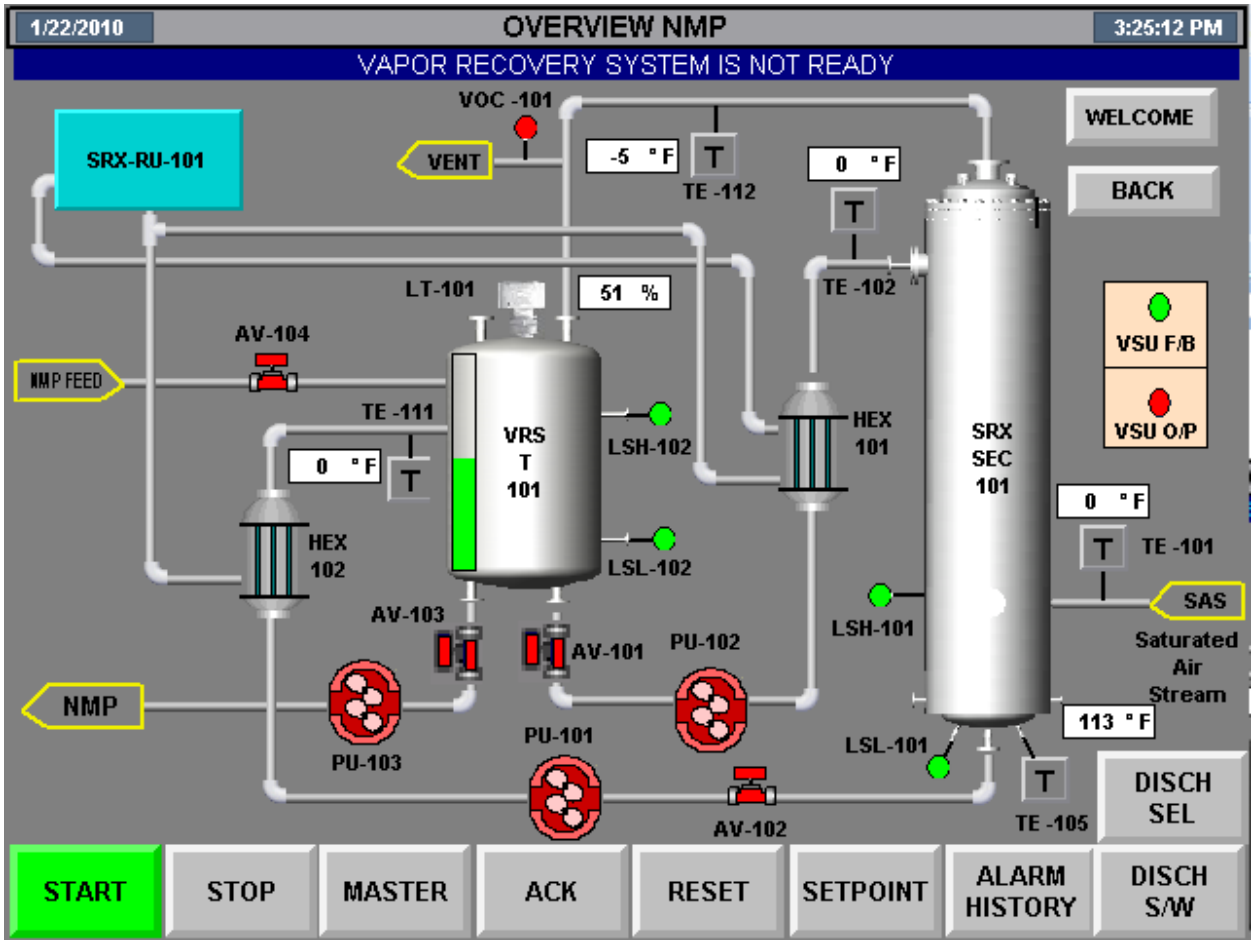
**Screen 1: Welcome Screen**



**Screen 2: Filling Overview**



**Screen 3: Overview NMP**

