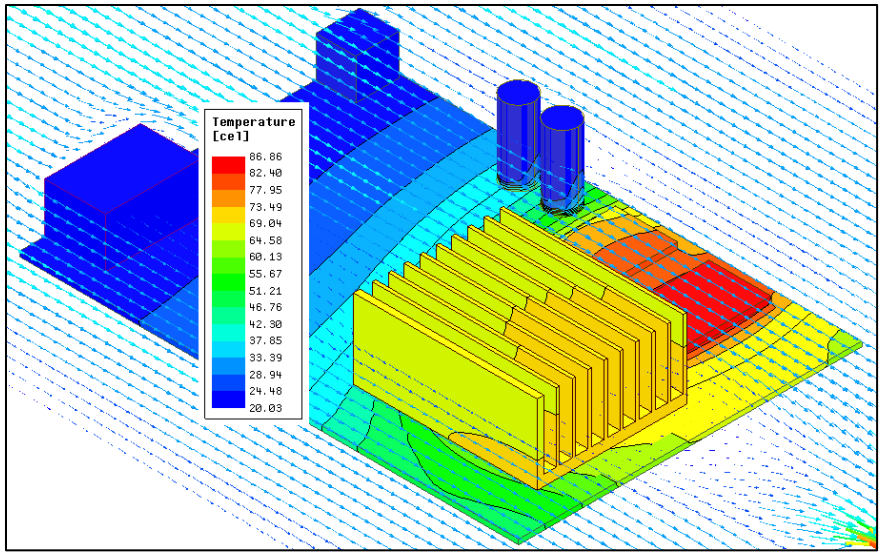
Introduction to Icepak in AEDT

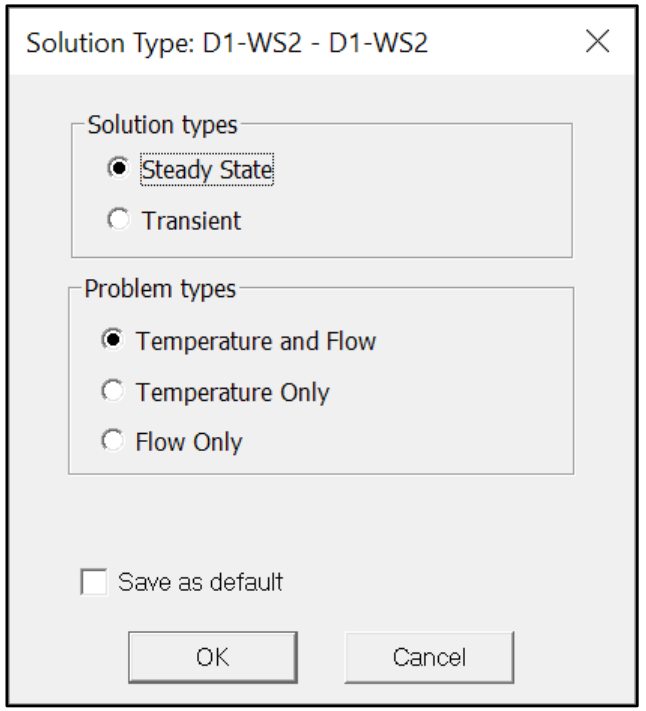
Module 3 – Lecture 2: Solving and Post-processing

Release 2020 R1

Icepak Solution Types

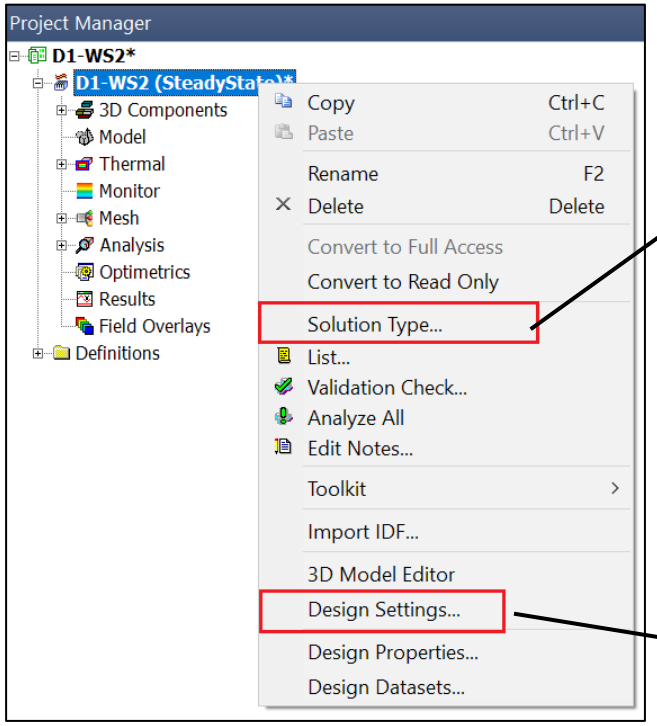
- **Temperature and Flow**
  - All CFD equations are solved
  - With proper model and mesh setup, this will provide the most accurate solution
- **Temperature Only**
  - Only the energy equation is solved
  - Typically the model will just include solids
  - Conduction through air can be modeled using the Air-solid material
  - The default air region is usually deleted
  - Walls **must** allow heat to escape the domain, otherwise the solver will diverge
- **Flow Only**
  - Useful to optimize flow conditions, study fan placement, characterize pressure drops, etc.
- **Steady and Transient solution types**
  - Solve for steady or time-dependent problem types



