Icepak Boundary Condition Usage in RHSC-ET

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Contents

Introduction

Thermal BC of package from system level analysis (Icepak) can be extracted and used for system-aware chip/package thermal analysis.

If the case includes Heatsink and need to consider wind or other forced airflow, recommend selecting the Icepak Boundary Condition.

Please notes, if user wants to use internal Icepak boundary condition, please install AEDT Icepak first and set AEDT Icepak license.

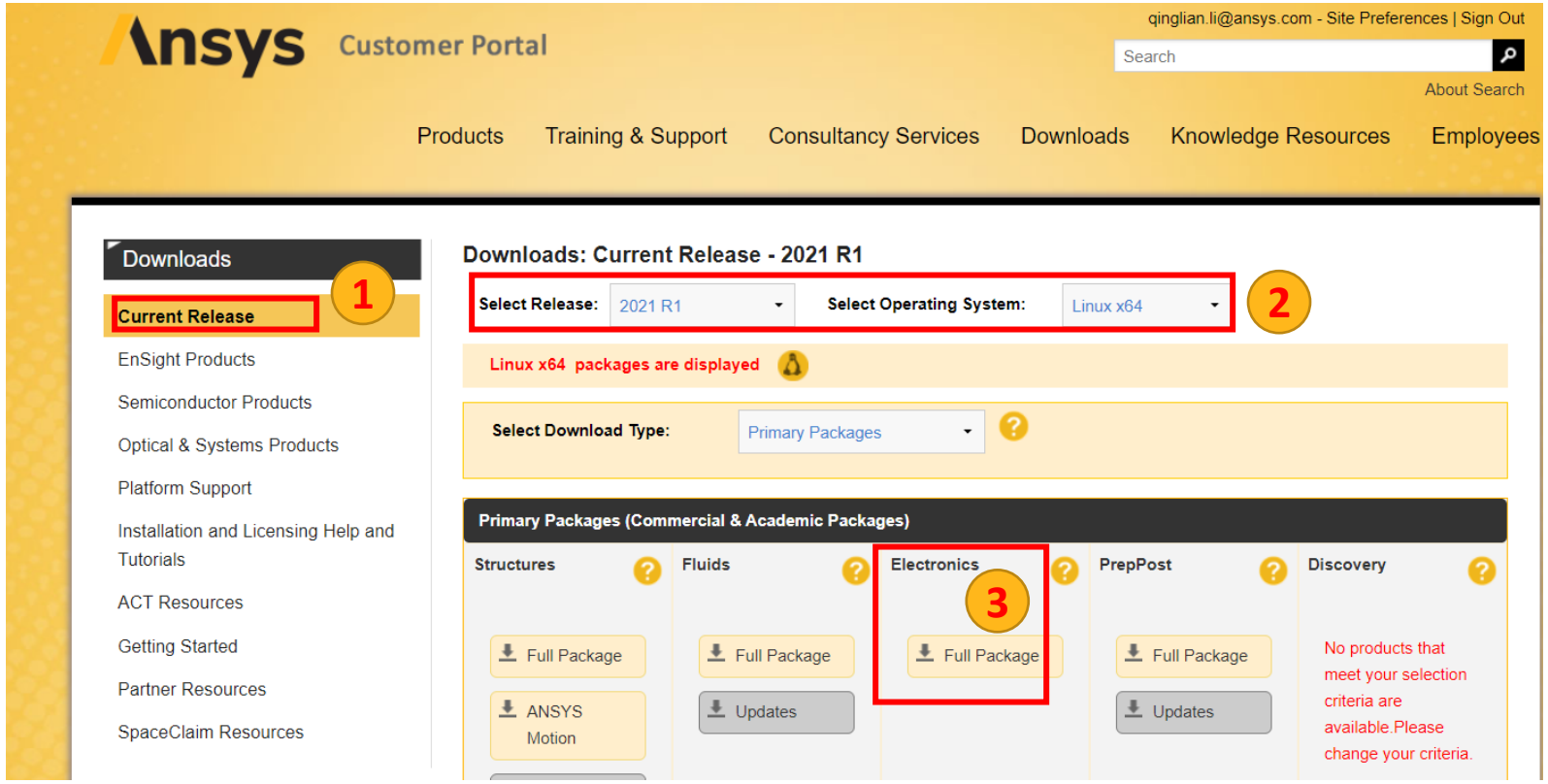
Install Electromagnetics Suite

Download Ansys Electromagnetics Suite Software

Download release tar ball.

Go to Ansys Customer Portal using below link:

https://download.ansys.com/Current%20Release?releaseno=2020%20R2&operatingsystem=Linux%20x64#

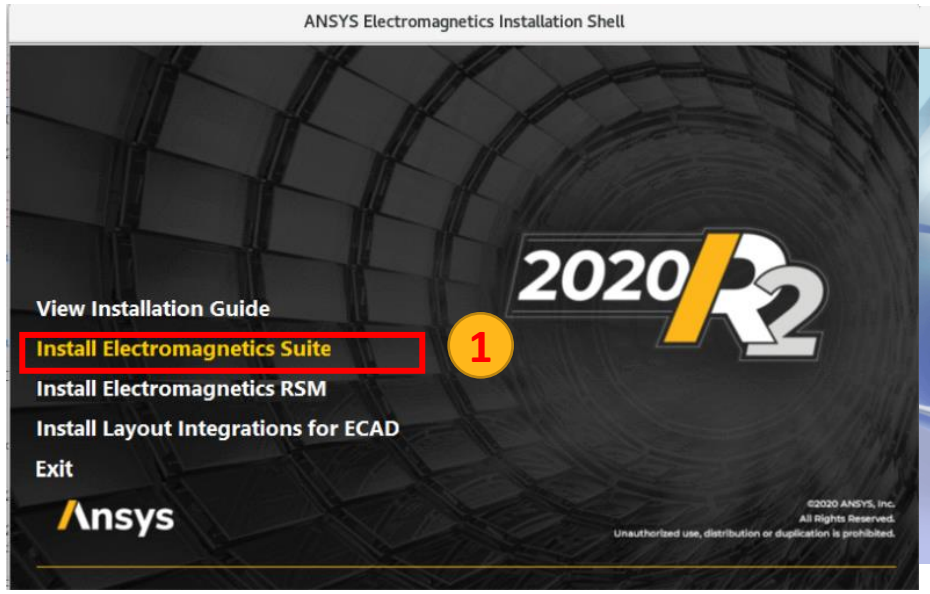


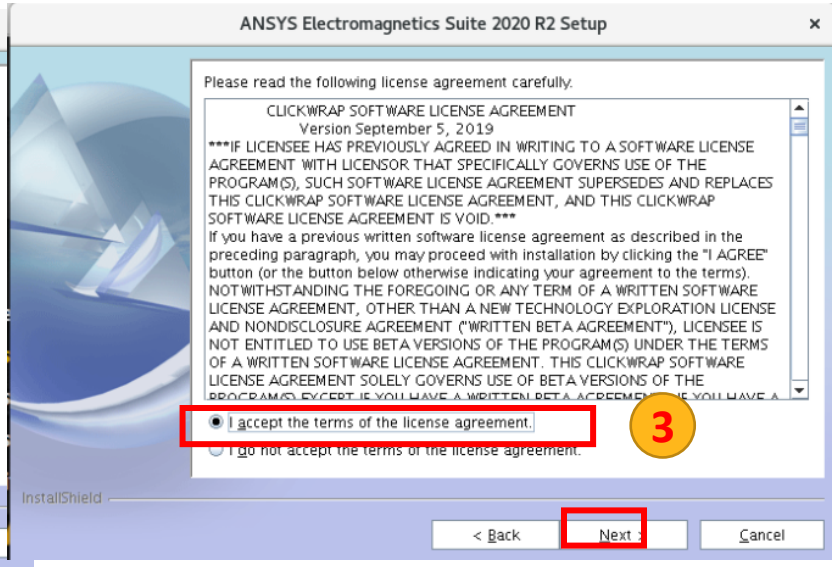
1.Click Current Release item.
2.Select the release version and the Linux operating system.
3.Download the package.

