Version 6.00

TECHNICAL REFERENCE GUIDE

2012

SIS-TECH Applications

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CONTENTS

PREFACE

SIL Solver® is an advisory software package intended for use in the verification of the Integrity Level (IL) of Protective Instrumented Functions (PIF). This package is a reliability block diagram based calculation tool. It uses fault tree analysis equations to verify the integrity level (IL) of protective instrumented functions (PIF). SIL Solver® uses globally recognized standards and methodologies to analyze components, subsystems, and PIFs, such as:

ANSI/ISA 84.00.01-2004 (IEC 61511)

ISA TR84.00.02

IEC 61511

IEC 61508

CPQRA

PURPOSE OF THIS GUIDE

This guide contains information to help the user use SIL Solver®. The guide presents information in a tutorial format. This guide is intended to explain the basic functions of the software.

CONVENTIONS

In this guide, an implied carriage return occurs at the end of each line, unless otherwise noted. The user *Press*es the ENTER or TAB to exit from an input box.

Example	Description
Edit	Words in bold indicate that the user enters or *Click*s button or menu
RETURN	Words in bold capital letters indicate names of keys and key sequences
Type/Click	Words in initialize indicate response needed

SECTION 1 DEFINITIONS

The following definitions are from the Center for Chemical Process Safety, *Guidelines for Safe and Reliable IPS* (2007).

1. Architecture–The physical organization, interconnection, or integration of the equipment of a system that operates according to the design basis.

2. Common Cause Failure–Failure of more than one device, function, or system due to the same cause.

3. Dangerous Failure–Failure affecting equipment within a system, which causes the process to be put in a hazardous state or puts the system in a condition where it may fail-to-operate when required.

4. De-Energize To Trip–Circuits where the final elements are energized under normal operation and the removal of power source (e.g., electricity, instrument air) causes the instrumented protective system to take its defined action.

5. Demand–See "Process Demand."

6. Detected Failure–Failure found through diagnostics or through the operator's normal observation of the process and its equipment. Synonyms include announced, revealed and overt.

7. Detected Fault– See "Detected Failure."

8. Diagnostic Coverage–Fractional decrease in the probability of dangerous failure resulting from diagnostics that report faults to the operator and take a specified action on fault detection.

9. Diverse–Use of independent and different means to perform the same function. Diversity may include the use of different physical methods, technology, manufacturers, installation, maintenance personnel and/or environment.

10. Energize To Trip–Circuits where the final elements require the power to take or maintain the safe state.

11. Failure–Termination of the ability of equipment to operate as specified.

12. Failure Rate–Limit when Δt goes to 0 of the expected rate at which equipment failures occur in the time interval t to $t+\Delta t$ given that no failures have occurred until time t.

13. Fault–Abnormal condition resulting in degraded operation or critical failure.

14. Fault Tolerant–Voting architecture that allows an equipment subsystem to continue to operate in the presence of one or more hardware or software faults.

15. Final Element–Device that takes action on the process or process equipment. For an instrumented protective function (IPF), the final element takes action on the process to achieve or maintain the safe state. The final element boundary includes the signal connection to the logic solver and the devices required to take action on the process.

16. Function Test–See "Proof Test."

17. Logic Solver–That portion of an instrumented system performing one or more logic functions.

18. Mean Time to Repair–The average time to identify a device failure, to repair it, and return it to normal operation.

19. On-line–Process equipment is operational (i.e., running, producing product).

20. Off-line–Process equipment is not operational (i.e., shutdown).

21. Process Demand–A process condition (or event) that requires a protective system to take action to achieve or maintain a safe state of the process.

22. Proof Test–A physical inspection and witnessed test, or series of tests, executed to demonstrate that the equipment operates according to the design basis and is maintained in the "as good as new" condition.

23. Protective Function–Function implemented to achieve or maintain a safe state of the process when unacceptable process conditions are detected to reduce the risk of an identified hazardous event. The protective function may be further classified in terms of the consequence severity and risk reduction requirement.

24. Protective Instrumented Function (PIF)–A protective function allocated to a protective instrumented system with an integrity level (IL) necessary to achieve the required risk reduction for an identified hazardous event.

25. Random Failure–Failure whose occurrence is unpredictable, which results from various degradation mechanisms in the hardware.

26. Redundancy–Use of two or more devices, systems, or layers to perform the same function.

27. Reliability–The probability that equipment operates according to its specification for a specified period of time under all relevant conditions. It is one of the core attributes of a protection layer.

28. Safety Instrumented System (SIS)–Composed of a separate and independent combination of sensors, logic solvers, final elements, and support systems that are designed and managed to achieve a specified safety integrity level. An SIS may implement one or more safety-instrumented functions (SIFs).

29. Safety Integrity Level (SIL)–Represents one of four discrete ranges used to benchmark the integrity of each SIF and the SIS, where SIL 4 is the highest and SIL 1 is the lowest.

30. Safety Requirements Specification (SRS)–Compilation of information and documentation that constitutes a design basis for the safety instrumented system. It may include logic narratives, Input/Output (I/O) list, cause & effect matrix, logic flow charts, system overview drawings, integrity level calculations, etc.

31. Sensor–A measurement device (instrument) or combination of devices that detect process variables or conditions (e.g., transmitters, transducer, process switches, and toxic gas detectors). The sensor boundary includes the process connection, sensor, transmitter, and signal connection to the logic solver.

32. Spurious Trip–Refers to a process shutdown, or disruption, due to the spurious operation of equipment. Other terms often used include nuisance trip and false shutdown.

33. Spurious Trip Rate (STR)–Expected rate (number of trips per unit time) at which a process shutdown, or disruption, occurs due to the spurious operation of equipment. Other terms used include nuisance trip rate and false shutdown rate.

34. Systematic Failure–Failure related in a deterministic way to a root cause, which can only be minimized by effective implementation of the protective management system.

35. Test Interval–Time period between two successive proof tests.

36. Verification–Activity of reviewing, inspecting, checking, testing, or by other means determining and documenting whether the outcome of work processes, activities or tasks conform to specified requirements and traceable input information.

37. Voting–Specific configuration of equipment within a subsystem. Voting is often expressed as MooN (M out of N). “N” designates the total number of devices (or channels) implemented; “M” designates the minimum number of devices (or channels) out of N required to initiate, take, or maintain the safe state. Also called voting system or voting architecture.

SECTION 2 ABBREVIATIONS AND SYMBOLS

ANSI	American National Standards Institute
β (beta)	Beta Factor or Common Cause Factor
BPCS	Basic Process Control System
DC	Diagnostic Coverage
DI	Diagnostic Interval
DTT	Deenergize To Trip
ETT	Energize To Trip
FTA	Fault Tree Analysis
IEC	International Electrotechnical Commission
IL	Integrity Level
ISA	Instrumentation, Systems and Automation Society
λ (lambda)	Failure Rate
MTTF	Mean Time To Failure
PFD	Probability to Fail on Demand
PIF	Protective Instrumented Function
PIS	Protective Instrumented System
PLC	Programmable Logic Controller
SIL	Safety Integrity Level
SIS	Safety Instrumented Systems
STR	Spurious Trip Rate
STRate	Spurious Trip Rate
TI	Test interval

SECTION 3 TOOLBAR

Toolbars are used throughout SIL Solver®. The following is a summary of the various toolbar functions:


Deletes the datasheet in view (deletes not permitted for SIL datasheets)


Close


Save


Allows print options to be selected


Allows new datasheet to be entered into database


Edit of current selected user datasheet (edits not permitted for SIL datasheets)


Recalculates required if edit(s) is/are performed on an existing datasheet.


Search database


Go to first record of database

Go back one record


Go forward one record


Go to last record


Revision level button


Create identical device sheet


Choose data sheet (s) for sharing non-SILSolver data

Import into SIL Solver® data the shared device data

Click for help

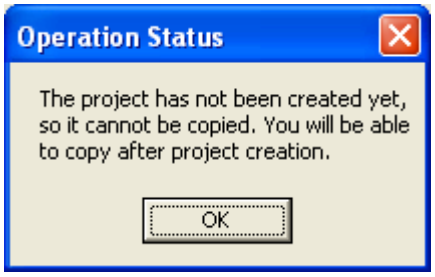
Tool tips are available on the icons by running your mouse over them as to their function.

SECTION 4 BASIC PROJECT OPERATIONS

SIL Solver® has many user-friendly features that make it easy to verify the Integrity Level (IL) of Protective Instrumented Functions (PIF). SIL Solver® also calculates the Mean Time to Failure Spurious ($MTTF^{SP}$), allowing the user to optimize the PIF to attain the appropriate balance between safety and reliability. Since the user can select various test intervals for the analysis of components and subsystems, SIL Solver® can provide an excellent tool for evaluating capital and maintenance costs.

These basic project operations instructions are intended to familiarize the user with the SIL Solver® interface. The process will be to create a project, open the project, create a protective function, open the function, select and add needed data devices, complete the protective function revision level documentation, and etc.

If, after creating a project you close SIL Solver® without opening that project, the project will disappear from the project list. Also, if you try to use the copy and rename features, you will receive a similar message.



This is the result of the databases, folders, and subfolder for a project not being created until the project is open.

Open SIL Solver®

Start SIL Solver® from the All Programs listing under Windows.

First time only on initial startup an error may occur due to the various Windows versions. See Installation of SIL Solver®, installer problems.

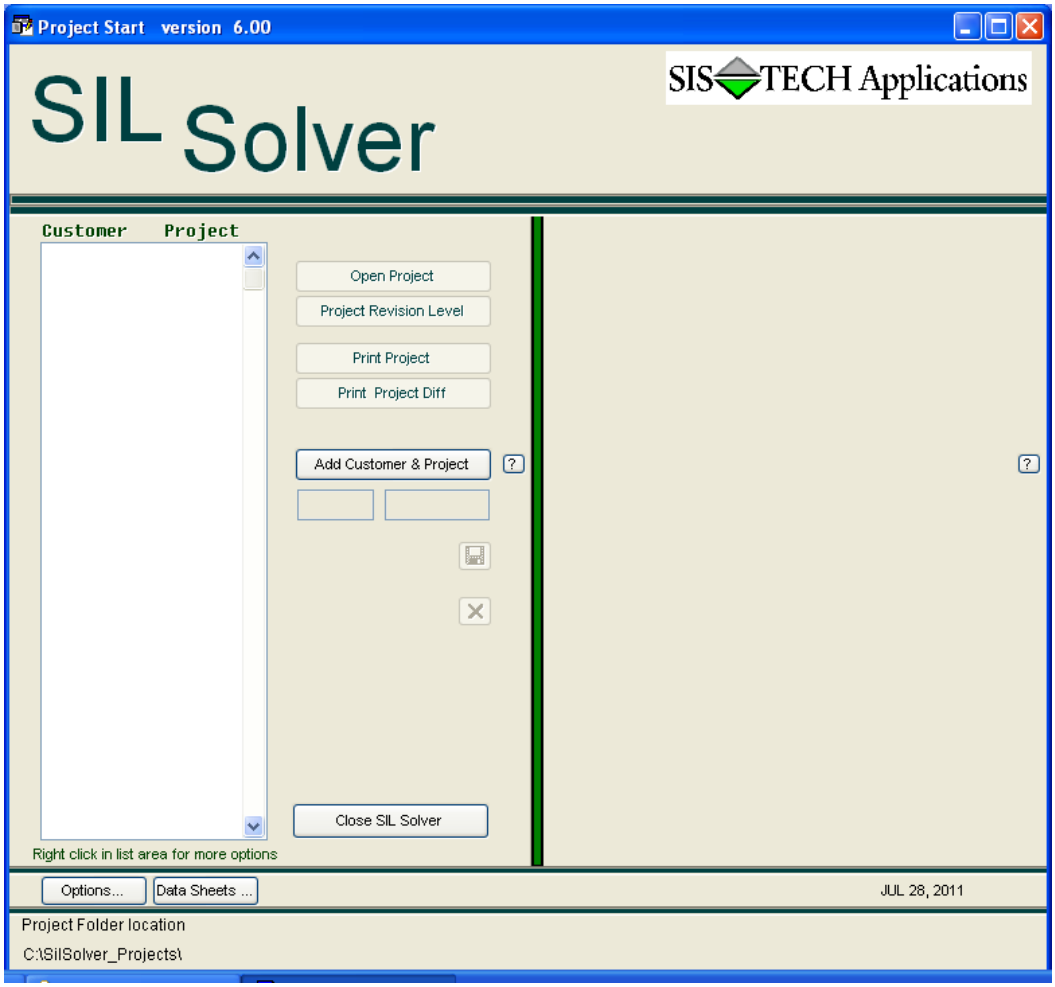


Figure 4. 1 Project Start View

Options - Default Settings

SIL Solver® default settings are: date American (month day year) format: project folder location "C:\SILSolver_Projects"; test reporting "color." If these defaults meet your needs, skip to Create Project. Otherwise *Click* Options to change SIL Solver® defaults to your personal preferences.

Date Selection

Click Options. From the Setup menu, *Click* American or European (day month year) date to select. The date format chosen will be in the lower right hand corner. The dates printed on the reports will reflect your date preference.

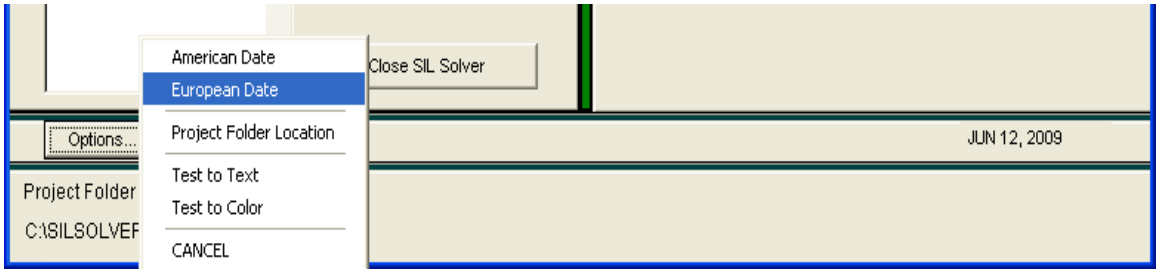


Figure 4. 2 Project Start, Setup menu Options: American or European Date

Project Folder Location

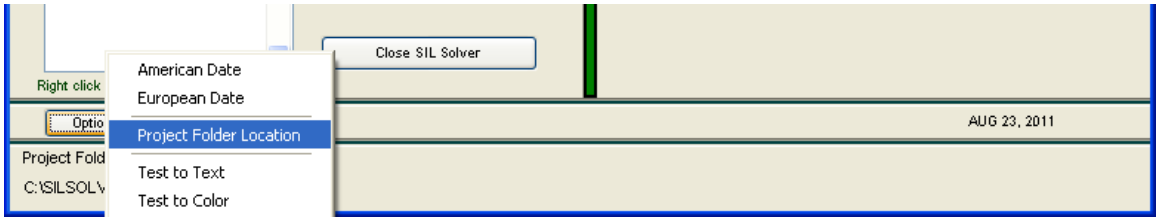


Figure 4. 3 Project Start, Setup menu Options: Project Folder Location

Click Options. From the Setup menu, *Click* Project Folder Location. This opens a Browse for Folder window. The project folder may be located in any designated location. *Click* OK or *Double Click*. Now selected, this folder will be displayed on the Project Start screen in the lower left hand corner. Warning: Problems have occurred with mirrored drives. Some SIL Solver® features, such as rename and delete project, have not work properly when using a mirrored drive.

Warning: When creating or selecting the SIL Solver® Project Folder Location, if a network location is selected remember that every time SIL Solver® is used to close it before the computer is disconnected from the network, failing to do it, will cause a corruption on the SIL Solver® tables.

Figure 4. 4 Project Folder Location - Browse For Folder

If your folder exists, *locate* the folder. *Click* OK.

If your project folder does not exist, *locate* the disk or folder where you want the project folder. *Click* Make New Folder. Type your folder name over the New Folder in the input box. *Click* OK.

Click OK to select this folder for your future projects. *Click* Cancel will maintain the old default project folder location. The project folder location will be displayed on the Project Start screen in the lower left hand corner.

Note: If you create a folder in the wrong location and want to remove this folder, *locate* the folder. Right *Click*. Select Delete from the browse windows menu. There is a slower response than Microsoft Explorer, but it works.

Test to Text and Test to Color

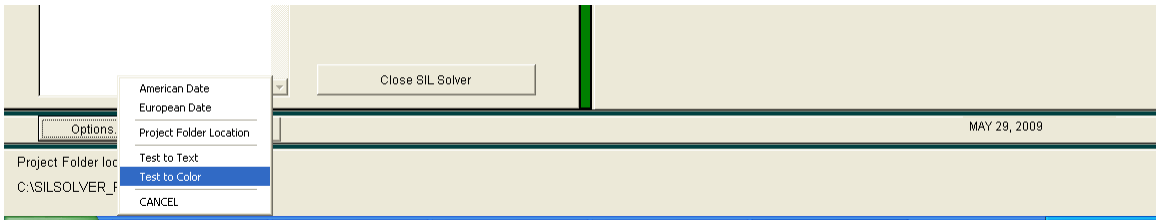


Figure 4. 5 Project Start, Setup menu Options: Test to Text and Test to Color Selection

Click Options. From the Setup menu, *Click* Test to Text or Test to Color. This will be use in the reporting of "Have Targets Been Met?" format located on the Protective Function screen. The reports will print the test as "Yes/No."

*Click*ing Test to Text toggles the reporting of the test success or failure to text display (yes/no). *Click*ing Test to Color toggles the test reporting to red/green boxes.

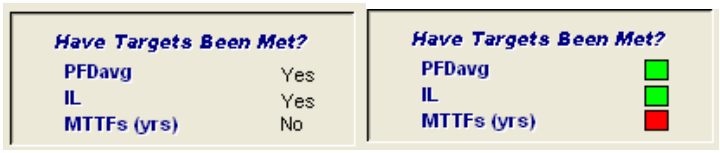
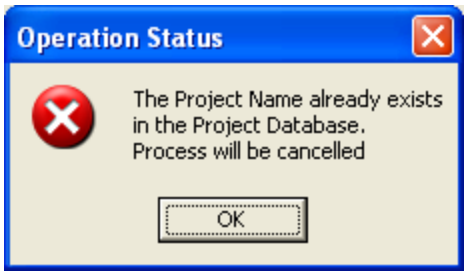


Figure 4. 6 Project Start, Options -Results of Test to Text and Test to Color on protective function screen

Create A Project

Creating a project is the starting point for any PIF analysis in SIL Solver®. Once a project is created, the user adds the PIFs that are to be analyzed. The suggested structure uses the Unit designation for the customer ID and an abbreviated process name (CHEM3) or project designation as the project.

Any time you attempt to add, copy, or rename a project that already exists in the projects database, you will receive this message. Project names must be unique within a project folder location.



