

Current TES Capabilities in TRNSYS

Hank Price Nate Blair

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NREL • 1617 Cole Boulevard • Golden, Colorado 80401-3393 • (303) 275-3000
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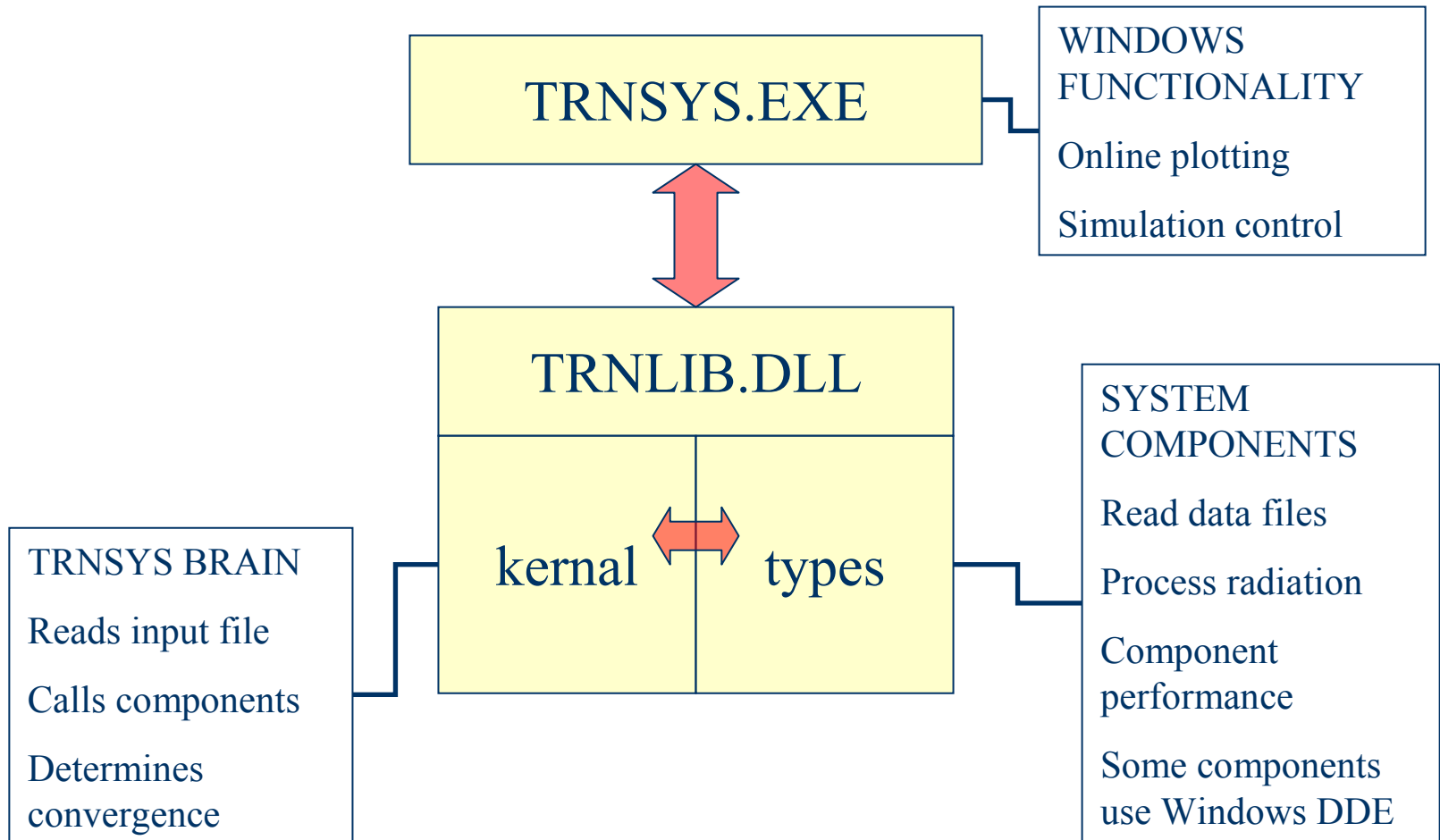
Agenda

- ◆ Quick overview of TRNSYS
- ◆ Review of current SolarPaces models
- ◆ Potential Other Models appropriate for CSP TES
- ◆ Review of Current Project Proposal
- ◆ Discussion

What is TRNSYS?

