TATE & LYLE
CONSISTENTLY FIRST IN RENEWABLE INGREDIENTS

How-To Guide

Developing a Control Narrative

Contents

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Tables and Figures

I. Revision History

Document the revision history by P&ID#, revision #, and date. Add any remarks on changes that were made to the draft. Also, type in your initials.

P&ID#	Revision	Date	Remarks	Initials

II. Supporting Documentation

List out any supporting documents that are used in compiling your control narrative. Include the document name, version, date modified, and the purpose (how you used the document).

Document Name	Version	Date Modified	Purpose
Instrument_list.xls	3	8/20/07	Imported devices to template
io_list4.xls	4	8/12/07	Reference used for narrative
FDL6.doc	6	8/2/07	Reference used for narrative

III. Introduction

A. Purpose of a Control Narrative

There are three primary purposes for control narratives. Control narratives provide:

1. An opportunity for process engineers to think through and document plant floor functional processes.
2. Documentation for operator training and understanding of the process equipment, parameters, and control logic. The control narrative should always become an integral part of the skill block manual and new operator training materials for all Tate & Lyle processes.
3. A starting point for control system programmers, with limited specific process knowledge, to be able to write configuration code for the control system that will control the process.

It is imperative that all narratives contain at least a minimal amount of key information to ensure the viability of the process and the process control scheme for that process. This *Control Narrative How-To Guide* will outline the key ingredients required for a comprehensive narrative. With a good narrative and an accurate Piping and Instrumentation Document (P&ID), a control system programmer can put together acceptable programming logic with minimal questions and rework. For these reasons, it is important to go through the exercise of putting together a control narrative.

This document should be used as an outline or checklist to make sure that all aspects of the process operation and control system design have been thought through before actually trying to make the process run. Another purpose of this document is to instruct on the Tate & Lyle standard process control philosophies and terminology.

B. What is a Control Narrative?

A Control Narrative contains the following:

1. Process Overview	Basic description of the overall system process, including: purpose, process chronology by functional unit, major functional units' description, basic description of the sub system process, and its interactions with utilities.
2. Equipment List	A comprehensive list of all physical equipment involved in the process. These include motors, valves, transmitters, etc.
3. Software Components	Components involved in the process that are not physical devices. These include control loops, totalizers, calculations and parameters.
4. Alarms	Definition for all non-default alarms associated with the process. These alarms will be displayed in numerous places throughout the end user interface.
5. Process Functionality Description	**Sequence Descriptions –** Step-by-step procedures that detail operational states of the unit. **A. Sequence Area** **1. Sequence Set Points** **a. Sequence Steps** **Interlocks –** Definition of all corrective actions designed to protect product, personnel or equipment. **Concurrent Tasks –** Definition of all normal process control functions that operate independently of the sequences.

Table 1: Control Narrative Requirements

C. Starting a Control Narrative

The following steps are required to begin writing a control narrative.

1. Break up the process into functional units

Start by reviewing the Piping and Instrumentation Diagram. Break up large processes into smaller, manageable functional units. You may find it helpful to group the equipment associated with the unit by circling the unit on the P&ID itself. Each functional unit, or circle, on the P&IDs will require a process control narrative.

2. Define the operational states for each functional unit

After determining the functional units for the process, define the operational modes for each unit. Typical operating modes consist of startup, hold, shutdown and e-stop. However, you may find that your particular process may require different or additional modes.

Typical operating states

Startup	Brings system from a non-operational state to a fully operational state.
Hold	Puts the given system in a safe state which also allows for manual- or maintenance-mode access.
Shutdown	Takes the system from an operational state to a non-operational state in a controlled manner (check for successful completion of each step before going on to next step, e.g. wait for valve to close before going to next step).
E-Stop	Takes every device to its Fail Safe State.

How-To Guide

Developing a Control Narrative

Sample Plant Process Layout

The following is an example of Process Layout. An entire plant has been broken down into areas and smaller functional units. Developing this type of layout early in a large project can be very helpful throughout.