From the Project Start, *Click* Add Customer & Project. This will enable the Customer and Project input boxes.

Figure 4. 7 Project Start - Add Project

Type 2-5 characters into the first input box then *Enter* or *Tab*. *Type* 2-10 characters into the second input box then *Enter* or *Tab* and *Click* or *Enter* on the Save.

If, before your save your input you decide to abort the Add Customer & Project, *Click* the X.

The X will cancel the process.

The Project will be added to the project list and to the projects database. For this project, the Customer ID is "TRIAL" and the Project ID is "TRIAL." Remember until you open this project it is a name only in the project list and the project database.

Note: For the remainder of this guide, the "Customer ID and Project ID" will be referred to as the "Project."

Open A Project

Any SIL Solver® projects that are located in the project folder location will auto-connect. This means that the project folder location is scanned for available projects and these projects are retrieved into the project list.

If you want to hide projects from the project list, use Microsoft Explorer to move the project folders from the project folder location. If you want to add projects, exit SIL Solver®, copy the project folder into the project folder location, open SIL Solver® and these projects will auto-connect.

To navigate through a long list of projects, *Click* into the project list. *Press* the Shift key and the first character of the project's name. Example: If your project starts with a Y, you will hold down the Shift key and *type* a "Y." This is also available under the protective functions. You could also use the scroll bar on the right of the project list.

From the Project list, *Click* Project to process. *Click* Open Project or *Double Click* on the project. A subfolder is now created under the project folder location and added to the project list. The name would be TRIAL_TRAIL.

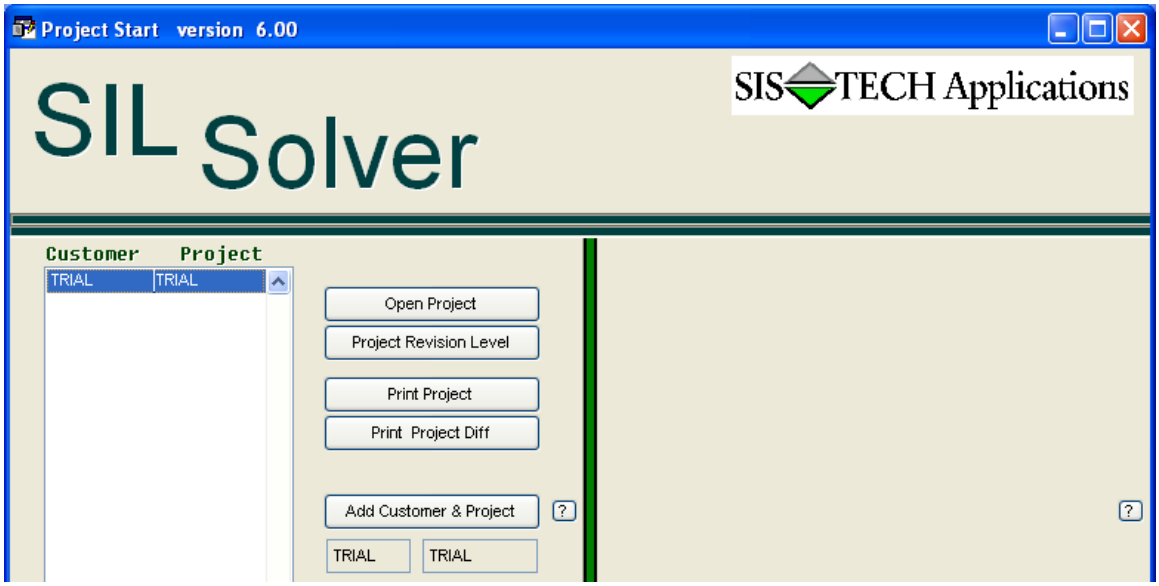


Figure 4. 8 Project Start - Open Project

This process will enable the protective function side and disable the project side.

Close A Project And Close The Protective Function

Click Close Project closes a protective function and a project. Once the project is open, another project cannot be opened until you *Click* Close Project.

Figure 4. 9 Project Start - Close the Open Project

Close SIL SOLVER®

To close SIL Solver®, *Click* Close SIL Solver on the lower left corner or the red X in the upper right hand corner.

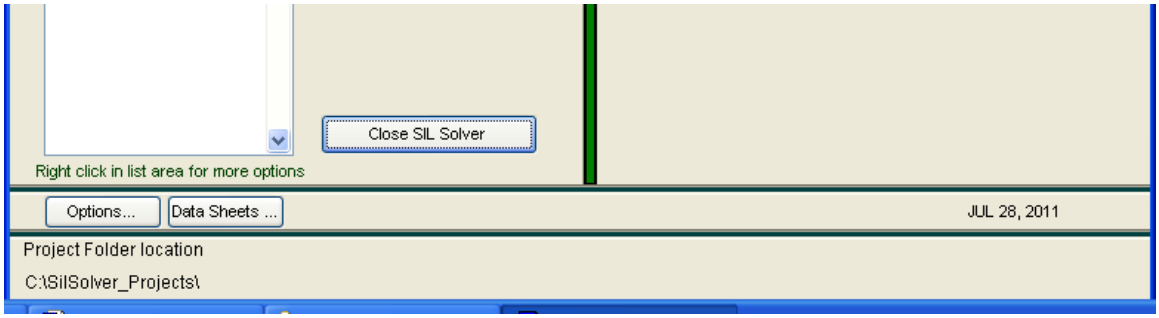


Figure 4. 10 Protect Start - Close SIL Solver®

Create Protective Function

After opening your project, the protective function side is enabled and the project side is disabled. Since there are no protective function records, only the Add Protective Function is enabled. When protective function list has protective function(s) available, the other buttons will be enabled.

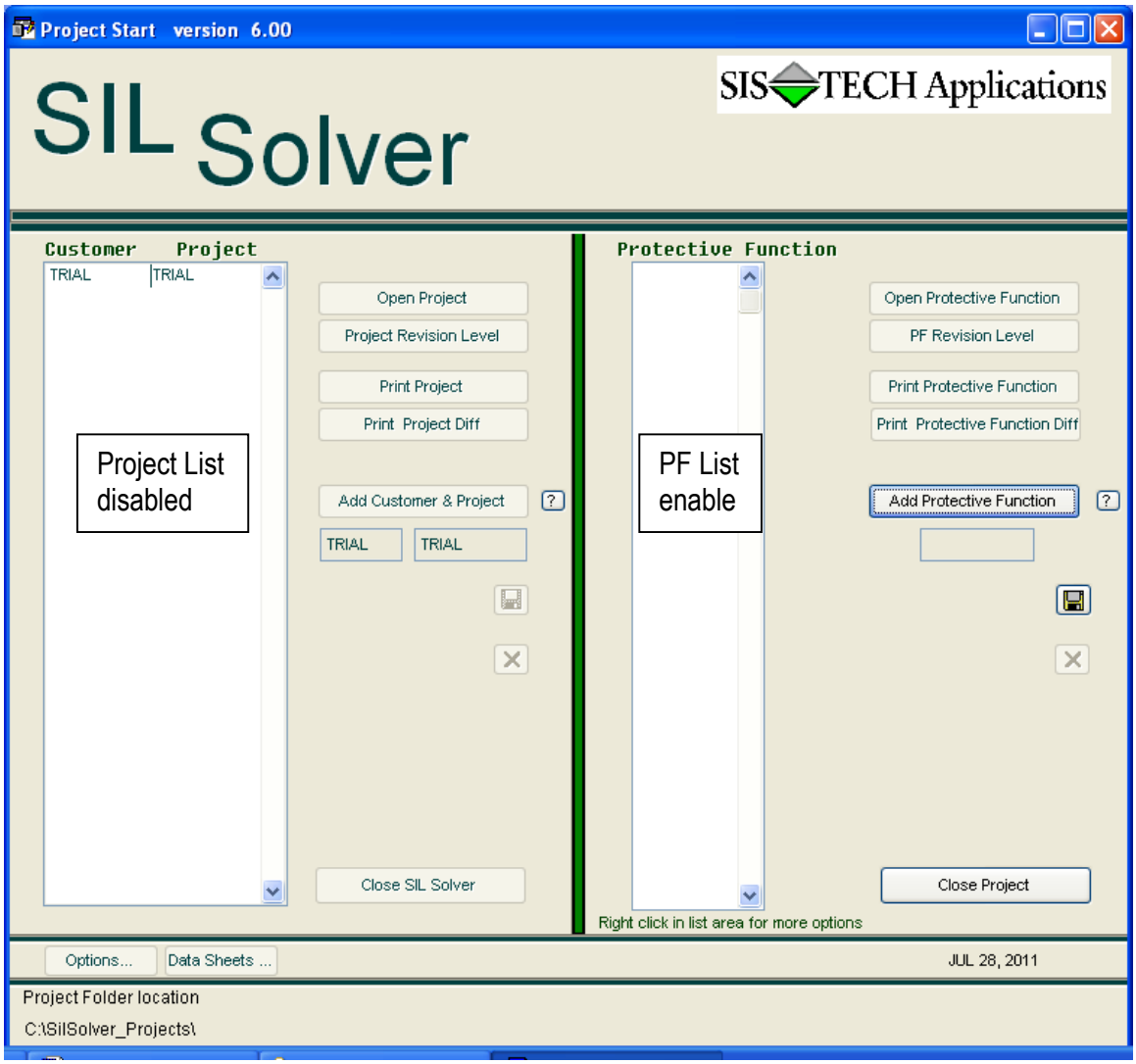


Figure 5. 11 Project Start - Disabled view of Project list - Enabled view of Protective Function list

A protective function ID has a maximum length of 10 characters with a minimum length of 2 characters. This is typically a protective function or interlock number. Typically, the name is alphanumeric and is traceable to the SRS documentation. Where possible, protective function name should be limited to 8 characters to support the division of functions into subparts when

complex functions are analyzed and to support multiple cases for a single function when optimizing the PIF design.

From the Project Start, *Click* Add Protective Function. This will enable the protective function input boxes. Protective Function names can be easily changed at any time within SIL Solver®. For this example, the protective function is named "SF1 CASE 1"

Click Save after entering the protective function name. You will notice the buttons on the protective function side are enabled now that there is a PIF in the protective function list.

If before you save the input you decide to abort the Add Protective Function, *Click* X.

Open A Protective Function

To navigate through a long protective function list, Click to highlight a protective function and *Press* the Shift and the first character of the project's name. Example: If your protective function's name starts with a Y, you will *Press* the Shift and type a "Y." This is also available under Projects.

After opening the project, *Click* Protective Function to begin the work process, *Click* Open Protective Function or *Double Click* on the protective function list.

Close A Protective Function

Click Close Project to close project. Once the project is open, another project cannot be open until you *Click* Close Project.

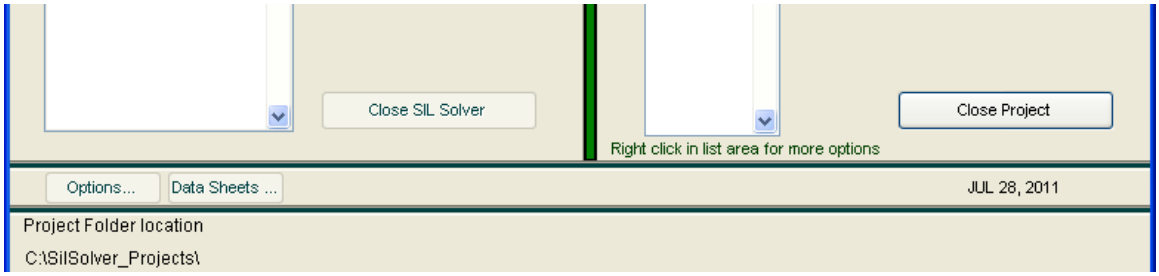
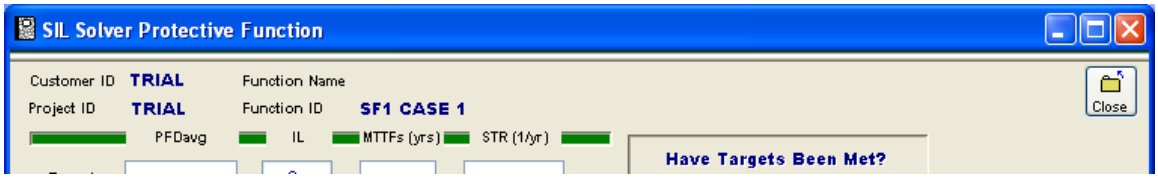


Figure 5. 12 Project Start - Close the open project

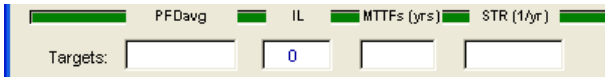
SECTION 6 PROTECTIVE FUNCTION

The protective function screen consists of six main parts (Figure 6.1 Protective Function Tabs - View)

1. Identifiers for Project, Project ID, and Protective Function, e.g. Customer ID: “TRIAL,” Project ID: “TRIAL”, and Protective Function ID: “SF1 CASE 1”



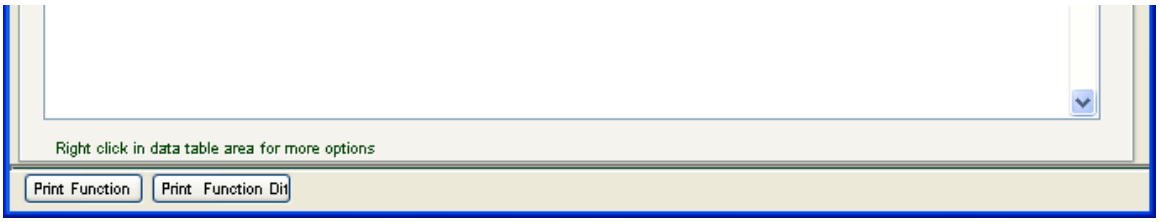
2. Protective function targets



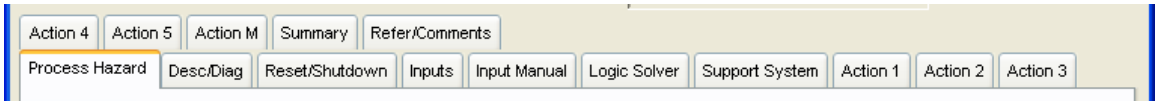
3. Protective function results

4. Have the protective function targets been met?

5. Printing protective function - see SECTION 11. Accessing the Data Sheets see SECTION 9.



6. Protective Function tabs



Project Identifiers

This identifies the specific Project and Protective Function that is being processed. These Protective Function identifiers cannot be changed from this screen. If a change is needed, from the Project Start, Rename is available for the Project (Section 7 Advanced Project Operations - Rename) and the Protective Function (Section 8 Advanced Protective Function Operations - Rename) identifiers.

Import Availability

The Import feature is available in Process Hazard, Inputs, and Action 1. Import is possible from other protective functions within the same project and also all protective functions from other projects inside the SIL Solver® project folder. For example, some protective functions have very similar logic, so it is only necessary to change minor items such as tag name(s).

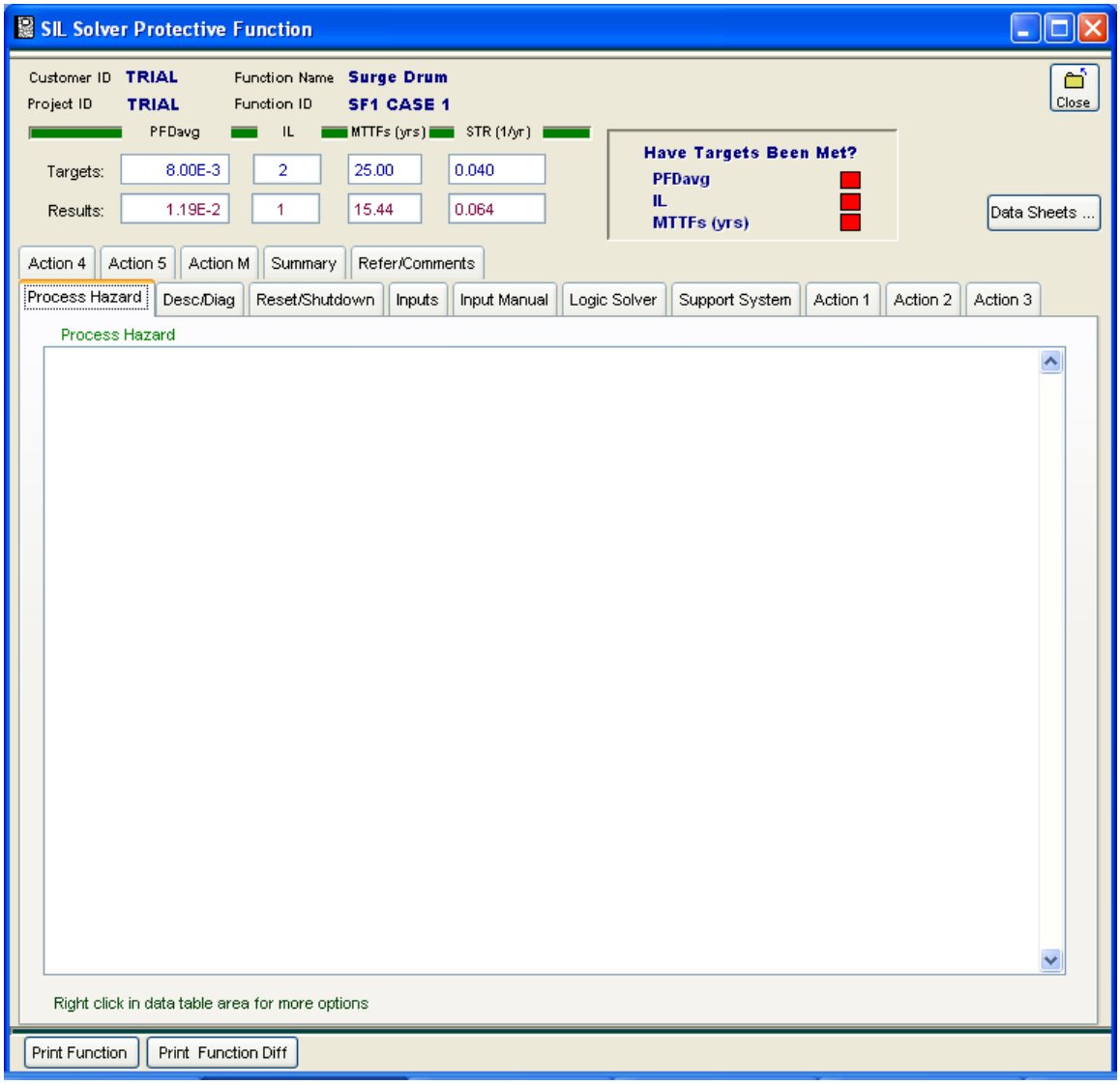


Figure 6. 1 Protective Function Tabs View (PROTECTIVE FUNCTION Documentation)

Enter Target Values For Protective Functions

When a protective function is opened you have the opportunity to enter target values. Target values are not required for operation of SIL Solver®, but are provided for documentation purposes. The software also uses these target values in the automatic check described in section 6.9.D.

