



SIL Solver® Enterprise

V1.3.0

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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 - eroche@sis-tech.com 713-909-2123
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 - asummers@sis-tech.com 713-909-2114

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. Accessing the Application
2. Project Management
3. Creating a new project and functions
4. Editing, Copying or deleting a project
5. Generating reports
6. Importing/Exporting projects and functions
7. Datasheets
8. Troubleshooting

1. ACCESSING THE APPLICATION

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

Licensing

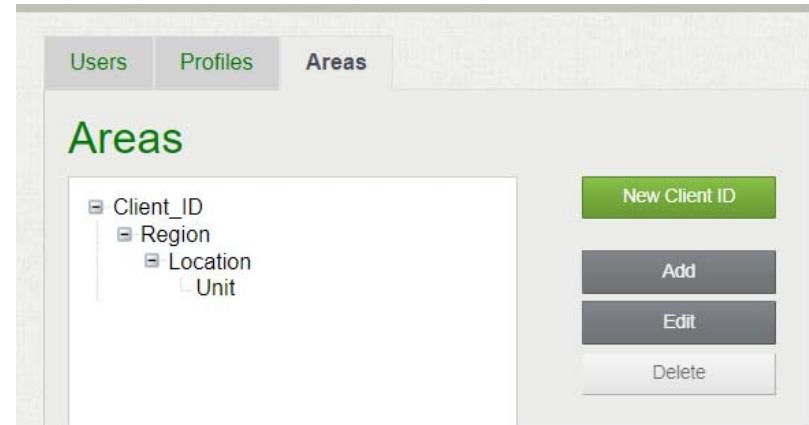
- SIL Solver® is licensed software
 - Each enterprise license includes one administrator account and two users (with read-write access)
 - Additional user (read-write) licenses can be purchased
 - 20 Read-Only seats with software at no additional cost
- To request a quote for a new license, contact SIS-TECH 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 *application's administrator account*.
- The administrator account also creates hierarchy and security access levels within the server
 - These are addressed in the ADMIN Guide

Hierarchy

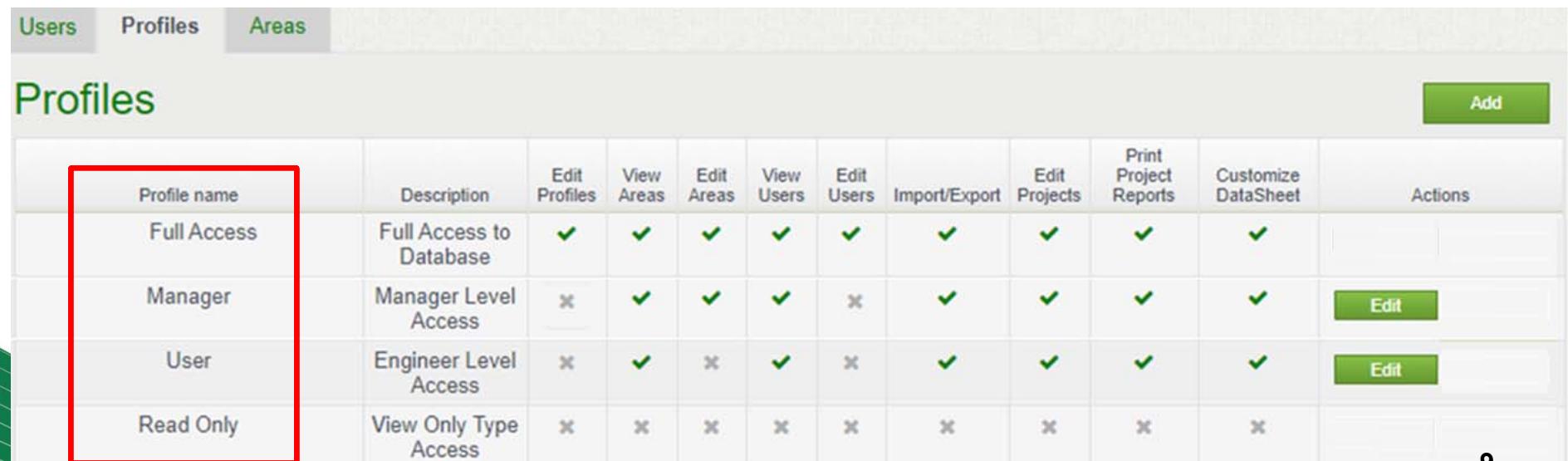
- Hierarchy has 4 levels:
 - Company/Client Name
 - Region
 - Location
 - Unit
- Project lies under unit. A Client ID can have multiple Regions, Locations and Units.
- User can be provided access to any level, which gives access to projects under that level.



Security Profiles

4 Defaults Profiles

- Full Access: Assigned to Admin, can not be edited
- Manager: Defined for supervisor/manager
- User: Limited rights to User
- Read Only: View only option for Projects, can not be edited

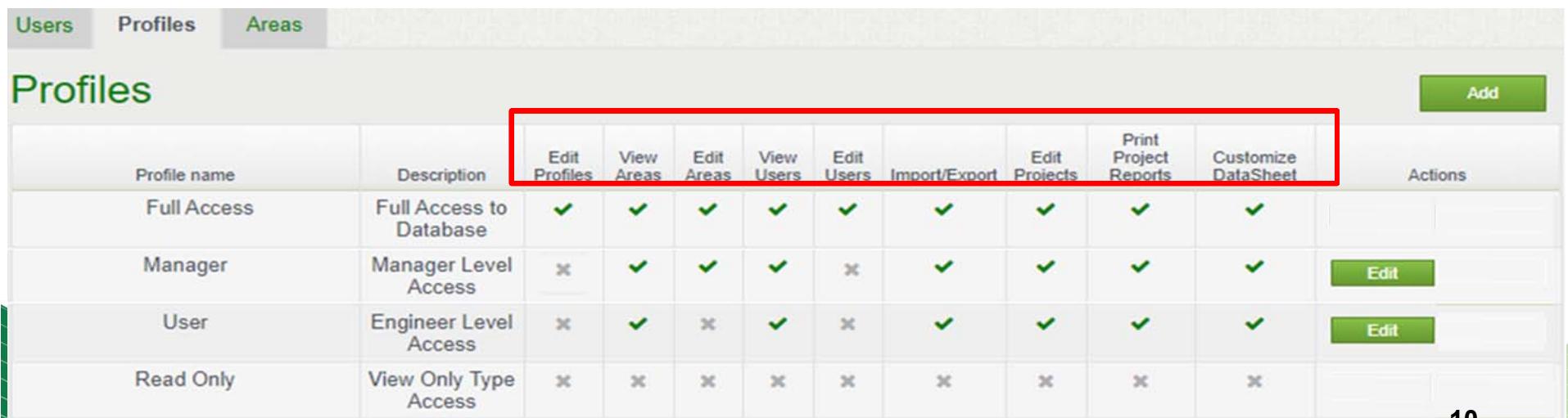


Profile name	Description	Edit Profiles	View Areas	Edit Areas	View Users	Edit Users	Import/Export	Edit Projects	Print Project Reports	Customize DataSheet	Actions
Full Access	Full Access to Database	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Manager	Manager Level Access	✗	✓	✓	✓	✗	✓	✓	✓	✓	<button>Edit</button>
User	Engineer Level Access	✗	✓	✗	✓	✗	✓	✓	✓	✓	<button>Edit</button>
Read Only	View Only Type Access	✗	✗	✗	✗	✗	✗	✗	✗	✗	

Security Profiles

List of Rights:

- Edit Profiles
- View Areas
- Edit Areas
- View Users
- Edit Users
- Import/Export
- Edit Projects
- Print Project Reports
- Customize Datasheet



The screenshot shows a software interface for managing security profiles. At the top, there are tabs for 'Users', 'Profiles', and 'Areas', with 'Profiles' being the active tab. Below the tabs, the word 'Profiles' is displayed in green. On the right side, there is a green 'Add' button. The main area is a table with the following data:

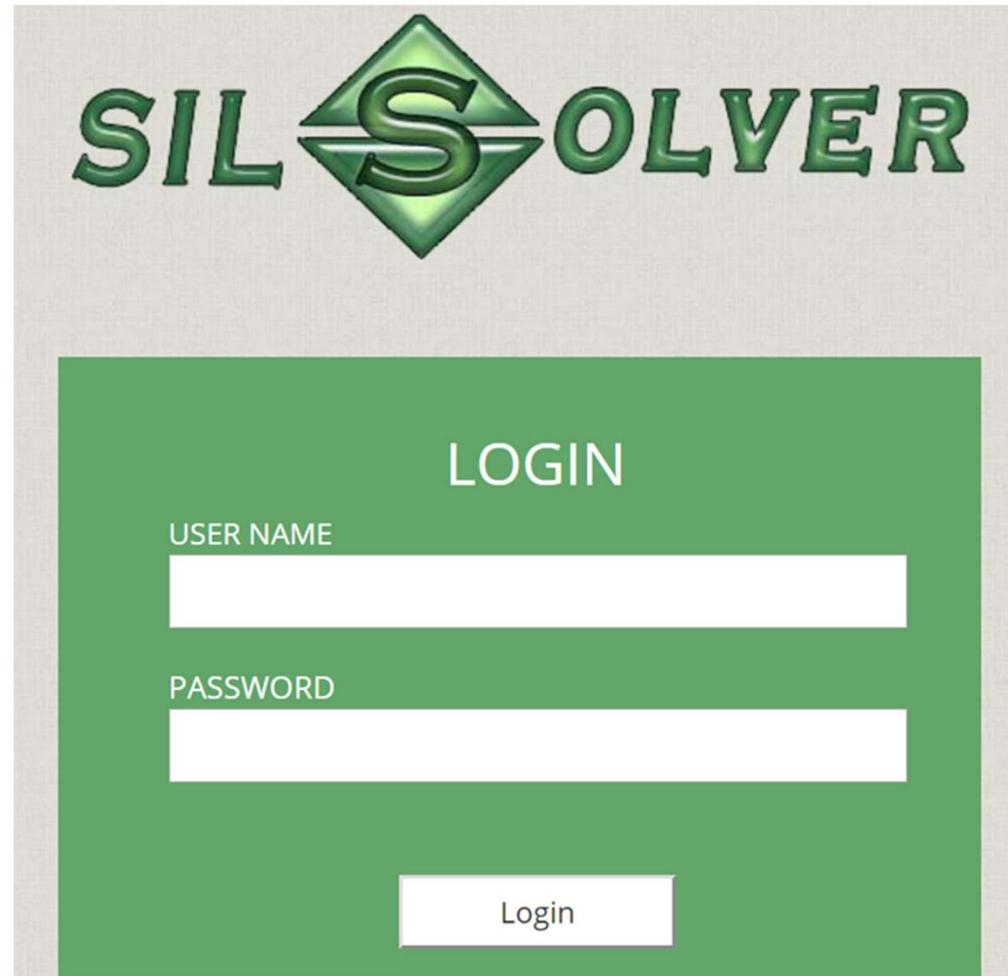
Profile name	Description	Edit Profiles	View Areas	Edit Areas	View Users	Edit Users	Import/Export	Edit Projects	Print Project Reports	Customize DataSheet	Actions
Full Access	Full Access to Database	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Manager	Manager Level Access	✗	✓	✓	✓	✗	✓	✓	✓	✓	<button>Edit</button>
User	Engineer Level Access	✗	✓	✗	✓	✗	✓	✓	✓	✓	<button>Edit</button>
Read Only	View Only Type Access	✗	✗	✗	✗	✗	✗	✗	✗	✗	

Logging In: Username and Password

Companies purchasing a license to a SIL Solver® application will typically have their own server locations.

For training classes provided by SIS-TECH, a link to a training server location will be provided.

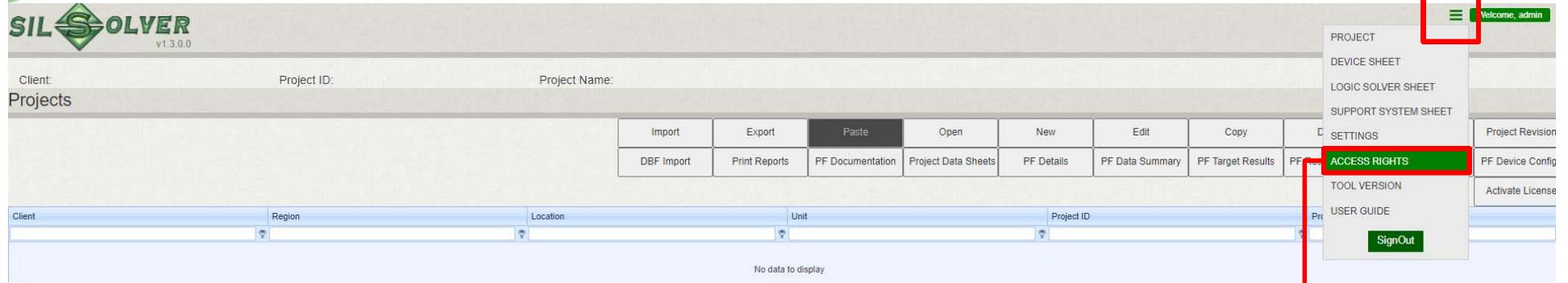
Log in with your assigned Username and Password



2. PROJECT MANAGEMENT

- Setting up User with Security Profile
- Creating Hierarchy
- Assigning User to a Hierarchy level

Setting up a New User



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Client: Project ID: Project Name: Projects

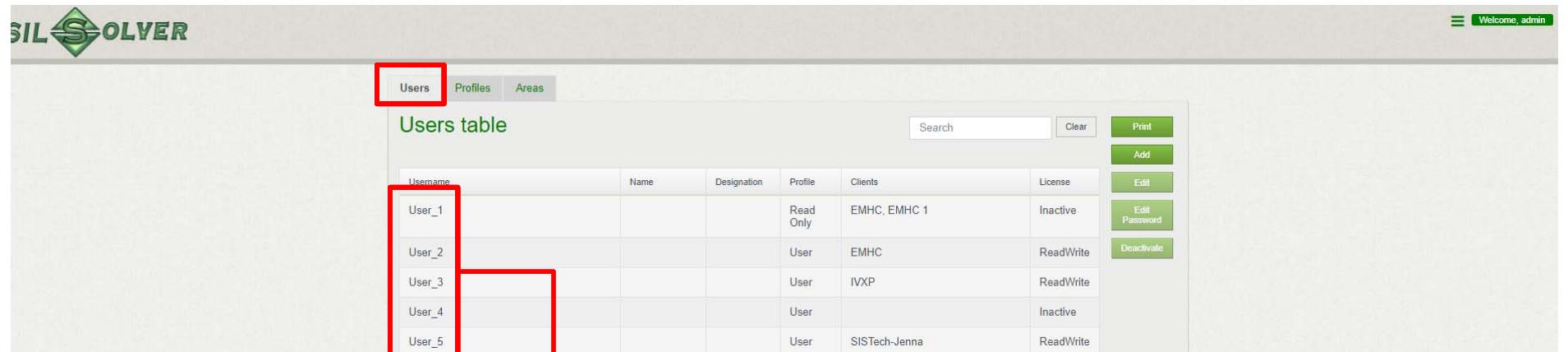
Import Export Paste Open New Edit Copy DBF Import Print Reports PF Documentation Project Data Sheets PF Details PF Data Summary PF Target Results PF

No data to display

PROJECT DEVICE SHEET LOGIC SOLVER SHEET SUPPORT SYSTEM SHEET SETTINGS ACCESS RIGHTS TOOL VERSION USER GUIDE SignOut

Welcome, admin

Select Access rights to access User tab



Users Profiles Areas

Users table

Username	Name	Designation	Profile	Clients	License
User_1			Read Only	EMHC, EMHC 1	Inactive
User_2			User	EMHC	ReadWrite
User_3			User	IVXP	ReadWrite
User_4			User		Inactive
User_5			User	SISTech-Jenna	ReadWrite

Print Add Edit Edit Password Deactivate

Welcome, admin

List of Users

Setting up User with License

- Select the License type for the user. The options are ‘Read and Write’ or ‘Read Only’

Edit User

User name	User1
Name	Name
Designation	Enter designation
Mobile	(123) 456-7890
Email	name@company.com
License	Read and Write
Authentication	Read and Write
Profile	User
Rights	<input type="checkbox"/> Edit Profiles <input checked="" type="checkbox"/> View Areas <input type="checkbox"/> Edit Areas <input checked="" type="checkbox"/> View Users <input type="checkbox"/> Edit Users <input checked="" type="checkbox"/> Edit Projects <input checked="" type="checkbox"/> Import / Export <input checked="" type="checkbox"/> Print All Project Reports <input checked="" type="checkbox"/> Custom Datasheets

Cancel **Save user**

Assigning a Security Profile

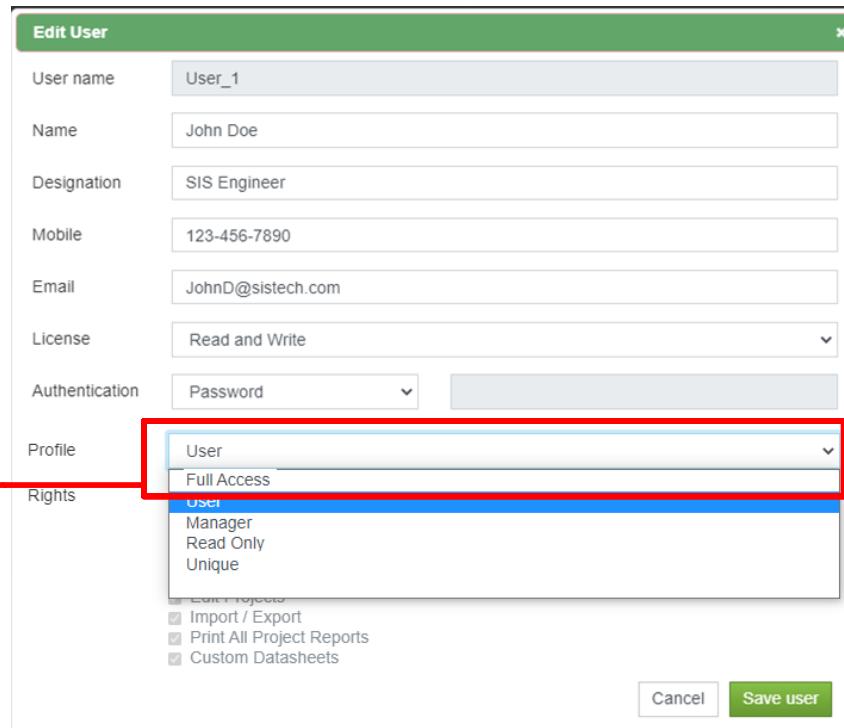


Users Profiles Areas

Users table

Username	Name	Designation	Profile	Clients	License
User_1		SIL Engineer			Inactive
User_2					ReadWrite

Search Clear Print Add Edit Edit Password Deactivate



Edit User

User name	User_1
Name	John Doe
Designation	SIS Engineer
Mobile	123-456-7890
Email	JohnD@sistech.com
License	Read and Write
Authentication	Password
Profile	User
Rights	Full Access

