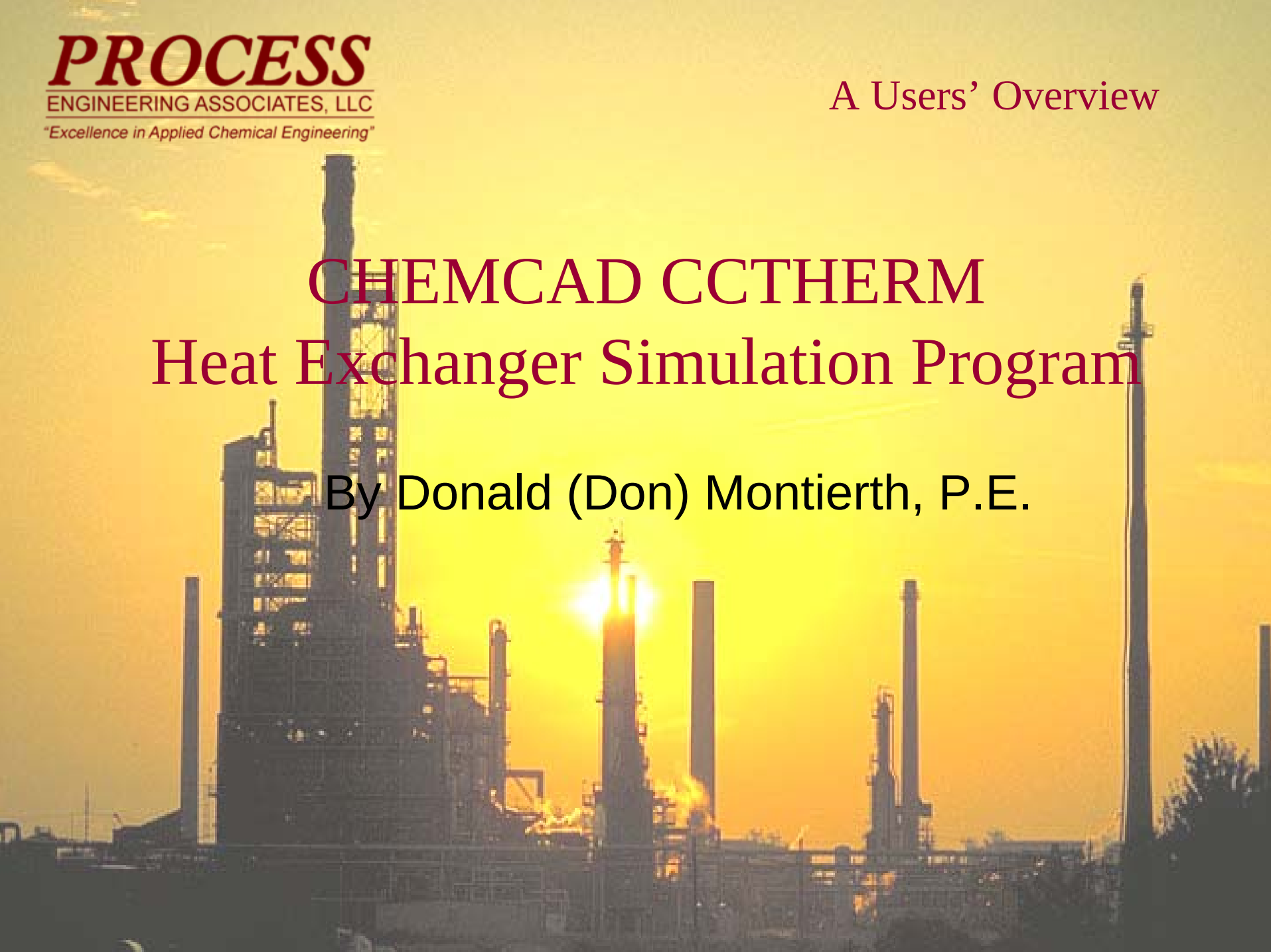
PROCESS
ENGINEERING ASSOCIATES, LLC
"Excellence in Applied Chemical Engineering"

A Users' Overview

CHEMCAD CCTHERM
Heat Exchanger Simulation Program

By Donald (Don) Montierth, P.E.



What is CCTHERM?

CCTHERM is an integrated software module for design and rating of heat transfer equipment

- Shell and Tube
- Plate and Frame
- Air-cooled
- Double Pipe

What Standards Can Be Applied?

Designs to International Standards

- TEMA
- ASME Code
- DIN
- BS5500

Shell and Tube Exchanger Types

- Sensible heat - liquid or gas
- Reboilers - forced flow, thermosyphon
- Condensers - vertical, horizontal, reflux, shell side or tube side condensation
- Falling film evaporators, heaters, coolers

Shell and Tube Mechanical Configurations

- All TEMA arrangements
- All baffle types
- Bare or finned tubes (finned tube data for popular manufacturers integral to program)

Plate and Frame Exchangers

- Sensible heating or cooling
- Condensers
- Evaporators
- Chevron plates
- Intermating plates
- User defined plates

Air-Cooled Exchangers

- Sensible cooling
- Condensers - vertical, horizontal, or reflux
- Bare or finned tubes
- Fan data for popular manufacturers integral to program

Double Pipe Exchangers

- Sensible heat transfer for liquid or vapor
- Single or multiple modules in series or parallel
- Single or multiple tubes per shell, straight or U tube

Double Pipe Exchanger Mechanical Configurations

- Bare or longitudinal fin tubes (Brown Fintube data integral to program)
- Standard Brown Fintube exchanger data integral to program

