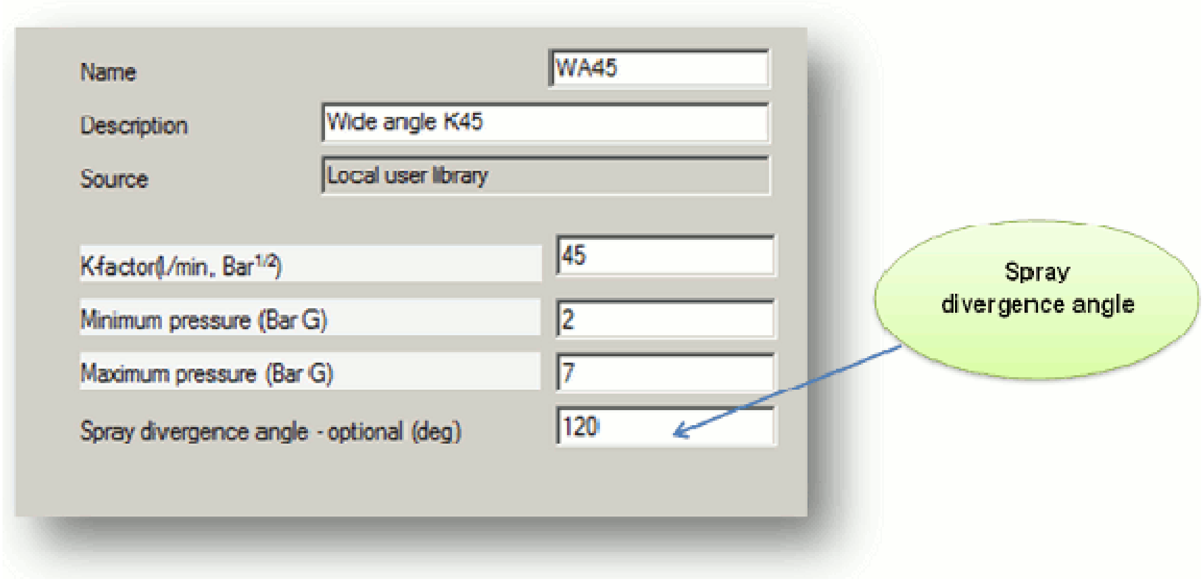
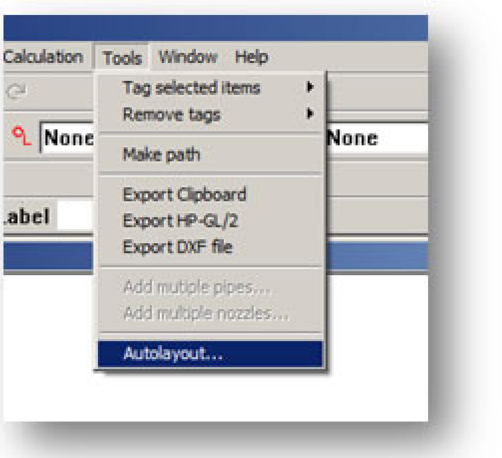
We assume here that the nozzle data has already been input into the library. Please note that the spray divergence angle must be input into the library. A dialog box for the nozzle in the library is shown below for illustration. (Please note that this is not the data used in the Autolayout example below. It is shown merely for illustration.)