- **1.1. Roll Dryers**
  - 1.1.1. Roll Dryers
  - 1.1.2. Rotary Vacuum
  - 1.1.3. Reslurry Tank
  - 1.1.4. Mill
  - 1.1.5. Hold Tank
  - 1.1.6. Filtrate
  - 1.1.7. Feed
- **1.2. Waste Treat**
  - 1.2.1. Influent Pumps
  - 1.2.2. Influent Screen
  - 1.2.3. Influent Surge Tank
  - 1.2.4. MBR
- **1.3. Packer**
  - 1.3.1. Pallet Convey
  - 1.3.2. Fugitive Dust
  - 1.3.3. Fill and Weigh
  - 1.3.4. Empty Bag Delivery
  - 1.3.5. Bag Conveying
- **1.4. Starch Modification & 5 New Reactors**
  - 1.4.1. Bleach Addition
  - 1.4.2. Hot Water System
  - 1.4.3. Hydrogen Peroxide
  - 1.4.4. Phosphorous Oxy-Chloride
  - 1.4.5. Propylene Oxide Addition
  - 1.4.6. Reactor Headspace Oxygen Purge
  - 1.4.7. Reactor Headspace PO Purge
  - 1.4.8. Reactor pH Adjust
  - 1.4.9. Reactor Temperature
  - 1.4.10. Reactor Transfer
  - 1.4.11. Salt-Caustic Addition
  - 1.4.12. Soda Ash
  - 1.4.13. Sodium Bisulfite
  - 1.4.14. Sodium Hydroxide System
  - 1.4.15. Starch Charging
  - 1.4.16. Sulfuric Acid
  - 1.4.17. Acetic Anhydride System
  - 1.4.18. Calcium Chloride
  - 1.4.19. HCL System
  - 1.4.20. N-octyl-Succinic
  - 1.4.21. Quaternary Amine
  - 1.4.22. Tri-poly Phosphate
  - 1.4.23. Wash Merco
  - 1.4.24. PO Scrubber
- **1.5. Steephouse**
  - 1.5.1. Sluice Transfer
  - 1.5.2. Steep Acid
  - 1.5.3. Steep Group 1
  - 1.5.4. Steep Group 2
  - 1.5.5. Steep Group 3
  - 1.5.6. Steep Group 4
  - 1.5.7. Steep Group 5
  - 1.5.8. Steep Group 6
  - 1.5.9. Steep Group 7
  - 1.5.10. Steep Group 8
  - 1.5.11. Steep Group 9
  - 1.5.12. Steep Group 10
  - 1.5.13. HSW/LSW
  - 1.5.14. Evaporator – Triple
  - 1.5.15. MVR
- **1.6. Spray 2**
  - 1.6.1. Hold Tank Fill
  - 1.6.2. Hold Tank Discharge
  - 1.6.3. 46F231 Collector Discharge
  - 1.6.4. 46F232 Collector Discharge
  - 1.6.5. Mill & Bins
  - 1.6.6. Phosphoric Tank Fill
  - 1.6.7. Pod Tank Discharge
  - 1.6.8. Feed Tank Discharge
  - 1.6.9. Cooker Tank Discharge
  - 1.6.10. Homogenizer Tank Discharge
  - 1.6.11. Dryer HP Feed Pump
  - 1.6.12. Sweco Tank, Merco Washer, and PODs

D. Using the Linked Word and Excel Control Narrative Templates

For all Tate & Lyle Control Narratives, it is important that you use the Tate & Lyle Control Narrative templates, including both a Word and Excel template. Write your Overview (Section 1.0) directly into the Word version of the Control Narrative template. Save the file name with the plant name and control narrative number in the title of the document.

When you are ready to write the Equipment List (Section 2.0), pull together all of your existing Excel spreadsheets. Cut and paste the content from your existing spreadsheets into the Excel Control Narrative template. This document is linked to the Word document and will update automatically by following these instructions.

Note

You must always keep your Word and Excel Control Narrative templates together in the same folder at the same directory level so that they can properly link to one another.

