

<Lessons learned – X2000 collision with a heavy guided vehicle>

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SUMMARY

The use of heavy track equipment/vehicles is increasing and at the same time that the demand for capacity for traffic is higher than ever. This abstract is about lessons learned from the fatal accident in Kimstad when a track guided backhoe was hit by SJ X2000 train No. 505 at Kimstad. The collision occurred when the working equipment, a guided road rail vehicle (backhoe), entered the safety zone of the adjacent track. The digger attempted to transport itself on the track to the site where neutralization of rails for track replacement should be performed. In the accident one passenger was killed and 16 were injured.

At 19.37 in the evening of September 12th 2010 a a guided backhoe loader was hit by a X2000 train running on the adjacent track. Rather, the backhoe loader hit the train, several times..

The accident happened when the back hoe loader was entering the track to go to its working place further along the track. The backhoe loader slid the rail. As the driver was inexperienced to work in the track area the efforts to get back on the rail did not work. The train was hit by the backhoes bucket, and due to the trains speed, it spun around several times and each time it spun the bucket hit the train

The accident investigation report from the infrastructure manager is completed.

The investigation from the Swedish Accident Investigation Authority is planned to be released later this year.



1. *The back hoe after the accident.*



2. *Part of the damaged train.*

Damage

In connection with the collision train 505 derailed with one bogie and then went perverted 91 meters by switch No. 106, where the derailed bogie hit the cross section of the switch. Causing the wheel bogie to climb back on track and the train continued a few 100 meters before it stopped. In the accident one person was killed and 17 were injured and there was an emission of about 250 liters of hydraulic oil.

Damage was caused to infrastructure where rails and sleepers were damaged on both tracks. A switch on the track carrying the train was damaged by the derailed train, especially the crossing part that had to be replaced. The catenarie system was also damaged when two articulated support wires to an mast of an overhead line was hit by the backhoe as it went out. When the IM accident report was completed there were known cost for rehabilitation of infrastructure to 1.1 million SEK The railway company's costs for damage to train 505 were about 10 million SEK. The damage to the buck hoe loader was great and the machine was considered scrap and contractor costs for damage to the machine were at the completion of the investigation to 1.5 million SEK.

Recording equipment on the train shows that the train kept under the speed limit (135 km/h). At the time of collision speed was 133 km/h. The distance between the two tracks was 3,22 m.

Causes

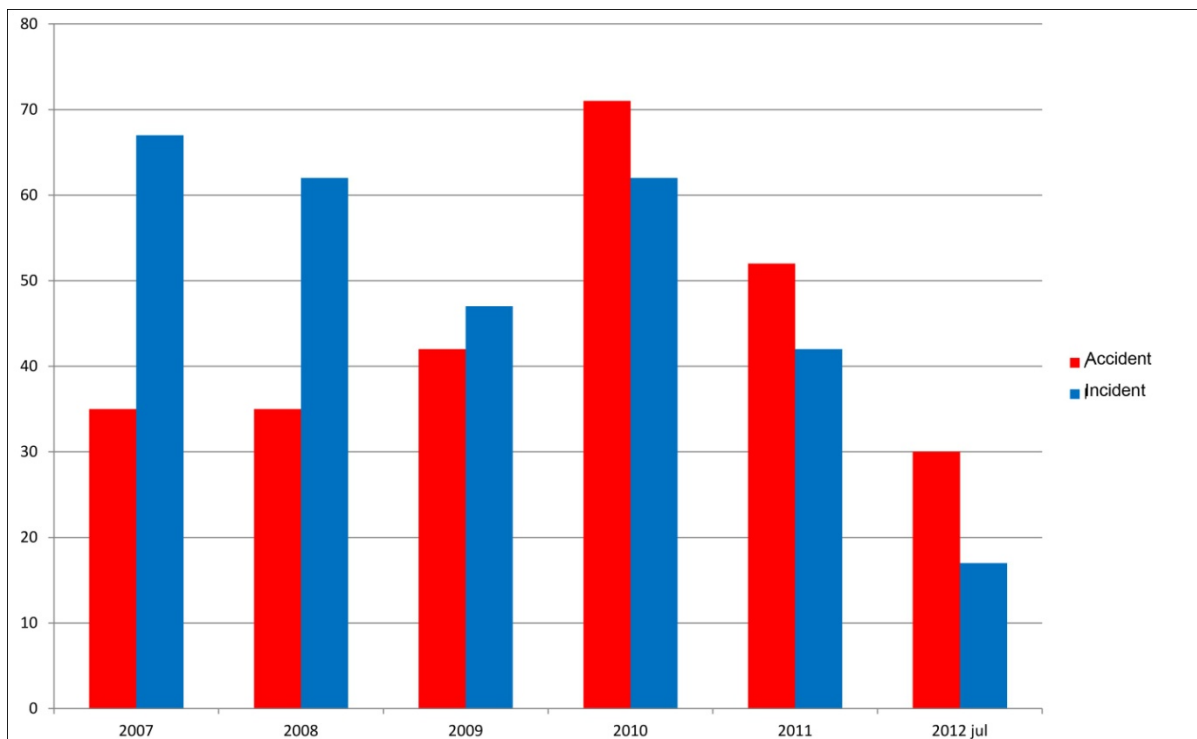
The direct cause of the accident was that the backhoe came into the safety zone as the operator turned the machine through its centre pivot oscillation in an attempt to get the machine back on the rails again.

