



# **SIL Solver® Enterprise**

## **Rev 1.2.0**

# **User Instructions**

SIS-TECH Solutions, LP

**We're Proven-in-Use®**

# Welcome

- Welcome to SIL Solver® Enterprise.
- This presentation is sectioned to make it easier to navigate. You can collapse the slides to the sections using the tool bar.
- **If you need assistance or would like to provide us with feedback, contact:**
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# SIL Solver®

## We are Proven in Use

- More than 100 companies have chosen SIL Solver® for their functional safety verification since 2002

## We Build upon Field Experience

- The built-in SIL Solver® database uses field failure data as a basis, reflecting real-world device performance

## We are Internationally Recognized

- SIL Solver® uses internationally recognized methods for PFD and STR calculation
- SIL Solver® is used by companies worldwide

# User Instructions

## Table of Contents

1. Logging in
2. Creating a new project and functions
3. Editing, Copying or deleting a project
4. Generating reports
5. Importing/Exporting projects and functions
6. Datasheets
7. Troubleshooting

# 1. LOGGING IN

- Licensing
- Assigning username and password for new user
- Logging in

# Licensing

- SIL Solver® is licensed software
  - Each enterprise license includes one administrator account and two user licenses
  - Additional user licenses can be purchased
- To request a quote for a new license, contact SIS-TECH at:  
<http://sis-tech.com/applications/sil-solver>

# Assigning username and password to new user

- Assignment/re-assignment of usernames and passwords is performed through the administrator account of the purchasing company

# Logging In: User Name and Password

Purchasing companies  
will have their own server  
locations

For training classes,  
in any web browser go to,  
[http://silsolver.sis-  
tech2.com/](http://silsolver.sis-tech2.com/)

Log in with your assigned  
User name and Password



## 2. CREATING A NEW PROJECT

- Setting up the project information
- Creating a safety function
- Copying a safety function
- Editing a safety function

Starting a new project

Exit the software

SIL SOLVER

Welcome, srtzvi

Site: BOGCI Project ID: SPLPNCwork

Projects

New

Exit

DBF Import Import Export Print Reports PF Documentation Project Data Sheets PF Details PF Data Summary PF Target Results PF Result Summary

Site	Location	Project ID	Project Name

No data to display

Create Filter

Project List  
Filters may be useful to users with long project lists

Site: BOGCI

Project ID: SPLPNCwork

## Projects

Open      **New**      Edit      Copy      Delete      Exit      Project Revision      User Guide

DBF Import      Import      Export      Print Reports      PF Documentation      Project Data Sheets      PF Details      PF Data Summary      PF Target Results      PF Result Summary

Site	Location	Project ID	Project Name

No data to display

→ Click to create a new project

The window below pops up, type in relevant information and click “Save”

**Add New Project**

<b>Site:</b>	<input type="text"/>
<b>Location:</b>	<input type="text"/>
<b>Project ID:</b>	<input type="text"/>
<b>Name:</b>	<input type="text"/>

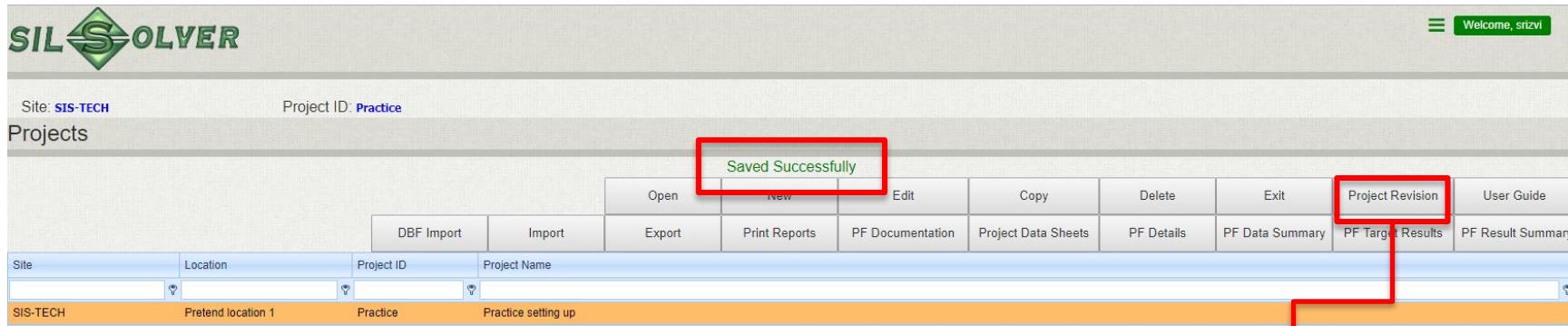
**Save** **Close**

**Add New Project**

<b>Site:</b>	<input type="text" value="SIS-TECH"/>
<b>Location:</b>	<input type="text" value="Pretend location 1"/>
<b>Project ID:</b>	<input type="text" value="Practice"/>
<b>Name:</b>	<input type="text" value="Practice setting up"/>

**Save** **Close**

# Success!



Site: SIS-TECH Project ID: Practice

Projects

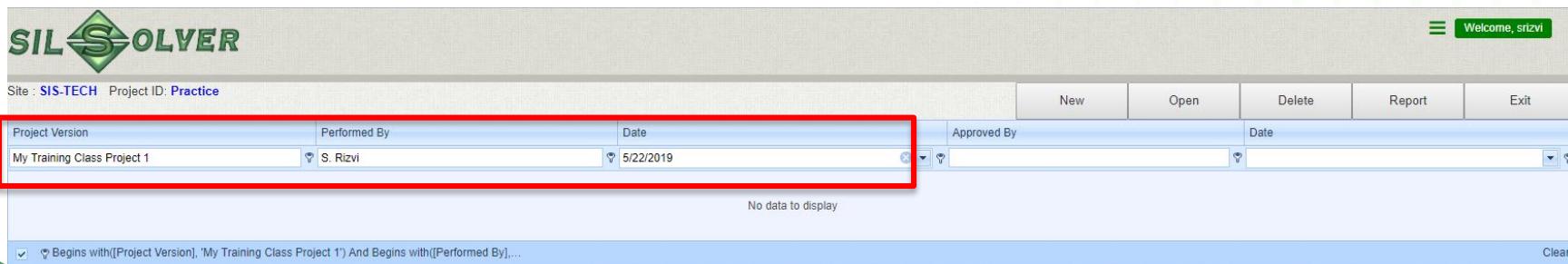
Saved Successfully

Open New Edit Copy Delete Exit Project Revision User Guide

DBF Import Import Export Print Reports PF Documentation Project Data Sheets PF Details PF Data Summary PF Target Results PF Result Summary

Site	Location	Project ID	Project Name
SIS-TECH	Pretend location 1	Practice	Practice setting up

Set initial project  
revision  
information



Site : SIS-TECH Project ID: Practice

Project Version	Performed By	Date	Approved By	Date
My Training Class Project 1	S. Rizvi	5/22/2019		

No data to display

Begins with([Project Version], 'My Training Class Project 1') And Begins with([Performed By],...)

Clear

# Steps for adding a safety function

1. Obtain functional description from Hazard and Risk Analysis (H&RA) documentation
2. Open Project
3. Select new function and enter function identification fields
4. Enter performance targets
5. Enter function architecture through GUI interface and populating the architecture with devices
6. Perform calculation
7. Re-iterate with design modifications if necessary to get successful design

# Example SIF

Information from H&RA and related process requirement specification (PRS) information

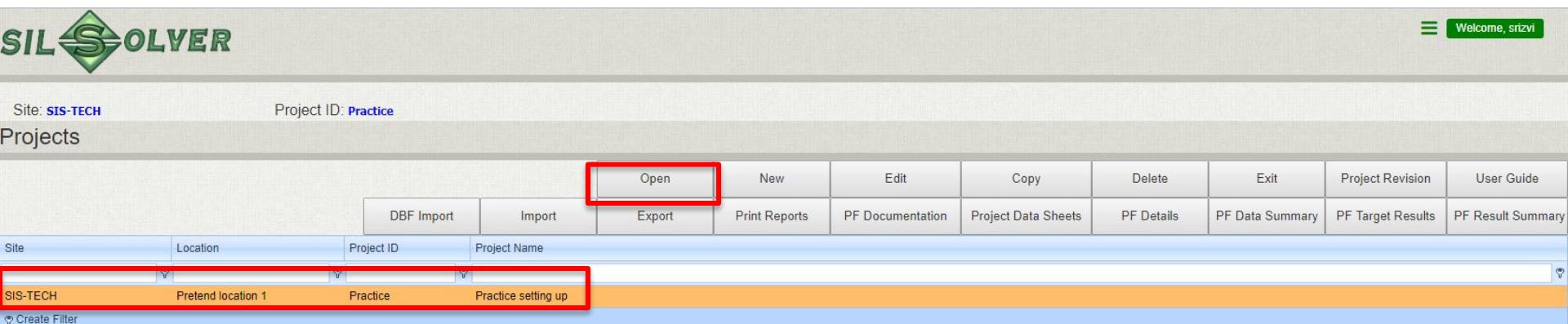
- SIF 01
- SIL-1 (20% design margin)
- Low Demand mode
- Spurious trip target = 20 yrs
- Desired test interval = 5 yrs
- V-101 High DP (2003,DP-101A/B/C) trip closes XV-101A and XV-101B (1002) ball valves spring loaded to the closed position, each with a single ETT solenoid (XY-101A and XY-101B)
- Power supply is monitored and is tested at 5 yr interval
- Existing logic solver (SIS-A) is safety configured system with 1002D CPU and simplex I/O

# Opening the project

Start from Project home page

Select the Project by left-click (first project in list is selected by default)

Click Open



Site: SIS-TECH Project ID: Practice

Projects

Site	Location	Project ID	Project Name
SIS-TECH	Pretend location 1	Practice	Practice setting up

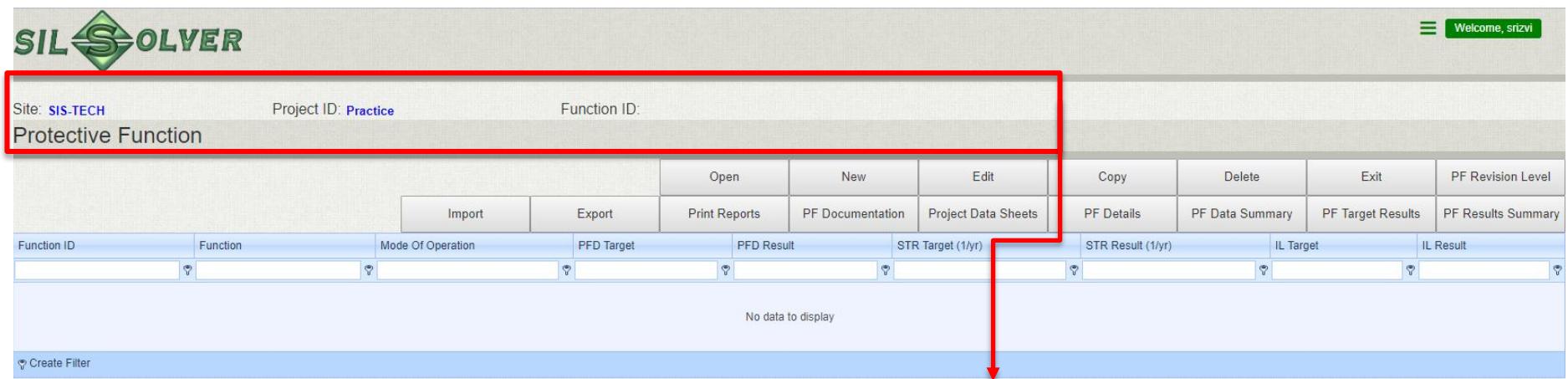
DBF Import Import Export Open New Edit Copy Delete Exit Project Revision User Guide

Print Reports PF Documentation Project Data Sheets PF Details PF Data Summary PF Target Results PF Result Summary

Create Filter

# Protective Function Level

- The layout is the same as the main page with list of projects except that on the project level, we have the project information listed and do NOT have the DBF import function



The screenshot shows the SIL SOLVER software interface. At the top, there is a navigation bar with the SIS SOLVER logo, a user welcome message 'Welcome, srizi!', and a 'Site: SIS-TECH' dropdown. Below the navigation bar, the main title 'Protective Function' is displayed. The toolbar contains buttons for 'Import', 'Export', 'Open', 'New', 'Edit', 'Copy', 'Delete', 'Exit', and 'PF Revision Level'. A red box highlights the 'Import' and 'Export' buttons, and a red arrow points from the 'Project Data Sheets' button in the toolbar to the text 'Project information.' located below the table.

Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result

No data to display

[Create Filter](#)

Project information.

# Start a new safety function

SIL SOLVER

Site: SIS-TECH Project ID: Practice Function ID:

Protective Function

		Open	New	Edit	Copy	Delete	Exit	PF Revision Level		
		Import	Export	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Results Summary
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result		

No data to display



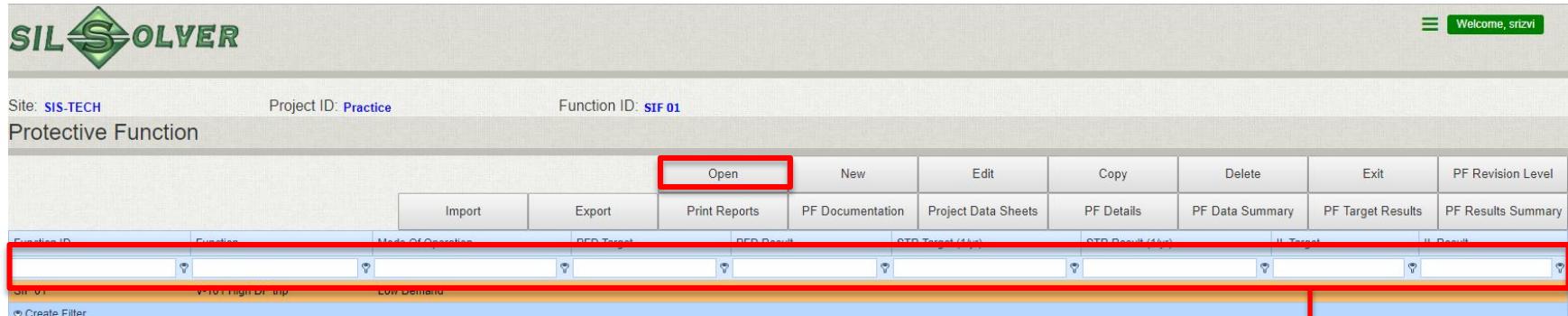
- Enter ID, brief version of H&RA description, Mode of Operation, and Save

Protective Function

Function ID:	SIF 01
Function :	V-101 High DP trip
Mode of Operation:	Low Demand ▾

Save Close

# Success!



The screenshot shows the SIL-SOLVER software interface. The top navigation bar includes the logo 'SIL-SOLVER', the site 'SIS-TECH', the project ID 'Practice', and the function ID 'SIF 01'. The main title is 'Protective Function'. The toolbar contains buttons for 'Import', 'Export', 'Open' (which is highlighted with a red box), 'New', 'Edit', 'Copy', 'Delete', 'Exit', and 'PF Revision Level'. Below the toolbar is a table with columns: Function ID, Function, Mode Of Operation, PFD Target, PFD Result, STD Target (4 hz), STD Result (4 hz), II Target, and II Result. A filter bar is positioned above the table, with dropdown menus for 'Function' (SIF 01), 'Mode Of Operation' (VTOV High Dr. Imp), and 'Low Demand'. A 'Create Filter' button is also present. A red arrow points from the text 'Fields for filtering can be useful for projects with long lists of protective functions' to the filter bar.

- Select function and click Open to begin configuring SIF

Fields for filtering can be useful for projects with long lists of protective functions

# Function GUI Interface

SIF project information

SIF calculation results both numerical and graphical

The screenshot shows the SIS TECH Function GUI Interface. At the top, there is a header with project information: Site: SIS-TECH, Function: and so on, Project ID: Prac Proj, Function ID: test42, and a Welcome message. Below the header is a table with columns for PFDavg, IL, STR (1/Yr), MTTFs (Yr), and HFT. The table has sections for TARGETS, RESULTS, and TARGETS MET?. To the right of the table is a 'PFD/STR Breakdown' section with two empty boxes labeled 'PFDavg' and 'STR', both showing 'No data'. To the right of this is a section for 'HFT for Logic Solver' with sub-sections for 'HFT for Inputs(s)', 'HFT for Action(s)', and 'HFT for Support System 1' (represented by a blue outline of a rectangular component). Below these are buttons for 'Calculate and Save' and 'Print'. At the bottom left is a 'Modelling panel' with a list of components: SRS, LOGIC SOLVER, INPUT CONFIGURATION, INPUT DEVICE, ACTION CONFIGURATION, ACTION DEVICE, SUPPORT CONFIGURATION, SUPPORT SYSTEM, CUSTOMER DEVICE, and MANUAL DEVICE. To the right of the modelling panel is a large text block with a red arrow pointing to it, stating: 'The Backward and Forward buttons only have meaning when you have multiple functions in the project'. Below this text is a 'Modelling panel' with a list of components: SRS, LOGIC SOLVER, INPUT CONFIGURATION, INPUT DEVICE, ACTION CONFIGURATION, ACTION DEVICE, SUPPORT CONFIGURATION, SUPPORT SYSTEM, CUSTOMER DEVICE, and MANUAL DEVICE. To the right of the modelling panel is a large text block with a red arrow pointing to it, stating: 'Modelling panel, where you select system configuration and component.'.

