

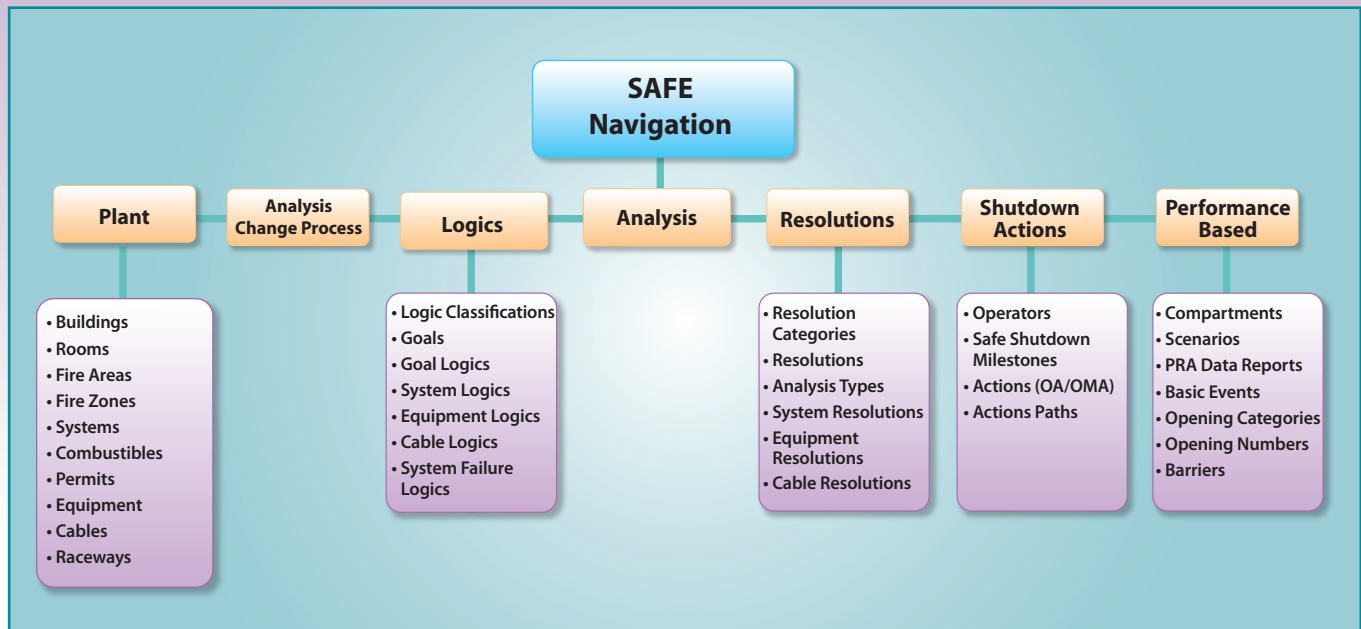


The Genesis® System Assurance and Fire Protection Engineering (SAFE) module automates plant-system failure analysis by evaluating the failure consequences of systems, equipment, and cable support relationships. This model is success path-based. SAFE maintains this success path model, including equipment, cable location, and resolution data.

SAFE is developed to automate the regulatory compliance analysis required by:

- 10 CFR 50 Appendix R
- NFPA 805 Performance-Based Analysis
- Fire PRA, NUREG/CR-6850
- Non-Power Operations
- Multiple Spurious Operations, RG 1.189

SAFE supports fire PRA models using dedicated reporting of individual fire events that report direct fire failures. These reports can directly input to PRA software such as CAFTA® or WinNUPRA®. The PRA code calculates the CCDP/CLERP for the fire, given the set of unavailable equipment.



System Features

Analysis Model

- Systems supporting performance goals
- Equipment supporting plant systems
- Equipment supporting equipment
- Cables supporting equipment
- Systems supporting equipment