The crucial broken barriers can be explained by the fact that no-protection for the adjacent track was requested. I. e. the adjacent track was open to traffic. Had that track been closed to traffic, the accident had never occurred.

A number of causes have had a negative impact on the course of events but were not decisive.

- Infringement of the trains safety zone was not included in the risk analysis, even though the risk analysis was made according to the rules it was not complete.
- An intrusion into the safety zone was not included in the risk assessment for the work environment safety plan either. Since both of these were missing, no protection of the other track was asked for and the traffic was still running...
- The driver, employed by a subcontractor to the contractor had not been informed of the rules for guided vehicles in the track.
- There was no requirement that drivers of guided vehicles need to know the rules for occupational health and safety activities at the track area
- The Supervisor did not have full view – as required by the rules. He had several vehicles in movement at the worksite
- No access ramp was used
- But most important – since the risk assessment did not include the adjacent track, there was no traffic shutdown on the line,

The greatest risk of catastrophic events



3. Accidents and incidents, Sweden January 2007 – July 2012. Guided vehicles.

The statistics show that the use of guided heavy vehicles is one of the greatest risks of catastrophic events in the railway today.

In the beginning of 2009 there was about 18.000 km railway in Sweden. Trafikverket is the IM for 14.475 km's of those 12.000 km are in the route network, and the rest is mostly yards and capillary tracks.

On the 12000 km managed by Trafikverket, there have been 265 accidents since 2007. But only 297 incidents reported.... This gives, a hint that there is underlying problems with unrecorded cases.

Rules changed in response of the accident

A few weeks after the accident the Trafikverket as the IM decided that

- Measures shall be taken in adjacent tracks when there is a risk that the vehicle / tools / equipment may interfere with the safety zone.
- Speed reductions, no more than 70 km/h is allowed past the workplaces. If the contractor believes that it the traffic still will interfere with the safety zone, a traffic shutdown is required on adjacent tracks.
- Work with track warning shall be conducted only on tracks with a maximum speed of 120 km/h
- It is a basic rule that work with track warning as a protection is not allowed on operational sites with more than four adjacent tracks. After special inventory and risk assessment, carried out by the contractor in consultation with the construction manager, work with train warning can be performed with the restrictions that are developed for the specific operation site.