The Backward and Forward buttons only have meaning when you have multiple functions in the project

Modelling panel, where you select system configuration and component.

SRS

LOGIC SOLVER

INPUT CONFIGURATION

INPUT DEVICE

ACTION CONFIGURATION

ACTION DEVICE

SUPPORT CONFIGURATION

SUPPORT SYSTEM

CUSTOMER DEVICE

MANUAL DEVICE

Calculate and Save Print

HFT for Logic Solver

HFT for Inputs(s)

HFT for Action(s)

HFT for Support System 1

HFT for Support System 2

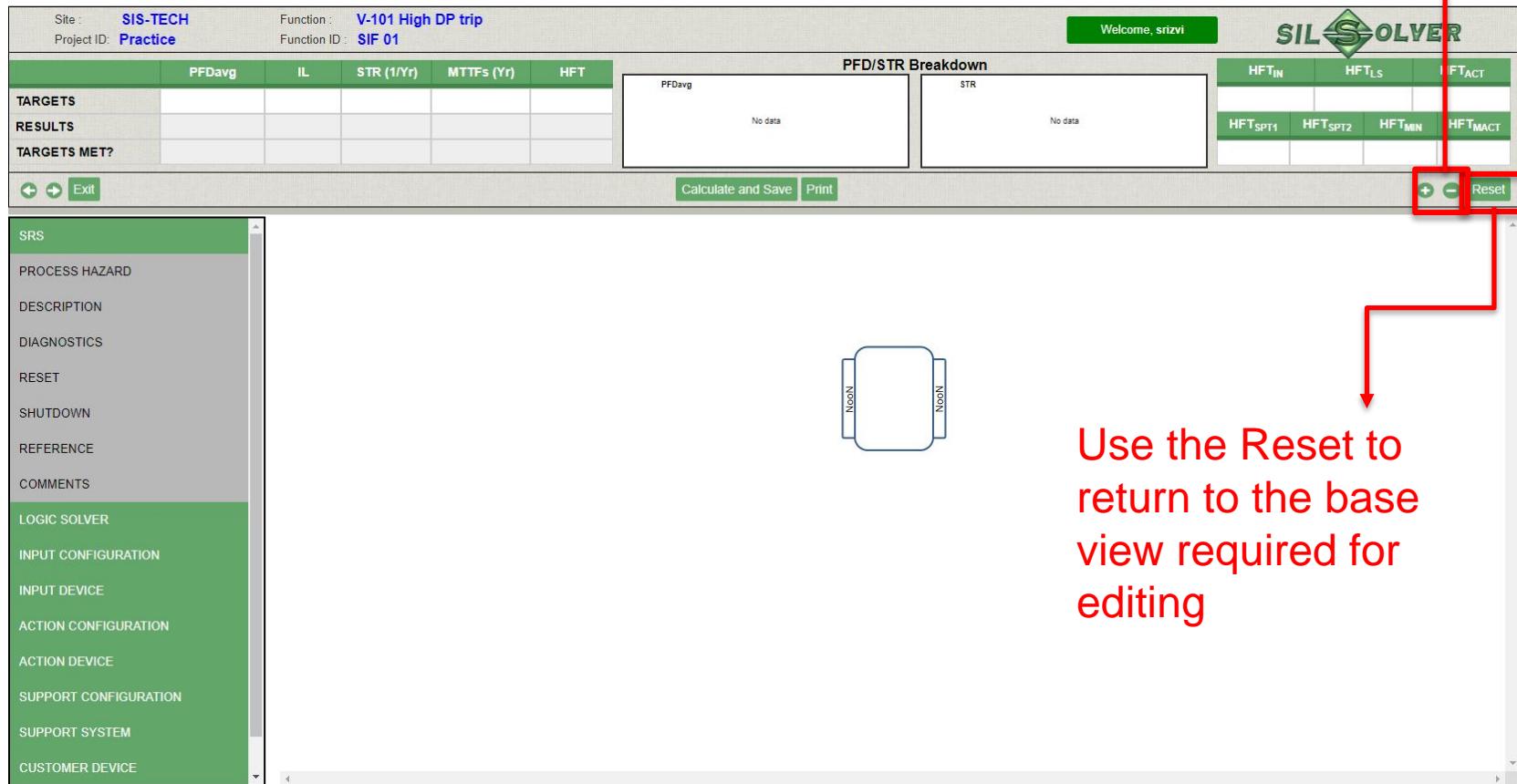
HFT for Manual Input

HFT for Manual Action

# Zooming

Use the + and – buttons to zoom in and out on the figure

*You cannot interact with certain features in a zoomed state*



Site : SIS-TECH Function : V-101 High DP trip  
Project ID: Practice Function ID : SIF 01

Welcome, srizvi

SIL SOLVER

PFDAvg IL STR (1/Yr) MTTFs (Yr) HFT

PFDAvg STR

HFT<sub>IN</sub> HFT<sub>LS</sub> HFT<sub>ACT</sub>

HFT<sub>SPT1</sub> HFT<sub>SPT2</sub> HFT<sub>MIN</sub> HFT<sub>MACT</sub>

PFDAvg

RESULTS

TARGETS MET?

Calculate and Save Print

Targets

RESULTS

TARGETS MET?

PFDAvg

STR

HFT<sub>IN</sub>

HFT<sub>LS</sub>

HFT<sub>ACT</sub>

HFT<sub>SPT1</sub>

HFT<sub>SPT2</sub>

HFT<sub>MIN</sub>

HFT<sub>MACT</sub>

Calculate and Save Print

Reset

SRS

PROCESS HAZARD

DESCRIPTION

DIAGNOSTICS

RESET

SHUTDOWN

REFERENCE

COMMENTS

LOGIC SOLVER

INPUT CONFIGURATION

INPUT DEVICE

ACTION CONFIGURATION

ACTION DEVICE

SUPPORT CONFIGURATION

SUPPORT SYSTEM

CUSTOMER DEVICE

NoON

NoON

Use the Reset to return to the base view required for editing

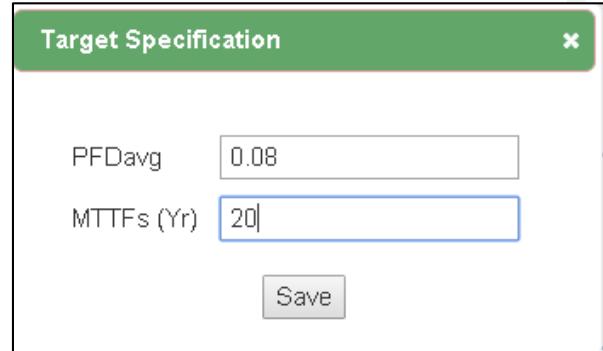
# Entering Performance Targets

Click any cell in Targets row of table to open dialog box

Site : SIS-TECH      Function : V-101 High DP trip  
 Project ID: Practice      Function ID : SIF 01

Welcome, srizvi      SIL SOLVER

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT	PFD/STR Breakdown		HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
TARGETS						PFDAvg	No data			
RESULTS						STR	No data			
TARGETS MET?										



Enter performance targets and save

# Success!

The screenshot shows the SIL Solver software interface. At the top, there is a header with the project details: Site: SIS-TECH Practice, Function: V-101 High DP trip, and Function ID: SIF 01. Below this is a table with columns: TARGETS, PFDavg, IL, STR (1/Yr), MTTFs (Yr), and HFT. The 'TARGETS' row shows values: 8.00E-02, 1, 5.00E-02, 20, and 0. The 'RESULTS' and 'TARGETS MET?' sections are empty. At the bottom of the main window are buttons for 'Calculate and Save' and 'Print'.

A modal dialog box titled 'Silsolver' is displayed, showing the message 'Target saved successfully..!!' with an 'OK' button.

The right side of the interface shows a 'Breakdown' section with a table for 'STR' and a note 'No data'. There are also tabs for 'HFT<sub>IN</sub>', 'HFT<sub>LS</sub>', 'HFT<sub>ACT</sub>', 'HFT<sub>SPT1</sub>', 'HFT<sub>SPT2</sub>', 'HFT<sub>MIN</sub>', and 'HFT<sub>MACT</sub>'. Below these tabs are 'Add', 'Delete', and 'Reset' buttons.

The left side of the interface features a sidebar with the following sections: SRS, PROCESS HAZARD, DESCRIPTION, DIAGNOSTICS, RESET, SHUTDOWN, REFERENCE, COMMENTS, and LOGIC SOLVER. The 'LOGIC SOLVER' section is highlighted with a red box. Below it are sections for INPUT CONFIGURATION, INPUT DEVICE, ACTION CONFIGURATION, ACTION DEVICE, SUPPORT CONFIGURATION, SUPPORT SYSTEM, and CUSTOMER DEVICE.

In the center of the main window, there is a logic solver configuration area showing a rectangular box with two vertical ports labeled 'NoonN' on each side.

Close dialog box and select Logic Solver on left to begin configuration

# HFT Target

HFT target is based on the SIL Target and SIS Mode of Operation. If no PFDavg target has been entered (which would result in no SIL target), HFT target will be set to null.

SIL Target	Mode of Operation	HFT target for each subsystem
1	Low Demand	0
1	High Demand	0
2	Low Demand	0
2	High Demand	1
3	Low Demand	1
3	High Demand	1

## HFT Target

Site : SIS-TECH Function : V-102 High DP/P Trip  
 Project ID: Practice Function ID : SIF 02 Welcome, srizvi

**SIL SOLVER**

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
<b>TARGETS</b>	8.00E-02	1	5.00E-02	20.00	0
<b>RESULTS</b>	5.53E-02	1	5.94E-02	16.84	0
<b>TARGETS MET?</b>					

**PFD/STR Breakdown**

PFDavg

89.4%

- Action
- Input
- Logic
- Support

STR

50%

- Action
- Input
- Logic

	HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
HFT <sub>SPT1</sub>	1	1	1
HFT <sub>SPT2</sub>			
HFT <sub>MIN</sub>			
HFT <sub>MACT</sub>			

← → Exit      Calculate and Save      Print      + - Reset

# Picking Logic Solver (LS)

Left click desired logic solver to copy

Move the mouse to the box in the middle and click to paste.

Site : SIS-TECH      Function : V-101 High DP trip  
 Project ID: Practice      Function ID : SIF 01

Welcome, srizvi

**SIL SOLVER**

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT	HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
<b>TARGETS</b>	8.00E-02	1	5.00E-02	20	0			
<b>RESULTS</b>								
<b>TARGETS MET?</b>								

PFDAvg      STR

No data      No data

Calculate and Save      Print      +      -      Reset

**SRS**

**LOGIC SOLVER**

GENERIC 2004D DUAL MP, DUAL I/O

**GENERIC 1002D DUAL MP, SIMPLEX I/O** (This item is highlighted with a red box)

NON-SC D/D

NON SC PES DUAL MP, DUAL I/O

NON-SC D/S

NON SC PES DUAL MP, SIMPLEX I/O

NON-SC S/S

NON SC PES SIMPLEX MP, SIMPLEX

FC

RELAY - FAIL TO CLOSE

FO

RELAY - FAIL TO OPEN



Wrong one?  
 To delete the logic solver, move the mouse to icon and right click to delete

# Adding LS details

Edit the logic solver parameter by left click the logic solver icon on in the box. Where Assign a tag name, select the voting, and enter the test interval (TI)

Note: the voting needs to be selected before test interval.

Caution: Logic Solver test interval may be prescribed in vendor safety manual or prior use justification documentation

Tool will automatically calculate LS contributions to PFDavg and STR

Logic Solver

Logic Solver ID: DMSIO

Logic Solver Type: GENERIC 1002D DUAL MP; SIMPLEX I/O

Configurations:

Logic Solver Tag: SIS-A

Voting: 1oo2D

Proof Testing Interval (yr): 5

PFDavg: 4.92E-04      STR: 4.50E-02

Note:

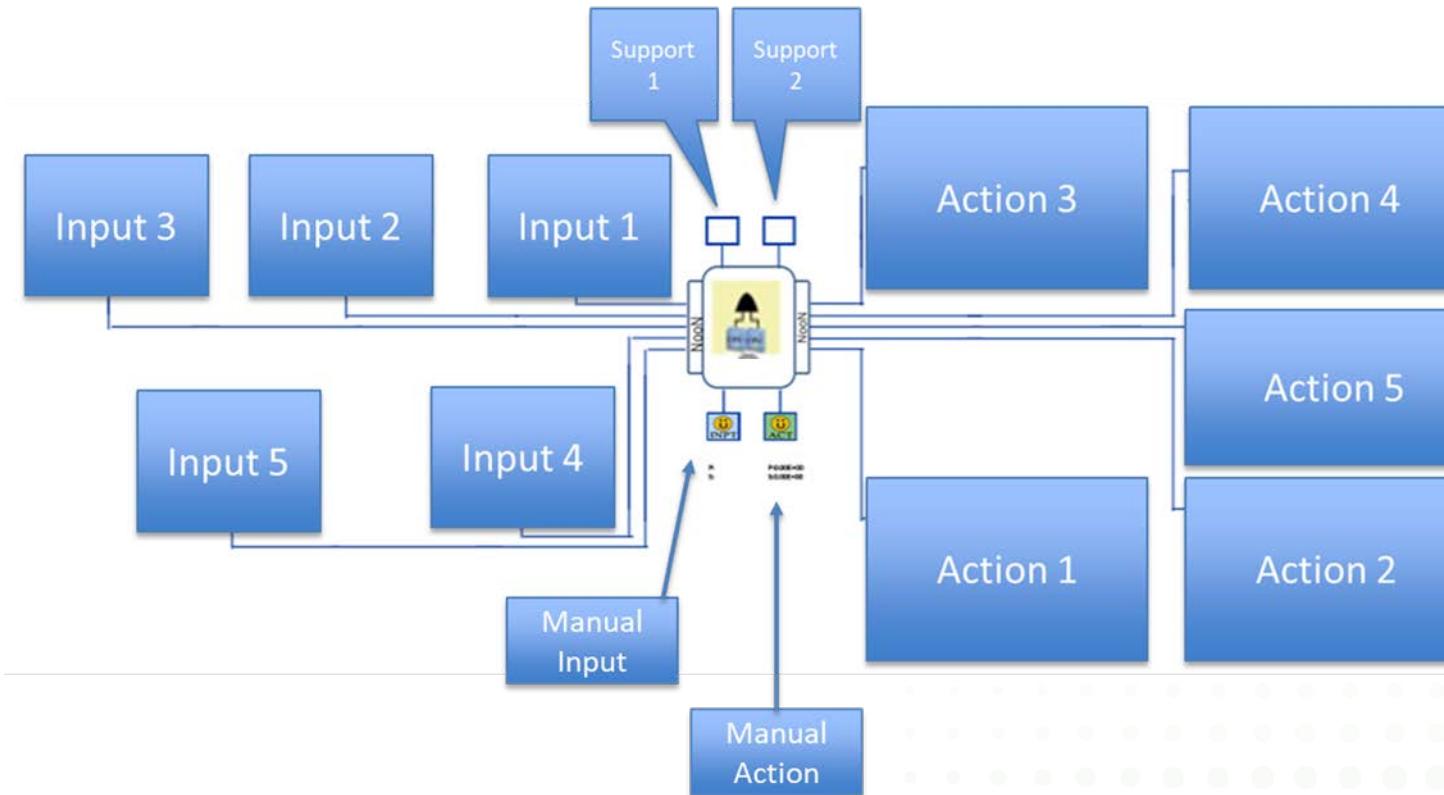
Boundary Description: Boundary includes 1oo2D logic solver with dual main processors, 1 simplex digital input module, 1 simplex analog input module, and 1 simplex digital output module.

Implementation Limitations and Exclusions: Refer to the SIL Solver manual for a discussion of "1oo2D" and "2oo2D" architectures. The logic solver is certified to IEC 61508 SIL 3 or TUV AK 5-6.

Data Source: SIL      HFT: 1      **Update**

Click Update to return to GUI page

# Other Subsystems are added to the GUI in the order selected



# Adding Inputs (aka Sensors)

Adding an input is divided into two steps

1. add the input configuration
2. add each device.

# Input Configuration

Click “Input Configuration” to open selection list

Select the desired voting. Click the selected configuration to add to the GUI.

