Thermal Tutorial

2022/12/1

12/8/2022

Introduction

※ We will be taking thermal through 6 sets of runs and analysis scripts:

※ RHSC-ET 1st run scripts:

- Thermal_flow.tcl: this script does the following:
  - ✓ Imports data
  - ✓ Performs 3DIC thermal assembly
  - ✓ Performs 3 static thermal analysis (4m16s, 5m21s, 10m2s)
  - ✓ Performs 1 transient thermal analysis (8m12s)
- Bring up RHSC-ET GUI to view results

※ RHSC 2nd run scripts:

- Electro_Thermal_flow.tcl: this script does the following:
  - ✓ Imports data
  - ✓ Performs 3DIC thermal assembly
  - ✓ Performs 3 static electro thermal analysis
  - ✓ Performs 1 transient electro thermal analysis (30m2s)
- Bring up RHSC-ET GUI to view results

Introduction

※ RHSC-ET 3rd run scripts:

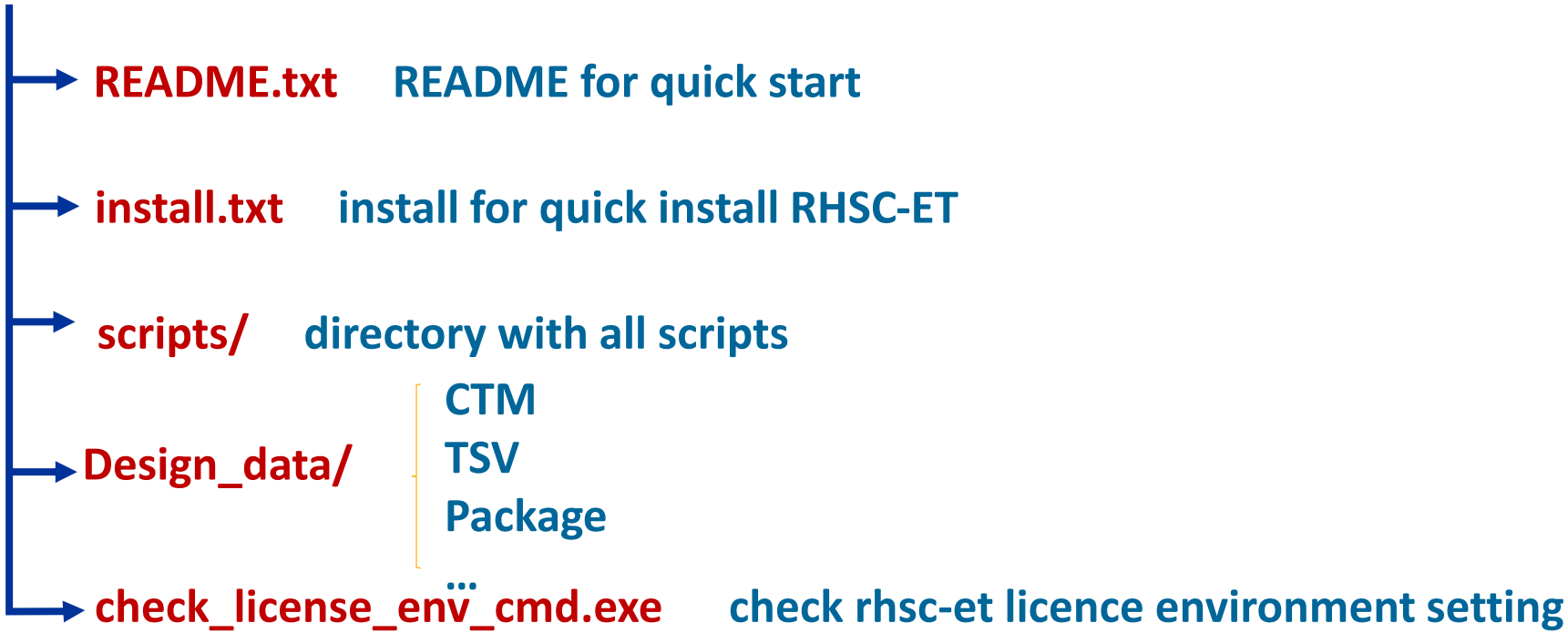
- TI_ComplexConnection.tcl: this script does the following:
  - ✓ Imports data
  - ✓ Performs 3DIC thermal assembly
  - ✓ Performs 1 static thermal analysis (Please note, it will take 6h17m23s)
- Bring up RHSC-ET GUI to view results

※ RHSC 4th and 5th run scripts:

- TI_Hiera1.tcl, TI_Ubump1.tcl, TI_Ubump2.tcl: these scripts do the following:
  - ✓ Imports data
  - ✓ Performs 3DIC thermal assembly
  - ✓ Performs 1 static thermal analysis
- Bring up RHSC-ET GUI to view results

RHSC-ET Thermal Flow Directory Structure

RHSC-ET Thermal Flow Training directory



Step I: RHSC-ET Install and Set License

※ Set Redhawk-SC Electrothermal path and license :

- setenv CPSROOT <choose the version installed on your server>
- set path = ($CPSROOT/bin $path)
- setenv ANSYSLMD_LICENSE_FILE <To your redhawk_sc_electrothermal license>

※ To execute Redhawk-SC Electrothermal :

- 2D: redhawk_sc_et&
- 3D: redhawk_sc_et -3dic

Step II: Running the script: Thermal_flow.tcl

※ First cd into the scripts directory

※ To run the first script:

```
% cd scripts/
% redhawk_sc_et -3dic –ng Thermal_flow.tcl
```

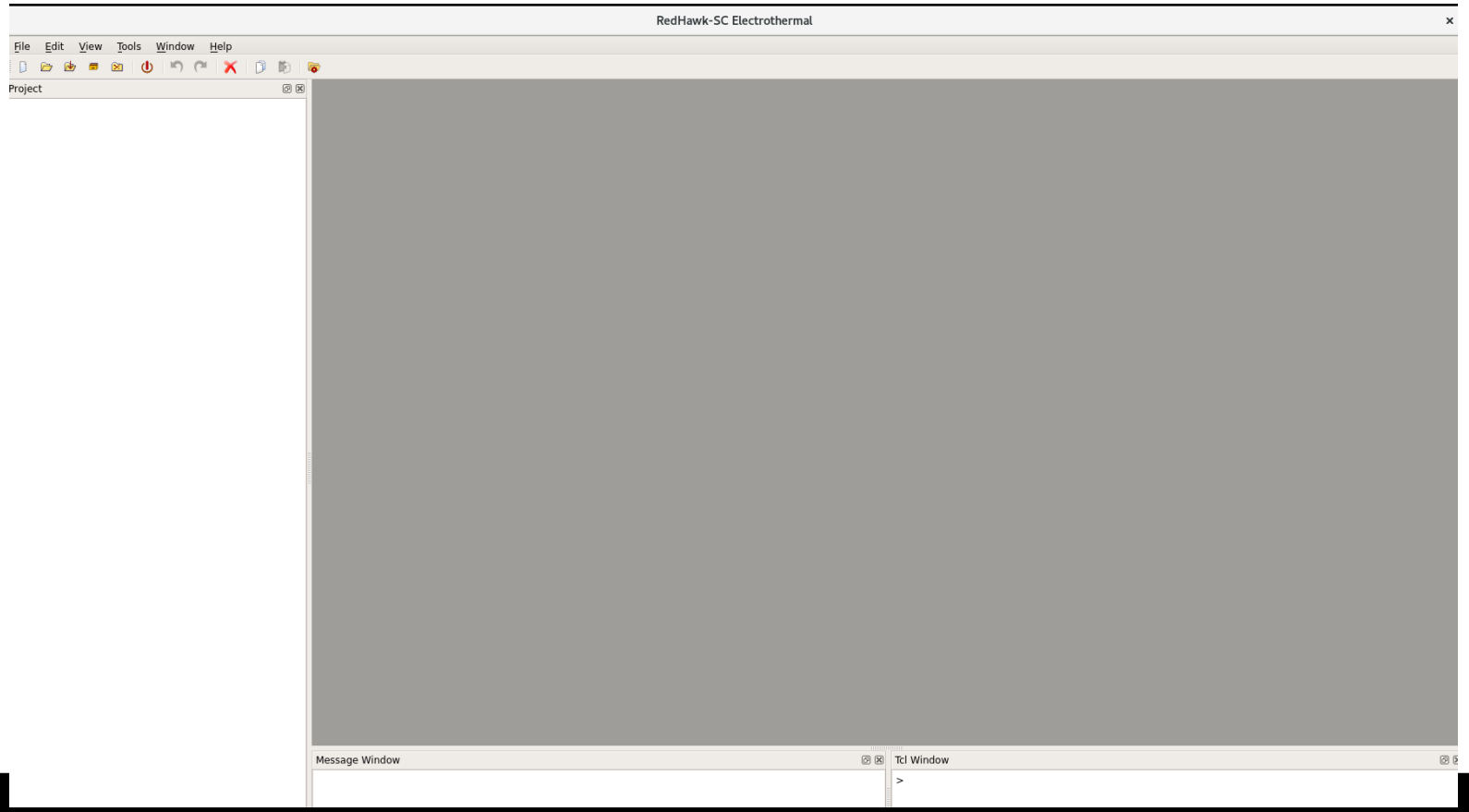
※ What does Thermal_flow.tcl do？

- ✓ Create the new project
- ✓ Import package, TSV and CTM, bump connection file.
- ✓ Perform 3DIC thermal assembly
- ✓ Perform 3DIC thermal analysis

