



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:**
 - **Eloise Roche**
 - eroche@sis-tech.com 713-909-2123
 - **Angela Summers**
 - 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

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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

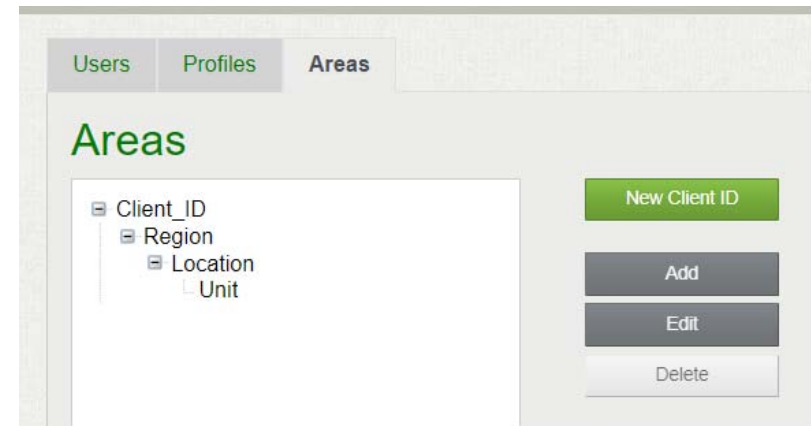
- SIL Solver[®] is licensed software
 - Each enterprise license includes one administrator account and two users (with read-write access)
 - Additional user (read-write) licenses can be purchased
 - 20 Read-Only seats with software at no additional cost
- To request a quote for a new license, contact 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

Users Profiles Areas											
Profiles											
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	✗	✓	✓	✓	✗	✓	✓	✓	✓	Edit
User	Engineer Level Access	✗	✓	✗	✓	✗	✓	✓	✓	✓	Edit
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

Users Profiles Areas											
Profiles											
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	✗	✓	✓	✓	✗	✓	✓	✓	✓	Edit
User	Engineer Level Access	✗	✓	✗	✓	✗	✓	✓	✓	✓	Edit
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

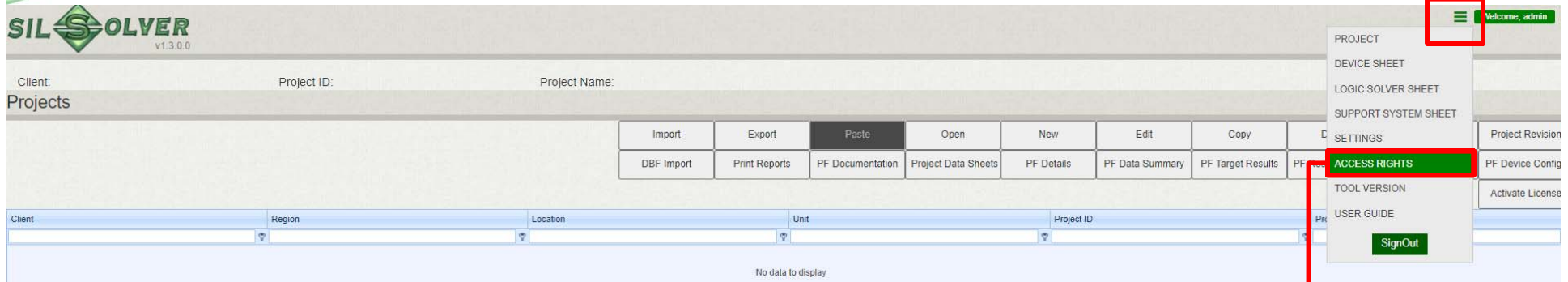


The image shows a login window for the SIL SOLVER application. At the top, the text "SIL SOLVER" is displayed in a large, green, 3D-style font, with a green diamond-shaped logo containing a stylized "S" between the words. Below this, the word "LOGIN" is centered in a white, sans-serif font. Underneath "LOGIN", there are two input fields: the first is labeled "USER NAME" and the second is labeled "PASSWORD", both in white, sans-serif font. At the bottom of the login area, there is a white button with the text "Login" in a black, sans-serif font. The entire login interface is set against a green background with a subtle pattern of small white dots.

2. PROJECT MANAGEMENT

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

Setting up a New User



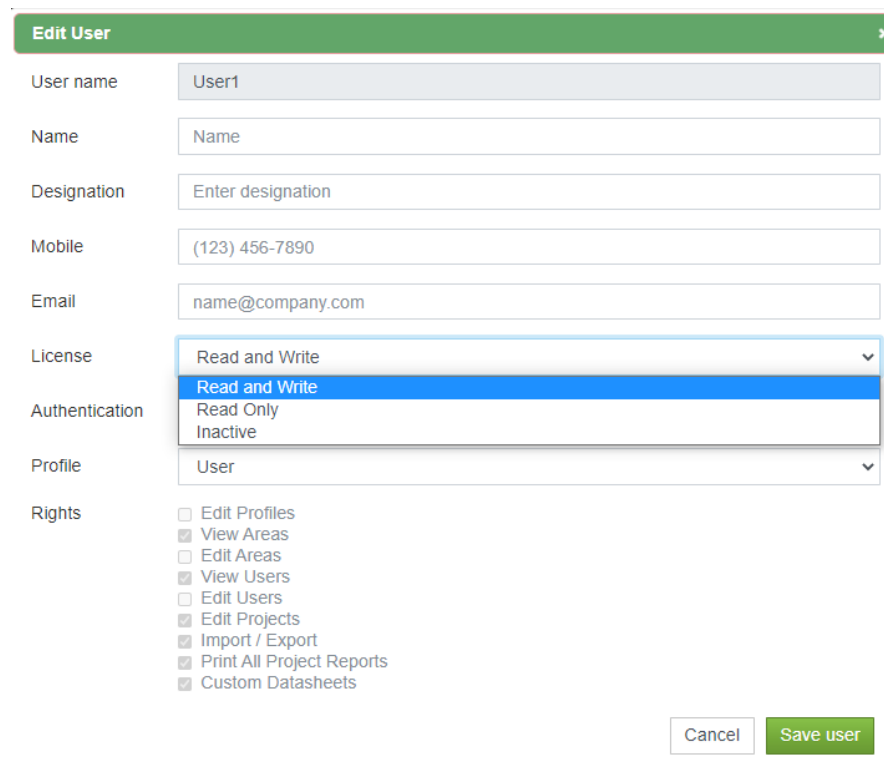
Select Access rights to access User tab



List of Users

Setting up User with License

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



The screenshot shows the 'Edit User' dialog box with the following fields and options:

- User name: User1
- Name: Name
- Designation: Enter designation
- Mobile: (123) 456-7890
- Email: name@company.com
- License: Read and Write (selected), Read Only, Inactive
- Authentication: Read Only, Inactive
- Profile: User
- Rights:
 - ☐ Edit Profiles
 - ☒ View Areas
 - ☐ Edit Areas
 - ☒ View Users
 - ☐ Edit Users
 - ☒ Edit Projects
 - ☒ Import / Export
 - ☒ Print All Project Reports
 - ☒ Custom Datasheets

Buttons: Cancel, Save user

Assigning a Security Profile

Users Profiles Areas

Users table

Search Clear Print Add Edit Edit Password Deactivate

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

Select User and click on "Edit"

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

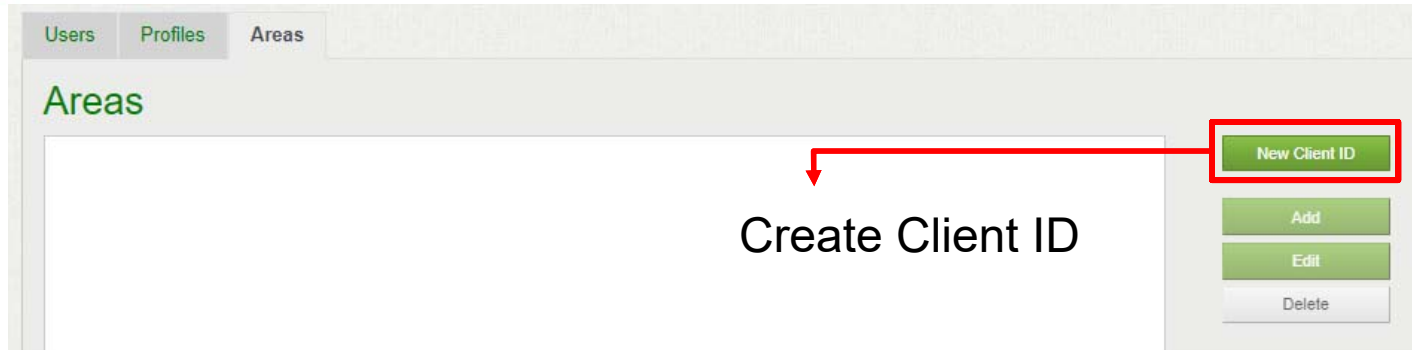
Rights: Full Access

Cancel Save user

Assign Security Profile

Tool use is affected by combination of license and security profile

Creating Hierarchy: Add Client



Users Profiles Areas

Areas

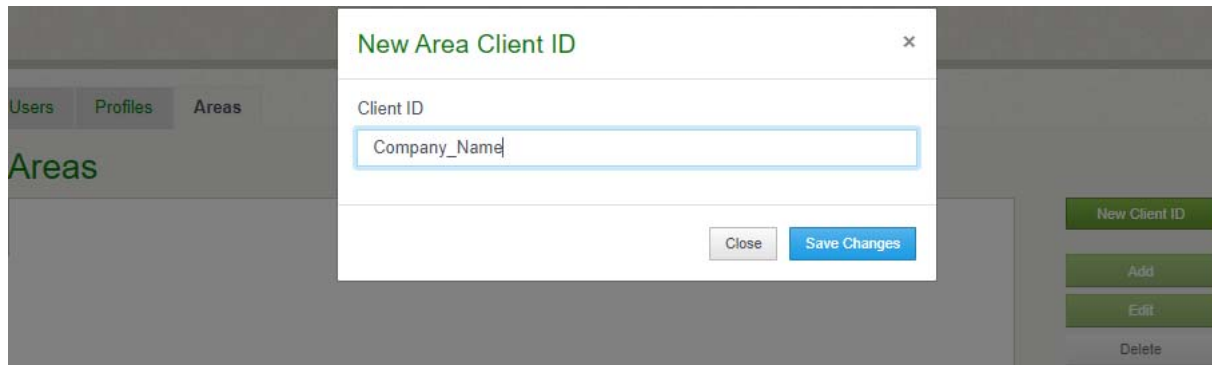
Create Client ID

New Client ID

Add

Edit

Delete



Users Profiles Areas

Areas

New Area Client ID

Client ID

Company_Name


Close Save Changes

New Client ID

Add

Edit

Delete



Users Profiles Areas

Areas

Company_Name

New Client ID

Add

Edit

Delete

Creating Hierarchy: Add Region

Users Profiles Areas

Areas

Company_Name

Region

Region_Gulf

Close Save Changes

New Client ID

Add Region

Edit Client ID

Delete

Add region under Client ID

Users Profiles Areas

Areas

Company_Name

Region_Gulf

New Client ID

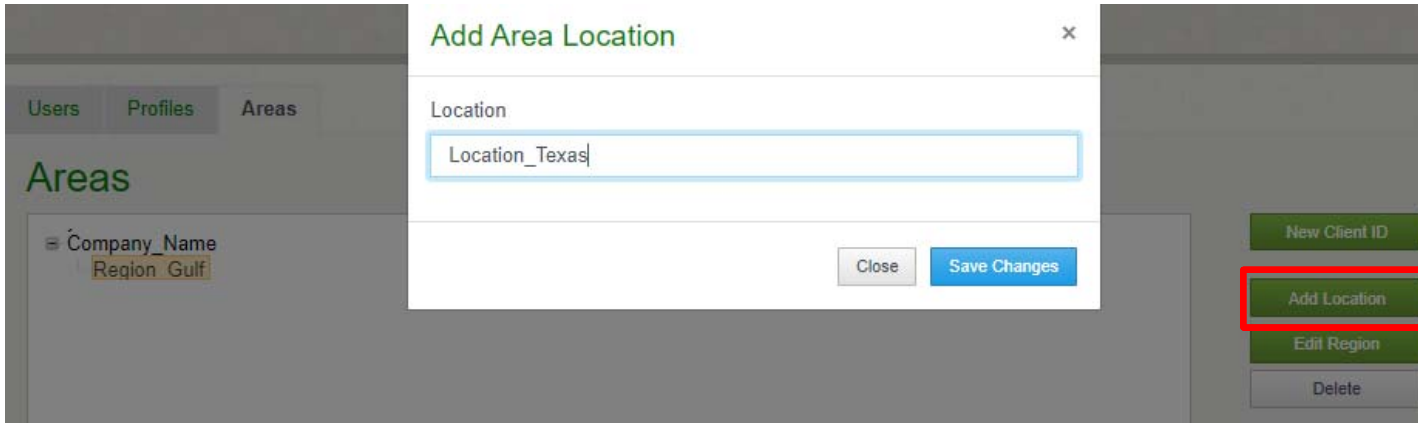
Add Location

Edit Region

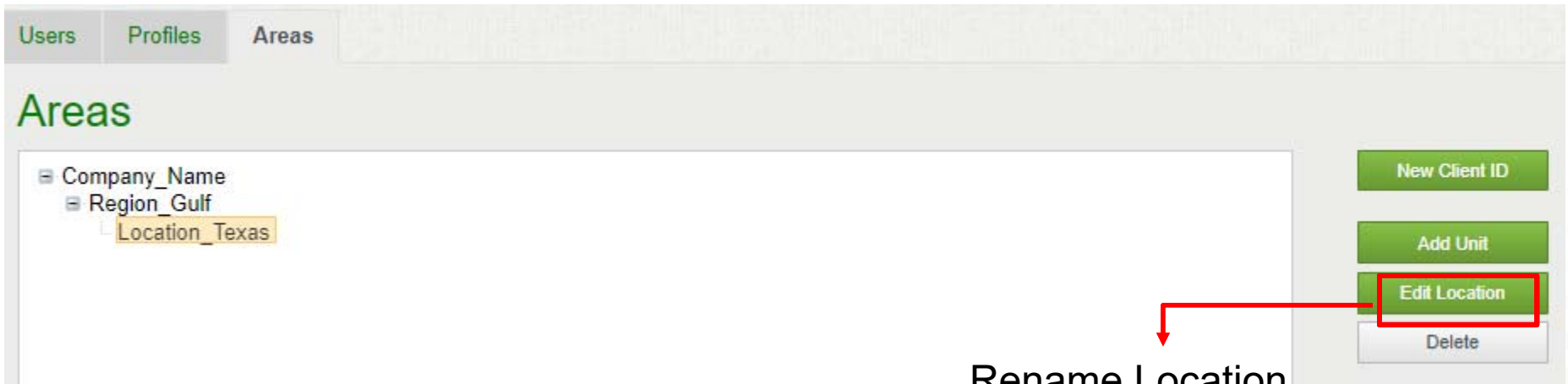
Delete

Rename Region using edit button

Creating Hierarchy: Add Location

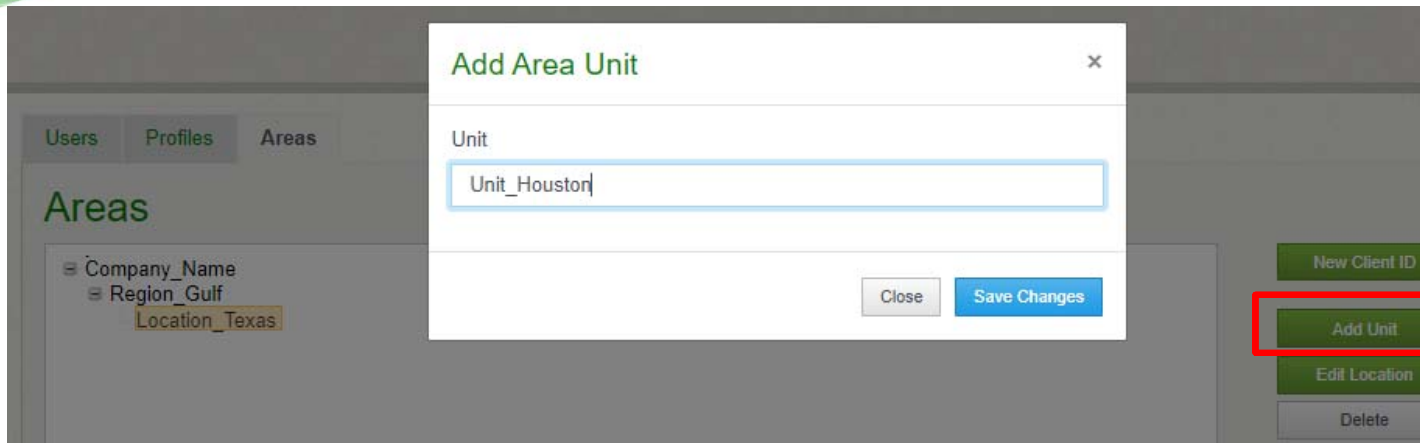


Add Location
under Client ID



Rename Location
using edit button

Creating Hierarchy: Add Unit



Add Unit under Location



Adding project is covered in next section...

