Accident Investigation Board Norway

PRELIMINARY REPORT WITH IMMEDIATE SAFETY RECOMMENDATION

RAILWAY ACCIDENT ALNABRU - SJURSØYA 24 MARCH 2010

ISSUED 3 MAY 2010

The Accident Investigation Board Norway (AIBN) has drawn up this report for the sole purpose of improving railway safety. The purpose of this study is to identify faults or inadequacies, both causal factors and non-causal factors, that can weaken railway safety, and to make recommendations. It is not the AIBN's duty to apportion blame or liability under criminal or civil law. The use of this report for purposes other than preventive safety work should be avoided.

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1. INTRODUCTION

On Wednesday, 24 March 2010 at 13.04, a set of empty wagons started to roll uncontrolledly from track A5 at Alnabru freight yard. The wagons rolled out of the Alnabru marshalling yard and onto the freight-train track towards Loenga. They rolled past Bryn station and continued down to Loenga station. At Loenga station, the wagons passed through track 10 and rolled into Oslo Port's track system heading for Sjursøya. Some of the rearmost wagons derailed at Sørenga, while the rest crashed into the terminal building in Oslo Port's container terminal. Three people died and four were seriously injured. There was extensive damage to buildings, infrastructure, motor vehicles and wagons.

This report is a preliminary report from the AIBN, and it provides an overview of the results of the investigation so far. The report describes the chain of events and the factors that caused the wagons to break loose and not stop before they rolled into the Oslo Port area. The report identifies areas in which the AIBN believes immediate action should be taken to improve safety, and describes those areas that have so far been identified as requiring more extensive investigation for presentation in the final report.

The AIBN has decided to describe in some detail the technical and operational conditions at Alnabru where the wagons broke loose, and give a more summary description of the circumstances after the wagons left Alnabru.

The report is based on information obtained from interviews with personnel, inspections and reviews of relevant documentation. We cannot exclude the possibility that more problems and a need to revise some parts of this report may be identified when further information is collected and further analyses are conducted. We do not plan to publish further details relating to this case until the final report containing an analysis of the chain of events and the AIBN's conclusions is published.

Annexes A, B and C contain plan drawings and maps of the areas. Annex C 'Schematic map of Alnabru' can be unfolded and used as reference when reading the report.

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2. ESTABLISHING THE FACTS

2.1 Chain of events

The description contained in the following was compiled by the AIBN on the basis of interviews with those involved, a review of log sheets, CCTV recordings, track plans and observations. The stated speeds are primarily estimates, based on logged passing times and the video recordings of the runaway wagons that have been available so far.

The set of wagons that broke loose had arrived at Alnabru on 24 March 2010 at 03.10 as train 5806. On arrival, the locomotive was decoupled and the set of wagons was shunted to the container terminal for unloading at 03.20. Unloading of the wagons was completed at approximately 04.20, and they were shunted to track A5 in the Alnabru marshalling yard for parking, and the track's mechanical brakes were used to hold them in place. The set of wagons were scheduled to be shunted back to the container terminal for loading in the afternoon of the same day.

The set of wagons that was parked on track A5 consisted of ten six-axled special wagons for containers, tank frames and semi-trailers and five two-axled special wagons for containers. Before the wagons broke loose, a six-axled special wagon for semi-trailers was shunted in, so that the runaway train consisted of 16 wagons, was 458 metres long and weighed 435.5 tonns.

Figure 1: Two-axled wagon.

Figure 2: Six-axled wagon.

The final wagon was shunted into and coupled with the wagon set just before 13.00. The shunter called the local traffic controller in the central signal control tower at Alnabru and requested a shunting route from track R47 to track A5 North. This shunting route was set at 12.59. The shunting engine drove up to Alnabru North, and, on receiving the signal, shunted the wagon into the wagon set. Once the wagon had been coupled with the wagon set, the shunter returned to the shunting engine, called the local traffic controller over the shunting channel and asked how far train 5800 had come. Receiving that train for unloading was to be his next task. The shunter was told that the train was arriving at Alnabru and being driven onto the G track. Train 5800 passed the approach signal for Alnabru at 13.03. The shunter requested a shunting route for the shunting engine from A5 in the north to the G track.

The local traffic controller was convinced that the set of wagons on track A5 was being prepared for loading and that the shunting engine would shunt it onto the G track. The local traffic controller therefore set the shunting route to track G4 and requested that the dwarf signal be withdrawn to behind the signal point so that a route could be set from the container terminal up to the Grefsen line. The mechanical brake was released at 13.04.

The shunter waited for permission to commence shunting for 2-3 minutes before deciding to call the local traffic controller to remind him/her. The shunter then noticed that the wagon set had started moving down through track A, and called the local traffic controller to inform him that the shunting engine was not connected to the wagon set.

Once it became clear that the wagons were in motion, the local traffic controller attempted to stop them by using the lowering brakes. The attempt was unsuccessful and the wagon set continued downwards through track G4. Tracks G4 and G5 are not equipped with diversion points or buffer stops and so there were no barriers to stop the wagons rolling out of Alnabru South. The wagon set passed the main dispatch signal at Alnabru at 13.07:07 at a speed of approximately 30 km/h. After leaving the Alnabru marshalling yard, there were no barriers to stop the wagons.

Once the local traffic controller at Alnabru became aware that it was not possible to stop the wagons, the traffic controller on the Hovedbanen line was informed of the situation. The Hovedbanen traffic controller, whose place of work is the traffic control centre at Oslo Central Station (Oslo S), informed the shift foreman and the Oslo S traffic controller. The Hovedbanen traffic controller also verified that the wagons would not be able to enter the Hovedbanen track at Brobekk, Bryn or Kværner.

The wagons travelled along the freight train track from Alnabru down towards Bryn station. The wagon set was travelling at 60 km/h as it passed the main approach signal at Bryn station. The wagons passed the main dispatch signal at Bryn station at 13.10:30 at a speed of approximately 70 km/h.

The Oslo S traffic controller phoned the local traffic controller at Loenga and informed him about the situation. They discussed possible routes for the wagon set. It was considered whether to direct the wagons to the Østfold line, down towards Sjursøya, to tracks 7 or 8 at Loenga, or to track 10 at Loenga where the wagons could be derailed. The latter option was chosen and the route was prepared for driving onto track 10 'along the wall' . On approaching Loenga station, the speed of the wagon set had increased to roughly 120 km/h.

It was decided not to steer the wagons onto track 7 or 8, because two workers were carrying out repair work on the wagons parked there. There was insufficient time to locate and warn these people. The option of directing the wagons to the Østfold line was also considered, but, according to the calculations of the AIBN, the wagons, if they didn’t derail on leaving Loenga, would have continued a certain way beyond Ljan station and then rolled back in an uncontrolled manner. A local train was occupying the track between Bekkelaget and Nordstrand stations. This was contacted and instructed to proceed towards Ski station.

