SAPHIRE Capabilities/Workspaces

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OVERVIEW

- SAPHIRE Background
- SAPHIRE Quality Assurance Activities
- SAPHIRE Workspaces
  - Significance Determination Process (SDP) Workspace
  - Events and Condition Assessment (ECA) Workspace

SAPHIRE Development History

Idaho National Lab has supported the development of SAPHIRE since the 1980s.

- 1987 – Version 1 of IRRAS code (precursor to SAPHIRE)
- 1997 – SAPHIRE 6.x released for Windows
- 1999 – SAPHIRE 7.x
  - enhancements in event tree linking rules
- 2010 – SAPHIRE 8.x
  - Improved user interface and reporting
  - Use of analysis Workspaces

SAPHIRE Features and Capabilities

- SAPHIRE Version 8.1.2 latest official release
  - Event Tree with linked Fault Tree analysis software
  - Built-in uncertainty analysis (MC and LHS)
  - Integrated Common-Cause Failure module
  - Provides importance measures (fault tree/accident sequences)
  - Post-processing cut set rule editor
  - Ability to handle different Model Types (Fire, Flood, Seismic)
  - Enhanced to allow Phase Modeling (transition from Level 1 PRA to Level 2)
  - Automated generation of Plant Risk Information e-Book (PRIB)
  - Capability to use SAPHIRE's native cut set solver or an external solver (e.g., FTREX)

SAPHIRE Quality Assurance

- SAPHIRE team maintains SAPHIRE Software Quality Assurance Program
  - Design reviews
  - Requirements tracking
  - User change request and bug reporting system
  - Software acceptance testing process

- Annual QA audit performed by NRC technical monitor
- Independent Verification & Validation performed prior to initial release of SAPHIRE version 8
- Results comparisons performed using SAPHIRE solver and FTREX solver
- Periodic comparisons with licensees' PRA model results
  - SAPHIRE can reproduce licensees' results if same modeling assumptions are used

SAPHIRE Workspaces

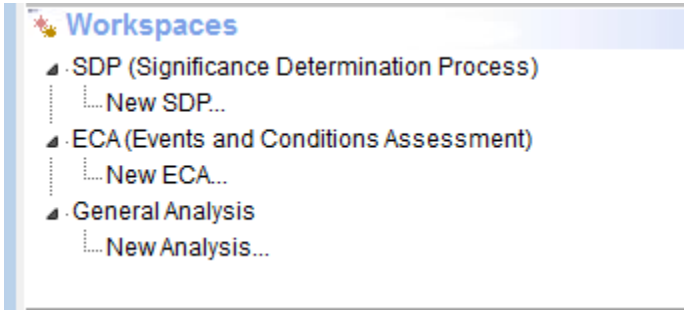
- What are Workspaces?
  - User-friendly SAPHIRE interface tools available to analysts for performing event and condition assessment
  - Creates a copy of the model with conditional settings
    - Allows user to save analysis settings and results
  - Results are summarized in pre-formatted reports
- Use of Workspaces
  - Use of Workspaces are not strictly prescribed, but allow analysts different options for performing assessments
  - Workspace functions can be replicated in general model environment using Change Sets.
  - Choice of Workspace or general model environment depends on analyst preference and type of issue being assessed
- SDP Workspace - Component-level model changes, intended for use as a screening tool
- ECA Workspace - Basic event-level model changes, Allows analyst more flexibility, Commonly used Workspace for condition assessments

SDP Workspace

- Workspace developed within SAPHIRE to analyze different identified deficiencies using the SPAR models
- SPAR models were modified in order to use this workspace directly, i.e., add system type, component type, failure mode, and specific component
- Provides analyst step by step inputs to perform analysis
- Automatically updates common cause failure (CCF) events based on input information
- Applies post-processing rules after cut set generation
- Provides output report of assessment

