

# Current TES Capabilities in TRNSYS

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**Feb. 20-21, 2003**

NREL/PR-550-40029

Presented at the 2003 Parabolic Trough Thermal Energy Storage Workshop  
on February 20-21, 2003, in Golden, Colorado.

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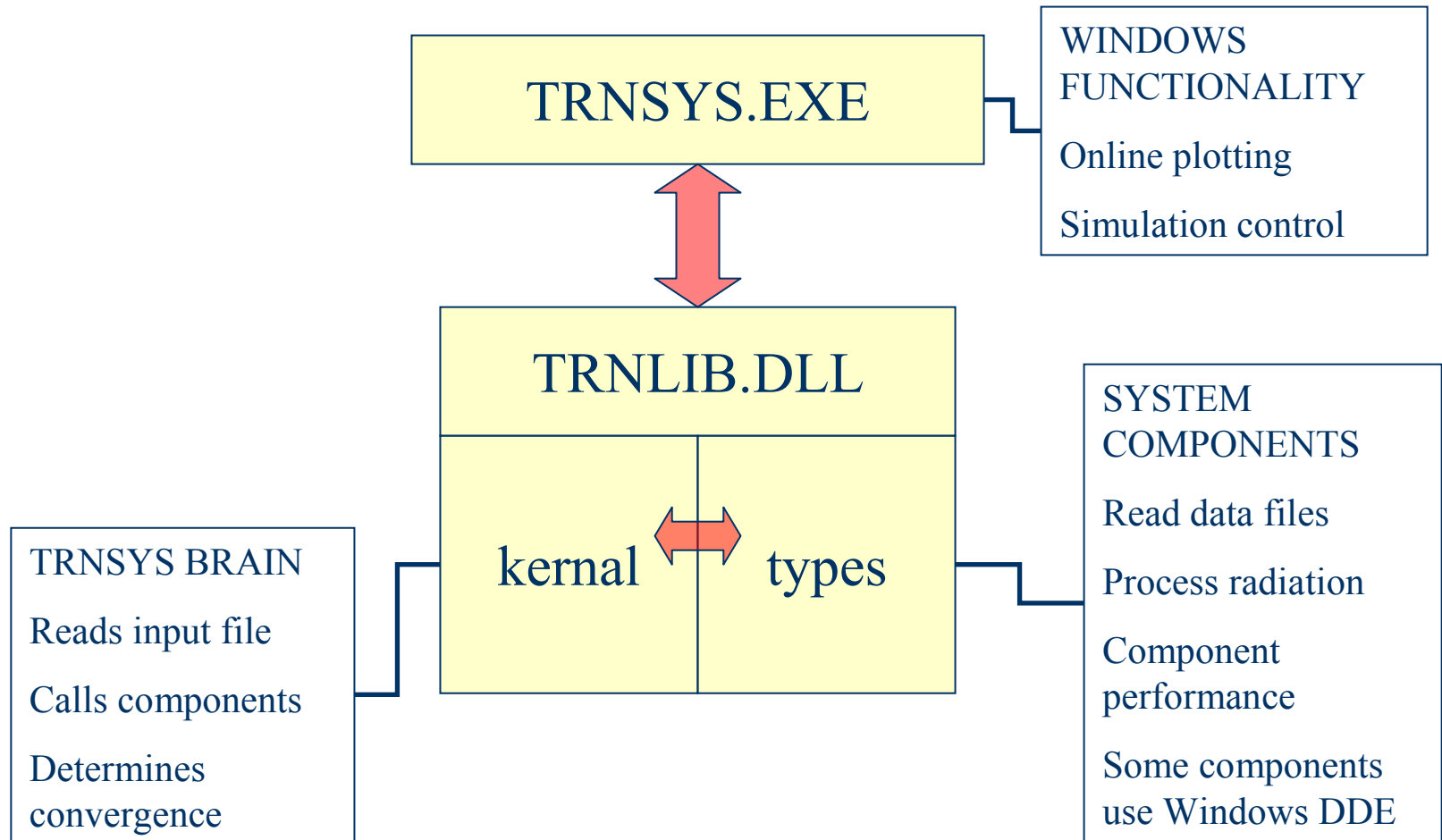
# Agenda

- ◆ 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 =  $\Sigma$  several smaller problems
- ◆ General formulation
- ◆ Entire problem reduced to :
  - Formulating mathematical models.
  - Describing interconnections.