Program Installation

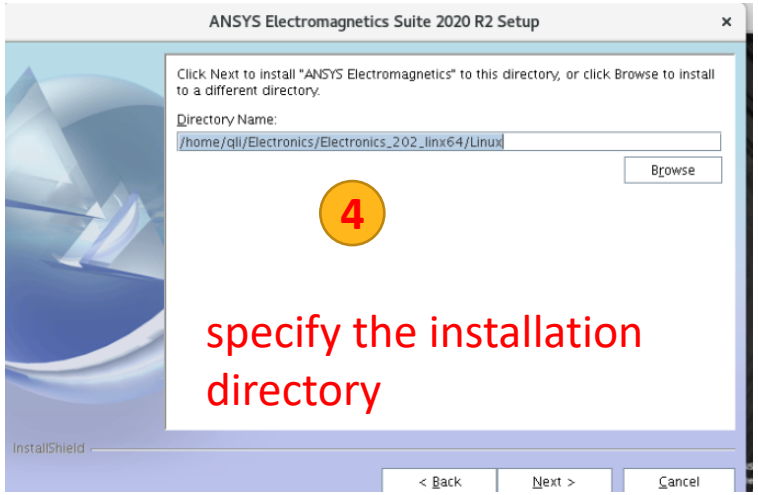
Download the software in the <*tarball_directory*>, such as /disk1/ecad, from where you want to install Electromagnetics Suite. Follow the instructions below.

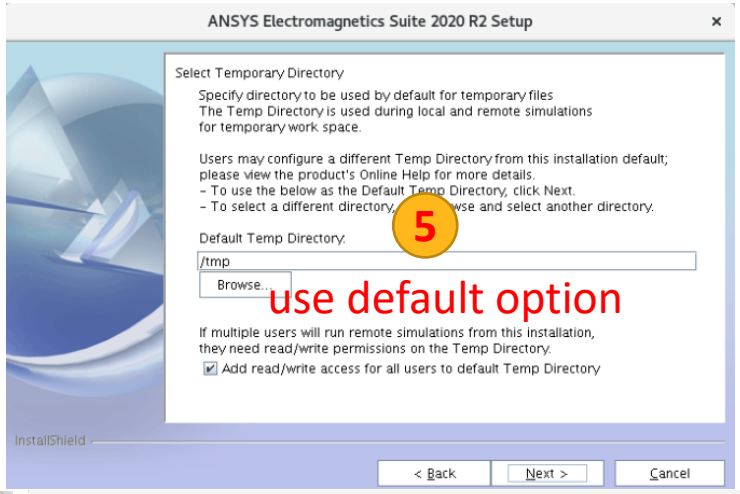
- cd <*tarball_directory*>
- unzip Electronics_202_linx64.tar.gz
- go to <*tarball_directory*>/Electronics_202_linx64/
- run **install**, then follow the installation steps.