Wrong choice? Hover over that portion of the architecture until grey selection box appears and right-click to get option to delete.

Site : SIS-TECH Practice Function : V-101 High DP trip Project ID: SIF 01 Welcome, srizvi SIL SOLVER

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS	8.00E-02	1	5.00E-02	20.00	0
RESULTS					
TARGETS MET?					

PFD/STR Breakdown

HFT <sub>IN</sub>	HFT <sub>L_S</sub>	HFT <sub>ACT</sub>
HFT <sub>SPT1</sub>	HFT <sub>SPT2</sub>	HFT <sub>MIN</sub>
		HFT <sub>MACT</sub>

Calculate and Save Print

← → Exit + - Reset

SRS

LOGIC SOLVER

INPUT CONFIGURATION

ONE DEVICE

TWO DEVICES

THREE DEVICES

1003

2003

3003

Calculate and Save Print

← → Exit + - Reset

**PFD/STR Breakdown**

HFT <sub>IN</sub>	HFT <sub>L_S</sub>	HFT <sub>ACT</sub>
HFT <sub>SPT1</sub>	HFT <sub>SPT2</sub>	HFT <sub>MIN</sub>
		HFT <sub>MACT</sub>

← → Exit + - Reset

**INPUT CONFIGURATION**

ONE DEVICE

TWO DEVICES

THREE DEVICES

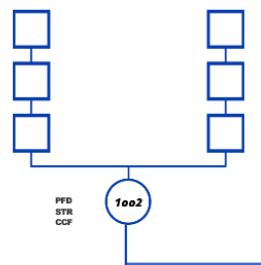
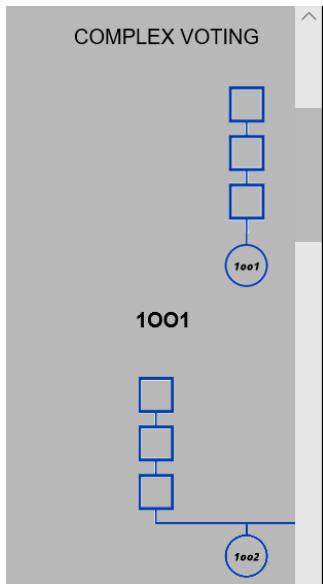
1003

2003

3003

← → Exit + - Reset

# Complex Voting Architectures



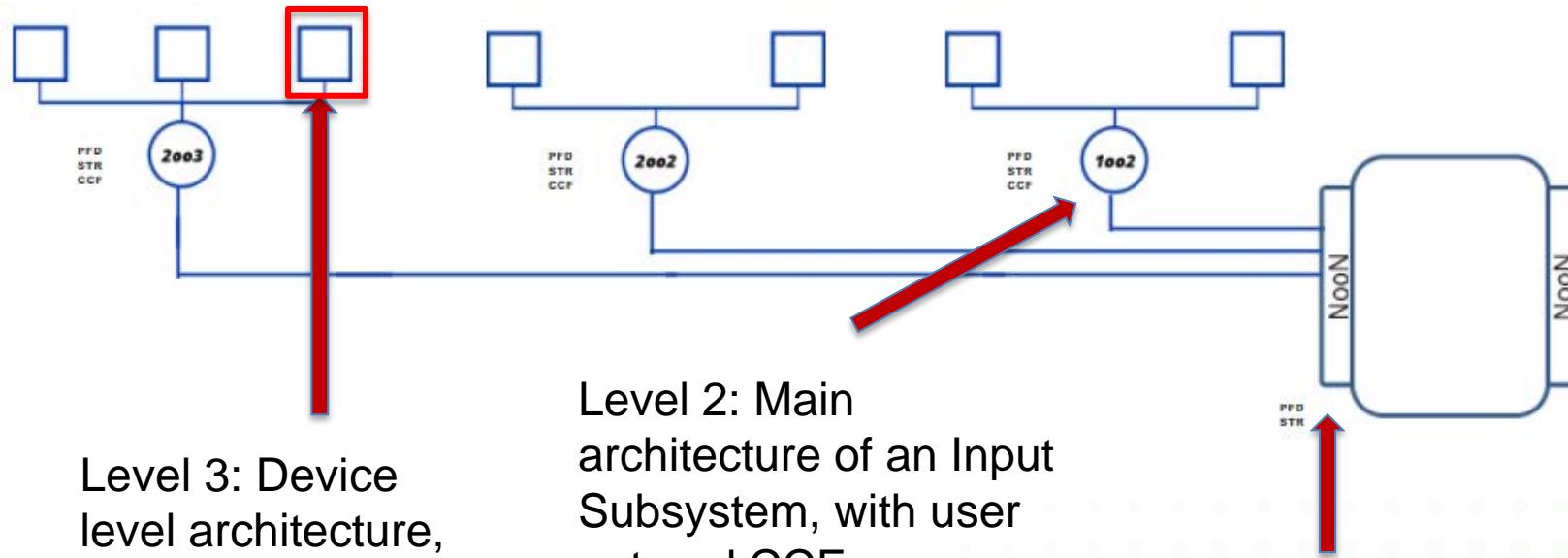
Common examples:

- Sensor Transmitter with a Signal Splitter, Trip Amp, or a Relay
- Pressure/Temperature compensated flow

- If a single variable value is made up of multiple devices, use a **Complex Voting Architecture**
- All the devices for each separate value go in a single vertical channel

# Three levels of Input Architecture

Best Practice: Only use Level 3 if you must for the complexity of the function (some details will not show on reports)



Level 3: Device level architecture, with fixed CCF from datasheet

Level 2: Main architecture of an Input Subsystem, with user entered CCF

Level 1: 1ooN or NooN **VOTING** between Input Subsystems, with no CCF

# Picking Technology

Click “input device” to access to the list of device categories  
Left-click the relevant category to access the list of devices technology

Site : SIS-TECH      Function : V-101 High DP trip  
Project ID: Practice      Function ID: SIF 01

Welcome, srizvi

**SIL SOLVER**

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT	PFD/STR Breakdown		HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
TARGETS	8.00E-02	1	5.00E-02	20.00	0					
RESULTS										
TARGETS MET?										

**INPUT DEVICE**

- TRIP AMPLIFIER
- ANALYZER
- PRESSURE
- DP** DIFFERENTIAL PRESSURE TRANSMITTER
- P** PNEUMATIC PRESSURE SWITCH
- PT+** PNEUMATIC PRESSURE TRANSMITTER
- P** PRESSURE SWITCH - NORMAL SERVICE
- PT** PRESSURE TRANSMITTER
- DP**

**PFD/STR Breakdown**

Calculate and Save   Print   +   -   Reset

# Selecting the Device

Scroll to the desired device

Left click device in list to copy (right-click to open datasheet – more later)

Left click in device box on diagram to add device to the input subsystem

Site : SIS-TECH      Function : V-101 High DP trip  
Project ID: Practice      Function ID: SIF 01

Targets      PFDavg      IL      STR (1/Yr)      MTTFs (Yr)      HFT

Targets	8.00E-02	1	5.00E-02	20.00	0
Results					
Targets Met?					

PF/STR Breakdown

Calculate and Save      Print      +      -      Reset

**INPUT DEVICE**

- TRIP AMPLIFIER
- ANALYZER
- PRESSURE
  - DIFFERENTIAL PRESSURE TRANSMITTER
  - PNEUMATIC PRESSURE SWITCH
  - PNEUMATIC PRESSURE TRANSMITTER
  - PRESSURE SWITCH - NORMAL SERVICE
  - PRESSURE TRANSMITTER
  - DIFFERENTIAL PRESSURE TRANSMITTER

**SIL SOLVER**

To delete or copy the device, move the mouse to device icon in function diagram and right click.

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# Adding Device Details

White boxes are editable fields. Some are pre-populated

**Device**

**Device ID:** DPTR      **Device Type:** DIFFERENTIAL PRESSURE TRANSMITTER

**Configurations:**

Device Tag:

Proof Testing Interval (yr):

Voting:

Subsystem Diagnostic Level: ?

**Properties:**

Failure Dangerous Failure Rate (1/yr):

Failure Spurious Failure Rate (1/yr):

Common Cause Factor CCF Dual (%):

Common Cause Factor CCF Triple (%):

Diagnostic Coverage Simplex DC1 (1/yr):

Diagnostic Coverage Dual DC2 (1/yr):

Diagnostic Coverage Triple DC3 (1/yr):

**Maintenance:**

Mean Time to Repair (hr):

Diagnostic Interval (hr):

Overhaul Interval (yr):

Proof Testing Coverage (%): ?

User Specified

**Note:**

Boundary Conditions: Boundary includes the electronic transmitter, sensing diaphragm and process connection.

Process Severity Assumption: Clean

Implementation Limitations and Exclusions: No limitations beyond standard assumptions (see SIS Solver Enterprise User Guide)

**Data Source:** SIL

**Update**

# Filled In

Test Interval is in years

Define Voting of one device. Use 1oo1 most of the time

Define Diagnostic NO DC in this case.

Define OI, default is 20Year

Define PTC, default is 100 %

Device ID: DPTR Device Type: DIFFERENTIAL PRESSURE TRANSMITTER

**Configurations:**

- Device Tag: DP-101A
- Proof Testing Interval (yr): 5
- Voting: 1oo1
- Subsystem Diagnostic Level: NO DC

**Properties:**

- Failure Dangerous Failure Rate (1/yr): 8.00E-03
- Failure Spurious Failure Rate (1/yr): 1.67E-02
- Common Cause Factor CCF Dual (%): 2
- Common Cause Factor CCF Triple (%): 2
- Diagnostic Coverage Simplex DC1 (1/yr): 60.00
- Diagnostic Coverage Dual DC2 (1/yr): 80.00
- Diagnostic Coverage Triple DC3 (1/yr): 90.00

**Maintenance:**

- Mean Time to Repair (hr): 72
- Diagnostic Interval (hr): 0.500
- Overhaul Interval (yr): 20
- Proof Testing Coverage (%): 100
- User Specified:

**Note:**

Boundary Conditions: Boundary includes the electronic transmitter, sensing diaphragm and process connection.

Process Severity Assumption: Clean

Implementation Limitations and Exclusions: No limitations beyond standard assumptions (see SII\_Solver Enterprise User

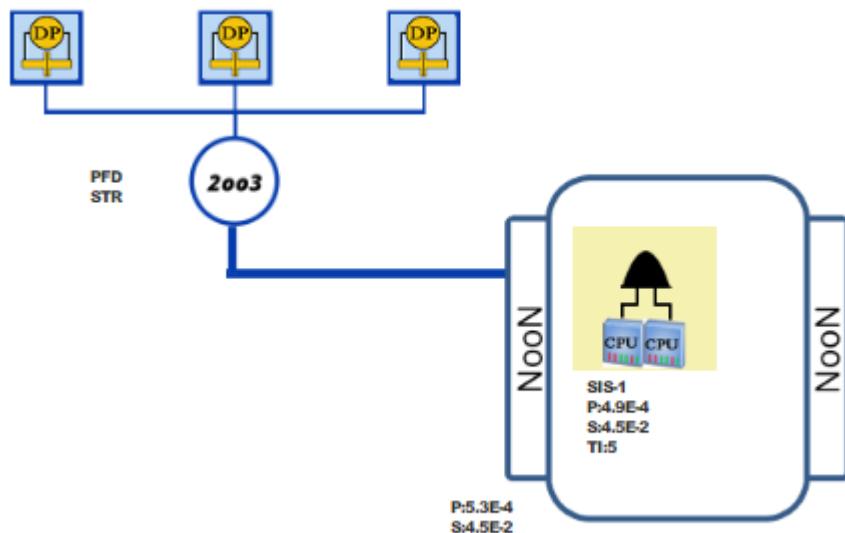
Data Source: SIL

Update

Click Update to save change

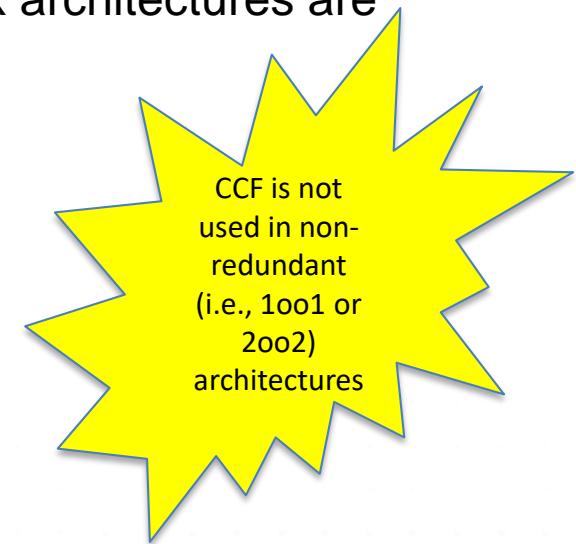
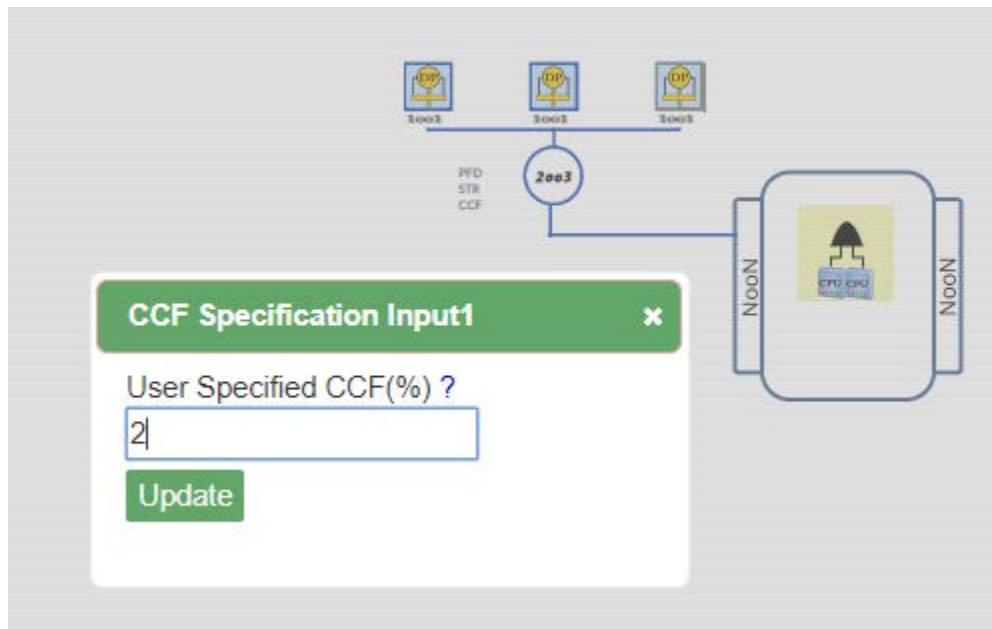
# Completing the subsystem

1. Copy DP-101A Pressure transmitter
2. Paste DP pressure transmitter to each of box in the 2oo3 input configuration
3. Update the tags for DP-101B and DP-101C and any other parameters that were modified for DP-101A.



# Adding Common Cause

- Left-click on the voting 2oo3 circle
- Put in CCF value as a percentage (for example, 2%)  
Note: Recommended values for duplex and triplex architectures are shown in the device datasheet under “Properties”
- Click Update to close the dialog box



Note: When using diverse instrumentation in a redundant architecture, use the rightmost box(es) of the subsystem (input or action) for the channel with the highest total dangerous failure rate.