# System Definition

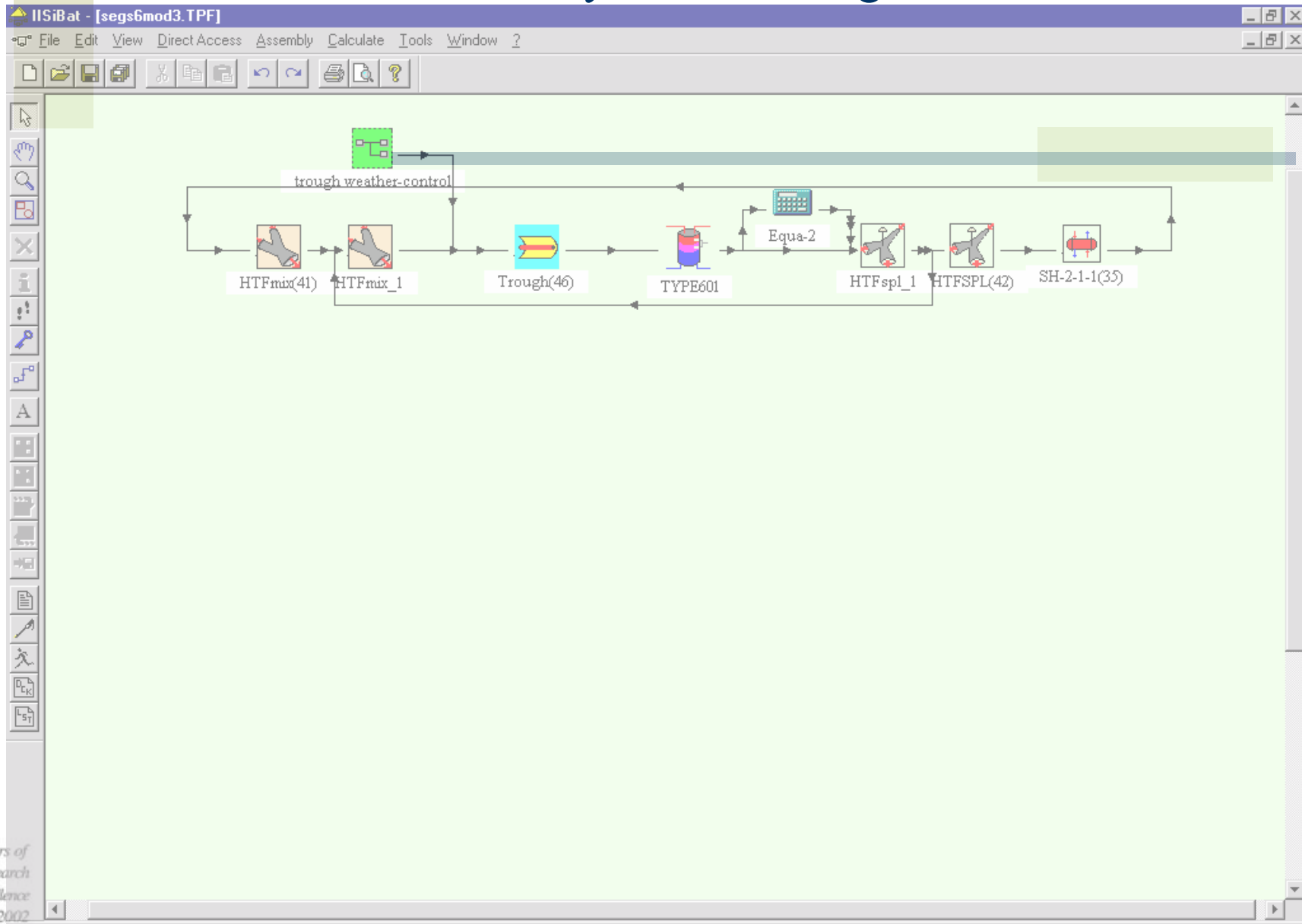
- ◆ System = set of components
  - Each component represents a process
- ◆ Components are connected to accomplish a specified task
- ◆ Simulate system performance by simulating the performance of the individual components.

