

# Survalent.

## Survalent Training Manual

SurvalentONE SCADA System Level 1

**Module 8 – Automation**

Revision 01



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## Module 8 – AUTOMATION

### INTRODUCTION

In this section we begin by running basic calculations and functions and then we progress into running scripts and programs that automate the processes associated with basic functions.

### BASIC CALCULATIONS

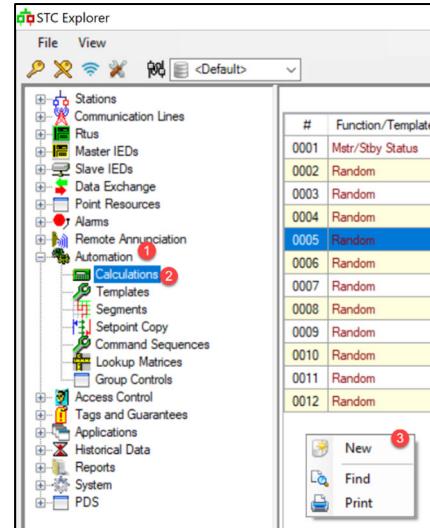


#### Exercise

In-class exercise: Create a substation called Calculations and, in the substation, create a point called Training\_Sum. The point type (User Type) can be AMPS and it has no Telemetry or Alarm settings.

You can guess from the exercise that we are going to place the results of our calculations in a station called Calculations. This is done by choice. Since our calculation is going to be on points in the North substation, we could place our calculations there or in a child station under North.

Simply summing up two points will give us a good look at how calculations get set up in STC Explorer. In addition, we've already had a quick look when we set up the simulated, random values for some of our analog points.



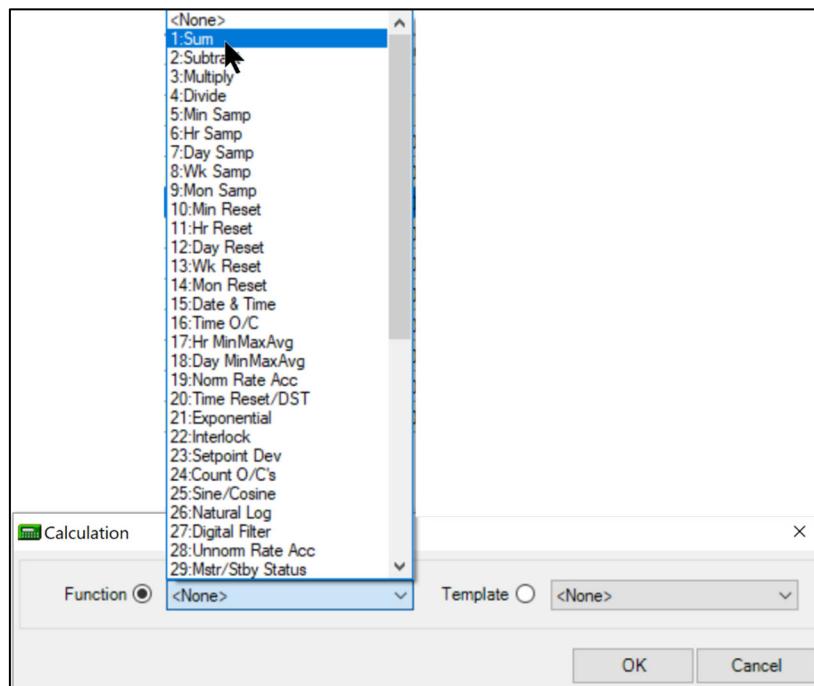
For this example, let's say we wish to calculate the total of North\_H1,IA and North\_H2,IA.

In STC Explorer, we would:

1. Select Automation.
2. Calculations.
3. Right-click on the right side and select New.

#### 8.1 Starting a Calculation

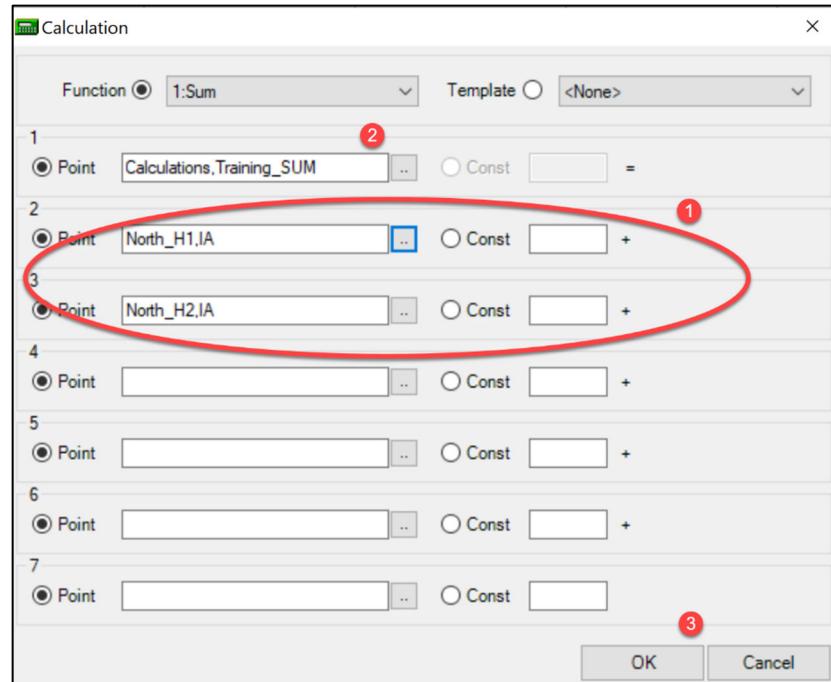
There are 57 options. For our example, we will choose 1: Sum.



*8.2 Choosing a Calculation*

The layout for calculations is similar for all types of calculations:

1. The components of the calculation (e.g. points to be added). Note that constant numbers can also be included.
2. The result (which is a pseudo point like the one we included in the exercise).
3. Hit OK



*8.3 Elements of a Calculation*

The calculations for these points have not yet started. Some utilities will create some for future use.

When they are ready start the calculation, they hit the Update and Commit buttons at the bottom right of the Calculations window.



8.4 Update and Commit

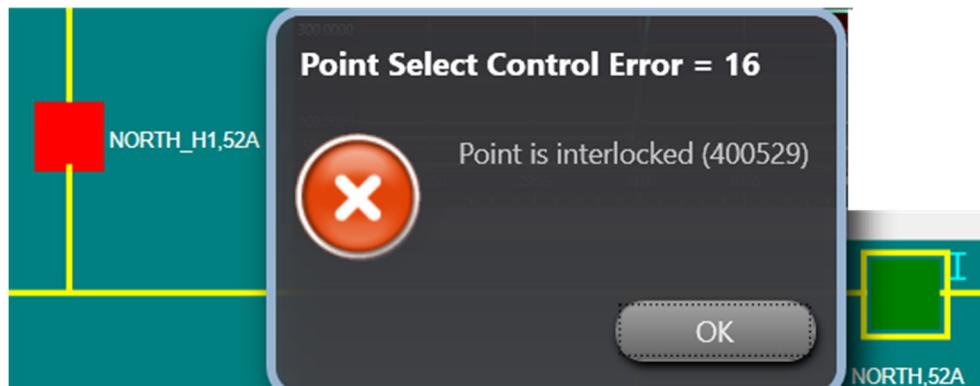
We verify the success of the operation by checking the Analog Point Viewer.

Calculations			Value
	Name	Description	Value
Brampton	Calculations.Training_SUM	Training Example for Summ	699.94

8.5 Calculated Value in Analog Point Viewer

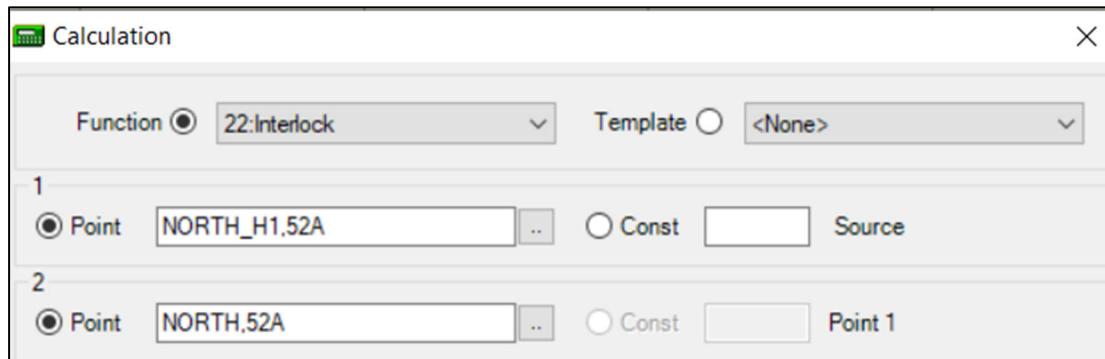
## ADVANCED FUNCTIONS

There are 57 options under the Calculations heading. Some of the options can be best described as functions. In the image below, North,52A can't be closed if North\_H1,52A is closed. Note the message about interlock and the Aqua colored "I" beside the North,52A.



8.6 Can't Close North,52A

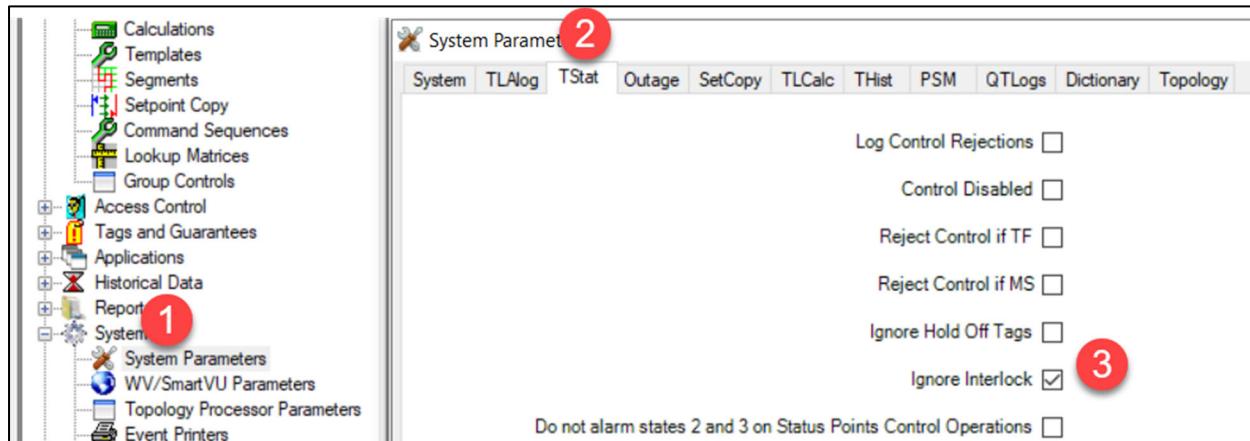
The behavior in image 8.6 is due to one of the functions – Interlock (22).



8.7 The Interlock Function

The behavior of all the calculations and functions can be found in the Calculations User Guide. For Interlock, the guide explains that, if Point 1 is closed, then it blocks Point 2 from closing.

You may not want to open and close North\_H1.52A to reset the interlock but deleting the calculation may take up to an hour for the Interlock to stop working. Restarting the server would stop the Interlock function but it's not practical. A quick solution would be to go to the (1) System Parameters and then (2) TStat tab, and check (3) Ignore Interlock.



8.8 Ignoring Interlock

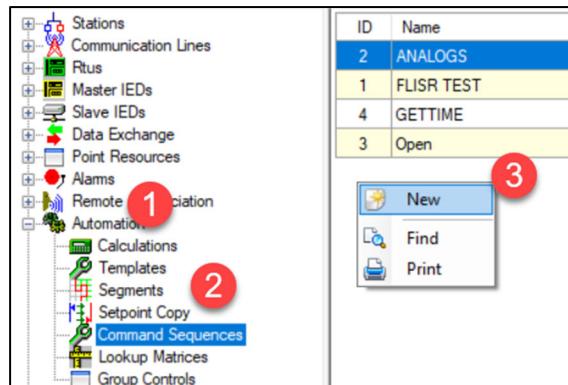
## COMMAND SEQUENCES

Look back to image 8.3. It allowed you to add values; however, there was a limit on how many values you could add. Also, there was no complexity where you could say that you wanted this calculation to occur only under certain circumstances. Any time you need to create a function over and above the 57 basic functions in Calculations, you'll consider Command Sequences.

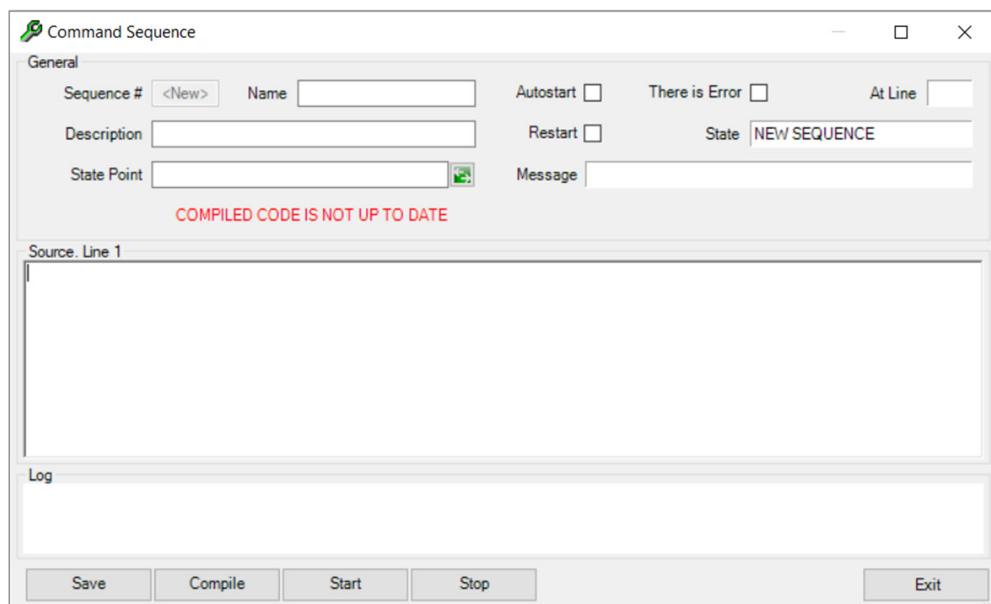
With Command Sequences, a scripting language with a large set of commands (see the Command Sequencing user guide) can be applied to the points in the database.

To access Command Sequences:

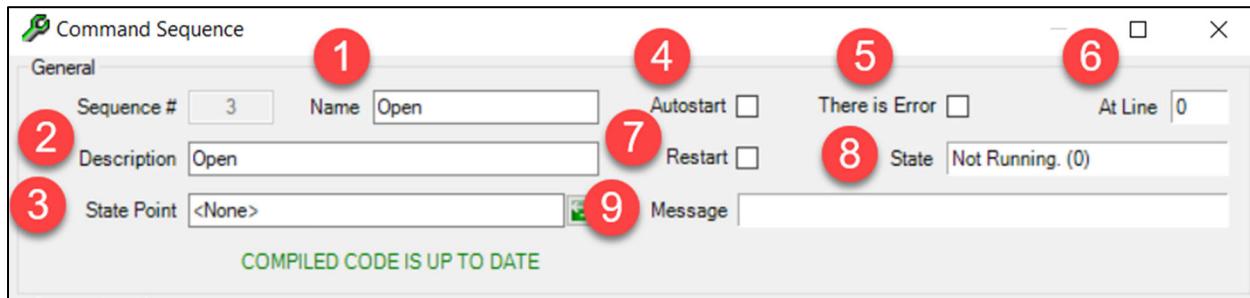
- 1 Click Automation.
- 2 Command Sequences.
- 3 Right-click on the right side and select New.