PFD_{AVG}–This is the probability to fail on demand average. It should be entered in exponential format, such as X.XXE-XX. If exponential format is not used, the automatic check provided by the software will not work.

IL–SIL Solver® performs automatic lookup based on Table 3 in IEC 61511.

MTTF^{SP} years–This is the mean time to failure spurious. The units are years. It should be entered as number format.

The STRate per year–This is calculated automatically by SIL Solver® based on the entered MTTFspurious.

Protective Function Results

The protective function results are updated with each change to the Protective Function. The format and description are consistent with the target values.

Figure 6. 2 Protective Function Results

Check Results Against The Target Values

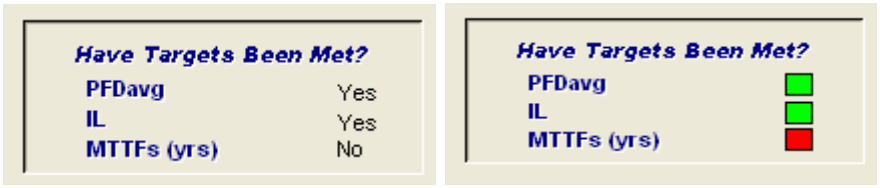


Figure 6. 3 Protective Function Target Check 'Test to Text' and 'Test to Color'

Target values for PFD and spurious trip rate can be entered into SIL Solver® so that it compares the target numbers with the calculated values and reports discrepancy. If the PIF does not meet the target values, changes to the design or maintenance strategy should be considered. If the overall PFD is not met, changes to the SIF design or maintenance strategy are likely required. When the STR is not met, the consequence of spurious trip should be evaluated and a cost-benefit analysis should be performed. If the consequence is acceptable or the cost-benefit ratio is poor, the target STR should be formally changed.

As the protective function is modeled, when the test to color option is chosen, the color of the boxes changes to notify the User to see easily whether the protective function is meeting the target. The boxes turn "red" if the target values are not met. Conversely, if the target values are met, the boxes turn "green."

If PFD_{AVG} result is greater than target value, the box remains "red."

If the SIL result is less than target value, the box remains "red."

If the MTTFspurious is less than the target value, the box remains "red."

PF DOCUMENTATION TAB

SIL Solver® provides a documentation screen for use in recording the following:

- Process hazard that the protective function is designed to address
- Logic description of the protective function
- Reference documents that were used as supporting information for the analysis
- Comments
- Reset Function
- Manual Shutdown

Note: For instructional purposes, additional protective functions with device information were created.

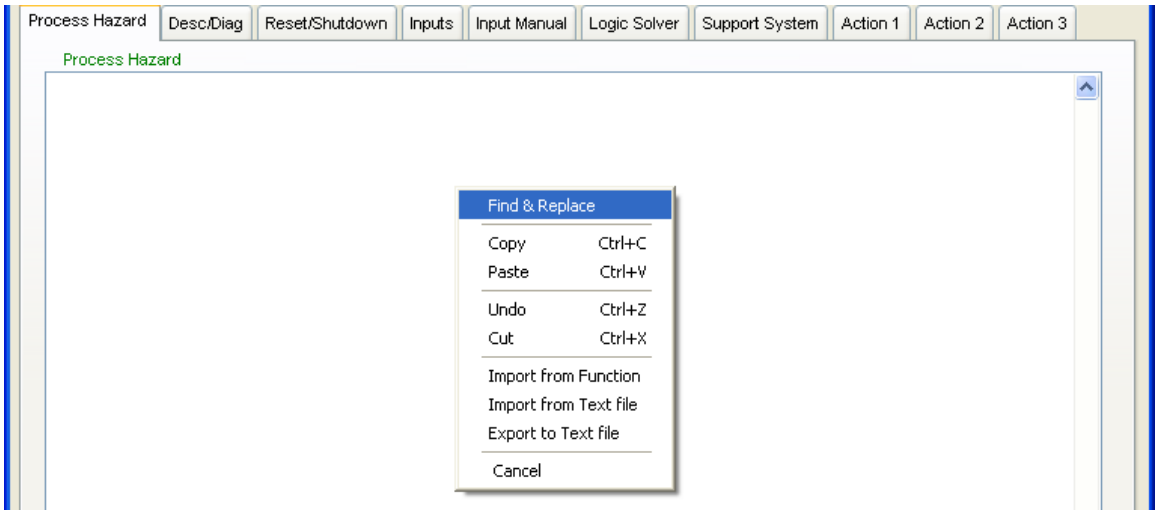


Figure 6. 4 Protective Function – Options: Documentation Menu

Edit - Options: Documentation menu

The standard Windows editing features are available on the documentation menu: find & replace, copy, paste, undo, cut. The Imports and Export features are available only on the Process Hazard tab.

Warning: The import feature will result in any existing documentation data on the documentation tabs to be overwritten.

Import from Function - Options: Documentation menu

From inside the documentation list. *Right Click*. From the Documentation editing menu, C*lick* Import from Function. Using the project location folder, an import list will be generated and displayed. Note: The protective functions that you are processing will not be displayed.

Double Click on protective function to import the data. The selected protective function's documentation will be imported. Once imported, any existing documentation data will be overwritten with the data from the selected project – protective function. It is changed without impacting any other protective function and no other information from the project – protective function is imported.

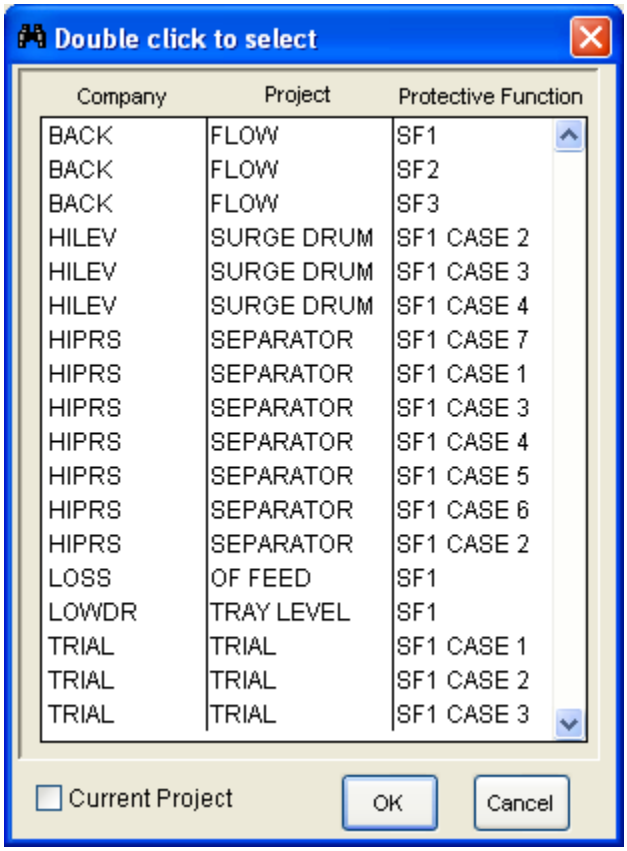


Figure 6. 5 Protective Function - Select Project to Import

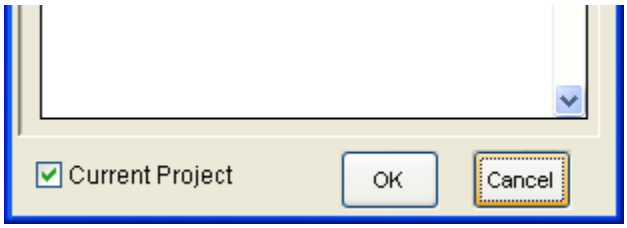


Figure 6. 6 Project Function – Filter Check Box

The import list default is to display all projects in the project folder location. To display the current project protective function(s) only, *Click* Current Project box. To return to the import list default, remove the check in the Current Project box, *Click* Current Project.

Import from Text file - Options: Documentation menu

When Protective Function information is available in a text file format it may be imported using the import as project documentation. From SIL Solver®, *Click* inside the documentation list (Process Hazard). *Right Click*. From the Documentation menu, C*lick* Import from Text file. A browse window for selecting the text file will display. *Select* and *Click.* The entire text file will be imported into the Process Hazard tab. The editing features available can be used to move the information into the appropriate documentation window.

Export to Text file - Options: Documentation menu

From the Documentation edit menu, C*lick* Export to Text file. The text file will be exported with the protective function documentation: Process Hazard, Description, Diagnostics, Reference Documents, Comments, Reset Function, and Manual Shutdown. A header identifying the documentation will be placed between each section. Example: "*** Process Hazard***". A message will display with the location and file name.

INPUTS TAB

SIL Solver® provides an Inputs tab for use in recording the following SIL Solver® Inputs (Figure 6.7), allowing the entry of non-redundant and redundant devices. A maximum of five entries can be made in each non-redundant and redundant section. The difference between the two types of entry is as follows:

Non-redundant: This is used when the correct action of multiple devices is required for the safe action to occur. For example, if a low flow trip is only active when the temperature exceeds a specified set point, both the flow transmitter and temperature transmitter must perform correctly.

Redundant: This is used when the correct action of any of the multiple devices will result in the safe action. For example, if both high temperature and high pressure are used to detect a runaway condition, the correct action of either transmitter will result in the safe action.

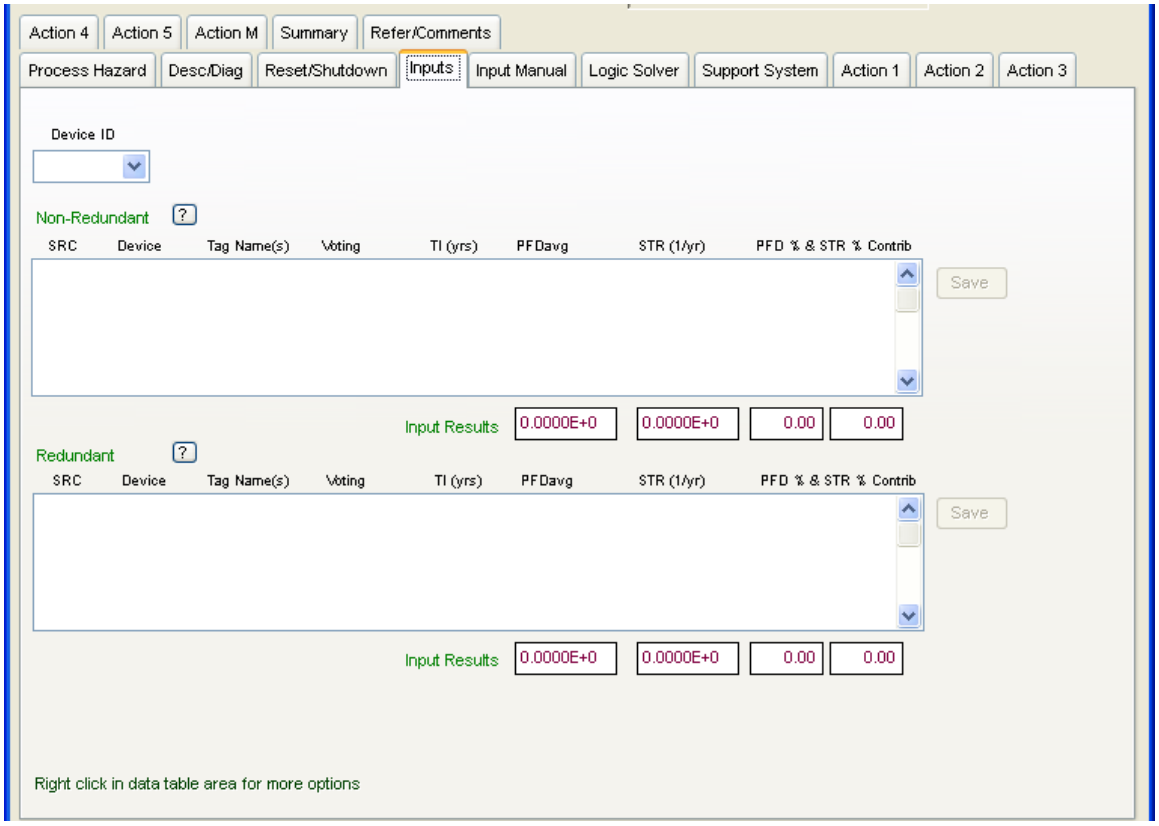


Figure 6. 7 Protective Function Inputs Tab View

The Import feature is last on the right click Inputs menu (Figure 6.8). Use this feature only when a new protective function is being created within a project. Otherwise, if you create entries and later want to use the import to include the entries from another protective function, your existing entries will be overwritten. You will need to use the import feature first, then modify or add any additional entries. See instructions: Import – Inputs menu.

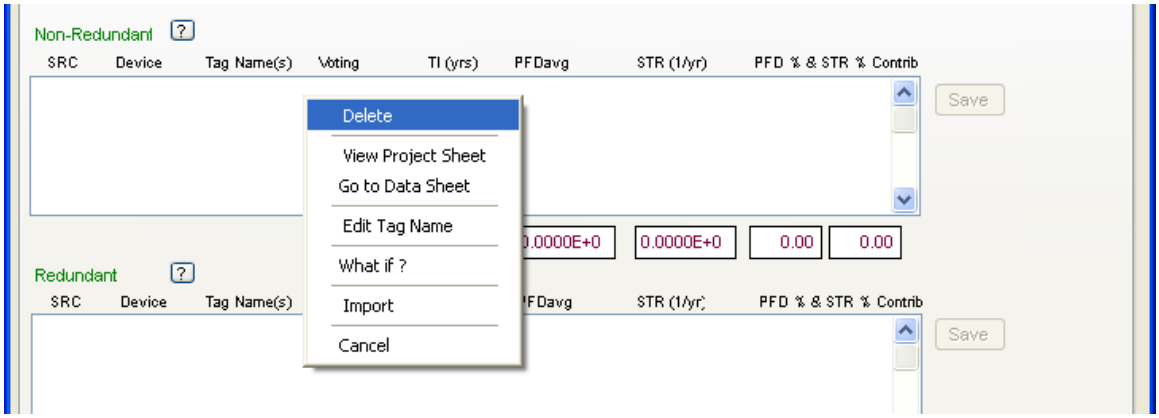
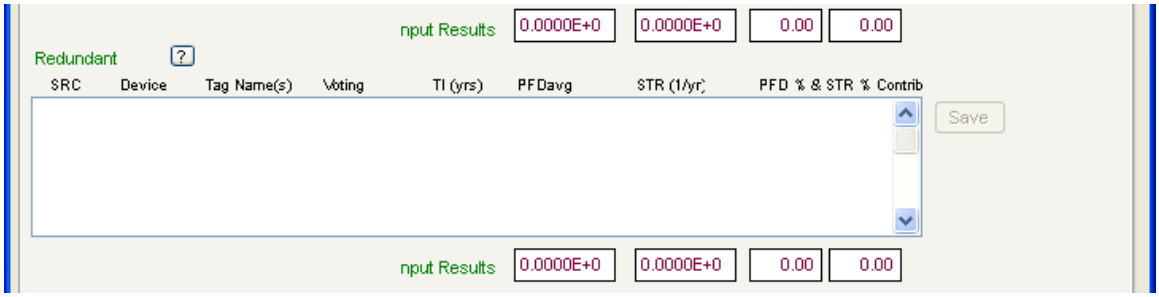


Figure 6. 8 Protective Function – Options: Inputs Menu

The percent contribution to the overall PFD_{AVG} and $MTTF^{SP}$ of each subsystem is displayed on each screen as you complete device selection.



The percent contribution is calculated as follows:

$$Percent\ Contribution = \frac{Subsystem\ \ Result}{Overall\ \ System\ Result}$$

To enter an input device into SIL Solver® it is necessary to select a device from the database. The devices are sorted alphabetically by device ID. The database is accessed using the dropdown arrow and scroll bar. The device can be selected quickly by typing in the first character of the device ID, then selecting the device from the dropdown.

The voting architecture and test interval for the device subsystem must be selected next. This enables the SAVE button, allowing the selection of Non-redundant and Redundant architecture for multiple device subsystems.

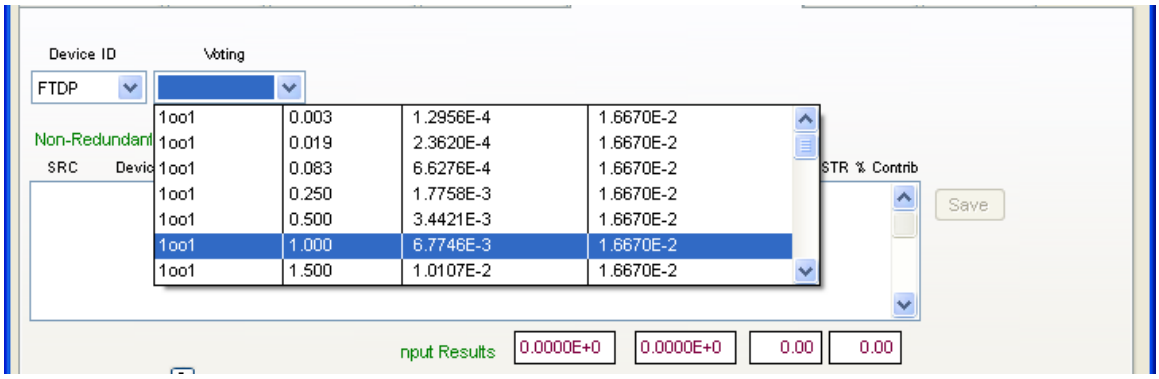


Figure 6. 9 Inputs showing the drop down box for voting architecture and test interval

After selecting the voting architecture, you have the option of entering tag name(s) for the device (s). The tag names are not required, but are included for documentation purposes.

Non-redundant subsystems: This is used when the correct action of multiple device subsystems is required for the safe action to occur. When you *Click* ?, the following tip is displayed:

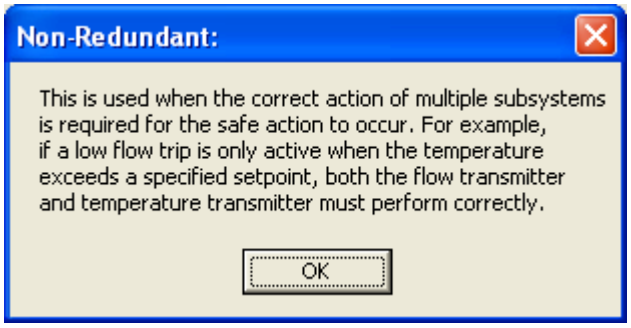


Figure 6. 10 The ? for Non-Redundant - Inputs Tab

The dangerous failure of any component (or subsystem) will result in a failure of the protective function. The spurious failure of any component (or subsystem) will potentially result in a spurious event. The flow device technology and voting architecture are selected using the select box as shown in Figure 6.9. The PFD_{AVG} values for each subsystem include the common cause contribution to the PFD_{AVG} based on the common cause factors selected in the datasheet.