Rename Unit using edit button

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)

The screenshot displays the 'Areas' configuration page in the SIL SOLVER application. The page has tabs for 'Users', 'Profiles', and 'Areas', with 'Areas' currently selected. A tree view on the left shows a hierarchy: 'Company_Name' (expanded) contains 'Region_Gulf' (highlighted with a red box and an arrow pointing to the text 'Select level'), 'Location_Texas', and 'Unit_Houston'. On the right, there are buttons for 'New Client ID', 'Add Location', 'Edit Region', and 'Delete'. Below the tree, there are two lists: 'Available' and 'Selected'. The 'Available' list contains 'admin', 'bnooris', 'dblackburn', 'sgallagher', 'mchenab', 'User_1' (highlighted with a red box and an arrow pointing to the right arrow button), 'User_2', 'User_3', and 'DonZ'. The 'Selected' list is empty. Between the lists are navigation buttons: '>>', '>', '<', and '<<'. The '>' button is highlighted with a red box. At the bottom right, there is a 'Save' button, also highlighted with a red box.

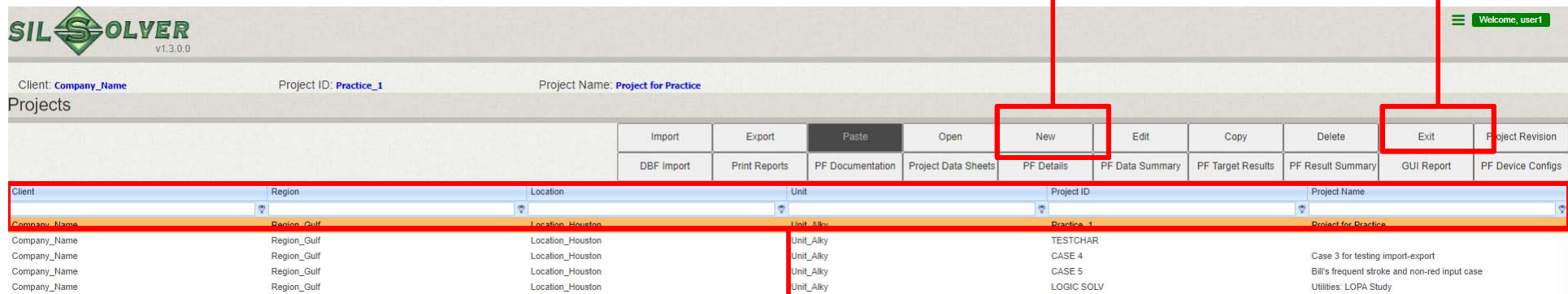
Move selected user to the right and save

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



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	TESTCHAR	
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

Project List

Filters may be useful to users with long project lists

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

Projects

					Import	Export	Paste	Open	New
					DBF Import	Print Reports	PF Documentation	Project Data Sheets	PF Details
Client	Region	Location	Unit		Project ID	Project Name			
Company_Name	Region_Gulf	Location_Houston	Unit_Alky		TEST CHAN	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			

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:

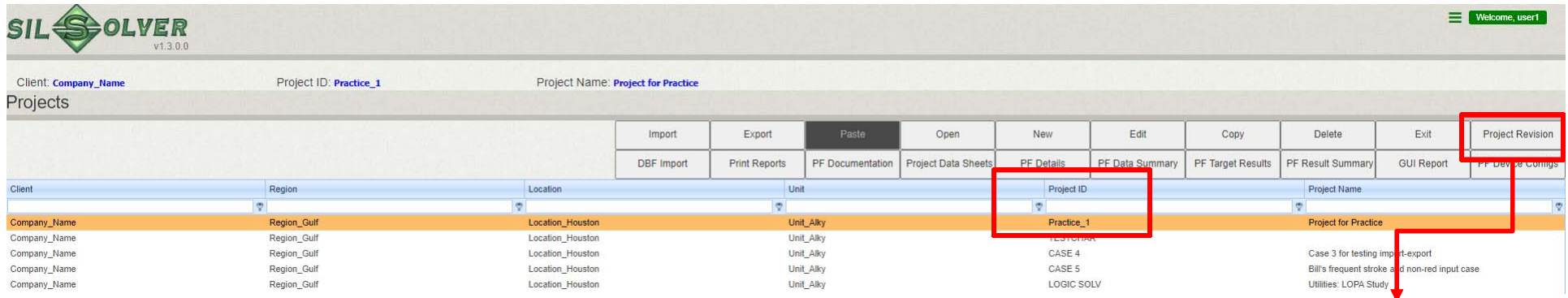
Save Close

Add New Project

Client Id:
Region:
Location:
Unit:
Project ID:
Name:

Save Close

Project Revision Data

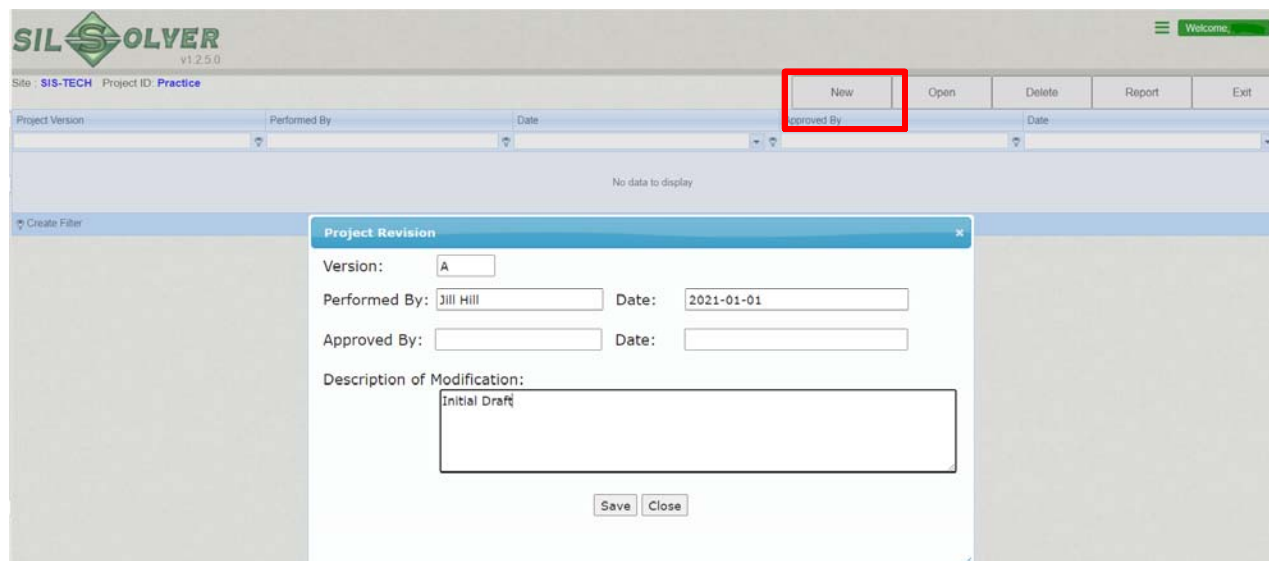


Client: **Company_Name** Project ID: **Practice_1** Project Name: **Project for Practice**

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

Create initial project revision information



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

Project Version: Performed By: Date: Approved By: Date:

No data to display

Create Filter

Project Revision

Version:

Performed By: Date:

Approved By: Date:

Description of Modification:

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

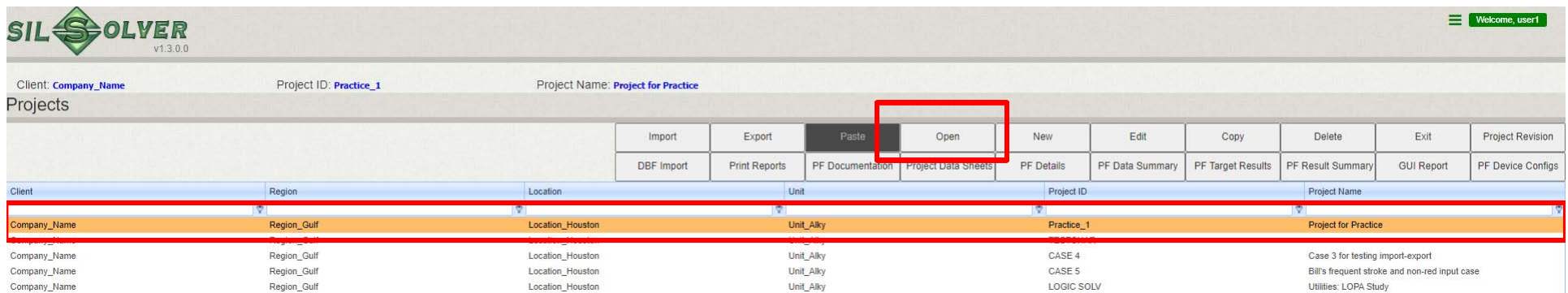
- SIF 01
- SIL-1 (20% design margin)
- Low Demand mode
- Spurious trip target = 20 yrs
- Desired test interval = 5 yrs
- V-101 High DP (2oo3, DP-101A/B/C) trip closes XV-101A and XV-101B (1oo2) ball valves spring loaded to the closed position, each with a single ETT solenoid (XY-101A and XY-101B)
- Power 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



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

Projects

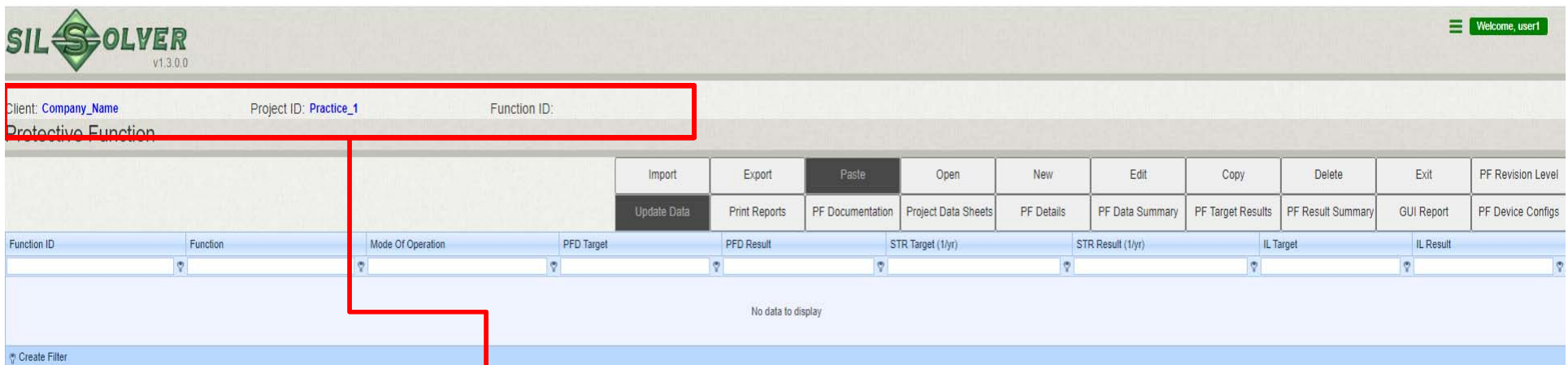
Client	Region	Location	Unit	Project ID	Project Name
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	Practice_1	Project for Practice
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	CASE 4	Case 3 for testing import-export
Company_Name	Region_Gulf	Location_Houston	Unit_Alky	CASE 5	Bill's frequent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

Toolbar: Import, Export, Paste, **Open**, New, Edit, Copy, Delete, Exit, Project Revision

Sub-toolbar: 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

Protective Function Level

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



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

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

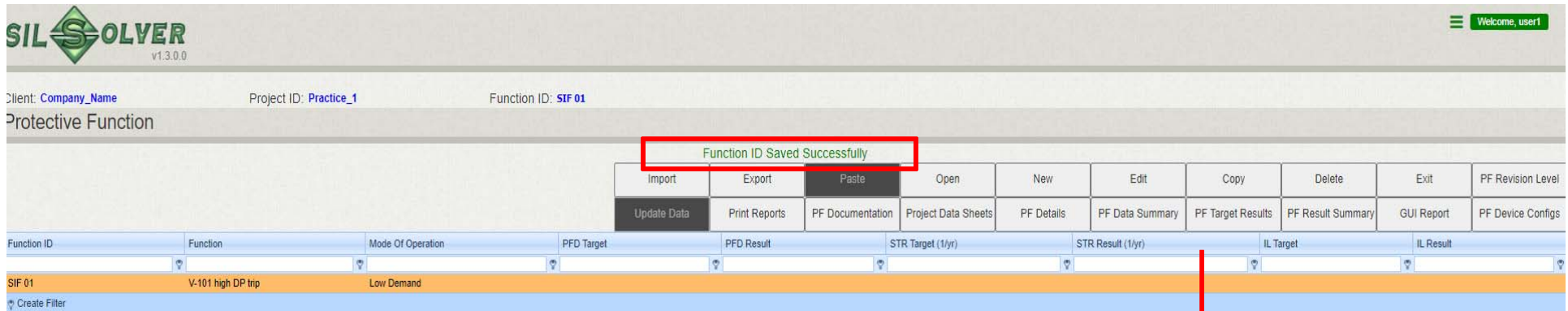
Function ID: SIF 01

Function : V-101 High DP trip

Mode of Operation: Low Demand ▼

Save Close

Select and Open Function



Function ID Saved Successfully

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						

- 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

HFT for Logic Solver

HFT for Inputs(s)

HFT for Action(s)

The screenshot shows the SIL SOLVER GUI interface. At the top, there is a header bar with client and function information, a welcome message, and a user guide link. Below this is a table with columns for PFDavg, IL, STR (1/Yr), MTTFs (Yr), and HFT. The table is divided into sections for TARGETS, RESULTS, and TARGETS. To the right of the table is a PFD/STR Breakdown section with two sub-sections: PFDavg and STR, both showing 'No data'. Below the table is a row of buttons: HFT_{IN}, HFT_{LS}, HFT_{ACT}, HFT_{SPT1}, HFT_{SPT2}, HFT_{MIN}, and HFT_{MACT}. Below these buttons is a row of buttons: Calculate and Save, and a reset button. On the left side, there is a vertical menu with options: SRS, LOGIC SOLVER, INPUT CONFIGURATION, INPUT DEVICE, ACTION CONFIGURATION, ACTION DEVICE, SUPPORT CONFIGURATION, SUPPORT SYSTEM, CUSTOMER DEVICE, and MANUAL DEVICE. In the center, there is a diagram of a support system with two input/output ports labeled 'NoON'. Red arrows point from the labels to the corresponding GUI elements.

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS					
RESULTS					
TARGETS					
RESULTS					

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

Welcome, User Guide

PFD/STR Breakdown

PFDavg No data STR No data

HFT_{IN} HFT_{LS} HFT_{ACT}
HFT_{SPT1} HFT_{SPT2} HFT_{MIN} HFT_{MACT}

Calculate and Save reset

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

NoON NoON

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.

HFT for Support System 1

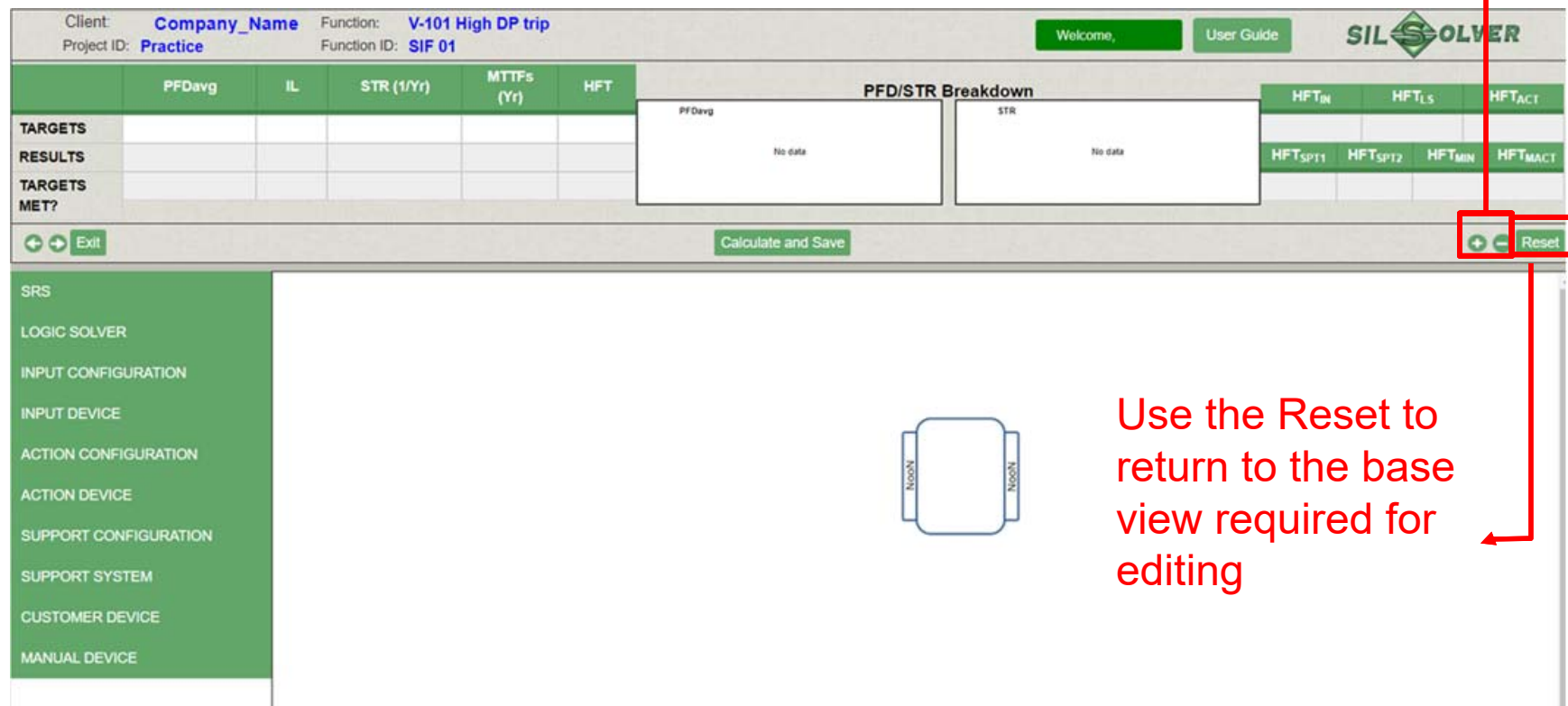
HFT for Support System 2

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



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
TARGETS					
RESULTS					
TARGETS MET?					