The wagon set continued on track 10 at 13.12:40 without derailing. Its speed had now reached about 125 km/h. A derailer is installed at the southern end of track 10, and it was expected that this would derail the wagons so that they would stop. Instead, the derailer was cut clean off and was found 250-300 metres further down the track. The wagons ran through the derailer at 13.12.54. The wagons passed Loenga station at 13.13.00 and continued along Oslo Port's track system towards Sjursøya.

On leaving Loenga station, the wagons had reached a speed of about 130 km/h. At Sørenga, one of the two-axled wagons derailed at a set of points. It pulled the wagons

behind it with it so that these, too, derailed, overturned and came to a stop. This occurred at 13.13.15, and caused a great deal of damage to the track, to a building close to the track and to motor vehicles along the road.

The front section of the wagon set (7 wagons, 194 tonnes, 207 m) continued past the pump station for the jet fuel train. One person walking close to the track was hit by the wagons and died. Where the tracks end, the wagons continued through a buffer stop, across a parking area, along the access road to the container terminal and through the terminal building. This happened at 13.13:25. The first wagon came to a stop on the quay; wagons numbers two and three continued over the quayside, across a boat and ended up in the harbour basin, while the remaining wagons came to a stop on the quayside. Two persons inside the building died, and four others were injured. The wagons damaged the terminal building so badly that it collapsed and there was extensive damage to motor vehicles and infrastructure.

2.2 Alarm and rescue efforts

Based on the timeline that the AIBN has thus far established, it took roughly seven minutes from the time it was discovered that the wagons were in uncontrolled motion until they hit the terminal building. The local traffic controller raised the alarm by phoning 110 at 13.12 and requested a triple alert[1]. At this stage, the wagons were approaching Loenga. So far in the investigation, the AIBN has not been able to verify whether, and, if so, in what manner, the Oslo Port Authority was notified.

An evaluation of the rescue work has not been conducted thus far, but this will be considered for inclusion in our further investigations.

2.3 Alnabru, design, conditions and use

2.3.1 Introduction

For ease of reference, the railway systems at Alnabru can be divided into Alnabru S (the marshalling yard) and Alnabru G (the container terminal). In broad terms, Alnabru S could be described as a sorting machine for wagons in which freight trains are broken up and made up, while Alnabru G consists of the tracks on which the wagons are loaded and unloaded. There are track connecting Alnabru S and Alnabru G, namely tracks G2-G5, hereinafter also referred to as the G tracks. Annexes B and C provide an overview of Alnabru.

The National Rail Administration is the infrastructure manager for Alnabru marshalling yard. CargoNet AS carries out terminal services in the container terminal, and the shunting and readying of wagon sets and wagons between the container terminal and the marshalling yard for the company's own traffic. The freight station and parts of the container terminal are also trafficked by railway undertakings other than CargoNet AS.

Rail traffic at both Alnabru S and Alnabru G is controlled from the main signal control centre at Alnabru S by a local traffic controller employed by the National Rail Administration. On Wednesday, 24 March, the Alnabru central control tower was manned by a local traffic controller, who managed the main signal control centre, an

[11] Notification to the police, ambulance and fire services.

assistant local traffic controller, who operated the slip signal control centre, and a trainee who had just begun the training at Alnabru. The trainee was not involved in the chain of events in question or the events prior to the wagon set beginning to roll.

The brake systems in the marshalling yard are controlled from the slip signal control centre. At the time of the incident, the assistant local traffic controller had completed his tasks and left for the day. At this point in time, it was the local traffic controller who operated the slip signal control centre, including the station's brake systems.

The local traffic controller at Alnabru is responsible for monitoring and ensuring safe operation of inbound and outbound train traffic and safe shunting operations at Alnabru. The local traffic controller does not have an overview of all planned shunting operations. The local traffic controller and the railway undertakings' shunters communicate about shunting using defined shunting channels.

Figure 3: The control panel for the brakes.

The workplace in the slip signal control centre. The control panel for the brakes on the left.

Cargonet AS´s shunter is responsible for shunting that company's rolling stock within the station area in accordance with a defined plan, which is obtained at the start of the shift. Shunting takes place using a driver-operated shunting engine. Before shunting begins, the shunter calls the local traffic controller and requests a shunting route. As far as the AIBN has been able to ascertain, no standard has been established for communication or 'readback' between the local traffic controller and the shunter.

2.3.2 Alnabru S

Alnabru S is designed to serve rail traffic in accordance with the load system, whereby individual wagons or groups of wagons are loaded in loading bays and subsequently allocated to trains, which then proceed to new freight yard where the wagons are reallocated to new loading bays or new trains.

2.4 Principal track plan

Alnabru S consists of an arrival group (5 A tracks) and 36 directional tracks (R tracks) divided into 5 (4+1) groups. The wagons are moved from the A tracks over the 'hump' and through various distribution points to their respective R tracks. The arrival group is on a gradient (gravity yard) so that the rail cars can roll from the A tracks over the 'hump' by force of gravity. As the rail cars roll down the hump, they accelerate and the distance

between them widens, so that the points can be switched between the passing of each rail car or group of rail cars.

At the southern end of the station, the R tracks converge via a switch-point zone and are connected to two extension tracks that end in a buffer stop.

2.4.1 Brakes (retarders)

In order to control the rail cars, the marshalling yard has a number of sets of brakes. In the access tracks (A1-A5) there are first the mechanical brakes, the function of which is to keep parked wagons stationary until sorting can commence. Just after the mechanical brakes are the lowering brakes in each A track. The purpose of these is to allow the controlled 'lowering' of sets of wagons from their 'braked' position on track A to the 'hump'. There is an access brake just before the hump, the purpose of which is to finely adjust the speed of the rail cars before they roll down the gradient. A second function of the brake is to ensure that there is sufficient slack in the couplings for them to be thrown off if the wagon set is to be broken up.

Figure 4: The mechanical brake is a beam brake that pinches against the rail car wheel.

In the final part of the hump and in the distribution zone, ASEA spiral brakes are installed to limit the speed of the most easy-running rail cars. At the bottom of the incline there are four primary retarders, the purpose of which is to reduce the speed of the rail cars before they run onto the R tracks. The R tracks are also equipped with ASEA spiral brakes, which reduce the speed of the rail cars to an acceptable 'follow-on' speed (< 2 m/s).