- ◆ Algebraic and differential equation solver.
- ◆ Library of common “energy system” components.
- ◆ Routines for input of weather and time-dependent forcing functions.
- ◆ Method for adding user-written components.
- ◆ Suite of utility programs.

Solver-Library Communication



TRNSYS Concepts

- ◆ Modular approach
 - Large problem = Σ several smaller problems
- ◆ General formulation
- ◆ Entire problem reduced to :
 - Formulating mathematical models.
 - Describing interconnections.

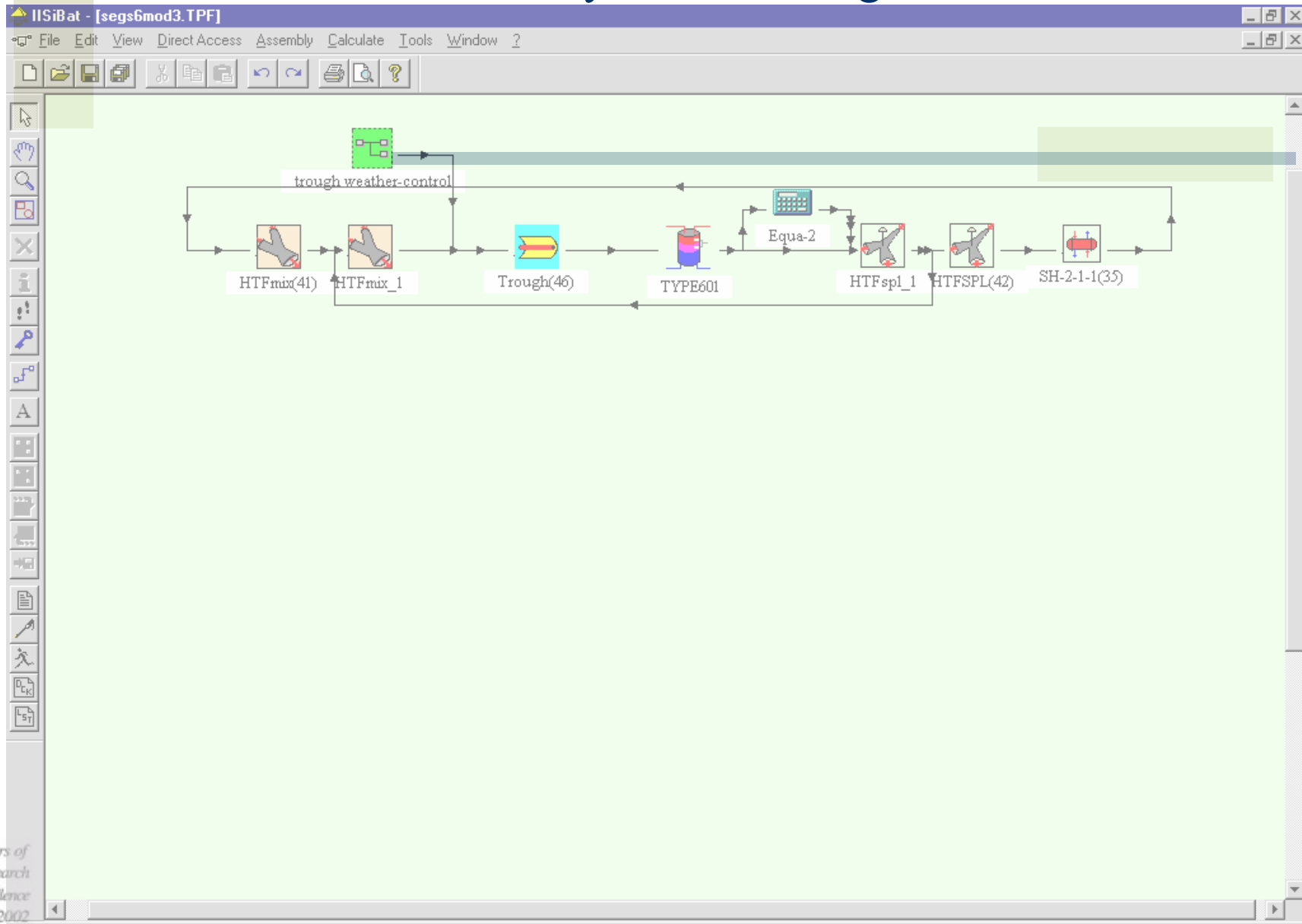
System Definition

- ◆ System = set of components
 - Each component represents a process
- ◆ Components are connected to accomplish a specified task
- ◆ Simulate system performance by simulating the performance of the individual components.