Step III: Result Exploration using GUI

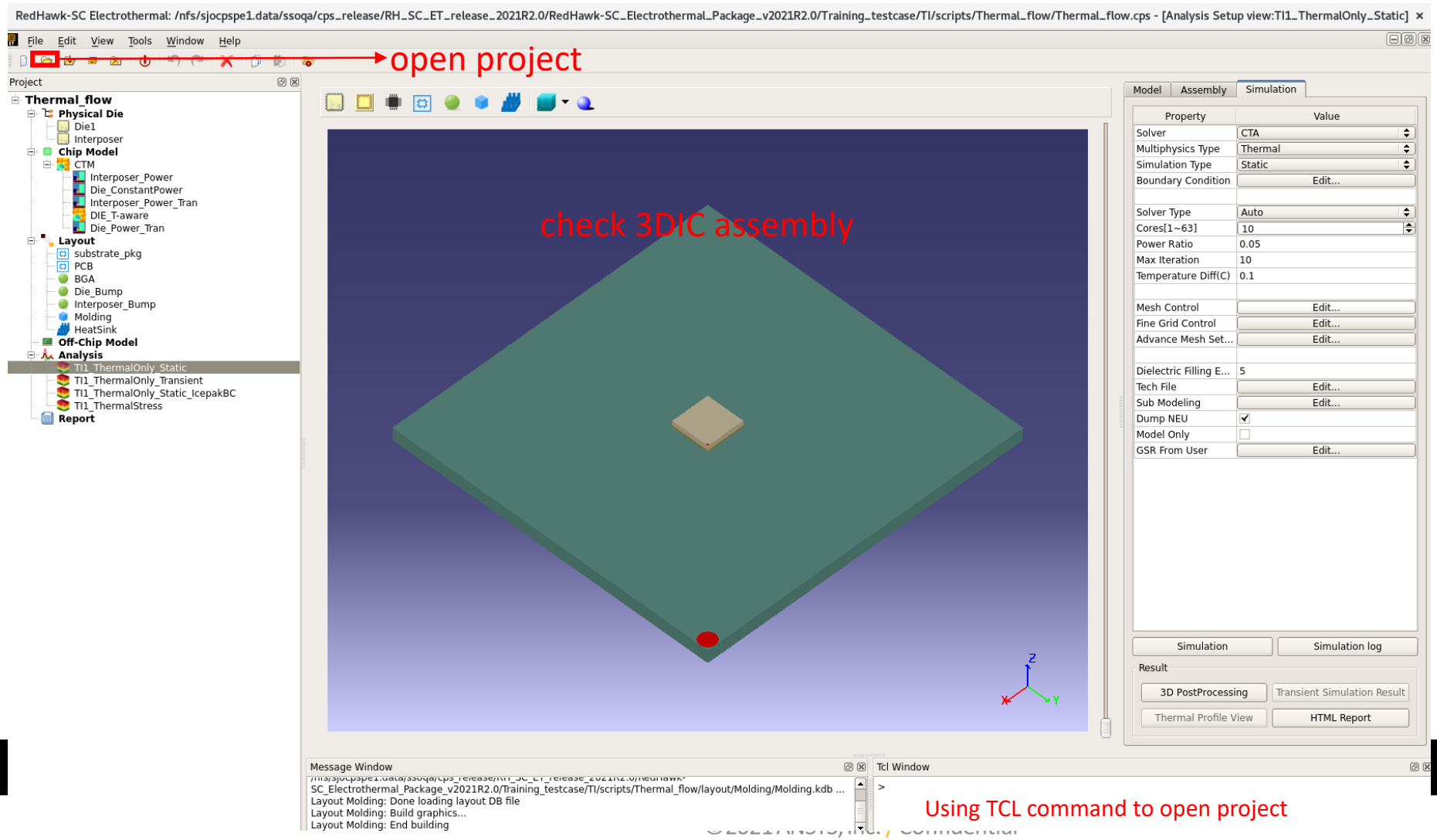
- View the results in RHSC-ET GUI

```
% redhawk_sc_et -3dic
```



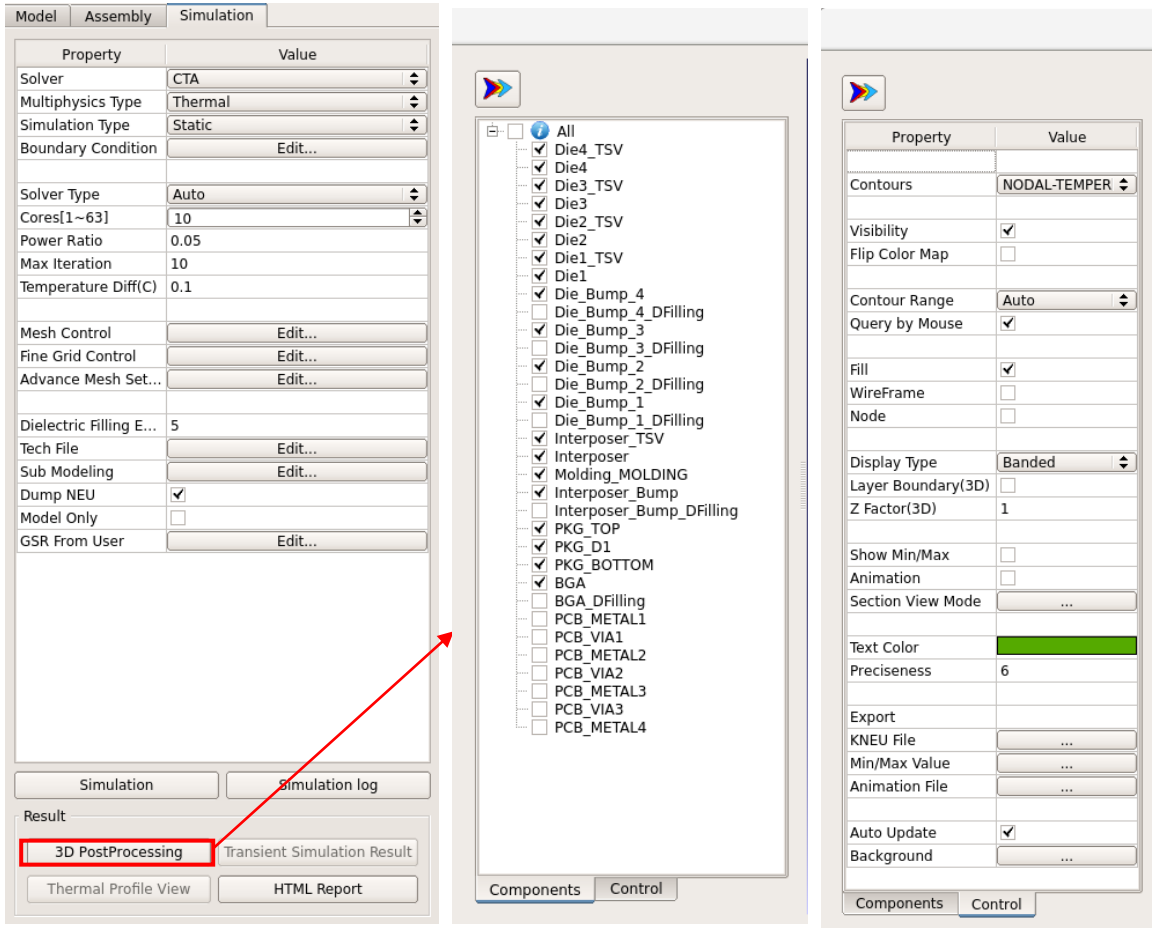
Step III: Result Exploration using GUI – Opening Case

```
% project open -name /home/user/project.cps
```