8.9 Creating a Command Sequence



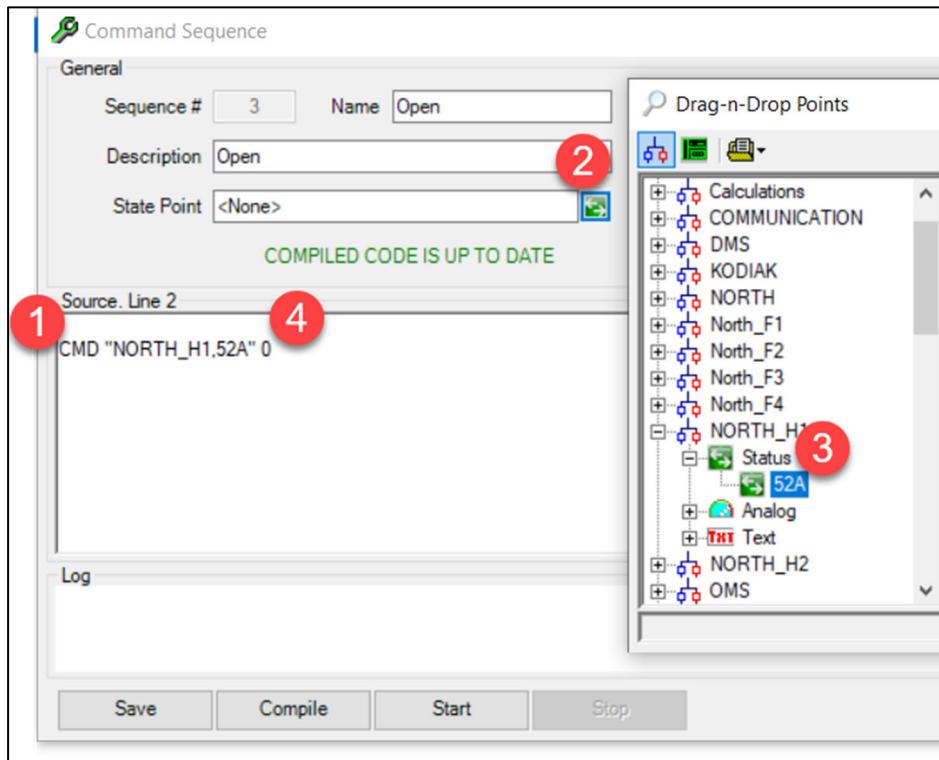
8.10 Command Sequence Window Launched



8.11 Command Sequence Fields

In your Command Sequence, using Image 8.11 as a reference:

1. Provide a name (we will demonstrate the opening of a point using Command Sequences).
2. Provide a description.
3. Optional – Create a status point to show if the Sequence is running.
4. Optional – If the Command Sequence is to run continually, would you like it to start up automatically if the system needs to restart (**even if it wasn't running when the system went down**)?
5. This box will show you if an error occurred when running the Command Sequence.
6. The line number – if there was an error – where the error occurred
7. The Restart box shows if the Command Sequence was restarted as requested in step 4.
8. The current state of the Command Sequence (e.g. New, Running, Stopped).
9. Where there any additional error messages from the Command Sequence.



8.12 Entering in the Commands

Recall we are demonstrating the opening of a point using Command Sequences.

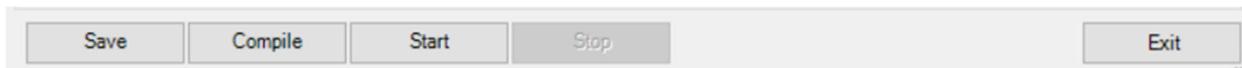
To enter in the commands (numbers below refer to 8.12):

1. Type in the command. In this case it's CMD which issues commands to telemetered points (this is often followed by a point name in quotation marks).
2. A quicker and more precise way of entering a point is to select the point using the green box in State Point.
3. If you select the box from Step 2, drag the selected point into the window.
4. Complete the command by entering 0 for Open.

When finished, click the Save button. In time when you begin writing long Command Sequences, you should save your work frequently before you finish writing the commands.

The Compile button tests your code. A message in green saying that the Compiled Code is Up to Date means that you are ready to go. A red message saying that the Compiled Code is Not Up to Date generally means you have to fix a syntax error. The red error messages can range from something simple such as forgetting to add a comma to something more complex such as using a command incorrectly. The message will point out where the error is located.

The Start command will run our Command Sequence. Since ours is a quick command to change a breaker it will only run for a short time.



### 8.13 Running a Command Sequence



#### Exercise

In-class exercise: Test your Command Sequence by running it and confirming the breaker changes its state to Open.

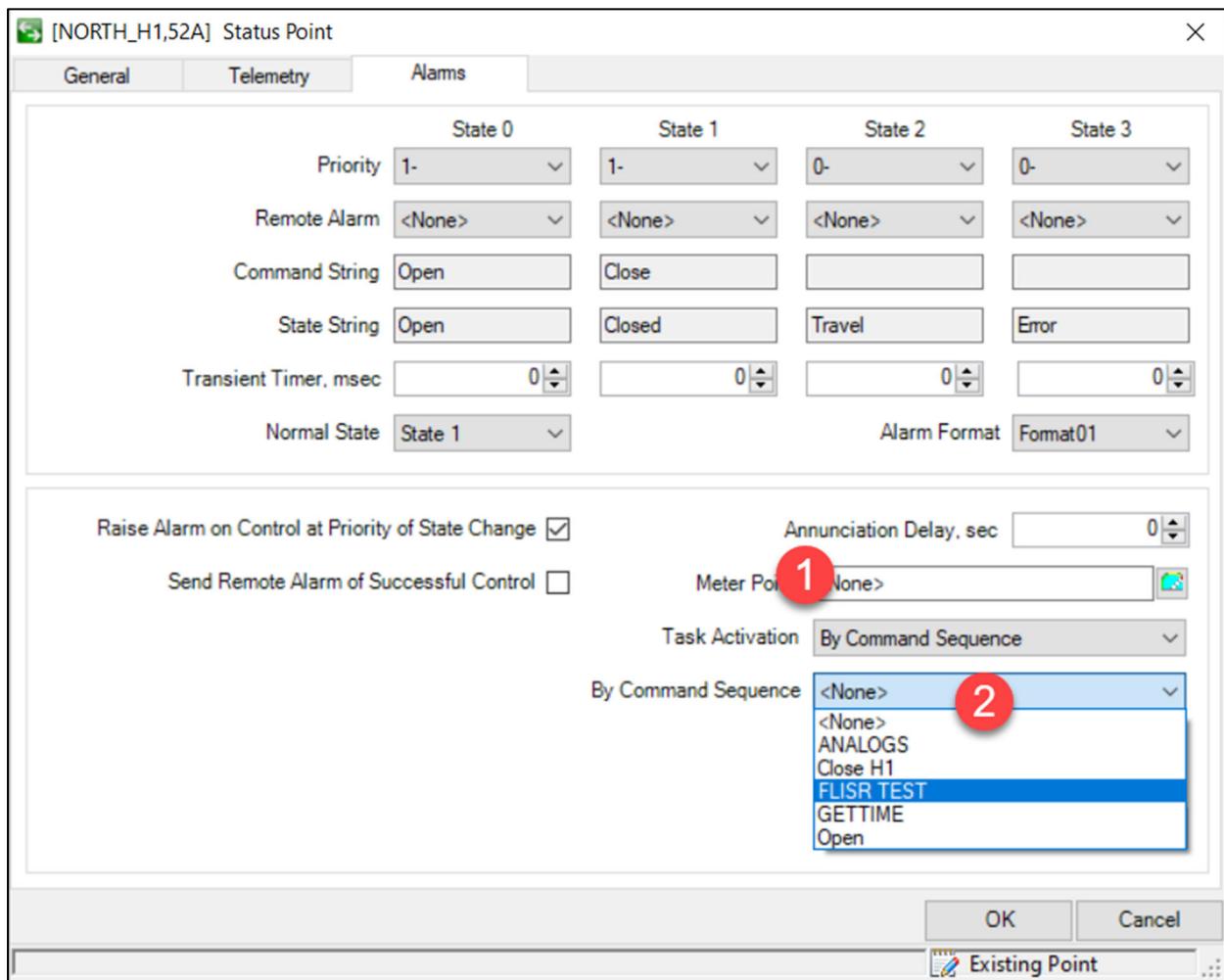
Two useful Command Sequence tips are:

1. Cutting, Copying, and Pasting is possible but only by using keyboard shortcuts.
2. In the Command Box, holding down the CTRL key and using the scroll button on a mouse can make the command larger for easier reading.

## PRACTICALLY RUNNING COMMAND SEQUENCES

Running Command Sequences from within SCADA Explorer isn't practical or efficient.

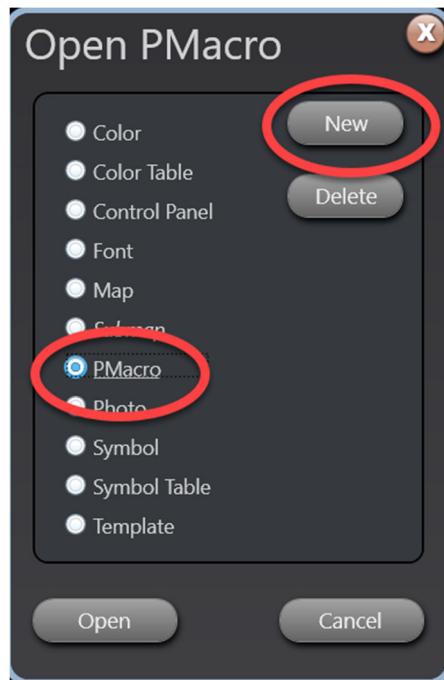
If the idea is to run the Command Sequence when a point changes state, this can be automated. In the image below, a Command Sequence has been selected to run automatically as soon as the point changes state. To do so, (1) Select Command Sequence from the Task Activation field, then (2) select the desire command sequence.



8.14 Command Sequence Connected to Point

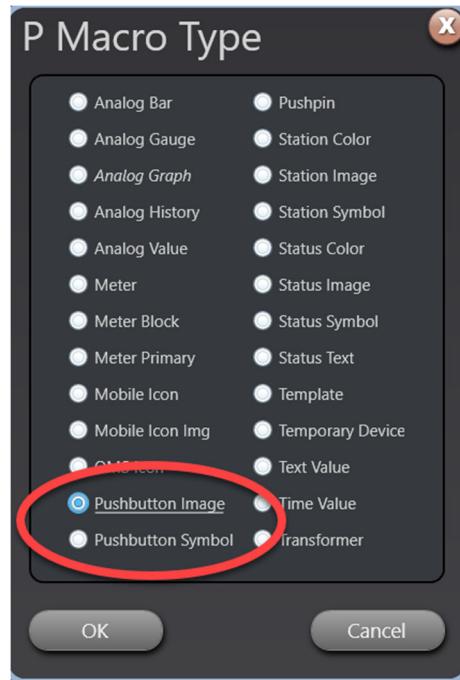
You may still want to have human intervention before running the Command Sequence but you don't want the person to have to switch to Internet Explorer in order to hit the Start button. In this case we can make use of the versatile Pushbutton PMacros.

Recall that these are created by choosing to create a new PMacro in the Library (see next page).



8.15 New PMacro for our Command Sequence

Recall a Pushbutton Image PMacro consists of images (JPG, PNG, GIF, BMP) that you have placed in the BMP folder whereas a Pushbutton Symbol PMacro consists of items you have drawn using SmartVU. In our example, we will create a Pushbutton Image PMacro.



8.16 Creating a Pushbutton Image PMacro

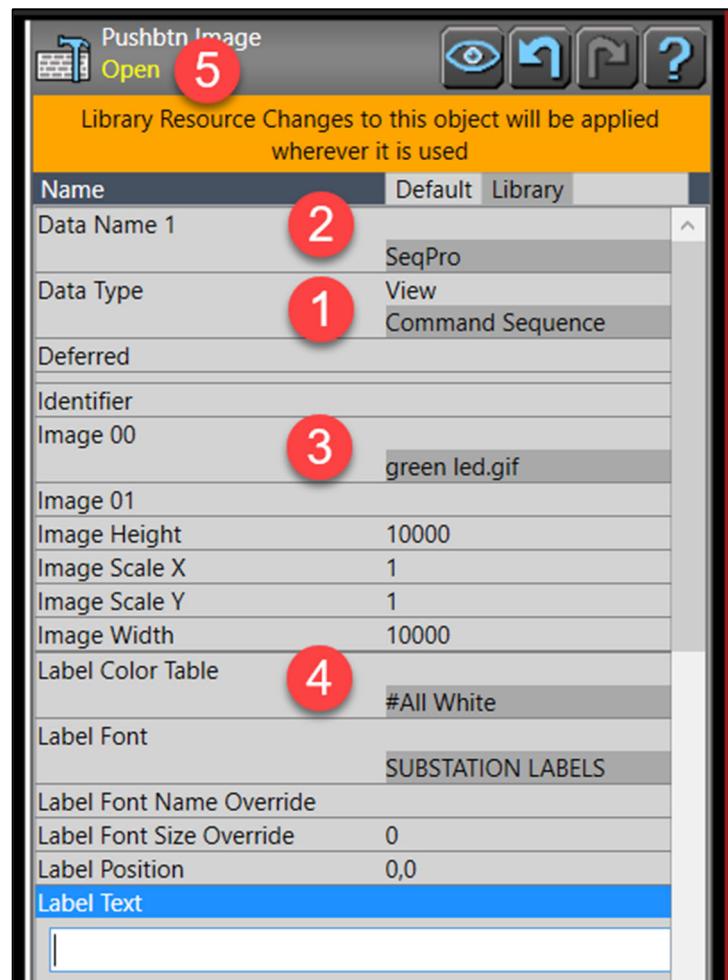
Here, we've named it to reflect that it will open a device.



8.17 Naming our PMacro 1

We've made a Pushbutton PMacro for Views in Module 4. The difference here is that pushing this PMacro will issue our Command Sequence. Therefore,

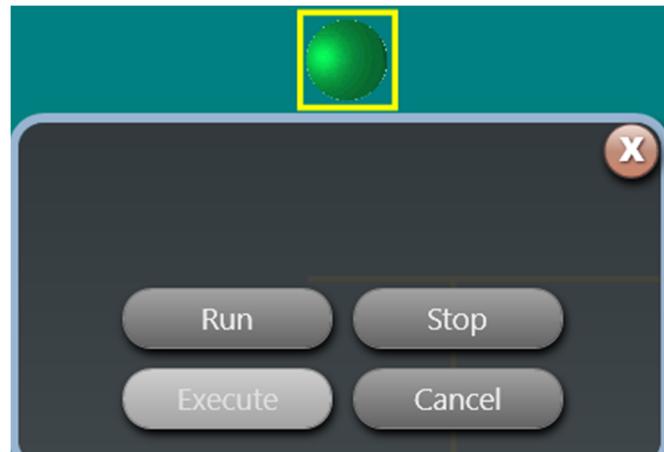
1. The Data Type we choose is Command Sequence (and, when we choose Command Sequence, we choose the specific Command Sequence).
2. We don't have to choose SeqPro. It fills in when we choose Command Sequence.
3. As with the Views Pushbutton, we choose the image for the button.
4. As with the Views Pushbutton, we choose the Font and Colors.
5. Recall that this is in the library. You may not want to tie this PMacro to your specific PMacro at this point like we did in Step 1. Always be aware of the difference between working in the Library versus working in Edit Parts when we add the PMacros to the map.



8.18 Configuring Command Sequence PMacro

It's a two-step process to minimize errors.

After clicking Run, the Execute activates and must be clicked too.



8.19 Running the Command Sequence

## CONTINUOUS COMMAND SEQUENCES

In the last example, the Command Sequence required human intervention – someone had to press a button. In this example, the Command Sequence will run continuously.

Here is the scenario:

- You are a hydro-electric company with flow meters.
- You can instantaneously get the current flow in Cubic Feet Per Second.
- You would like to be able to get the Average Flow in Cubic Feet Per Second.
- From the average flow, you would like to be able to project the Total Daily Flow in Cubic Feet Per Second.
- You would like to be able to convert it to the Totally Daily Flow in Acres.

