

# Summer Fellowship Report

On

#### Development and Extension of Thermodynamic Models and Functions in OpenModelica

Submitted by

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Under the guidance of

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## Introduction

OpenModelica" is a free and open-source modelling environment that uses "Modelica" modelling language. It follows equation oriented approach. OpenModelica can be used for modelling, simulation, optimization and analysis of complex steady state and dynamic systems. Modelica modelling language allows users to express a system in the form of equations. OpenModelica complies expressions, equations, functions and algorithms into C code. The generated C code is combined with a library of utility functions, a run-time library, and a numerical Differential-Algebric Equation (DAE) solver. OpenModelica Connection Editor, called as OMEdit is the integrated Graphical User Interface (GUI) in OpenModelica for graphical modelling and editing. OMEdit consists of several libraries for various domains like Electrical, Magnetic, Math, Thermal, etc. It provides various user friendly features like representation of a model in the form of block diagrams. OMEdit can be used for creating custom models and for editing or drawing connections between the model interfaces. It also allows users to plot graphs between parameters of the model simulated.

# **Chapter 1: Thermodynamic Functions**

#### 1. Surface Tension

**Description**: Surface tension of a liquid is the property which makes it behave like a stretched membrane. The cohesive forces in the liquid act on the molecules on the surface to create tension. If surface molecules could be displaced slightly outward from the surface, they would be attracted back by the nearby molecules. The energy responsible for the phenomenon of surface tension may be thought of as approximately equivalent to the work or energy required to remove the surface layer of molecules in a unit area. Surface tension may be expressed, therefore, in units of energy (joules) per unit area (square meters).

#### **Equations:**

The surface tension formula has 2 ways to go about it. In DWSIM, the Surface tension of a pure component is calculated using the formula, in a certain temperature range:

$$ST = A + e^{\left(\frac{B}{T} + C + DT + ET^2\right)}$$

Where A, B, C, D and E are coefficients provided in the ChemSep Database. The temperature range for each component is also provided in the database.

For components outside this temperature range, the Brock-Bird Equation is used as the empirical equation to calculate surface tension:



Here,  $P_c$  and  $T_c$  are critical pressure and temperature respectively.  $T_r$  is reduced temperature and  $T_{br}$  is reduced boiling point of the pure component.

#### **Development:**

The Brock Bird equation used for empirical calculation of Surface Tension was referred from the Solution Inspector in DWSIM. The VB code on GitHub had the following equation:

$$ST = A + e^{\left(\frac{B}{T} + C + DT + ET^2\right)}$$

This gives us identical values to DWSIM results in a middle range of temperatures. Whereas the Brock Bird equation is employed at extreme temperatures outside the specified range for each component.

#### Table:

$\mathbf{Compound/s}$	Temperature (K)	Composition	DWSIM value (N/m)	Experimental
Water	298.15	Pure component	0.07	0.07
Ethanol	298.15	Pure component	0.221	0.221
Acetic Acid	298.15	Pure component	0.027	0.027
Acetone	298.15	Pure component	0.023	0.023

#### 1.2 Joule Thompson Coefficient

**Description:** The Joule-Thompson effect refers to the temperature change which occurs when a Real Gas is expanded through a valve or porous plug in adiabatic conditions. The non-ideality of the gas along with the change in kinetic energy leads to this temperature change. The JT Coefficient is defined as the change in temperature per change in unit pressure at adiabatic conditions. At adiabatic conditions, the kinetic energy change has no effect and just the non-ideal nature contributes to the change in temperature. The JT Coefficient is a measure of the non-ideality of the gas.

#### Equations:

This is the derivation of the Joule coefficient,  $\eta = (\partial T / \partial V)_U$ .

Now entropy is a function of state – i.e. of the intensive state variables P, V and T. (V = molar volume.). Let us choose to express S as a function of V and T, so that

$$dS = \left(\frac{\partial S}{\partial V}\right)_T dV + \left(\frac{\partial S}{\partial T}\right)_V dT$$

In the Joule experiment, the internal energy of the gas is constant, so that TdS- PdV=0 $dS = \frac{PdV}{T}$ 

For the first term on the right hand side of equation we make use of the Maxwell relation:

$$\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

For the second term on the right hand side we obtain

$$\left(\frac{\partial S}{\partial T}\right)_{V} = \left(\frac{\partial S}{\partial U}\right)_{V} \left(\frac{\partial U}{\partial T}\right)_{V} = \frac{\left(\frac{\partial U}{\partial T}\right)_{V}}{\left(\frac{\partial U}{\partial S}\right)_{V}} = \frac{Cv}{T}$$
$$\frac{PdV}{T} = \left(\frac{\partial P}{\partial T}\right)_{V} dV + \frac{Cv \ dT}{T}$$

Multiply through by T, and divide by dV, taking the infinitesimal limit as  $dV \rightarrow 0$  and given that internal energy is constant, and we get

$$P = T \left(\frac{\partial P}{\partial T}\right)_V + C v \left(\frac{\partial T}{\partial V}\right)_U$$

from which we obtain

$$\left(\frac{\partial T}{\partial V}\right)_U = \frac{1}{Cv} \left[ P - T \left(\frac{\partial P}{\partial T}\right)_V \right]$$

Let us now consider the Joule-Thomson coefficient

$$\mu = (\partial T/\partial P)_H$$

Differentiating S as a function of P and T, so that

$$dS = \left(\frac{\partial S}{\partial P}\right)_T dP + \left(\frac{\partial S}{\partial T}\right)_P dT$$

In the Joule-Thomson experiment, the enthalpy of the gas is constant, so that

$$TdS + VdP = 0$$

dS = - VdP/T

From the Gibbs function,

$$\left(\frac{\partial S}{\partial P}\right)_T = - \left(\frac{\partial V}{\partial T}\right)_P$$

 $\left(\frac{\partial S}{\partial T}\right)_P = \left(\frac{\partial S}{\partial H}\right)_P \left(\frac{\partial H}{\partial T}\right)_P = \left(\frac{\partial H}{\partial T}\right)_P \left(\frac{\partial H}{\partial S}\right)_P = Cp/T$   $Hence, - \frac{VdP}{T} = - \left(\frac{\partial V}{\partial T}\right)_P dP + \frac{CvdT}{T}$ 

Multiply through by T, and divide by dP, taking the infinitesimal limit as  $dP \rightarrow 0$  and we arrive at

$$- V = - T \left(\frac{\partial V}{\partial T}\right)_P + Cp \left(\frac{\partial T}{\partial P}\right)_H$$
  
from which we get  $\left(\frac{\partial T}{\partial P}\right)_H = \frac{1}{Cp} \left[T \left(\frac{\partial V}{\partial T}\right)_P - V\right]$ 

**Development:** For the code in OpenModelica we use the DWSIM equations provided in the Solution Inspector as well as the VB Code are given below:

For gases, we used:

$$\mu$$
 JT = 0.0048823 \*  $Tc * \frac{18}{(Tr^2 - 1)(Pc * Cp * \gamma)}$ 

For liquids,

 $\mu_{\rm JT} = -\frac{1}{(1000*\rho*Cp)}$ 

Where,

 $\mu_{JT}$ : Joule Thompson Coefficient

Tc: Critical Temperature of the component

Tr: Reduced Temperature

Pc: Critical Pressure

Cp: Heat Capacity at constant pressure

 $\gamma$ : Heat capacity ratio

#### $\rho$ : Density of the component

The density of the liquid and gases are calculated using LiqDens and VapDens functions available in the Simulator.

The Joule Thompson coefficient is obviously zero for Solids.

#### Table:

$\mathbf{Compound/s}$	Temperature	Composition	nOm Res	$\mathbf{sult}$	DWSIM	value	State
	(K)		(K/Pa)		(K/Pa)		
Ethanol+Benzene	300	$\{0.3, 0.7\}$	-6.1 e -10		-2.94 e-10		liquid
Water+Pyridine	298.15	$\{ 0.4, 0.6 \}$	-4.5 e-10		-2.36 e-10		liquid
Phosgene	300	{ 1}	-1.8 e -07		-1.218 e-07		gas
Ammonia	298.15	{ 1}	-1.4 e-07		-1.135 e-07		Gas

#### 1.3 Isothermal Compressibility

$$\kappa_T = \frac{-1}{V} \left(\frac{\partial V}{\partial p}\right)_T$$

Gases are highly compressible when pressure is applied to them. In the same way liquids get compressed when subjected to high pressure and isothermal compressibility is a measure of that. It is also the reciprocal of bulk modulus.

#### **Equations:**

The equations involved in the definition of isothermal compressibility include:

$$\left(\frac{\partial V_g}{\partial p}\right)_T = \frac{nRT}{p} \left(\frac{\partial z}{\partial p}\right)_T - \frac{znRT}{p^2} = \left(\frac{znRT}{p}\right) \frac{1}{z} \frac{dz}{dp} - \left(\frac{znRT}{p}\right) \frac{1}{p}$$

From the real gas equation of state,

$$\frac{1}{V_g} = \frac{p}{znRT}$$
  
and 
$$\frac{1}{V_g} \left(\frac{\partial V_g}{\partial p}\right)_T = \frac{1}{z} \frac{dz}{dp} - \frac{1}{p};$$

hence,

$$c_g = \frac{1}{p} - \frac{1}{z} \left( \frac{\partial z}{\partial p} \right)_T$$

For gases at low pressures, the second term is small, and the isothermal compressibility can be approximated by  $c_g \approx 1/p$ . Here, z is the compressibility factor and p is pressure whereas  $c_g$  is Isothermal compressibility for gases.

For liquids, the following relation was found in the following article:

Here,  $v_p$  is the parachor, n is the moles, k is the Eötvös constant (approximately equal to 2.12) and  $T_c$  is the is the critical temperature.

#### **Development:**

Isothermal compressibility of gases is calculated in DWSIM is given by the following equation:

$$arkappa _{\mathrm{T}}=rac{1}{P}$$
 —  $rac{(Z-Z1)*0.0001}{Z}$ 

Where z is ideal compressibility factor equal to 1 and Z1 is calculated using the Van der Waal EOS and P is the pressure.

The other equation being used is for liquids as discussed above.

#### Table:

Compound/s	Temperature	Om Result	Data	State
	(K)	(1/Pa)	Value	
Water	298.15	3.08 e -10	4.58 e-10	liquid
Ethanol	298.15	1.19 e -09	1.1 e-09	liquid
Carbon diox- ide	298.15	9.37 e-06	-	gas
Phosgene	298.15	7.875 e -06	-	vapour

#### 1.4 Bulk Modulus:

**Description:** Bulk modulus is defined as the resistance that a substance offers to compression. It is the reciprocal of isothermal compressibility. It is also defined at the ratio of infinitesimal change in pressure and the subsequent change in volume of the substance. It is equal to the pressure of a real gas and is infinite for an ideal solid. The calculation of bulk modulus of a complex anisotropic solid is done using Hooke's law.

#### Equations:

The bulk modulus of any substance can be defined by

$$K = -V \frac{dP}{dV}$$

Where K is bulk modulus, V is volume and P is pressure. The negative sign is there as dV is a negative value if dP is positive and it makes the value of K positive overall. But as we are dealing with mostly just liquids and gases, the definition involving Isothermal Compressibility is used.

**Development**: The Bulk Modulus function requires the Isothermal compressibility function as we use the following equation to calculate it:

 $K = \frac{1}{\varkappa}$ 

Where  $\varkappa$  is isothermal compressibility of the pure compound or mixture.

#### Table:

$\mathbf{Compound/s}$	Temperature (K)	Om Result (m/s)	Data Value (m/s)	State
Water	298.15	3.246 e 09	2.18 e 09	liquid
Ethanol	298.15	$8.403 \ge 08$	9.09 e 08	Liquid
Carbon diox-	298.15	$1.067 \ge 05$	-	Gas
ide				

#### 1.5 Speed of Sound

**Description:** The speed of sound is the distance travelled by sound waves in unit time. Being mechanical waves, the speed of sound waves depends on the material it is travelling in. If the waves are travelling in a fluid, the speed of sound can be expressed in terms of pressure, density and specific heat capacity ratios ( $\gamma$ ). It can also be expressed in terms of bulk modulus and density as well.

#### Equations:

The Newton Laplace equation is used to calculate the speed of sound for an ideal gas:

$$c = \sqrt{\gamma \frac{P}{
ho}}$$

which can be replaced with  $c = \sqrt{\frac{\gamma \cdot k \cdot T}{m}}$  where,  $\gamma$  is the specific heat ratio, P is pressure,  $\rho$  is density, k is Boltzmann's constant, T is temperature and m is molecular weight.

But for a non-ideal gas and liquid, the following equation is used:

$$c = \sqrt{\frac{K}{\rho}}$$

where K is the bulk modulus.

#### **Development:**

The bulk modulus is calculated using the thermodynamic functions and then the density is calculated for the liquid or gas based on the equations and coefficients

provided in the Thermodynamic functions available for in the Simulator. The speed of sound is then calculated using the equation:

c = 
$$\sqrt{\frac{K}{\rho}}$$

$\mathbf{Compound/s}$	Temperature (K)	Om Result (m/s)	Data Value	State
Water	298.15	1741.754	1481	Liquid
Ethanol	298.15	1034.68	1144	Liquid
Carbon diox-	298.15	242.93	267	Gas
ide				

#### Chapter 2: Thermodynamic Packages

### 2.1 Peng Robinson Stryjek Vera 1 (PRSV1) and PRSV2

**Description:** The Peng Robinson Stryjek Vera 1 is an extension (1986) to the existing Peng Robinson equation of state. Instead of the attraction term being described just by the accentric factor, the PRSV 1 equation of state introduces an adjustable pure component parameter  $\kappa$  which is used in the polynomial fit of the accentric factor. This adjustment leads to a more accurate calculation of the compressibility factor, which leads to a better calculation of the fugacity coefficients as well as vapour and liquid phase fractions. Stryjek and Vera gave the values for these adjustable parameters for a number of compounds.

#### **Equations:**

The equation of state defined by Peng Robinson is given by:

$$P = \frac{RT}{(V-b)} - \frac{a(T)}{V(V+b) + b(V-b)}$$

Where P and V are pressure and molar volume respectively whereas a(T) and b are constants defined as follows:

$$a = 0.45724 \frac{\alpha R^2 T c^2}{Pc}$$
$$b = 0.07780 \frac{\text{R Tc}}{Pc}$$

Tc and Pc are pure component critical temperature and pressure respectively and R is real gas constant.

The value of  $\alpha$  was updated to the following equation:

$$\alpha = \left(1 + \kappa \left(1 - \sqrt{Tr}\right)\right)^2$$

PRSV1:

$$\kappa = \kappa_0 + \kappa_1 \left( 1 + \sqrt{Tr} \right) \left( 0.7 - Tr 
ight)$$

$$\kappa_0 = 0.378893 + 1.4897153\omega - 0.17131848\omega^2 + 0.0196554\omega^3$$

#### PRSV2:

The second update to Peng Robinson was the PRSV2 (1986) which improved the accuracy of the calculation by adding more adjustable pure component parameters  $\kappa_1$ ,  $\kappa_2$  and  $\kappa_3$  which are provided as data and used in the following equation:

$$\kappa = \kappa_0 + \left(1 + \sqrt{Tr}\right) \left(0.7 - Tr\right) \left[\kappa_1 + \kappa_2 \left(\kappa_3 - Tr\right) \left(1 - \sqrt{Tr}\right) \kappa_0 = 0.378893 + 1.4897153\omega - 0.17131848\omega^2 + 0.0196554\omega^3\right]$$

Where Tr is reduced temperature (T/Tc),  $\omega$  is the accentric factor and  $\kappa_{1, \kappa}_{2 \text{ and } \kappa_{3}}$  are the adjustable pure component parameters.

#### **Development:**

The PRSV1 and PRSV2 calculations are developed as follows:

- 1) The values of the interaction parameters are saved in a function called BIPPR which takes the number and names of the components and returns the interaction parameter values.
- 2) Values for each of the above parameters  $\mathbf{a}\alpha$  is calculated for every single component in the system and then the parameter  $a_{ij}$  is calculated following the mixing rules given below:

$$a_{ij} = \sum_{j=1}^{N} \sum_{i=1}^{N} (1 - kij) \sqrt{a_{ij}}$$

where kij is the interaction parameter between 2 components

3) Then the following parameters are calculated for both liquid and gas mixtures. The value of vapour and liquid mixture fractions is :

aMliq = 
$$\sum_{j=1}^{n} \sum_{i=1}^{n} x i_{ij}$$
 aMvap =  $\sum_{j=1}^{n} \sum_{i=1}^{n} y i_{ij}$ 

$$\mathrm{bMliq} = \sum_{i=1}^N bi \quad \mathrm{bMvap} = \sum_{i=1}^N bi$$

$$Aliq = \frac{aMliq*P}{(RT)^2}$$
 Avap  $= \frac{aMvap*P}{(RT)^2}$ 

 $Bliq = \frac{bMliq*P}{(RT)} Bvap = \frac{bMvap*P}{(RT)}$ 

4) The value of the compressibility factor is then calculated by finding the roots of the following equation:

$$Z^{3} + (Bliq - 1)Z^{2} + (Aliq - 2Bliq - 3Bliq^{2})Z + (Bliq^{3} + Bliq^{2} - AliqBliq) = 0$$

The smallest root of this equation is considered the correct compressibility factor. This is also solved using the Avap and Bvap parameters abnd the largest root of that equation is considered to be the answer there.

$$\ln \phi = (Z-1) - \ln (Z-B) - \frac{A}{2\sqrt{2}B} \ln \left(\frac{Z + (\sqrt{2}+1)B}{Z - (\sqrt{2}-1)B}\right)$$

Where  $\Phi$  is the fugacity coefficient, Z is the vapour or liquid compressibility factor and A and B are Aliq, Avap and Bliq, Bvap for the respective states.

5) The component activity coefficient is calculated as follows:

$$K = \frac{phivap(fugacitycoefficientofvapor)}{philiq(fugacitycoefficientofliquid)} \text{ of each component}$$

#### Table for PRSV1:

Compour	ndsMole Frac- tion	Temperatu	reVapour Phase Mole Fraction	Vapour Fugac- ity Coeffi- cient		Liquid Fu- gacity Coef- ficient	
		kelvin K		OM Value	DWSIM	OM Value	DWSIM
Methane	0.33	180	0.5	0.9877	0.987765	17.304	16.3884
Ethane	0.33			0.961	0.962017	0.215	0.219543
Ethylene	0.34			0.968	0.968483	0.581	0.580671
Ethane	0.33	300	1	0.991	0.991	none	none
Methane	0.33			0.999	0.999	none	none
Propane	0.34			0.985	0.985	none	none
Ethane	0.33	300	1	0.992	0.992	0	0
Acetylene	0.33			0.994	0.994	0	0
Isobutane	0.34			0.977	0.977	0	0
Ethane	0.33	70	0	1	1	4.66 e- 08	9.771 е - 09
Methane	0.33			1	1	0.0077	0.0039
Isobutane	0.34			1	1	5.45 e- 14	5.425 e - 15

## Table for PRSV2:

${f CompoundsMole}$		Temperatu	TemperatureVapour Phase			Liquid	
	Frac- tion		Mole Fraction	Fugac- ity Coeffi- cient		Fu- gacity Coeffi- cient	
		kelvin K		OM Value	DWSIM	OM Value	DWSIM
Methane	0.5	200	0.5129	0.99	0.99	nan	nan
Isobutane	0.5			0.96	0.958	nan	nan
Propylene	0.5	200	0	none	none	0.289	0.278
Propane	0.5					0.21	0.199
Isobutane	0.5	300	1	0.974	0.974	nan	nan
N-butane	0.5			0.973	0.973	nan	nan
Ammonia	0.5	300	0.512	0.991	0.991	88.8345	88.8345
Water	0.5			0.985	0.985	0.03499	0.03499

# 2.2 Debugging Lee-Kesler Plocker Thermodynamic Package

 $\underline{\textbf{Task Assigned:}}$  Debugging given Lee-Kesler Plocker Thermodynamic Package

Accomplished: The following parts of the debugging process were accomplished:

- 1. Found which part of the given Lee-Kesler Plocker flat model was causing issues, but could not fix it. Broke the flat model into smaller parts and made LKPTest, which is the portion of the model which gets converged
- 2. Changed the flat model to be compatible with the Simulator for future use. This model is named LKP.

## **Errors Encountered:**

2.2.1.1. Convergence Error: The main error that I faced during the LKP debugging process is of convergence. The following code showed the error:

 $\begin{array}{l} 3.phi\_l[i] = \exp(z\_l[i] - 1 - \log(z\_l[i]) + B\_l[i] \ / \ V\_r\_l[i] + C\_l[i] \ / \ (2 * V\_r\_l[i] \\ ^ 2) + D\_l[i] \ / \ (5 * V\_r\_l[i] \ ^ 5) + E\_l[i]); \end{array}$ 

 $\begin{array}{l} 4. \ phi\_v[i] = \exp(z\_v[i] - 1 - \log(z\_v[i]) + B\_v[i] \ / \ V\_r\_v[i] + C\_v[i] \ / \ (2 * V\_r\_v[i] \ ^ 2) + D\_v[i] \ / \ (5 * V\_r\_v[i] \ ^ 5) + E\_v[i]); \end{array}$ 

This error appeared only in LKP, which is the package made compatible with the Simulator and Material Stream. These lines of code did work in the LKPTest flat model.

- 2.1.2. **Partial Convergence**: Only a part of the original LKP file gets converged, from reduced volume calculation to enthalpy departure calculation.
- 2.1.3. **DWSIM Values**: Lee Kesler Plocker uses certain mixing rules to calculate constants and parameters which are used later to calculated fugacity coefficients of the reference and simple liquid. These values are then used in a separate equation to give the final value of fugacity coefficient of the liquid and vapour mixture using the

vapour and liquid mixture fractions calculated. These mixture values could not be found in DWSIM for cross-checking. The fugacity coefficient was calculated in DWSIM using another equation, by finding individual fugacity coefficients and finding their molar average in mixture.

