Reaction Table for Two Reactions

To make a mole balance when there are two reactions, you proceed just as is done for one reaction, except that you do it twice. Choose as a basis 1.0 mole of methane, which also means 3.0 moles of water (steam). (These are arbitrary, as long as the steam/methane ratio is 3.0.) Let conv1 be the moles of methane reacting in the first reaction and conv2 be the moles of carbon monoxide reacting in the second reaction. Then the moles of each component are determined from the stoichiometry.

$CH_4 + H_2O \Leftrightarrow CO + 3H_2$

-conv1 -conv1 +conv1 + 3*conv1

$CO + H_2O \Leftrightarrow CO_2 + H_2$

-conv2 -conv2 +conv2 +conv2

Thus, the equations for all the species are

methane = 1–conv1
water = 3–conv1–conv2
CO = conv1–conv2
hydrogen = 3*conv1+conv2
CO2 = conv2

The mole fractions are these values divided by the sum of all of them. These come from the reaction table (like Table 4.2 and 4.3, but for two reactions):

4.7. RxnTable	moles in	reacting 1	reacting2	moles out
CH4	1	-conv1	0	1-conv1
H2O	3	-conv2	-conv2	3-conv1-conv2
CO	0	+conv1	-conv3	conv1-conv2
H2	0	+3*conv1	+conv2	3*conv1+conv2
CO2	0	0	+conv2	conv2
total	4	2*conv1	0	4+2*conv1

You then write the equation for equilibrium (Eq. 4.10) for each reaction.