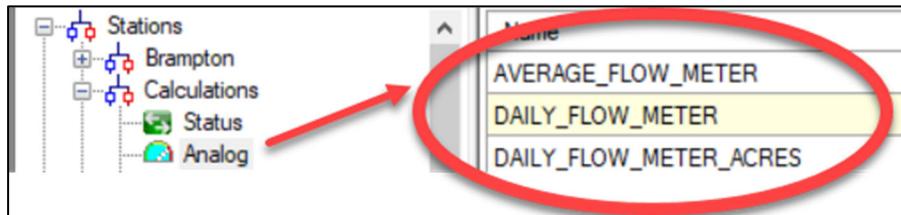
Similar to what we did in Module 4, below we create an Analog point that is producing CFS values between 190-200. The point is called CURRENT\_FLOW\_METER. We use the Random calculation to simulate the values.

Name	Description	Value	C	Limit	Nak	B	TA	Zones	UserType	Dev.Class
NORTH.CURRENT_FLOW	Current Value From the Flow	198.54	CFS	Norm				AllZones	Flow Meter	Analog

8.19 CURRENT\_FLOW\_METER Values

We also will create 3 Calculated Points. Our Command Sequence will continuously calculate and report

the values shown on the next page.



8.20 Calculated Points for Our Exercise

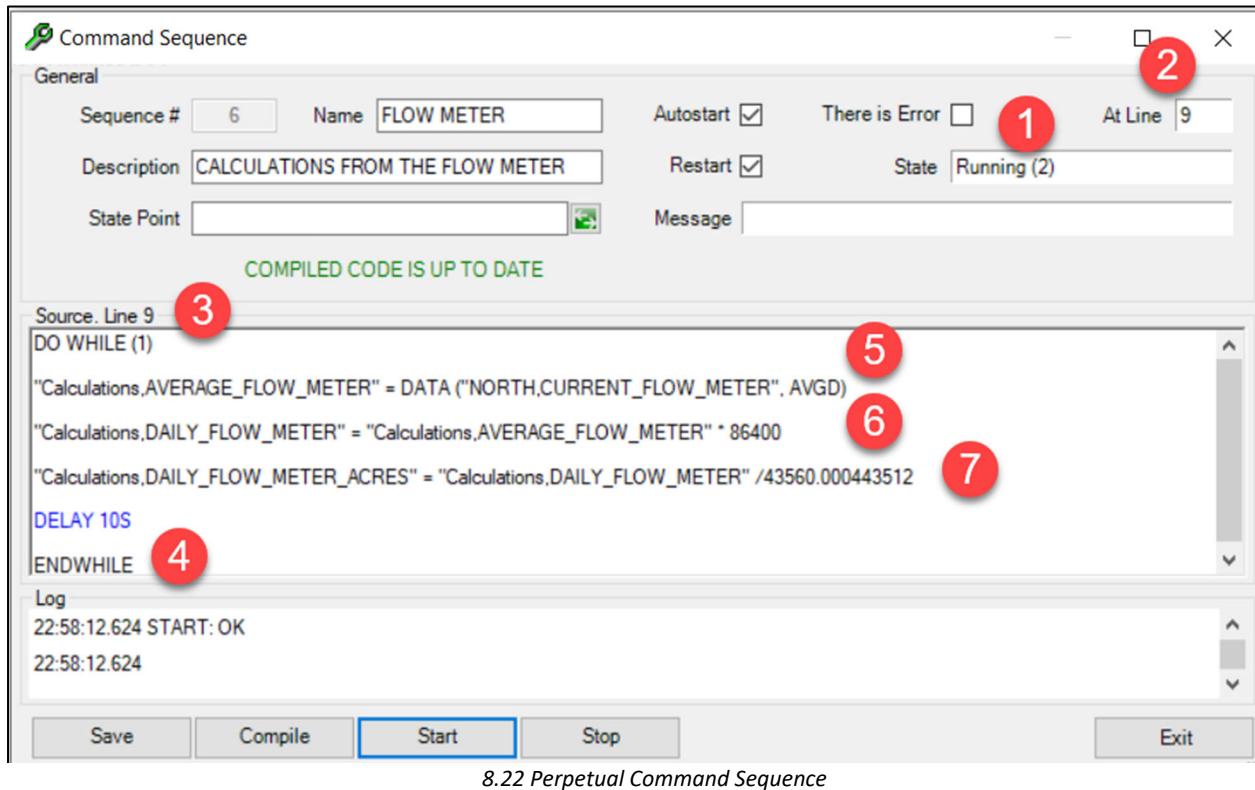
We will also need a command from the Command Sequence User's Guide.

All Point Types		
MINH	Minimum	current hour
MAXH	Maximum	current hour
MINTIMH	Time of minimum	current hour
MAXTIMH	Time of maximum	current hour
AVGPH	Average	previous hour
MINPH	Minimum	previous hour
MAXPH	Maximum	previous hour
MINTIMPH	Time of minimum	previous hour
MAXTIMPH	Time or maximum	previous hour
AVGD	Average	current day
MIND	Minimum	current day
MAXD	Maximum	current day
MINTIMD	Time of minimum	current day
MAXTIMD	Time of maximum	current day

8.21 AVG Value for Command Sequences

The next page shows the Command Sequence that will give us the values we need at any time. Note at the top that the Autostart and Restart buttons are checked. These are used to instruct the Command Sequence to start again if the system goes down. The difference between the two is that Autostart instructs the Command Sequence to run when the system begins running again **regardless if the Command Sequence was active when the system went down**.

The other changes require more explanation:



1. The current state of the Command Sequence is that it is running. Later, we will make use of an optional State Point. A chart of all the states is shown on the next page in image 8.24.
2. The perpetual Command Sequence runs through all the lines. Currently we are at Line 9 and you will notice the line is in Blue. It is advisable to have some sort of break after running through a series of commands and we will be on line 9 for 10 seconds (Delay Command).
3. The DO WHILE (1) Command is a well-known example of an Infinite Loop. As you may expect, the Command Sequence will run as long as the bracketed information is in effect. In this case, it's saying to do this as long as 1 is 1 (perpetual).
4. Syntax dictates that a DO WHILE statement must be paired with an ENDWHILE statement. In this case, ENDWHILE will never be called.
5. Here we apply the Command we saw in image 8.21 to the point producing telemetered CFS values.
6. The result from that last calculation (point 5) is multiplied to show what the estimated daily

value would be if we apply this value (per second) to a daily value.

7. The result from point 6 is divided to show the daily value by the larger Acres per Second Value.

Calculations	Calculations.AVERAGE_FLOW_METER		7.82
COMMUNICATION	Calculations.DAILY_FLOW_METER		675723.41
DMS	Calculations.DAILY_FLOW_METER_ACRES		15.51

8.23 Values Perpetually Calculated

State Message	Description
NOT RUNNING (0)	The command sequence is not running.
LOADED (1)	The command sequence has been loaded, but is not running.
RUNNING (2)	The command sequence is running.
DONE NORMAL (4)	The command sequence exited normally.
HALTED (5)	The command sequence was halted before execution completed.
DONE WITH ERROR (6)	The command sequence exited with errors.

8.24 States of a Perpetual Sequence

## STATE POINT

If we compare the Command Sequence below with the one shown in image 8.22, we see the new one is using a State Point.

Command Sequence

General

Sequence # 6 Name FLOW METER Autostart  There is Error  At Line 9

Description: CALCULATIONS FROM THE FLOW METER

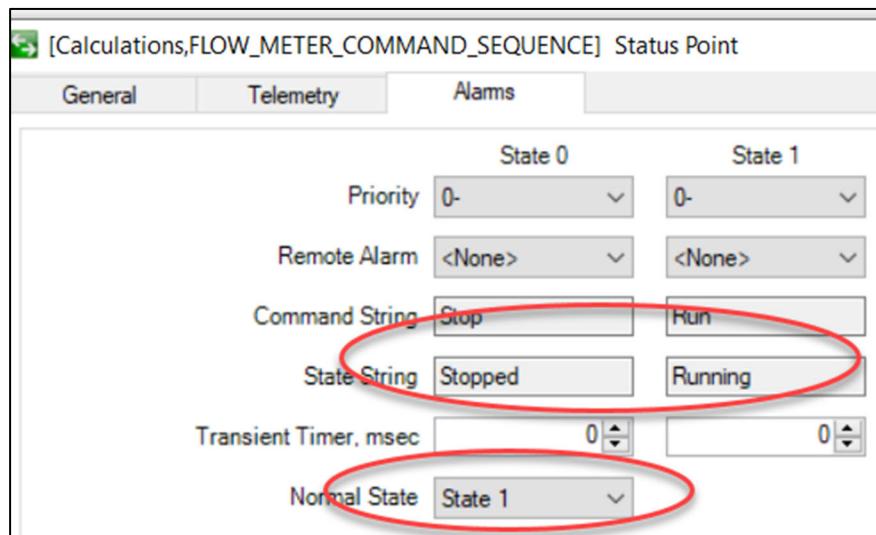
Restart  State Running (2)

State Point: Calculations.FLOW\_METER\_COMMAND\_SE

Message:

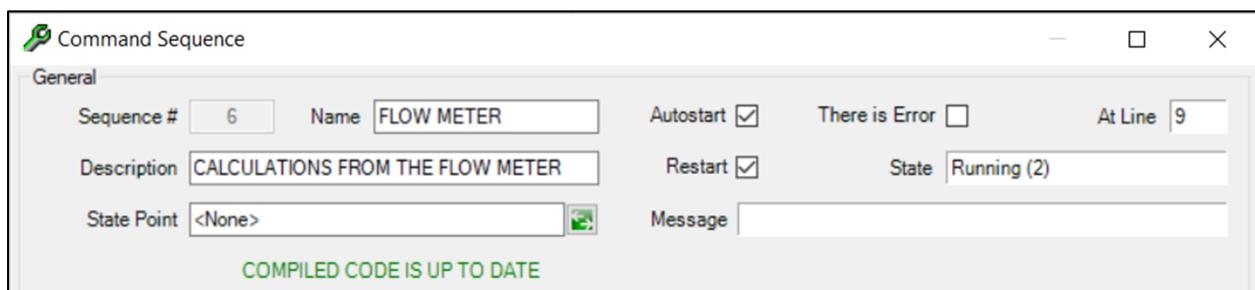
8.25 State Point

The State Point is a Calculated or Pseudo point that will show if the Command Sequence is Running or Not Running. We expect it to be Running so we set State 1 as the Normal State.



8.26 Setting Up the State Point

If the Command Sequence is running ....



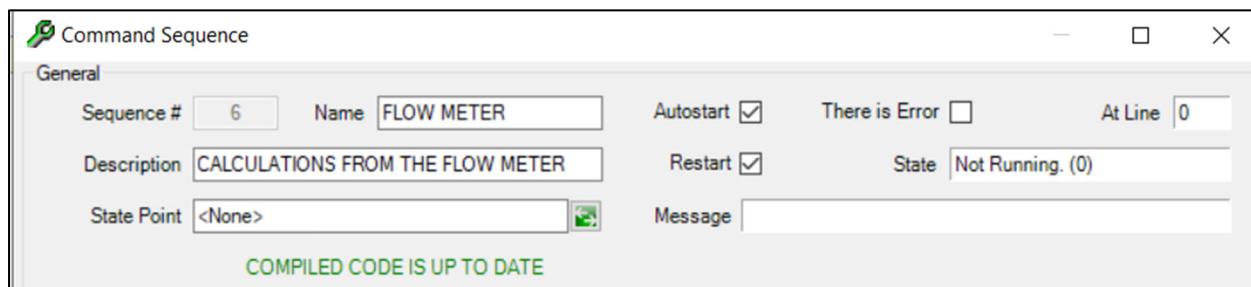
8.27 Command Sequence Running

The State Point shows that it's running (this can be represented on SmartVU if needed).

Brampton	Name	Value
Calculations	Calculations.FLOW_METER_COMMAND_SEQUENCE	Running(1)

8.28 State Point Showing CS Running

Similarly, if the Command Sequence has stopped ...



8.29 Command Sequence Not Running

Brampton	Name	Value
Calculations	Calculations.FLOW_METER_COMMAND_SEQUENCE	Stopped(0)

8.30 State Point Showing CS Stopped

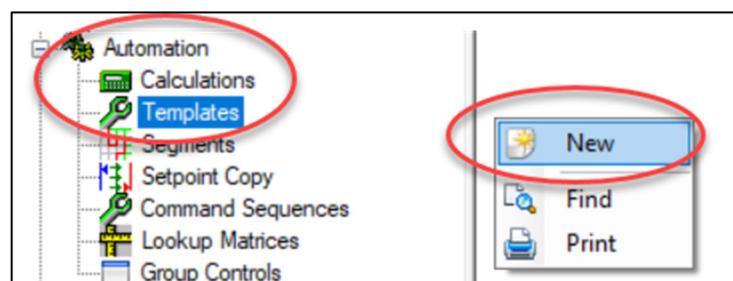
## CREATING AN AUTOMATION TEMPLATE

In Module 6, we created Templates for SmartVU. Creating templates in Automation are different.

In the Calculations and Command Sequences we've been working through this chapter, we've specified the points to be used. Automation Templates allow you to create commands without having to specifically name points. Therefore, they can be applied later to any point.

To start, we choose Templates under Automation.

Next, right-click on the right side and select New.



8.31 Creating an Automation Template

Source. Line 1

```
! There are 3 points and they call cannot all be closed.  
! If you try to change the state of a point,  
! This template will check the other two points to see if the change is allowed.  
  
IF ($P2 .AND. $P3)  
$P1= 0  
$ERRORMESSAGE = 'NOT ALLOWED'  
ELSE  
$P1 = 1  
ENDIF
```

### 8.32 Adding the Code

A good place to decipher what is happening can be the remarks after the exclamation points. These are used to describe what is happening. Here we learn this script will not allow 3 chosen points to all be closed.

You will notice that the actual points are not named here. If you look to the top right, you see the three points are generally described as \$P1, \$P2, and \$P3. \$P1 would represent a point you may want to open or close. Whether you can depends on the status of points \$P2 and \$P3. In other words, the decision to allow \$P1 to change state (the output) depends on the states of \$P2 and \$P3 (the input).

The code uses commands from the Command Sequencing user guide. A translation of the 6 lines is:

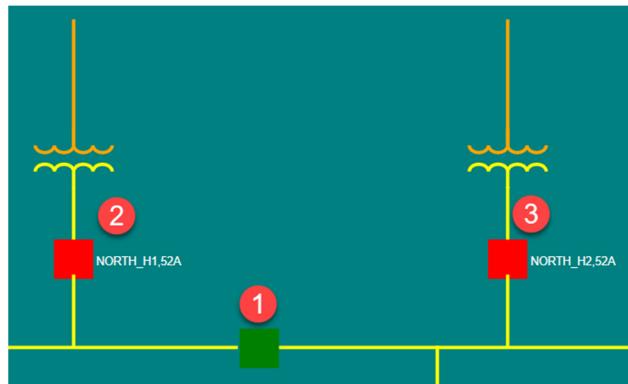
1. If Point 2 and Point 3 are both closed,
2. Then Point 1 must be open.
3. If you try to close Point 1, you will receive a message saying the action is not allowed.
4. However, if Point 2 and Point 3 are not both closed,
5. Then Point can be closed.
6. End of the script.

Next, we will see how to apply the Template.