2.5 Principal use

Incoming freight trains intended for sorting in the marshalling yard are driven along the access tracks to one of the A tracks, where they are held stationary by the mechanical brake, and the train's own brakes are released. The train's locomotive is decoupled and can leave the arrival group along the access tracks. Shunting crews bleed the air to release the brakes on the wagons, disconnect the air hoses and slacken the couplings where the wagon set is to be broken up (in accordance with a list that has been prepared in advance). The wagon set is then ready for slipping. When other conditions are right, the wagon set is lowered towards the hump, controlled by the lowering brakes. The lowering brakes are used to regulate the speed and ensure slack in the couplings. One person stands on the 'ball' and throws off the couplings where the wagons are to be separated. The wagons/

groups of the wagons accelerate along the hump and are switched to their respective R tracks while being controlled by the primary brakes and ASEA brakes. Once on the R tracks, the wagons are slowed down to an acceptable follow-on speed. Ideally, the wagons on the R track should end up next to each other when slipping is completed.

When the incoming wagon sets have been slipped, they are placed next to each other on the R tracks and coupled together. Alternatively, groups of wagons can be shunted from one R track to another using a shunting engine and the track extensions at the southern end of the R tracks. The end product is a 'group-shunted' train. Locomotives are coupled to the new wagon sets on the R tracks, the trains' brakes are tested, the train documents are issued, and the trains can then leave Alnabru S.

2.5.1 Alnabru G

Alnabru container terminal is designed to service rail traffic using the shuttle train principle. This means that whole wagon sets shuttle between major terminals. Whole wagon sets are loaded and unloaded without being broken up. Changes to the composition of the wagon sets are relatively rare, and are, as a rule, the result of maintenance or repair work on individual wagons.

2.5.1.1 *Principal track plan*

The main part of the terminal is located at Alfaset, and has four groups of loading tracks with pertaining loading docks. The tracks are through-going; in the north via the Grorud track, which is connected to the Hovedbanen line at Grorud; and, in the south, via tracks connected to tracks G2-G5 at Alnajordet. There is also a through-going track that connects tracks G2-G5 with the Grorud track. The traction power has been installed as far as to the end of most of the loading tracks in both the south and north.

2.5.1.2 *Brakes*

This part of the terminal has no separate braking systems. The loading tracks are horizontal and the wagon sets are secured by engaging the parking brakes on the cars at the southern end of the loading tracks. The four tracks for driving down from the terminal to G2-G5 are equipped with 'derailing points' that will derail the rolling stock unless a train route has been set through the points.

2.5.1.3 *Principal use*

Arriving trains are directed onto tracks G2-G5. A shunting engine is coupled to the train and the train’s locomotive is decoupled. The shunting engine pulls or pushes the wagon set onto the relevant loading track, where it is secured by means of the parking brake. The wagon set is unloaded by container forklift trucks or container cranes. If required, the empty wagon set can be removed from the terminal track and parked at Alnabru S, thereby freeing space for another arriving train.

The empty wagons are inspected and replaced as required, before the wagon set is loaded with a new cargo. When loading is completed, the locomotive is coupled to the train and a departure check conducted. The train can then leave the terminal via either the Grorud track (to the north) or tracks G2-G5 (to the south and west).

2.5.2 Structural change in freight traffic by rail

During the latter part of the 1980s and throughout the 1990s, there was a series of structural changes in freight traffic by rail. Traffic switched from conventional wagon loads to shuttle trains with unit loads (containers, swop bodies and eventually semi-trailers). At the same time, the transport of timber and wood chips was separated from the wagon loads system and transferred to separate 'system trains'.

These structural changes led to a decline in the use of Alnabru S for breaking up trains, sorting wagons and making up new trains. Today, these activities are relatively rare. The tracks at Alnabru S are mainly used for stabling unused rolling stock or rolling stock awaiting maintenance. At times, the demand for parking space can exceed the capacity of the R tracks.

2.5.3 Conversion and development plans

While the marshalling yard was completed in the early 1970s, the main part of the container terminal was built in the first half of the 1990s. Some completion work and minor changes have also been carried out during the latter part of the 1990s. So far, the AIBN has had limited time to review the various stages of development and dates of completion of the terminal.

Over the past 10 years, plans have been drawn up for a major conversion and development of the facilities at Alnabru, designed to increase the capacity and adapt the facilities to the structural changes that have taken place. The conversion work has not started yet.

2.6 Inspection of the mechanical brakes, lowering brakes and track system

Together with representatives from the Police, the AIBN inspected the mechanical brakes and lowering brakes on track A5 at Alnabru S on 24 March 2010. Following the inspection and documentation of the conditions, a simple function test was performed by applying and releasing the brakes. These inspections did not uncover anything to suggest technical failure in the brakes. Nor were there any marks to indicate that the wagons had 'climbed out of' the lowering brakes.

The condition and position of the points along the route from track A5 via track G4 to the last set of points at the southern end of Alnabru were inspected. The finds were compared with descriptions provided by the personnel involved, and logged information. One set of points was found to have been cut through (no. 693). This was considered to be a natural consequence of the incident and the main train route as it was at the time of the incident. No abnormal conditions were found to exist on the other tracks or in the remaining points, which were positioned in accordance with the incident and the known train movements subsequent to the incident.

The mechanical brakes were also tested on the day after the accident, by applying them to a 'test train' with a corresponding number of wagons. The train's brakes were then released and it was noted that the train did not move despite the locomotive gently pulling on the wagons. A shunting route to G4, corresponding to the one on the day of the accident, was planned and the mechanical brake was released. The train started to roll by virtue of its own weight, and its speed was observed and the train was video-recorded

until it was stopped before the exit from Alnabru. The test train's wagons were decoupled from the locomotive, and the locomotive drove the freight train route from Alnabru to Loenga and back while the section was video-recorded.

2.7 Inspection of the actual barriers against and the possibilities of stopping runaway wagons

This section provides an overview of the thus-far identified technical or manual barriers intended to prevent the uncontrolled rolling of wagons without brakes, alternatively to regain control of such cars, or to limit the damage that they can cause. The investigation is limited to the stretch of track from track A5 at Alnabru S to the crash site in Oslo Port.

2.7.1 The mechanical brakes on track A5

The mechanical brakes on track A5 are designed to hold wagons weighing up to 1,000 tonnes stationary while these are being prepared for slipping. In order to release the brakes, two switches in the slip signal control centre must be activated. It is a precondition that the freight train is stationary before the mechanical brakes are engaged. The brakes are spring-loaded. They are released by means of compressed air and engaged when the compressed air is released.

2.7.2 The lowering brakes on track A5

The lowering brakes on track A5 are located just below the mechanical brakes. Normally, these brakes are used to regulate the speed of the wagon sets when these are 'lowered' towards the access brakes. The braking effect is achieved by means of compressed air. The braking effect can be regulated in steps. The brakes can be engaged while the wagon set is in motion and can stop wagon sets provided that a sufficient part of the wagon set is located in or above the brakes and that it does not exceed a certain speed.

2.7.3 Point no. 125

When leaving track A5, point no. 125 can be set to one of two routes: a) wagons can be directed towards the access break, or b) wagons can be directed towards tracks G2-G5 by passing the access breaks. Point no. 125 is controlled via the traffic control system so that it is normally set towards the access brakes, unless a set train route passes through it to the G tracks. In a normal situation, any runaway wagon will roll onto the directional tracks, collide with any rail car standing in its way and finally be caught by the end buffers at the southern end of the marshalling yard.

