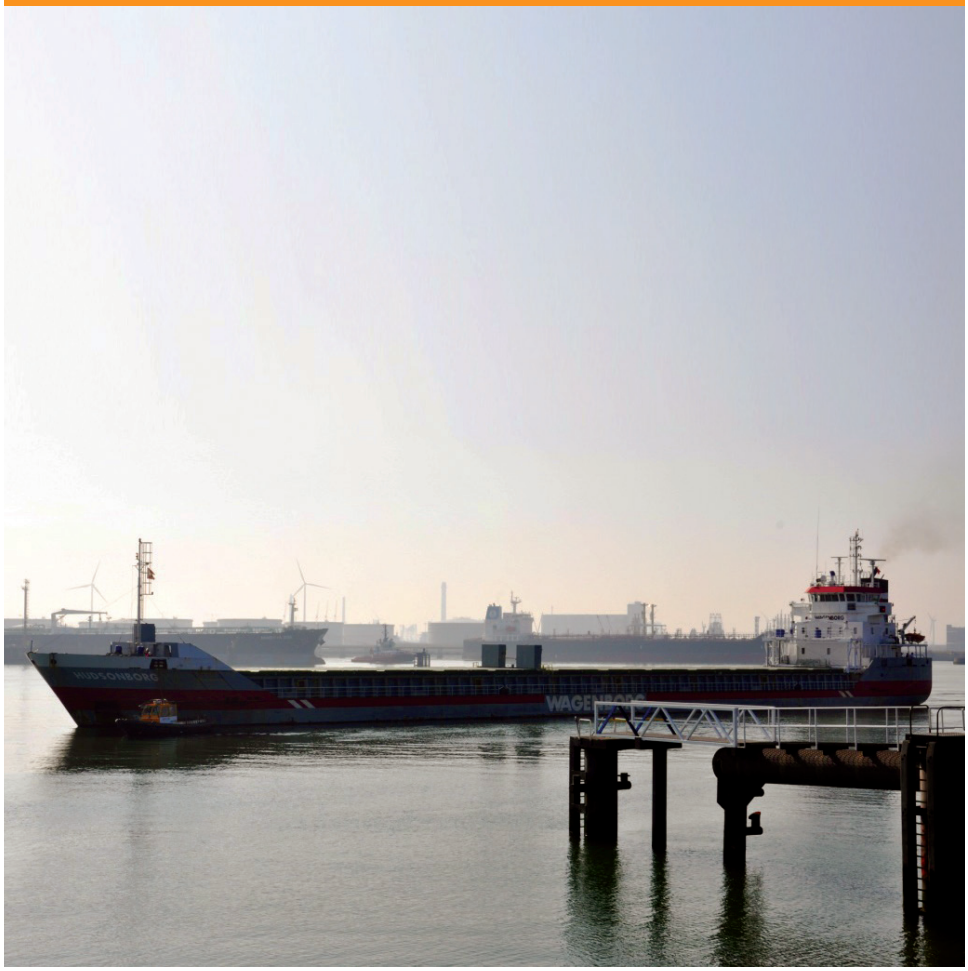
DUTCH
SAFETY BOARD

Asphyxiated after entering cargo hold

Hudsonborg - North Sea



Asphyxiated after entering cargo hold

Hudsonborg - North Sea, 12 March 2014

The Hague, May 2015

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Source photo cover: Dutch Safety Board

Dutch Safety Board

The aim in the Netherlands is to limit the risk of accidents and incidents as much as possible. If accidents or near accidents nevertheless occur, a thorough investigation into the causes, irrespective of who are to blame, may help to prevent similar problems from occurring in the future. It is important to ensure that the investigation is carried out independently from the parties involved. This is why the Dutch Safety Board itself selects the issues it wishes to investigate, mindful of citizens' position of independence with respect to authorities and businesses. In some cases the Dutch Safety Board is required by law to conduct an investigation.

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NB: This report is published in the Dutch and English languages. If there is a difference in interpretation between the Dutch and English versions, the Dutch text will prevail.

CONTENT

SUMMARY

On 12 March 2014 the first mate of the Hudsonborg died after entering a stairwell leading to a cargohold containing zinc concentrate.

The ship was sailing with a bulk cargo when the first mate was going to perform a cargo inspection. The cargo oxygen-depletion hazard had been underestimated while performing this job. No sufficient safety precautions have been taken.

The investigation performed by the Dutch Safety Board showed that the cargo inspection procedure is inconsistent with the execution of the task in practice: Firstly, there is a contradiction, because in accordance with legislation and procedures the hold must be ventilated before entry is permitted. however, the same legislation and procedures prohibit ventilation of the hold during the voyage. Secondly, in order to inspect cargo three different safety sheets and a permit-to-work must be read side by side so as to deduce the appropriate procedure to be followed. Thirdly, according to the procedure five individuals are required to take part in the activities that apply to entering an enclosed space, the ship had an eight-man crew.

The cargo documents were in this case not coherent and clear. The documentation emphasized the chemical hazards more than it emphasized the hazard of oxygen depletion.

INTRODUCTION

On 12 March 2014 the first mate of the Hudsonborg, a motor vessel registered in the Netherlands, died after entering a stairwell leading to a hold containing zinc concentrate.

This was a very serious accident as referred to in the Code for the Investigation of Marine Casualties and Incidents adopted by the International Maritime Organisation (IMO), and in EU Directive 2009/18/EC. This means that the Netherlands, as the flag state, has a duty to conduct a safety investigation. This statutory investigation duty is also set out in the Dutch Safety Board Decree (*Besluit Onderzoeksraad voor Veiligheid*).

After the accident two Dutch Safety Board investigators conducted an investigation on board the ship. The forensic pathologist established that the first mate died as a result of asphyxiation. This report describes the relevant facts of the incident and discusses the immediate and underlying causes. The report also examines the information that was available on the cargo, how the information was used and what is required by law.