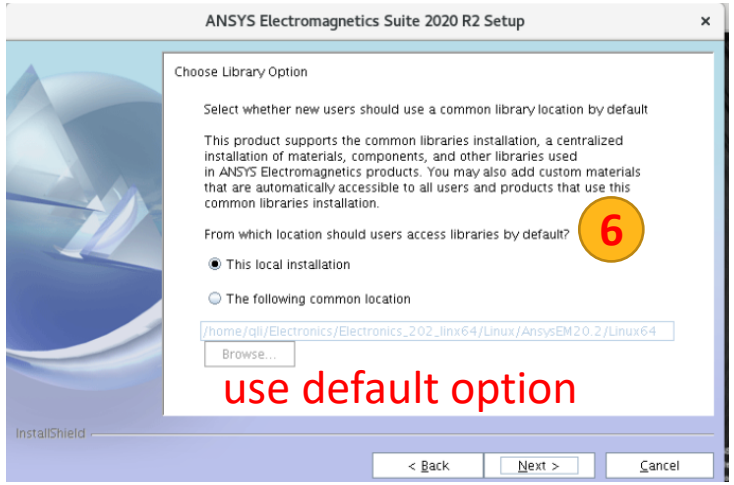


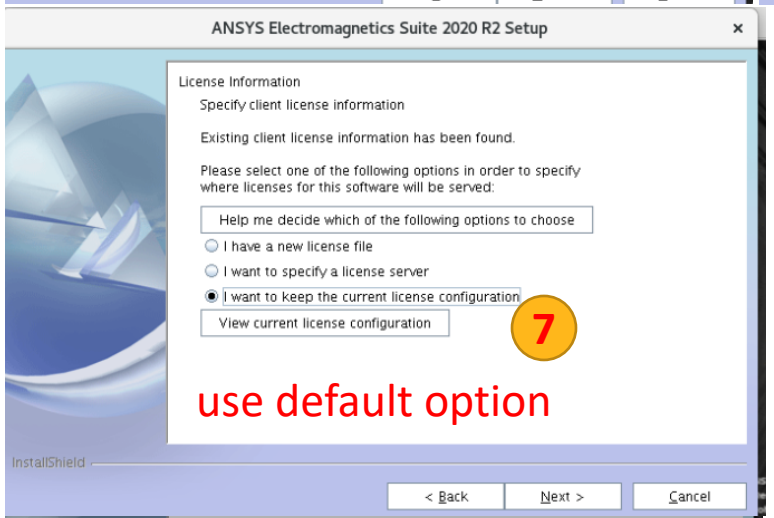


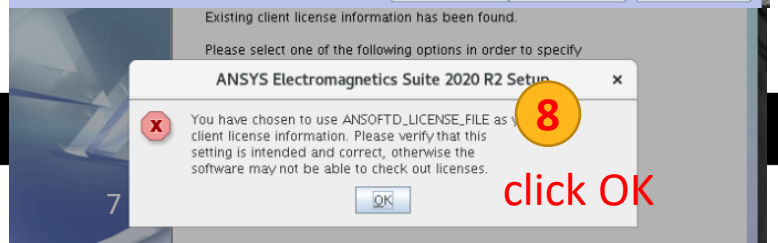
Program Installation

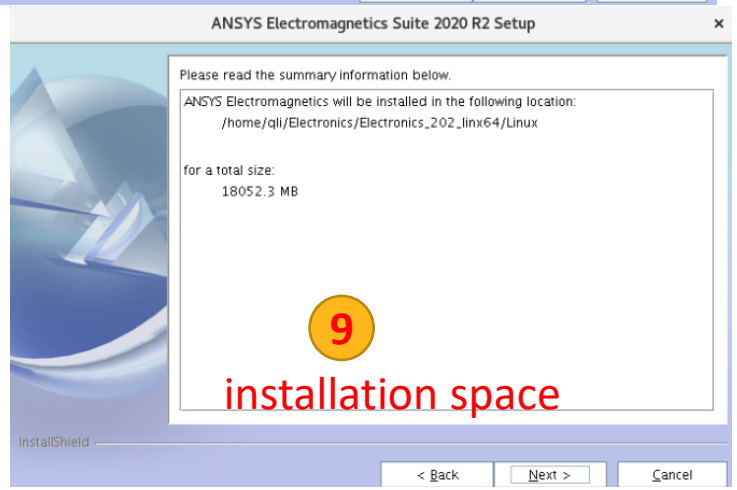


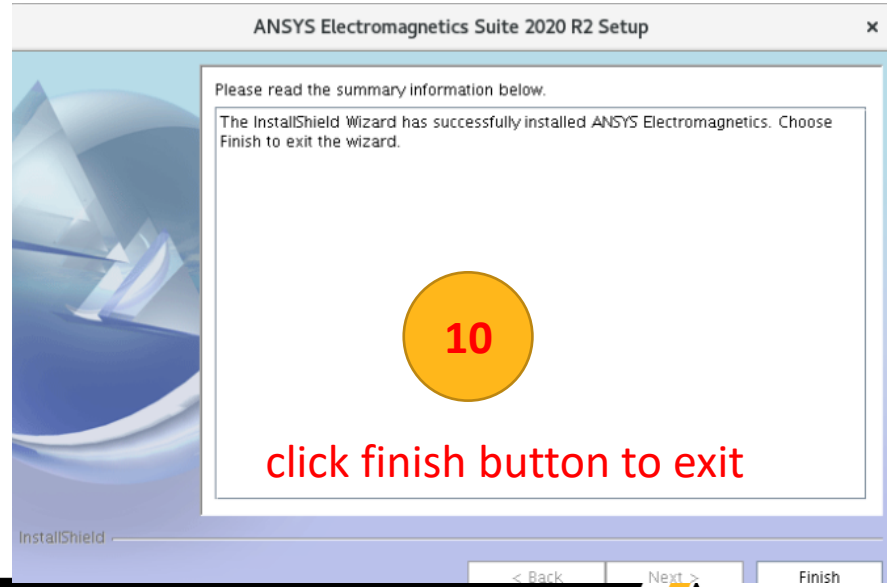












Internal Icapak Boundary Condition Usage In RHSC-ET

Set the Environment

- **Set RedHawk-SC Electrothermal license:**
  setenv APACHEDA_LICENSE_FILE <To your redhawk_cta, redhawk_cta_ex or redhawk_sc_electrothermal license> **or**
  setenv LM_LICENSE_FILE <To your redhawk_cta, redhawk_cta_ex or redhawk_sc_electrothermal license>

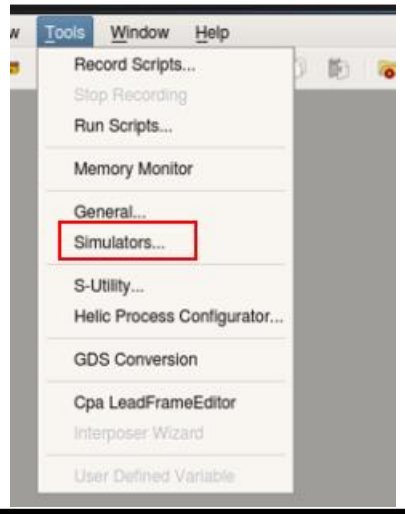
- **Set Ansys Electromagnetics Suite license:**
  setenv ANSYSLMD_LICENSE_FILE <ansys electromagnetics suit license>

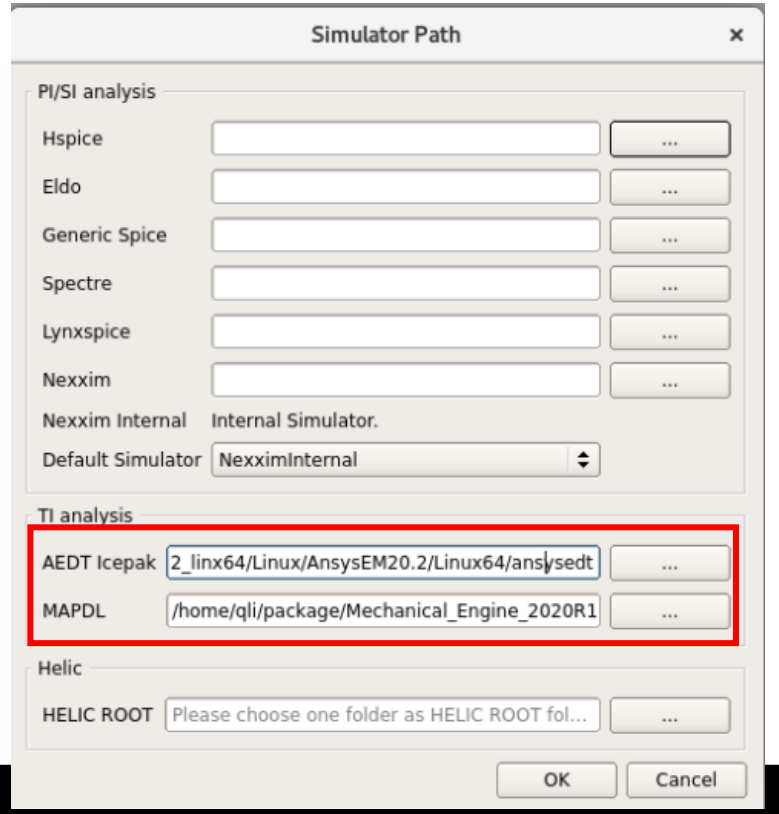
- **Please make sure using 3dic option.**
  redhawk_sc_et -3dic

Add AEDT Icepak through GUI

Open RHSC ET GUI to set the AEDT Icepak path by the following steps.

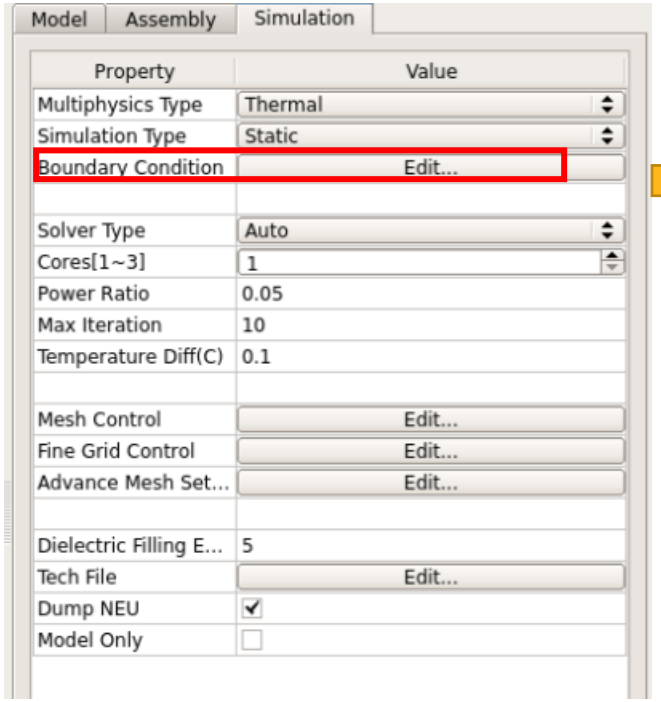
1. Click "Tools" -> "Simulators" to open Simulator Path dialog box.
2. Enter the AEDT Icepak and MAPDL path, for example, *"/appls/tools/snpkg/mapdl/v201/ansys/bin/mapdl"* and *"/home/qli/Electronics/Electronics_202_linx64/Linux/AnsysEM20.2/Linux64/ansysedt"*
3. And set the default simulator to NexximInternal, then click OK