# Components

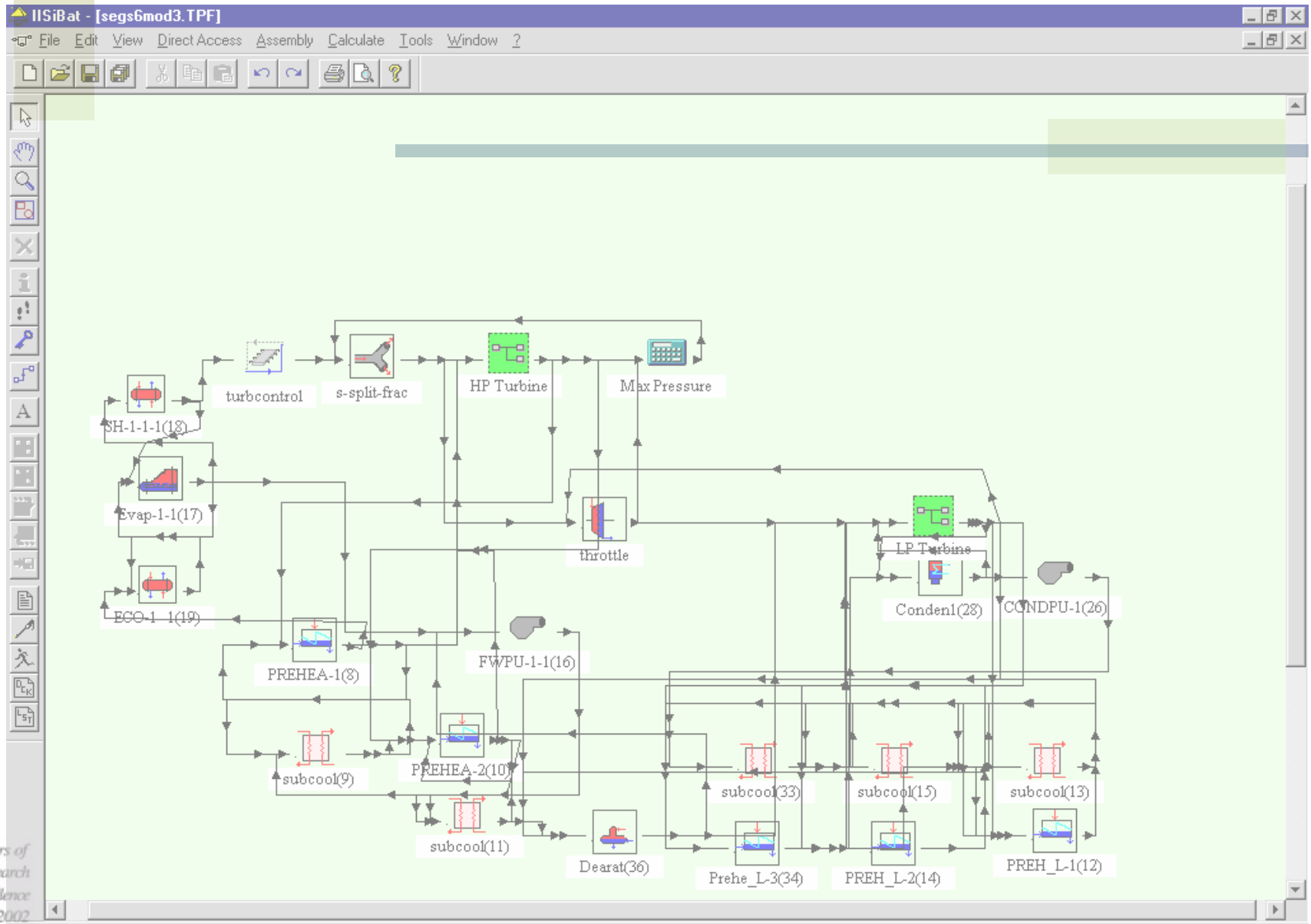
- ◆ Fortran subroutines
- ◆ Generic formulation
- ◆ Choose them from a “black box” library
- ◆ Write them yourself



