Release Notes for NPSS® v3.2, EMI v14.0, and IDE v2.0

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Summary of Contents

Southwest Research Institute® (SwRI®) is excited to provide this latest release of NPSS, which includes updates to the Core and EMI projects, plus our long-awaited Integrated Development Environment (IDE). NPSS is an object-oriented simulation environment that enables development, collaboration and seamless integration of system models. The primary application areas for NPSS include aerospace propulsion systems and thermodynamic energy systems. However, since it is fundamentally a flow-network solver, it has also been applied to a variety of other fluid/thermal subjects such as heat transfer systems, refrigeration cycles, variations of common power cycles (i.e. Rankine and Brayton), and overall vehicle mission analyses.

EMI is a library of standard [E]lements, [M]odels, and [I]nterface examples. Elements are all of the engineering functions that allow for the creation of system models. Example elements include Compressor, Turbine, and Shaft. The Models library contains a reference set of demonstration models developed in NPSS to facilitate the learning process for new users. Similarly, the Interface examples provide hands-on guides for interfacing NPSS with other third-party tools. Go have a look around EMI to see what useful examples you might find. SwRI's development team is always developing new examples, so if you are wondering about something specific, please reach out to a member of the SwRI NPSS team.

IDE is our newest tool; it is an [I]ntegrated [D]evelopment [E]nvironment designed to aid the NPSS user in creating, running, and evaluating models and results. The IDE provides access to all of the files important to model development, files in the current working directory, case file management, and model inspection through interactive schematics with on-schematic parameter values.

The following paragraphs provide more detail on the updates for each of the main products: NPSS Core, NPSS EMI, and NPSS IDE.

What's New in NPSS Core

The single most significant change in this release of NPSS is the consolidation of the various flow station classes into a single uniform class. In previous versions of the software, the FlowStation class was used to model air-breathing gas turbine engine cycles, whereas the UnReactedFlowStation class was required to model other fluid systems. This difference was most evident in all of the "FN_" elements used to model Fluid Network systems. Going forward, only one FlowStation class is needed to work with all of the thermodynamic packages. Although the old architecture is still in place (in order to support legacy models), new models should take advantage of the simpler architecture, which no longer requires the `loadResource()` function to instantiate UnReactedFlowStations. Refer to the reorganized NPSS Thermodynamic Guide for more details.

We have also added a convenient new function that streamlines the process of creating fluid property tables (FPT) from a series of REFPROP calls. Although NPSS does not come with REFPROP, users who have REFPROP can directly link to it and then build their own property tables to expedite simulations. Previously, users had to modify a sample script to generate FPT files. Now, it is simply a function call. Again, refer to the NPSS Thermodynamic Guide, specifically the chapter on Fluid Property Tables, for more details.

Another important update is the new set of NPSS user manuals. The content in the old manuals has been reorganized, duplicate content removed, and major errors fixed. For example, there is now only one chapter for the Solver, as compared to two chapters in the previous versions of the user guide; all of the solver content is in one location. The updated user manuals are delivered as searchable pdf files and will also be made available on the internet in html format.

Model sharing and interfacing is an important feature of the NPSS environment. Therefore, more improvements have been made to keep up with the evolving SAE ARP4868 API requirements. This release of NPSS includes new functions for the ARP4868C interface such as the ability to evaluate string expressions from the calling program and return the appropriate scalar or 1D array result. There have also been improvements to the implementation of model security features which improve the usability of secured models.

In total, there are approximately 150 change requests included in this release of NPSS since the v2.8 release. Many of these are minor bug fixes that relate to the steady stream of new features constantly being added to the code. A more comprehensive summary of the change requests included in this release of the NPSS Core can be found in the “ReleaseNotes.txt” file.

What’s New in NPSS EMI

The majority of the NPSS EMI updates are to maintain consistency with the changes in the NPSS Core, most notably the common FlowStation architecture. All of the previous “FN_” elements have been moved to a Deprecated library, still available for use, but not preferred for new models. In their place, the FluidNetwork library now contains elements that are uniquely named based on their intended functions (the “FN_” prefix was removed) and some of the element functions were combined to consolidate common functionality. In addition, the example models dependent on the “FN_” elements have been updated to use the new FluidNetwork elements and use the common FlowStation class. Other updates include a variety of bug fixes for Elements and a few new Model examples (including how to create secure customer decks).