User
Full Access
User
Manager
Read Only
Unique

Import / Export
Print All Project Reports
Custom Datasheets

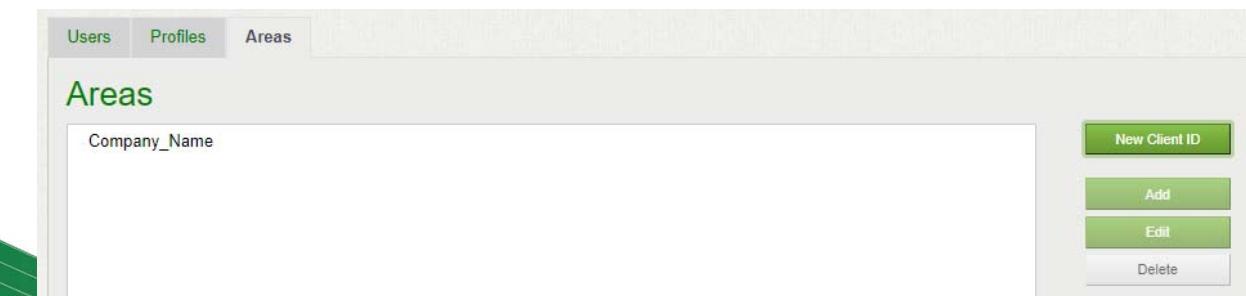
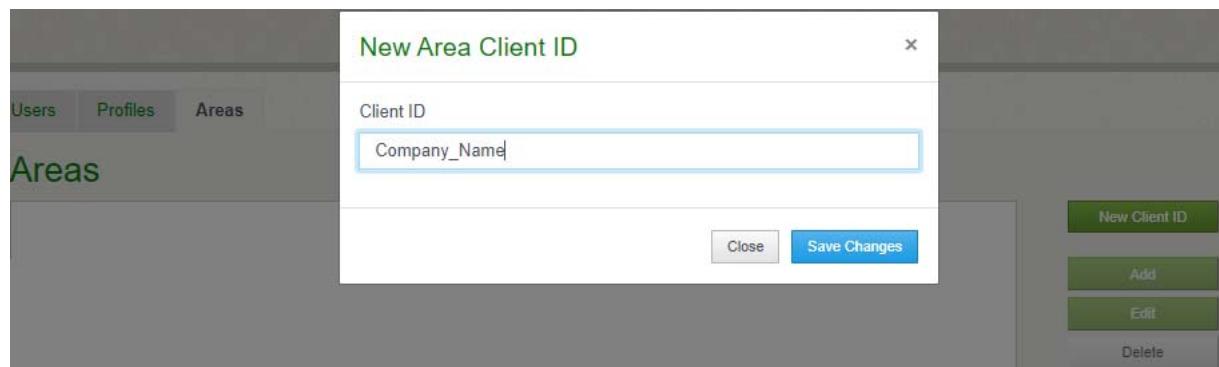
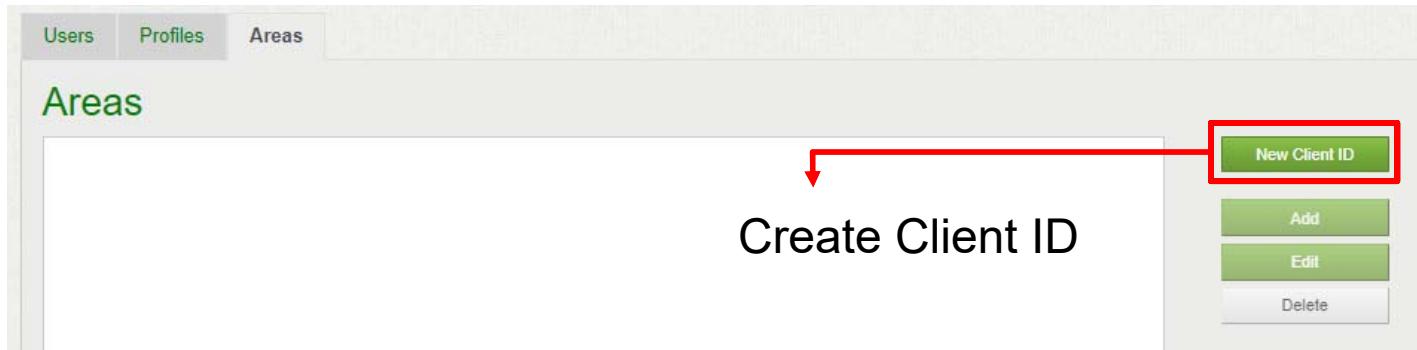
Cancel Save user

Assign
Security
Profile

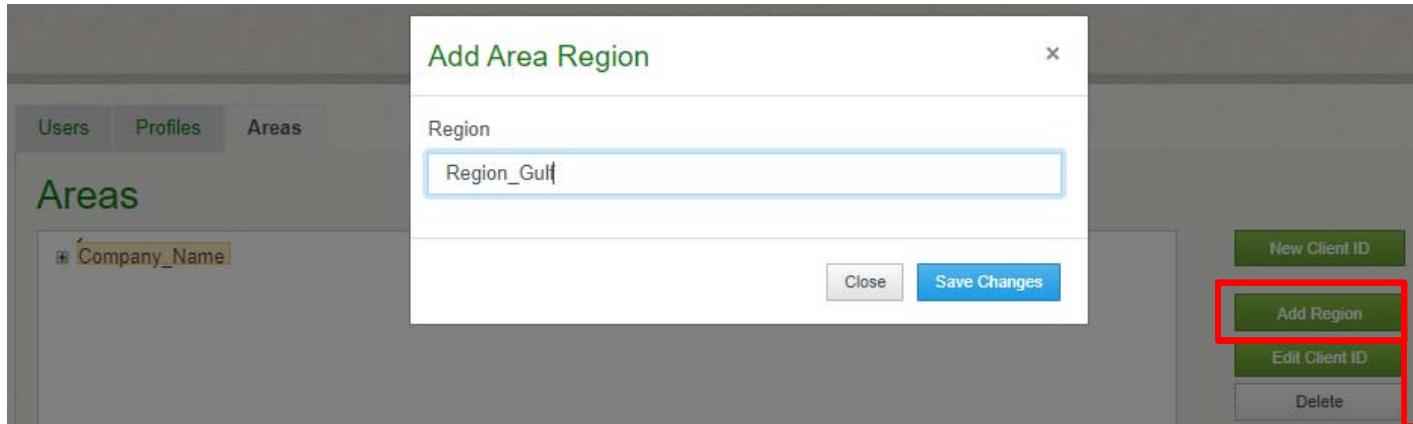
Select User and
click on "Edit"

Tool use is affected by
combination of license
and security profile

Creating Hierarchy: Add Client



Creating Hierarchy: Add Region

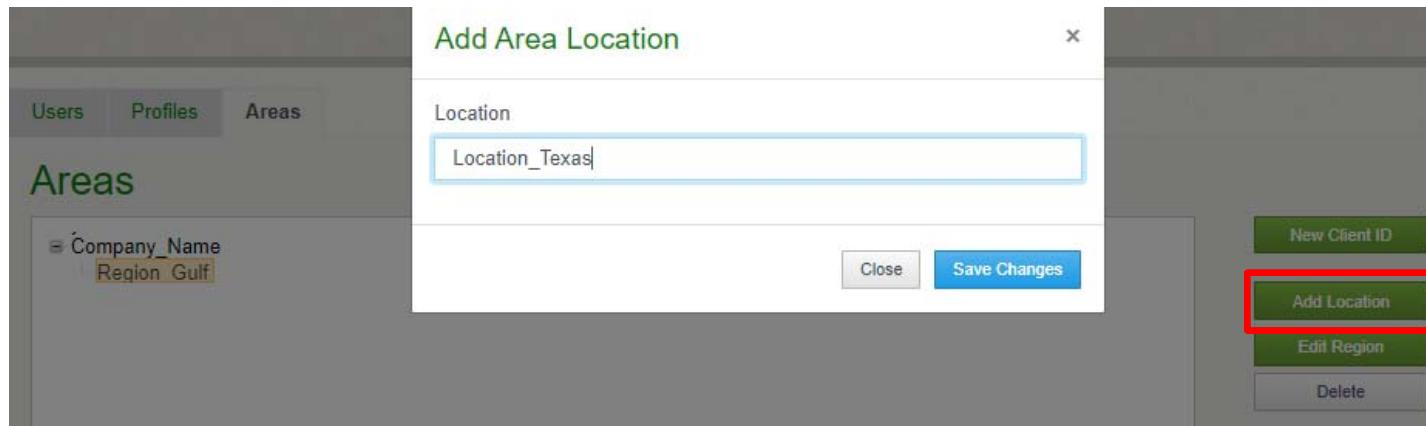


Add region under Client ID

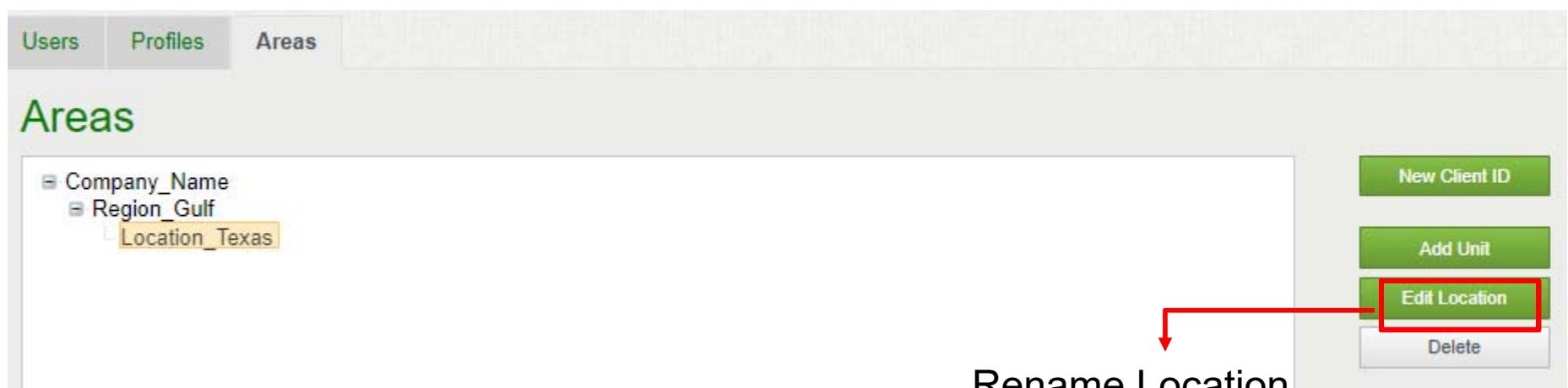


Rename Region using edit button

Creating Hierarchy: Add Location

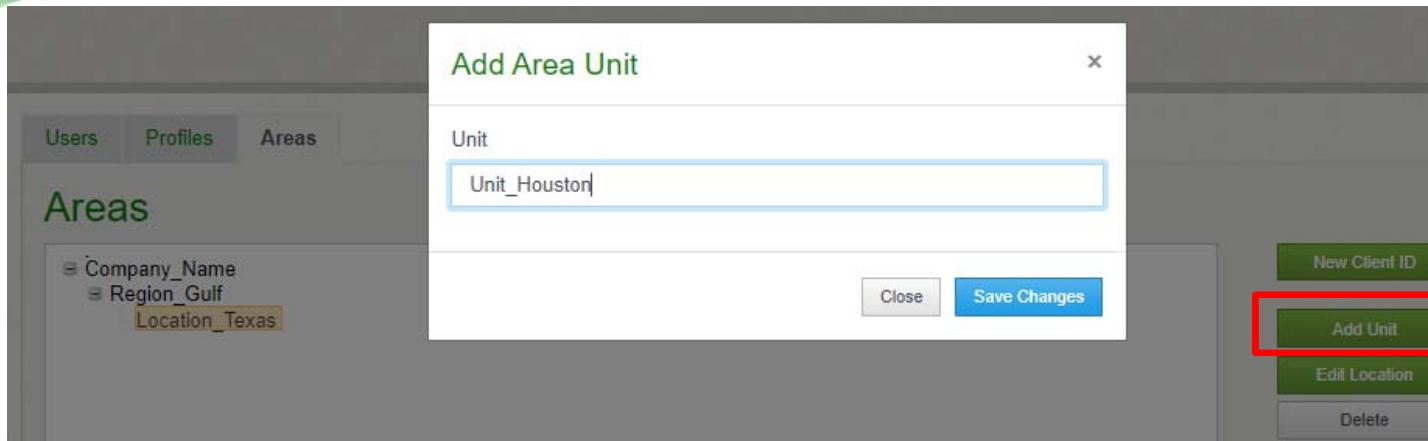


Add Location
under Client ID



Rename Location
using edit button

Creating Hierarchy: Add Unit



Add Unit under Location



Rename Unit using edit button

Adding project is covered in next section...

Assign User to the Hierarchy

- User can be assigned to area by Admin or a Manager
- If user is assigned to a level (for instance region), user will have access to that level and levels under it (and the projects under them)

SIL SOLVER

Users Profiles Areas

Areas

= Company_Name
= Region_Gulf
= Location_Texas
Unit_Houston

New Client ID

Add Location

Edit Region

Delete

Select level

Available

Selected

User 1

Move selected user to the right and save

Save

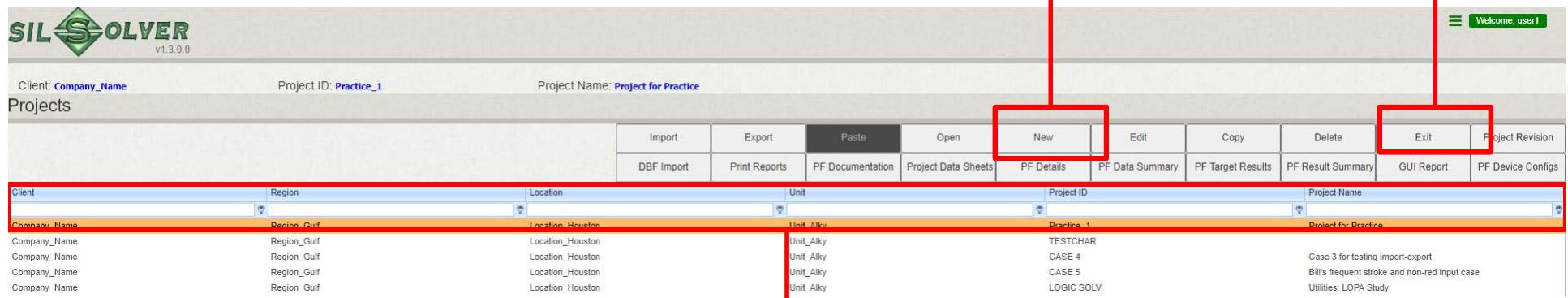
20

3. 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



Project List

Filters may be useful to users with long project lists

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Client: Company_Name Project ID: Practice_1 Project Name: Project for Practice

Projects

Client	Region	Location	Unit	Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	Project Revision
				DBF Import	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
Company_Name	Region_Gulf	Location_Houston	Unit_Alky										
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	TEST CHAR									
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	CASE 4									
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	CASE 5									
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	LOGIC SOLV									

Click to create a new project

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

Add New Project

Client Id:

Region:

Location:

Unit:

Project ID:

Name:

Add New Project

Client Id:

Region:

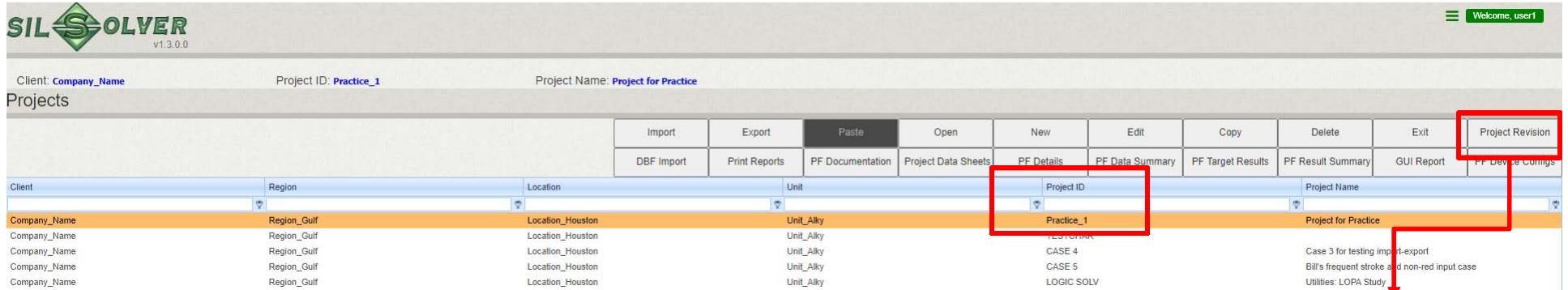
Location:

Unit:

Project ID:

Name:

Project Revision Data



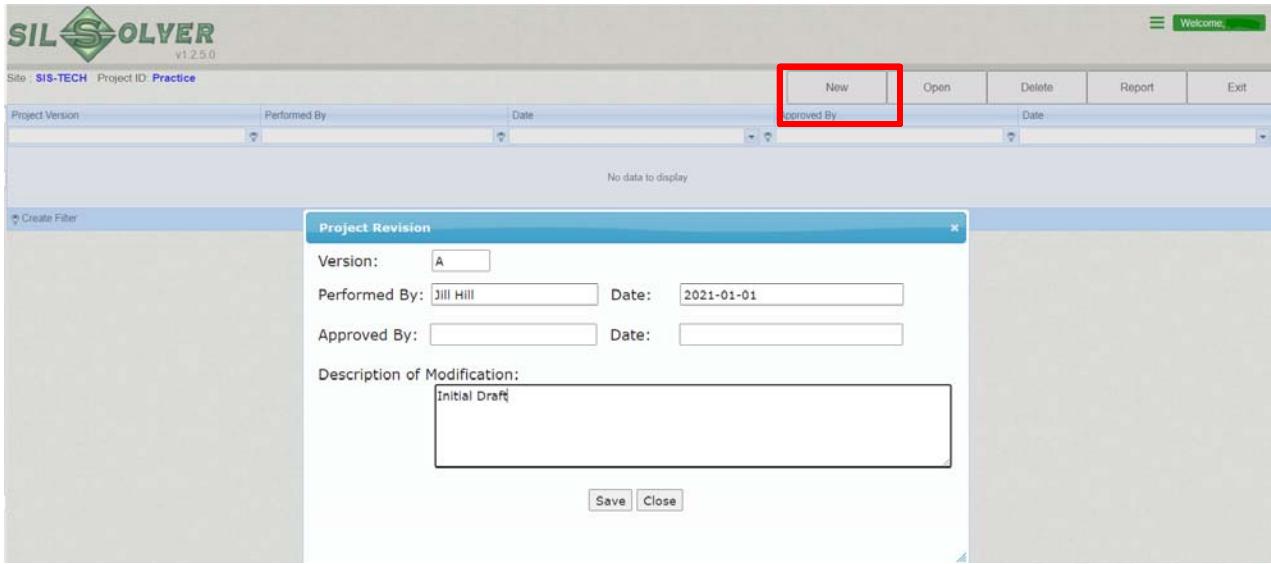
Client: Company_Name Project ID: Practice_1 Project Name: Project for Practice

Projects

				Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	Project Revision
				DBF Import	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
Client	Region	Location	Unit					Project ID					Project Name
Company_Name	Region_Gulf	Location_Houston	Unit_Alky					Practice_1					Project for Practice
Company_Name	Region_Gulf	Location_Houston	Unit_Alky										Case 3 for testing import-export
Company_Name	Region_Gulf	Location_Houston	Unit_Alky										CASE 4
Company_Name	Region_Gulf	Location_Houston	Unit_Alky										CASE 5
Company_Name	Region_Gulf	Location_Houston	Unit_Alky										LOGIC SOLV

TEST DATA
CASE 4
CASE 5
Utilities: LOPA Study

Create initial project revision information



Site : SIS-TECH Project ID: Practice

New

No data to display

Project Revision

Version: A

Performed By: Jill Hill Date: 2021-01-01

Approved By: Date:

Description of Modification:
Initial Draft

Save Close

Click “New” to open dialog box, enter data, and Save

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 (2oo3,DP-101A/B/C) trip closes XV-101A and XV-101B (1oo2) 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 1oo2D CPU and simplex I/O
- Assume no sensor diagnostic response will be implemented, so no DC credit should be taken

Opening the project

Start from Project home page

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

Click Open

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Welcome, user!