Start Importing Data in Excel

In order to populate the Word Control Narrative Template with data from your plant, cut from your existing Excel spreadsheets and paste directly into the linked Excel Control Narrative Template. Follow these steps to import your Excel data into the linked Excel Control Narrative template:

Step	Action
1	Open the Control Narrative Excel template and your original Excel spreadsheets containing data from your plant.
2	Copy data from your original spreadsheet by column.
3	In the Control Narrative Excel template, right click on the first row available in the corresponding table and row.
4	Select Paste.

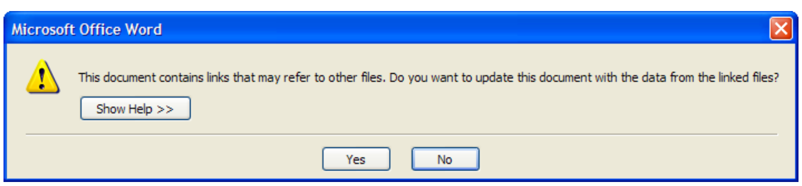
5	Select all the cells inserted.
6	Add gridlines.
7	Select Font>Arial 9.
8	Save.

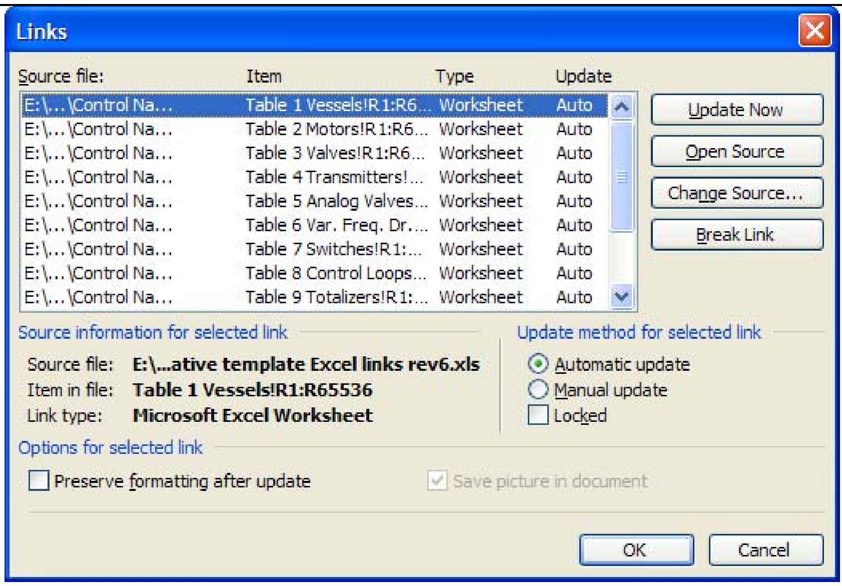
Updating Links in the Word Template

Once you have imported data from your plant into the Excel Control Narrative template, you are ready to update links to the Word Control Narrative template and add additional text to fill in the narrative.

Automatic and Manual Updating

In order to automatically update your Word Control Narrative template with your data from the Excel Control Narrative template:

Step	Action
1	Open your Word Control Narrative template. This dialog box should appear:  If it does, click Yes to automatically update the document with the data from the linked Excel template. If it does not appear, go to Step 2.
2	Click Edit>Links. This dialog should appear:

	 Select all the linked source files you would like to update. For "Update method for selected link," select Automatic update. Click Update Now. Click OK.

Updating Tables Individually

In order to update the linked tables in Word individually:

Step	Action
1	At the Word table, bring the cursor over the upper left corner of the table until a box with a cross insides appears.
2	Click on the box. The entire table will highlight black.
3	Go to Edit>Update Link.

Linking or Re-Linking Tables

In order to link or re-link a table:

Step	Action
1	In Excel, copy the entire spreadsheet you want to link.
2	In Word, click where you want to paste the table.
3	Select Edit>Paste Special.
4	Select Paste Link and Formatted Text (RTF).
5	Click OK.

Deleting Ghost Cells

Additional rows and columns can be added to or deleted from your linked Excel tables and will update in Word. However, any rows and columns deleted after an initial paste will leave gray lines in the Word document. To remove these ghost cells:

Step	Action
1	In Word, highlight the empty ghost row or column you want to delete.
2	Enter Backspace.
3	Select Delete Entire Row or Delete Entire Column.