The ability to interface between NPSS and other third-party tools remains important to our customer base, so significant effort has been made to update and provide working examples of interfacing with NPSS. This includes an update of the Simulink S-Function to work with MatLab releases up through 2018a, an example of NPSS driving a third-party tool through a wrapper, and updating the ARP4868 API examples. Python and Java ARP4868 API examples are under current development, but they are not available in this current NPSS release.

Finally Introducing the New NPSS IDE

This NPSS IDE has been under active development for several years, and we are excited to finally announce its beta release. This release is available for commercial customers only who have updated support. We are aware of several inadequacies of the NPSS IDE, and we are actively seeking feedback from our commercial users before distributing a non-beta release to our academic and demo community.

The design philosophy of the NPSS IDE is to facilitate NPSS model development, interrogation, and visualization, while maintaining the normal NPSS operating modes. The model and simulation interactions are still based on text files manipulated by the user, but the feedback is now collocated into a single interface which includes: a text editor, a command window, a file system window, and an annotated schematic. These windows provide the ability to quickly make changes and, with a single button push, rerun the model or even reload the entire environment to evaluate the results of the changes. All of these features are intended to bring more information to the developer with more clarity, compared to the conventional command line interactions. More details can be found in the NPSS IDE Users Guide.

This NPSS IDE is intended to provide users with an environment that is more intuitive than the command line, without sacrificing any of the extreme versatility that NPSS is renowned for. Below are just a few screen images to highlight some of the useful interface features.

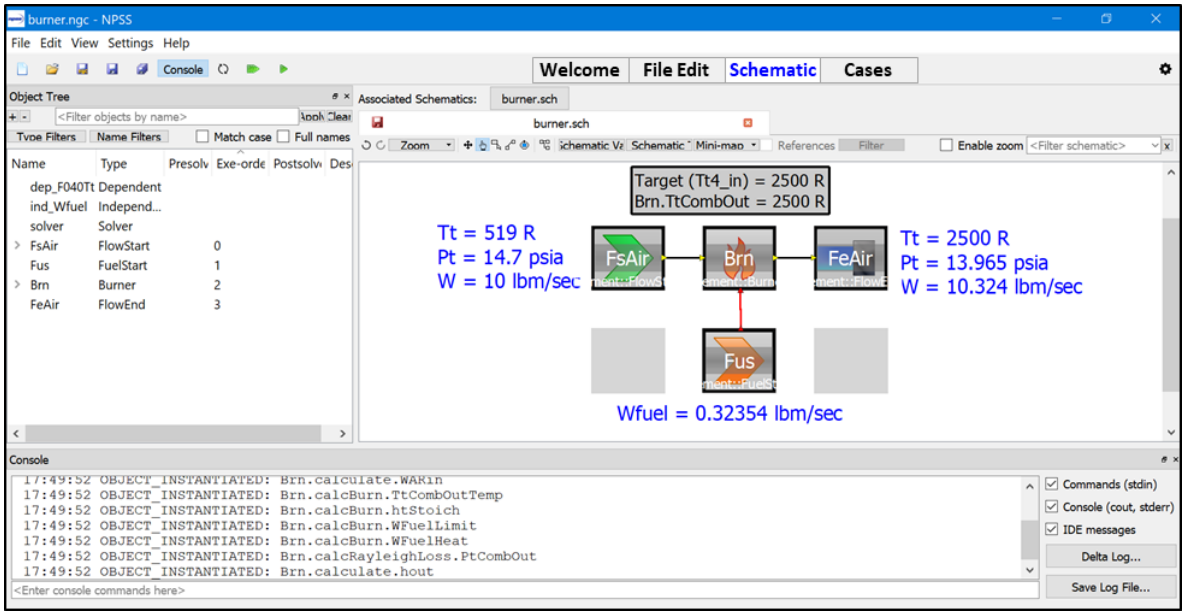

Figure 1. A customizable schematic view provides informative views of the current solution