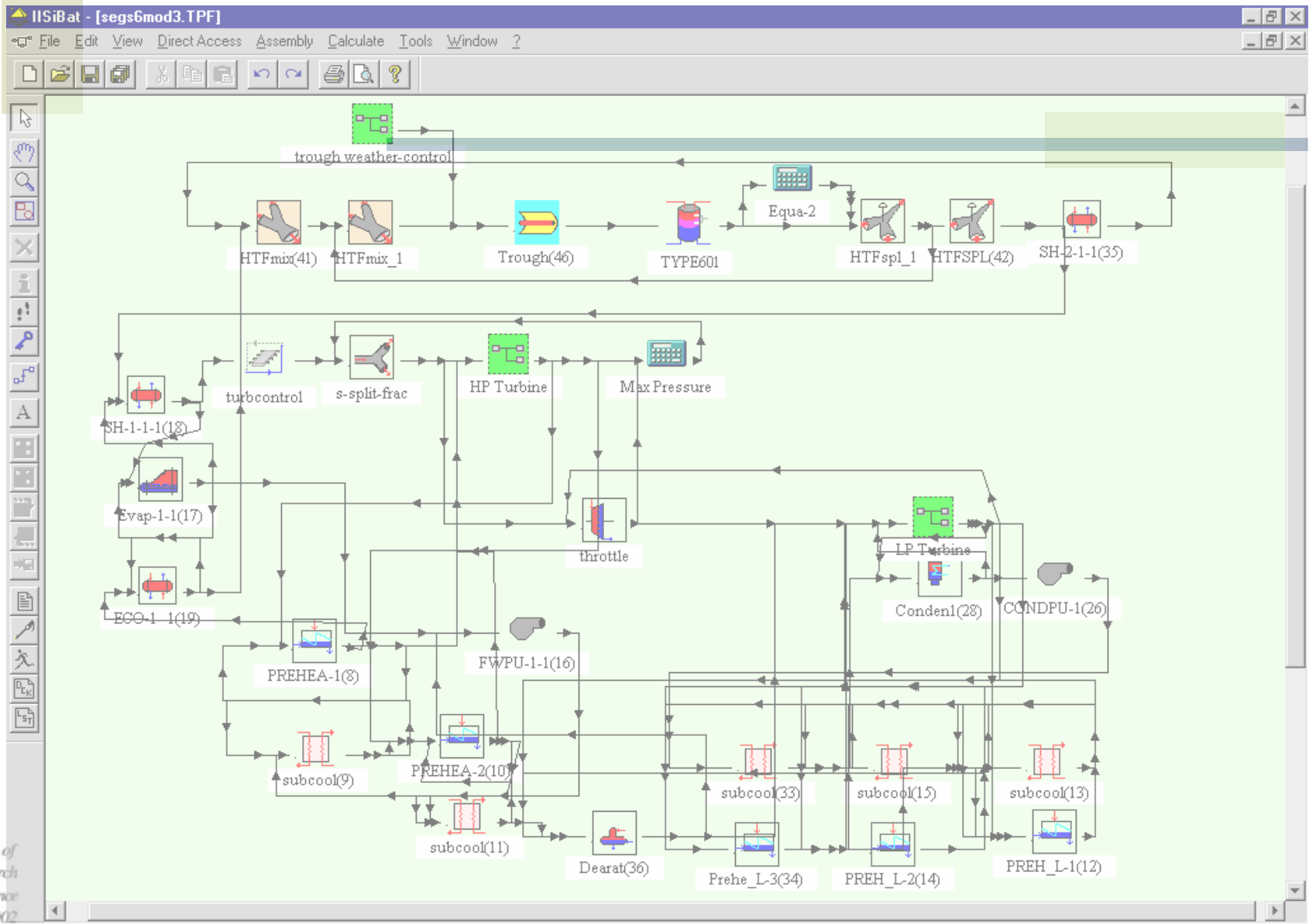
# Solar-Side of SEGS 6 System Drawing in IISiBat