# 2003D vs. 2003

- What if automated diagnostics is going to be used to take safe action on diagnosed failure?
- Enter each device and change the Diagnostic level to DC3 (diagnostic level for intercomparison of 3 transmitters)
- Click Update to close dialog box

Define Diagnostic DC3 is used since 3 PTs are used for comparison. The DC used in 90% ←

**Device**

**Device ID:** DPTR **Device Type:** DIFFERENTIAL PRESSURE TRANSMITTER

**Configurations:**

Device Tag: DP-101A  
 Proof Testing Interval (yr): 5  
 Voting: 1001  
 Subsystem Diagnostic Level: **DC3**

**Properties:**

Failure Dangerous Failure Rate (1/yr): 8.00E-03  
 Failure Spurious Failure Rate (1/yr): 1.67E-02  
 Common Cause Factor CCF Dual (%): 2  
 Common Cause Factor CCF Triple (%): 2  
 Diagnostic Coverage Simplex DC1 (1/yr): 60.00  
 Diagnostic Coverage Dual DC2 (1/yr): 80.00  
 Diagnostic Coverage Triple DC3 (1/yr): **90.00**

**Maintenance:**

Mean Time to Repair (hr): 72  
 Diagnostic Interval (hr): 0.500  
 Overhaul Interval (yr): 20  
 Proof Testing Coverage (%): 100  
 User Specified

**Note:**

Boundary Conditions: Boundary includes the electronic transmitter, sensing diaphragm and process connection.  
 Process Severity Assumption: Clean  
 Implementation Limitations and Exclusions: No limitations beyond standard assumptions (see SII\_Solver Enterprise User

**Data Source:** SIL **Update**

The triplex DC for this device is 90%

# FYI: DC for other architectures

For all other input configurations with safe action on diagnosed failure, the general rule for the selection of Diagnostic level is as below:

1oo1D → DC1 (Diagnostic Coverage Simplex)

1oo2D and 2oo2D → DC2 (Diagnostic Coverage Dual)

1oo3D, 2oo3D and 3oo3D → DC3(Diagnostic Coverage Triplicated)

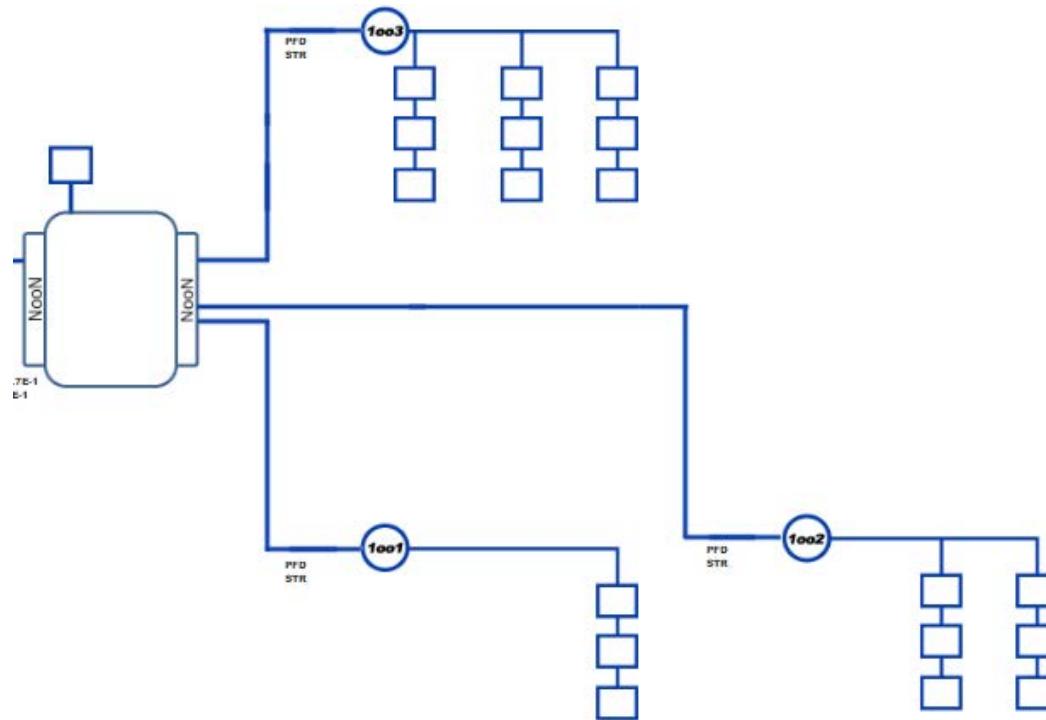
May need to select a lower DC when diverse devices are used in the same voting.

May select a higher DC when an external independent reading can be used for inter-comparison with the SIF sensor.

# Adding the rest of the system

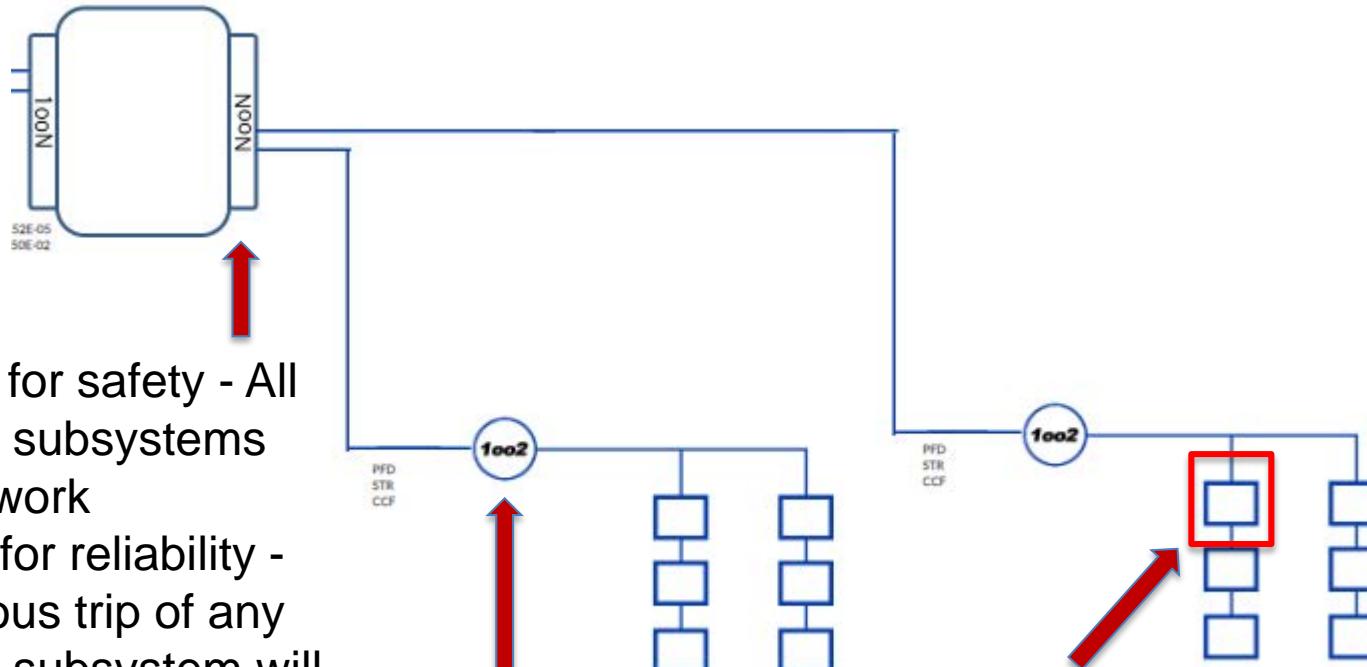
The support system and final actions are modelled in a similar way as the input.

1. Select the action configuration
2. Select the action device (Identical logic as SIL Solver® V 7.0)
3. Specify relevant parameters



# Two configurable levels of Action Architecture

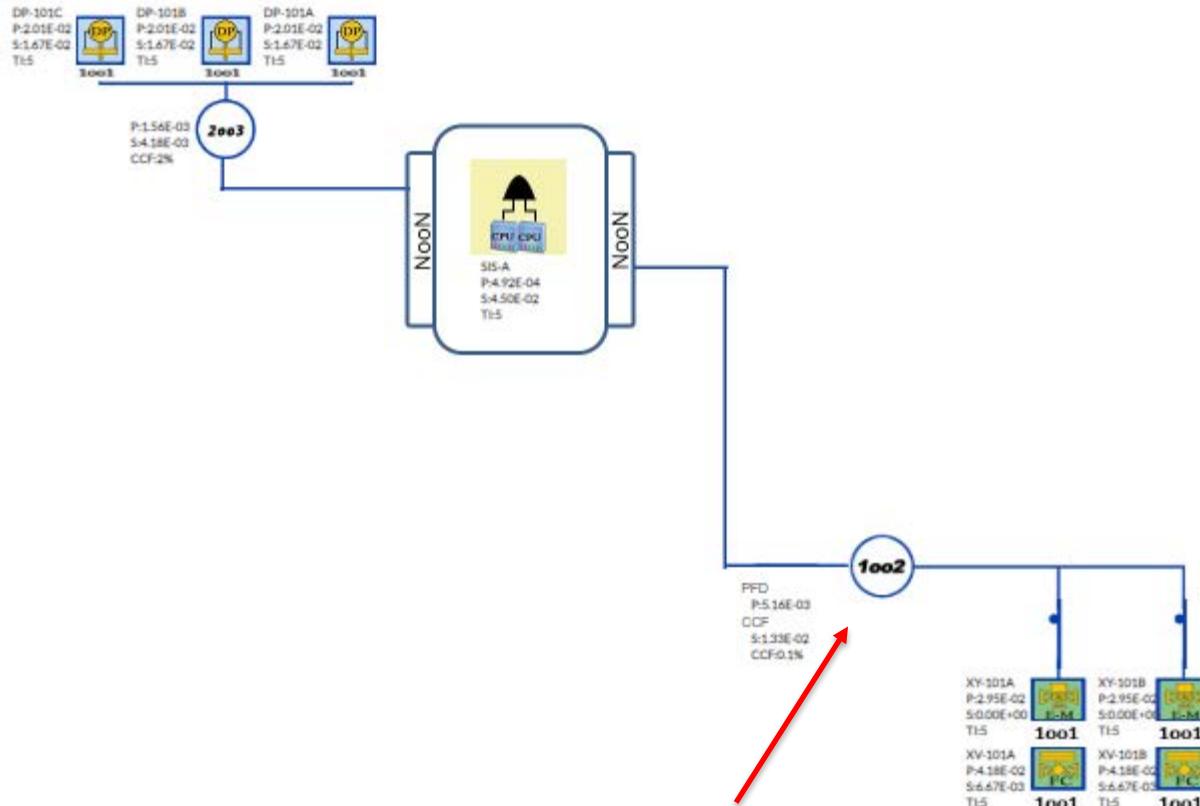
Best Practice: Only use Level 2 if you must for the complexity of the function (some details will not show on reports)



Level 1: Main architecture of an Action Subsystem, with user entered CCF

Level 2: Device level architecture, with fixed CCF from datasheet

# Adding valves and solenoids



Don't forget to enter CCF

Device ID:	SVETHM	Device Type:	SOLENOID VALVE - ETT - MONITORED
<b>Configurations:</b>		<b>Properties:</b>	
Device Tag:	XY-101A	Failure Dangerous Failure Rate (1/yr):	1.18E-02
Proof Testing Interval (yr):	5	Failure Spurious Failure Rate (1/yr):	0
Voting:	1001	CCF Dual(%):	1
Subsystem Diagnostic Level:	NO DC	CCF Triple(%):	1
<b>Maintenance:</b>		Diagnostic Coverage Simplex(1/yr): 0.00	
Mean Time to Repair (hr):	72	Diagnostic Coverage Dual(1/yr): 0.00	Diagnostic Coverage Triple(1/yr): 0.00
Diagnostic Interval (hr):	0.000		
Overhaul Interval (yr):	20		
Proof Testing Coverage (%):	100		
User Specified	<input type="checkbox"/>	PFDavg:	2.00E-002
	<input type="checkbox"/>	STI:	0.00E+000

Device	BLOCK VALVE-BALL-FTC-CLEAN																
Device ID:	BVFCC	Device Type:	BLOCK VALVE-BALL-FTC-CLEAN														
<b>Configurations:</b> <table border="1"> <tr> <td>Device Tag:</td> <td>XV-101A</td> </tr> <tr> <td>Proof Testing Interval (yr):</td> <td>5</td> </tr> <tr> <td>Voting:</td> <td>1oo1</td> </tr> <tr> <td>Subsystem Diagnostic Level:</td> <td>NO DC</td> </tr> </table>				Device Tag:	XV-101A	Proof Testing Interval (yr):	5	Voting:	1oo1	Subsystem Diagnostic Level:	NO DC						
Device Tag:	XV-101A																
Proof Testing Interval (yr):	5																
Voting:	1oo1																
Subsystem Diagnostic Level:	NO DC																
<b>Maintenance:</b> <table border="1"> <tr> <td>Mean Time to Repair (hr):</td> <td>72</td> </tr> <tr> <td>Diagnostic Interval (hr):</td> <td>0.000</td> </tr> <tr> <td>Overhaul Interval (yr):</td> <td>20</td> </tr> <tr> <td>Proof Testing Coverage (%):</td> <td>100</td> </tr> <tr> <td>User Specified</td> <td><input type="checkbox"/></td> </tr> </table>				Mean Time to Repair (hr):	72	Diagnostic Interval (hr):	0.000	Overhaul Interval (yr):	20	Proof Testing Coverage (%):	100	User Specified	<input type="checkbox"/>				
Mean Time to Repair (hr):	72																
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Overhaul Interval (yr):	20																
Proof Testing Coverage (%):	100																
User Specified	<input type="checkbox"/>																
<b>Properties:</b> <table border="1"> <tr> <td>Failure Dangerous Failure Rate (1/yr):</td> <td>1.67E-02</td> </tr> <tr> <td>Failure Spurious Failure Rate (1/yr):</td> <td>6.67E-03</td> </tr> <tr> <td>CCF Dual(%):</td> <td>0.1</td> </tr> <tr> <td>CCF Triple(%):</td> <td>0.1</td> </tr> <tr> <td>Diagnostic Coverage Simplex(1/yr):</td> <td>85.00</td> </tr> <tr> <td>Diagnostic Coverage Dual(1/yr):</td> <td>85.00</td> </tr> <tr> <td>Diagnostic Coverage Triple(1/yr):</td> <td>85.00</td> </tr> </table>				Failure Dangerous Failure Rate (1/yr):	1.67E-02	Failure Spurious Failure Rate (1/yr):	6.67E-03	CCF Dual(%):	0.1	CCF Triple(%):	0.1	Diagnostic Coverage Simplex(1/yr):	85.00	Diagnostic Coverage Dual(1/yr):	85.00	Diagnostic Coverage Triple(1/yr):	85.00
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Diagnostic Coverage Dual(1/yr):	85.00																
Diagnostic Coverage Triple(1/yr):	85.00																
<table border="1"> <tr> <td>PTD Avg:</td> <td>4.11E-002</td> </tr> <tr> <td>STR:</td> <td>6.67E-003</td> </tr> </table>				PTD Avg:	4.11E-002	STR:	6.67E-003										
PTD Avg:	4.11E-002																
STR:	6.67E-003																
<b>Note:</b> <p>Boundary Conditions: Boundary includes spring return, pneumatically-operated ball valve, operating in a standby (dormant) mode of operation. The solenoid is NOT INCLUDED. Safe-state specified is fail closed.</p>																	
<p>Process Severity Assumption: Clean</p>																	
<b>Data Source:</b> SIL		<input type="button" value="Update"/>															

# What if the design has a complicated “black box” subsystem?

SUPPORT  
CONFIGURATION  
SUPPORT SYSTEM  
CUSTOMER DEVICE  
MANUAL DEVICE  
MANUAL INPUT  
MANUAL ACTION

Most commonly used for complex designs where there is a complicated subsystem in the design that is evaluated using an advanced method such as FTA

SIL Solver® allows for a MANUAL ACTION subsystem and a MANUAL INPUT subsystem

**THESE ARE NOT POPULATED LIKE NORMAL DEVICES**



Click to add field to GUI

The PFDavg and STR contributions for these subsystems are entered directly into the tool

These performance of these subsystems are additive to the overall PFD and STR analysis

# Manual Inputs

The user can enter two parts of a Manual Input analysis:

If two are used, the user must define whether they are redundant to each other (i.e., EITHER subsystem working will allow the overall Manual Input to work) or non-redundant (i.e., BOTH parts must work for the overall Manual Input to work)

DeviceID, Tag, voting architecture and TI are entered for completeness of reporting. The PFDavg and STR are entered directly for each portion of the Manual Input

Check to allow entry of the second Manual Input

Manual Inputs

Redundancy: Non-Redundant

Enable second manual input device

Manual Input Device 1		Manual Input Device 2	
Device ID		Device ID	
Device Tag		Device Tag	
Voting		Voting	
TI (Yr)		TI (Yr)	
PFDavg	0	PFDavg	
STR (1/Yr)	0	STR (1/Yr)	
HFT	0	HFT	0

Update

The user selects the Hardware Fault Tolerance value appropriate for each part of the Manual Input

# Manual Action

Manual Actions

Manual Action

Device ID	<input type="text"/>
Device Tag	<input type="text"/>
Voting	<input type="text"/>
TI (Yr)	<input type="text"/>
PFDavg	0
STR (1/Yr)	0
HFT	0 <input type="button" value="▼"/>

Update

DeviceID, Tag, voting architecture and TI are entered for completeness of reporting. The PFDavg and STR are entered directly for each portion of the Manual Input