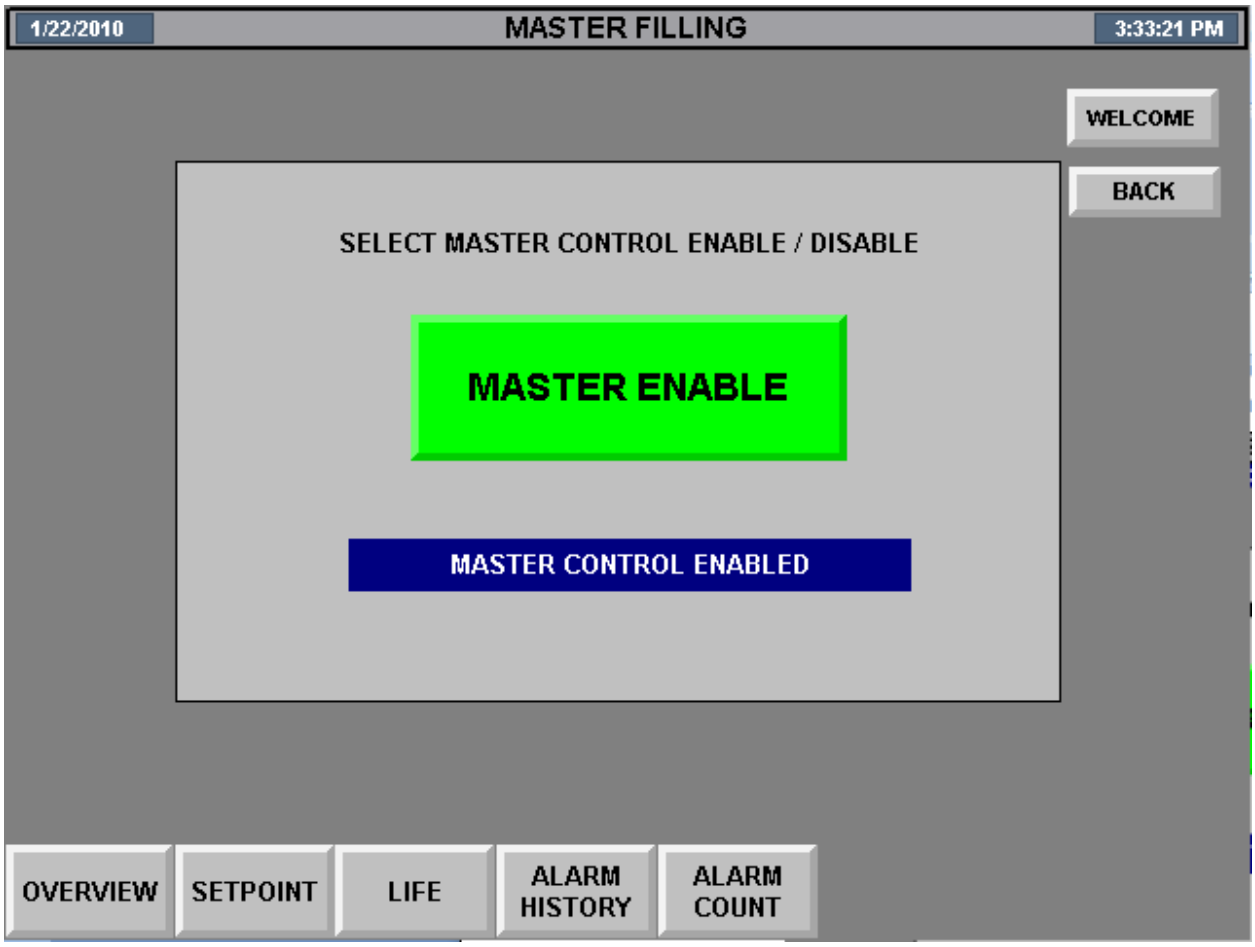



This is the Main Screen which allows navigation to “SET POINT, MASTER, ALARM HISTORY, DISCH SEL, screens.

