

- Fermenter exhaust to scrubber
- Fermenter exhaust to scrubber
- Fermenter exhaust to HE54003 Exhaust filter pre-heater
- Fermentation gas monitor
- 30# Oxygen gas
- Regulated compressed air supply to HV54168
- 125# Compressed Air
- Instrument air Supply to control enclosure
- 100# Pure steam
- 125# Utility steam
- Cooling water supply
- Cooling water return back to cooling tower
- To bio sewer for pure steam condensate from sterilization
- To utility sewer for process steam condensate & jacket blowdown water
- Fermenter exhaust and steam entry for sterilization
- Top gas overlay on fermenter
- Bottom gas sparger ring on fermenter
- Clean steam supply to top ports on fermenter
- Clean steam supply to lower ports on fermenter. Page 3
- Condensed clean steam to agitator seal
- Water return from fermenter jacket. Air & steam entry for sterilization
- Tempered water supply to fermenter jacket. Also drain exit for sterilization
- From steam header low point condensate page 2
- From bio-waste line page 3
- Utility sewer from fermenter

Keep PSI equal or less than tank psi

**NATIONAL CORN -TO-ETHANOL RESEARCH CENTER
CONTROL SKID PROCESS FLOW DIAGRAM
1500 LITER FERMENTER #1**

TERRY LASH
APRIL 1, 2014

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To HV54037
High point steam
vent to scrubber

Clean steam supply from
PCV54028 to top
ports on fermenter

Fermenter exhaust
to HE54003
Exhaust filter
pre-heater

Filtered air/pure steam from HV54095
Overlay isolation

Tempered water return from fermenter jacket
to PSV54006

Hose connection for
inoculants entry

Hose connection for
media entry

Tempered water supply/
to fermenter jacket
From FCV54024


Filtered air/pure steam
from HV54120
Sparge isolation

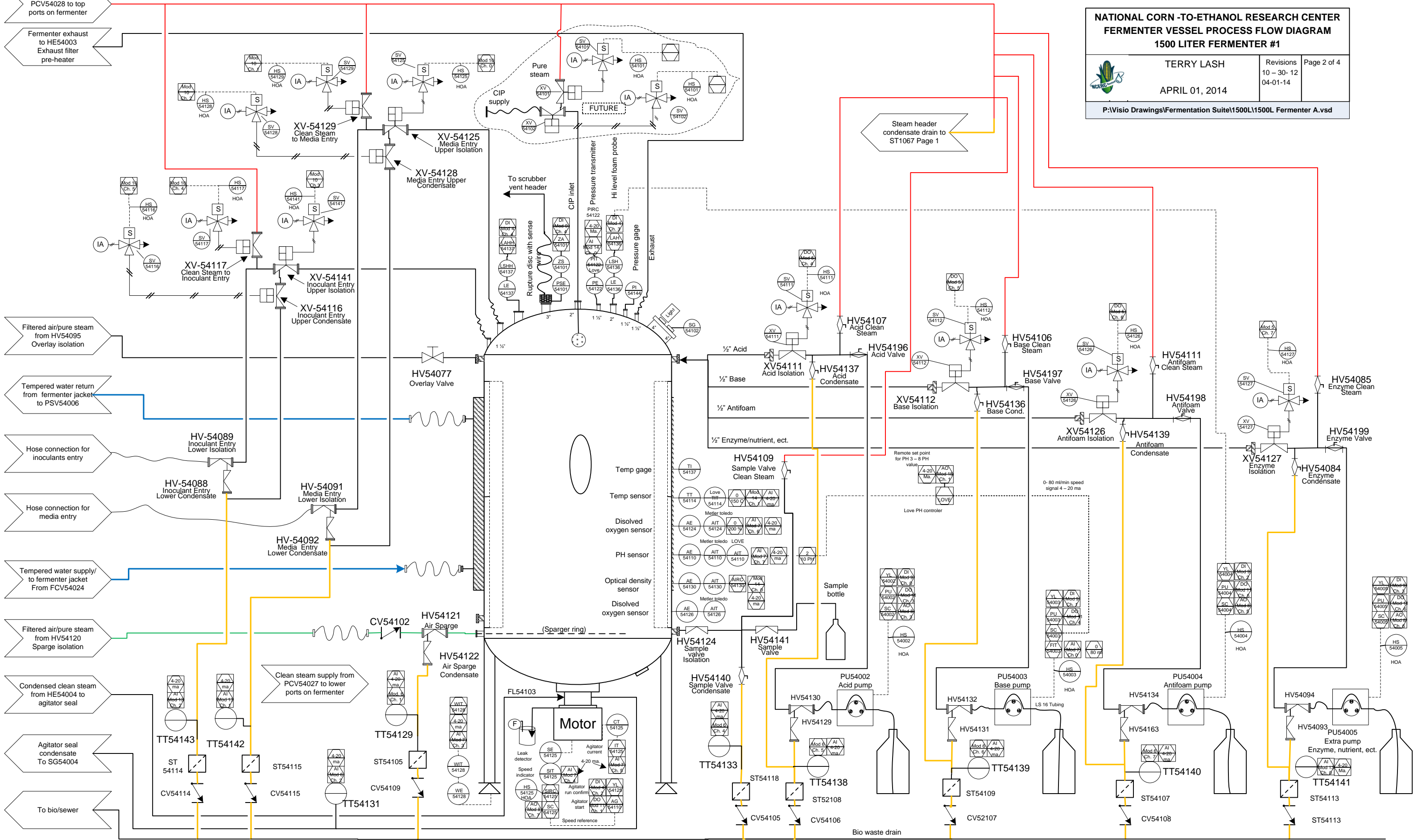
Condensed clean steam
from HE54004 to
agitator seal