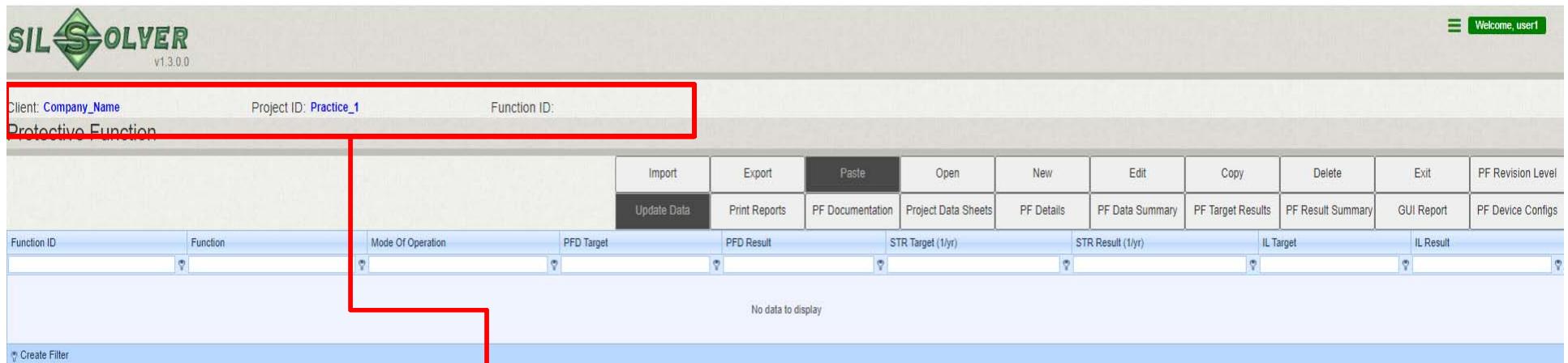
Client: Company_Name Project ID: Practice_1 Project Name: Project for Practice

Projects

Client	Region	Location	Unit	Project ID	Project Name
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	Practice_1	Project for Practice
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	CASE 4	Case 3 for testing import-export
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	CASE 5	Bill's frequent stroke and non-red input case
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	LOGIC SOLV	Utilities: LOPA Study

Protective Function Level

- The general layout is the same as the main page with list of projects



SIL SOLVER v1.3.0.0

Welcome, user1

Client: Company_Name Project ID: Practice_1 Function ID:

Protective Function

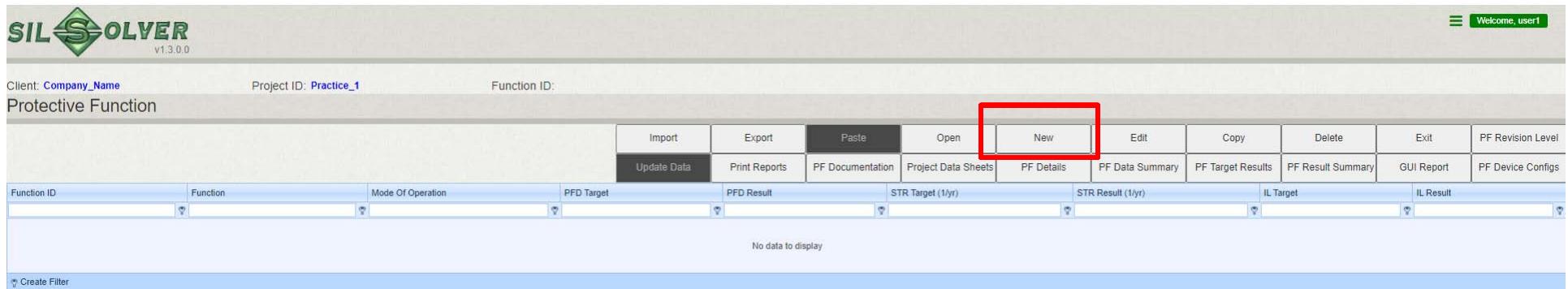
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result

No data to display

Create Filter

Project information.

Start a new safety function



SIL SOLVER v1.3.0.0

Welcome, user!

Client: Company_Name Project ID: Practice_1 Function ID:

Protective Function

Import Export Paste Open New Edit Copy Delete Exit PF Revision Level

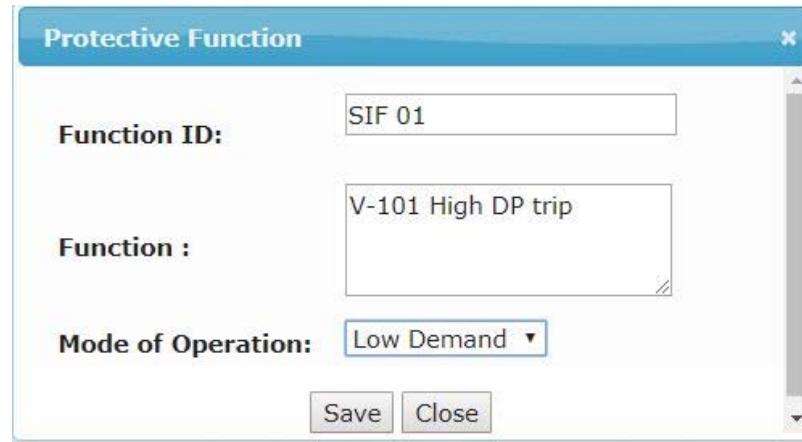
Update Data Print Reports PF Documentation Project Data Sheets PF Details PF Data Summary PF Target Results PF Result Summary GUI Report PF Device Configs

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

- Enter Function ID, brief version of function description (e.g., from H&RA), Mode of Operation, and Save



Protective Function

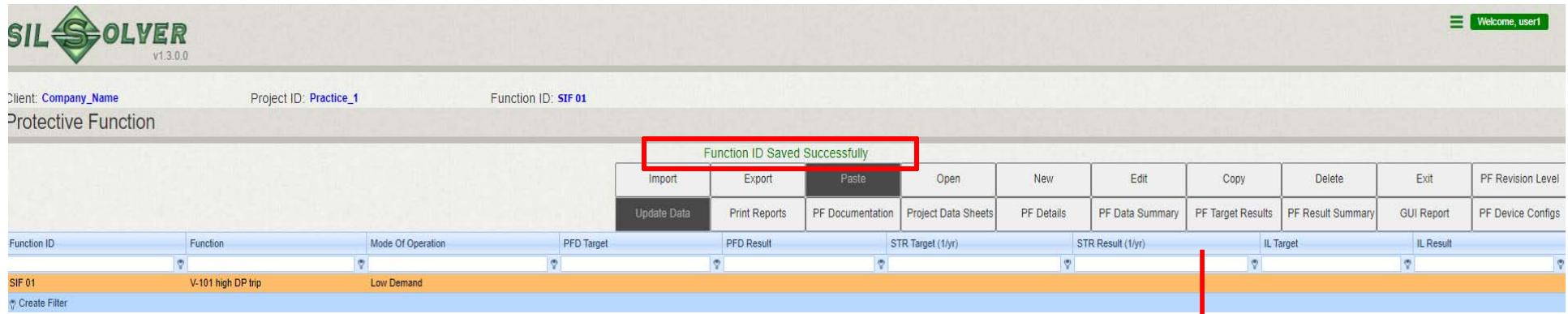
Function ID: SIF 01

Function : V-101 High DP trip

Mode of Operation: Low Demand ▾

Save Close

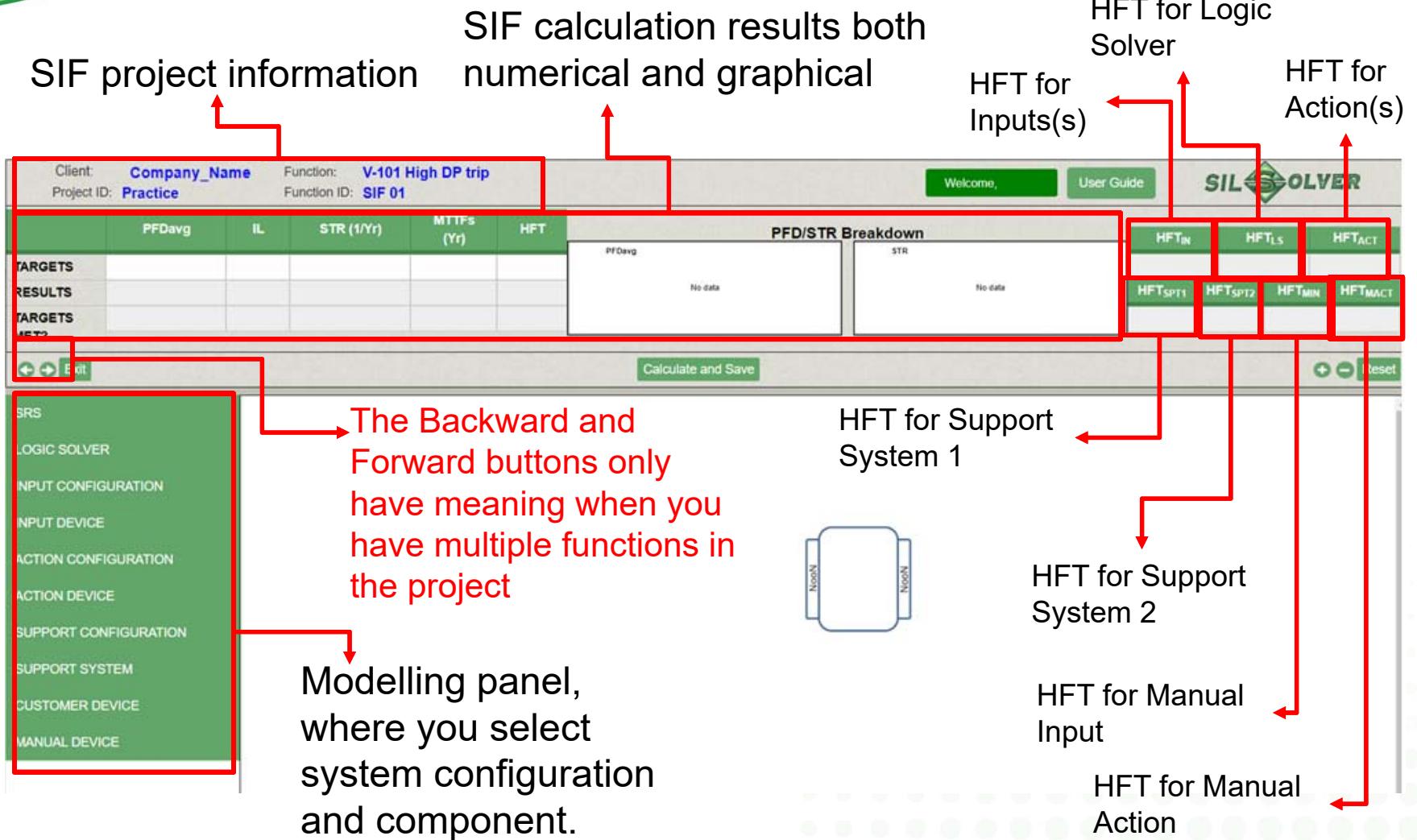
Select and Open Function



- 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



Zooming

Use the + and – buttons to zoom in and out on the figure
You cannot interact with certain features in a zoomed state

Client: **Company Name** Function: **V-101 High DP trip**
Project ID: **Practice** Function ID: **SIF 01**

Welcome User Guide **SIL SOLVER**

	PFDavg	IL	STR (1Yr)	MTTFs (Yr)	HFT	PFD/STR Breakdown		HFT _{IN}	HFT _{LS}	HFT _{ACT}
TARGETS						PFDavg	STR			
RESULTS						No data	No data			
TARGETS MET?								HFT _{SPT1}	HFT _{SPT2}	HFT _{MIN}
										HFT _{MAX}

Calculate and Save

Reset

SRS
LOGIC SOLVER
INPUT CONFIGURATION
INPUT DEVICE
ACTION CONFIGURATION
ACTION DEVICE
SUPPORT CONFIGURATION
SUPPORT SYSTEM
CUSTOMER DEVICE
MANUAL DEVICE

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

The screenshot shows the SIL SOLVER software interface. At the top, it displays the client information: Company Name (Practice), Function (V-101 High DP trip), and Function ID (SIF 01). The main area features a table titled 'PFD/STR Breakdown' with columns for PFDavg, IL, STR (1/Yr), MTTFs (Yr), and HFT. The 'TARGETS' row is highlighted with a red box. To the right of the table, there are buttons for 'Welcome', 'User Guide', and the 'SIL SOLVER' logo. Below the table, there are buttons for 'Exit', 'Calculate and Save', and 'Reset'. On the left, a sidebar lists various configuration options: SRS, LOGIC SOLVER, INPUT CONFIGURATION, INPUT DEVICE, ACTION CONFIGURATION, ACTION DEVICE, SUPPORT CONFIGURATION, SUPPORT SYSTEM, CUSTOMER DEVICE, and MANUAL DEVICE. A 'Target Specification' dialog box is open in the foreground, showing fields for PFDavg (0.08) and MTTFs (Yr) (20), with an 'Update' button.

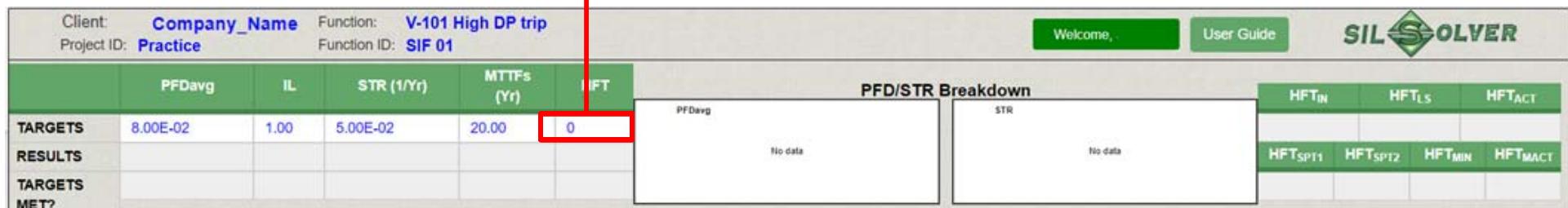
Enter performance targets and update

HFT Target

HFT target is based on the SIL Target and SIS Mode of Operation, following ANSI/ISA61511-1:2018 requirements. 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



Client: **Company_Name** Function: **V-101 High DP trip**
 Project ID: **Practice** Function ID: **SIF 01**

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0
RESULTS					
TARGETS MET?					

PFD/STR Breakdown

PFDavg	STR	HFT _{IN}	HFT _{LS}	HFT _{ACT}
No data	No data	HFT _{SPI1}	HFT _{SPI2}	HFT _{MIN}
				HFT _{MACT}

←

Picking Logic Solver (LS)

Select Logic Solver header on left to begin configuration

Left click desired logic solver to copy and then click in middle box to paste.

Client: **Company_Name** Function: **V-101 High DP trip**
 Project ID: **Practice** Function ID: **SIF 01**

Welcome, . . . User Guide **SIL SOLVER**

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT	PFD/STR Breakdown		HFT _{IN}	HFT _{LS}	HFT _{ACT}
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0	PFDAvg	STR			
RESULTS								HFT _{SPT1}	HFT _{SPT2}	HFT _{MIN}
TARGETS MET?										HFT _{MACT}

← → Exit Calculate and Save + - Reset

SRS

LOGIC SOLVER

Search Clear

GENERIC 2004D DUAL MP, DUAL I/O

GENERIC 1002D DUAL MP, SIMPLEX I/O

NON-SC DP

NON SC PES DUAL MP, DUAL I/O

Wrong one?

To delete the logic solver, move the mouse to icon, right click to make the delete option appear, left click on the delete option

Adding LS details

Left click the logic solver icon on in the center box. Enter a logic solver tag name, select the voting (may be only one option), 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 1002D logic solver with dual main processors, 1 simplex digital input module, 1 simplex analog input module, and 1 simplex digital output module.

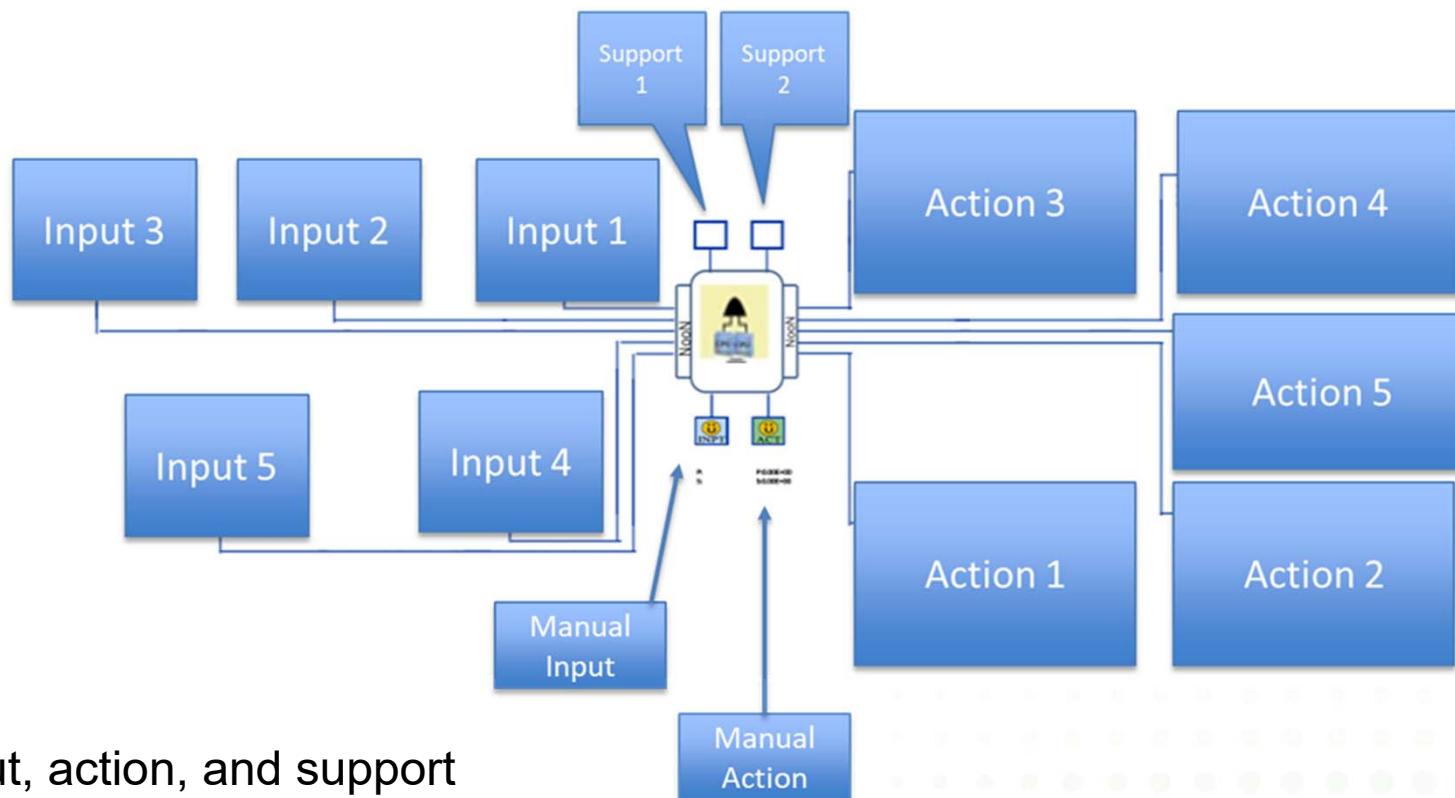
Implementation Limitations and Exclusions: Refer to the SIL Solver manual for a discussion of "1oo2D" and "2oo2D" architectures. The logic solver is certified to IEC 61508 SIL 3 or TUV AK 5-6.