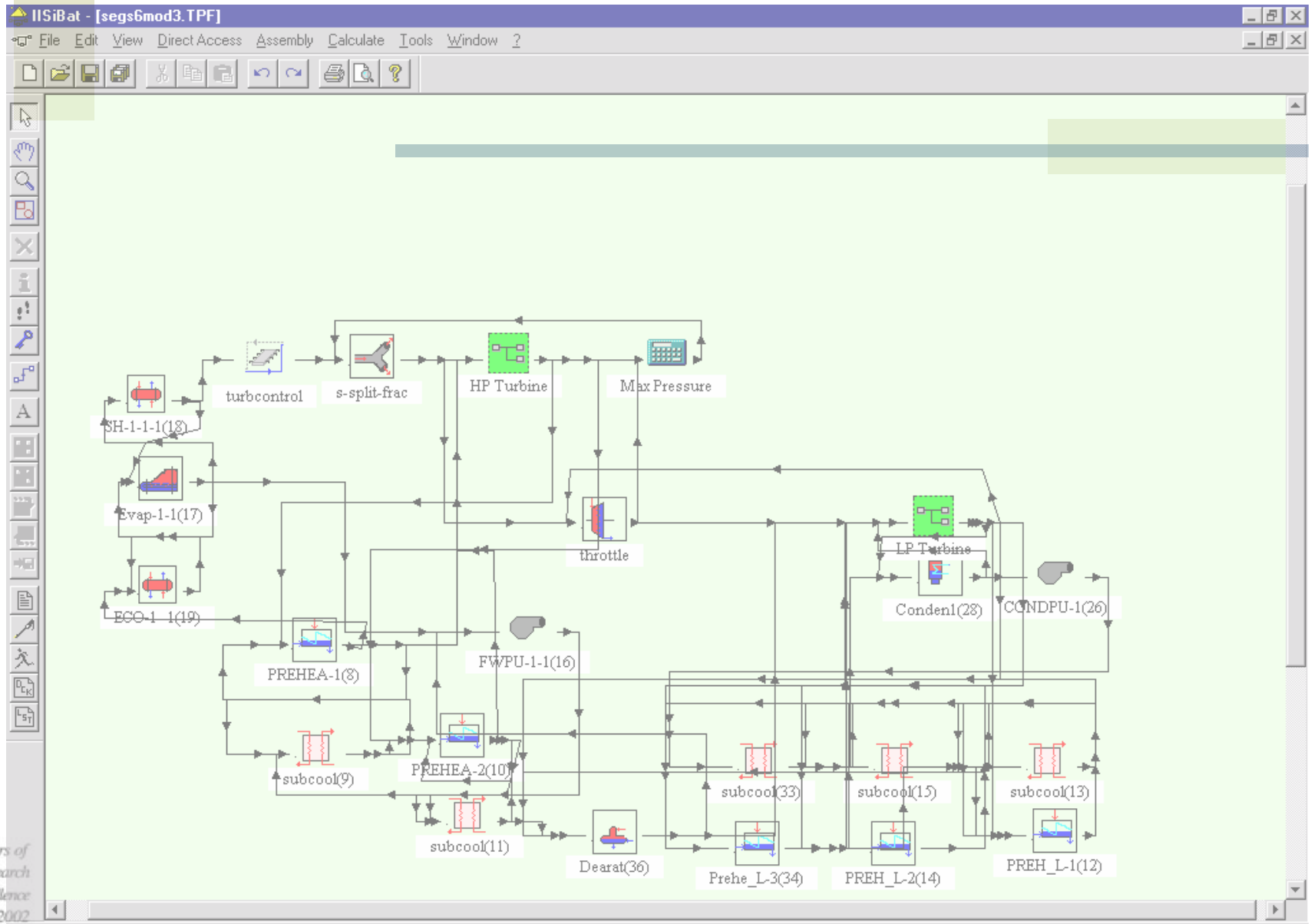
Components

- ◆ Fortran subroutines
- ◆ Generic formulation
- ◆ Choose them from a “black box” library
- ◆ Write them yourself