SDP Workspace – Screen Shots

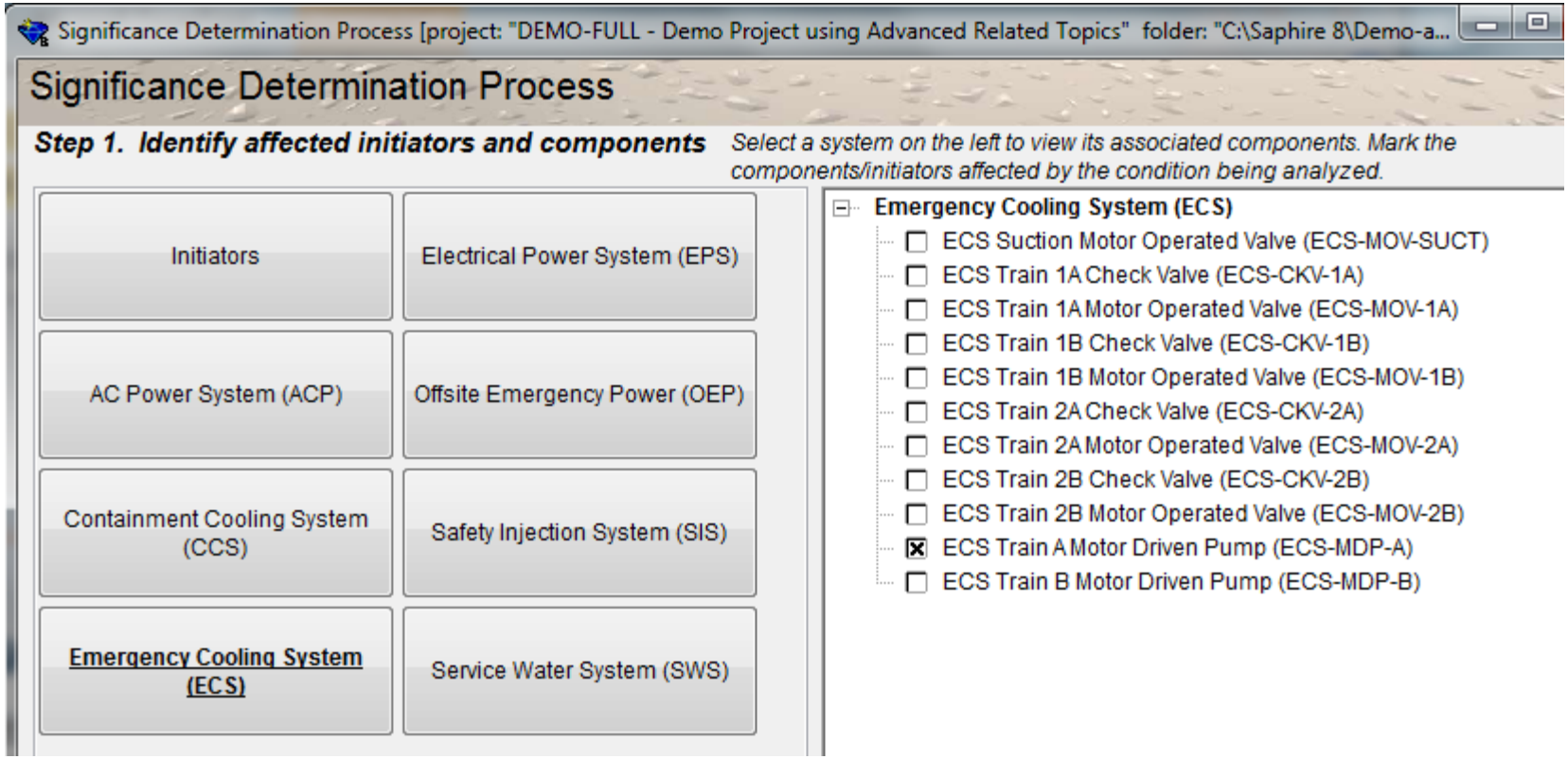
- Example – DEMO project with failure of one train of ECS
  - SAPHIRE Workspaces



- Select New SDP – SAPHIRE makes a copy of project and has an interface screen that displays all of the systems modeled within the project
  - The analyst at this time chooses the system of interest in order to identify the deficient component