The input screen models the non-redundant device subsystems as follows:

$$PFD_{avg} = \sum_{1}^{n} PFD_{avg}$$

$$STR = \sum_{1}^{n} STR_{n}$$

Redundant subsystems: This is used when the correct action of any of the multiple device subsystems will result in the safe action. When you *Click* ?, the following tip is displayed.

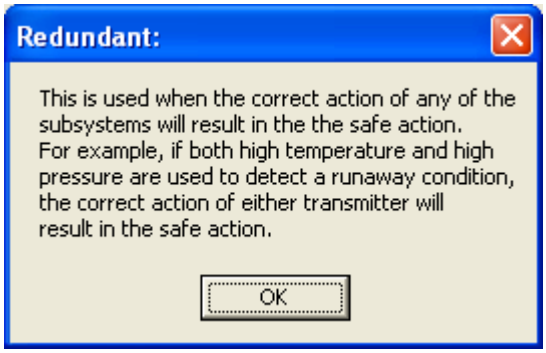


Figure 6. 11 The ? for Redundant - Inputs Tab

Any listed component (or subsystem) will detect the hazardous event. As discussed under non-redundant subsystems, each subsystem architecture is selected using the drop down button. After selection of a device and a voting architecture, shown in Figure 6.9, the device must be placed as redundant or non-redundant. For example, if temperature is measured by redundant devices, each

device is placed by a *Click* on the Save button to the right of the redundant portion of the screen. The PFD_{AVG} values for each subsystem include the common cause contribution to the PFD_{AVG} based on the common cause factors selected in the datasheet. Therefore, the calculations assumes that the redundant subsystems are sufficiently diverse from either a technology, installation, access, or maintenance standpoint that additional common cause contribution does not need to be considered. If common cause should be considered, the appropriate values should be entered manually under input manual on the next screen.

The input screen models the redundant device subsystems as follows:

$$PFD_{avg} = \prod_{1}^{N} PFD_{AVG}$$

$$STR = \sum_{1}^{n} STR_n$$

Warning: The SAVE button is not activated until the voting architecture and test interval are selected for each device.

Delete – Options: Inputs menu

To delete any entry, *Click* to highlight the entry. *Right Click*. From the Inputs Menu, *Click* Delete. There is no warning. The entry will be removed from the Inputs list and the protective function database.

View Project Sheet – Options: Inputs menu

Right Click on an entry. *Click* View Data Sheet. Depending on when the protective function was created, this may not be the current version of the device. *Click* Close or the red X to return.

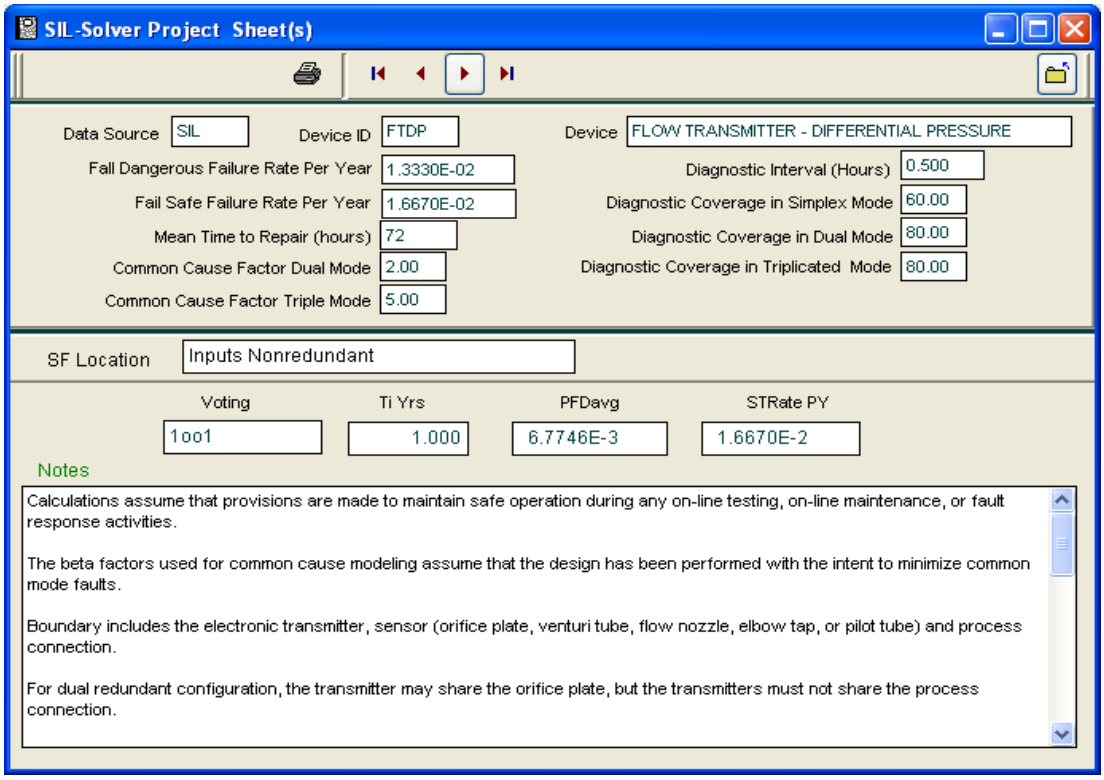


Figure 6. 12 Project Sheet View - Inputs menu

Go to Data Sheet – Options: Inputs menu

Right Click on an entry. From the Inputs menu, *Click* Go to Data Sheet. This selection will take you directly to the SIL Solver® Data Sheet. The device sheets are described later in this guide.

Edit Tag Name – Options: Inputs menu

To edit the listed tag name, *Right Click* on the entry. From the Inputs menu, *Click* Edit Tag Name. *Type* tag name into input box. *Click* Save.

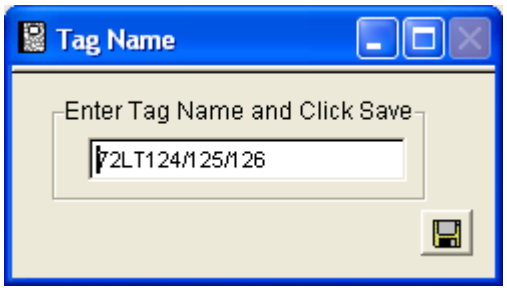


Figure 6. 13 Edit Tag Name - Inputs menu

What if? – Options: Inputs menu

You can play what-if scenarios by selecting a previously entered value. *Right Click.* From the Inputs menu, *Click* What-if?. The existing value is displayed in blue above the technology selection

dropdown. The dropdown auto-selects the previous value, allowing you to rapidly adjust the device technology, voting architecture, or test interval as desired. After selecting from the drop down, *Click* Save.

To abort the process, *Click* Cancel to retain the previously entered value.

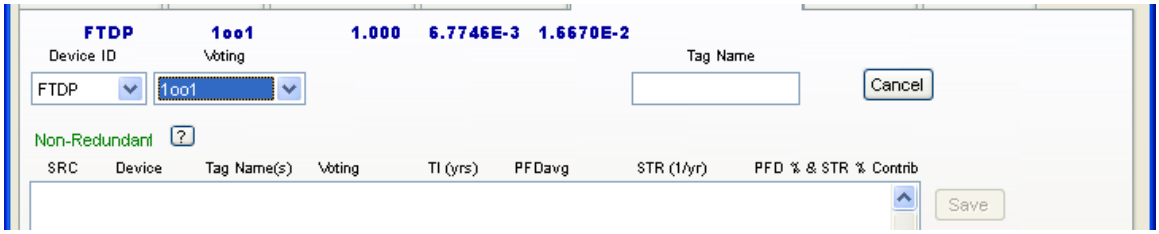


Figure 6. 14 What if? View prior to selection – Inputs menu

Import – Options: Inputs menu

Warning: The import function will cause any existing data on the input tab to be overwritten.

The Non-Redundant and Redundant devices from the selected project will be retrieved into the Inputs without impacting any other protective function and no other information within the project – protective function.

Click the non-redundant or redundant list. *Right Click*. From the Inputs menu, *Click* Import. A list of your projects available for import will display. *Double Click* on protective function to import the data.

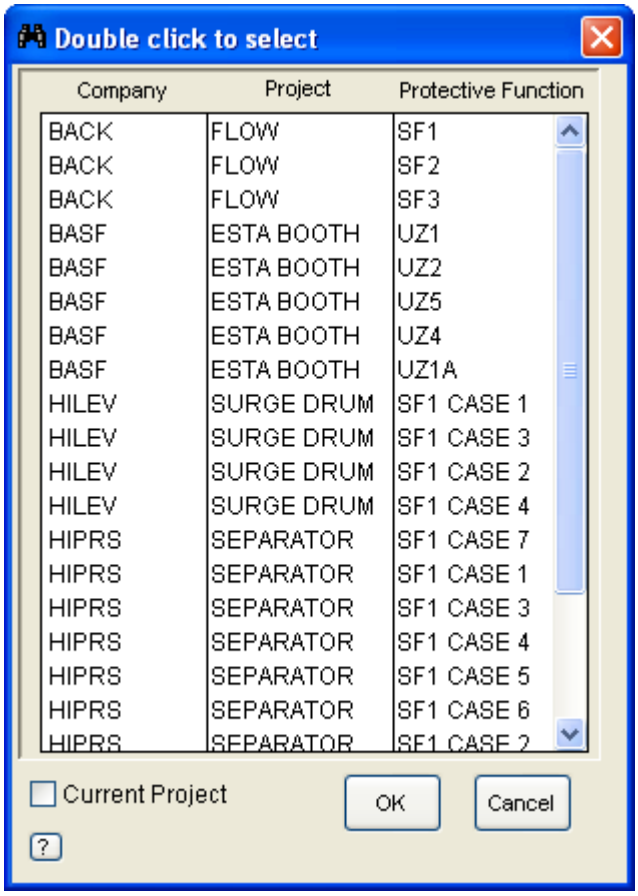


Figure 6. 15 Protective Function - Select Project to Import - Inputs

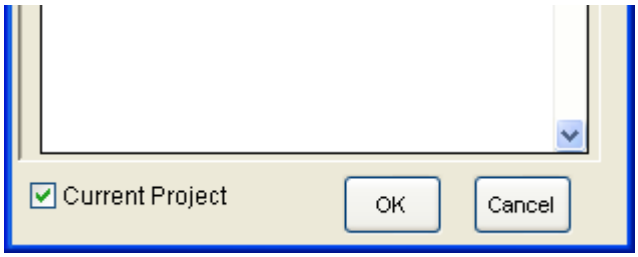


Figure 6. 16 Project Function – Filter Check Box

The import list default is to display all projects located in the project folder. To display the current project protective function(s) only *Click* Current Project box. To return to the import list default uncheck the Current project with a *Click* Current Project box.

Selected project – protective function will be imported. Once imported, any existing data will be overwritten with the inputs data from the inputs of the selected project – protective function. The Inputs, Non-Redundant and Redundant, are changed without impacting any other protective function and no other information within the project – protective function.

Click Cancel. Selected project will not be imported.

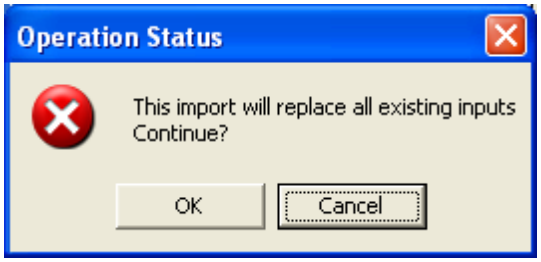


Figure 6. 17 Overwrite confirmation – Inputs

Click OK.

INPUT MANUAL TAB

The manual entry for input architectures allows a maximum of 2 manual entries. The manual entry is used for modeling devices or architectures that are not included in SIL Solver®. The manual entry must include the PFD_{AVG} and STR. All other entries are provided for documentation purposes and are treated as text by the program. For example, if the user enters 2oo10D voting in the input boxes, this is treated as text and SIL Solver® does not modify any of the other values typed into the row. The user must enter the value of the PFD_{AVG} and STR, associated with the device failure rate, voting architecture, and test interval, as well as any common cause failure potential.

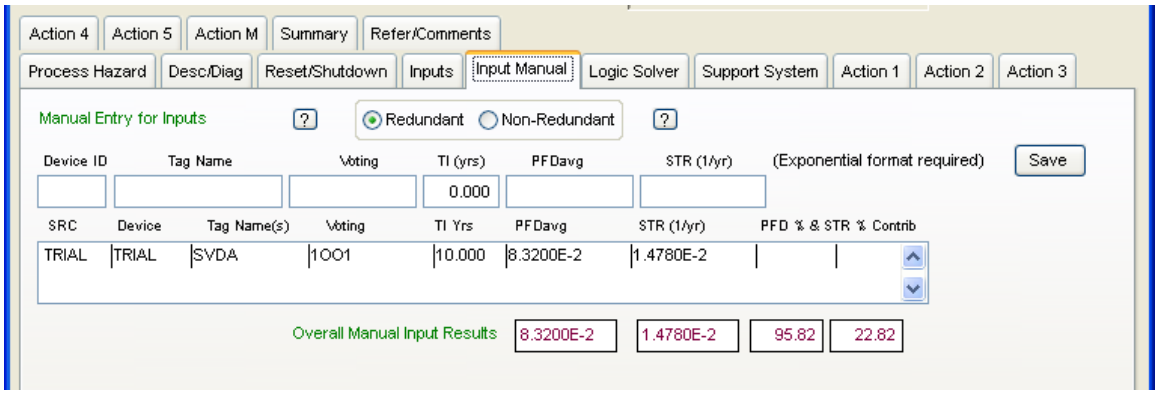


Figure 6. 18 Input Manual Tab View

Figure 6. 19 - Buttons to convert the voting logic - Manual Entry

Click Redundant or Non-Redundant button to convert the voting logic of the two entries into redundant (AND) logic or non-redundant (OR) logic. The selected entry is then added to the PIF as a redundant or non-redundant input. For help with the redundant or non-redundant selection, *Click* "?" shown next to the entry area.

Figure 6. 20 Options: Manual Entry for Input - Manual Entry menu

Edit – Options: Manual Input menu

To edit entry, *Right Click* on entry. From the Manual Input menu, *Click* Edit. The entries will be inserted into the input boxes allowing editing. When completed, *Click* Save.

Delete - Options: Manual Input menu

Click device. To delete entry, *Right Click.* . From the Manual Input menu, *Click* Delete

LOGIC SOLVER TAB

The most prevalent error made in modeling PIFs is forgetting to enter the logic solver. This occurs because it is same in all of the functions in the project, so the user tends to focus on the inputs and actions. Always check the Summary tab to make sure there are an input, logic solver, action, and support system, as required.

The logic solver specification is based on type, voting, and proof test interval. The equipment type includes the diagnostics and voting architecture. Review the logic solver data sheet assumptions to make sure that they match the system specified. A proof test of the logic solver involves testing its diagnostics, components, and support systems. Logic solvers cannot be tested on-line, so it must be capable of meeting the requirements at the expected turnaround.

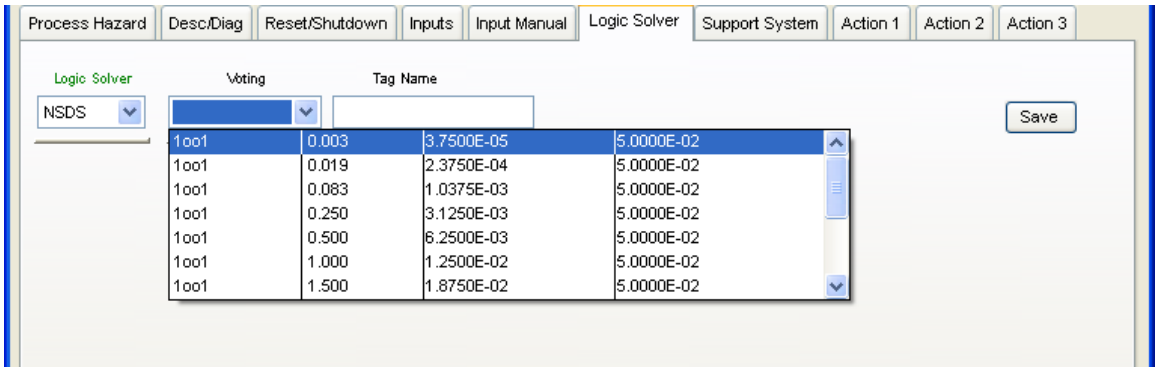


Figure 6. 21 Selection for Logic Solver View

Add - Logic Solver

For the Logic Solver entry, use the drop down to *Select* the Logic Solver from the Logic Solver database. Voting drop down will be enabled. *Select* Voting. *Type* Tag Name. *Click* Save.

If there is an existing entry, the Logic Solver drop down will automatically delete the existing Logic Solver entry.

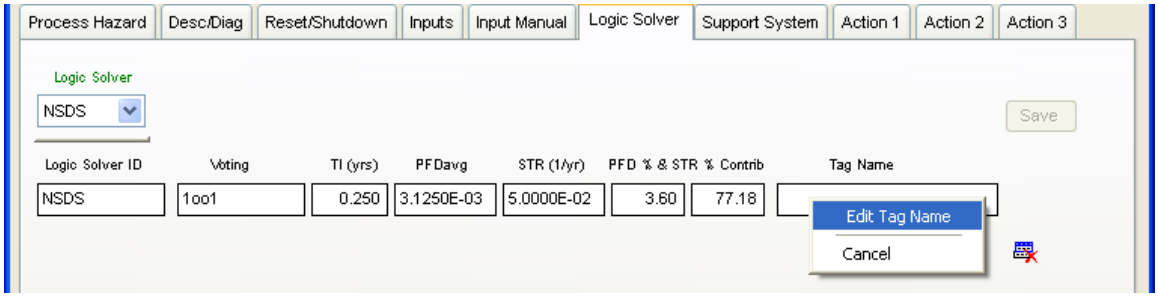


Figure 6. 22 - Options: Logic Solver menu

Edit Tag Name – Options: Logic Solver menu

To edit the listed tag name, *Right Click* in the tag name area. From the Logic Solver menu, *Click* Edit Tag Name. *Type* tag name into the input box. *Click* Save.