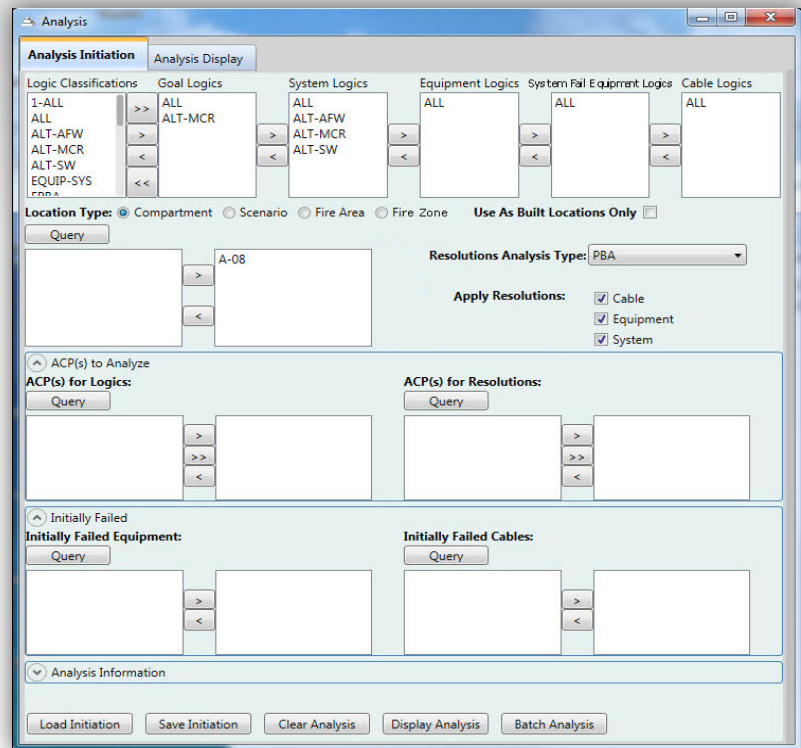
Automated Analysis

The analyst can identify the failed cables and equipment in the evaluation area and determine the effects of those failures by propagating the failures through the success paths defined in the analysis model.

Analysis Change Process

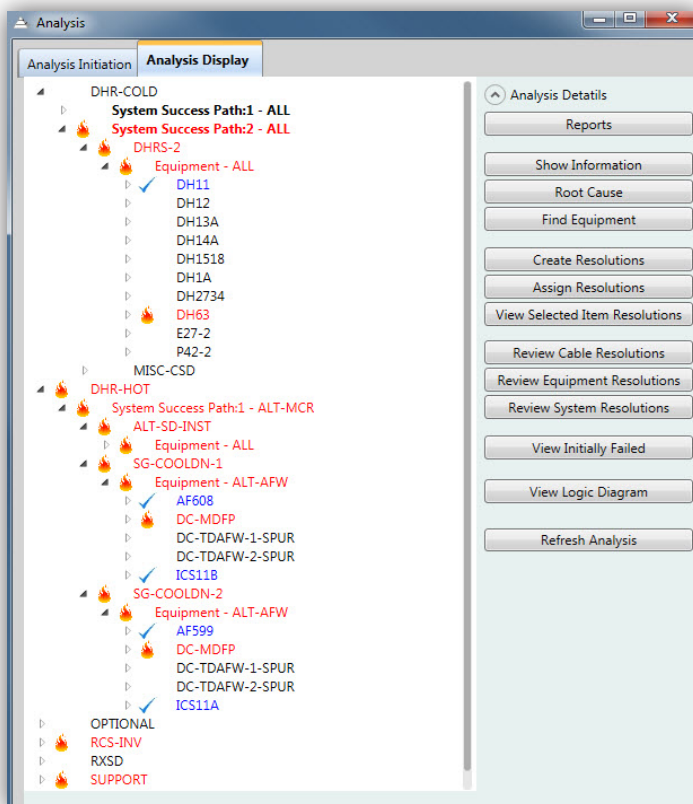
SAFE will track and manage the revision of the analysis model using the Analysis Change Process (ACP). What-if analyses will be performed by placing portions of the analysis model into the revised plant design state.

Automated status updates will be provided based on electronic signatures for the preparer, reviewer, and approver. Electronic history files are automatically created and viewable from within SAFE.



What-If Analysis

The analyst can postulate changes and evaluate the results without affecting the database analysis of record, thereby maintaining data integrity during the evaluation. The what-if scenario feature allows the analyst to postulate a particular set of equipment and cables to be considered as failed by the analysis.