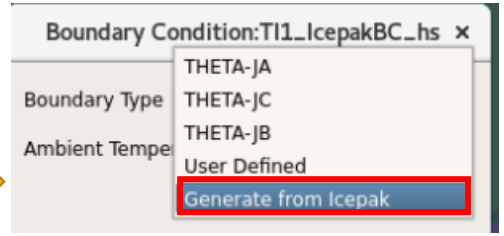


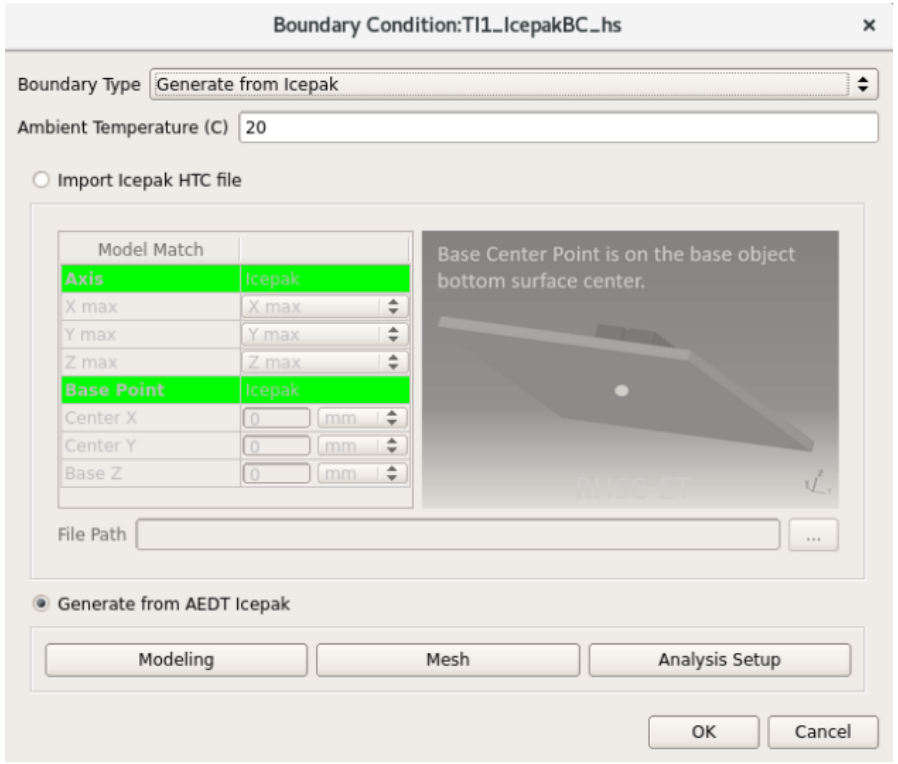


AEDT Icepak usage in RH-SC ET

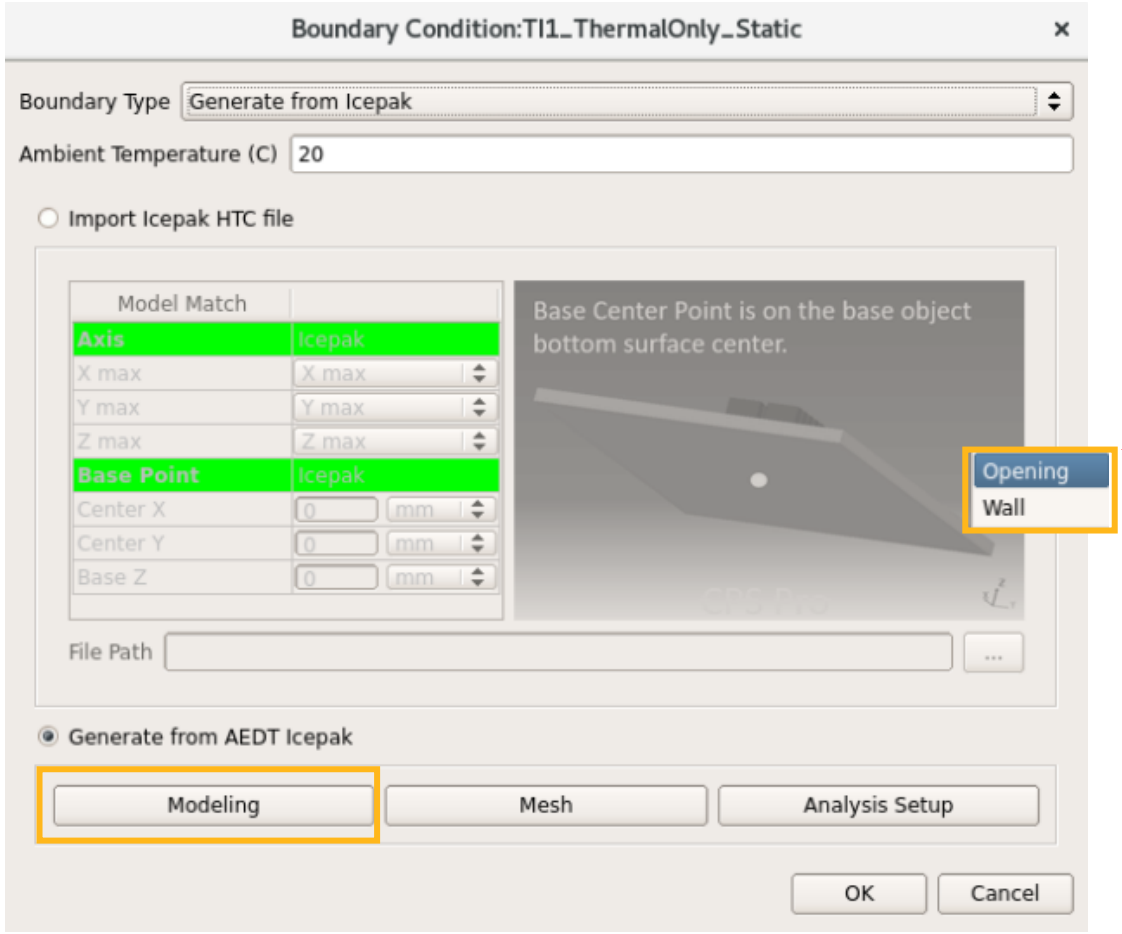
Go to Simulation tab of thermal analysis model, click **Boundary Condition -> Generate from Icepak -> Generate from AEDT Icepak**, then do the Icepak setting.