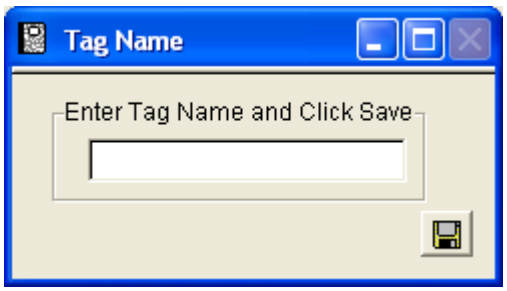


Figure 6. 23 Edit Tag Name – Logic Solver menu

Delete - Logic Solver

To delete the Logic Solver entry, *Click* Delete.

SUPPORT SYSTEM TAB

Support system analysis must be included for energize to trip and double acting valve applications. If all of the actions are energize to trip, the failure of the power must be included in the analysis by selecting the appropriate power supply tested and the expected turnaround. If only one action is energize to trip, the power supply is selected as an output related to the final element it supports in taking action on the process.

In general protective equipment should be designed to fail safe on loss of support systems, such as the power supply, instrument air, hydraulic supply, or communications. When protective equipment requires a support system to achieve the safe state, the support system is included in the calculation.

Two types of support systems are provided in SIL Solver®: instrument air and power. Instrument air should be used when air-to-move valves is implemented. Power should be included when energize to trip action is implemented. Power is entered at the support system level if all of the actions are energize to trip. Otherwise, power should be entered as an output for a specific action and final element. For example, an interposing relay may de-energize to close a contact that energizes a motor control circuit.

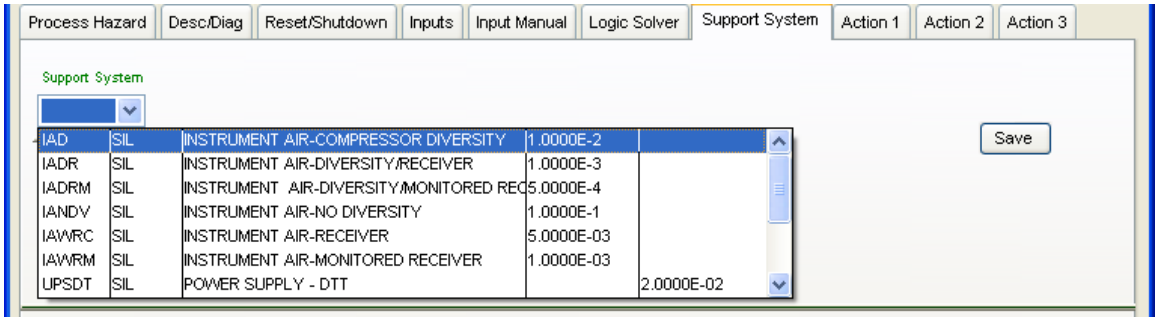


Figure 6. 24 Support System drop down

Add Support System

For the Support System entry, use the drop down to *Select* the Support System from the Support System database. *Click* Save.

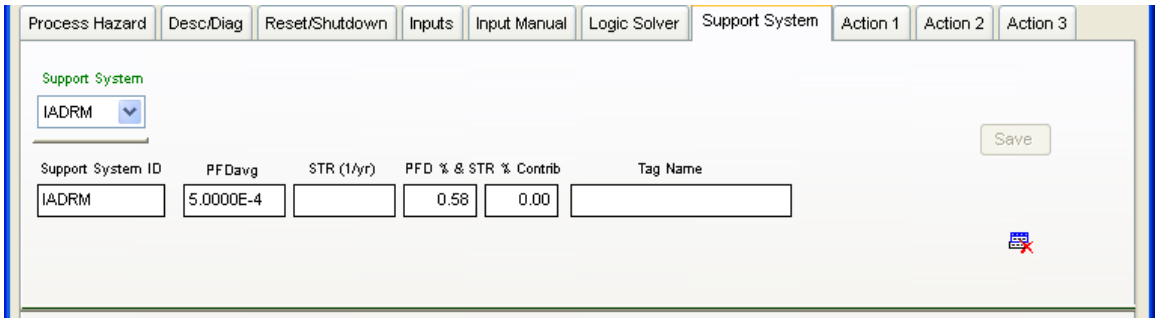


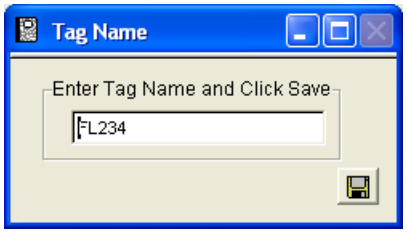
Figure 6. 25 Support System Completed View

If there is an existing entry, the Support System drop down will automatically delete the existing Support System entry.

Figure 6. 26 – Options: Support System Menu – Edit Tag Name

Edit Tag Name – Options: Support System menu

To edit the listed tag name, *Right Click* in the tag name field. From the Support System menu, *Click* Edit Tag Name. *Type* tag name into the input box. *Click* Save.



Delete Support System

To delete the Support System entry, *Click* Delete.

ACTION 1 – ACTION 5 TABS

SIL Solver® accommodates up to five sets of parallel actions: Action 1, Action 2, Action 3, Action 4 and Action 5. For example, in response to an overpressure scenario you may close steam isolation valves to a re-boiler (process action 1), open cooling water valves to a condenser (process action 2), close reactant A feed isolation valves (process action 3), close reactor B feed isolation valves (process action 4), and open reaction kill valves (process action 5).

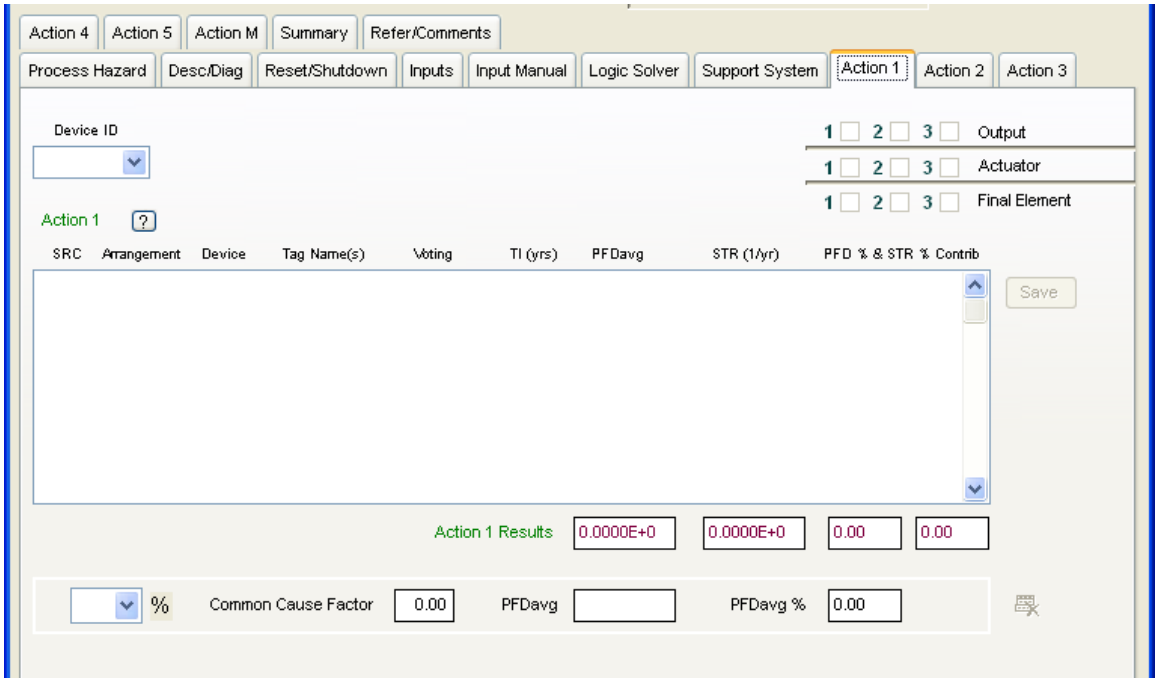


Figure 6. 27 Action 1 - Action 5 View

Please be aware that it is very unusual to have a protective function with five separate process actions. Normally only one or two actions are required for safe operation.

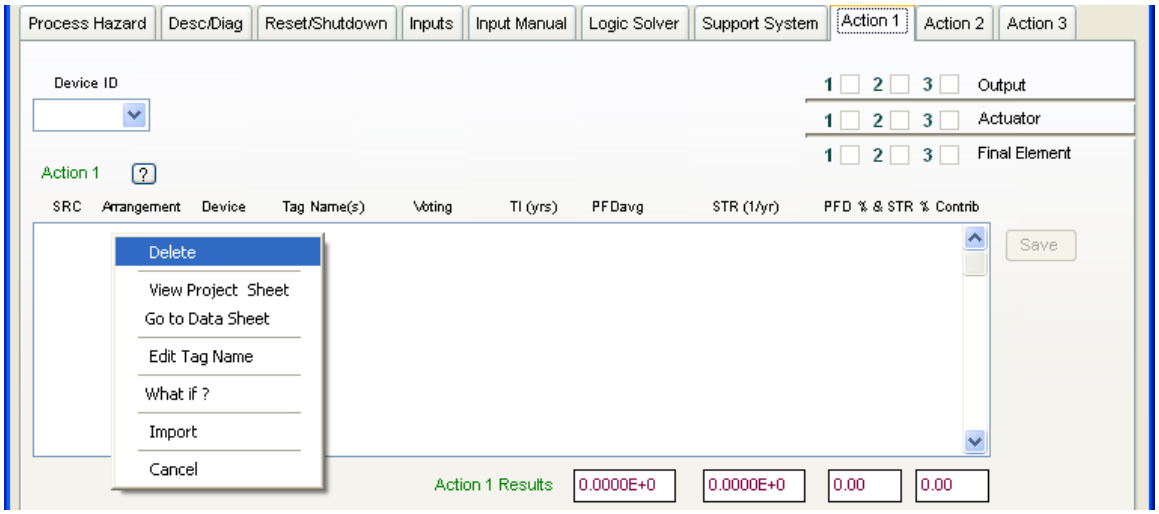


Figure 6. 28 Options: Action menu - Action 1 – Action 5

Note: Import is available in Action 1. The Action 2 – Action 5 Action menu will not show the import feature.

Each Action screen represents a single process action that must take place to ensure safe operation. Each process action can be executed using up to three subsystems and each subsystem can consist of three devices. For example, a process action can be executed using three valve subsystems in series and each valve subsystem can consist of an interposing relay, a solenoid, and a valve (See Figure 6.30-38). Please note that many PIFs utilize only an actuator and final element. Each output action is calculated as follows:

$PFD_{AVG} = (PFD_{O1} + PFD_{A1} + PFD_{FE1}) * (PFD_{O2} + PFD_{A2} + PFD_{FE2}) * (PFD_{O3} + PFD_{A3} + PFD_{FE3})$

$STR = (STR_{O1} + STR_{A1} + STR_{FE1}) + (STR_{O2} + STR_{A2} + STR_{FE2}) + (STR_{O3} + STR_{A3} + STR_{FE3})$

All screens provide the percent contribution of each action to the overall PFD_{AVG} and $MTTF^{spurious}$. The percent contribution is calculated as follows:

$$Percent\ Contribution = \frac{Action\ \ Result}{Overall\ \ System\ Result}$$

While valves are being used for this example, the final element could also be a compressor or pump shutdown using a relay in the motor control circuit.

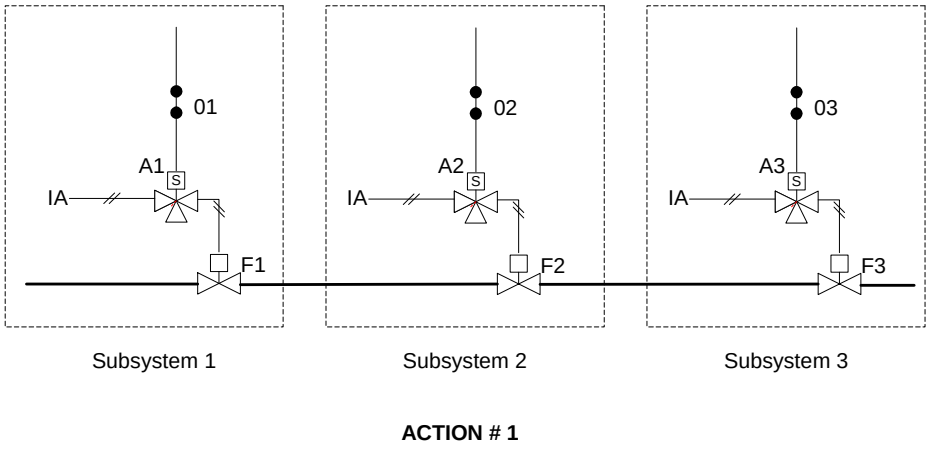
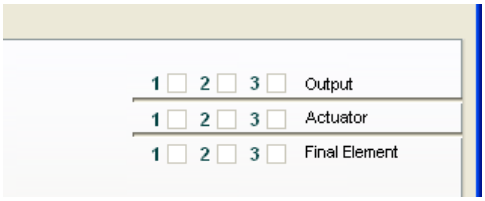


Figure 6. 29 Schematic showing Action #1 and associated subsystems

The relationship of the three devices that comprise the subsystem is established using the checkboxes on the upper right hand side of the action screen. The three devices are designated as output (e.g., relay), actuator (e.g., solenoid) and final element (e.g., valve). The 1, 2, and 3 checkboxes define the first subsystem, the second subsystem, and third subsystem, respectively.

To establish the correct relationships, you must determine whether you are adding an output, actuator, or final element. Then, select 1, 2 or 3 to assign the device to a specific subsystem.



Action 1 substitute 1-5 for X				
X=1-5	AX01	AX02	AX03	Output
X=1-5	AXA1	AXA2	AXA3	Actuator
X=1-5	AXF1	AXF2	AXF3	Final Element

Figure 6. 30 - Detail view of output relationship check box and Definition

As an example, Action 1 screen will be used. The other action screens are utilized similarly with the exception of the Action menu right click Import feature. It is available on Action 1 only. In the instructions provided below, simply substitute Action 2, Action 3, Action 4, or Action 5 for Action 1.

Step 1 in Entering Action 1

Step 1. For the interposing relay, select the "RELFO," the voting architecture, and test interval. Next, select the appropriate check box to assign it to a specific location in the overall system. For the example, this is being entered in as the first subsystem, so "1" is selected. After entering the target values, *Click* SAVE to continue.

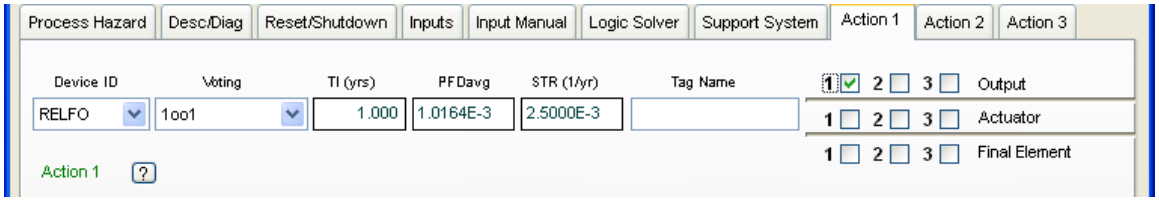


Figure 6. 31 Example showing entry of Action 1 Output 1 (A1O1)

Step 2 in Entering Action 1

Step 2. Select the solenoid valve with the appropriate voting architecture and test interval. This solenoid will be de-energized by the relay selected in Step 1, so the "1" is checked again. *Click* SAVE to continue.

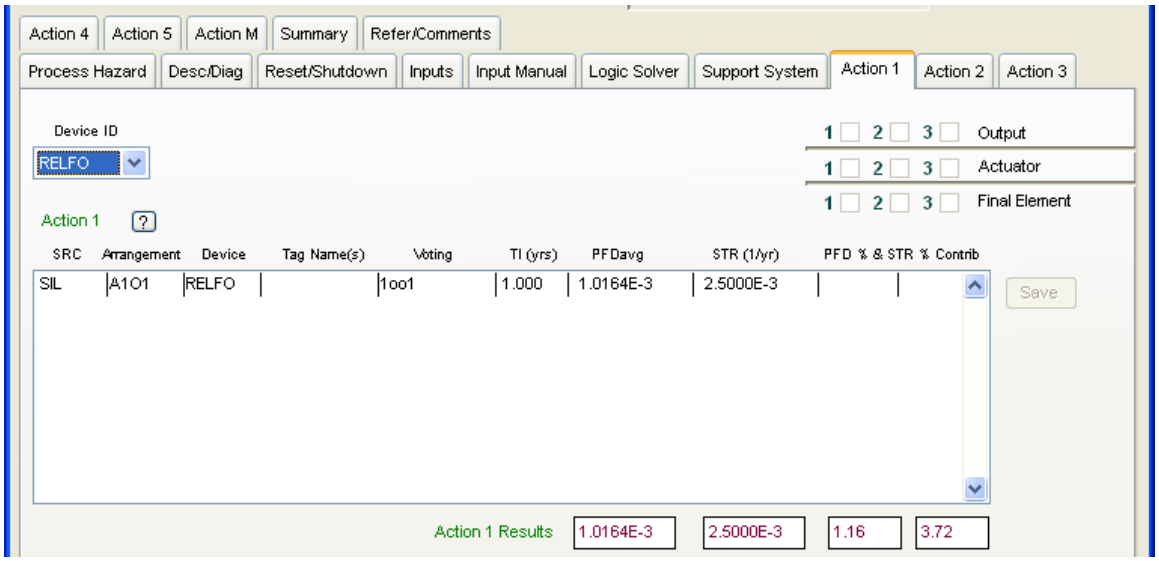


Figure 6. 32 Example showing entry - Action 1 Actuator 1 (A1A1)

Step 3 in Entering Action 1

Step 3. Select the block valve with the appropriate voting architecture and test interval. The air is removed from the actuator of this valve using the solenoid selected in Step 2, so the "1" is checked again.