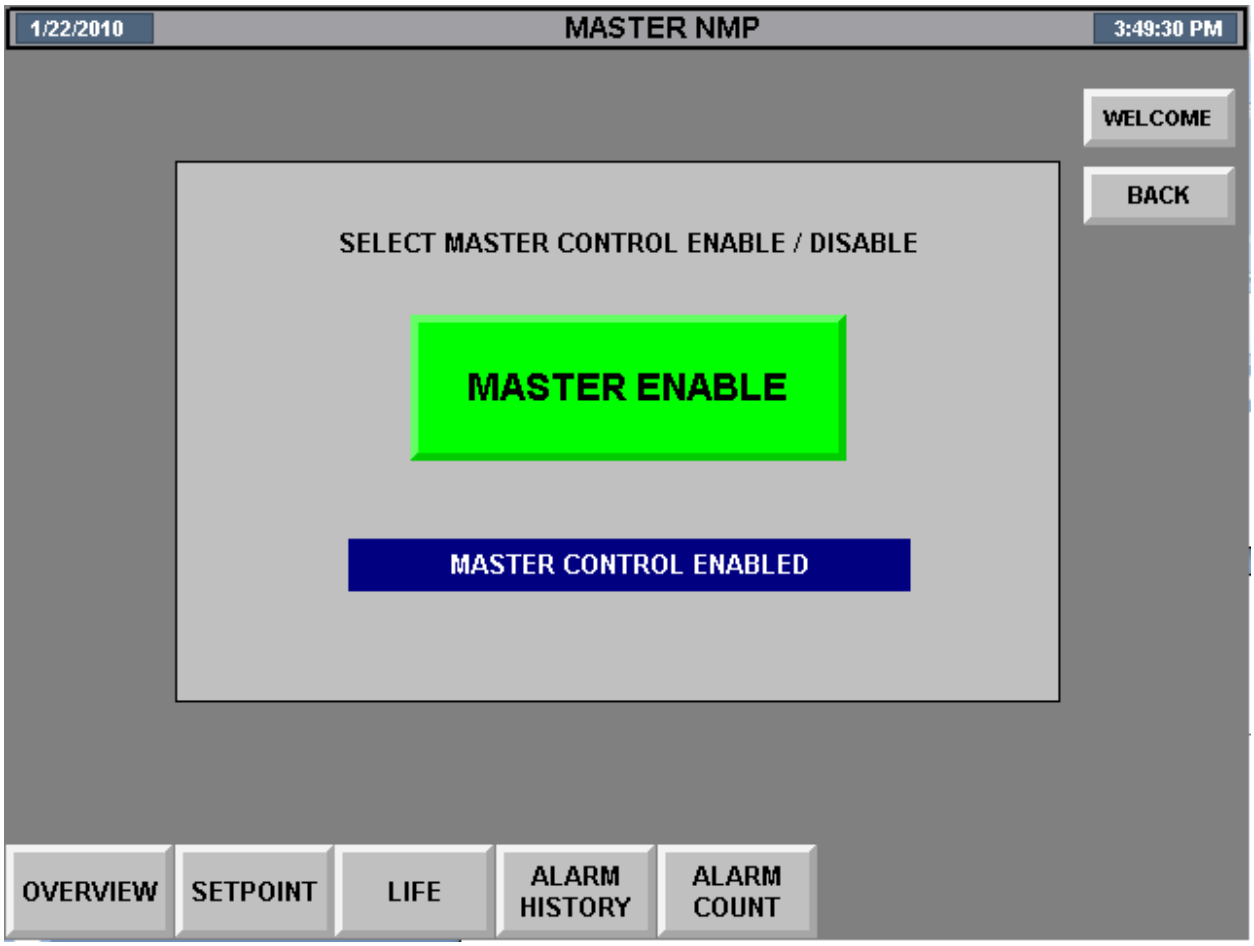
“ACK / RESET” buttons are provided to acknowledge and reset the alarms respectively.

### 5.3 Interface Buttons

**Screen 4: Master Filling**

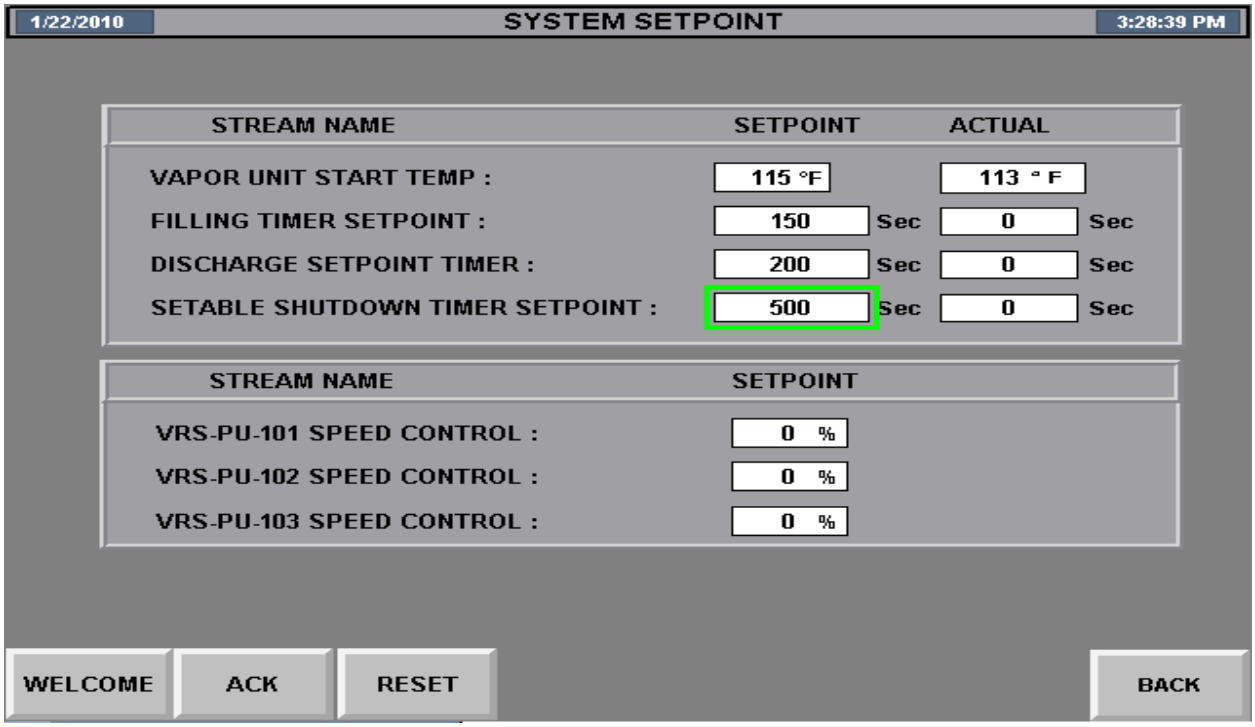


**Screen 5: Master NMP**




When “MASTER ON/OFF” button is enable text below show Master Control, Enable then Operator can start system in Manual as well as in Auto Mode. If this button is in disable then system get disable and never run in auto & manual mode.