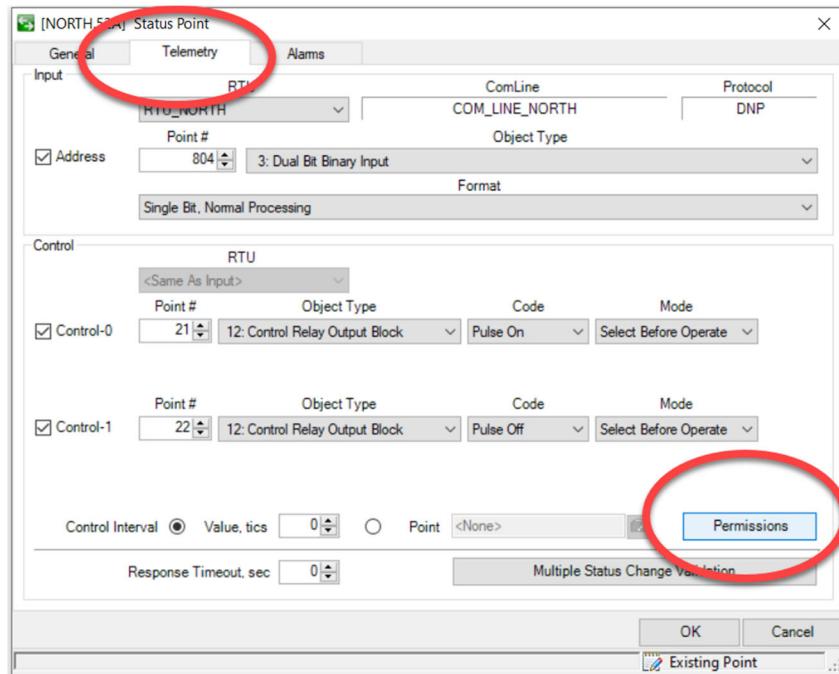
## APPLYING AN AUTOMATION TEMPLATE

How do we apply the template to actual points? Let's work through an example. Since the template is about opening and closing points, we could apply it to the map below. Let's say our Point 1 is going to be the Tie Switch.

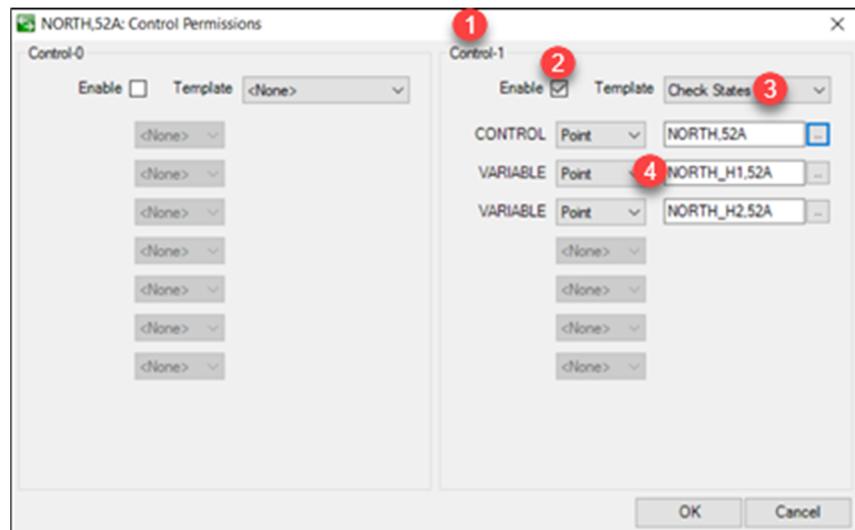
The inputs are the positions of 2 and 3. The output will be 1. If 2 and 3 are both closed, then the tie switch cannot close.



To apply this, we go the Tie Switch in STC Explorer. Specifically, the Telemetry tap and then we click Permissions.



8.34 Permission Tab for Status Point

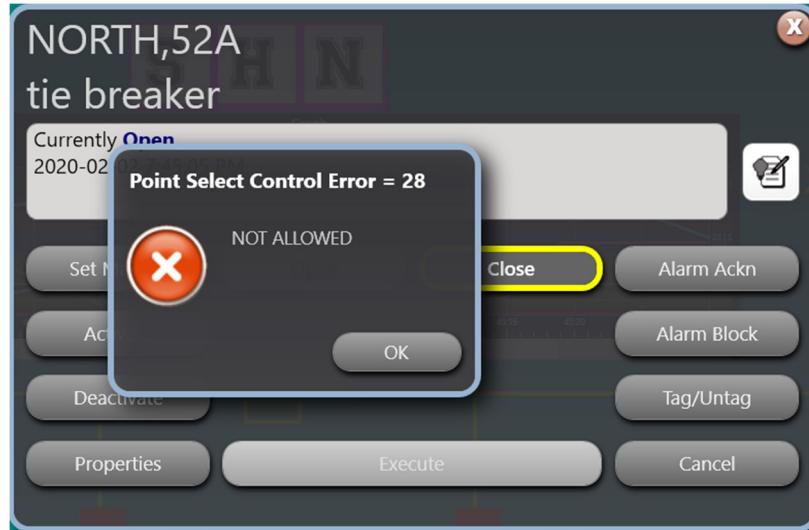


8.35 Filling in the Forms

From here, it's a matter of assigning the points to the template:

1. Since this task is about closing points, we are only working on the Control-1 side.
2. Check the box to enable template.
3. Select the template.
4. Assign Points 1, 2, and 3 to the proper Control and Variable values. In our case, the Tie Breaker is

the Control Point. If both Variable Points are closed, the Tie Breaker cannot close.

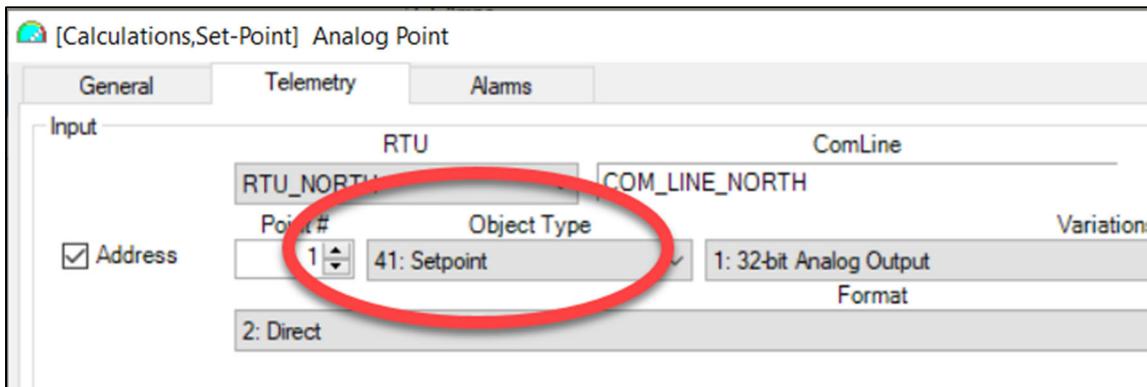


8.36 Not Allowed to Close Tie Breaker

## SET-POINT and SET-POINT COPY

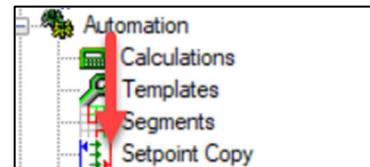
Let's create a SET-POINT (a desired value for measuring performance).

8.37A Creating a Set-Point 1



8.37B Creating a Set-Point 2

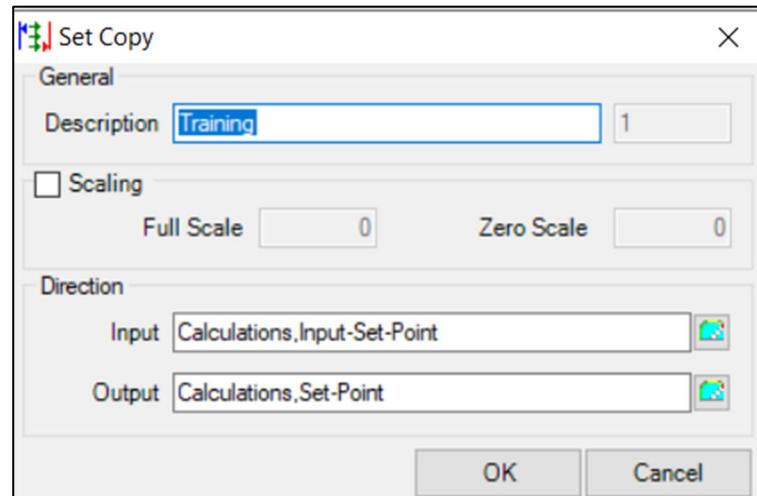
Using Automation, we can change the value of the Set-Point when another point that we choose changes value. The program is Set-point Copy.



8.38 Setpoint Copy

In this configuration, we set up our Setpoint as the Output.

The Input is another point that can obtain values from telemetry or calculation. If the Output changes, the changes get written to the Setpoint.



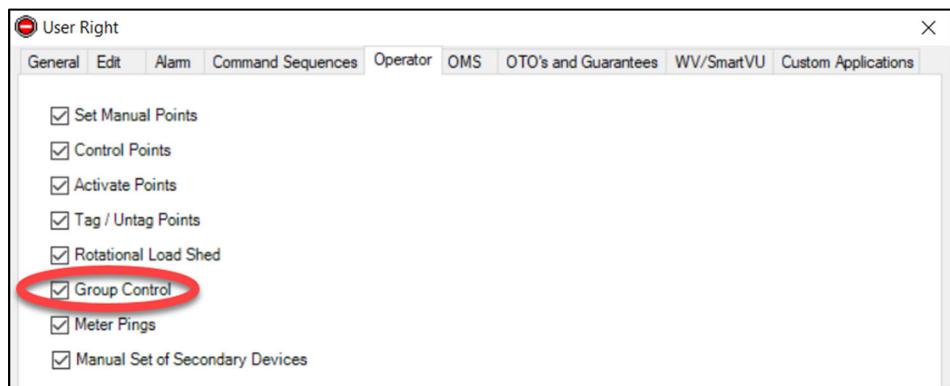
8.39 Setting up the Set-Pont Copy

Calculations.Input-Set-Point	Input	45.00
Calculations.Set-Point	Set-Point	45.00

8.40 Behavior Shown in Analog Viewer

## GROUP CONTROLS

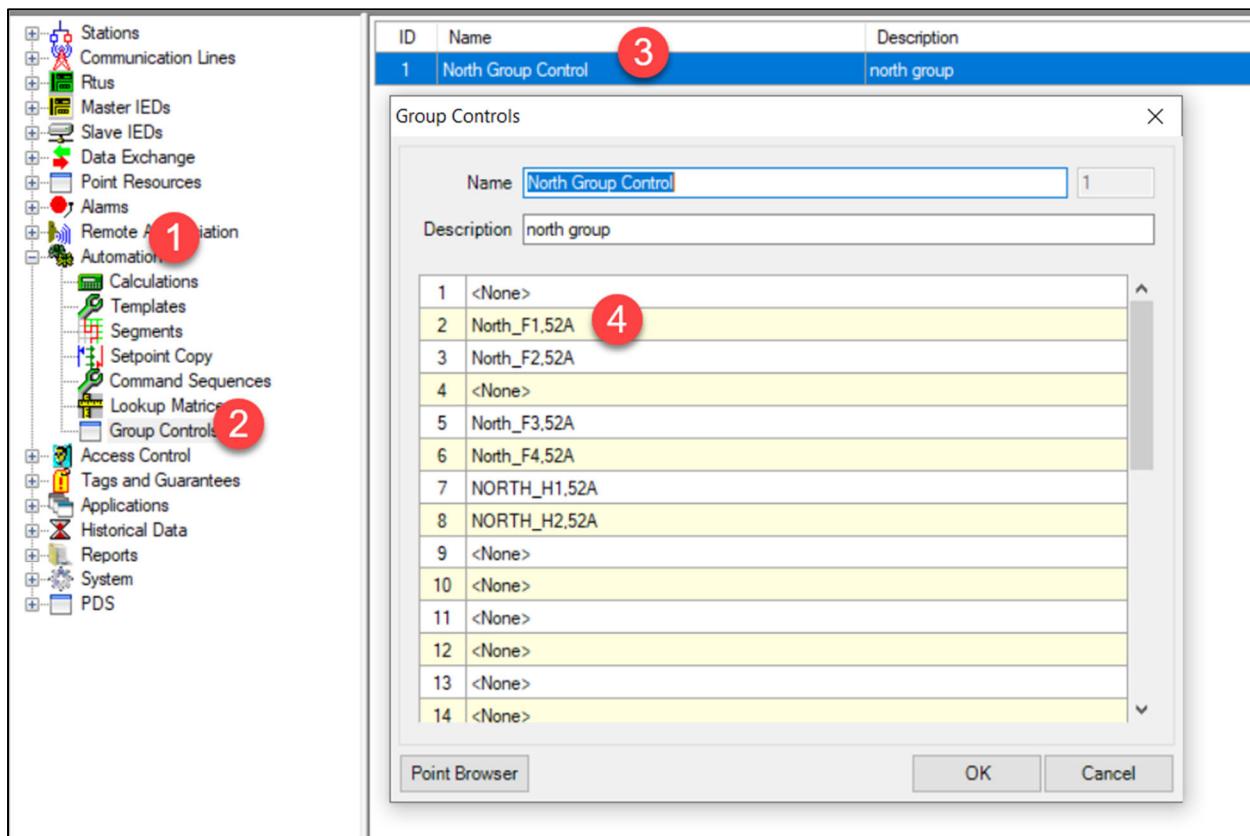
Permissions to execute Group Controls are granted with great discretion. As the name implies, you can set up multiple control points to open or close simultaneously. Below, you'll see the option that must be checked for a User Group to use Group Controls.



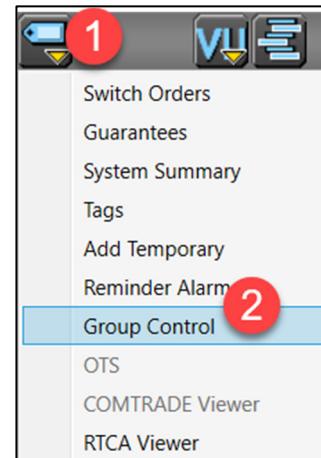
8.41 Group Control Permission

To set up a Group Control:

1. Select Automation.
2. Select Group Controls.
3. Right-click and give the Group Control a Name.
4. Use the Point Browser to add the Points in your group.