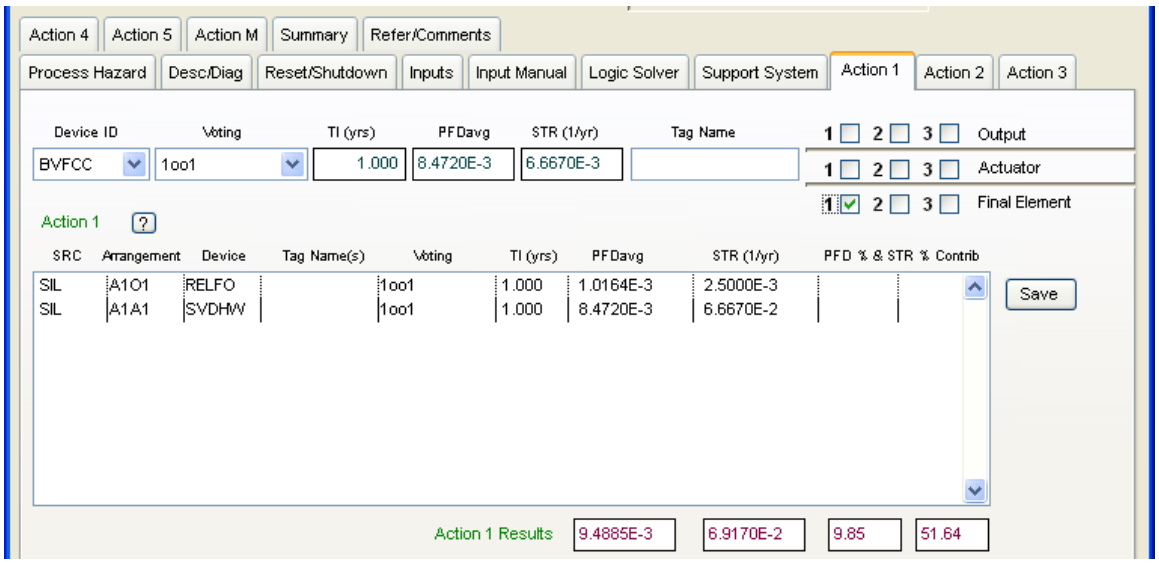


Figure 6. 33 Example showing entry - Action 1 Final Element 1 (A1F1)

Step 4 in Entering Action 1

Step 4. The first subsystem has now been added. The architecture can be reviewed by examining the arrangement field.

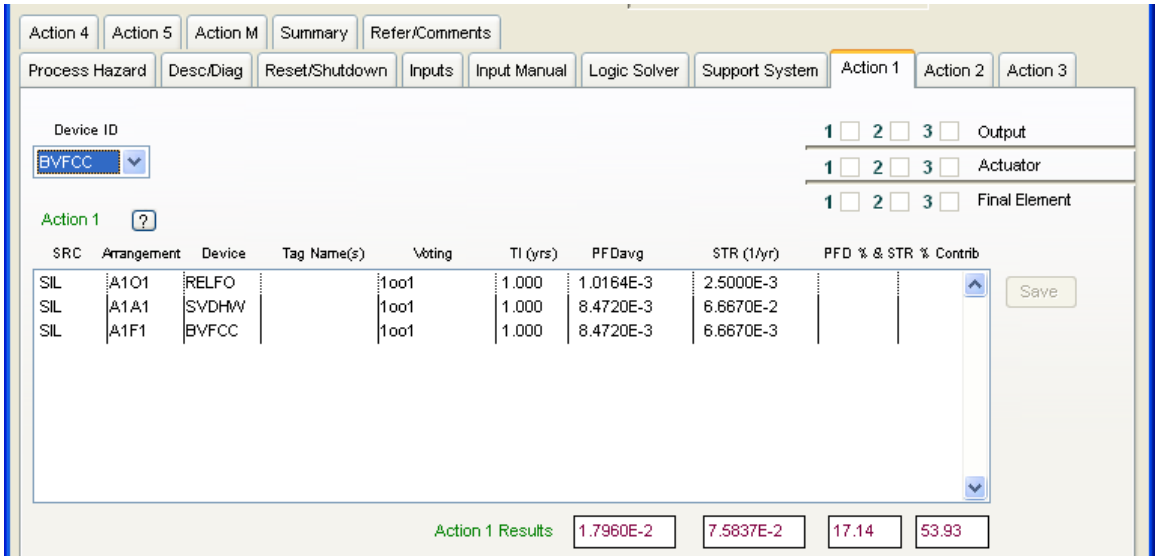


Figure 6. 34 Example showing completed subsystem 1 – Action 1

Step 5 in Entering Action 1

Step 5. To add a second subsystem repeat Steps 1 through 4 checking column 2, likewise for the third subsystem check column 3. The tag names can then be edited later.

SIL Solver® is not sensitive to the order of data selection. You can enter the devices in any order as long as the proper relationships are established. Consequently, you can select the relay, voting, and test interval, followed by selecting the "1", "2", and "3." *Click* Save.

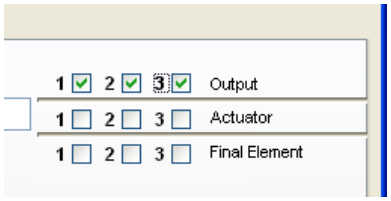


Figure 6. 35 Example showing the entry of three outputs

You can then select the solenoid valve, voting, and test interval, followed by selecting the "1", "2", and "3." *Click* Save.

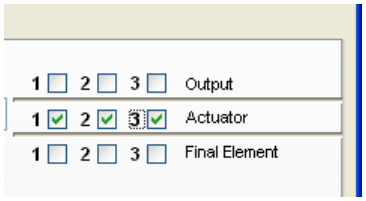


Figure 6. 36 Example showing the entry of three actuators

You can then select the block valve, voting, and test interval, followed by selecting the "1", "2", and "3." *Click* Save.

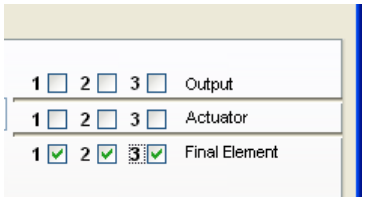


Figure 6. 37 Example showing entry of three final elements

Delete – Options: Action menu

To delete an entry, *Click* to highlight the entry. *Right Click*. From the Action menu, *Click* Delete. There is no warning. The entry will be removed from the Action list and the protective function database.

View Project Sheet – Options: Action menu

Click on device in Action list. *Right Click* . From the Action menu, *Click* View Data Sheet.

Depending on when the protective function was created, this may not be the current version of the device. This feature shows the data in the project database, not the device database. The data used in a protective function is pulled from the device database into the project database when the protective function was created. The View Project Sheet selection therefore allows the user to view the data that was available and used at the time of protective function creation. This data may be different from the data provided in the current SIL Solver® database due to on-going revision.

Click Close or the red X to return.

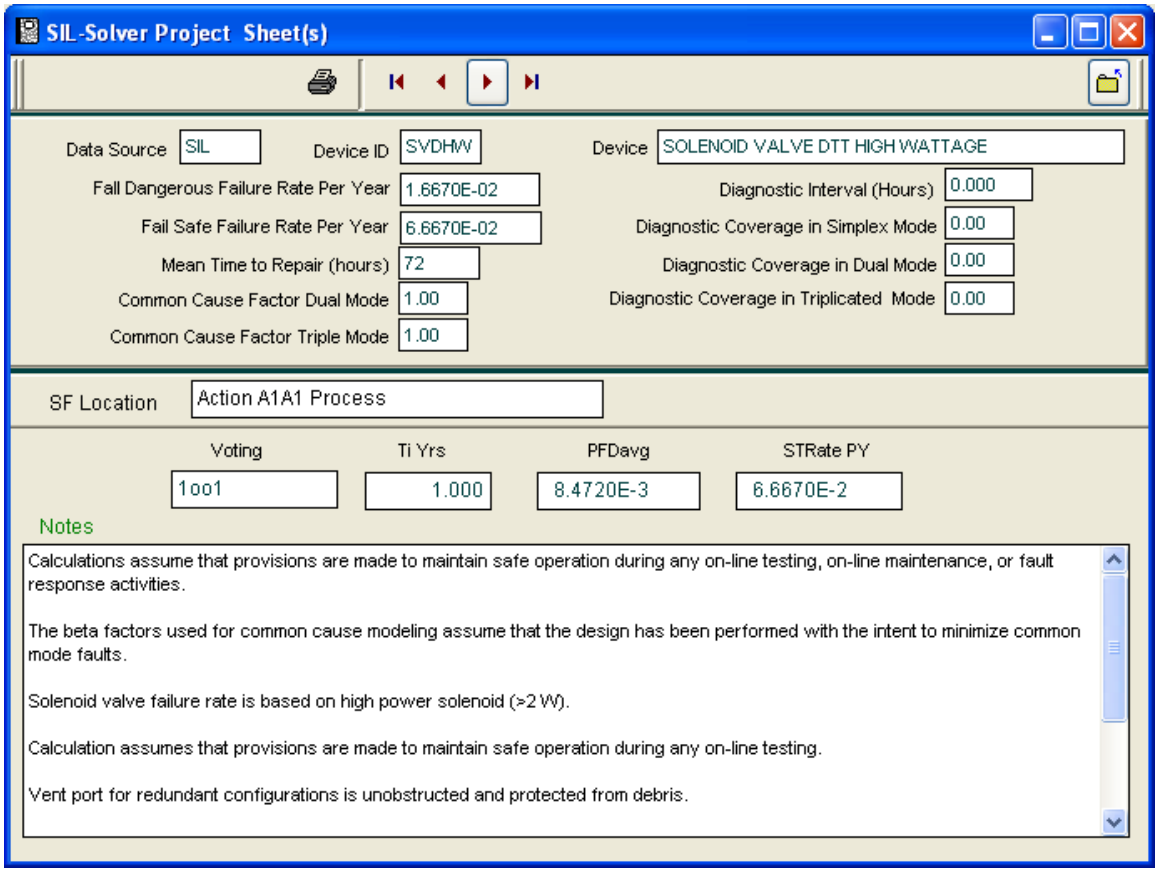


Figure 6. 38 View Project Sheet - Action menu

To return to the current protective function tab, simply *Click* Close or red X.

Go to Datasheet – Options: Action menu

For any input or action device entered into the database, you can view the SIL Solver® database associated with the device.

Click the device. *Right Click.* *Click* Go to Datasheet, which shows the complete datasheet for the specific device. This data is pulled from the SIL Solver® database at the time of selection. This data may be different from what is currently in the protective function sheet due to modification of the database since the time of protective function correction. This selection will take you directly to the SIL Solver® Data Sheet. The device sheets are described Section 9 Access to Datasheets.

To exit, simply *Click* Close.

Edit Tag Name – Options: Action menu

To edit the listed tag name, *Right Click* on entry. From the Action menu, *Click* Edit Tag Name. *Type* tag name into input box. *Click* Save.

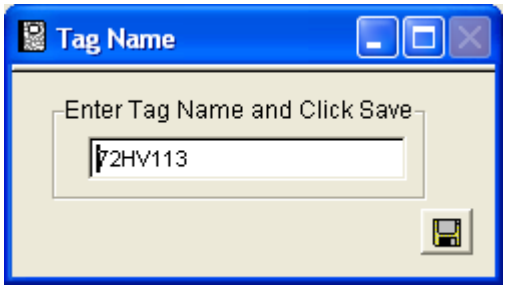


Figure 6. 39 Edit Tag Name - Action menu

What if? - Options: Action menu

You can play what-if scenarios by selecting a previously entered value. *Right Click..* From the Inputs menu, *Click* What-if?.

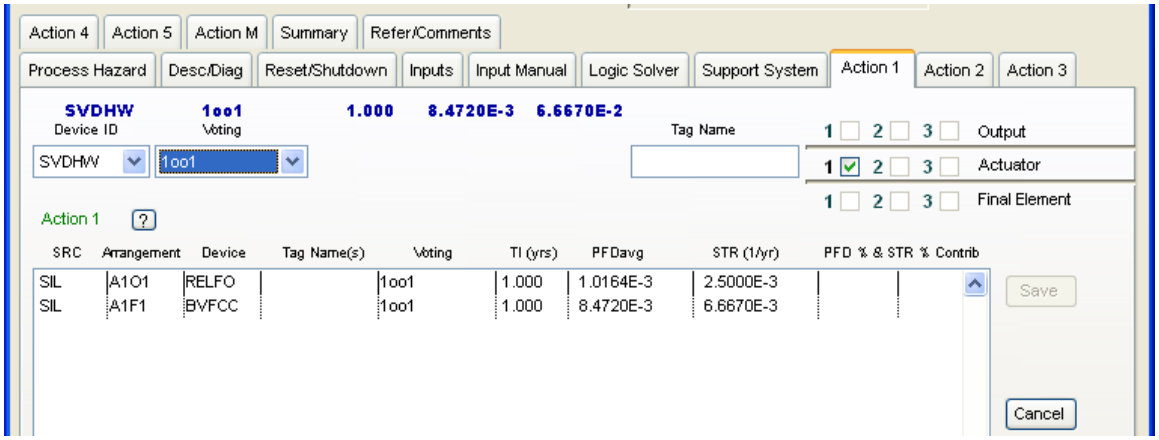


Figure 6. 40 What if? View prior to selection Action menu

The existing value is displayed in blue above the technology selection dropdown. The dropdown auto-selects the previous value, allowing you to rapidly adjust the device technology, voting architecture, or test interval as desired. Also the select the block valve previously selected “A1A1” has been checked. After you select from the drop down, *Click* Save.

To abort the process, *Click* Cancel to retain the previously entered value.

Import – Options: Action menu

To import click inside the Action 1 list. *Right Click*. From the Action menu, C*lick* Import. A list of your projects – protective functions available for import will display. You cannot select the one that you are processing. *Double Click* on protective function to import the data. Selected project will be imported. Once imported, any existing data in Action 1 – Action 5 will be overwritten with the data that exists in the selected protective function. This imports all action data found in Action 1 – Action 5 tabs not just Action 1. The action data is changed without impacting any other information

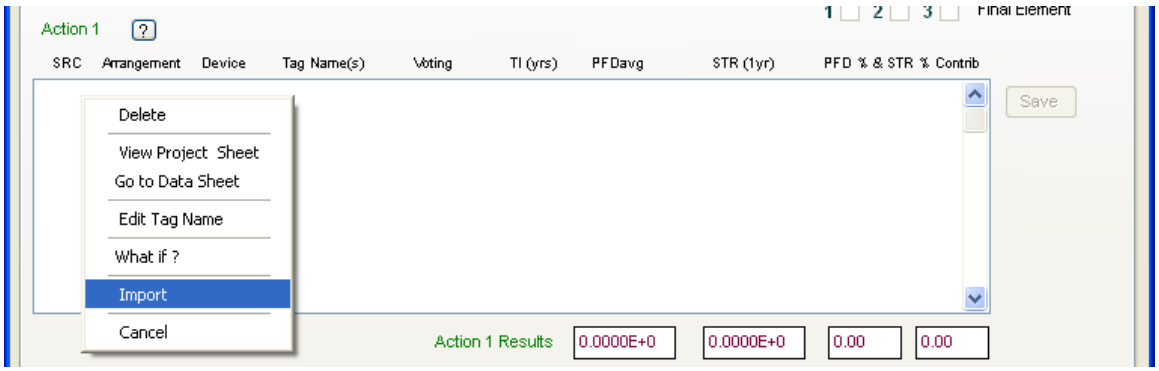


Figure 6. 41 Options: Action menu - Action 1 – Action 5

Remember import is available in Action 1. The Action 2 – Action 5 Action menu will not show the import feature.

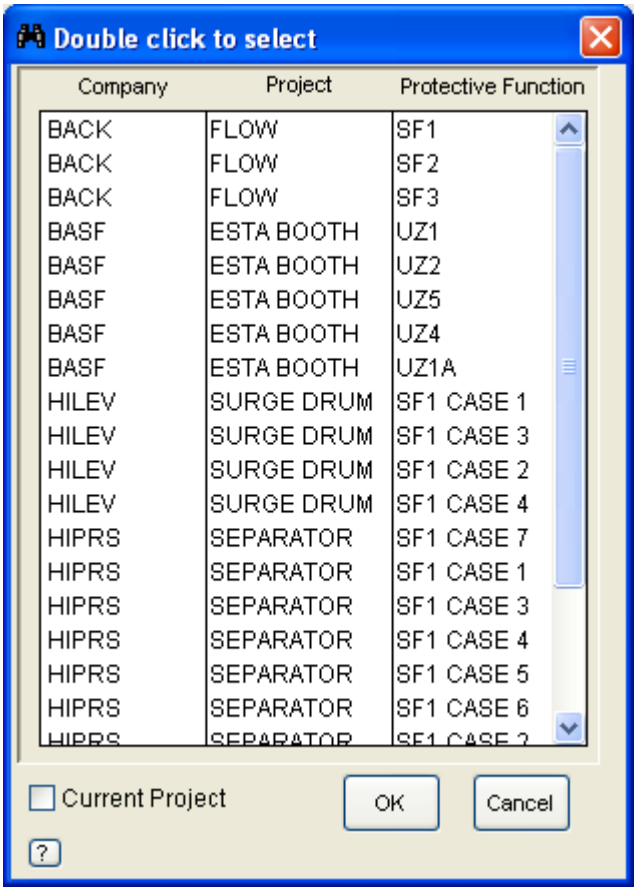


Figure 6. 42 Select Project to Import – Action menu Action 1 only

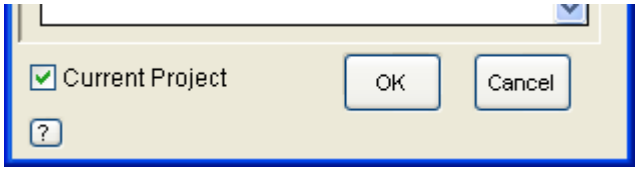


Figure 6. 43 Project Function – Filter Check Box

The import list default is to display all projects in the project folder location. To display the current project protective function(s) only *Click* Current Project box. To return to the import list default uncheck the Current project with a *Click* Current Project box.

You will lose previous entries, if you wait to import. A warning message is displayed as follows:

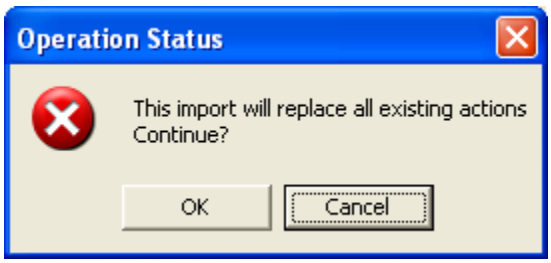


Figure 6. 44 Overwrite confirmation - Action menu Action 1 only

Click OK. Selected project – protective function will be imported.

Click Cancel. Selected project will not be imported.

Common Cause Factor – Action 1 Tab

The common cause factor for inputs is included in the SIL Solver® device database. In contrast, actions built by the user require the common cause factor selection to be entered by the user.

The common cause factor selected with each process action output can be entered into SIL Solver® using the drop down list of common cause factors (beta factors.) SIL Solver® calculates the common cause factor PFD_{AVG} as follows:

$$CCF \quad PFD_{avg} = Common\ Cause\ Factor / 100 * (PFD_{avg}^{A1O1} + PFD_{avg}^{A1A1} + PFD_{avg}^{A1F1})$$

Consequently, the devices that you want utilized in the common cause factor PFD_{AVG} calculation should be entered as subsystem 1. In SIL Solver® common cause factor can be included for each output action. If you wish to consider common cause factor for the overall outputs for the function only, simply select which output subsystem that you want to use for the common cause factor contribution and enter these as subsystem 1 on the associated action page.

