UNMASKING THE MYSTERY OF THE WORST CASE RELEASE & THE ALTERNATIVE RELEASE SCENARIO

by Lee Pyle, SCS Engineers

All of us with over 10,000 pounds of ammonia in our system are well aware of the EPA Risk Management Program Hazard Assessment requirements (40 CFR Part 68.20). Well, at least we have some note scribbled on a napkin or some unrecognizable report from a consultant regarding the topic. When the EPA inspector shows up, we hand them the manual and cross our fingers that they understand what they are reading and pray they do not ask a question.

Do not fret; chances are that the inspector at your plant is probably not much more fluent in dispersion modeling than you are.

In 1994, the EPA came out with their first draft of the RMP rule. It was not welcomed with open arms by industry. One of the biggest complaints was the potential expense associated with the Hazard Assessment portion of the draft regulation. With the comments received, EPA went back to the drawing board and came back with something much simpler as well as the RMP*Comp software. Good news — right. Well, yes, they simplified it such that it does not cost much to get a good Hazard Assessment report on paper. However, in the oversimplified of the process we have lost some of the finesse associated with the intricacies of dispersion modeling.

Let's start with the difference between the Worst Case Release (WCR) and the Alternative Release Scenario (ARS). Besides the obvious, which is that one is not likely to occur and the other is supposed to be more representative of a possible situation at your plant, one difference is the meteorological conditions are different:

- WCR: F Stability and 1.5 m/s wind speed
- ARS: D stability and 3 m/s wind speed

So what does that mean? Doesn't more wind push the release further? No, more wind speed means greater dilution of your "cloud".

What are the effects of "Stability"[1]? Our atmosphere is three-dimensional, not two-dimensional. Wind speed causes mixing of our "cloud" in the X and Y plane (down and outward) while Stability causes mixing of our "cloud" in the Z plane (up and down). Stability Class takes into account, time of day, incoming solar radiation, and surface wind speed. Class A is the most unstable category meaning greatest mixing and is typical daytime, strong incoming solar radiation, and low wind speed. Strong incoming solar radiation refers to a high sun angle with no cloud cover. Example, the tarmac at Phoenix Sky Harbor airport in July (aka turbulence).

F Stability is considered the most stable condition and is typical of nighttime, light to no cloud cover, and low wind speed. Example, 2 a.m. - 4 p.m.

How drastically does Stability and Wind Speed affect our release scenario? Let us run a Worst Case Release using each set of meteorological conditions with RMP*Comp[2] (*see figure 1*).

Another difference between the two release scenarios is that they use different techniques:

- Worst Case Release is a PUFF or INSTANTANEOUS Release
- Alternative Release Scenario is a STEADY STATE Release

A PUFF or INSTANTANEOUS release is when a large quantity is "dumped" in a short amount of time whereas a STEADY STATE release is a constant rate of release of an infinite amount of time.

Using the example again, let us use the worst-case meteorology but change the "dump" time (note that this is not allowed under the EPA RMP rule — you must use a 10-minute time for your INSTANTANEOUS release) (*see figure 2*).

Steady State Release:

One area of the regulation that can cause issues in an inspection is the criteria under the Alternative Release Scenario is 68.39 (c):

Documentation of estimated quantity released, release rate, and ***duration*** *of release.*

I have highlighted "duration" because when using a steady-state model, duration has no meaning. It assumes that there is a constant release over time. For an ammonia system, it assumes no pressure-drop following the initial release or that the pressure is constant (aka the compressors keep operating during our scenario).

Much debate occurs over how long it would take to stop a release. Some extremes include – what if it happens on a Friday night and the plant has no coverage over a weekend? Well, it could continue until the entire charge is released. Alternatively, we could have 24/7 coverage and a response team that can mobilize in 30 minutes. At the end of the day (or at the end of the EPA inspection), does it really matter when preparing the downwind distance for our ARS? No, because the RMP* Comp, Alternative Scenario is a "steady state" model (*see figure 3*).

While the logic is plain and clear, you still do not want to get into a debate with an EPA inspector. So best to go conservative on your response time and report a downwind distance of 0.1 miles than to have to justify being able to shut down a release in 30 minutes while still reporting a downwind distance of 0.1 miles. The last caveat for the ARS is to make sure the total quantity released does not exceed your WCR total quantity. Even though, we can release the same quantity using various parameters and get various answers, you just do not want to have to pull out this article to explain it all. Happy Modeling!

FIGURE 1

- Release Quantity = 10,000 pounds of ammonia
- Release is outside; there is no mitigation
- Release Rate = 10,000 pounds / 10 minutes = 1,000 pounds /minute
- Urban Terrain
- Level of Concern = 200 ppm

1.5 m/s and F Stability results in a downwind distance of **1.2 miles**

3.0 m/s and D Stability results in a downwind distance of **0.2 miles**

FIGURE 2

- Release Quantity = 10,000 pounds of ammonia
- Release is outside; there is no mitigation
- Urban Terrain
- Meteorological Conditions: F Stability and 1.5 m/s wind speed
- Level of Concern = 200 ppm

10-minute "instantaneous" release results in a downwind distance of **1.2 miles**

20-minute "instantaneous" release results in a downwind distance of **0.9 miles**

FIGURE 3

- Release Quantity = 10,000 pounds of ammonia
- Release Rate = 90 lbs. / minute (based on a pin-hole leak on the medium pressure liquid line)
- Release is outside; there is no mitigation
- Urban Terrain
- Meteorological Conditions: D Stability and 3 m/s wind speed (typical for the ARS)
- Level of Concern = 200 ppm

30-minute release (2,700 pounds) results in a downwind distance of **0.1 miles**

110-minute release (9,900 pounds) results in a downwind distance of **0.1 miles**