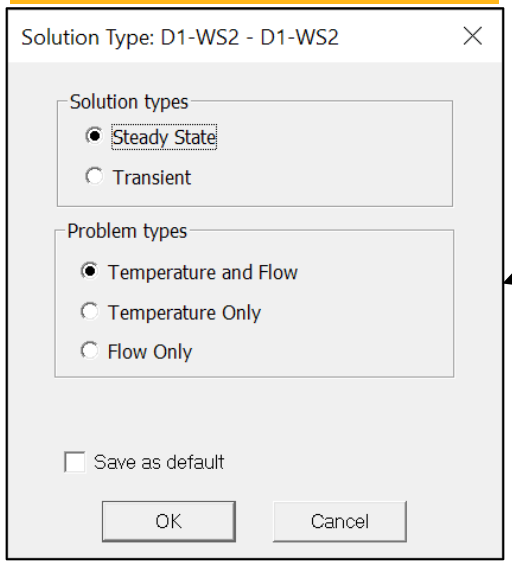


Solution Setup – Solution Type and Design Settings

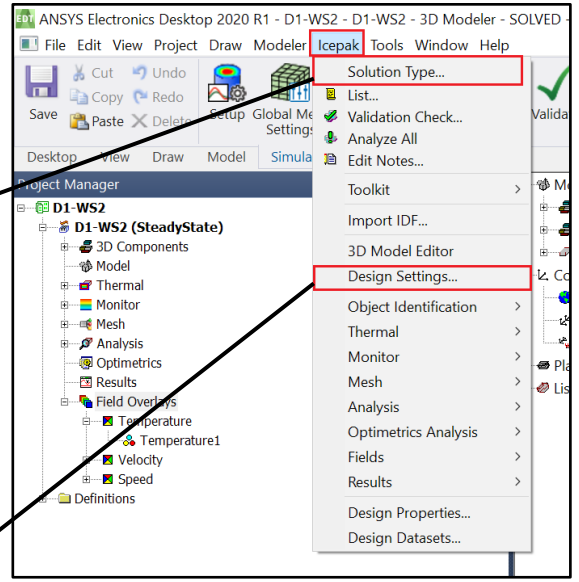
Right-click Icepak Design

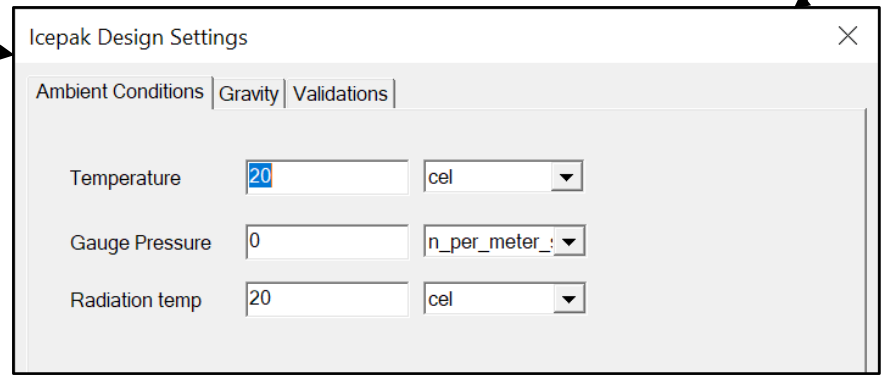


Solution Type



Drop-Down Menu





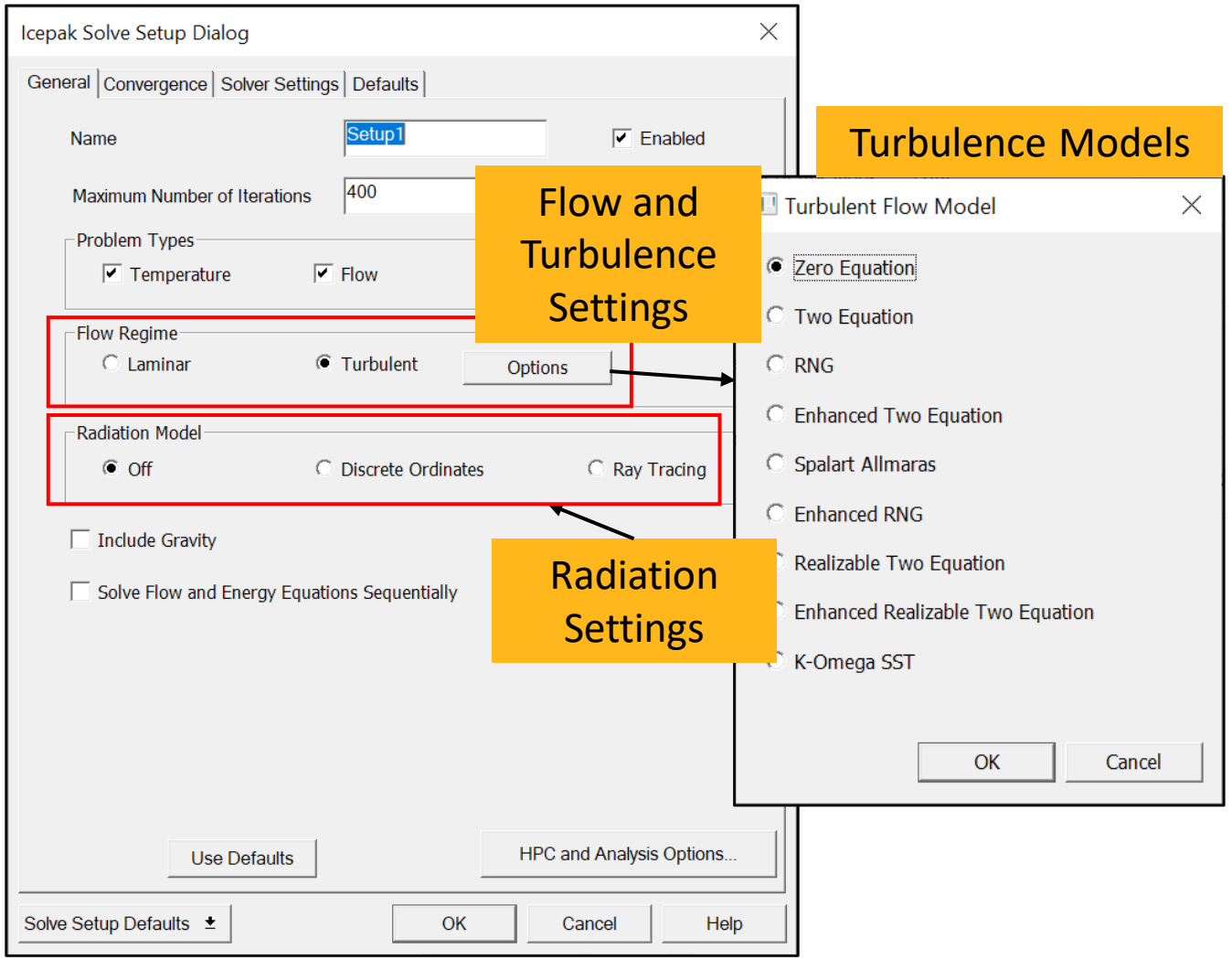
- **Set ambient conditions**
- **Set gravity vector (if applicable)**

- **Temperature and Flow (Conjugate Heat Transfer)**
- **Temperature Only**
- **Flow only**
- **Steady and Transient solution types**

Solution Setup: Physics

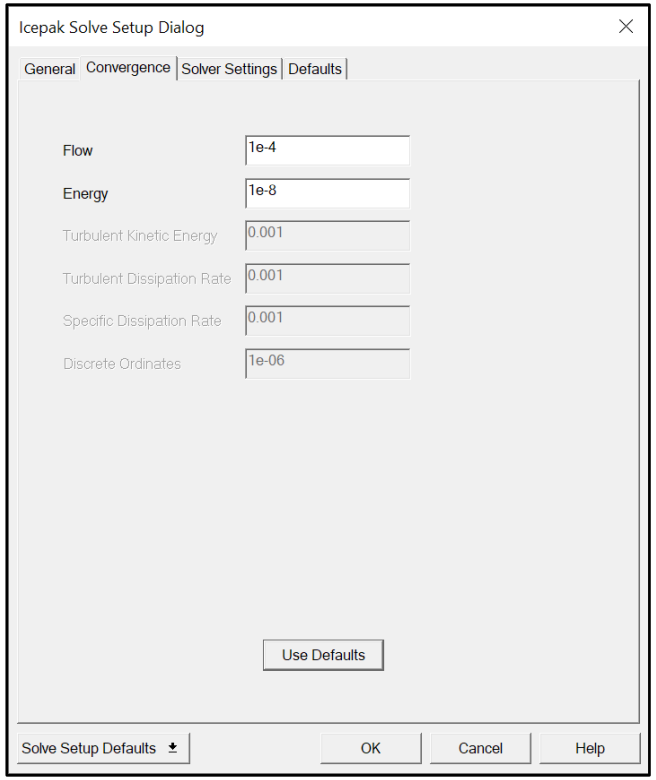
- Specify a laminar and turbulent flow regime
- Flow with fans are typically turbulent
- Natural convection model are typically laminar
- Specify settings for radiation heat transfer
- Radiation is always important for natural convection models
- Radiation models available:
  - Discrete Ordinates
  - Ray Tracing

In natural convection, fluid motion is caused due to buoyancy, whereas in forced convection, fluid motion is caused by an external mover such as fan or pump