Back to Contents



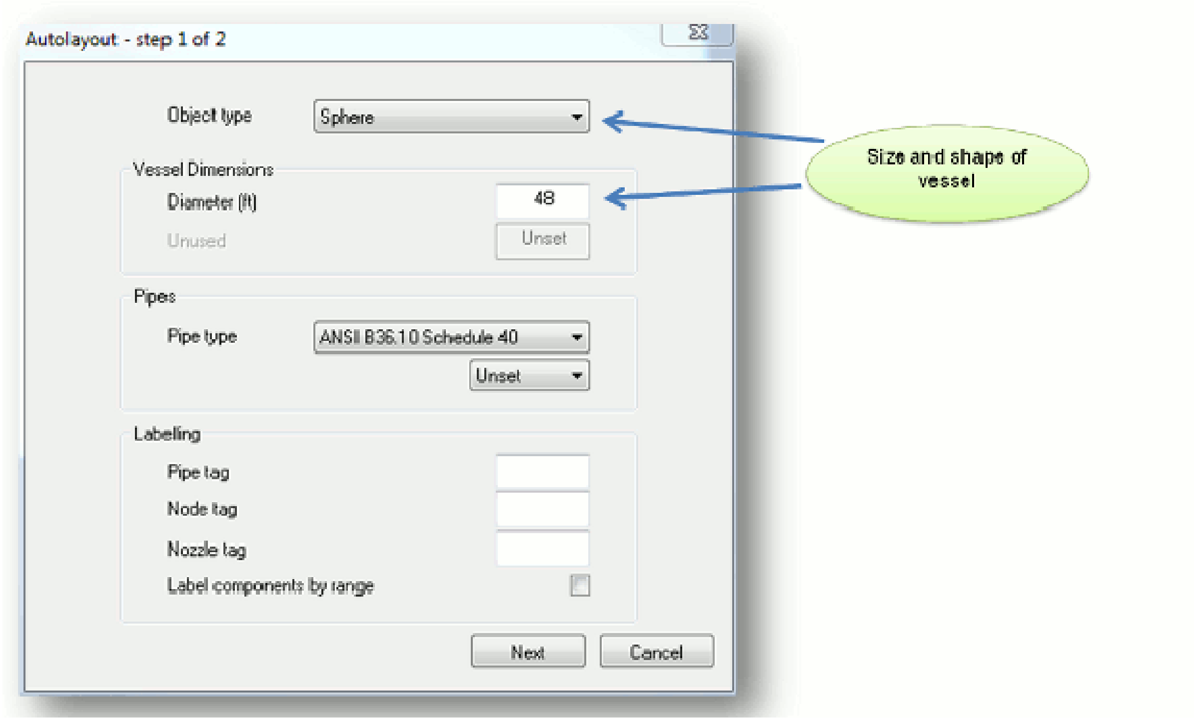
In **PIPENET** menu bar we click on the Autolayout option as shown below:



Back to Contents

1.1 Autolayout example

As mentioned above, we will consider the need to cover the lower hemisphere of a 48ft diameter spherical tank with a minimum of 0.1 gpm ft-2 at every point. The definition of the tank and basic pipe details are input in the dialog box below.