RELEVANT FACTS AND BACKGROUND INFORMATION

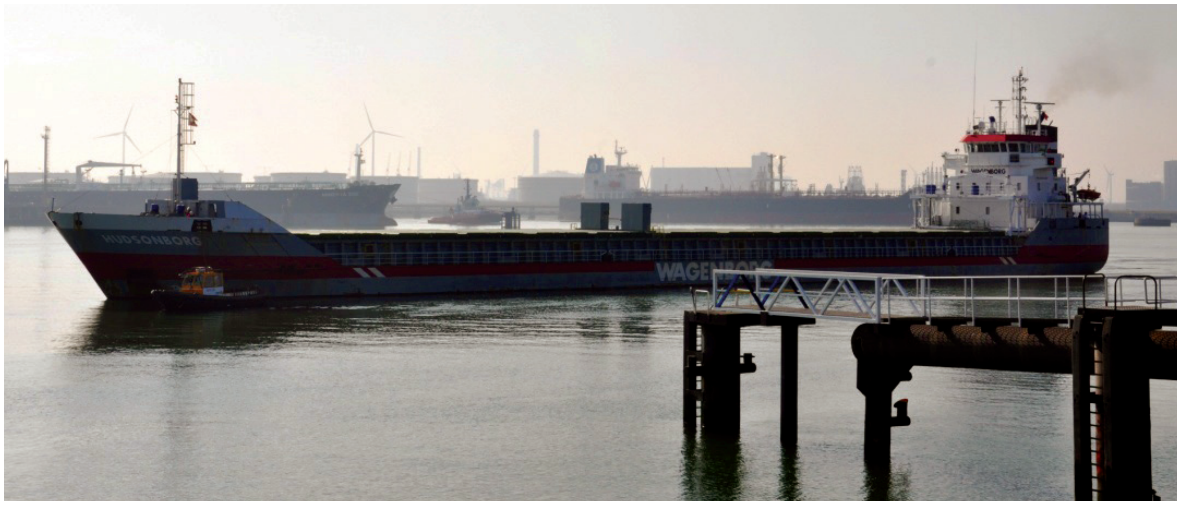

Figure 1: Hudsonborg. (Source: Dutch Safety Board)

Vessel specifications - Hudsonborg	
Call sign	PHGD
IMO number	9321407
Flag state	The Netherlands
Home port	Delfzijl
Vessel type	General/heavy cargo with container capacity
Owner	Wagenborg Shipping B.V.
Classification society	Bureau Veritas
ISM	Lloyd's Register
Year of build	2006
Shipyard	Niestern Sander, Delfzijl, the Netherlands
Length overall (LOA)	113.76 m
Breadth	14.40 m
Draught	6.01 m
Gross tonnage	4206 GT
Engines	Wartsila 6L32
Propulsion	1 propeller – controllable pitch
Maximum propulsion power	2999 kW
Maximum speed	13 knots

Relevant facts

On 4 March 2014 the Hudsonborg departed empty from Agadir (Morocco) setting sail to its destination Setubal (Portugal) to load a cargo of zinc concentrate on board. There were eight crew on board, five of Philippine and three of Russian nationality, including the first mate. The first mate had been working for the shipping company since 2013 as second mate. He joined the Hudsonborg in December 2013 as first mate.

On 5 March 2014, two days before arriving in Setubal, the captain received the cargo documents from the shipper, which included a 'Form for Cargo Information for Solid Bulk Cargoes' and a safety sheet (Material Safety Data Sheet, MSDS). On receipt of the documents the captain, together with the first mate, called a safety meeting on board the vessel to discuss the cargo information with the crew. The toxic hazards of the cargo were discussed based on the safety sheet and attention was paid to the use of personal protective equipment (full-vision goggles and respiratory filters) to protect against exposure to dust during loading.

On 7 March 2014 the Hudsonborg arrived in Setubal and the crew subsequently proceeded to load the zinc concentrate on board. The dust created during loading was released into the air due to which dust covered the ship's deck. Some of the dust released also found its way into the accommodation. A number of crew members experienced irritated airways and burning eyes as a result of the dust released in the accommodation. The accommodation was cleaned on completion of loading and the Hudsonborg departed from Setubal on 7 March 2014 at 23:50 setting sail for Kokkola (Finland) as its next destination.

On 12 March the Hudsonborg passed the Strait of Dover. The wind speed had a wind force 4 Bft[1] (11-15 knots,[2] 20-28 km/h) from an east-northeasterly direction and the visual significant wave height[3] had fallen to about one metre. After the first mate had performed his bridge watch from 04:00 to 08:00 hours he went to the forward part of the ship at around 09:30 hours. He was carrying a breathing mask and a filter (ambient air-dependent). When he arrived at the forecastle, he walked past the paint locker to the entrance of the cargo hold. A seaman was mixing paint in the paint locker at that time. The first mate informed the seaman that he was going into the hold to inspect the cargo and then opened the door to the stairwell leading to the cargo hold. He descended into the hold at around 09:50 hours and closed the door behind him. The seaman did not pay any further attention to the matter and continued working.

A few minutes later the seaman began to head towards the mess to drink coffee. The seaman opened the door to the stairwell and asked the first mate whether everything was okay. The first mate answered the seaman's question in the affirmative and the

1 The Beaufort wind force Scale is used to indicate wind velocity. The scale was created in 1805 by the Irishman Francis Beaufort. The scale is based on the force which is exerted by the wind per unit area. In this regard, wind speed is measured, not the force it exerts. From 1838 onwards, the Beaufort scale has been used as a standard measurement instrument by the ship's log to indicate wind velocity.

2 Knot is a unit of speed velocity which is frequently used in seafaring and the motorised aviation. A knot is a nautical mile per hour. A nautical mile is equal to 1852 meters. Thus, a knot of a speed of 1,852 km/h is 0,5144... m/s.

3 The significant wave length is used in the physical oceanography, marine technology en partly in the civil technique to indicate an average height of one-third of the highest measured waves.

seaman subsequently closed the door again. Having arrived in the mess the seaman told the second mate that the first mate was in the hold inspecting the cargo. The second mate found this rather odd and, because he was not entirely happy with the situation, went to the entrance of the hold in the forecastle after the coffee break. After opening the access door to the stairwell, the second mate saw that the first mate was wedged between the stairs unconscious, about three metres from the door.

The second mate already suspected what had happened, locked the door and attempted to call the captain. However, in the panic of the moment the second mate called the captain's cabin instead of the bridge and therefore was unable to reach the captain. The second mate then rushed back to the bridge to inform the captain, meanwhile warning the seaman working at the fore of the ship. The crew made an attempt to rescue the first mate. Two crew members, equipped with breathing apparatus tied a rope around the first mate's waist. Two men, who were located at the top of the stairwell, subsequently pulled the rope and then lifted the first mate out of the stairwell with the assistance of two crew members equipped with breathing apparatus. The rescue attempt was compounded by the fact that the stairwell was in an awkward position and the first mate's strong build. Once on deck the first mate was unsuccessfully resuscitated. The first mate had died. The forensic pathologist in the port established asphyxiation as the cause of death.

Figure 2: Entrance from the outer deck on the forecastle to the stairwell leading to the hold. (Source: Dutch Safety Board)

Figure 3: Access stairway to the forecastle and access door to the stairwell leading to the hold. (Source: Dutch Safety Board)

The incident analysis and conclusions are based on the Tripod method. This method of analysis presupposes failing safety provisions, or 'barriers'. These failing barriers are analysed with respect to the immediate causes, circumstances and underlying factors of the failure in the organisation. In the analysis of this rapport, the underlying causes which could have contributed to the actions of the first mate relating to the cargo control, will be discussed.

The cargo

The rules laid down in the International Maritime Solid Bulk Cargoes Code (IMSBC Code) apply to the carriage of solid bulk cargoes.[4] Section 3 of the IMSBC Code states that when transporting solid bulk cargoes, the crew on board the ship must always take into account that solid bulk cargoes can be susceptible to oxidation.

