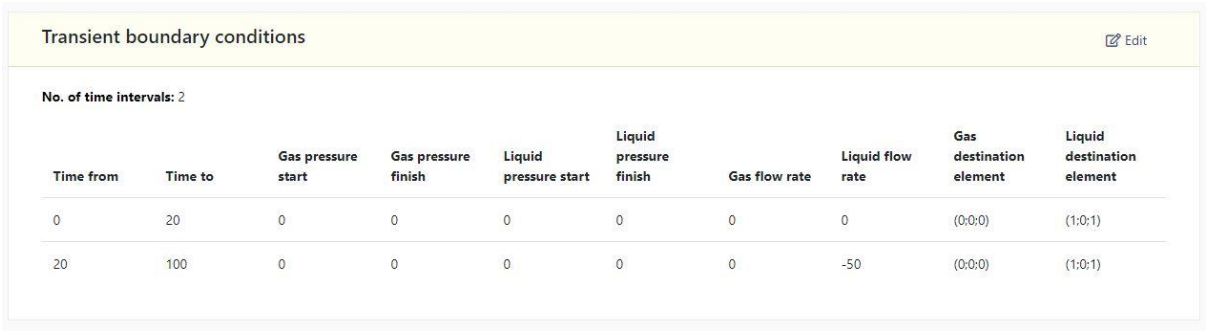
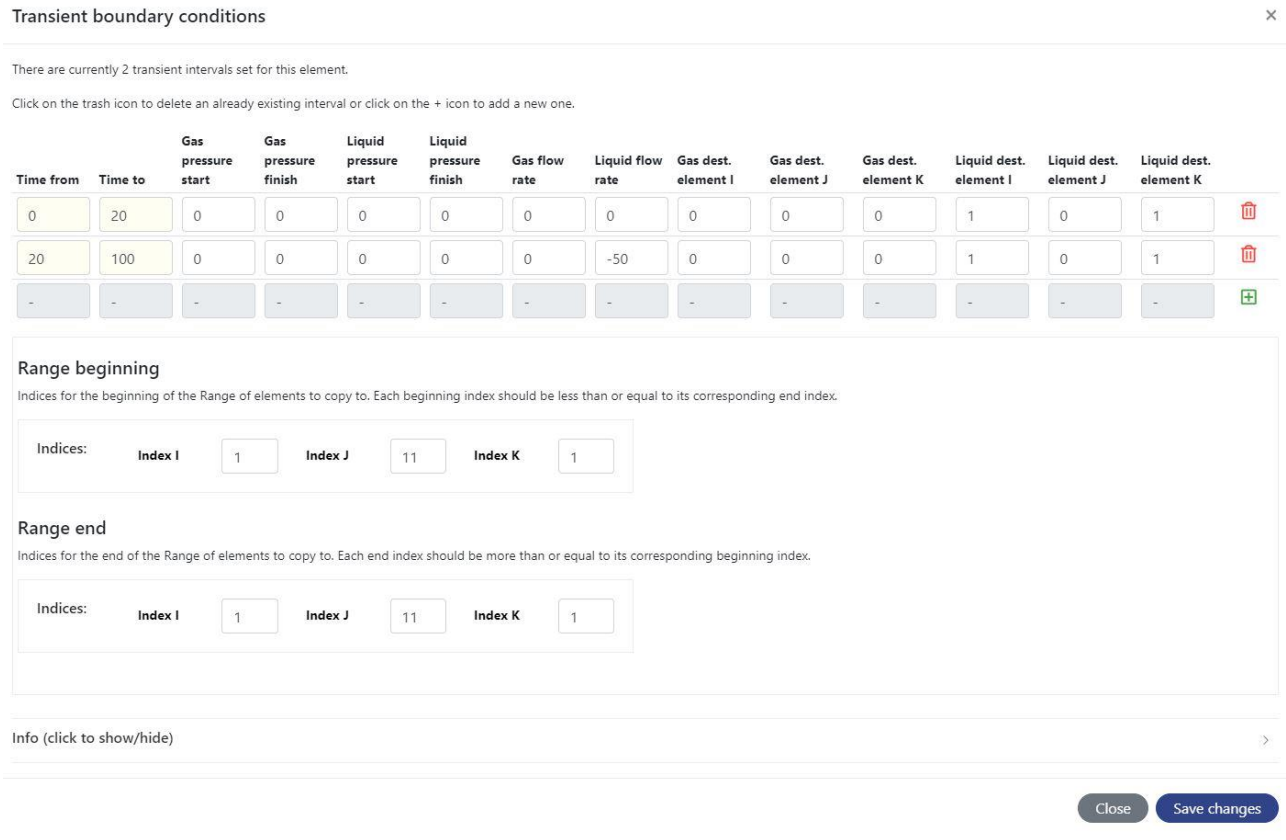
**How to set a transient boundary condition**