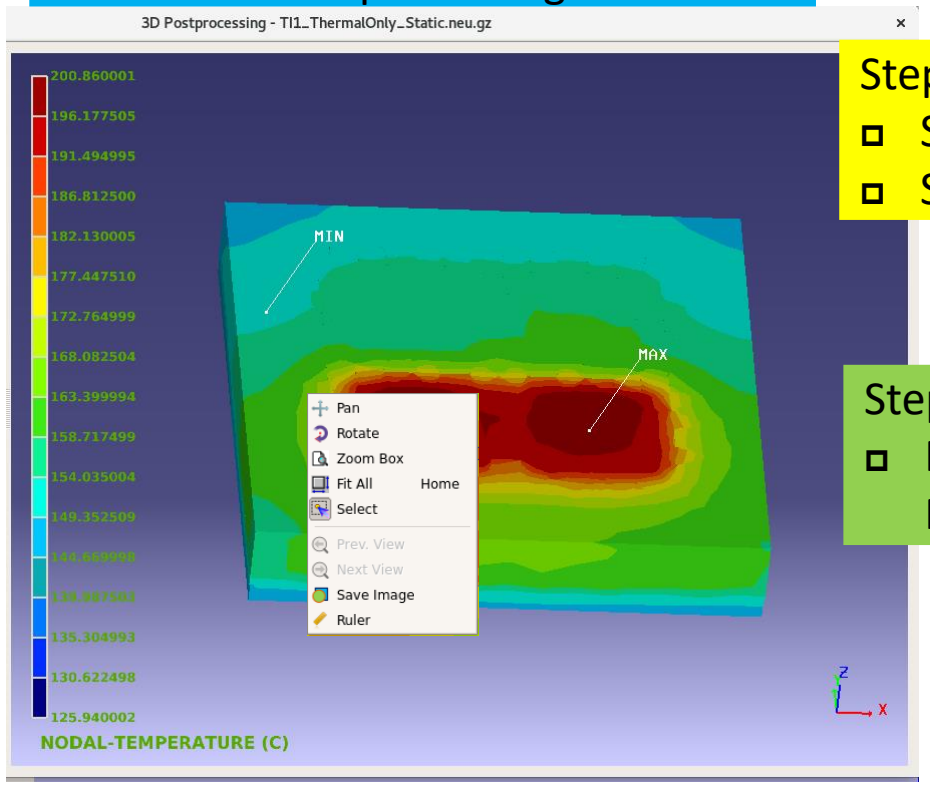
Using TCL command to open project

Step III: Result Exploration using GUI – Viewing 3D Postprocess Results



Step1:

- Go to Simulation tab
- Click 3D Postprocessing



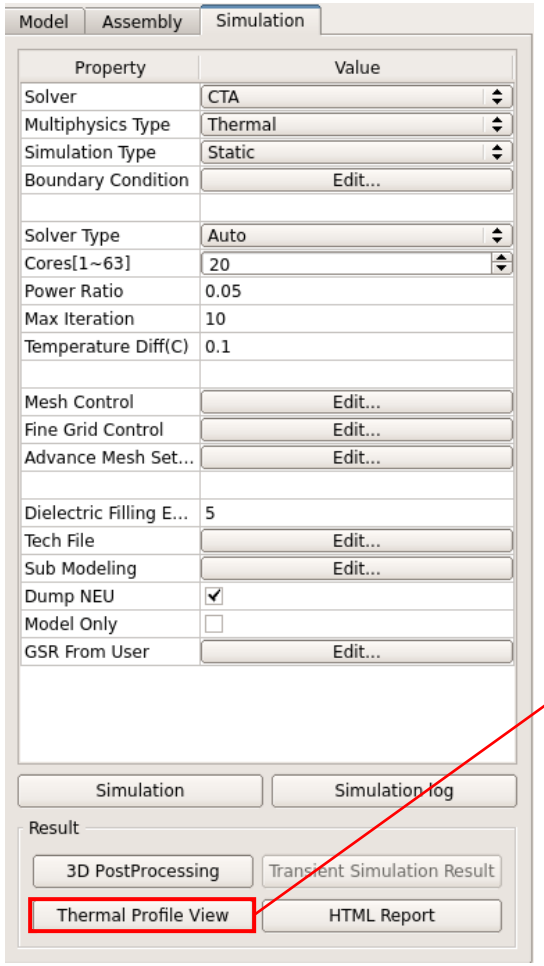
Step2:

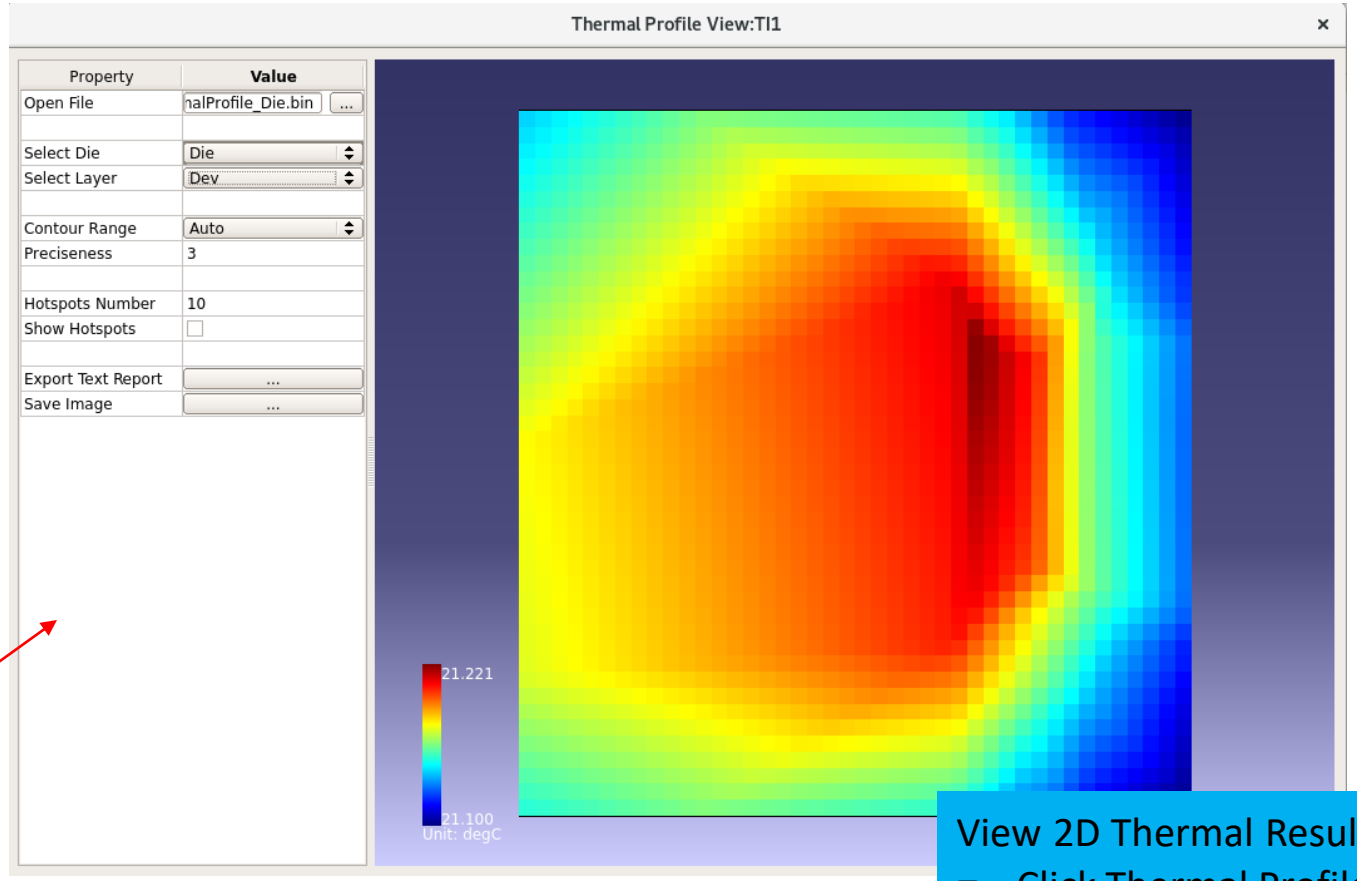
- Select Components
- Set control options

Step3:

- Right-click to select Rotate or Fit All

Step III: Result Exploration using GUI – Viewing 2D Results

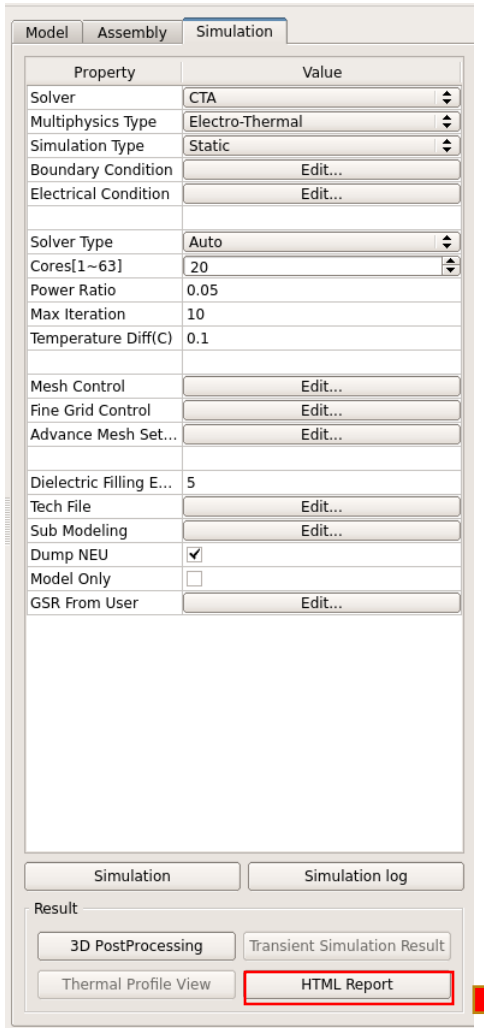


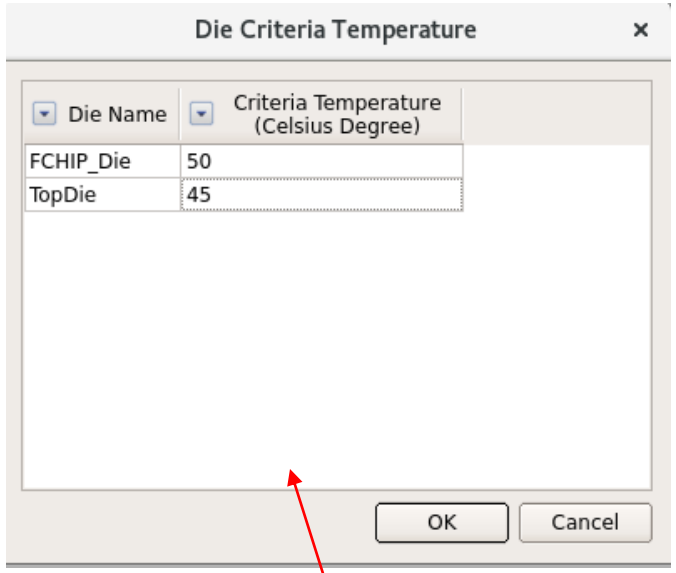


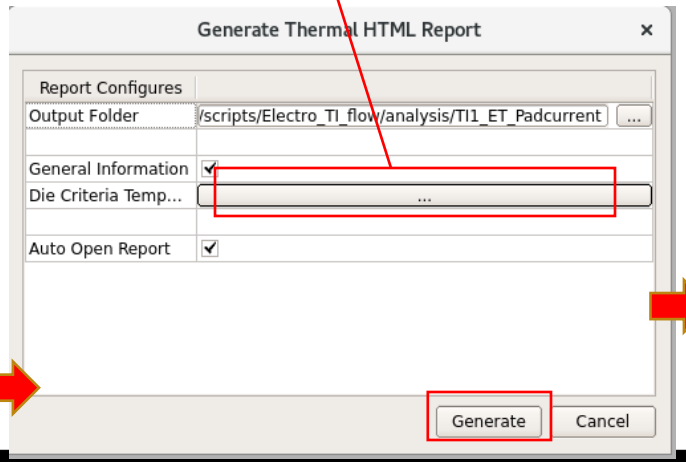
View 2D Thermal Result

- Click Thermal Profile View
- View thermal result of each layer
- Please note, only there is CTM file, this feature would be available.

Step III: Result Exploration using GUI – Generate HTML Report



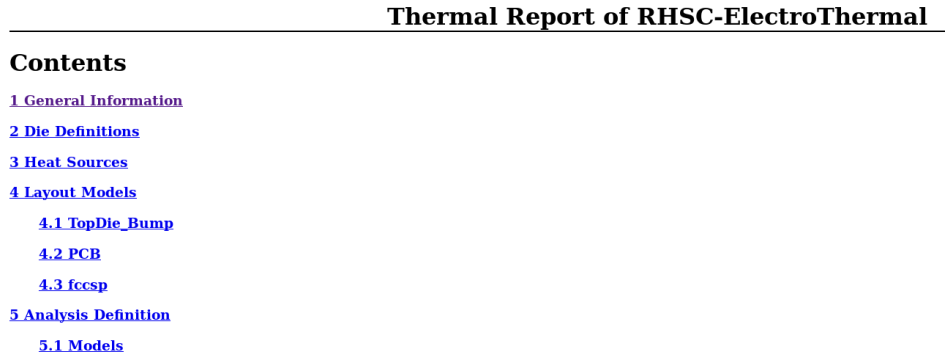




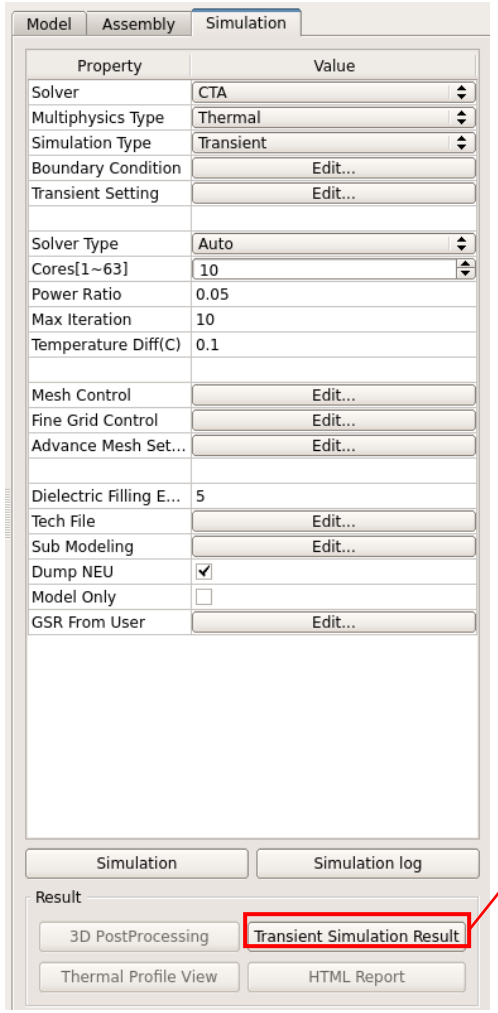
Step1:
- Go to Simulation tab
- Click HTML Report

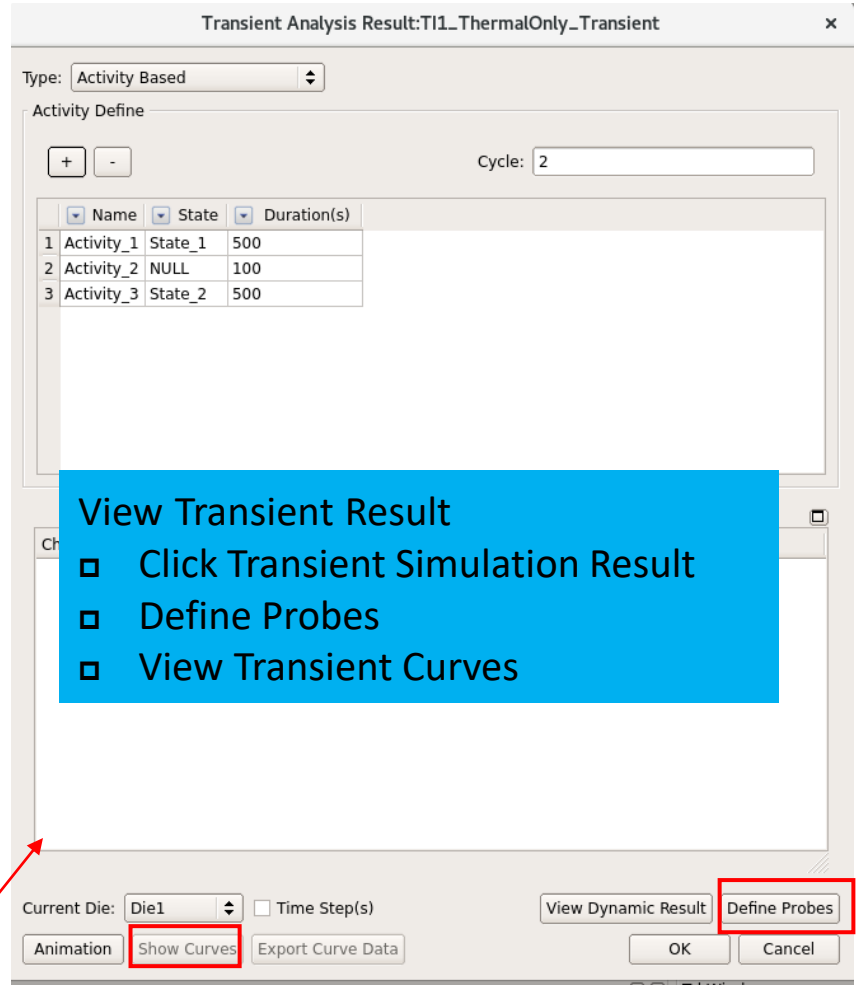
Step2:
- Define Output path
- Define Die criteria T

Step3:
- View thermal report



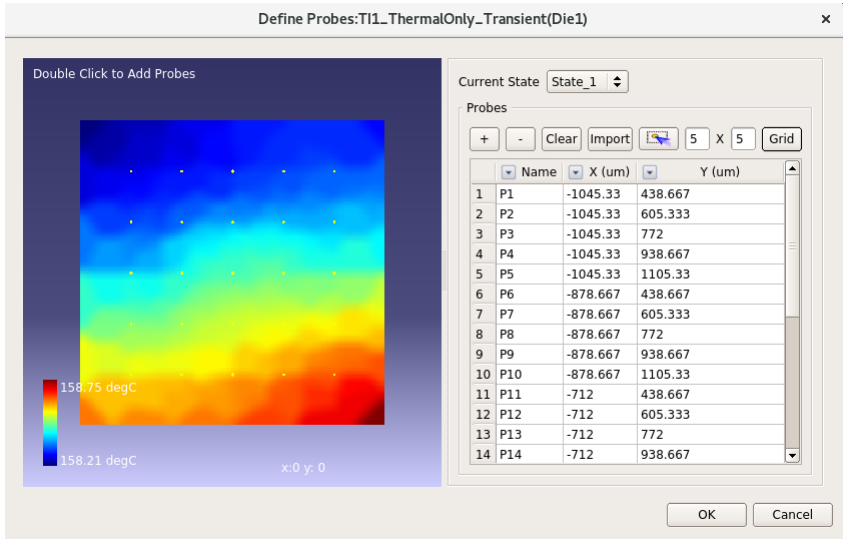
Step III: Result Exploration using GUI – Viewing Transient Results