**Description:** Lee-Kesler Plocker developed the value of compressibility factor to be determined from the following equation:

$$Z = \left(\frac{P_r V_r}{T_r}\right) = 1 + \frac{B}{V_r} + \frac{C}{V_r^2} + \frac{D}{V_r^5} + \frac{c_4}{T_r^3 V_r^2} \left(\beta + \frac{\gamma}{V_r^2}\right) \exp\left(-\frac{\gamma}{V_r^2}\right)$$

Where:

$$B = b_1 - b_2/T_r - b_3/T_r^2 - b_4/T_r^3$$
$$C = c_1 - c_2/T_r + c_3/T_r^3$$
$$D = d_1 + d_2/T_r$$

The constants are taken from the following table:

Constant	Simple fluids	<b>Reference</b> fluids	Constant	Simple fluids	Reference fluid
$b_1$	0.1181193	0.2026579	C <sub>3</sub>	0.0	0.016901
$b_2$	0.265728	0.331511	C4	0.042724	0.041577
$b_3$	0.154790	0.027655	$d_1 \times 10^4$	0.155488	0.48736
$b_4$	0.030323	0.203488	$d_2 \times 10^4$	0.623689	0.0740336
$c_1$	0.0236744	0.0313385	B	0.65392	1.226
$c_2$	0.0186984	0.0503618	γ	0.060167	0.03754

To facilitate analytical representation, the compressibility factor of any fluid has been expressed in this work in terms of the compressibility factor of a simple fluid ( $Z_0$ ) and the compressibility factor of a reference fluid ( $Z_r$ ), as follows:



To improve overall accuracy, several sets of mixing rules have been studied. The following set of mixing rules have been found to give the best results:

$$V_{ci} = Z_{ci}RT_{ci}/P_{ci}$$

$$Z_{ci} = 0.2905 - 0.085\omega_i$$

$$V_c = \frac{1}{8} \sum_{j} \sum_{k} x_j x_k (V_{cj}^{1/3} + V_{ck}^{1/3})^3$$

$$T_c = \frac{1}{8V_c} \sum_j \sum_k x_j x_k (V_{cj}^{1/3} + V_{ck}^{1/3})^3 \sqrt{T_{cj}T_{ck}}$$
$$\omega = \sum_j x_j \omega_j$$
$$P_c = Z_c R T_c / V_c = (0.2905 - 0.085\omega) R T_c / V_c$$

Calculation of fugacity follows this equation:

$$\ln\left(\frac{f}{P}\right) = Z - 1 - \ln(Z) + \frac{B}{V_r} + \frac{C}{2V_r^2} + \frac{D}{5V_r^5} + E$$

Here, E is a parameter defined as:

$$\ln\left(\frac{f}{P}\right) = Z - 1 - \ln(Z) + \frac{B}{V_r} + \frac{C}{2V_r^2} + \frac{D}{5V_r^6}$$
  
where  
$$E = \frac{c_4}{2T_r^3\gamma} \left\{ \beta + 1 - \left(\beta + 1\right) + \frac{\gamma}{V_r^2} \right\} \exp\left(-\frac{\gamma}{V_r^2}\right) \left\{ \beta + 1 - \left(\beta + 1\right) + \frac{\gamma}{V_r^2} \right\}$$

Enthalpy Departure follows:

$$\frac{H - H^*}{RT_c} = T_r \left\{ Z - 1 - \frac{b_2 + 2b_3/T_r + 3b_4/T_r^2}{T_r V_r} - \frac{c_2 - 3c_3/T_r^2}{2T_r V_r^2} + \frac{d_2}{5T_r V_r^5} + 3E \right\}$$

c. Entropy departure

Where:

bl, b2, bs, bq = constants as given in	Table
cl, c2, c3, c4 = constants as given in $'$	Table
dl, $d2 = \text{constants}$ as given in Table	B, C, D = coefficients
$C_p$ = isobaric heat capacity	$C_v = isochoric heat capacity$
E= defined above	f = fugacity
$\mathrm{H}=\mathrm{enthalpy}$	P = pressure
Po=reference	R = gas constant
S = entropy	T = temperature
V = volume	$V_r = P_c V / RT_c,$
$\mathbf{x} = $ molar composition	$\mathbf{Z} = \text{compressibility factor}$

#### Development and Issues faced:

The values for reference and simple fluid were calculated separately and then used in the given equations for vapour and liquid phase mixtures separately. All the mixing rules and other equations related to fugacity and enthalpy are calculated separately for vapour and liquid mixtures.

#### Code:

• **LKP Test:** This is the flat model which gives us results for fugacity coefficients, enthalpy deviation and compressibility factor.

#### Table for LKP Test:

COMPOUND MOLE		LIQUID	VAPOUR	VAPOUR	LIQUID	Temperature
SYSTEM	FRAC- TION IN FEED	MOLE FRAC- TION	MOLE FRAC- TION	MIX- TURE FUGAC-	MIX- TURE FUGAC-	(K)
				ITY COEFF	ITY COEFF	
N-Butane	0.5	0.3590478	0.85280566	0.9657	0.5034	300
N-Heptane	0.5	0.6409522	0.14719434			
Ethanol	0.5	0.5	0.319988	0.9601	0.00194	300
Methanol	0.5	0.5	0.680012			
Acetone	0.5	0.5	0.949496	0.9552	0.00265	300
Acetic Acid	0.5	0.5	0.050504			

• **Package LKP:** This is the package that is compatible with the Simulator but does not simulate due to a calculation/runtime error with the logarithmic function used in the fugacity coefficient calculation. I could not find a way to resolve it.

# OpenModelica Code

## Surface Tension

```
package SurfaceTension
1
     function SurfTens
\mathbf{2}
        extends Modelica.Icons.Function;
3
        import Simulator.Files.Thermodynamic Functions.*;
4
        input Real T, coeff[6];
5
        output Real sigma;
6
     algorithm
7
        sigma := \operatorname{coeff}[2] + \exp(\operatorname{coeff}[3] / T + \operatorname{coeff}[4] + \operatorname{coeff}[5] * T + \operatorname{coeff}[6] * T
8
            * T);
     end SurfTens;
9
10
          model Test
11
                   import Simulator.*;
12
                   import data = Simulator.Files.ChemsepDatabase;
13
                   parameter data.Benzene ace;
14
                   parameter data. Phenol meth;
15
                   parameter data.Aniline benz;
16
                   parameter Integer Nc = 3;
17
                   parameter data.GeneralProperties C[Nc] = \{ace, meth, benz\};
18
                   Real ST;
19
                   parameter Real x[Nc] = \{0.33, 0.33, 0.34\}, P = 101325, T = 300;
20
                   Real R[Nc];
21
          equation
22
23
                   for i in 1:Nc loop
                            if T > C[i]. SigmaT[1] and T < C[i]. SigmaT[2] then
24
                                     R[i] = SurfaceTension.SurfTens(T, C[i].Sigma);
25
                             else
26
                                     R[i] = SurfaceTension.SurfTensEmp(P, T, C[i].Pc /
27
                                          100000, C[i].Tc, C[i].Tb) / 1000;
                            end if:
28
                   end for;
29
                   ST = sum(x[:] .* R[:]);
30
          end Test;
31
32
33
34
     function SurfTensEmp
35
36
        extends Modelica.Icons.Function;
       import Simulator.Files.Thermodynamic Functions.*;
37
       input Real P, T;
38
        input Real Pc, Tc, Tb;
39
       output Real sigma;
40
     protected
41
        Real Tr, Tbr;
42
        Real alpha;
43
     algorithm
44
45
        Tr := T / Tc;
        Tbr := Tb / Tc;
46
        alpha := 0.9076 * (1 + Tbr * log(Pc / 1.01325) / (1 - Tbr));
47
        sigma := Pc ^ (2 / 3) * Tc ^ (1 / 3) * (0.132 * alpha - 0.279) * (1 - Tr) ^
48
            (11 / 9);
     end SurfTensEmp;
49
   end SurfaceTension;
50
```

## Joule Thompson Coefficient

```
package JouleThompsonCoefficient
1
     function JTCoeff
\mathbf{2}
        extends Modelica.Icons.Function;
3
4
       import Simulator.Files.Thermodynamic Functions.*;
       input Real P, T, a;
\mathbf{5}
        input Real Pc, Tc, Cp, rho;
6
        Real Tr, gamma;
7
        output Real mu;
8
     algorithm
9
        Tr := T / Tc;
10
       gamma := Cp / (Cp - 8.314);
11
12
        if a = 1 then
          mu := 0.0048823 * Tc * (18 / (Tr ^ 2 - 1)) / (Pc * Cp * gamma);
13
        elseif a = 2 then
14
         mu := -1 / (1000 * rho * Cp);
15
        else
16
         mu := 0;
17
       end if;
18
   //compound is a gas
19
     end JTCoeff;
20
21
          model Test
22
                   import Simulator.*;
23
                   import data = Simulator.Files.ChemsepDatabase;
24
25
                   parameter Integer Nc = 2;
                   parameter data.Water eth;
26
                   parameter data.Pyridine benz;
27
                   parameter data.GeneralProperties C[Nc] = \{eth, benz\};
^{28}
                   Real Pc[Nc], Tc[Nc], Tb[Nc], Tm[Nc], rho[Nc], Cp[Nc];
29
                   Integer a [Nc];
30
                   Real P, T;
31
                   Real mu[Nc], x[Nc] = \{0.4, 0.6\};
32
                   Real JTC;
33
          equation
34
                   P = 101325;
35
                   T \;=\; 2\,9\,8\,.\,1\,5\,;
36
37
                   for i in 1:Nc loop
                            Pc[i] = C[i].Pc;
38
                            Tc[i] = C[i].Tc;
39
                            Tb[i] = C[i].Tb;
40
                            Tm[i] = C[i].Tm;
41
                            if T >= Tb[i] then
42
                                     a[i] = 1;
43
                                     rho[i] = 0;
44
                                     Cp[i] = Files.ThermodynamicFunctions.VapCpId(C[i]).
45
                                         VapCp, T);
                            elseif T < Tb[i] and T >= Tm[i] then
46
                                     a[i] = 2;
47
                                     Cp[i] = Files.ThermodynamicFunctions.LiqCpId(C[i]).
48
                                         LiqCp, T);
                                     rho[i] = Files.ThermodynamicFunctions.Dens(C[i].
49
                                         LiqDen, Tc[i], T, P);
                            else
50
                                     a[i] = 3;
51
                                     Cp[i] = 0;
52
                                     rho[i] = 0;
53
                            end if;
54
                            mu[i] = JouleThompsonCoefficient.JTCoeff(P, T, a[i], Pc[i])
55
                                Tc[i], Cp[i], rho[i]);
```

```
56
                   end for;
                   JTC = sum(x[:] .* mu[:]);
57
          end Test;
58
59
60
   end JouleThompsonCoefficient;
```

61

## beginjustify Isothermal Compressibility

```
package IsothermalCompressibility
1
      function CalcIsoComp
2
        extends Modelica.Icons.Function;
3
        import Simulator.Files.Thermodynamic_Functions.*;
4
        input Real P, Z, Z1;
\mathbf{5}
        output Real K;
\mathbf{6}
      algorithm
7
       K := 1 / P - (Z - Z1) / Z * 0.0001;
8
      end CalcIsoComp;
9
10
      model Test
11
        import Simulator.*;
12
        import data = Simulator.Files.ChemsepDatabase;
13
        parameter data.Carbondioxide ace;
14
        parameter Integer Nc = 1;
15
        parameter data.GeneralProperties C[Nc] = \{ace\};
16
17
        parameter Real T = 298.15, x[Nc] = \{1\}, P = 101325;
        Real Z, ST, rho;
18
        Real K[Nc], IC;
19
      equation
20
        for i in 1:Nc loop
21
          if \ T > C[i]. Tb \ then
22
             rho = 0;
23
            ST = 0;
24
            Z = CompressibilityFactor(T, 101325, C[i].Tc, C[i].Pc);
25
            K[i] = CalcIsoComp(101325, 1, Z);
26
          \label{eq:constraint} \textbf{elseif} \ T > \ C[\ i \ ] \ . Tm \ \textbf{and} \ T <= \ C[\ i \ ] \ . Tb \ \textbf{then}
27
             if T > C[i]. SigmaT[1] and T < C[i]. SigmaT[2] then
28
               ST = SurfaceTension.SurfTens(T, C[i].Sigma);
29
30
             else
               ST = SurfaceTension.SurfTensEmp(P, T, C[i].Pc / 100000, C[i].Tc, C[i].Tb
31
                   ) / 1000;
            end if;
32
            Z = 0;
33
            rho = IsothermalCompressibility.DensityRacket(T, P, C[i].Pc, C[i].Tc, C[i
34
                 ]. Racketparam, C[i]. AF, C[i]. MW, Files. Thermodynamic Functions. Psat (C[i
                 [.VP, T));
            K[i] = IsothermalCompressibility.CalcIsoCompLiq(ST, C[i].MW, rho, C[i].Tc,
35
                  T);
          else
36
37
            ST = 0;
            Z = 0;
38
            rho = 0;
39
            K[\,\,i\,\,] \ = \ 0\,;
40
          end if;
41
        end for;
42
        IC = sum(x[:] .* K[:]);
43
      end Test;
44
45
46
      function CompressibilityFactor
        extends Modelica.Icons.Function;
47
```

```
import Simulator.Files.ThermodynamicFunctions.*;
48
49
         parameter Real R = 8.314;
         input Real T, P, Tc, Pc;
50
         Real V[3, 2], a, b, D[4];
51
         output Real Z;
52
       algorithm
53
         a := IsothermalCompressibility.EOSConstants(Tc, Pc, T);
54
         b := IsothermalCompressibility.EOSConstantII(Tc, Pc);
55
56
         D[1] := 1;
         D[2] := (-8.314 * T) / P;
57
         D[\,3\,] \ := \ (-b \ \ \ 2\,) \ - \ 8.314 \ * \ T \ * \ b \ / \ P \ + \ a \ / \ P;
58
         D[4] := (-a * b) / P;
59
         V := Modelica.Math.Vectors.Utilities.roots(D);
60
         {\rm Z} \; := \; {\rm P} \; \ast \; {\rm V}[\, 1 \, , \ 1 \, ] \; \; / \; \; (8 \, . \, 3 \, 1 \, 4 \; \ast \; {\rm T}) \; ; \;
61
       end CompressibilityFactor;
62
63
       function CalcIsoCompLiq
64
         extends Modelica.Icons.Function;
65
         import Simulator.Files.Thermodynamic Functions.*;
66
         input Real ST, MW, rho, Tc, T;
67
         output Real IC;
68
       protected
69
         Real Vp;
70
       algorithm
71
         Vp := ST ^ 0.25 * MW / rho;
72
         IC := 1.33 * 10 ^{(-2)} * Vp ^{(12.2)} (2.12 ^{(12.2)} * (Tc - T) ^{(12.8)};
73
74
       end CalcIsoCompLiq;
75
       function EOSConstants
76
         extends Modelica.Icons.Function;
77
         parameter Real R gas = 8.314;
78
         input Real Tc, Pc;
79
         input Real T;
80
         output Real a;
81
82
       algorithm
         a := 0.42748 * R gas ^ 2 * (Tc ^ 2.5 / (Pc * T ^ 0.5));
83
       end EOSConstants;
84
85
       function EOSConstantII
86
         extends Modelica.Icons.Function;
87
         parameter Real R_{gas} = 8.314;
88
         input Real Tc, Pc;
89
         output Real b;
90
       algorithm
91
         b := 0.08664 * R gas * (Tc / Pc);
92
       end EOSConstantII;
93
^{94}
       function DensityRacket
95
         extends Modelica.Icons.Function;
96
         input Real T;
97
         input Real P;
98
         input Real Pc c;
99
         input Real Tc c;
100
         input Real RP c;
101
         input Real AF_c;
102
         input Real MW c;
103
         input Real Psat;
104
         output Real rho c;
105
         parameter Real R = 83.14;
106
       protected
107
         Real Tr c, Pcbar c, temp, Tcor c, a, b, c c, d, e c, Beta c, f, g, h, j, k,
108
             RPnew c;
```

```
109
       algorithm
110
         Pcbar c := Pc c / 100000;
         Tr c := T / Tc c;
111
          if Tr c > 0.99 then
112
            Tr c := 0.5;
113
         end if;
114
         if RP c = 0 then
115
            RPnew\_c \ := \ 0.29056 \ - \ 0.08775 \ * \ AF\_c;
116
         else
117
            RPnew_c := RP c;
118
         end if;
119
         \operatorname{temp} := \operatorname{R} * (\operatorname{Tc} \operatorname{c} / \operatorname{Pcbar} \operatorname{c}) * \operatorname{RPnew} \operatorname{c} \widehat{\phantom{a}} (1 + (1 - \operatorname{Tr} \operatorname{c}) \widehat{\phantom{a}} (2 / 7));
120
          if T < Tc c then
121
            a := -9.070217;
122
            b := 62.45326;
123
            d \ := \ -135.1102;
124
            f := 4.79594;
125
            g := 0.250047;
126
            h := 1.14188;
127
            j := 0.0861488;
128
            k := 0.0344483;
129
            e_c := exp(f + g * AF_c + h * AF_c * AF_c);
130
            c c := j + k * AF c;
131
            132
                 + d * (1 - Tr_c) + e_c * (1 - Tr_c) (4 / 3);
            Tcor c := temp * (1 - c c * log((Beta c + P) / (Beta c + Psat)));
133
            rho c := 0.001 * MW c / (Tcor c * 0.000001);
134
135
          else
            rho c := 0.001 * MW c / (temp * 0.000001);
136
         end if;
137
       end DensityRacket;
138
    end IsothermalCompressibility;
139
```

## Bulk Modulus

```
package BulkModulus
1
\mathbf{2}
      function BM
        extends Modelica.Icons.Function;
3
        import Simulator.Files.Thermodynamic_Functions.*;
^{4}
        input Real K;
\mathbf{5}
        output Real B;
6
7
      algorithm
        B := 1 / K;
8
      end BM;
9
10
^{11}
      model Test
        import Simulator.*;
12
        import data = Simulator.Files.ChemsepDatabase;
13
        parameter data. Phosgene ace;
14
15
        parameter Integer Nc = 1;
        parameter data.GeneralProperties C[Nc] = \{ace\};
16
        parameter Real T = 350, x[Nc] = \{1\};
17
        Real Z[Nc];
18
        {\rm Real}\ {\rm K[Nc]},\ {\rm IC},\ {\rm BM};
19
      equation
20
        for i in 1:Nc loop
21
          Z[i] = IsothermalCompressibility.CompressibilityFactor(T, 101325, C[i].Tc, C
22
               [i].Pc);
          K[i] = IsothermalCompressibility.CalcIsoComp(101325, 1, Z[i]);
23
        end for;
24
```

25 IC = sum(x [:] .\* K[:]);
 26 BM = BulkModulus.BM(IC);
 27 end Test;
 28 end BulkModulus;

# Speed OfS ound

1	package SpeedOfSound
<b>2</b>	function SoundSpeed
3	<b>extends</b> Modelica.Icons.Function;
4	<b>import</b> Simulator.Files.Thermodynamic_Functions.*;
5	input Real B, rho;
6	output Real S;
7	algorithm
8	$\mathrm{S} := \mathrm{sqrt}\left(\mathrm{B} \ / \ \mathrm{rho} ight);$
9	end SoundSpeed;
10	
11	
12	model Test
13	import Simulator.*;
14	$\mathbf{import}$ data = Simulator.Files.ChemsepDatabase;
15	parameter data.Water ace;
16	<b>parameter</b> Integer $Nc = 1$ ;
17	<b>parameter</b> data.GeneralProperties $C[Nc] = \{ace\};$
18	parameter Real T = 298.15, $x[Nc] = \{1\}$ , P=101325;
19	Real Z[Nc];
20	Real K[Nc], IC, BM, S, rho[Nc], Density;
21	equation
22	for i in 1:Nc loop
23	Z[i] = IsothermalCompressibility.CompressibilityFactor(T, P, C[i].Tc, C[i]. Pc);
24	K[i] = IsothermalCompressibility.CalcIsoComp(P,1, Z[i]);
25	if $T \le C[i]$ . The then
26	$rho[i] = \hat{C}[i]. SolDen[2] + C[i]. SolDen[3] * T;$
27	else
28	rho[i] = Files.ThermodynamicFunctions.Dens(C[i].LiqDen, C[i].Tc, T, P);
29	$\operatorname{end}$

if ;

```
end for;
30
                IC \; = \; sum(x[:] \; .* \; K[:]) \; ;
31
              Density = sum(x[:] .* rho[:]);
BM = BulkModulus.BM(IC);
32
33
             S = SpeedOfSound.SoundSpeed(BM, Density);
34
                           end Test;
35
36
37
38
39
40
    end SpeedOfSound;
```