1.0 Writing a Process Overview

Each control narrative should first include a process overview. A process overview is a paragraph description that includes a basic description of the overall system process, including the purpose, process chronology by functional unit, major functional units' description, basic description of the sub system process, and its interactions with utilities. A process overview should include:

1.1 Process Overview of Overall System

- Basic description of the process including purpose of the process
- Overall process chronology by functional units
- Major functional units' description - a functional unit as defined here means a distinct portion of the process that performs a processing step such as a reaction, separation, concentration, etc.

Remember the audience: non-process programmers and operators. Don't be lengthy, but provide enough information that the reader can picture the key operations of the process and have a layman's idea how they tie together.

1.2 Process Overview of Sub System (if required)

- Basic description of the sub system process including purpose of the subsystem.
- Describe the interactions this particular sub system operation has with other systems in the overall process, including:
    - Interactions with other upstream and down stream process functional units
    - Interactions with utilities such as cooling water, chilled water, cooling tower water, city water, tempered water, sewer, waste treatment, plant air, electricity, steam, steam condensate, vapor condensates, process water, etc.

2.0 Developing an Equipment List

The next step in writing a good control narrative is to develop a comprehensive list all devices and equipment, including equipment numbers, descriptions of the equipment, the area where the equipment is located, and other relevant information about the equipment.

Note

Use the linked Word and Excel Control Narrative templates together when developing your control narrative. Follow the instructions on pages 8-11 of this guide.

First, all devices need an equipment number. An equipment number should identify the area and include a unique identifier.

2.1 Vessels

First, in developing an equipment list, start with vessels. Include an equipment number and description. Also, list its capacity.

Equipment #	Description	Capacity
21V1	Gluten Storage Tank	20,000 gal
21V10	21F10 Low Vacuum Tank	10,000 gal

Table 2: Sample Vessels

2.2 Motors

Next, list the Motors. Include an equipment number and description. List horsepower, uniquely identify the Motor Control System (MCC) by location, and provide any helpful feedback that may be needed, such as describing AUX, OL, and HOA functionality for each motor.

Equipment #	Description	Horsepower	MCC	Feedback
21C10	21F10 Vacuum Pump	75	FH7B-24	AUX, OL, HOA
21C6	21F6 Vacuum Pump	125	FH7B-25	AUX, OL, HOA

Table 3: Sample Motors

2.3 Valves

Next, make a list of all the Valves. Include an equipment number and description. Also provide the fail action for the valve. Fail action is defined as the position that the valve will default to when power is lost. Typically, this is open or closed. However, some valves will remain in their last state. For Feedback, indicate the limit switches on the valve as either Open, Closed, both Open / Closed, or None.

Equipment #	Description	Fail Action	Feedback
NV21216	Water to 21F10 Filter Valve	Fail Closed	Open / Closed
NV21217	Water to 21F9 Filter Valve	Fail Open	Open / Closed

Table 4: Sample Valves

2.4 Transmitters

For Transmitters, include an equipment number and description. Give the range and units.

Equipment #	Description	Range	Units
AT2104	Gluten Water Quality Transmitter	0-1000	my
FT2109	Gluten Flow to Feedhouse	0-300	GPM
LT15108	Heavy Gluten Tank Millhouse Level Transmitter	0-100	%

Table 5: Sample Transmitters

2.5 Analog Valves

Next, make a list of all the Analog Valves. Include an equipment number and description. Also, list fail action as defined in the discrete valves section of this document.

Equipment #	Description	Fail Action
FV21225	Seal Water to 21C6 Flow Control Valve	Closed
LCV2187	21F7 Gluten Filter Level Control Valve	Closed

Table 6: Sample Analog Valves

2.6 Variable Frequency Drives

For Variable Frequency Drives, include an equipment number, description, along with the horsepower. Also, uniquely identify the Motor Control System (MCC) by location. Also, indicate if the VFD is hard-wired or tied to a network.