Agitator seal
condensate
To SG54004

To bio/sewer

NATIONAL CORN -TO-ETHANOL RESEARCH CENTER
FERMENTER VESSEL PROCESS FLOW DIAGRAM
1500 LITER FERMENTER #1

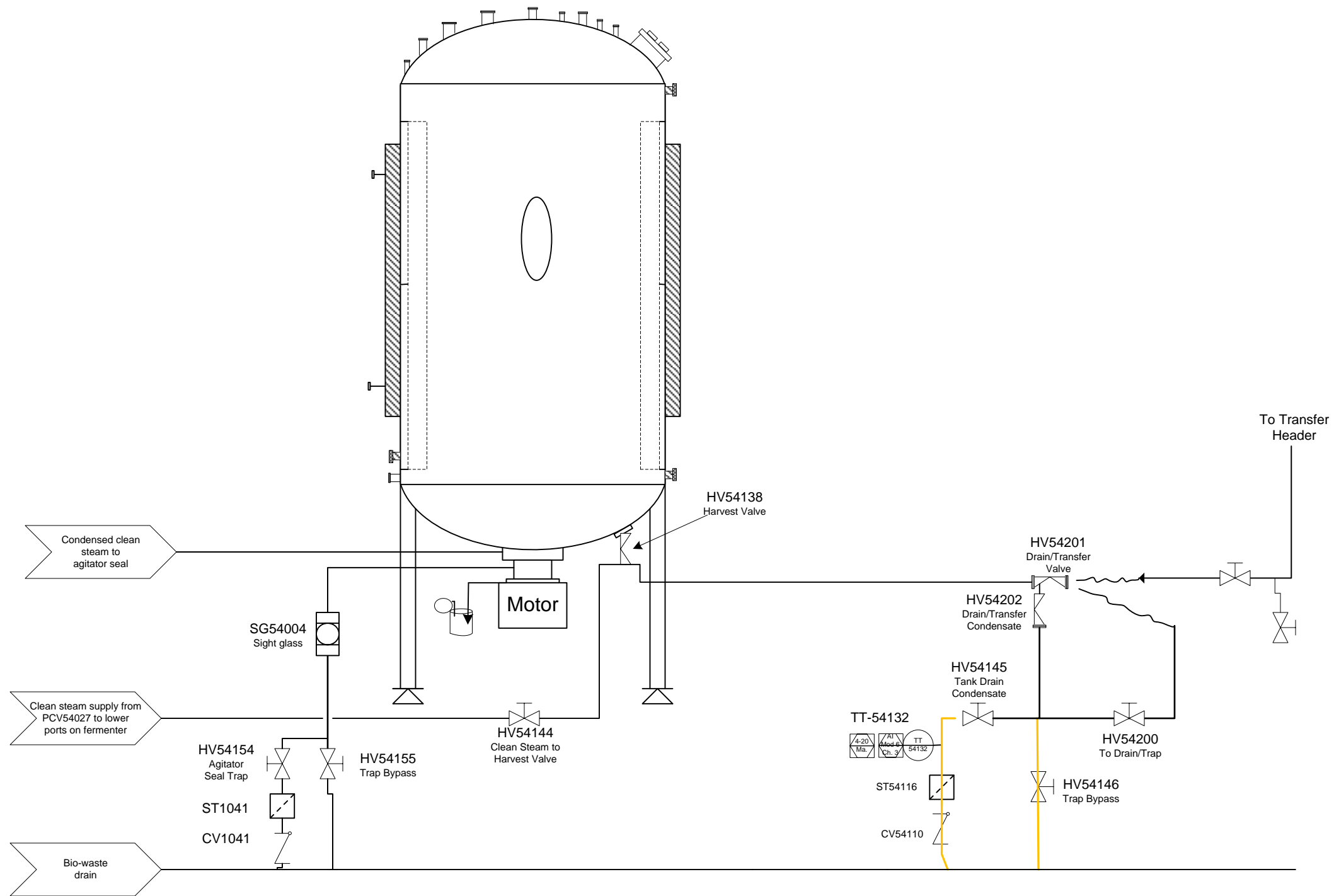
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Steam header
condensate drain to
ST1067 Page 1