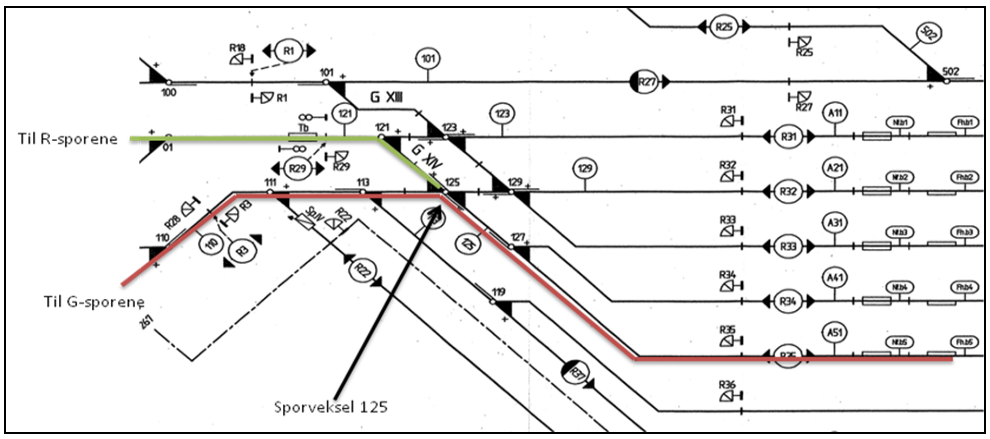

Figure 5: Schematic track plan section.

2.7.4 Procedure for releasing the mechanical brakes

In *Slippstillverk Alnabru skiftestasjon, instruks for sporbestemmer, delanlegg 7* ('Slip signal control centre for the Alnabru marshalling yard, section 1.1.2 Conditions for releasing the mechanical brakes' – in Norwegian only), item b3 describes the conditions for pushing a train backwards from an arrival track past the access brakes when it is coupled to a locomotive at the northern end. It states:

> *'1. A shunting train route is set from the relevant A track towards the relevant access brake. The dwarf signal displays signal 46*
> *2. The access brake is set to braking pressure 2*
> *3. The mechanical brake and lowering brake is opened*
> *4. The shunting route towards the access brakes is cancelled*
> *5. When it has been checked that the locomotive is in control of the shunting, shunting route R31-R35 can be set to bypass the access brake.*

2.7.5 Special provisions for Alnabru station

In *Strekningsbeskrivelse for Jernbaneverkets nett, del 3 Særbestemmelser for Ruteområde Øst* ('Section description for the National Rail Administration's railway network, Part 3 Special provisions for Network Area East' – in Norwegian only) dated 28 February 2010, section 3.4.2 describes the use of mechanical brakes to hold trains in place in arrival tracks. It states the following, among other things: '*In the case of trains left for more than four hours in the access tracks, the hand brakes shall be engaged*'.

2.7.6 Tracks G2-G5

Tracks G2-G5 meet at the southern end of Alnabru from where they run straight into the wagon track between Alnabru and Loenga. There is no diversion point or extension buffer leading away from this track group in the south. In the southern part of G2, there is a track connection from track G2 to track R47, and, before that, there is a track connection from G3 to G2. The AIBN has been informed that no function has been installed whereby the switch-points for these connections would be automatically set towards track R47. There are no connections for tracks G4 and G5. Even though the control system for choosing train routes through this track system has some prioritisation rules, these can be overridden by the operator according to the specific use he/she wants to make of the tracks. This means that the choice of train routes that can be set from track A5 to the end of the track group is not blocked in any way. Thus the possibility of

regaining control of runaway wagons by leading them onto track R47 is limited to wagons that run through track G2 and G3, provided that the situation is noticed in time for it to be possible to set the switch-points for the connections in question towards R47.

2.7.7 Brobekk

Just after departure from Alnabru South there are some connections between the freight train track and the Hovedbanen line. These connections simply allow for transfer of trains between the Hovedbanen tracks and the Alnabru tracks. However, there are no installations for stopping or derailing runaway rail cars. The same applies to the stretch of track between Brobekk and Bryn.

2.7.8 The stretch from Bryn to Loenga

At Bryn station we also find connections that make it possible to transfer to the Hovedbanen line. However, there are no installations for stopping or derailing runaway rail cars here either. Between Bryn and Kværner, the track passes through both cut and fill sections. There are no installations for stopping or derailing runaway rail cars.

At Kværner there is a connection to the Gjøvik line and onwards to the Hovedbanen line. However, there is no possibility of stopping or derailing rail cars here either. The same applies to the stretch of track between Kværner and Loenga.

2.7.9 Loenga

At Loenga, there is a track system with a total of ten tracks. The tracks converge in the southern end and lead either to the Østfold line or to Oslo Port's track system. There is no possibility of stopping or derailing runaway rail cars at great speed here either. A derailer was mounted on one of the tracks leading to Oslo Port. The type of derailer was designed for maximum speeds of around 50 km/h.

2.7.10 Oslo Port's track system

The track system in Oslo Port belongs to the Oslo Port Authority. The track system is designed for limited speeds. The track system reaches approx. 2 km from Loenga and covers the area to the south branching into a number of tracks. The points are manual and the track system has no barriers against runaway rail cars approaching from Loenga at high speed. Activities at Sjursøya include loading of the jet fuel train for Gardermoen airport. The wagon set followed the train route that had last been used, which meant that it ran through the loading track for the jet fuel train which had stopped at Gardermoen at the time of the accident. There is a great deal of road traffic to and from the freight facilities in the area.
Collaboration between the National Rail Administration and Oslo Port regarding traffic handling will be reviewed in the final report.

2.8 Available risk analyses

The National Rail Administration has informed us that two risk analyses are available for Alnabru – one from 2001 and the other from 2004. A 'line-specific' risk analysis from 2001 is also available for the Hovedbanen line, including Oslo S, which was carried out for the National Rail Administration by Det Norske Veritas.

2.8.1 Risk analysis for Alnabru freight yard 2001

The report *Risikoanalyse av arbeidsforhold ved Skifteoperasjon Alnabru Skiftestasjon* ('Risk analysis of the working conditions during shunting operations in Alnabru marshalling yard' – in Norwegian only), produced by the National Rail Administration together with representatives of NSB Gods in 2001, identified a hazard that may be relevant to the accident on 24 March 2010:

> *'11. Brakes not engaged for rail car and it rolls onto the main track at Alnabru South'*

The report shows that the analysis team was split in its view of whether or not this was a realistic incident and priority was therefore not given to identifying appropriate measures. It is also evident from the report that the basis for hazard identification was normal slipping of rail cars to the directional tracks. Activities such as parking of wagon sets in the A tracks, shunting in additional rail cars while the wagon set was parked in an A track and reserving wagon sets past the access brakes do not appear to have been included in the basis for the analysis.