Advice on the characteristics and transhipment methods for standard solid bulk cargoes are provided in the schedules included in the IMSBC Code. The exact substance being transported and the IMSBC Code schedule that should be used can be found in the cargo information form for solid bulk cargoes. The form which was provided to the Hudsonborg provides little information regarding the transmission of the chemicals, in this case zinc concentrate (Appendix C). The IMSBC code contains two schedules that relate to zinc concentrate: a schedule for mineral concentrates and a schedule for metal sulphide concentrates. The schedules refer to each other.

The form refers to the MSDS (Material Safety Data Sheet) for specific details. Also according to the MSDS zinc concentrate was loaded on board the Hudsonborg. However, the MSDS additionally states 'metal sulphide concentrate' as 'proper shipping name'.[5] Given the composition of the substance, this was in fact a metal sulphide concentrate (see Appendix A). The ship management used the MSDS to obtain information about the hazards and risks inherent in the cargo on board. The risks stated in the MSDS include:

- Toxic risk;
- Carcinogenicity;
- Risk of cargo liquefaction,[6] which will endanger the ship's stability (the moisture content of the cargo when loaded was 10.84%, whereas the cargo was allowed to be trans-

4 Solid bulk cargo: Any cargo, other than liquid or gas, consisting of a combination of particles, granules or any larger pieces of material generally uniform in composition, which is loaded directly into the cargo spaces of a ship without any intermediate form of containment. (IMSBC Code Regulation 1-1 para 2)

5 Proper shipping name is a term used in the International Maritime Dangerous Cargo Code (IMDGC). However, in this case the MSDS refers to the wrong regulation. The term which should have been used in agreement with the IMSBC, is Bulk Cargo Shipping Name (BCSN).

6 Liquefaction: A situation that occurs when a mass of granular material is saturated with liquid to such an extent that under the influence of external forces such as vibration, impaction, or ship's motion, it loses its shear strength and flows like a liquid (IMSBC Code, Section 1.7).

ported until a percentage of 11,90%. At a percentage of 13,23%, the substance would liquefy;
- Oxygen depletion from the surrounding area (oxidation).

The schedules in the IMSBC code state the same risks as the MSDS. In this context the IMSBC schedule states that protective measures must be adhered to, including the following:

- Personal protective measures during loading.
- Appropriate measures to protect machines and accommodation against dust during loading.
- Entering the hold space is prohibited until the hold space has been ventilated and the atmosphere has been tested for concentrations of oxygen.
- The space where the cargo is stored may not be ventilated during the voyage.
- The appearance of the cargo surface must be regularly inspected during the voyage. If, during the voyage, free water appears on the cargo surface or the cargo is found to be in a liquefied condition, the captain must take appropriate measures.

Safety Management System

The shipping company Wagenborg Shipping B.V., uses a safety management system (SMS) that was set up in accordance with the International Safety Management (ISM) Code. The SMS provides safety sheets for high-risk activities. For the purpose of controlling the risks involved in entering a hold or an enclosed space, the SMS contains the following work instructions:

- Cargo sheet for bulk cargoes: the instructions state that entry to the hold is prohibited if it is not absolutely necessary, and refers to the safety sheet on entering a enclosed space.
- Safety sheet on entering an enclosed space: this sheet sets out the procedure for entering a enclosed space.
- Safety sheet on cargo inspection: this sheet contains instructions on how to inspect cargo. The space must also be well-ventilated, the work must be performed by a competent individual under the supervision of a responsible officer.
- Permit-to-work: in order to perform critical activities. a permit-to-work must be issued by a responsible officer. The permit contains a checklist that sets out the relevant safety risks and the corresponding precautionary measures. A permit-to-work is also required for entering a enclosed space, hot work (work constituting a fire hazard) and work involving the use of compressed air under high pressure.

These work instructions are included in the SMS to be prepared for all kinds of situations which relate to loading. When conducting a cargo inspection, one has to take into account if the cargo is stored in the hold or if it concerns deck cargo. For every method there is a different check-up procedure. The first mate which had to conduct the inspection in this specific case, had to conduct it via the inspection procedures indicated in the instruction sheets of the SMS.

Cargo inspection in an enclosed space

All of these instructions describe the hazard of oxygen deficiency when entering the hold as an enclosed space. To prevent oxygen depletion, the hold has to be ventilated and the air must be tested before entering the space. When combining the above instructions, the crew must follow the procedure set out below when inspecting cargo:

- The responsible officer, in this case the first mate himself, must issue a permit-to-work to the individual who will perform the activities. The permit contains the safety measures that must be put in place in the form of a checklist and must contain the captain's signature.
- An enclosed space may only be entered by at least two individuals after the space has been sufficiently ventilated and the air has been tested for sufficient oxygen.
- A supervisor must be present at the entrance to the enclosed space and must be in communication (if necessary by radio) with the individuals who will enter the space.
- A rescue team must be on standby, equipped with a rescue plan.
- All equipment used must be checked, calibrated and in good condition.
- The usage of (ambient air independent) SCBA's (Self-Contained Breathing Apparatus) is in this case not stipulated. It is not specified in what situation the crew may/must use respiratory protection. If a(n) (ambient air independent) breathing apparatus is used when entering the enclosed space, the users must know how to use the apparatus and it must be tested.

In order to enter an enclosed space in accordance with this procedure, five individuals are needed (a supervisor at the door, two to enter the space and two on the standby team). The ship had an eight-man crew. To be able to conduct the cargo inspection, which is considered to be a fairly short and easy job, a lengthy procedure needs to be followed. This procedure is considered as to be of great impact on the crew. When taking into account the composition of the crew, it can be considered as un-workable.

Safety meeting and safety consciousness

Prior to loading, the ship management drew attention to the measures to be taken in connection with the toxic and carcinogenic characteristics of the substance. The MSDS was used as the basic document to inform the crew in a safety meeting. The MSDS mainly emphasises the toxic and carcinogenic characteristics of the cargo, the oxidising hazard of the cargo, however, is not emphasised as strongly. The first paragraphs of the MSDS describe the toxic and carcinogenic characteristics, while paragraph 7 briefly discusses oxidation (see Appendix B). From the notes of the assembly and the statements of the crew, it appears that information which was provided to the crew focused on hazards during loading in the port and that no attention was paid to the risk of oxidising cargo during the voyage.

During the loading procedure, people walk in and out of the accommodation. A small percentage of dust is therefore not avoidable. However, despite the safety briefing the accommodation nonetheless became so dusty during loading procedures that the crew suffered irritated airways. The accommodation had therefore not been closed properly during loading.