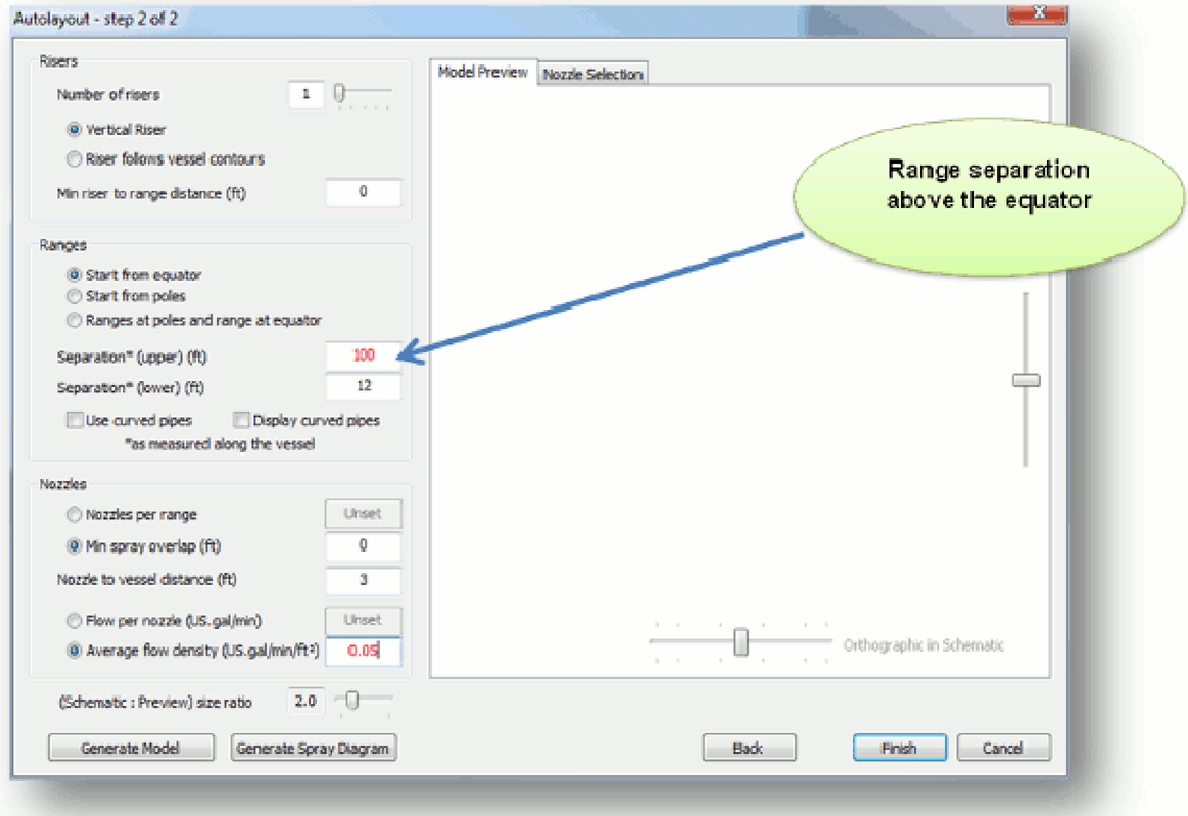


Back to Contents

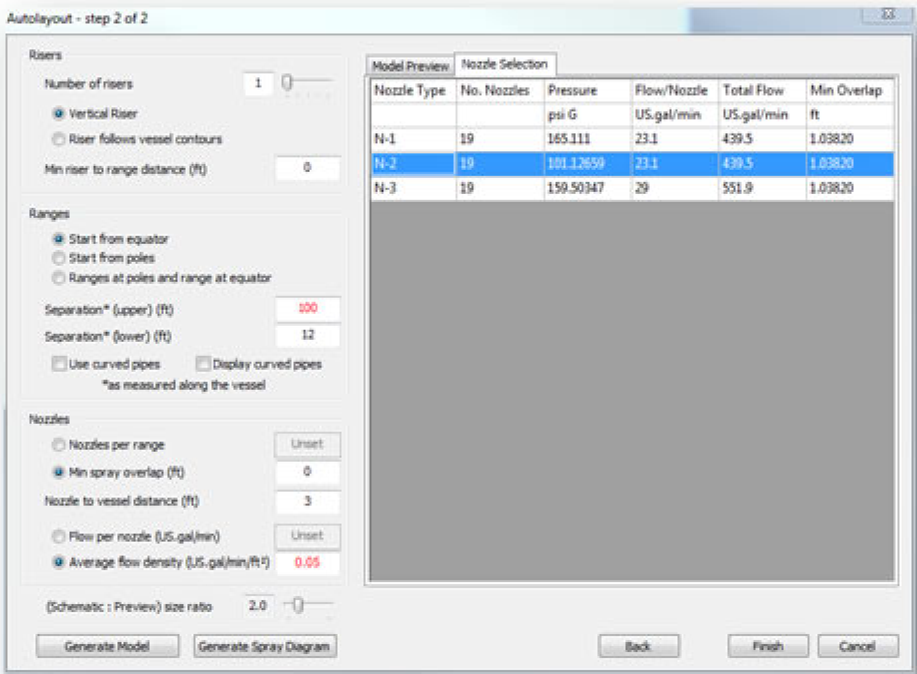
1.2 The Base Case

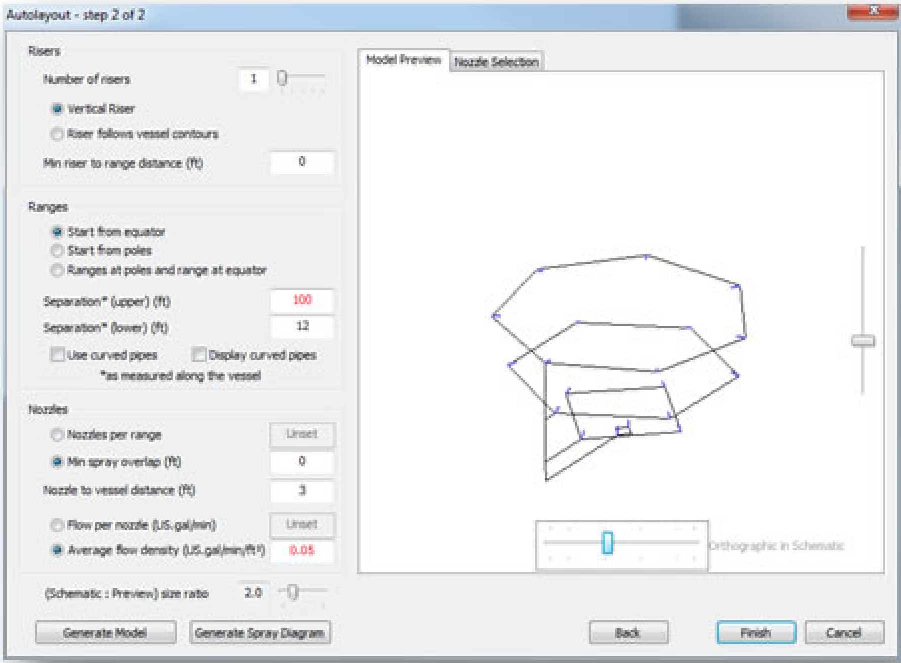
The initial setup of the model is shown in the dialog box below. As we are only interested in the lower hemisphere, we set the start point to be the equator, and set the upper hemisphere separation to be a large distance, so that no ranges appear above the equator. We achieve this by setting the vertical separation between the rows above the equator to 100 ft which is well above the separation prescribed in the NFPA rules. It is set to a value higher than half the diameter of the tank. So in effect the range above the equator is well above the top of the tank and does not form part of the model.

The minimum spray overlap was set to 0 ft and nozzle-vessel distance was set to 3 ft in the initial case – these will be changed later in further cases. The choice of the average flow density has initially been set to 0.05 gpm ft -2, to give a reasonable initial guess for the flow per nozzle. This is based on the total flow impacting on the vessel, divided by the surface area of the vessel; in other words this takes into account the whole of the sphere. As we know that the entire flow is impacting on only the lower hemisphere, we half this value in order to obtain the total flowrate from the nozzles on the lower half. This puts the value below the NFPA minimum for the entire sphere and turns the value red, but we are not considering the entire sphere and so this too can be ignored.

