Protecting rail yards with new developments in fire fighting

The ultimate safety for firefighters: distant from the source. Railway yards, or marshalling yards, are a special and unique type of establishments. In railway yards, trains are split, re-assembled or parked pending a new destination. The high numbers of trains, wagons and locomotives that are shunted on the yard entails specific risks, especially when hazardous materials are involved.

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Trains can unexpectedly collide or derail, resulting in spills, leakage or fires of chemicals. Combating such an incident can't be compared with regular firefighting tasks. The complex environment demands specialist expertise, equipment and dedicated safety measures. In addition, there are specific risks for the firefighters during an intervention. So, are there innovative developments in the field of fire safety that facilitate a safer intervention? And can we reach the ultimate safety for firefighters: a solid, but humanless intervention?

Risks on railway yards

A railway yard is a limited part of the railway infrastructure, off the main lines, where activities with trains and individual train wagons are carried out. These activities include among others the storing and sorting of train wagons and locomotives. The sorting of the wagons can be done in different ways. On a flat yard the sorting will for example be done by a locomotive, on a hump yard by rolling wagons from a hump to the right track. Rail yards consist of a complex series of railroad tracks, connected by switches and crossings, often close together. The larger railway yards may be kilometres long and up to 50 or 60 tracks wide. Most yards are partly electrified by overhead lines. Hundreds to several thousands of freight wagons are sorted and shunted on the larger yards every day. Railway yards are usually located at major railway junctions, industrial areas or seaports. A railway yard thus forms an important link between seaports, industrial areas and the hinterland.

The many wagons close together pose special risks, especially when the wagons transport hazardous materials. A leak on a wagon does not only have to arise after a collision or derailment of one or more wagons. A leak can also be caused by the

▼ **Wagons with chemicals close together on the railway yard Kijfhoek.**

▶ Derailed tanker-wagon on a Dutch railway yard.

failure of the wagon itself, for example due to age, corrosion or improper closing of valves. Because of the risk of a possible accident with hazardous materials, and the large effects this can pose to the external environment, a railway yard can be appointed as a Seveso- or COMAH-establishment. This means a yard needs to take special measures to prevent accidents with hazardous materials. Despite the measures taken, accidents with hazardous materials can still occur and the responsible authority for the railway yards has to prepare for that as well.

Credible scenarios on yards

On November 22, 1988 the voluntary fire brigade in the German town Seevetal was alarmed for an incident at the largest rail yard in Europe in Maschen (near Hamburg). A wagon was leaking sodium cyanide, which forms toxic hydrogen cyanide when it comes in contact with water. Local incident-volunteers at the yard started suppression of the incident, but alarmed Seevetal after 10 hours. And the responders of Seevetal needed the support of the Hamburg fire service to finish the job. On January 14, 2011, things went wrong at Kijfhoek, the largest railway yard in the Netherlands. The local fire service of the municipality of Zwijndrecht was called for a burning wagon with ethanol. For a long time, the fire brigade had difficulties in determining the burning chemical and the chemicals in the surrounding wagons. As a result of that, it took a long time to determine the appropriate intervention strategy. On October 5, 2012, the North Platte Fire Department (Nebraska, USA) was called to the largest railway yard in the world, the Bailey Railyard. This time not a wagon was leaking or on fire, but a large storage tank filled with diesel fuel for the locomotives on the yard, short circuited, resulting in a full surface tank fire.

Fire protection on rail yards: challenges

All the accidents described above have one thing in common: they all belonged to the predetermined risk profile for the locations. However, the chance of occurrence was considered so small that the fire services were not sufficiently prepared for this with neither knowledge, preplanning nor resources. Controlling the accidents required a lot of time and specialist support from neighbouring fire services. After the accidents, all three yards considerably reinforced in terms of operational effectiveness for firefighting and emergency response. Maschen and Kijfhoek nowadays have their own on-site fire service in addition to the voluntary fire services of the local government. The North Platte Fire Brigade is significantly reinforced with equipment, vehicles and foam divided over three fire stations in a 26.500 community.

The accidents show that rail yards share some challenges with fighting fires or chemical spills in and around wagons. Examples of the challenges are, among others:

- the huge dimensions of railway yards and the large number of tracks side by side;
- partial electrification of the yard with overhead lines;
- the limited availability of large amounts of firewater for suppression-activities;
- difficulty of rail-connection for road fifi-vehicles;
- the limited accessibility and bad sightlines for firefighters;
- information about content of the wagons, especially the one with chemicals;
- limited space between the wagons and the height of wagons of over 4 meters.

▼ Ethanol-wagon on fire at Kijfhoek: how to be effective on a large distance.

© Image courtesy of Sven van Beek

All these challenges come together in the surroundings where a fireteam has to perform.