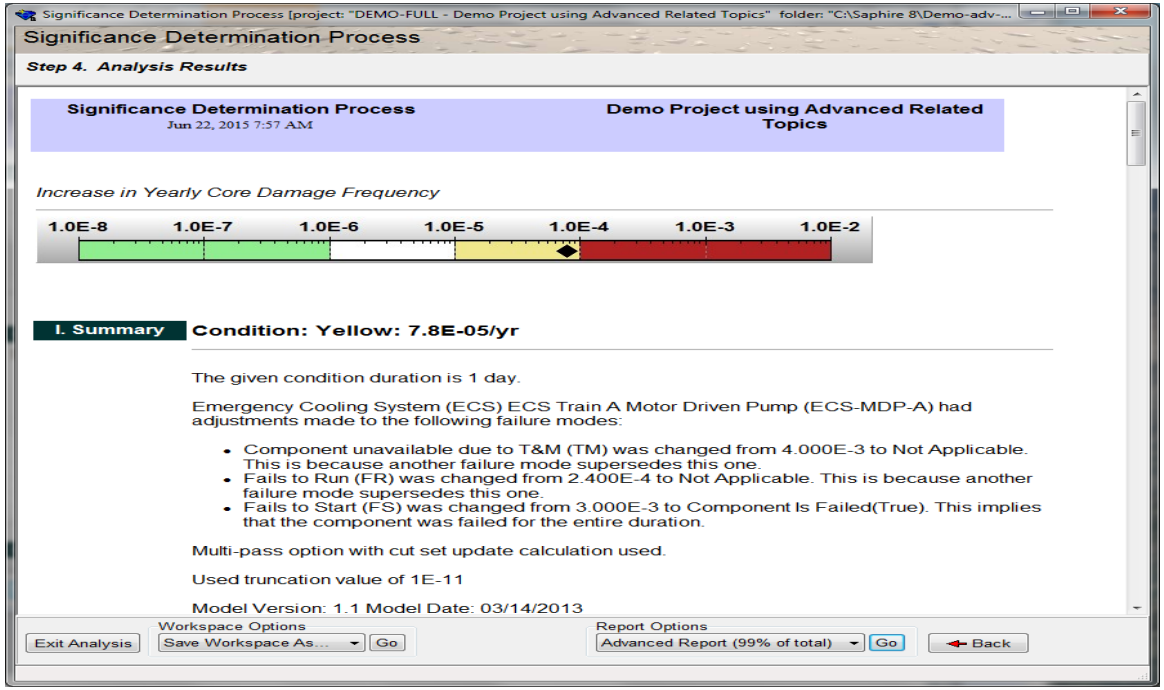
SDP Workspace – Screen Shots

- Select the appropriate system and SAPHIRE will then list all of the components identified to that system
- Select component of interest and click the Next option