# Steam Turbine-Side of SEGS 6 System Drawing in IISiBat



# Combined Solar And Steam Systems in IISiBat



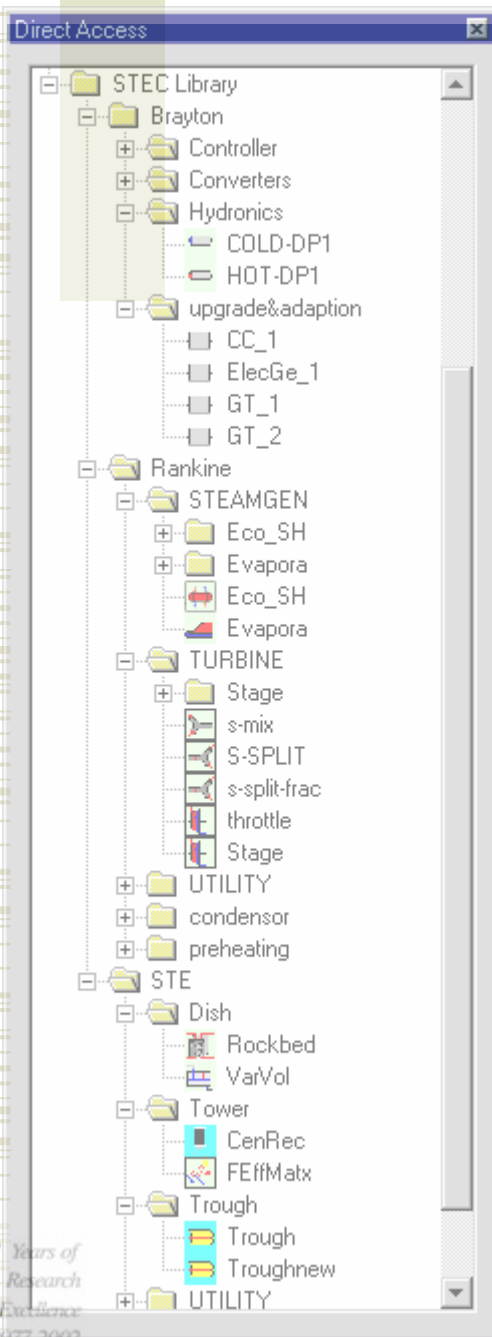
# Available Components

- ◆ 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