The measures are put in force and their task is to strengthen the requirements of the Rules for occupational health and safety activities at the track area

The contractors also took action

The contractors took a number of precautions after the accident. As examples may be mentioned:

- The establishment and un-establishment of a guided vehicle is protected by closed traffic on the adjacent track.
- Maximum speed 40 km/h will be organized on adjacent tracks during the work hours.

Both of the above was abolished when the enhanced measures of Transport Administration became active.

- Installation of a second camera in the vehicle showing the front of the guided vehicle and the wheels position relative to the rails
- Safety education for all drivers of guided vehicles

And, the manufacturer of the backhoe, Huddig, have developed a anti derail device for guided vehicles

Contractors commented on their work environment:

- The speed is too high and the passing trains are to frequent at the track worksites,
- We need stricter requirements to help shut the traffic down completely or at least slow the trains down. - 40 km/h should be the highest speed allowed, for the sake of safety.

A new set of rules 8 months after the accident

New and changed rules were developed to replace the additional rules adopted right after the accident. The changes were entered into the regulations: Rules for occupational health and safety activities at the track area, 8 months after the accident.

The additional and changed rules were:

- A documented risk assessment should always be carried out before work in the track area, and in addition to the working environment safety plan, also contain clear planning of safety on adjacent tracks

The consequence reducing measure, speed restriction of 70 km/h on adjacent tracks, that were introduced in the decision on October 4, are removed and replaced with the security measure above.

The provisional decision track warning at maximum speed 120 km / h is abolished. As a safety measure the possibility to use outer track warning is removed, this limits the ability to work with protection form track warning if the visibility is inadequate.

When working with track warning at a operation site, the risk analysis determines the possibility of traffic shutdown or track warning and speed reductions. The prohibition of train warning at locations with more than four main tracks is dropped.

A checklist for risk assessment are developed as a separate document. The checklist document will be done in conjunction with the track contractors and other interested parties and submitted to the Transportation Board for review. After reviewing the checklist expected to be released in September, one year after the accident. This document should be used for risk assessment of all activities included in the planned work. The risk assessment should be first in the pre planning of the work, and then again for each activity involved.

The new set of rules pays special attention to evacuation for work conducted at operational sites.

A risk analysis of guided vehicles

At the same time as the new rules for track work was prepared, a risk analysis was made about heavy guided vehicles.

The risk analysis showed several problems.

- Policies and technical framework

The lack of clear technical framework for the design and performance of heavy track guided vehicles creates an ambiguity which in turn allows for various technical solutions that are not always thought through.

Many rules are governing the management of vehicles, but very few have focused on Road Rail Vehicles. The rules, however, is unclear and has not been updated in many years. As the technical framework and administrative rules and procedures fully or partially is missing, are unclear and/or not in harmony with each other. This also affects attitude and compliance with regulations in a negative way.

- Key barriers that will prevent the occurrence of accidents are missing or seriously weakened.

It is known that there are situations where the task of moving heavy vehicles is done in mutual understanding among dispatcher, supervisor and operator. This way of manipulating the rules for will claim them being a train and they can then be transported in a shunting mode

- Classification

The classification of machine individuals is also an area that needs to be analyzed. Should a large and heavy machine that is guided be considered as a vehicle or a tool? Some machines are also classed as both vehicles and tools which creates an ambiguity with risk of identity conflict. The regulations for the tools and vehicles are different and it is of the utmost weight to know which rules to apply.

- Education

It is a shortcoming that there are no requirements of adequate rail-specific training for operators of Road Rail Vehicle/work tools. It can't be expected that an operator has the right conditions to work in the railway environment if proper education is missing. The supervisor needs to have knowledge of the work tool properties. Training or experience in similar work can be recommended.

- Communications

The communication between the supervisor and the operator is an important tool that must work. Much will depend on if operators understand instructions from the supervisor and the supervisor knows that the operator understands the information correctly. Misunderstandings can be disastrous. Clear rules of communication must exist for information and instructions from supervisor and operator shall be properly understood.

