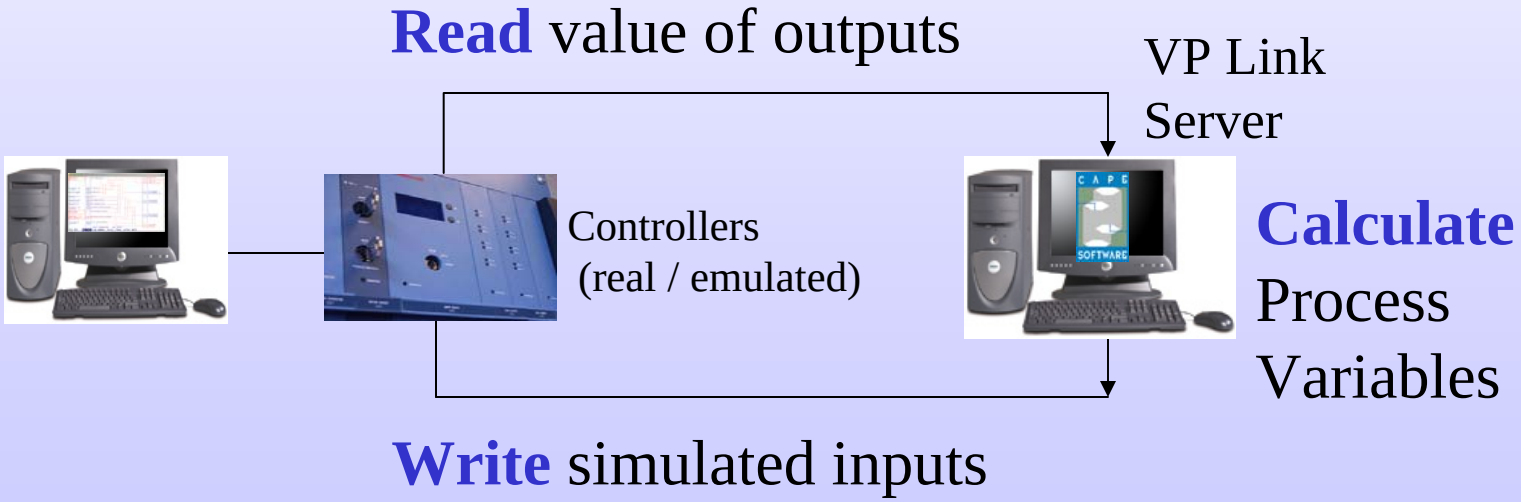
The Virtual Process Overview and Applications

Cape Software Inc.
Houston TX

The Virtual Process Loop

- ✓Read Control Outputs
- ✓Calculate new process states via configured algorithms
- ✓Write new process variables



Supported Systems

- ✓ **Honeywell Experion PKS ,TPS , Honeywell FSC, eXperion Safety Manager**
- ✓ **Honeywell Plantscape / Rockwell ProcessLogix**
- ✓ Foxboro I/A series, Archestra, A^2
- ✓ Triconex:Tricon / Trident / Emulator
- ✓ GE Fanuc series 90
- ✓ A-B PLC5/SLC500,CLX, Modicon,Siemens-Ti 505
- ✓ Siemens APACS, PCS7, S7
- ✓ ABB Mod300, Advant
- ✓ Yokogawa CS3000/R3/ ProSafe
- ✓ Etc...

Some of our customers...

5 steps to Logic Validation with VP Link 3.x

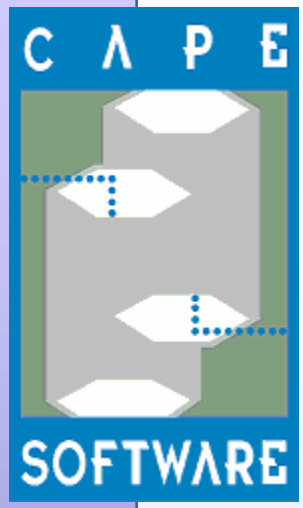
- ✓ Extract the control systems I/O image, using platform specific tools
- ✓ Import the image in VP Link
- ✓ Write training/failure scenarios
- ✓ Connect to ESD
- ✓ Execute validation test (scenario based or manually)