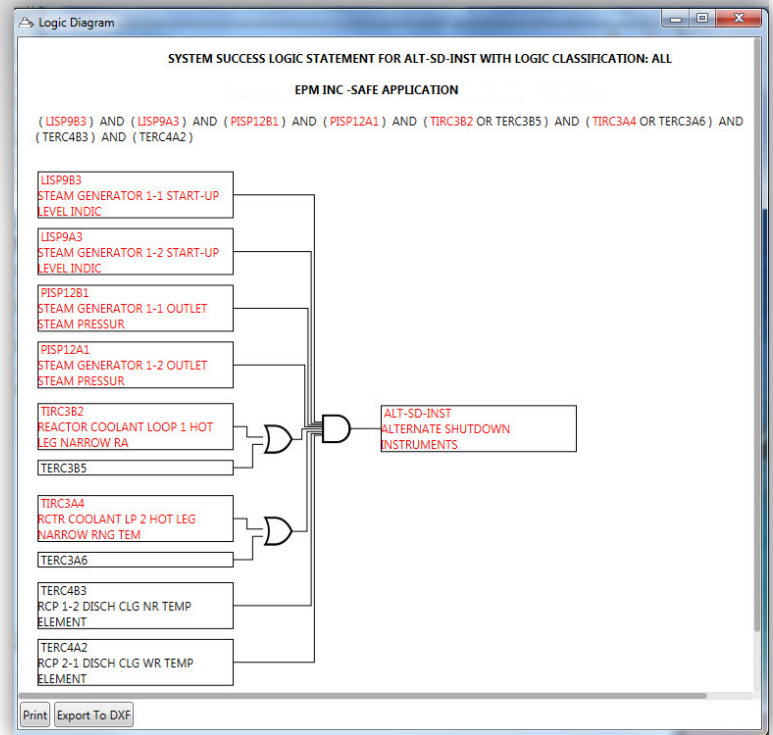
Analysis Results

SAFE's hierarchical tree view displays the analysis model by success path, and the post-fire status of all components and their support success paths. To distinguish between failed and unaffected components within the analysis tree, failed components are displayed in red text. The analyst uses this information to develop and assign resolutions to system, equipment or cable failures, thereby crediting their performance. When an analysis is displayed (or refreshed), resolutions prevent failure of the resolved items. SAFE provides an analysis review form for evaluating the contribution of a resolution to the analysis. SAFE displays resolved components in blue text.

Analysis Reporting

SAFE allows the user to generate the following reports:

- **Analysis Summary**
- **Analysis Failure**
- **Success Paths and Boolean Statements Reports for all Goal, System, Equipment, Cable and System Failure Logics**
- **Logic Diagrams**
- **Component and Cable Data Sheet**
- **System, Equipment and Cable Resolutions by Analysis Type or Location**
- **Level II Reports**
- **Basic Events**
- **PRA Data reports**
- **Cable Block Diagrams**
- **Analysis Dashboard**
- **Actions Timelines**



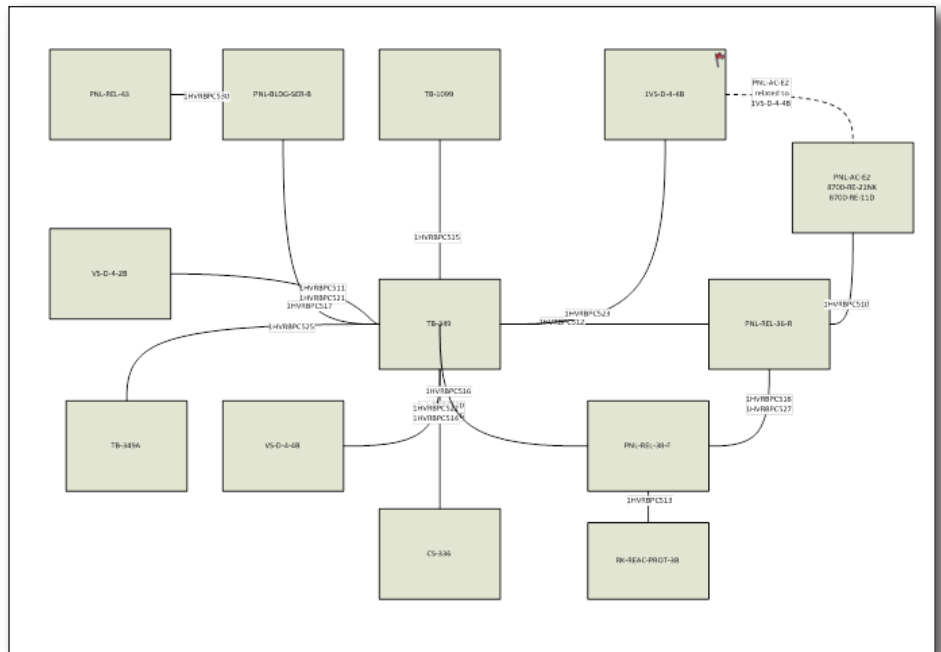
Cable Block Diagrams

SAFE automatically generates Cable Block Diagrams in Microsoft® Visio® format to provide a visual display of connected equipment, parent equipment, cables, and associated documents. SAFE Cable Block Diagrams can be edited by the user.