1 package PRSVTest

2 model PRSV1

```
3
        //==
         //Header files and Parameters
4
        import Simulator.*;
\mathbf{5}
        parameter Real R = 8.314 "Ideal Gas Constant";
6
        parameter Real kij_c[Nc, Nc](each start = 1) =
7
             Simulator.Files.ThermodynamicFunctions.BIPPR(Nc, C.name);
8
         //Model Variables
9
        Real Tr c[Nc](each start = Tg) "Reduced temperature";
10
        Real b c[Nc];
11
        Real a c[Nc](start = xg);
12
        Real m c[Nc];
13
        Real q_c[Nc];
14
15
        Real p c[Nc];
        Real aij_c[Nc, Nc];
16
        Real K_{c[Nc]}(start = K_{guess});
17
        Real Pvap c[Nc](start = Pg) "Saturated Vapor Pressure";
18
        Real philiq_c[Nc](each start = 5) "Liquid Phase Fugasity coefficient";
19
        Real phivap c[Nc](each start = 5) "Vapor Phase Fugasity coefficient";
20
        Real gmabubl c[Nc], gmadew_c[Nc];
21
        Real philiqbubl_c[Nc], phivapdew_c[Nc];
22
        Real Cpres p[3], Hres p[3], Sres p[3];
23
        Real aMliq, bMliq;
24
        Real Aliq(start = xliqg), Bliq(start = xvapg);
25
        Real Cliq [4];
26
        Real Z RL[3, 2](start = xliqg);
27
        Real Zliq [3] (start = xliqg), Zll (start = xvapg);
28
29
        Real sumxliq [Nc];
        Real aMvap, bMvap;
30
        Real Avap(start = xliqg), Bvap(start = xvapg);
31
        Real Cvap [4];
32
        Real Z_RV[3, 2]( start = xvapg);
33
        Real \overline{Zvap}[3](start = xvapg), Zvv;
34
        Real sumxvap[Nc];
35
        Real A, B, Cdummy, D c[Nc], E, F, G, H c[Nc], I c[Nc], J c[Nc];
36
37
        Real gma[Nc];
        extends GuessModels.InitialGuess;
38
39
40
      equation
        for i in 1:Nc loop
41
           Pvap c[i] = Simulator.Files.ThermodynamicFunctions.Psat(C[i].VP, T);
42
           gmadew_c[i] = 1;
43
           gmabubl_c[i] = 1;
44
           philiqbubl c[i] = 1;
45
           phivapdew c[i] = 1;
46
47
          gma[i] = 1;
        end for;
48
        Cpres_p[:] = zeros(3);
49
        Hres p[:] = zeros(3);
50
        \operatorname{Sres}_p[:] = \operatorname{zeros}(3);
51
        Tr c = T ./ C.Tc;
52
        b_c = 0.0778 * R * C.Tc ./ C.Pc;
53
        m_c[1] = p_c[1] + 0.00159 * (1.0 + Tr_c[1] ^ 0.5) * (0.7 - Tr_c[1]);
54
         \begin{array}{l} m_{c}^{-}[2] = p_{c}^{-}[2] - 0.02669 * (1.0 + Tr_{c}^{-}[2] \cap 0.5) * (0.7 - Tr_{c}^{-}[2]); \\ m_{c}^{-}[3] = p_{c}^{-}[3] - 0 * (1.0 + Tr_{c}^{-}[3] \cap 0.5) * (0.7 - Tr_{c}^{-}[3]); \\ \end{array} 
55
56
        q_c = 0.45724 * R^2 * C.Tc^2 / C.Pc;
57
        a_c = q_c .* (1 .+ m_c .* (1 .- sqrt(Tr_c))) .^{2};
58
        p\_c = \ 0.378893 \ .+ \ 1.4897153 \ * \ C.AF \ .- \ 0.17131848 \ * \ C.AF \ .^{\phantom{abc}} 2 \ .+ \ 0.0196554 \ *
59
             C.AF .^{3};
        aij_c = \{\{(1 - kij_c[i, j]) * sqrt(a_c[i] * a_c[j]) \text{ for } i \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:Nc\}
60
             Nc;
   //=
61
```

```
62
         //Liquid Fugacity Coefficient Calculation Routine
                   aMliq = sum(\{\{x\_pc[2, i] * x\_pc[2, j] * aij\_c[i, j] for i in 1:Nc\} for j in 1:
 63
                           Nc } ;
                   bMliq = sum(b_c .* x_pc[2, :]);
 64
                   Aliq = aMliq \times P / (\overline{R} \times T)
 65
                   Bliq = bMliq * P / (R * T);
 66
                   \operatorname{Cliq}[1] = 1;
 67
                   \operatorname{Cliq}[2] = \operatorname{Bliq} - 1;
 68
                   69
 70
                  Z RL = Modelica.Math.Vectors.Utilities.roots(Cliq);
 71
                   Zliq = \{Z RL[i, 1] \text{ for } i \text{ in } 1:3\};
 72
                   Zll = min({Zliq});
 73
                   sumxliq = \{sum(\{x\_pc[2, j] * aij\_c[i, j] for j in 1:Nc\}) for i in 1:Nc\};
 74
                   if Zll + 2.4142135 * Bliq \ll 0 then
 75
 76
                       A = 1;
                   else
 77
                       A = Zll + 2.4142135 * Bliq;
 78
                  end if;
 79
                   if Z11 - 0.414213 * Bliq \le 0 then
 80
                       B = 1;
 81
                   else
 82
                       B = Z11 - 0.414213 * Bliq;
 83
                   end if;
 84
                   if Zll - Bliq \ll 0 then
 85
 86
                       Cdummy = 0;
                   else
 87
                       Cdummy = log(Zll - Bliq);
 88
                   end if;
 89
                   for i in 1:Nc loop
 90
                        if bMliq = 0 then
 91
                            D c[i] = 0;
 92
                        else
 93
                           D_c[i] = b_c[i] / bMliq;
 94
                       end if;
 95
                  end for;
 96
                   for i in 1:Nc loop
 97
                        if aMliq == 0 then
 98
                            J c[i] = 0;
 99
100
                        else
                            J c[i] = sumxliq[i] / aMliq;
101
                       end if;
102
                  end for;
103
                   philiq_c = exp(Aliq / (Bliq * sqrt(8)) * log(A / B) .* (D_c .- 2 * J_c) .+ (D_c .- 2
104
                            Zll - 1) * D c .- Cdummy);
105
         //Vapour Fugacity Calculation Routine
106
                  aMvap = sum(\{x pc[3, i] * x pc[3, j] * aij c[i, j] for i in 1:Nc\} for j in 1:
107
                           Nc } ;
                  bMvap = sum(b_c \cdot x pc[3, :]);
108
                   Avap = aMvap \overline{*} P / (\overline{R} * T) \hat{}
109
                                                                                        2;
                   Bvap = bMvap * P / (R * T);
110
                   \operatorname{Cvap}[1] = 1;
111
                   \operatorname{Cvap}[2] = \operatorname{Bvap} - 1;
112
                  113
114
                  Z RV = Modelica.Math.Vectors.Utilities.roots(Cvap);
115
                   Zvap = \{Z RV[i, 1] \text{ for } i \text{ in } 1:3\};
116
                   Zvv = max({Zvap});
117
                   sumxvap = \{sum(\{x_pc[3, j] * aij_c[i, j] for j in 1:Nc\}) for i in 1:Nc\};
118
119
                   if Zvv + 2.4142135 * Avap <= 0 then
                       E = 1;
120
```

```
121
                     else
122
                         E = Zvv + 2.4142135 * Bvap;
                    end if;
123
                     if Zvv - 0.414213 * Bvap <= 0 then
124
                         F = 1;
125
                     else
126
                         F = Zvv - 0.414213 * Bvap;
127
                    end if;
128
                     if Zvv - Bvap \ll 0 then
129
                         G = 0;
130
                     else
131
                         G = \log (Zvv - Bvap);
132
                    end if:
133
                     for i in 1:Nc loop
134
                          if bMvap == 0 then
135
                               H_c[\,i\,] \;=\; 0\,;
136
                          else
137
                               H_c[i] = b_c[i] / bMvap;
138
                          end if;
139
                    end for;
140
                     for i in 1:Nc loop
141
                          if aMvap = 0 then
142
                               I c[i] = 0;
143
144
                          else
                               I c[i] = sumxvap[i] / aMvap;
145
146
                          end if;
147
                    end for;
                     phivap_c = \exp(Avap / (Bvap * sqrt(8)) * log(E / F) .* (H_c .- 2 * I c) .+ (P_c .- 2 *
148
                              Zvv - 1) * H c .- G);
                     for i in 1:Nc loop
149
                          if philiq_c[i] = 0 or phivap_c[i] = 0 then
150
                               K c[i] = 0;
151
                          else
152
                               K_c[i] = philiq_c[i] / phivap_c[i];
153
                          end if;
154
155
                    end for;
156
               end PRSV1;
157
158
               model ms
159
                     extends Simulator.Streams.MaterialStream;
160
                    extends PRSVTest.PRSV1;
161
               end ms;
162
163
               model Test
164
                     extends Modelica.Icons.Example;
165
                    import data = Simulator.Files.ChemsepDatabase;
166
                    parameter Integer Nc = 3;
167
                    parameter data.Methane ace;
168
                    parameter data. Ethane eth;
169
                    parameter data.Noctane noct;
170
                    parameter data.GeneralProperties C[Nc] = \{ace, eth, noct\};
171
                    PRSVTest.ms S1(C = C, Nc = Nc) annotation(
172
                          Placement (visible = true, transformation (origin = \{-128, 14\}, extent =
173
                                    \{\{-10, -10\}, \{10, 10\}\}, \text{ rotation } = 0\}));
               equation
174
                    S1.F_p[1] = 100;
175
                     S1.x_pc[1, :] = \{0.33, 0.33, 0.34\};
176
                     S1.P = 101325;
177
```

S1.T = 150;

178

179end Test; 180 model PRSV2 181 182 //Header files and Parameters 183 import Simulator.\*; 184 parameter Real R = 8.314 "Ideal Gas Constant"; 185 parameter Real kij\_c[Nc, Nc](each start = 1) = 186 Simulator.Files.ThermodynamicFunctions.BIPPR(Nc, C.name); 187 //Model Variables 188 Real Tr c[Nc](each start = Tg) "Reduced temperature"; 189 Real b c[Nc]: 190 Real a c[Nc](start = xg);191 Real m c[Nc]; 192 Real  $q_c[Nc];$ 193Real p c[Nc]; 194Real aij c[Nc, Nc]; 195 Real  $K c[Nc](start = K_guess);$ 196 Real Pvap\_c[Nc](start = Pg) "Saturated Vapor Pressure"; 197 Real philiq\_c[Nc](each start = 5) "Liquid Phase Fugasity coefficient"; 198 Real phivap c[Nc](each start = 5) "Vapor Phase Fugasity coefficient"; 199 Real gmabubl c[Nc], gmadew c[Nc]; 200 Real philiqbubl c[Nc], phivapdew c[Nc]; 201 Real Cpres\_p[3], Hres\_p[3], Sres\_p[3]; 202 203 Real aMliq, bMliq; Real Aliq(start = xliqg), Bliq(start = xvapg); 204Real Cliq [4]; 205Real  $Z_RL[3, 2](start = xliqg);$ 206 Real Zliq [3] (start = xliqg), Zll (start = xvapg); 207 208 Real sumxliq |Nc|; Real aMvap, bMvap; 209 Real Avap(start = xliqg), Bvap(start = xvapg); 210Real Cvap[4];211 Real Z\_RV[3, 2](start = xvapg); Real Zvap[3](start = xvapg), Zvv; 212213Real sumxvap [Nc]; 214Real A, B, Cdummy, D c[Nc], E, F, G, H c[Nc], I c[Nc], J c[Nc]; 215216Real gma | Nc |; extends GuessModels.InitialGuess; 217218equation 219for i in 1:Nc loop 220 Pvap c[i] = Simulator.Files.ThermodynamicFunctions.Psat(C[i].VP, T);221 gmadew c[i] = 1;222 gmabubl c[i] = 1;223 philiqbubl c[i] = 1;224phivapdew c[i] = 1;225gma[i] = 1;226 end for; 227  $Cpres_p[:] = zeros(3);$ 228 229  $\operatorname{Hres}_p[:] = \operatorname{zeros}(3);$ 230  $\operatorname{Sres}_p[:] = \operatorname{zeros}(3);$ Tr c = T ./ C.Tc;231b c = 0.0778 \* R \* C.Tc ./ C.Pc; 232  $m_c[1] = p_c[1] + (0 + 0 * (0 - Tr_c[1])) * (1.0 + Tr c[1] ^ 0.5) * (0.7 - Tr_c[1])$ 233  $Tr\_c[1]);$  $\mathbf{m_c[2]} = \mathbf{p_c[2]} + ((-0) + 0 * (0 - \mathbf{Tr_c[2]})) * (1.0 + \mathbf{Tr_c[2]} \uparrow 0.5) * (0.7 - \mathbf{Tr_c[2]} \to 0.5) * (0.7 - \mathbf{Tr_c[2]}$ 234 $Tr_c[2]$ ;  $q c = 0.45724 * R^2 * C.Tc^2 ./ C.Pc;$ 235a  $c = q c .* (1 .+ m c .* (1 .- sqrt(Tr c))) .^{2};$ 236  $p\_c = \ 0.378893 \ .+ \ 1.4897153 \ * \ C.AF \ .- \ 0.17131848 \ * \ C.AF \ .^{\phantom{a}} 2 \ .+ \ 0.0196554 \ *$ 237

C.AF .^ 3;  $aij_c = \{\{(1 - kij_c[i, j]) * sqrt(a_c[i] * a_c[j]) \text{ for } i \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:Nc\}$ 238 Nc; 239//Liquid Fugacity Coefficient Calculation Routine 240 $aMliq = sum(\{\{x\_pc[2, i] * x\_pc[2, j] * aij\_c[i, j] for i in 1:Nc\} for j in 1:$ 241Nc } ; 242 243Bliq = bMliq \* P / (R \* T);244 $\begin{array}{l} \operatorname{Cliq}[1] = 1;\\ \operatorname{Cliq}[2] = \operatorname{Bliq} - 1; \end{array}$ 245246247248Z RL = Modelica.Math.Vectors.Utilities.roots(Cliq); 249 $Zliq = \{Z_RL[i, 1] \text{ for } i \text{ in } 1:3\};$ 250 $Zll = min({Zliq});$ 251 $sumxliq = \{sum(\{x\_pc[2, j] * aij\_c[i, j] for j in 1:Nc\}) for i in 1:Nc\};$ 252if  $Zll + 2.4142135 * Bliq \le 0$  then 253 A = 1;254else 255A = Z11 + 2.4142135 \* Bliq;256end if; 257if  $Z11 - 0.414213 * Bliq \le 0$  then 258B = 1;259260 else B = Z11 - 0.414213 \* Bliq;261262end if; if  $Zll - Bliq \ll 0$  then 263 Cdummy = 0;264else 265 $Cdummy = \log(Z11 - Bliq);$ 266 end if; 267for i in 1:Nc loop 268 if bMliq = 0 then 269 270D c[i] = 0;else 271D c[i] = b c[i] / bMliq;272end if; 273end for; 274for i in 1:Nc loop 275if aMliq = 0 then 276 $J\_c\,[\,\,i\,\,]\ =\ 0\,;$ 277 else 278 J c[i] = sumxliq[i] / aMliq;279end if; 280end for; 281philiq  $c = \exp(Aliq / (Bliq * sqrt(8)) * \log(A / B) .* (D c .- 2 * J c) .+ ($ 282Zll - 1) \* D c .- Cdummy); 283 //Vapour Fugacity Calculation Routine 284 $aMvap = sum(\{\{x\_pc[3, i] * x\_pc[3, j] * aij\_c[i, j] for i in 1:Nc\} for j in 1:$ 285Nc } ;  $bMvap = sum(b_c \cdot x pc[3, :]);$ 286 287 2;288 Cvap[1] = 1;289 $\operatorname{Cvap}[2] = \operatorname{Bvap} - 1;$ 290  $\operatorname{Cvap}[3] = \operatorname{Avap} - 3 * \operatorname{Bvap} \widehat{2} - 2 * \operatorname{Bvap};$ 291  $\operatorname{Cvap}[4] = \operatorname{Bvap} \widehat{\phantom{a}} 3 + \operatorname{Bvap} \widehat{\phantom{a}} 2 - \operatorname{Avap} * \operatorname{Bvap};$ 292 293 Z RV = Modelica.Math.Vectors.Utilities.roots(Cvap);  $Zvap = \{Z RV[i, 1] for i in 1:3\};$ 294

```
295
        Zvv = max({Zvap});
        sumxvap = \{sum(\{x\_pc[3, j] * aij\_c[i, j] for j in 1:Nc\}) for i in 1:Nc\};
296
        if Zvv + 2.4142135 * Avap <= 0 then
297
298
         E = 1;
        else
299
         E = Zvv + 2.4142135 * Bvap;
300
        end if;
301
        if Zvv - 0.414213 * Bvap <= 0 then
302
          F = 1;
303
        else
304
          F = Zvv - 0.414213 * Bvap;
305
        end if;
306
        if Zvv - Bvap \ll 0 then
307
308
         G = 0;
        else
309
         G = \log (Zvv - Bvap);
310
        end if;
311
        for i in 1:Nc loop
312
          if bMvap == 0 then
313
            H_c[i] = 0;
314
          else
315
            H c[i] = b c[i] / bMvap;
316
          end if;
317
        end for;
318
        for i in 1:Nc loop
319
320
          if aMvap = 0 then
            I c[i] = 0;
321
322
          else
            I_c[i] = sumxvap[i] / aMvap;
323
          end if;
324
        end for;
325
        326
           Zvvv - 1) * H_c .- G);
        for i in 1:Nc loop
327
          if philiq_c[i] = 0 or phivap_c[i] = 0 then
328
329
            K c[i] = 0;
          else
330
            K c[i] = philiq c[i] / phivap c[i];
331
          end if;
332
        end for;
333
334
    //
```

```
end PRSV2;end PRSVTest;
```

## Lee Kesler Plocker Package

```
package LKP
1
2
     model ms
       extends Simulator.Streams.MaterialStream;
3
       extends LKP.LKPTest;
4
     end ms;
5
6
     model LKPTest
7
       import Simulator.*;
8
       import data = Simulator.Files.ChemsepDatabase;
9
10
       //constants for simple fluid
       parameter Real b1[2] = \{0.1181193, 0.2026579\} "Constants for the
11
           BWR-Lee Kesler Equation";
```

12	parameter Real $b2[2] = \{0.265728, 0.331511\}$ "Constants for the BWR-Lee_Kesler Equation":
13	parameter Real b3[2] = {0.154790, 0.027655} "Constants for the BWR-Lee_Kesler Equation":
14	parameter Real b4[2] = {0.030323, 0.203488} "Constants for the BWR-Lee_Kesler Equation":
15	parameter Real $c1[2] = \{0.0236744, 0.0313385\}$ "Constants for the BWR-Lee Kesler Equation":
16	parameter Real $c2[2] = \{0.0186984, 0.0503618\}$ "Constants for the BWR-Lee Kesler Equation":
17	<pre>parameter Real c3[2] = {0, 0.016901} "Constants for the BWR-Lee_Kesler Equation";</pre>
18	parameter Real c4[2] = $\{0.042724, 0.041577\}$ "Constants for the BWR-Lee_Kesler Equation";
19	parameter Real d1[2] = $\{0.0000155488, 0.000048736\}$ "Constants for the BWR-Lee Kesler Equation";
20	parameter Real d2[2] = $\{0.0000623689, 0.00000740336\}$ "Constants for the BWR-Lee Kesler Equation";
21	<pre>parameter Real beta[2] = {0.65392, 1.226} "Constants for the BWR-Lee_Kesler Equation";</pre>
22	parameter Real gamma[2] = $\{0.060167, 0.03754\}$ "Constants for the BWR-Lee Kesler Equation";
23	<b>parameter</b> Real omega $r = 0.397$ "acentric factor of N-octane";
24	<b>parameter</b> Real $R = 8.314472$ "Universal gas constant";
25	<b>parameter</b> data.GeneralProperties $comp[:] = C[:];$
26	<b>parameter</b> Real kij [Nc, 2] = $\{\{1, 1.018\}, \{1.018, 1\}\}$ "binary interaction parameter for the i-i mixture rule for the pseudo critical temperature":
27	Real Cores p[3]. Hres p[3]. Sres p[3]:
28	Real $T_{c}[N_{c}] = comp[:]$ Tc [Critical Temperature]:
20	Real $P_{c}[Nc] = comp[:] Pc$ "critical Pressure".
30	Real $V_{c}[Nc] = comp[:] V_{c}$ "Critical Volume":
21	Real or generation of the state
20	Real omega[iki] - comp[.]. Ar Acentric factor,
22	Real omega_1 recentric factor in require phase mixture".
34	Real V cm   "pseudo-critical volume in liquid phase mixture".
35	Real V cm v "pseudo - critical volume in require phase mixture".
36	Real <u>cm</u>   "pseudo critical Temperature in liquid phase mixture".
27	Real T cm v "pseudo critical Temperature in vapour phase mixture".
38	Real P cm   "pseudo - critical pressure in liquid phase mixture".
20	Real prometry "pseudo critical pressure in vanour phase mixture".
40	Real <u>cm</u>   "pseudo critical compressibility factor in liquid phase mixture".
40	Real Z cm v "pseudo critical compressibility factor in vapour phase mixture".
41	Real Z r ] "Reduced Temperature in liquid phase mixture".
42	Real T r v "Reduced Temperature in vapour phase mixture".
44	Real P.r.   "Reduced Pressure in liquid phase mixture".
45	Real P r v "Reduced Pressure in vapour phase mixture":
46	<b>Real</b> B 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending
10	on temperature only".
47	Real $C_1[2]$ "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only":
48	Real $D_1[2]$ "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only":
49	Real $B_v[2]$ "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only":
50	Real $C_v[2]$ "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only":
51	Real $D_v[2]$ "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only":
52	Real V r $[2](ach start = 0.1)$ "Reduced volume in liquid phase mixture".
53	Real V r v[2](each start = 1000) "Reduced volume in vapour phase mixture":
54	Real z_1[2] "compressibility factor in liquid phase(for simple and reference component)":
	1 / /