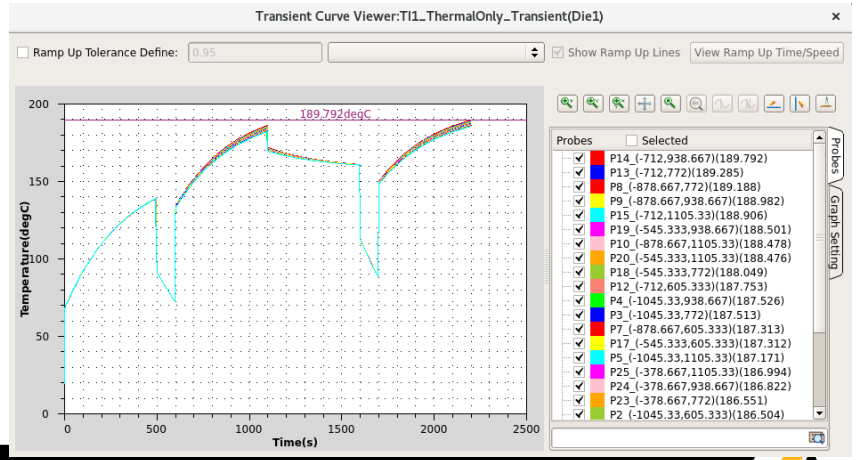




View Transient Result

- Click Transient Simulation Result
- Define Probes
- View Transient Curves





Step IV: Running the script: Electro_Thermal_flow.tcl

※ **To run the script:**

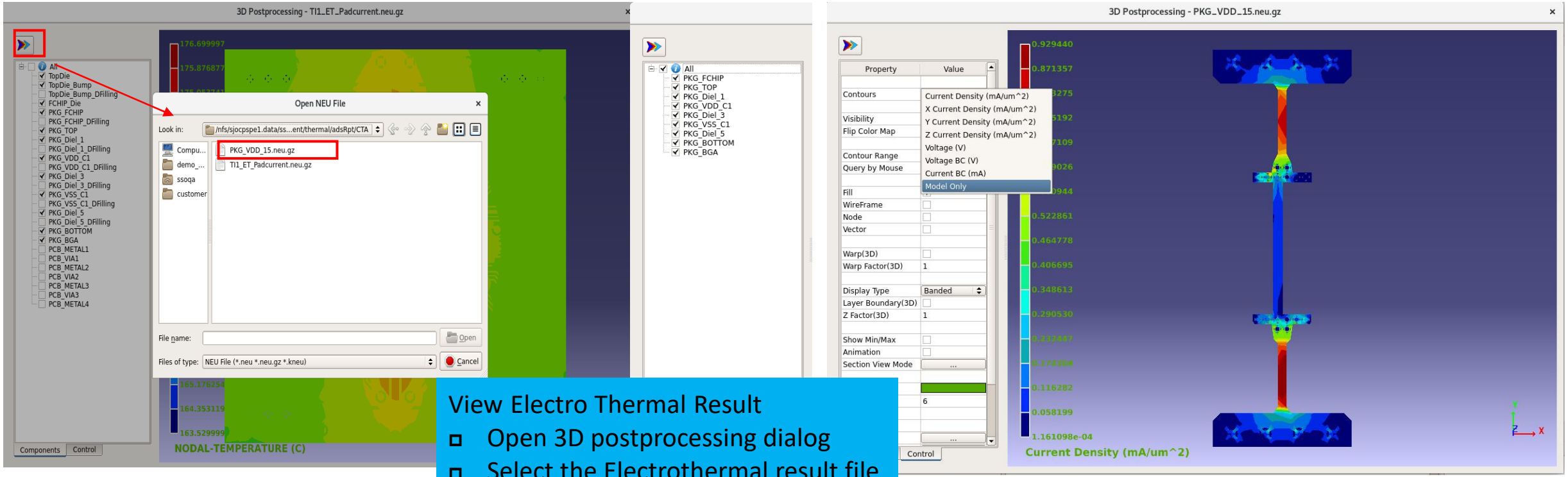
```
% cd scripts/
% redhawk_sc_et -3dic –ng Electro_Thermal_flow.tcl
```

※ **What does Electro_Thermal_flow.tcl do？**

- ✓ **Create the new project**
- ✓ **Import package, TSV, CTM, bump connection file, etc.**
- ✓ **Perform 3DIC thermal assembly**
- ✓ **Perform 3DIC Electro-Thermal analysis**

Step V : Viewing Static Electrothermal Results

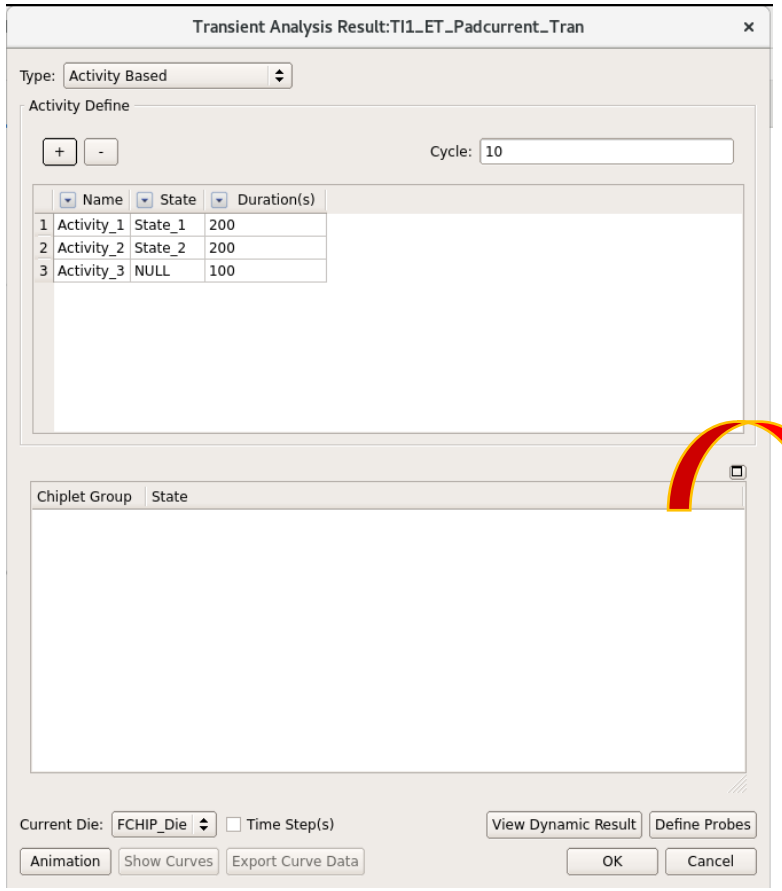
```
% redhawk_sc_et -3dic
% open project
```

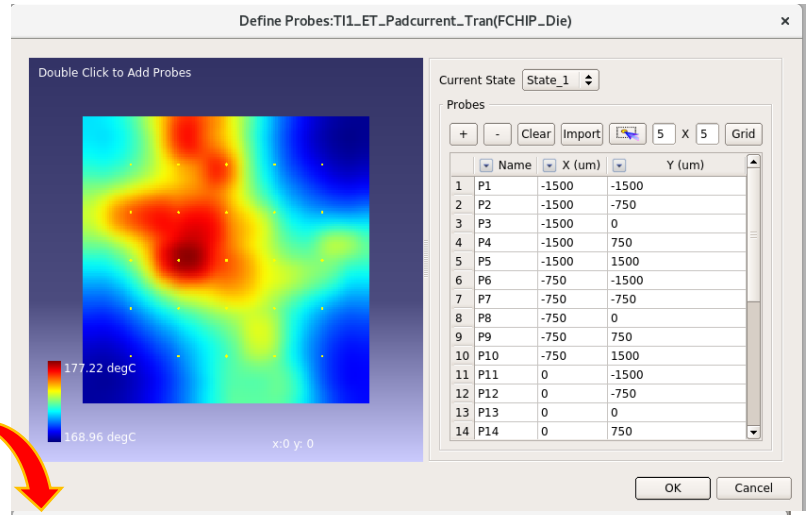


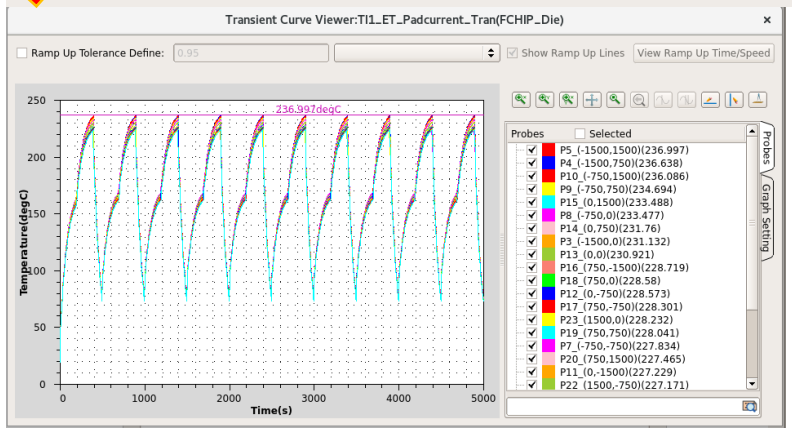
View Electro Thermal Result

- Open 3D postprocessing dialog
- Select the Electrothermal result file
- View current density, voltage, etc.