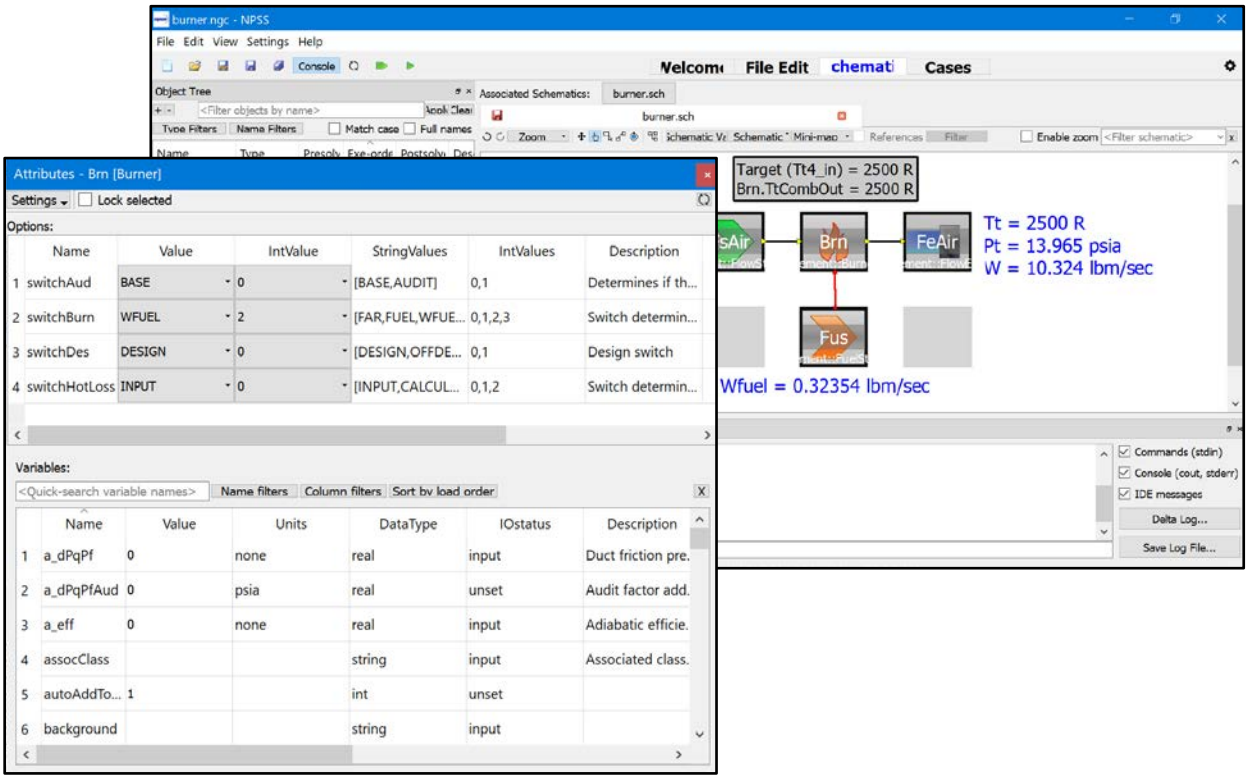

Figure 2. Attribute windows allow inspection of in-depth details of each object

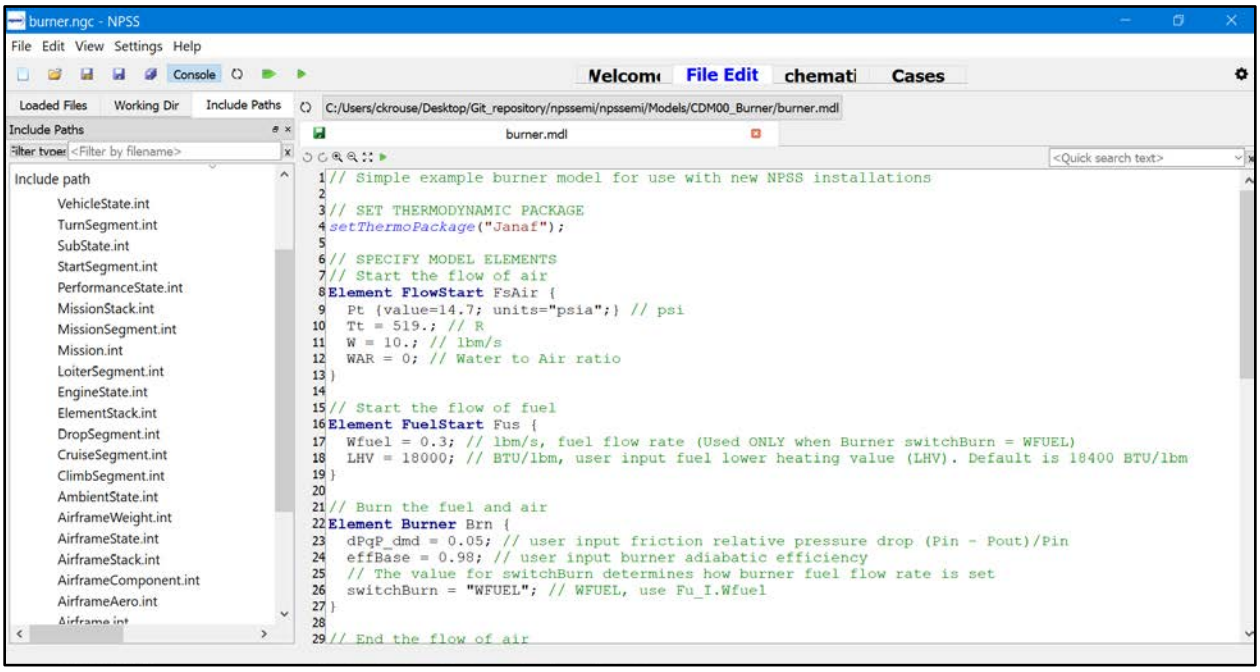

Figure 3. The files windows provide easy access to the current working directory, include paths, and file editing

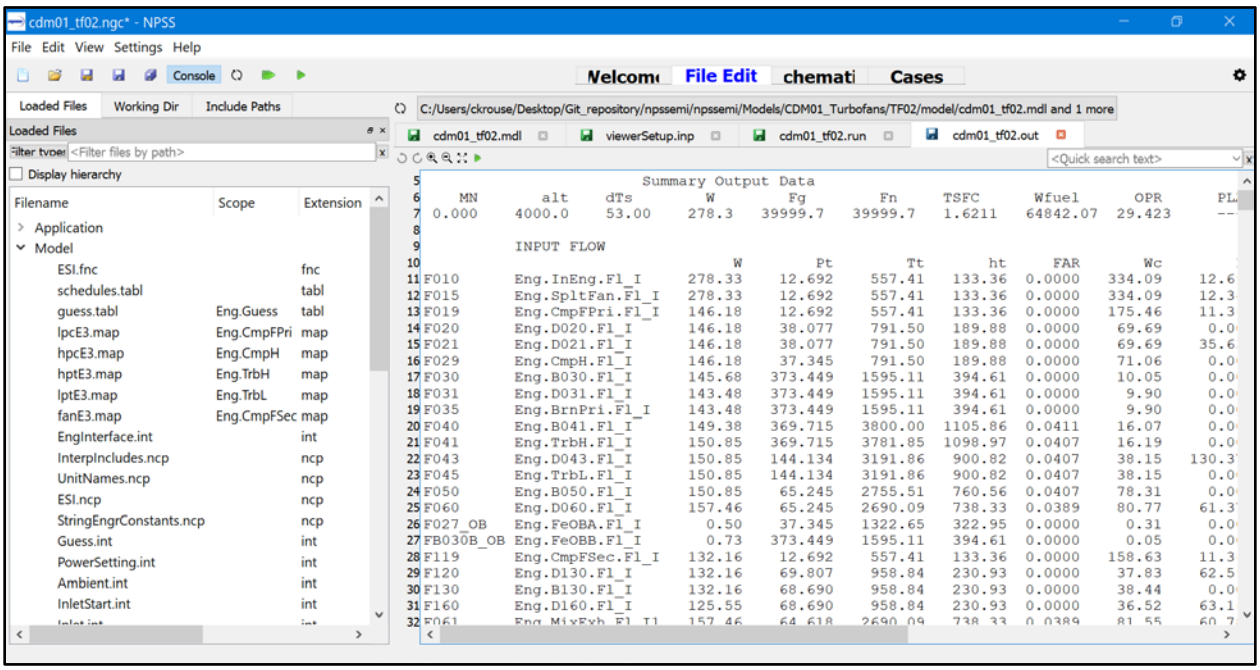

Figure 4. Include path contents are easily inspected and result files can easily be viewed

How to Get NPSS

SwRI manages the NPSS Consortium on behalf of the Consortium members. Thus, you can purchase a NPSS license online via SwRI's NPSS Licenses page. Since NPSS is export controlled, the sale of NPSS licenses is restricted to countries not currently listed on the U.S. Department of Commerce Anti-Terrorism watch list.

For users or companies with significant experience using NPSS, or for companies with a large user base, Consortium membership may be beneficial. Members enjoy all the features of the commercial software, plus access to the full source code (a significant value for building the source to fit your own computing resources), unlimited NPSS licenses, opportunity to contribute towards defining future NPSS development efforts, and the legal right to sub-license NPSS to sub-contractors and vendors for the purpose of model sharing.

To contract SwRI for any NPSS modeling or development needs, for questions about the software, or for additional information about consortium membership, send an email to the NPSS Consortium Manager, Charles Krouse, or call +1 210 522 5001.