When removal and isolation of an incident-wagon is no option, most intervention-tactics on railway yards are based on firefighters moving hoses and monitors between the railroad tracks and wagons. However, this is a labour-intensive strategy with high risks for firefighters as a result of poor sightlines and the risks of rolling stock, electrical overhead lines and falling over the railway tracks. When an accident escalates it's very difficult for the firefighters to escape the yard and there is a risk of getting trapped between the (burning) wagons. In addition, such an intervention takes a lot of time. After the accident in Kijfhoek they calculated it takes a firefighter, packed with hoses and full equipment, two minutes to cross one railway track. This means that when a fire takes place at a wagon in the middle of the yard, it possibly takes tens of minutes to reach the accident location. In the meantime, the fire can escalate to the many other wagons on the yard.

Tactics without people in the frontline

The question arises whether a safer and quicker intervention is possible. The most obvious way for a safer intervention is the installation of fixed systems, such as a large-capacity water network with ground sprinkler systems or remote-operated monitors. The biggest advantage is the immediate availability of the systems, so that no valuable time is lost. In addition, firefighters are not exposed to the risks of the railway yard. The big question, however, is the feasibility of fixed systems. When the yard is a few tracks wide, a sprinkler system is easy to install, but on a yard of tens of tracks wide and kilometres long it is an extensive measure, both technically and financially. Besides, a fixed system can often only be used for a specific incident type, in a predetermined manner and at a single location. Something which is not practical in a large railway yard, when there is a need for more flexibility in the intervention strategy to be chosen.

In a large and complex railway yard it seems impossible to escape from an intervention with mobile equipment. Reasons why railway yards are experimenting with new types of mobile interventions. One example is the deployment of fire engines with high capacity roof monitors, possibly placed on beams. With monitor capacities of 5.000 litre per minute or more, it would be possible to reach the wagons in the middle of the railyard from a larger distance, for example from the side of the railyard or from a special emergency road in the middle of the yard. Such an intervention means firefighters don't need to move between the railroad tracks anymore.

In Belgium they tested the Turboslöscher from BASF (6.000 l/min) on the yard in the harbour of Antwerp Noord. The biggest problem with such an intervention is to organize enough water intake within a limited time. Many railway yards don't have a sufficient water supply.

The solutions for all the problems

▼ **Firefighters between wagons during an exercise.**

© Image courtesy of Prorail/Stefan Verkerk

◀ **Fire truck with high volume water/foam: prepared for aside the yard and between tracks.**

mentioned above, may lie in an overall 'humanless' intervention. Over the last few years many new products have been developed in the field of fire safety and fire protection regarding interventions with distant firefighters. Many of these developments can be applied on rail yards. For example (semi) automatically, remotely operated vehicles. Several companies have developed firefighting robots that can move over rail and even the somewhat older firefighting trains can possibly be automated. These trains or robots can drive over the rails close to the accident location and start shielding-, cooling- or extinguishing tasks.

Essential: free tracks

When remote controlled suppression equipment, train vehicles or robot(s) are considered, one important precondition has to be taken into account: the logistics or shunting-software used on the yard must be able to organize free tracks for the train or robot in the case of an accident. It is not important where the empty tracks are located, as long as it automatically ensures that between a span of eight or ten filled tracks, there is always an open track for the fire extinguishing train or robot. The deployment of the trains or robots can be supported by the use of (autonomous) drones with (thermal imaging) cameras. Especially, on a large and broad yard with hundreds of wagons, a drone can provide a good overview. Universities are developing autonomous drones with nano sensors that can identify the composition and amounts of hazardous materials in a toxic cloud. In contrast to the current situation, where fire services take measurements on the ground, this allows fire services to gain better insight into the hazardous materials that are involved and the way in which the clouds have spread.

Food for thought

The deployment of autonomous rail vehicles like firefighting trains or robots have a big advantage: firefighters can stay at a distance and only have to come close to the accident if they have all the information to do this well prepared and at an acceptable risk. A direct deployment of firefighters between the tracks is with these new developments no longer necessary and an intervention can take place much faster and safer compared with the current intervention strategies in railway yards. Because there are no firefighters needed to roll out hoses and set up mobile equipment, another advantage will be the limited number of firefighters that are needed for the intervention. This makes it possible to optimize vehicle requirements and scale down in the number of staffing of an industrial fire team.

The rail authorities in the Netherlands are rapidly developing new fire tactics, from large team hose-carriers in 2010 to smart use of a high-capacity foam truck between the track, looking for direct knock-down in 2020. The next step comes with further innovation: getting the equipment remotely to the incident and keeping the responders distant, in the safe zone.

In the end every emergency response organization has the same responsibility: creating maximum safety for the people who do the most difficult work.

For more information, go to www.kappetijn.eu

▼ **Example of remotely operated firefighting robot.**