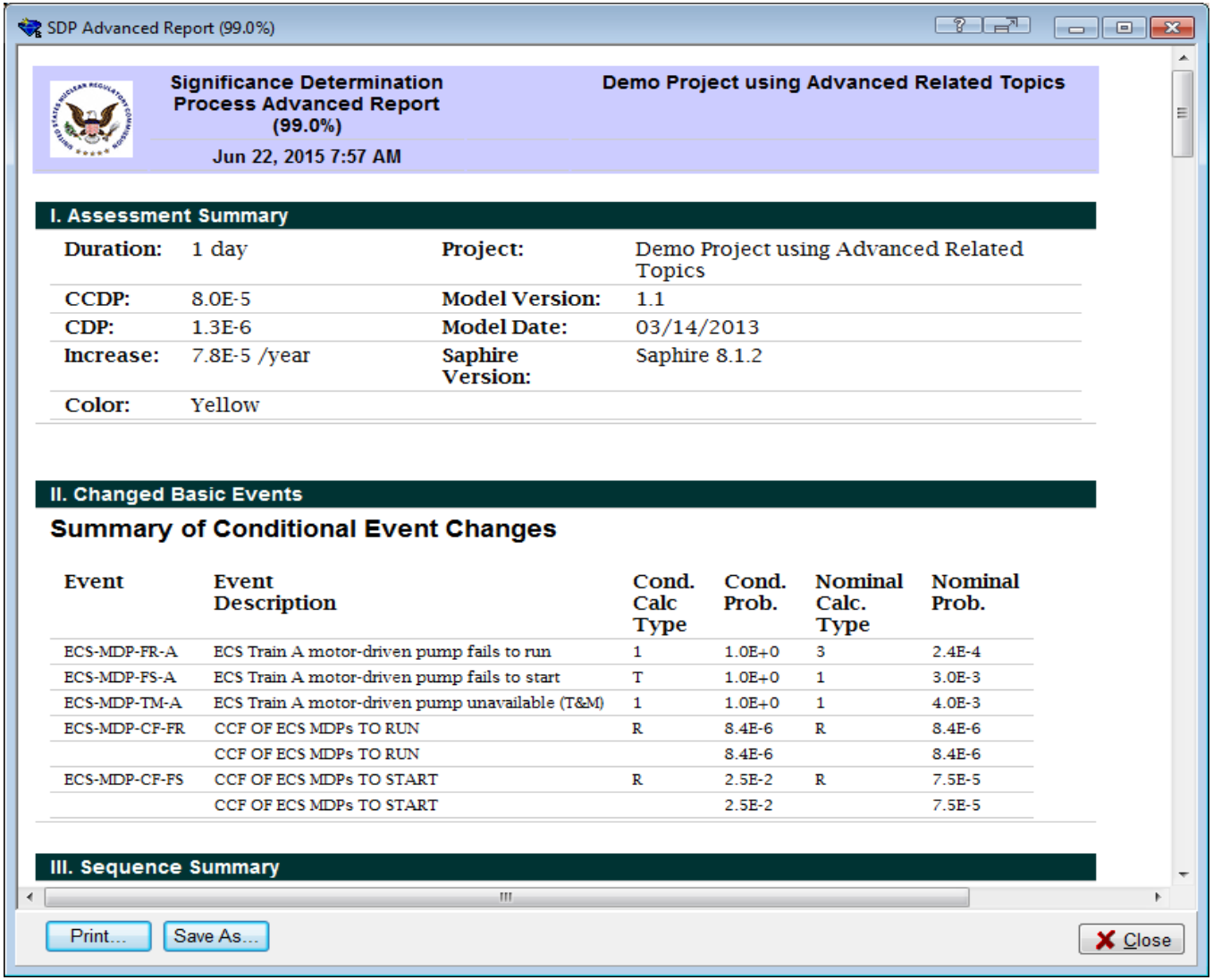
SDP Workspace – Screen Shots

- Designate the duration of the condition and any pertinent information about the event
  - SAPHIRE will make correct adjustments based on condition, apply any post-processing rules, calculate delta CDF based on duration of condition, and provide results



SDP Workspace – Screen Shots

- Advanced Report

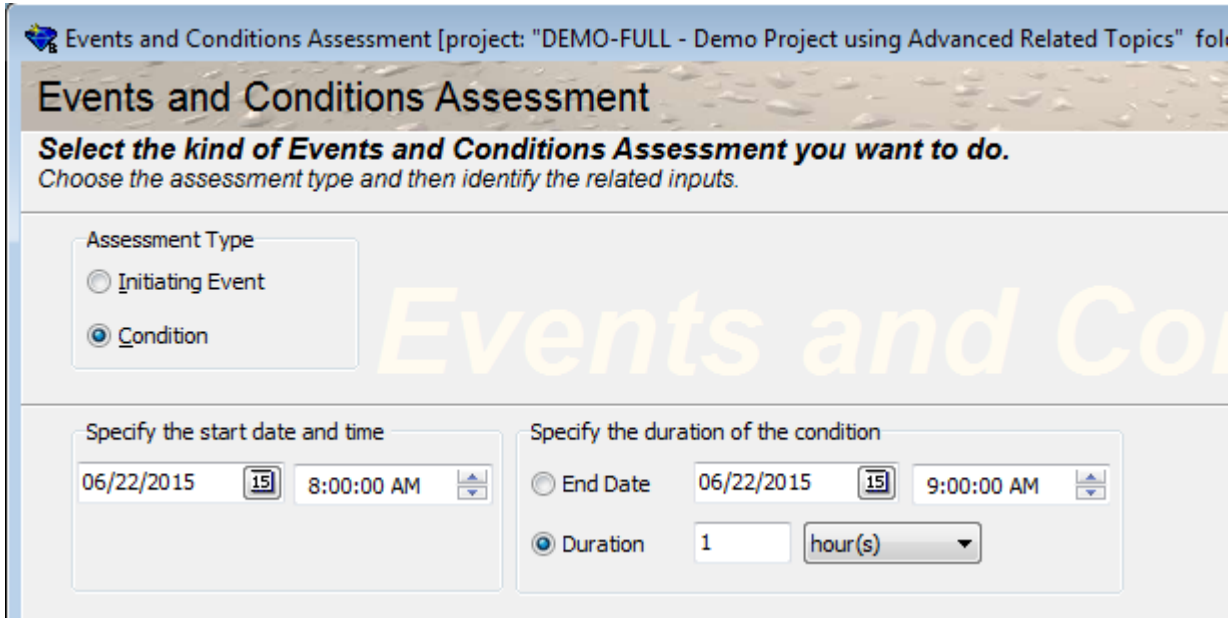


ECA Workspace

- ECA Workspace is similar to the SDP workspace, except it allows for initiating event assessments (SDP is just conditional assessments)
- User defines the issue needing to be assessed
- SAPHIRE provides guidance (step by step)
- SAPHIRE performs multi-pass solution (for both SDP and ECA)
- Result is Incremental Conditional Core Damage Probability (ICCDP)