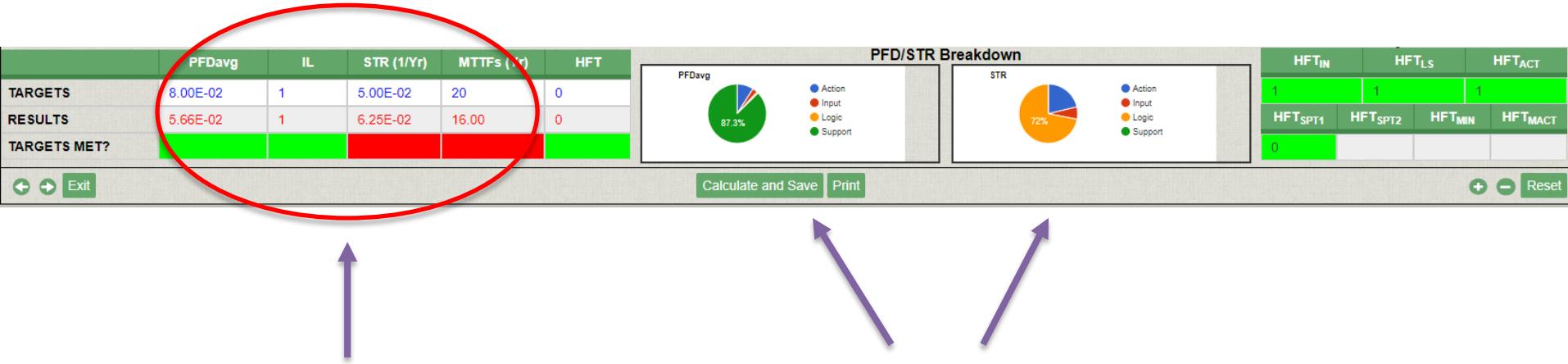
User enters Manual Action HFT Value

# Ready to Calculate?

All devices entered, filled out, and CCF added?  
 Click the “Calculate and Save” button

Site :	SIS-TECH		Function :	and so on	
Project ID:	Prac Proj		Function ID :	test42	
Welcome, kkottawar					
<b>SIL SOLVER</b>					
	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS	8.00E-02	1	5.00E-02	20	0
RESULTS					
TARGETS MET?					
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<b>PFDAvg</b> <					

# Are PFDavg and STR good enough?



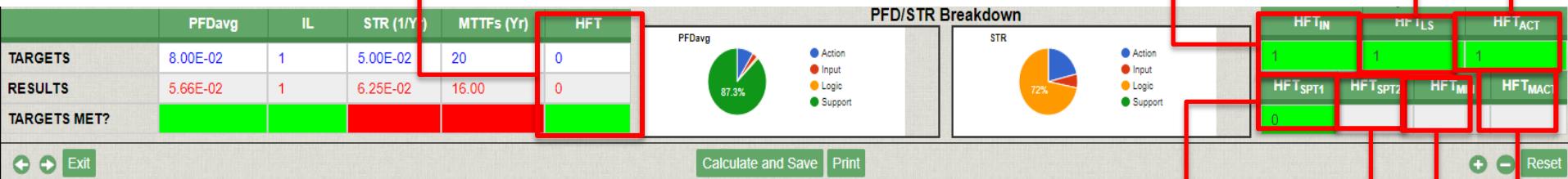
Numerical results and red-green pass-fail indicator on top left of GUI and most SIF reports

Graphical Charts provide information on which components are dominating PFDavg and STR

If necessary, modify design until performance targets are achieved.

# Don't forget Hardware Fault Tolerance (HFT)

HFT Target and  
Overall HFT  
Result



Overall HFT result is the minimum HFT out of the seven main subsystems (see far right side of GUI) for those subsystems that are configured for use in that architecture

HFT for Support  
System 1

HFT for Support  
System 2

HFT for Manual  
Input

HFT for Manual  
Action

HFT for  
Logic  
Solver

HFT for  
Action(s)

HFT for Input(s)

# HFT for Device

The HFT for each field device box (MooN) is determined by the selected architecture within that box as below. The resulting HFT value for each field device is not shown on the GUI, except for logic solver, support system, manual input, and manual action in their respective data sheets.

Architecture(s)	HFT = N - M
1oo1, 1oo1D	0
1oo2, 1oo2D	1
2oo2, 2oo2D	0
1oo3, 1oo3D	2
2oo3, 2oo3D	1
3oo3, 3oo3D	0
2oo4, 2oo4D	2
HFAT/HPATD (unused for LS, but used for some action devices)	1

Site : SIS-TECH Function : V-102 High DP/P Trip  
Project ID: Practice Function ID : SIF 02

Welcome, srizvi

**SIL SOLVER**

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT	HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
<b>TARGETS</b>	8.00E-02	1	5.00E-02	20.00	0	1	1	1
<b>RESULTS</b>	5.53E-02	1	5.94E-02	16.84	0	HFT <sub>SPT1</sub>	HFT <sub>SPT2</sub>	HFT <sub>MIN</sub>
<b>TARGETS MET?</b>						0		HFT <sub>MACT</sub>

PFDAvg STR Breakdown

PFDAvg: 89.4% (Action: 5%, Input: 1%, Logic: 10%, Support: 83%)

STR: 89.4% (Action: 5%, Input: 1%, Logic: 10%, Support: 83%)

Calculate and Save Print

Exit

48

# HFT for Logic Solver

The HFT value for the logic solver (MooN) is determined by the selected architecture. The resulting HFT value for the logic solver is shown on the logic solver data sheet and on the GUI as below. Default value is 0 when importing a logic solver that is not in the current SIL Solver logic solver datasheet.

In this case,  
MooN is 1002D  
2-1=1

Logic Solver  
HFT Value

Logic Solver

Logic Solver ID: DMSIO

Logic Solver Type: GENERIC 1002D DUAL MP; SIMPLEX I/O

Configurations:

Logic Solver Tag: SIS-A

Voltage: 1002D

Proof Testing Interval (yr): 5

PFDavg: 4.92E-004 STR: 4.50E-002

Note:

Boundary Description: Boundary includes 1002D logic solver with dual main processors, 1 simplex digital input module, 1 simplex analog input module, and 1 simplex digital output module.

Implementation Limitations and Exclusions: Refer to the SIL Solver manual for a discussion of "1002D" and "2002D" architectures. The logic solver is certified to IEC 61508 SIL 3 or TUV AK 5-6.

Data Source: SIL HFT: 1

Update

HFT for  
Logic  
Solver

Site: SIS-TECH Function: V-102 High DP/P Trip  
Project ID: Practice Function ID: SIF 02

Welcome, srizvi

SIL SOLVER

	HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
HFT <sub>SPT1</sub>	1	1	1
HFT <sub>SPT2</sub>	0	0	0
HFT <sub>MIN</sub>	0	0	0
HFT <sub>MACT</sub>	0	0	0

PFDavg 89.4% Action  
STR 89.4% Input  
Logic Support

Calculate and Save Print

# HFT for Support System

The HFT value for the support system is shown on the support system data sheet and on the GUI as below. Default value is 0 when importing support systems that are not in the current SIL Solver support system datasheet.

Support System

**Support System ID:** UPSE5S

**Support System Type:** POWER SUPPLY - ETT - 5

**Support System Tag:** UPSE5S-101

**Proof Testing Interval (yr):** 5

**PFDAvg:** 4.94E-002      **STR:** 0.00E+000

**Note:**

Boundary Description: The boundary includes: the incoming ac surge-protection rectifier stage, input capacitors, dc/dc converter or chopper circuit, dc battery circuit and a dc pulse with modulation (PWM) inverter.

Implementation Limitations and Exclusions: Energize-to-trip (ETT) circuits must include: "Line monitoring and loss of circuit continuity alarm"

**Data**      **Source:** SIL      **HFT:** 0      **Update**

Support System  
HFT Value

HFT for Support  
System 1 and  
Support System 2

Site: SIS-TECH      Function: V-102 High DP/P Trip  
Project ID: Practice      Function ID: SIF 02      Welcome, srizvi      SIL SOLVER

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
<b>TARGETS</b>	8.00E-02	1	5.00E-02	20.00	0
<b>RESULTS</b>	5.53E-02	1	5.94E-02	16.84	0
<b>TARGETS MET?</b>	Green	Red	Red	Green	Green

**PFDAvg**      **STR**

**PFD/STR Breakdown**

**HFT IN**      **HFT LS**      **HFT ACT**

	HFT SPT1	HFT SPT2	HFT MIN	HFT MACT
1	1	1	1	1
0	0	0	0	0

Calculate and Save      Print      +      -      Reset

# HFT Results for Manual Input and Manual Action

HFT Results for Manual Input and Manual Action

←

Site : SIS-TECH  
Project ID: Practice

Function : V-102 High DP/P Trip  
Function ID : SIF 02

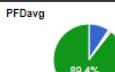
Welcome, srizvi

**SIL SOLVER**

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS	8.00E-02	1	5.00E-02	20.00	0
RESULTS	5.53E-02	1	5.94E-02	16.84	0
TARGETS MET?	Green	Red	Red	Red	Green

**PFD/STR Breakdown**

PFDavg



- Action
- Input
- Logic
- Support

STR



- Action
- Input
- Logic
- Support

HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>
1	1	Green
HFT <sub>SPT1</sub>	HFT <sub>SPT2</sub>	HFT <sub>MIN</sub>
0		HFT <sub>MACT</sub>

**Calculate and Save** **Print**

**Reset**

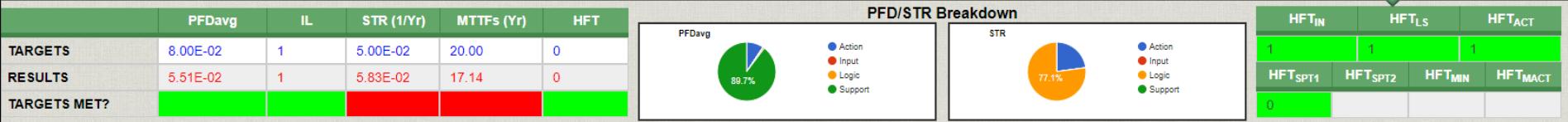
# Is that all?

- The SIL Calculation is performed within a context of performance assumptions and other SIL evaluations (e.g., independence of SIF from other functions in the hazard case the SIF is designed for)
- The documentation of the SIL calculation should include sufficient SRS information to provide this context

# SRS Info

Site : **SIS-TECH** Function : **V-101**  
Project ID: **Practice** Function ID : **SIF 01**

Welcome, srizvi



  [Exit](#)

[Calculate and Save](#) [Print](#)

Reset

SRS

## PROCESS HAZARD

### DESCRIPTION

## DIAGNOSTICS

RESET

SHUTDOWN

## REFERENCE

## COMMENTS

LOGIC SOLVED

## INPUT CONFIGURATION

INPUT DEVICE

• 100 •

1000 JOURNAL OF CLIMATE

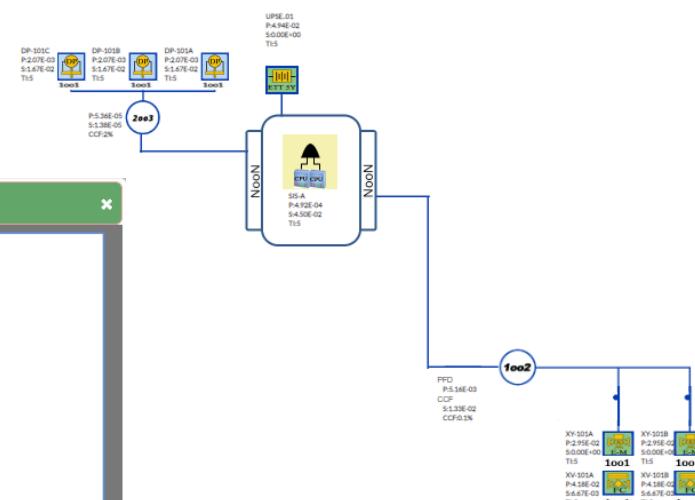
1000

1000000000

1000

## Process Hazard

Save



# Done with SIF 01

Site : SIS-TECH Function : V-101  
Project ID: Practice Function ID : SIF 01

Welcome, srizvi

**SIL SOLVER**

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT		HFT <sub>IN</sub>	HFT <sub>LS</sub>	HFT <sub>ACT</sub>	
<b>TARGETS</b>	8.00E-02	1	5.00E-02	20.00	0					
<b>RESULTS</b>	5.51E-02	1	5.83E-02	17.14	0					
<b>TARGETS MET?</b>	Met						1	1	1	
							HFT <sub>SPT1</sub>	HFT <sub>SPT2</sub>	HFT <sub>MIN</sub>	HFT <sub>MACT</sub>
							0			

**PFD/STR Breakdown**

PFDavg  
89.7%

Action  
Input  
Logic  
Support

STR  
77.1%

Action  
Input

**Exit**   Exit to return to main Protective Function screen for this project

**Calculate and Save** **Print**     **Reset**

**SRS**

PROCESS HAZARD

DESCRIPTION

DIAGNOSTICS

RESET

SHUTDOWN

REFERENCE

COMMENTS

**LOGIC SOLVER**

INPUT CONFIGURATION

INPUT DEVICE

ACTION CONFIGURATION

ACTION DEVICE

SUPPORT CONFIGURATION

SUPPORT SYSTEM

CUSTOMER DEVICE

MANUAL DEVICE

The diagram illustrates a 2oo3 logic configuration. It features a central SIF CPU (SIS-A) with three inputs (P-207E-03, P-207E-02, P-207E-01) and three outputs (XV-501A, XV-501B, XV-501C). The logic is configured as follows:

- Inputs: P-207E-03 (T15), P-207E-02 (T15), P-207E-01 (T15) are connected to a 2oo3 logic block.
- 2oo3 logic block output connects to the SIF CPU.
- SIF CPU output connects to a 1oo2 logic block.
- 1oo2 logic block output connects to the following outputs:
  - XV-501A (T15): 1001 (T15)
  - XV-501B (T15): 1001 (T15)
  - XV-501C (T15): 1001 (T15)
- Each output (XV-501A, XV-501B, XV-501C) is connected to a 1oo2 logic block.
- 1oo2 logic block output connects to the following inputs:
  - P-207E-03 (T15): 1001 (T15)
  - P-207E-02 (T15): 1001 (T15)
  - P-207E-01 (T15): 1001 (T15)
- Inputs P-207E-03, P-207E-02, and P-207E-01 are connected to a 2oo3 logic block.
- 2oo3 logic block output connects to the SIF CPU.

# Second Function

- This project includes V-102 as well
- V-102 has an analogous protective function, SIF 02
- Key difference, SIF 02 uses a single pressure transmitter as the third device, instead of a DP
- Tags: DP-102A/B, PT-102, XV/XY-102A/B

# Copy SIF 01

Site: SIS-TECH Project ID: Practice Function ID: SIF 01

Protective Function

			Import	Export	Print Reports	PF Documentation	Project Data Sheets	PF Details	Copy	Delete	Exit	PF Revision Level
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result				
SIF 01	V-101	Low Demand	8.00E-02	7.21E-03	5.00E-02	6.25E-02	1	2				

[Create Filter](#)

From the main Protective Function page, selecting the function to be copied and clicking the Copy button...

Site: SIS-TECH Project ID: Practice Function ID: SIF 01

Protective Function

			Import	Export	Print Reports	PF Documentation	Project Data Sheets	PF Details	Paste	Copy	Delete	Exit	PF Revision Level
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result					
SIF 01	V-101	Low Demand	8.00E-02	7.21E-03	5.00E-02	6.25E-02	1	2					

[Create Filter](#)

Causes the Paste button to activate...

# Create SIF 02

Clicking the Paste button opens the dialog box to enter the new function ID and description

The screenshot shows the SIL SOLVER software interface for creating a Protective Function. The main window displays a table with columns for Function ID, Function, Mode Of Operation, PFD Target, PFD Result, STR Target (1/yr), STR Result (1/yr), IL Target, and IL Result. A row for SIF 01 is selected, showing values: V-101, Low Demand, 8.00E-02, 7.21E-03, 5.00E-02, 6.25E-02, 1, and 2. A modal dialog box titled "Protective Function" is open, prompting for a new Function ID (SIF 02) and Function description (V-102 High DP/P Trip). The "Save" button is visible at the bottom of the dialog.

Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result
SIF 01	V-101	Low Demand	8.00E-02	7.21E-03	5.00E-02	6.25E-02	1	2

**Protective Function**

**Function ID:** SIF 02

**Function :** V-102 High DP/P Trip

# Success!



Welcome, srizvi

Site: SIS-TECH

Project ID: Practice

Function ID: SIF 01

Protective Function

Function ID Saved Successfully

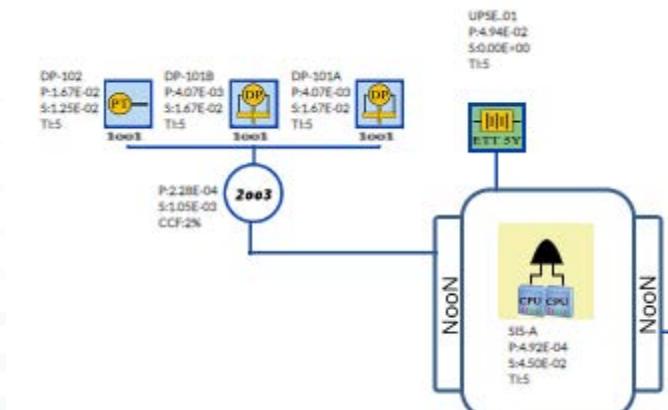
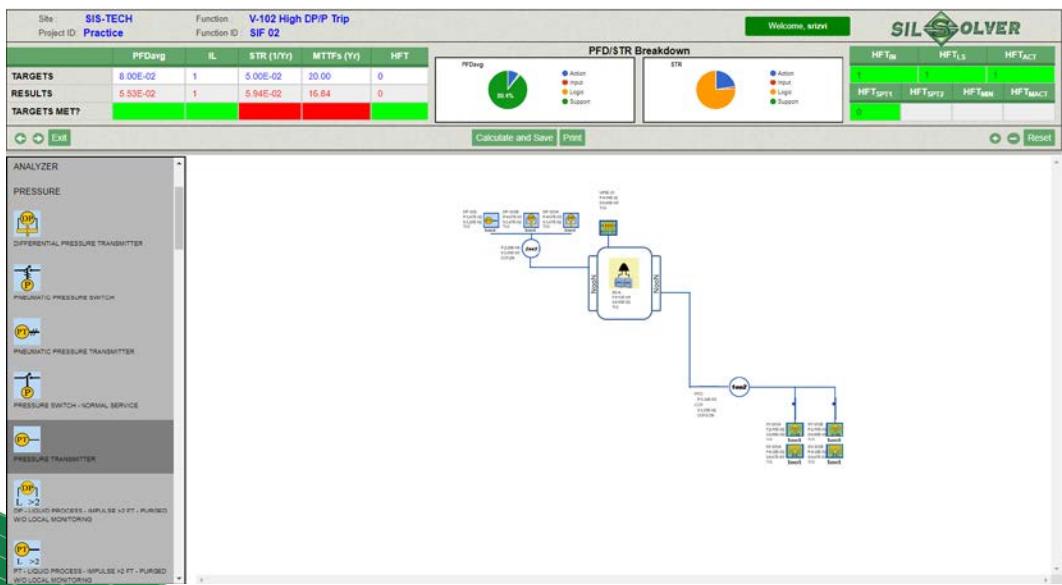
			Import	Export	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Results Summary
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result			
SIF 01	V-101	Low Demand	8.00E-02	7.21E-03	5.00E-02	6.25E-02	1	2			
SIF 02	V-102 High DP/P Trip	Low Demand	8.00E-02	7.21E-03	5.00E-02	6.25E-02	1	2			

Create Filter

Select the new function and Open  
Update tag ID fields for all devices

# Modeling diverse sensors

1. Delete the third DP sensor
2. Copy General Pressure transmitter
3. Paste General pressure transmitter to the last box in the 2oo3 input configuration
4. Change Diagnostic level to DC2 for the two DP pressure transmitters and keep the General PT Diagnostic level as NO DC (no device to compare with).



# Partial Stroke Testing of Valves

- For valves, the DC selection can be used to model partial stroke testing

1. Set the diagnostic level to DC1

2. Set the diagnostic interval to partial stroke testing interval

Both fields must be configured for correct use of equation

Properties:	
Failure Dangerous Failure Rate (1/yr):	1.67E-02
Failure Spurious Failure Rate (1/yr):	6.67E-03
Common Cause Factor CCF Dual (%):	0.1
Common Cause Factor CCF Triple (%):	0.1
Diagnostic Coverage Simplex DC1 (1/yr):	85.00
Diagnostic Coverage Dual DC2 (1/yr):	85.00
Diagnostic Coverage Triple DC3 (1/yr):	85.00

Maintenance:	
Mean Time to Repair (hr):	720
Diagnostic Interval (hr):	720
Overhaul Interval (yr):	20
Proof Testing Coverage (%):	100

Note:  
Boundary Conditions: Boundary includes spring return, pneumatically-operated ball valve, operating in a standby (dormant) mode of operation. The solenoid is NOT INCLUDED. Safe-state specified is fail closed.  
Process Severity Assumption: Clean

Data Source: SIL      Update

# Partial Interim Testing of Sensors

- Sometimes an imperfect test is performed on a sensor at a shorter interval, with a 100% proof test (or complete replacement) performed at a longer interval
- Use the Proof Test coverage and Overhaul interval to model this

Example:  
Sensor installation  
with an 85% test  
performed  
annually with  
100% test or full  
replacement done  
every 10 years

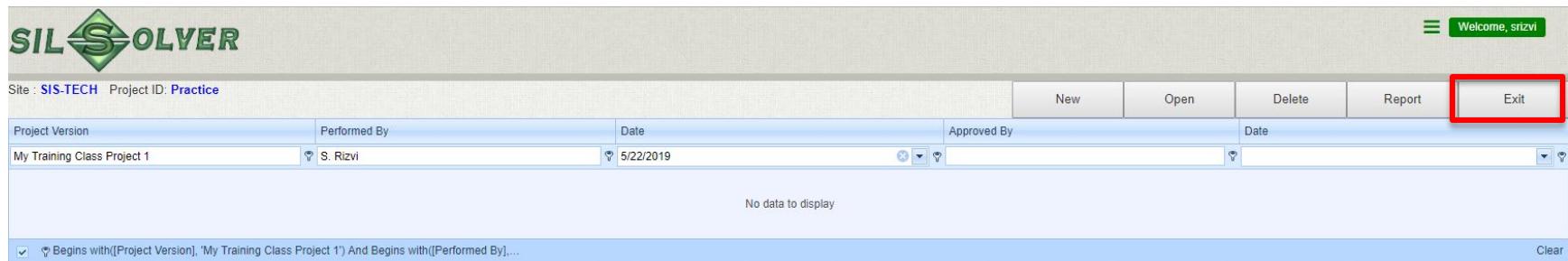
Device

Device ID:	THMLS	Device Type:	THERMOCOUPLE - LOW STRESS ENVIRONMENT
Configurations:		Properties:	
Device Tag:	TT1	Failure Dangerous Failure Rate (1/yr):	5.00E-03
Proof Testing Interval (yr):	1	Failure Spurious Failure Rate (1/yr):	4.00E-02
Voting:	1oo1	Common Cause Factor CCF Dual (%):	2
Subsystem Diagnostic Level:	NO DC	Common Cause Factor CCF Triple (%):	2
Maintenance:		Diagnostic Coverage Simplex DC1 (1/yr):	
Mean Time to Repair (hr):	72	Diagnostic Coverage Dual DC2 (1/yr):	60.00
Diagnostic Interval (hr):	0.500	Diagnostic Coverage Triple DC3 (1/yr):	80.00
Overhaul Interval (yr):	10	Note:	
Proof Testing Coverage (%):	85	Boundary Conditions: Boundary includes thermocouple element and insulators, terminal head and protecting tube or thermowell.	
User Specified		Process Severity Assumption: Clean	
		Implementation Limitations and Exclusions: A low stress environment does not include the following: high vibration application	
Data Source: SIL		Update	

Both fields must be  
configured for correct use  
of equation

# Getting back to Project Home

2 WAYS



SIL SOLVER

Welcome, srizvi

Site : SIS-TECH Project ID: Practice

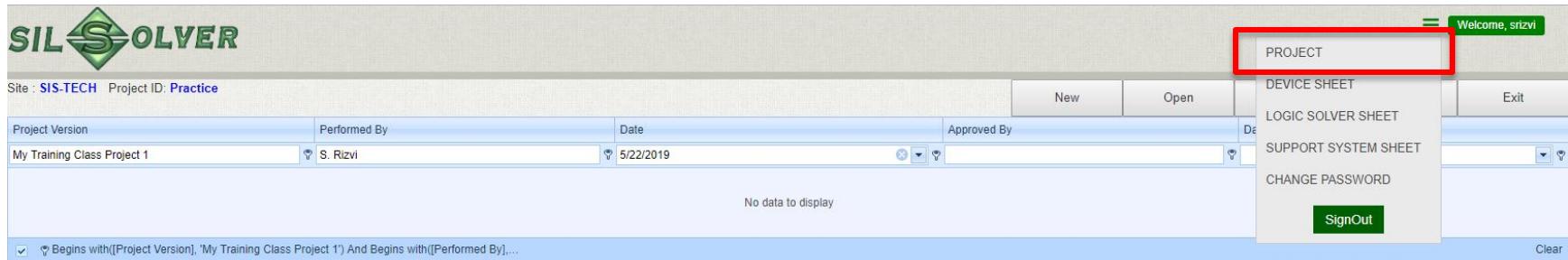
Project Version	Performed By	Date	Approved By	Date
My Training Class Project 1	S. Rizvi	5/22/2019		

No data to display

Begins with([Project Version], 'My Training Class Project 1') And Begins with([Performed By],...)

Clear

New Open Delete Report Exit



SIL SOLVER

Welcome, srizvi

Site : SIS-TECH Project ID: Practice

Project Version	Performed By	Date	Approved By	Date
My Training Class Project 1	S. Rizvi	5/22/2019		

No data to display

Begins with([Project Version], 'My Training Class Project 1') And Begins with([Performed By],...)

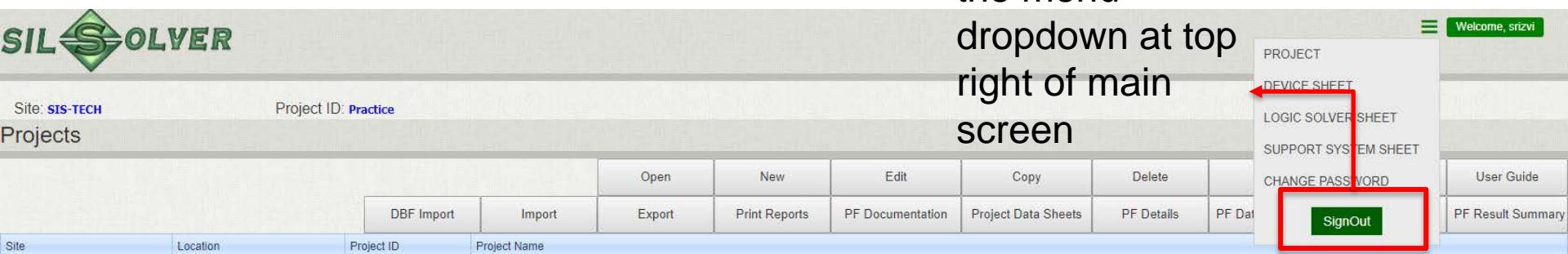
Clear

PROJECT DEVICE SHEET LOGIC SOLVER SHEET SUPPORT SYSTEM SHEET CHANGE PASSWORD SignOut

# Exiting SIL Solver®?



Exit the software  
from the main  
screen



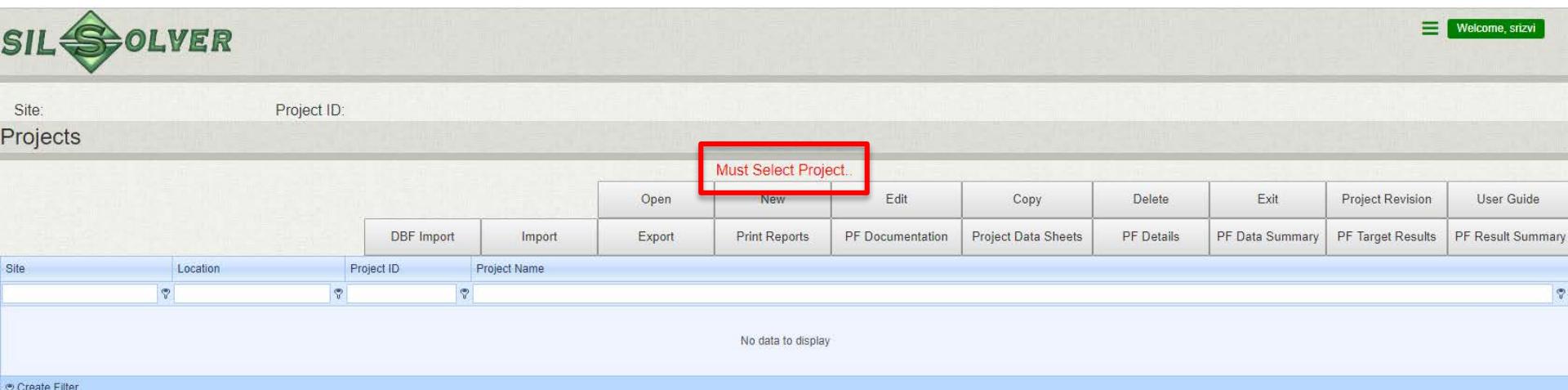
SignOut from  
the menu  
dropdown at top  
right of main  
screen

### **3. EDITING, COPYING OR DELETING AN EXISTING PROJECT**

# If click Edit on main screen when there are No projects...

By default, the first project in the project list is selected.

Error text will pop up if user attempts a feature (e.g., Edit) that requires a project to be selected and there are no projects in the list.



The screenshot shows the SIL SOLVER software interface. At the top, there is a navigation bar with 'SIL SOLVER' on the left and 'Welcome, srizvi' on the right. Below the navigation bar, there are fields for 'Site:' and 'Project ID:' and a 'Projects' button. The main area is a table with columns: Site, Location, Project ID, and Project Name. Below the table, there is a message 'No data to display'. At the top of the table, there is a toolbar with buttons: Open, New, Edit, Copy, Delete, Exit, Project Revision, and User Guide. The 'Edit' button is highlighted with a red box and contains the text 'Must Select Project..'. Other buttons in the toolbar include DBF Import, Import, Export, Print Reports, PF Documentation, Project Data Sheets, PF Details, PF Data Summary, PF Target Results, and PF Result Summary.

# Function Revision Info

To create/edit function revision information, select the function and click “function Revision level” to get to the editing page, where you can create/edit and delete the function revision information

SIL SOLVER      Welcome, srizvi

Site: SIS-TECH      Project ID: Practice      Function ID: SIF 02

Protective Function

			Import	Export	Print Reports	PFD Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Results Summary	PF Revision Level
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result				
SIF 02	V-102 High DP/P Trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1				
SIF 01	V-101	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1				

Create Filter

SIL SOLVER      Welcome, srizvi

Site : SIS-TECH Project ID: Practice Function : SIF 02

Function Version	Performed By	Date	Approved By	Date	New	Open	Delete	Report	Exit

No data to display

Create Filter

# Copying or deleting a project works like copying or deleting a function

Appear when a project is copied

Select the project

Copy → Make a copy of the selected project and after that a paste button will appear, when “paste” is click a window will pop up for you to enter new project designation.

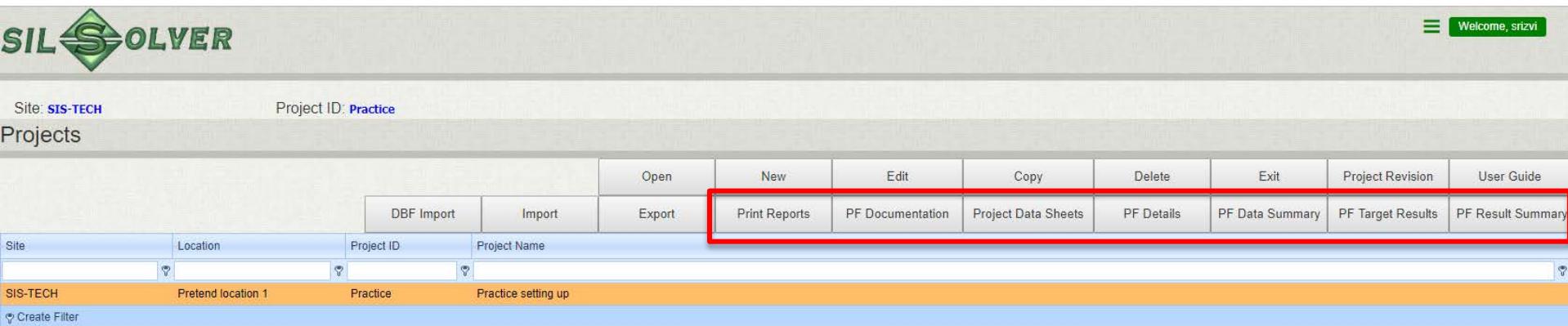
Delete → Delete the selected project

## 4. GENERATING REPORTS

# Project Report generation

Print the reports for the whole project by selecting project and click relevant report tab.