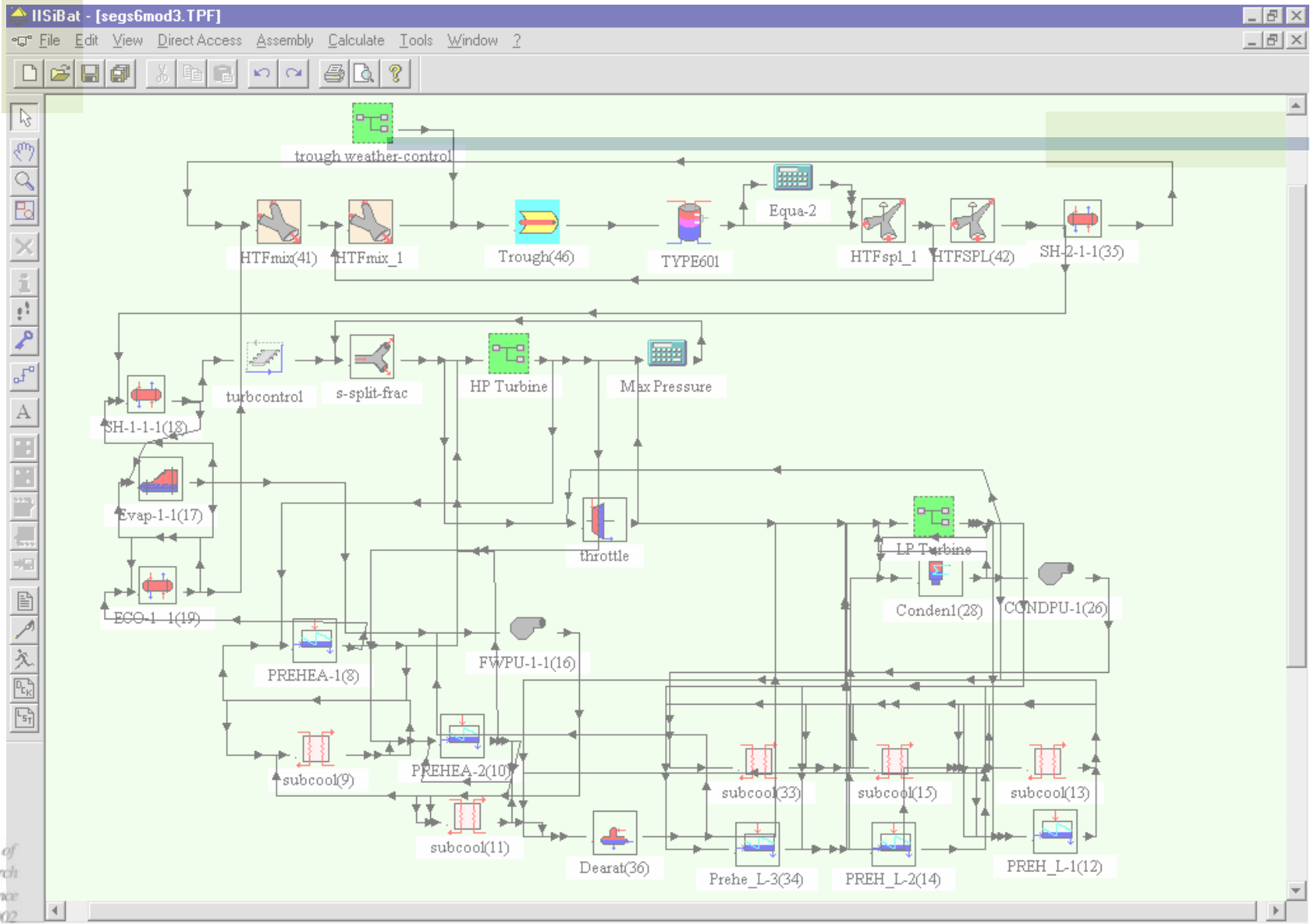
Solar-Side of SEGS 6 System Drawing in IISiBat