55	Real $z_v[2]$ "compressibility factor in vapour phase(for simple and reference component)":
50	Pool 7 1 "compressibility factor in liquid phase".
56	Real Z_1 "compressibility factor in liquid phase";
57	Real Z v "compressibility factor in vapour phase";
58	Real Icij[Nc, Nc];
59	Real Vcij[Nc, Nc];
60	parameter Real $n = 0.25$ "universal exponent in mixing rule for the pseudo
	critical temperature";
61	<b>Real</b> phi_1[2] "fugacity coefficient for liquid phase(for simple and reference
	fluid)";
62	Real phi_v[2] "fugacity coefficient for vapour phase(for simple and reference
	fluid)";
63	Real $E_1[2];$
64	Real $E_v[2]$ ;
65	Real phi_lm "fugacity coefficient for liquid phase mixture";
66	Real phi vm "fugacity coefficient for vapour phase mixture";
67	Real del h 1[2] "isothermal enthalpy departure for liquid phase (for simple and
	reference fluid)":
68	<b>Real del h <math>\mathbf{y}[2]</math></b> "isothermal enthalpy departure for vapour phase(for simple and
	reference fluid)":
69	<b>Beal del h lm</b> "isothermal enthalpy departure for liquid phase mixture":
70	Real del h vm "isothermal enthalpy departure for vanour phase mixture"
71	Real sum [Nc].
72	Real sum [Nc].
72	Roal sum2[No];
73	Pool dram [No. No] "derivatives of the provide critical compressibility factor
74	tear usem_read and reading the second contrast compressionity factor
	In inquite phase";
75	Keal avem_1[NC, NC] "derivatives of the pseudo critical volume in liquid phase
76	Keal dtcm_1[Nc, Nc] "derivatives of the pseudo critical temperature in liquid
	phase";
77	Real dpcm_1[Nc, Nc] "derivatives of the pseudo criticals pressure in liquid
	phase";
78	Real dphim_l "derivatives of the fugacity coefficient for liquid phase";
79	Real dphim_v "derivatives of the fugacity coefficient for vapour phase";
80	Real phi_liq[Nc] "fugacity coefficient in liquid phase";
81	Real sum4[Nc];
82	Real sum5[Nc];
83	Real sum6 [Nc];
84	Real dzcm_v[Nc, Nc] "derivatives of the pseudo critical compressibility factor
	in vapour phase";
85	Real dvcm $v[Nc, Nc]$ "derivatives of the pseudo critical volume in vapour phase
	";
86	Real dtcm v[Nc, Nc] "derivatives of the pseudo critical temperature in vapour
	phase";
87	Real dpcm v[Nc, Nc] "derivatives of the pseudo criticals pressure in vapour
	phase":
88	Real phi vap[Nc] "fugacity coefficient in vapour phase":
89	Real K cINcl "Equilibrium constant":
90	Real gma c[Nc] gmabubl c[Nc] gmadew c[Nc]
91	Real philiopubly clock physodew clock Pyan clock
02 0	ouation
92 C	diving Bules
93 // 10	among l = $sum(\{x, pc\})$ i ] * $among[i]$ for i in 1.Ncl).
94	$\operatorname{sum}(\lambda_{p}(\lambda_{p}))$
90	$\operatorname{Uncga}_v = \operatorname{Sum}(\chi_{\mathbf{x}}\operatorname{pc}[o, 1] * \operatorname{Uncga}[1] \operatorname{Ur} 1 \operatorname{III} 1:\operatorname{NC});$ $\operatorname{Taij} = \left\{ \left[ \left( \operatorname{T} a[i] * \operatorname{T} a[i] \right) \land 0.5 * kii[i; i] fon : in 1:\operatorname{Nc} fon : in 1:\operatorname{Nc} \right] \right\}$
90	$ \begin{array}{c} 1 \text{ Cij} = \{ \{ 1, 201, 100, 100, 100, 100, 100, 100, 1$
97	$v_{c1j} - \{\{0, 120 \\ * \\ (v_{c1j} - \{1 \\ 0\} + v_{c1j} - \{1 \\ 0\} + v_{c1j} - \{1 \\ 0\} \} = 0$
	$\frac{100^{2} \text{ IOF } [111 1:100]}{100 \text{ IOF } [101 1:100]};$
98	$v_{cn_1} = sum(\{\{x_pc[2, 1] * x_pc[2, 1] * vcij[1, j] \text{ for } 1 \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:$
	$MU_{j}$
99	$v \_ cin\_v = sum(\{\{x\_pc[0, 1] * x\_pc[0, 1] * vc1j[1, j] \text{ for } 1 \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:$
	1NC } ) ;

```
T cm l = 1 / V cm l ^ n * sum({{x_pc[2, i] * x_pc[2, j] * Vcij[i, j] ^ n *
100
                                                                   Tcij[i, j] for i in 1:Nc} for j in 1:Nc});
                                             T cm v = 1 / V cm v ^ n * sum({{x pc[3, i] * x pc[3, j] * Vcij[i, j] ^ n *
101
                                                                    Tcij[i, j] for i in 1:Nc} for j in 1:Nc});
                                              P_cm_l = (0.2905 - 0.085 * omega_l) * R * T_cm_l / V_cm_l;
102
                                             P\ cm\ v =\ (0.2905\ -\ 0.085\ *\ omega\_v)\ *\ R\ *\ T\_cm\_v\ /\ V\_cm\_v;
103
                                              \mathbf{Z}\_\mathbf{cm}\_\mathbf{l} = \mathbf{P}\_\mathbf{cm}\_\mathbf{l} * \mathbf{V}\_\mathbf{cm}\_\mathbf{l} / (\mathbf{R} * \mathbf{\overline{T}}\_\mathbf{cm}\_\mathbf{l});
104
                                            105
106
107
                                                       r_l = P / P_cm_l;
r_v = P / P_cm_v;
                                              Р
108
                                             Р
109
                                               for i in 1:2 loop
110
                                                          B_{l}[i] = b1[i] - b2[i] / T_{r_{l}} - b3[i] / T_{r_{l}}^{-1} - b3[i] / T_{r_{l}}^{-1} - b4[i] / T_{r_{l}}^{-1} - 3;
111
                                                          \begin{array}{c} C_{l}[i] = c1[i] - c2[i] / T_{r}] + c3[i] / T_{r}]^{-1} - 2 \\ D_{l}[i] = d1[i] + d2[i] / T_{r}]; \end{array} 
112
113
                                                         B_v[i] = b1[i] - b2[i] / T_rv - b3[i] / T_rv^2 - b4[i] / T_rv^3;
114
                                                         C_v[i] = c1[i] - c2[i] / T_rv + c3[i] / T_rv^3;
115
                                                        D_v[i] = d1[i] + d2[i] / T_rv;
116
                                                         \begin{array}{c} P_{r_{l}i} * V_{r_{l}i} / I_{r_{l}i} / T_{r_{l}i} = 1 + B_{l}[i] / V_{r_{l}i}[i] + C_{l}[i] / V_{r_{l}i}[i] ^{2} + \\ D_{l}[i] / V_{r_{l}i}[i] ^{5} + c4[i] / (T_{r_{l}i} ^{3} * V_{r_{l}i}[i] ^{2}) * (beta[i] + \\ \end{array}
117
                                                                              gamma[i] / V r l[i] ^ 2) * exp(-gamma[i] / V r l[i] ^ 2);
                                                         P_r_v * V_r_v[i] / T_r_v = 1 + B_v[i] / V_r_v[i] + C_v[i] / V r v[i] ^ 2 + C_v[i] / V r v[i] / V r v[i] ^ 2 + C_v[i] / V r v[i] / V r v v[i] / V r v v[i] / V r v[i] / V r v v v v v v v v v v v v v v v 
118
                                                                              D_v[i] / V_r_v[i] ^ 5 + c4[i] / (T_r_v ^ 3 * V_r_v[i] ^ 2) * (beta[i] + c4[i] / (T_r_v ^ 3 * V_r_v[i] ^ 2) * (beta[i] + c4[i] + c4[i] / (T_r_v ^ 3 + c4[i] - c4[i] + c4[i] +
                                                                               gamma[i] / Vr_v[i] ^ 2) * exp(-gamma[i] / V_r_v[i] ^ 2);
                                                          z v[i] = P r v * V r v[i] / T r v;
119
                                              end for;
120
                                              z_l[1] = -1 * P_r_l * V_r_l[1] / T_r_l;
121
                                              z_l[2] = -1 * P_r_l * V_r_l[2] / T_r_l;
122
                                               Z_l = z_l[1] + omega_l / omega_r * (z_l[2] - z_l[1]);
123
                                             Z_v = z_v[1] + omega_v / omega_r * (z_v[2] - z_v[1]);
124
                        //fugacity coefficient calculation
125
                                               for i in 1:2 loop
126
                                                                               \begin{bmatrix} i \end{bmatrix} = c4 \begin{bmatrix} i \end{bmatrix} / (2 * T_r_l ^3 * gamma \begin{bmatrix} i \end{bmatrix}) * (beta \begin{bmatrix} i \end{bmatrix} + 1 - (beta \begin{bmatrix} i \end{bmatrix} + 1 + gamma \begin{bmatrix} i \end{bmatrix} / V_r_l \begin{bmatrix} i \end{bmatrix} ^2) * exp(-gamma \begin{bmatrix} i \end{bmatrix} / V_r_l \begin{bmatrix} i \end{bmatrix} ^2); 
                                                          E \ l[i] = c4[i]
127
                                                         \begin{array}{l} \text{gamma[i]} / \sqrt{2} \frac{1}{2} \frac{1}{1} \frac{1}{2} \frac{1
128
129
                                                           \begin{array}{c} V_{r_{i}}[i] \land 2) + D_{l}[i] / (5 * V_{r_{i}}[i] \land 5) + E_{l}[i]); \\ phi_{v}[i] = exp(z_{v}[i] - 1 - \log(z_{v}[i]) + B_{v}[i] / V_{r_{v}}[i] + C_{v}[i] / (2 * C_{v}[i])) \\ \end{array} 
130
                                                                               V_r_v[i] ^2 + D_v[i] / (5 * V_r_v[i] ^5) + E_v[i]);
                                              end for;
131
                                              phi_lm = exp(log(phi_l[1]) + omega_l / omega_r * (log(phi_l[2]) - log(phi_l)))
132
                                                                     [1])));
                                              phi vm = \exp(\log(\text{phi v}[1]) + \text{omega v} / \text{omega r} * (\log(\text{phi v}[2]) - \log(\text{phi v}))
133
                                                                    [1])));
134
                       //enthalpy deviation
                                               for i in 1:2 loop
135
                                                           del_h_l[i] = T_r_l * (z_l[i] - 1 - (b2[i] + 2 * b3[i] / T_r_l + 3 * b4[i] / [b_1] + 2 * b3[i] / [b_1] + 
136
                                                                              \begin{array}{c} T_{r} 1 & 2 \end{array} / (T_{r} 1 & V_{r} 1 [i]) - (c2[i] - 3 & c3[i] / T_{r} 1 & 2 ) / (2 & x \\ T_{r} 1 & V_{r} 1 [i] & 2 ) + d2[i] / (5 & T_{r} 1 & V_{r} 1 [i] & 5 ) + 3 & x \\ E_{1} 1 & V_{1} 1 [i] & 2 & 1 \\ \end{array}
                                                           del_h_v[i] = T_r_v * (z_v[i] - 1 - (b2[i] + 2 * b3[i] / T_r_v + 3 * b4[i] / 
137
                                                                              end for;
138
                                              del_h_{lm} = del_h_{l[1]} + omega_l / omega_r * (del_h_{l[2]} - del_h_{l[1]});
139
                                              del_h_vm = del_h_v[1] + omega_v / omega_r * (del_h_v[2] - del_h_v[1]);
140
                                               Cpres_p[:] = zeros(3);
141
                                               \begin{array}{ll} \mathrm{Hres}_{p}\left[:\right] &= \mathrm{zeros}\left(3\right); \\ \mathrm{Sres}_{p}\left[:\right] &= \mathrm{zeros}\left(3\right); \end{array} 
142
143
144
                                               for i in 1:Nc loop
                                                          gma c[i] = 1;
145
```

146gmabubl c[i] = 1;gmadew c[i] = 1;147philiqbubl c[i] = 1;148 149phivapdew c|i| = 1;end for; 150for i in 1:Nc loop 151Pvap\_c[i] = Simulator.Files.ThermodynamicFunctions.Psat(C[i].VP, T); 152end for; 153  $dphim_l = 1 / omega_r * (log(phi_l[2]) - log(phi_l[1]));$ 154 $dphim_v = 1 / omega_r * (log(phi_v[2]) - log(phi_v[1]));$ 155algorithm 156for i in 1:Nc loop 157for 1 in 1:Nc loop 158dzcm l[i, :] := -0.085 .\* (omega[:] .- omega[i]); 159160 161162  $\ldots$  dvcm l[i, l] / V cm l); dzcm v[i, 1] := -0.085 .\* (omega[1] .- omega[i]); 163 dvcm v[i, 1] := 2. \* sum(x pc[3, :] .\* (Vcij[:, 1] - Vcij[:, i])); 164 $dtcm_v[i, 1] := (2. * sum(x_pc[3, :] .* (Vcij[:, 1] .^ n .* Tcij[:, 1] -$ 165Vcij[:, i] .^ n .\* Tcij[:, i]) .- n \*  $V_cm_v$  ^ (n - 1) .\*  $dvcm_v[i, 1]$  $.* T cm v) . / V cm v ^ n;$ dpcm v[i, l] := P cm v \* (dzcm v[i, l] / Z cm v .+ dtcm v[i, l] / T cm v 166 - dvcm v[i, 1] / V cm v);end for; 167 end for; 168 for i in 1:Nc loop 169for 1 in 1:Nc loop 170 if  $l \Leftrightarrow i$  then 171 $sum1[i] := x_pc[2, l] * dtcm_l[i, l];$ 172 $sum2[i] := x_pc[2, 1] * dpcm_l[i, 1];$ 173  $sum3[i] := x_pc[2, 1] * (omega[1] - omega[i]);$ 174 $\begin{array}{l} sum4[i] := x_pc[3, 1] * dtcm_v[i, 1]; \\ sum5[i] := x_pc[3, 1] * dpcm_v[i, 1]; \\ sum6[i] := x_pc[3, 1] * (omega[1] - omega[i]); \end{array}$ 175176 177end if; 178end for; 179end for; 180equation 181 for i in 1:Nc loop 182  $phi_liq[i] = exp(log(phi_lm) - del_h_lm / T * sum1[i] + (Z_cm_l - 1) / (D_cm_l) + (Z_cm_l) + (D_cm_l) + (D_c$ 183  $\begin{array}{c} P\_cm\_l \ \ast \ sum2[\ i \ ] \ - \ dphim\_l \ \ast \ sum3[\ i \ ]) \ ; \\ phi\_vap[\ i \ ] \ = \ exp(\log(phi\_vm) \ - \ del\_h\_vm \ / \ T \ \ast \ sum4[\ i \ ] \ + \ (Z\_cm\_v \ - \ 1) \ / \\ \end{array}$ 184 $P \operatorname{cm} v * \operatorname{sum5}[i] - \operatorname{dphim} v * \operatorname{sum6}[i]);$ end for; 185for i in 1:Nc loop 186 if phi liq[i] = 0 or phi vap[i] = 0 then 187  $K_c[i] = 0;$ 188 else 189 K c[i] = phi liq[i] / phi vap[i];190 end if: 191 end for; 192end LKPTest; 193 194model Test 195extends Modelica.Icons.Example; 196 **import** data = Simulator.Files.ChemsepDatabase; 197 198 **parameter** Integer Nc = 2; parameter data.Nbutane but; 199

```
200
        parameter data.Nhexane hex;
        parameter data.GeneralProperties C[Nc] = {but, hex};
201
        LKP.ms S1(C = C, Nc = Nc) annotation(
202
          Placement(visible = true, transformation(origin = \{-128, 14\}, extent =
203
              \{\{-10, -10\}, \{10, 10\}\}, \text{ rotation} = 0\}\};
      equation
204
        S1.F_p[1] = 100;
205
        S1.x_pc[1, :] = \{0.5, 0.5\};
206
        S1.P = 101325;
207
        S1.T = 300;
208
      end Test;
209
    end LKP;
210
    model LKPTest
 1
     import Simulator.*;
 2
    import data = Simulator.Files.ChemsepDatabase;
 3
    parameter data.Acetone but:
 4
   parameter data.Aceticacid hex;
 5
    parameter Integer Nc=2;
 6
 7
    parameter data.GeneralProperties comp[Nc]={but,hex};
 8
    //constants for simple fluid
 9
    parameter Real b1[2]={0.1181193,0.2026579}"Constants for the BWR-Lee Kesler
10
        Equation":
    parameter Real b2[2] = \{0.265728, 0.331511\}"Constants for the BWR-Lee Kesler Equation
11
    parameter Real b3[2]={0.154790,0.027655}"Constants for the BWR-Lee Kesler Equation
12
        ";
    parameter Real b4[2]={0.030323,0.203488}"Constants for the BWR-Lee Kesler Equation
13
        ";
    parameter Real c1[2]={0.0236744,0.0313385}"Constants for the BWR-Lee Kesler
14
        Equation";
    parameter Real c2[2]={0.0186984,0.0503618}"Constants for the BWR-Lee Kesler
15
        Equation";
    parameter Real c_3[2] = \{0, 0.016901\} "Constants for the BWR-Lee Kesler Equation";
16
    parameter Real c4[2] = \{0.042724, 0.041577\}"Constants for the BWR-Lee Kesler Equation
17
        ";
    parameter Real d1[2]={0.0000155488,0.000048736}"Constants for the BWR-Lee Kesler
18
        Equation";
    parameter Real d2[2]={0.0000623689,0.00000740336}"Constants for the BWR-Lee Kesler
19
         Equation";
    parameter Real beta [2]={0.65392,1.226}"Constants for the BWR-Lee Kesler Equation";
20
    parameter Real gamma [2] = \{0.060167, 0.03754\} "Constants for the BWR-Lee Kesler
21
        Equation";
    parameter Real omega r=0.397" acentric factor of N-octane";
22
    parameter Real R=8.314472" Universal gas constant";
23
    parameter Real T(unit = "K") = 300"input Temperature";
24
    parameter Real P(unit = "Pa") = 101325" input Pressure";
25
    parameter Real z [Nc](each min=0, each max=1) = {0.5, 0.5}"feed mole fraction";
26
    parameter Real kij [Nc,2] = \{\{1,1\},\{1,1\}\}" binary interaction parameter for the i-j
27
    mixture rule for the pseudo critical temperature";
Real T_c[Nc]=comp[:].Tc"Critical Temperature";
28
    Real P_c[Nc]=comp[:].Pc"critical Pressure";
29
    Real V c[Nc]=comp[:].Vc"Critical Volume";
30
    Real omega[Nc]=comp[:].AF"Acentric Factor";
31
    Real omega l"Acentric factor in liquid phase mixture";
32
    Real omega v"Acentric factor in vapour phase mixture";
33
    Real x[Nc] (each min=0,each max=1 )={0.5,0.5}"Mole fraction in liquid phase";//
34
        = \{0.3590478, 0.6409522\};
    Real y[Nc](each min=0,each max=1) = \{0.949496, 0.050504\}"Mole fraction in vapour
35
        phase "; // = \{0.85280566, 0.14719434\};
```