Benefits of CCTHERM

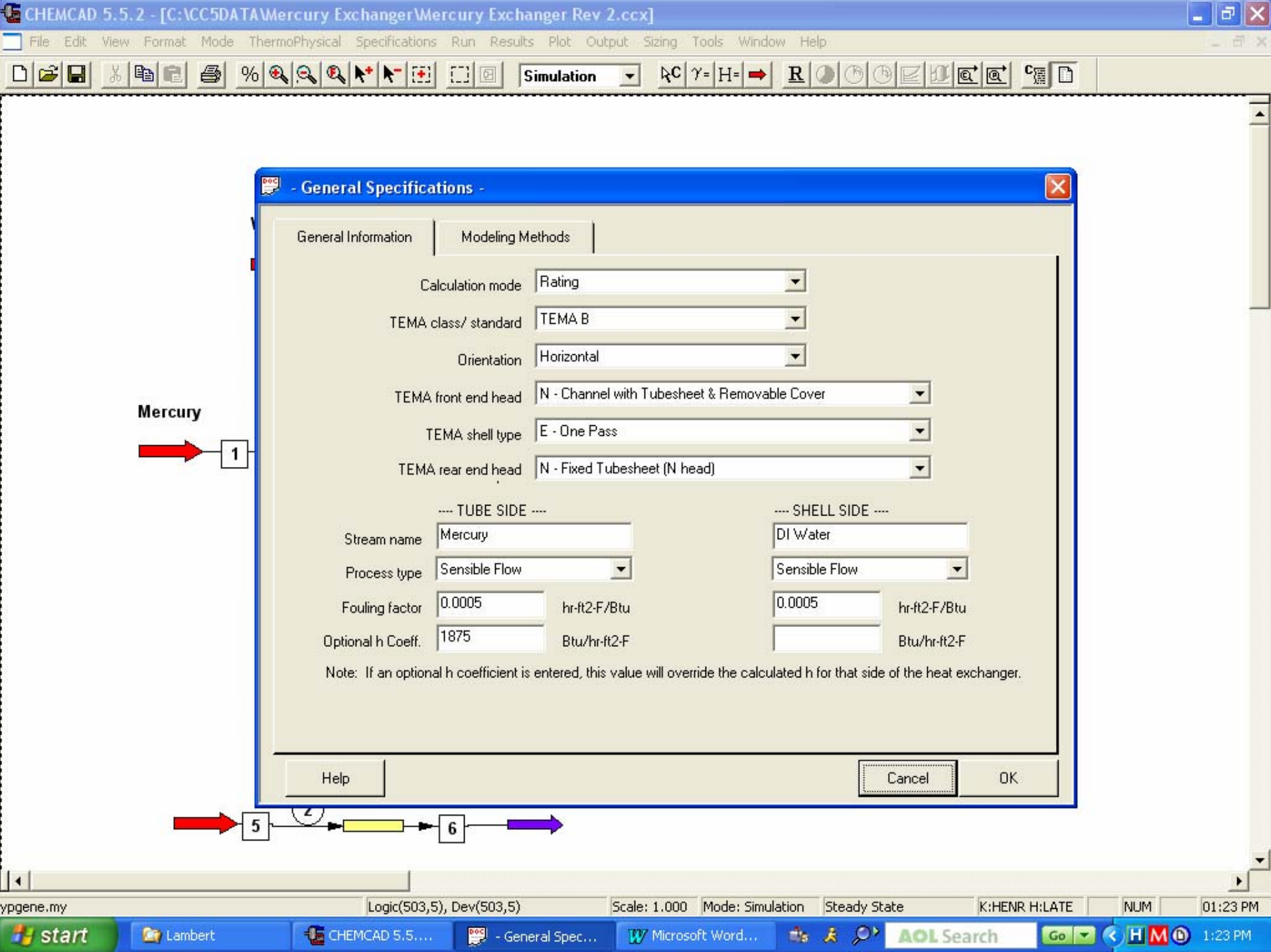
- Fully integrated with process flowsheet with multiple simulation modes
  - Design
  - Rating
  - Fouling factor rating
  - Geometry simulation
- Uses actual fluid properties