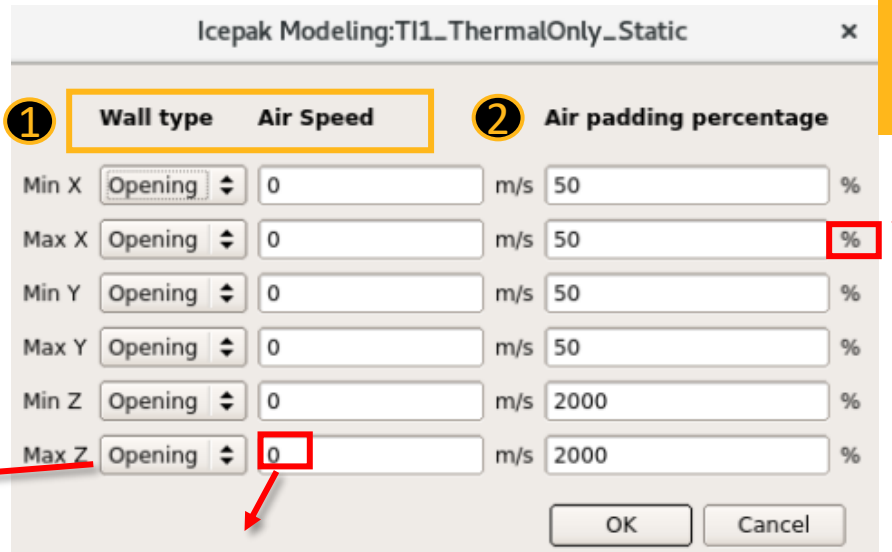






AEDT Icepak Setting - Modeling



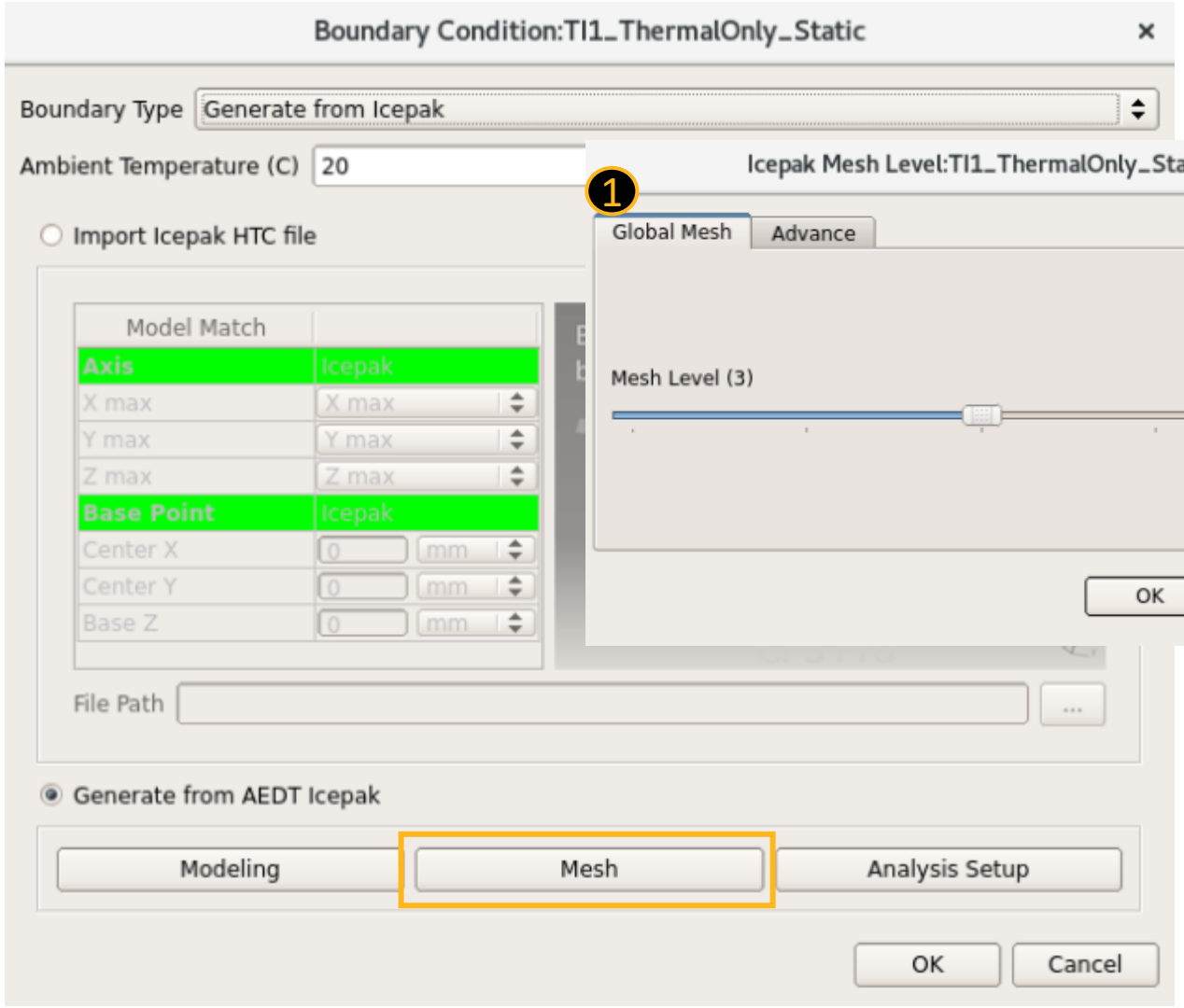


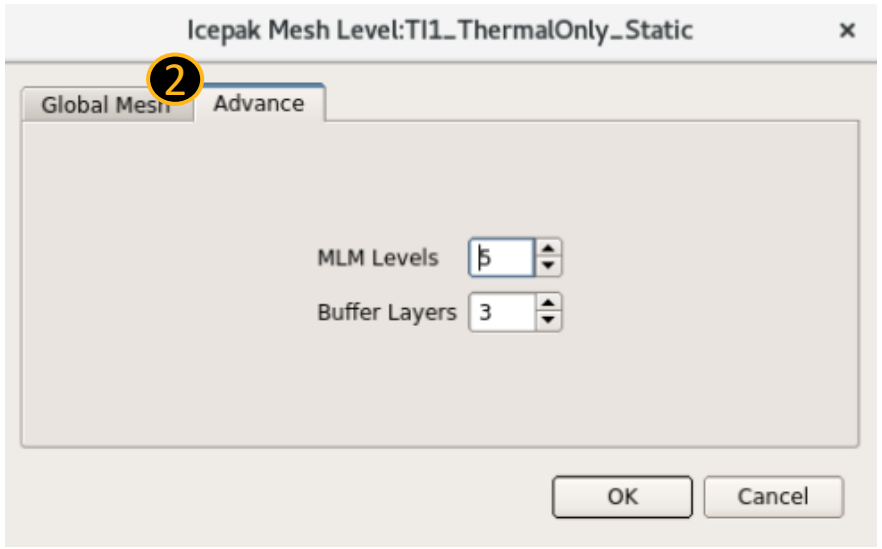
specify the size of the air box is to an extent of 50% in the Xmax direction.

If it's a positive value, the air speed is going from min to max, if it's a negative value, the air speed is going from max to min.

1. Wall type and Air speed:
   Please consider the settings according to the real test conditions or product real working environment conditions,
2. Air padding percentage:
   a. Usually, for X and Y direction, 50% is good for simulation,
   b. For Z direction, please adjust this value based on the model total thickness.
      - Recommend settings:
      - w/o heatsink, input 2000 ~ 1000.
      - w/ heatsink, input 200~400