2.8.2 Risk analysis for Alnabru from 2004

The National Rail Administration also informs that another risk analysis for Alnabru was conducted in 2004. The analysis was carried out by the National Rail Administration together with representatives from CargoNet AS. However, the report has not been completed and the AIBN has not had access to it. According to the National Rail Administration, the draft report does not identify any hazards of relevance to the accident.

2.8.3 Line-specific risk analysis for the Hovedbanen line, conducted in 2001

The National Rail Administration also informs that the line-specific risk analysis for the Hovedbanen line, which Det Norske Veritas conducted for the National Rail Administration in 2001, identifies one hazard on a general basis and which is relevant in relation to the accident. Section 4.3.4 of the report was entitled 'Collision with runaway rolling stock':

> *'Rolling stock that accidentally breaks lose and rolls away without personnel on board and without operational brakes, represent a particular hazard since neither the general traffic control system nor the ATC system can prevent a collision between such rolling stock and other trains. When wagons or rolling stock are parked, the parking brakes shall be engaged and the rolling stock shall otherwise be secured so that it cannot roll towards train tracks. They can be secured by means of a derailer or a run-off point, or by natural topographical conditions. It seems that the biggest risk of rolling stock breaking loose may be linked to unauthorised parking of rolling stock in connection with maintenance operations.*
>
> *Runaway rolling stock from the Hovedbanen or Gjøvik lines can end up at Oslo Central Station or even pass through this station. Should runaway rolling stock approach Oslo Central Station, the prescribed procedure is to direct it into the tunnel, where it will eventually come to a stop at the lowest point of the tunnel.*

At Lillestrøm, runaway rolling stock can run into the station from the Hovedbanen line in the south.'

The above report does not discuss Alnabru in any detail.

The AIBN has had a limited period of time in which to review the assumptions underlying the report before its publication of this preliminary report, but will study it in greater detail as the work proceeds.

2.8.4 Other risk analyses

So far in its investigations, the AIBN has not found any other risk analyses that may be relevant to the present incident. It cannot be precluded that such analyses exist and that they can provide more information. We will follow up this issue in our further investigations.

2.8.4.1 *Acts and regulations*

The following relevant regulatory requirements have been identified so far in connection with the investigation:

Regulations No. 1621 of 19 December 2005 relating to requirements for railway enterprises on the national rail network (the Safety Regulation) sections 4-1 and 4-3, requirements for safety management systems.
The Safety Regulations sections 5-2, 5-3 and 5-4, requirements for Risk analyses, Following up of risk analyses, Updating risk analyses.

Regulations No. 240 of 29 February 2008 on the operation of trains on the national rail network (Train Operation Regulations), requirements for shunting.

The Train Operation Regulations section 2-7, requirements for communication.

2.8.4.2 *Other similar incidents*

At this point in its work, the AIBN has registered the following similar incidents:

- In 1938 some wagons broke loose and derailed at Loenga. Geita bridge was damaged and collapsed.
- In 1981, a wagon set came loose from the mechanical brake at Alnabru S, rolled along the goods train track and caught up with an uncoupled locomotive at Bryn before all the items of rolling stock derailed at Loenga. Major material damage was sustained.
- In 2006, a wagon set came loose from the mechanical brake at Alnabru S and collided with a shunting engine after only 50 m, causing only minor material damage.

In our further investigation, we will try to register any other cases of out-of-control rail cars without brakes.

3. THE AIBN'S PRELIMINARY CONCLUSIONS

3.1 Introduction

Since this is a preliminary report issued relatively soon after the accident, sufficient information is not yet available to provide a full explanation of all the issues involved. In its preliminary report, the AIBN has therefore chosen to consider in relative detail the technical and operational factors that led to the accident, providing the greatest level of detail in the case of Alnabru and a somewhat more summary description of what happened after the wagons had left Alnabru. With respect to matters relating to safety management and leadership, operating licences and authority, this report has limited itself to listing the issues that have so far been identified as requiring further investigation in the final report.

3.2 Technical and operational matters

According to the AIBN's preliminary evaluation, the immediate cause of the accident was unclear communication between the shunter and the local traffic controller concerning the setting of a shunting route. The shunter requested a shunting route for the shunting engine to depart from track A5 and head north and then continue via the bypass track to the G track. The local traffic controller understood the situation to be one in which the shunting engine was connected to the wagon set and the latter was to be pushed backwards down along the G track under the control of the shunting engine. The use of a shunting engine to both pull and push rail cars is common practice at Alnabru. The AIBN believes that unclear communication between the local traffic controller and shunter can undoubtedly occur since no standard has been prepared for communication and readback that could help to clarify the meaning of any messages being transmitted between the local traffic controller and the shunter. However, this is required by the Train Operation Regulations section 2-7 first paragraph, which states that the whole wording or essential content shall be repeated by the person receiving the order, permission or notification. The regulations entered into force on 13 December 2009.

The AIBN believes that several unfortunate factors contributed to the fatal outcome of the unclear communication. The factors identified so far in the process are listed below:

3.2.1 Use of the A track for parking and adjusting sets of wagons

The development of a form of operation whereby arrival tracks are used for intermediate storage of wagon sets between loading operations and, above all, the practice of adding rail cars to the wagon set in this position, does not appear to conform with the originally planned use of access tracks. The AIBN believes that it produces a situation in which the safety margins are reduced. The practice appears to have developed as a result of insufficient space for parking on the directional tracks.

Such a practice increases the possibility of misunderstandings at the same time as the potential consequences of any such misunderstanding are great. The fact that local traffic controllers do not have a full overview of the operations to be carried out on the wagon sets can contribute to increasing the possibility of unclear communication and misunderstandings.

3.2.2 Non-conformity with procedure for releasing the mechanical brake

The procedure for releasing the mechanical brake in a situation where a set of rail cars coupled to a locomotive at the northern end is to be pushed backwards past the access brakes prescribes the following:

- The shunting route shall be set from the relevant track for arrival and to the access brakes
- The access brakes shall be engaged
- The mechanical brakes and access brakes shall be released
- When it has been checked that the locomotive is in control of the shunting, the shunting route can be set to bypass the access brakes.

The fact that the set of wagons rolled towards the G tracks suggest that the shunting route towards the G tracks, which bypassed the access brakes, was set without the local traffic controller having ascertained whether the locomotive was in control of the rail cars. At this point in the investigation, the AIBN has not looked at the status of or practice relating to this procedure in any detail, but it has noted that this is a factor that requires further investigation.