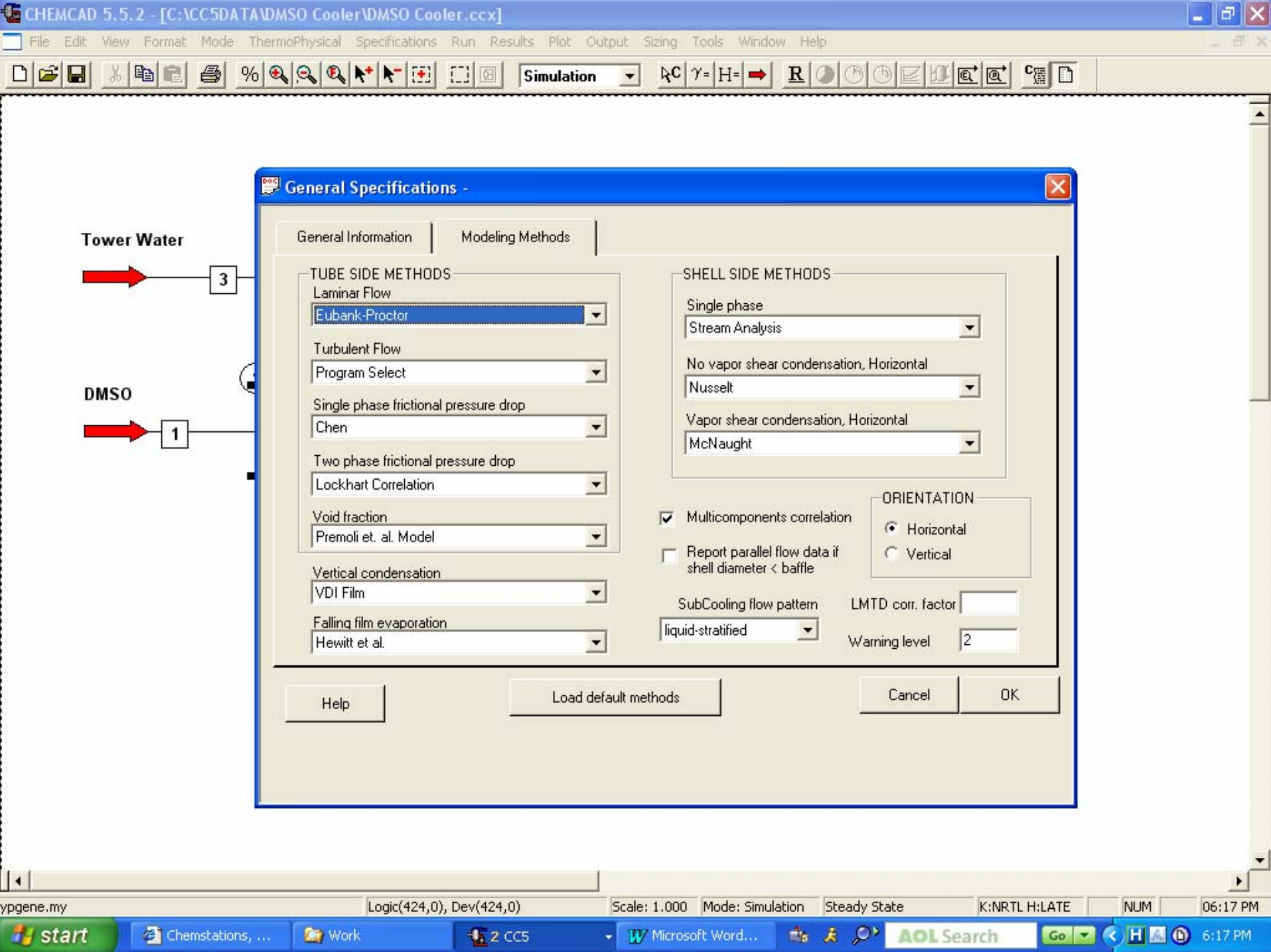
Other Benefits of CCTHERM

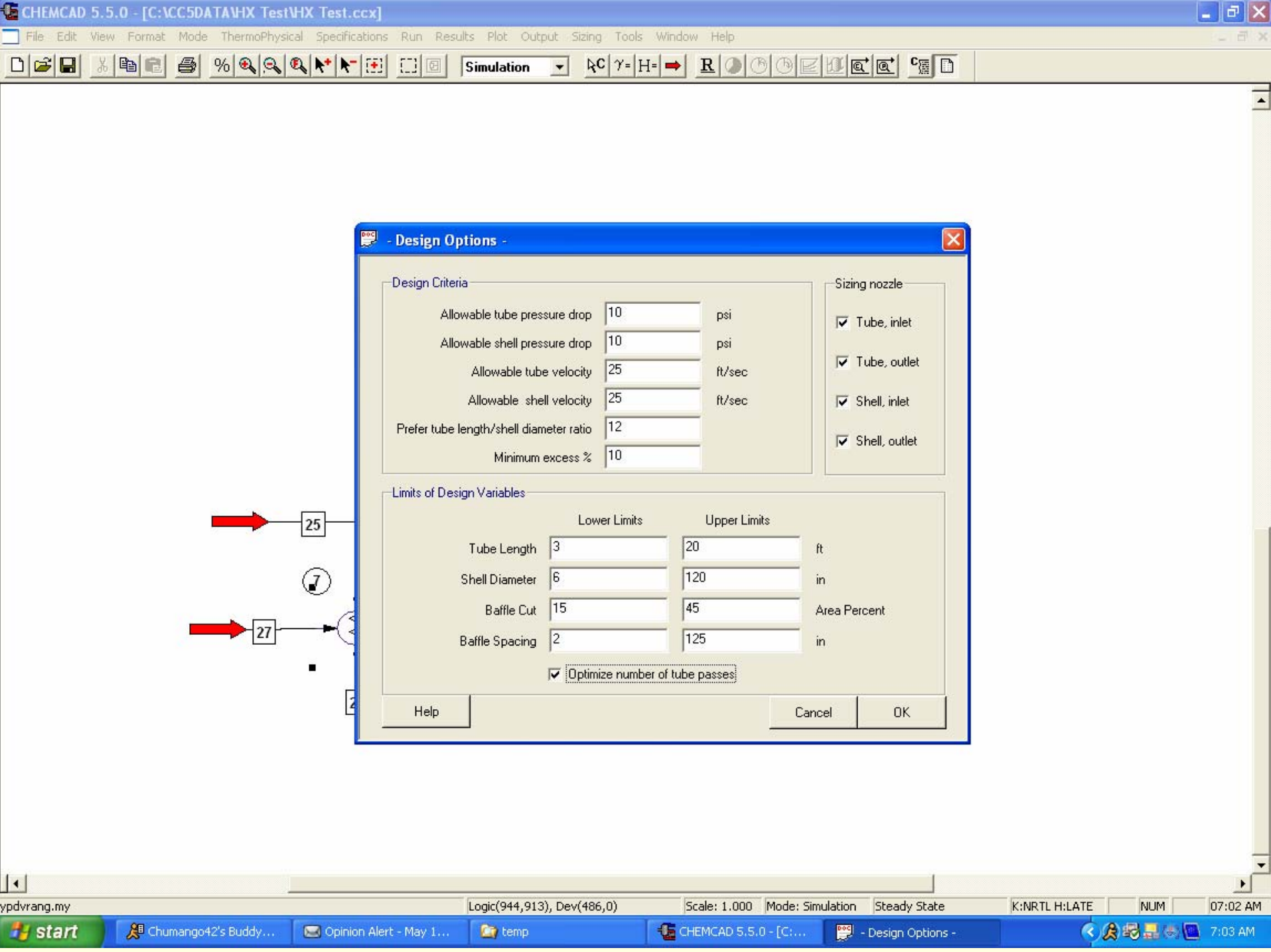
- Optimizes heat exchanger design while accounting for process variability
- Reduces overall design time
- Allows reduction of equipment overdesign