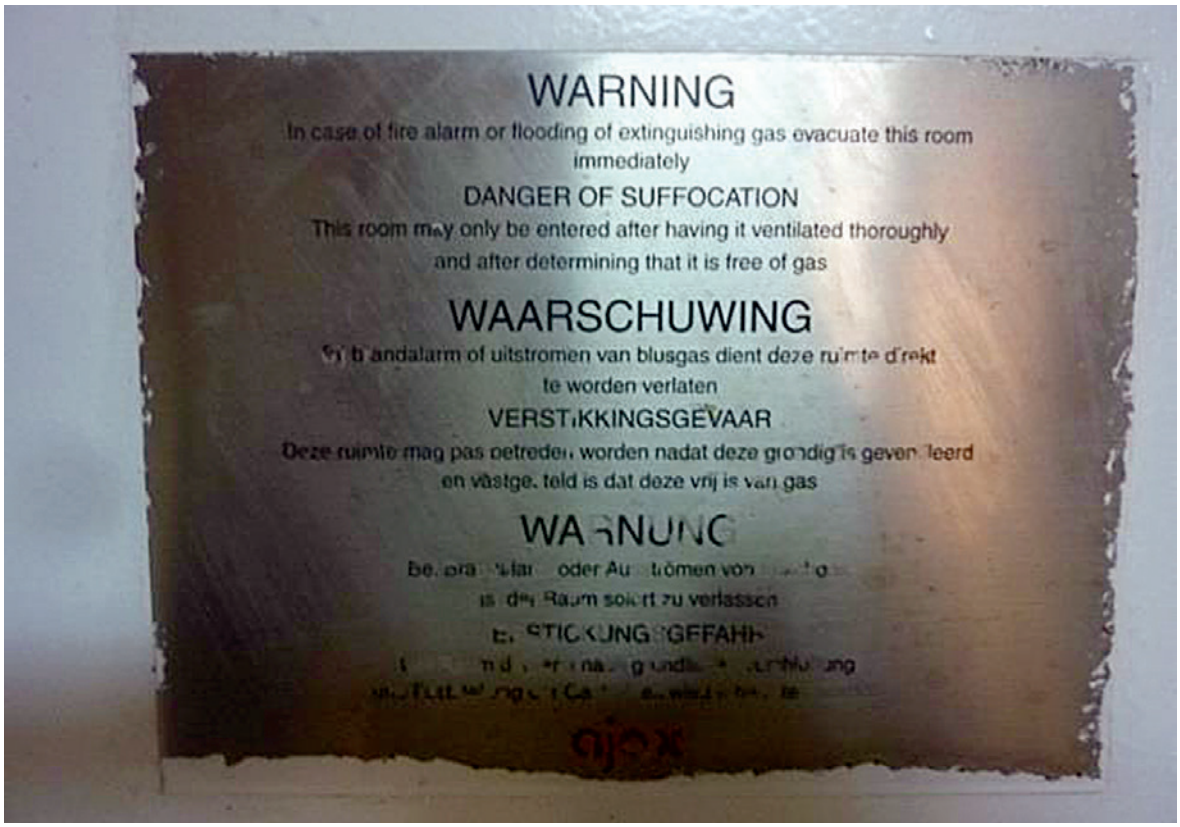

Figure 4: Warning on the access doors to the stairwell. (Source: Ameyde Marine)

Contradictory instructions

The first mate went to inspect the cargo in accordance with the instructions. One of the first mate's most important tasks is to safeguard the cargo and to ensure the ship's stability. This was his first voyage in the role of first mate. For this reason the Dutch Safety Board considers it plausible that he felt that he had an additional responsibility to perform his task competently. In view of the measures set out in the IMSBC Code he was required to inspect the cargo regularly on account of the risk of liquefaction. There were no further clues that the cargo actually was liquefying, such as a bilge alarm or because of unexpected listing of the ship.

When inspecting the cargo the first mate was faced with a contradiction caused by multiple risks and associated precautionary measures. The IMSBC Code and the MSDS state that the cargo may be toxic and carcinogenic and that personal protective measures must be taken accordingly. The IMSBC Code states that the cargo spaces in which solid bulk cargo is transported may not be ventilated, whereas the cargo hold is an enclosed space. According to the procedure, as set out in the MSDS and the IMSBC Code, the enclosed space must therefore be ventilated and the atmosphere tested for oxygen concentrations before permitting entry to the enclosed space. Both entrances to the hold are designated as a enclosed space and both access doors displayed warning signs indicating entry into a enclosed space (see image 4). This therefore is contradictory: ventilation is mandatory, on the one hand, whereas ventilation is prohibited, on the other.

The first mate handled in accordance with the toxic and carcinogenic risks of the substance. He used personal protective equipment, an ambient dependent respiratory filter to protect himself against chemical hazards. He did not ventilate the space before

entering it. He did not adhere to the procedure for entering an enclosed space and furthermore did not use an ambient independent breathing apparatus to protect himself against potential oxygen deficiency. The usage of Oxygen SCBA's is in these circumstances not prescribed.

The first mate, did not adequately identify the immediate hazard of oxygen deficiency. The procedure for entering a confined space was not followed.

From the actions of the sailor and the second mate it can be concluded that they were not directly alarmed by the situation in which the first mate was situated. More than half an hour elapsed between the inspection performed by the seaman and that of the second mate. The statements made by the second mate and the seaman show that while they generally were well aware of the hazards inherent in the cargo, they focused mainly on toxicity and less on the substance's oxygen-depletion characteristics. The normal day-to-day operations which were related to the first mate and the hierarchal structure on board of the vessel could have played a significant role. The first mate was not supervised when executing his daily activities.

During the rescue operation the crew members who entered the stairwell did use respiratory protection. At that moment the individuals concerned were well aware of the oxygen deficiency hazard and took the appropriate measures. The rescue operation was compounded by the fact that the access stairwell leading to the hold is in an awkward space in which to evacuate a person and no emergency evacuation provisions were available. Given the time between the moment the first mate entered the access stairwell and the moment at which the second mate found him, it is unlikely that the first mate could still have been saved on time.

Measurements performed the day after the accident show that the amount of oxygen in the air at stairwell was 2,6%. An oxygen concentration lower than 18% and, in particular, lower than 10% can pose an (acute) risk of asphyxiation resulting in permanent brain damage within a few minutes, causing death in the absence of intervention.

CONCLUSIONS

Factors contributing to the accident

The Dutch Safety Board has established that the cargo inspection procedure is inconsistent with the execution of the task in practice:

- Firstly, in this case there is a contradiction: under the IMSBC Code, the MSDS and in accordance with the procedure, the hold must be ventilated before entry is permitted. The IMSBC Code, however, prohibits ventilation of the hold during the voyage. The use of oxygen-independent breathing apparatus is not stipulated in this situation.
- Secondly, according to the procedure five individuals are required to take part in the activities that apply to entering enclosed spaces. The ship had an eight-man crew. For the purpose of inspecting cargo, which in itself is a relatively short and straight-forward task, performing the entire procedure has a huge impact on the crew. In view of the crew composition, this is unworkable.
- Thirdly, in order to inspect cargo three different safety sheets and a permit-to-work must be read side by side so as to deduce the appropriate procedure to be followed. This is impractical for such a straight-forward task.