Equipment #	Description	Horsepower	MCC	Hard-wired or Network
21C10	21F10 Vacuum Pump	75	FH7B-24	Hard-wired
21C6	21F6 Vacuum Pump	125	FH7B-25	Hard-wired

Table 7: Sample Variable Frequency Drives

2.7 Switches

Next, make a list of all the switches. Describe the switch. "Indicate If" should indicate the process state and contact closure. 0 indicates open contacts while 1 indicates closed. The process state associated with the contact state should also be listed. When the statement in the "Indicate If" box is true, a flag will appear on the HMI screen which displays the process state which has been defined.

Equipment #	Description	Indicate If
LS2186	21F6 Gluten Filter Level Switch	0 = High
LS2187	21F7 Gluten Filter Level Switch	0 = Low

Table 8: Sample Switches

2.8 Manual Devices

Note

Entering manual devices is an optional step. Programmers do not need this information. However, listing out all the manual devices may be beneficial in encapsulating the entire plant process.

Next, make a list of all the manual devices. Categories should include at least manual valves and manual field switches, providing the ability to start and stop motors.

Manual Valves

For manual valves, include an equipment # and description.

Equipment #	Description
MV2042	Manual Valve #42
MV2052	Manual Valve #52

Table 9: Sample Manual Valves

Manually-Started Motors

Next, make a list of all the motors that can be started manually through a field switch. The motors listed here are also started automatically, but they have the additional option to be started manually through a field switch. All that is needed in this table is the equipment # and description.

Equipment #	Description
21C10	21F10 Vacuum Pump
21C6	21F6 Vacuum Pump

Table 10: Sample Manually-Started Motors

3.0 Documenting Software Components

For programming purposes, always include a unique identifier and a unique tag name.

3.1 Control Loops

For Control Loops, include an equipment number and description. Also, note if the PID Action is Direct or Reverse. In a direct acting PID loop, when the PV is greater than the SP, the CV will decrease to allow the PV to achieve SP. In a reverse acting loop, when the PV is greater than the SP, the CV will increase to allow the PV to achieve SP. Below you'll find an example for each.

