When Will Rail Authorities Start Addressing Active Fire Suppression for Rolling Stock?

Trains represent the oldest form of mass land transportation that is still in use today. Rolling stock in some form has been with us for over 200 years. Rail is one of the most energy-efficient transport modes and rolling stock conveyances are so popular because they are efficient, have less overall environmental impact than other forms of transportation, are a relatively inexpensive way to move freight, and most of all, rolling stock is safe.

In terms of safety, rolling stock is second only to commercial airlines. In the U.S. most incidents involving rolling stock are the result of a collision or derailment. In the UK, 78% of all rail fatalities are due to 'suicide by rail'. Fires on rolling stock are thankfully rare events with many of them being secondary to a collision or derailment.

But fires on rolling stock do occur, and often with catastrophic consequences. Since opening in 1994, the English Channel tunnel has experienced several high-profile fires that, while not resulting in fatalities, have resulted in significant downtime to the rail service. In other instances, those involved in rolling stock fire incidents have not been nearly so lucky.

One of the most significant, in terms of lives lost, is the Kaprun disaster that involved a funicular railway in Austria on 11 November 2000. In this incident, as the train was ascending through a tunnel, fire broke out in an unoccupied cabin that quickly spread throughout the conveyance. Before the event was over, the fire killed 155 people: 150 in the cars where the fire originated, two on the descending companion train, and three at the rail station on the summit. Only twelve people managed to survive the ordeal.

Kaprun Funicular Railway | Photo courtesy of: Wikipedia

Photos courtesy of: Fire Safety | FRA (dot.gov)

Controversy surrounded this incident with allegations of a coverup and several people receiving criminal indictments. Of immediate interest to investigators was the fact that the train was not equipped with engines or fuel and had no driver. There was only low-voltage equipment, hydraulic fluid to operate the brakes, and a single attendant charged with operating the doors.

The Kaprun fire was a perfect storm where circumstances conspired to make the disaster exponentially more horrific. Firstly, the fire broke out in an unoccupied cabin which gave it a several-minute head start before it was discovered. Secondly, the spreading fire burned through the hydraulic lines which, in addition to feeding the fire, caused the train to halt in the tunnel because of low hydraulic pressure. The descending companion train was already stopped in the tunnel waiting for the ascending train to pass.

In this instance, the tunnel contained the smoke and toxic fire gases and acted as a chimney to direct the fire gas effluent up the tunnel, past the companion train, and into the occupied rail station at the summit. Because hydraulic pressure was lost, the train's doors could not be opened, and shatter-resistant glass further hindered escape. Adding to the tragedy was that several passengers and the attendant who managed to escape the car egressed up the tunnel instead of downwards and were overcome in the smoke plume.

The ensuing investigation revealed that a faulty heater was the cause of the fire. The tragedy was that this incident was yet another example of a fire that started out small, was undetected, and with no fire suppression system present, grew unchallenged. As a result, many people perished.

There is no shortage of fire safety standards in the rail industry. But, when you examine the rail fire safety initiatives underway in both the U.S. and Europe, the focus appears to be squarely on passive fire protection measures.

According to the Federal Railroad Administration (FRA), their most pressing need is the "development of refined testing techniques and metrics of performance that can be applied by car manufacturers and operating authorities for new equipment purchases." The FRA seems mostly concerned with the burning characteristics of the materials used in the manufacture and furnishing of passenger railcars.

In the European Union (EU), the story is almost the same. Proposed improvements to TRANSFEU (Transport Fire Safety Engineering in the European Union) standards call for better and more dynamic modelling and measurement capabilities in predicting fire behaviour and controlling the production of toxic effluents from burning materials. Materials fire testing is a huge business in the EU.

Absent from all these initiatives is the demand for better fire suppression should a fire break out. While reducing the flammability of materials and selecting materials that do not off-gas toxic vapours is a critical task, experience has taught us that you cannot wholly rely on passive fire protection measures.

The rail industry needs to recognise that even if cabin materials and cabin layout are designed to resist fire to the greatest degree possible, all of the personal belongings and luggage with which passengers board are not subject to the same flammability standards. Therefore, the entire fire behaviour modelling – based on combustion of the as-built contents of the car – is incomplete.

In the case of the Kaprun disaster, had there been any form of fire suppression in the car where the fire originated, the event would have made a good story for the train's occupants after they enjoyed a day of skiing. But because the sole focus is passive fire suppression, everything is left to chance once a fire gains a foothold.

Rail authorities need the realisation that passive fireproofing measures are only one part of the fire protection triangle for rolling stock. Of equal importance is the timely detection of fires.

Find out more!

Rolling Stock Fire Protection Triangle

But conspicuously missing is the inclusion of an active fire suppression system. Fire suppression on rolling stock can be challenging because it is mobile and is comprised of individual railcars that may change as the train runs its route. These two factors rule out legacy fire suppression systems such as sprinkler systems. Clean agent systems are a possibility for the locomotive and other select locations but are difficult to extend from one car to another.

Two areas need fire suppression: where the known fire hazards exist, such as the traction motor compartments in the locomotive, as well as around the fuel system and electrical cabinets and in the passenger railcars to quickly suppress a fire, allowing time for the occupants to escape.

Because of the perceived difficulties in developing a suitable system, it has largely been eschewed in favour of passive measures. But innovative changes in fire suppression systems have resulted in new agents and delivery methods that appear tailored to rolling stock fire suppression.

The authorities with jurisdiction need to make the critical decision to address the fire suppression leg of the rolling stock fire protection triangle. They should do this by mandating effective fire suppression measures on rolling stock, but especially in occupied areas such as passenger and sleeper cars.

The solution is readily available and relatively inexpensive. If this decision is not undertaken, it is only a matter of time before there is yet another tragic rolling stock disaster.

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