- The actions of the first mate show that the cargo oxygen-depletion hazard had been underestimated or was unknown whereas he was in fact aware of the toxic and carcinogenic hazards to which attention had been paid during the safety briefing based on the cargo information.

- The MSDS was used to inform the crew of the hazards during loading, mainly emphasising the toxic hazards, which is attributable to the structure of the MSDS.

The immediate causal factors

- The access doors to the stairwells leading to the hold displayed warnings highlighting that the door provided entry to an enclosed space. These warnings were prominently placed and could not be overlooked. The first mate, one of the senior officers on board, failed to take adequate measures irrespective of the warnings, or had not been motivated to do so.
- The first mate was not supervised when executing his daily activities.

LESSONS LEARNED

- The check-up procedures of the cargo load are not consistent with the procedures in practise: there are inconsistencies about when to ventilate; there are three different safety sheets and a working permit included in the SMS. Five of the eight crew-members are necessary to execute the procedure. Although the procedure of the SMS includes all rules and regulations, it does not work in practise. It is up to the ship's owners and the seafarers to establish workable procedures and to transform those in practice unworkable procedures.

- When bulk cargoes are transported by sea, it is essential that the crew of the vessel is informed in advance about the risk levels of every stage of transport. These risks, with their matching control measures, should be easily deducted from the cargo documentation and regulation. It is up to the ship management to interpret the cargo loading documentation and to inform the crewmembers of the dangers and the necessary safety measures which need to be taken. A good way to inform the crew is by providing the entire crew with a clear safety briefing. This briefing should contain all phases of the transportation. Thereby it must be pointed out that everyone has the responsibility to hold each other accountable for actions which are not in accordance with the safety procedures.

- The research into this accident shows that more attention needs to be paid to the safety awareness and safety culture on board of ships. This appears, for example, out of acts such as not closing the accommodation during loading, the crew which does not heed warning signs regarding the entering of enclosed spaces and does not check-up on each other and is unable or unwilling to address each other during unsafe circumstances.

APPENDIX A

CARGO LEGISLATION

The rules laid down in the International Maritime Solid Bulk Cargoes Code (IMSBC Code) apply to the carriage of solid bulk cargoes. Advice on the characteristics and transhipment methods for standard solid bulk cargoes are provided in the schedules included in the IMSBC Code. The IMSBC Code is divided into three categories:

A. Substances that may liquefy if shipped with a higher moisture content than their maximum permissible moisture content.
B. Substances that possess a chemical hazard, broken down into:
   – hazardous material: materials classified under the International Dangerous Goods (IMDG) Code[7]
   – Materials Hazardous only in Bulk (MHB): materials that may possess chemical hazards when transported in bulk.
C. Substances that do not fall under A or B.

In some cases a material may fall under both group A and group B.

Even though the flow chart states separately that some materials are susceptible to oxidation (oxygen depletion), oxidation is deemed to be a general hazard (cf. Section 3 of the IMSBC Code). A material which could possibly lead to oxidation does not necessarily fall under category B.[8] The crew must be aware of oxidising hazard at all times. The crew is deemed to consider the hold as an enclosed space, especially because of the transportation of these kinds of cargo.

According to Rule 2 of the IMSBC Code, the shipper must provide the captain or the latter's representative the correct cargo information well in advance of loading. A document has been drawn up for that purpose, the Form for Cargo Information for Solid Bulk Cargoes, in which the required information should be provided in accordance with the IMSBC Code. Furthermore it is mandatory for the shipper to make available to the captain of the ship all the hazard information relating to the material that is to be transported.

7 IMDG Code: Regulations for the transport of dangerous goods by sea. It contains lists of dangerous goods. The goods are divided into classes, are given a number (UN number) and a proper shipping name. The Code also contains the risks and the precautionary measures to be taken. Goods that are only dangerous when transported as Materials Hazardous only in Bulk (MHB) are not incorporated in the Code.

8 There are a wide variety of oxygen-depleting bulk cargoes. If this constitutes a criterion for classification in group B, further classification in group B is irrelevant.

The cargo transported

Prior to loading the Hudsonborg, the following documents were supplied to the ship:

- Form for Cargo Information for Solid Bulk Cargoes (stipulated by the IMSBC Code)
- Certificate of pre-shipment moisture determination and Transportable Moisture Limit (TML).
- Declaration from the International Zinc Association concerning the Classification of zinc concentrates as harmful to the marine environment (requirement cf. MARPOL Annex V (IMO-MEPC resolution 219 (63)).[9]
- Material Safety Data Sheet (MSDS).

The Form for Cargo Information for Solid Bulk Cargoes classifies the cargo as 'zinc concentrates', grouped in cargo group A and states that the material is not harmful to the marine environment (cf. IMO MARPOL ANNEX V). It also refers to additional certificates, namely the Certificate of pre-shipment moisture determination and TML in addition to the MSDS.

In the Certificate of pre-shipment moisture determination and TML the cargo is also classified as 'zinc concentrate' stating the current and maximum moisture content in connection with liquefaction risk.

The MSDS provides detailed information on the composition of the substance and tips and recommendations are provided on safety measures in addition to personal protective measures. The MSDS is not a mandatory document required by law but it does set out the shipper's duty to declare information.

While the declaration from the International Zinc Association also indicates the classification 'zinc concentrate' and deems the substance 'not harmful to the maritime environment under IMO MARPOL Annex V', it does deem the substance toxic in various ways.

From the MSDS, it did not become clear to the ship management which substance was supposed to be transported. The shipping company management used the MSDS as a basic document to provide information to the crew. The MSDS shows a discrepancy between the substance name and the proper shipping name. The substance name stated in Section 1.1 is 'zinc concentrate' whereas Section 14.2 states 'metal sulphide concentrate', Materials Hazardous in Bulk (MHB), as the proper shipping name. The term 'proper shipping name' is used in the International Maritime Dangerous Cargo (IMDG) code. The MSDS refers in this case to the wrong regulation. The term which should have been used in agreement with the IMSBC code is Bulk Cargo Shipping Name (BCSN). According to the MSDS the concentrate is composed of 52,9 (weight)% zinc, 31,8% sulphur, 5,4% iron, 2,2% lead and a number of other minerals, each less than 1%.

9 MARPOL Annex V (IMO-MEPC resolution 219 (63)): guidelines for the implementation of Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL). Article 3.4 stipulates that it is mandatory for the shipper to declare this information.