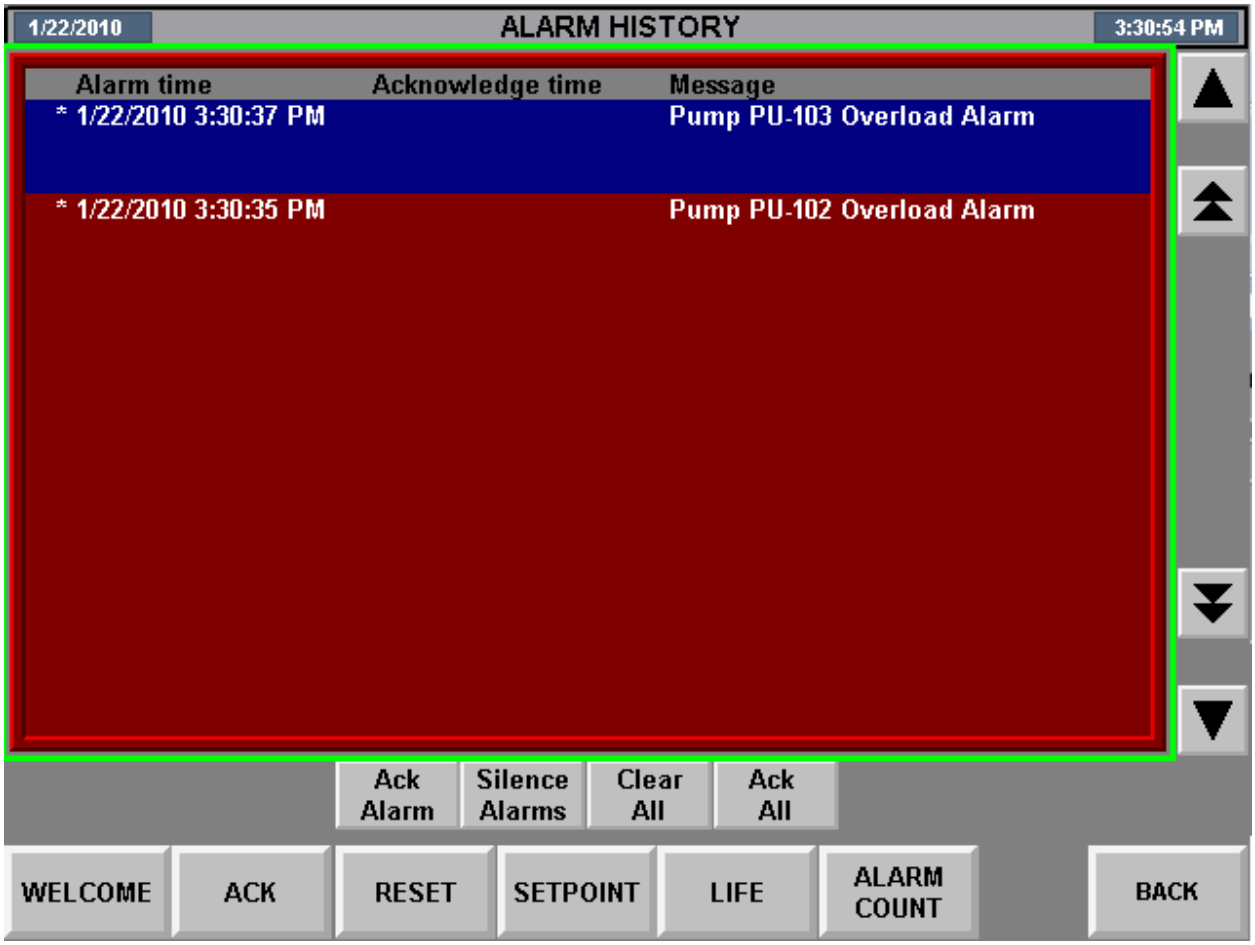
**Screen 6: System Set point**




Pressing the SYSTEM POINT key while in the Main screen can access the Setup screen. The Set point screen is where the operator can view and / or change all operating parameters. (In order to insert or install any values) To adjust parameters, the operator will use touch keys to move around from set point to set point. Once the operator has reached there parameter they wish to change, touch the desired set point and press the enter key. After all values have been changed, the operator presses the MAIN key again to Main screen. At any time operating or in idle, the operator can access the setup menu to change parameters. The NMP parameter changes will take effect immediately. All values will have to be "entered" within the parameters displayed next to the message, or the terminal will maintain the previous values entered. The enter key must be pressed after each entry or value will not be accepted. On completion or at any time "MAIN" key must be pressed, returning you to the main screen. The set point screen also offers to set NMP level Low and High set points and vent valve on time.