Data Source: SIL HFT: 1

Update

Click Update to return to GUI page

Screen locations of the other subsystems



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 grouping.

Left-click the selected configuration to add to the GUI.

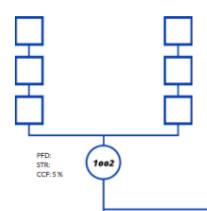
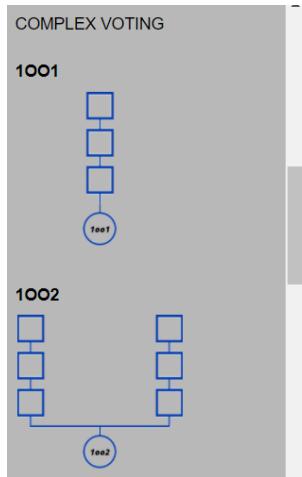
The screenshot shows the SIL SOLVER software interface. At the top, there is a header with 'Client: Company_Name' (V-101 High DP trip), 'Project ID: Practice', 'Function: V-101 High DP trip', 'Function ID: SIF 01', 'Welcome', 'User Guide', and the 'SIL SOLVER' logo. Below the header, there is a table for 'PFDavg', 'IL', 'STR (1/Yr)', 'MTTFs (Yr)', and 'HFT'. The 'PFD/STR Breakdown' section shows two circles: one for PFDavg (Logic, 100%) and one for STR (Logic, 100%). On the right, there is a 'HFT' section with columns for 'HFT_{IN}', 'HFT_{LS}', and 'HFT_{ACT}', and rows for 'HFT_{SPT1}', 'HFT_{SPT2}', 'HFT_{MIN}', and 'HFT_{MACT}'. At the bottom, there are buttons for 'Exit', 'Calculate and Save', and 'Reset'.

The main area is divided into two sections: 'SRS' and 'LOGIC SOLVER'. The 'LOGIC SOLVER' section has a 'INPUT CONFIGURATION' button, which is highlighted with a red box. Below it are buttons for 'ONE DEVICE', 'TWO DEVICES', and 'THREE DEVICES'. Under 'ONE DEVICE', there are two configurations: '1003' and '2003'. The '1003' configuration is shown with a logic diagram: three inputs (squares) connected to a '2out3' logic block, which then connects to a 'NooN' device. The '2003' configuration is shown with a logic diagram: three inputs (squares) connected to a '2out3' logic block, which then connects to a 'NooN' device. The '2003' configuration is also highlighted with a red box. To the right of the logic solver, there is a logic architecture diagram with a red box around the '2out3' logic block. The architecture consists of three inputs, a '2out3' logic block, and a 'NooN' device.

Below the logic solver, there is a text box with the following instructions:

Wrong choice? Hover over that portion of the architecture until grey location field appears, right-click to get option to copy or delete, left-click delete.

Complex Voting Architectures



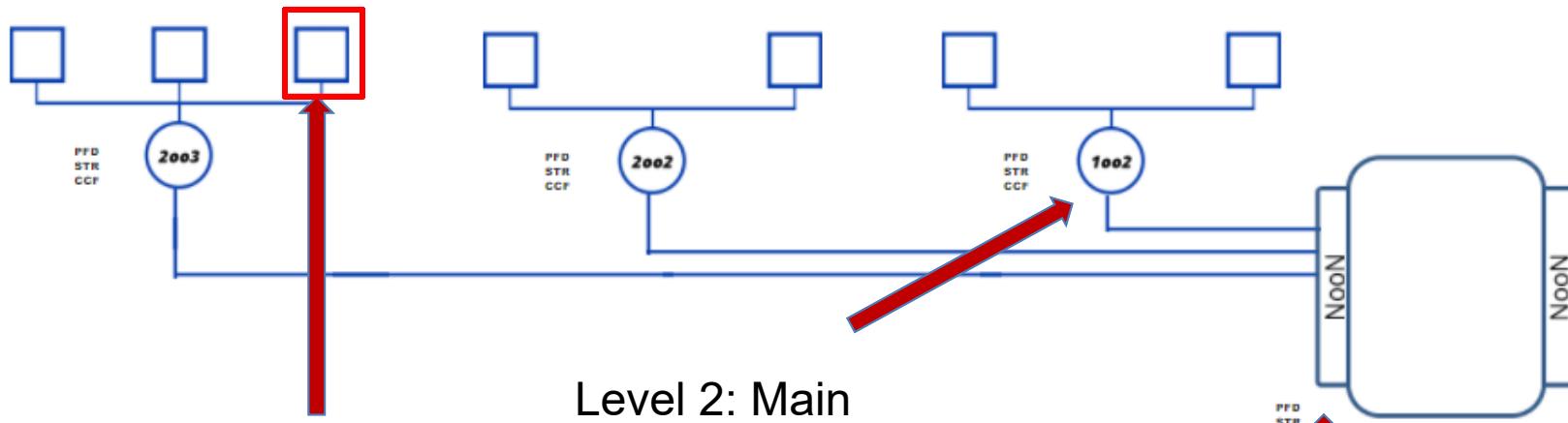
Common examples:

- 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 the GUI)



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

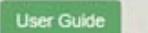
Level 2: Main architecture of an Input Subsystem, with user entered CCF

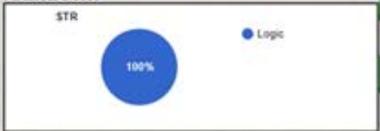
Level 1: 1ooN or NooN **VOTING** between Input Subsystems, with no CCF

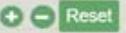
Picking Sensor Technology

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

Client: **Company_Name** Function: **V-101 High DP trip**
Project ID: **Practice** Function ID: **SIF 01**

Welcome,  

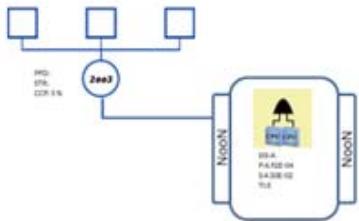
	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT	PFD/STR Breakdown		HFT _{IN}	HFT _{LS}	HFT _{ACT}
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0			1		
RESULTS								HFT_{SPT1}	HFT_{SPT2}	HFT_{MIN}
TARGETS MET?										HFT_{MACT}

 **Exit** **Calculate and Save** 

INPUT DEVICE

Search 

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



42

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

Client: **Company_Name** Function: **V-101 High DP trip**
 Project ID: **Practice** Function ID: **SIF 01**

SIL SOLVER

	PFDAvg	IL	STR (1/Yr)	MTTFs (Yr)	HFT		HFT _{IN}	HFT _{LS}	HFT _{ACT}
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0	PFDAvg	1		
RESULTS						STR			
TARGETS MET?									

INPUT DEVICE

Search Clear

- TRIP AMPLIFIER
- ANALYZER
- PRESSURE
- Differential Pressure Transmitter**
- Pneumatic Pressure Switch
- Chamber Pressure Transmitter

PFDAvg ● Logic 100% **STR** ● Logic 100%

Calculate and Save **Reset**

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

Adding Device Details

White boxes are editable fields. Some are pre-populated

×

Device

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

Configurations:

Display Tag for Device(s):

Proof Testing Interval (yr):

Voting:

Subsystem Diagnostic Level: [?](#)

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 SIL Solver Enterprise User Guide)

Data Source: SIL Update

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):

PFDAvg:

STR:

Filled In

Test Interval is in years

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

Define Diagnostic Level that will be implemented

Default OI is 20Year

Default PTC is 100 %

Device

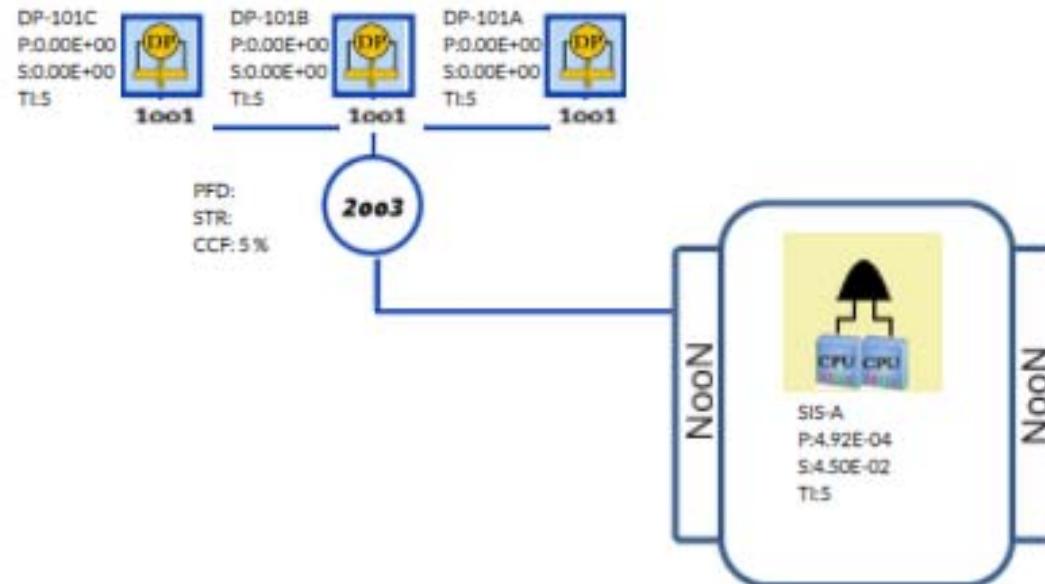
Device ID:	DPTR	Device Type:	DIFFERENTIAL PRESSURE TRANSMITTER
Configurations:		Properties:	
Display Tag for Device(s)	DP-101A	Failure Dangerous Failure Rate (1/yr):	8.00E-03
Proof Testing Interval (yr)	5	Failure Spurious Failure Rate (1/yr):	1.67E-02
Voting:	1oo1	Common Cause Factor CCF Dual (%):	2
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
Diagnostic Interval (hr):	0.5	Diagnostic Coverage Triple DC3 (1/yr):	80
Overhaul Interval (yr):	20		90
Proof Testing Coverage (%):	100		
User Specified:	<input type="checkbox"/>	PPDavg:	0.00E+00
Note:	STR: 0.00E+000		
Boundary Conditions: Boundary includes the electronic transmitter, sensing diaphragm and process connection.			
Process Severity Assumption: Clean			
Implementation Limitations and Exclusions: No limitations beyond standard documentation. See SIS Calver Enterprise User			
Data Source: SIL		Update	

Will updated once SIF is calculated

Update button will activate once minimum date is entered.

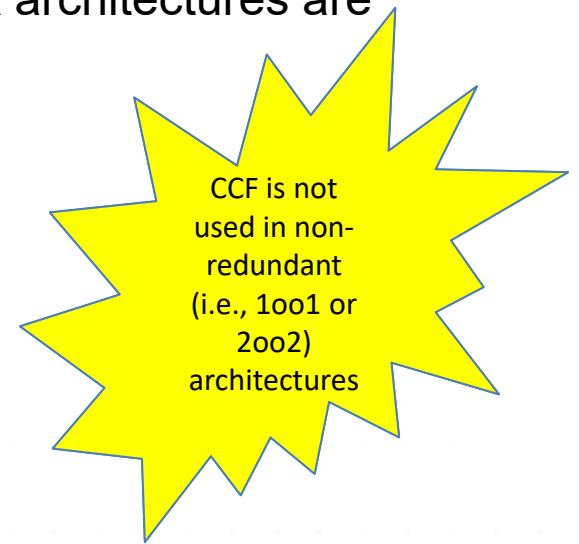
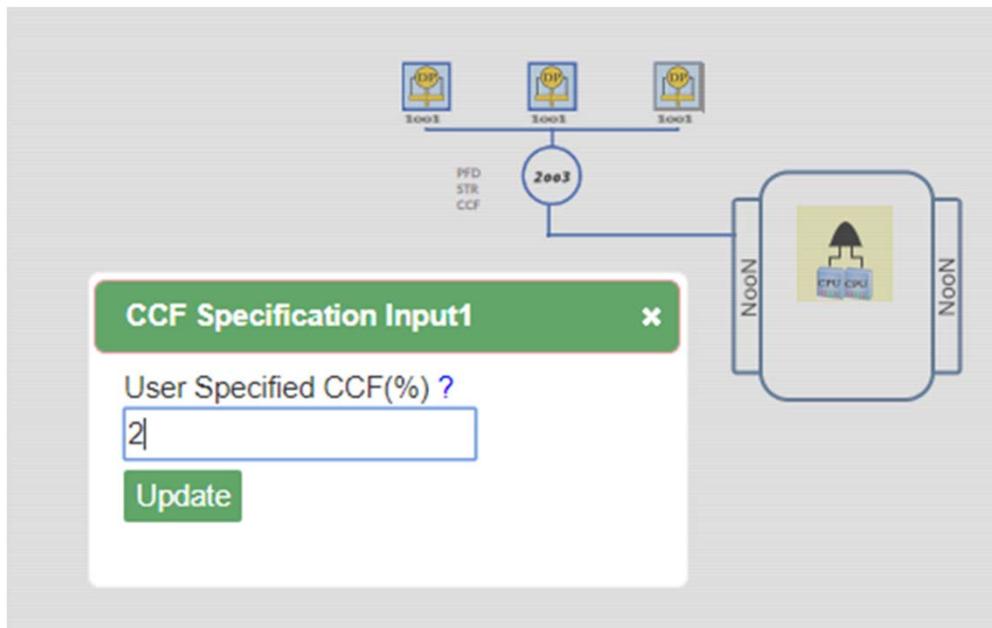
Completing the subsystem

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
- Update the default CCF value as needed (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, there might still be some CCF. A judgement based on the technology and installation details should be made.

2oo3D vs. 2oo3

- 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 inter-comparison 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: <table border="1"> <tr> <td>Device Tag:</td> <td>DP-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>DC3</td> </tr> </table>		Device Tag:	DP-101A	Proof Testing Interval (yr):	5	Voting:	1oo1	Subsystem Diagnostic Level:	DC3						
Device Tag:	DP-101A														
Proof Testing Interval (yr):	5														
Voting:	1oo1														
Subsystem Diagnostic Level:	DC3														
Properties: <table border="1"> <tr> <td>Failure Dangerous Failure Rate (1/yr):</td> <td>8.00E-03</td> </tr> <tr> <td>Failure Spurious Failure Rate (1/yr):</td> <td>1.67E-02</td> </tr> <tr> <td>Common Cause Factor CCF Dual (%):</td> <td>2</td> </tr> <tr> <td>Common Cause Factor CCF Triple (%):</td> <td>2</td> </tr> <tr> <td>Diagnostic Coverage Simplex DC1 (1/yr):</td> <td>60.00</td> </tr> <tr> <td>Diagnostic Coverage Dual DC2 (1/yr):</td> <td>80.00</td> </tr> <tr> <td>Diagnostic Coverage Triple DC3 (1/yr):</td> <td>90.00</td> </tr> </table>		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
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: <table border="1"> <tr> <td>Mean Time to Repair (hr):</td> <td>72</td> </tr> <tr> <td>Diagnostic Interval (hr):</td> <td>0.500</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):	0.500	Overhaul Interval (yr):	20	Proof Testing Coverage (%):	100	User Specified	<input type="checkbox"/>				
Mean Time to Repair (hr):	72														
Diagnostic Interval (hr):	0.500														
Overhaul Interval (yr):	20														
Proof Testing Coverage (%):	100														
User Specified	<input type="checkbox"/>														
Note: <p>Boundary Conditions: Boundary includes the electronic transmitter, sensing diaphragm and process connection.</p> <p>Process Severity Assumption: Clean</p> <p>Implementation Limitations and Exclusions: No limitations beyond standard assumptions (see SII_Solver Enterprise User</p>															
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.

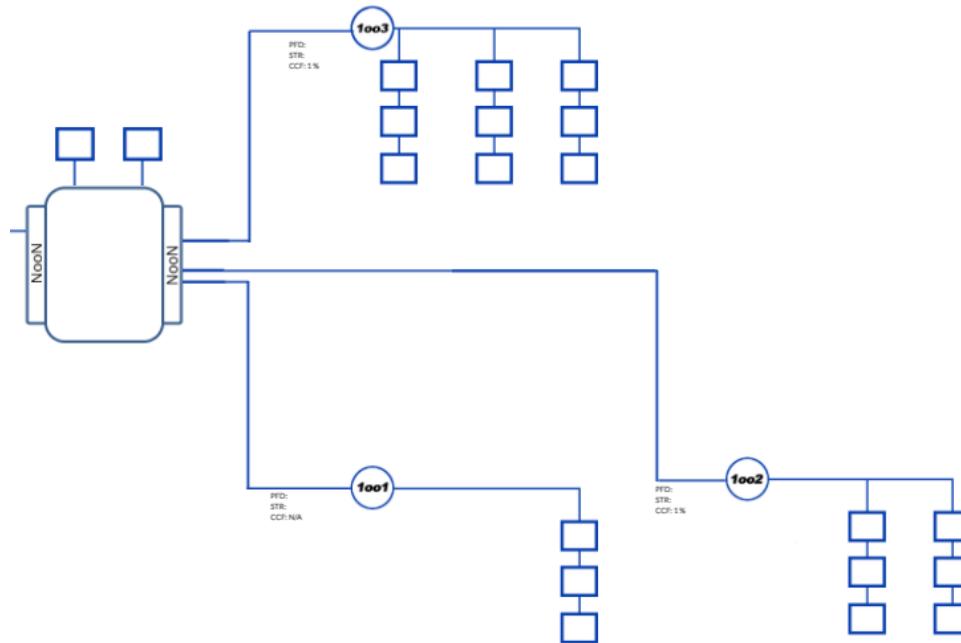
May select a higher DC when an external independent reading can be used for inter-comparison with the SIF sensor.