<ul> <li>27 Real V_cm_"pseudo-critical volume in liquid phase mixture";</li> <li>28 Real Y_cm_"pseudo-critical Tomperature in liquid phase mixture";</li> <li>29 Real T_cm_"pseudo-critical Tomperature in vapour phase mixture";</li> <li>21 Real P_cm_"pseudo-critical pressure in vapour phase mixture";</li> <li>21 Real Z_cm_"pseudo-critical compressibility factor in liquid phase mixture";</li> <li>22 Real T_r_"Reduced Tomperature in liquid phase mixture";</li> <li>23 Real T_r_"Reduced Tomperature in vapour phase mixture";</li> <li>24 Real T_r_"Reduced Tomperature in vapour phase mixture";</li> <li>25 Real T_r_"Reduced Temperature in vapour phase mixture";</li> <li>26 Real T_r_"Neduced Pressure in vapour phase mixture";</li> <li>27 Real P_r."Reduced Pressure in vapour phase mixture";</li> <li>28 Real P_r v" Reduced Pressure in vapour phase mixture";</li> <li>29 Real B_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>20 Real D_2[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>21 Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>22 Real D_2[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>23 Real D_2[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>24 Real D_2[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>25 Real V_r [2] (each start-0.1)" Reduced volume in liquid phase mixture";</li> <li>26 Real Z_1(2) (each start-0.1)" Reduced volume in vapour phase mixture";</li> <li>27 Real Z_1 (2) (each start-0.1)" Reduced volume in vapour phase (for simple and reference component)";</li> <li>28 Real Z_1[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>29 Real Z_1 (2) (See (1) (S</li></ul>	<ul> <li><sup>37</sup> Real V cm l<sup>*</sup> pseudo-critical volume in liquid phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real T_cm_l<sup>*</sup> pseudo-critical Temperature in liquid phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real T_cm_l<sup>*</sup> pseudo-critical Temperature in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_cm_l<sup>*</sup> pseudo-critical pressure in liquid phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real Z_cm_l<sup>*</sup> pseudo-critical pressure in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real T_cm_l<sup>*</sup> pseudo-critical compressibility factor in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real T_r_l<sup>*</sup>Reduced Temperature in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real T_r_l<sup>*</sup>Reduced Temperature in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real T_r_l<sup>*</sup>Reduced Temperature in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_r_l<sup>*</sup>Reduced Pressure in liquid phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_r_l<sup>*</sup>Reduced Pressure in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_r_l<sup>*</sup>Reduced Pressure in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_r_l<sup>*</sup>Reduced Pressure in vapour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_r_l<sup>*</sup>Reduced Pressure in suppour phase mixture<sup>*</sup>;</li> <li><sup>37</sup> Real P_1[2] <sup>*</sup>abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only<sup>*</sup>;</li> <li><sup>38</sup> Real V_1<sup>*</sup>2] <sup>34</sup> breviations in BWR-Lee-Kesler equation for functions depending on temperature only<sup>*</sup>;</li> <li><sup>36</sup> Real Z_1[2] <sup>*</sup>abbreviations in BWR-Lee-Kesler equation for functions depending on temperature<sup>*</sup>;</li> <li><sup>37</sup> Real Z_1<sup>*</sup>2] each start=0.1)<sup>*</sup>Reduced volume in vapour phase mixture<sup>*</sup>;</li> <li><sup>36</sup> Real Y_1<sup>*</sup>2] each start=0.10<sup>*</sup>0] <sup>*</sup>Reduced volume in vapour phase (for simple and reference component)<sup>*</sup>;</li> <li><sup>37</sup> Real Z_1<sup>*</sup>2] <sup>*</sup>eompressibility factor in liquid phase(for simple and reference</li></ul>	36	
<ul> <li>Real V_en_v*pseudo-critical volume in vapour phase mixture*;</li> <li>Real T_en_v*pseudo-critical Temperature in liquid phase mixture*;</li> <li>Real T_en_v*pseudo-critical Temperature in vapour phase mixture*;</li> <li>Real T_en_v*pseudo-critical pressure in liquid phase mixture*;</li> <li>Real T_en_v*pseudo-critical compressibility factor in vapour phase mixture*;</li> <li>Real T_r_*Reduced Temperature in liquid phase mixture*;</li> <li>Real T_r_*Reduced Temperature in liquid phase mixture*;</li> <li>Real T_r_*Reduced Temperature in liquid phase mixture*;</li> <li>Real T_r_*Reduced Temperature in vapour phase mixture*;</li> <li>Real P_r_*Reduced Pressure in liquid phase mixture*;</li> <li>Real P_1 Reduced Pressure in vapour phase mixture*;</li> <li>Real P_1 Reduced Pressure in Napour phase mixture*;</li> <li>Real P_1 Reduced Pressure in Napour phase mixture*;</li> <li>Real P_1 Reduced Pressure in SWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real P_2 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real P_2 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real P_2 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functions depending on temperature only*;</li> <li>Real V * 12 * abtreviations in BWR-Lee-Kesker equation for functi</li></ul>	<ul> <li>Real V. cm. v<sup>*</sup> pseudo-critical volume in vapour phase mixture";</li> <li>Real T. cm. v<sup>*</sup> pseudo-critical Temperature in liquid phase mixture";</li> <li>Real P. cm. V<sup>*</sup> pseudo-critical pressure in vapour phase mixture";</li> <li>Real P. cm. v<sup>*</sup> pseudo-critical pressure in vapour phase mixture";</li> <li>Real Z. cm. v<sup>*</sup> pseudo-critical compressibility factor in liquid phase mixture";</li> <li>Real T. r. V<sup>*</sup> Reduced Temperature in liquid phase mixture";</li> <li>Real T. r. V<sup>*</sup> Reduced Temperature in liquid phase mixture";</li> <li>Real T. r. V<sup>*</sup> Reduced Temperature in liquid phase mixture";</li> <li>Real P. r. V<sup>*</sup> Reduced Temperature in liquid phase mixture";</li> <li>Real P. r. V<sup>*</sup> Reduced Pressure in upour phase mixture";</li> <li>Real P. r. V<sup>*</sup> Reduced Pressure in upour phase mixture";</li> <li>Real P. r. V<sup>*</sup> Reduced Pressure in upour phase mixture";</li> <li>Real P. r. V<sup>*</sup> Reduced Pressure in upour phase mixture";</li> <li>Real C. [2] " abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D. [2] " abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D. [2] " abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real N. [2] (" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real Z. [2] " abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real Z. [2] (" compressibility factor in liquid phase";</li> <li>Real Z. [2] " abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real Z. [2] (" compressibility factor in liquid phase (for simple and reference component)";</li> <li>Real Z. [2] (" compressibility factor in liquid phase";</li> <li>Real Z. [2] (compressibility factor in liquid phase ";</li> <li>Real Z. [2] (" compressibility factor in liquid phase (for simple and reference fluid );</li> <li>Real Z. [2] (" compressibility</li></ul>	37	Real V_cm_l"pseudo-critical volume in liquid phase mixture";
<ul> <li>Meal T_em_["pseudo-critical Temperature in liquid phase mixture";</li> <li>Meal T_em_"*pseudo-critical pressure in vapour phase mixture";</li> <li>Meal P_em_"*pseudo-critical pressure in vapour phase mixture";</li> <li>Meal Z_em_"*pseudo critical compressibility factor in liquid phase mixture";</li> <li>Meal T_T_N"Reduced Temperature in liquid phase mixture";</li> <li>Meal T_T_N"Reduced Temperature in vapour phase mixture";</li> <li>Meal P_T_N"Reduced Pressure in vapour phase mixture";</li> <li>Meal T_N"Reduced Pressure in vapour phase mixture";</li> <li>Meal P_T_N"Reduced Pressure in vapour phase mixture";</li> <li>Meal D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Meal D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real Z_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real X eq</li></ul>	<ul> <li>as Real T_cm_l" pseudo-critical Temperature in liquid phase mixture"; as Real T_cm_l" pseudo-critical pressure in liquid phase mixture"; as Real P_cm_l" pseudo-critical pressure in vapour phase mixture"; as Real Z_cm_l" pseudo-critical compressibility factor in liquid phase mixture"; as Real T_r_l"Reduced Temperature in vapour phase mixture"; as Real T_r_l"Reduced Temperature in vapour phase mixture"; as Real P_r_l"Reduced Temperature in vapour phase mixture"; as Real P_r_l"Reduced Temperature in vapour phase mixture"; as Real P_r_l"Reduced Pressure in uspour phase mixture"; as Real P_r_l"Reduced Pressure in vapour phase mixture"; as Real P_r_l"Reduced Pressure in vapour phase mixture"; as Real P_r_l"Reduced Pressure in wapour phase mixture"; as Real P_r_l"Reduced Pressure in wapour phase mixture"; as Real C_l[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; as Real C_l[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; as Real C_l[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; as Real C_l2[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; as Real V_l2[1] (abch start=-010)"Reduced volume in liquid phase mixture"; as Real Y_l2[2] (abch start=-010)"Reduced volume in vapour phase mixture"; as Real Y_l2[1] (cach start=-010)"Reduced volume in vapour phase mixture"; as Real Y_l2[1] (cach start=-010)"Reduced volume in vapour phase mixture"; as Real Y_l2[1] (cach start=-010)"Reduced volume in vapour phase mixture"; as Real Y_l2[1] (cach start=-010)"Reduced volume in vapour phase (for simple and reference component)"; as Real Y_l2[1] (cach start=-010)"Reduced volume in wapour phase (for simple and reference component)"; as Real Z_l2[1] (compressibility factor in vapour phase(for simple and reference fluid), as Real Z_l2[1] (compressibility factor in vapour phase (for simple and reference fluid), as Real Z_l2[1] "usp</li></ul>	38	Real V_cm_v" pseudo-critical volume in vapour phase mixture";
<ul> <li>80 Real T_cm_v<sup>*</sup> pseudo-critical Temperature in vapour phase mixture";</li> <li>81 Real Z_cm_v<sup>*</sup> pseudo-critical pressure in liquid phase mixture";</li> <li>81 Real Z_cm_v<sup>*</sup> pseudo-critical compressibility factor in liquid phase mixture";</li> <li>81 Real Z_cm_v<sup>*</sup> pseudo critical compressibility factor in vapour phase mixture";</li> <li>81 Real T_v<sup>*</sup> Reduced Temperature in liquid phase mixture";</li> <li>82 Real P_r<sup>*</sup> v<sup>*</sup> Reduced Pressure in uapour phase mixture";</li> <li>83 Real P_r<sup>*</sup> v<sup>*</sup> Reduced Pressure in uapour phase mixture";</li> <li>84 Real P_r<sup>*</sup> v<sup>*</sup> Reduced Pressure in Ulguid phase mixture";</li> <li>84 Real P_r<sup>*</sup> v<sup>*</sup> Reduced Pressure in Napour phase mixture";</li> <li>84 Real P_r<sup>*</sup> v<sup>*</sup> Reduced Pressure in Napour phase mixture";</li> <li>84 Real P_r<sup>*</sup> v<sup>*</sup> Reduced Pressure in WR-Lee-Kesler equation for functions depending on temperature only";</li> <li>87 Real C_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>87 Real C_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>87 Real C_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>87 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>87 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>88 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>89 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>80 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>80 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>80 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>80 Real V_l<sup>*</sup> abvervations in BWR-Lee-Kesler</li></ul>	<ul> <li>ao Real T_cm_v" pseudo-critical Temperature in vapour phase mixture";</li> <li>an Real P_cm_v" pseudo-critical pressure in liquid phase mixture";</li> <li>an Real Z_cm_v" pseudo-critical compressibility factor in liquid phase mixture";</li> <li>an Real Z_cm_v" pseudo critical compressibility factor in vapour phase mixture";</li> <li>an Real T_rv!Reduced Temperature in liquid phase mixture";</li> <li>an Real T_rv!Reduced Temperature in liquid phase mixture";</li> <li>an Real T_rv!Reduced Pressure in upour phase mixture";</li> <li>an Real T_rv!Reduced Pressure in liquid phase mixture";</li> <li>an Real T_l!2! "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>an Real D_l!2! "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>an Real D_l!2! "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>an Real D_v!2! "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>an Real D_v!2! "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>an Real D_v!2! "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>an Real V_v!2! (each start=0.1)"Reduced volume in vapour phase mixture";</li> <li>an Real V_v!2! (each start=0.10)"Reduced volume in vapour phase mixture";</li> <li>an Real V_v!2! (each start=0.10)"Reduced volume in vapour phase mixture";</li> <li>an Real Z_v!2! "compressibility factor in liquid phase(for simple and reference component)";</li> <li>an Real Z_v!2! "compressibility factor in vapour phase";</li> <li>an Z_v!2! "compressibility factor in liquid phase(for simple and reference fuid)";</li> <li>an Z_v!2! "compressibility factor in vapour phase (for simple and reference fuid)";</li> <li>an Z_v!2! "compressibility factor in vapour phase (for simple and reference fuid)";</li> <li>an Real Pi!1!2! fugacity coefficient for liquid phase(for simple and re</li></ul>	39	Real T_cm_l"pseudo-critical Temperature in liquid phase mixture";
<ul> <li>at Real P_cm_l<sup>m</sup> pseudo-critical pressure in liquid phase mixture";</li> <li>at Real Z_cm_l<sup>m</sup> pseudo-critical compressibility factor in liquid phase mixture";</li> <li>at Real Z_cm_l<sup>m</sup> pseudo critical compressibility factor in vapour phase mixture";</li> <li>at Real T_r_N<sup>m</sup> Reduced Temperature in liquid phase mixture";</li> <li>at Real T_r_N<sup>m</sup> Reduced Pressure in vapour phase mixture";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real D_12!" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>at Real V_12!(each start=0.1)"Reduced volume in liquid phase mixture";</li> <li>at Real V_12! (each start=0.1)"Reduced volume in vapour phase mixture";</li> <li>at Real Z_12!" compressibility factor in vapour phase(for simple and reference component)";</li> <li>at Real Z_12!" compressibility factor in liquid phase(for simple and reference fund )";</li> <li>at Real Y_1!" compressibility factor in liquid phase mixture";</li> <li>at Real Z_12!" compressibility factor in liquid phase (for simple and reference fluid )";</li> <li>at Real Y_12!" fugacity coefficient for liquid phase mixture";</li> <li>at Real Y_12!" fugacity coefficie</li></ul>	<ul> <li>a Real P_cm_l<sup>m</sup> pseudo-critical pressure in liquid phase mixture";</li> <li>a Real P_cm_v<sup>m</sup> pseudo critical compressibility factor in liquid phase mixture";</li> <li>a Real T_r_l<sup>m</sup> Reduced Temperature in vapour phase mixture";</li> <li>a Real T_r_v<sup>m</sup> Reduced Temperature in vapour phase mixture";</li> <li>a Real T_r_v<sup>m</sup> Reduced Temperature in vapour phase mixture";</li> <li>a Real T_r_v<sup>m</sup> Reduced Pressure in upour phase mixture";</li> <li>a Real B_[12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real D_[12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real D_[12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real C_[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real C_[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real C_[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real C_[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviation in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>a Real V_[1]" aboreviation in aboreviation in t</li></ul>	40	Real T_cm_v"pseudo-critical Temperature in vapour phase mixture";
<ul> <li>Real P_cm_v<sup>*</sup> pseudo-critical pressure in vapour phase mixture"; Real Z_cm_v<sup>*</sup> pseudo critical compressibility factor in liquid phase mixture"; Real T_ v<sup>*</sup> Reduced Temperature in liquid phase mixture"; Real P_ v<sup>*</sup> Reduced Temperature in liquid phase mixture"; Real P_ v<sup>*</sup> Reduced Pressure in upour phase mixture"; Real D_ 12[1<sup>*</sup> abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real C_ 12[1<sup>*</sup> abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_ v[2]<sup>*</sup> abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_ v[2]<sup>*</sup> abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_ r[2](each start=0.1)<sup>*</sup> Reduced volume in liquid phase mixture";</li> <li>Real V_ r[2](each start=0.0)<sup>*</sup> Reduced volume in upour phase mixture";</li> <li>Real Z_ r[2]<sup>*</sup> compressibility factor in liquid phase(for simple and reference component)<sup>*</sup>;</li> <li>Real Z_ 12[2]<sup>*</sup> compressibility factor in liquid phase";</li> <li>Real Z_ 1<sup>*</sup> compressibility factor in vapour phase";</li> <li>Real Z_ 1<sup>*</sup> compressibility factor in vapour phase (for simple and reference fluid )<sup>*</sup>;</li> <li>Real Z_ 1<sup>*</sup> compressibility factor in vapour phase (for simple and reference fluid )<sup>*</sup>;</li> <li>Real Z_ 1<sup>*</sup> compressibility factor in vapour phase (for simple and reference fluid )<sup>*</sup>;</li> <li>Real Z_ 1<sup>*</sup> compressibility factor in vapour phase (for simple and reference fluid )<sup>*</sup>;</li> <li>Real Z_ 1<sup>*</sup> cascity coefficient for liquid phase mixture";</li> <li>Real Z_ 1<sup>*</sup> cascity coefficient for vapour phase (for simple and reference fluid )<sup>*</sup>;</li> <li>Real del h_ 1<sup>*</sup> 12] <sup>*</sup> fugacity coefficient for vapour phase mixture";</li> <li>Real del h_ 1<sup>*</sup> 1</li></ul>	<ul> <li>Real P. cm _"pseudo-critical pressure in vapour phase mixture";</li> <li>Real Z. cm _"pseudo critical compressibility factor in liquid phase mixture";</li> <li>Real T. r. "Reduced Temperature in liquid phase mixture";</li> <li>Real T. r. "Reduced Temperature in liquid phase mixture";</li> <li>Real P. r "Reduced Pressure in vapour phase mixture";</li> <li>Real P. r "Reduced Pressure in vapour phase mixture";</li> <li>Real P. r "Reduced Pressure in vapour phase mixture";</li> <li>Real P. r "Reduced Pressure in vapour phase mixture";</li> <li>Real D. [2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C. v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V. v[12] (each start=0.1)"Reduced volume in liquid phase mixture";</li> <li>Real V. r [12] (each start=0.00)"Reduced volume in vapour phase mixture";</li> <li>Real Z. [12] "compressibility factor in liquid phase";</li> <li>Real Z. [12] "compressibility factor in vapour phase";</li> <li>Real Z. [12] "compressibility factor in vapour phase.[for simple and reference component)";</li> <li>Real Z. [12] "compressibility factor in vapour phase.[for simple and reference fluid )";</li> <li>Real Z. [12] "moderity coefficient for liquid phase (for simple and reference fluid )";</li> <li>Real Z. [12] "fugacity coefficient for liquid phase (for simple and reference fluid )";</li> <li>Real Z. [12]: "fugacity coefficient for liquid phase (for simple and reference fluid )";</li> <li>Real phi_v[2]: "fugacity coefficient for liquid phase mixture";</li> <li>Real phi_w<sup>1</sup>[10]: "fugacity coefficient for vapour phase (for simple and reference fl</li></ul>	41	Real P_cm_l"pseudo-critical pressure in liquid phase mixture";
<ul> <li>as Real Z_cm_l*pseudo critical compressibility factor in liquid phase mixture";</li> <li>4 Real T_r_l*Reduced Temperature in liquid phase mixture";</li> <li>4 Real T_r_N*Reduced Pressure in vapour phase mixture";</li> <li>4 Real F_r_N*Reduced Pressure in vapour phase mixture";</li> <li>4 Real F_r_N*Reduced Pressure in vapour phase mixture";</li> <li>4 Real F_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real F_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real F_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real F_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real C_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real C_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real C_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real C_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>5 Real V_r.v[2](each start-01)*Reduced volume in liquid phase mixture";</li> <li>6 Real V_1[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>7 Real Z_1[2]*compressibility factor in liquid phase(for simple and reference component)";</li> <li>7 Real Z_v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>8 Real Y_1[2]*compressibility factor in vapour phase mixture";</li> <li>8 Real Y_1[2]*compressibility factor in liquid phase(for simple and reference component)";</li> <li>9 Real Z_1[2]*compressibility factor in vapour phase(for simple and reference fluid );</li> <li>9 Real Z_1*compressibility factor in liquid phase(for simple and reference fluid );</li> <li>1 Real Pi_1[2]*fugacity coefficient for liq</li></ul>	<ul> <li>43 Real Z_cm_l"pseudo critical compressibility factor in vapour phase mixture"; 43 Real T_r_l"Reduced Temperature in liquid phase mixture"; 44 Real T_r_l"Reduced Temperature in vapour phase mixture"; 45 Real P_r_l"Reduced Pressure in liquid phase mixture"; 47 Real P_r_l"Reduced Pressure in vapour phase mixture"; 48 Real P_r_l"Reduced Pressure in vapour phase mixture"; 49 Real B_1[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature only"; 50 Real C_1[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature only"; 51 Real P_1[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature only"; 52 Real P_1[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature only"; 53 Real V_1[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature only"; 54 Real V_1[2]" each start=0.1)" Reduced volume in liquid phase mixture"; 55 Real V_1[2]" each start=0.0]" Reduced volume in vapour phase mixture"; 56 Real V_1[2]" compressibility factor in liquid phase(for simple and reference 40 component)"; 57 Real Z_1[2]" compressibility factor in vapour phase(for simple and reference 40 component)"; 58 Real Z_1[2]" compressibility factor in vapour phase(for simple and reference 40 component)"; 59 Real Z_1" compressibility factor in vapour phase(for simple and reference 40 temperature"; 40 Real Z_1" (be,Nc]; 41 Real Teij [Ne,Nc]; 42 Real Veij [Ne,Nc]; 43 Real D_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid 40 )'; 43 Real E_1[2]; 44 Real A_1[2]" isothermal enthalpy departure for liquid phase(for simple and 45 reference fluid)"; 45 Real A_1 = [12]" isothermal enthalpy departure for liquid phase (for simple and 46 reference fluid)"; 47 Real del_h_1[2]" isothermal enthalpy departure for liquid phase mixture"; 48 Real del_h_1" isothermal enthalpy departure for vapour phase mixture"; 49 Real del_h_1" isothermal enthalpy departure for vapour phase mixture"; 40</li></ul>	42	Real P_cm_v"pseudo-critical pressure in vapour phase mixture";
<ul> <li>44 Real Z_cm_v"pseudo critical compressibility factor in vapour phase mixture"; 55 Real T_r_v"Reduced Temperature in liquid phase mixture"; 56 Real P_r_v"Reduced Pressure in vapour phase mixture"; 57 Real P_r v"Reduced Pressure in vapour phase mixture"; 58 Real P_r v"Reduced Pressure in vapour phase mixture"; 59 Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on 50 temperature only"; 50 Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on 51 temperature only"; 52 Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on 52 temperature only"; 53 Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on 53 temperature only"; 54 Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on 55 temperature only"; 55 Real V_r1[2] (each start=0.1)"Reduced volume in liquid phase mixture"; 56 Real V_r1[2] (each start=0.0)"Reduced volume in vapour phase mixture"; 57 Real z_v[2]" compressibility factor in liquid phase(for simple and reference 57 compressibility factor in liquid phase"; 58 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference 57 Real z_v[2]" fugacity coefficient for liquid phase(for simple and reference fluid 58 Pressibility factor in vapour phase(for simple and reference fluid 59 Real Z_l" compressibility factor in vapour phase(for simple and reference fluid 50 Pressibility factor in vapour phase(for simple and reference fluid 51 Pressibility coefficient for liquid phase(for simple and reference fluid 51 Pressibility coefficient for vapour phase(for simple and reference fluid 51 Pressibility coefficient for vapour phase mixture"; 52 Real Phi_v[2]" fugacity coefficient for vapour phase mixture"; 53 Real Phi_v[2]" isothermal enthalpy departure for liquid phase(for simple and 51 reference fluid)"; 53 Real del_h_v"" fugacity coefficient for vapour phase mixture"; 54 Real del_h_v[2]" isothermal enthalpy departure for vapour pha</li></ul>	<ul> <li>44 Real Z_cm_v"pseudo critical compressibility factor in vapour phase mixture"; 47 Real T_r_v"Reduced Temperature in liquid phase mixture"; 48 Real P_r_v"Reduced Pressure in vapour phase mixture"; 49 Real B_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature only"; 40 Real D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on 41 temperature only"; 40 Real D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on 42 temperature only"; 41 Real D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on 43 temperature only"; 42 Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on 44 temperature only"; 43 Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on 45 temperature only"; 44 Real Y_12]"abbreviations in BWR-Lee-Kesler equation for functions depending on 46 temperature only"; 47 Real Y_12]"abbreviations in BWR-Lee-Kesler equation for functions depending on 47 temperature only"; 48 Real Y_12]"abbreviations in BWR-Lee-Kesler equation for functions depending on 48 temperature only"; 49 Real Y_12]"abbreviations in BWR-Lee-Kesler equation for functions depending on 49 temperature only"; 40 Real Y_12]"abbreviations in BWR-Lee-Kesler equation for functions depending on 40 temperature"; 40 Real Y_12]"compressibility factor in liquid phase(for simple and reference 40 component)"; 40 Real Z_v12]"compressibility factor in liquid phase"; 40 Real Z_v12]" compressibility factor in vapour phase"; 41 Real Vi][NcNC]; 42 Real Vi][NcNC]; 43 Real Pii_12]" fugacity coefficient for liquid phase(for simple and reference fluid)"; 44 Real Pii_12]: fugacity coefficient for liquid phase (for simple and reference fluid)"; 45 Real Pii_1wi fugacity coefficient for vapour phase mixture"; 46 Real Pii_1wi fugacity coefficient for vapour phase mixture"; 47 Real del_h_w[2]: fisothermal enthalpy departure for liquid phase(for simple and 47 reference fluid)"; 4</li></ul>	43	Real Z_cm_l"pseudo critical compressibility factor in liquid phase mixture";
<ul> <li>Keal T, r , PReduced Temperature in liquid phase mixture";</li> <li>Real P, r_l.PReduced Temperature in vapour phase mixture";</li> <li>Real P, r_l.PReduced Pressure in vapour phase mixture";</li> <li>Real B, [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C, 1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V, r_V 2[2] (abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V, r_V 2[2] (abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V, r_V 2[2] (acch start =0.00) "Reduced volume in vapour phase mixture";</li> <li>Real V, r_V 2[2] (acch start =0.00) "Reduced volume in vapour phase mixture";</li> <li>Real Z_1[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_1[2] "compressibility factor in vapour phase";</li> <li>Real Z_1[2] "compressibility factor in vapour phase for simple and reference fluid )";</li> <li>Real M, [1] [Negacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>Real Pi_1[2] "fugacity coefficient for vapour phase mixture";</li> <li>Real Pi_1[2] "sothermal enthalpy departure for liquid phase(for simple and reference fluid )";</li> <li>Real del_h_1[2] "isotherma</li></ul>	<ul> <li>48 Real T - 1"Reduced Temperature in liquid phase mixture";</li> <li>48 Real P - T_"Reduced Temperature in vapour phase mixture";</li> <li>49 Real P - T_"Reduced Pressure in vapour phase mixture";</li> <li>40 Real B [12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>50 Real C [12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>51 Real D [12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>52 Real D [12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>53 Real C [12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>54 Real D [12]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>55 Real V [2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>56 Real Z [2]" compressibility factor in liquid phase mixture";</li> <li>57 Real Z [12]" compressibility factor in liquid phase (for simple and reference component)";</li> <li>58 Real V [2]" abbreviations and the vapour phase mixture";</li> <li>59 Real Z [12]" compressibility factor in vapour phase";</li> <li>60 Real Z [10 compressibility factor in vapour phase";</li> <li>61 Real Z [10 compressibility factor in vapour phase";</li> <li>62 Real Z [10 compressibility factor in vapour phase";</li> <li>63 Real C [12];</li> <li>64 Real T [12]" fugacity coefficient for liquid phase (for simple and reference fluid );</li> <li>66 Real E [12];</li> <li>67 Real E [12];</li> <li>68 Real P [12]" fugacity coefficient for vapour phase mixture";</li> <li>69 Real P [12]" isothermal enthalpy departure for liquid phase (for simple and reference fluid );</li> <li>70 Real del h [12]" isothermal enthalpy departure for vapour phase mixture";</li> <li>71 Real del h [12]" isothermal enthalpy departure for vapour phase mixture";</li> <li>72 Real del h [12]"</li></ul>	44	Real Z_cm_v"pseudo critical compressibility factor in vapour phase mixture";
<ul> <li>A Real Tr v VReduced Temperature in vapour phase mixture";</li> <li>A Real Pr v VReduced Pressure in vapour phase mixture";</li> <li>A Real P r vVReduced Pressure in vapour phase mixture";</li> <li>A Real P [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>A Real D [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D [12] (each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>Real V r [12] (each start=0.0) "Reduced volume in vapour phase mixture";</li> <li>Real V r [12] (each start=0.0) "Reduced volume in vapour phase mixture";</li> <li>Real Z [12] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z [12] "compressibility factor in vapour phase";</li> <li>Real Z [12] "compressibility factor in vapour phase";</li> <li>Real Z [12] "compressibility factor in vapour phase";</li> <li>Real Z [12] "fugacity coefficient for liquid phase(for simple and reference fluid );</li> <li>Real Phi_1[2] "fugacity coefficient for vapour phase(for simple and reference fluid );</li> <li>Real Phi_1[2] "isothermal enthalpy departure for liquid phase mixture";</li> <li>Real Phi_1[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid );</li> <li>Real Aci [1] [N; ([1] *sothermal enthalpy departure for vapour phase(for simple and reference fluid );</li> <li>Real Aci [1] [N; ([1] *sothermal enthalpy departure for vapour phase mixture";</li> <li>Real Aci [N N N N N N N N N N N N N N N N N N N</li></ul>	<ul> <li>Meal T_r_v"Reduced Tremperature in vapour phase mixture";</li> <li>Real P_r_v"Reduced Pressure in liquid phase mixture";</li> <li>Real P_r_v"Reduced Pressure in Napour phase mixture";</li> <li>Real P_[12]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_[12]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_r_v][(each start=0.1)"Reduced volume in liquid phase mixture";</li> <li>Real V_r_v][(each start=0.1)"Reduced volume in uspour phase mixture";</li> <li>Real V_r_v][(each start=0.1000)"Reduced volume in vapour phase mixture";</li> <li>Real Z_v[2]" compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_v[2]" compressibility factor in vapour phase(for simple and reference funce component)";</li> <li>Real Z_v[2]" compressibility factor in vapour phase(for simple and reference fluid )";</li> <li>Real Tei[Nex.Ne];</li> <li>Real D_112]" fugacity coefficient for liquid phase (for simple and reference fluid )";</li> <li>Real B_112[2]" fugacity coefficient for vapour phase mixture";</li> <li>Real B_112]" fugacity coefficient for vapour phase (for simple and reference fluid )";</li> <li>Real del_hi_v[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid )";</li> <li>Real del_h_[12]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_wm*isothermal enthalpy depart</li></ul>	45	Real T_r_l"Reduced Temperature in liquid phase mixture";