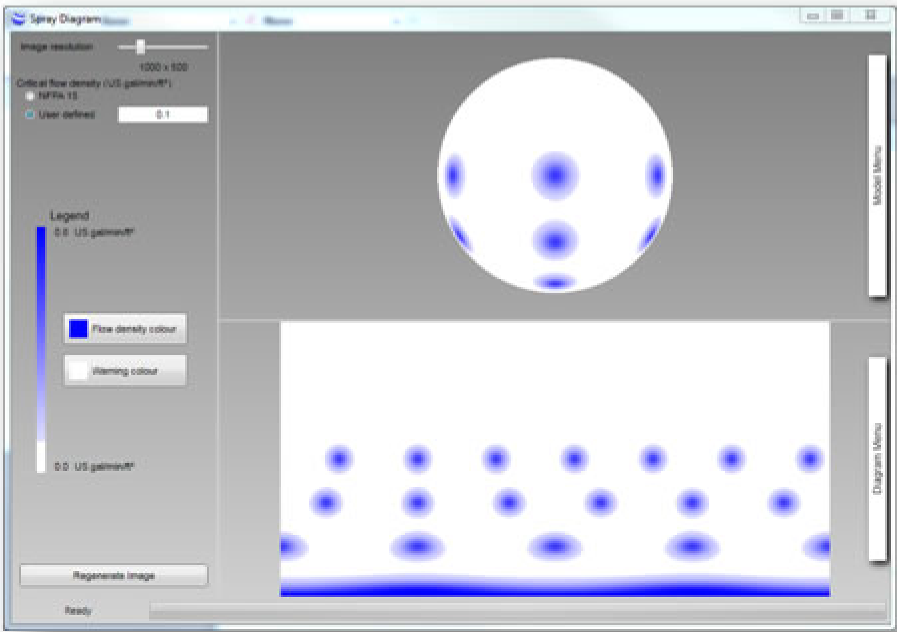


The library had 3 nozzles in this case. Our choice of nozzle N-2 below is arbitrary just to illustrate the dialog box. Note that the total flow for the chosen nozzle divided by the surface area of the vessel is $439.5/(\pi \, 48^2) = 0.0607$ gpm ft-2 which is significantly higher than 0.05. We will see why this is later on.



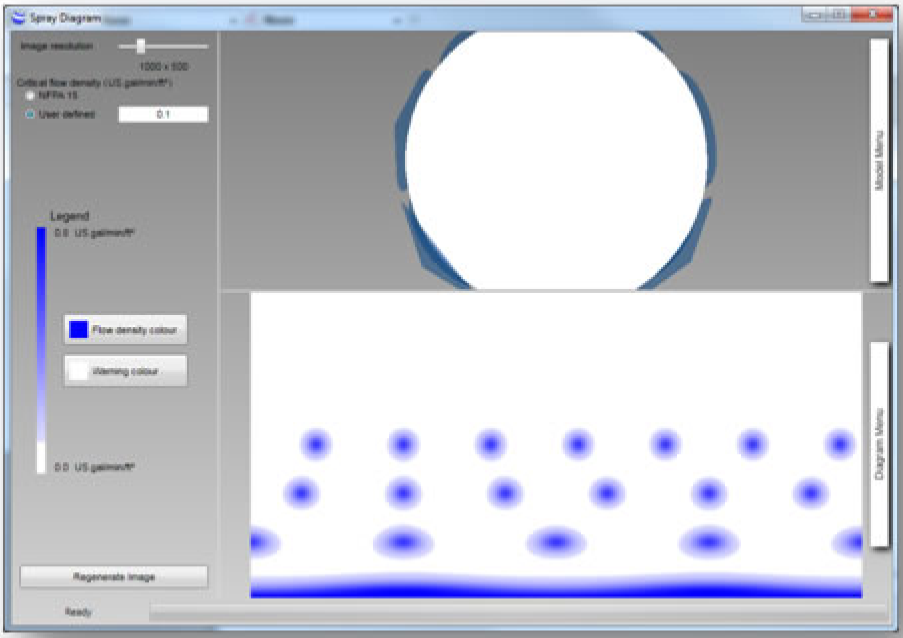


Generating the spray diagram for the model results in the following.