Reminder: Credit for diagnostics shouldn't be taken if the diagnostic result isn't going to be used to take prompt safe action, either automatically or manually, to address any risk gap caused by the failure.

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(s)
3. Specify relevant parameters

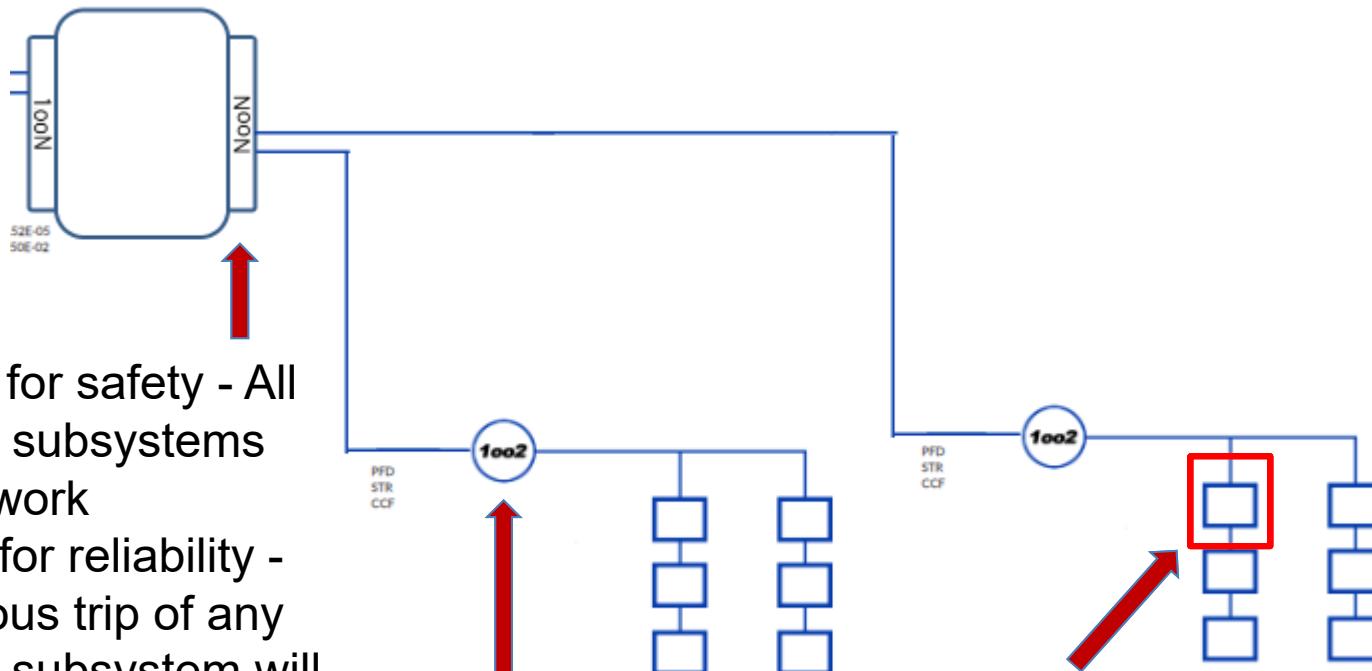


Two configurable levels of Action Architecture

Best Practice: To show the most information on the GUI, only use Level 2 if you must for the complexity of the function.

FIXED:

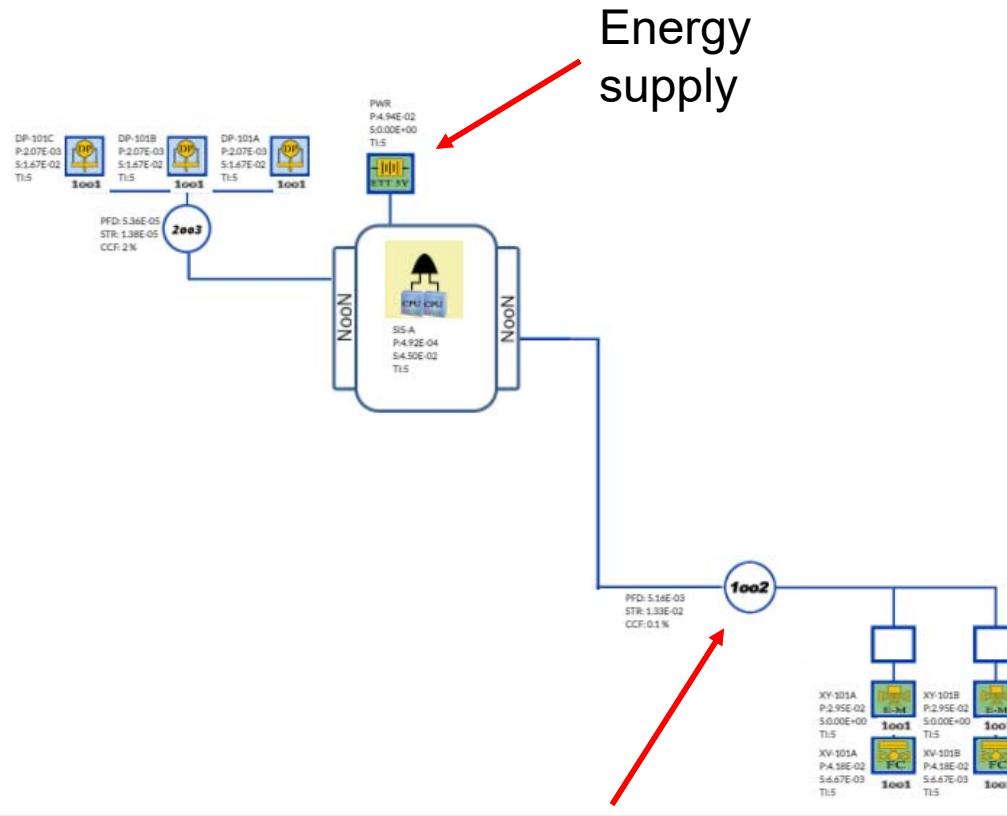
- NooN for safety - All action subsystems must work
- 1ooN for reliability - Spurious trip of any action subsystem will cause an operational problem



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

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

Adding valves, solenoids, and support system



Don't forget to update CCF

Device

Device ID: SVETM Device Type: SOLENOID VALVE - ETT - MONITORED

Configurations:

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

Properties:

Failure Dangerous Failure Rate (1/yr):	1.18E-02
Failure Spurious Failure Rate (1/yr):	0
CCF Dual(%):	1
CCF Triple(%):	1
Diagnostic Coverage Simplex(1/yr):	0.00
Diagnostic Coverage Dual(1/yr):	0.00
Diagnostic Coverage Triple(1/yr):	0.00

Maintenance:

Mean Time to Repair (hr):	72
Diagnostic Interval (hr):	0.000
Overhaul Interval (yr):	20
Proof Testing Coverage (%):	100
User Specified	<input checked="" type="checkbox"/>

Note:
Boundary Conditions: Boundary includes solenoid and solenoid wiring up to monitoring device.
Process Severity Assumption: N/A
Implementation Limitations and Exclusions: Vent port for redundant configurations is unobstructed and protected from debris.

Data Source: SIL

Device

Device ID: BVFCC Device Type: BLOCK VALVE-BALL-FTC-CLEAN

Configurations:

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

Properties:

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

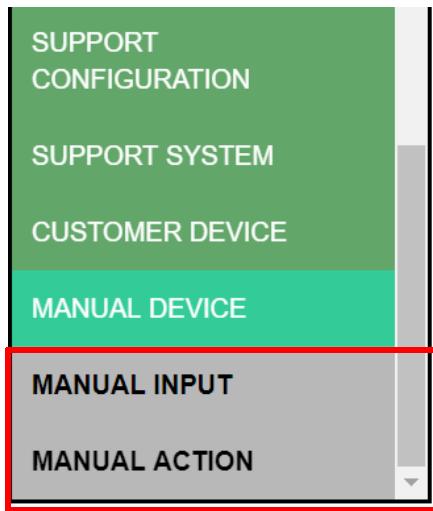
Maintenance:

Mean Time to Repair (hr):	72
Diagnostic Interval (hr):	0.000
Overhaul Interval (yr):	20
Proof Testing Coverage (%):	100
User Specified	<input checked="" type="checkbox"/>

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

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



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

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

The 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

Manual Inputs

Redundancy: Non-Redundant

Enable second manual input device

Manual Input Device 1

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

Manual Input Device 2

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

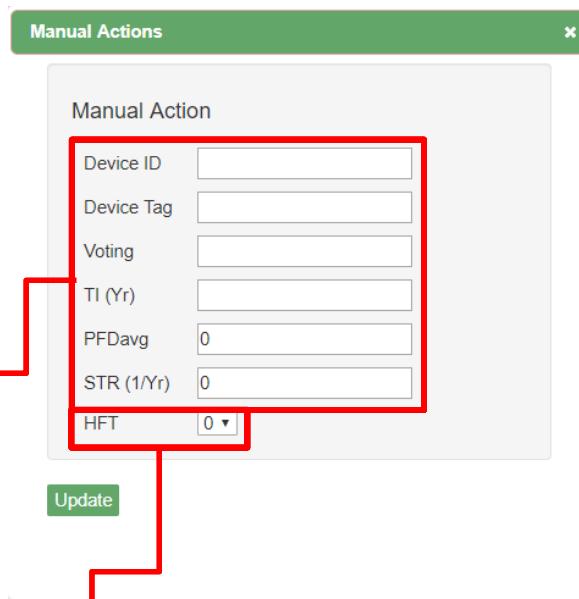
Update

Check to allow entry of the second Manual Input

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

Manual Action

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



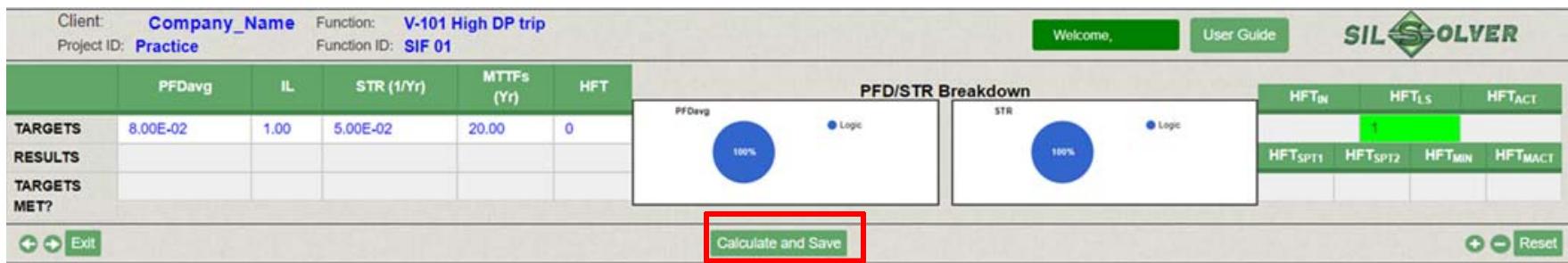
Manual Action	
Device ID	<input type="text"/>
Device Tag	<input type="text"/>
Voting	<input type="text"/>
TI (Yr)	<input type="text"/>
PFDavg	0
STR (1/Yr)	0
HFT	0 ▾

Update

User enters Manual Action HFT Value

Ready to Calculate?

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



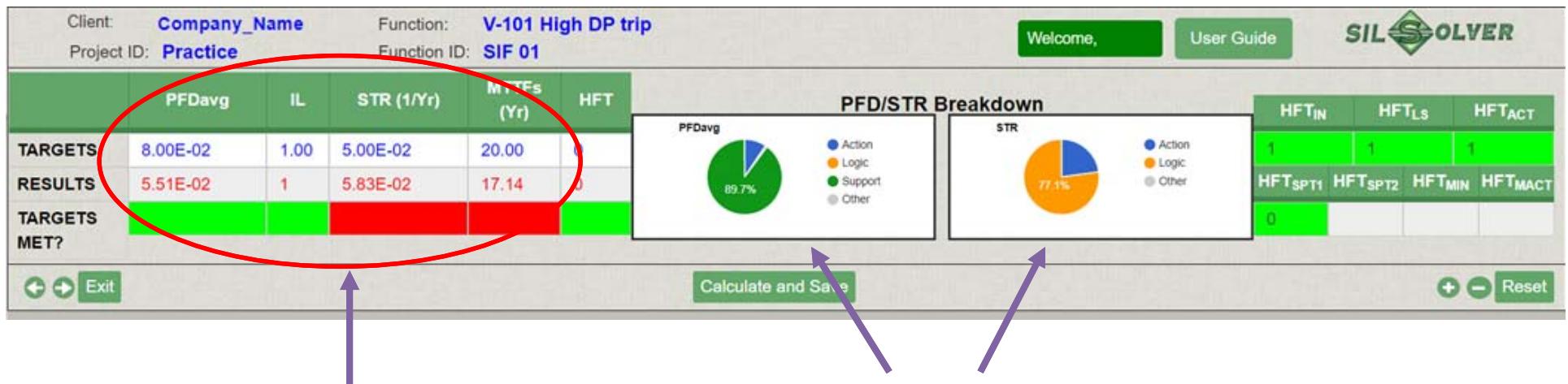
The screenshot shows the 'SIL SOLVER' software interface. At the top, it displays 'Client: Company_Name' (V-101 High DP trip), 'Function: V-101 High DP trip', 'Project ID: Practice', 'Function ID: SIF 01', 'Welcome,' and 'User Guide'. The main area is titled 'PFD/STR Breakdown' and shows two circular diagrams: 'PFDavg' and 'STR', both with 100% logic. Below these are tables for 'TARGETS' and 'RESULTS'. The 'TARGETS' table includes columns for PFDavg, IL, STR (1/Yr), MTTFs (Yr), and HFT. The 'RESULTS' table includes columns for HFT_{IN}, HFT_{LS}, and HFT_{ACT}. At the bottom, there are buttons for '+', 'Exit', 'Calculate and Save' (which is highlighted with a red box), and 'Reset'.

Note any **ERRORS** or **Warnings** that are generated during the calculation:

ERRORS: A problem exists in GUI or device configuration that will make the calculated results **INCORRECT**

Warning: A value is missing from the configuration that may or may not be a technical issue, depending on the overall design

Are PFDavg and STR good enough?



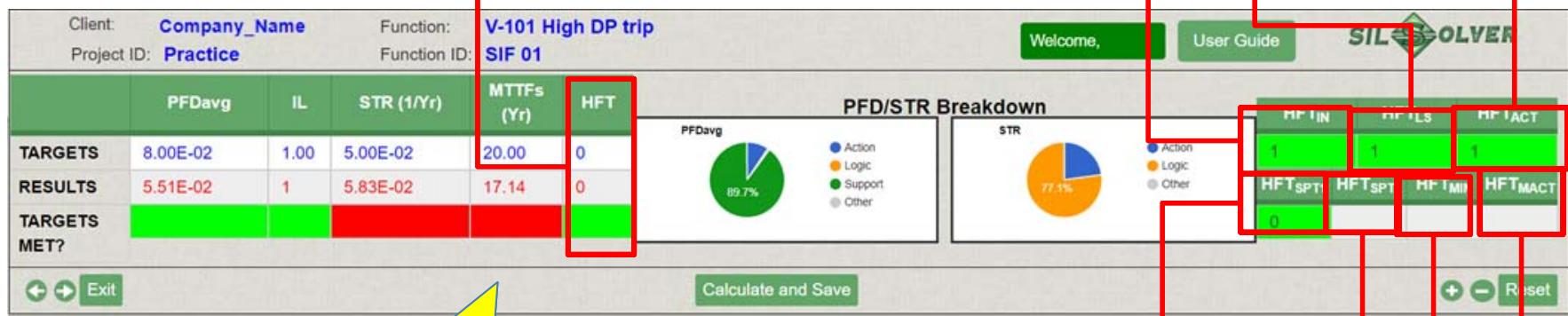
Numerical results and red-green pass-fail indicator on top left of GUI and most SIF reports

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 Input and Action Subsystems

The HFT for each field device box (MooN) is determined by the selected architecture within that box as below.

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

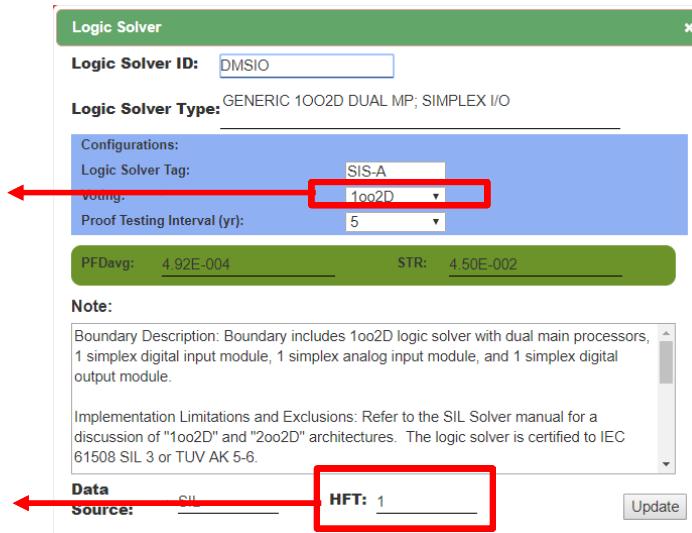
The results of the individual device boxes are combined based on the mid-level architecture.

HFT for Logic Solver

The HFT value for the logic solver is based on the technology and 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.

In this case,
architecture is
1oo2D

Logic Solver
HFT Value



Default value is 0 when importing a logic solver that is not in the current SIL Solver logic solver datasheet.

HFT for Support System

The HFT value for the support system is fixed and shown on the support system data sheet and on the GUI as below.

Support System

Support System ID: UPSE5S

POWER SUPPLY - ETT - 5

Support System Type: YEAR TESTING

Support System Tag: UPSE5S-101

Proof Testing Interval (yr): 5

PFDavg: 4.94E-002

STR: 0.00E+000

Note:

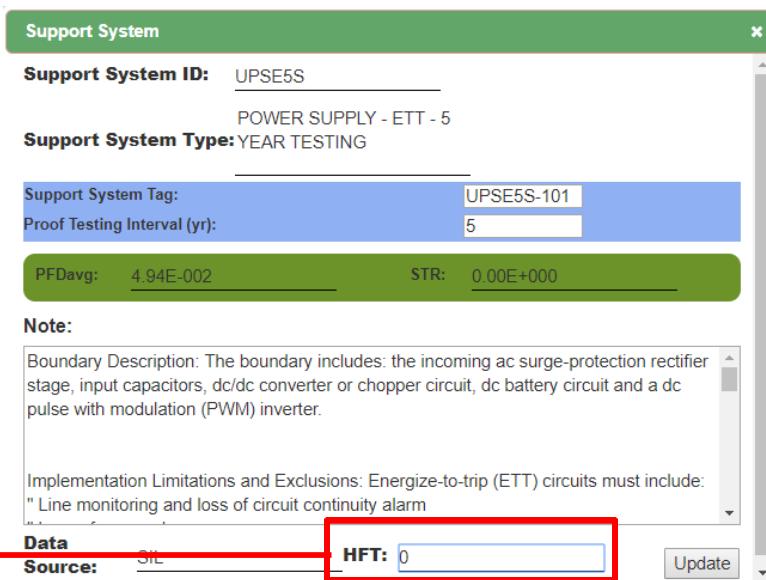
Boundary Description: The boundary includes: the incoming ac surge-protection rectifier stage, input capacitors, dc/dc converter or chopper circuit, dc battery circuit and a dc pulse with modulation (PWM) inverter.