3.2.3 Non-conformity with the provision that a train that is left standing for more than four hours on the arrival track shall be secured with parking brakes

The investigation so far has not shown that any of the wagons of which the train consisted had engaged the parking brake. Since the set of wagons was parked in track A5 at approximately 04.20 and there were no plans to use it before 18.00, the requirement that the parking brakes should be engaged to secure the set of wagons was not observed when it was parked in A5 during the night before the accident.

3.2.4 The development was discovered too late for the set of wagons to be stopped by engaging the lowering brakes

Having set the shunting route from A5 to G4, the local traffic controller regarded having completed this operation and started on the next task. The shunter and shunting engine driver were directing their attention to the north (away from the set of wagons) pending a clearance signal to head north from track A5. Since the expected all-clear signal did not appear, the shunter turned around and, noticing that the set of wagons was moving, called the local traffic controller on the shunting channel and notified what was happening. The AIBN has preliminarily concluded that the development was discovered too late for the local traffic controller to be able to stop the set of wagons by engaging the lowering brakes, since most of the set of wagons had passed the brake before it could be engaged.

3.2.5 There was no 'end barrier' at Alnabru that could catch runaway rail cars

A review of the track system design in the area of tracks G2 to G5 shows that the structure and securing of the system in this area does not include any possibility of catching runaway rail cars before they enter the goods train track towards Loenga. In terms of track design, the possibility of diverting runaway cars passing through tracks G2 and G3 appears to exist, but this possibility is not built into the traffic control system. There is no such possibility in the case of tracks G4 and G5.

Since there were no limitations as to which shunting routes could be chosen from track A5 to the G tracks, it was chosen to set the route to G4 during this operation. The use of track G4 appeared to be the natural choice since track G5 was occupied by train 5800 and the local traffic controller planned to use tracks G3 and G2 for a train leaving the container terminal towards Grefsen. Hence there was in fact no possibility of stopping the set of wagons once it had passed the lowering brake.

The investigation so far seems to indicate that the focus was on functionality rather than safety when the G tracks were laid. The AIBN will look more closely at these problems and the processes behind the design of this track system in its continuing investigation.

3.2.6 There was no possibility of diverting or stopping the runaway wagons after they left Alnabru

The stretch of line between Alnabru and Loenga has no devices for diverting, derailing or stopping runaway rail cars in a controlled manner. There are options to steer the wagons onto the Hovedbanen track and towards Oslo S at Brobekk, Bryn and Kværner and onto the Østfold line at Loenga. None of these options were chosen, since it would not have been possible to gain control of the situation on any of these lines either. An attempt at derailing the wagons at Loenga by driving them through a curve and across a derailer failed since the speed at that point far exceeded the capacity of the derailer.

Nor does the track system in Oslo's port facility have any device for catching runaway wagons in an acceptable manner.

3.3 Factors relating to safety control and management

3.3.1 Follow-up of operational factors

The change in the use of the marshalling yard that finally led to the A track being used to park sets of wagons seems to have taken place over a certain period of time without any changes in the risk picture or any need to change procedures or instructions having been identified. The fact that the possibility of losing control of rolling stock bypassing the access brake was not identified in the risk analysis relating to the working conditions in the marshalling yard, and the fact that the analysis conducted in 2004 has not yet been completed are signs of inadequate safety management.

The fact that the investigation so far has shown that two operational procedures/ provisions were probably breached, suggest that there may have been insufficient follow-up of existing provisions. The division of labour between the National Rail Administration as traffic controller for Alnabru and the railway undertakings that carry out the shunting, terminal handling and parking of rolling stock at the station, may also have had a bearing on control and follow-up of safety in the area.

These matters will be investigated further in order to identify any factors that can improve safety.

3.3.2 Factors linked to construction history and mapping of local risks

The fact that the G2-G5 track system was constructed and equipped with a control system that lacked barriers capable of catching runaway wagons suggests that the track and safety systems were designed without adequate risk identification having been carried out beforehand. This track system was designed and established over a period (of some length) characterised by major and frequent reorganisation and replacement of personnel. Hence, critical competence relating to conditions at Alnabru S may have been lost, so that circumstances known to involve risk were neither taken into account during design and construction, nor passed on to the operating organisation when the construction was completed.

The fact that the risk analysis conducted in 2001 did not pay sufficient attention to the lack of barriers against rolling wagons without brakes suggests that there may be a lack of overriding guidelines for the weight that should be assigned to various elements of risk in local analyses. These matters will be investigated further in order to identify any factors that can improve safety.

The AIBN believes that there is an immediate need for the National Rail Administration, possibly together with the railway undertakings, to carry out a fresh review of the conditions at Alnabru with a view to introducing adequate barriers against runaway wagons so that they cannot leave the station.

3.3.3 Factors relating to the overall mapping of risks

The AIBN notes that the risks associated with runaway wagons were only summarily dealt with in the line-specific risk analysis for the Hovedbanen line, and that Alnabru was not considered in that analysis. It is true that runaway wagons from Alnabru will not roll directly onto the Hovedbanen line, but to date the AIBN has not been informed of any corresponding analyses for the freight train track between Alnabru and Loenga. It is likewise a fact that nowhere along the track systems leading down to Oslo S and Loenga are there any solutions whereby runaway rail cars can be stopped, derailed or diverted. Furthermore, it seems that all possibilities of establishing such solutions have gradually disappeared through changes to the track system, re-planning and the development of built-up areas.

This situation stresses the need to draw up clear guidelines to establish good solutions to prevent runaway rail cars from leaving local areas. However, the AIBN believes that it may be useful to consider carrying out a survey to map the possibilities and consequences of establishing systems to stop any runaway rail cars heading for Oslo S or Loenga.

3.4 Factors relating to operating licences and the authorities

The systems were designed, constructed and put into operation before the current regime for approval of infrastructure was established. The approvals regime that existed at the time appears not to have been satisfactory from the point of view of safety. Whether any benefits can be reaped from a closer review of these factors remains to be seen.

Other factors relating to the authorities may also have contributed to the situation at Alnabru developing into one in which this accident could happen. It may be relevant to consider whether the availability of funds or the zoning situation in the area may have contributed to the fact that terminal reconstruction and development have not been in step

with developments in traffic. As a result, operational safety margins have been reduced in a time of increasing freight movement by rail.

In addition to the above, it will also be relevant to look into whether the current regimes for approval and supervision could have identified the deficiencies in the mapping of risks and risk control relating to the possibility of handling runaway rail cars in general, and Alnabru in particular, before the accident occurred.