Figure 6. 1 Dropdown for selecting common cause factor for the subsystem - Action Tab

ACTION M TAB

The Action M (manual) tab allows you to manually enter data for output combinations. These values may be obtained from separate fault tree analysis or reliability block diagrams.

Add - Manual Entry for Action Architecture

The device ID, tag name, voting, and test interval are entered as text into SIL Solver®. The PFD_{AVG} and STRate must be entered in exponential format and are used in the calculation of the overall results. After completing the fields in the data entry, *Click* Save.

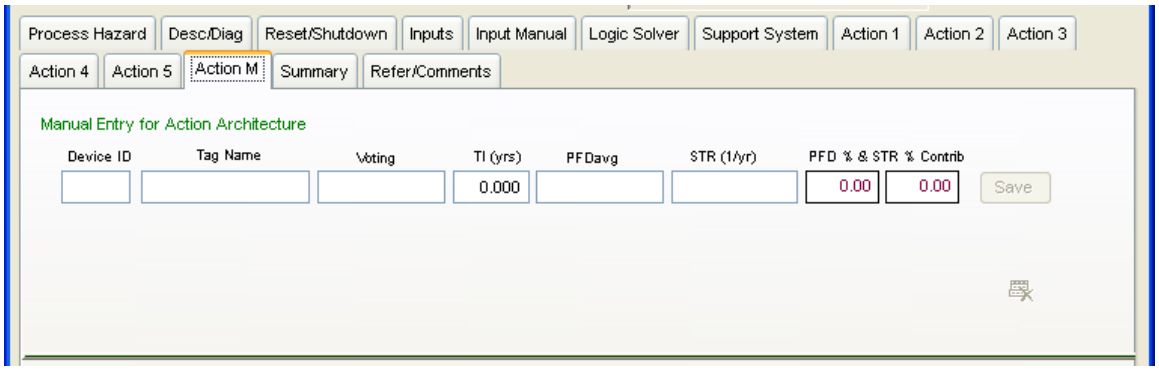


Figure 6. 2 Output Manual data entry View

Delete – Manual Entry for Action Architecture

To delete the Manual Entry for Action Architecture's data, *Click* Delete.

SUMMARY TAB

The Summary tab in SIL Solver® provides an overview of the percent contribution of each subsystem on the overall PFD and STR. This value represents the percentage of the overall PFD and STR that is attributable to the subsystem. When the PIF design does not meet the target initial changes should address the subsystem that has the highest percent contribution. Changes to the test interval, voting architecture, and alternative device selection may be considered. Note that in many cases, the information entered on the Action tabs is the main contributors to the PFD due to

the difficulty of complete on-line testing. The performance of such PIFs can be improved through implementation of means to facilitate on-line testing.

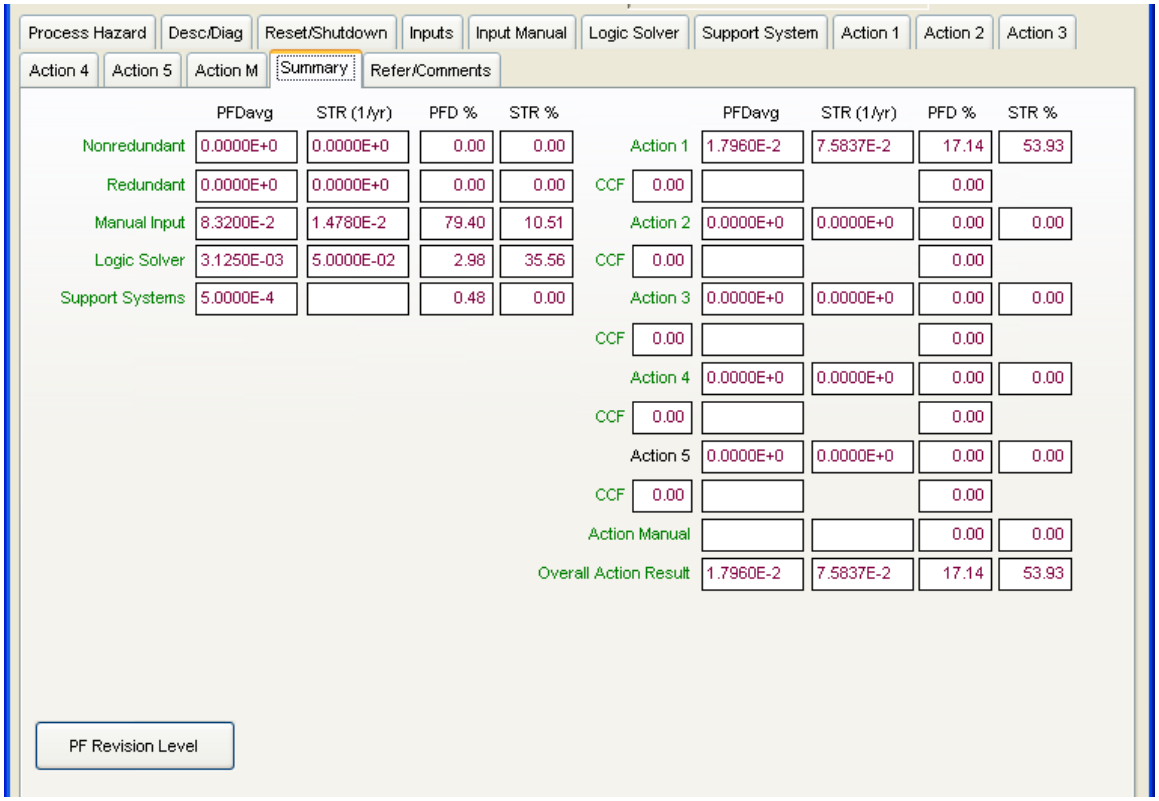


Figure 6. 3 Summary Tab View

Access to Protective Function Revision Level

The summary sheet has a protective function revision level. When this button is selected, a revision control form opens and any modifications can be described with new revision noted. This revision level button opens the same database as the protective function revision level button on the Project Start. The data only needs to be entered in once. The user is provided two points to enter this information for convenience purposes. The current information may be printed at the bottom of the reports. See Section 10 for instructions to completing this documentation.

SECTION 7 ADVANCE PROJECT OPERATIONS

Advance project operations allow the flexibility of cloning an existing project (copy), renaming an existing project (rename), and permanently removing an existing project (delete). Remember that a project to be copied or renamed must have been opened at least once for SIL Solver® to locate the project folders and databases. If not, you will receive a similar message that the project has not been created yet so it cannot be copied. You will be able to copy after project creation. There is a similar message for rename.

Note: the project drop down menu is in the order of most used. If you want to add projects created in another folder, close SIL Solver®, copy the project folder(s) into the project folder location, open SIL Solver® and these projects will auto-connect. For example, copy the project folder from the SIL Solver® directory on User #1's computer project folder location on User #2's computer. Do not use Windows Explorer to copy a project creating two projects or to rename your project or the project folders outside of SIL Solver®. This will result in errors. There is data within each database that links to other database.

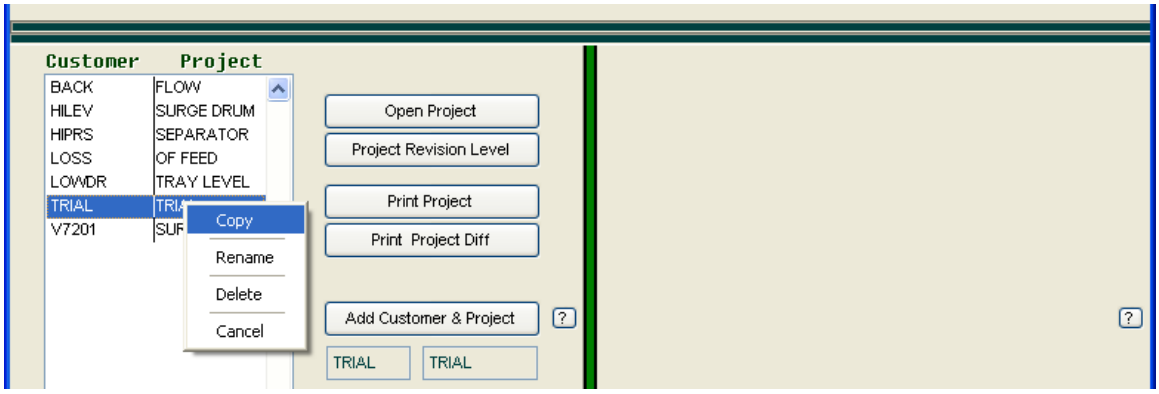


Figure 7. 1 Options: Project menu

Copy – Options: Project menu

Once you have created a project, you may have project with functions that are very similar, or you may want to run cases where you change the test intervals or system configuration on just a few of the inputs or outputs.

From the project list, *Click* a project. *Right Click*. From the Project menu, *Click* Copy.

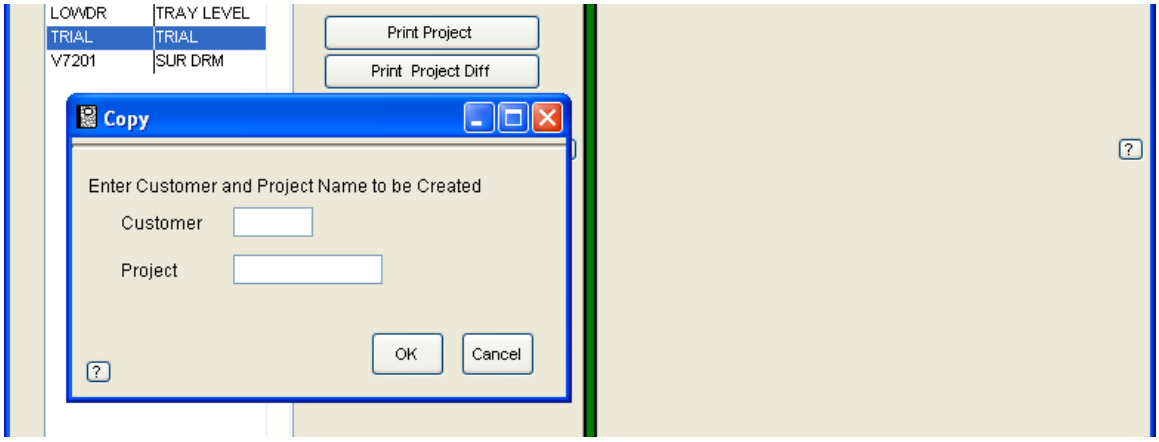


Figure 7. 2 Copy - Options: Project menu

Type in input boxes a new Customer ID Project ID.

See Section 4 Basic Project Operations for requirements. *Click* OK. You have created another project identical to the select project.

To abort the process, *Click* Cancel.

The entered project's name must be unique. If SIL Solver® determines that the project name already exists, the process will be cancelled.

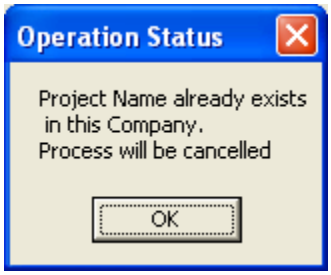


Figure 7. 3 Entered Project Source name not unique

Rename – Options: Project menu

From the project list, *Click* on project. *Right Click*. From the Project menu, *Click* Rename.

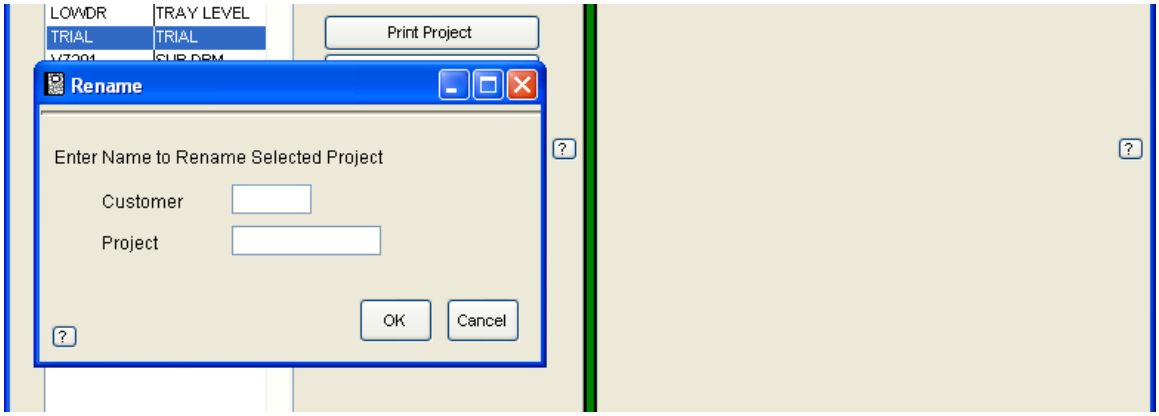


Figure 7. 45 Rename - Project menu

Type a new Customer ID Project ID into the input boxes.

See Section 4 Basic Project Operations for requirements. *Click* OK. You have changed the name of your old project to the entered name. *Click* Cancel. This will abort the process.

The rename project's name entered must be unique. If SIL Solver® determines that the project name already exists, the process will be cancelled. This will abort the process.

Delete - Options: Project menu

From the project list, *Click* on project. *Right Click*. From the Project menu, *Click* Delete.

A warning message will be displayed. This process will permanently remove the folders and all associated databases. These files are not available for recovery. These files will not be in the recycle bin. When delete is selected, it is permanent.

Warning: *Click*ing Delete permanently removes the project. These are not recoverable.

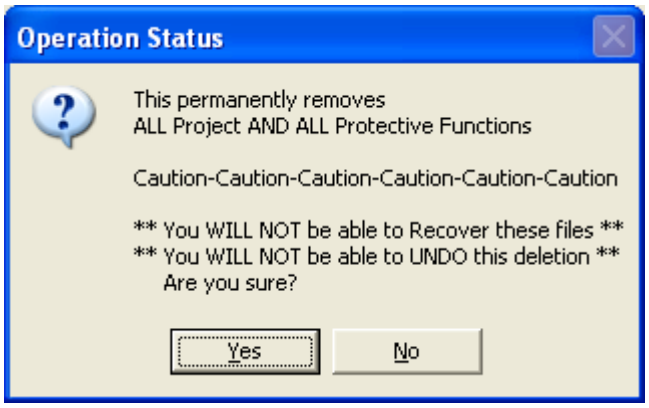


Figure 7. 5 Warning and confirmation needed to Are you sure?

Click Yes to remove this project's databases and protective functions folders. . *Click* No. This will abort the process. Not shown.

Possible problem: If the user creates a folder(s) under a project folder, the project folder or the unknown subfolder will not be deleted by SIL Solver® and a message will be generated. The project list will appear as if the project was deleted, but the next time you open SIL Solver® it will be one of the projects in the project list. Use Windows Explorer to delete this project folder with its contents.

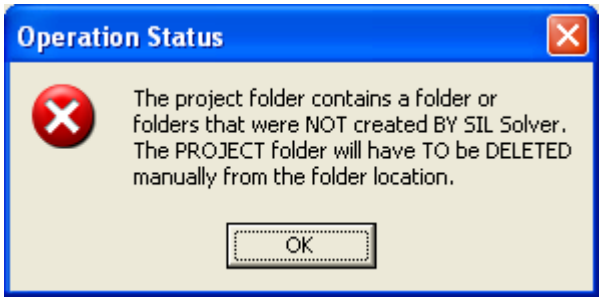


Figure 7. 6 Folder(s) in Project Folder

Windows Explorer may also be used to deleted or move the project folder to different location. Neither will affect SIL Solver® future processing.

SECTION 8 ADVANCE PROTECTIVE FUNCTION OPERATIONS

Advance protective function operations allow the flexibility of cloning an existing function (copy), renaming an existing protective function (rename), connecting a protective function copied into the project folder or one that was previously disconnected, removing from the protective function list (disconnect) and permanently removing an existing function (delete). Remember, a protective function to be copied or renamed must have been opened at least once for SIL Solver to locate the project folders and databases. If not, you will receive a similar message that the project has not been created yet so it cannot be copied. You will be able to copy after project creation. There is a similar message for rename.

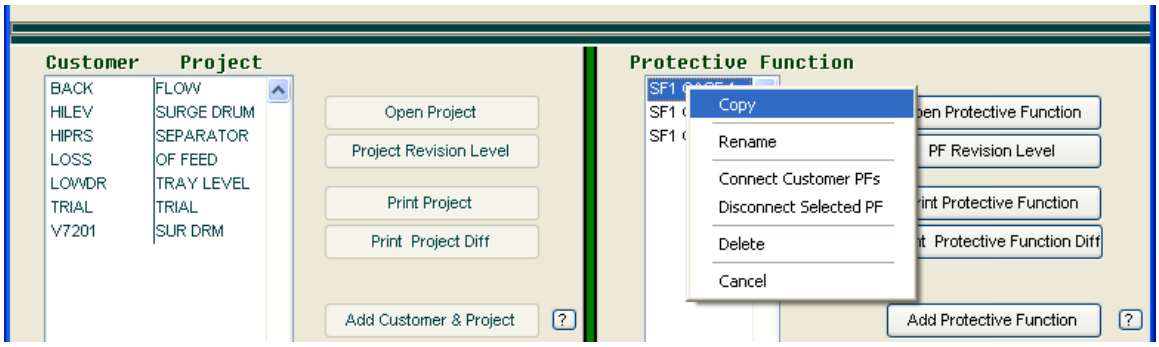


Figure 8. 1 Protective Function menu

Copy – Options: Protective Function menu

Once you have created a protective function, you may have other functions that are very similar, or you may want to run cases where you change the test intervals or system configuration on just a few of the inputs or outputs. There are two short-cuts available for creating these new protective function models:

1. You can create a new function as discussed previously, then follow the instructions to import the protective function documentation, inputs, or actions from another protective function into the one that is open.

2. You can use the copy protective function on the Project Start. This creates an exact duplicate of the original protective function. You can then edit the new function as desired.

From the project list, *Click* a protective function. *Right Click*. From the Protective Function menu, *Click* Copy.

Type the new name for the Protective Function into the input box. See Section 5 Basic Protective Function Operations for requirements. *Click* OK.