NOTE: All values are retentive and will remain as set until changed through the setup procedure. All “setup” values are retentive when power is shut-off or power failure occurs.

**Screen 7: Alarm History**

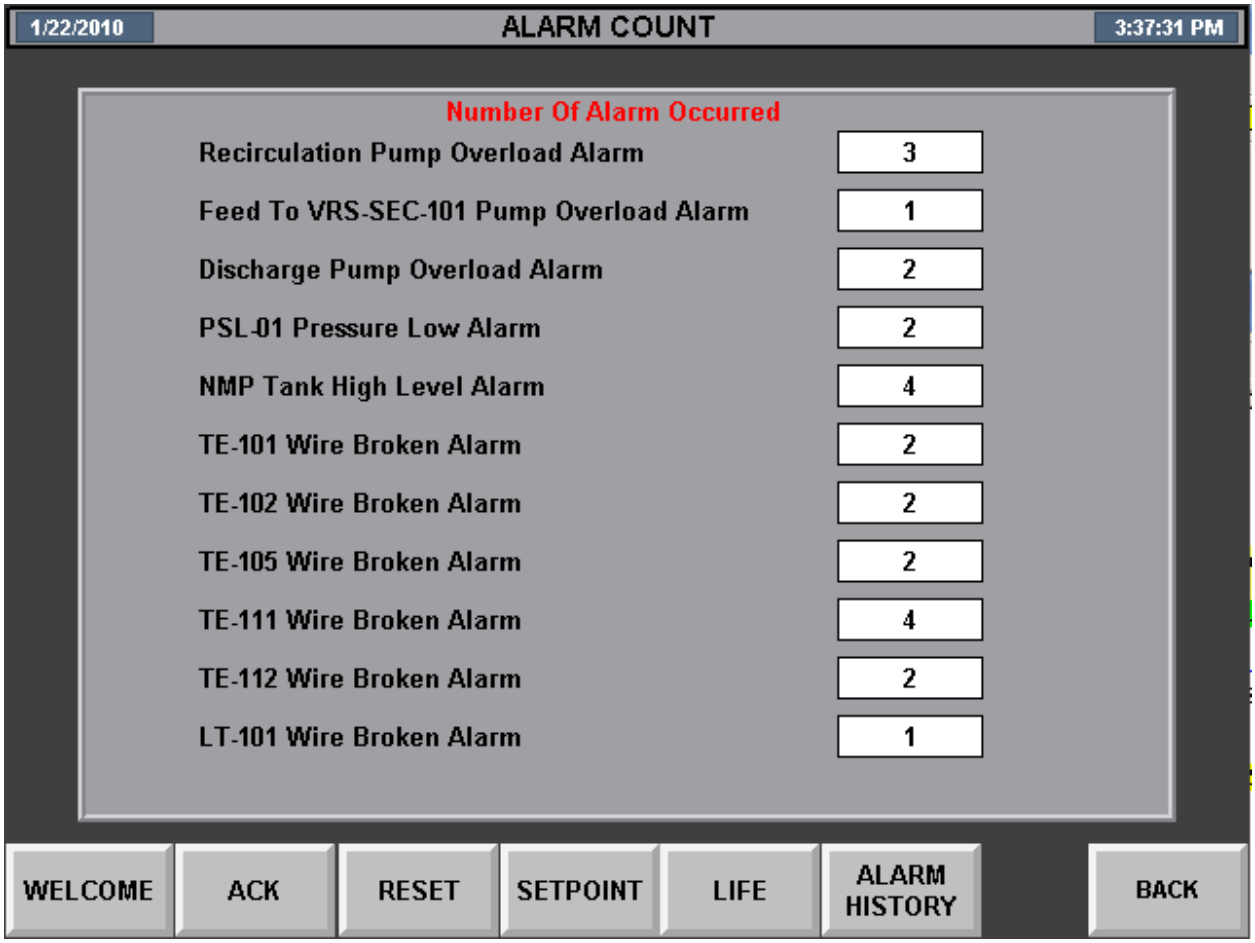



Pressing the ALARM HISTORY key while in the Main screen can access the Alarm History screen. The Alarm screen is where the operator can view all alarm history.

This screen also displays any current alarms or faults to the system. A brief message will show where or what has faulted. By pressing the ACK button, you acknowledge any faults and attempt to reset them from main screen. If the faults continue to exist, the fault will return. The ACK button must be pressed to reset all faults.