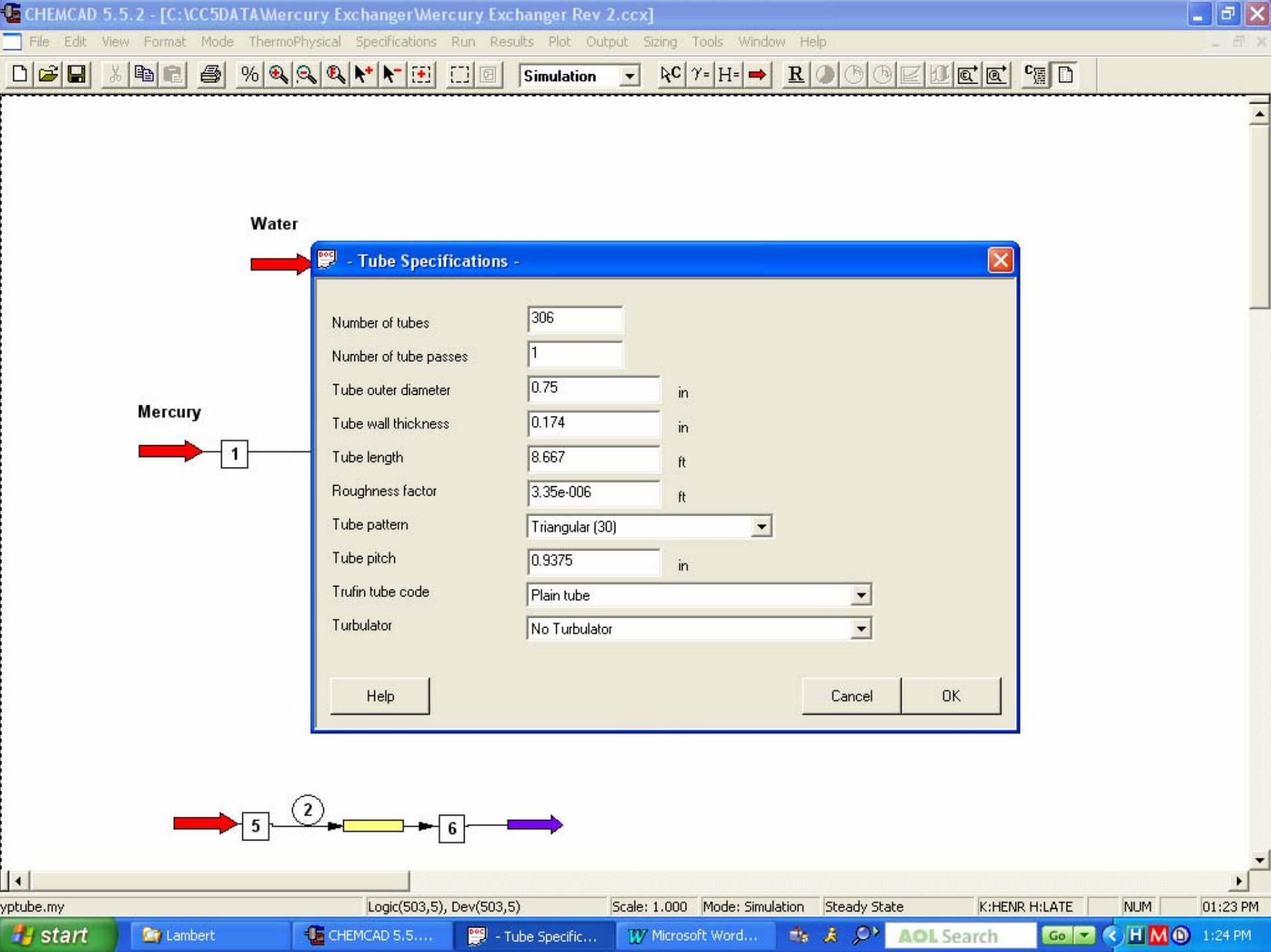
CCTHERM Inputs

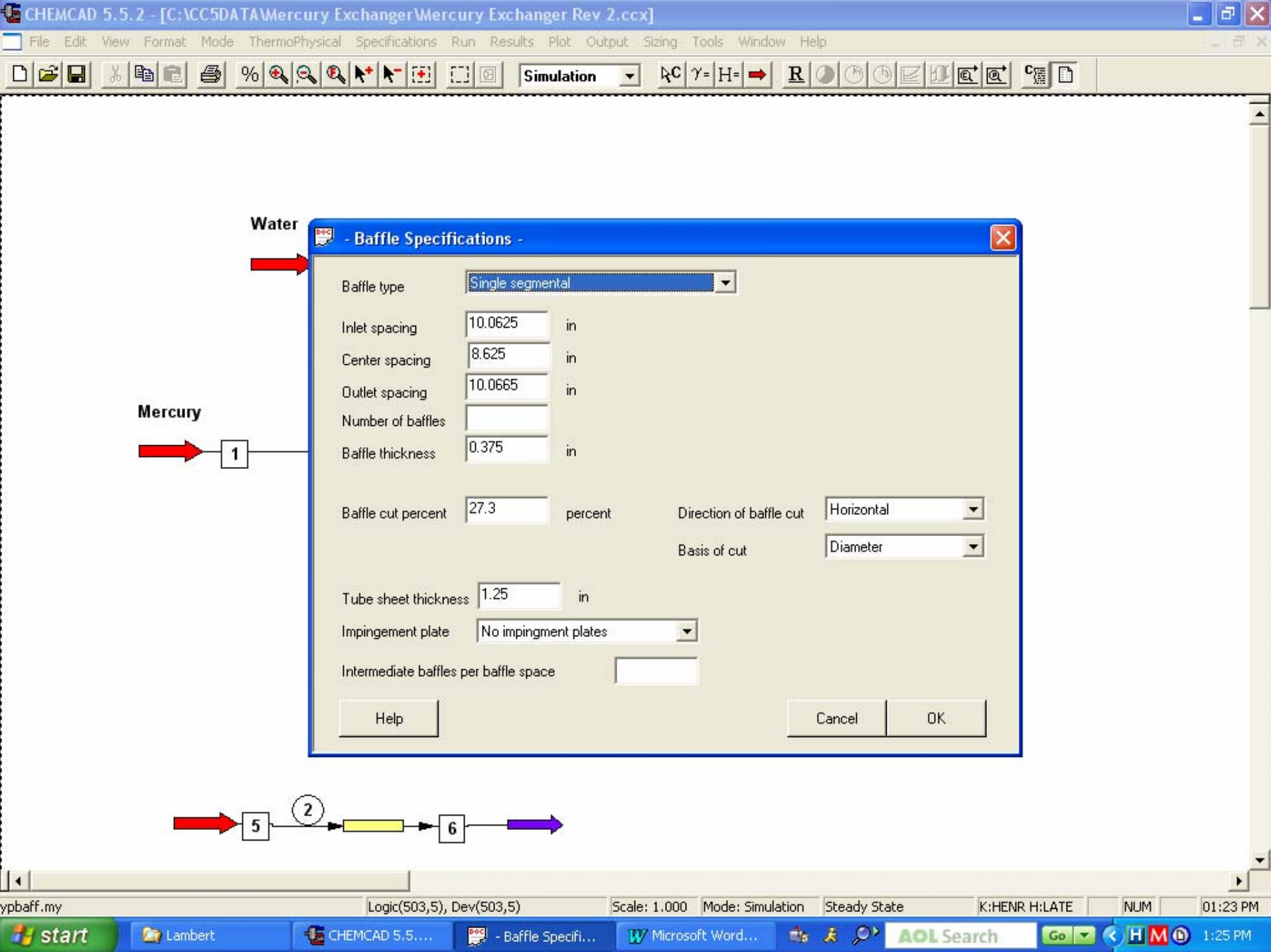
- TEMA Type
- Design Mode
- Tube Data
- Shell Data
- Baffle Data

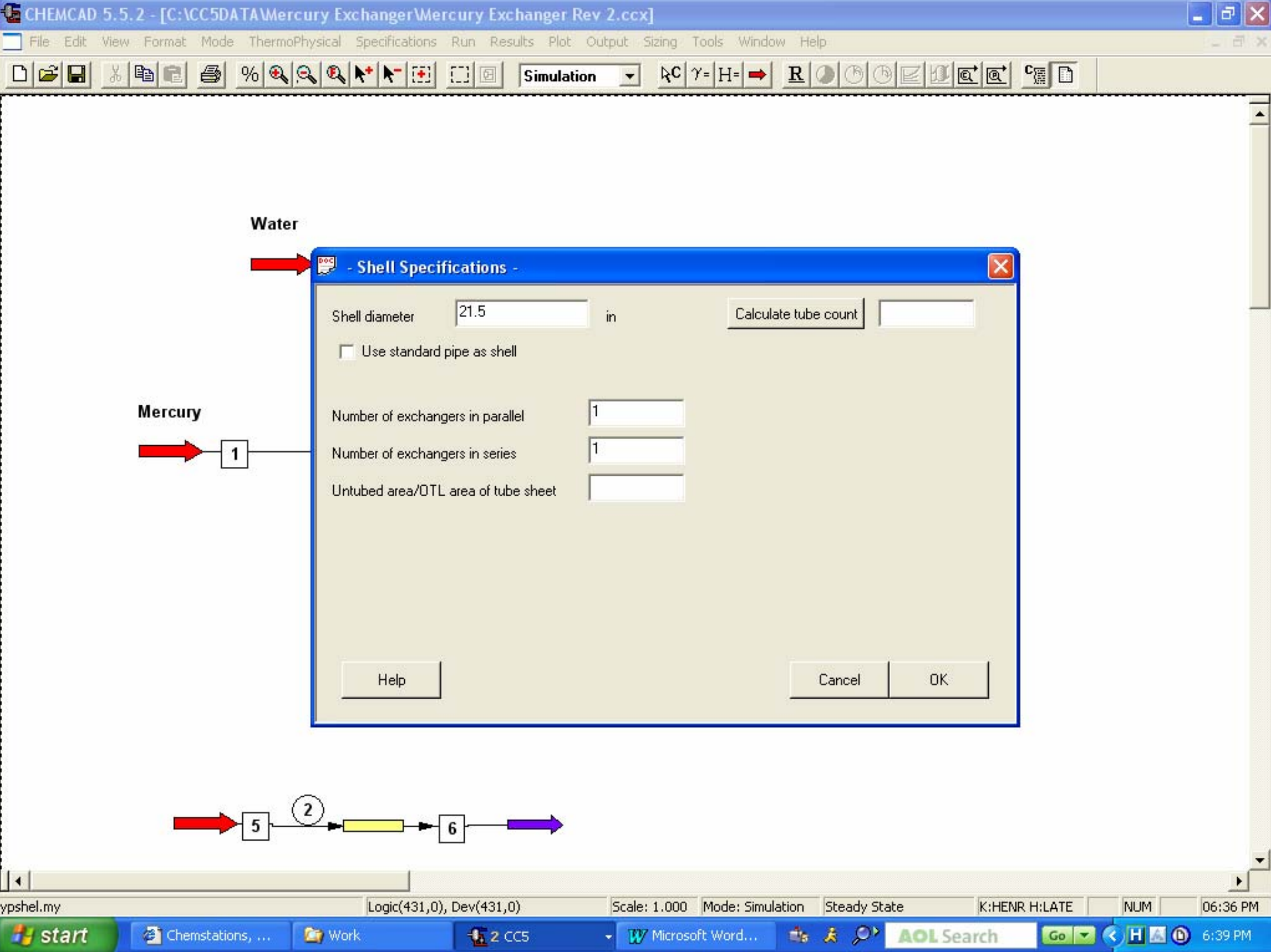

CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
- General Specifications -
General Information
Modeling Methods
Calculation mode
Rating
TEMA class/ standard
TEMA B
Orientation
Horizontal
TEMA front end head
N - Channel with Tubesheet & Removable Cover
TEMA shell type
E - One Pass
TEMA rear end head
N - Fixed Tubesheet (N head)
---- TUBE SIDE ----
---- SHELL SIDE ----
Stream name
Mercury
DI Water
Process type
Sensible Flow
Sensible Flow
Fouling factor
0.0005
hr-ft2-F/Btu
0.0005
hr-ft2-F/Btu
Optional h Coeff.
1875
Btu/hr-ft2-F
Btu/hr-ft2-F
Note: If an optional h coefficient is entered, this value will override the calculated h for that side of the heat exchanger.
Help
Cancel
OK
Mercury
1
5
2
6
ypgene.my
Logic(503,5), Dev(503,5)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
01:23 PM
start
Lambert
CHEMCAD 5.5....
- General Spec...
Microsoft Word...
AOL Search
Go
1:23 PM