The Analysis Summary Report

The analysis summary report provides a detailed representation of the area being analyzed. This report provides post-fire statuses for all modeled performance goals, systems, equipment, and cables.

The analysis summary report includes a detailed analysis of causes for each failed performance goal, system, equipment and cable. Failure presentation details support components associated with equipment failure, such as electrical equipment failure and/or cable failures.



UNIT 1 STATUS				
Nuclear Safety Performance Criteria	DECAY HEAT REMOVAL	INV & PRESS CONTROL	PROCESS MONITORING	VITAL AUXILIARIES
Performance Goals	1-DHR-CONT 1-DHR-RPV	1-INV-PRESS-LONG TERM 2-INV-PRESS-SHORT TERM	1-PROCESS_MON	1-VITAL-AUX
Plant Systems	SHUTDOWN COOLING LOOP A SHUTDOWN COOLING LOOP B SHUTDOWN COOLING LOOP C SHUTDOWN COOLING LOOP D SUPPRESSION POOL COOLING A SUPPRESSION POOL COOLING B SUPPRESSION POOL COOLING C SUPPRESSION POOL COOLING D RHR LPCI A RHR LPCI B RHR LPCI C RHR LPCI D RHRSW A RHRSW B RHRSW C RHRSW D ALT SHUTDOWN COOLING BYPASS MAIN STEAM RELIEF VALVES SUPPRESSION POOL DRAIN DOWN	CORE SPRAY LOOP A CORE SPRAY LOOP B CORE SPRAY LOOP C CORE SPRAY LOOP D RHR LPCI A RHR LPCI B RHR LPCI C RHR LPCI D RCIC RCIC RPV ISOLATION MSRV Inventory Concerns HPCI-CST-DRAINDOWN HPCI-OVERFILL RCIC-CST-DRAINDOWN RCIC-OVERFILL	DRYWELL PRESSURE DRYWELL TEMPERATURE RPV LEVEL RPV PRESSURE S.P. LEVEL S.P. TEMPERATURE RPV Instruments RPV LVL-A RPV LVL-B RPV PRESS-A RPV PRESS-B	CB HVAC TRAIN A CB HVAC TRAIN B EECW TRAIN A EECW TRAIN B EB ROOM HVAC DW NITROGEN AC Distribution SHUTDOWN BUS 1 SHUTDOWN BUS 2 4KV SHUTDOWN BD A 4KV SHUTDOWN BD B 4KV SHUTDOWN BD C 4KV SHUTDOWN BD D Emergency Power DIESEL GENERATOR A DIESEL GENERATOR B DIESEL GENERATOR C DIESEL GENERATOR D
Major Plant Equipment	RHR PUMP A RHR PUMP B RHR PUMP C RHR PUMP D RHRSW PUMP A1 RHRSW PUMP A2 RHRSW PUMP B1 RHRSW PUMP B2 RHRSW PUMP C1 RHRSW PUMP C2 RHRSW PUMP D1 RHRSW PUMP D2	CORE SPRAY PUMP 1A CORE SPRAY PUMP 1B CORE SPRAY PUMP 1C CORE SPRAY PUMP 1D CONDENSATE PUMP 1A CONDENSATE PUMP 1B CONDENSATE PUMP 1C COND. BOOSTER PUMP 1A COND. BOOSTER PUMP 1B COND. BOOSTER PUMP 1C HPCI-ALT-PUMP SUCT RCIC-ALT-PUMP SUCT	Over Current Concerns SHUTDOWN BD A OCTs SHUTDOWN BD B OCTs SHUTDOWN BD C OCTs SHUTDOWN BD D OCTs Over Load Concerns SHUTDOWN BD A OL SHUTDOWN BD B OL SHUTDOWN BD C OL SHUTDOWN BD D OL	RHRSW PUMP A3 RHRSW PUMP B3 RHRSW PUMP C3 RHRSW PUMP D3 Battery Chargers BATT CHGR 1 BATT CHGR 2A BATT CHGR 2B BATT CHGR 3 BATT CHGR 4 BATT CHGR 5 BATT CHGR 6