47 Real P. *_1"Reduced Pressure in liquid phase mixture*; 87 Real P. T*N'Reduced Pressure in vapour phase mixture*; 48 Real B. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only*; 50 Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only*; 51 Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only*; 52 Real C. [21] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only*; 53 Real C. [21] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only*; 54 Real V. [21] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only*; 55 Real V. r. [12] (cach start=0.1)"Reduced volume in liquid phase mixture*; 56 Real V. r. [12] (cach start=0.00)"Reduced volume in vapour phase mixture*; 57 Real V. r. [12] (cach start=0.00)"Reduced volume in vapour phase mixture*; 58 Real V. r. [12] (cach start=0.00)"Reduced volume in vapour phase mixture*; 59 Real Z. [12] "compressibility factor in liquid phase(for simple and reference component)*; 50 Real Z. [12] "compressibility factor in vapour phase"; 60 Real Z. [12] "compressibility factor in vapour phase"; 61 Real T. [12] Real K. [1] [N. Ke]; 62 Real V. [1] Ke, Nc]; 63 Parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature*; 64 Real phi. [12] "fugacity coefficient for liquid phase(for simple and reference fluid )"; 75 Real C. [12] "sothermal enthalpy departure for liquid phase(for simple and reference fluid) "; 76 Real A. [12] "sothermal enthalpy departure for vapour phase (for simple and reference fluid) "; 77 Real del_h_N'misothermal enthalpy departure for vapour phase (for simple and reference fluid) "; 78 Real del_h_N'misothermal enthalpy departure for vapour phase mixture"; 79 Real del_h_N'misothermal enthalpy departure for vapour phase mixture"; 70 Real del_h_N'misothermal enthalpy departure for vapour phase mixture"; 71 Real del_	<ul> <li>47 Real P_r_! Reduced Pressure in liquid phase mixture";</li> <li>48 Real P_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>50 Real C_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>51 Real D_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>52 Real P_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>53 Real C_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>54 Real D_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>55 Real C_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>56 Real V_![2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>57 Real Z_![2] (each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>58 Real V_r][2] (each start=0.000) "Reduced volume in vapour phase mixture";</li> <li>59 Real Z_![2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>50 Real Z_![2] compressibility factor in liquid phase";</li> <li>60 Real Z_![2] mompressibility factor in vapour phase mixture";</li> <li>71 Real Z_! compressibility factor in liquid phase(for simple and reference fluid )";</li> <li>72 Real Pii_[1][2] "fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>73 Real Pii_[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid );</li> <li>74 Real del_h_[2] "isothermal enthalpy departure for vapour phase (for simple and reference fluid);</li> <li>75 Real Z_![2] "isothermal enthalpy departure for vapour phase (for simple and reference fluid);</li> <li>76 Real del_h_[2] "isothermal enthalpy departure for liquid phase (for simple and reference fluid);</li> <li>77 Real del_h_m"isothermal enthalpy de</li></ul>	46	Real T_r_v"Reduced Temperature in vapour phase mixture";
<ul> <li><sup>45</sup> Real P. r. v<sup>N</sup>Reduced Pressure in vapour phase mixture<sup>8</sup>; <sup>45</sup> Real B. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>50</sup> Real C. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>51</sup> Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>52</sup> Real C. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>56</sup> Real C. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>57</sup> Real D. [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>58</sup> Real V. r. [12] (each start=0.1)"Reduced volume in liquid phase mixture"; <sup>57</sup> Real z. [12] "compressibility factor in liquid phase(for simple and reference component)"; <sup>58</sup> Real Z. [21] "compressibility factor in vapour phase"; <sup>69</sup> Real Z. [21] "compressibility factor in vapour phase."; <sup>60</sup> Real Z. [21] "compressibility factor in vapour phase."; <sup>61</sup> Real Z. [21] "compressibility factor in vapour phase."; <sup>62</sup> Real Z. [21] "compressibility factor in vapour phase."; <sup>63</sup> Real Z. [21] "compressibility factor in vapour phase."; <sup>64</sup> Real phi_1[2] "fugacity coefficient for liquid phase."; <sup>65</sup> Real Z. [21] "compressibility factor for liquid phase."; <sup>66</sup> Real J. [2]." fugacity coefficient for vapour phase.[for simple and reference fluid <sup>11</sup>;." <sup>77</sup> Real A. [12]: <sup>78</sup> Real Pi]. [21] "fugacity coefficient for vapour phase.[for simple and reference fluid <sup>11</sup>;." <sup>79</sup> Real phi. [12] "isothermal enthalpy departure for liquid phase.[for simple and reference fluid)"; <sup>70</sup> Real del_h 1[2] "isothermal enthalpy departure for vapour phase.[for simple and reference fluid]"; <sup>71</sup> Real del_h. [14] "isothermal enthalpy departure for vapour phase.[for simple and reference fluid]"; <sup>72</sup> Real del_h. [14] "isothermal enthalpy departure for vapour phase.[for simple and reference fluid]"; <sup>73</sup></li></ul>	<ul> <li>48. Real P. r v<sup>R</sup> Reduced Pressure in vapour phase mixture";</li> <li>48. Real B.[12]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>50. Real C.[12]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>51. Real D.[12]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>52. Real B. v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>53. Real C. v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>54. Real D. v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>55. Real V. v[1](ach start=0.1)*Reduced volume in liquid phase mixture";</li> <li>56. Real V. v. v[2](each start=0.0)*Reduced volume in vapour phase mixture";</li> <li>57. Real V. v. v[2](each start=0.0)*Reduced volume in vapour phase mixture";</li> <li>58. Real V. v.</li></ul>	47	Real P_r_l"Reduced Pressure in liquid phase mixture";
<ul> <li>Neal B_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_1[2] "compressibility factor in liquid phase mixture";</li> <li>Real Z_1[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_1[2] "compressibility factor in vapour phase(for simple and reference component);</li> <li>Real Z_1" compressibility factor in liquid phase";</li> <li>Real Y_1" (upacity coefficient for liquid phase(for simple and reference fluid phi [1] [2] "upacity coefficient for vapour phase(for simple and reference fluid phi;</li> <li>parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature";</li> <li>Real Di_1[2] "upacity coefficient for liquid phase(for simple and reference fluid phi;</li> <li>Real E_1[2];</li> <li>r Real Di_1[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid phi;</li> <li>Real del_h_1[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>Real del_h_w[3] "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[3] [1] tormal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[3] "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[3] "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[3</li></ul>	<ul> <li>40 Real B_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>50 Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>51 Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>52 Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>53 Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>54 Real D_1[2] (ach start=0.1) "Reduced volume in liquid phase mixture";</li> <li>56 Real V_r_1[2] (ach start=0.1) "Reduced volume in liquid phase mixture";</li> <li>57 Real Z_1[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>58 Real Z_1[2] "compressibility factor in vapour phase(for simple and reference component)";</li> <li>59 Real Z_1[2] "compressibility factor in liquid phase";</li> <li>60 Real Z_1" compressibility factor in vapour phase(for simple and reference functions temperature";</li> <li>61 Real Tci][Nc,Nc];</li> <li>62 Real Vci][Nc,Nc];</li> <li>63 Parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature";</li> <li>64 Real pli_1[2] "fugacity coefficient for liquid phase (for simple and reference fluid )";</li> <li>65 Real L_1[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid )";</li> <li>76 Real L_1[2] "isothermal enthalpy departure for liquid phase (for simple and reference fluid)";</li> <li>77 Real del_h_1[2] "isothermal enthalpy departure for liquid phase (for simple and reference fluid)";</li> <li>78 Real del_h_1[2] "isothermal enthalpy departure for liquid phase (for simple and reference fluid)";</li> <li>79 Real del_h_1[2] "isothermal enthalpy departure for liquid phase (for simple and reference fluid)";</li> <li>70 Real del_h_1[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>71 Rea</li></ul>	48	Real P_r_v"Reduced Pressure in vapour phase mixture";
<pre>temperature only"; Real C.12]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D.12]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real C.v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real C.v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D.v[2]*abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real V.r_1[2](each start=0.1)*Reduced volume in liquid phase mixture"; Real V.r_1[2](each start=0.1)*Reduced volume in upour phase mixture"; Real V.r_1[2](each start=0.00)*Reduced volume in vapour phase mixture"; Real Z.v[2]*compressibility factor in liquid phase(for simple and reference component)*; Real Z_1*[2]*compressibility factor in upour phase(for simple and reference component)*; Real Z_0*compressibility factor in upour phase"; Real Z_0*compressibility factor in upour phase"; Real Teij[Nc,Nc]; Real Teij[Nc,Nc]; Real Fui][2]*fugacity coefficient for liquid phase(for simple and reference fluid )*; Real Fui][2]*fugacity coefficient for liquid phase(for simple and reference fluid )*; Real Fui][2]*fugacity coefficient for vapour phase(for simple and reference fluid )*; Real Fui][2]*isothermal enthalpy departure for liquid phase(for simple and reference fluid)*; Real del_h_v[2]*isothermal enthalpy departure for vapour phase(for simple and reference fluid)*; Real del_h_v[2]*isothermal enthalpy departure for vapour phase(for simple and reference fluid)*; Real del_h_wim*isothermal enthalpy departure for vapour phase mixture"; Real del_h_wim*isothermal</pre>	<pre>temperature only"; 8 Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 8 Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 8 Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 8 Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 8 Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 9 Real V_r_l2](each start=0.1)"Reduced volume in liquid phase mixture"; 8 Real V_r_v1[2](each start=0.0)"Reduced volume in vapour phase mixture"; 9 Real V_r_v2](each start=0.0)"Reduced volume in vapour phase mixture"; 9 Real Z_v1[2] "compressibility factor in liquid phase(for simple and reference component)"; 9 Real Z_w1(2) "compressibility factor in vapour phase"; 9 Real Z_w1(2) "compressibility factor in vapour phase"; 9 Real Z_w1(2) [Ne.Nc]; 9 parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical 9 temperature"; 9 Real P_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid 0)"; 9 Teal E_1[2]; 9 Real P_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid 0)"; 9 Real phi_1[2] "fugacity coefficient for vapour phase(for simple and reference fluid 0)"; 9 Real phi_1[2] "fugacity coefficient for liquid phase mixture"; 9 Real del_h_v[2] "isothermal enthalpy departure for liquid phase(for simple and 9 reference fluid)"; 9 Real del_h_v[2] "isothermal enthalpy departure for liquid phase mixture"; 9 Real del_h_v[2] "isothermal enthalpy departure for liquid phase mixture"; 9 Real del_h_vm"isothermal enthalpy departure for liquid phase mixture"; 9 Real del_h_hm"isothermal enthalpy departure for vapour phase mixtur</pre>	49	Real B_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on
<pre>50 Real C [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 51 Real D [12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 52 Real C [2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 53 Real C [2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 54 Real V [2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 55 Real V [2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 56 Real V [2] [ceach start=0.1] "Reduced volume in liquid phase mixture"; 57 Real z [2] "compressibility factor in liquid phase(for simple and reference component)"; 58 Real Z [2] "compressibility factor in vapour phase(for simple and reference component)"; 58 Real Z [10] compressibility factor in liquid phase"; 60 Real Z [10] compressibility factor in vapour phase(for simple and reference component)"; 59 Real Z [10] compressibility factor in liquid phase"; 60 Real Z [10] compressibility factor in liquid phase"; 61 Real prici [Nc.Ne]; 62 Real Nei [] [12] "fugacity coefficient for liquid phase(for simple and reference fluid )"; 63 Real phi v[2] "fugacity coefficient for liquid phase(for simple and reference fluid )"; 64 Real phi v[2]; 65 Real z [2]; 67 Real z [2]; 67 Real z [2]; 67 Real z [2]; 67 Real a phi [wm fugacity coefficient for liquid phase mixture"; 69 Real phi [wm fugacity coefficient for vapour phase(for simple and reference fluid)"; 70 Real del _h v[2] "isothermal enthalpy departure for liquid phase (for simple and 71 Real del _h v[2] "isothermal enthalpy departure for vapour phase mixture"; 73 Real del _h wm "isothermal enthalpy departure for vapour phase mixture"; 74 Real del _h wm "isothermal enthalpy departure for vapour phase mixture"; 75 Real del _h vy [1] ***********************************</pre>	<ul> <li>So Real C_[12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[1] [abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[1] [abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[1] [abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[1] [abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[1] [abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[2] [abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_[1][2] (each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>Real Z_[2] "compressibility factor in liquid phase";</li> <li>Real Tei [Nc,Nc];</li> <li>Real Tei [Nc,Nc];</li> <li>Real Phi_[12] "fugacity coefficient for liquid phase (for simple and reference fluid )";</li> <li>Real Phi_[12] fugacity coefficient for liquid phase mixture";</li> <li>Real Phi_[12];</li> <li>Real E_[12];</li> <li>Real E_[12];</li> <li>Real del_h_[12] "isothermal enthalpy departure for liquid phase(for simple and reference fluid )";</li> <li>Real del_h_[12] "isothermal enthalpy departure for liquid phase mixture";</li> <li>Real del_h_[12] "isothermal enthalpy departure for liquid phase mixture";</li> <li>Real del_h_[11] "isothermal</li></ul>		temperature only";
<pre>temperature only"; Real D_[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real B_[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D_v[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real V_r_1[2](cach start=0.1)"Reduced volume in liquid phase mixture"; Real V_r_v[2](cach start=000)"Reduced volume in vapour phase mixture"; Real Z_1[2]" compressibility factor in liquid phase(for simple and reference component)"; Real Z_1"compressibility factor in vapour phase(for simple and reference component)"; Real Z_v"compressibility factor in vapour phase(for simple and reference component)"; Real Z_1" compressibility factor in vapour phase(for simple and reference component)"; Real Z_1"compressibility factor in vapour phase(for simple and reference component)"; Real Z_1"compressibility factor for liquid phase"; Real Teij[Nc,Nc]; Real Teij[Nc,Nc]; Real Phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; Real E_1[2]; Real B_1[_2"]; Real E_1[2]; Real E_1[2]; Real E_1[2]; Real E_1[2]; Real Abi_1[m"fugacity coefficient for vapour phase(for simple and reference fluid )"; Real Abi_1[m"fugacity coefficient for vapour phase mixture"; Real Abi_1[m"fugacity coefficient for vapour phase mixture"; Real Abi_1[m"fugacity coefficient for vapour phase mixture"; Real del_h_v[2]"isothermal enthalpy departure for liquid phase (for simple and reference fluid)"; Real del_h_w[3]"isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; Real del_h_w[3]=misothermal enthalpy departure for vapour phase mixture"; Real del_h_w[3]=misothermal enthalpy departure for vapour phase mixture"; Real del_h_w[3]=misothermal enthalpy departure for vapour phase mixture"; Real del_h_w[3]=hom(f(x[i]*omega[i]) for i in 1:Nc}); mega_v=sum(({y[i]*omega[i]) for i in 1:Nc}); mega_v=sum(</pre>	<pre>temperature only"; a Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real V_r_1[2] (each start=0.1)"Reduced volume in liquid phase mixture"; Real V_r_v[2](each start=000)"Reduced volume in vapour phase mixture"; Real Z_v[2][ compressibility factor in liquid phase[for simple and reference component)"; Real Z_v[2][ compressibility factor in vapour phase(for simple and reference component)"; Real Z_v[2][ compressibility factor in vapour phase(for simple and reference component)"; Real Teij [Nc.Nc]; Real Teij [Nc.Nc]; Real phi_l[2] "fugacity coefficient for liquid phase(for simple and reference fluid )"; Real phi_l[2] "fugacity coefficient for vapour phase(for simple and reference fluid )"; Real phi_v[2]" fugacity coefficient for liquid phase mixture"; Real phi_u[2]; Real phi_u[2]" fugacity coefficient for liquid phase mixture"; Real phi_u[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for liquid phase mixture"; requation r//Mixing Rules romga_u=sum({{x[i]*omga[i]} for i in 1:Nc}); romga_u=sum({{x[i]*omga[i]} for i in 1:Nc}); romga_u=sum({{x[i]*omga[i]} for i in 1:Nc}); romga_u=sum({{x[i]*omga[i]} for i in 1:Nc}); requation r//Mixing Rules romga_u=sum({{x[i]*omga[i]} for i in 1:Nc}); requation r//Mixing Rules requation r/Mixing Rules requation</pre>	50	Real C_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on
<pre>51 Real D_1[2]"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 52 Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 53 Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 54 Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; 55 Real V_r.1[2](each start=0.1)"Reduced volume in liquid phase mixture"; 56 Real V_r.1[2](each start=0.1)"Reduced volume in vapour phase mixture"; 57 Real z_1[2]" compressibility factor in liquid phase(for simple and reference component)"; 58 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; 59 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; 50 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; 50 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference fuel temperature"; 50 Real Teij[Nc.Nc]; 61 Real Teij[Nc.Nc]; 62 Real Phi_v[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; 73 Real del_hl_[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; 74 Real phi_v[2]] fugacity coefficient for vapour phase mixture"; 75 Real E_v[2]; 76 Real phi_w[1][2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 77 Real del_h_v[2]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; 78 Real del_h_w[2]" isothermal enthalpy departure for liquid phase mixture"; 76 equation 77 //Mixing Rules 78 omega_w==sum({(x i]*omega[i]) for i in 1:Nc}); 79 omega_w==sum({(y i]*omega[i]) for i in 1:Nc}); 70 omega_w==sum({(y i]*omega[i]) for i in 1:Nc}); 70 omega_w==sum({(y i]*omega[i]) for i in 1:Nc}); 71 Teij={{(((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc}; 72 Partici Partici Partici Partici Partici Partici Partici Partici Partici ParticiPartici Partici Partici ParticiPart</pre>	<ul> <li>51 Real D_[12] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>52 Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>53 Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>54 Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>55 Real V_r 1[2] (each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>56 Real V_r v[2] (each start=1000) "Reduced volume in vapour phase mixture";</li> <li>57 Real z_1[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>58 Real Z_v[2] "compressibility factor in vapour phase(for simple and reference component)";</li> <li>59 Real Z_1" compressibility factor in vapour phase";</li> <li>60 Real Z_v" compressibility factor in vapour phase";</li> <li>61 Real nci] Nc.Nc;</li> <li>62 Real nci] Nc.Nc;</li> <li>63 Real phi_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>64 Real phi_v[2] "guacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>67 Real E_1[2];</li> <li>68 Real phi_v[2] "fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>69 Real L_v[2];</li> <li>60 Real Phi_l="1" (sothermal enthalpy departure for liquid phase(for simple and reference fluid )";</li> <li>70 Real del_h_1[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>71 Real del_h_u"[3:othermal enthalpy departure for liquid phase mixture";</li> <li>72 Real del_h_u"[3:othermal enthalpy departure for liquid phase mixture";</li> <li>73 Real del_h_um"isothermal enthalpy departure for vapour phase mixture";</li> <li>74 Real del_h_um"isothermal enthalpy departure for vapour phase mixture";</li> <li>75 Real del_h_um"isothermal enthalpy departure for liquid phase mixture";</li> <li>76 Real del_h_um"isothermal enthalpy departure</li></ul>		temperature only";
<pre>temperature only"; Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real V_r[1]("abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; Real V_r[2]("ach start=0.1)"Reduced volume in liquid phase mixture"; Real V_r_v[2]("ach start=0.1000)"Reduced volume in liquid phase mixture"; Real V_r_v[2]("ach start=0.1000)"Reduced volume in vapour phase mixture"; Real Z_v[2]" compressibility factor in liquid phase(for simple and reference component)"; Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; Real Z_v[2]" four compressibility factor in vapour phase(for simple and reference full temperature"; Real Totij Nc.Nc]; Real Potij Nc.Nc]; Real Poti_v[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; Real Phi_v[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; Real E_v[2]; Real Phi_v[2]" fugacity coefficient for liquid phase mixture"; Real Phi_w[2]" sothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_w[2]" isothermal enthalpy departure for vapour phase mixture"; Real del_h_w[3] isothermal enthalpy departure for vapour phase mi</pre>	<ul> <li>temperature only";</li> <li>Real B.v[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D.v[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_r_l[2](each start=0.1)"Reduced volume in liquid phase mixture";</li> <li>Real V_r_v[2](each start=1000)"Reduced volume in vapour phase mixture";</li> <li>Real V_r_v[2](cach start=1000)"Reduced volume in vapour phase mixture";</li> <li>Real Z_r'v[2](each start=1000)"Reduced volume in vapour phase mixture";</li> <li>Real Z_rv[2]" compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_l" compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_v'vompressibility factor in vapour phase";</li> <li>Real Tcij[Nc,Nc];</li> <li>Real Tcij[Nc,Nc];</li> <li>Real phi_v[2]"fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>Real bhi_u[2]"fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>Real del_h_v[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid);</li> <li>Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid);</li> <li>Real del_h_w[2]"isothermal enthalpy departure for vapour phase (for simple and reference fluid);</li> <li>Real del_h_w[2]"isothermal enthalpy departure for vapour phase mixture";</li> <li>equation // // Xing Rules</li> <li>momga_l=sunt({(x[i]*omega[i]) for i in 1:Nc});</li> <li>momga_l=sunt({(x[i]*omega[i]) for i in 1:Nc});</li> <li>momga_l=sunt({(x[i]*omega[i]) for i in 1:Nc});</li> </ul>	51	Real D_1[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on
<ul> <li>Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_r v[2](each start=0.1)"Reduced volume in liquid phase mixture";</li> <li>Real V_r v[2](each start=1000) "Reduced volume in vapour phase mixture";</li> <li>Real Z_v[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_v[2] "compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_v[2] "compressibility factor in vapour phase";</li> <li>Real Z_u" compressibility factor in vapour phase";</li> <li>Real Tcij[Nc,Nc];</li> <li>Real Tcij[Nc,Nc];</li> <li>Real Point[2] "fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>Real phi_1[2] "fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>Real Phi_1[2] "fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>Real Phi_1[2] "fugacity coefficient for vapour phase (for simple and reference fluid )";</li> <li>Real Phi_1[2] "fugacity coefficient for vapour phase (for simple and reference fluid )";</li> <li>Real Phi_1[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>Real del_h_v[2]"isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[2]"isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[2]"isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_w[2]"isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_w[3] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_w[3] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_w[3</li></ul>	<ul> <li>Real B_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_r_l[2](each start=0.1)"Reduced volume in liquid phase mixture";</li> <li>Real V_r_v[2](each start=0.0)"Reduced volume in vapour phase mixture";</li> <li>Real Z_v[2]" compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_v[2]" compressibility factor in liquid phase";</li> <li>Real Z_v" compressibility factor in vapour phase";</li> <li>Real Z_v" compressibility factor in vapour phase";</li> <li>Real T_v[1][N_cN_c];</li> <li>Real T_v[1]" fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>Real E_v[2];</li> <li>Real E_v[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid )";</li> <li>Real del_h_v[2]"stothermal enthalpy departure for vapour phase(for simple and reference fluid )";</li> <li>Real del_h_v[2]"stothermal enthalpy departure for vapour phase(for simple and reference fluid )";</li> <li>Real del_h_v[2]"stothermal enthalpy departure for vapour phase(for simple and reference fluid);</li> <li>Real del_h_v[2]"stothermal enthalpy departure for vapour phase(for simple and reference fluid);</li> <li>Real del_h_v[2]"stothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v[2]*stothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v[2]*stothermal enthalpy departure for v</li></ul>		temperature only";
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<sup>33</sup> Real C_V[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>54</sup> Real D_v[2]" abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only"; <sup>55</sup> Real V_r v[2](each start=0.1)"Reduced volume in liquid phase mixture"; <sup>56</sup> Real V_r v[2](each start=1000)"Reduced volume in vapour phase mixture"; <sup>57</sup> Real z_V[2](compressibility factor in liquid phase(for simple and reference component)"; <sup>58</sup> Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; <sup>59</sup> Real Z_V" compressibility factor in vapour phase(for simple and reference component)"; <sup>50</sup> Real Z_V" compressibility factor in vapour phase(for simple and reference component)"; <sup>50</sup> Real Z_V" compressibility factor in vapour phase. <sup>51</sup> Real Z_V" compressibility factor in vapour phase. <sup>52</sup> Real Z_V" compressibility factor in vapour phase. <sup>53</sup> Real Z_V" compressibility factor in vapour phase. <sup>54</sup> Real Z_V" compressibility factor in vapour phase. <sup>55</sup> Real Z_V" compressibility factor in vapour phase. <sup>56</sup> Real Z_V" compressibility factor in vapour phase. <sup>57</sup> Real Z_V" compressibility factor in vapour phase. <sup>58</sup> Real Phi_V[2]" fugacity coefficient for liquid phase(for simple and reference fluid). <sup>59</sup> <sup>50</sup> <sup>51</sup> <sup>51</sup> <sup>51</sup> <sup>51</sup> <sup>51</sup> <sup>51</sup> <sup>51</sup> <sup>51</sup>	<ul> <li>Keal C_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V r_1[2](each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>Real V_r_1[2](each start=0.1) "Reduced volume in vapour phase mixture";</li> <li>Real Z_1[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_v[2] "compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_1" compressibility factor in liquid phase";</li> <li>Real Z_1" compressibility factor in vapour phase";</li> <li>Real Toij [Nc,Nc];</li> <li>Real Toij [Nc,Nc];</li> <li>Real phi_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>Real E_1[2];</li> <li>Real Mein_im" fugacity coefficient for liquid phase mixture";</li> <li>Real E_1[2];</li> <li>Real del_h_1[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid '';</li> <li>Real del_h_1[2] "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_1[2] "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for vapour phase mixture";</li> <li>Real del_h_v"] isothermal enthalpy departure for</li></ul>		temperature only";
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<li>momeg_l=sum({(x[i]*omega[i]) for i in 1:Nc});</li> <td><ul> <li>Keal D_v[2] "abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_r_l[2] (each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>Real V_r_v[2] (each start=000) "Reduced volume in vapour phase mixture";</li> <li>Real Z_l[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_v[2] "compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_l'(compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_l'(compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_l'(compressibility factor in vapour phase";</li> <li>Real Tcij[Nc,Nc];</li> <li>Real Tcij[Nc,Nc];</li> <li>parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature";</li> <li>Real phi_l[2] "fugacity coefficient for liquid 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"abbreviations in BWR-Lee-Kesler equation for functions depending on temperature only";</li> <li>Real V_r_l[2] (each start=0.1) "Reduced volume in liquid phase mixture";</li> <li>Real V_r_v[2] (each start=000) "Reduced volume in vapour phase mixture";</li> <li>Real Z_l[2] "compressibility factor in liquid phase(for simple and reference component)";</li> <li>Real Z_v[2] "compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_l'(compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_l'(compressibility factor in vapour phase(for simple and reference component)";</li> <li>Real Z_l'(compressibility factor in vapour phase";</li> <li>Real Tcij[Nc,Nc];</li> <li>Real Tcij[Nc,Nc];</li> <li>parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature";</li> <li>Real phi_l[2] "fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>Real E_l[2];</li> <li>Real E_l[2];</li> <li>Real E_l[2];</li> <li>Real E_l[2];</li> <li>Real phi_mrugacity coefficient for liquid phase mixture";</li> <li>Real phi_wrugacity coefficient for vapour phase mixture";</li> <li>Real del_h_l'[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>Real del_h_l'(2] "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_l'(2) "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_l'(2) "isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>Real del_h_l'':</li> <li>Real del_h_l''':</li> <li>Real del_h_l'''':</li> <li>Real del_h_l''':</li> <li>Real del_h''':</li> <li>Real del_h''':</li> <li>Real del_h''':</li> <li>Real del_h''':</li> <li>Real del_h''':</li></ul>		temperature only";
<pre>temperature only"; 5 Real V_r 1[2](each start=0.1)"Reduced volume in liquid phase mixture"; 5 Real V_r v[2](each start=1000)"Reduced volume in vapour phase mixture"; 5 Real Z_1[2]" compressibility factor in liquid phase(for simple and reference component)"; 5 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; 5 Real Z_1" compressibility factor in liquid phase"; 6 Real Z_v" compressibility factor in vapour phase"; 6 Real Z_v" compressibility factor in vapour phase"; 6 Real Tcij [Nc,Nc]; 7 Real Tcij [Nc,Nc]; 7 Real Acij [Nc,Nc]; 7 Real Phi_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; 7 Real E_1[2]; 7 Real Phi_2[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; 7 Real E_1[2]; 8 Real phi_v[2]" fugacity coefficient for liquid phase mixture"; 8 Real phi_v" fugacity coefficient for vapour phase mixture"; 8 Real phi_u" fugacity coefficient for vapour phase mixture"; 9 Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 7 Real del_h_1[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 7 Real del_h_1[2]" isothermal enthalpy departure for vapour phase mixture"; 7 Real del_h_1[2]" isothermal enthalpy departure for vapour phase mixture"; 7 Real del_h_1[3]" isothermal enthalpy departure for vapour phase mixture"; 7 Real del_h_1[4]" isothermal enthalpy departure for vapour phase mixture"; 7 Real del_h_1[7]" isothermal enthalpy departure for vapour phase mixture"; 7 Real del_h_1[8]" isothermal enthalpy departure for vapour phase mixture"; 7 Real del_h_1[8]" isothermal enthalpy departure for vapour phase mixture"; 7 requation 7 //Mixing Rules 7 omega_1=sum({(x[i]*omega[i]) for i in 1:Nc}); 8 mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 8 mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 8 mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}; 8 mega_v=sum({(y[i]*omega[i]) for</pre>	<pre>temperature only"; Facal V r_1[2] (each start=0.1)"Reduced volume in liquid phase mixture"; Real V_r_v[2] (each start=1000)"Reduced volume in vapour phase mixture"; Real z_1[2] "compressibility factor in liquid phase(for simple and reference component)"; Real z_v[2] "compressibility factor in vapour phase(for simple and reference component)"; Real Z_1"compressibility factor in liquid phase"; Real Z_v"compressibility factor in vapour phase(for simple and reference component)"; Real Z_v"compressibility factor in vapour phase"; Real Z_v"compressibility factor in vapour phase"; Real Teij[Ne,Nc]; Real Pti_J[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; Real phi_1[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; Real E_v[2]; Real Phi_v[2]" fugacity coefficient for liquid phase mixture"; Real phi_wm"fugacity coefficient for vapour phase mixture"; Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; Real del_h_v[1]************************************</pre>	54	Real $D_v[2]$ "abbreviations in BWR-Lee-Kesler equation for functions depending on