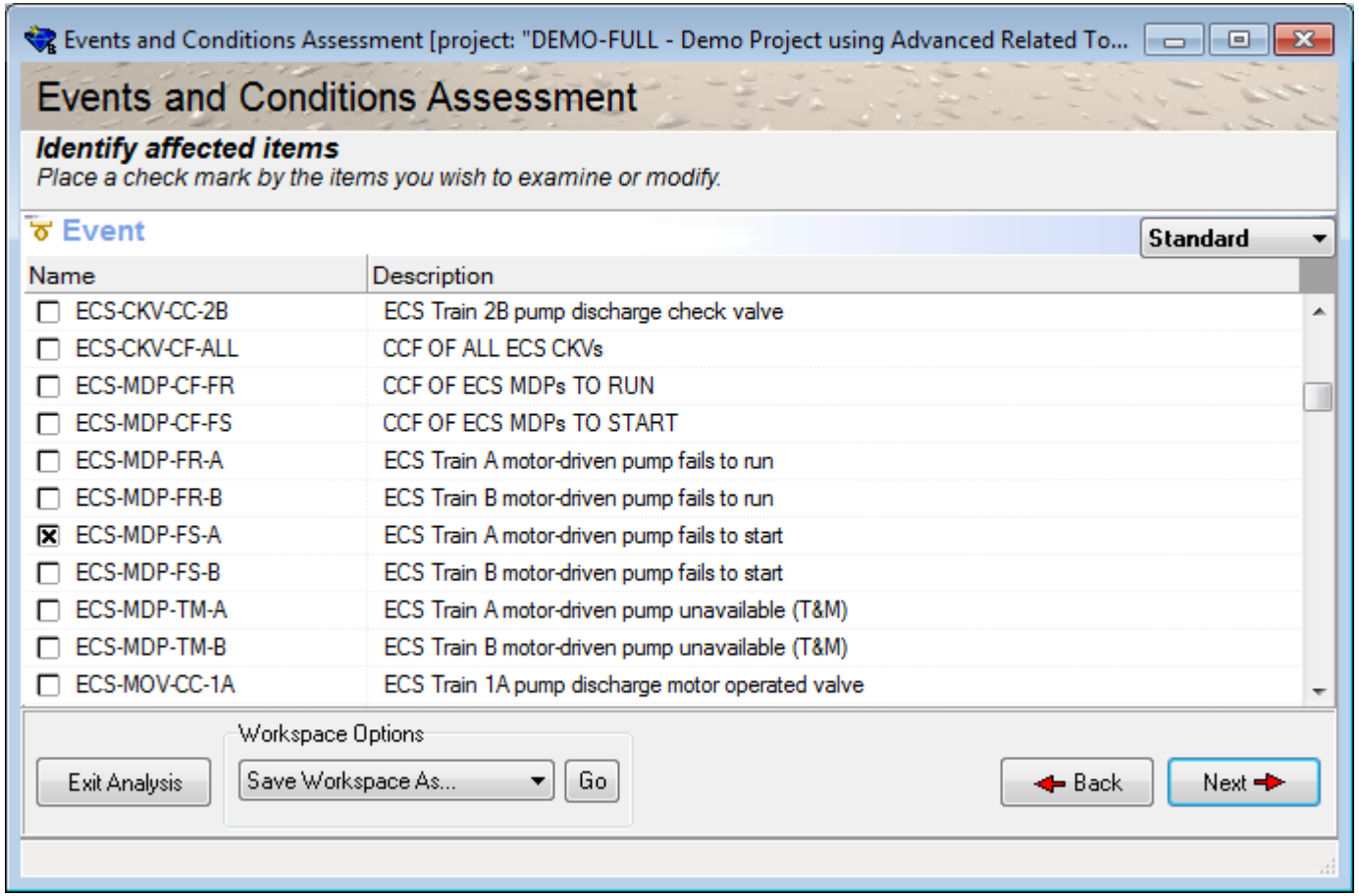
ECA Workspace – Screen Shots

- Example – DEMO project with failure of one train of ECS
  - Specify type of assessment (initiating event or condition)