VP Link / FSC Interface Specifics

- ✓ Automated Extraction utility for *up to date I/O database image for running periodical tests*
- ✓ Fast *FSC interface* using RS485 or RS232
- ✓ Writes to Real Inputs or com points locations for exhaustive testing (DCS resets etc…)
- ✓ Utilization of *non-modified actual Control Program*

VP Link / Safety Manager Interface Specifics

- ✓ Automated Extraction utility for *up to date I/O database image for running periodical tests*
- ✓ Fast *Ethernet interface* ,allowing total turnaround time lower than 300ms(depending on system load)
- ✓ Writes to Real Inputs or com points locations for exhaustive testing (DCS resets etc…)
- ✓ Utilization of *non-modified actual Control Program*



HSF Interface Details

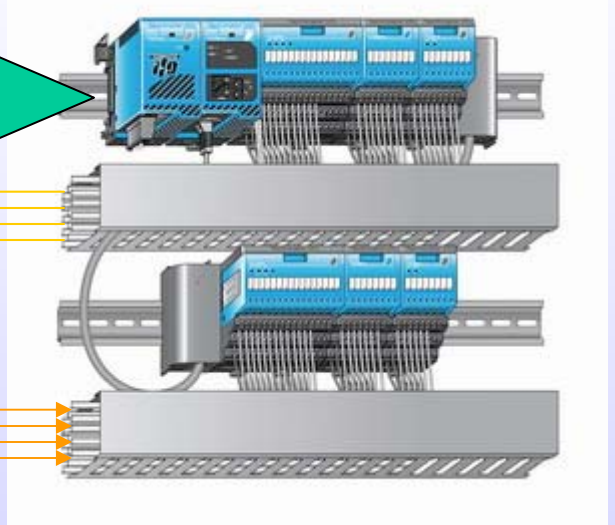
- ✓ Automated Extraction for easy setup and match with terminator I/O modules, based on Honeywell hardware arrangement
- ✓ Direct stimulation of Honeywell field terminator assembly (FTA)
- ✓ No change/modification to the application