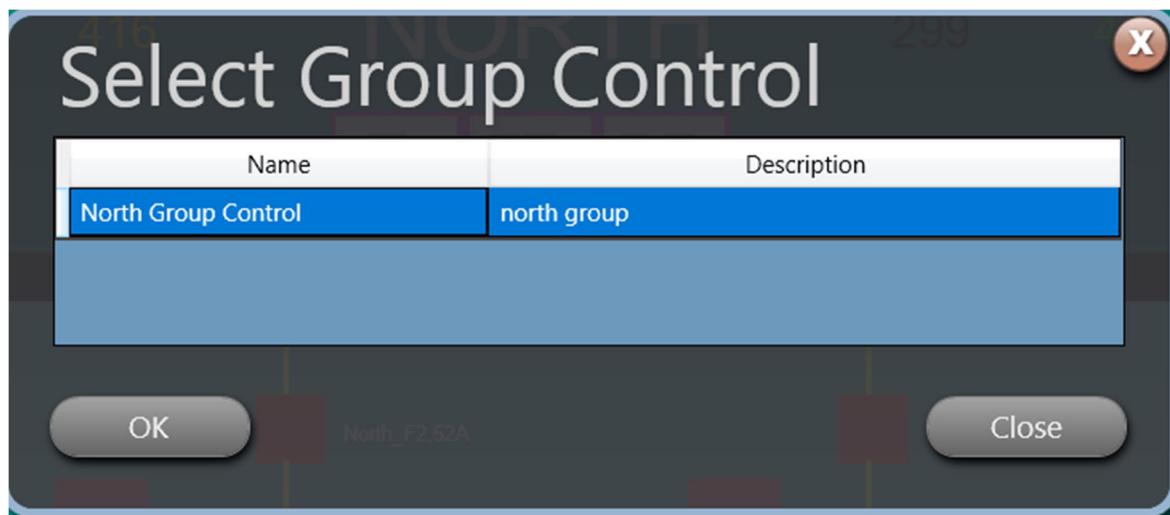


8.42 Setting Up a Group Control



8.43 Selecting Group Control

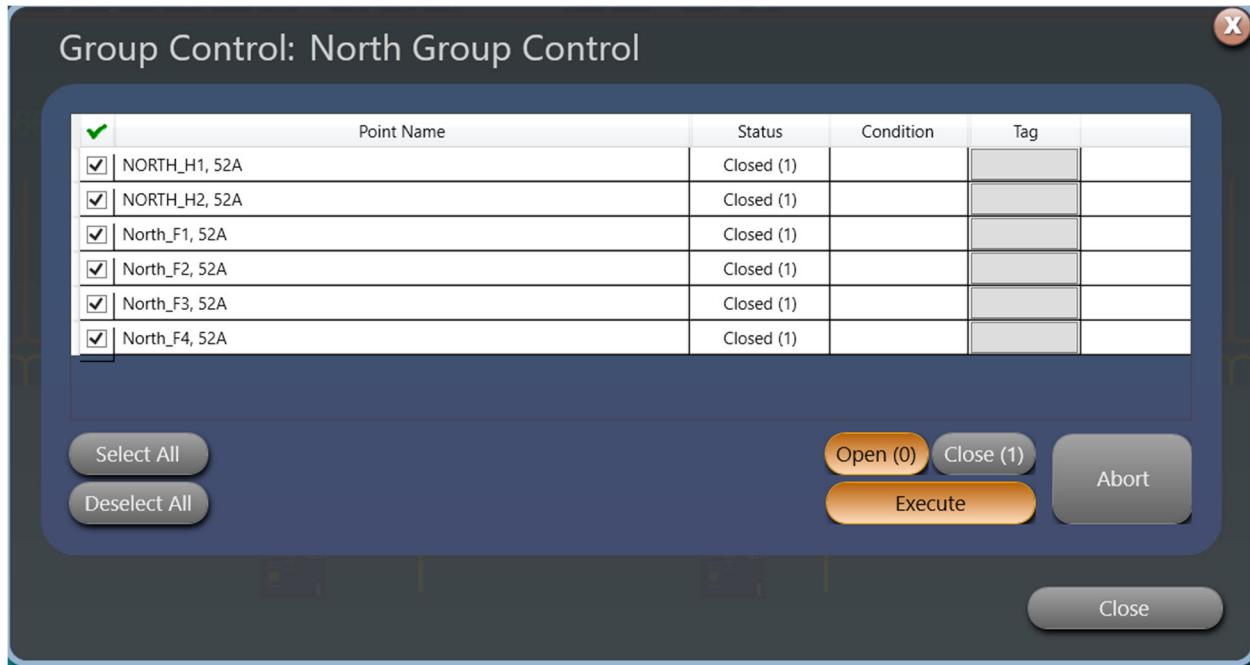
If multiple Group Controls have been set up, select the one you wish you execute and select OK.



8.44 Selecting the Group Control

In the image below, all the points have been selected. They are all currently closed but clicking Open and then Execute will open all of them.

If an error has been made but detected before all the points have opened, the Abort button can be pushed.



8.45 Execution

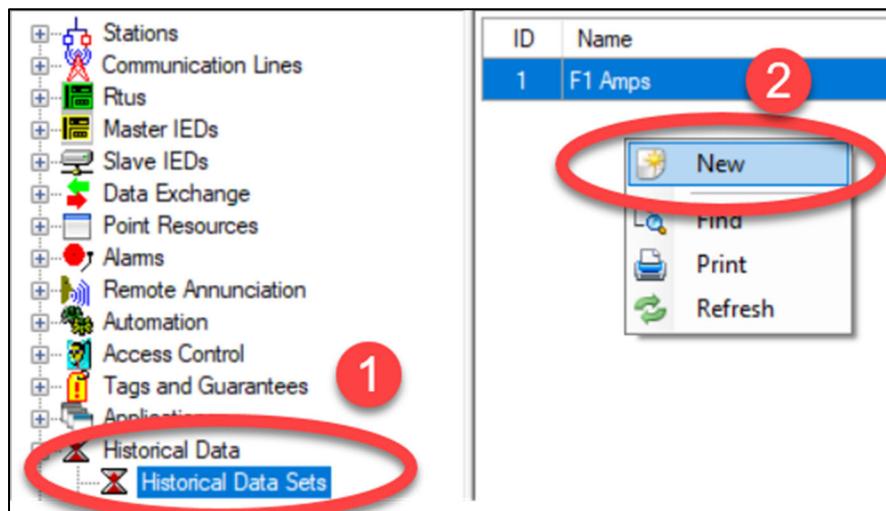
## AUTOMATION and HISTORICAL DATASETS

Upon looking at the Calculations, you'll see that we are given values to IA in both the North,H1 and North,H2 substations. In time, we should be able to collect 30 days of data on each of these points.

0003	Random	NORTH_H1,IA	#0	#500
0014	Random	NORTH_H2,IA	#0	#500

8.46 Points Collecting Data

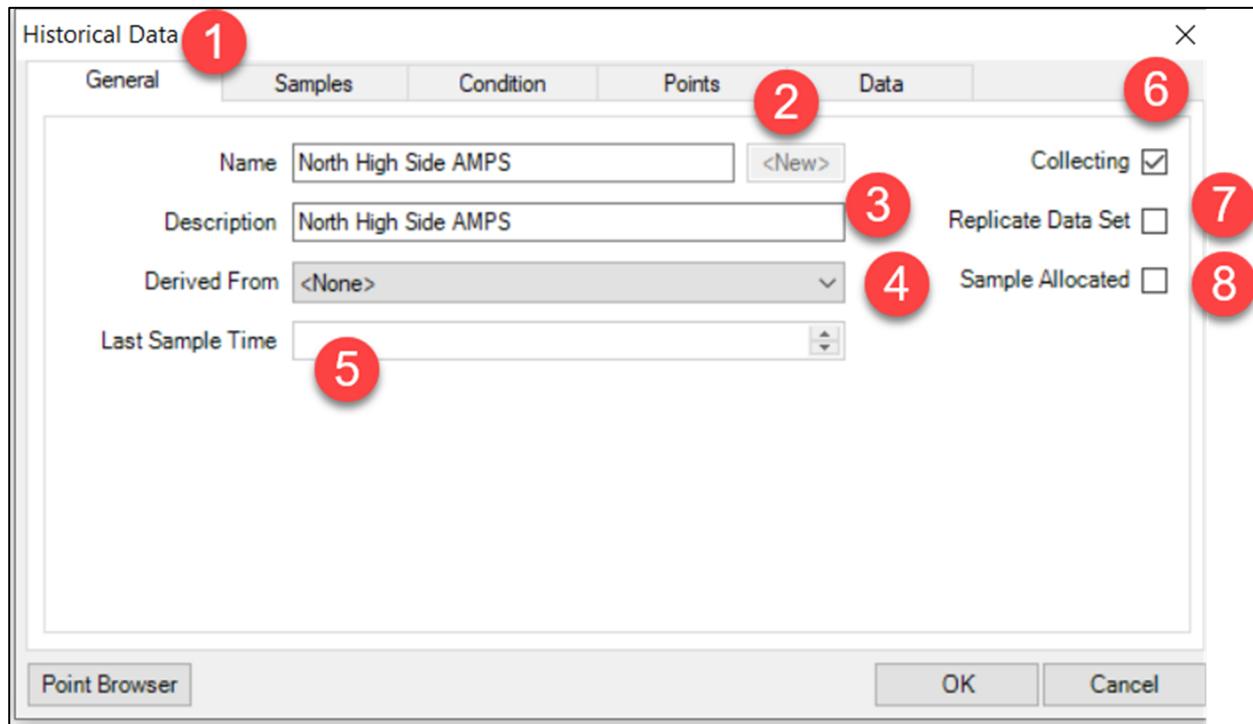
We can also make a report that includes both points and that report can also cover years of time. To do this, we create a dataset. Here are the steps:



8.47 Creating a Historical Dataset

1. Click on Historical Data Sets (under Historical Data).
2. Right-click on the right side and select New.

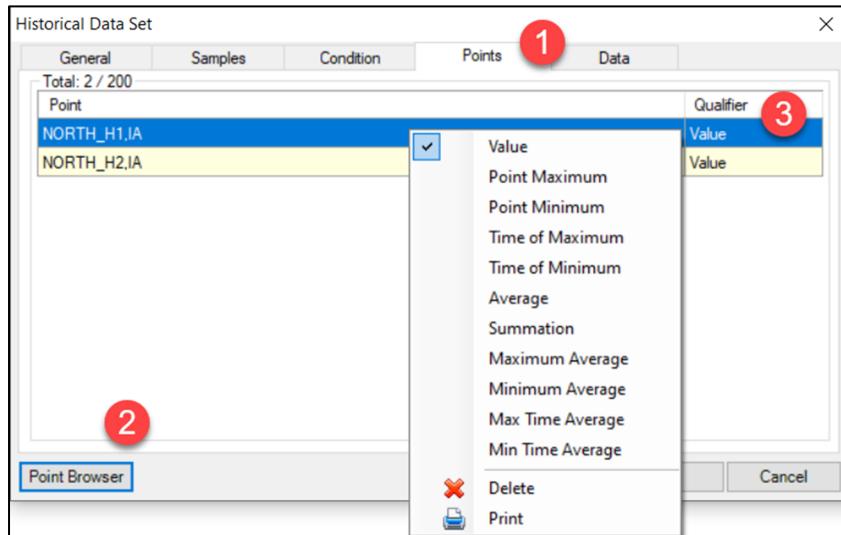
The first tab of information to complete is the General Tab (shown on next page).



8.48 General Tab

1. Select the General Tab.
2. Give and dataset a name.
3. ....and a Description.
4. You can pull information from other datasets using this dropdown.
5. This is the last data entered into the set – it is read only.
6. Check this box if you want the dataset to start collecting data immediately upon clicking OK.
7. Select this box if you are replicating (separate product) the database AND want this dataset to be part of the replication.
8. As soon as the database starts collecting data, this read only box will be checked to confirm space has been set up for collecting the data.

We will go slightly out of order and jump over to the options under Points on the next page.



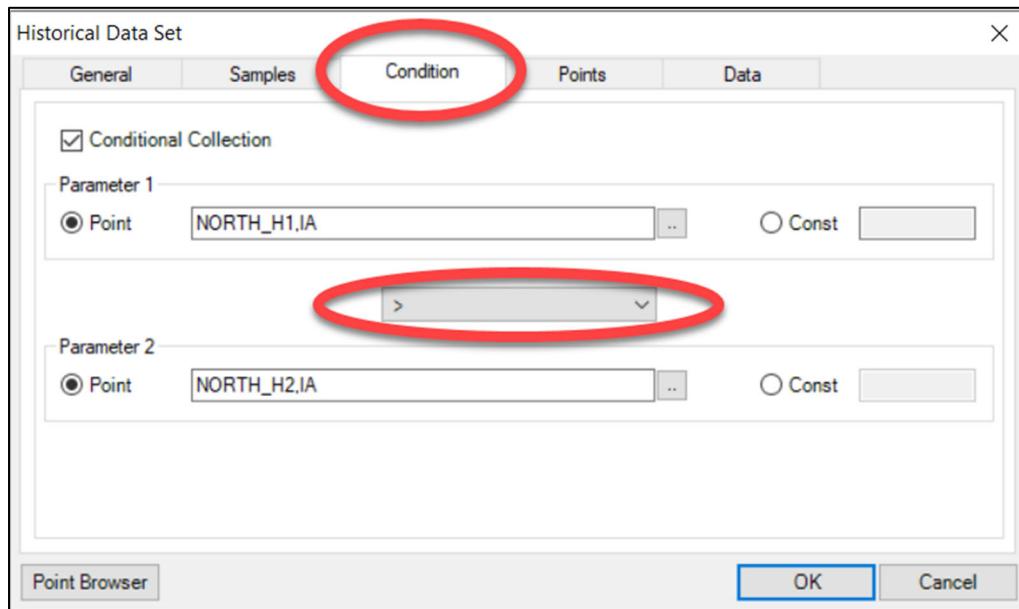
**8.49 Points Tab**

1. Select Points.
2. Use the Point Browser to drag in the points we need.
3. By default, the value of the point will be provided at the time we request (in Samples tab).

Providing the Value is the default setting; however, there are other options. Below is a screen capture from the Historical Database User Guide. It provides a brief description of options other than value.

Item	Description
Value	Store the actual value of the point, instead of doing any average, max or min calculations. Value is the only one that really makes sense if the observation interval is the same as the sample interval.
Point Maximum	Store the maximum value of all the observations taken during the sample interval.
Point Minimum	Store the minimum value of all the observations taken during the sample interval.
Time of Maximum	Store the time of the maximum value during the sample interval.
Time of Minimum	Store the time of the minimum value during the sample interval.
Average	Store the average of all the observations taken during the sample interval.
Summation	Store the sum of all the observations taken during the sample interval.
Maximum Average	Used in a derived (secondary) dataset, to store the maximum value observed of an average stored in the primary dataset.
Minimum Average	Store the minimum value observed of an average stored in the primary dataset.
Max Time Average	Store the time of the above maximum value of the average.
Min Time Average	Store the time of the above minimum value of the average.
Delete	Deletes the point in the list.

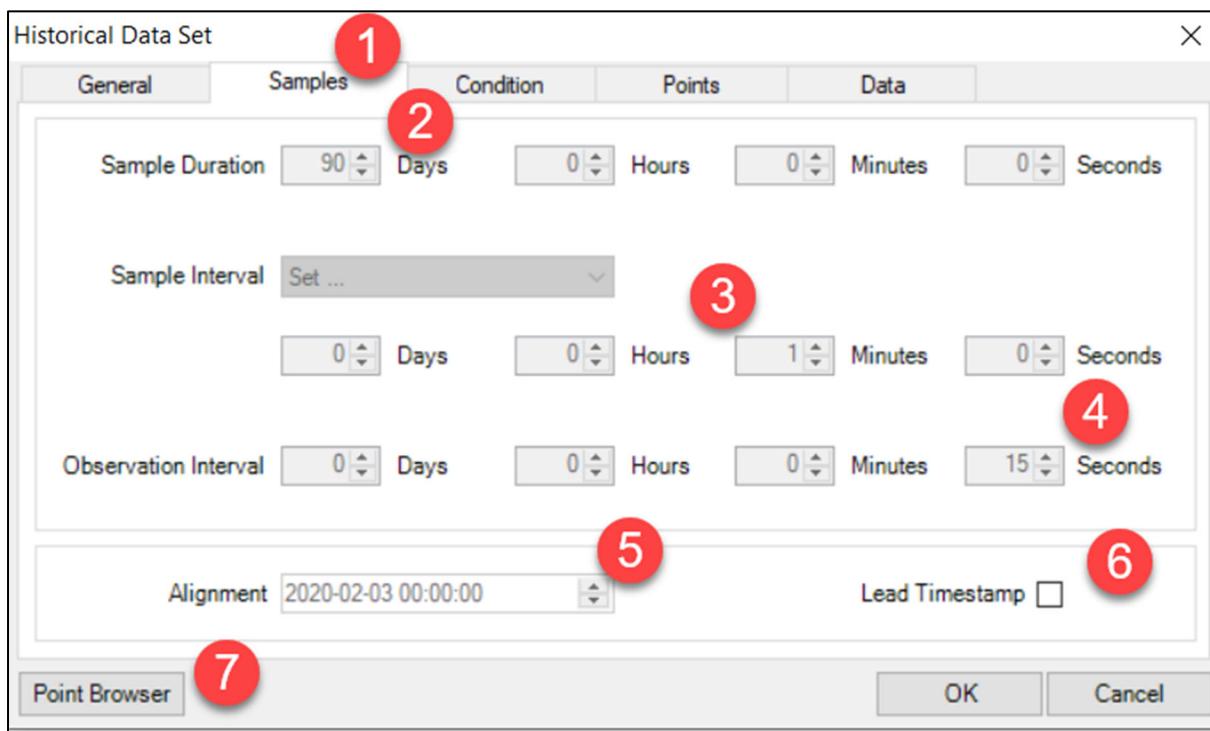
## 8.50 Options for Points in a Data Set



8.51 Condition Tab

In 8.51, we stay out of order and have a quick look at the Condition Tab as it's not used often. You can put conditions on datasets. For example, we're saying here that we only want the data if the H1 value is greater than the H2 value.