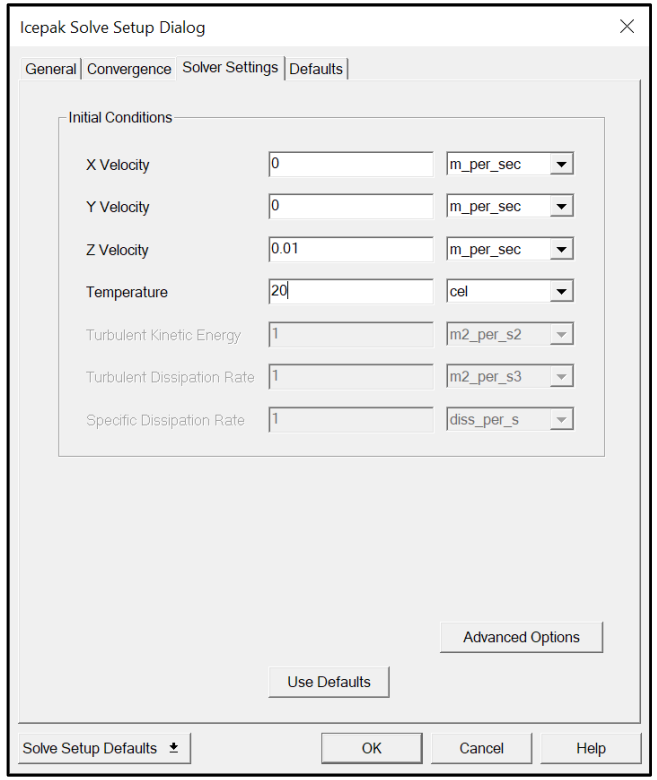


Solution Setup – Solve

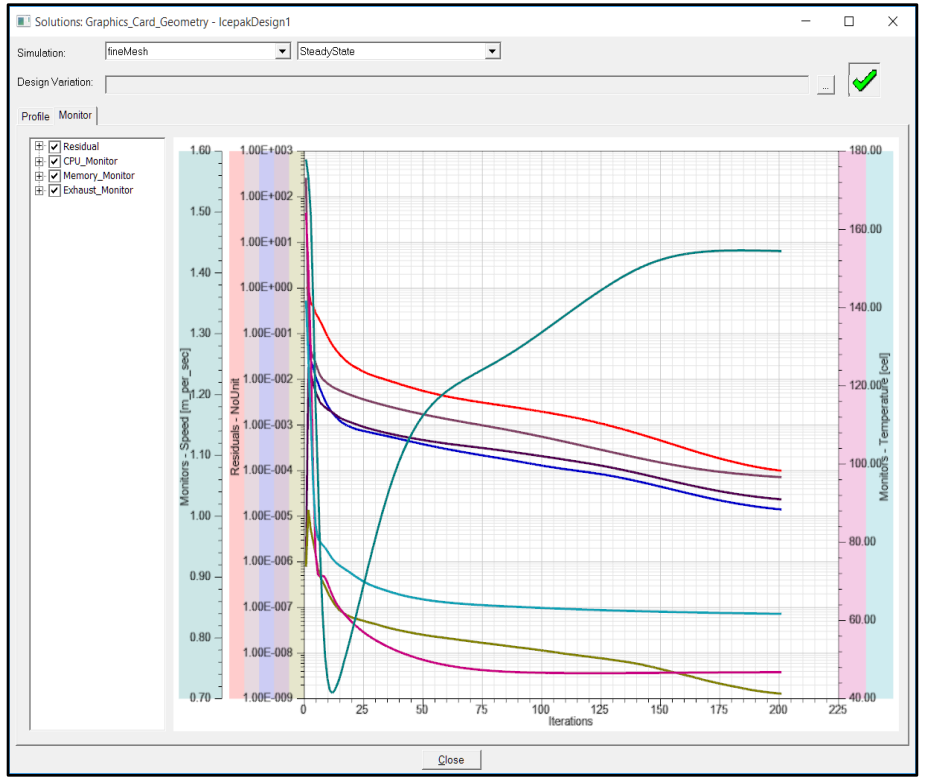
Convergence Criteria



Solution Initialization



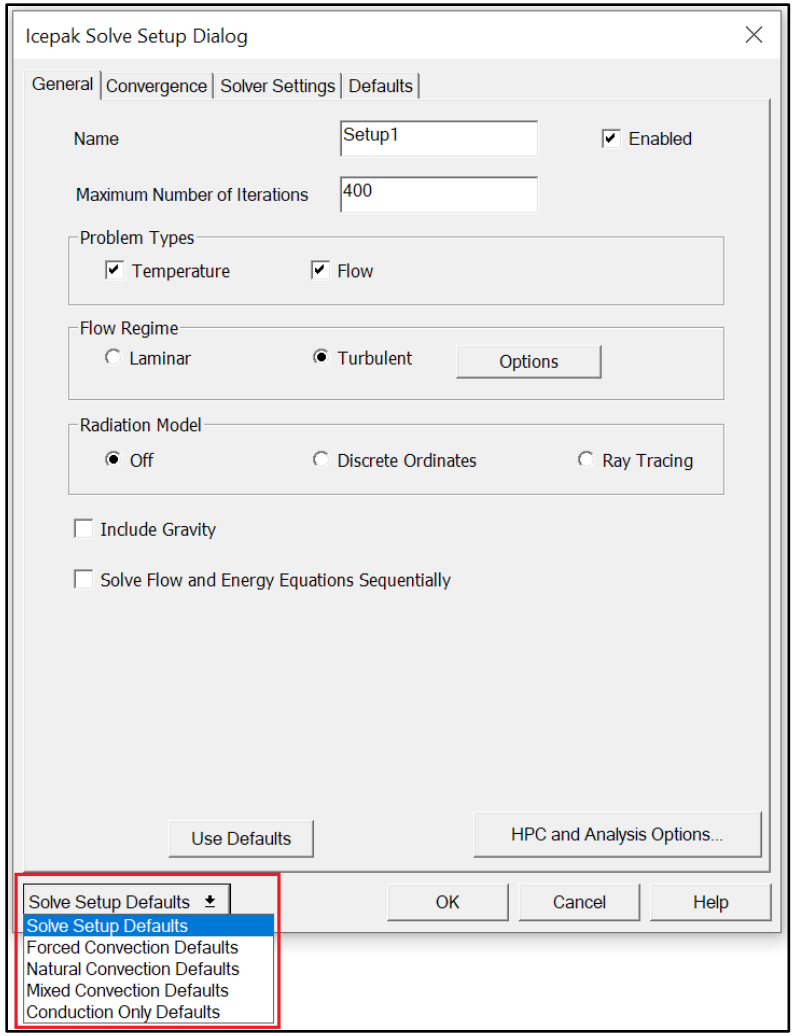
Convergence and Monitor Point Plots



- **Initial conditions are necessary to get the solver started.**
  - **For natural convection problems, a small velocity (~0.01 m/s) should be applied in the direction opposite to gravity.**
- **Convergence should be determined from both convergence residuals and monitor point plots.**
- **For steady state problems, convergence is achieved when monitor points flatten out.**

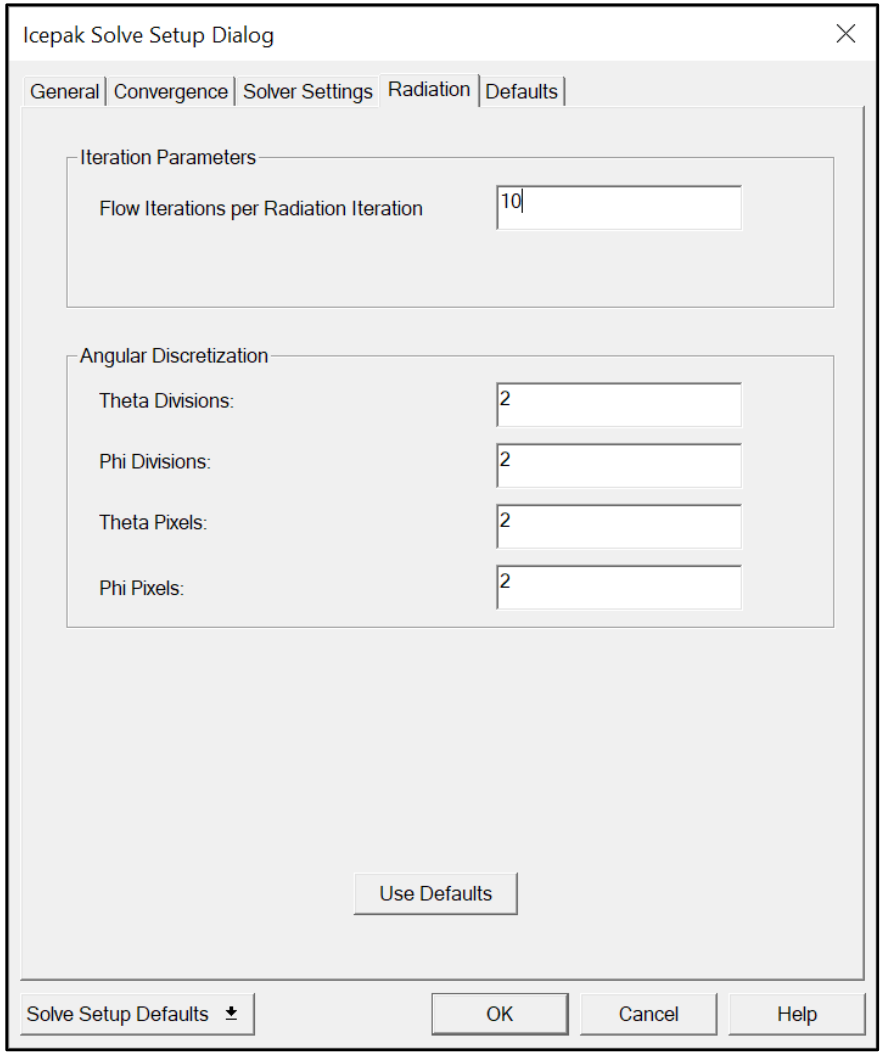
Solution Setup – Solve Setup Defaults

- **Convergence, solver and advanced settings can be set using defaults for Forced convection, natural convection, mixed convection and conduction only models**
- **Forced Convection**
  - Convergence criteria: Flow = 1e-3 and Energy = 1e-12
  - Solve Flow and Energy equation sequentially
  - Radiation and gravity is switched off
  - Under-relaxation Factor (URF): Pressure = 0.3, Momentum = 0.7
- **Natural and Mixed Convection**
  - Convergence criteria: Flow = 1e-3 and Energy = 1e-12
  - Gravity and radiation is ON
  - Default radiation model = Discrete Ordinate Model
  - A small velocity in the direction opposite to gravity as initial condition in steady state problems
  - URF: Pressure = 0.7, Momentum = 0.3
- **Conduction only**
  - Flow equations are switched OFF
  - Radiation is switched OFF