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

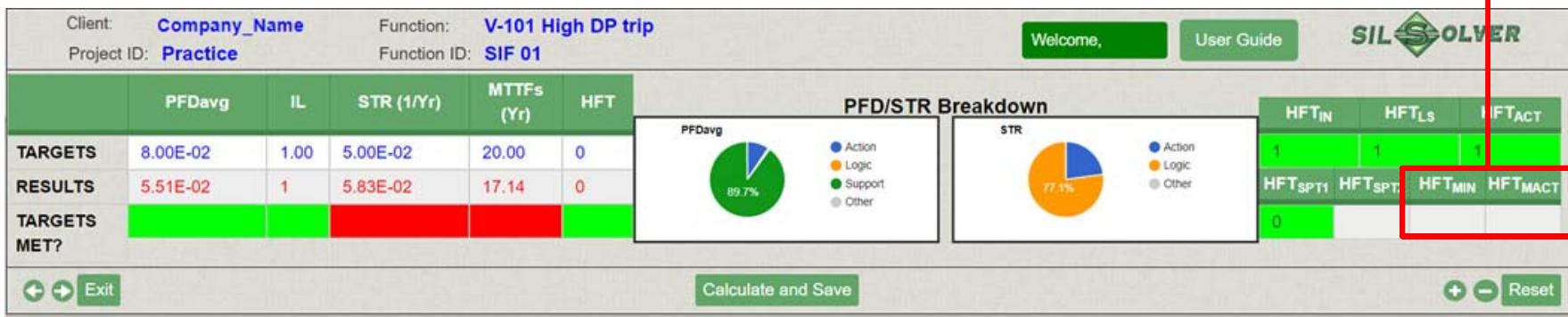


Support System
HFT Value

Default value is 0 when importing support systems that are not in the current SIL Solver support system datasheet.

HFT Results for Manual Input and Manual Action

HFT Results from Manual Input and Manual Action entries



Is that all?

- The SIL Calculation is performed within a context of standard SIL evaluation assumptions, such as
 - Sufficient independence exists between the SIF and other functions used in the hazard case the SIF is designed for
 - Functional safety management program meets ISA61511-1 requirements
- The documentation of the SIL calculation should include sufficient SRS information to provide this context

SRS Info

Client: **Company_Name** Function: **V-101 High DP trip**
Project ID: **Practice** Function ID: **SIF 01**

Welcome, User Guide **SIL SOLVER**

	PFavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT		HFT _{IN}	HFT _{LS}	HFT _{ACT}
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0				
RESULTS	5.51E-02	1	5.83E-02	17.14	0				
TARGETS MET?									

PFD/STR Breakdown

PFDavg



Action
Logic
Support
Other

STR



Action
Logic
Other

Calculate and Save

SRS

- PROCESS HAZARD
- DESCRIPTION
- DIAGNOSTICS
- RESET
- SHUTDOWN
- REFERENCE
- COMMENTS

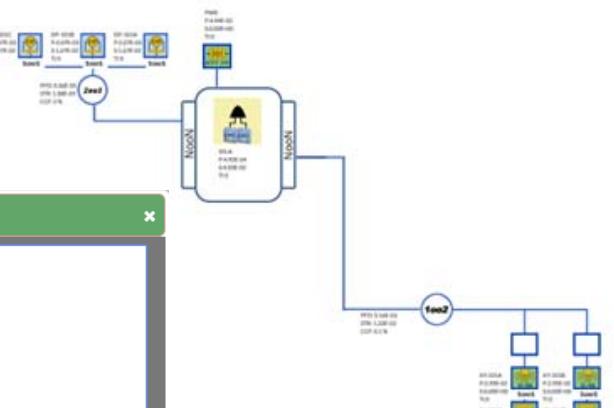
LOGIC SOLVER

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

Process Hazard

Save

+ **Exit** **+** **Reset**



Done with SIF 01

Client: **Company_Name** Function: **V-101 High DP trip**
 Project ID: **Practice** Function ID: **SIF 01**

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

TARGETS	8.00E-02	1.00	5.00E-02	20.00	0
RESULTS	5.51E-02	1	5.83E-02	17.14	0
TARGETS MET?					

PFDavg **STR**

PFD/STR Breakdown

HFT_{IN} **HFT_{LS}** **HFT_{ACT}**

1	1	1
HFT _{SPT1}	HFT _{SPT2}	HFT _{MIN}
0		

Calculate and Save **Exit** **+** **Reset**

SRS
PROCESS HAZARD
DESCRIPTION
DIAGNOSTICS
RESET
SHUTDOWN
REFERENCE
COMMENTS

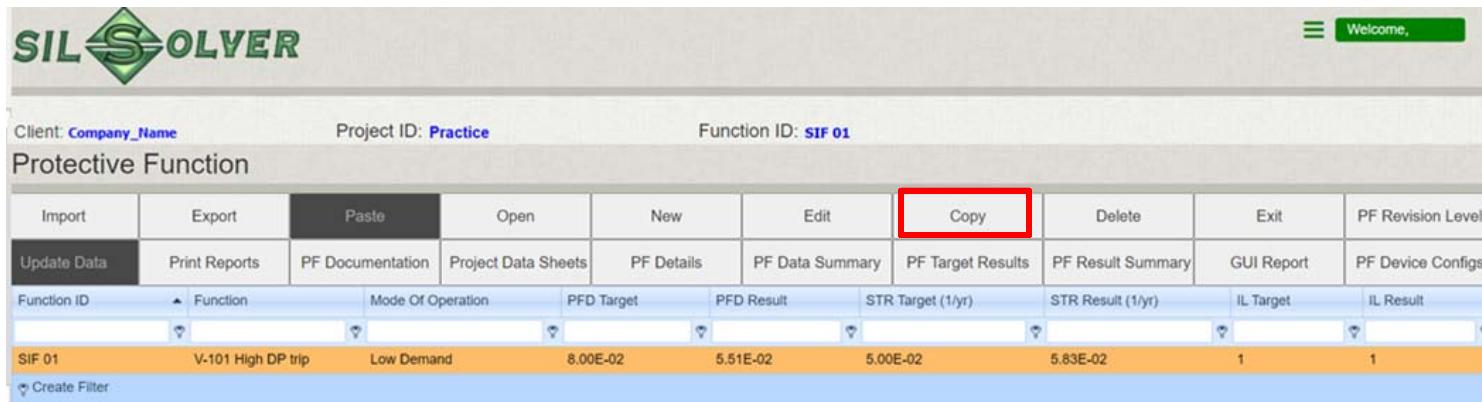
LOGIC SOLVER
INPUT CONFIGURATION
INPUT DEVICE
ACTION CONFIGURATION
ACTION DEVICE
SUPPORT CONFIGURATION
SUPPORT SYSTEM
CUSTOMER DEVICE
MANUAL DEVICE

Exit to return to main Protective Function screen for this project

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



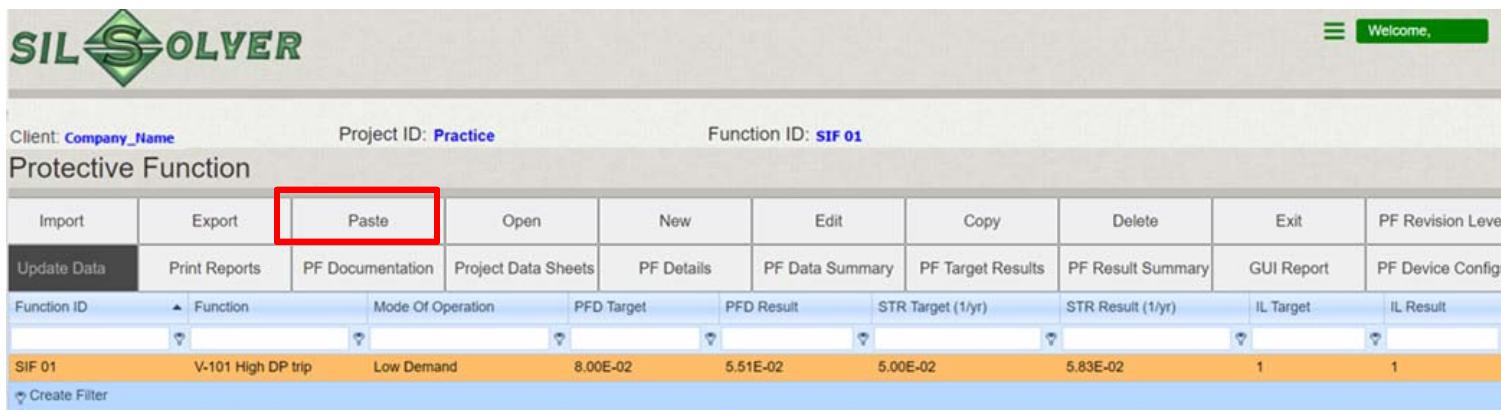
Client: Company_Name Project ID: Practice Function ID: SIF 01

Protective Function

Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	PF Revision Level
Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
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 High DP trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1	

⋮ Create Filter

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



Client: Company_Name Project ID: Practice Function ID: SIF 01

Protective Function

Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	PF Revision Level
Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
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 High DP trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1	

⋮ 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. At the top, there are tabs for 'Client: Company_Name', 'Project ID: Practice', and 'Function ID: SIF 01'. The main window is titled 'Protective Function' and displays a table with columns: Function ID, Function, and Mode Of Operation. The first row shows 'SIF 01', 'V-101 High DP trip', and 'Low Demand'. Below this table is a 'Create Filter' button. A 'Protective Function' dialog box is overlaid on the main window. It contains two input fields: 'Function ID:' with the value 'SIF 02' and 'Function:' with the value 'V-102 High DP/P trip'. At the bottom of the dialog are 'Save' and 'Close' buttons. The background of the main window shows a table with columns: Delete, Exit, PF Revision Level, PF Result Summary, GUI Report, PF Device Configs, STR Result (1/yr), IL Target, and IL Result. The first row of this table has values: Delete, Exit, PF Revision Level, PF Result Summary, GUI Report, PF Device Configs, STR Result (1/yr), IL Target, and IL Result. The second row has values: 5.83E-02, 1, 1, 5.83E-02, 1, 1, 1, 1, and 1.

Success!

SIL SOLVER

Client: Company_Name Project ID: Practice Function ID: SIF 02

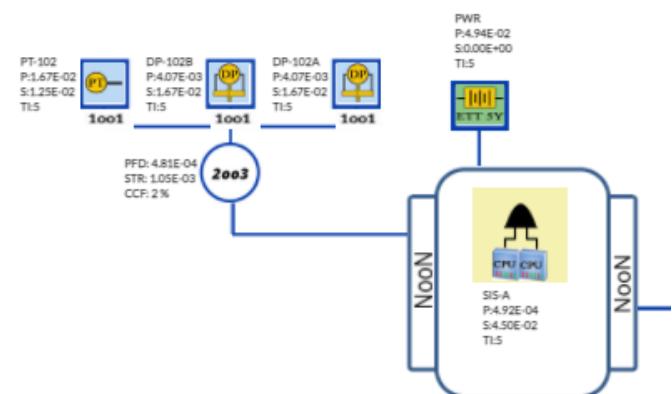
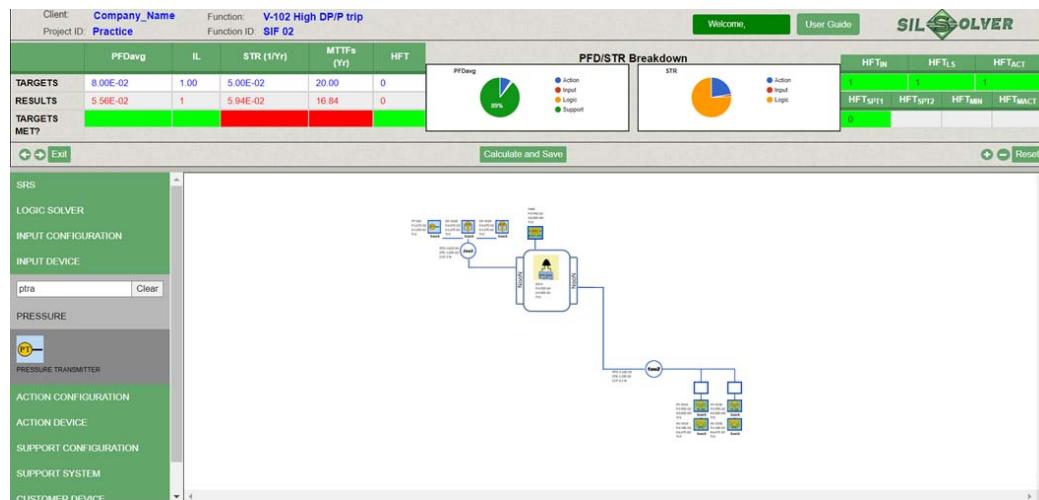
Protective Function

Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	PF Revision Level
Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
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 High DP trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1	
SIF 02	V-102 High DP/P trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1	

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

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

- Set the diagnostic level to DC1
- Set the diagnostic interval to partial stroke testing interval

Both fields must be configured for correct use of equation

Device

Device ID: BVFCC Device Type: BLOCK VALVE-BALL-FTC-CLEAN

Configurations:

- Device Tag: BV1
- Proof Testing Interval (yr): 5
- Voting: 1001
- Subsystem Diagnostic Level: 2

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
- User Specified

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

Both fields must be
configured for correct use
of equation

Device

Device ID: THMLS Device Type: THERMOCOUPLE - LOW STRESS ENVIRONMENT

Configurations:

Device Tag: TT1
Proof Testing Interval (yr): 1
Voting: 1oo1
Subsystem Diagnostic Level: NO DC

Maintenance:

Mean Time to Repair (hr): 72
Diagnostic Interval (hr): 0.500
Overhaul Interval (yr): 10
Proof Testing Coverage (%): 85
User Specified

Properties:

Failure Dangerous Failure Rate (1/yr): 5.00E-03
Failure Spurious Failure Rate (1/yr): 4.00E-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

PFDavg: 0.00E+000
STR: 0.00E+000

Note:

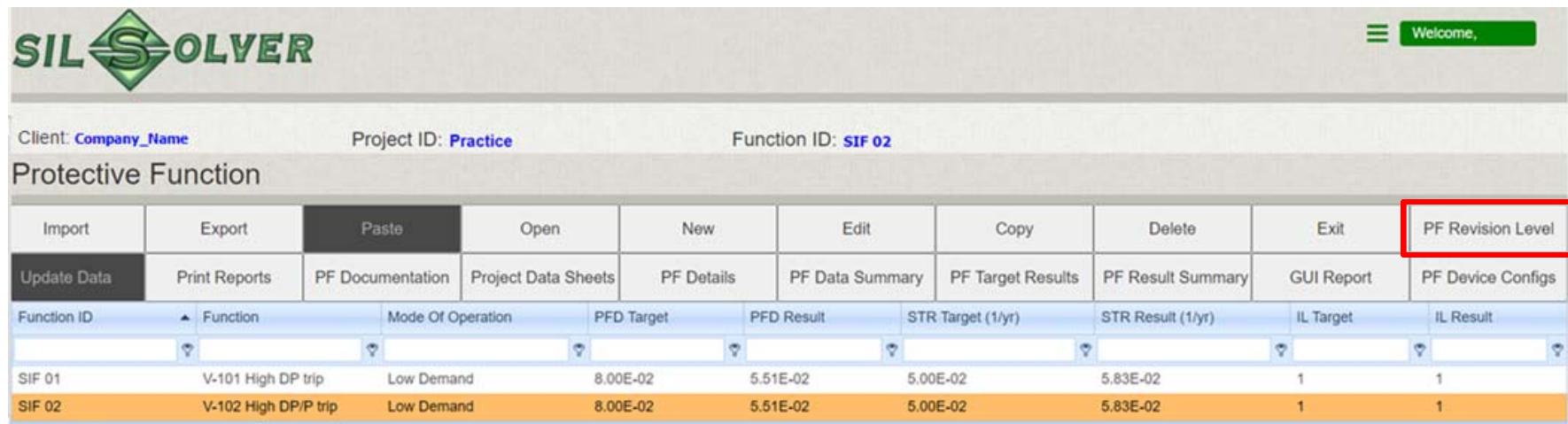
Boundary Conditions: Boundary includes thermocouple element and insulators, terminal head and protecting tube or thermowell.
Process Severity Assumption: Clean
Implementation Limitations and Exclusions: A low stress environment does not include the following: high vibration application

Data Source: SIL

4. EDITING, COPYING OR DELETING AN EXISTING PROJECT

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 a new function revision entry, open to edit it, or delete an entry.