PFD/STR Breakdown

HFT _{IN}	HFT _{LS}	HFT _{ACT}
HFT _{SPT1}	HFT _{SPT2}	HFT _{MIN}

Calculate and Save

Exit

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

Client: **Company_Name** Function: **V-101 High DP trip** Welcome, User Guide **SIL SOLVER**
 Project ID: **Practice** Function ID: **SIF 01**

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS					
RESULTS					
TARGETS MET?					

PFD/STR Breakdown
 PFDavg: No data
 STR: No data

HFT_{IN} HFT_{LS} HFT_{ACT}
 HFT_{SPT1} HFT_{SPT2} HFT_{MIN} HFT_{MACT}

Exit Calculate and Save Reset

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

Noon Noon

Target Specification ✕

PFDavg

MTTFs (Yr)

Update

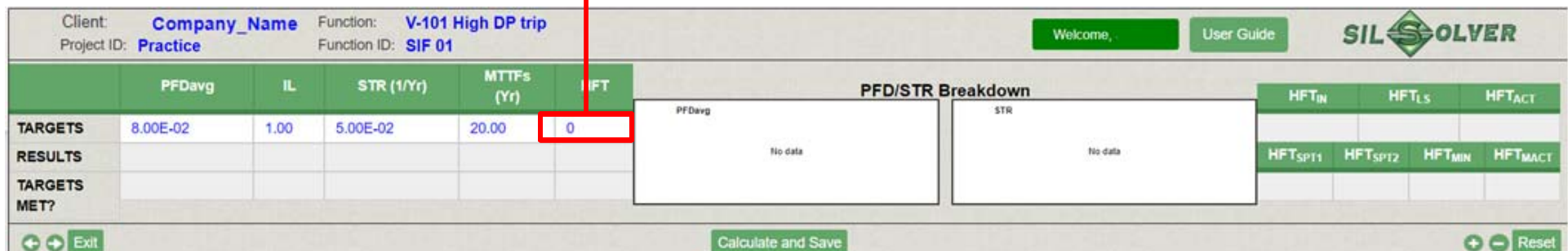
Enter performance targets and update

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.

SILTarget	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**

Welcome, User Guide **SIL SOLVER**

	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: No data
 STR: No data

HFT_{IN} HFT_{LS} HFT_{ACT}
 HFT_{SPT1} HFT_{SPT2} HFT_{MIN} HFT_{MACT}

Exit Calculate and Save Reset

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**
Project ID: **Practice**

Function: **V-101 High DP trip**
Function ID: **SIF 01**




Welcome, **.**

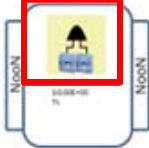
User Guide



	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										
TARGETS MET?										

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 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

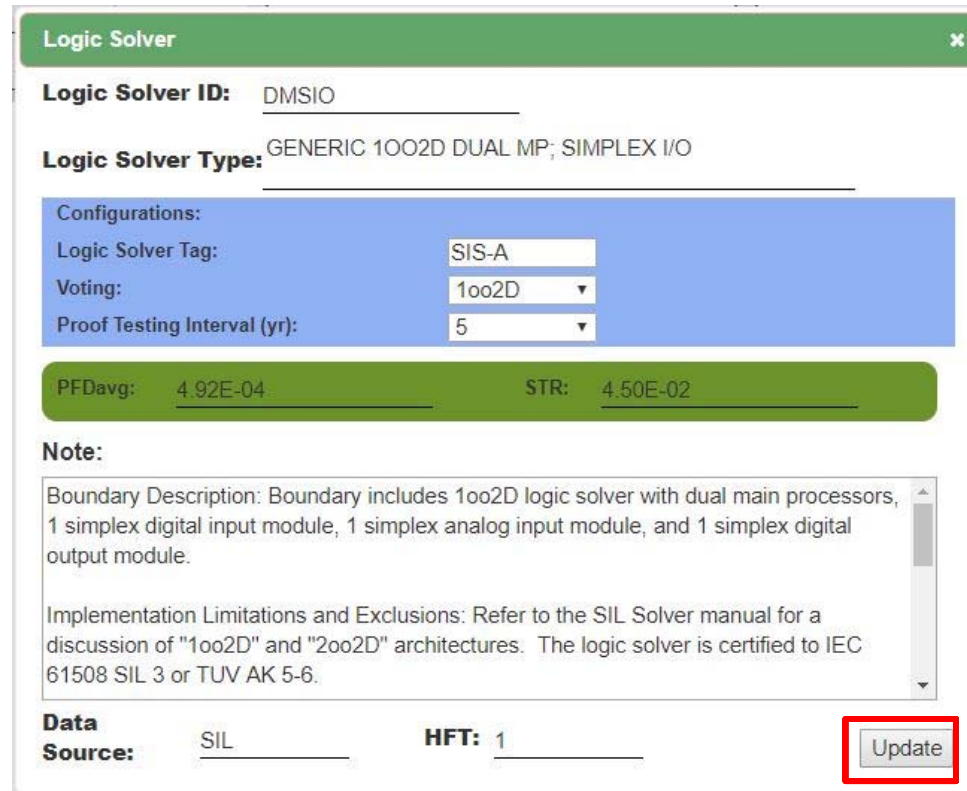
Adding LS details

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

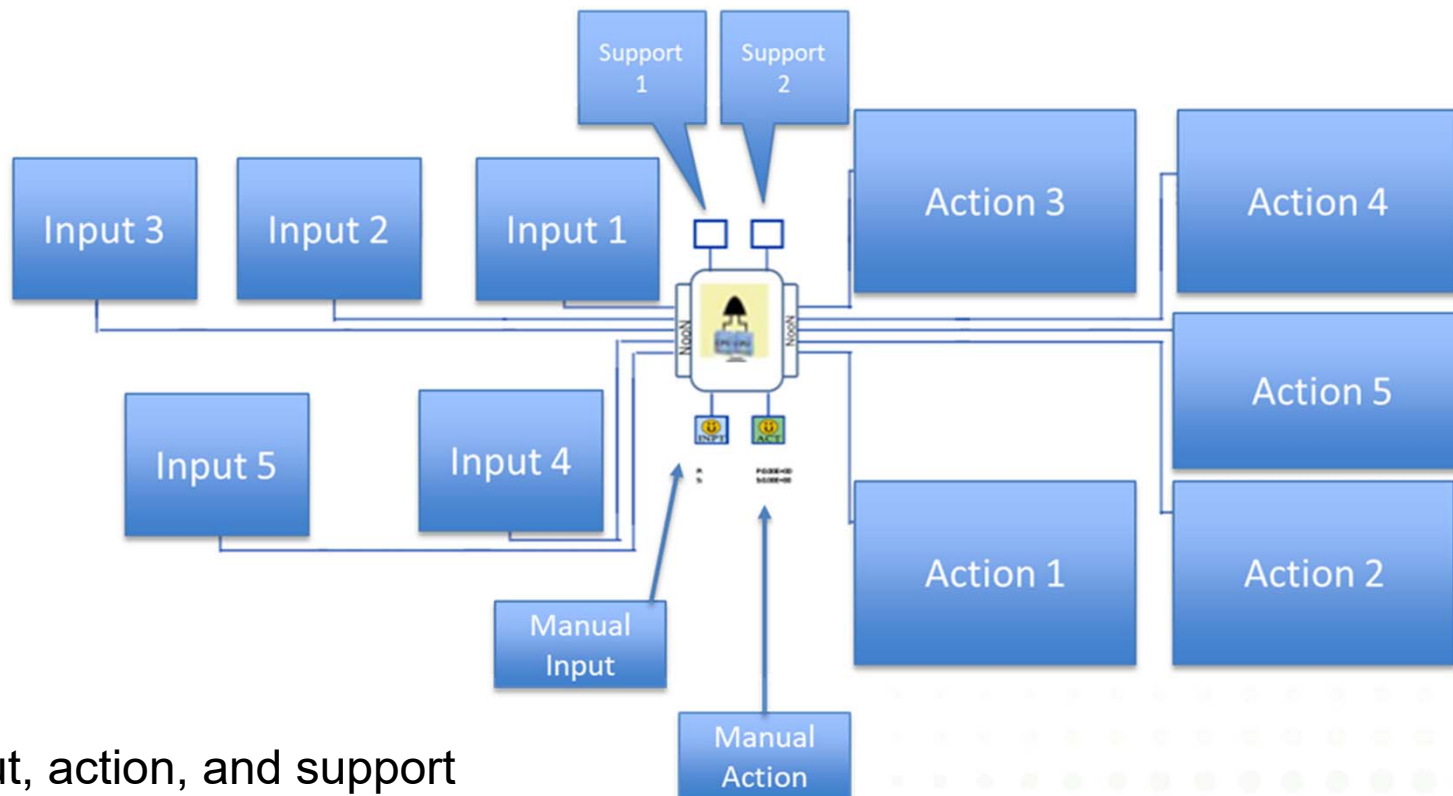
Tool will automatically calculate LS contributions to PFDavg and STR



The screenshot shows a 'Logic Solver' configuration window. It includes fields for 'Logic Solver ID' (DMSIO), 'Logic Solver Type' (GENERIC 1OO2D DUAL MP; SIMPLEX I/O), and a 'Configurations' section with 'Logic Solver Tag' (SIS-A), 'Voting' (1oo2D), and 'Proof Testing Interval (yr)' (5). Below this, it displays 'PFDavg: 4.92E-04' and 'STR: 4.50E-02'. A 'Note' section contains boundary and implementation details. At the bottom, 'Data Source' is set to 'SIL' and 'HFT' is '1'. An 'Update' button is highlighted with a red box.

Click Update to return to GUI page

Screen locations of the other subsystems



Input, action, and support system locations are filled in the order entered

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.

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
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0
RESULTS					
TARGETS MET?					

PFD/STR Breakdown

PFDavg 100% Logic

STR 100% Logic

HFT _{IN}	HFT _{LS}	HFT _{ACT}
	1	
HFT _{SPT1}	HFT _{SPT2}	HFT _{MIN}
HFT _{MACT}		

← → Exit Calculate and Save + - Reset

SRS
LOGIC SOLVER
INPUT CONFIGURATION

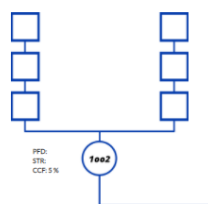
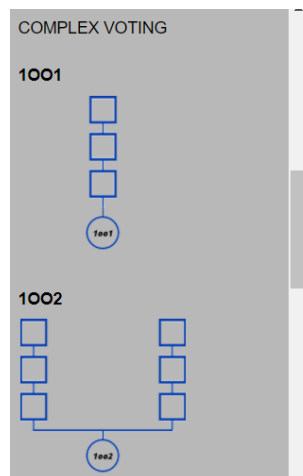
ONE DEVICE
TWO DEVICES
THREE DEVICES

1003

2003

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



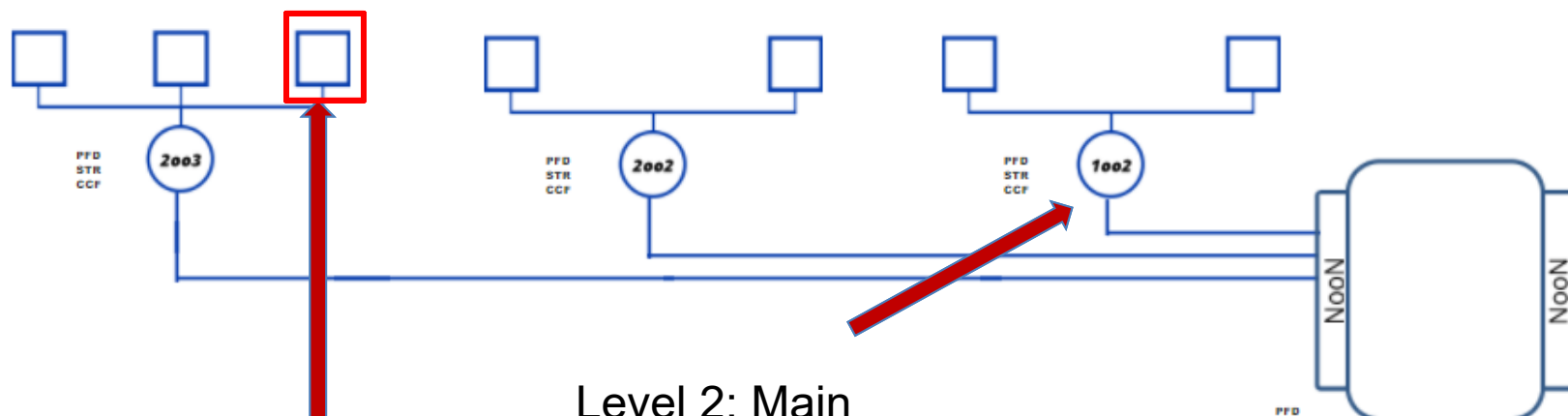
- If a single variable value is made up of multiple devices, use a **Complex Voting Architecture**
- All the devices for each separate value go in a single vertical channel

Common examples:

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

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 User Guide **SIL SOLVER**

	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 100% Logic
STR 100% Logic




HFT _{IN}	HFT _{LS}	HFT _{ACT}	
	1		
HFT _{SPT1}	HFT _{SPT2}	HFT _{MIN}	HFT _{MACT}

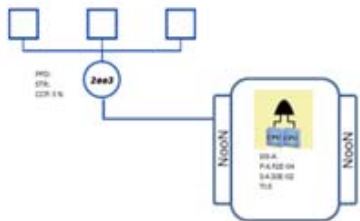
Exit Calculate and Save Reset

INPUT DEVICE

Search Clear

TRIP AMPLIFIER
ANALYZER
PRESSURE

 DIFFERENTIAL PRESSURE TRANSMITTER
 PNEUMATIC PRESSURE SWITCH
 PNEUMATIC PRESSURE TRANSMITTER

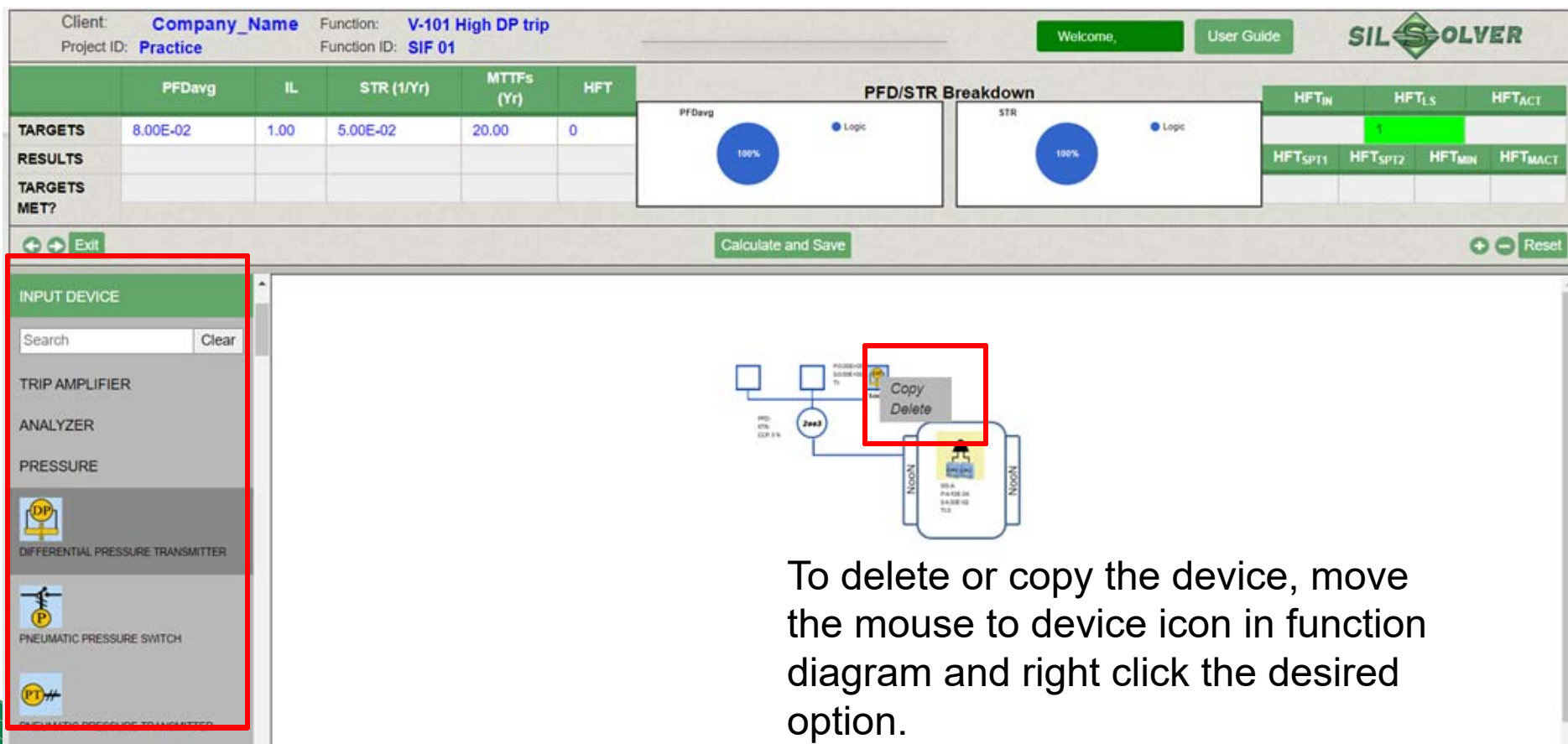


Selecting the Device

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



The screenshot displays the SIL SOLVER software interface. At the top, the client information is "Company_Name" and "Practice", and the function is "V-101 High DP trip" with ID "SIF 01". The main table shows targets for PFDavg, IL, STR, MTTFs, and HFT. Below the table, there are two circular progress indicators for PFDavg and STR, both at 100%. To the right, there are buttons for HFTIN, HFTLS, HFTACT, HFTSPT1, HFTSPT2, HFTMIN, and HFTMACT. A red box highlights the "INPUT DEVICE" list on the left, which includes a search bar and a list of devices: TRIP AMPLIFIER, ANALYZER, PRESSURE, DIFFERENTIAL PRESSURE TRANSMITTER, and PNEUMATIC PRESSURE SWITCH. Another red box highlights a device icon in the function diagram, with a context menu showing "Copy" and "Delete" options.

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: 100% Logic
STR: 100% Logic

HFTIN: 1
HFTLS: 1
HFTACT: 1
HFTSPT1: 1
HFTSPT2: 1
HFTMIN: 1
HFTMACT: 1

Exit Calculate and Save Reset

INPUT DEVICE

Search Clear

TRIP AMPLIFIER
ANALYZER
PRESSURE
DIFFERENTIAL PRESSURE TRANSMITTER
PNEUMATIC PRESSURE SWITCH

Copy
Delete

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):
Individual Tags

Proof Testing Interval (yr):

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):
8.00E-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

Diagnostic Coverage Dual DC2 (1/yr):
80

Diagnostic Coverage Triple DC3 (1/yr):
90

PFDavg:
0.00E+00

STR:
0.00E+000

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

Data Source:
SIL

Update

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:

Display Tag for Device(s): Individual Tags DP-101A

Proof Testing Interval (yr): 5

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): 8.00E-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

Diagnostic Coverage Dual DC2 (1/yr): 80

Diagnostic Coverage Triple DC3 (1/yr): 90

PFDavg: 0.00E+00

STR: 0.00E+000

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

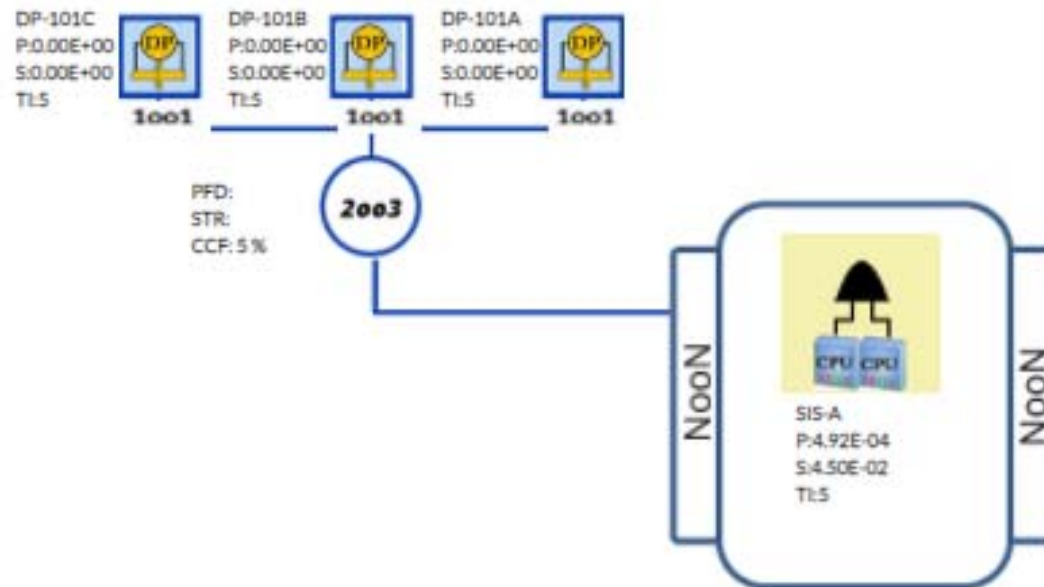
Update

Will updated
once SIF is
calculated

Update button will activate once
minimum date is entered.

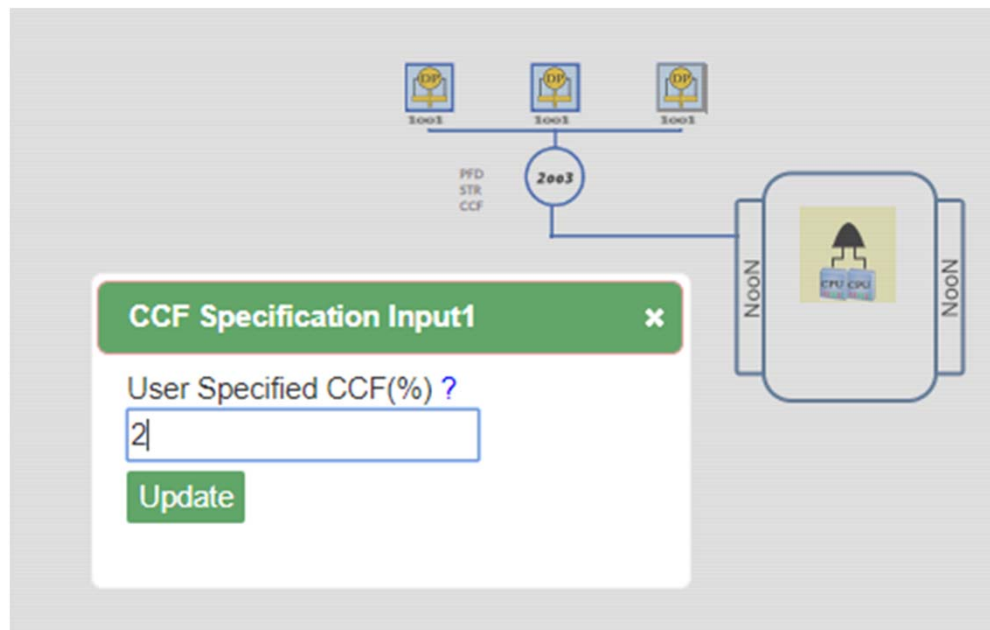
Completing the subsystem

1. Copy DP-101A Pressure transmitter
2. Paste DP pressure transmitter to each of box in the 2003 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



CCF is not used in non-redundant (i.e., 1oo1 or 2oo2) architectures

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:

Device Tag: DP-101A

Proof Testing Interval (yr): 5

Voting: 1oo1

Subsystem Diagnostic Level: ? DC3

Maintenance:

Mean Time to Repair (hr): 72

Diagnostic Interval (hr): 0.500

Overhaul Interval (yr): 20

Proof Testing Coverage (%): ? 100

User Specified ☐

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

PFDavg: 2.01E-002

STR: 1.67E-002

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

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.

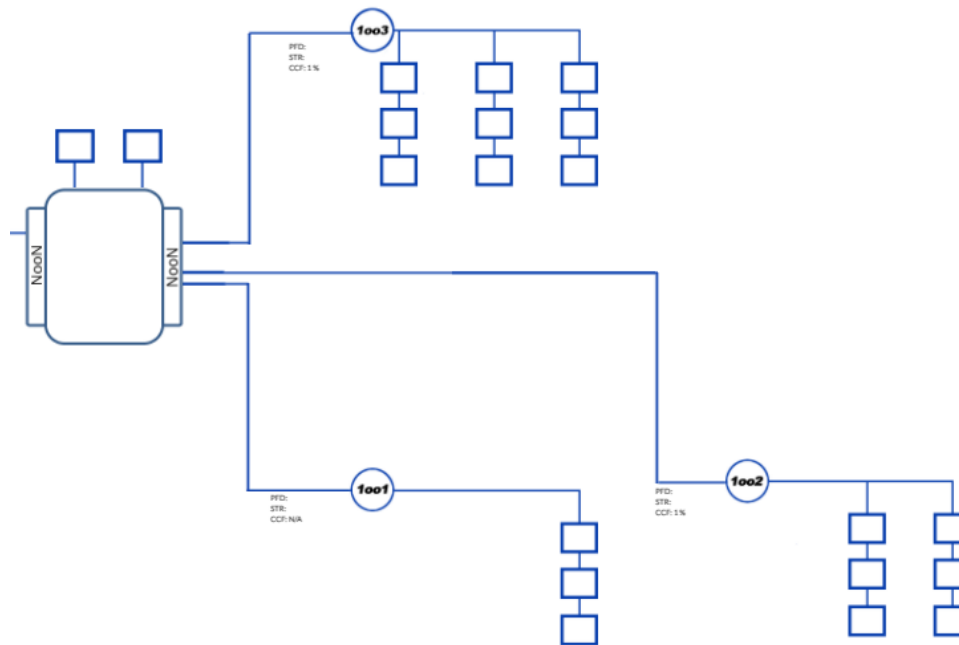
May select a higher DC when an external independent reading can be used for inter-comparison with the SIF sensor.

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

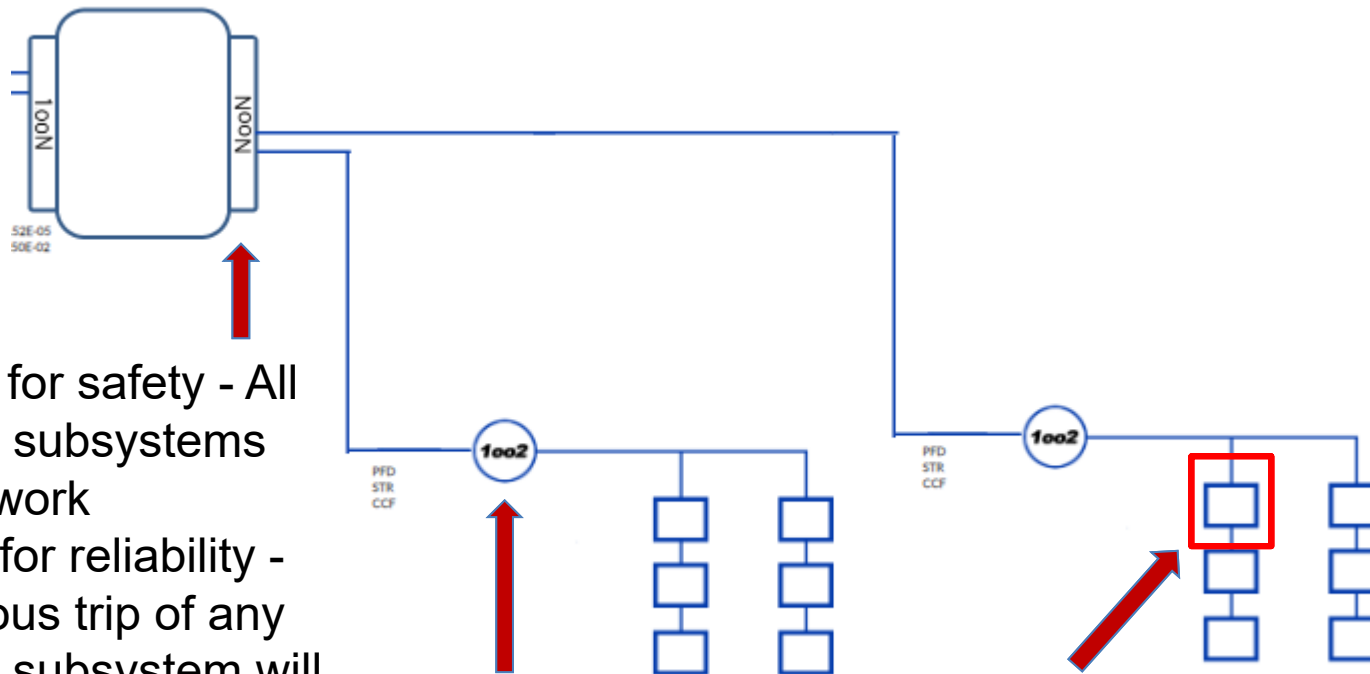


Two configurable levels of Action Architecture

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

FIXED:

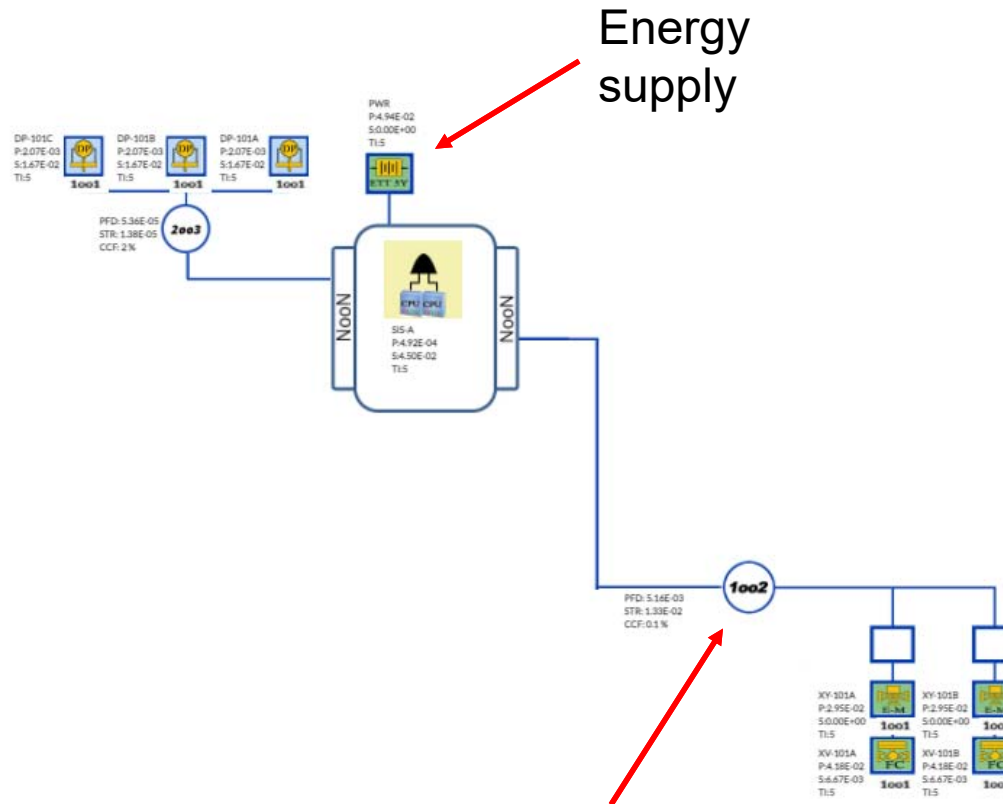
- NooN for safety - All action subsystems must work
- 1ooN for reliability - Spurious trip of any action subsystem will cause an operational problem



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



Device

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

Configurations:

Device Tag: XY-101A
 Proof Testing Interval (yr): 5
 Voting: 1001
 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 (%): ?
 User Specified

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 Update

Device

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

Configurations:

Device Tag: XV-101A
 Proof Testing Interval (yr): 5
 Voting: 1001
 Subsystem Diagnostic Level: ? NO DC

Properties:

Failure Dangerous Failure Rate (1/yr): 1.67E-02
 Failure Spurious Failure Rate (1/yr): 8.67E-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:

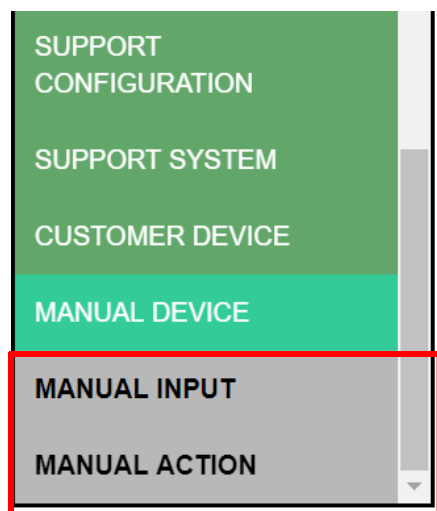
Mean Time to Repair (hr): 72
 Diagnostic Interval (hr): 0.000
 Overhaul Interval (yr): 20
 Proof Testing Coverage (%): ?
 User Specified

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

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



Click to add
field to GUI

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

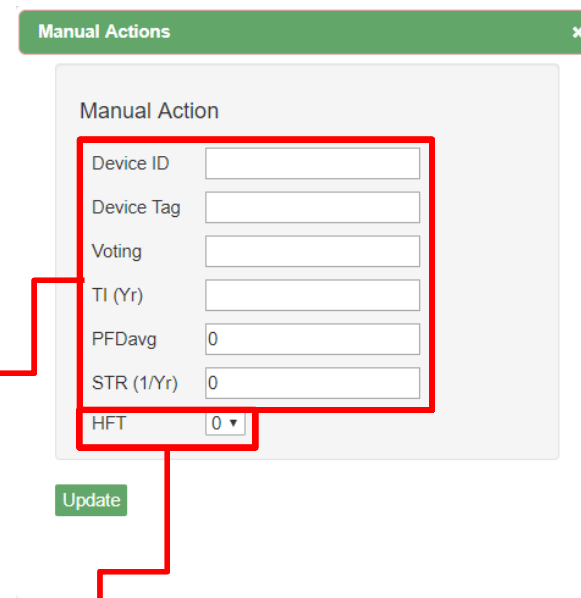
Check to allow entry of the second Manual Input

The screenshot shows a web form titled 'Manual Inputs'. At the top, there is a 'Redundancy' dropdown menu set to 'Non-Redundant'. To its right is a checkbox labeled 'Enable second manual input device'. Below these are two columns for 'Manual Input Device 1' and 'Manual Input Device 2'. Each column contains input fields for 'Device ID', 'Device Tag', 'Voting', 'TI (Yr)', 'PFDavg', 'STR (1/Yr)', and 'HFT'. The 'HFT' field is a dropdown menu currently set to '0'. A green 'Update' button is at the bottom left. Red arrows and boxes highlight specific elements: one arrow points to the 'Redundancy' dropdown, another points to the 'Enable second manual input device' checkbox, a third points to the 'Device ID' and 'Device Tag' fields of Device 1, and a fourth points to the 'HFT' dropdown of Device 1.

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

Manual Action

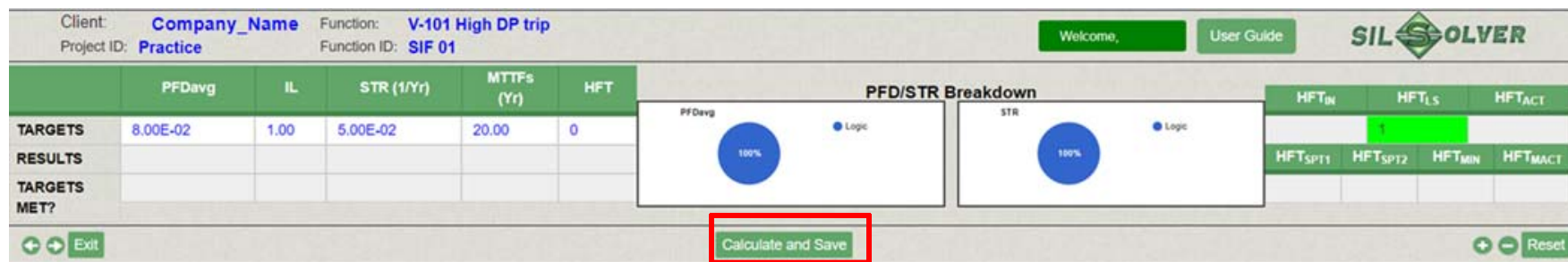
DeviceID, Tag, voting architecture and TI are entered for completeness of reporting. The PFDavg and STR are entered directly for each portion of the Manual Input



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, there are fields for Client (Company_Name), Project ID (Practice), Function (V-101 High DP trip), and Function ID (SIF 01). There are also buttons for 'Welcome,' and 'User Guide'. The main area contains a table with columns for PFDavg, IL, STR (1/Yr), MTTFs (Yr), and HFT. The table has rows for TARGETS, RESULTS, and TARGETS MET?. To the right of the table are two circular progress indicators for PFDavg and STR, both showing 100%. Below these are two 'PFD/STR Breakdown' charts. At the bottom right, there are buttons for 'Calculate and Save' (highlighted with a red box) and 'Reset'.

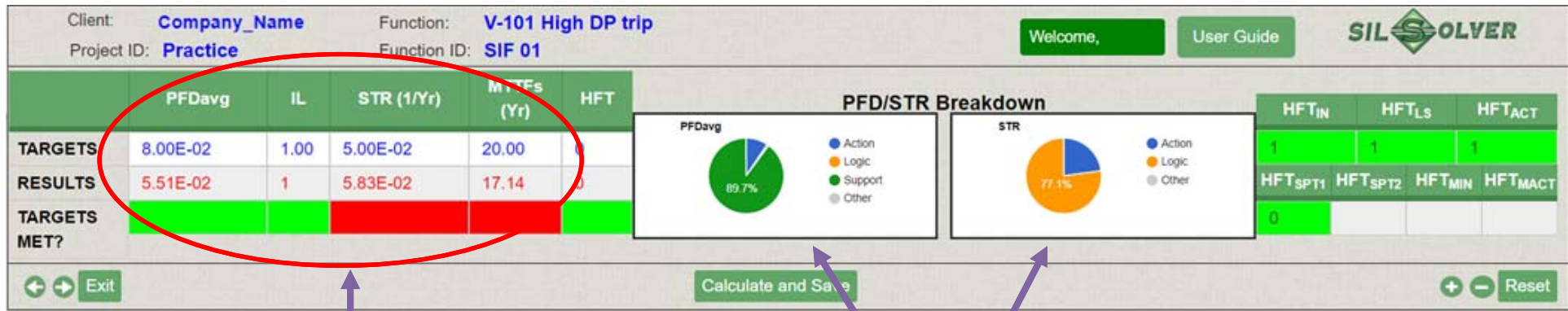
	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS	8.00E-02	1.00	5.00E-02	20.00	0
RESULTS					
TARGETS MET?					

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

ERRORS: A problem exists in GUI or devie 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.

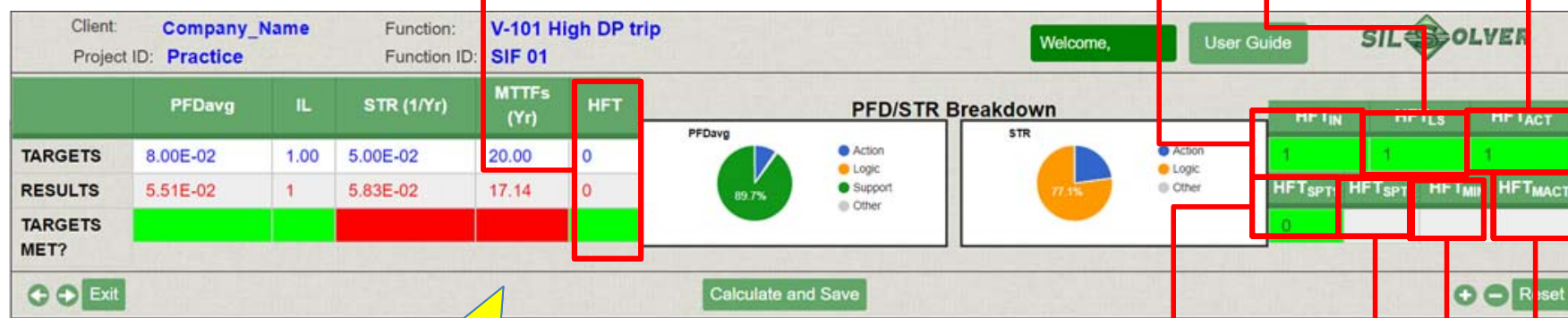
Don't forget Hardware Fault Tolerance (HFT)

HFT Target and
Overall HFT
Result

HFT for Input(s)

HFT for
Logic
Solver

HFT for
Action(s)



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

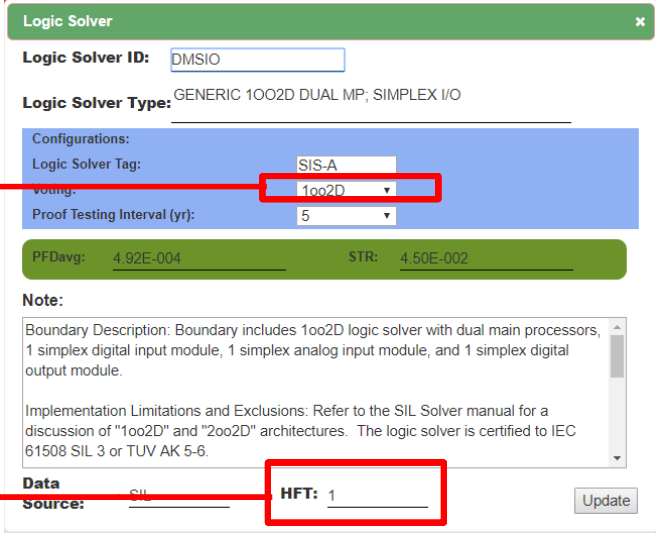
The results of the individual device boxes are combined based on the mid-level architecture.

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



The screenshot shows the 'Logic Solver' configuration window. Key fields include:

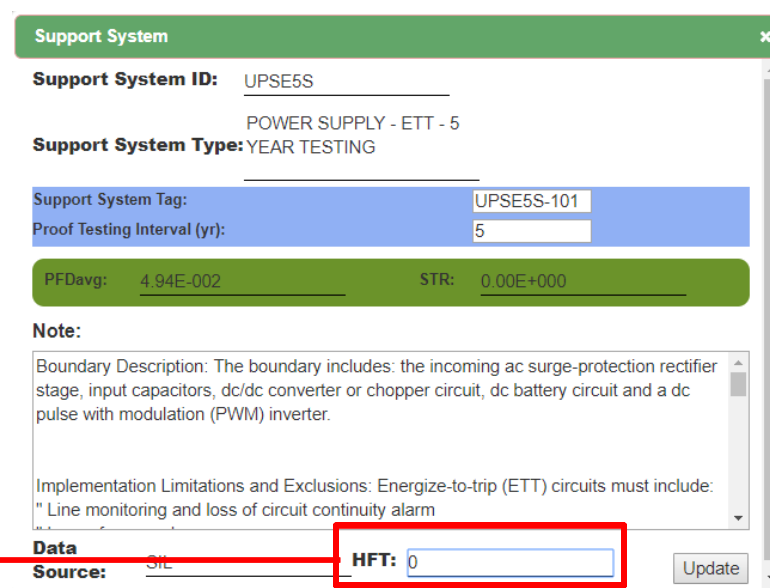
- Logic Solver ID:** DMSIO
- Logic Solver Type:** GENERIC 1OO2D DUAL MP; SIMPLEX I/O
- Configurations:**
 - Logic Solver Tag:** SIS-A
 - Logic Solver Arch:** 1oo2D (highlighted with a red box and an arrow from the text 'architecture is 1oo2D')
 - Proof Testing Interval (yr):** 5
- PFDavg:** 4.92E-004
- STR:** 4.50E-002
- 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 (highlighted with a red box and an arrow from the text 'Logic Solver HFT Value')
- Update** button

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
HFT Value



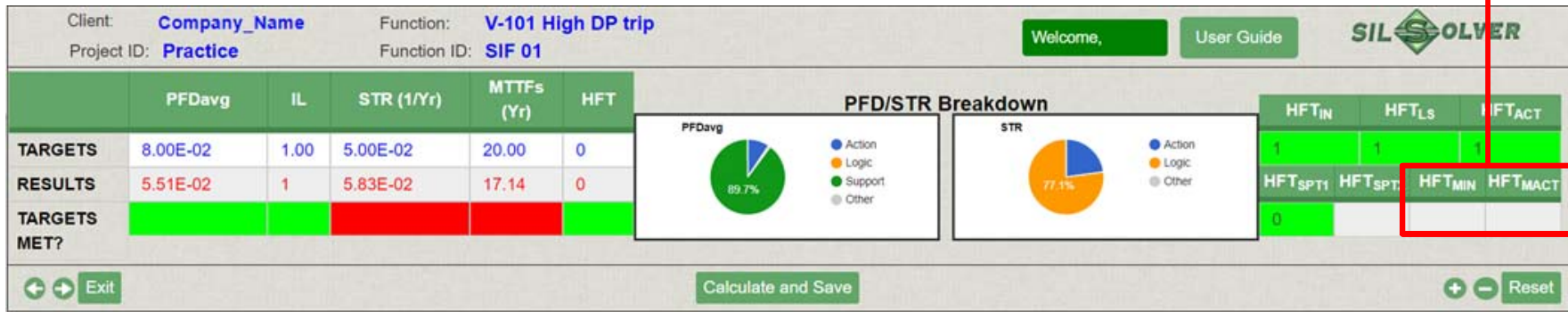
The screenshot shows a 'Support System' window with the following details:

- Support System ID:** UPSE5S
- Support System Type:** POWER SUPPLY - ETT - 5 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 (highlighted with a red box)
- Update** button

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

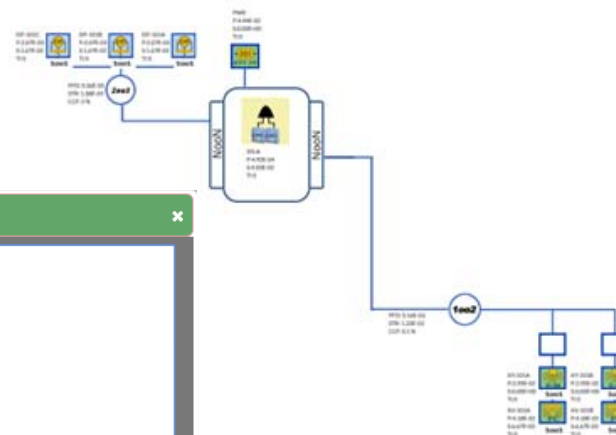


Is that all?

