System Effects and Capability Losses from Inserted Failures

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SEaCLIF is a "quick look" analysis tool that captures the relationship between requirements, requirement decomposition, and the hardware/software necessary to implement those requirements. SEaCLIF provides the capability to analyze cross-subsystem effects of component failures and/or state changes. It was developed for NASA to support the ARC Engineering of Complex Systems SimStation Project. Current customers include the International Space Station VIPER team, Safety & Mission Assurance at Johnson Space Center, and JSC Chief Engineers Office.

SEaCLIF can support a program from initial concept/requirements definition by providing a requirements tracing capability, through design by providing a design compliance/verification capability, and transition to operations by providing an anomaly resolution and effects analysis capability.

The basic SEaCLIF architecture and capabilities are non vehicle-specific and can be applied to any program. SEaCLIF captures and visually displays the interaction between requirements as requirement decomposition and validation occurs. An example of such a test case is the capturing of Lockheed Martin's decomposition and implementation of human rating requirements for the Orbital Space Plane program. In addition, SEaCLIF can capture the location or complete data set of the trade studies used to validate the requirements sets then trace through the requirements into the actual physical architecture required to satisfy the requirements providing a verification capability. An additional test case is underway to model Shuttle element and Shuttle integrated hazard reports capturing the transfers in and out of integrated hazard causes and controls. Initial results are very promising with the next step being linking physical controls to implemented design architecture models.

Current SEaCLIF Capabilities

- Functional and power system connectivity visualization and search capabilities
- Modeling of impacts of component failures/state changes on system capabilities & functions Estimates electrical and thermal loads by selecting power distribution system components
- Evaluation of hardware failures/state changes on the overall power and thermal demands
- Intuitive system configuration editing capability
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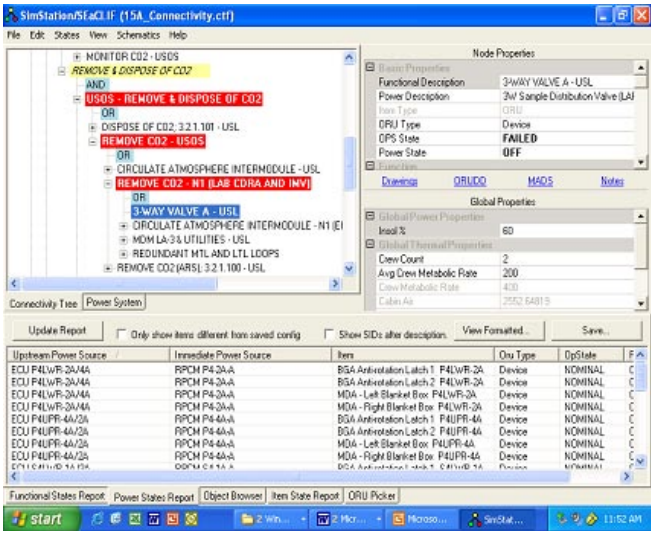
- One-Click connection to existing data sources for detailed part information and history such as drawings, close-out photos, PRACA, and other data sources



- Software to sensor/effector analysis by integrating an S/W calling tree with a physical C&DH architecture model
- Provides a "Notes" tab for each item allowing input of user defined text information and miscellaneous links to additional web based data issues

Proposal efforts are underway to develop an International Space Station flight software connectivity model based upon the flight software calling tree linked to Station hardware sensors/effectors with inclusion of command paths. Inclusion of the software into the dataset represents the actual control of the physical hardware implementation, significantly expanding anomaly investigation capabilities. If included during the design phase, it also provides a method of quickly determining software criticalities by allowing the user to simulate faults and view potential system level effects.

The present safety review process captures hazards, hazard causes, and their controls and documents them in hazard reports. In their present forms, they lack implementation detail and are ineffectively used in the performance of safety assessments and anomaly resolution conducted during operations. Additionally, this lack of information about the software controlling the end effector in the hazard report does not allow the software engineers to present an informed defense of high PR severity ratings before the Control Boards. SEaCLIF solves this problem by providing the much needed link between systems and safety engineers, providing each specialist with data in the most efficient format suitable for the current analysis task they are performing.