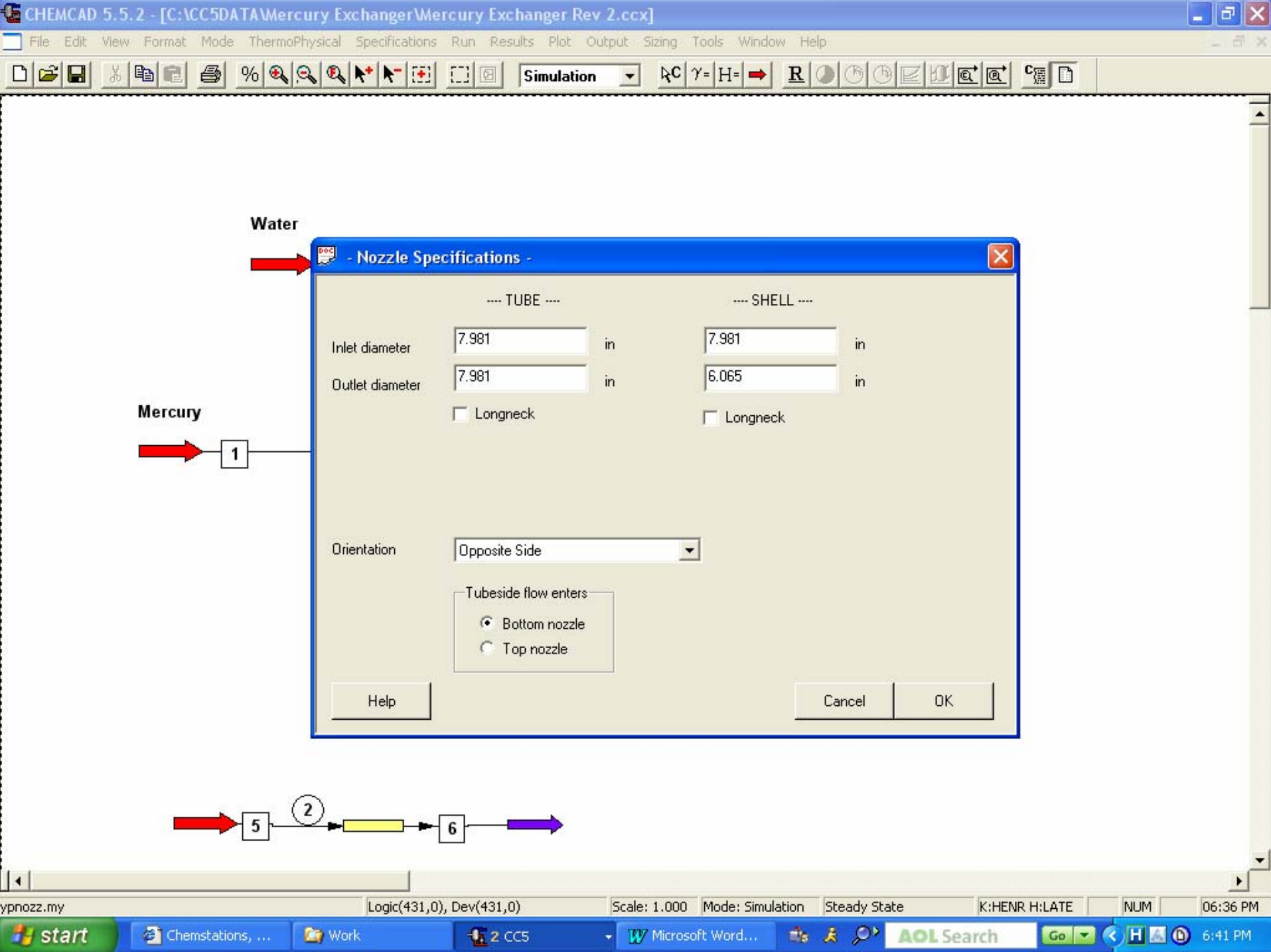

CHEMCAD 5.5.2 - [C:\CC5DATA\DMSO Cooler\DMSO Cooler.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Tower Water
3
DMSO
1
General Specifications -
General Information
Modeling Methods
TUBE SIDE METHODS
Laminar Flow
Eubank-Proctor
Turbulent Flow
Program Select
Single phase frictional pressure drop
Chen
Two phase frictional pressure drop
Lockhart Correlation
Void fraction
Premoli et. al. Model
Vertical condensation
VDI Film
Falling film evaporation
Hewitt et al.
SHELL SIDE METHODS
Single phase
Stream Analysis
No vapor shear condensation, Horizontal
Nusselt
Vapor shear condensation, Horizontal
McNaught
Multicomponents correlation
Report parallel flow data if shell diameter < baffle
ORIENTATION
Horizontal
Vertical
SubCooling flow pattern
liquid-stratified
LMTD corr. factor
Warning level
2
Help
Load default methods
Cancel
OK
ypgene.my
Logic(424,0), Dev(424,0)
Scale: 1.000
Mode: Simulation
Steady State
K:NRTL H:LATE
NUM
06:17 PM
start
Chemstations, ...
Work
2 CC5
Microsoft Word...
AOL Search
Go
6:17 PM