Steam Turbine-Side of SEGS 6 System Drawing in IISiBat



Combined Solar And Steam Systems in IISiBat

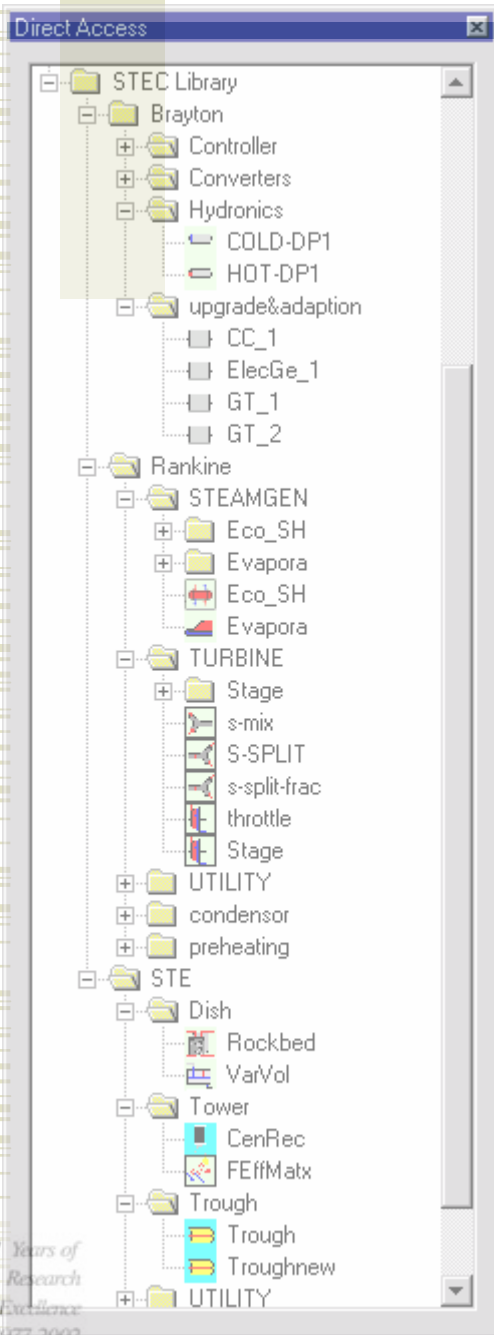


Available Components

- ◆ Three General Types of Components
 - Utility Components
 - ex: data readers, printers, plotters
 - Equipment Components
 - ex: chillers, solar collectors, pumps, fans
 - Physical Phenomena Components
 - ex: psychrometrics, radiation processors, steam properties

Standard Components

- ◆ *Thermal Storage*
 - Stratified Fluid Storage Tank
 - Rock Bed
 - Algebraic (Plug Flow) Tank
 - Variable Volume Tank
 - Detailed Stratified Fluid Storage Tank