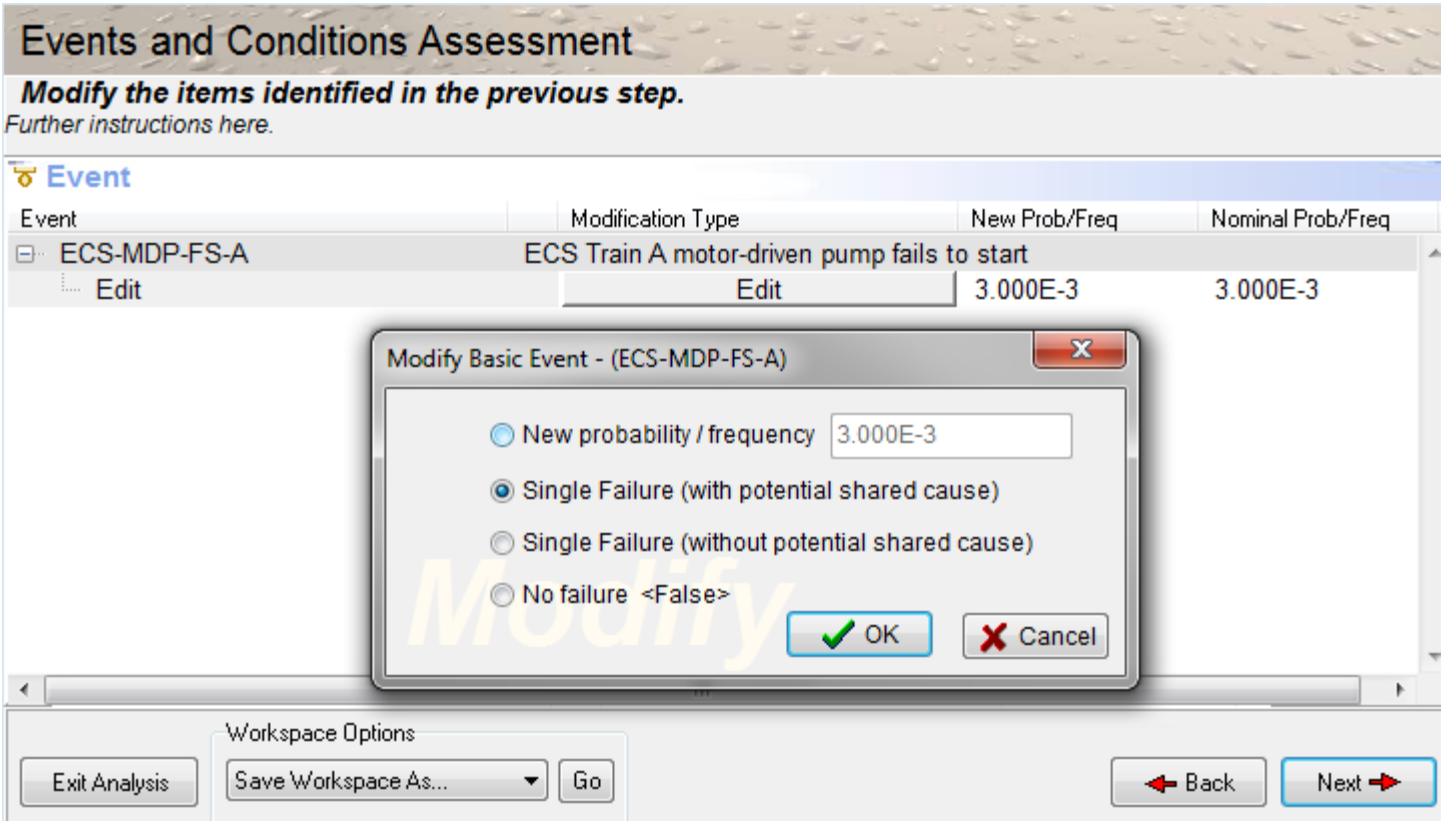
ECA Workspace – Screen Shots

- Select of the component of interest