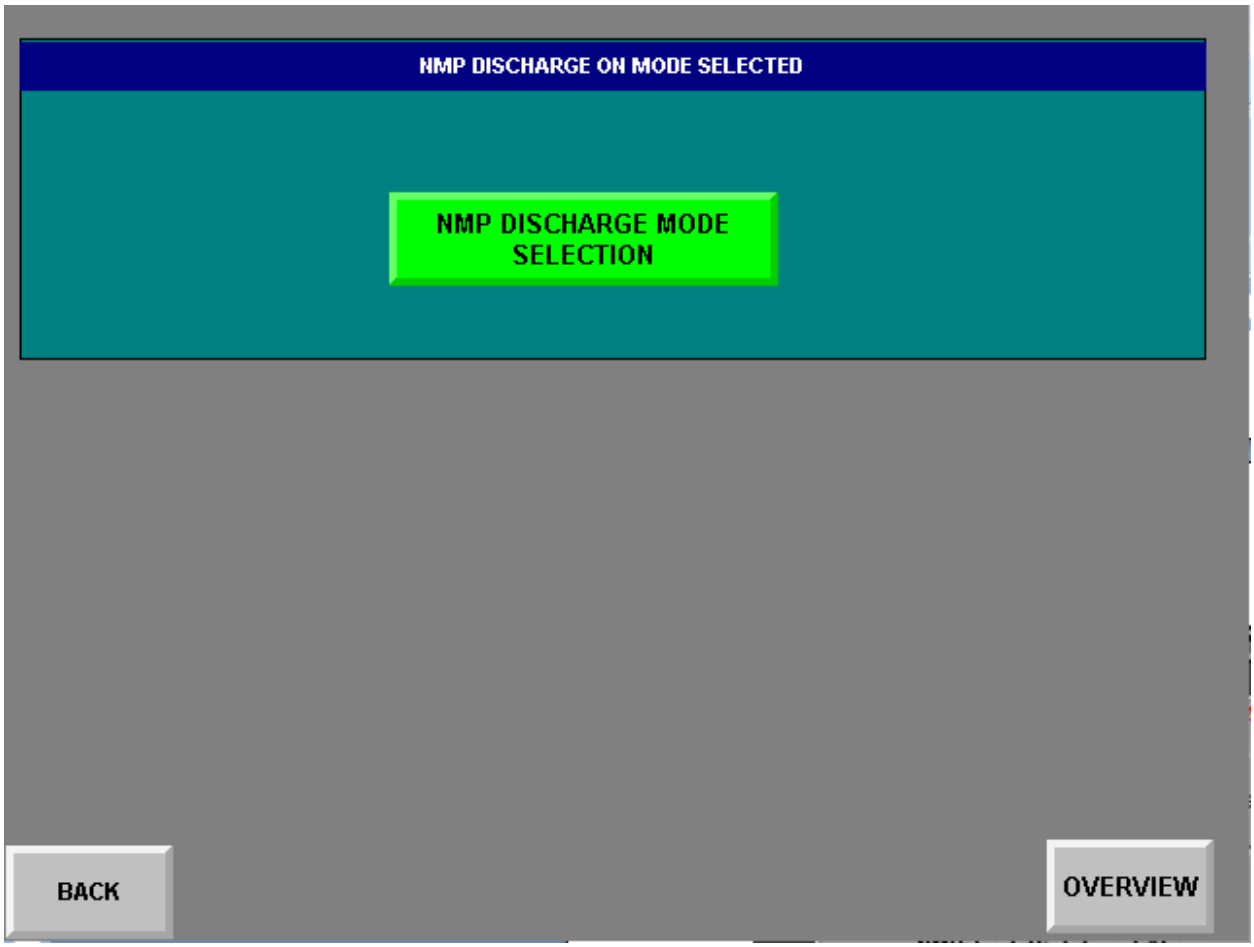
NOTE: All faults must be reset to "start" the system. To display the faults press the Alarms history key. To reset the faults, correct the problem and press the “ACK” key and then press Reset key for fault reset.