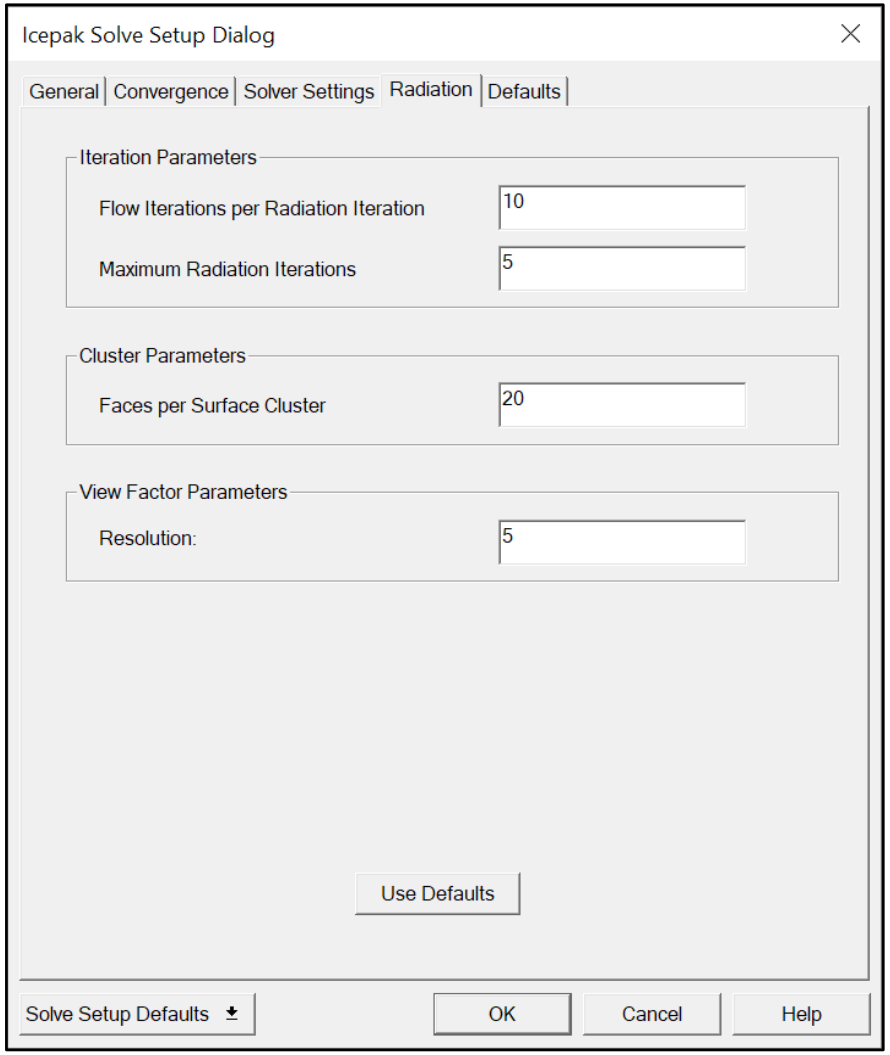


Radiation Settings

Discrete Ordinate Method



Ray Tracing Method



Post-Processing

Ansys

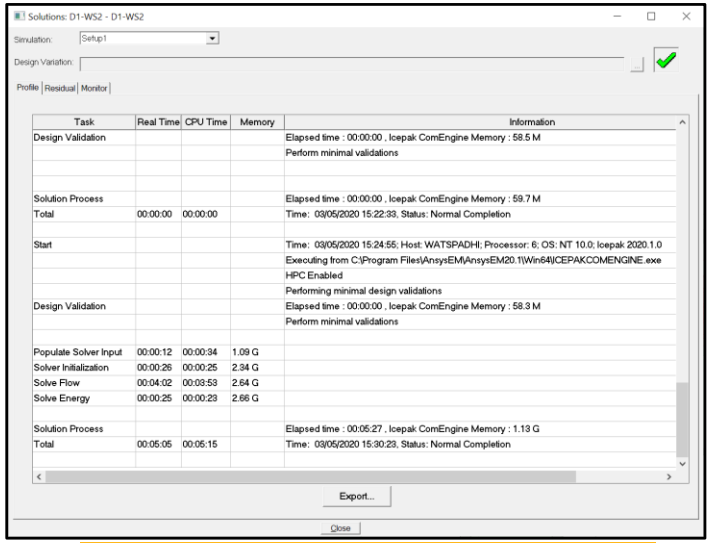
Post-processing – Formats

In AEDT Icepak, simulation results can be viewed in four different formats:

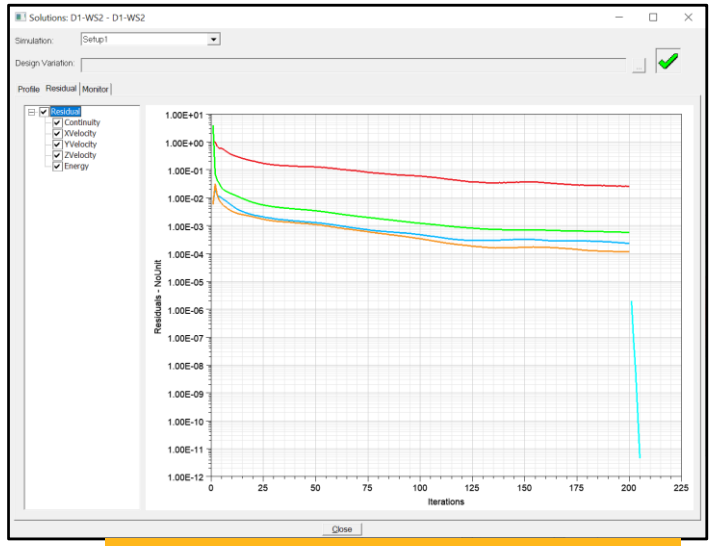
- **Solution Data**
  - Computing resources
  - Solution residuals, monitor point plots
- **Field Overlays**
  - Contour plots
  - Vector plots
- **Field Calculator**
- **Reports**
  - Fields summary

Post-processing – Solution Data

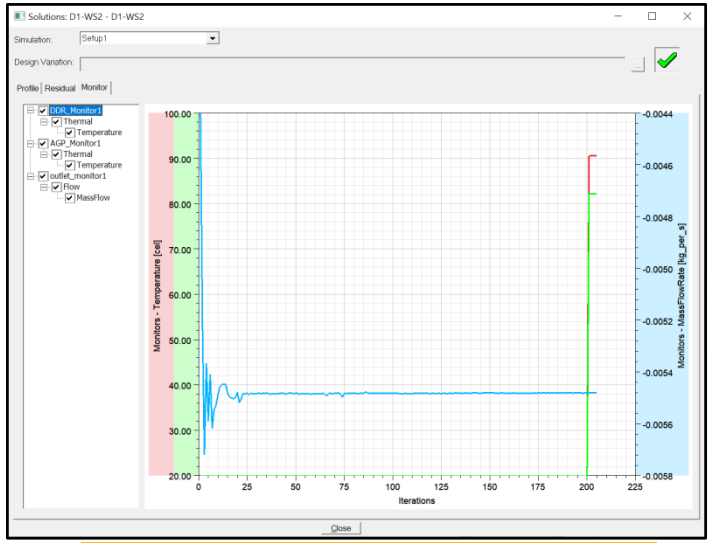
- Solution Data contains all the information related to the executed solution process.
- To view solution data, go to **Icepak > Results > Solution Data.**
- If there are multiple solutions, select a solution under **Simulation.**
- **Profile Tab:** Contains log of tasks performed by Icepak during the solution process and the time taken for each task. It also reports the physical memory used for each task.
- **Residual Tab:** Displays the solution residual
- **Monitor Tab:** Displays the monitor point plots



Profile Tab



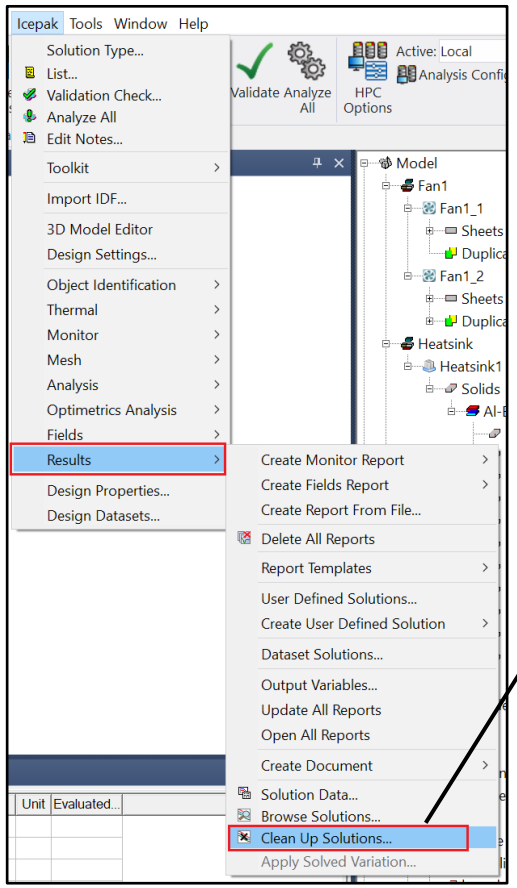
Residual Tab

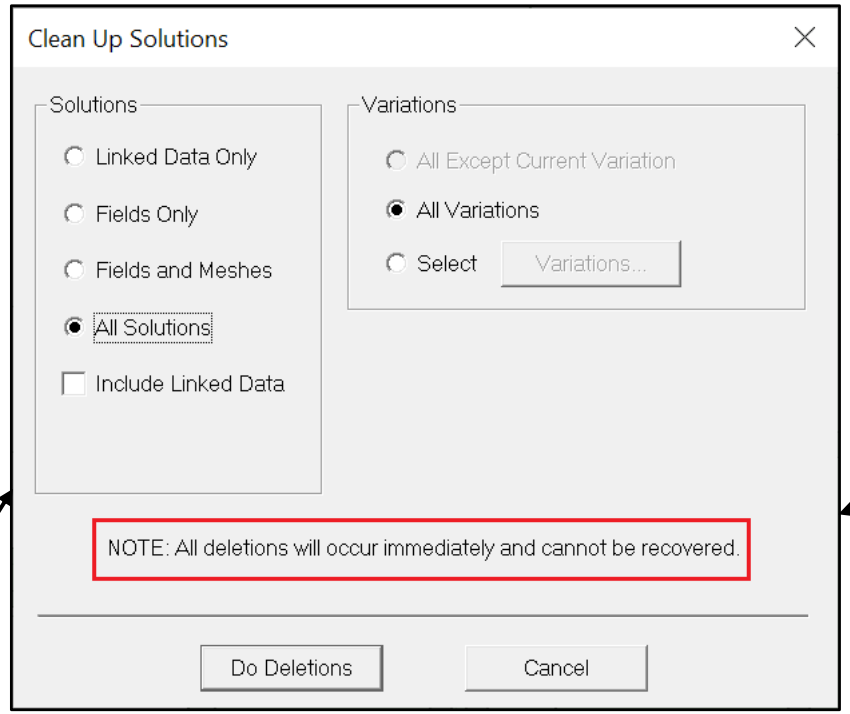


Monitor Tab

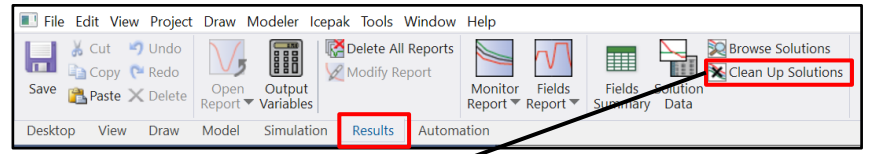
Post-processing – Delete Solution Data

- **Clean Up Solutions** can be used to selectively make deletions (fields only, fields and mesh etc.) or remove all solutions from the results.
- To delete solution(s), go to **Icepak > Results > Clean Up Solutions.**