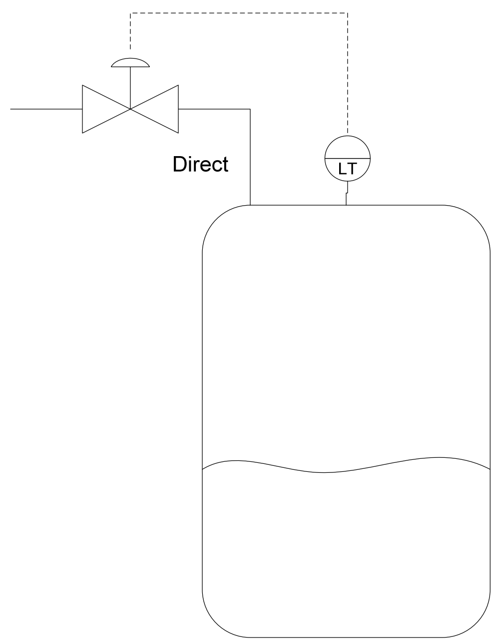


Figure 1: Direct PID Action

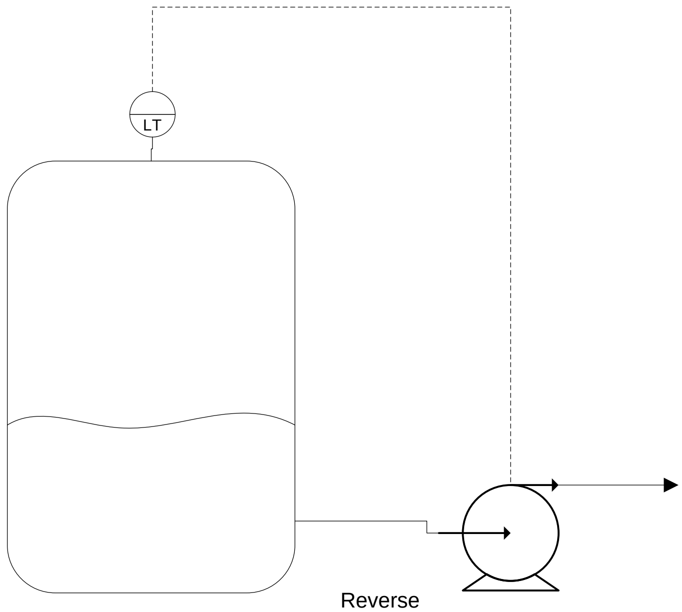


Figure 2: Reverse PID Action

Next, enter the Process Variable (PV), Control Variable (CV), and Set Point (SP). The Process Variable is the input to the loop (usually a transmitter value). A Control Variable is the output of the loop (usually a control valve or VFD). The Set Point is typically operator-defined. However, in a cascaded loop example, the Set Point of the slave loop will be the CV of the master loop.

Equipment #	Description	PID Action	PV	CV	SP
FIC21225	Seal Water to 21C6 Flow Controller	Direct	FT21225	FV21225	FIC21225_SP
LIC2190	21F10 Gluten Filter Level Controller	Direct	LT2190	LCV2190	LIC2190_SP
TIC2104	Gluten Cooler Temperature Controller	Reverse	TT2104	TV2104	TIC2104_SP

Table 11: Sample Control Loops

3.2 Totalizers

For Totalizers, provide a tag number and description. Also, list the transmitter involved in the process and a rate in seconds. Additionally, let the user know when to start, stop, and reset the totalizer in Section 5.1: Sequence Description or in Section 5.3: Concurrent Tasks.

Tag #	Description	Transmitter	Rate
FQ2109	Gluten Flow to Feedhouse	FT2109	1 second

Table 12: Sample Totalizer

3.3 Primary System Calculations

All primary system calculations must be defined using variables or tag names. The tag number, description, the formula (equation) itself, and units should be provided for all calculations used in the narrative. Define units as the unit that should be applied to the result of the formula.

Tag #	Description	Equation/Formula	Units
FQ2100	Total Level Gluten Filters	FQ2100 = (LT2186) + (LT2187) + (LT2188) + (LT2189) + (LT2190)	%

Table 13: Sample Calculation

3.4 Parameters

Parameters (often referred to as Definitions) fields on the HMI that allow for operators to enter data. Most commonly, parameters are found on operator prompts, parameter screens, or directly on HMI screens. The data within them can be referenced in other parts of the narrative, such as sequences, interlocks and concurrent tasks.

All parameters should be provided in the form of a tag number, description, value, range, and location. The location will be the name of the HMI screen or the name of the parameter box.

Tag Number	Description	Value	Range	Location
LT2159_HIGH	LT2159 High Level Value for Gluten Shutoff	90% (HMI input)	0-100%	Gluten Overview Screen
LT2159_LOW	LT2159 Low Level Value for Gluten Shutoff	20% (HMI input)	0-100%	Parameter Screen #1

Table 14: Sample Parameters

4.0 Defining Alarms

The current Tate and Lyle alarming strategy consists of both default and custom alarms. Default alarms do not require definition in the narrative. Each type of equipment has one or more default alarms associated with it. For example, each discrete valve will have a fail to open and a fail to close alarm. A complete list of default alarms can be found in table 13. Custom alarms can also be created. However, they must be clearly defined in the narrative using the guidelines provided in this document.

4.1 Default Alarms

Device	Alarm Points	Description	Priority	Latched	Delay
Transmitter	High	Analog input is above operator entered high limit	Yellow Priority	No	20 seconds
	Low	Analog input is below operator entered low limit	Yellow Priority	No	20 seconds
Motor	Aux Fail	Output to motor is on but PLC is not receiving run indication	Yellow Priority	Yes	2 seconds
	Overload	Motor has shutdown due to overload conditions	Yellow Priority	No	N/A
	H-O-A	Indicates that the hand - off - auto switch is not in the auto position	Yellow Priority	No	N/A
Valve	Fail to Open	Valve has been requested to open but valve limit switches do not indicate fully open	Yellow Priority	Yes	20 seconds
	Fail to Close	Valve has been requested to close but valve limit switches do not indicate fully closed	Yellow Priority	Yes	20 seconds
VFD Motor	Run Fail	PLC output to motor is on but PLC is not receiving run indication	Yellow Priority	Yes	2 seconds
	VFD Fault	Frequency drive is faulted	Yellow Priority	Yes	N/A
	Comm Fault	Communication has been lost	Yellow Priority	Yes	N/A