Hardware Interface (TSF) Overview

VP Link Workstation

VP Link I/O Modules

Ethernet



Write Inputs

Read Outputs

FTA

Hard Wires

MMI or Builder Station

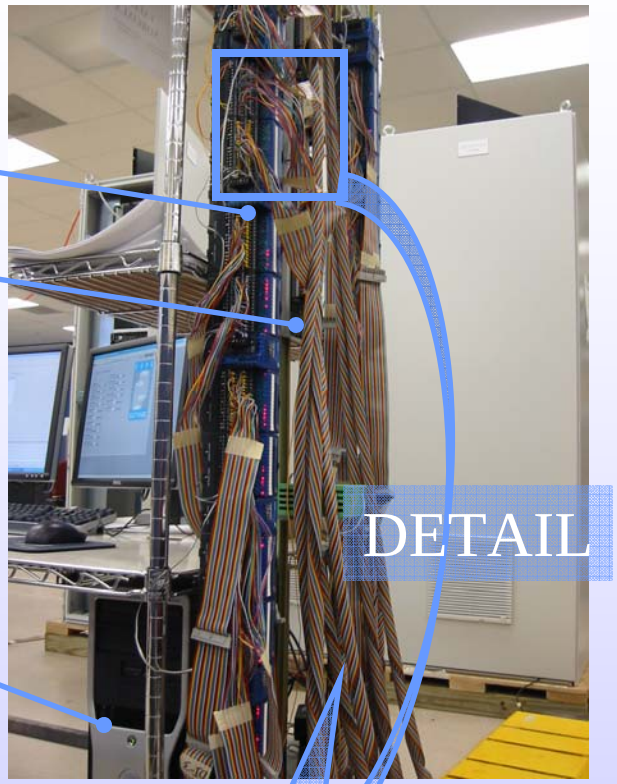
Ethernet Communication

Client Staging floor setup

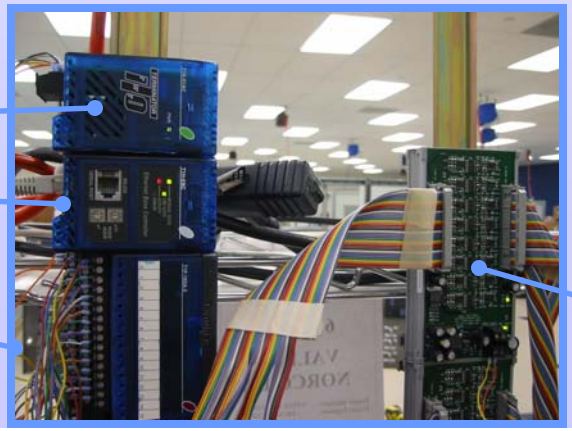
Terminator IO

Signal conditioning boards

VP Link workstation



DETAIL



Power supply

Ethernet Module

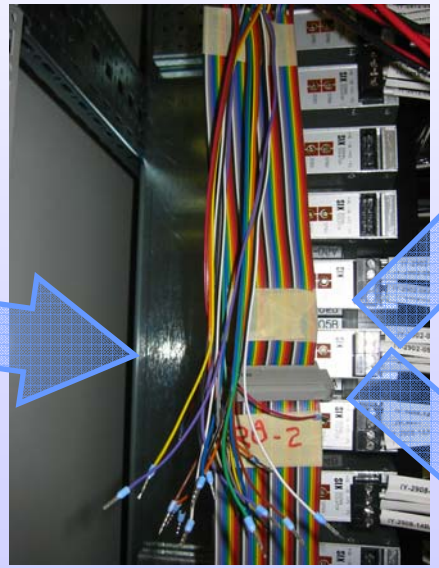
Terminator IOs

Signal conditioning boards

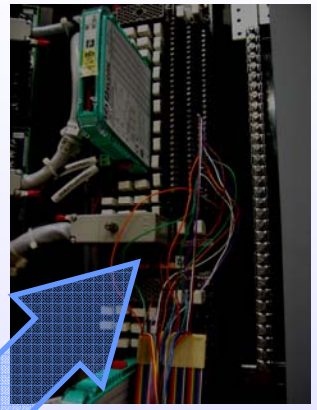
Connection to SIS FTA

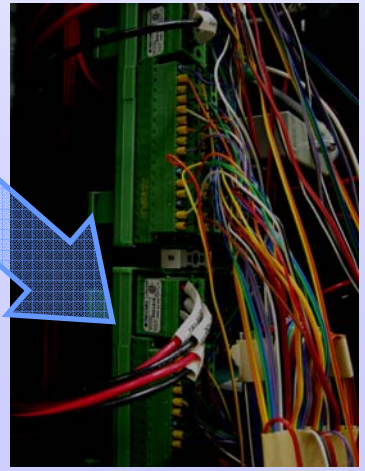
Simulation Cart

Terminated
Ribbon Cable

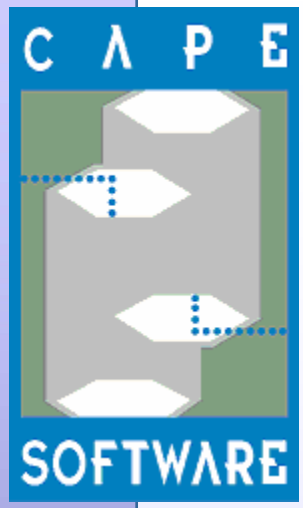


AI Fieldbus FTA





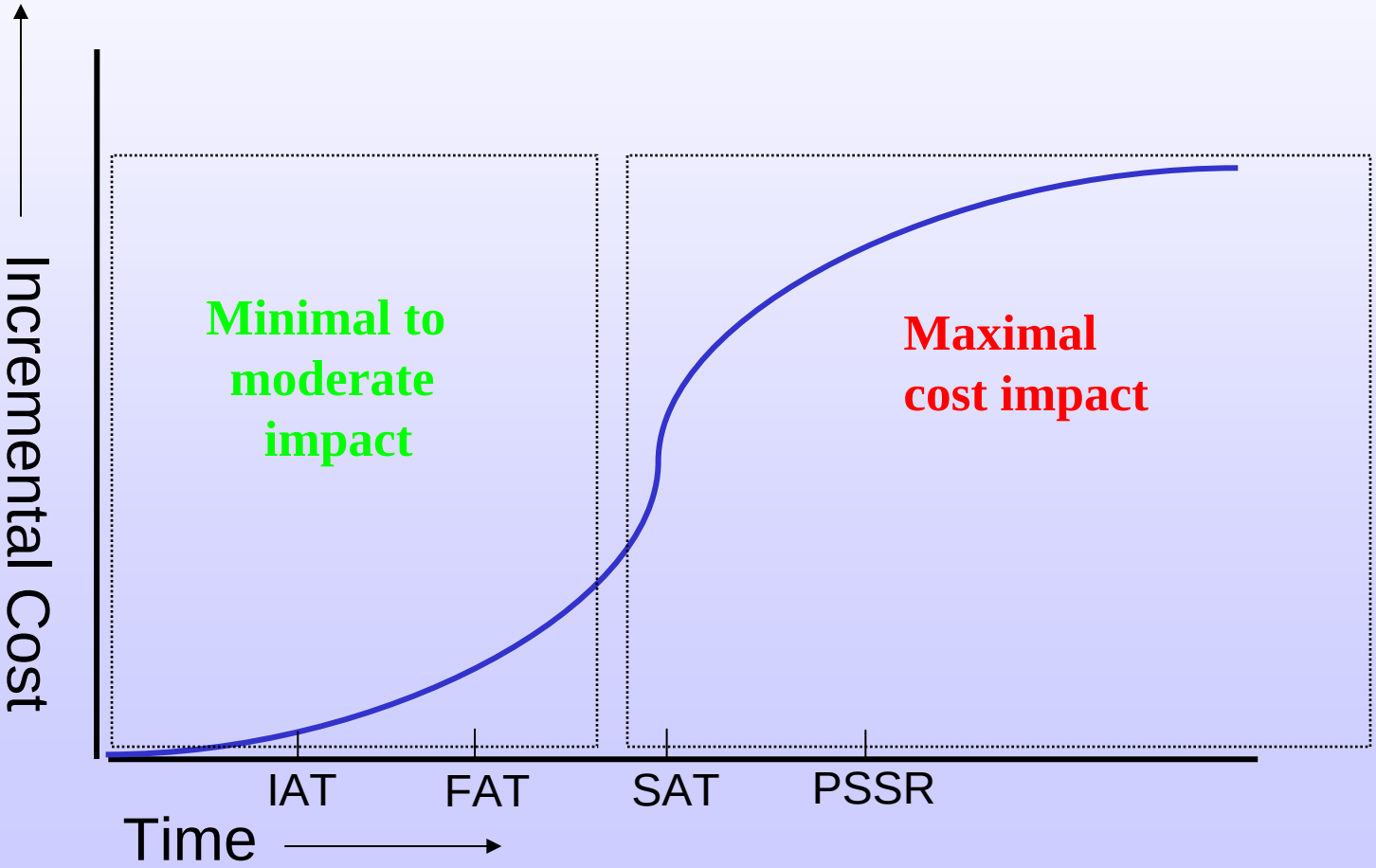
DI FTA