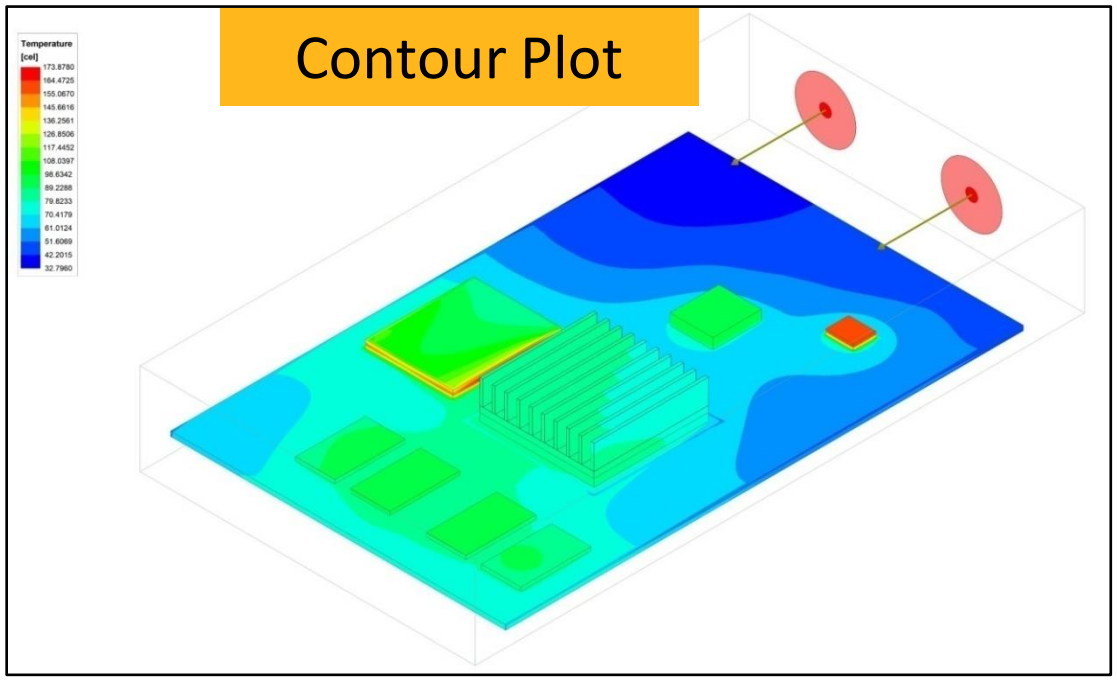


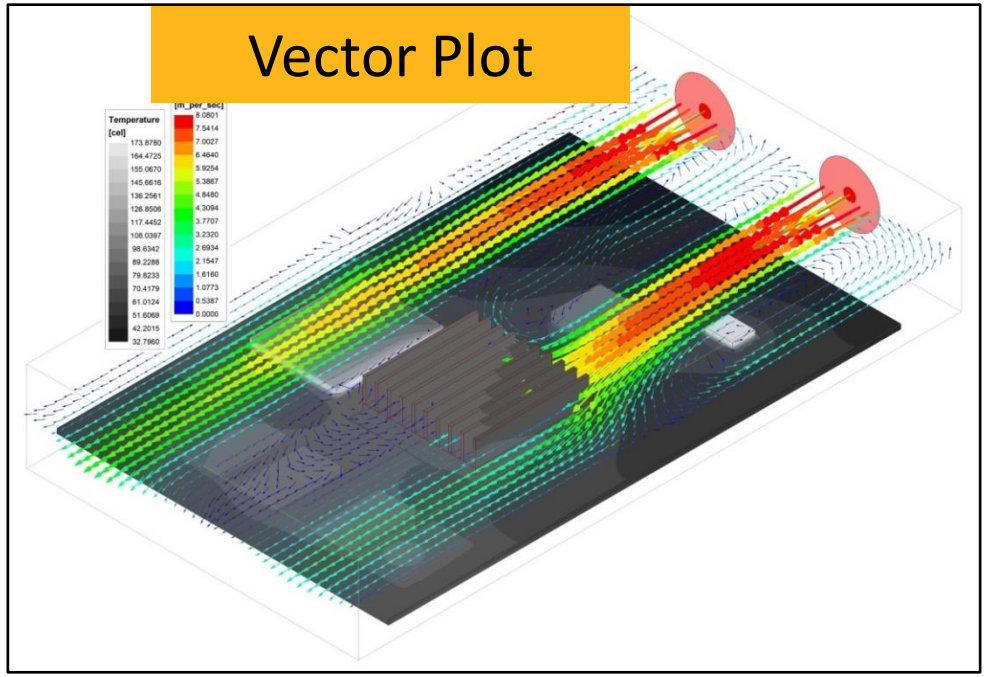
Ribbon



Post-processing – Field Overlays

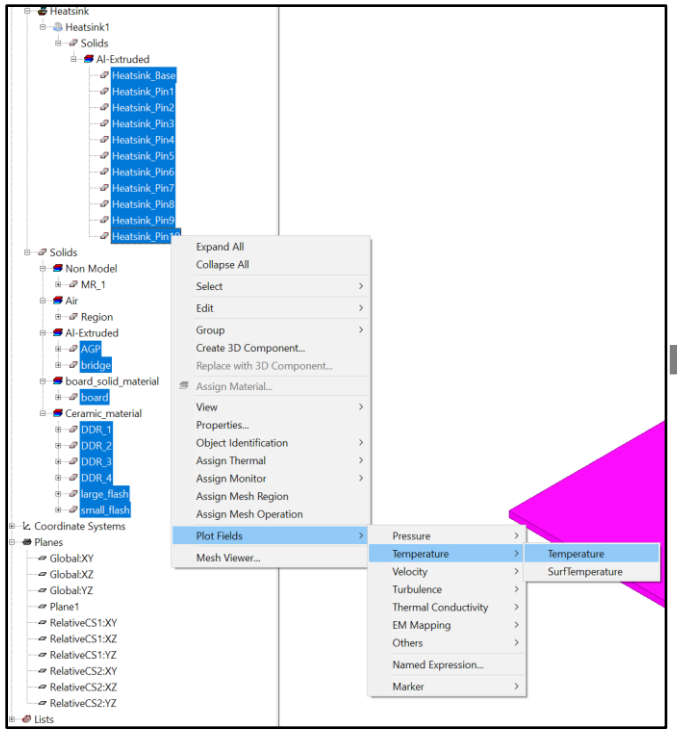
- Field overlays are representations of basic or derived field quantities on surfaces or volumes.
- All the basic field quantities (velocity, temperature) and built-in derived quantities (heat flux, heat transfer coefficient, etc.) can be directly used for plotting.
- Additional quantities can be derived using **Fields Calculator** and used for plotting.
- A field plot can be a contour plot or a vector plot.

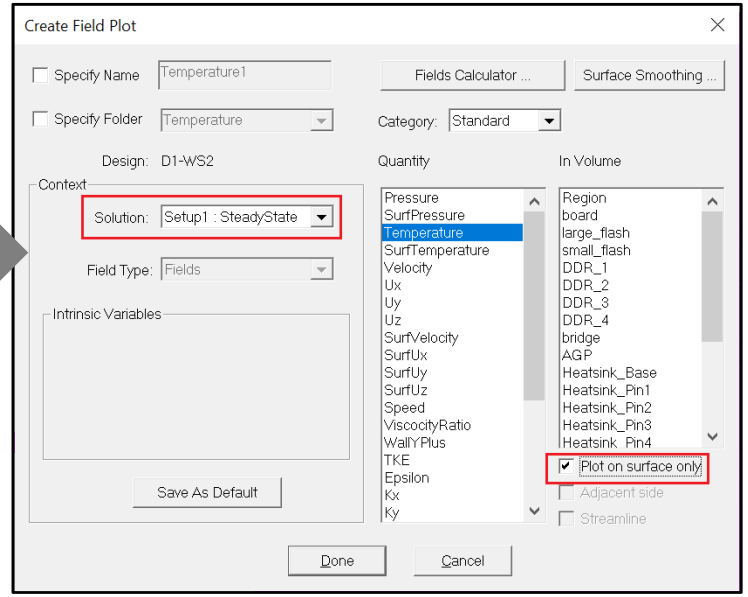


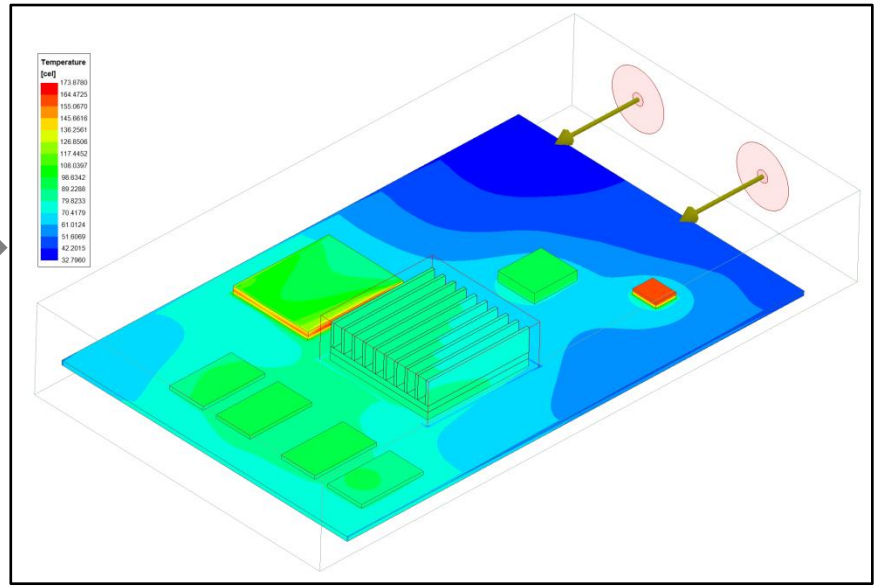


Post-processing – Field Overlays – Contour Plots

- To create contour plots on surfaces of objects or planes, select those entities in the History Tree.
- Right-click **Field Overlays** in the Project Manager and select **Plot Fields → **Field Quantities*.***
- To view contours on object surfaces only, in the **Create Field Plot** panel enable **Plot on surface only.**
- If there are multiple solutions, choose the solution data to be used under **Context → Solution** in the Create Field Plot panel.
- The new plot appears in the GUI and is also listed in the Project Manager.