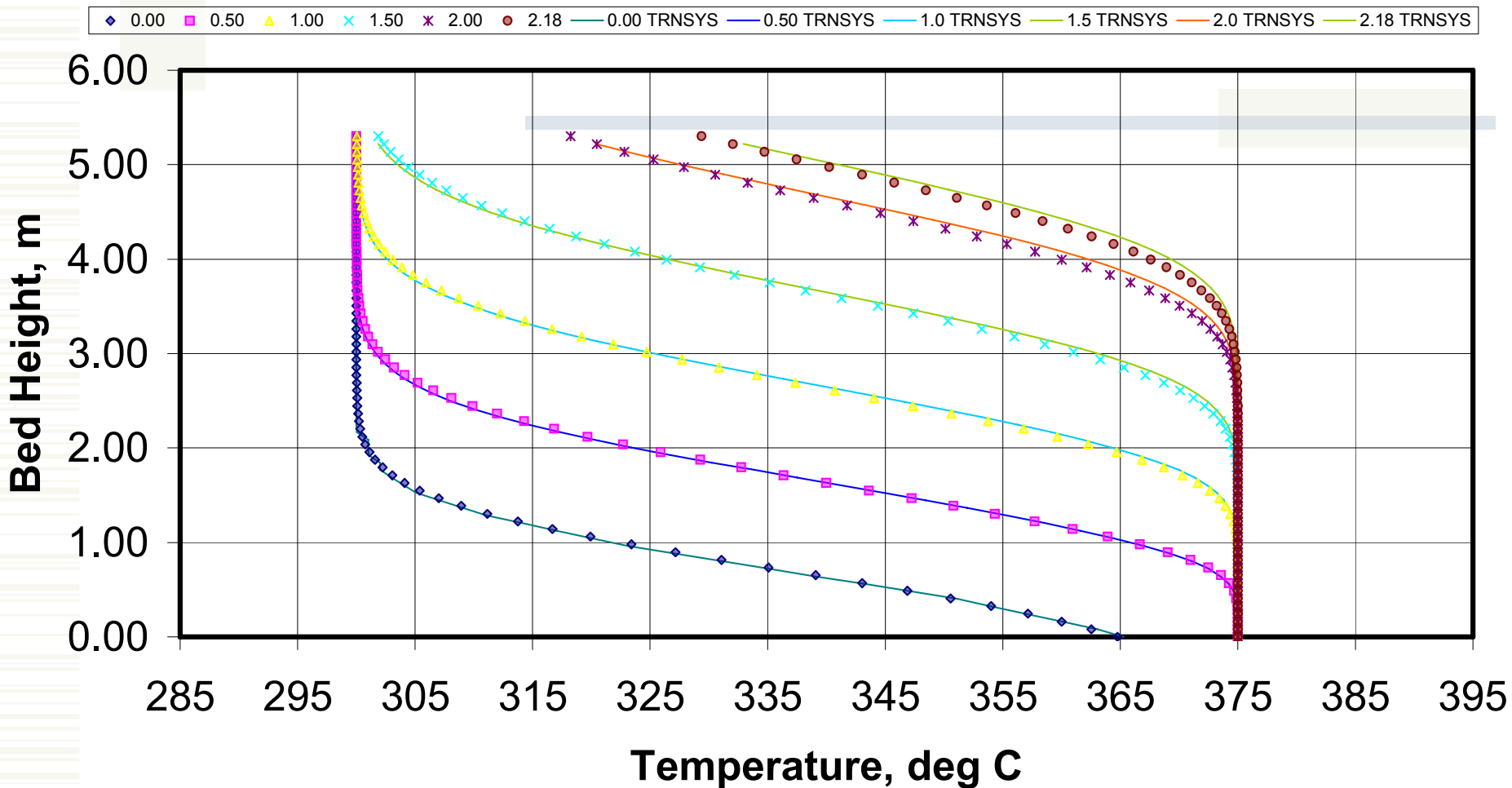
STEC TRNSYS Library

- Large Number of Components
- Reusable
- Able to configure different Systems with same components
- Created by DNR and Sandia
- Upgraded to new release of IISIBat 3 (the interface) and TRNSYS 15