Not Analyzed Resolved Failure Success

Analysis Dashboard

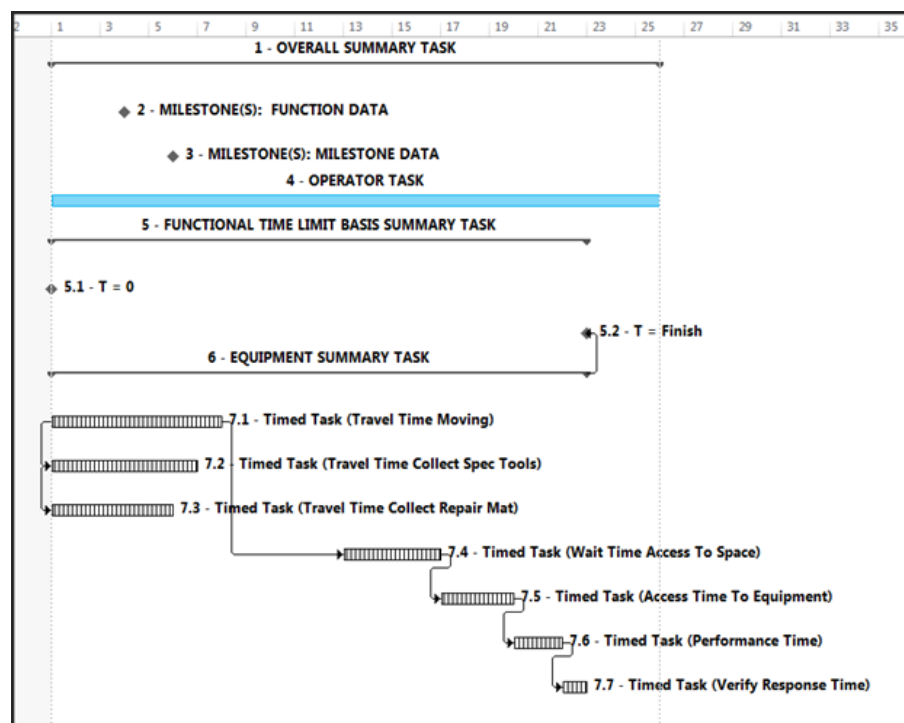
SAFE is equipped with an Analysis Dashboard feature, a design tool that offers a simplified view of analysis results. Dashboards are user defined to allow for maximum flexibility among various applications. Users can simply drag and drop analysis tree objects onto the Dashboard, which is capable of displaying status of Equipment, Systems and Goals as well as associated success paths. Analysis results as displayed on the Dashboard can be exported for printing.

NEI 00-01 / Regulatory Guide 1.189

SAFE allows the analyst to extend the deterministic analysis to include the potential for multiple, simultaneous and spurious actuations by associating the affected system to a RIS performance goal (method). SAFE's analysis engine, using the existing deterministic cable logic, provides the results of a fire as a result of multiple shorts. SAFE enables the analyst to refine the analysis model by evaluating fire model scenarios for a given compartment. The Appendix R analysis and the NFPA 805 analysis models share data.

Actions Timeline

SAFE provides capability to generate an Actions Timeline Report providing a visual representation of all Operator Actions to achieve safe shutdown for a given analysis area. Timelines can be tailored through the user interface to illustrate various attributes such as equipment and component information, staff and special requirements, functional time limits, etc. This report allows for documentation and control of field validation results to comply Appendix R / NFPA 805 feasibility requirements. SAFE enables the user to optimize operator staffing or evaluate a potential change in staffing.



Non-Power Operational Mode Analysis

SAFE includes Non-Power Operational (NPO) mode assessments. Each assessment includes an analysis of a set of systems, components and time dependencies during non-power operations and full power operations, as well as an evaluation of Key Safety Functions (KSF) for High Risk Evaluations (HRE) as mandated by NUMARC 91-06.

NPO positional requirements, which may differ from the Appendix R Analysis, are defined. The analyst performs a separate non-power operational mode analysis using NPO-specific resolutions.

NFPA 805 Performance-Based Transition

For plants transitioning to NFPA 805, the entire plant is partitioned into fire compartments.

SAFE supports a fire compartment characterization for the entire plant. The compartmentalization includes calculating the barrier failure probabilities, evaluating barrier openings and penetrations, and identifying the presence of automatic suppression/detection in support of analyses with multiple compartments and scenarios.

