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Shell FRED 2020 Release Note

A summary of the changes for the release of FRED 2020
October 2020



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Document History

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Executive Summary

This release note documents a significant update to the user interface of Shell FRED of Shell FRED major hazard consequence software. This update does not change the fundamental ethos of Shell FRED, e.g. its usability or how the science models are used. Instead the new version of Shell FRED has been designed to make the comparison of results and the ability to perform sensitivity analysis easier than the previous architecture. It was also necessary to future proof future developments and maintenance by updating the software languange and architecture.

Overall, the focus was therefore on the user interface and not on modifying the core science, although a few updates to the models were also included as part of the release.

Contents

03 Document History
04 Executive Summary
06 Introduction
07 Changes to User Interface
07 General View
08 Modified Functionality
10 Update Science Models
10 Enhancements
10 Bug Fixes
11 Backwards Compatibility
12 References
13 Bibliographic Information

Introduction

This release note documents the updates to the Shell FRED software tool, which has been rewritten to improve the functionality to perform sensitivity analysis and compare results. As this is a significant change, it is not useful or relevant to document every change compared to the FRED 7.1.1 and instead this release note will focus on major changes to the user interface and when/ where users would interact differently with the software. A full description of the user interface is documented in the User Guide, which has been completely rewritten.

Changes to User Interface

General View

The main user interface for Shell FRED 2020 is shown in Figure 2-1.

The main differences of the new interface are

- The input section which is always shown on the left hand side (#3)
- The scenario results section in the centre (#4), which breaks up the results into a series of paners (see Figure 2-2)
- The tab bar (#7), which allows multiple scenarios to be “open” and available for quick display.
- Working in the Map “work area” is now optional

The other features labelled in Figure 2-1 are visually different but have the same operation to previous versions of Shell FRED.

An example of the results section is shown in Figure 2-2. The individual panels are grouped by sub-model, e.g. release, jet fire and noise for Gas Jet Fire scenario. The panels themselves can be maximised to view the specific results (either charts or tables) in more detail.

It is also possible to use and manipulate scenarios on a “map”. This functionality is very similar to FRED 7.1 and will not be described here. For further details, please see the User Guide.