- Conclusions

Performance and design of Road Rail Vehicle/tool is now completely uncontrolled and has no

governing regulations. It creates an ambiguity for track contractors and machine manufacturers. An unregulated activity leaves room for the emergence of various technical solutions that are often deficient. The administrative rules governing the movement of Road Rail Vehicle/tool is also perceived as cumbersome, bureaucratic and not adapted to the current situation. The movement may only occur within traffic operations

The regulation for heavy guided vehicles has not been updated since 1994. Many of the machine individuals who currently is classified as track guided work tools could be classified as vehicles. That would mean that they were covered by clear administrative and technical rules and must undergo an approval process.

The supervisor and the operator may not have the right conditions for working with Road Rail Vehicle implements. It is remarkable that an operator may act in railway environment without having sufficient knowledge of rail-specific conditions. The supervisor needs to have knowledge of the work tool-specific properties such as lift and swivel function, connectivity to the track, tipping function, or anything that may in any way affect safety.

Communication between the supervisor and operator affect much in the handling of tools and must be clear. This communication is not worth much if the parties misunderstand each other, it may even worsen the situation

This risk analysis formed the basis for the

New rules for Heavy guided vehicles

Since the risk analysis showed the need for new rules – the work began to construct the new rules. Some of the main issues in the new rules was..

- The supervisor's role and responsibilities have been clarified in the rule book.
- The operator's role and responsibilities have been expanded and clarified in the handling of Road Rail Vehicle. This means that a new qualification "operator for heavy rail-tools "is introduced.
- Risk assessment is introduced in the rule book to describe how work on Road Rail Vehicle/track guided tools should be planned
- Road Rail Vehicle/track guided tools that are self-sustaining should be equipped with working brakes. Brakes are mandatory on all new and rebuilt heavy rail-tools The brake shall be able to secure and maintain the Road Rail Vehicle/track guided tool still so it does not in any position can come in uncontrolled rolling.
- The requirements for daily operational check have been expanded by more points.
- Stopping distances: A table has been created with speeds and maximum stopping distances. This complies with the requirements of EN 15746-2.
- In the case of establishment of Road Rail Vehicle/track guided tools should an establishment method (eg "ramps") be used that will not damage the track or cause disruption to traffic.
- No more than two Road Rail Vehicle/track guided tools can linked together for transport. The hauling Road Rail Vehicle may not have more connected, after weight, than their own gross weight.
- The overall requirements of technical regulations have been clarified. Road Rail Vehicle/track guided tools must meet the technical requirements for use in the track area.
- As of June 2012 it is no longer possible to decide that a guided tool is a train for a short period of transport.

Conclusions

Since the accident at Kimstad a lot of work has been done, a lot more need to be done, the planning procedure is one. The possibility of closing part of the track and do all the maintenance work during a period is a solution we need to look into, and how that would affect traffic and maintenance. We also need to make sure that we follow up on the demands for education, rules and regulations we make in the procurements.

Looking at the recent workplace inspections made, we still have a long way to go.

Workplace inspections (2012-05-01 - 2012-08-31)

| Contractor | Number of inspections | No remark | | Minor remarks | | Serious deviations | |
|-----------------|-----------------------|-----------|-------|---------------|-------|--------------------|-------|
| | | | | | | | |
| Contractor no 1 | 76 | 3 | 4,0% | 47 | 61,8% | 26 | 34,2% |
| Contractor no 2 | 13 | 1 | 7,7% | 9 | 69,2% | 3 | 23,1% |
| Contractor no 3 | 9 | 1 | 11,1% | 3 | 33,3% | 5 | 55,6% |
| Contractor no 4 | 3 | 0 | 0,0% | 2 | 66,7% | 1 (SC) | 33,3% |
| Övriga | 23 | 5 | 21,7% | 7 | 30,4% | 11 | 47,8% |
| Summa | 124 | 10 | 5,0% | 68 | 60,4% | 45 | 33,6% |