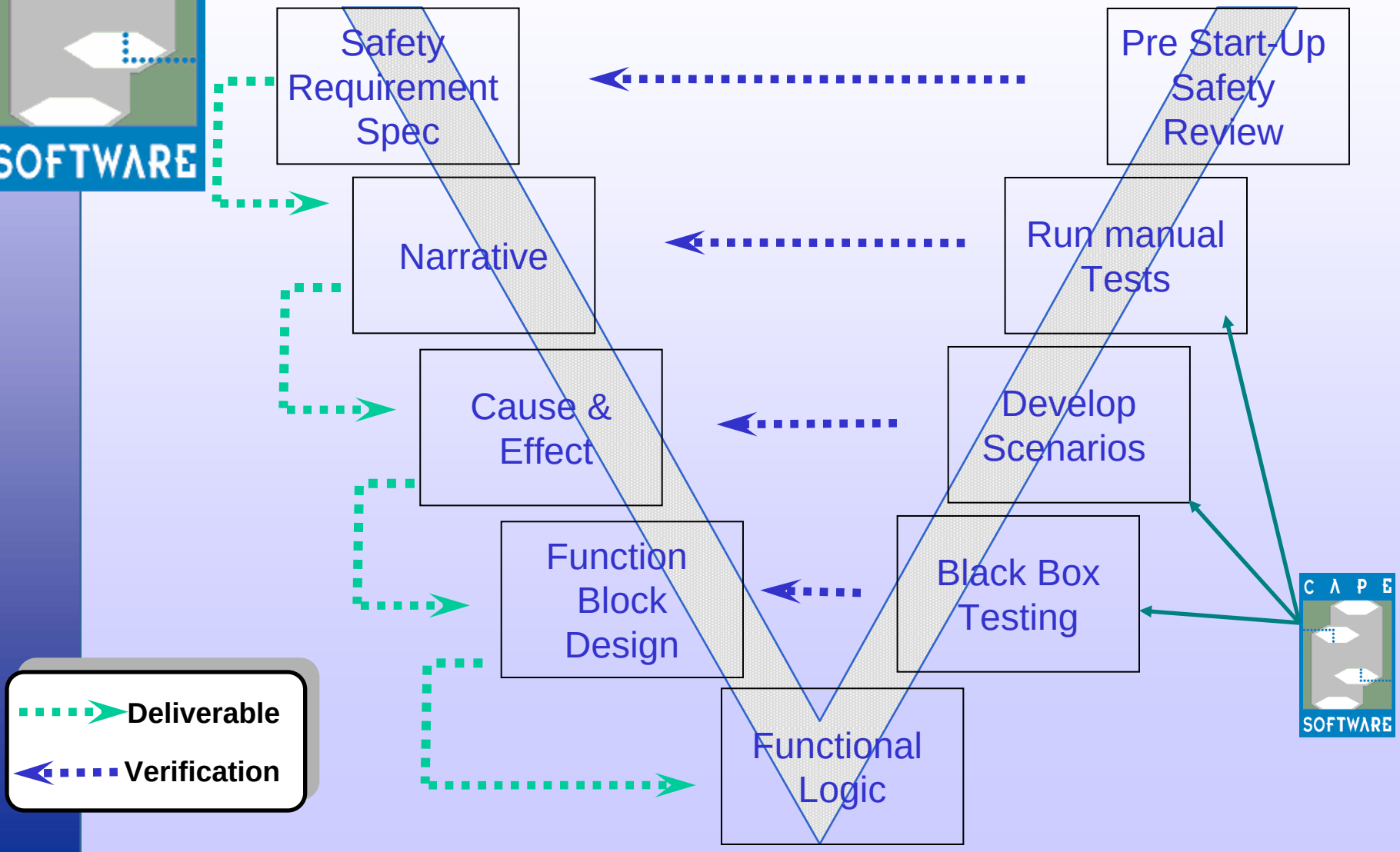
VP Link Applications

Logic Validation

Cost of changes over a typical project development cycle



V-Approach methodology: application to validation

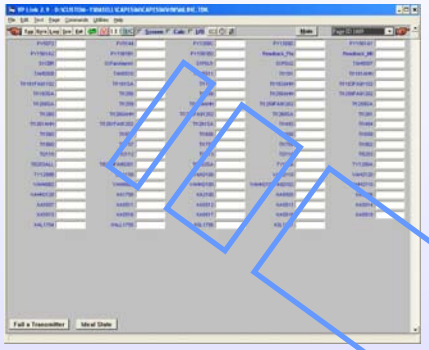


Logic Validation with VP Link

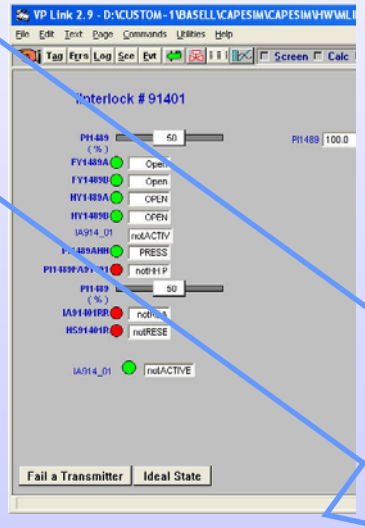
- ✓ VP Link Allows:
  - ✓ Graphics verification
  - ✓ Logic checkout at I/O / block / module / system level
  - ✓ Interlock schedule approval
  - ✓ Integrated Testing :Mapping to DCS and interaction between DCS/PLC logic (gateway points tests)
- How ?
  - Automates repetitive testing task (ie resets etc…)
  - Facilitates FAT with customized graphics
  - Collaborative testing framework thru distributed architecture