- 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
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



Save

Done with SIF 01

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
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

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

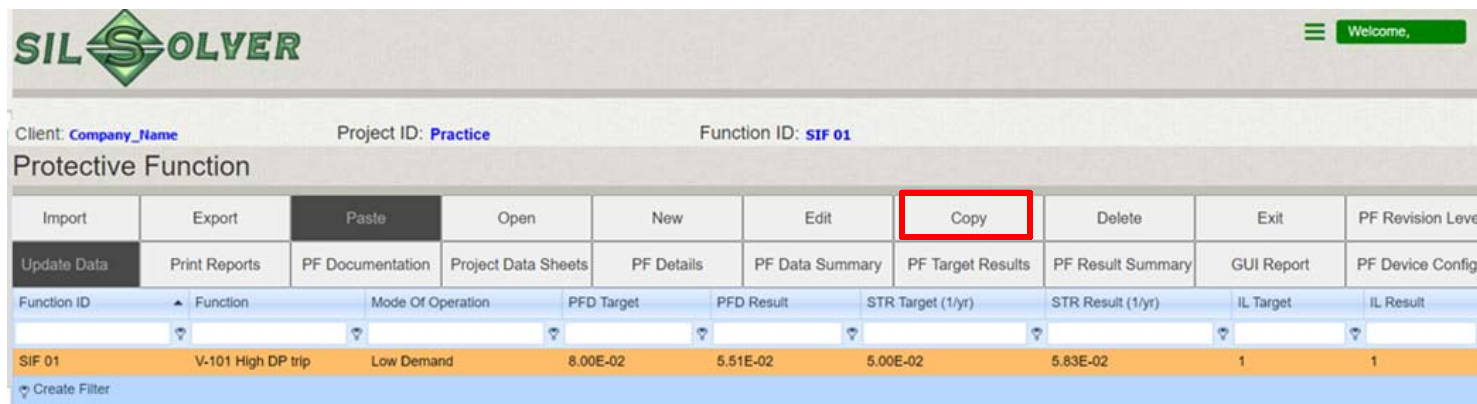
MANUAL DEVICE

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

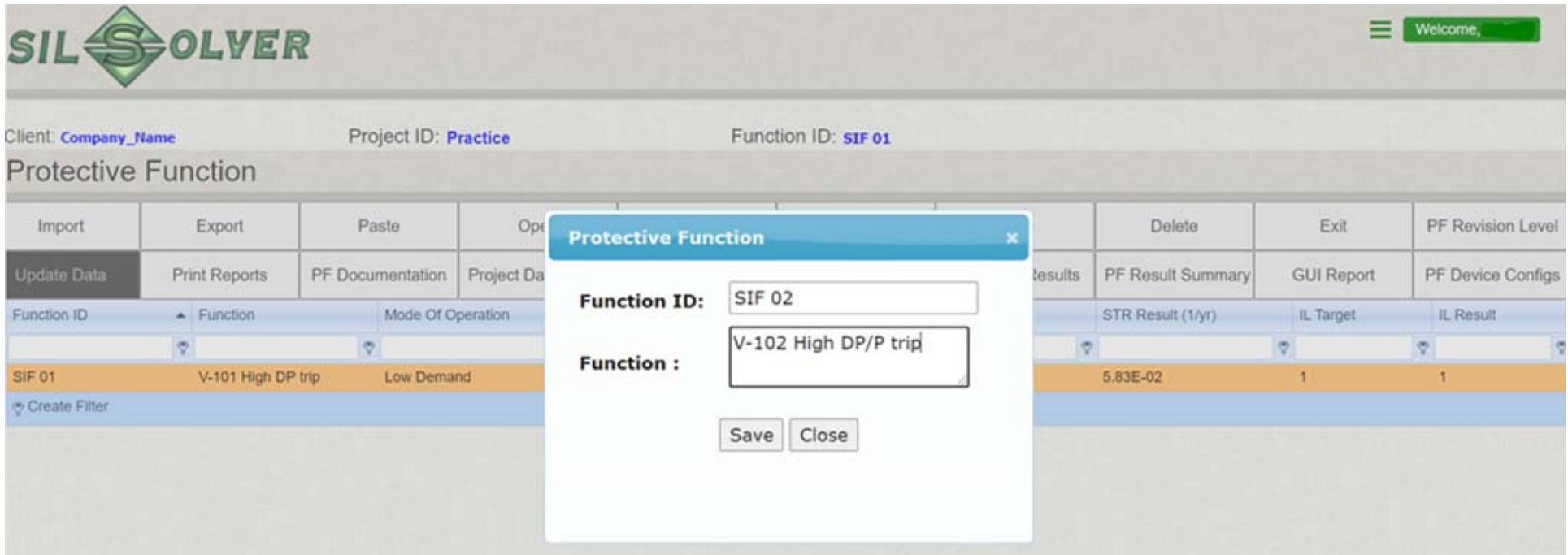
Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	PF Revision Level
Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs
Function ID	Function	Mode Of Operation	PFD Target	PFD Result	STR Target (1/yr)	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. The main window displays the 'Protective Function' section with a table of functions. A dialog box titled 'Protective Function' is open, allowing the user to enter a new function ID and description.

Protective Function Dialog Box:


- Function ID:** SIF 02
- Function :** V-102 High DP/P trip
- Buttons:** Save, Close


Background Software Interface:

- Client:** Company_Name
- Project ID:** Practice
- Function ID:** SIF 01
- Protective Function Table:**

Function ID	Function	Mode Of Operation
SIF 01	V-101 High DP trip	Low Demand
- Buttons:** Import, Export, Paste, Update Data, Print Reports, PF Documentation, Project Data, Delete, Exit, PF Revision Level, PF Result Summary, GUI Report, PF Device Configs, STR Result (1/yr), IL Target, IL Result.

Success!



 Welcome,

Client: [Company_Name](#) Project ID: [Practice](#) Function ID: [SIF 02](#)

Protective Function

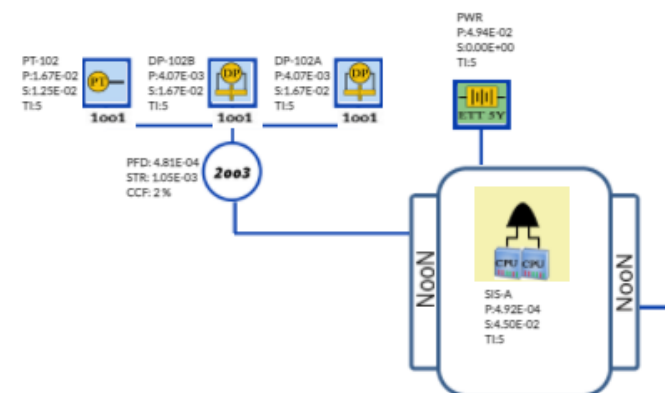
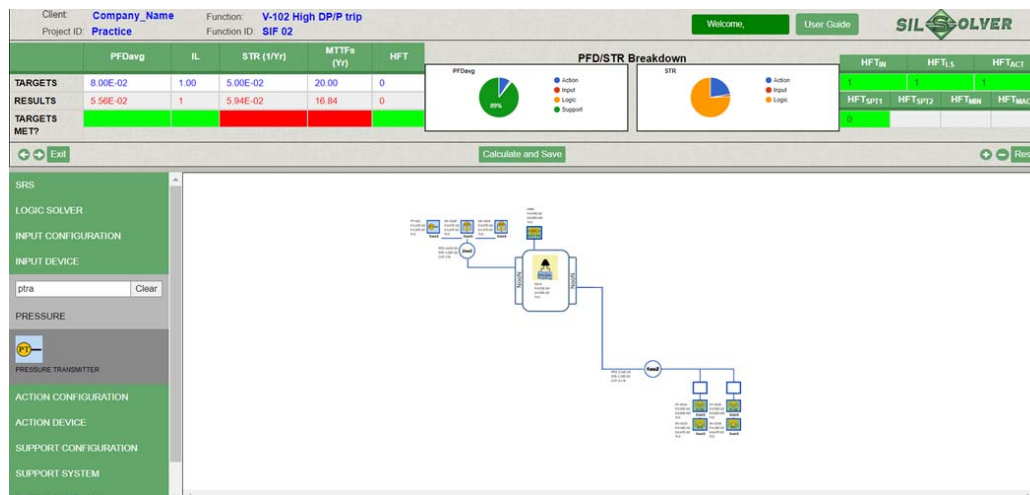
Import	Export	Paste	Open	New	Edit	Copy	Delete	Exit	PF Revision Level
Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Summary	PF Target Results	PF Result Summary	GUI Report	PF Device Configs

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

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).



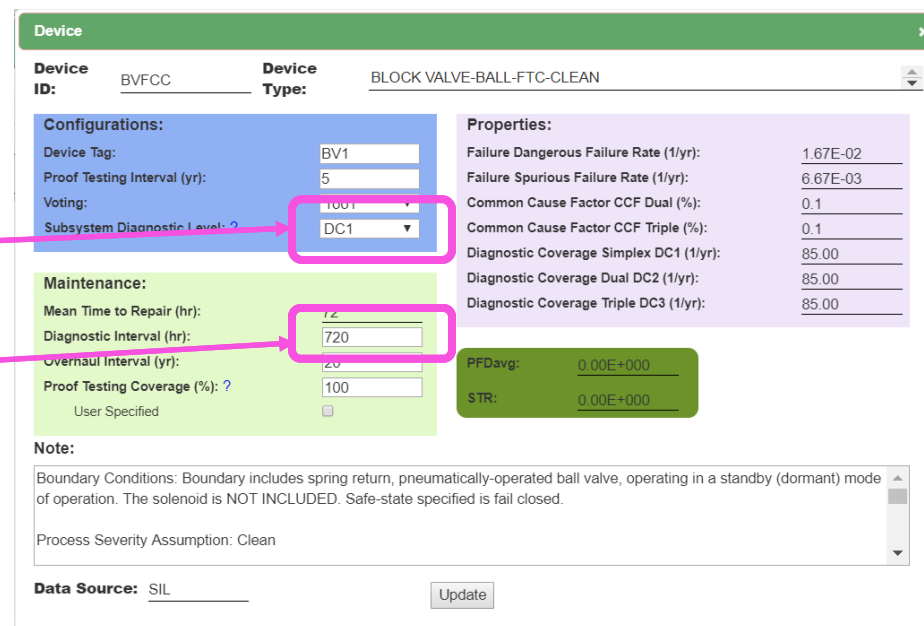
Partial Stroke Testing of Valves

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

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



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: DC1

Maintenance:

Mean Time to Repair (hr): 12

Diagnostic Interval (hr): 720

Overhaul Interval (yr): 20

Proof Testing Coverage (%): 100

User Specified ☐

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

PFDavg: 0.00E+000

STR: 0.00E+000

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: 1001

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

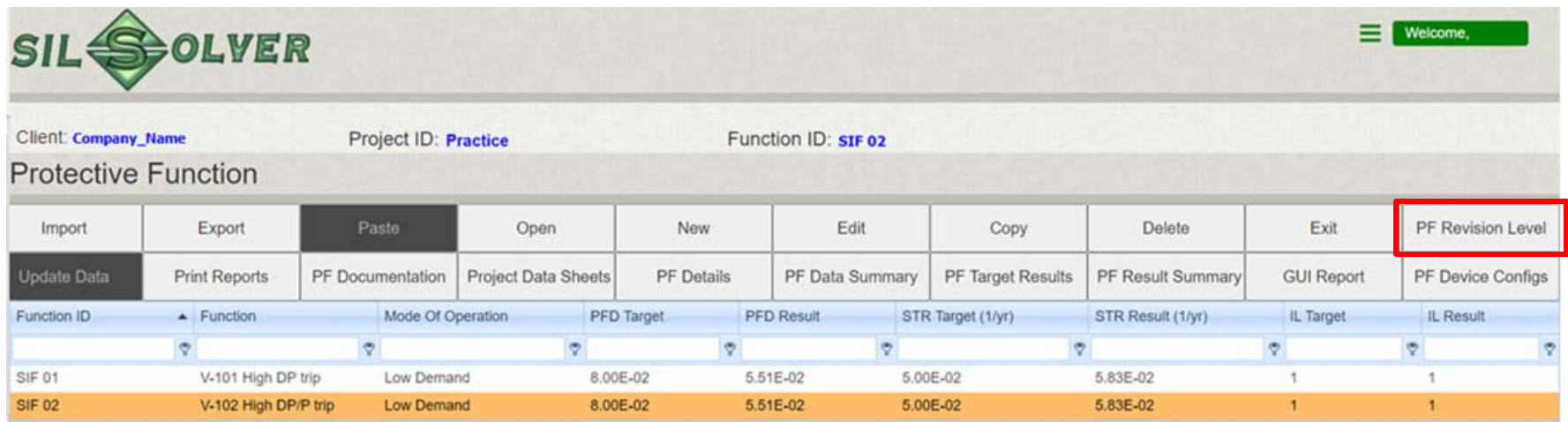
Data Source: SIL

Update

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.

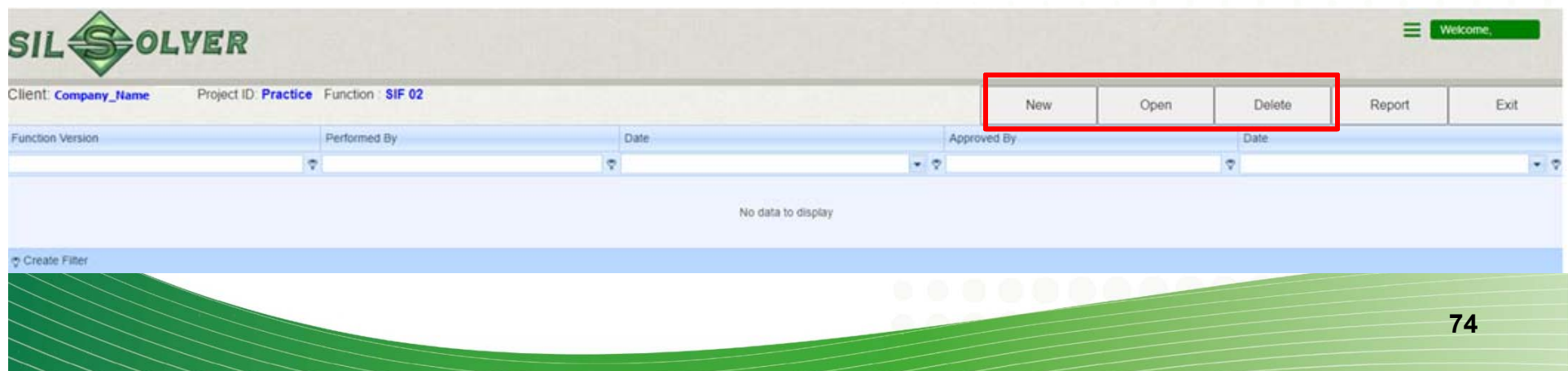


SIL SOLVER Welcome,

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,

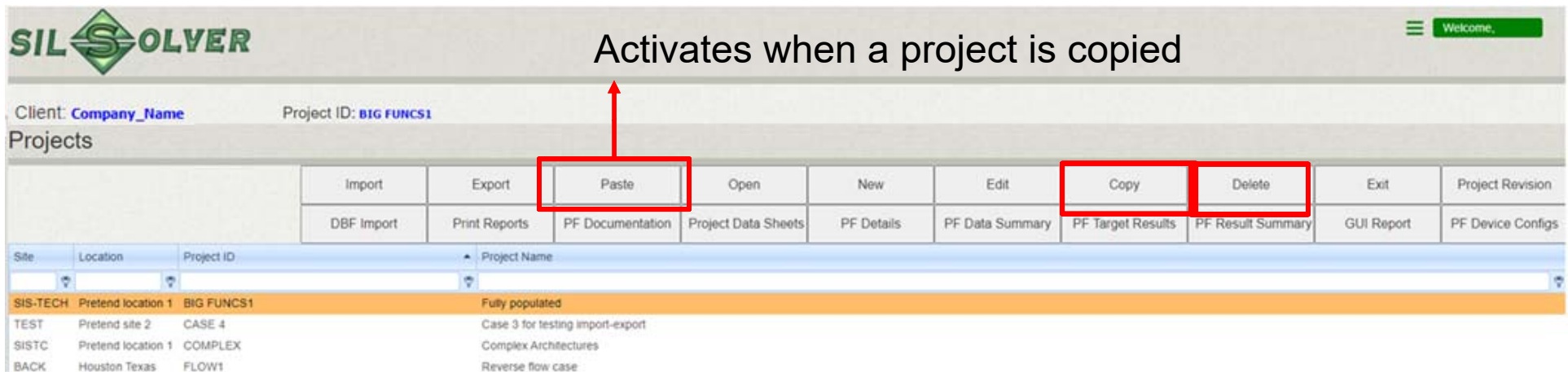
Client: [Company_Name](#) Project ID: [Practice](#) Function: [SIF 02](#)

New Open Delete Report Exit

Function Version	Performed By	Date	Approved By	Date
No data to display				

[Create Filter](#)

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



SIL SOLVER Welcome,

Client: **Company_Name** Project ID: **BIG FUNCS1**

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

Activates when a project is copied

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

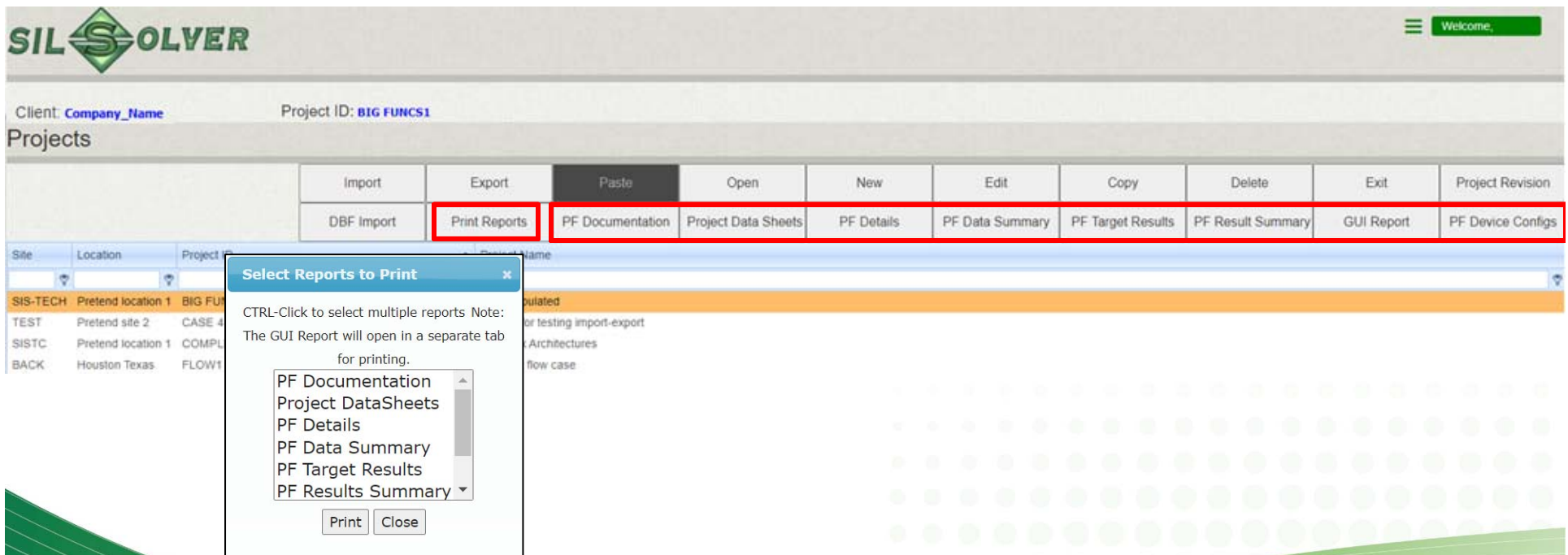
5. GENERATING REPORTS

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



The screenshot shows the SIL SOLVER software interface. At the top, the client name is 'Company_Name' and the project ID is 'BIG FUNCS1'. Below this, there is a 'Projects' section with a table of project data. A menu bar is visible with options: Import, Export, Paste, Open, New, Edit, Copy, Delete, Exit, and Project Revision. The 'Print Reports' option is highlighted in the menu. A dialog box titled 'Select Reports to Print' is open, showing a list of reports to be printed: PF Documentation, Project Data Sheets, PF Details, PF Data Summary, PF Target Results, and PF Results Summary. The dialog also includes a 'Print' button and a 'Close' button.