Bio waste drain

NATIONAL CORN -TO-ETHANOL RESEARCH CENTER HARVEST SYSTEM PROCESS FLOW DIAGRAM 1500 LITER FERMENTER #1			
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0	E-stop switch	0	SV54035 Exhaust isolation valve Switched 24 VAC	0	TT54041 Post filter exhaust line condensate 4-20 ma 0-150C	0	FIT54003 Master flex base pump flow rate 0-20 ma 0-80 ml/min.	0	PCV54033 PLC output to fermenter back pressure control valve 4-20 ma 0 - 100 % 0% = closed 100% = open	0	YL54002 Acid pump run confirm 15 VDC	0	SV54125 Fermenter top media entry steamlock isolation valve Switched 24 VAC	0	PU54001 Circulation Pump start/ stop Switched 24 VAC	0	SPARE	0	TT54141 Enzyme/nutrient line condensate 4-20 ma 0-150C	0	PIT54122 Fermenter pressure from Love 4 - 20 ma. 0 - 50 PSI	0	SPARE	
1	YL54001 Circulation pump run confirm	1	SV54022 Fermenter cooling water to jacket valve Switched 24 VAC	1	TT54129 Tank sparge line condensate 4-20 ma 0-150C	1	FIT54040 Air flow rate from Newport transmitter 4-20 ma 32.5 -1435 L/minute	1	PCV54040 PLC output to fermenter air sparge/ overlay control valve 4-20 ma 0 - 100 % 0% = closed 100% = open	1	YL54003 Base pump run confirm 24 VAC	1	SV54129 Fermenter top clean steam to media entry steamlock isolation valve Switched 24 VAC	1	AG54110 Fermenter agitator start/stop Switched 24 VDC	1	SPARE	1	TT54142 Media entry steamlock line condensate 4-20 ma 0-150C	1	TIT54114 Fermenter temperature from Love 0-20 ma 0-150C	1	RSP54003 Remote set-point for PH to Love 0 - 20 ma. 3 - 8 PH	
2	YL54125 Agitator run confirm	2	SV54026 Steam to heat jacket water valve Switched 24 VAC	2	TT54131 Agitator sealing water temp. 4-20 ma 0-150C	2	SPARE	2	SPARE	2	YL54004 Anti-foam run confirm 24 VDC	2	SV54128 Fermenter top media entry condensate valve Switched 24 VAC	2	FV54039 Enable for brooks flow controller Switched -15 VDC	2	SPARE	2	TT54143 Innoculant entry steamlock line condensate 4-20 ma 0-150C	2	FIT54039 Gas sparge air flow from Brooks ch. 1 +5v -5V -800 SPLM - 800 SLPM	2	FC54039 Gas sparge rate to Brooks ch.1 0 - 800 SPLM 0 - 20 ma.	
3	LSH54136 Hi level foam probe for anti-foam pump	3	SV54024 Steam valve for sterilizing water jacket Switched 24 VAC	3	TT54132 Tank drain/CIP return line condensate 4-20 ma 0-150C	3	WIT54128 Fermenter load cell from Metter Toledo 4-20 ma 0 - 1615 KG	3	SC54002 PLC output to Masterflex pump for acid 4-20 ma 0 - 100% speed	3	YL54005 Enzyme pump run confirm 24 VDC	3	SV54141 Fermenter top inoculant entry steamlock isolation valve Switched 24 VAC	3	PU54002 Enable for Masterflex acid pump Switched 15 VDC	3	3	3	TT54144 Tank blow down filter line condensate 4-20 ma 0-150C IS it here??	3	SPARE	3	3	