These choices will not be saved for our exercise.

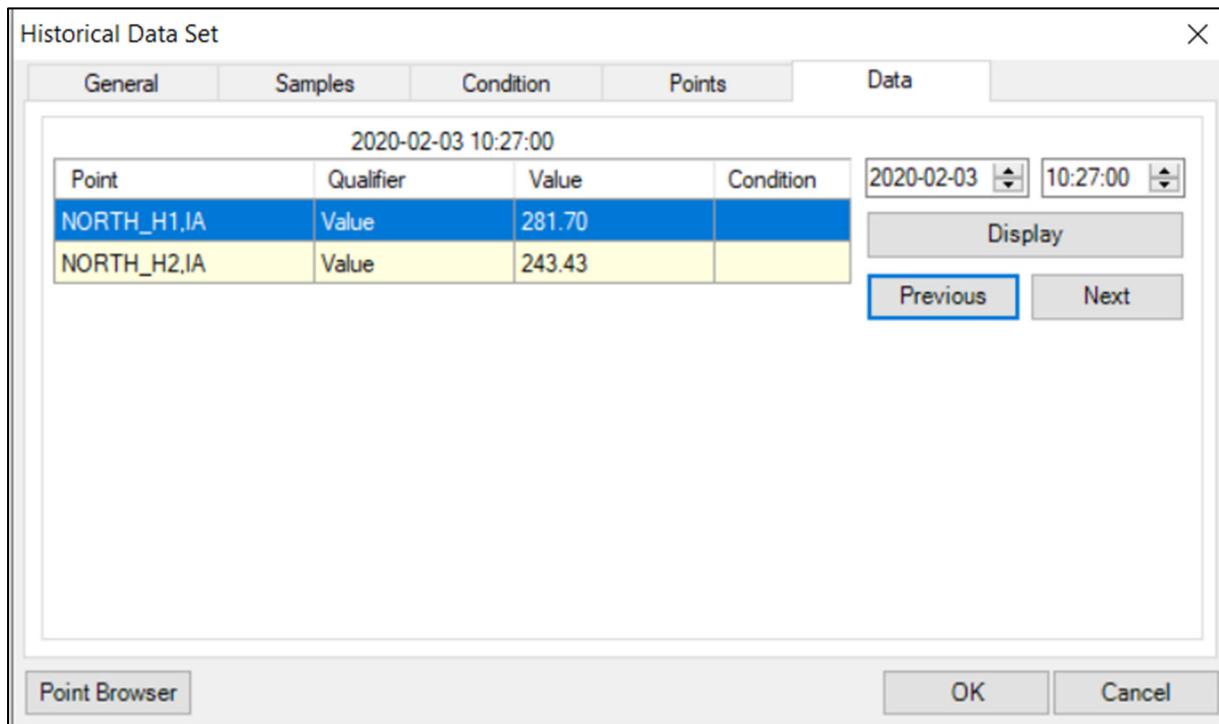


8.52 Samples Tab

The samples tab, once set, cannot be changed since it is the definition of the dataset. If you would like to make a change, you would delete the data set and create a new one.

1. Select Samples.
2. For how long does this data set collect data? We have set 90 days. One day 91, data from day 1 will be overwritten and the data set will continue.
3. We want information every minute. We can be very specific here or, if we chose, we can use the drop-down arrow beside Sample Interval and choose a general monthly or yearly interval.
4. Item 3 is straightforward for values – give us a value every minute. If we are using another option from image 8.50, we may need to set another time. For example, what if we want the average every minute? Our setting here says to check the value every 15 seconds and give us the average after 1 minute (the 1 minute was set in item 3).
5. Our Sample will start timing when we click OK; however, if we want to delay the start until a certain time is reached, we would use alignment.
6. Our interval (set in item 3) is 1 minute. Timestamps are precise values that include milliseconds. By default, the time for the reported value will be at the end of the minute. However, clicking Lead Timestamp moves the time to the beginning of the minute (for example, for daily records, you may want this value to report at 23:59.01 instead of 24 which moves it into the next day).
7. We've configured the tabs and can now hit the OK button at the bottom right of our data set.

Below, the Data tab shows us that we are collecting the data we need.

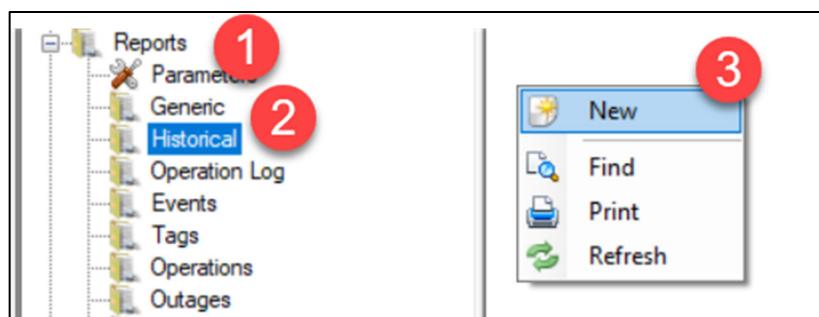


8.53 Data Tab

One way we can add automation to this data set would be to add it to a report that gets automatically generated.

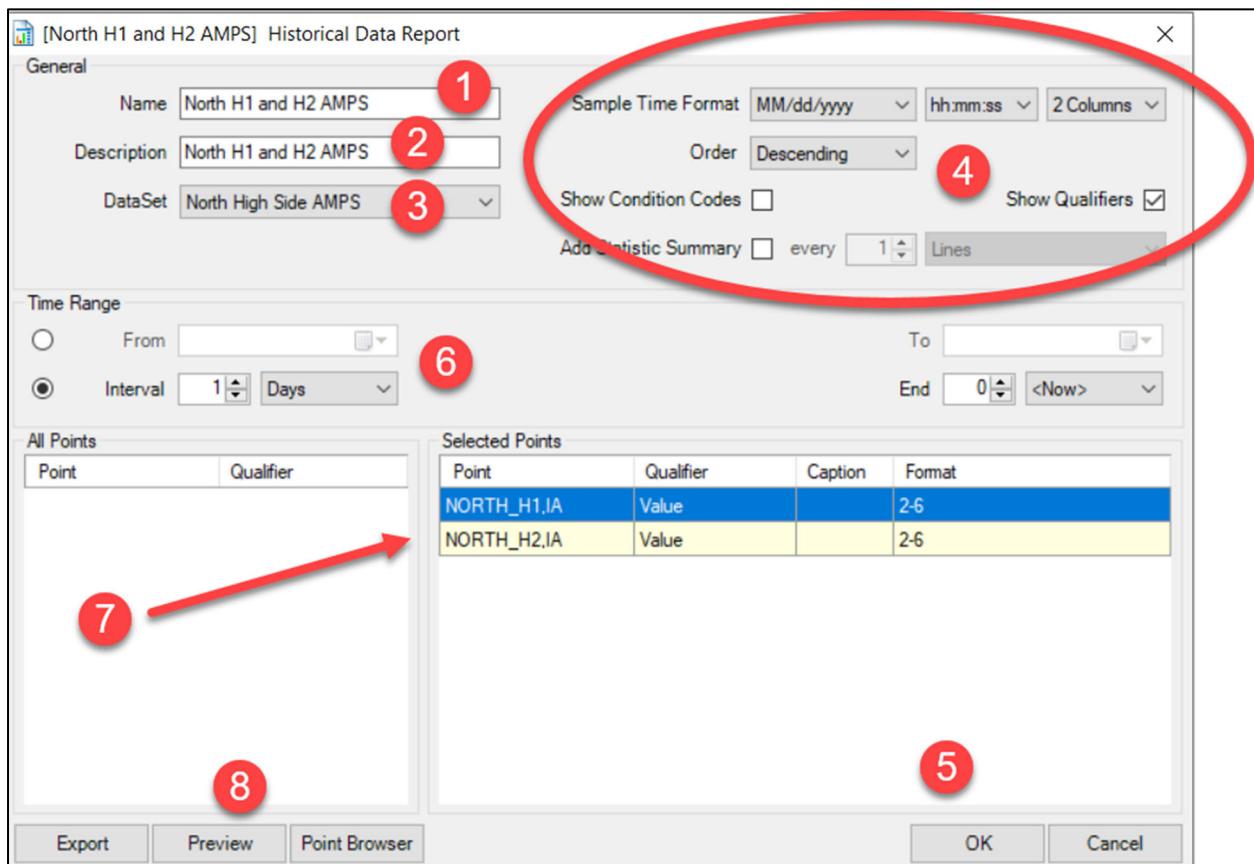
To start, (1) click Reports and then select (2) Historical.

(3) Right-click on the right side and select New.



8.54 Creating a new Historical Report.

Options to be filled out for a Historical Data Set are on the next page.



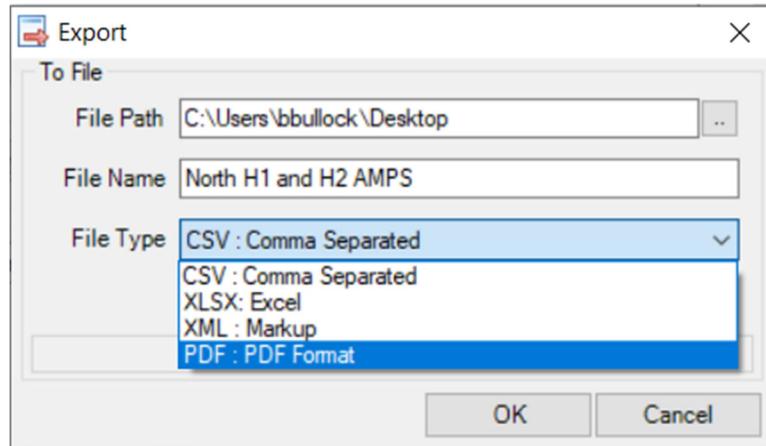
8.55 Options for a Historical Report

1. Name the report.
2. Provide a description.
3. Choose the data set for the report.
4. Choose aesthetic settings (e.g. descending order, date order).
5. It's a good idea to hit OK at this point. OK saves the report and, if you actually back out without having hit OK, you will have to start again.
6. Choose a time range. We checked the Interval option – e.g. show us 1 day of information up to the current time. The other option is to select hard dates such as January 15 at 9AM to January 22 at 8:59AM.
7. When we select the data set in 3, the associated points appear in this box. Only the ones we drag to the bigger box on the right will be in the report.
8. Before Exporting the Report, we can Preview it.

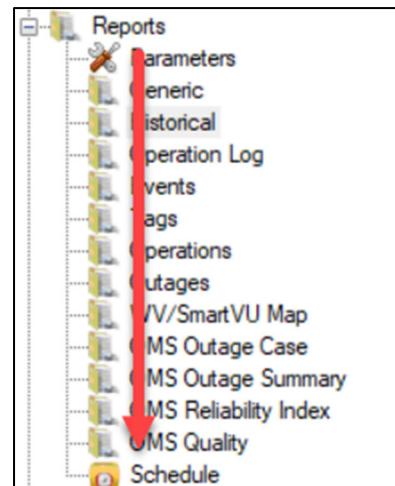
Click Preview and turn the page to see the result.

North H1 and H2 AMPS				
From: 2020-02-02 14:30	To: 2020-02-03 14:30	DataSet Name	DataSet Description	2020-02-03 14:30
North High Side AMPS				
Date	Time	NORTH_H1.IA Value		NORTH_H2.IA Value
02-03-2020	14:30:00	251.20		452.27
02-03-2020	14:29:00	264.93		43.05
02-03-2020	14:28:00	87.27		375.26
02-03-2020	14:27:00	132.86		419.28
02-03-2020	14:26:00	110.26		322.32
02-03-2020	14:25:00	334.51		220.77
02-03-2020	14:24:00	39.54		62.86
02-03-2020	14:23:00	190.79		371.01
02-03-2020	14:22:00	297.59		164.41
02-03-2020	14:21:00	225.73		121.54
02-03-2020	14:20:00	9.98		42.62
02-03-2020	14:19:00	166.52		52.11
02-03-2020	14:18:00	5.49		461.27
02-03-2020	14:17:00	443.49		70.54

8.56 Report Preview



8.57 Export Options



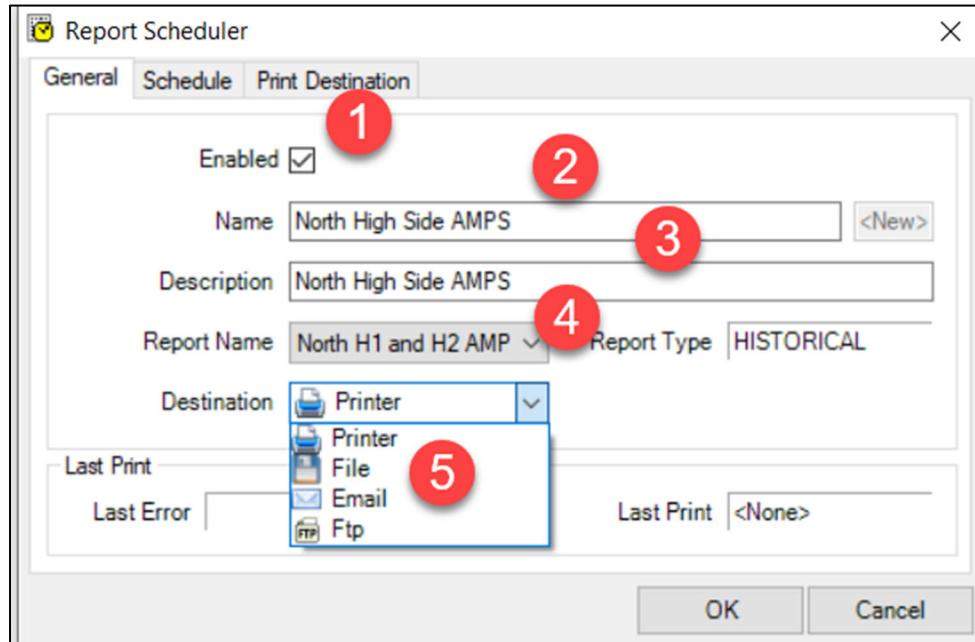
8.58 Schedule Option

Refer to 8.55 and notice the Export Button. Image 8.56 shows the Exporting Options.

The generation of these reports can be automated or scheduled using the Schedule option at the bottom of the Reports menu.

Starting with the General tab:

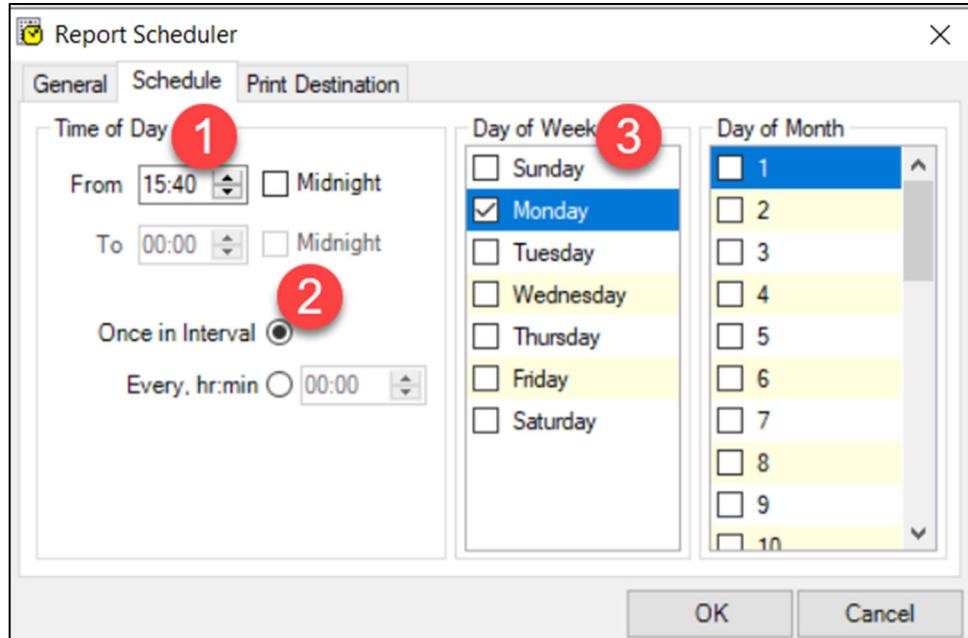
1. Select enabled.
2. Provide a name for this Print Job.
3. Provide a description.
4. Choose the report from the dropdown list.
5. Choose how the report is to be delivered (choose file for our example).