The IMSBC code contains two schedules that could be applied to this cargo: a schedule for mineral concentrate and another for metal sulphide concentrate. Both schedules state the substance zinc concentrate and refer to each other. Both schedules refer to liquefaction risk and therefore state that it is mandatory to inspect the cargo regularly. Both schedules also state that ventilating the hold is prohibited. Moreover the flow chart for metal sulphide concentrate points out the potential chemical hazards as well as oxidising hazard.

Conclusion
Oxidising hazard is a general hazard which the crew must always take into account when entering a hold containing bulk cargoes (iaw. Section 3, IMSBC Code). The schedule for metal sulphide concentrate places greater emphasis on the hazard, in contrast to the mineral concentrate schedule.

From the MSDS it does not become clear which substance was to be transported.

According to the official Form for Loading Solid Bulk Cargoes, the cargo was classified in group A of the IMSBC Code, As the cargo transported was susceptible to liquefaction and possessed chemical hazards, therefore the cargo needed to be classified as group A&B.

MATERIAL SAFETY DATA SHEET

lundin mining

MATERIAL SAFETY DATA SHEET

Neves-Corvo Zinc Concentrate 8

Revsion Date:	20 May 2013
Version Number:	2.3
Supercedes date:	15 February 2013

SECTION 1: IDENTIFICATION OF THE SUBSTANCE /PREPARATION AND OF THE COMPANY / UNDERTAKING

1.1: Product identifier

Substance Name	Zinc Concentrate
Chemical Name and Formula	Zinc concentrate is a naturally occurring UVCB, obtained from crushed zinc ore by conventional mineral processing.
CAS No.	Not Applicable
EINECS No.	310-127-6
Molecular weight	Not Applicable
REACH Registration number	Naturally occurring substance exempt from registration

1.2: Relevant identified uses of the substance or mixture and uses advised against

Identified Uses	Refined metal production, concentrate is smelted to produce metallic zinc.
Uses advised against	None known

1.3: Details of the supplier of the safety data sheet

Name	Sociedade Mineria de Neves-Corvo, S.A.
Address	Apartado 12 7798-909 Castro Verde Portugal
Phone	+ 351 286 689 000
Fax	+351 286 689 289
E-mail of competent person responsible for SDS	sds@lundinmining.com

1.4 : Emergency telephone number

+351 (0) 962 426204 (09:00-17:00 Mon-Fri)

SECTION 2: HAZARDS IDENTIFICATION

2.1: Classification of the substance or mixture

Classification according to EC 1272/2008 (CLP):	Carcinogenicity: Cat. 2 H351	(PbS)
	Reproductive toxicity: Cat. 1A H360	(PbS)
	Specific Target Organ Toxicity - Repeated Exposure: Cat. 2 H373	(PbS)
	Chronic aquatic toxicity: Cat. 3 H412	

Classification according to 1999/45/EC (DPD):	Carc. Cat. 3; R40	(PbS)
	Repr. Cat. 1; R60/61*	(PbS)
	Xn; R48/20/22*	(PbS)
	N; R52-53*	

The classification of the concentrate specified above was done according to guidelines and criteria outlined in IMO-MEPC resolution 219(63), annex 24, and according to the Global Harmonised System (GHS 2011). Major drivers of health hazard classifications are listed in parentheses ()
See section 16 for full text. Of H statements and R phrases.

2.2: Label elements (according to EC 1272/2008 (CLP))	
Hazard pictogram(s):	
Signal word:	Danger
Hazard statement(s):	Suspected of causing cancer. May damage fertility or the unborn child. May cause damage to organs through prolonged or repeated exposure. Harmful to aquatic life with long lasting effects.
Precautionary statement(s):	Obtain special instructions before use. Do not breathe dust. Wear protective gloves/ protective clothing/ eye protection/ face protection.. If exposed or concerned: Get medical advice/attention. Avoid release to the environment. Dispose of in accordance with local/regional/national/ international regulation.
Label elements (according to1999/45/EC(DPD))	
Hazard pictogram(s):	
Indication(s) of danger:	T; Toxic, N; Dangerous for the environment
Risk phrase(s):	Limited evidence of a carcinogenic effect May impair fertility. May cause harm to the unborn child Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
Safety phrase(s):	Wear suitable protective clothing and gloves In case of accident or if you feel unwell seek medical advice immediately. Avoid exposure - Obtain special instructions before use. Use appropriate containment to avoid environmental contamination. This material must be disposed of as hazardous waste.

2.3: Other Hazards	
PBT or vPvB	This product is exempt from REACH and therefore does not meet the criteria for PBT or vPvB assessment under Annex XIII of EC No. 1907/2006.
	Dust may irritate eyes and respiratory system. Metal sulphides, when heated, may release sulphur dioxide, which will irritate the upper respiratory tract. Conditions and work practices which generate dust and fume should be controlled or avoided. Primary routes of exposure are inhalation and ingestion.

According to GHS, the substance merits environmental classification Acute 2:H401 Toxic to aquatic life.

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

3.1: Substances

Identification Name	EINECS Number	CAS Number	Annex Index Number	Weight % (w/w)	Remarks
Zn	231-175-3	7440-66-6	See remarks	52	Assumed to be ZnS (EC 215-251-3, CAS 1314-98-3)**
S	231-722-6	7704-34-9	See remarks	35	Sulphur present as sulfide minerals**
Fe	231-096-4	7439-89-6	-	9	Assumed to be FeS_2 (EC 235-106-8, CAS 12068-85-8)**
Non- Metallic Gangue Minerals	-	-	-	<1	
Pb	231-100-4	7439-62-1	-	<1	Assumed to be PbS (EC 215-246-6, CAS 1314-87-0)**
Cd	231-152-8	7440-43-9	See remarks	<1	Assumed to be CdS (EC 215-147-8, CAS 1306-23-6, Annex 048-010-00-4)**
Cu	231-159-6	7440-50-8	-	<1	Assumed to be CuS (EC 215-271-2, CAS 1317-40-4)**

Mineralogical composition: 84.3% Sphalerite ((Zn, Fe) S_2), 11.2% Pyrite (FeS_2), 2.4% Chalcopyrite ($CuFeS_2$), 0.9% Galena (PbS), 0.4% Arsenopyrite (FeAsS), 0.8 % Non-metallic gangue minerals. Weight percentages of each component were calculated from the above mineralogical composition.
Non-metallic gangue minerals consist of non-hazardous minerals including: typical Pyroxene (augite) $Ca(Mg,Fe,Al)(Al,Si)O_2$, typical Amphibole (hornblende) $Na,Ca_2(Mg,Fe,Al)_5(Si,Al)_8O_{22}(OH)_2$, Microcline $KAlSi_3O_8$, Plagioclase $(Ca,Na)(Al,Si)AlSi_2O_8$, Muscovite $KAl_2(AlSi_3O_{10})(OH)_2$,Calcite $CaCO_3$.

3.2: Mixture

Not applicable – product is a substance.