Step V : Viewing Transient Electrothermal Results

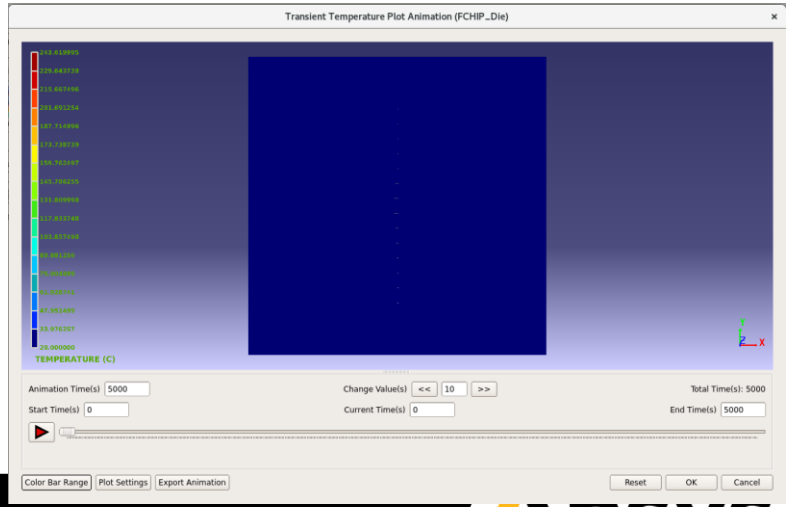






View Transient Result

- Click Transient Simulation Result
- Define Probes
- View Transient Curves
- View Animation



Step VI: Running the script: TI_Hiera1.tcl.tcl

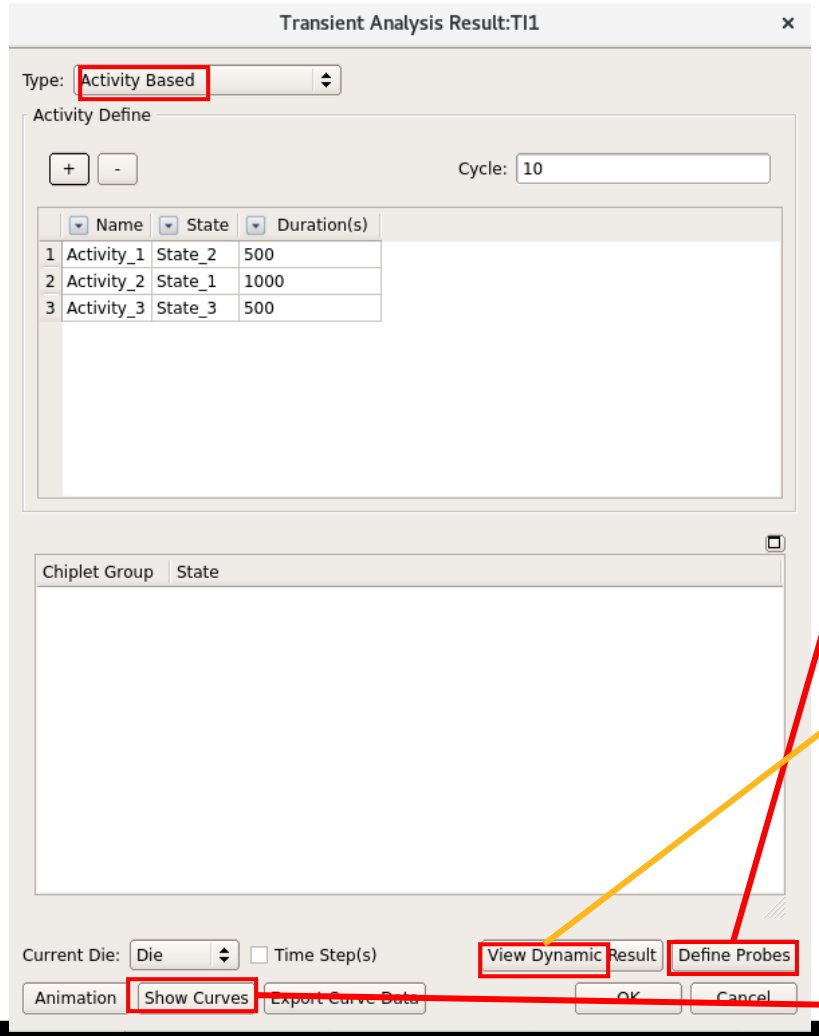
※ **To run the script:**

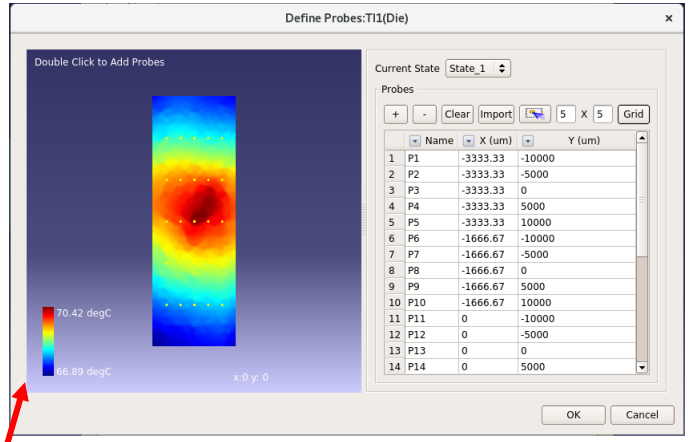
```
% cd scripts/
% redhawk_sc_et -3dic –ng TI_Hiera1.tcl
```

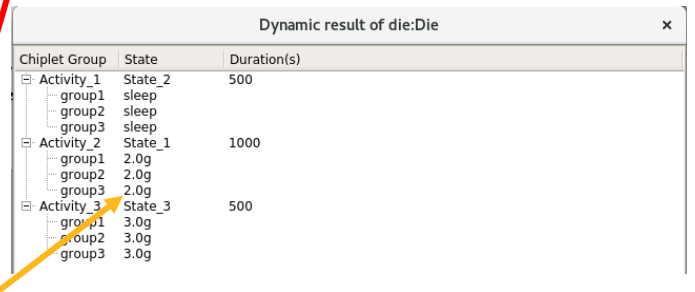
※ **What does Electro_Thermal_flow.tcl do？**

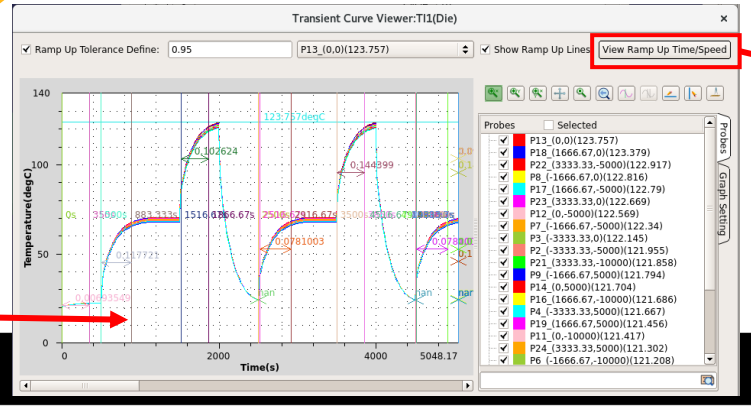
- ✓ **Create the new project**
- ✓ **Create Hierarchy CTM model.**
- ✓ **Perform 3DIC thermal assembly**
- ✓ **Perform 3DIC Electro-Thermal analysis**

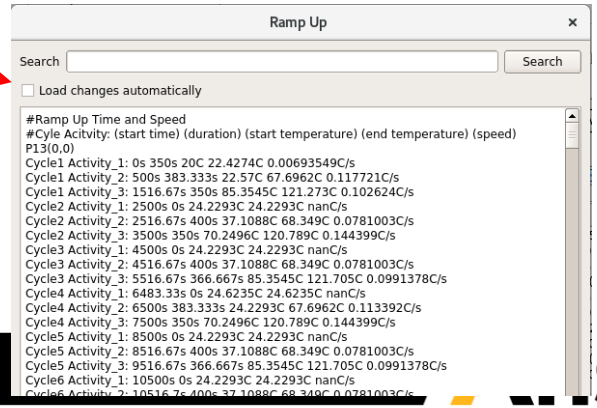
Step VI : Viewing Transient Results – Activity Based