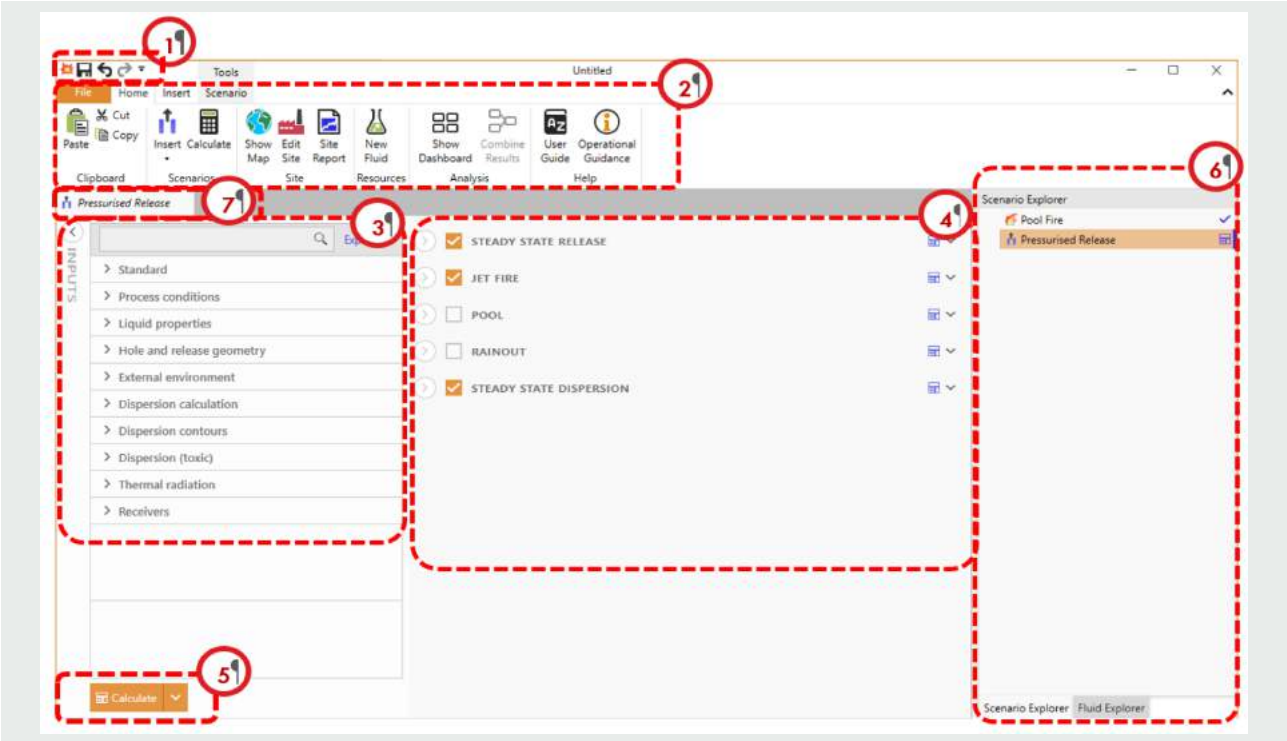

Figure 2-1 An overview of the interface in Shell FRED 2020

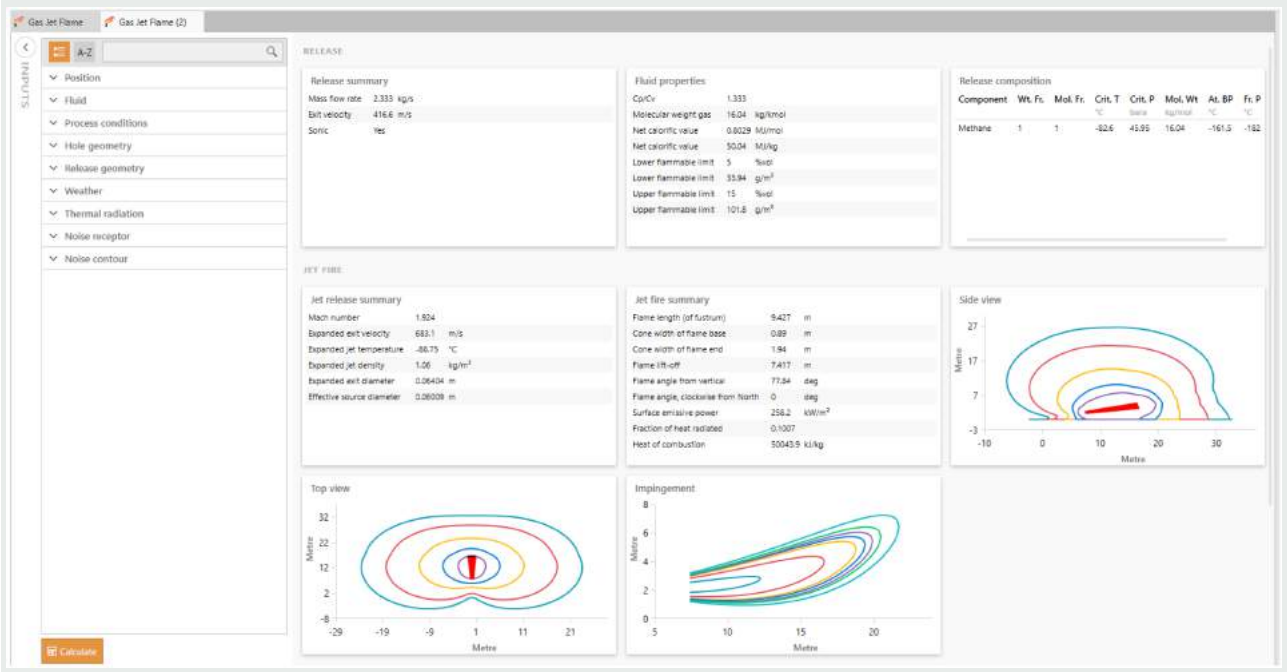

Figure 2-2 An example of the results section for the default Gas Jet Fire Scenario

Modified Functionality

Visual display of input changes
Shell FRED will now display if an input value has been changed from its default value. This is shown adjacent to the current input and also for the group in which the input belongs. This makes it very easy to see what input values are "updated" when loading older files.

It is also easier for new users of the software to find the required input using the expland/ collapse all groups and the Search inputs functionality.

Default values
The current inputs values for all scenarios can be stored as the default values. This allows the user to specify inputs specific to their location and ensure that new scenarios always start with these inputs.

Multiple units for inputs
The units for input values in all scenarios can now be modified, e.g. flow rate in kg/s, tonne/hr, lbs/s. These units can be defined globally in File | Settings or per input parameter. The units selected for a given input can be stored along with scenario inputs as default values.