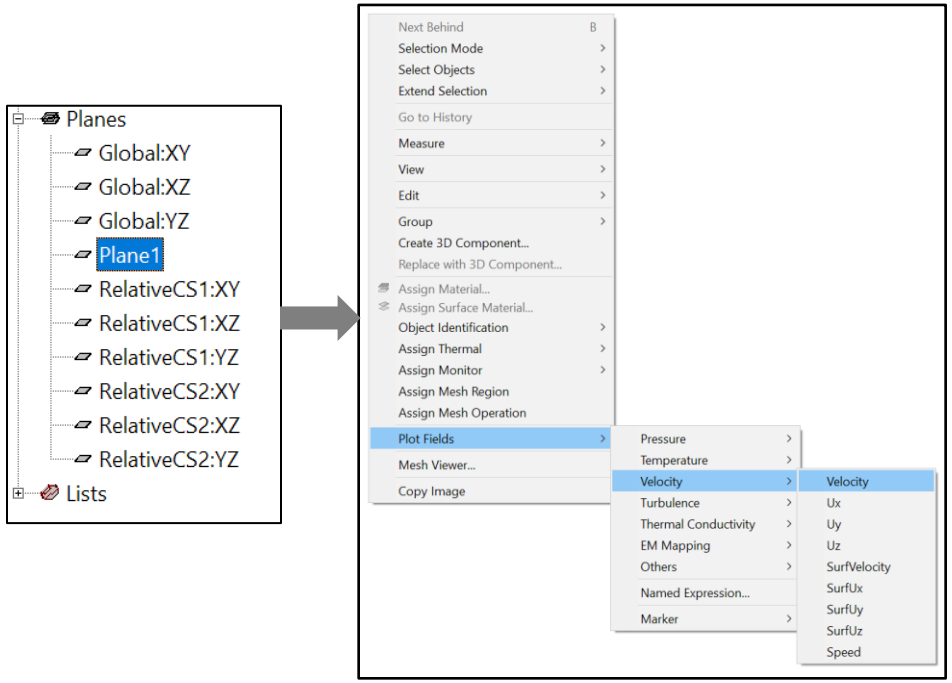


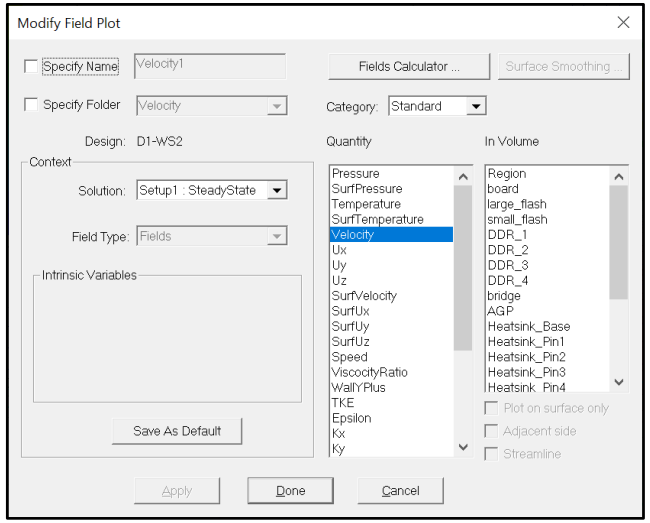


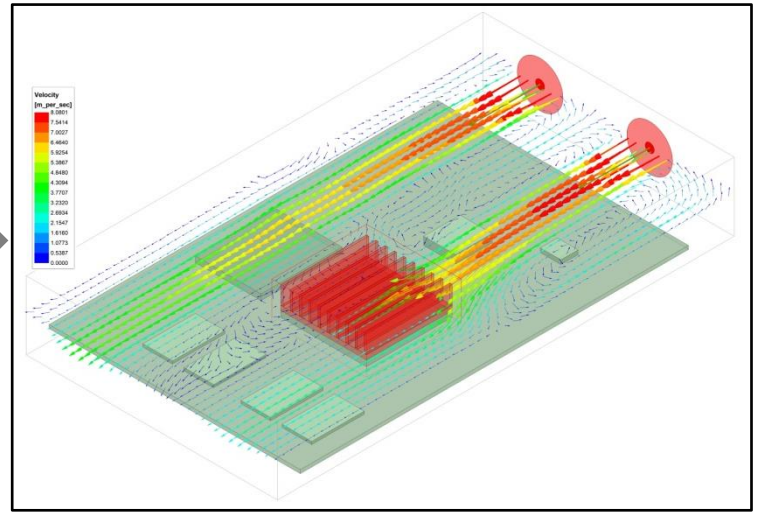


Post-processing – Field Overlays – Vector Plots

- To create vector plots, first select the entity (plane, point, etc.) in the History Tree.
- Right-click **Field Overlays** in the Project Manager and select **Plot Fields → Velocity.**
- The vector plot will be displayed on the selected entity and is also listed in the Project Manager.

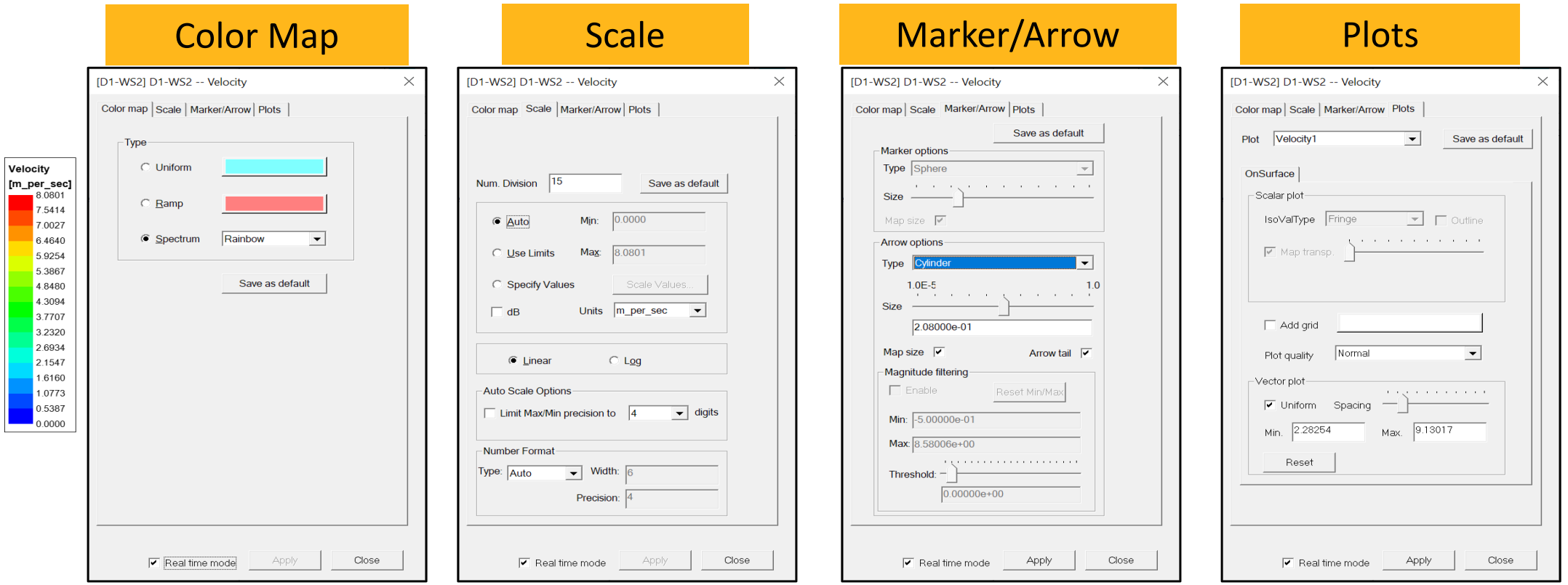






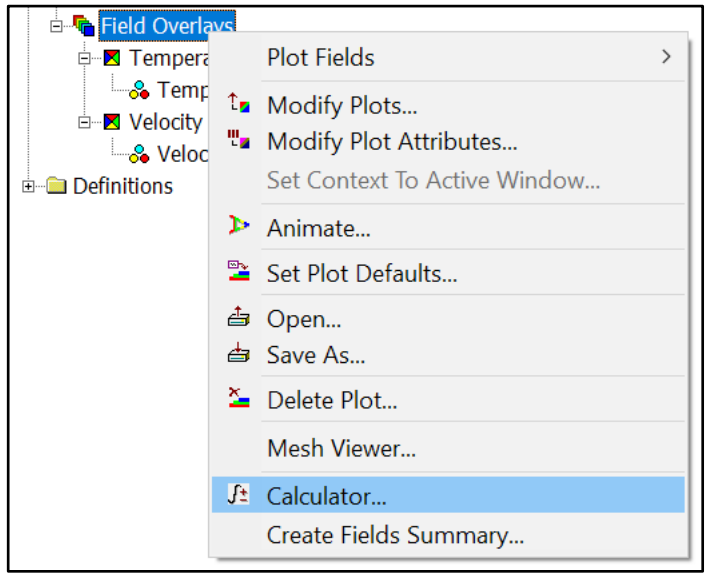
Post-processing – Plot Attributes

- Double-click on the color legend to open the modify plot attributes panel.
  - **Color Map:** Sets predefined color schemes.
  - **Scale:** Sets range and number of colors to plot.
  - **Marker/Arrow:** Sets size and style of arrows for vector plots.
  - **Plots:** Sets display style of contour plots and arrow density of vector plots.