When the project reports are printed, the report will include project revision information

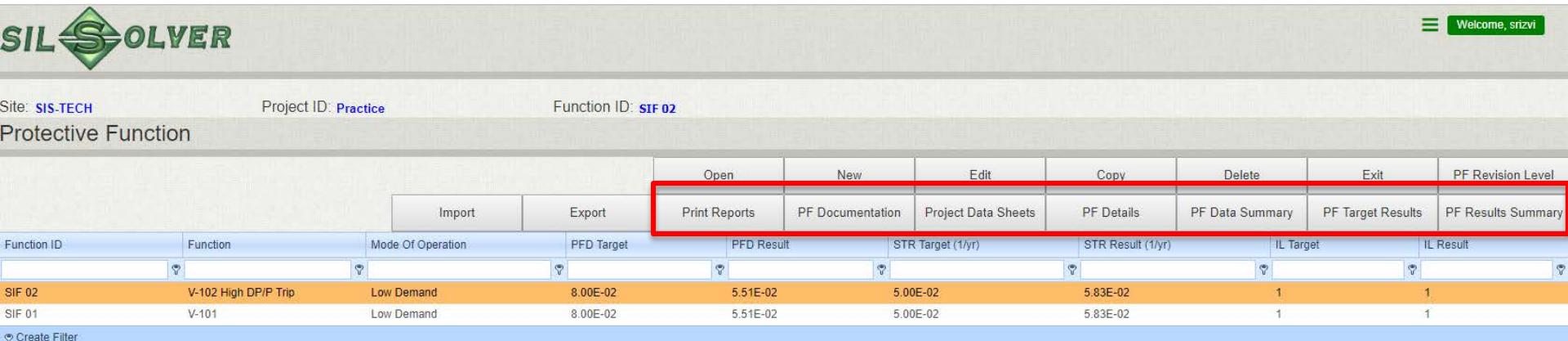


The screenshot shows the SIL-SOLVER software interface. At the top, there is a navigation bar with the 'SIL-SOLVER' logo, a user welcome message 'Welcome, sruvi', and a menu icon. Below the navigation bar, the main title 'Projects' is displayed. The main content area shows a table with columns for 'Site', 'Location', 'Project ID', and 'Project Name'. The 'Project Name' column for the first row contains the value 'Practice'. Below the table, there is a status bar with the text 'SIS-TECH', 'Prefend location 1', 'Practice', and 'Practice setting up'. At the bottom of the status bar, there is a 'Create Filter' link. The top menu bar is highlighted with a red box, showing various options like 'Open', 'New', 'Edit', 'Copy', 'Delete', 'Exit', 'Project Revision', and 'User Guide'. The 'Print Reports' option is specifically highlighted within this menu bar.

# Function Report generation

Print the reports for a function by going to the function list, select a function and click relevant report tab.

When the function level reports are printed, the report will include function revision information

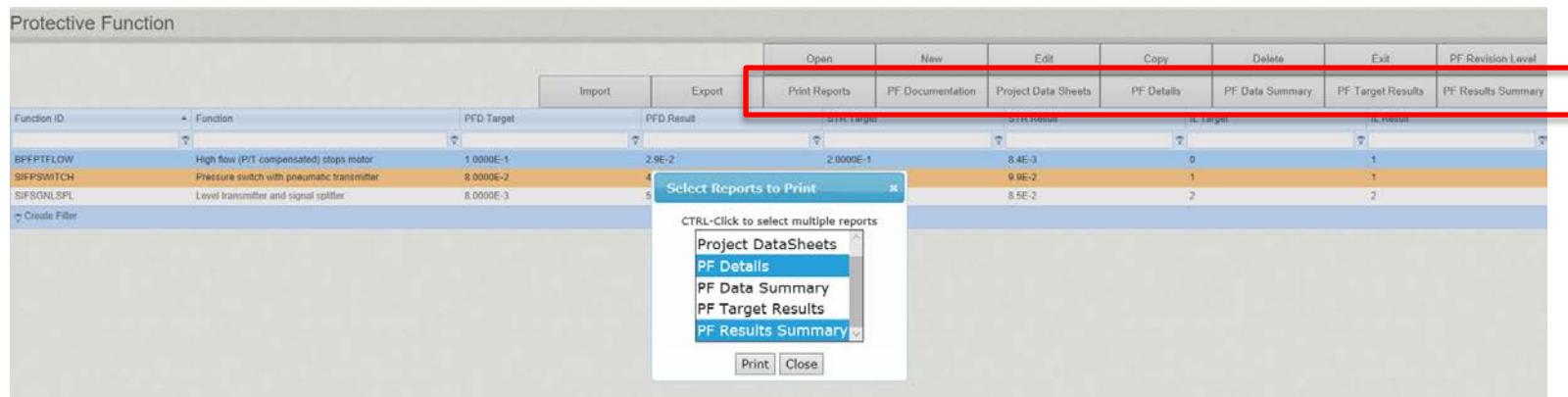


The screenshot shows the SIL SOLVER software interface. At the top, there is a navigation bar with the SIS TECH logo, a search bar, and a user welcome message 'Welcome, srizvi'. Below the navigation bar, the main title 'Protective Function' is displayed. The central part of the screen shows a table of functions with columns for Function ID, Function, Mode Of Operation, PFD Target, PFD Result, STR Target (1/yr), STR Result (1/yr), IL Target, and IL Result. The 'Function ID' column shows 'SIF 02' and 'SIF 01'. The 'Function' column shows 'V-102 High DP/P Trip' and 'V-101'. The 'Mode Of Operation' column shows 'Low Demand' for both. The 'PFD Target' column shows '8.00E-02' for SIF 02 and '8.00E-02' for SIF 01. The 'PFD Result' column shows '5.51E-02' for SIF 02 and '5.51E-02' for SIF 01. The 'STR Target (1/yr)' column shows '5.00E-02' for both. The 'STR Result (1/yr)' column shows '5.83E-02' for SIF 02 and '5.83E-02' for SIF 01. The 'IL Target' column shows '1' for both. The 'IL Result' column shows '1' for both. At the top of the table, there is a toolbar with various buttons: Import, Export, Open, New, Edit, Copy, Delete, Exit, and PF Revision Level. The 'Print Reports' button is highlighted with a red box. The 'Function ID: SIF 02' is also highlighted in the table header.

Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result
SIF 02	V-102 High DP/P Trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1
SIF 01	V-101	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1

# Selecting Reports

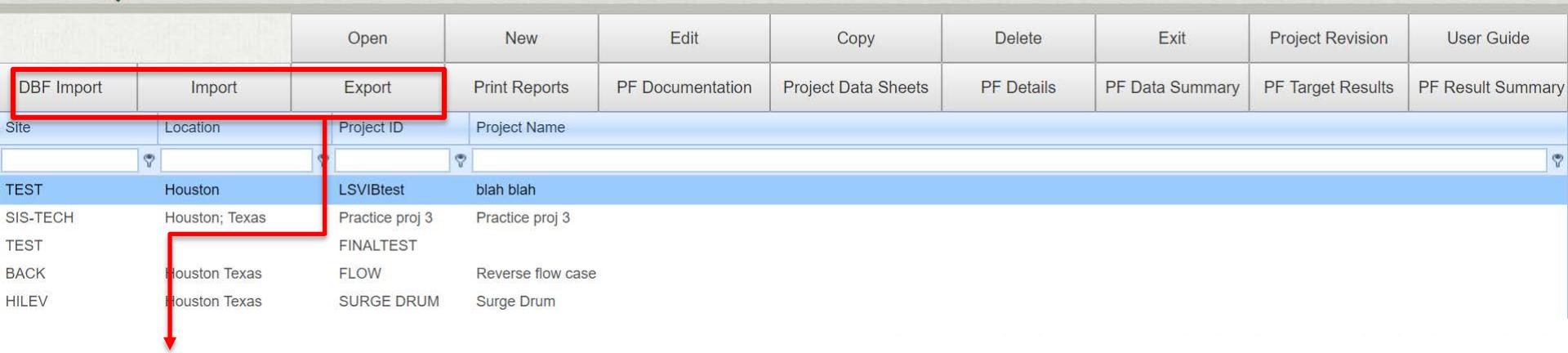
Use Print Report to select multiple reports at once or look at one at a time...



<input type="checkbox"/> Name	Type	Compressed size	Password pr...
<a href="#"> PF_DETAILS-20180205-224320</a>	Adobe Acrobat Document	183 KB	No
<a href="#"> PF_RESULT-SUMMARY-20180205-22...</a>	Adobe Acrobat Document	122 KB	No

## 5. IMPORTING/EXPORTING

- Project export from SIL Solver® Enterprise
- SIL Solver® Enterprise project import
- Function Export/Import
- Importing SIL Solver® desktop application files into SIL Solver® Enterprise (DBF Import)



		Open	New	Edit	Copy	Delete	Exit	Project Revision	User Guide
DBF Import	Import	Export	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary
Site	Location	Project ID	Project Name						
TEST	Houston	LSVIBtest	blah blah						
SIS-TECH	Houston; Texas	Practice proj 3	Practice proj 3						
TEST		FINALTEST							
BACK	Houston Texas	FLOW	Reverse flow case						
HILEV	Houston Texas	SURGE DRUM	Surge Drum						

Used to transfer information

- between people
- between SIL SOLVER® Enterprise tool versions
- from SIL SOLVER® desktop program to SIL SOLVER® Enterprise

# Import and export

- The way to share a project/function between SIL Solver® Enterprise users



## DBF Import

- The way to transfer a project from a SIL Solver® desktop program into SIL Solver® Enterprise

# Project export

To export a project:

1. Go to the project page
2. Select the project
3. Click export – confirm the Site and ProjectID and click Export in dialog
4. A \*.sifprj file of the project will be created in the download folder

The screenshot shows a software interface for managing projects. At the top, there is a toolbar with buttons for 'Open', 'New', 'Print Reports', and 'PF'. Below the toolbar is a table with columns: 'Site', 'Location', 'Project ID', and 'Project Name'. The table contains the following data:

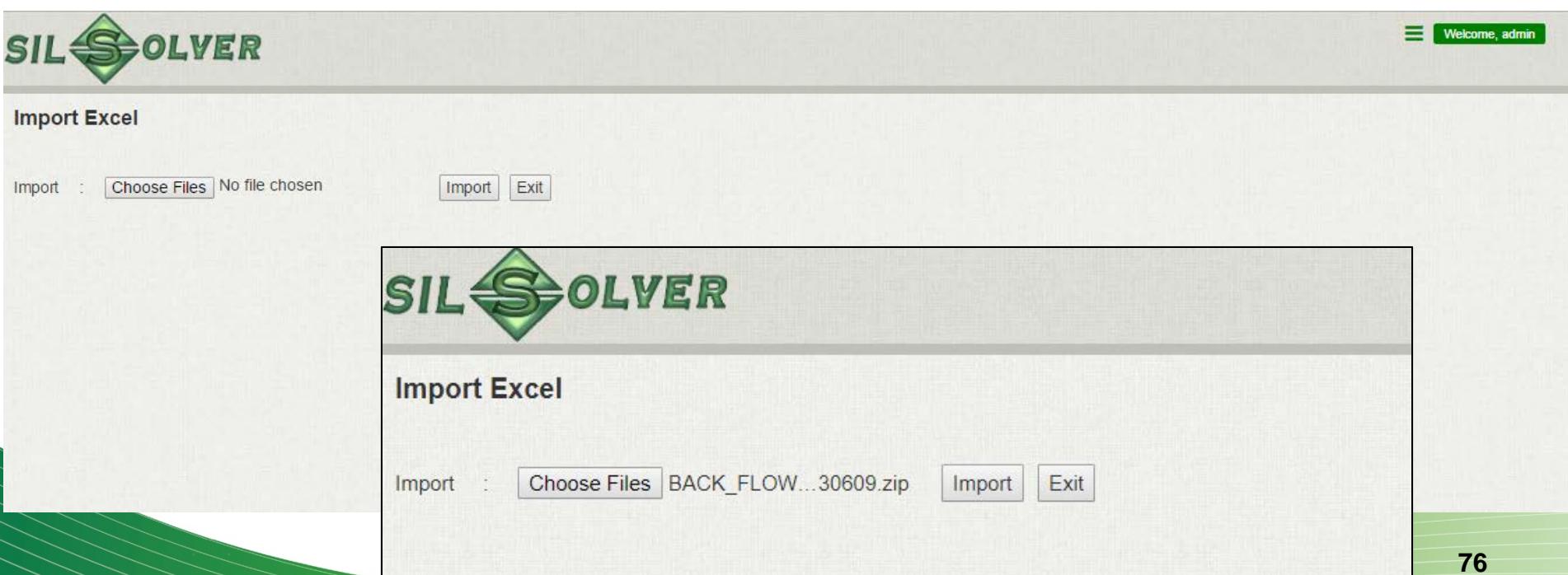
Site	Location	Project ID	Project Name
TEST		FINALTEST	
TEST	Houston	LSVIBtest	blah blah
SIS-TECH	Houston; Texas	Practice proj 3	Practice proj 3
PUMP	Houston	PROTECT	Dead Protection Study
LOWDR	Houston	TRAY LEVEL	Scrubber 15-10-003
LOSS	Houston	PASS FLOW	Reboiler
HILEV	Houston Texas	SURGE DRUM	Surge Drum
BACK	Houston Texas	FLOW1	Reverse flow case

At the bottom left of the table, there is a 'Create Filter' button. On the right side of the interface, a modal dialog box titled 'Export Project' is displayed. The dialog box contains two input fields: 'Site:' with the value 'BACK' and 'Project ID:' with the value 'FLOW1'. Below the input fields are two buttons: 'Export' and 'Close'.

# Project import

To import a previously exported Enterprise project:

1. Go to the project page
2. Click import, the following page will open
3. Click “choose files”, then change the directory to the project (\*.silprj) file you want to import
4. Click Import and the tool will attempt to import the file



The screenshot shows the SIL SOLVER software interface. At the top, there is a navigation bar with the SIL SOLVER logo and a 'Welcome, admin' message. Below the navigation bar, the main title 'Import Excel' is displayed. The interface includes a file input field labeled 'Import : Choose Files' with the placeholder 'No file chosen', and two buttons: 'Import' and 'Exit'. A large central window displays the same 'Import Excel' title and the same file input field. The bottom right corner of the slide contains the number '76'.

# SIL Solver® Enterprise Function export/import

To export/import an Enterprise function is the same as for a project, the only difference is that the operations are on the function level page and the exported file extension is \*.silsif

# DBF import to Enterprise

To import a **project** from SIL Solver® desktop versions into SIL SOLVER® Enterprise

1. Go to the folder where you saved the desktop software project
  - For example the default directory: C:\SILSolver\_Projects
2. Make sure the project folder name is correct, the files in the folder have not been modified, and no additional files have been added to the folder
3. Zip the project folder that you want to import to SIL Solver® Enterprise
4. Go to the SIL Solver® Enterprise project page
5. Click “DBF import” tab, the following page will open
6. Click Choose Files to browse to the Zipped project folder
7. Click “Upload\_ZipFile”
8. When the upload is ready, click import
9. A message will pop up when the import is done, including any warnings



Upload Files to Import

No file chosen



Upload Files to Import

SISTC\_MIMOS.zip



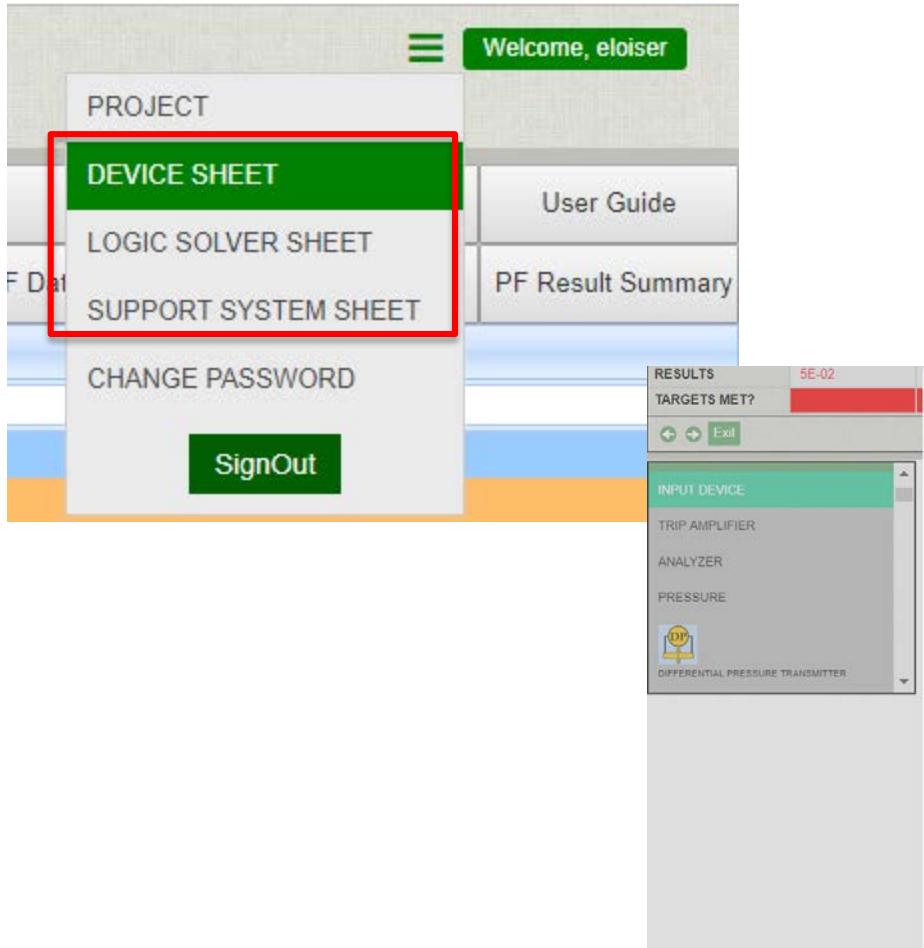
Press Import to complete the DBF import process.