- Thoroughly debug prior to online download, ie, Management of Change and periodical testing
- **Test Compiler complies with IEC61508/61511**

Simulation Screen shots

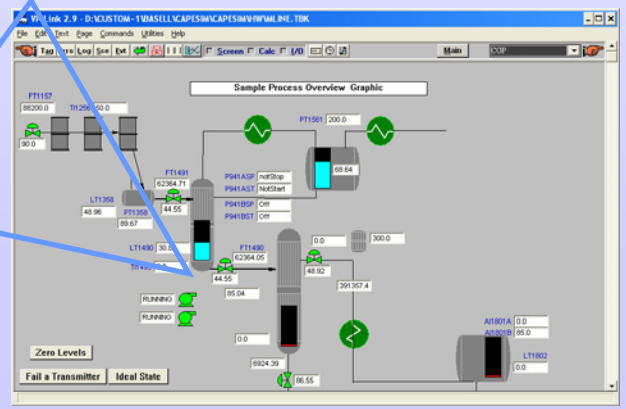
Automated Tag sheet



Input/Output sheets per ESD



HMI for advanced testing or training



OSHA 29 CFR Part 1910

Emergency Shutdown systems :

Document each inspection and test, including:

-Date of test

-Name of person who performed the test [..]

-Description of test results

IEC-61511-1

16.3.1.1: Periodic proof test shall be conducted using a written procedure to reveal undetected faults

Our Answer ?

Test Compiler

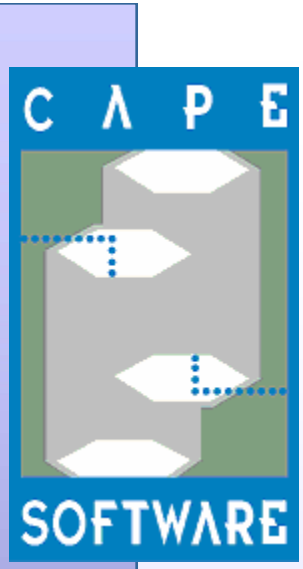
IEC-61508