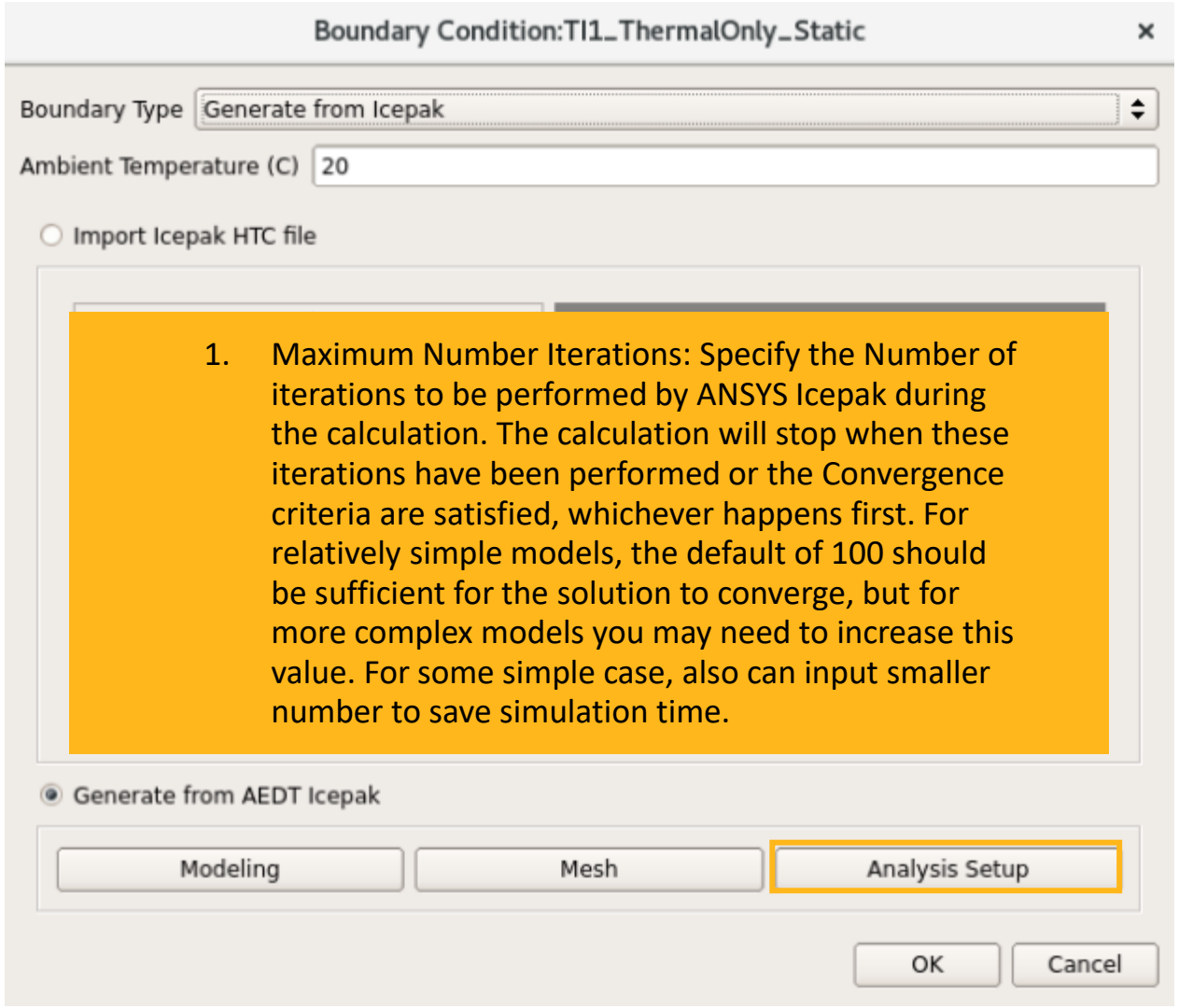
AEDT Icepak Setting - Mesh



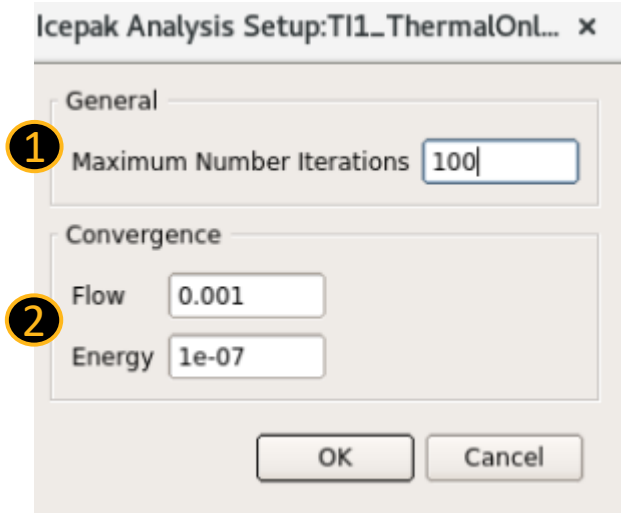


1. Global Mesh:
   5 mesh levels provided. Default level is 3. User can modify this number according to the case.
2. Advanced:
   a. MLM(Multi-level meshing) Levels: default number is 5. If the objects in some case have very different sizes, recommend to add the level to 7 or more. The simulation time will increase.
   b. Buffer Layers: recommend to use the default number. For some very special cases, user can adjust the number to try the simulation convergence.

AEDT Icepak Setting - Analysis Setup



1. Maximum Number Iterations: Specify the Number of iterations to be performed by ANSYS Icepak during the calculation. The calculation will stop when these iterations have been performed or the Convergence criteria are satisfied, whichever happens first. For relatively simple models, the default of 100 should be sufficient for the solution to converge, but for more complex models you may need to increase this value. For some simple case, also can input smaller number to save simulation time.



2. Convergence: These are the solution-residual values used to determine convergence. Solution residuals measure the error or imbalance in the conservation equations that ANSYS Icepak solves, and are defined in Solution Residuals. When all solution residuals are less than or equal to their specified convergence criteria, the solution will be considered converged. You can adjust the convergence criteria values that are suitable for the type of problem you are trying to solve.

   Flow: 0.01, 0.001, 0.0001
   Energy: 1e-07, 1e-08, 1e-09, …

AEDT Icepak Boundary Condition

During simulation, AEDT would generate a system level Icepak boundary condition file htc.fld, then ET imports this file to run system-aware chip/package thermal analysis.

```
[qli@shhcpsqa1][/home/qli/testcase/CoWoS/analysis/TI1_IcepakBC_hs]> ll Icepak/
total 62796
-rw-rw-r--. 1 qli qli   125640 Feb 21 13:18 IPK_RH_pythondrive.aedt
drwxr-xr-x. 4 qli qli      110 Feb 21 13:18 IPK_RH_pythondrive.aedtresults
-rw-rw-r--. 1 qli qli      919 Feb 21 13:19 IcepakScripts.log
-rw-rw-r--. 1 qli qli    51150 Feb 21 12:58 IcepakScripts.py
-rw-rw-r--. 1 qli qli 64115910 Feb 21 13:18 htc.fld
```

If the case include Heatsink and need to consider wind or other forced airflow, strongly recommend selecting the Icepak Boundary Condition.

RHSC-ET exports power map and converts to the data sheet format for AEDT-Icepak.

Simplify the simulation model for AEDT-Icepak simulation. Create model with dimensions in Python.

BC simulation in AEDT-Icepak

- Modeling
- Mesh
- Analysis setup
- Simulation
- Export HTC

The HTC file format is .fld.

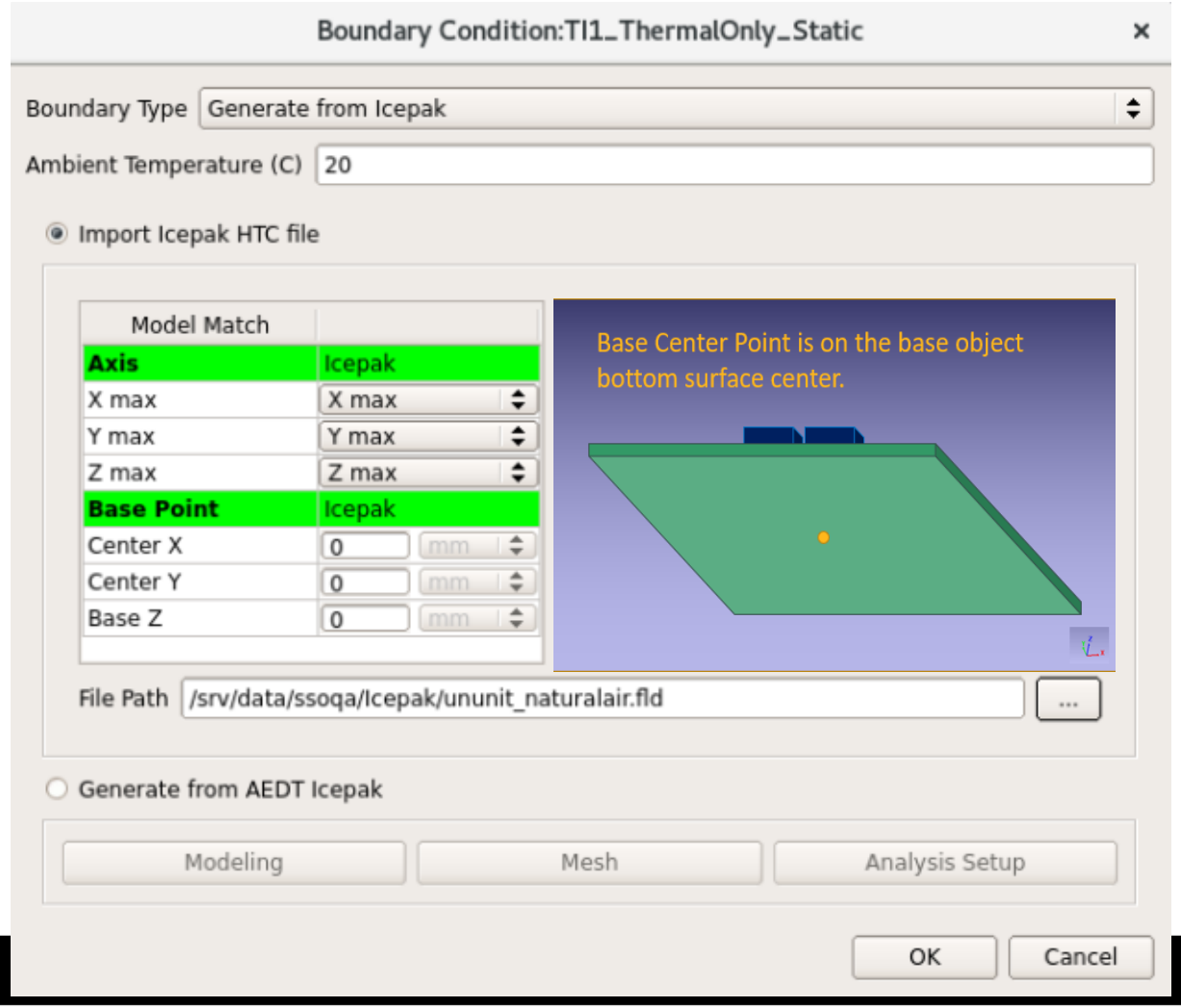
write_surface.fld

RHSC-ET imports the HTC file and run simulation.

External Icepak Boundary Condition Usage

External Icepak Boundary Condition Setting

If user has generated Icapk HTC file, he can import this file through **"Simulation tab -> Boundary Condition -> Generate from Icepak -> Import Icepak HTC file"**.



Import Icepak HTC File
The format of the HTC file should be *.fld file.
Node (X, Y, Z), HTC.