**Screen 8: Alarm Count**



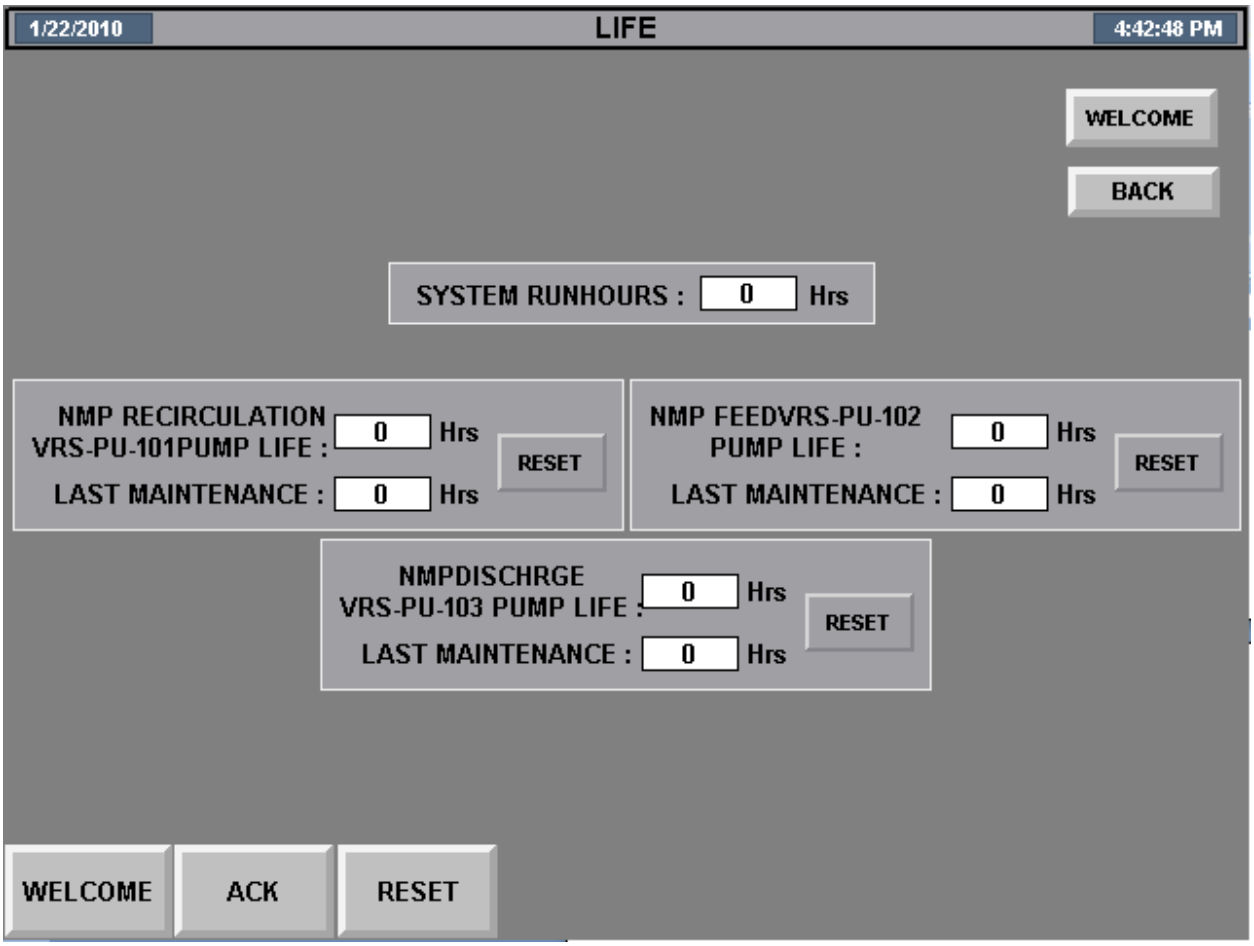

Alarm counts can be seen on Alarm Count Screen.

**Screen 9: NMP Discharge Mode Selection**




NMP Discharge mode Select from This Screen.

**Screen10: Life Screen**




This screen shows the System Run Hours & Pump Run Hours

## 6. Additional Trouble Shooting

**Control Panel Trouble Shooting**: Refer to blueprints for locations and wiring details when troubleshooting faults as listed below.

**Blackout of Operator Interface**: Check fuse located at the back of the terminal. Check if power cable is secured. Check the secondary fuse on transformer TX-1. Check wiring. Reference: Electrical Schematics.

**Blackout of PLC**: Check fuse to the processor. Outputs and inputs have separate fuses and should be checked if all the lights are out on the card or cards. Check PLC runs light (on) battery (off) and CPU (off). If out of sequence PLC will not operate. Reference Electrical Schematics.

**Complete blackout**: Check power supply to the main disconnect on the panel. If a purge panel is provided see "purge panel". If main power is as listed on the nameplate, check the fuses on the primary and secondary side of the control transformer. If an "emergency" stop button is provided, test for continuity when "power is off". Reference Electrical Schematics.

**Operator interface**: (The following applies to customers with the Ethernet hub option). Failure to communicate may be a result of a loose communication cable between the PLC and HMI-1 Check if Interface displays a message on the screen.

**Input / output failure**: "see blackout of PLC". If a specific I/O is not functioning observe I/O lights on the card. Reference I/O number on blueprint to specific item on the card.

All inputs are 24V DC. If device can be manually activated then verify input to light on the input card. Light should go "on" or "off" as positions change. < 50 V DC is indicated with a conductor color of Blue.

All outputs are 24V DC. Check output light on card and verify voltage at the card and the terminal strip if used. Output card supply fuse should be checked if no lights appear, when the system is started. Outputs are indicated with a conductor color of Blue. <120V AC but not less than 50V DC is indicated with a conductor color of Red.

## 7. SAFETIES

### 7.1 Safety Features

The processor through individual *RTD*'s monitors the temperature continually positioned in these areas. RTD failure will result in a shut down of the system. All 3 *RTD*'s provide temperature readings to the processor. These readings are used to control the process and provide high limit protection. All three limits are adjustable high limits. A *pressure relief valve* rated at 21.5 P.S.I.G, Is built into the vessel should an over pressure situation occur. **Do not** remove factory seal. Adjustment of this valve is to be done only at the manufacturer.