Post-processing – Fields Calculator

- Field calculator enables the user to create customized expressions using basic field quantities.
- The resulting quantities can be plotted, tabulated or exported.
- To open **Fields Calculator**, right-click on **Field Overlays** in the Project Manager and select **Calculator.**
- Alternatively, go to **Icepak → Fields → Calculator** to open the same panel from the main menu.



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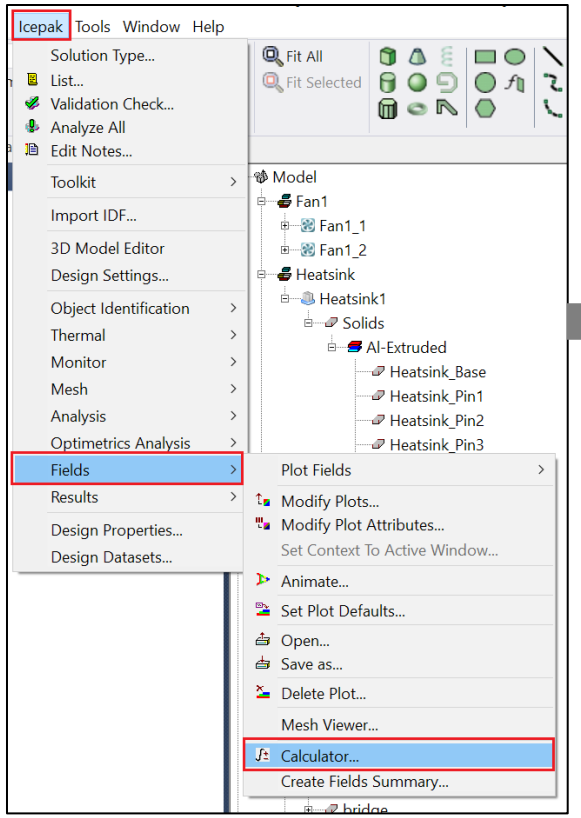
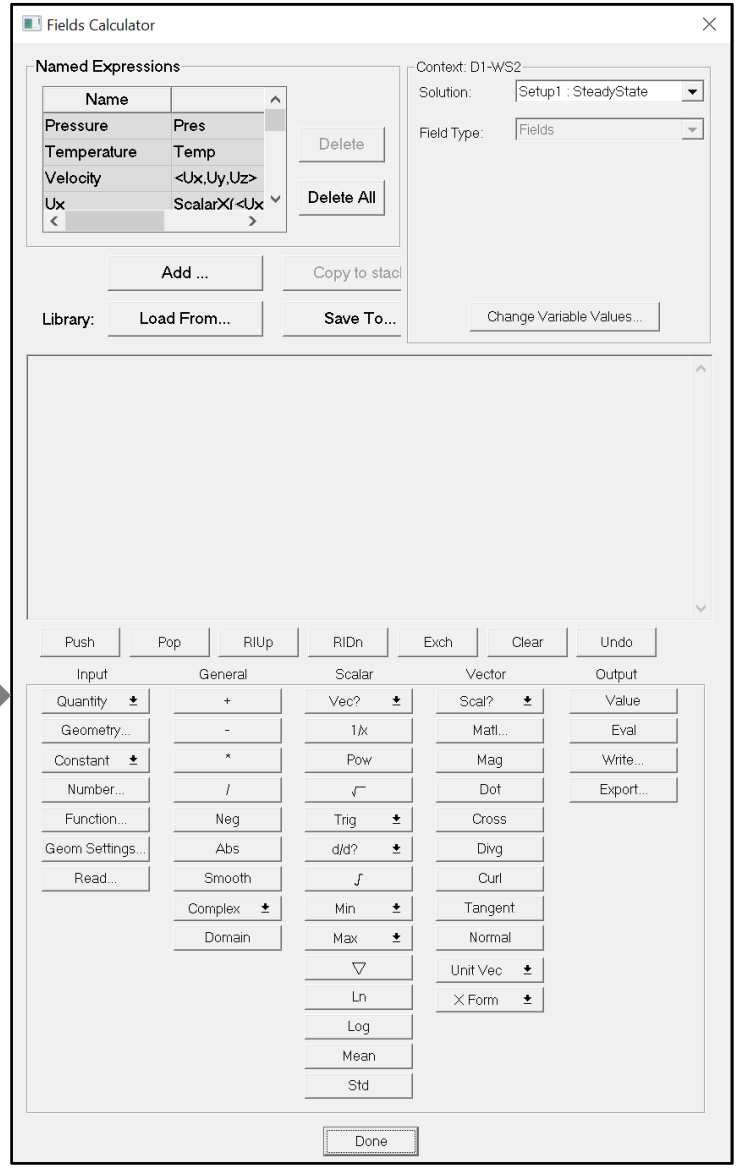
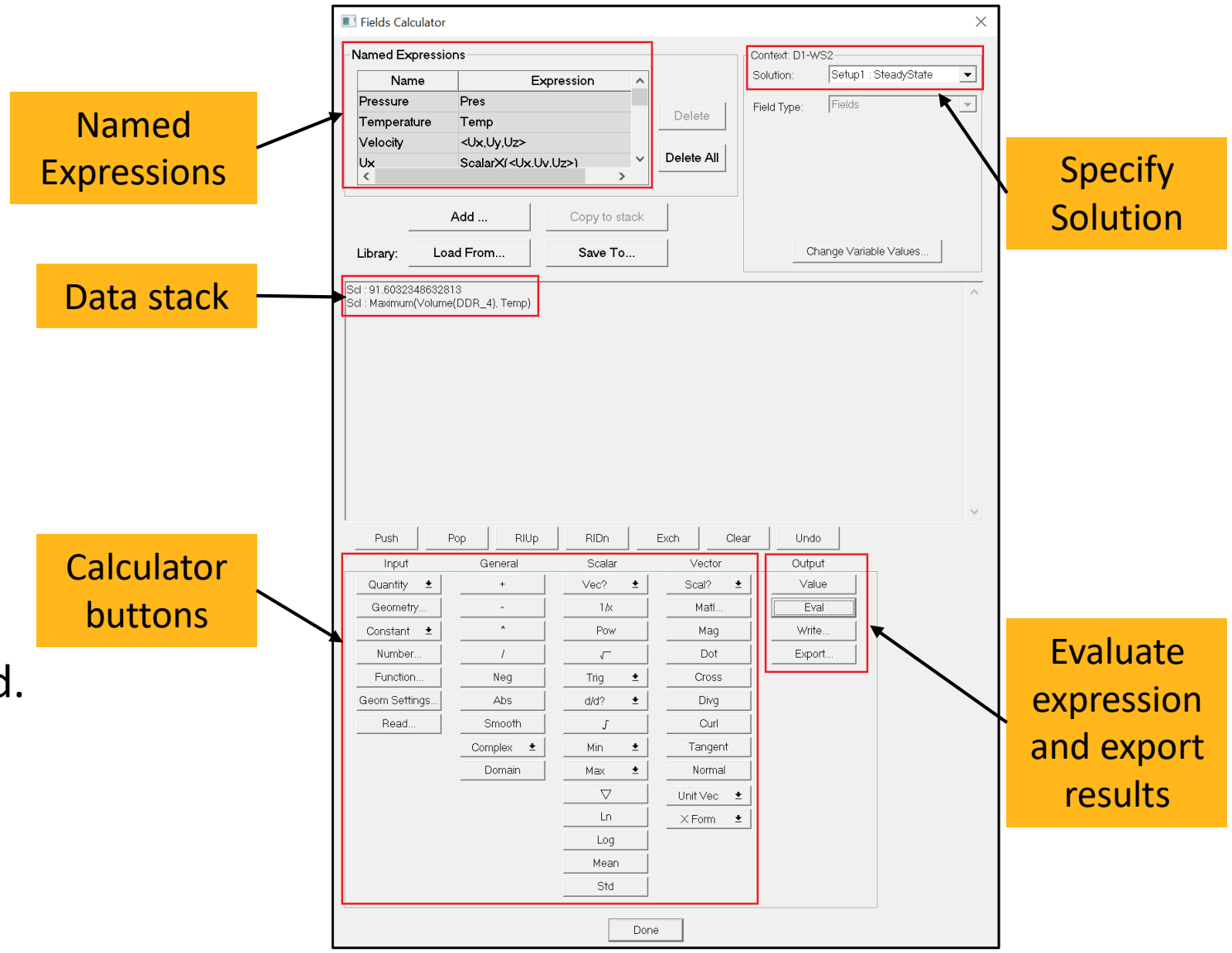