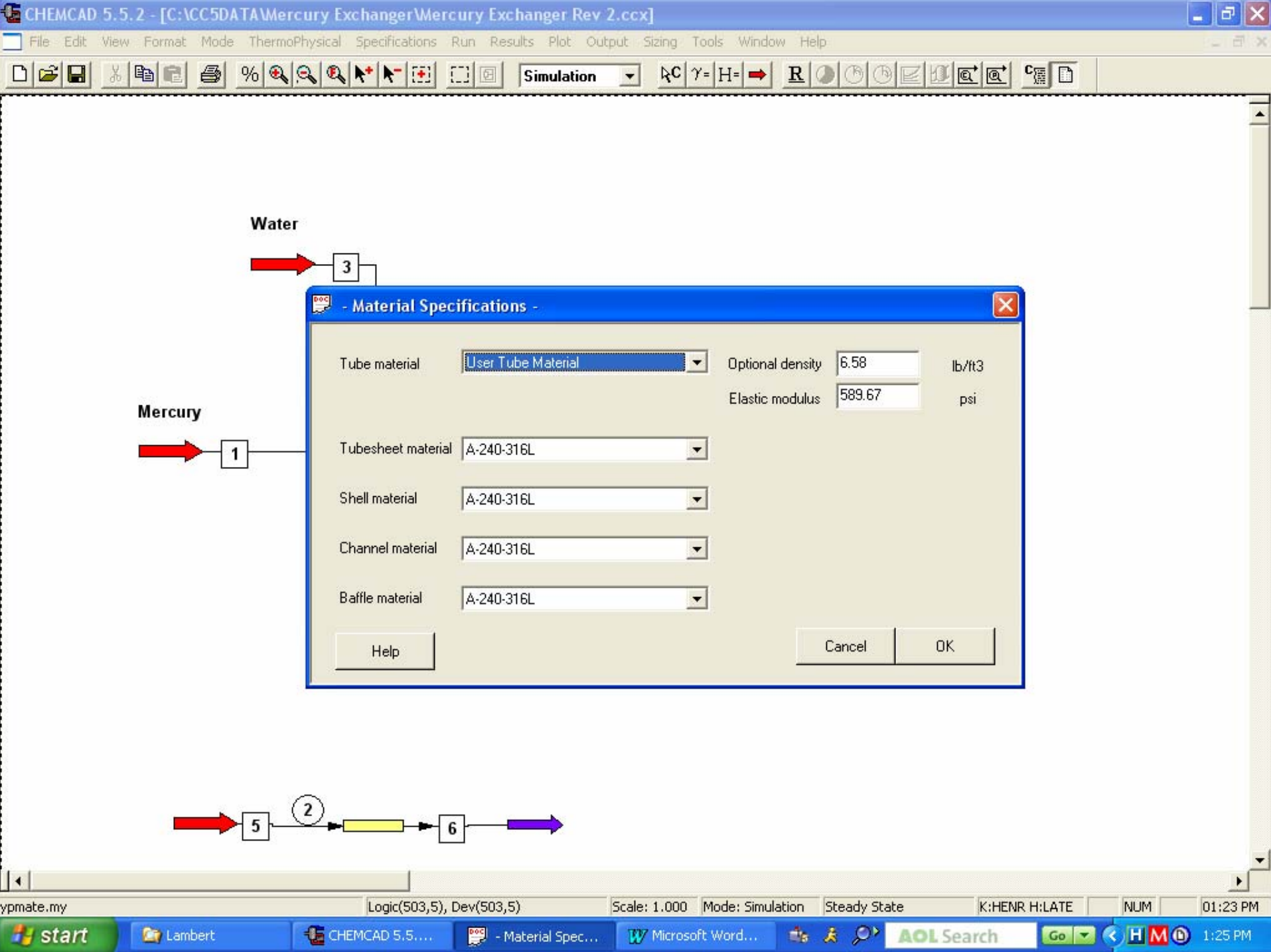

CHEMCAD 5.5.0 - [C:\CC5DATA\HX Test\HX Test.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
- Design Options -
Design Criteria
Allowable tube pressure drop 10 psi
Allowable shell pressure drop 10 psi
Allowable tube velocity 25 ft/sec
Allowable shell velocity 25 ft/sec
Prefer tube length/shell diameter ratio 12
Minimum excess % 10
Sizing nozzle
Tube, inlet
Tube, outlet
Shell, inlet
Shell, outlet
Limits of Design Variables
Lower Limits
Upper Limits
Tube Length 3 20 ft
Shell Diameter 6 120 in
Baffle Cut 15 45 Area Percent
Baffle Spacing 2 125 in
Optimize number of tube passes
Help
Cancel
OK
25
7
27
ypdvrang.my
Logic(944,913), Dev(486,0)
Scale: 1.000
Mode: Simulation
Steady State
K:NRTL H:LATE
NUM
07:02 AM
start
Chumango42's Buddy...
Opinion Alert - May 1...
temp
CHEMCAD 5.5.0 - [C:...
- Design Options -
7:03 AM

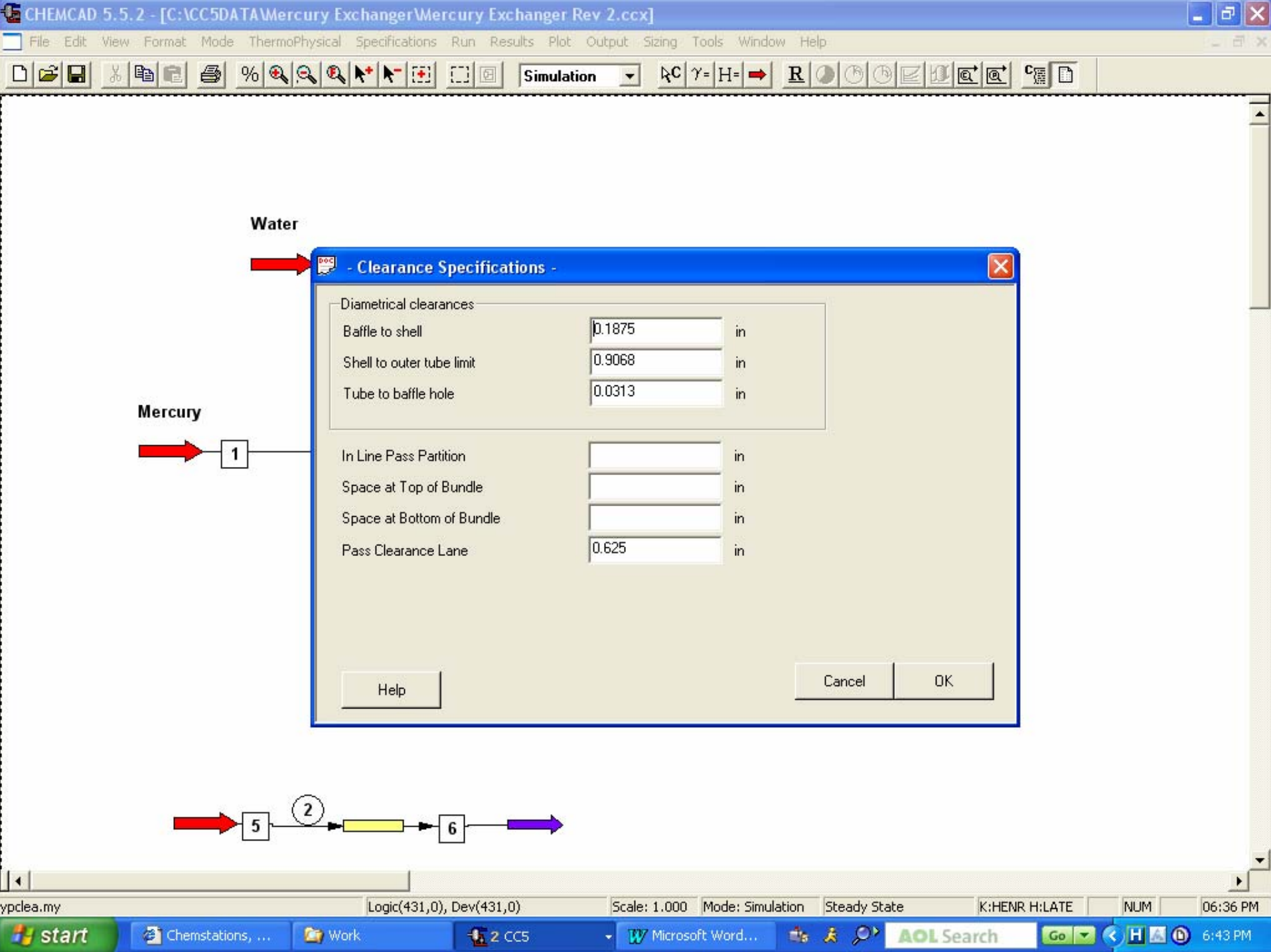

CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
Mercury
1
- Tube Specifications -
Number of tubes 306
Number of tube passes 1
Tube outer diameter 0.75 in
Tube wall thickness 0.174 in
Tube length 8.667 ft
Roughness factor 3.35e-006 ft
Tube pattern Triangular (30)
Tube pitch 0.9375 in
Trufin tube code Plain tube
Turbulator No Turbulator
Help
Cancel
OK
5
2
6
yptube.my
Logic(503,5), Dev(503,5)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
01:23 PM
start
Lambert
CHEMCAD 5.5....
- Tube Specific...
Microsoft Word...
AOL Search
Go
1:24 PM