**Note**: Maximum allowable temperature may vary according to your application.

The *pressure relief valve* must be vented to a containment vessel to prevent the escape of vapors or liquids in the event of an over pressure situation. If the unit has been overflow with heavily contaminated product or residues from previous cycles, a carry over of these solids may occur. There is a very remote chance that blockage of the condenser may occur and cause the pressure within the receiver to rise. This would be indicated by the pressure gauge. Over pressure would discharge through the *pressure relief valve* provided, and into a disposal drum supplied by the user.Do not install anything that will restrict the vapor path from the fractionation unit through the condenser.

## 7.2 Hazards & Warnings

In order to operate the system safely, be sure qualified personnel check the safeties monthly.

***Never*:** **Bypass a safety for testing or operating.**

***Never*:** **Attempt to operate a unit with safeties bypassed.**

***Never*:** **Operate or test a unit when connections piping or assemblies are leaking.**

***Never*:** **Replace any item with a temporary component without consulting a factory representative.**

***Never*:** **Allow anyone other than qualified personnel to service the unit.**

***Never*:** **Service or attempt to correct a problem with the electrical power supply on. Ensure proper disconnection of wash supply and return lines before servicing.**

***Never*:** **Service the unit if solvent is present in the SR-55 system.**

**Never:** **Crawl into the distillation system because it is deemed confined space unless system is locked out and the scrapers need to be adjusted. Caution when entering vessel. VOC's may be present.**

***Always*:** **Ensure flammable liquids are kept out of and away from the unit.**

***Always*:** **Use caution in loading and unloading the system to reduce the possibility injury.**

***Always*:** **Wear protective gloves, glasses, respiratory equipment and clothing when loading and unloading the unit.**

***Always*:** **Do a visual inspection for leaks upon start-up.**

## 8. MAINTENANCE

During the testing or trouble shooting of the Fractionation Unit it is recommended that you review the manual for operating procedures, safeties and warnings listed in various sections.

Daily, Weekly, & Monthly cleaning and inspection are required to optimize the safety and performance of this unit. Only qualified personnel should conduct a test or repair of this system. Replace part with originals that were designed to work with the unit.

### 8.1 Monthly Inspections Include

**A**. Visual inspection of the flange joints to determine if leakage is occurring.

**B**. Check all piping to see if any blocking has occurred.

**D**. Inspection of piping and components within the system for leaks. Tighten unions, flanges to reduce the possibility of leaking caused by normal vibration of the fractionation unit.

**F**. Keep operator interface touch screen clean - **Do not use solvent**. Hand wipe or use soap and water. Clear plastic may be taped to the face and periodically changed.

**G.** Visual check of level sensors to ensure materials are not accumulating that will cause false alarms.

**I.** Check mechanical seals on pressure pumps by a visual inspection of the seal area to determine if a leak are present. Use manufactures procedures for replacement of seal or other components.

**J.** Check all motors, gears, and/or pumps to see if they require any priming.

**K.** Ensure connection to ground. Check equipment ground and bonding to building ground system.

**L.** On completion restore all utilities required to operate the system and observe at least one operation with a qualified operator to ensure the system is functioning properly.

## 9. WARRANTY

Warranty period extends for 12 months after commissioning and not more than 15 months from the shipping date. All systems are tested at the factory prior to shipment. The manufacturer is not responsible for defects or damages resulting from the shipping or from the usage of our equipment. This includes corrosion or misuse of the system or components that results in damages or excessive wear.

In no event shall “SRS” be liable for any direct, incidental or consequential damages from the sale or use of our product. This disclaimer applies both during and after the term of this warranty.

Customer failure to provide information or adequate analysis of the chemicals being processed could result in excessive wear or damages to the system and will result in loss of warranty.

Component replacement which become defective during the conditions set forth by the manufacturer will be replaceable free of charge provided they were not subjected to corrosion and comply with the conditions and warranty offered by the supplier or manufacturer. Exclusions include gaskets, pump packing, mechanical seals and pumps subjected to normal use.

We will repair or replace components deemed defective during the commissioning of the system without cost. Services of a field engineer will be provided at current rates if specialized knowledge beyond the scope of normal and routine servicing is required. The customer at no charge will provide Normal and routine servicing and component replacement to SRS. No claims for loss, damage or labor will be allowed.

## 10. GUARANTEES

No guarantees are implied or intended regarding performance of the system. The system is designed to be compatible with the chemicals being processed based on information provided by the customer. The system is designed to wash parts covered with materials that have not hardened or cured. The unit should not be unnecessarily loaded with containers that are partially or full of product to prevent blockage of nozzles and prohibit cleaning. Performance assessments are directly related to these conditions and due to production inconsistencies are impossible to guarantee.