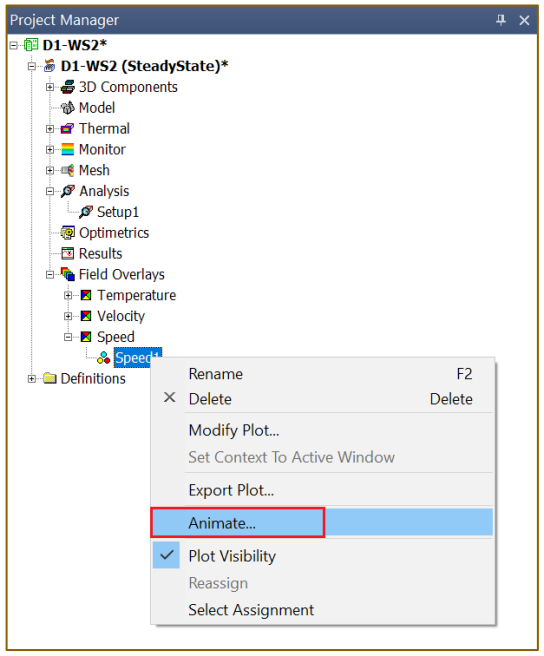
Post-processing – Fields Calculator

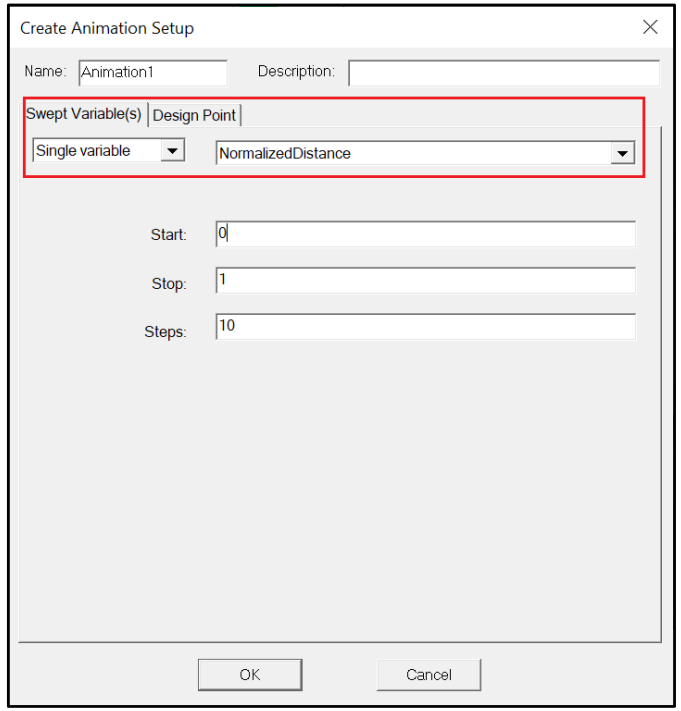
- **Named Expressions** list standard or user defined field quantities.
- **Context** section specifies which Solution data to use.
- **Data Stack** lists the calculator entries, which are held in stack registers.
- **Calculator buttons** are organized into columns, classifying them by the type of operation and type of data, upon which the operation can be performed.
- Expressions can be evaluated or exported using the buttons under the **Output** section.

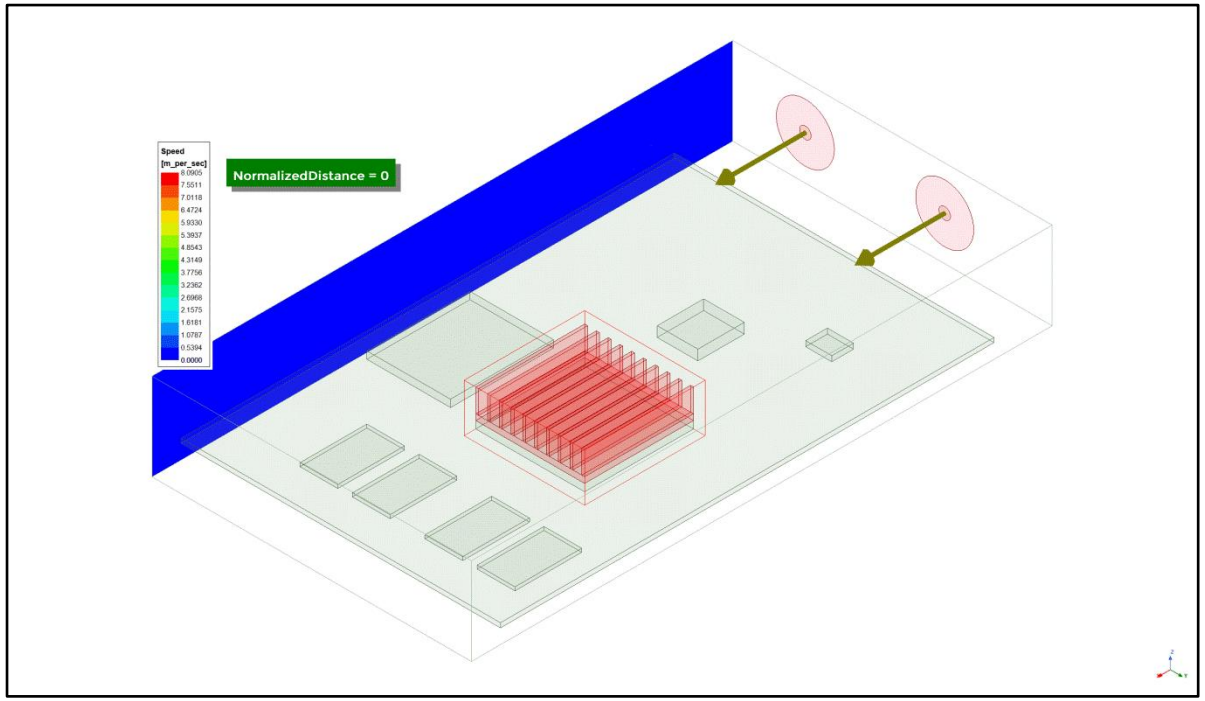


Post-Processing – Field Animations

- An animated plot is a series of frames that displays changes in a field, mesh or geometry.
- To create an animation, right-click an existing field plot and select **Animate.**
- To animate from one end of the cabinet to the other, choose **NormalizedDistance** for Swept variable.
- **Steps** will set the number of frames to be displayed between the two ends of the Cabinet.

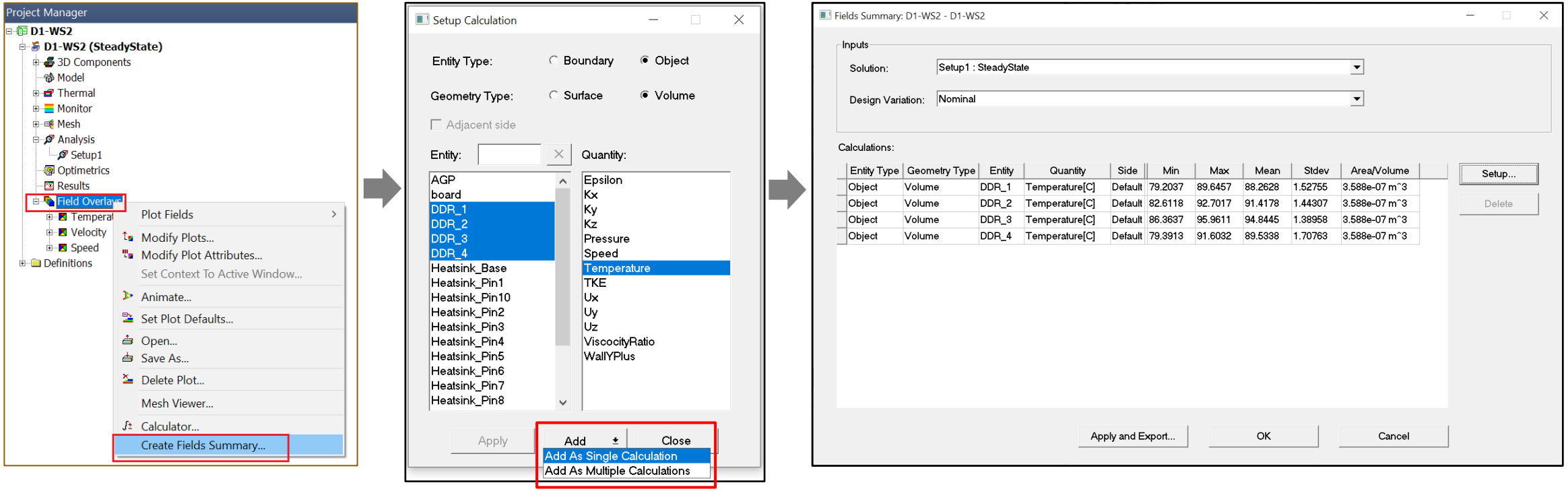






Post-processing – Fields Summary

- Fields summary can be used to create a summary report.
- In the Project Manager, right-click Field Overlays and select **Create Fields Summary.**
- In the **Setup Calculation** panel, select the Entity and the Quantity for generating the report.
- You can add as either a single calculation (one row) or multiple calculations (many rows).



End of presentation