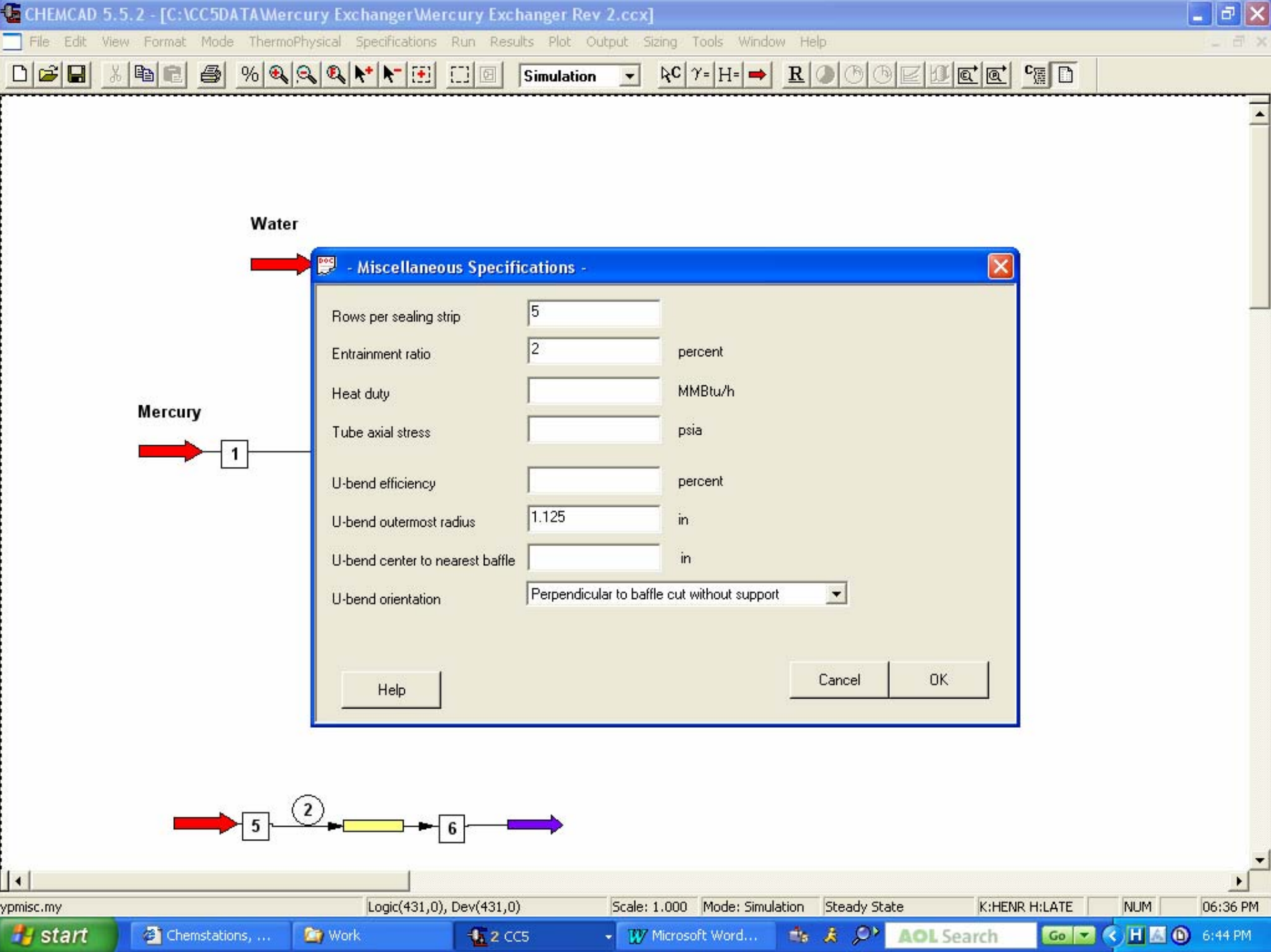

CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
Mercury
1
- Baffle Specifications -
Baffle type
Single segmental
Inlet spacing
10.0625
in
Center spacing
8.625
in
Outlet spacing
10.0665
in
Number of baffles
Baffle thickness
0.375
in
Baffle cut percent
27.3
percent
Direction of baffle cut
Horizontal
Basis of cut
Diameter
Tube sheet thickness
1.25
in
Impingement plate
No impingment plates
Intermediate baffles per baffle space
Help
Cancel
OK
5
2
6
ypbaff.my
Logic(503,5), Dev(503,5)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
01:23 PM
start
Lambert
CHEMCAD 5.5....
- Baffle Specifi...
Microsoft Word...
AOL Search
Go
1:25 PM


CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
- Shell Specifications -
Shell diameter
21.5
in
Calculate tube count
Use standard pipe as shell
Mercury
Number of exchangers in parallel
1
Number of exchangers in series
1
Untubed area/OTL area of tube sheet
Help
Cancel
OK
1
2
5
6
ypshel.my
Logic(431,0), Dev(431,0)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
06:36 PM
start
Chemstations, ...
Work
2 CC5
Microsoft Word...
AOL Search
Go
6:39 PM


CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
Mercury
1
- Nozzle Specifications -
---- TUBE ----
---- SHELL ----
Inlet diameter
7.981
in
7.981
in
Outlet diameter
7.981
in
6.065
in
Longneck
Longneck
Orientation
Opposite Side
Tubeside flow enters
Bottom nozzle
Top nozzle
Help
Cancel
OK
5
2
6
ypnozz.my
Logic(431,0), Dev(431,0)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
06:36 PM
start
Chemstations, ...
Work
2 CC5
Microsoft Word...
AOL Search
Go
6:41 PM


CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
3
Mercury
1
- Material Specifications -
Tube material
User Tube Material
Optional density
6.58
lb/ft3
Elastic modulus
589.67
psi
Tubesheet material
A-240-316L
Shell material
A-240-316L
Channel material
A-240-316L
Baffle material
A-240-316L
Help
Cancel
OK
5
2
6
ypmate.my
Logic(503,5), Dev(503,5)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
01:23 PM
start
Lambert
CHEMCAD 5.5....
- Material Spec...
Microsoft Word...
AOL Search
Go
1:25 PM


CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
Mercury
1
- Clearance Specifications -
Diametrical clearances
Baffle to shell
0.1875
in
Shell to outer tube limit
0.9068
in
Tube to baffle hole
0.0313
in
In Line Pass Partition
in
Space at Top of Bundle
in
Space at Bottom of Bundle
in
Pass Clearance Lane
0.625
in
Help
Cancel
OK
5
2
6
ypclea.my
Logic(431,0), Dev(431,0)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
06:36 PM
start
Chemstations, ...
Work
2 CC5
Microsoft Word...
AOL Search
Go
6:43 PM