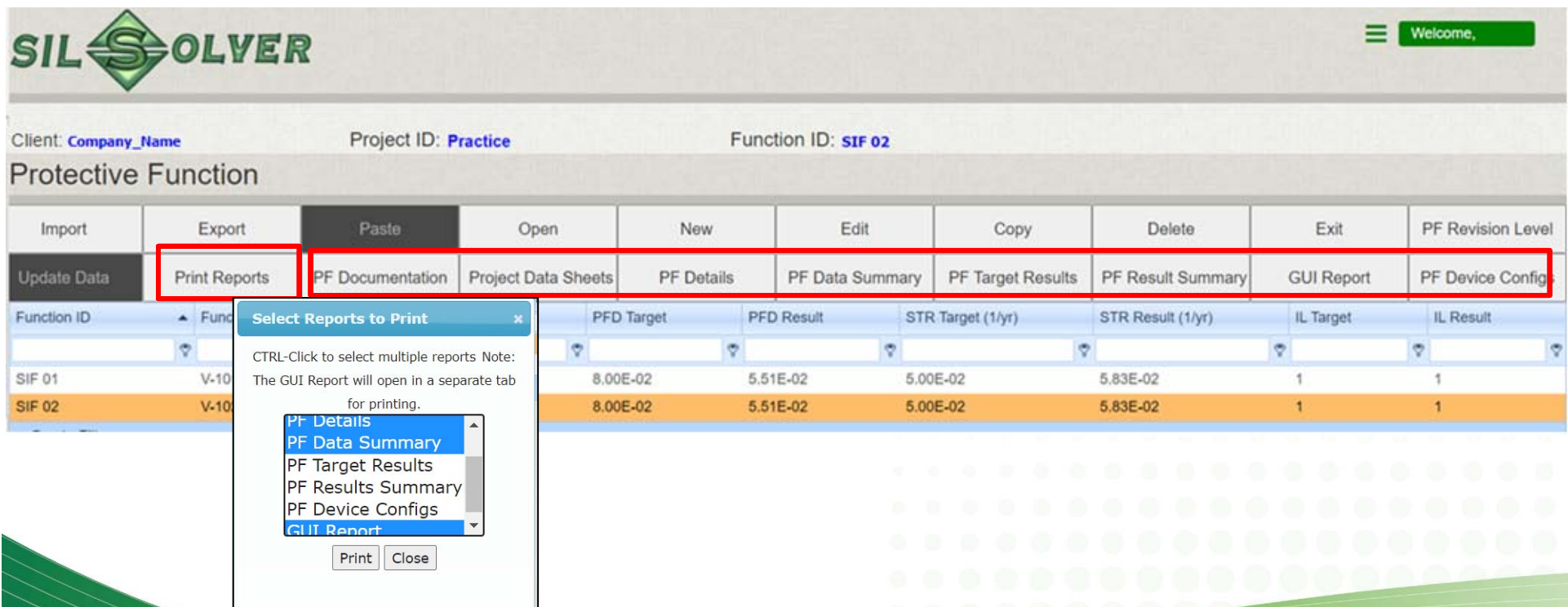
Site	Location	Project
SIS-TECH	Pretend location 1	BIG FUNCS1
TEST	Pretend site 2	CASE 4
SISTC	Pretend location 1	COMPL
BACK	Houston Texas	FLOW

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



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

Select Reports to Print

CTRL-Click to select multiple reports Note:
The GUI Report will open in a separate tab for printing.

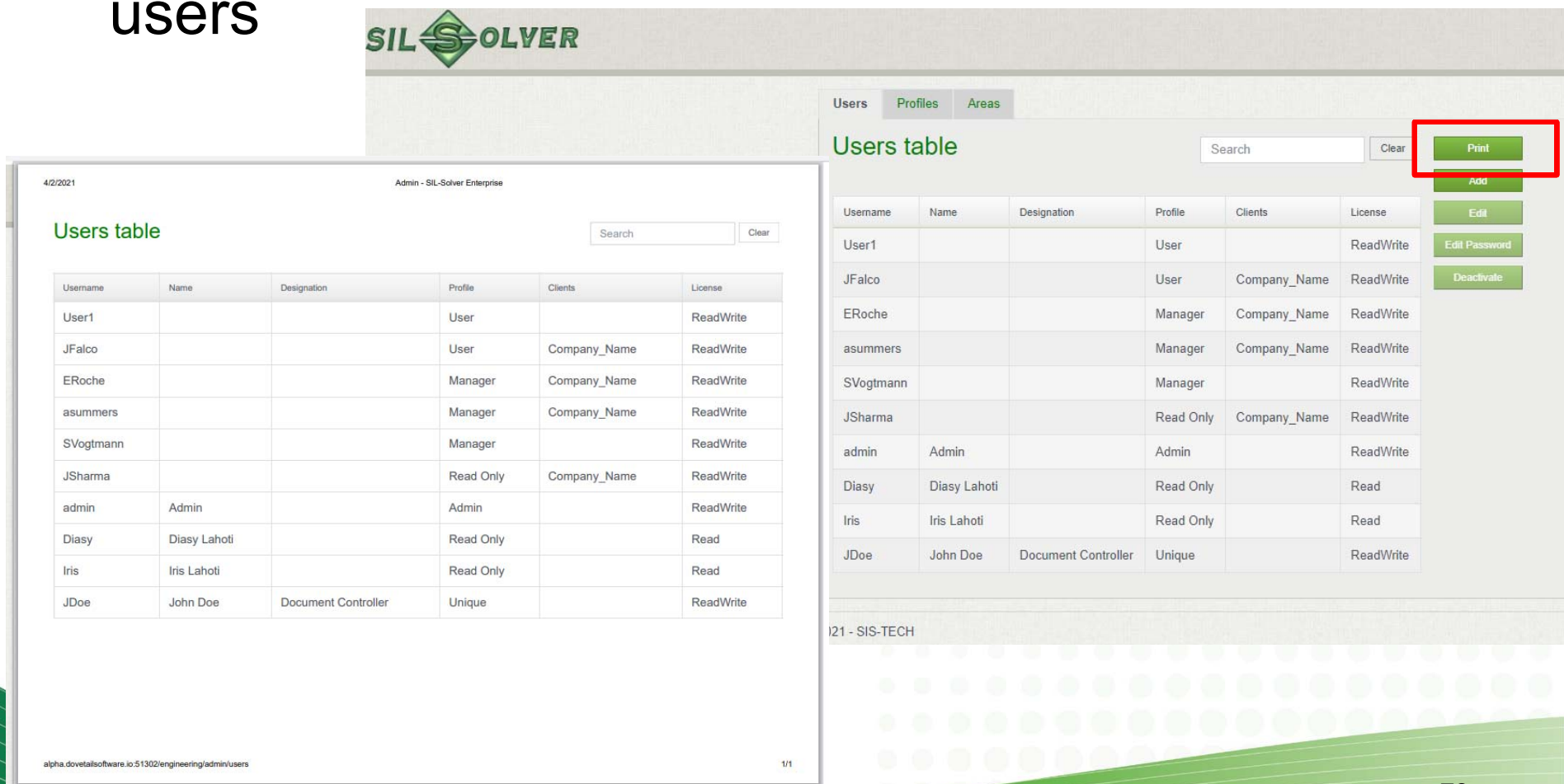
- PF Details
- PF Data Summary
- PF Target Results
- PF Results Summary
- PF Device Configs
- GUI Report**

Print Close

Function ID	Function Name	PFD Target	PFD Result	STR Target (1/yr)	STR Result (1/yr)	IL Target	IL Result
SIF 01	V-10	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1
SIF 02	V-10	8.00E-02	5.51E-02	5.00E-02	5.83E-02	1	1

User Report for Admin

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



The screenshot shows the SIL-SOLVER Admin interface. The 'Users' tab is selected, and the 'Users table' is displayed. A red box highlights the 'Print' button in the top right corner of the table area.

Users table

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
Diasy	Diasy Lahoti		Read Only		Read
Iris	Iris Lahoti		Read Only		Read
JDoe	John Doe	Document Controller	Unique		ReadWrite

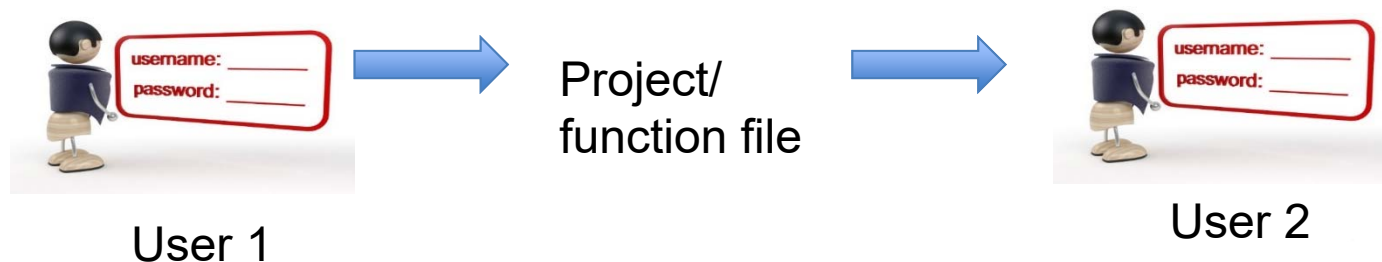
121 - SIS-TECH

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



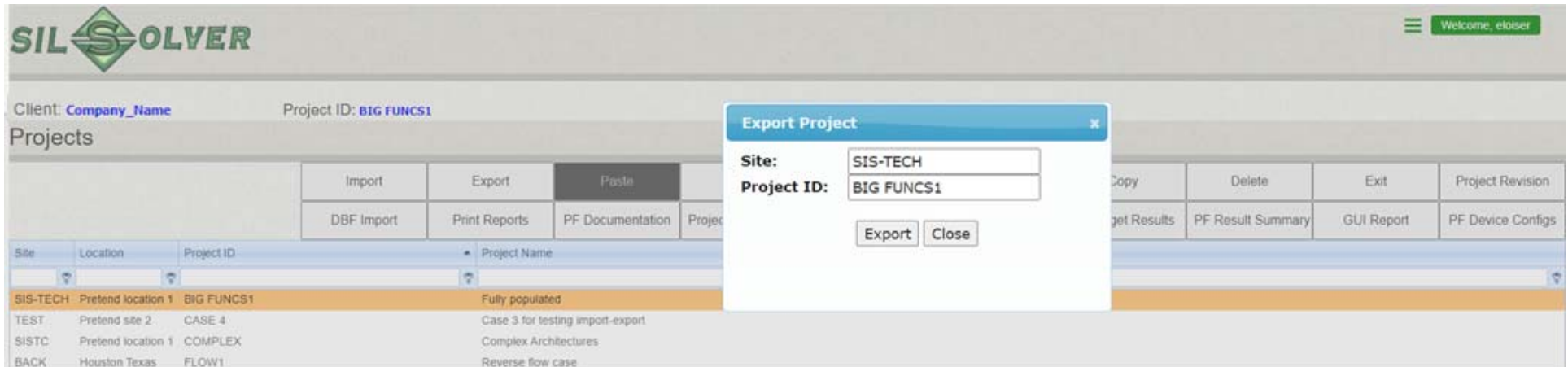
DBF Import

- 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

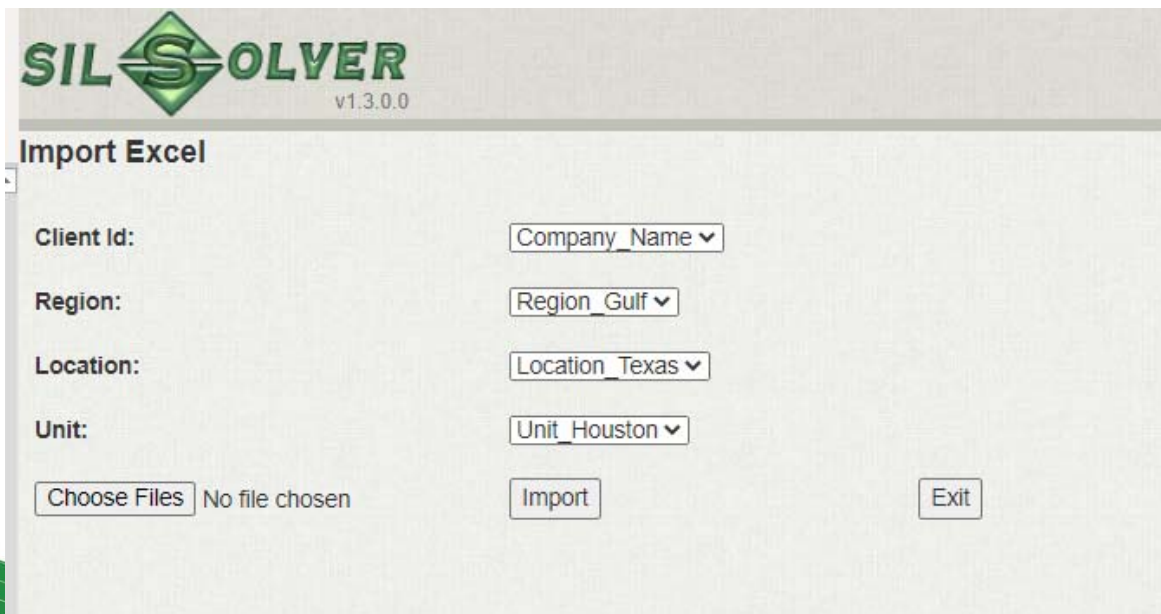


The screenshot shows the SIL SOLVER web application interface. At the top, the logo 'SIL SOLVER' is on the left, and a user greeting 'Welcome, eloisier' is on the right. Below the header, the 'Client: Company_Name' and 'Project ID: BIG FUNCS1' are displayed. The main area is titled 'Projects' and contains a table with columns: Site, Location, Project ID, and Project Name. The table lists four projects: 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), and BACK (Houston Texas, FLOW1, Reverse flow case). Above the table, there are buttons for 'Import', 'Export', 'Paste', 'DBF Import', 'Print Reports', 'PF Documentation', and 'Project'. An 'Export Project' dialog box is open, showing 'Site: SIS-TECH' and 'Project ID: BIG FUNCS1' with 'Export' and 'Close' buttons. To the right of the table, there are buttons for 'Copy', 'Delete', 'Exit', 'Project Revision', 'Get Results', 'PF Result Summary', 'GUI Report', and 'PF Device Configs'.

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
v1.3.0.0

Import Excel

Client Id: Company_Name ▼

Region: Region_Gulf ▼

Location: Location_Texas ▼

Unit: Unit_Houston ▼

Choose Files No file chosen Import Exit

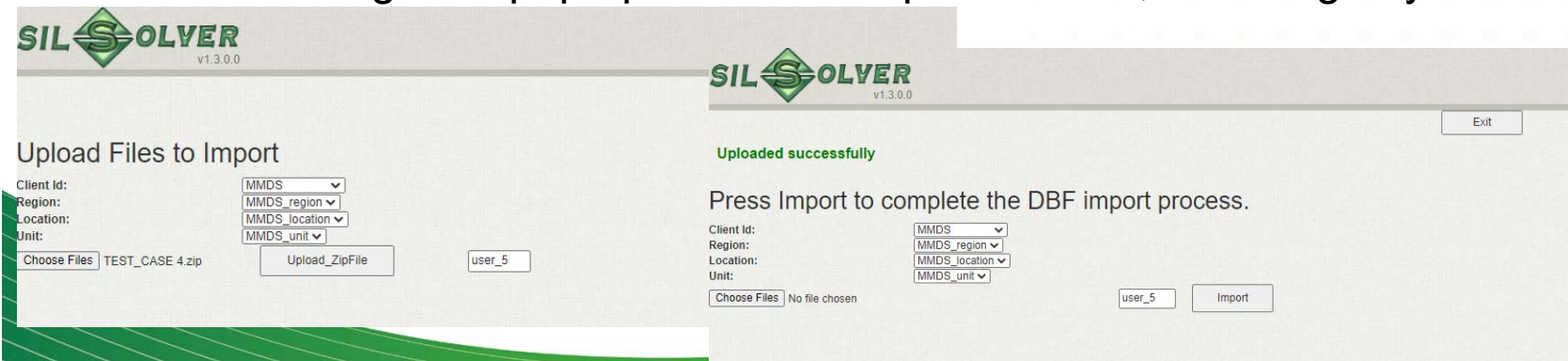
SIL Solver® Enterprise Function export/import

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



SIL SOLVER v1.3.0.0

Upload Files to Import

Client Id: MMDS
 Region: MMDS_region
 Location: MMDS_location
 Unit: MMDS_unit

Choose Files TEST_CASE 4.zip Upload_ZipFile user_5

SIL SOLVER v1.3.0.0

Uploaded successfully

Press Import to complete the DBF import process.