8.59 Defining the Job in the General tab.

Under Schedule:

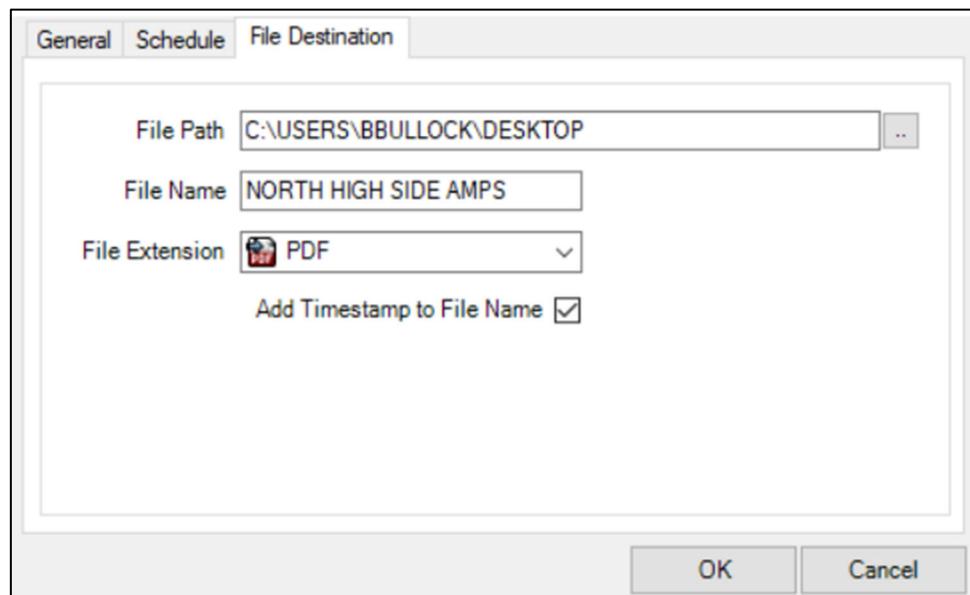
1. We have selected a single time. Note that we could have selected a range.
2. Because we selected a single time, it will only run once. We could have had it run multiple times if we selected a range in step 1.
3. Our report will print every Monday. Instead of using the 7 days of the week, we could have set it up by using the days of the month.



## 8.60 Setting the Date.

In the final tab, we set the path for the file and the extension.

Checking the Timestamp is a good idea so the files will have unique names.



## 8.61 Path for the File



### Exercise

In-class exercise: Three other reports covered in this section are the Operations Log (items the Operators see in Operator Summary), Events (points that have Event Data Recording checked), and Tags (currently active tags).

Create tasks that will populate these reports and then run each similarly to how we ran the Historical Report.

The Command Sequence User Guide provides many examples of where automation can be used with Historical Datasets. You will find an example on the next page which we will set it up after you've read it.

## FCAST

This function goes to a specified point in a dataset, and computes a prediction of the point's value for *m* sample times ahead. The prediction is performed by extrapolation of a best-fitting curve that is passed through the last *n* samples. The function supports linear, quadratic and cubic curve fitting.

### Format:

```
result = HLIB\FCAST("HISTDATASETS:dsname", "pname", n, type, m)
result = HLIB\FCAST("HISTDATASETS:dsname", "pname", qual, n, type, m)
```

where: dsname = name of dataset  
pname = point name  
qual = historical data qualifier, one of ...  
VALUE MIN MAX MIN TMAX SUM  
MAXA MINA TMAXA TMINA  
n = number of historical samples on which to base the curve-fit  
type = type of curve-fit (see Table 3-16)  
m = number of sample times ahead to predict the value

The function returns the forecasted value for *m* sample times ahead based on the last *n* samples of point *pname* in the dataset named *dsname*, using the type of curve-fit specified by *type*:

If the qualifier is not specified, "VALUE", the instantaneous value, is assumed.

**Table 3-16      Types of Curve Fit**

Type	Curve-Fit	Minimum Value of n
1	Linear	2
2	Quadratic	3
3	Cubic	4

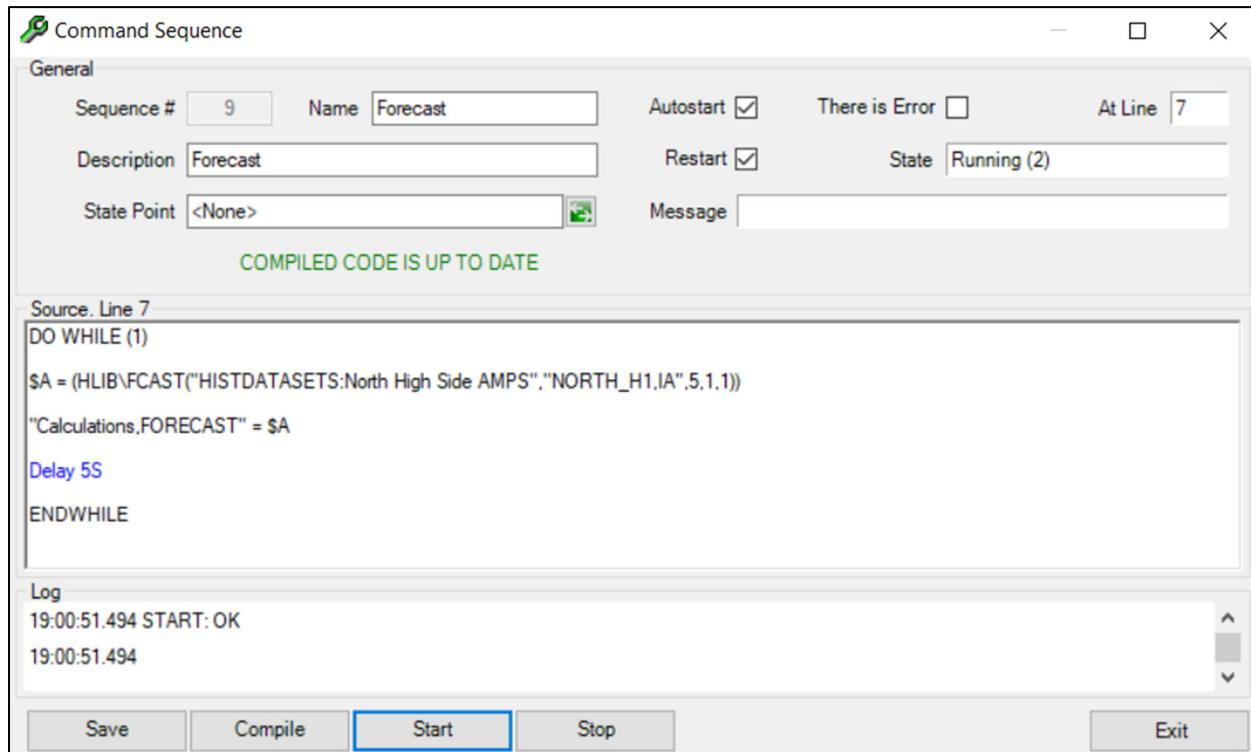
(**Note:** Both the dataset and point name specifications must be enclosed in double quotes.)

### Example:

```
$A = FCAST ("HISTDATASETS:SystemLoad", "SYS$,LOAD", 6, 3, 4)
```

In this example, a load is being predicted for 4 sample times ahead based on fitting a cubic curve through the last 6 historical samples. This function can be used to produce a supervisory command sequence that triggers load shedding when the immediate-term forecast (e.g. 15 minutes) of the load exceeds a threshold.

Let's take the instructions from the last page and apply them to (North\_H1,IA). We will use the last 5 values of this point to forecast the next 1 value.

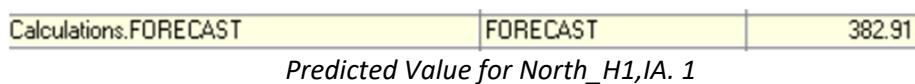


8.63 Command Sequence for Forecasting

Line by line information is:

1. Run this Infinitely.
2. The value we are looking for is based on looking at the last 5 values of North\_H1,1A to figure out the next value.
3. We will put the value in a point we make up called Calculations,FORECAST.
4. We will pause a few seconds before checking again.
5. End the program.

We can see the predicted value using the Analog Point Viewer.

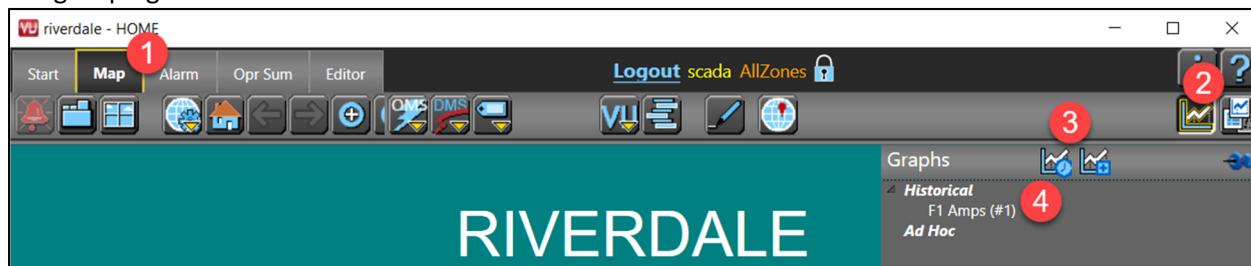


## APPENDIX 1 – Trend Graphs

We included Reports in our discussion on Automation because reports can be automated. The first report we looked at was the Historical Report. A section on Historical Reports is incomplete without mentioning Trend Graphs. Trend Graphs provide a visual report of datasets.

In SmartVU, as shown below:

1. Go to Map view.
2. Select the icon for graphs.
3. Choose the first of the two options (the second is for ad hoc graphs with no history).
4. Note, in the future when you have numerous graphs, SmartVU will begin to group them automatically. For example, another graph with F1 in the title will result in SmartVU making an F1 grouping.



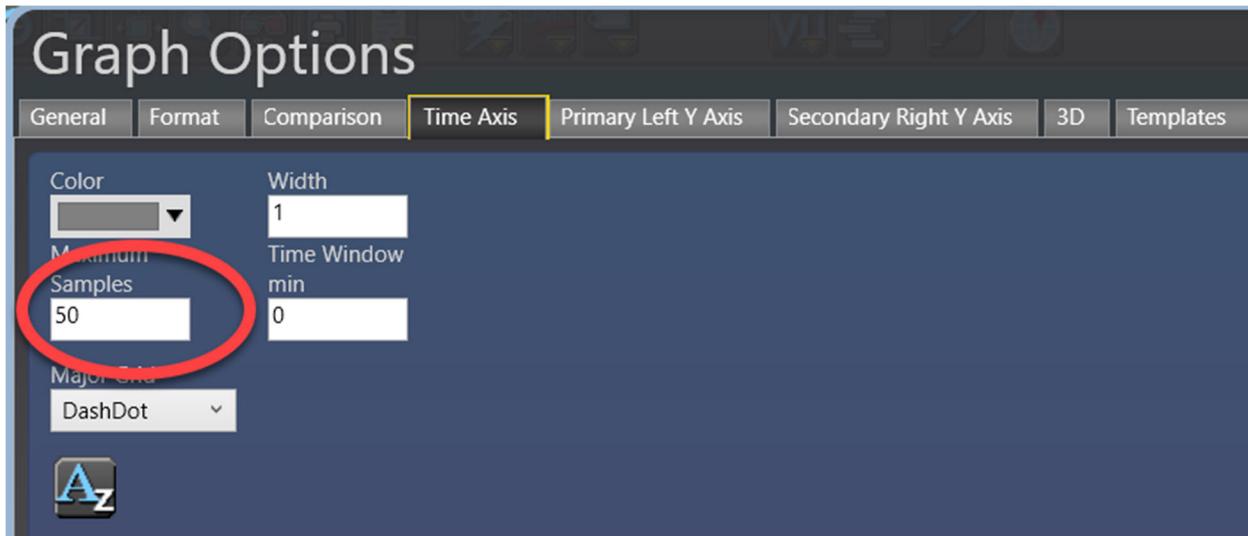
8.64 Starting a Trend Graph

1. Provide a Title.
2. Select a Data Set.
3. Select a point from the Data Set.
4. It's a good idea to add color if you will be using multiple points.
5. Many clients like to increase the thickness.
6. In time, you will be able to compare this point to itself (this month versus last month).
7. Choose insert to add another point.
8. Proceed to the Time Axis tab.



8.66 Setting Up A Trend Graph

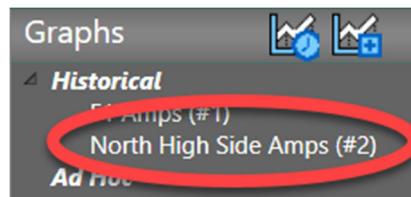
There are many settings you can use to enhance the graph's appearance. One useful setting is the ability to control the number of Samples from the default setting of 5000.



8.67 Adjusting Number of Samples

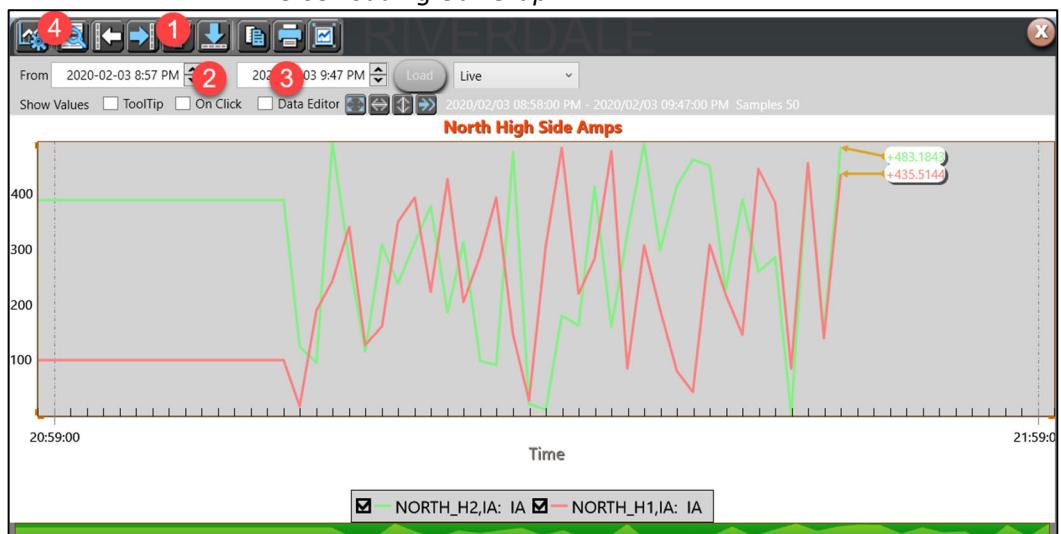
The OK button at the bottom right of the screen will save the graph in the CHT folder located inside the Standard Folder.

We can now load our new graph.



8.68 Loading Our Graph

1. Graph can be pinned.
2. On Click option will show values on map when the map is clicked.
3. Data Editor will show values in a table.
4. Button at top right will allow you to edit and resave the map.