<pre>55 Real V_r_[2](each start=0.1)"Reduced volume in liquid phase mixture"; 57 Real z_1[2]"compressibility factor in liquid phase(for simple and reference component)"; 58 Real z_v[2]"compressibility factor in vapour phase(for simple and reference component)"; 59 Real Z_1"compressibility factor in liquid phase"; 60 Real Z_v"compressibility factor in vapour phase"; 61 Real Tcij[Nc,Nc]; 62 Real Vcij[Nc,Nc]; 63 parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; 64 Real phi_1[2]" fugacity coefficient for liquid phase mixture"; 65 Real E_1[2]; 66 Real E_1[2]; 67 Real E_1[2]; 68 Real E_1[2]; 69 Real Bhi_m" fugacity coefficient for liquid phase mixture"; 69 Real phi_v[2]" sothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 71 Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 73 Real del_h_v[2]" isothermal enthalpy departure for liquid phase (for simple and reference fluid)"; 74 Real del_h_v[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 75 Real del_h_w[3]" isothermal enthalpy departure for liquid phase (for simple and reference fluid)"; 76 requation 77 //Mixing Rules 78 omega_==sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(x[i]*omega[i]) for i in 1:Nc}); 70 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 78 real del_h_v[5]" isothermal enthalpy departure for liquid phase mixture"; 79 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc}; 79 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 70 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc}; 71 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 72 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 73 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 74 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for j in 1:Nc} ; 75 rej for the second departure for the second departure fo</pre>	55 Real V_r_1[2](each start=0.1) "Reduced volume in liquid phase mixture"; 56 Real Z_1[2]" compressibility factor in liquid phase(for simple and reference component)"; 57 Real Z_1[2]" compressibility factor in vapour phase(for simple and reference component)"; 58 Real Z_1" compressibility factor in liquid phase"; 50 Real Z_1" compressibility factor in vapour phase"; 51 Real Tcij [Nc,Nc]; 52 Real Vcij [Nc,Nc]; 53 Parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; 54 Real phi_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; 55 Real E_1[2]; 56 Real E_1[2]; 57 Real E_1[2]; 58 Real E_1[2]; 59 Real bhi_vv [2]" fugacity coefficient for liquid phase mixture"; 59 Real bhi_vv [2]" sothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 50 Real del_h_1[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 57 Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 50 Real del_h_vv [3]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 51 Real del_h_vv [3]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 52 Real del_h_vv [3]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; 53 Real del_h_vv [3]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; 54 Real del_h_vv [3]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)"; 55 Real del_h_vv [3] isothermal enthalpy departure for vapour phase mixture"; 56 Real del_h_vv [3] isothermal enthalpy departure for vapour phase mixture"; 57 reac del_h_vv [3] isothermal enthalpy departure for vapour phase mixture"; 58 reac del_h_vv [3] isothermal enthalpy departure for vapour phase mixture"; 59 reac_l=sum({(x[i]*reac][1]) for i in 1:Nc}); 50 reac_l=sum({(x[i]*reac][1]) for i in 1:Nc}); 50 reac_l=sum({(x[i]*reac][1]) for i in 1		temperature only";
<pre>56 Keal V _r v[2](each start=1000) "Reduced volume in vapour phase mixture"; 57 Real z_1[2]" compressibility factor in liquid phase(for simple and reference component)"; 58 Real Z_1" compressibility factor in vapour phase(for simple and reference component)"; 59 Real Z_1" compressibility factor in vapour phase"; 60 Real Z_v" compressibility factor in vapour phase"; 61 Real Tcij[Nc,Nc]; 62 Real Vcij[Nc,Nc]; 63 parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; 64 Real phi_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; 65 Real E_1[2]; 66 Real E_1[2]; 67 Real E_1[2]; 68 Real phi_v[2]" fugacity coefficient for liquid phase mixture"; 69 Real phi_vm" fugacity coefficient for liquid phase mixture"; 69 Real Aphi_vm" fugacity coefficient for vapour phase (for simple and reference fluid )"; 70 Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 73 Real del_h_1[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_wm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_wm"isothermal enthalpy departure for liquid phase mixture"; 75 equation 77 //Mixing Rules 78 omega_==sum({{x[i]*omega[i]} for i in 1:Nc}); 79 omega_v=sum({{x[i]*omega[i]} for i in 1:Nc}); 79 omega_v=sum({{x[i]*omega[i]} for i in 1:Nc}); 70 Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 72 Appendix A</pre>	<sup>56</sup> Real V_r_v 2 (each start=1000)"Reduced volume in vapour phase mixture"; <sup>57</sup> Real z_[2]" compressibility factor in liquid phase(for simple and reference component)"; <sup>58</sup> Real Z_v[compressibility factor in vapour phase(for simple and reference component)"; <sup>59</sup> Real Z_1"compressibility factor in liquid phase"; <sup>60</sup> Real Z_v"compressibility factor in vapour phase"; <sup>61</sup> Real Tcij [Nc,Nc]; <sup>62</sup> Real Vcij [Nc,Nc]; <sup>63</sup> parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; <sup>64</sup> Real phi_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; <sup>65</sup> Real E_1[2]; <sup>66</sup> Real E_1[2]; <sup>67</sup> Real E_1[2]; <sup>68</sup> Real phi_w" fugacity coefficient for liquid phase mixture"; <sup>70</sup> Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; <sup>71</sup> Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; <sup>72</sup> Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; <sup>73</sup> Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; <sup>74</sup> Real del_h_uw" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; <sup>75</sup> Real del_h_lw" isothermal enthalpy departure for vapour phase mixture"; <sup>76</sup> equation <sup>77</sup> //Mixing Rules <sup>78</sup> mega_l=sum({(x[i]*mega[i]) for i in 1:Nc}); <sup>79</sup> omega_uw=uw({(x[i]*mega[i]) for i in 1:Nc}); <sup>70</sup> omega_uw=uw({(x[i]*mega[i]) for i in 1:Nc}); <sup>70</sup> omega_vw=uw({(x[i]*mega[i]) for i	55	Real V_r_1[2] (each start=0.1)" Reduced volume in liquid phase mixture";
<pre>57 Real Z_1[2] compressibility factor in liquid phase(for simple and reference component)"; 58 Real Z_v[2]" compressibility factor in vapour phase(for simple and reference component)"; 59 Real Z_1" compressibility factor in liquid phase"; 60 Real Z_v" compressibility factor in vapour phase"; 61 Real Tcij[Nc,Nc]; 62 aparameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; 64 Real phi_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; 65 Real E_1[2]; 66 Real Phi_v[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; 67 Real E_v[2]; 68 Real phi_lm" fugacity coefficient for liquid phase mixture"; 69 Real bhi_um" fugacity coefficient for vapour phase (for simple and reference fluid)"; 70 Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 71 Real del_h_1[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 72 Real del_h_um"; othermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_um"; othermal enthalpy departure for vapour phase (for simple and reference fluid)"; 74 Real del_h_um"; othermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_u=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(x[i]*omega[i]) for i in 1:Nc}); 81 Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 82 83 defined and the second defined approach to the second defined defined</pre>	bit Real Z_1[2] "compressibility factor in fiquid phase(for simple and reference component)"; seal Z_1" compressibility factor in vapour phase(for simple and reference component)"; Real Z_1" compressibility factor in liquid phase"; Real Z_1" compressibility factor in vapour phase"; Real Teij[Nc,Nc]; Real Teij[Nc,Nc]; Real phi_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid )"; Real phi_v[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; Real Phi_v[2]; Real phi_v[2]; Real phi_v[2]; Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for liquid phase mixture"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase mixture"; Real del_h_v[1]": othermal enthalpy departure for liquid phase mixture"; Real del_h_v[2]" isothermal enthalpy departure for vapour phase mixture"; Real del_h_v[2]": othermal enthalpy departure for vapour phase mixture"; Real del_h_v[2]": othermal enthalpy departure for vapour phase mixture"; Real del_h_v[2]": othermal enthalpy departure for vapour phase mixture"; Real del_h_v[2]": othermal enthalpy departure for vapour phase mixture"; Real del_h_v[0]": othermal enthalpy departure for vapour phase mixture"; Real del_h_v[0]: othermal enthalpy departure for vapour phase mixture"; reguetion r//Mixing Rules mega_l=sum({(x[i]*mega[i]) for i in 1:Nc}); omega_v=sum({(x[i]*mega[i]) for i in 1:Nc}); omega_v=sum({(x[i]*mega[i]) for i in 1:Nc});	56	Real $v r v[2]$ (each start=1000) "Reduced volume in vapour phase mixture";
<pre>component)"; Real Z_v[2]" compressibility factor in vapour phase(for simple and reference</pre>	<pre>component);; seal z_v[2]" compressibility factor in vapour phase(for simple and reference</pre>	57	<b>Real z</b> 1[2] "compressibility factor in liquid phase(for simple and reference
<pre>ss Real 2_[12] compressibility factor in vapour phase(for simple and reference component)"; se Real Z_"compressibility factor in liquid phase"; eReal Z_"compressibility factor in vapour phase"; eReal Vcij[Nc,Nc]; se Real Phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; eReal phi_1[2]"fugacity coefficient for vapour phase(for simple and reference fluid )"; eReal E_1[2]; eReal E_1[2]; eReal phi_w"fugacity coefficient for liquid phase mixture"; eReal phi_w"fugacity coefficient for vapour phase mixture"; eReal phi_w"fugacity coefficient for vapour phase mixture"; eReal phi_w"fugacity coefficient for vapour phase mixture"; eReal del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; eReal del_h_V[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; equation reference fluid); equation for in 1:Nc}); equation for j m 1:Nc}for j in 1:Nc} ; erequation for circle[((T_c[i].*T_c[j])^0.5).*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; equation for circle[((T_c[i].*T_c[j])^0.5).*kij[i,j] for j in 1:Nc}for j in 1:Nc}; equation for circle[((T_c[i].*T_c[j])^0.5).*kij[i,j] for j in 1:Nc}for j in 1:Nc}; for circle[((T_c[i].*T_c[j])^0.5).*kij[i,j] for j in 1:Nc}for j in 1:Nc} ; for circle[((T_c[i].*T_c[j])^0.5).*kij[i,j] for j in 1:Nc}for j in 1:Nc} ; for circle[((T_c[i].*T</pre>	<pre>ss Real Z_v[2] compressibility factor in vapour phase(for simple and reference component)"; se Real Z_1" compressibility factor in liquid phase"; end Z_v" compressibility factor in vapour phase"; end Tcij[Nc,Nc]; grameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; end phi_l[2]" fugacity coefficient for liquid phase(for simple and reference fluid )"; end Real phi_v[2]" fugacity coefficient for vapour phase(for simple and reference fluid )"; end Real E_1[2]; end Real E_1[2]; end Real E_v[2]; end Real phi_um" fugacity coefficient for liquid phase mixture"; end Real phi_um" fugacity coefficient for vapour phase mixture"; end Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; ra Real del_h_v[2]" isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; ra Real del_h_v[2]" isothermal enthalpy departure for liquid phase mixture"; equation reference fluid)"; ra Real del_h_v[2]" isothermal enthalpy departure for liquid phase mixture"; equation reference fluid)"; ra Real del_h_um" isothermal enthalpy departure for liquid phase mixture"; equation r//Mixing Rules somega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); end component for the second s</pre>	-	component)";
<pre>component); Real Z_l"compressibility factor in liquid phase"; Real Z_v"compressibility factor in vapour phase"; Real Tcij[Nc,Nc]; Parameter Real n=0.25"universal exponent in mixing rule for the pseudo critical temperature"; Real phi_l[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; Real E_l[2]; Real E_l[2]; Real E_v[2]; Real phi_um"fugacity coefficient for liquid phase mixture"; Real phi_vm"fugacity coefficient for vapour phase mixture"; Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for liquid phase mixture"; Real del_h_v[2]"isothermal enthalpy departure for liquid phase mixture"; Real del_h_v[2]"isothermal enthalpy departure for liquid phase mixture"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[1]"isothermal enthalpy departure for liquid phase mixture"; requation ///Mixing Rules momega_v=sum({(x[i]*omega[i]) for i in 1:Nc}); mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ;</pre>	<pre>component); Real Z_l"compressibility factor in liquid phase"; Real Z_v"compressibility factor in vapour phase"; Real Tcij[Nc,Nc]; Real Vcij[Nc,Nc]; Parameter Real n=0.25"universal exponent in mixing rule for the pseudo critical temperature"; Real phi_l[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )"; Real E_v[2]; Real Phi_um"fugacity coefficient for liquid phase mixture"; Real phi_mm"fugacity coefficient for vapour phase mixture"; Real phi_um"fugacity coefficient for vapour phase mixture"; Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase mixture"; Real del_h_v[2]"isothermal enthalpy departure for liquid phase mixture"; Real del_h_wm"isothermal enthalpy departure for liquid phase mixture"; requation //Mixing Rules somega_b=sum({(x[i]*somega[i]) for i in 1:Nc}); omega_v=sum({(x[i]*somega[i]) for i in 1:Nc}); Tabi=(f((T a[i] aT a[i]))); Note that the set of the set of</pre>	58	<b>Real z_v[z]</b> compressibility factor in vapour phase (for simple and reference
<pre>59 Real Z_1'compressibility factor in liquid phase; 61 Real Z_v"compressibility factor in vapour phase"; 62 Real Tcij[Nc,Nc]; 63 parameter Real n=0.25"universal exponent in mixing rule for the pseudo critical 63 temperature"; 64 Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid 0"; 75 Real E_1[2]; 65 Real E_1[2]; 66 Real E_1[2]; 67 Real E_v[2]; 68 Real phi_um"fugacity coefficient for liquid phase mixture"; 69 Real phi_um"fugacity coefficient for vapour phase mixture"; 70 reference fluid)"; 71 Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and 72 reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and 73 reference fluid)"; 73 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and 74 reference fluid)"; 73 Real del_h_w"isothermal enthalpy departure for vapour phase(for simple and 73 reference fluid)"; 74 Real del_h_w"isothermal enthalpy departure for liquid phase mixture"; 75 requation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 70 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 71 reij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 72 real del_h_w reference refusion</pre>	<ul> <li><sup>59</sup> Real Z_v" compressibility factor in liquid phase";</li> <li><sup>60</sup> Real Z_v" compressibility factor in vapour phase";</li> <li><sup>61</sup> Real Tcij [Nc,Nc];</li> <li><sup>62</sup> Real Vcij [Nc,Nc];</li> <li><sup>63</sup> parameter Real n=0.25 "universal exponent in mixing rule for the pseudo critical temperature";</li> <li><sup>64</sup> Real phi_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li><sup>65</sup> Real E_1[2];</li> <li><sup>66</sup> Real E_v[2];</li> <li><sup>67</sup> Real E_v[2];</li> <li><sup>68</sup> Real phi_lm" fugacity coefficient for liquid phase mixture";</li> <li><sup>69</sup> Real del_h_l[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid ) ";</li> <li><sup>70</sup> Real del_h_v[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid) ";</li> <li><sup>71</sup> Real del_h_v[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid) ";</li> <li><sup>72</sup> Real del_h_v[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid) ";</li> <li><sup>73</sup> Real del_h_v[1] "isothermal enthalpy departure for liquid phase mixture";</li> <li><sup>74</sup> Real del_h_v[1] "isothermal enthalpy departure for liquid phase mixture";</li> <li><sup>75</sup> equation</li> <li><sup>77</sup> // Mixing Rules</li> <li><sup>78</sup> somega_l=sum({(x[i]*omega[i]) for i in 1:Nc});</li> <li><sup>79</sup> omega_v=sum({(y[i]*omega[i]) for i in 1:Nc});</li> </ul>		component)";
<pre>66 Real Z_v compressionty factor in vapour phase ; 16 Real Tcij [Nc,Nc]; 16 Real Vcij [Nc,Nc]; 17 Real phi_1[2] "fugacity coefficient for liquid phase(for simple and reference fluid</pre>	<ul> <li>a Real Z_v compression y factor in vapour phase;</li> <li>a Real Tcij [Nc,Nc];</li> <li>a Real Vcij [Nc,Nc];</li> <li>a parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature";</li> <li>a Real phi_1[2]" fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>a Real E_1[2];</li> <li>a Real E_1[2];</li> <li>a Real el_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid reference fluid)";</li> <li>a Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>a Real del_h_1[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>a Real del_h_v[2]" isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>a Real del_h_v[2]" isothermal enthalpy departure for liquid phase (for simple and reference fluid)";</li> <li>a Real del_h_v[2]" isothermal enthalpy departure for vapour phase (for simple and reference fluid)";</li> <li>a Real del_h_v[2]" isothermal enthalpy departure for vapour phase mixture";</li> <li>a Real del_h_u" isothermal enthalpy departure for liquid phase mixture";</li> <li>a Real del_h_um" isothermal enthalpy departure for vapour phase mixture";</li> <li>a Real del_h_um" isothermal enthalpy departure for vapour phase mixture";</li> <li>a Real del_h_um" isothermal enthalpy departure for vapour phase mixture";</li> <li>a requirement (x[i]*omega[i]) for i in 1:Nc};;</li> <li>a mega_l=sum({(x[i]*omega[i]) for i in 1:Nc});</li> <li>a mega_u=sum({(x[i]*omega[i]) for i in 1:Nc});</li> </ul>	59	Real Z 1" compressibility factor in liquid phase";
<pre>61 Real Yeij [Ne,Ne]; 62 Real Veij [Ne,Ne]; 63 parameter Real n=0.25"universal exponent in mixing rule for the pseudo critical 63 temperature"; 64 Real phi_l[2]"fugacity coefficient for liquid phase(for simple and reference fluid 0)"; 65 Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid 0)"; 66 Real E_l[2]; 67 Real E_v[2]; 68 Real phi_um"fugacity coefficient for liquid phase mixture"; 69 Real phi_um"fugacity coefficient for vapour phase mixture"; 70 ri Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and 71 reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and 73 reference fluid)"; 73 Real del_h_w[3]"isothermal enthalpy departure for vapour phase mixture"; 74 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(x[i]*omega[i]) for i in 1:Nc}); 70 mega_v=sum({(x[i]*omega[i]) for i in 1:Nc}); 71 rej={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 72 restrict temperature for temperature for temperature for temperature for temperature for temperature"; 73 restrict temperature for temperature for temperature for temperature"; 74 restrict temperature for temperature for temperature"; 75 restrict temperature for temperature for temperature"; 76 restrict temperature for temperature for temperature"; 77 restrict temperature for temperature for temperature"; 78 restrict temperature for temperature for temperature"; 79 restrict temperature for temperature for temperature"; 70 restrict temperature for temperature for temperature"; 71 restrict temperature for temperature for temperature"; 72 restrict temperature for temperature for temperature"; 73 restrict temperature for temperature for temperature for temperature"</pre>	<ul> <li>a Real Tcij [Nc,Nc];</li> <li>a Real Vcij [Nc,Nc];</li> <li>a parameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature";</li> <li>a Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid )";</li> <li>b Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )";</li> <li>c Real E_1[2];</li> <li>c Real E_v[2];</li> <li>c Real phi_um"fugacity coefficient for liquid phase mixture";</li> <li>e Real phi_vm"fugacity coefficient for vapour phase mixture";</li> <li>e Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>c Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>c Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>c Real del_h_wm"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>c Real del_h_wm"isothermal enthalpy departure for vapour phase mixture";</li> <li>equation</li> <li>//Mixing Rules</li> <li>mega_b=sum({(x[i]*omega[i]) for i in 1:Nc});</li> <li>mega_b=sum({(x[i]*omega[i]) for i in 1:Nc});</li> </ul>	60	Real Z_v compressionity factor in vapour phase ;
<pre>near very fixe, very fixe, very fixed v</pre>	<pre>near veig[neq.veig] arameter Real n=0.25" universal exponent in mixing rule for the pseudo critical temperature"; Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )"; Real E_v[2]; Real E_v[2]; Real phi_lm"fugacity coefficient for liquid phase mixture"; Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_w[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_w[2]"isothermal enthalpy departure for vapour phase mixture"; Real del_h_w[3]"isothermal enthalpy departure for vapour phase mixture"; To mega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); To mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); To mega_v=sum({(y[i]*omega[i]) for i in 1:Nc});</pre>	61	Real Teij [Re, Ne],
<pre>63 parameter item in-0.25 universal exponent in mixing fute for the pseudo critical     timperature"; 64 Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid     )"; 65 Real E_1[2]; 66 Real E_v[2]; 67 Real E_v[2]; 68 Real phi_um"fugacity coefficient for liquid phase mixture"; 69 Real phi_vm"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and     reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and     reference fluid)"; 73 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_wm"isothermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_u=sum({(x[i]*omega[i]) for i in 1:Nc}); 81 Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 82</pre>	<pre>63 parameter item in -0.25 universal exponent in mixing fute for the pseudo critical     temperature"; 64 Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid     )"; 66 Real phi_v[2]"fugacity coefficient for liquid phase mixture"; 67 Real E_v[2]; 68 Real phi_vm"fugacity coefficient for vapour phase mixture"; 69 Real phi_vm"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and     reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and     reference fluid)"; 73 Real del_h_wisothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_wisothermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 70 raii = f[((T_alid +T_alid) = 0.5) + thili i i for i in 1:Nc}); 71 Tein f((T_alid +T_alid) = 0.5) + thili i i for i in 1:Nc}; 72 rai = f((T_alid +T_alid) = 0.5) + thili i i for i in 1:Nc}; 73 rai = f((T_alid +T_alid) = 0.5) + thili i i for i in 1:Nc}; 74 rai = 0.50 rai =</pre>	62	near very $[n, n, n]$ ,
<pre>Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; 64 Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )"; 65 Real E_l[2]; 66 Real E_v[2]; 68 Real phi_lm"fugacity coefficient for liquid phase mixture"; 69 Real phi_vm"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_w"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_lm"isothermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 70 reij={{(((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 72 Real del_h_umedate departed departed for in 1:Nc}; 73 reij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}}</pre>	<pre>Real phi_1[2]"fugacity coefficient for liquid phase(for simple and reference fluid )"; Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )"; Real E_1[2]; Real E_v[2]; Real phi_lm"fugacity coefficient for liquid phase mixture"; Real phi_vm"fugacity coefficient for vapour phase mixture"; Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_w"isothermal enthalpy departure for liquid phase mixture"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_wm"isothermal enthalpy departure for vapour phase mixture"; Real del_h_wm"isothermal enthalpy departure for vapour phase mixture"; Real del_h_wm"isothermal enthalpy departure for vapour phase mixture"; Real del_h_wm[isothermal enthalpy departure]; Real del_h_wm[isothermal enthalpy departure]; Real del_h_wm[isothermal enthalpy departure]; Real del_h_wm[isothermal enthalpy departu</pre>	63	temperature".
<pre>Not ited [12] ingletry coefficient for inquid phase(for simple and reference fluid )"; 65 Real phi_v[2] "fugacity coefficient for vapour phase(for simple and reference fluid )"; 66 Real E_v[2]; 67 Real E_v[2]; 68 Real phi_um"fugacity coefficient for vapour phase mixture"; 69 Real phi_um"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_l[2] "isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 72 Real del_h_v[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 80 Tcij={{(((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 83</pre>	<pre>64 Near phi_1[2] Tagaenty coefficient for inquite phase(for simple and reference fluid )"; 65 Real phi_v[2]"fugacity coefficient for vapour phase(for simple and reference fluid )"; 66 Real E_l[2]; 67 Real E_v[2]; 68 Real phi_um"fugacity coefficient for liquid phase mixture"; 69 Real phi_vm"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_wm"isothermal enthalpy departure for vapour phase mixture"; 75 76 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 70 71 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 73 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 74 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 75 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 76 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 77 Tait=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 78 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 79 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 70 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 71 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 72 Taii=f(((T_c[i]+T_c[i]) = 0.5), whii[i i l_for i in 1:Nc}); 73 Taii=f(((T_c[i]+T_c[i]+T_c[i])); 74 Taii=f((T_c[i]+T_c[i])); 75 Taii=f(((T_c[i]+T_c[i]+T_c[i])); 76 Taii=f((T_c[i]+T_c[i])); 77 Taii=f(((T_c[i]+T_c[i]+T_c[i])); 78 Taii=f((T_c[i]+T_c[i])); 78 Taii=f((T_c[i]+T_c[i]); 78 Taii=f((T_c[i]+T_c[i]); 78 Taii=f(T_c[i]+T_c[i]); 78 Taii=f(T_c[i]+T</pre>	64	Real phi [12]"fugacity coefficient for liquid phase(for simple and reference fluid
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<pre>66 Real F_1[2]; 67 Real E_v[2]; 68 Real phi_lm"fugacity coefficient for liquid phase mixture"; 69 Real phi_vm"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_1[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 81 Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc} ; 82 83 84</pre>	66 Real E_v[2]; 67 Real E_v[2]; 68 Real phi_lm"fugacity coefficient for liquid phase mixture"; 69 Real phi_vm"fugacity coefficient for vapour phase mixture"; 70 71 Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; 75 76 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 70 71 72 73 74 75 75 75 76 76 77 77 79 77 78 79 79 79 70 70 70 70 70 70 70 70 70 71 71 72 73 74 74 75 75 76 76 77 77 78 79 79 70 70 70 70 70 70 70 70 70 70 70 70 70	00	)".
<pre>note iter is a set of the interval of the interval is a set of the</pre>	<ul> <li>a Real E_v[2];</li> <li>c Real phi_lm"fugacity coefficient for liquid phase mixture";</li> <li>c Real phi_vm"fugacity coefficient for vapour phase mixture";</li> <li>c Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>c Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>c Real del_h_lm"isothermal enthalpy departure for liquid phase mixture";</li> <li>c Real del_h_w"isothermal enthalpy departure for liquid phase mixture";</li> <li>c Real del_h_vm"isothermal enthalpy departure for vapour phase mixture";</li> <li>c Real del_h_vm"isothermal enthalpy departure for vapour phase mixture";</li> <li>c Real del_h_vm"isothermal enthalpy departure for vapour phase mixture";</li> <li>c equation</li> <li>c //Mixing Rules</li> <li>c omega_l=sum({(x[i]*omega[i]) for i in 1:Nc});</li> <li>c omega_v=sum({(y[i]*omega[i]) for i in 1:Nc});</li> </ul>	66	Beal E 1[2]
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<ul> <li>Real phi_vm"fugacity coefficient for vapour phase mixture";</li> <li>Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>Real del_h_lm"isothermal enthalpy departure for liquid phase mixture";</li> <li>Real del_h_vm"isothermal enthalpy departure for vapour phase for the for the</li></ul>	Real phi_vm"fugacity coefficient for vapour phase mixture"; Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; Real del_h_vm"isothermal enthalpy for i in 1:Nc}; Real del_h_vm"isothermal[i] for i in 1:Nc}; Real del_h_vm"isothermal[i] for i in 1:Nc]; Real del_h_vm"isothermal[i] for i in 1:Nc]; Real del_h_vm"isothermal[i] for i in 1:Nc];	68	Real phi Im fugacity coefficient for liquid phase mixture":
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71 Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)"; 72 Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; 73 Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; 74 Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; 75 equation 77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 80 81 Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc}; 82	<ul> <li>Real del_h_l[2]"isothermal enthalpy departure for liquid phase(for simple and reference fluid)";</li> <li>Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)";</li> <li>Real del_h_lm"isothermal enthalpy departure for liquid phase mixture";</li> <li>Real del_h_vm"isothermal enthalpy departure for vapour phase mixture";</li> <li>equation </li> <li>//Mixing Rules </li> <li>mega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); </li> <li>mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); </li> </ul>	70	F= ,
<pre>reference fluid)"; reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; requation // Mixing Rules // Mixing Rules // Mixing Rules // Mixing Rules // Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc}; // Real del_h_vm_vm_vm_vm_vm_vm_vm_vm_vm_vm_vm_vm_vm_</pre>	<pre>reference fluid)"; reference fluid)"; Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; requation //Mixing Rules mega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); mega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); </pre>	71	<b>Real del h</b> $1[2]$ "isothermal enthalpy departure for liquid phase(for simple and
Real del_h_v[2]"isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; equation //Mixing Rules omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc};	Real del_h_v[2] "isothermal enthalpy departure for vapour phase(for simple and reference fluid)"; Real del_h_lm"isothermal enthalpy departure for liquid phase mixture"; Real del_h_vm"isothermal enthalpy departure for vapour phase mixture"; equation //Mixing Rules omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); Taii=f(((T_a[i]*T_a[i])^0, 5)_atkii[i i] for i in 1:Nc});		reference fluid)":
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<pre>77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 80 81 Tcij={{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc}for j in 1:Nc}; 82 83</pre>	77 //Mixing Rules 78 omega_l=sum({(x[i]*omega[i]) for i in 1:Nc}); 79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 80 80 80 80 81 82 84 85 85 86 86 86 86 86 87 86 86 86 86 86 86 86 86 86 86	76	equation
78 $\text{omega}_{i=\text{sum}(\{(x[i]*\text{omega}[i]) \text{ for } i \text{ in } 1:Nc\});}$ 79 $\text{omega}_{v=\text{sum}(\{(y[i]*\text{omega}[i]) \text{ for } i \text{ in } 1:Nc\});}$ 80 81 $\text{Tcij}=\{\{((T_c[i].*T_c[j])^0.5) .*kij[i,j] \text{ for } i \text{ in } 1:Nc\}\text{ for } j \text{ in } 1:Nc\};$ 82 83	78 $\operatorname{omega\_l=sum}(\{(x[i]*\operatorname{omega}[i]) \text{ for } i \text{ in } 1:Nc\});$ 79 $\operatorname{omega\_v=sum}(\{(y[i]*\operatorname{omega}[i]) \text{ for } i \text{ in } 1:Nc\});$ 80 80 Toii= $\{(((T, c[i]*T, c[i]) \cap 5) + t; i \in [i], for i in , 1:Nc\})$	77	//Mixing Rules
79 omega_v=sum({(y[i]*omega[i]) for i in 1:Nc}); 80 81 $Tcij = \{\{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc\} for j in 1:Nc\};$ 82 83 84 $Tcij = \{\{(T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc\} for j in 1:Nc\};$	79 omega_v=sum( $\{(y[i]*omega[i])$ for i in 1:Nc $\}$ ); 80 Toii=[ $(((T, a[i]*T, a[i]) \cap 5)$ , this[i i] for i in 1:Na] for i in 1:Na] for i in 1:Na].	78	omega $l=sum(\{(x[i]*omega[i]) for i in 1:Nc\});$
$ \begin{array}{c} & & & \\ 80 \\ 81 \\ 82 \\ 83 \\ 83 \\ \end{array} $ T c i j = { { ((T_c[i].*T_c[j])^0.5) .* kij[i,j] for i in 1:Nc } for j in 1:Nc } ;	$T_{\text{oii}} = \left\{ \left( \left( T_{\text{oii}} \right) + T_{\text{oii}} \right) \right\} = \left\{ \left( \left( T_{\text{oii}} \right) + T_{\text{oii}} \right) \right\} = \left\{ \left( \left( T_{\text{oii}} \right) + T_{\text{oii}} \right) \right\} = \left\{ \left( \left( T_{\text{oii}} \right) + T_{\text{oiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiii}} \right) + T_{\text{oiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiii}} \right) + T_{\text{oiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiii}} \right) + T_{\text{oiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiiii}} \right) + T_{\text{oiiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiiii}} \right) + T_{\text{oiiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiiii}} \right) + T_{\text{oiiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiiiii}} \right) + T_{\text{oiiiii}} \right) \right\} = \left\{ \left( \left( T_{\text{oiiiiii}} \right) + T_{\text{oiiiii}} \right) + T_{\text{oiiiiii}} \right\} = \left\{ \left( \left( T_{\text{oiiiiiii}} \right) + T_{\text{oiiiiiiii}} \right) + T_{oiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiiii$	79	omega v=sum $({(y[i]*omega[i])}$ for i in 1:Nc $);$
81 $Tcij = \{\{((T_c[i].*T_c[j])^0.5) .*kij[i,j] for i in 1:Nc\} for j in 1:Nc\};$ 82 83	$T_{aii} = \left[ \left( \left( T_{aii} \right) + T_{aii} \right) + \left( T_{aii} \right) +$	80	
82 83	$81  1 \text{ CI} = \{\{(1  C 1 , *1  C j )  0.5\}  .* \text{ KI} = \{1, j 1, j $	81	$Tcij = \{\{((T c[i].*T c[j])^0.5) .*kij[i,j] for i in 1:Nc\} for j in 1:Nc\};$
83	82	82	
	83	83	
84 $Vcij = \{\{(0.125*(V_c[i]^(1/3) + V_c[j]^(1/3))^3)/1000 \text{ for } i \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:Nc\}$	$84  Vcij = \{\{(0.125*(V_c[i]^(1/3) + V_c[j]^(1/3))^3)/1000 \text{ for } i \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:Nc\}$	84	$Vcij = \{\{(0.125*(V_c[i]^(1/3) + V_c[j]^(1/3))^3)/1000 \text{ for } i \text{ in } 1:Nc\} \text{ for } j \text{ in } 1:Nc\}$