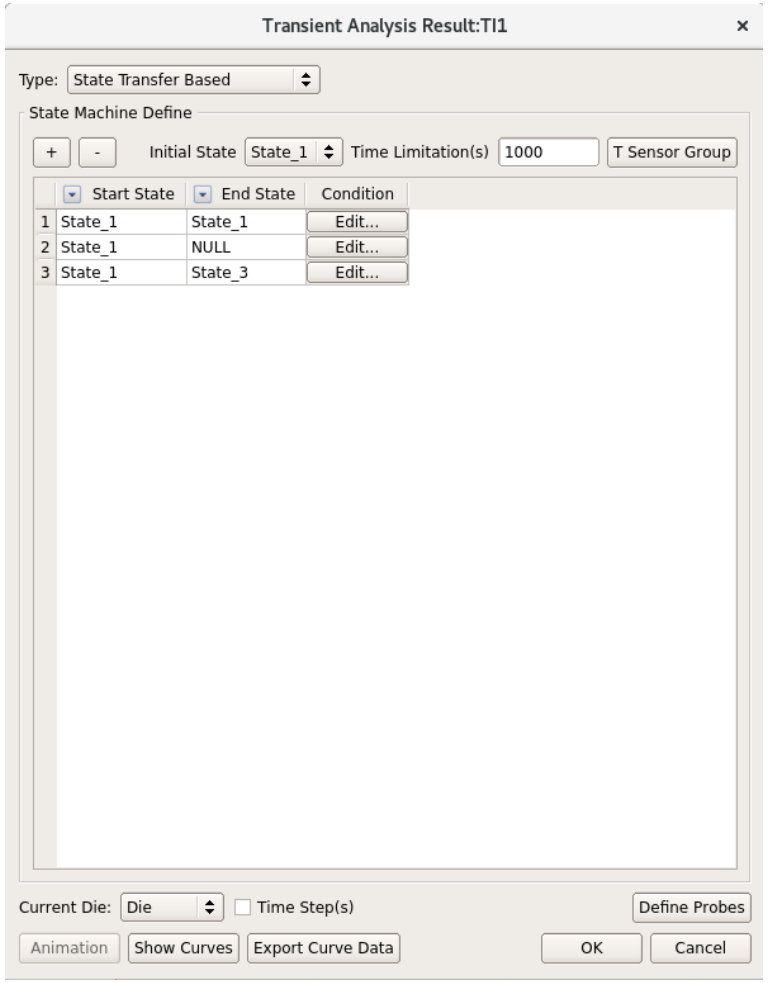


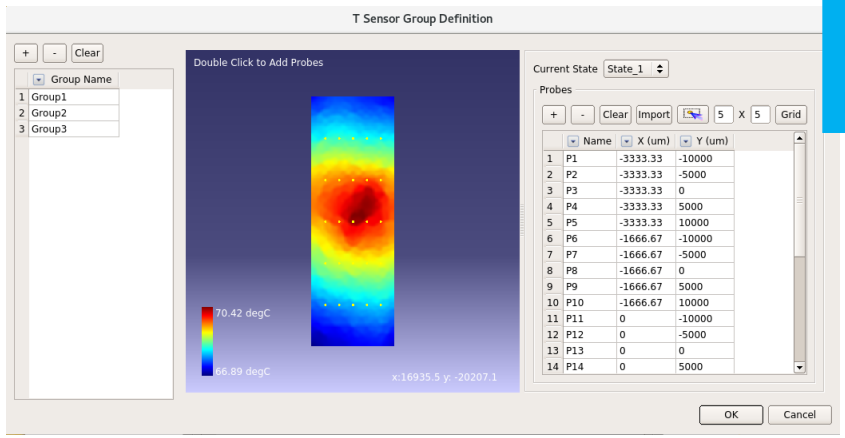
Step1:
- Open Transient Analysis Result dialog
- Define probes

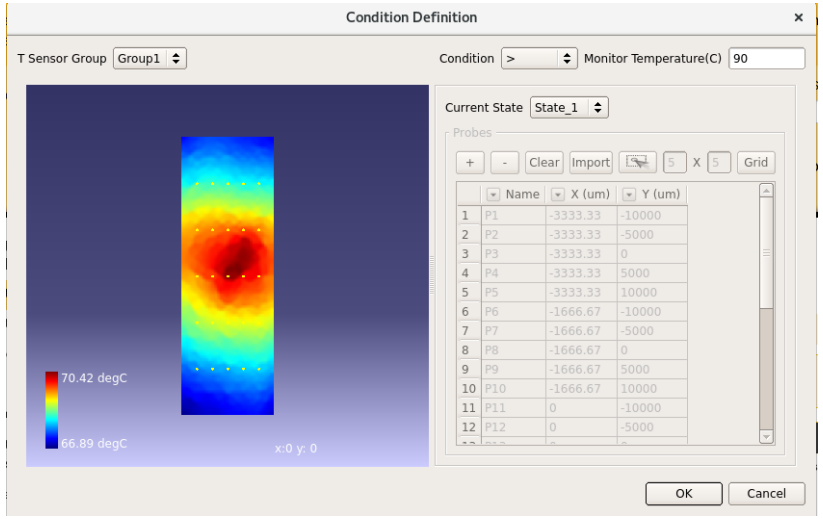
Step2:
- View dynamic result
- Show transient curves

Step3:
- View ramp up time/speed

Step VI : Viewing Transient Results – State Transfer Based



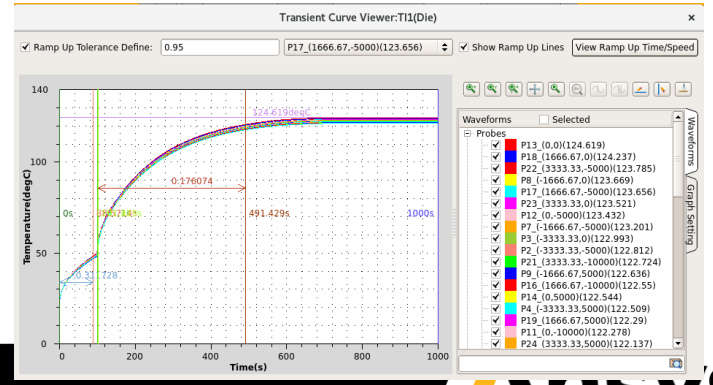




Step1：
- Select State Transfer Based
- Define State

Step2：
- Initial state
- Define T Sensor Group

Step3：
- View curves



Step VII : TI_Ubump1.tcl

※ **To run the script:**

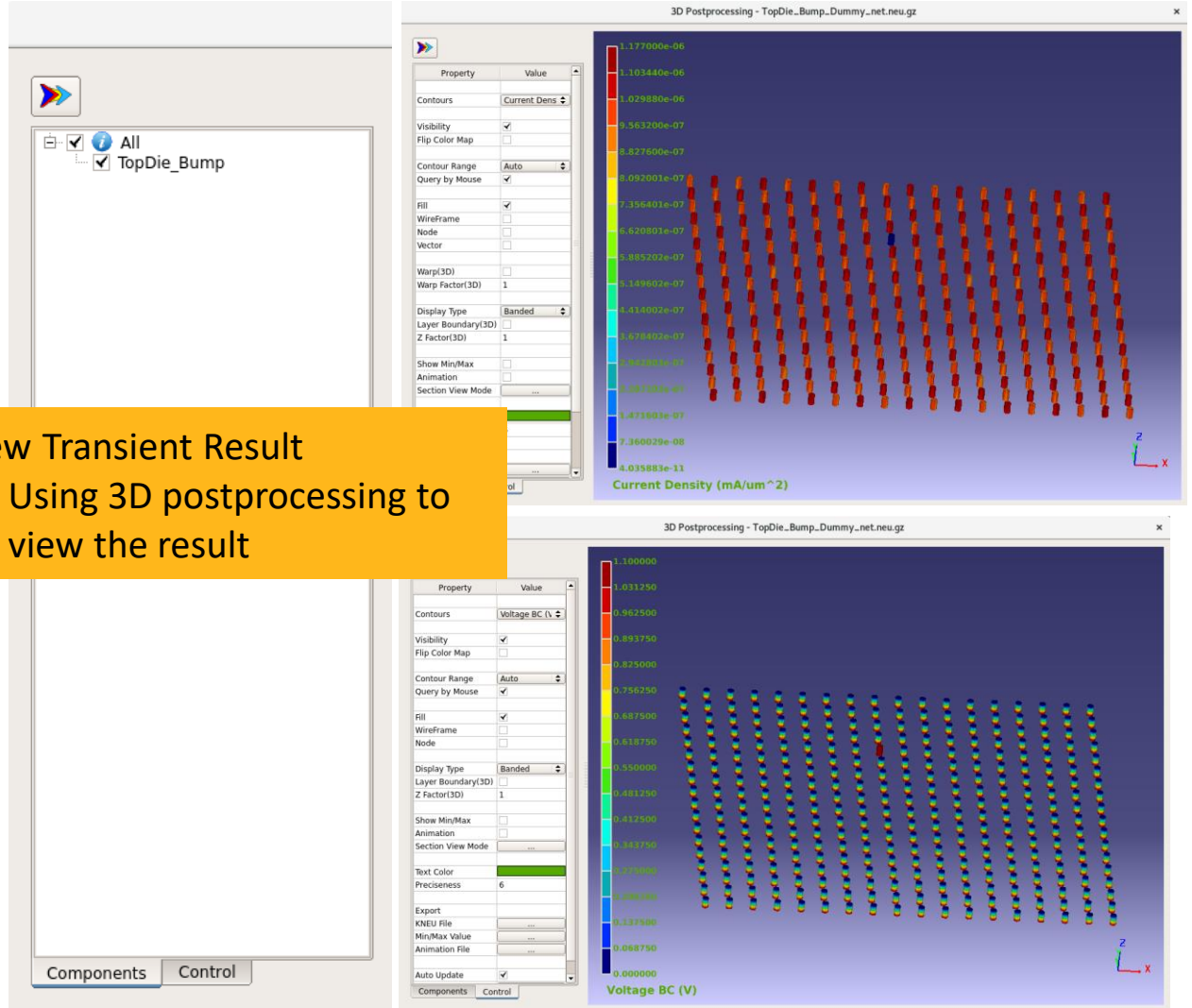
```
% cd scripts/
% redhawk_sc_et -3dic –ng TI_Ubump1.tcl
```