8.69 Trend Graph

8.69 Trend Graph

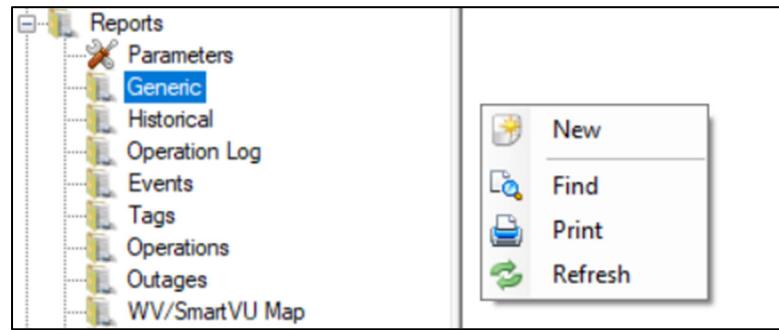
## APPENDIX 2 – Generic Reports

In addition, our discussion of reports wouldn't be complete without time spent on Generic Reports. Unlike the other reports we worked with in this section, Generic Reports start by giving you nothing. You must select all the tables and fields. A review of the material in Module 5 will benefit you as you decide on what to include.

In this scenario, we want to find out how many analog points have emergency alarm values. We'd like to know the value that triggers the alarms as well as the priority of the alarms. Remember that the choice of Table and Fields becomes easier when you understand the fields we discussed in Module 5.

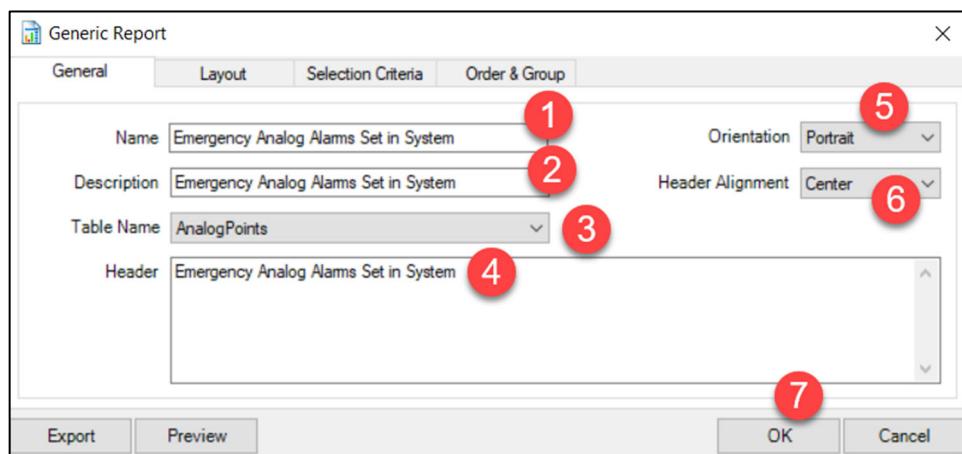
We start by selecting Generic from the Reports menu.

Next, we right-click and select New.

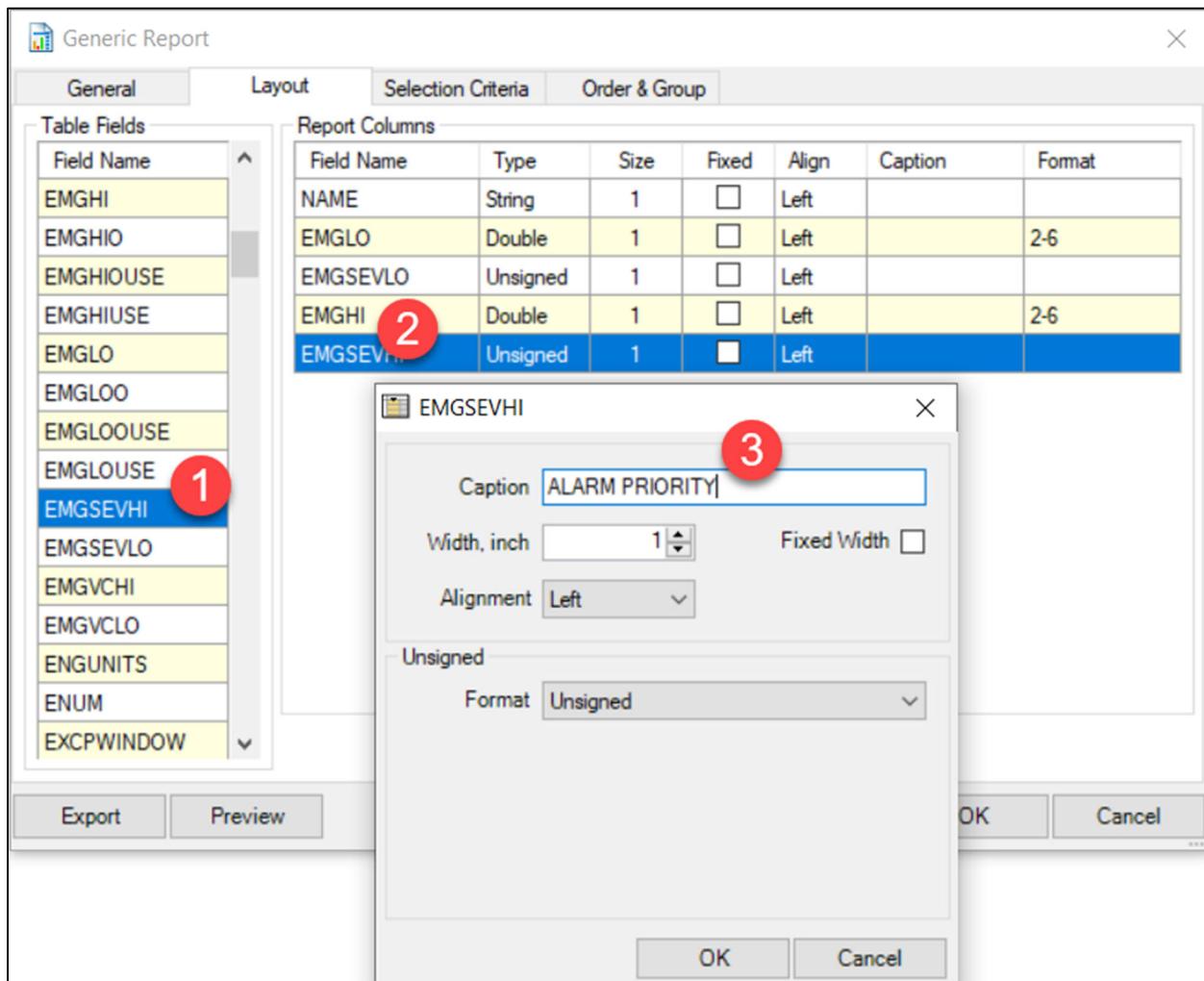


8.70 Creating a New Generic Report

- 1 Provide a name.
- 2 Provide a description.
- 3 Select your table (this report will report on Analog Points).
- 4 The Header is what the readers will see for the title.
- 5 Do you want Portrait or Landscape?
- 6 Should the title be centered for set to the right or left.
- 7 Always click OK early and often in the process to save the report.



8.71 General Tab

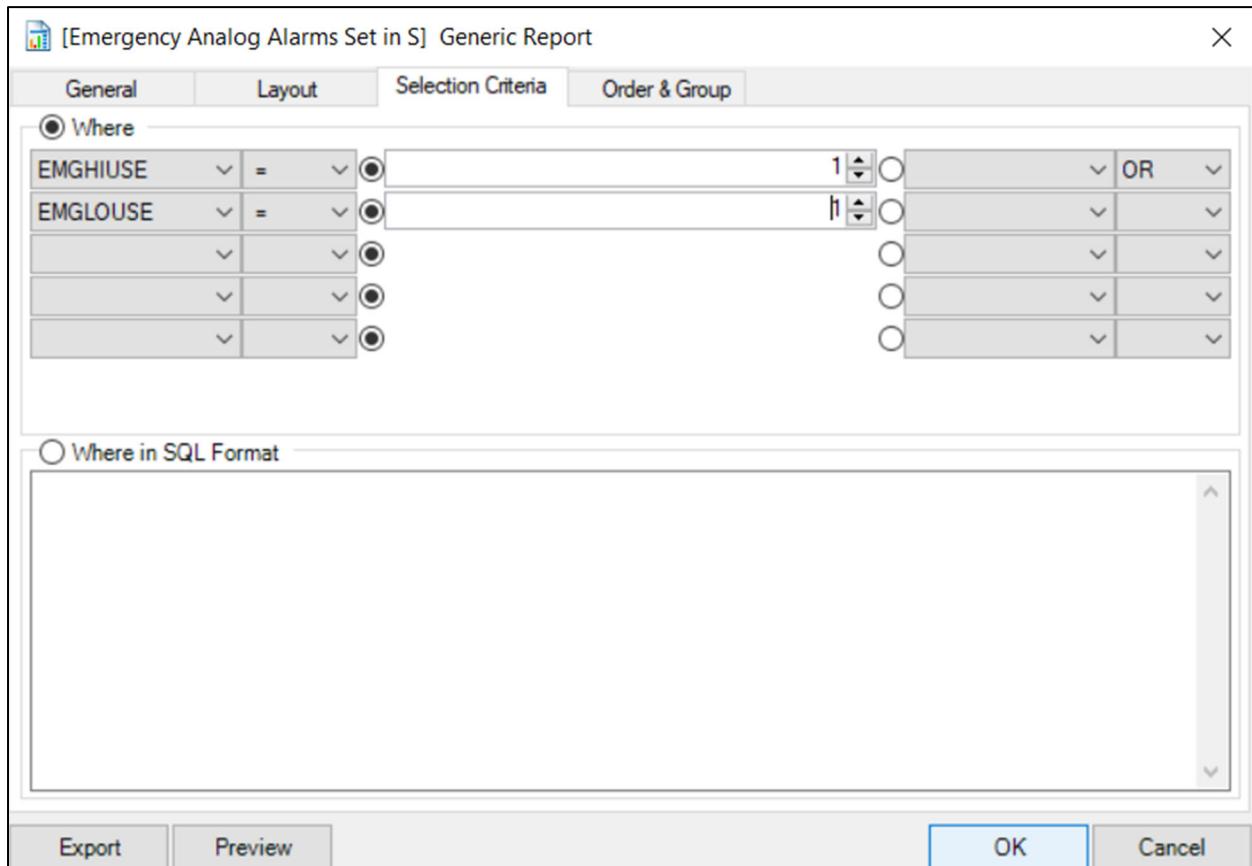


8.72 Layout Tab

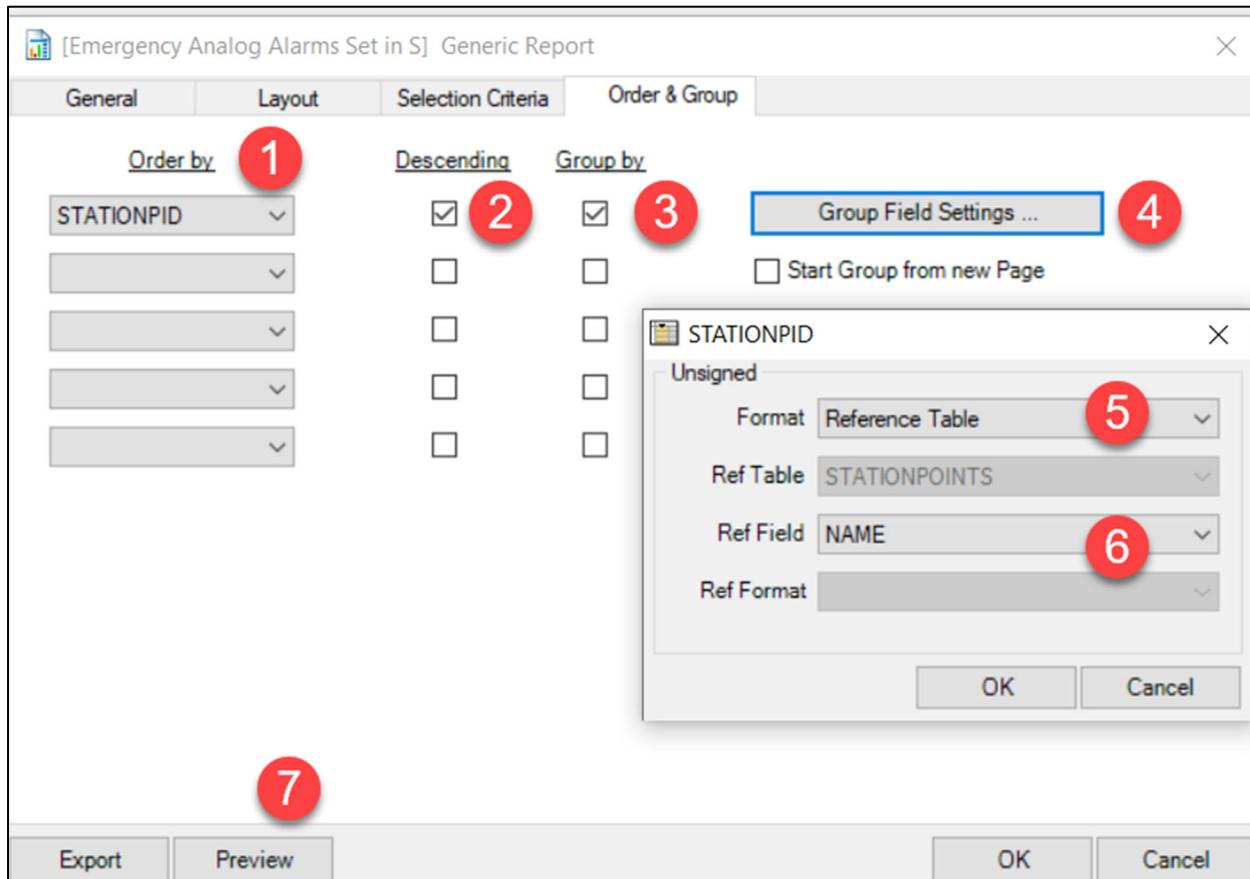
- 1 In the Layout Tab, you are offered all the fields that belong to the table we choose in the General Tab.
- 2 When you decide upon your fields, drag them into the center section. The fields we selected are Name (Point Name), EMGLO (Emergency Low Value), EMGSEVLO (Emergency Low Priority), EMGHI (Emergency Hight Value), EMGSEVHI (Emergency High Priority).
- 3 Since many of the field names are not user friendly, they can be overwritten here. EMGSEVHI is better understood if it's titled Alarm Priority.

The Selection Criteria keeps the report from showing all 10,000 points in the system. Below, we are saying just show us the points using Emergency Low OR Emergency High values (the number "1" means "yes").

Also don't forget to keep clicking OK to save your changes.



The final tab, Order & Group, lets us present the data so it's easy to read and follow. Please see the settings on the following page.



#### 8.74 Order and Group

- 1 Here we make the decision to separate the points and list them by the station that contains them.
- 2 We will report them from Z to A and not A to Z.
- 3 Not only will we list the points by their stations – we will physically separate them and group them by stations.
- 4 Sometimes values such as Stations will show a number (e.g. 13) instead of a name (e.g. North). The settings button will allow you to report by name instead of number.
- 5 When we click the button in item 4, we select a Reference Table.
- 6 When we select the Reference table in item 5, we instruct the program to use the name and not the number.
- 7 We can now Preview, Export, and Schedule this report.

Please turn the page for the preview.

Emergency Analog Alarms Set in System				
2020-02-03 23:09				
NAME	LOW VALUE	ALARM PRIORITY	HIGH VALUE	ALARM PRIORITY
x2				
IA	50.00	2	450.00	2
IC	50.00	0	450.00	0
North_F4				
IC	50.00	0	450.00	0
IA	50.00	2	450.00	2
North_F3				
IC	50.00	0	450.00	0
IA	50.00	2	450.00	2
North_F2				
IC	50.00	0	450.00	0
IA	50.00	2	450.00	2
North_F1				
IC	50.00	0	450.00	0
IA	50.00	2	450.00	2
NORTH_H2				
IA	50.00	3	450.00	3
NORTH_H1				
IA	50.00	3	450.00	3
Brampton				
Current	50.00	1	450.00	1

## 8.75 Report Preview

This concludes the SCADA System Level 1 workshop.