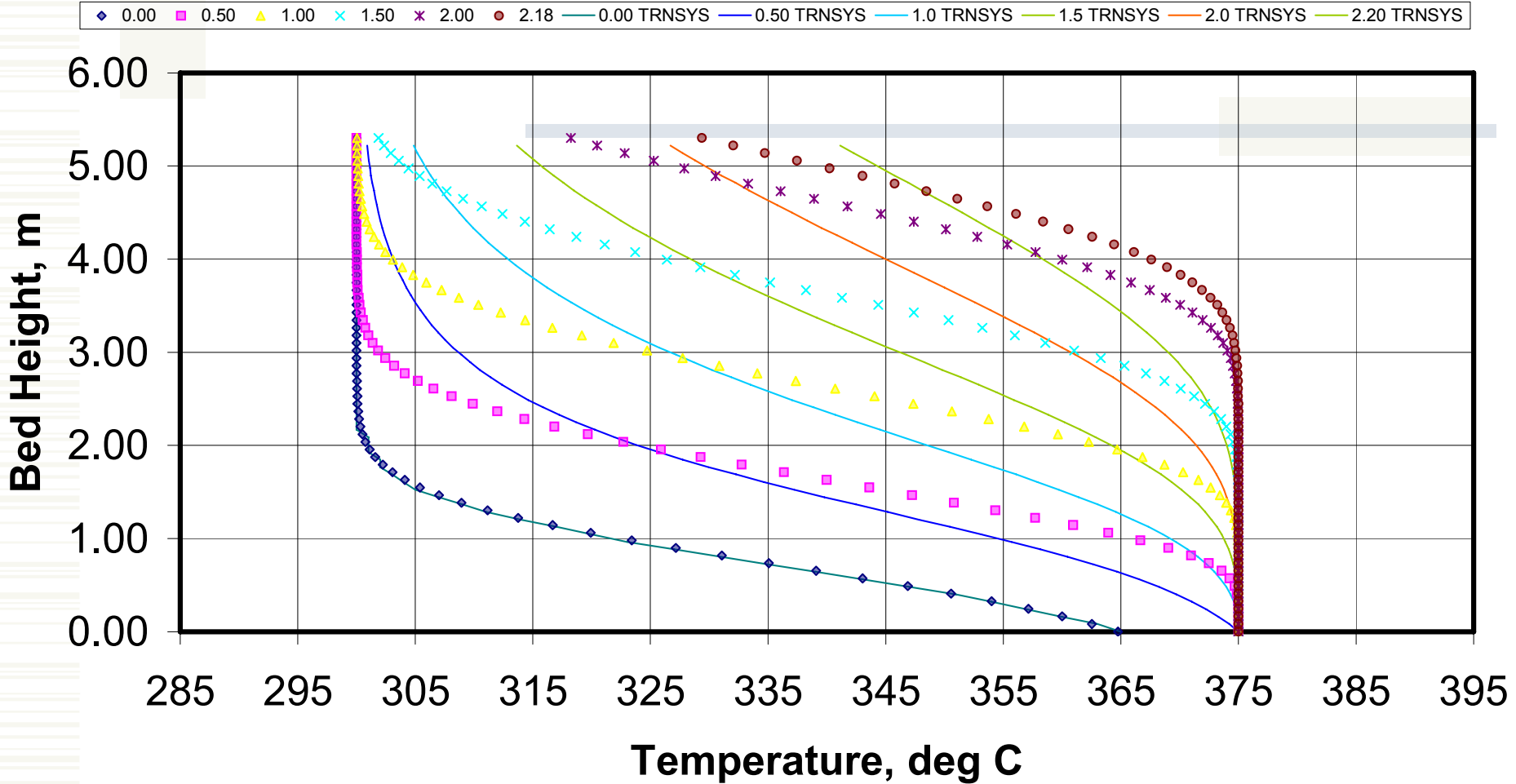
Thermocline Storage Modeling

- ◆ Existing Excel model for this thermocline storage at Sandia by Jim Pacheco
- ◆ In Summer 2000:
 - I compared Excel results with standard TRNSYS rockbed model (Type 10).
 - Converted the Excel model to FORTRAN as a TRNSYS component.
 - Compared both components with Pacheco's Excel model

Thermocline Profiles cond=0,loss=0,66 nodes,dt=0.001



Thermocline Profiles cond=0,loss=0,66 nodes,dt=0.5



Other Potential Storage Models

- ◆ TESS Geothermal Heat Pump Component Library:
 - Buried Horizontal Pipes (Simple and Detailed)
 - U-Tube Vertical Ground Heat Exchangers
 - Tube-in-Tube Vertical Ground Heat Exchangers
- ◆ TESS Storage Tank Component Library:
 - Vertical Cylindrical Tank
 - Horizontal Cylindrical Tank
 - Spherical Tank
 - Rectangular Tank

Other Potential Storage Models

- ◆ Transsolar Models (Stuttgart):
 - ◆ Seasonal Ground Heat Storage (Multiport Pit Storage Model) (L. Mazarella)
 - ◆ Multiport Tank Storage Model (H. Drück)
 - ◆ ICEPIT Pit Storage Model for Heat and Cold Storage (M. Hornberger)

Other Potential Storage Models

- ◆ Various PCM TRNSYS Models
 - ◆ Other very large scale (aquifer size) models
 - ◆ Continuing to do a literature search for existing, appropriate models



Discussion