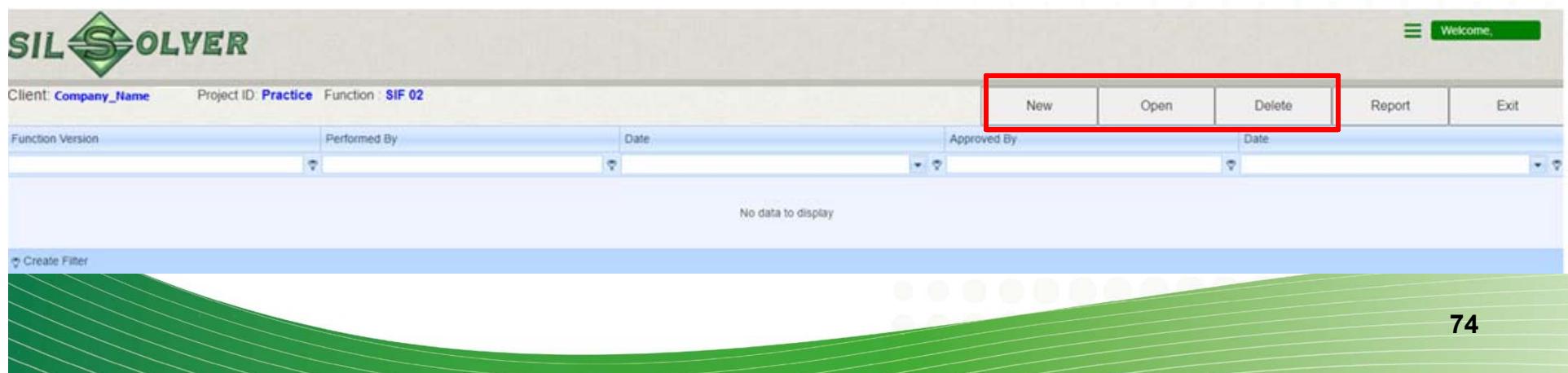
SIL SOLVER

Welcome

Client: Company_Name Project ID: Practice Function ID: SIF 02

Protective Function

Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	PF Revision Level
Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
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 High DP trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1	
SIF 02	V-102 High DP/P trip	Low Demand	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1	



SIL SOLVER

Welcome

Client: Company_Name 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

Activates when a project is copied

Client: Company_Name Project ID: BIG FUNCS1

Projects

Site	Location	Project ID	Project Name
SIS-TECH	Pretend location 1	BIG FUNCS1	Fully populated
TEST	Pretend site 2	CASE 4	Case 3 for testing import-export
SISTC	Pretend location 1	COMPLEX	Complex Architectures
BACK	Houston Texas	FLOW1	Reverse flow case

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

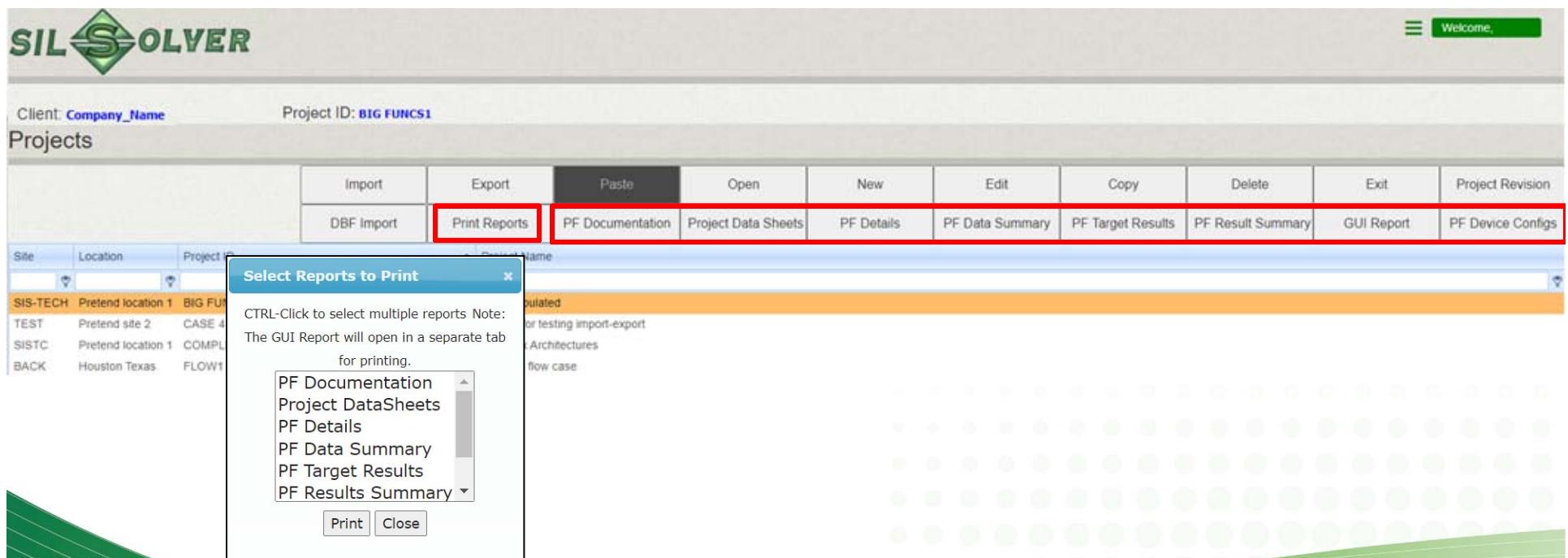
5. GENERATING REPORTS

Project Report generation

Print a single report for a whole project by selecting project and click relevant report tab...

or use “Print Reports” and select multiple reports at once

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



Function Report generation

Print a report for an individual function by going to the function list for that project, select a function and click relevant report tab ...

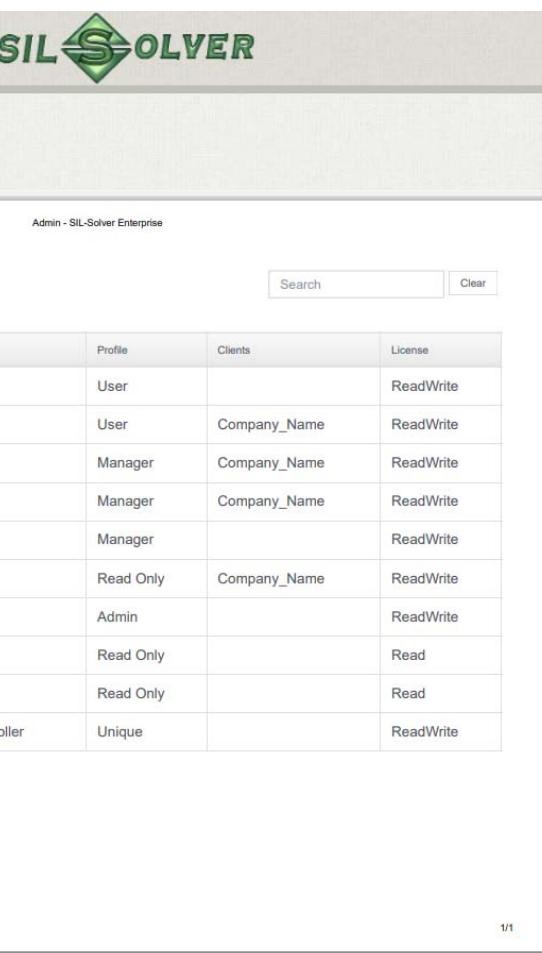
or use “Print Reports” and select multiple reports at once

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

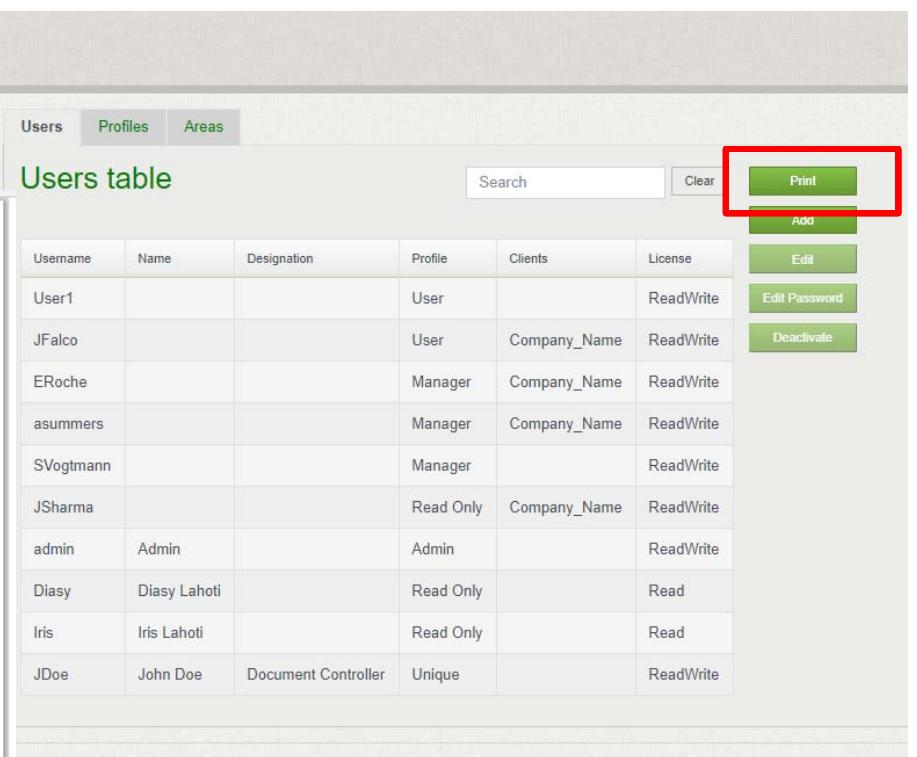
The screenshot shows the SIL SOLVER software interface. At the top, there is a navigation bar with 'Welcome' and other options. Below it, the main header displays 'Client: Company_Name', 'Project ID: Practice', and 'Function ID: SIF 02'. The main content area is titled 'Protective Function' and shows a table of functions. The 'Function ID' column lists 'SIF 01' and 'SIF 02'. The 'PFD Target' column for both rows contains '8.00E-02'. The 'PFD Result' column contains '5.51E-02'. The 'STR Target (1/yr)' column contains '5.00E-02'. The 'STR Result (1/yr)' column contains '5.83E-02'. The 'IL Target' column contains '1'. The 'IL Result' column contains '1'. A red box highlights the 'Print Reports' button in the top menu bar. A modal window titled 'Select Reports to Print' is open, listing report types: 'PF Details', 'PF Data Summary', 'PF Target Results', 'PF Results Summary', 'PF Device Configs', and 'GUI Report'. The 'Print' and 'Close' buttons are at the bottom of the modal. The entire modal window is also highlighted with a red box.

User Report for Admin

- Click on Print on Users tab to print the list of all users



Username	Name	Designation	Profile	Clients	License
User1			User		ReadWrite
JFalco			User	Company_Name	ReadWrite
ERoche			Manager	Company_Name	ReadWrite
asummers			Manager	Company_Name	ReadWrite
SVogtmann			Manager		ReadWrite
JSharma			Read Only	Company_Name	ReadWrite
admin	Admin		Admin		ReadWrite
Diisy	Diisy Lahoti		Read Only		Read
Iris	Iris Lahoti		Read Only		Read
JDoe	John Doe	Document Controller	Unique		ReadWrite



Username	Name	Designation	Profile	Clients	License
User1			User		ReadWrite
JFalco			User	Company_Name	ReadWrite
ERoche			Manager	Company_Name	ReadWrite
asummers			Manager	Company_Name	ReadWrite
SVogtmann			Manager		ReadWrite
JSharma			Read Only	Company_Name	ReadWrite
admin	Admin		Admin		ReadWrite
Diisy	Diisy Lahoti		Read Only		Read
Iris	Iris Lahoti		Read Only		Read
JDoe	John Doe	Document Controller	Unique		ReadWrite

alpha.dovetailsoftware.io:51302/engineering/admin/users

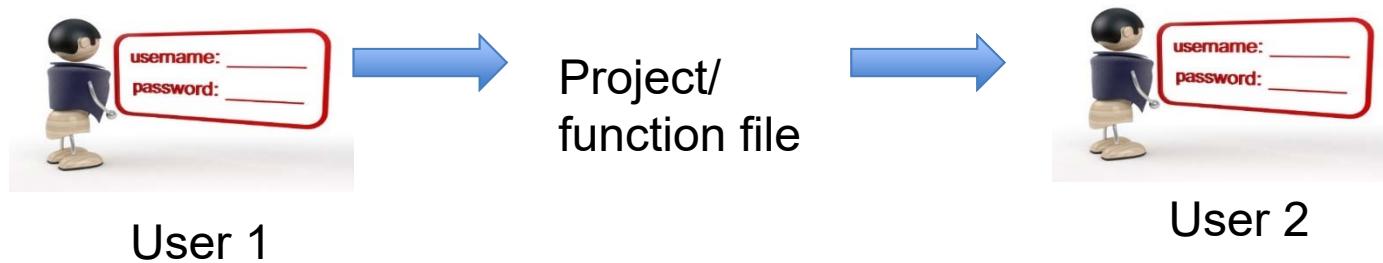
1/1

6. 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)

Import and export

- The way to share a project/function between **SIL Solver[®] Enterprise users** on different databases



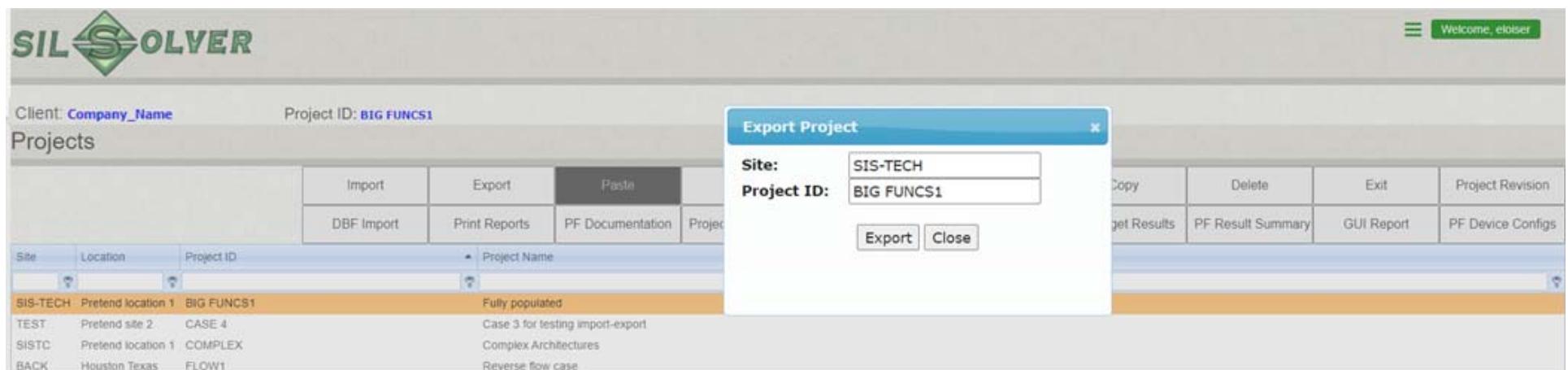
DBF Import

- 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



Project import

To import a previously exported SIL Solver® Enterprise project:

1. Go to the project page
2. Click “Import”, which will open the import page
3. Choose the Client ID, region, location and unit for this project
4. Click “choose files”, then change the directory to the project (*.silprj) file you want to import
5. Click Import and the tool will attempt to import the file



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” button to open the DBF import page
6. Choose the client, region, location and unit for this project
7. Click Choose Files to browse to the Zipped project folder
8. Click “Upload_ZipFile”
9. When the upload is ready, click import
10. A message will pop up when the import is done, including any warnings

The image shows two screenshots of the SIL SOLVER Enterprise software interface for DBF import.

Left Screenshot (Upload Files to Import):

- Header: SIL SOLVER v1.3.0.0
- Section: Upload Files to Import
- Form fields:
 - Client Id: MMDS
 - Region: MMDS_region
 - Location: MMDS_location
 - Unit: MMDS_unit
- Buttons:
 - Choose Files (button)
 - TEST_CASE 4.zip (file selection box)
 - Upload_ZipFile (button)
 - user_5 (input box)

Right Screenshot (Import successful):

- Header: SIL SOLVER v1.3.0.0
- Section: Imported successfully
- Text: Press Import to complete the DBF import process.
- Form fields:
 - Client Id: MMDS
 - Region: MMDS_region
 - Location: MMDS_location
 - Unit: MMDS_unit
- Buttons:
 - Choose Files (button)
 - No file chosen (input box)
 - user_5 (input box)
 - Import (button)

CAUTION: Know the version the work needs to be performed in!

- Projects/functions from older versions **can** be imported into a newer version of SIL Solver® Enterprise.
- However, projects and functions from a newer version **cannot** be imported back into an older version of SIL Solver® Enterprise or into the desktop application.

What if Data Changed from Version the Imported Project was created in?

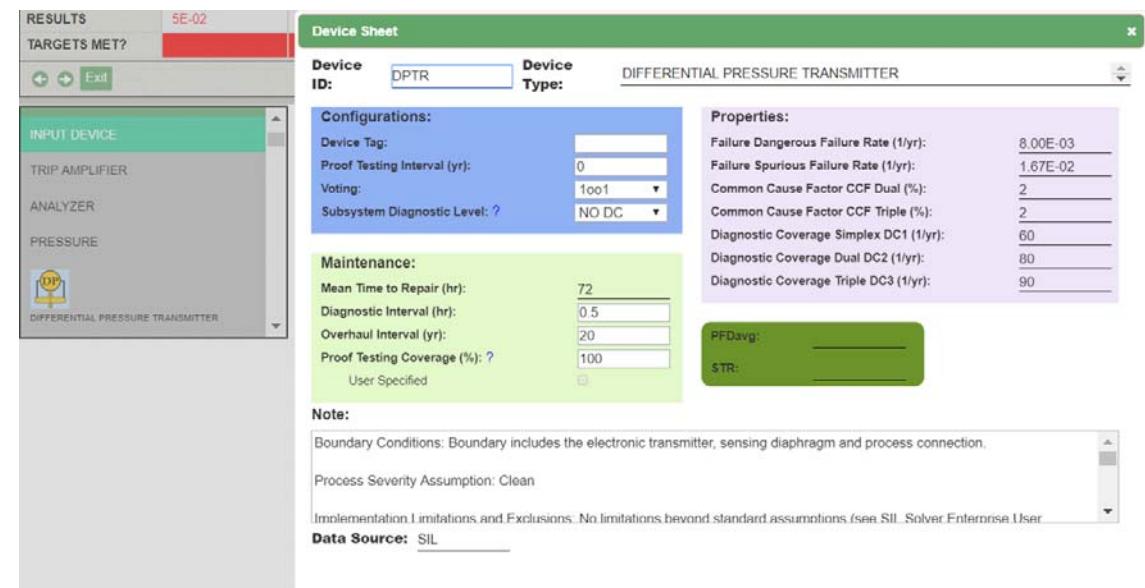
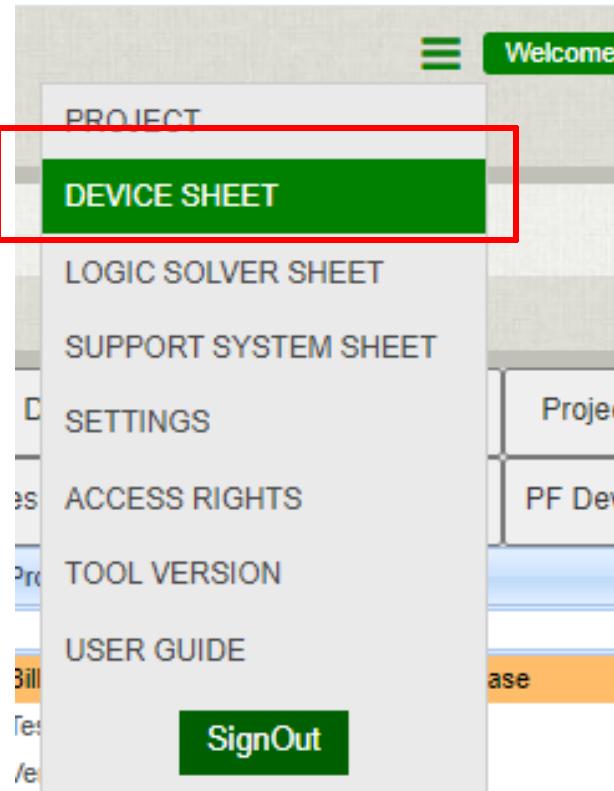
- i Indicates the data has been updated for one or more devices in this function

Function ID		Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)
1002 complex		Duplex Complex Inputs with incomplete entries	Low Demand		1.21E-02	
1002new			Low Demand		1.21E-02	
3003 Complex	3	Full set of 3003 Complex Inputs with 1003 Actions	Low Demand	8.00E-02	3.24E-02	1.00E-01
<input type="checkbox"/> Create Filter		Some devices in this protective function don't match the 'master pool' device sheets. Click the Update Data button to correct.				