Selection of units for charts/ maps
The default distance in metres used for displaying results can be updated to ft and miles so that contour information on charts and background maps can be displayed in imperial units.

Improved chart tools
The functionality to check and interrogate results on chart tools is improved. Shell FRED will automatically highlight the current cursor position on the X and Y axis. In addition, the facility to highlight points will lock to the nearest contour data point, so that calculated values and the maximum extents of a hazard can quickly be visualised. The usability of other features, such as copy chart to clipboard and copy data to clipboard, has also been improved.

Improved data tools
Shell FRED 2020 allows the user to quickly copy the results stored as a list or in a table, to paste into other applications. Funtionality is also available in data tables (for instance when combining results) to sort and filter, similar to Excel functionality.

Undo/ redo
Many actions in Shell FRED can now be undone or redone if a mistake has been made. This includes scenario movement, renaming, deletion, modifications to input values, modifications to background map. Note the undo list gets reset when a calculation is carried out.

Dashboard
Results generated by Shell FRED (charts and data tables) can now be pinned so that they appear on a dashboard. These results can be of any individual result panel from any type of scenario. Updates to the scenario are reflected automatically in the dashboard. It is therefore easy to see the impact of any changes.

Combined results
It is possible to combine the results for any number of scenarios of the same type, e.g. comparing the results for just Pressurised Release scenarios. The results are displayed in a "combined" panel. In a text panel, the results are shown in a table and therefore the data tools described earlier can be used to analyse the impact of the different scenarios. In charts, the data for one contour, e.g. thermal radiation = 6.3 kW/m^2 is plotted for all scenarios selected to be combined. The results for other contours can be seen via a slider control.

Variants
The use of variants makes it possible to do sensitivity studies on the majority of inputs in all scenarios. This is an improvement on the batch run option that was available in previous versions of FRED but limited to the Pressurised Release scenario. Each input that allows variants can be selected to have multiple values and this creates child scenarios for each combination of variants. The results of variants can be shown individually or combined together using the Combine results functionality. In addition, variants can be defined to be part of the default inputs for a scenario, e.g. specifying two Pasquill stability classes.

Custom fluid
The interface for defining and managing custom fluids is now centralised, rather than within a scenario. This makes it easier to define and see which scenarios can use the fluid. This centralised functionality also includes the two explosion scenarios; CAM and SCOPE, so a custom fluid can be generated once for all types of scenarios.

Reporting functionality
Reporting functionality has been extended to allow results generated using combined scenarios or results on dashboard, as well as individual scenario reports or site reports. The report format has also been improved and it is now possible to directly output to either Word or PDF format.

Background maps
Imported image and file formats that are used as background image are now stored internally within the .fred file. This means that map files no longer need to be stored alongside the FRED file.

Updated Science Models

Enhancements

- The circular pool fire and tack fire scenarios have now been combined with the trench fire scenatio into one scenario. The model can be switched between circular (Pool/ Tank top) and rectangular (Trench) fires within inputs of the Pool Fire scenario.
- It is now possible to use custom fluid mixtures in the pool fire scenario (circular option). This functionality was previously only available in the equivalent pool fire model in the Pressurised Release scenario.
- The valid range for the rainout model has been extended, especially for cryogenic fluids that are usually superheated in their reservoir conditions.
- The validation ranges for some input parameters have been extended following a review of recent experiments. For instance, the extrapolated range for mass flow rate in the Pressurised Release scenario has been changed from 0.1 kg/s to 0.001 kg/s and the absolute limit for initial fluid temperature in Heat Up scenario has been extended to 200℃
- Reduced dependency of models on File I/O (Scope, Temperature Rise, Heat Up, Two-phase blowdown), which will improve the future maintainability of these models and should give a small improvement in calculation speed.
- The removal of File I/O in SCOPE will also improve the accuracy of the calculations, which will adjust the results obtained in existing scenarios. Most results are within 0.1% of results generated in FRED 7.1, but a larger difference was seen for specific test cases with side vents that also used mixtures with deluge enabled.