Switch	Alarm	Digital indication that level, pressure, flow, etc. has reached an alarm state	Yellow Priority	No	20 seconds

Table 15: Default Alarms

4.2 Custom Alarms

Custom alarms are any alarms needed for the process other than the default alarms listed above. Below is an example of how to define a custom transmitter alarm:

If Vessel One level (LT1234) is greater than 85% for 5 seconds and the Vessel One Inlet Valve (NV1234) is open, Red Alarm.

Information required for Custom Alarms include:

- **Trip Point** - The point at which an analog input value from the field will start the delay timer.
- **Delay** – The amount of time needed to expire before displaying an alarm.
- **Active Conditions** – Any other conditions needed to activate an alarm.
- **Priority** -- Alarming severities include:

  Priority 1 – Red: Safety and Environmental Critical

  Priority 2 – Orange: Process Critical

  Priority 3 – Yellow: Process Restrictions

  Priority 4 – Blue: Communication

Device	Description	Trip Point	Delay	Active Condition	Priority Level	Latched
LT1234	Vessel One Level	85%	5 seconds	Vessel One Inlet Valve (NV1234) is open	1 – Red	No
LIC1000	Vessel One Level Control, Deviation Alarm	+/-10%	20 seconds	Vessel One Inlet Valve (NV1234) is open	1 – Red	Yes

Table 16: Custom Alarms

5.0 Writing Process Functionality Descriptions

To write a good control narrative, control engineers will need to provide detailed descriptions of each operational state associated with each functional unit. Write a three-tiered sequence description as described below, including Sequence Area, Sequence SetPoints, and Sequence Steps. Use the actions identified below. Start, stop, and reset times should be specified in the Sequence Steps. The rate should always be 1 second.

5.1 Sequence Description

There are three hierarchical levels to writing a good sequence description:

Sequence Area – A number of devices / instruments grouped together as a functional unit. This is the highest level, (e.g. Tank #1 Functional units) directly associated with functional units—one functional unit, you have a sequence group associated with it. Example: Tank 1.

Sequence Set Points – The defined modes of operation for a Sequence Area. Example: Startup.

Sequence Steps – Sequence steps are actions associated with objects which are defined in the Equipment List and Software Components sections of the narrative. Each step should contain the object tag name, object description, and action. (Example: Close NV21532 Steepheater Strainer 1 Drain Valve)

Sequence SetPoints interact with one another in such a way that you cannot have two SetPoints in the same sequence running at the same time. When you transition from hold back to startup, the SetPoints will restart from the beginning.

Actions that can be used in Sequence Descriptions

Start | Stop [Motor] | [Totalizer]

The start \ stop command is a discrete command used to start and stop motors, totalizers and tasks.

Start Primary Water Pump (21P45)

Open | Close [Valve]

The open \ close command is a discrete command used to open and close valves.

Open Water Inlet Valve (NV21A8)

Reset [Totalizer]

The reset command is used to reset totalizers or other registers to zero.

Reset Water Inlet Totalizer (Water_Tot)

Set [Register]

The set command is used to set value into an analog register.

Set Caustic Control Loop Set-Point to 7.5 ph (FIC21H9)

Wait [Seconds]

The wait command is used to wait for a pre-determined amount of time.

Wait for 30 seconds

Compare [Register] >= [Register]

The compare statement is used to compare two or more registers.

FT21H10 < 100 GPM for 10 seconds = FT21H10 Low Low Alarm

Jump [Sequence Step]

The jump statement is used to skip a step or groups of steps in a sequence.

Jump to Step 34 of Tank #1 Water Addition Sequence

The narrative should describe the detailed sequence of events that occur to move the entire functional unit through each operational state and from one operational state to the next. It should include a description of not just the computer's sequential manipulation of field instruments, but also the actions needed of the operator.