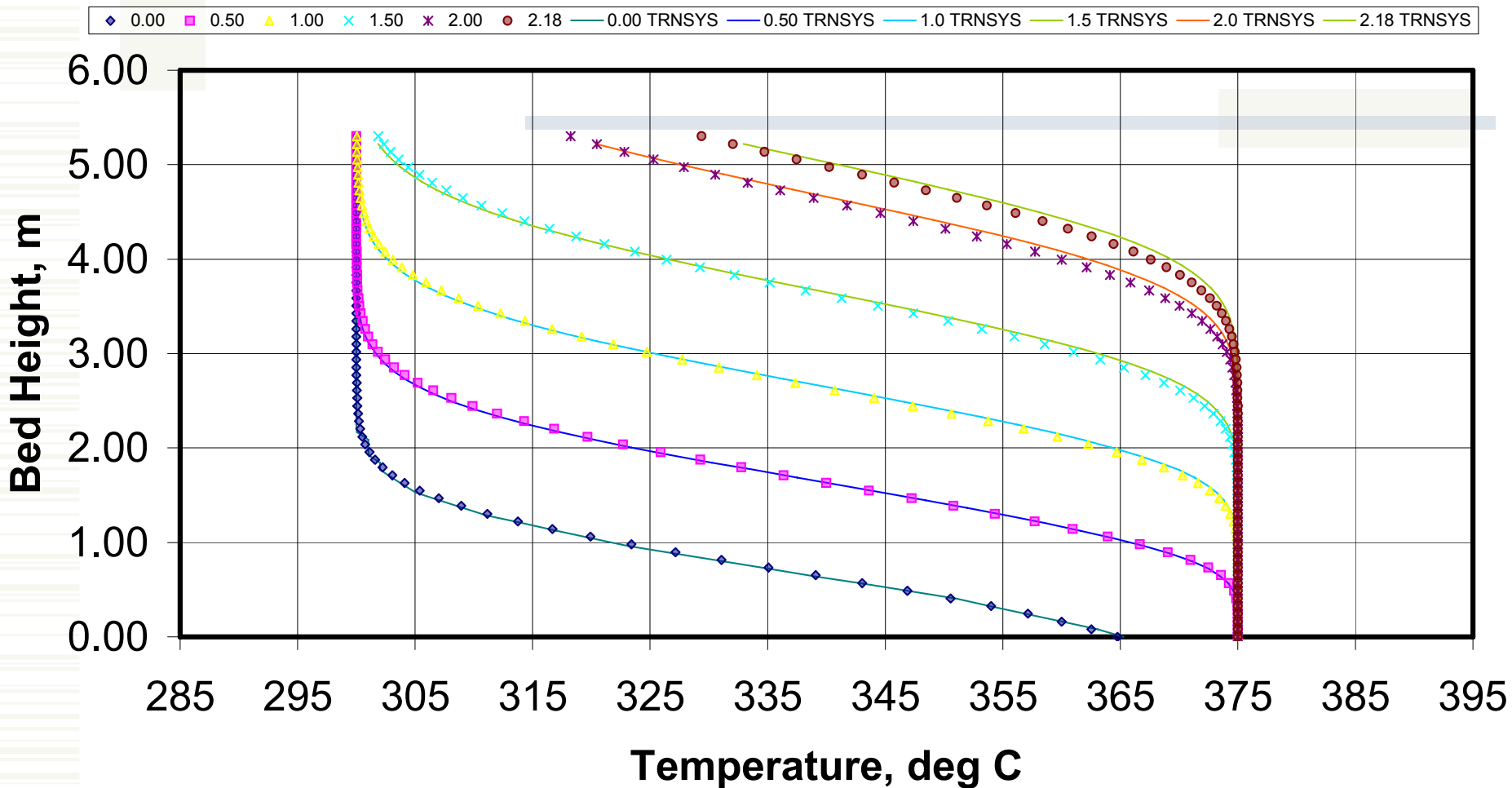


- Large Number of Components
- Reusable
- Able to configure different Systems with same components
- Created by DNR and Sandia
- Upgraded to new release of IISIBat 3 (the interface) and TRNSYS 15