The same spray diagram with the sphere rotated to show the plan view results in the following. This diagram also shows the spray cone.
The critical flow density is set to be a user defined value of 0.1 gpm ft-2, the resolution is increased slightly, the warning colour is changed to white (in order to see the cut-off more clearly) and then regenerated the image. In the image in the bottom pane of the window we can see that the coverage is not good. Turning on the spray cones in the Model Menu panel, we also see that due to the wide spray angle of the nozzle and their distance from the vessel, much of the spray from the nozzles actually misses the vessel itself.

That flow is being completely wasted by not hitting the vessel. This inefficiency is the reason for the unnecessarily high value of the total flow required.

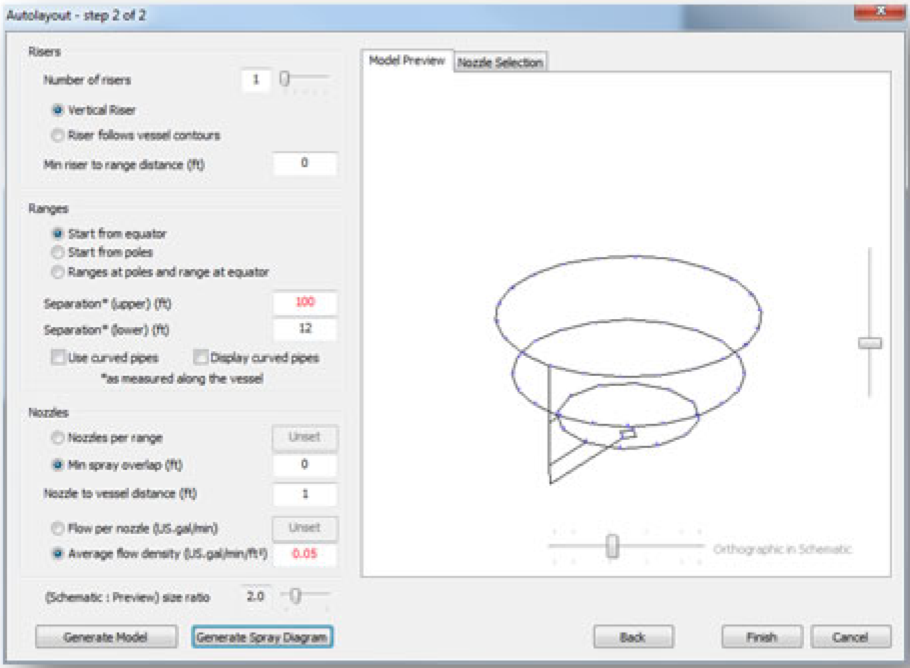


Back to Contents

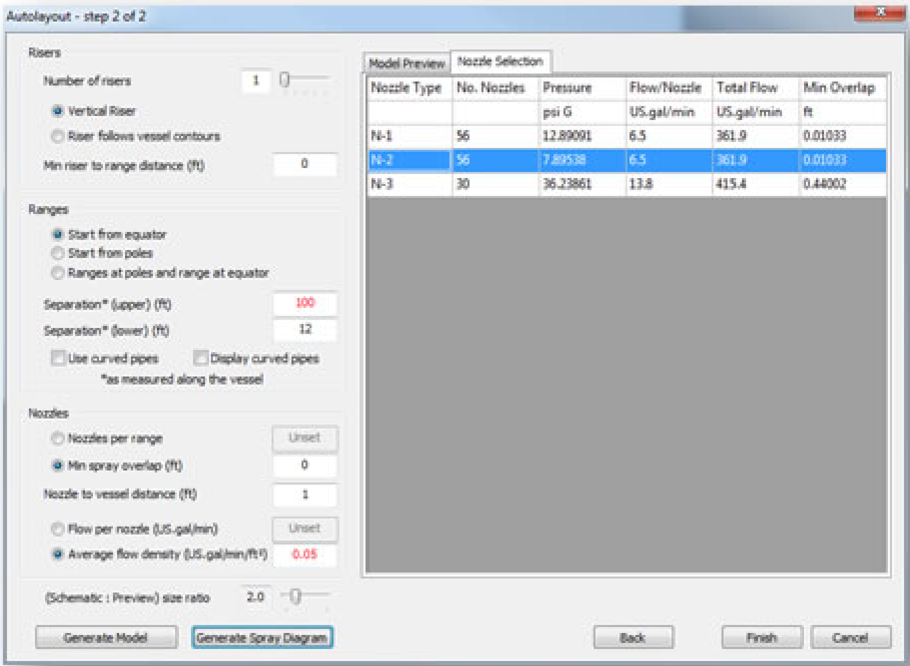
1.3 VARIATION 1: Effect of Bringing the Nozzles Closer to the Vessel