Part 1,7.18: Information on the verification activities shall be collected and documented as evidence that the phase being verified has, in all respects, been satisfactorily completed.

Part 1,7.14 :Documentation for validation shall include:

-Activities in chronological order

-Discrepancies between expected and actual results



VP Link Test Compiler

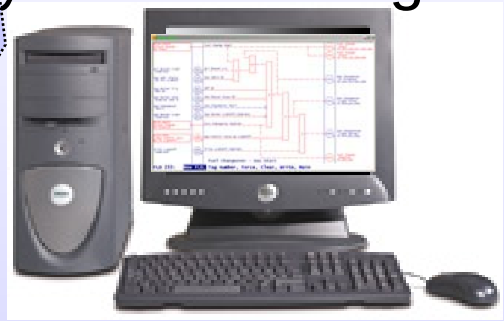
- ✓ Generates Test Scripts, using an Excel front-end
- ✓ Scripts Based on Customer Test Plan and Functional Specifications
- ✓ A Script is a stand alone entity that:
  - Forces inputs to a specified State
  - Compares the outputs to an expected state table (Cause and Effect Matrix)
  - Logs errors to HTML format
- ✓ Runs and documents entire test plan unattented
- ✓ **Results Summarizer** utility
- ✓ **Scenario Template** Generator