SECTION 4: FIRST AID MEASURES

4.1: Description of first aid measures

Eyes	Rinse with plenty of water for several minutes, occasionally lifting upper and lower eyelids. Remove contacts if present and easy to do so. Seek medical attention if irritation develops or persists.
Inhalation	Remove to fresh air and seek medical attention if required. If breathing has stopped, perform emergency resuscitation.
Ingestion	Do not induce vomiting unless directed to do so by medical personnel. Never give anything by mouth or induce vomiting in an unconscious or convulsing person. Seek medical attention if large quantities are swallowed or you feel unwell.
Skin	Thoroughly wash affected areas with mild soap and water and seek medical attention if required. Remove contaminated clothing and shoes and launder before reuse.
General advice	After first aid, get appropriate medical attention.

4.2: Most important symptoms and effects, both acute and delayed

Acute toxic effects are considered unlikely. Mechanical irritation of skin and eyes may occur. Inhalation

of powder or dust may cause cancer. May damage fertility or cause birth defects. Repeat or prolonged exposure may cause organ damage.

4.3: Indication of any immediate medical attention and special treatment needed

Symptomatic treatment as required.

SECTION 5: FIREFIGHTING MEASURES

5.1: Extinguishing media

Extinguishing methods depend upon hazards in vicinity. Use suitable extinguishing media for surrounding material.

5.2: Special hazards

Product has no visible flames. Discoloration of product is evident upon combustion. Dust may form combustible atmospheres. When heated to temperatures approaching decomposition may release sulphur dioxide and metal oxide fumes. May form corrosive mists or vapors during combustion.

5.3: Advice for firefighters

Wear self-contained breathing apparatus and full protective equipment (bunker gear).

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1: Personal precautions

Remove any ignition sources. Use personal protective equipment (i.e., gloves, safety goggles, dust respirator) as specified in Section 8 of this SDS. Avoid formation and accumulation of dust.

6.2: Environmental precautions

Avoid release into the environment.

6.3: Methods for cleaning up

Use clean-up methods which avoid dust generation. Damp down if necessary and transfer into appropriate labelled containers. Dispose of wastes according to regulations.

6.4: Reference to other sections

See Sections 8 and 13 for exposure controls and disposal considerations.

SECTION 7: HANDLING AND STORAGE

7.1: Handling

Wear protective clothing. Use in a well ventilated area and maintain good housekeeping procedures to reduce accumulation of dust or generation of airborne dust particles. Wash thoroughly after handling. Do not eat, drink or smoke when handling. Avoid contact with ignition sources.

7.2: Storage

Store in a dry, well-ventilated area away from sources of combustion, acids and strong oxidizers. Some sulphide concentrates may slowly oxidize in storage, causing heating of the material and generation of sulphur dioxide (SO_2). The atmosphere within confined spaces containing concentrate, such as a ship's hold, should be tested for oxygen depletion before entry and the space ventilated if necessary. Store concentrate in a way that minimizes dust generation.

7.3: Specific use(s)

Concentrate is smelted to produce metallic zinc.

SECTION 8: EXPOSURE CONTROLS / PERSONAL PROTECTION

8.1 : Exposure limit values

No exposure limit values established for the mixture

Cadmium sulfide (as Cd)	0.03 mg/m^3 8 hr TWA (UK, EH40-2011)
Copper	
Fume	0.2 mg/m^3 8 hr TWA (UK, EH40-2011)
Dusts and mists (as Cu)	1 mg/m^3 8 hr TWA, 2mg/m^3 15 min STEL (UK, EH40-2011)
Lead	0.15 mg/m^3 8 hr TWA (CLAW Regulations 2002
Biological action levels	60 µg/dl 30 µg/dl (for woman of reproductive capacity)

DNELs and PNECs: Not available

8.2: Exposure controls

Appropriate engineering controls:

To reduce dust emission during handling, covered conveyor belts are preferred. Mobile equipment used for handling concentrate, such as front end loaders, should preferably be equipped with cab air filtration systems.

Individual protection measures:

Eye/face protection	Use safety glasses as appropriate and reasonably necessary.
Skin protection	Use work gloves and work clothes as appropriate and reasonably necessary.
Respiratory protection	Use respiratory protection when airborne levels exceed exposure limit values.
Environmental exposure controls	Avoid release into the environment. Do not allow to enter drains or water courses.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1: General information

Appearance	Brown to grey powder
Odour	None
Odour threshold	Not applicable
pH	No data available
Melting point/freezing point	> 1000 °C
Initial boiling point/boiling range	Not applicable
Flash point	No data available
Evaporation rate	Not relevant
Flammability	Non-flammable
Upper/lower flammability or explosive limits	Not relevant
Vapour pressure	Not relevant
Vapour density	Not relevant

Relative density	No data available
Solubility in water	No data available
Partition coefficient (n-octanol/ water)	Not relevant
Auto-ignition temperature	No data available
Decomposition temperature	No data available
Viscosity	No data available
Explosive properties	Not classified as explosive
Oxidising properties	Not classified as oxidising

9.2: Other information

None known.

SECTION 10: STABILITY AND REACTIVITY

10.1: Reactivity

No hazardous reactions known under normal ambient and anticipated storage and handling conditions of temperature and pressure.

10.2: Chemical stability

Stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

10.3: Possibility of hazardous reactions

None known under normal ambient, temperature and pressure storage and handling conditions.

10.4: Conditions to avoid

Avoid formation of dusty atmospheres.

10.5: Incompatible materials

Oxidizing agents, acids, iodine pentachloride, iodine monochloride, and hydrogen peroxide.

10.6: Hazardous decomposition products

Decomposition may release sulphur dioxide, metal oxide fumes and flammable hydrogen sulfide gas.

SECTION 11: TOXICOLOGICAL INFORMATION

11.1: Information on toxicological effects

Acute inhalation	No data were identified for this product as a whole.Based on its constituents this product is not considered to meet the classification criteria for harmful if inhaled. Exposure to dust may be irritating to the nose, throat and respiratory tract with dryness, coughing and metallic taste. Elemental zinc resulted in a LC_{50} of >5.41 mg/m^3; no mortality was observed. Less intense short-term exposure to copper and zinc during smelting could result in the condition called metal fume fever. The symptoms of metal fume fever will occur within 3 to 10 hours, and include immediate dryness and irritation of the throat, tightness of the chest, and coughing which may later be followed by flu-like symptoms of fever, malaise, perspiration, frontal headache, muscle cramps, low back pain, occasionally blurred vision, nausea, and vomiting. The symptoms are temporary and generally disappear, without medical intervention, within 24 to 48 hours of onset.