}; 85 V cm  $\models$ sum({{(x[i]\*x[j]\*Vcij[i,j]) for i in 1:Nc} for j in 1:Nc}); 86 V cm v=sum({{(y[i] \* y[j] \* Vcij[i,j]) for i in 1:Nc} for j in 1:Nc}); 87 88 T cm  $l=(1/(V \text{ cm } l^n))*sum(\{\{(x[i]*x[j]*Vcij[i,j]^n *Tcij[i,j]) \text{ for } i \text{ in } 1:Nc\}\}$  for 89 j **in** 1:Nc});  $T_cm_v = (1/(V_cm_v^n)) * sum(\{\{(y[i]*y[j]*Vcij[i,j]^n * Tcij[i,j]) for i in 1:Nc\} for i in 1:Nc\} for i in 1:Nc\}$ 90 j **in** 1:Nc}); 91 P cm l = ((0.2905 - (0.085 \* omega l)) \* R \* T cm l) / V cm l;92 P cm v=((0.2905 - (0.085 \* omega v)) \* R\*T cm v)/V cm v; 93 94 Z cm l=(P cm l\*V cm l)/(R\*T cm l);95Z cm v = (P cm v \* V cm v) / (R \* T cm v);96 97 T r l=T/T cm l; 98 T r v=T/T cm v; 99 100 P r l=P/P cm l; 101  $P_r_v=P/P_cm_v;$ 102103 104for i in 1:2 loop 105B  $l[i]=b1[i]-(b2[i]/T r l)-(b3[i]/(T r l^2))-(b4[i]/(T r l^3));$ 106 107 C  $l[i]=c1[i]-(c2[i]/T r l)+(c3[i]/(T r l^3));$ D l[i]=d1[i]+(d2[i]/T r l);108  $B_v[i] = b1[i] - (b2[i]/T_r_v) - (b3[i]/(T_r_v^2)) - (b4[i]/(T_r_v^3));$ 109  $C_v[i] = c1[i] - (c2[i]/T_r_v) + (c3[i]/(T_r_v^3));$ 110 D v[i] = d1[i] + (d2[i]/T r v);111 112  $(P r l*V r l[i])/T r l = 1 + (B l[i]/V r l[i]) + (C l[i]/(V r l[i]^2)) + (D l[i]/(V r l))$ 113 gamma[i]/V\_r\_l[i]^2));  $\begin{array}{c} (P\_r\_v*V\_r\_v[i])/T\_r\_v=1+ & (B\_v[i]/V\_r\_v[i]) + (C\_v[i]/(V\_r\_v[i]^2)) + (D\_v[i]/(V\_r\_v[i]^2)) \\ & [i]^5) + ((c4[i]/((T\_r\_v^3)*(V\_r\_v[i]^2)))*(beta[i]+(gamma[i]/V\_r\_v[i]^2))*exp(-1) \\ \end{array}$ 114gamma  $[i]/V r v [i]^2$ ; 115z l[i] = (P r l\*V r l[i]) / (T r l);116z v[i] = (P r v V r v[i]) / (T r v);117end for 118 $Z_l=z_l[1] + ((omega_l/omega_r)*(z_l[2]-z_l[1]));$ 119  $Z_v = z_v [1] + ((omega_v/omega_r) * (z_v [2] - z_v [1]));$ 120 121 //fugacity coefficient calculation 122 for i in 1:2 loop 123124 $|^{2})) + \exp(-\text{gamma}[i]/(V r l[i]^{2})));$ 125 $[^{2})) \approx \exp(-\text{gamma}[i]/(V r v[i]^{2})));$  $phi_{l}[i] = exp(z_{l}[i]-1-(log(z_{l}[i]))+(B_{l}[i]/V_{r}_{l}[i])+(C_{l}[i]/(2*V_{r}_{l}[i]^{2}))+(D_{l}[i]/(2*V_{r}_{l}[i]^{2}))$ 126 $[i]/(5*V_r_l[i]^5))+E_l[i]);$ phi v[i]=exp(z v[i]-1-(log(z v[i]))+(B v[i]/V r v[i])+(C v[i]/(2\*V r v[i]^2))+(D v[i]/(2\*V r v[i]^2)) 127 $[i]/(5*V r v[i]^5))+E v[i]);$ end for: 128 phi lm=exp(log(phi l[1])+((omega l/omega r)\*(log(phi l[2])-log(phi l[1]))));129 $phi_vm=exp(log(phi_v[1])+((omega_v/omega_r)*(log(phi_v[2])-log(phi_v[1]))));$ 130 131//enthalpy deviation 132for i in 1:2 loop 133 del h l[i] = T r l\*(z l[i]-1-((b2[i]+((2\*b3[i])/T r l) + (3\*b4[i]/T r l^2))/(T r l\* 134

 $V r l[i]) - ((c2[i]-((3*c3[i])/T r l^2))/(2*T r l*(V r l[i]^2)))+(d2[i]/(5*T))$ 

$$\begin{array}{ccc} T_r_l*(V_r_l[i]^5)) + (3*E_l[i]));\\ 135 & del_h_v[i] = T_r_v*(z_v[i]^{-1} - ((b2[i] + ((2*b3[i])/T_r_v) + (3*b4[i]/T_r_v^2))/(T_r_v* \\ & V_r_v[i])) - ((c2[i] - ((3*c3[i])/T_r_v^2))/(2*T_r_v*(V_r_v[i]^2))) + (d2[i]/(5*T_r_v*(V_r_v[i]^5))) + (3*E_v[i]));\\ 136 & end for; \end{array}$$

- $\begin{array}{l} {\rm del\_h\_lm=del\_h\_l[1]+((omega\_l/omega\_r)*(del\_h\_l[2]-del\_h\_l[1]));} \\ {\rm del\_h\_vm=del\_h\_v[1]+((omega\_v/omega\_r)*(del\_h\_v[2]-del\_h\_v[1]));} \\ {\rm end\ LKPTest;} \end{array}$