Client Id: MMDS
 Region: MMDS_region
 Location: MMDS_location
 Unit: MMDS_unit

Choose Files No file chosen user_5 Import

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


Client: **Company_Name** Project ID: **BIG FUNCS1** Function ID: **3003 Complex**

Protective Function

		Import	Export	Paste	Open	New	Edit
		Update Data	Print Reports	PF Documentation	Project Data Sheets	PF Details	PF Data Su



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 i	Full set of 3003 Complex Inputs with 1003 Actions	Low Demand	8.00E-02	3.24E-02	1.00E-01

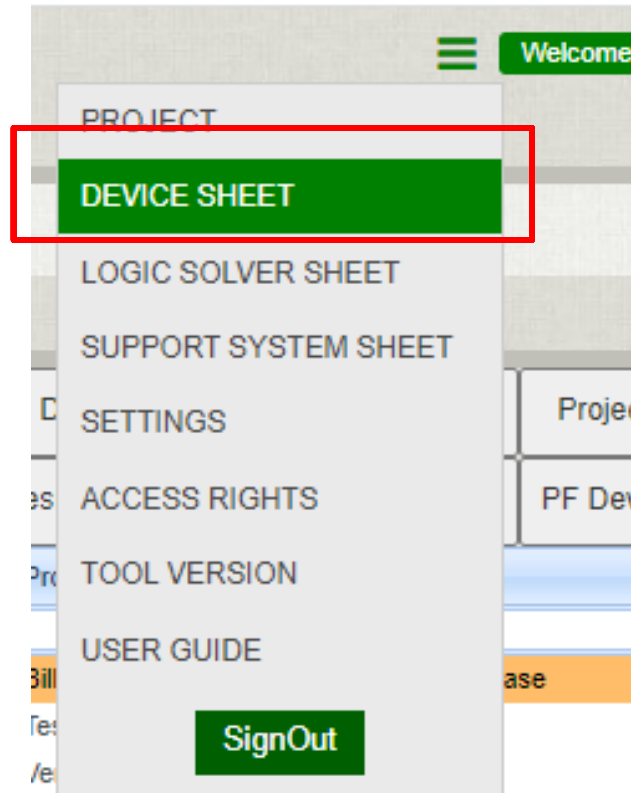
 Create Filter

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



A screenshot of the 'Device Sheet' window for a 'DIFFERENTIAL PRESSURE TRANSMITTER'. The window is divided into several sections:

- Device ID:** DPTR
- Device Type:** DIFFERENTIAL PRESSURE TRANSMITTER
- Configurations:**
 - Device Tag: [empty]
 - Proof Testing Interval (yr): 0
 - Voting: 1001
 - 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):	8.00E-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
Diagnostic Coverage Dual DC2 (1/yr):	80
Diagnostic Coverage Triple DC3 (1/yr):	90
- PF Davg:** [empty]
- STR:** [empty]
- 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

Data Source: SIL







Device datasheet list

SIL SOLVER Welcome.

SIL Solver Data Sheet


Back Version History Data ID List

Page 1 of 5 (248 items) [1] 2 3 4 5

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


Welcome,

SIL Solver Data Sheet

[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 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 Welcome

SIL Solver Logic Solver Sheet






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	NSDO		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	RELFCCL		RELAY - FAIL TO CLOSE
Open	8	SIL	RELFCOL		RELAY - FAIL TO OPEN

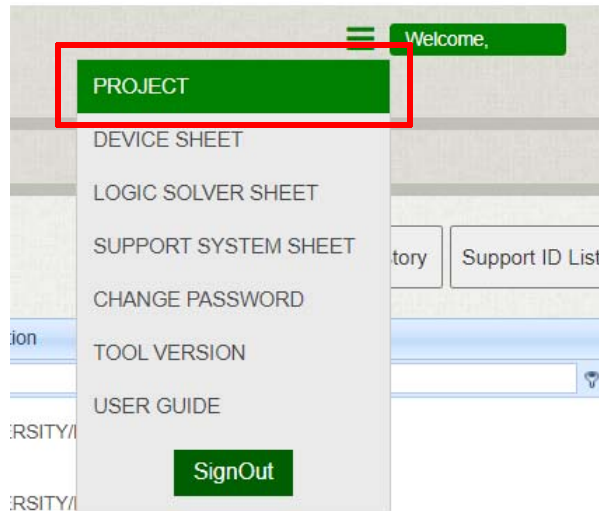
SIL SOLVER Welcome

SIL Solver Support System Data Sheet

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	IAWRCS		INSTRUMENT AIR-RECEIVER

Returning to Project View

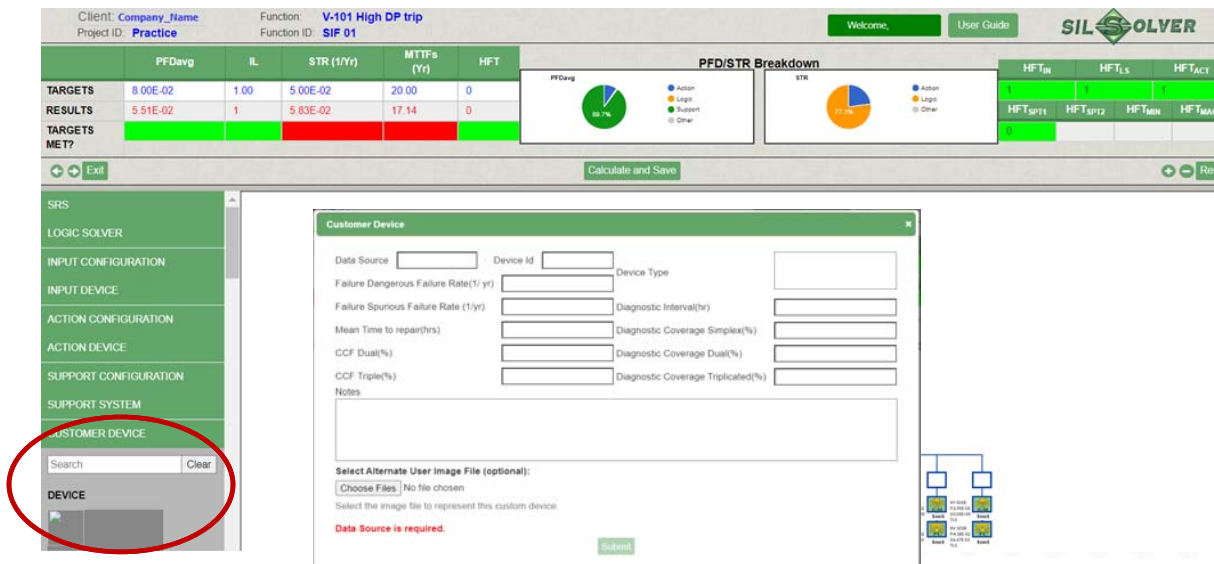


Click Project on the dropdown menu or use Back buttons on the datasheet pages



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 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
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

Calculate and Save + - Reset

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(hrs): 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.

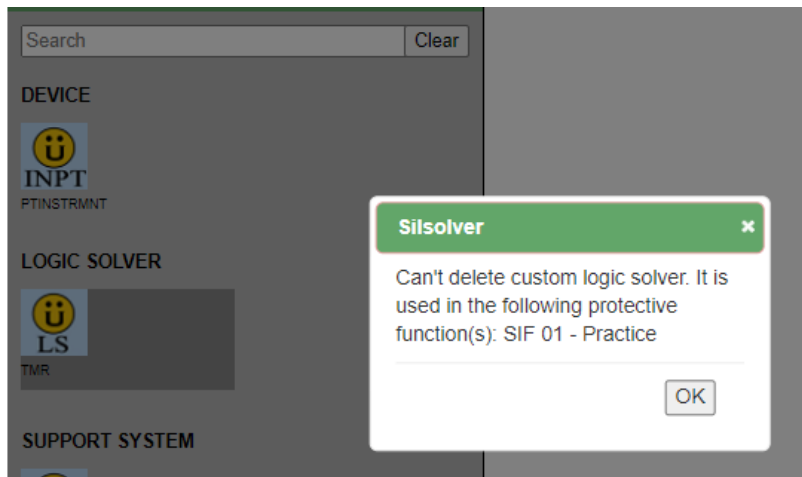
Data Source is required.

Submit

Once created, custom datasheets cannot be edited!

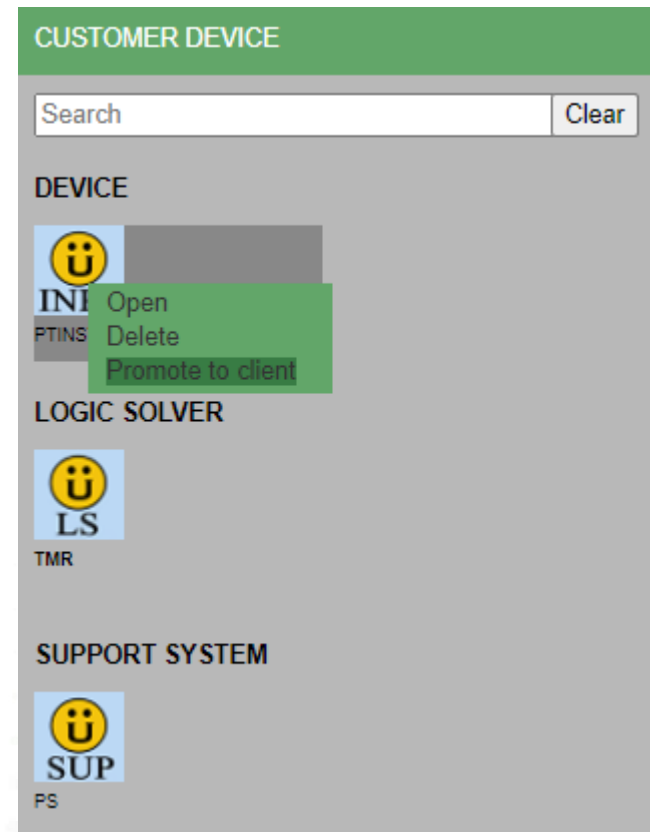
Project level custom datasheet

- 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

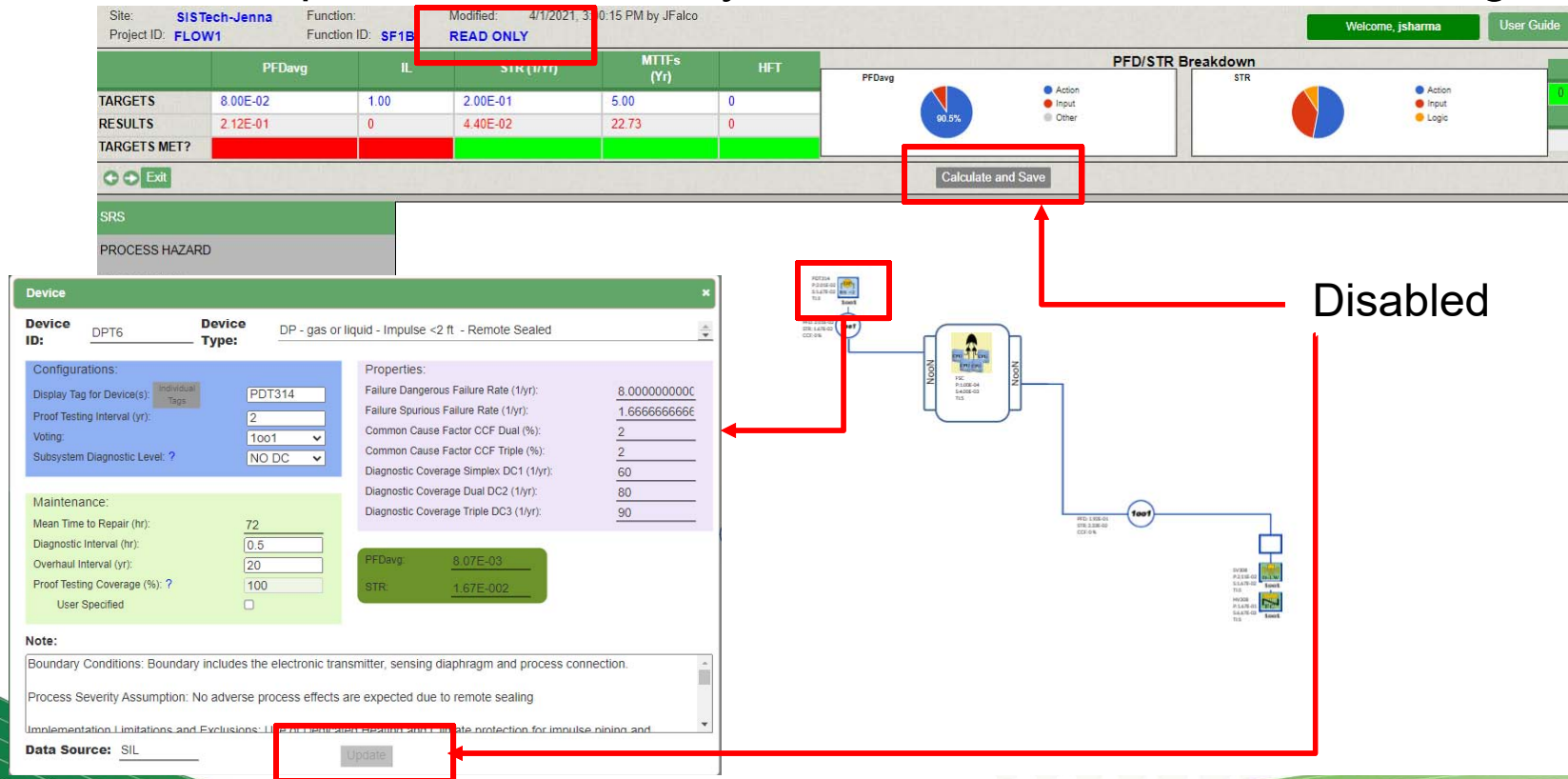
- Some SIL Solver® Enterprise application screen content may be obscured if
 - Window is not maximized
 - Zoom >100% is used on the window

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.



The screenshot displays the SIS TECH software interface. At the top, a status bar shows the site as 'SISTech-Jenna', project ID as 'FLOW1', and function ID as 'SF1B'. A red box highlights the 'Modified' date and time, and another red box highlights the 'READ ONLY' status. Below this, a table shows targets and results for various metrics. To the right, there are two pie charts labeled 'PFDavg' and 'STR', each showing a breakdown by Action, Input, and Logic. A 'Calculate and Save' button is highlighted with a red box. Below the main interface, a 'Device' configuration window is open, showing details for device ID 'DPT6' and type 'DP - gas or liquid - Impulse <2 ft - Remote Sealed'. The window includes sections for Configurations, Properties, Maintenance, and a Note. A red box highlights the 'Update' button at the bottom of the device window. A red arrow points from the 'Update' button to the 'Calculate and Save' button in the main interface. Another red arrow points from the 'Device' window to a 'Disabled' label. A third red arrow points from the 'Disabled' label to the 'Calculate and Save' button. A fourth red arrow points from the 'Device' window to the 'Update' button.

	PFDavg	IL	STR (1/yr)	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?					

Device Configuration Window:

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

Configurations:

- Display Tag for Device(s): Individual Tag
- Proof Testing Interval (yr): 2
- Voting: 1001
- Subsystem Diagnostic Level: ?
- Subsystem Diagnostic Level: NO DC

Properties:

- Failure Dangerous Failure Rate (1/yr): 8.0000000000
- Failure Spurious Failure Rate (1/yr): 1.6666666666
- 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

Maintenance:

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

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: Implementation includes protection for impulse piping and

Data Source: SIL

Update

Troubleshooting: Multiple user editing SIF

- If two users edit 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

Client: Company_Name
Project ID: FLOW1
Function: Function ID: SF1B
Modified: 3/2/2021, 12:19:25 AM by JSharma
READ ONLY

	PFDavg	IL	STR (1/Yr)	MTTFs (Yr)	HFT
TARGETS	8.00E-02	1.00	2.00E-01	5.00	0
RESULTS	2.00E-01	0	4.40E-02	22.73	0
TARGETS MET?					

Function Locked
Operation not permitted.
This function is currently locked by another user.

Function locked out msg and read only status

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