7. DATASHEETS

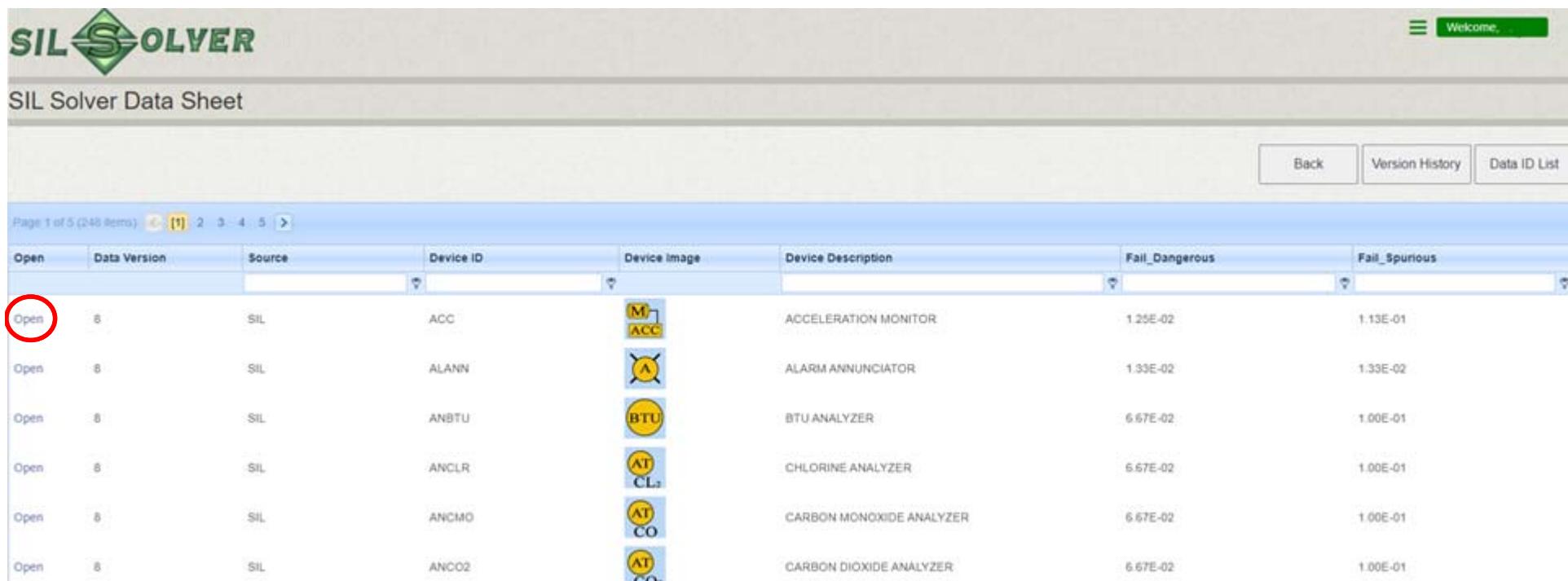
- Device
- Logic Solver
- Support System

Accessing Datasheets



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

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

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

Device Datasheet

SIL SOLVER

Welcome

SIL Solver Data Sheet

DATA SHEET Back

DataSource	SIL	Device Id	ACC	 	Device Type	ACCELERATION MONITOR
Fail Dangerous Failure Rate(1/yr)	1.25E-02	Fail Spurious Failure Rate(1/yr)	1.13E-01	Diagnostic Interval(hrs)	0.00	
Mean Time to Repair(hrs)	72	Common Cause Factor Dual Mode(%)	2.00	Diagnostic Coverage in Simplex Mode(%)	0	
Common Cause Factor Triple Mode(%)	2.00	Diagnostic Coverage in Dual Mode(%)	0	Diagnostic Coverage in Triplicated Mode(%)	0	

Notes

Boundary Conditions: Boundary includes probe/cable assembly and monitor with alarm relay or analog output.

Process Severity Assumption: N/A

Implementation Limitations and Exclusions: For redundant configurations, separate probes and mounting brackets must be used for each monitor. If dual channel monitors are used, the appropriate output voting should be selected from the table.

"D" configuration assumes that each monitor circuit is provided with a means to detect spurious activation of a circuit. "D" configurations can be used when the analog outputs from the monitor are connected to the SIS, providing signal deviation alarming, OR when the relay output from the monitor is used to generate a fault alarm to the operator HMI. This diagnostic does not benefit the PFD so no diagnostic coverage credit is taken in the analysis.

Same for Logic Solvers and Support Systems

SIL SOLVER

SIL Solver Logic Solver Sheet

Welcome

Back Version History Logic ID List

Open	Data Version	Source	Logic Solver ID	Logic Solver Image	Logic Solver Description
Open	8	SIL	DMDIO		GENERIC 2004D DUAL MP, DUAL I/O
Open	8	SIL	DMSIO		GENERIC 1002D 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	RELFCI		RELAY - FAIL TO CLOSE
Open	8	SIL	RELFCO		RELAY - FAIL TO OPEN

SIL SOLVER

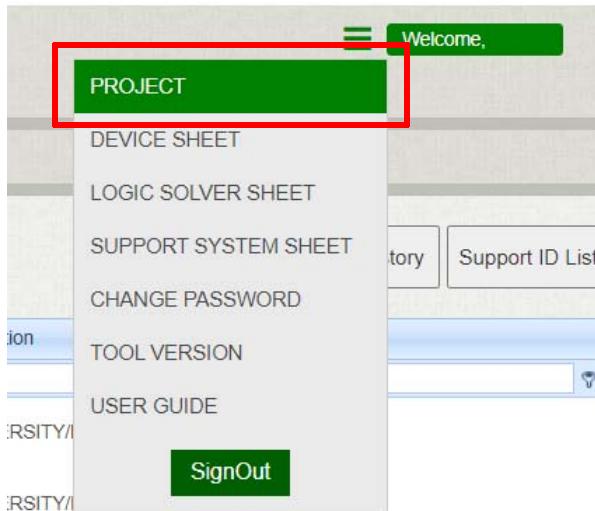
SIL Solver Support System Data Sheet

Welcome

Back Version History Support ID List

Open	Data Version	Source	Support System ID	Support System Image	Support System Description
Open	8	SIL	IADRMS		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	IAWRCRS		INSTRUMENT AIR-RECEIVER

Returning to Project View



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

A screenshot of the 'SIL SOLVER' software interface. The title bar says 'SIL SOLVER v1.2.5.0'. The main title is 'SIL Solver Support System Data Sheet'. In the top right corner, there is a 'Welcome' button. Below the title, there is a table with columns: Open, Data Version, Source, Support System ID, Support System Image, and Support System Description. At the bottom right of the table, there are buttons for Back, Version History, and Support ID List, with the 'Back' button highlighted with a red box.

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 to be created
- Enter the data for the new custom device and Save
 - Do not use special characters or spaces in the Data Source or Device ID fields
 - If desired, browse to a new image for this device to replace the default

Client: Company Name
Project ID: Practice
Function: V-101 High DP trip
Function ID: SIF 01

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

TARGETS	8.00E-02	1.00	5.00E-02	20.00	0
RESULTS	5.51E-02	1	5.83E-02	17.14	0
TARGETS MET?					

PFDAvg Breakdown

SRS

LOGIC SOLVER

INPUT CONFIGURATION

INPUT DEVICE

ACTION CONFIGURATION

ACTION DEVICE

SUPPORT CONFIGURATION

SUPPORT SYSTEM

CUSTOMER DEVICE

Search Clear

DEVICE

Customer Device

Data Source: Device Id: Device Type:

Failure Dangerous Failure Rate(1/yr): Diagnostic Interval(hr):

Failure Spurious Failure Rate (1/yr): Diagnostic Coverage Simplex(%):

Mean Time to repair(hr): Diagnostic Coverage Dual(%):

CCF Dual(%): Diagnostic Coverage Triplicated(%):

CCF Triple(%):

Notes:

Select Alternate User Image File (optional): Choose Files | No file chosen

Select the image file to represent this custom device:

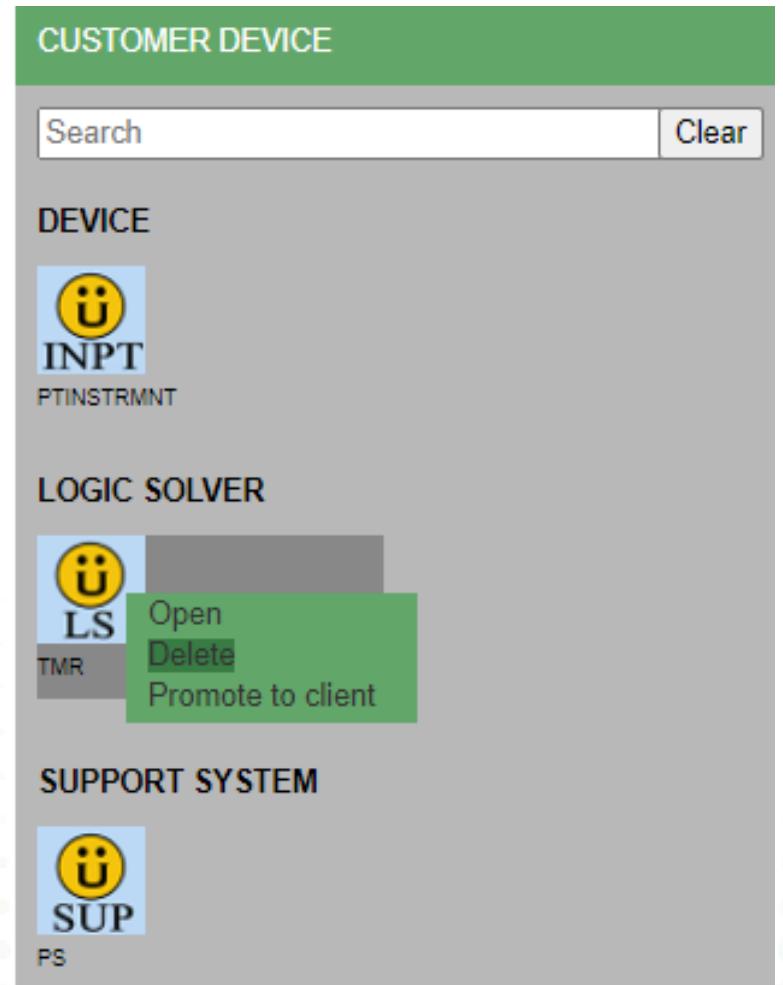
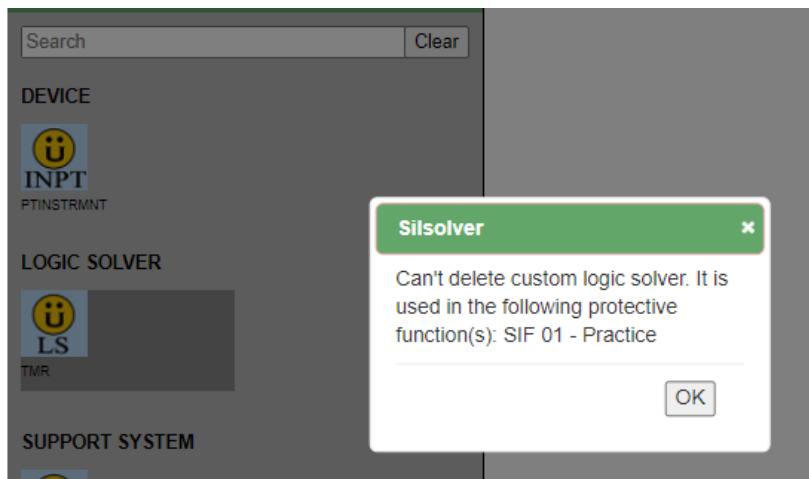
Data Source is required.

Submit

Once created, custom datasheets cannot be edited!

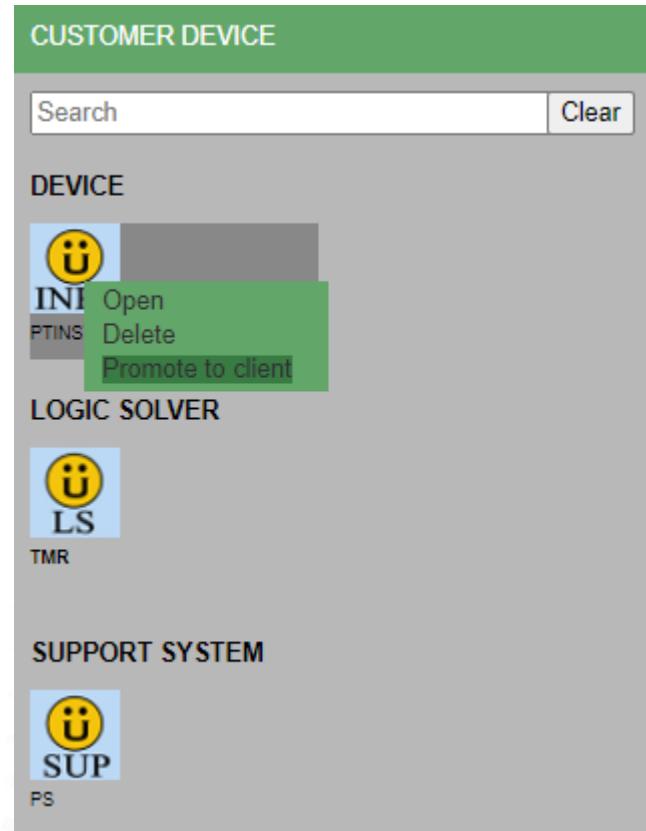
Project level custom datasheet

- Input/Output, Logic Solver and Support system custom datasheets can be created
- By default, datasheets are specific to a Project
- Used datasheet can not be deleted



Client level custom datasheet

- If promoted to client level, datasheet can be accessed by other projects within a client
- Promoted datasheet will green outline around it
- It is a one-way process, promoting to client level can not be undone.



8. 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: Multiple user editing SIF

- A function is checked-out when a user makes a change in it
- If other user opens the function while it's checked out, other user can open it as Read Only and it will be locked out for changes.

Site: SIS Tech-Jenna Function: Modified: 4/1/2021, 3:01:15 PM by JFalco
 Project ID: FLOW1 Function ID: SF1B **READ ONLY**

PFDAvg IL STR (Init) MTTFs (Yr) HFT

TARGETS	8.00E-02	1.00	2.00E-01	5.00	0
RESULTS	2.12E-01	0	4.40E-02	22.73	0
TARGETS MET?					

SRS

PROCESS HAZARD

Device

Device ID: DPT6 Device Type: DP - gas or liquid - Impulse <2 ft - Remote Sealed

Configurations:

- Display Tag for Device(s): PDT314
- Proof Testing Interval (yr): 2
- Voting: 1oo1
- Subsystem Diagnostic Level: NO DC

Maintenance:

- Mean Time to Repair (hr): 72
- Diagnostic Interval (hr): 0.5
- Overhaul Interval (yr): 20
- Proof Testing Coverage (%): 100
- User Specified

Properties:

- Failure Dangerous Failure Rate (1/yr): 8.0000000000C
- Failure Spurious Failure Rate (1/yr): 1.666666666E
- Common Cause Factor CCF Dual (%): 2
- Common Cause Factor CCF Triple (%): 2
- Diagnostic Coverage Simplex DC1 (1/yr): 60
- Diagnostic Coverage Dual DC2 (1/yr): 80
- Diagnostic Coverage Triple DC3 (1/yr): 90

Note:

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

Process Severity Assumption: No adverse process effects are expected due to remote sealing.

Implementation Limitations and Exclusions: Use in application dependent on ultimate protection for impulse piping and

Data Source: SIL **Update**

PFD/STR Breakdown

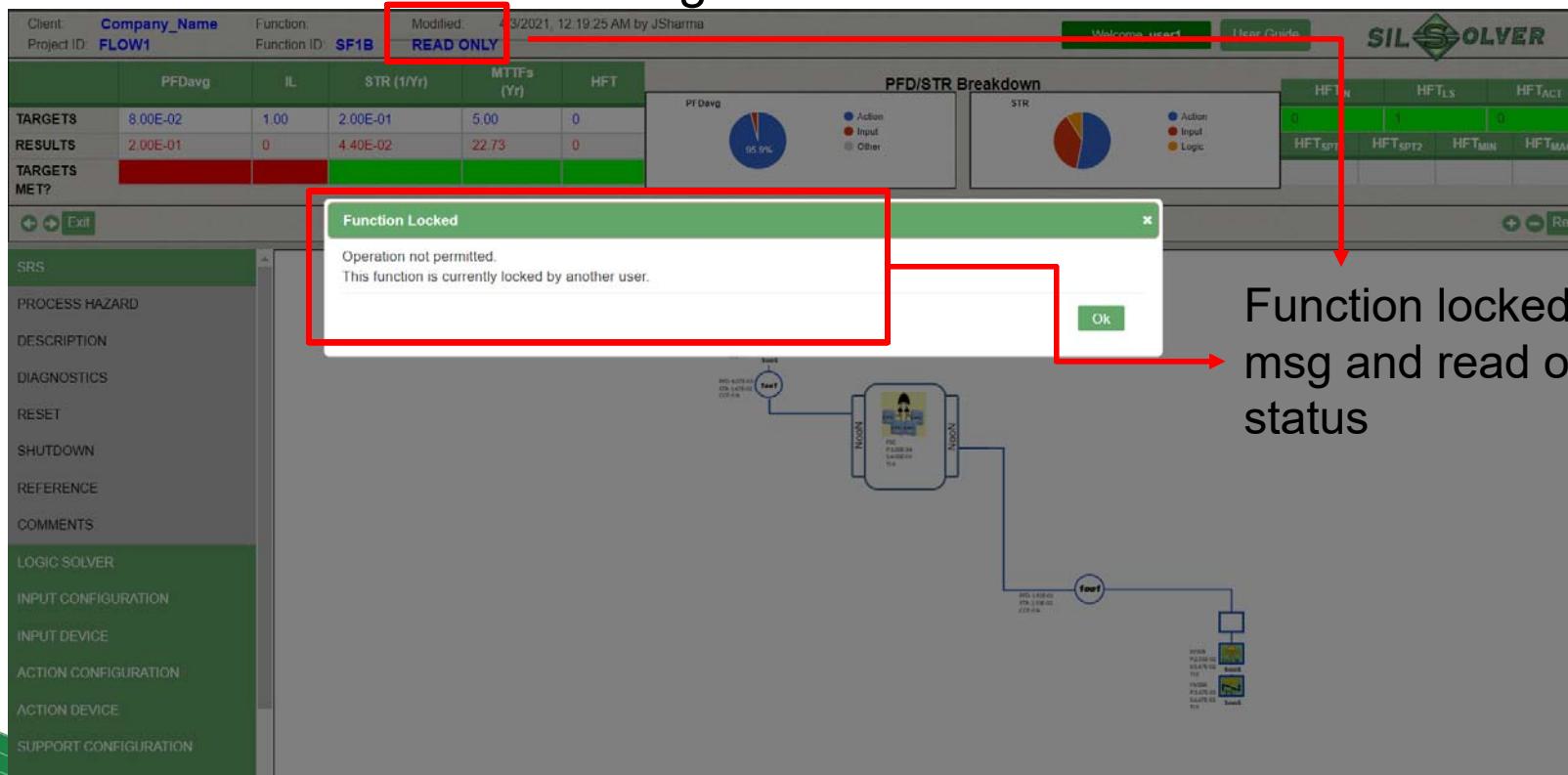
PFDAvg STR

Calculate and Save

Disabled

Troubleshooting: Multiple user editing SIF

- If two users edits a function at once, it will be checked-out by the user updating the function first.
- Other User's screen will be updated with Read Only status and function locked out warning



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