Application to Integrated Testing of Distributed Program

DCS

SIS MMI

or Safety Builder/Navigator



Force

Validate

FSc or Safety Manager Chassis

TC Master Document

- Similar to a Cause and Effect Matrix
- Copy and paste from original C&E
- Verify ALL outputs change
- Scripting keywords for maximum flexiblity

		tag/label	setpoint/value	pre delay	post delay	post execute	output1	output2	output3	output4	output5
start scenario	SCENARIO	AProcedure.sct									
	OUTPUTS						<output01>	<output02>	<output03>	<output04>	<output05>
Initialization	DISABLE	<input01>,<input04>									
good signal value	SET	<input01>	819								
bypass is not restricted	OFF	<input04>									
error alarm reset button pressed	ON	<input05>							0		
	SET	TAG_01	0								
	GOTO	:WATCH_TAG (<output03> == 0)									
	ON	<input06>									
	LABEL	:WATCH_TAG									
	PAUSE	1					<input03>	<input03>	0	0	0
Test Start	SET	<input01>	4095				<input02>	<input02>			
	SET	<input01>	700								
	SET	<input01>	750								
	ON	<input05>									
	SET	<input01>	819								
	ON	<input06>							1	1	
	PAUSE	(<input07>.pve -3)								0	
	PAUSE	3								1	
	ON	<input06>							0	0	
	ON	<input04>									1
	ON	<input06>							0		
	ENABLE	<input01>,<input04>,<input05>,<input06>									
end scenario	END										

Test Compiler output (1): Documentation

HTML Test description

Source

D:\tb40\Books\Refinery\BMS.xls[templates]

Documentation created: Jun 19, 2003 at 13:08
Source File: D:\tb40\Books\refinery[template] last modified Jun 19, 2003 at 13:03

History

Purpose:

This scenario will: Start Heater Purge and Verify Purge Completion

Database

VP Database:

This scenario is designed to run with the database in refinery_5.cfg. Click on these links for the list of input and output tags. If this scenario was built from a template, then the tags will be listed, but they will be marked as "not found".

Global Parameters

Defaults:

The standard delay inserted before values are checked is 0 seconds for this scenario. The relative tolerance used in the test for equality is 0.002 %. Values in SET_HI and SET_LO commands are set 1 units above or below the alarm value specified in the Excel sheet.

Scenario Steps

Scenario Actions:

…
… Turn i17HS0669B OFF, Field Trip for Heater

Line 4(Row 6): Set i17HS0669B to the OFF state. Set i17XSC1971 to the OFF state. Wait for seconds beyond the standard delay before continuing.
Line 5(Row 7): Set i17HS0669B to the ON state. Set i17XSC1971 to the ON state.
… Get Heater Ready to Purge
… Set Level i17LT1641 to 10
Line 8(Row 10): Set i17LT1641 to 10.

ETC….