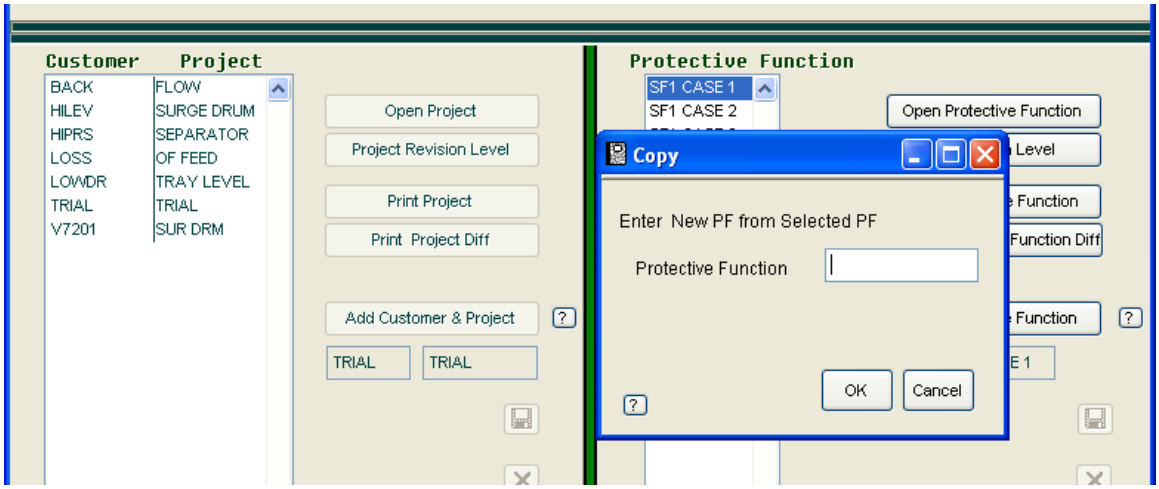


Figure 8. 2 Enter New protective function

Note: The new protective function name that you entered must be unique to this project. If SIL Solver® determines that the protective function name already exists, the process will be cancelled.

Figure 8. 3 New name was found.

Rename - Options: Protective Function menu

From the protective function list, *Click* on the protective function to be renamed. *Right Click*. From the Project menu, *Click* Rename.

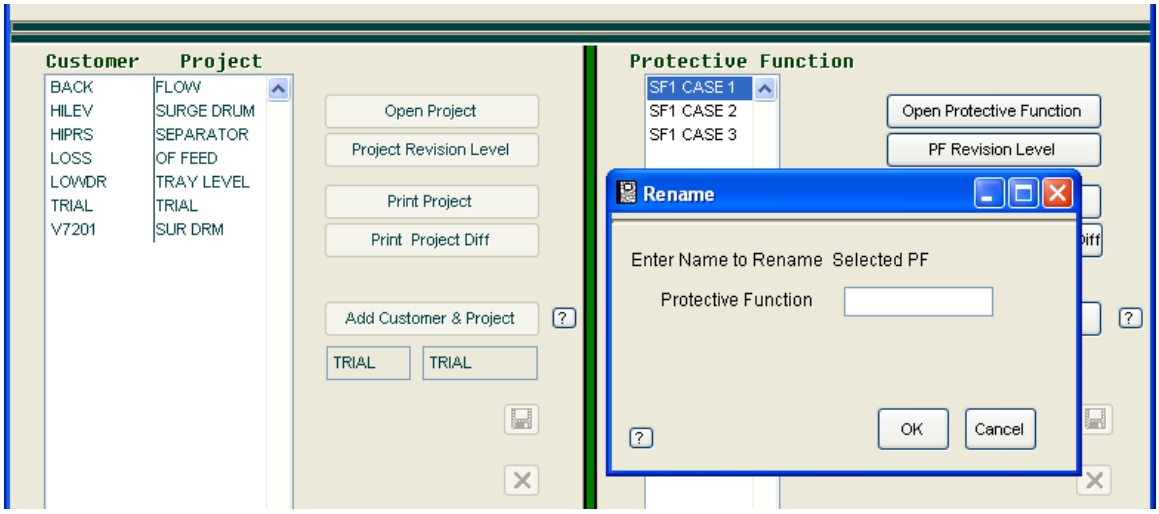


Figure 8. 4 Rename - Options: Protective Function menu

Type a new name into the input box.

See Section 5 Basic Protective Function Operations for requirements. *Click* OK. You have changed the name of your old protective function to the entered name. *Click* Cancel. This will abort the process.

The rename protective function's name entered must be unique. If SIL Solver® determines that the protective function name already exists, the process will be cancelled. The rename process will be aborted.

Connect All PFs - Options: Protective Function menu

Why do you need this? Protective Functions that are currently connected to SIL Solver® are shown in the protective function listing. As you eliminate testing options or cases, you may wish to remove these from the protective function listing to prevent the need to scroll through a long list to find a specific protective function. Or if you have disconnect a protective function because you wanted to print the project without that protective function printing but now want to continue processing. Or, if using Windows Explorer, you have copied or moved a protective function into the project folder location subfolder to one of your projects. For example, copied the protective function folder from the SIL Solver® directory on User #1's computer to the project folder location on User #2's computer. In this example, the same project name is assumed.

From the protective function list, *Click* on protective function. *Right Click*. From the Protective Function menu, *Click* Connect all PFs. All protective function located under the project will be available for processing.

Disconnect - Options: Protective Function menu

To remove a protective function from the protective function listing, *Click* the Protective Function. *Right Click*. From the Protective Function menu, *Click* Disconnect. This process does not delete the folder or tables from the folder; it removes it from the protective function listing only. After

disconnect from the protective function listing, you could reattach the protective function to SIL Solver® by re-entering the Protective Function ID using Connect all PFs.

Delete - Options: Protective Function menu

From the Protective Function list, *Click* on protective function. *Right Click*. From the Protective Function menu, *Click* Delete.

A warning message and confirmation will be displayed.

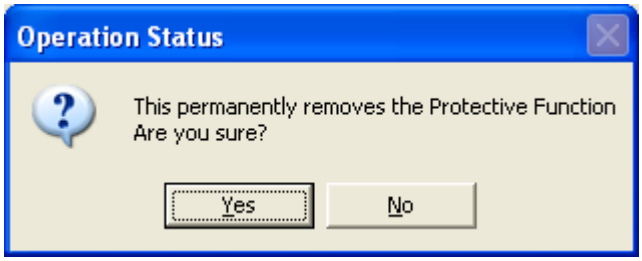


Figure 8. 5 Warning and confirmation needed to Are you sure?

Click Yes will remove the protective function. *Click* No to cancel process and an Aborted message will be displayed. Not shown.

Possible problem: If the user creates a folder(s) under a protective function folder, the protective function folder and unknown subfolder will not be deleted by SIL Solver® and a message will be generated. The protective function list will appear as if the protective function was deleted, but from Windows Explorer you can see the folder or if you use the Connect All PFs, it will be connect as one of the protective function in the protective function list. Use Windows Explorer to delete this protective function folder with its contents.

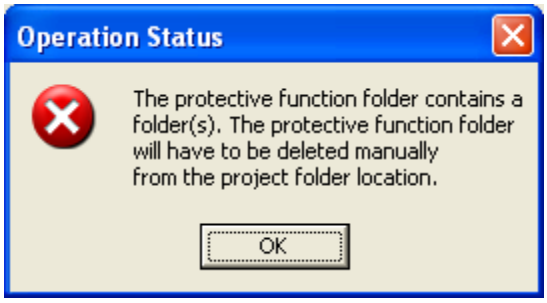


Figure 8. 6 Deletion could not be completed

Using Windows Explorer, you can delete or move the project folder out of the project folder location. Neither will affect SIL Solver® future processing.

SECTION 9 ACCESS TO DATASHEETS

Data Sheets allows you to open the device sheets, logic solver sheets, and support system sheets databases. You also can access these from the Go to the device sheet from Inputs and Action (1-5).

From the Project Start or from the Protective Function screen, *Click* Data Sheets. From the Data sheets menu, *Click* Device Sheets.

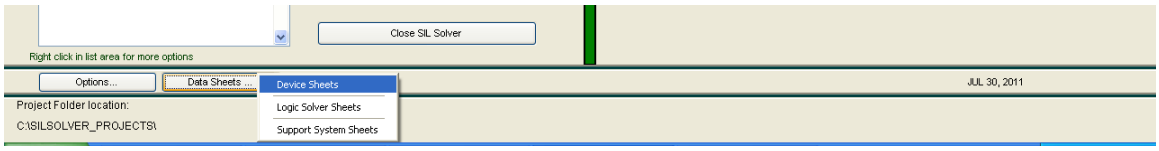


Figure 9. 1 Project Start Data Sheet Access - Options: Data sheets menu

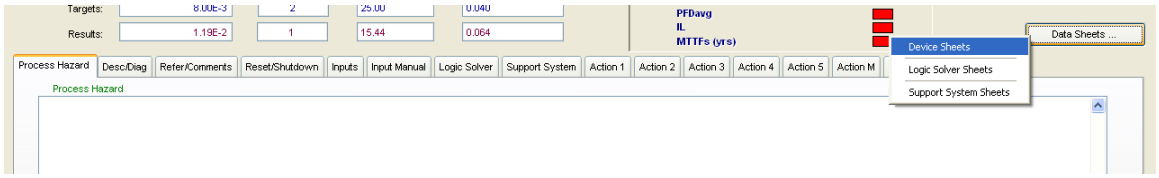


Figure 9. 2 Protective Function Data Sheet Access – Options: Data sheets menu

DEVICE SHEETS

The device sheet database is available. From this screen, you can view the default datasheets, which are tagged as data source SIL, or any device sheets that you have entered into the database. This Device sheet includes a toolbar with icons defined in Section 3. Remember tool tips are available on the icons by running your mouse over them.

Searching for a Device ID – Tool bar

From the toolbar, *Click* Search. When the Search window opens you have the option to sort the devices by Data ID (SVDS) or by Data Source (SRC). *Click* in the area directly above the first column to change sort option. Once you have chosen the sort option you may type the first letter to quicken your search. To sort the devices by Description, *Click* Description. Then use the scroll bar to find the device. *Double Click* on device to retrieve.

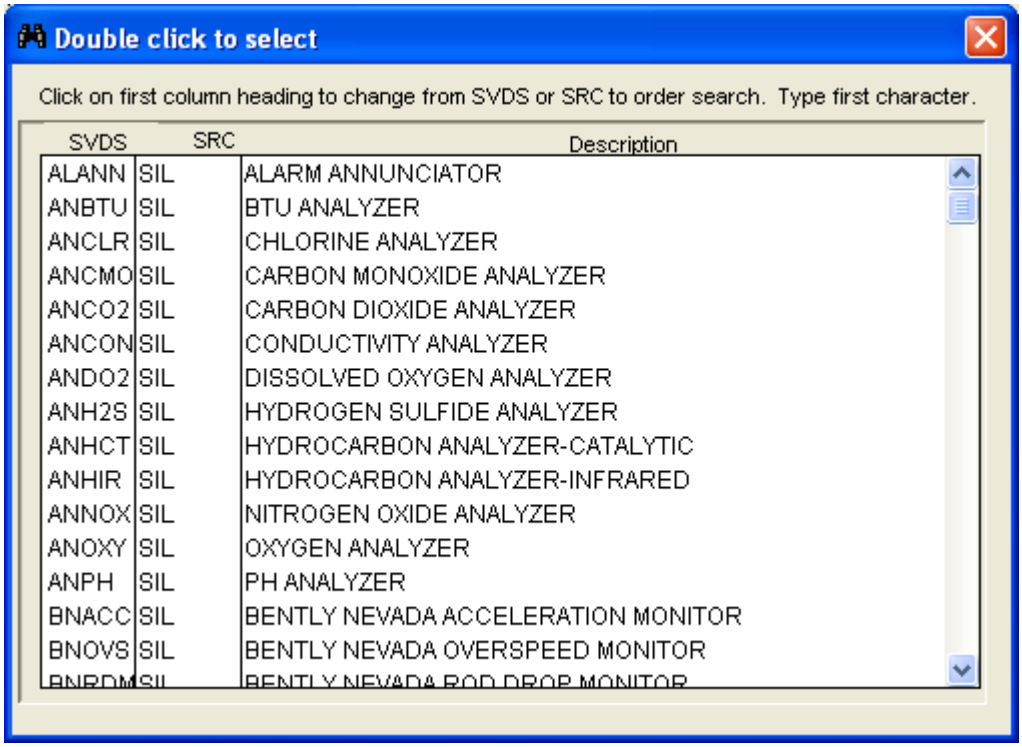


Figure 9. 3 Search for Device datasheet

Or from the toolbar, *Click* Arrows to go to the next data sheet in the database.

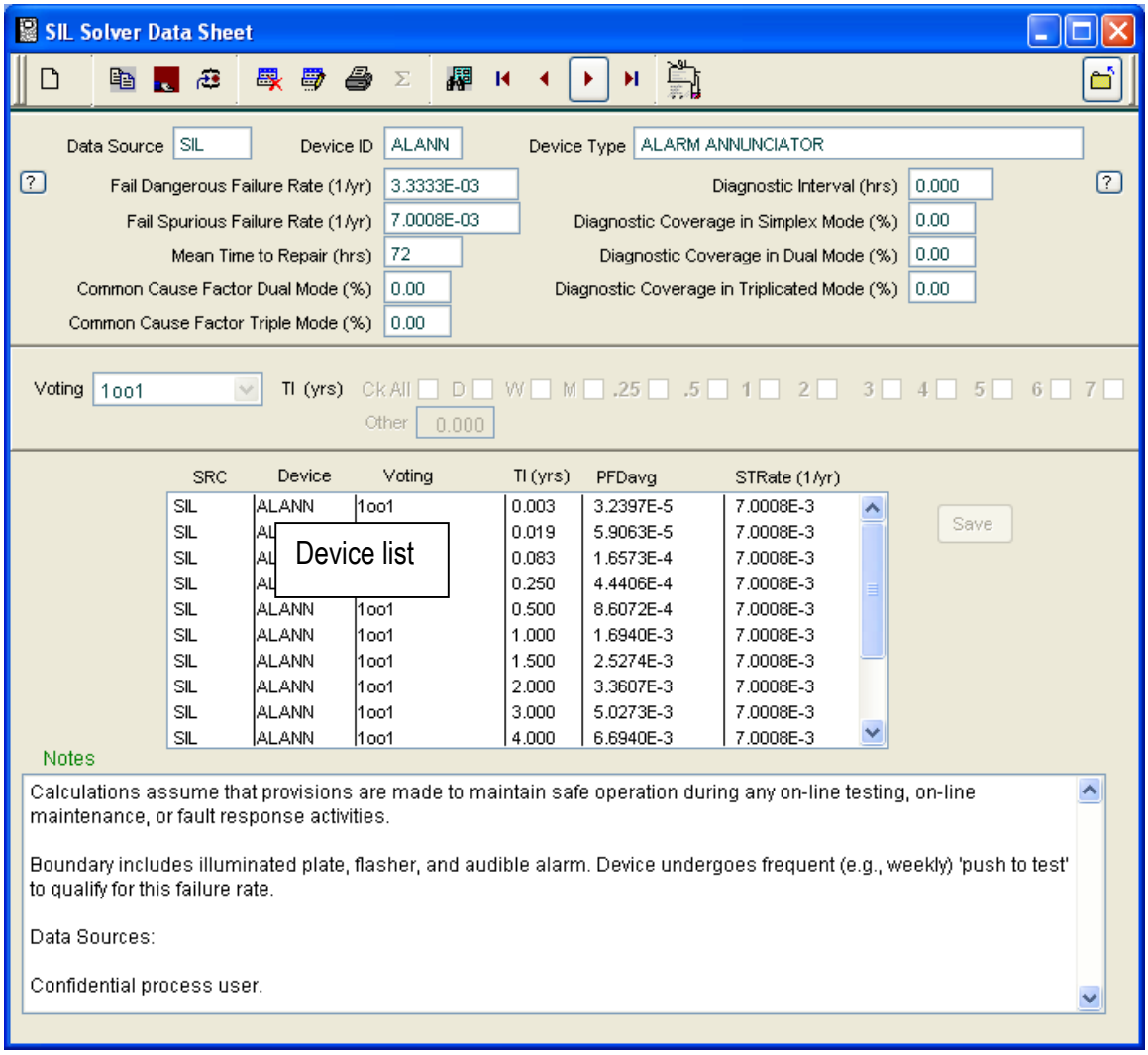


Figure 9. 4 Data Sheet View – Device Sheets

You can add your own projects specific datasheets. Modify or delete is not allowed to any data associated with the default database (Data Source is “SIL.”) If you attempt to make a change, a message will be displayed.

Figure 9. 5 if you attempt to change default data

The authorization level is restricted to prevent unauthorized changes to the default database. This is an administrative function that is not accessible by users. If you receive a message requiring a password, *Click* No.

Figure 9. 6 Project Start

New Data Sheet – Tool bar

Data Sheets can be added to the device sheets, logic solver sheets, and support system sheets. There are two options for user to add a datasheet, New and Copy Device Sheet. Each option has the following steps:

1. Input data and notes
2. Select architecture and test intervals

New option – Input data and notes

Click New

The data source is tagged with the Project Start Customer ID (SRC), however, it can be changed to a generic name for the company projects. The SRC and Device ID input boxes are enabled.

Type 2-5 characters into the second input box, then *Click* OK. The SRC and the device ID are used for the protective function drop down device selection and must be unique from all other datasheets.

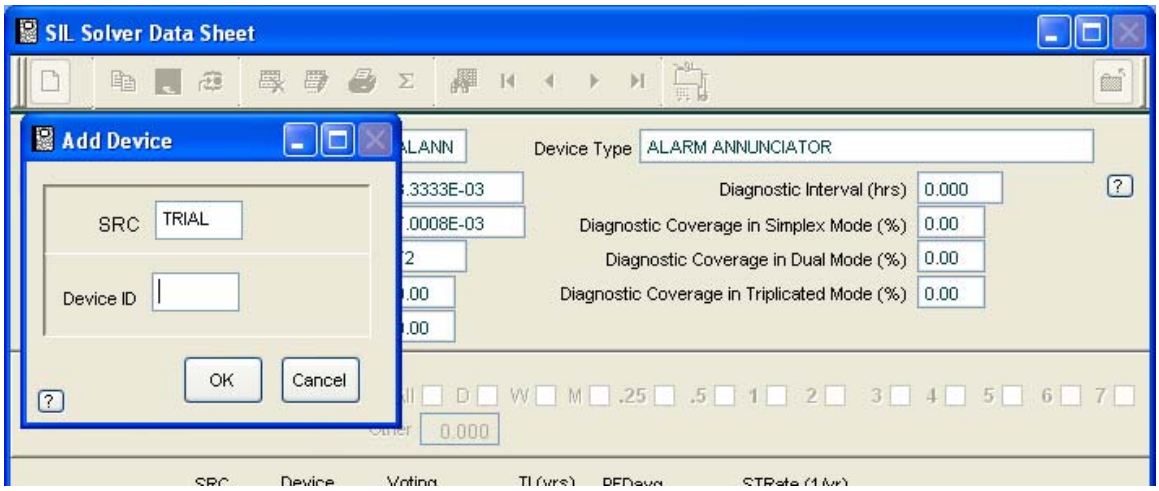


Figure 9. 7 Detail showing how to create the Project Device ID

If the device ID entered exists in the device database, you will receive a warning message that this device already exists. SIL Solver® will then display that datasheet.