4. SUMMARY

The conclusion after the preliminary investigation concludes that the immediate cause of the accident was unclear communication between the local traffic controller in the Alnabru marshalling yard and the shunter. That this could occur and have such fatal consequences was due to a number of factors that, in an overall perspective, can be summed up as follows:

- There are deficiencies in the system of communication between the local traffic controller at Alnabru and the railway undertakings' shunter insofar as the local traffic controller is not fully informed about many of the shunting operations to be carried out by the shunter. To the best of the AIBN's knowledge, no standard has been established for communication or 'readback' between the local traffic controller and shunter when shunting routes are requested for the varying shunting operations to be carried out in the course of the working day.
- Together with inadequate adaptation and updating of the physical systems, restructuring and the increase in freight movement via Alnabru may have led to a situation in which safety margins were reduced so as to handle the traffic load.
- Inadequate safety management has caused the safety margins to be reduced, and non-conformities to go unidentified and uncorrected.
- Defective risk management in connection with the planning, approval and reconstruction of the G tracks at Alnabru has resulted in the absence of an important 'end barrier' against runaway wagons leaving Alnabru.
- The problem of runaway wagons appears not to have been satisfactorily dealt with in overriding or local risk analyses. As a consequence of this, no system has been established whereby runaway wagons can be stopped in an acceptable manner. The problem does not appear to have been identified and hence it has not been taken into account in area planning or the design of installations in areas potentially affected by such an accident.

This is a preliminary report, and our further investigations may include other elements of safety. We do not plan to publish further details relating to this case until the final report containing an analysis of the course of events and the AIBN's conclusions is published.

5. IMMEDIATE SAFETY RECOMMENDATION

Based on the results of the preliminary investigation, the AIBN finds it necessary to propose one immediate safety recommendation.

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Immediate safety recommendation

The barriers established to prevent rail cars without brakes from breaking loose and rolling away from Alnabru have proved insufficient. The Accident Investigation Board Norway recommends that the Norwegian Railway Inspectorate order the National Rail Administration to analyse the operational situation at Alnabru and to establish necessary barriers so that runaway rail cars cannot roll out of the station.

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6. REFERENCES

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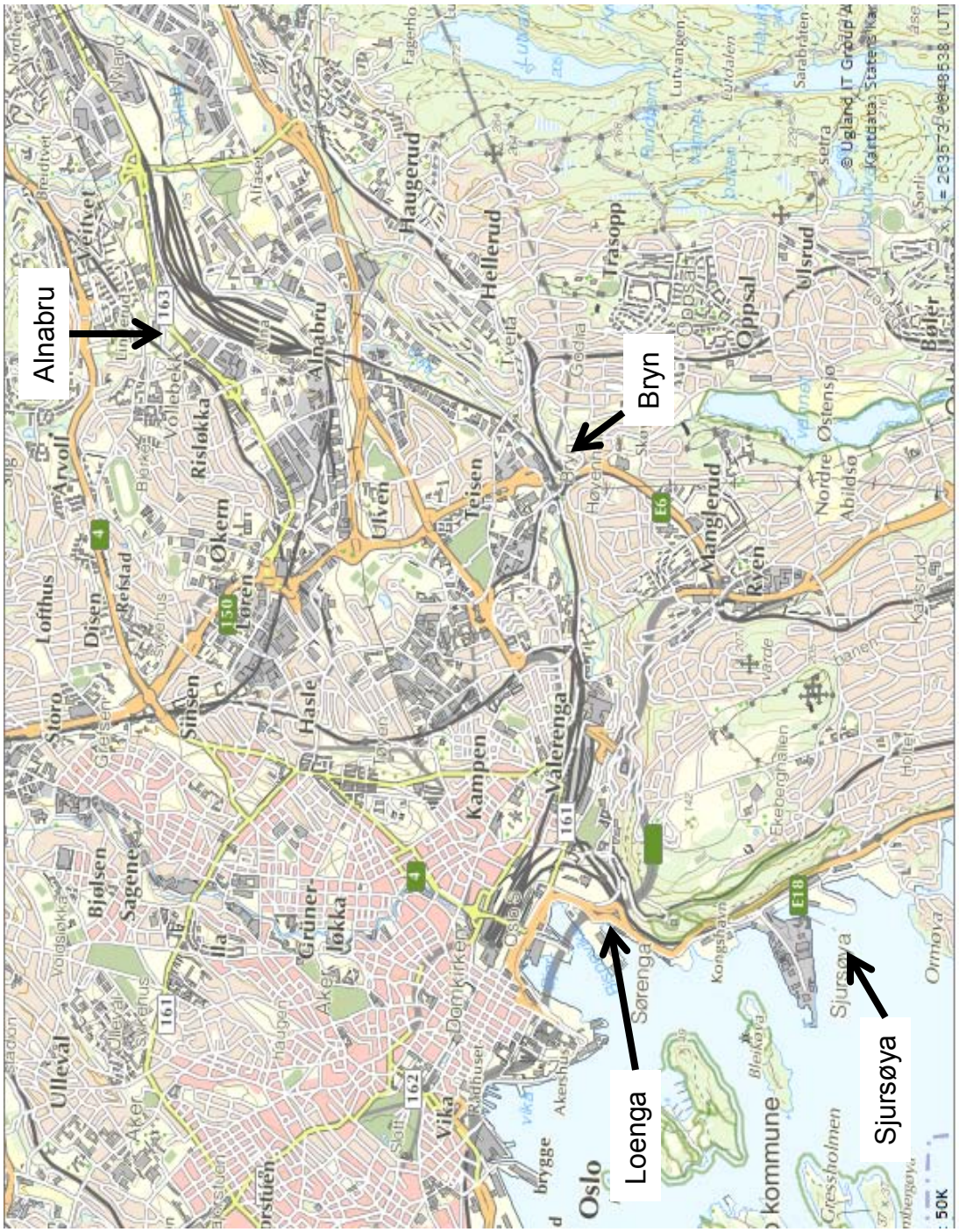
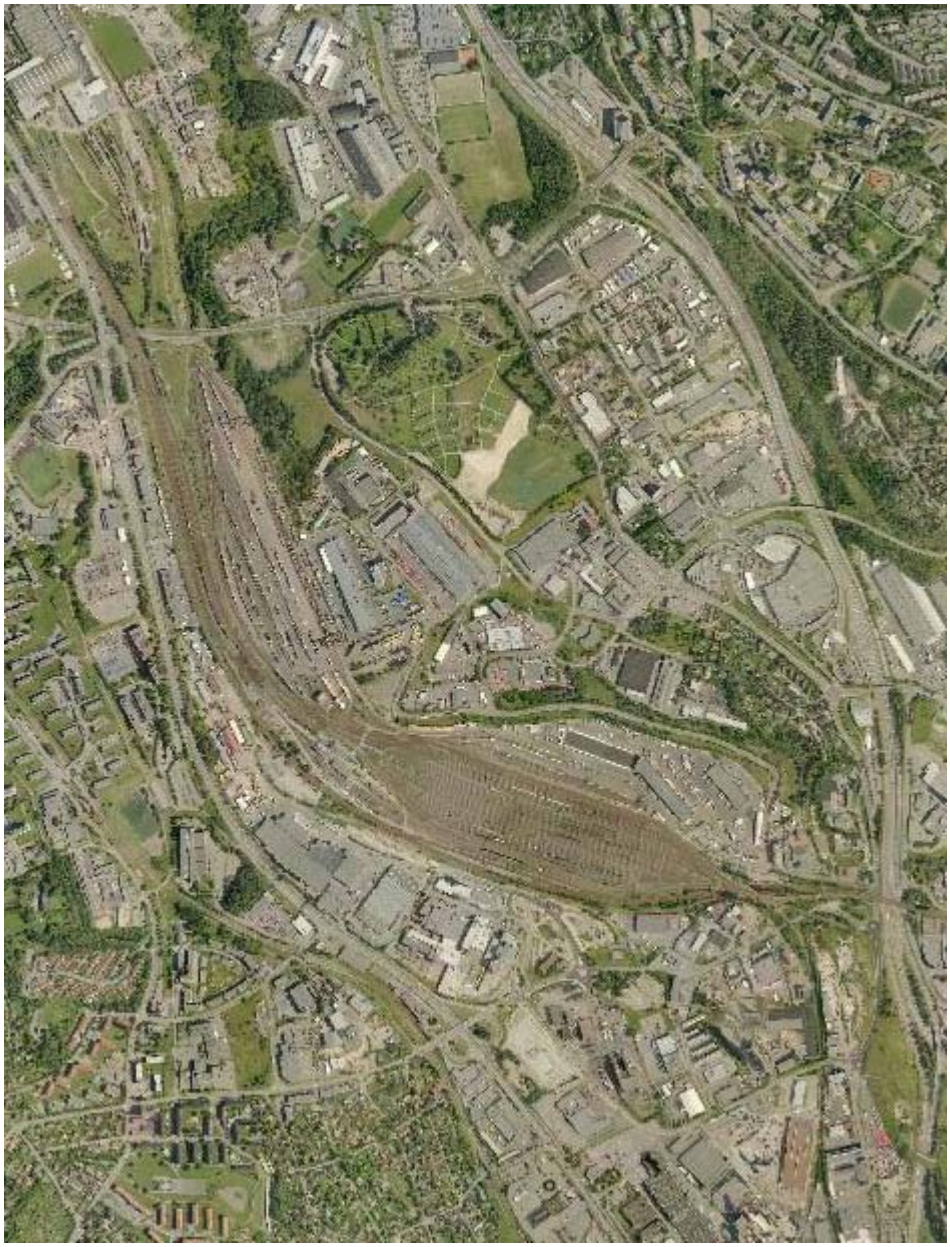
7. APPENDICES