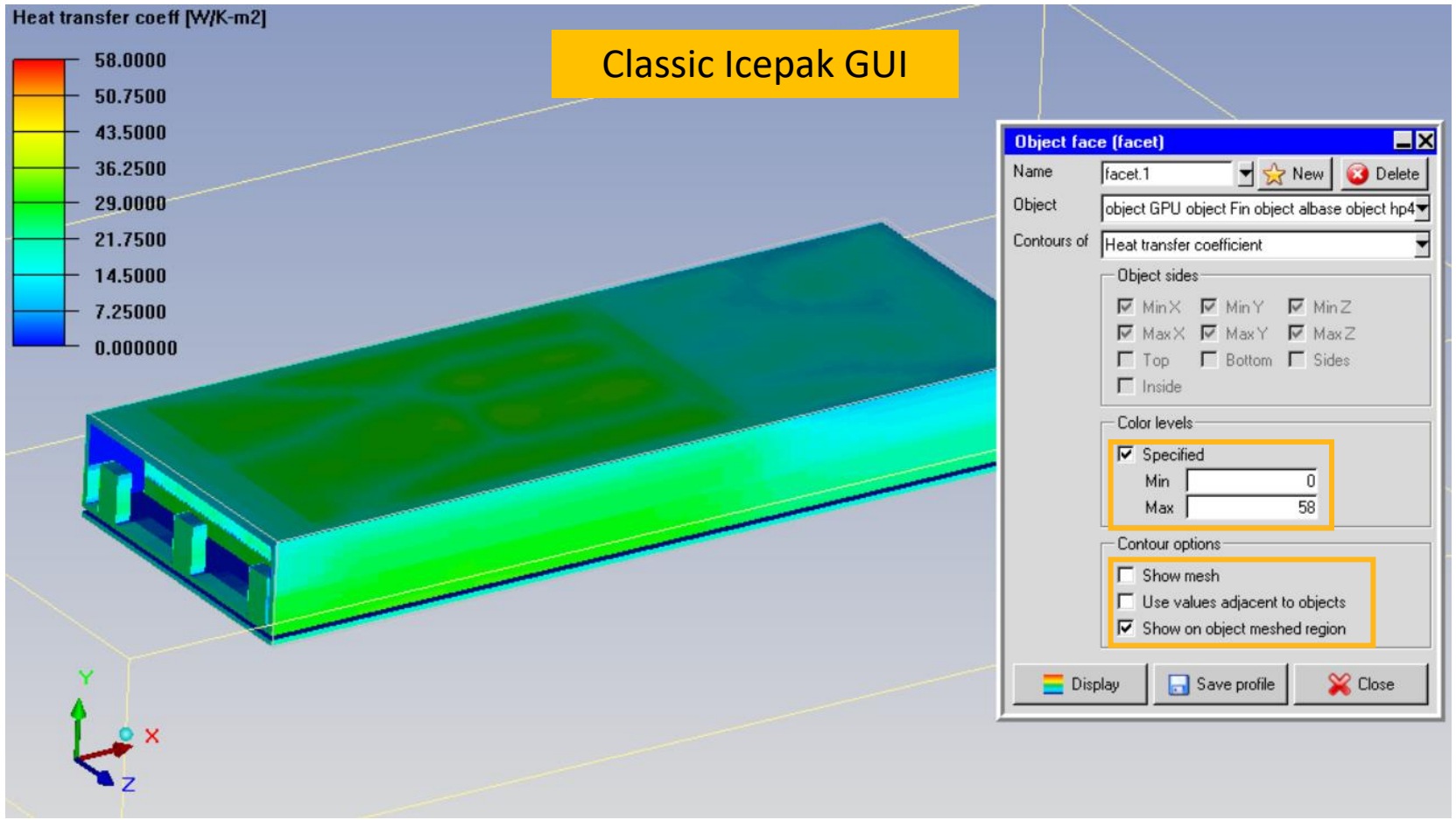
```
4.9350000000000002e-03 4.5533854166666665e-03 2.6766825000000003e-03 5.0252587906181098e+01
4.9350000000000002e-03 4.6894531249999996e-03 2.6766825000000003e-03 5.0252587906181098e+01
4.9350000000000002e-03 4.5533854166666665e-03 2.7035200000000001e-03 5.0252587906181098e+01
4.9350000000000002e-03 4.6894531249999996e-03 2.6766825000000003e-03 5.0252587906181098e+01
4.9350000000000002e-03 4.6894531249999996e-03 2.7035200000000001e-03 5.0252587906181098e+01
4.9350000000000002e-03 4.2812500000000003e-03 2.7035200000000001e-03 4.4182067911437606e+01
4.9350000000000002e-03 4.1451822916666655e-03 2.7035200000000001e-03 4.4182067911437606e+01
4.9350000000000002e-03 4.2812500000000003e-03 2.6766825000000003e-03 4.4182067911437606e+01
4.9350000000000002e-03 4.1451822916666655e-03 2.7035200000000001e-03 4.4182067911437606e+01
4.9350000000000002e-03 4.1451822916666672e-03 2.6766825000000003e-03 4.4182067911437606e+01
4.9350000000000002e-03 4.2812500000000003e-03 2.6766825000000003e-03 4.4182067911437606e+01
```

To match the models in AEDT/Icepak:

1. Please first check the X/Y/Z axis.
2. Check the base point coordinates.
3. Import the *.fld file. Make sure that the HTC data in the *.fld file include all the object surfaces.

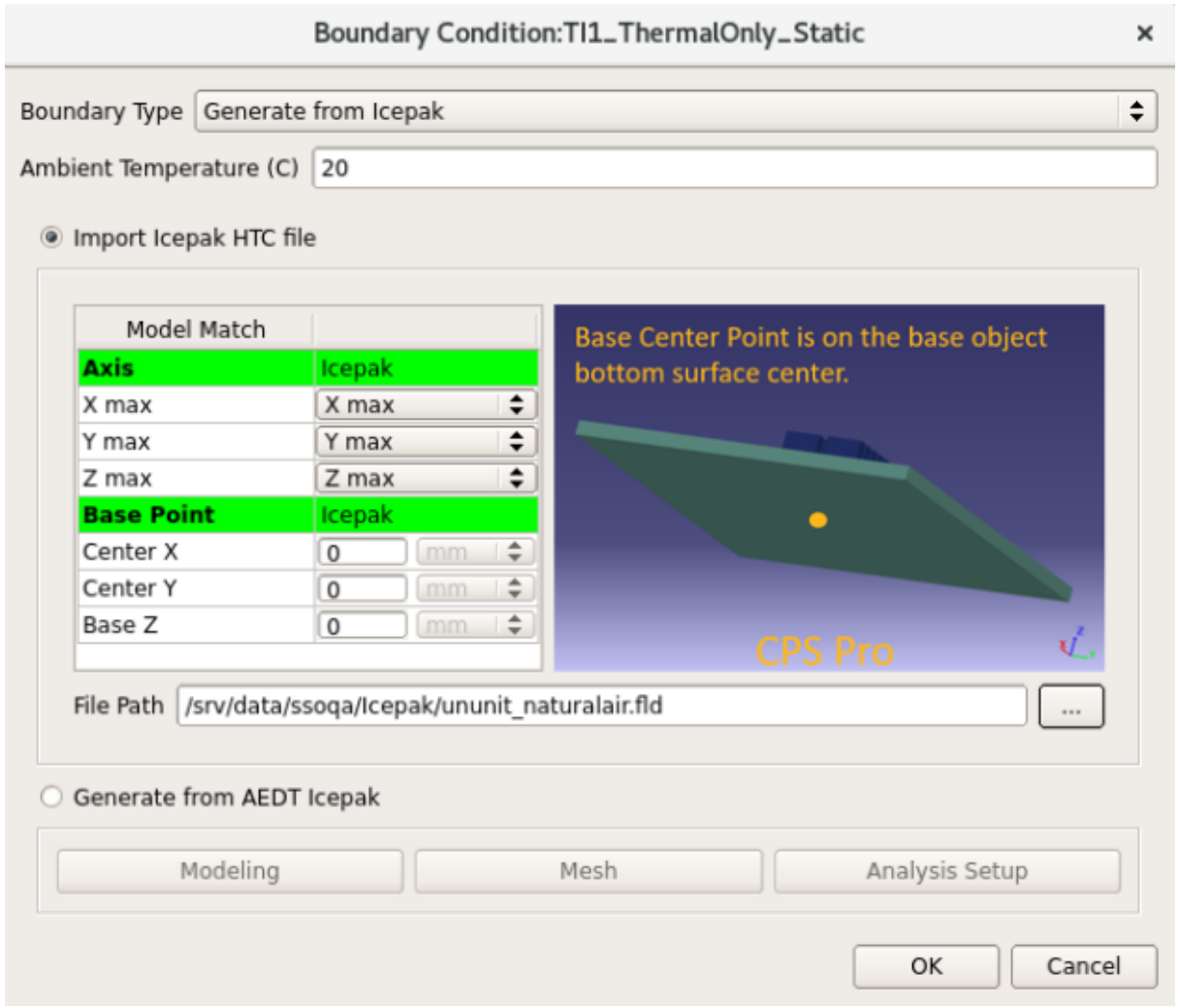
External Icepak Boundary Condition Setting

File Path /srv/data/ssoqa/Icepak/ununit_naturalair.fld ...