No file chosen

## 6. DATASHEETS

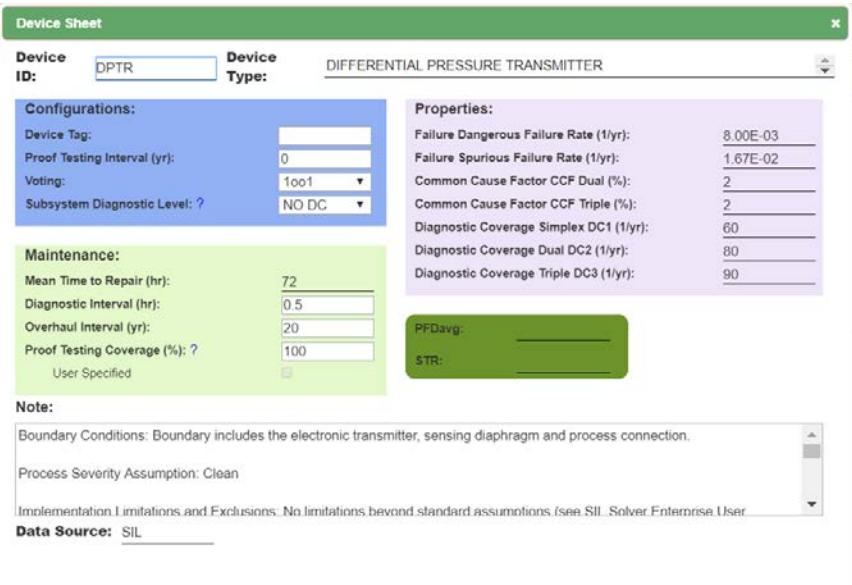
- Device
- Logic Solver
- Support System

# Accessing Datasheets



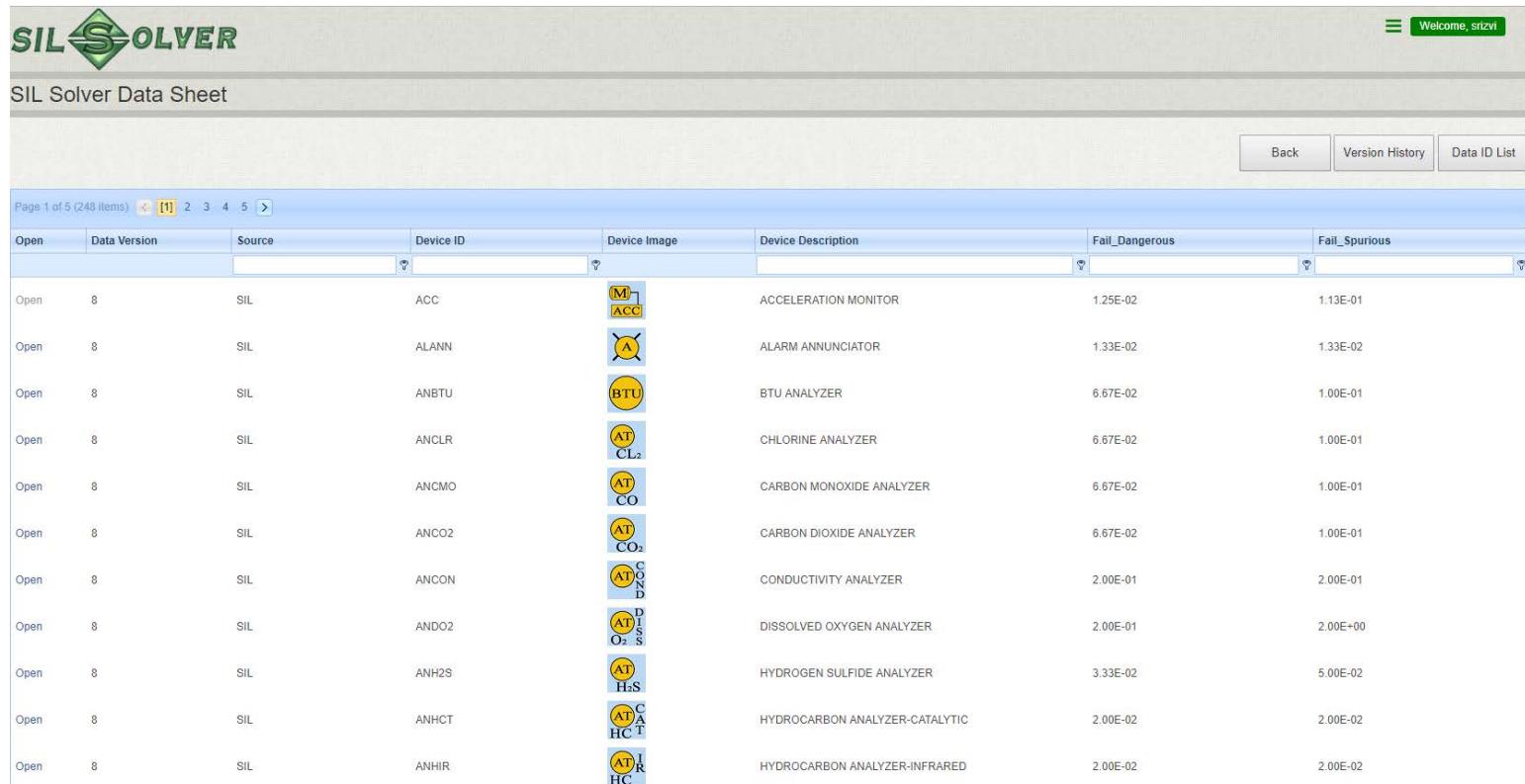
The screenshot shows the software's main menu on the left. A red box highlights the 'DEVICE SHEET' option in the 'PROJECT' dropdown menu. Other options in the dropdown include 'LOGIC SOLVER SHEET' and 'SUPPORT SYSTEM SHEET'. Below the dropdown, there are buttons for 'CHANGE PASSWORD' and 'SignOut'. The main workspace shows a 'User Guide' and 'PF Result Summary' panel. A 'RESULTS' panel indicates 'TARGETS MET?' with a red '5E-02'. A 'Device Sheet' window is open, showing details for a 'DIFFERENTIAL PRESSURE TRANSMITTER' with ID 'DPTR'. The window includes sections for 'Configurations', 'Properties', 'Maintenance', and 'Note'.

Access from main page dropdown menu or for individual devices right-click when in device list on GUI



The 'Device Sheet' window for a 'DIFFERENTIAL PRESSURE TRANSMITTER' (DPTR) is shown. The 'Device ID' is 'DPTR' and the 'Device Type' is 'DIFFERENTIAL PRESSURE TRANSMITTER'. The 'Configurations' section includes fields for 'Device Tag' (empty), 'Proof Testing Interval (yr)' (0), 'Voting' (1oo1), and 'Subsystem Diagnostic Level' (NO DC). The 'Properties' section lists failure rates and common cause factor values. The 'Maintenance' section shows 'Mean Time to Repair (hr)' (72), 'Diagnostic Interval (hr)' (0.5), 'Overhaul Interval (yr)' (20), and 'Proof Testing Coverage (%)' (100). The 'Note' section contains boundary conditions, process severity assumptions, and implementation limitations.

# Device datasheet list



Open	Data Version	Source	Device ID	Device Image	Device Description	Fail_Dangerous	Fail_Spurious
Open	8	SIL	ACC		ACCELERATION MONITOR	1.25E-02	1.13E-01
Open	8	SIL	ALANN		ALARM ANNUNCIATOR	1.33E-02	1.33E-02
Open	8	SIL	ANBTU		BTU ANALYZER	6.67E-02	1.00E-01
Open	8	SIL	ANCLR		CHLORINE ANALYZER	6.67E-02	1.00E-01
Open	8	SIL	ANCMO		CARBON MONOXIDE ANALYZER	6.67E-02	1.00E-01
Open	8	SIL	ANCO2		CARBON DIOXIDE ANALYZER	6.67E-02	1.00E-01
Open	8	SIL	ANCON		CONDUCTIVITY ANALYZER	2.00E-01	2.00E-01
Open	8	SIL	ANDO2		DISSOLVED OXYGEN ANALYZER	2.00E-01	2.00E+00
Open	8	SIL	ANH2S		HYDROGEN SULFIDE ANALYZER	3.33E-02	5.00E-02
Open	8	SIL	ANHCT		HYDROCARBON ANALYZER-CATALYTIC	2.00E-02	2.00E-02
Open	8	SIL	ANHIR		HYDROCARBON ANALYZER-INFRARED	2.00E-02	2.00E-02

- Click open (far left) to look at the datasheet for that device

# Device Datasheet



## SIL Solver Data Sheet

Welcome, srizvi

DATA SHEET

Back

DataSource

Device Id



Device Type

Fail Dangerous Failure Rate(1/yr)

Fail Spurious Failure Rate(1/yr)

Mean Time to Repair(hrs)

Common Cause Factor Dual Mode(%)

Common Cause Factor Triple Mode(%)

Diagnostic Interval(hrs)

Diagnostic Coverage in Simplex Mode(%)

Diagnostic Coverage in Dual Mode(%)

Diagnostic Coverage in Triplicated Mode(%)

### Notes

Boundary Conditions: Boundary includes process connection, sampling system and analyzer.

Process Severity Assumption: Clean

Implementation Limitations and Exclusions: Calculation assumes the sampling system is monitored and alarmed. Calibration may be required more frequently than the calculation indicates due to sensor degradation and replacement.

Diagnostic coverage and common cause factors are based on common sampling system. If sampling system is separate for each analyzer, the use of these values will result in a conservative PFDavg.

Data Sources:

# Same for LS and Support Systems

**SIL SOLVER**

SIL Solver Logic Solver Sheet

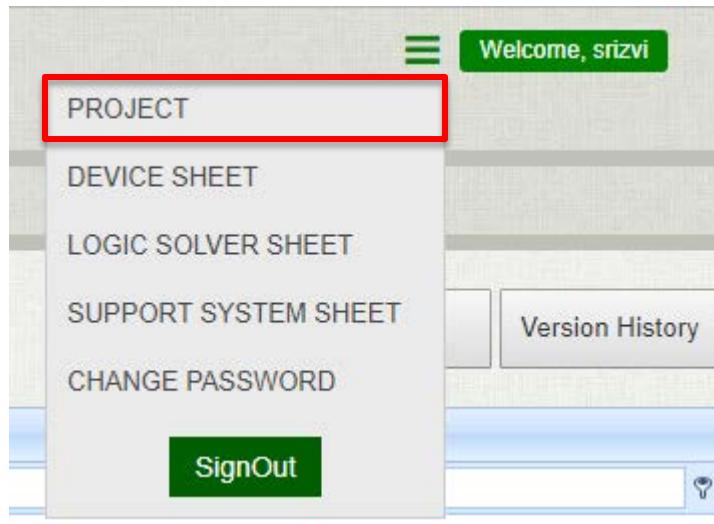
Open	Data Version	Source	Logic Solver ID	Logic Solver Image	Logic Solver Description
Open	8	SIL	DMDIO		GENERIC 200AD DUAL MP: DUAL I/O
Open	8	SIL	DMSIO		GENERIC 100DD DUAL MP: SIMPLEX I/O
Open	8	SIL	NSDD		NON SC PES DUAL MP: DUAL I/O
Open	8	SIL	NSDS		NON SC PES DUAL MP: SIMPLEX I/O
Open	8	SIL	NSSS		NON SC PES SIMPLEX MP: SIMPLEX
Open	8	SIL	RELFLC		RELAY - FAIL TO CLOSE

**SIL SOLVER**

SIL Solver Support System Data Sheet

Open	Data Version	Source	Support System ID	Support System Image	Support System Description
Open	8	SIL	IADMRS		INSTRUMENT AIR-DIVERSITY/MONITORED RECEIVER
Open	8	SIL	IADRS		INSTRUMENT AIR-DIVERSITY RECEIVER
Open	8	SIL	IADS		INSTRUMENT AIR-COMPRESSOR DIVERSITY
Open	8	SIL	IANDVS		INSTRUMENT AIR-NO DIVERSITY
Open	8	SIL	IARWCS		INSTRUMENT AIR-RECIEVER
Open	8	SIL	IARWRMS		INSTRUMENT AIR-MONITORED RECEIVER
Open	8	SIL	UPSDOMS		UPS - POWER SUPPLY - DTT - MONITORED
Open	8	SIL	UPSDTS		POWER SUPPLY - DTT
Open	8	SIL	UPSE1S		POWER SUPPLY - ETT - 1 YEAR TESTING
Open	8	SIL	UPSE2S		POWER SUPPLY - ETT - 2 YEAR TESTING
Open	8	SIL	UPSE3S		POWER SUPPLY - ETT - 3 YEAR TESTING
Open	8	SIL	UPSE4S		POWER SUPPLY - ETT - 4 YEAR TESTING

# Returning to Project View



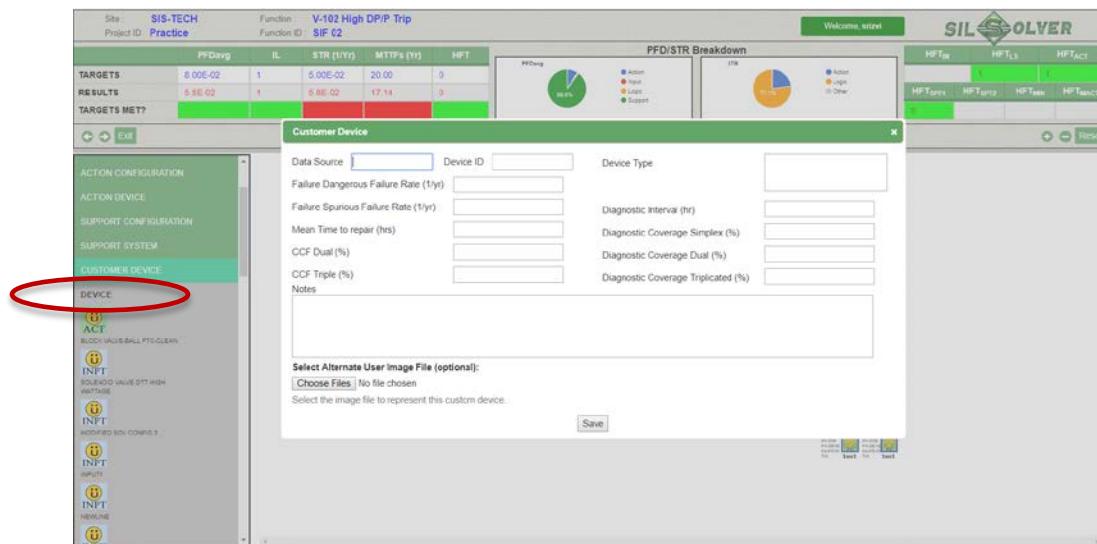
Click Project on the dropdown menu or use Back buttons on the datasheet pages

A screenshot of a software interface titled 'SIL SOLVER'. At the top right, it says 'Welcome, srizvi'. Below that is a 'Back' button (highlighted with a red box) and a 'Version History' button. The main area is titled 'SIL Solver Support System Data Sheet'. At the bottom, there is a table with the following columns: Open, Data Version, Source, Support System ID, Support System Image, and Support System Description. The 'Back' button is located at the bottom right of the table area.

Open	Data Version	Source	Support System ID	Support System Image	Support System Description

# Adding a Custom Datasheet

- From GUI page, go to bottom of lists to the Customer Device section
- Left-click the **header** for the type of sheet this will be
- Enter the data for the new custom device and Save
  - Do not use special characters in the Data Source or Device ID fields
  - If desired, browse to a new image for this device to replace the default



Once created, custom datasheets are available to anyone on the server!

## 7. TROUBLESHOOTING

- Lost passwords
- Screen settings
- Import challenges
- Disconnects/timing out

# Troubleshooting: Lost Username or Password

- Individual username and password assignment is performed by the company that purchases the license through the ADMIN account for that license

# Troubleshooting: Screen Settings

- Some SIL Solver® Enterprise application screen content may be obscured if
  - Window is not maximized
  - Zoom >100% is used on the window

# Troubleshooting: Import Challenges

- When importing, confirm the final function successfully transferred into SIL Solver® Enterprise
- If warnings are generated during the import, there is an import log file that can be downloaded
- For DBF Import, use the Windows native “Send to” “Compressed (zipped) folder” feature, not any other zip application

# Troubleshooting: Disconnects/Timing Out

- Do not delay too long before saving.
- SIL Solver® Enterprise will time out after a period of inactivity.
- A warning screen will pop up during the last minute.
  - Click “Yes” to extend the session