Transient, or time dependent, boundary conditions enable prescribed time related changes to be made to the gas and liquid pressures and masses in the boundary. These may be set up for a boundary element by entering the number of time intervals required to define the transient, and then entering data into a Table to define the behaviour of the key boundary parameters during each time interval.

Clicking on the Edit settings **Boundary elements** Tab reveals the boundary condition parameter groups, one of which is **Transient boundary conditions** which displays how many transient time intervals have been set for that element, and a read only Table of the current settings (if any).




Clicking on the Edit button shows a popup dialog containing an editable version of the transient Table for the element. You will be able to add and/or delete rows in the Table. For each row you can set the time intervals, the beginning and end of interval values for the element Gas and Liquid pressures, the Gas and Liquid flow rates out of the element and specify the destination elements that are to receive these flows.



You can also apply these settings to a Range of boundary elements by using the two Range element selectors.

For each time interval there are the following data items.

The times at the beginning and end of each interval, $t_{\min}$ and $t_{\max}$.

The rate at which mass of liquid is added or removed during the interval $\dot{m}^L$, and a similar item for gas $\dot{m}^G$.

The pressures of liquid at the beginning and end of the time interval $p^L_{t_{\min}}$ $p^L_{t_{\max}}$, and two similar items for gas $p^G_{t_{\min}}$ $p^G_{t_{\max}}$.

The destination elements to which the gas and liquid is being delivered from the source element.

In the time interval defined by $t > t_{\min}$ AND $t < t_{\max}$ operations are carried out to calculate the change in pressure in the element and/or the change in the mass of liquid and gas.

$$p^P_t = p^P_{t_{\min}} + \frac{p^P_{t_{\max}} - p^P_{t_{\min}}}{t_{\max} - t_{\min}}\left(t - t_{\min}\right)$$

$m^P_{n,t+\Delta t} = m^P_{n,t} + f_n^{m,P}\dot{m}^P\Delta t$ where $m^P_{n,t}$ is the current mass of the $n^{\text{th}}$ component in phase *P* and $f_n^{m,P}$ is the mass fraction of compound *n*.

The pressure changes are applied to the boundary element concerned, and the mass changes are applied to both this element and the destination elements.

Note again that it is important to specify both gas and liquid pressures as this sets the capillary pressure, which is later used, through the parameter $b_C$ in the flow algorithm, and in conjunction with the gas pressure to apply the boundary condition.

Note that the sign convention for flow values is –ve for flow being removed from the source boundary element.

When setting up a transient boundary condition in a boundary element the changes to the liquid and gas pressures apply only to that element. However the total phase mass changes apply to both the element which is termed the source element and the destination elements (one for liquid and one for gas), which are defined in the transient data. Any liquid mass extraction from the source element for example, will be reflected by an identical mass injection into the destination element, thus preserving the mass balance in the model.

When an increment of the total phase mass is removed from one element to another it is distributed amongst the individual compounds of the destination element in proportion to the mass fraction of compounds in the source element. As a result the mass fractions in the destination element are likely to change. This may or may not be the desired result depending upon the nature of the process that is being simulated by the transfer between the elements. For example, in the case of recirculation from a basal drain to an injection boundary at the top of a landfill column it may be required that the injected leachate has the same quality as the drain leachate. In this case the values of the compound volume fractions need to be continuously updated in relation to the contents of the boundary elements. However, if the leachate is expected to be treated to a fixed standard prior

to injection, then it would be more appropriate not to update the compound volume fractions in the injection boundary, but to leave them constant with values that reflect the fixed standard of treatment. The options whether or not to update the compound volume fractions in a particular boundary element are controlled using the ‘Boundary Conditions’ group Liq/Gas update fractions option for that element.