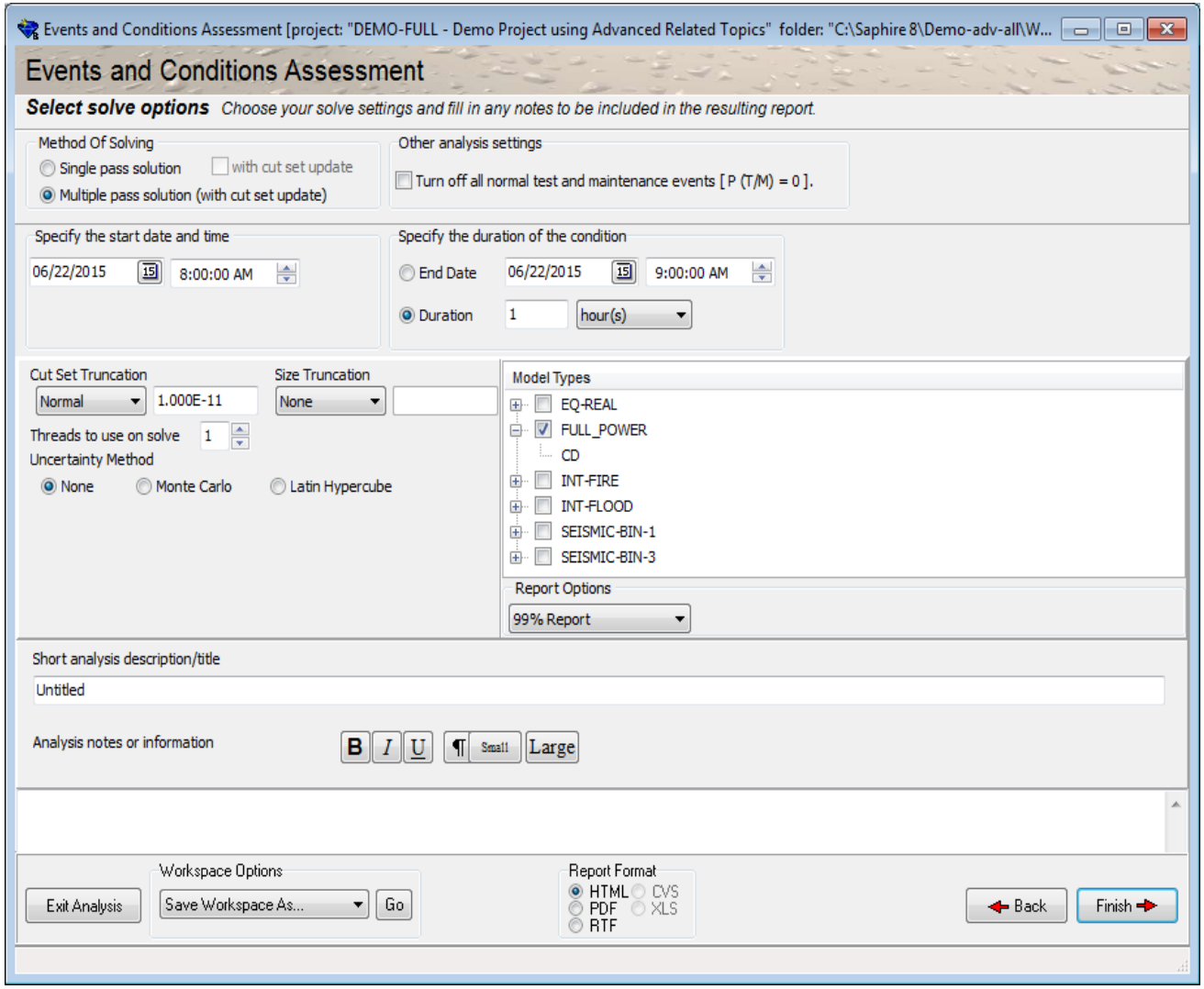
ECA Workspace – Screen Shots

- Make appropriate changes (based on the observed information)