Test Compiler output (2): Test Logs

Scenario Log Sample

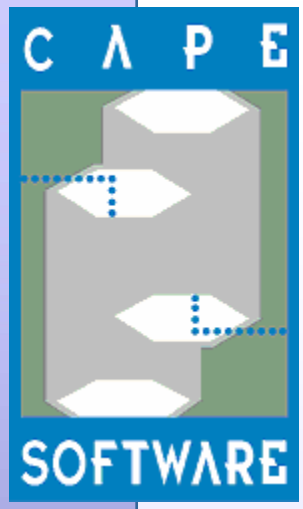
Time stamps

Assertion passed

Assertion Failed

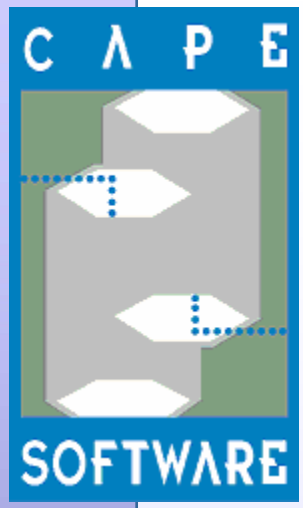
```
0          Starting test 'D:\TB40\BOOKS\FLINT\PLC5\H1_BRNR.SCE'
           at Wed May 28 18:23:48 2003
 1181      # …
 1181      # … 17H-1 Start Main Burner Sequence
 1181      # … Satisfy and Reset Fuel Gas Trip
 1181      # … Turn i17HS1964, i17HS1964A ON to Satisfy FG Trip
 5397      # … Turn i17HS1964RST ON to Reset FG Trip
 9614      # … Turn i17HS1923 ON to Start Main Burner
13830      # Test at line 10 of 'H1_BRNR.SCE'          ON   i17HS1923
13830       Verification <i17XY1904> = 1.000000 passed
13830      **Verification <i17XY2419> = 1.000000 FAILED Value is 0.000000
13830        Verification <i17YL1906> = 0.000000 passed
13830        Verification <i17XY1907> = 0.000000 passed
13830        Verification <i17YL1921> = 0.000000 passed
13830      # …
13830      Closing test log after 0 mins 13.8 secs at Wed May 28 18:24:02 2003

   0       Starting test 'D:\TB40\BOOKS\FLINT\PLC5\H1_BRNR.SCE'
           at Wed May 28 18:26:34 2003
 851       # …
 851       # … 17H-1 Start Main Burner Sequence
 851       # … Satisfy and Reset Fuel Gas Trip
```



Conclusion

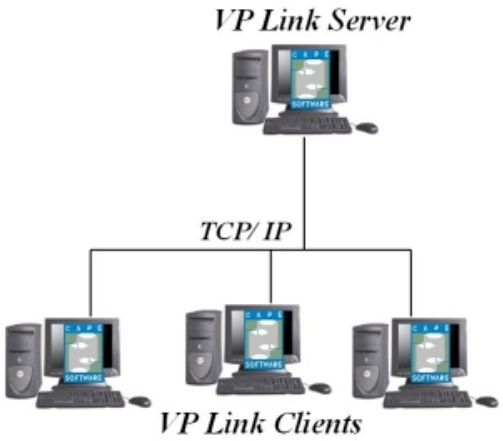
- ✓ VP Link solves simulation needs from *simple to sophisticated* modeling in a continuous fashion
- ✓ OTS node can used as an engineering Test Bed system for *preventive / periodical logic validation*
- ✓ *Unattended Real Time* trainee performance logs
- ✓ Modeling environment is *flexible, easy to learn and maintain*
- ✓ *Lowest Total Cost of Ownership* thanks to a non-invasive, I/O based simulation
- ✓ *Cost Effective* simulation package for *OTS And Validation*, using Off the Shelf components
- ✓ *Cross platform* functionalities makes VP Link a *durable* , *portable investment*



Backup Slides

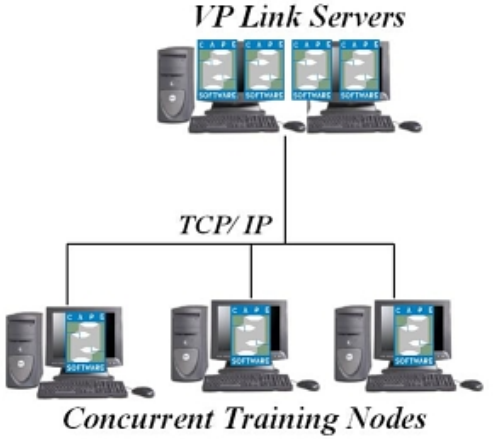
Different Architectures for different Applications

Integrated Training or FAT Setup



Trainees operate different units, interacting with each other

Parallel Training Setup



Trainees operate identical units, in parallel

Summary:
HSF Equipped staging floors

- ✓ Standardized simulation carts
- ✓ Off the shelf terminator I/O components
- ✓ Total implementation time per project : 20-40 hrs depending on fidelity level
- ✓ Advantages for Integrator:
  - Reproducible (reliability)
  - Exhaustive (quality)
  - Interactive (improved testing speed)
  - Integrated (quality)
- ✓ Advantages for Customer:
  - All the above
  - Reusable testing interface (IEC 61511)
  - basic operator training / option for rigorous model