Optimization at your finger tips

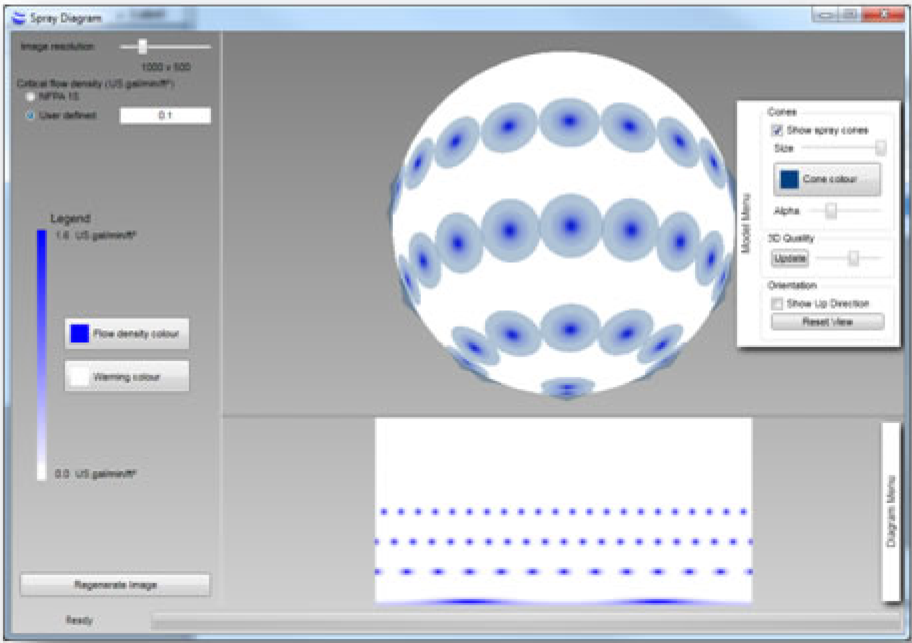
We return to the Autolayout dialog in **PIPENET** and reduce the nozzle-vessel distance to 1 ft from 3 ft. This may be considered to be too small but it is interesting to see its effect. It only costs a few seconds in time to generate another spray diagram.



It is indeed interesting to note that there is a large increase in the number of nozzles but each nozzle is required to flow less water. What is even more interesting to note is the fact that the total flowrate required is considerably less. On the other hand, the minimum required pressure at the nozzle inlet is also less. It is important to make sure that this is above the vendor recommended minimum pressure. It is true that the nozzles are horizontally spaced for the circles of spray impact to touch each other as required by the NFPA rules. The problem is not only a significant increase in the number of nozzles and a reduction in the inlet pressure of the nozzles. It can also be clearly seen that, as the nozzles are too close to the vessel, its coverage vertically is poor.



By generating a new spray diagram the following can be obtained:



The nozzle cones are shown and they are extended to full size so that they touch the sphere. We see that, although the nozzles are now utilizing 100% of their flow, there are now large areas of unprotected surface. So, increased efficiency and reduced flowrate have been obtained at the cost of increased number of nozzles and poor vertical coverage. Furthermore, the nozzles may be working below the vendor recommended minimum pressure.

Back to Contents