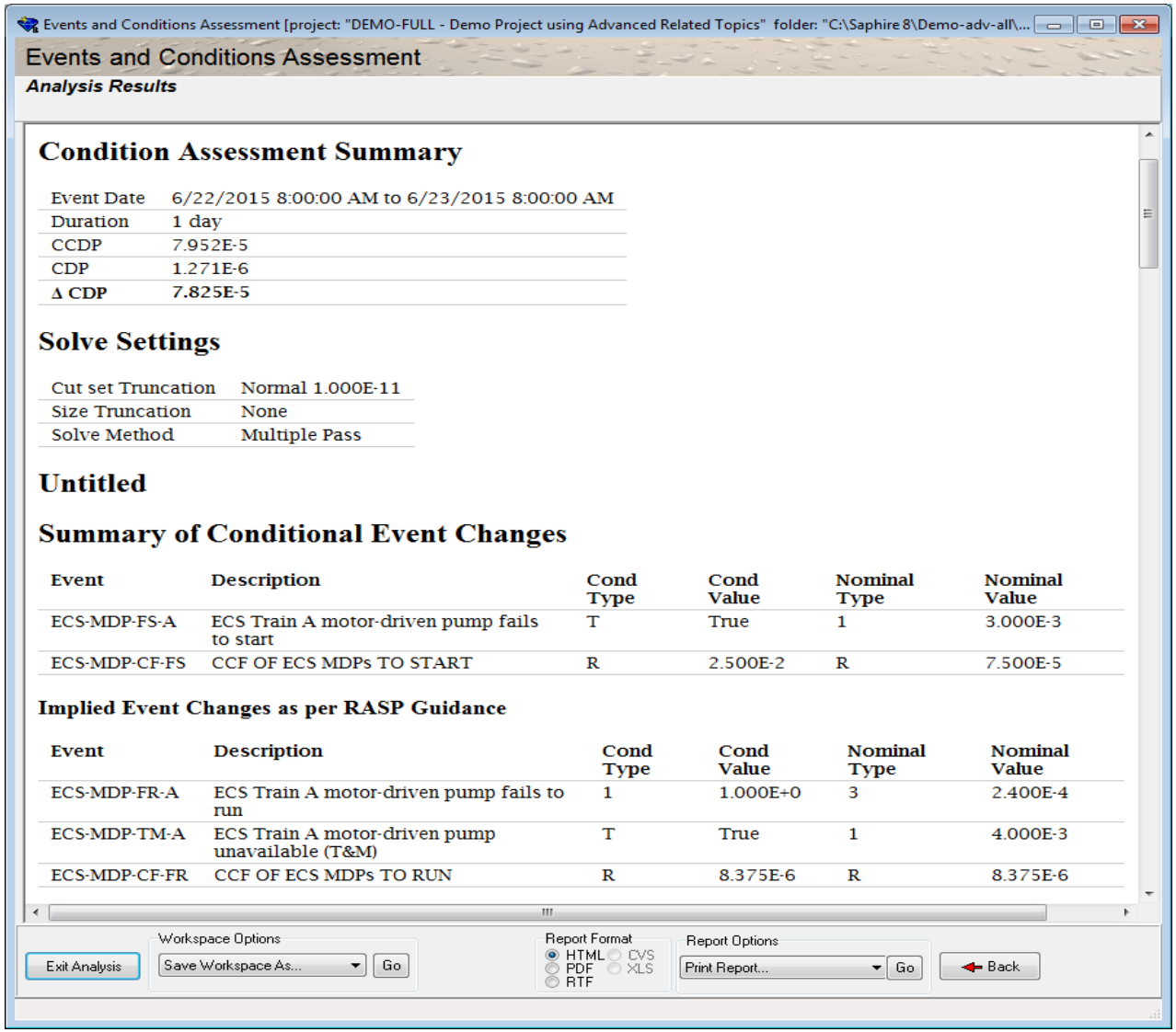
ECA Workspace – Screen Shots

- Specify analysis options (duration, notes, etc.)



ECA Workspace – Screen Shots

- SAPHIRE Results



SAPHIRE Resources

- SAPHIRE 8 Documentation: NUREG/CR-7039 Volumes 1-7

http://www.nrc.gov/reading-rm/doc-collections/nuregs/contract/cr7039/

- SAPHIRE Website

https://saphire.inl.gov/saphire.cfm

- Requesting a copy of SAPHIRE:
  - Complete a non-disclosure agreement (NDA) form, found here

http://www.nrc.gov/about-nrc/regulatory/research/obtainingcodes.html

  - Submit NDA form to safetycodes@nrc.gov or directly to jeffery.wood@nrc.gov, phone: 301-415-0953
  - After review and acceptance of NDA, INL will establish access to SAPHIRE Users Group to download SAPHIRE installer
  - SAPHIRE Users Group membership may require a fee depending on requestor's status and intended use of SAPHIRE