A Schematic map of Alnabru - Sjursøya
B. Overview of Alnabru
C. Schematic map of Alnabru

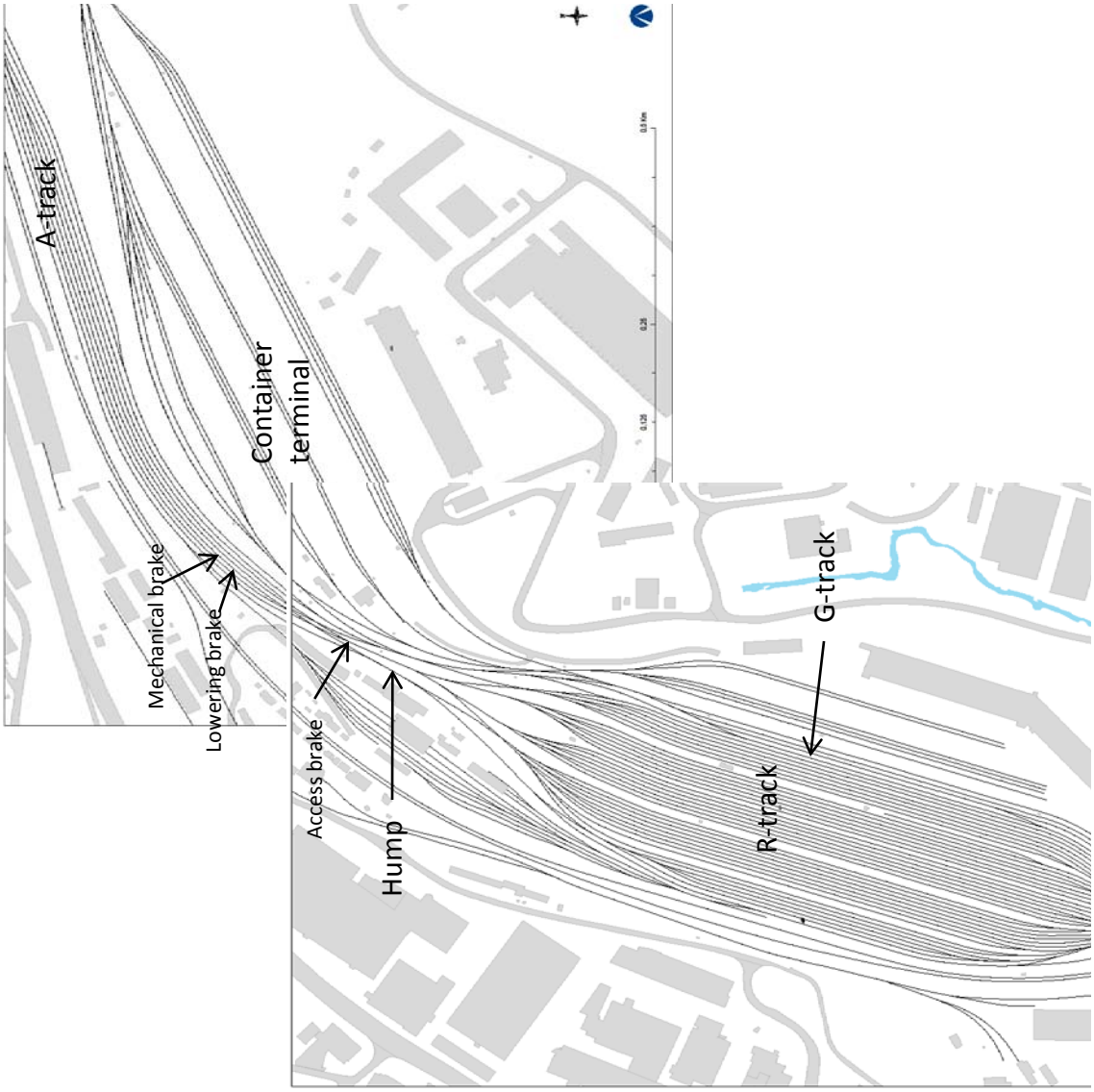


Schematic map Alnabru – Sjursøya
Source: Statens Kartverk 12247NE-178 from Ugland IT Group AS



Overview of Alnabru
Source: Gule sider

APPENDIX C



Schematic map Alnabru