4	LSH54137 Hi-Hi level foam probe	4	SV54111 Fermenter top acid steamlock isolation valve Switched 24 VAC	4	TT54133 Tank sample valve line condensate 4-20 ma 0-150C	4	SIT54125 Fermenter agitator RPM from Newport display 4-20 ma. 0 - 300 RPM	4	SPARE	4	ZS54101 Rupture disc integrity 24 VDC	4	SV54117 Fermenter top clean steam to inoculant entry steamlock isolation valve Switched 24 VAC	4	PU54003 Enable for Masterflex base pump Switched 15 VDC	4	4	4	PT54033 Post exhaust filter pressure 0 - 30 PSI 4 - 20 ma.	4	OGM5008-CO2 Carbon dioxide monitor 0 - 0.999 % 4 - 20 ma.	4	4	
5	SPARE	5	SV54112 Fermenter top base steamlock isolation valve Switched 24 VAC	5	TT54138 Acid line condensate 4-20 ma 0-150C	5	IT54125 Agitator power usage 4 - 20 ma. 0 -200 %	5	SC54004 PLC output to Masterflex pump for anti-foam 4-20 ma. 0 - 100% speed	5	SPARE	5	SV54116 Fermenter top inoculant entry condensate valve Switched 24 VAC	5	PU54004 Enable for Masterflex anti-foam pump Switched 15 VDC	5	5	5	PT54040 Gas inlet filter pressure 0 - 30 PSI 4 - 20 ma.	5	OGM5008-ETOH Ethanol monitor 0 - 0.65 % 4 - 20 ma.	5	5	
6	SPARE	6	SV54126 Fermenter top anti-foam steamlock isolation valve Switched 24 VAC	6	TT54139 Base line condensate 4-20 ma 0-150C	6	AIT54124 Fermenter DO transmitter 4-20 ma 0 - 200 % free air	6	SC54005 PLC output to Masterflex pump for enzyme 4-20 ma. 0 -100% speed	6	SPARE	6	SPARE	6	PU54005 Enable for Masterflex enzyme pump Switched 15 VDC	6	6	6	SPARE	6	OGM5008-O2 Oxygen monitor 0 - 22 % 4 - 20 ma.	6	6	
7	SPARE	7	SV54127 Fermenter top enzyme/nutrient steamlock isolation valve Switched 24 VAC	7	TT54040 Anti-foam line condensate 4-20 ma 0-150C	7	AIT54110 Love PH Transmitter outputs 0-20 ma. = 0 -10 PH DCS spanned for 4-20 ma. = 2 - 10 PH	7	SC54125 PLC output to agitator VFD for speed control 4-20 ma	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

Digital Input Module 4 120 VAC DO Module 5 8 X Relay 24 VAC output AI Module 6 Loop Powered AI Module 7 Field powered AO Module 8 DI Module 9 8 X 24-48 VDC DO Module 10 8 X Relay 24 VAC output DO Module 11 8 X Relay DO Module 12 8 X Relay AI Module 13 Loop powered AI Module 14 Field powered AO Module 15

**NATIONAL CORN -TO-ETHANOL RESEARCH CENTER
PROCESS I/O ASSIGNMENT TO CONTROL COMPUTER
1500 LITER FERMENTER #1**

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From bio-waste
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