Bug Fixes

- Fixed calculation of droplet size prediction and so rainout for sub-cooled LNG releases. In previous versions of FRED, a null result was obtained.
- Custom fluids that can contain non-flammable components (including water) can now be used in Pool Fire models (Pressurised Release and Pool Fire scenarios). The pool fire calculation is now stopped only when the fraction on non-flammable components is greater that 60%. This is likely to still be a conservative prediction, because the flammable components are likely to vaporise and burn even in small quantities.
- The BLEVE overpressure chart was not updating until the scenario closed and reopened (resolved due to changes to the FRED UI).
- Additional checks have been added to the Cascade model to stop the modelling of single compenent fluids that are gases at the storage temperature.
- Fixed crash in Vessel Burst scenario if the difference between reservoir pressure and ambient pressure was less than 1 bara.
- Removed duplicate of cyclooctene from standard fluids in Pressurised Release scenario.
- Fixed crash if modelling bunds greater than 10,000 m^2 in the Transient pool model within the Unified scenario.

Backwards Compatibility

Shell FRED 2020 will load files created using FRED 7.

If files are saved in older version of FRED, these can be loaded into FRED 7.1 and saved as .fr7 files to make them compatible with Shell FRED 2020.

References

FRED 2020 User Guide, SR.20.01161, October 2020.

Bibliographic Information

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Notes

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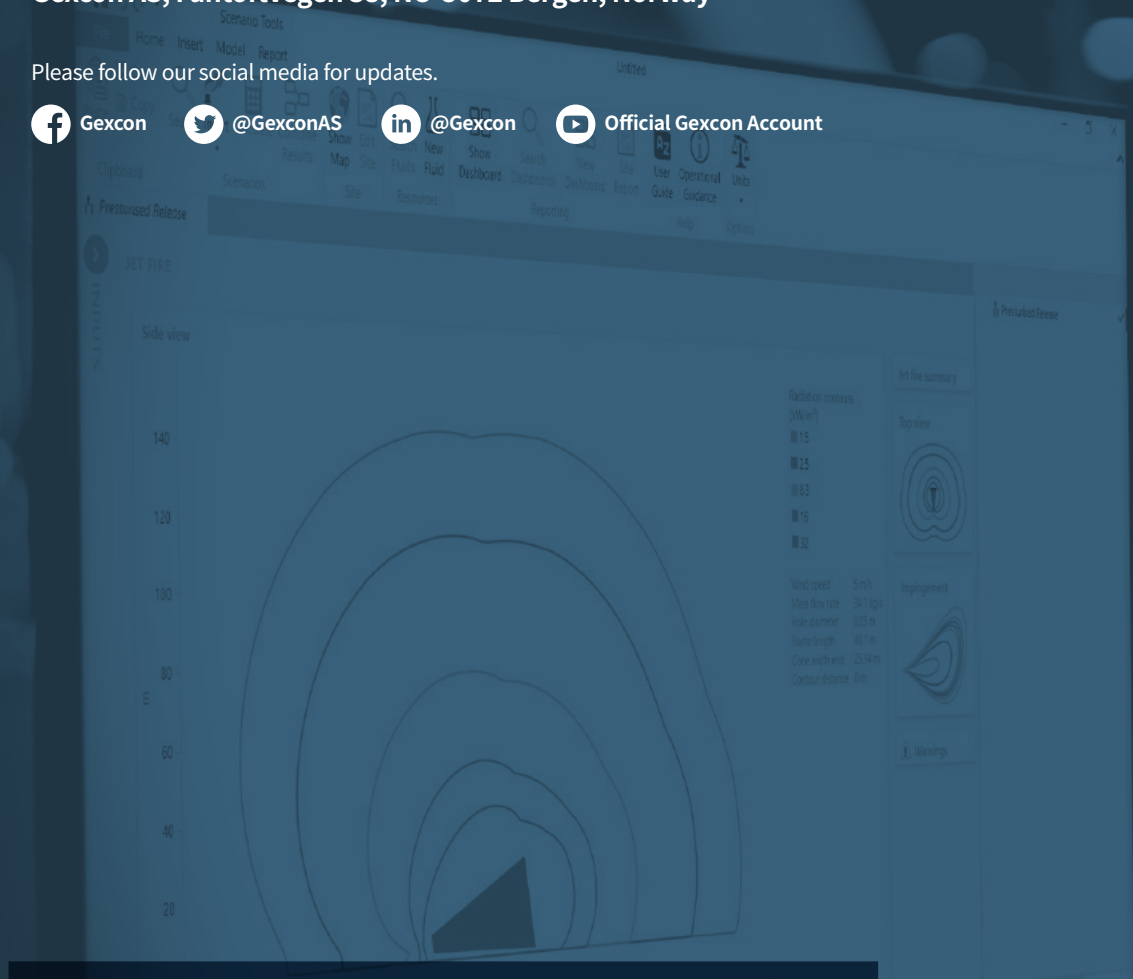

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