It is also important to note that by default each sequence step will verify successful completion before moving to the next step in all Set Points with the exception of E-Stop. For example, during a step that closes a digital valve the program will wait for the closed limit switch to make before moving to the next step. However, during E-Stop the limit switch will not be checked. The sequence will move forward to immediately take all other devices to their fail safe state.

The following is an example of a full sequence.

Sample Sequencing Description:

5.1 Tank #1

5.1.1 Startup

5.1.1.1 If LT21H8 is greater than 80 then jump to step 0, else continue

5.1.1.2 Start Primary Water Pump (21P45)

5.1.1.3 Open Water Inlet Valve (NV21A8)

5.1.1.4 Reset Water Inlet Totalizer (Water_Tot)

5.1.1.5 Start Water Inlet Totalizer (Water_Tot)

5.1.1.6 Wait Until Water Inlet Totalizer is Complete (Water_TotDn)

5.1.1.7 Stop Water Inlet Totalizer (Water_Tot)

5.1.1.8 Stop Primary Water Pump (21P45)

5.1.1.9 Set Caustic Control Loop to Manual (FIC21H9)

5.1.1.10 Set Caustic Loop Control Variable to 0% (FIC21H9)

5.1.1.11 Close Water Inlet Valve (NV21A8)

5.1.1.12 Set Caustic Control Loop to Auto (FIC21H9)

5.1.1.13 Set Caustic Control Loop Set-Point to 7.5 ph (FIC21H9)

5.2.1 Hold

5.3.1 Shutdown

5.3.1.1 Stop Primary Water Pump (21P45)

5.3.1.2 Stop Secondary Water Pump (21P46)

5.3.1.3 Wait 20 seconds

5.3.1.4 Close Water Inlet Valve (NV21A8)

5.3.1.5 Stop Water Inlet Totalizer (Water_Tot)

5.3.1.6 Set Caustic Control Loop to Manual (FIC21H9)

5.3.1.7 Set Caustic Loop Control Variable to 0% (FIC21H9)

5.4.1 E-stop

5.4.1.1 Stop Primary Water Pump (21P45)

5.4.1.2 Stop Secondary Water Pump (21P46)

5.4.1.3 Close Water Inlet Valve (NV21A8)

5.4.1.4 Stop Water Inlet Totalizer (Water_Tot)

5.4.1.5 Set Caustic Control Loop to Manual (FIC21H9)

5.4.1.6 Set Caustic Loop Control Variable to 0% (FIC21H9)

5.2 Interlocks

An interlock is a corrective action, usually initiated from an operational process state, which is designed to protect product, equipment, or personnel. Interlocks indicate abnormal process conditions and generate alarm messages. Individual devices or sequences can be interlocked.

For each Interlock, provide a message description, condition (device and state), and action (device or sequence and action).

Message Description	Conditions	Actions
21C6 Vacuum Pump Fail Gluten Vacuum to Hold	21C6 Fails and System in Startup	Gluten Vacuum Filter System to Hold
21C7 Vacuum Pump Fail Gluten Vacuum to Estop	21C7 Fails and LS2187 High and System in Startup or Hold	Gluten Vacuum Filter System to Estop
Vacuum Pump High Level Gluten Vacuum to Shtdn	LS2168 High or LS2167 High or LS2168 High or LS2169 High	Gluten Vacuum Filter System to Shutdown
Feedhouse Gluten Storage High Level - Gluten Storage to Hold	LT15108 > 95 and System in Startup	Gluten Vacuum Filter System to Hold

Table 17: Sample Interlocks

5.3 Concurrent Tasks

A Concurrent Task is a normal process control function that occurs independent of the sequence of operations. These tasks run independently from a sequence, usually during the end of a startup sequence. These are normal events that happen regularly, therefore do not require alarm messages or flags.

Concurrent Task Examples:

When Slurry Tank Level Probe (LT21V1) is greater than 40% start Slurry Tank Agitator (21A34)

When Slurry Tank Level Probe (LT21V1) is less than 30% stop Slurry Tank Agitator (21A34)