Import Icepak HTC File Tips:
1.Please define the Color levels specified min value to be 0.
2. Please select the 3rd option for 'Contour options'.

External Icepak Boundary Condition Setting

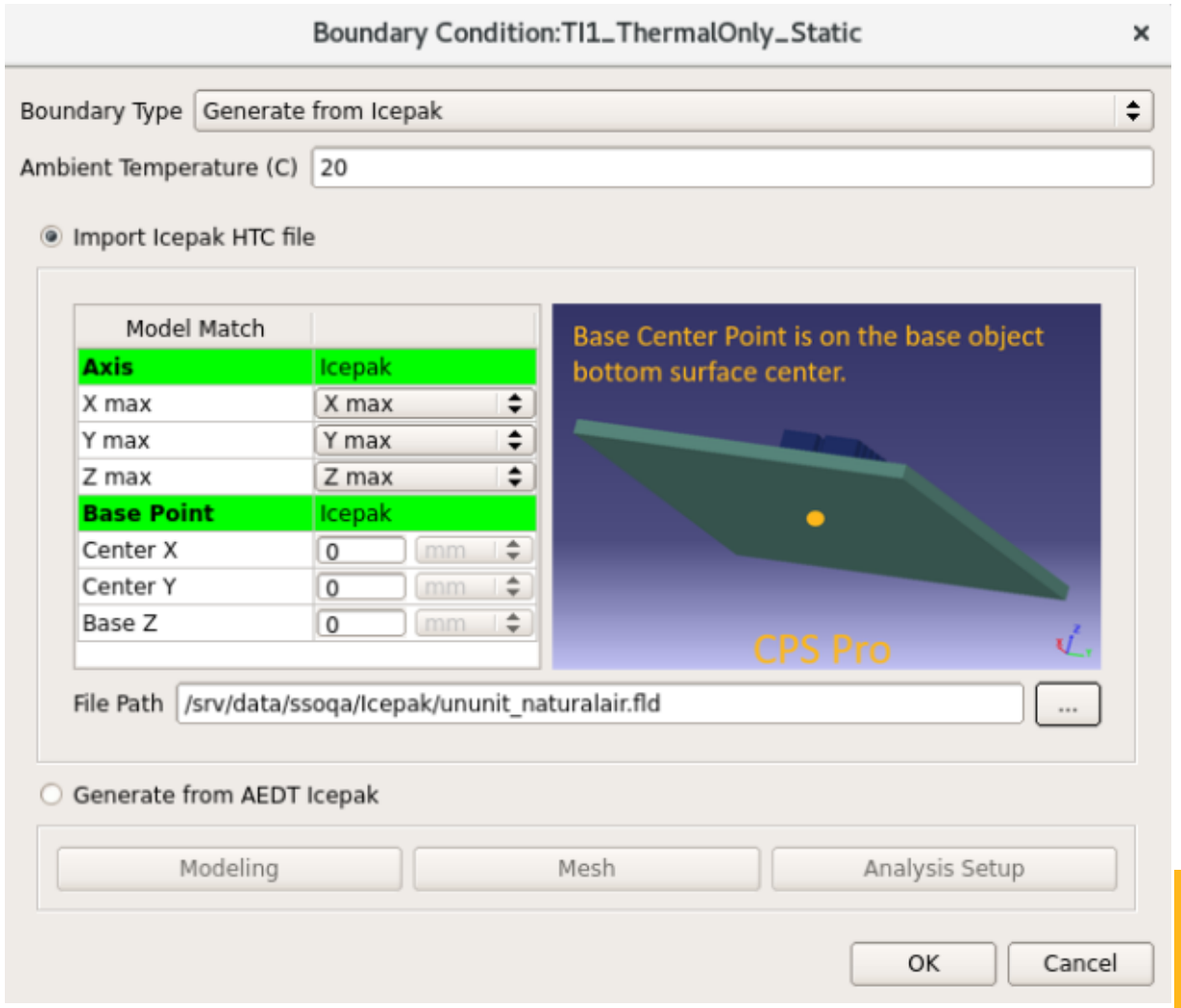


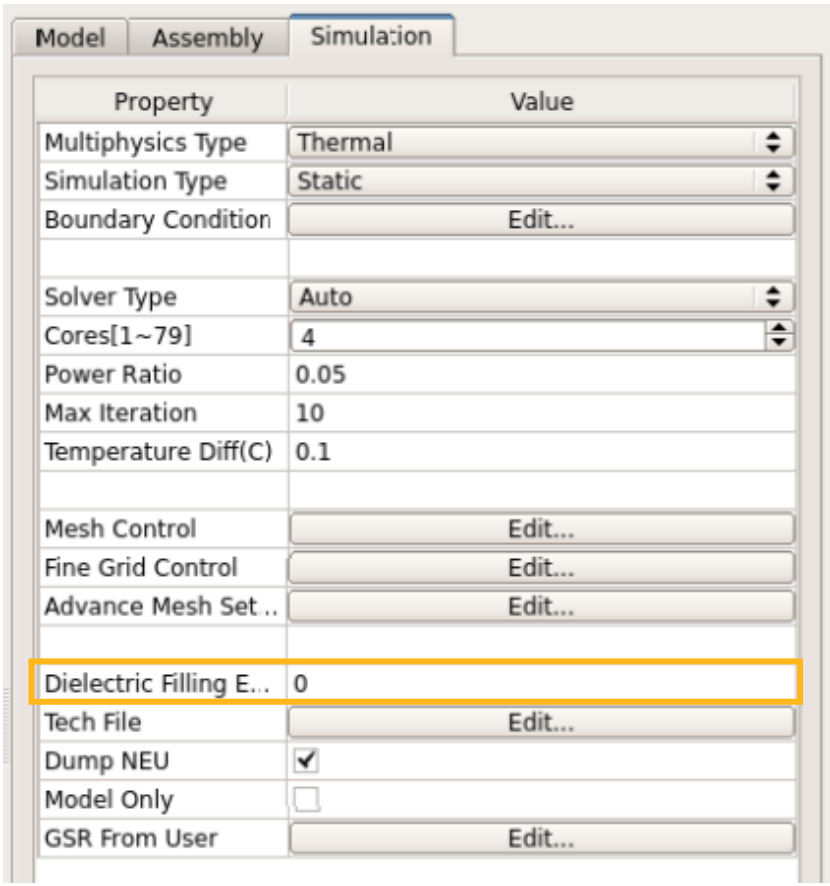
About Radiation:
In AEDT Icepak simulation, the default calculation of HTC include convection and radiation.

For RHSC-ET Icepak Boundary Condition:
If user select the flow 'Generate from AEDT Icepak', radiation setting in program is on. Icepak radiation setting is off. We only pass the convection into RHSC-ET.

If user select the flow 'Import Icepak HTC file', radiation setting in program is off. User need to consider the radiation effect when running project in Icepak.

External Icepak Boundary Condition Setting





Dielectric Filling Expanding(%):
Default setting is 5. Please adjust it to 0. For import fld boundary condition, this value should be 0. Or else the model will be not matched.


Ansys