※ **What does Electro_Thermal_flow.tcl do？**

- ✓ **Create the new project**
- ✓ **Import package and CPM file**
- ✓ **Perform 3DIC thermal assembly**
- ✓ **Perform 3DIC Electro-Thermal analysis to ubump**

View Transient Result

- Using 3D postprocessing to view the result



Step VIII : TI_Ubump2.tcl

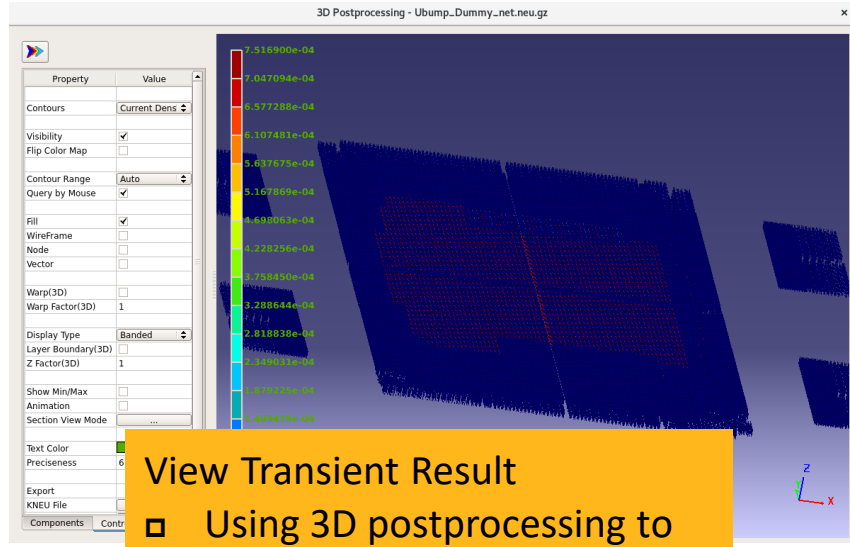
※ **To run the script:**

```
% cd scripts/
% redhawk_sc_et –ng TI_Ubump2.tcl
```

※ **What does Electro_Thermal_flow.tcl do？**

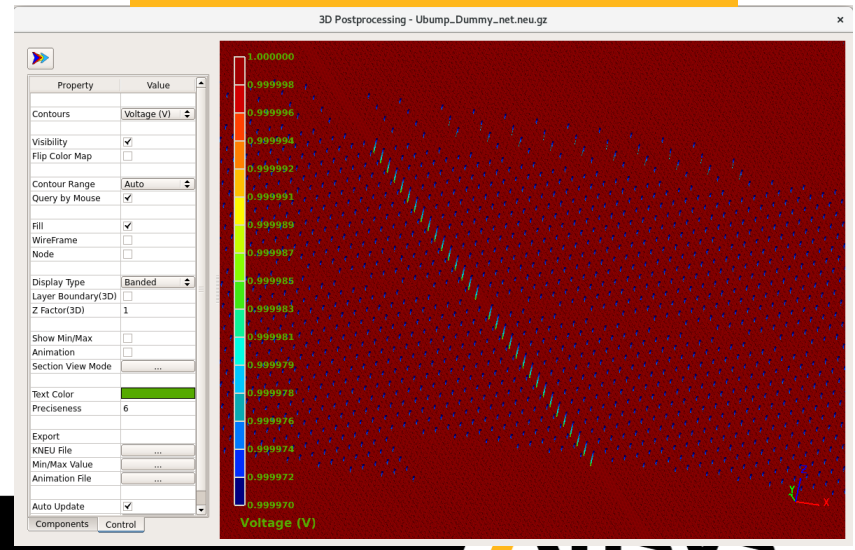
- ✓ **Create the new project**
- ✓ **Import Interposer Ubump file and CPM file**
- ✓ **Perform 3DIC Electro-Thermal analysis**

※ **In this case, it’s used to run Electro Thermal analysis on Ubump.**



View Transient Result

- Using 3D postprocessing to view the result



Step IX : TI_ComplexConnection.tcl

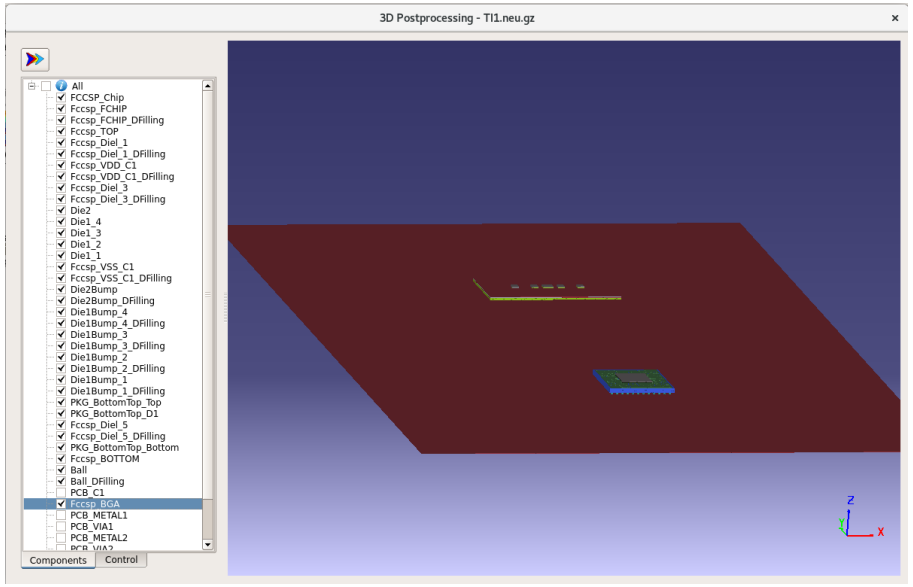
※ To run the script:

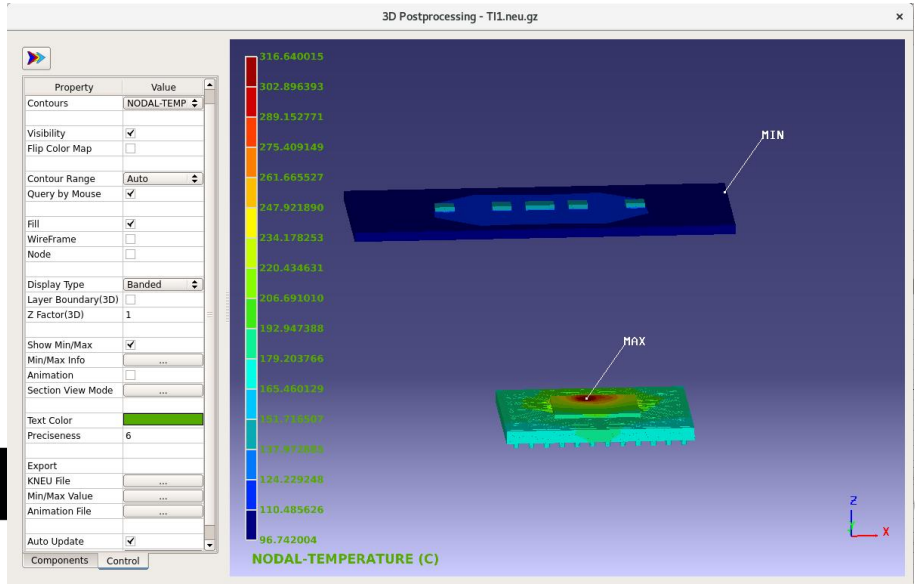
```
% cd scripts/
% redhawk_sc_et -3dic –ng TI_ComplexConnection.tcl
```

※ What does TI_ComplexConnection.tcl do？

- ✓ Create the new project
- ✓ Import package and CTM file
- ✓ Perform 3DIC static thermal analysis

※ This case, it connects to two package file, one is fccsp, the other is prototype package. There are 5 dies on prototype package, 1 die on fccsp package.






Ansys