The screenshot displays the 'Compartments' tab in the SAFE software. The interface features a top menu bar with options: Query, Save, Undo, Add, Delete, Refresh, and Quick Query. Below this is a table with columns for 'Compartment', 'ACP', and 'Status'. The 'Data' tab is active, showing various input fields for compartment characterization. These include 'Compartment', 'Description', 'Total Fire Frequency', 'Remarks', 'Screening Conclusions', 'Adjusted Fire Frequency', 'Status', 'Properties', 'Generic Plant Location', 'Detection', 'Fire Barrier Drawings', 'Conclusions', 'Suppression', 'Exemptions', 'Appendix R Compliance', 'Transient/Cable Factors', 'Maintenance Influence', 'Storage Influence', 'General Transient Wght Factor', 'Cable Fires - Weld and Cut', 'Cable Combustible Load', 'Occupancy Influence', 'Fire Influencing Factor', 'Transient Fires - Weld and Cut', 'Cable Weighting Factor Bins', 'Uncertainty', 'Uncertainty Analysis', and 'Uncertainty File Name'.

Combustible Loading

SAFE calculates combustible loads of cables, as well as fixed and transient combustibles by fire area and fire zone. A transient combustible material permit controls which transient combustibles are allowed within a fire zone location. Based on the permit's status, SAFE automatically adds transient combustibles to or removes them from a fire zone and updates the fire zone's combustible loading calculations. The fire protection combustible loading feature also calculates fire severity. SAFE fire area records track fire zone specific data for suppression, detection, and exemptions.

The screenshot displays the 'Combustibles' tab in the SAFE software. The interface features a top menu bar with options: Query, Save, Undo, Add, Delete, Refresh, and Quick Query. Below this is a table with columns for 'Compartment', 'ACP', and 'Status'. The 'Data' tab is active, showing various input fields for combustible loading calculations. These include 'Compartment', 'Description', 'Total Fire Frequency', 'Remarks', 'Screening Conclusions', 'Adjusted Fire Frequency', 'Status', 'Properties', 'Generic Plant Location', 'Detection', 'Fire Barrier Drawings', 'Conclusions', 'Suppression', 'Exemptions', 'Appendix R Compliance', 'Transient/Cable Factors', 'Maintenance Influence', 'Storage Influence', 'General Transient Wght Factor', 'Cable Fires - Weld and Cut', 'Cable Combustible Load', 'Occupancy Influence', 'Fire Influencing Factor', 'Transient Fires - Weld and Cut', 'Cable Weighting Factor Bins', 'Uncertainty', 'Uncertainty Analysis', and 'Uncertainty File Name'.

User Interface Navigation

SAFE includes an intuitive user interface consisting of forms, tabs, and windows. It includes:

Simple Form Navigation - All forms are accessible from a sidebar navigation pane, which includes a Favorites tab for accessing frequently-used forms. Tab and Window Views: Each form can be viewed as a window or a tab within a window, and each window is expandable.

Ad Hoc Query Functionality

Advanced Query Options - The Query form can be used to search for any data on a form. Multiple conditional operators are available for building complex queries.

Quick Query Functionality - A query can be used to perform a search directly from a form.

Detailed List Contents Tables - Query results provide additional information about each record for quick reference.

User Customization

Field View Options - Fields can be hidden, renamed and re-ordered.

Permissions Personalization - Read-write and Read-only permissions can be granted to individual users, or to groups of users, and specified on the field level.

Document Path Specification - The location where documents are saved to and retrieved from can be specified in the SAFE application.

Ad Hoc Wizard

The Ad Hoc Wizard form provides the user with a graphical query tool for accessing the entire SAFE data table set and generating custom reports.

For more information, contact Vincent Renzi at vrr@epm-inc.com or 508-532-7167

SAFE Version 6.5.0

SAFE.NET DEPLOYMENT:

Server:

Database Management System

Oracle® 10g (or greater) or

Microsoft® SQL Server 2012

Operating System - Microsoft® Windows server 2012 or Unix/Solaris

Disk Space - 6 GB (minimum) / Memory - 6 GB (minimum)

Client:

Operating System - Microsoft® Windows 7 (or greater)

Disk Space - 4 GB / Memory - 6 GB (minimum)

Microsoft® .NET Framework 4.6.1



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