CHEMCAD 5.5.2 - [C:\CC5DATA\Mercury Exchanger\Mercury Exchanger Rev 2.ccx]
File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help
Simulation
Water
Mercury
1
- Miscellaneous Specifications -
Rows per sealing strip
5
Entrainment ratio
2
percent
Heat duty
MMBtu/h
Tube axial stress
psia
U-bend efficiency
percent
U-bend outermost radius
1.125
in
U-bend center to nearest baffle
in
U-bend orientation
Perpendicular to baffle cut without support
Help
Cancel
OK
5
2
6
ypmisc.my
Logic(431,0), Dev(431,0)
Scale: 1.000
Mode: Simulation
Steady State
K:HENR H:LATE
NUM
06:36 PM
start
Chemstations, ...
Work
2 CC5
Microsoft Word...
AOL Search
Go
6:44 PM

CCTHERM Outputs

- TEMA specification sheet
- Summary data for shellside, tubeside, baffles, and overall performance
- Zone analysis
- Vibration analysis
- Heat curve

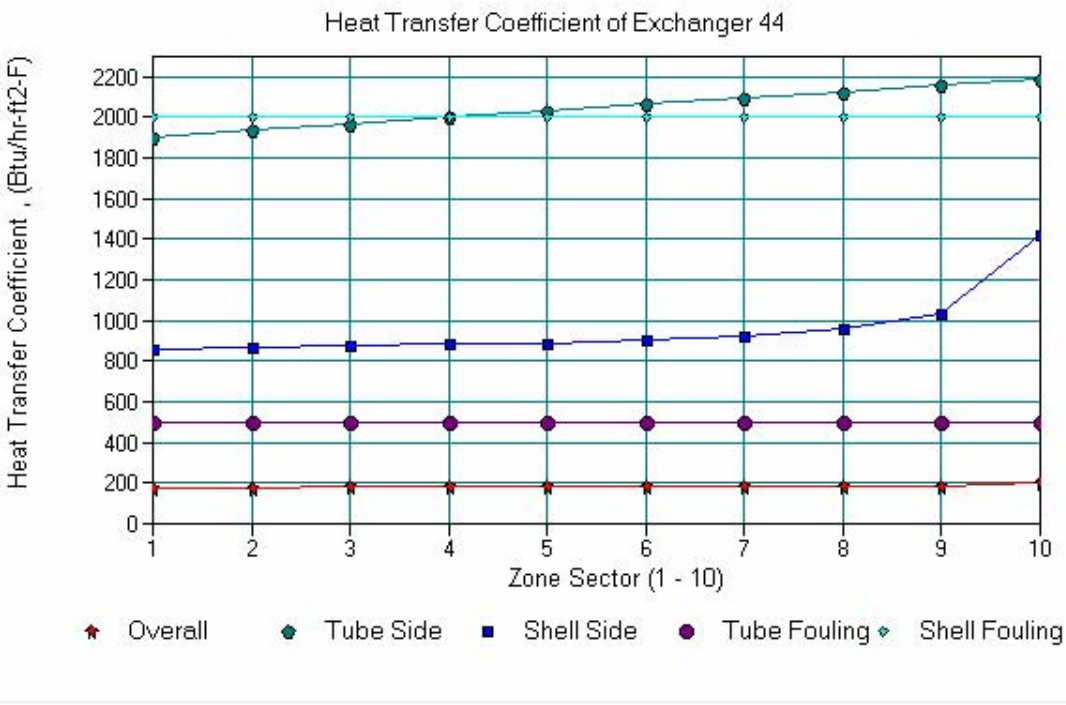
CHEMCAD 5.5.2 - [C:\CC5DATA\Lambert\Condensers.ccx]

File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help

Simulation

Plot

Wizard Print Cancel OK



20 % Flow Condenser 15 PSI Saturated

Cooling Water

100

220 F Water

Spr

50 psi Sa

Cooling

@BF00.my | Logic(674,719), Dev(542,-1) | Scale: 1.000 | Mode: Simulation | Steady State | K:NRTL H:LATE | NUM | 01:13 PM

start | Lambert | CHEMCAD 5.5.2 - [C:... | Microsoft Word - CCT... | AOL Search | Go | 1:20 PM

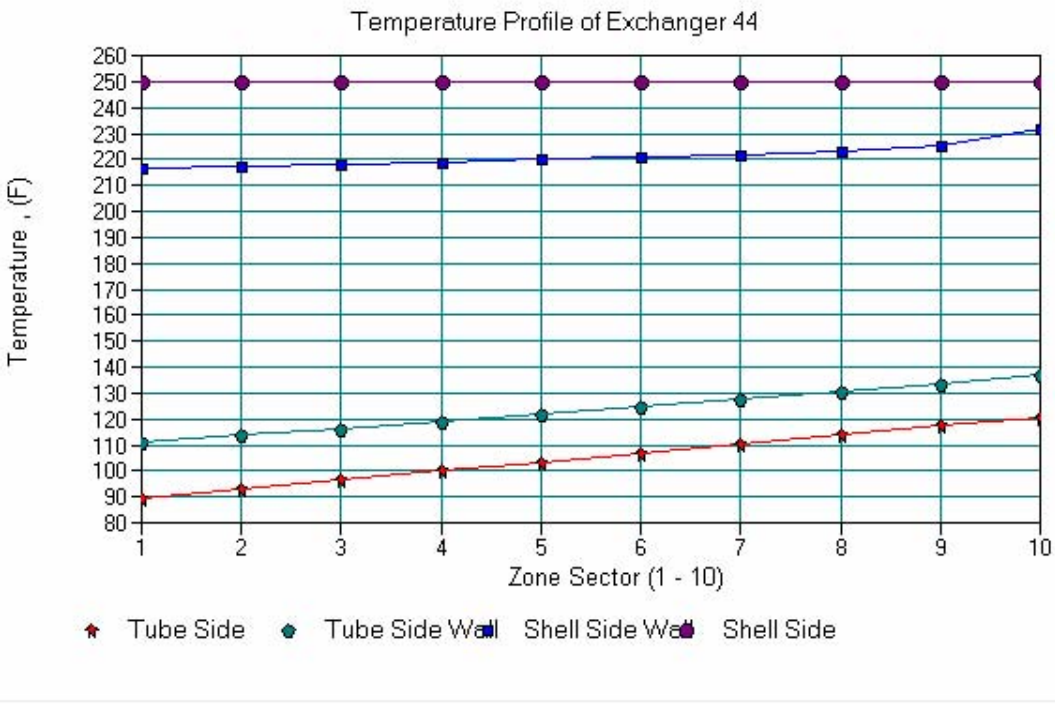
CHEMCAD 5.5.2 - [C:\CC5DATA\Lambert\Condensers.ccx]

File Edit View Format Mode ThermoPhysical Specifications Run Results Plot Output Sizing Tools Window Help

Simulation

Plot

Wizard Print Cancel OK



Spr

50 psi Sa

Cooling

20 % Flow Condenser 15 PSI Saturated

Cooling Water

100

220 F Water

@BF00.my | Logic(674,719), Dev(542,-1) | Scale: 1.000 | Mode: Simulation | Steady State | K:NRTL H:LATE | NUM | 01:13 PM

start | Lambert | CHEMCAD 5.5.2 - [C:... | Microsoft Word - CCT... | AOL Search | Go | 1:21 PM

CCTHERM Caveats

- Design mode only provides the starting point.
- Always inspect vibration results carefully.
- Verify calculated tube count.
- Some TEMA configurations require careful review of results.

CCTHERM Summary

- CCTHERM provides conservative and accurate heat exchanger design and rating.
- CCTHERM is much more than heat exchanger design and rating software. It is a powerful simulation tool, integrated into the system flow sheet.