# Thermocline Storage Modeling

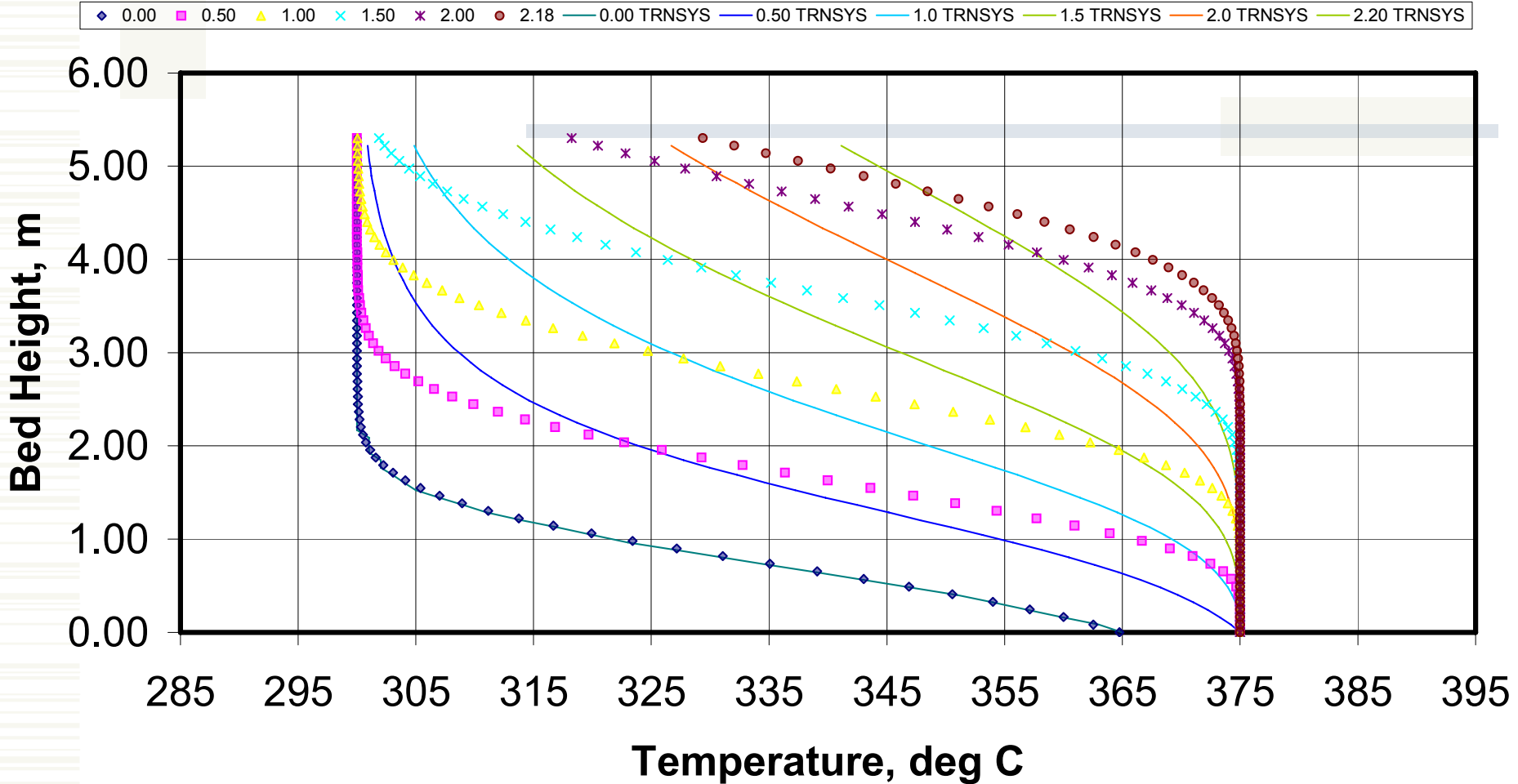
- ◆ Existing Excel model for this thermocline storage at Sandia by Jim Pacheco
- ◆ In Summer 2000:
  - I compared Excel results with standard TRNSYS rockbed model (Type 10).
  - Converted the Excel model to FORTRAN as a TRNSYS component.
  - Compared both components with Pacheco's Excel model

# 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