Neves-Corvo Zinc Concentrate 8

Acute oral	No data were identified for this product as a whole. Based on its constituents, this product is not considered to meet the classification criteria for harmful if swallowed. Ingestion of large quantities may result in gastrointestinal upset, vomiting, constipation or bloody diarrhea. Zinc sulfide resulted in a rat oral LD_{50} >15000 mg/kg bw.
Acute dermal	No data were identified for this product as a whole. Zinc sulfide resulted in a rat dermal LD_{50} >2 g/kg bw. Elemental copper resulted in an rat LD_{50} of >2000mg/kg bw.
Skin corrosion/irritation	No data were identified for this product or its constituents. The product may cause mechanical skin irritation.
Eye damage/irritation	No data were identified for this product as a whole. The product may cause mechanical eye irritation.
Respiratory/skin sensitisation	No data were identified for this product as a whole. None of the components have been identified as sensitisers, and this product is not expected to cause sensitization.
Germ cell mutagenicity	No data were identified for this product as a whole. Product contains cadmium compounds which may be mutagenic, however they are present only at concentrations below thresholds for concern.
Carcinogenicity	No data were identified for this product as a whole. Product contains lead and cadmium compounds which may cause cancer. Lead is classified according to IARC – Category 2 carcinogen; ACGIH - A3 - Confirmed Animal Carcinogen with Unknown Relevance to Humans; NTP – Category B: Reasonably Anticipated To Be A Human Carcinogen. Cadmium is classified according to IARC - Category 1 carcinogen; IRIS Group B1 Probable Human Carcinogen. Classification of the product is based on metal release rates assessed by in-vitro bio-solubility tests in gastric fluids (ASTM 55717-07). The results demonstrate lower bio-accessibility of the metals from the concentrates compared to the soluble reference metal compounds.
Reproductive toxicity	No data were identified for this product as a whole. Product contains lead compounds which are known to damage fertility and cause birth defects. Chronic over-exposure to lead has been implicated as a causative agent for impairment of male and female reproductive capacity. Classification of the product is based on metal release rates assessed by in-vitro bio-solubility tests in gastric fluids (ASTM 55717-07). The results demonstrate lower bio-accessibility of the metals from the concentrates compared to the soluble reference metal compounds.
Specific Target Organ Toxicity–single exposure	No data were identified for this product or its constituents.
Specific Target Organ Toxicity–repeated exposure	No data were identified for this product as a whole. Product contains lead compounds. Kidney dysfunction and neurological damage has been associated with chronic lead poisoning. Product contains copper compounds, Workers exposed to high levels of copper dust may report symptoms suggestive of respiratory irritation, including coughing, sneezing, thoracic pain, and runny nose. Product contains cadmium compounds which are known to cause organ damage by prolonged or repeated exposure.
Aspiration hazard	Not relevant. Physical form of solid or powder indicates no aspiration hazard potential.

Information on likely routes of exposure
The relevant routes of exposure are the oral, dermal, and inhalation.

Symptoms related to the physical, chemical and toxicological characteristics
Inhalation of dusts may cause cancer. Prolonged or repeated may cause organ damage. May damage fertility or cause birth defects.

Delayed and immediate effects as well as chronic effects from short and long-term exposure
Inhalation of dusts may cause cancer. Prolonged or repeated exposure may cause organ damage. May damage fertility or cause birth defects.

Interactive effects
None known.

SECTION 12: ECOLOGICAL INFORMATION

12.1: Toxicity

No data were identified for this product as a whole. Some of the elemental metal constituents in the concentrate exhibit acute and/or chronic toxicity to fish, invertebrates and/or algae.

Dissolution tests demonstrated that Neves Corvo zinc concentrate in general shows metal ion release rates for Zn, Pb, Cd, that are lower than from the soluble metal compounds with known hazard profile.The product is classified according UN-GHS 4th rev 2011 as Acute Aquatic Toxicity Cat. 2 and Chronic Aqiuatic Toxicity Cat. 3.

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Toxicity to fish	**Zinc** *Pimephales promelas* (fathead minnow) Flow-through 96-h-LC_{50} = 2.16 – 3.05 mg/L Semi-static 96-h-LC_{50} = 0.211 – 0.269 mg/L Static 96-h-LC_{50} = 2.66 mg/L *Oncorhynchus mykiss* (rainbow trout) Flow-through 96-h-LC_{50} = 0.24 mg/L Semi-static 96-h-LC_{50} = 0.59 mg/L Static 96-h-LC_{50} = 0.41 mg/L *Lepomis macrochirus* (bluegill sunfish) Static 96-h-LC_{50}= 3.5 mg/L **Lead** *Pimephales promela* 96 Hr LC_{50} = 6.5 mg/L
Toxicity to invertebrates	**Zinc** *Daphnia magna* (water flea) Static 48-h-EC_{50} = 0.139 – 0.908 mg/L **Lead** *Daphnia magna* (water flea) 48 Hr EC_{50} = 600 µg/L
Toxicity to algae and plants	**Zinc** *Pseudokirchneriella subcapitata* (green algae) Static 96-h-EC_{50} = 0.11 - 0.271 mg/L 72-h-NOEC = 0.09 - 0.125 mg/L

12.2: Persistence and degradability

Not relevant for naturally-occurring inorganic compounds.

12.3: Bioaccumulative potential

Zinc is an essential element and therefore, animals regulate their internal zinc concentrations in most cases. The fact that zinc, as an essential metal, is naturally concentrated by living organisms means that the BCF for zinc bears no relationship to toxicity.

The concentrate contains lead which is known to bioaccumulate in aquatic organisms

12.4: Mobility in soil

Not relevant for naturally-occurring minerals.

12.5: Results of PBT and vPvB assessment

This product is exempt from REACH and therefore does not meet the criteria for PBT or vPvB assessment under Annex XIII of EC No. 1907/2006.

12.6: Other adverse effects

This product contains materials known to be hazardous to the aquatic environment.

SECTION 13: DISPOSAL CONSIDERATIONS

13.1: Waste treatment methods

Dispose of material in accordance with local/regional/national/international regulations.

SECTION 14: TRANSPORT INFORMATION

	Road (ADR)	Sea (IMDG)	Air (ICAO)
14.1: UN-No.:	None	None	None
14.2: Proper shipping name:	None	Metals sulphide concentrate, MHB (Materials Hazardous in Bulk),	None
14.3: Hazard class(es):	None	None	None
14.4: Packing group:	None	None	None
14.5: Environmental hazard(s):	None	None	None
14.6: Special precautions for the user	None	This material may liquefy if shipped at moisture content in excess of its transportable moisture limit. It may also present chemical hazards. Recommendations set out in Appendix 1 of the International Marine Solid Bulk Cargo Code should be observed.	None
14.7: Bulk transportation (according to Annex II of MARPOL 73/78 and the IBC Code:	Not applicable	Not applicable (solid product)	Not applicable

Note that this material has been tested under the United Nations Transport of Dangerous Goods, Manual of Tests and Criteria, Fifth Revised Edition (2009) Test results indicate that the concentrate qualifies neither as a flammable solid under Class 4.1 nor a self-heating substance under Class 4.2. The aquatic toxicity classification of the zinc concentrate according UN-GHS 4th rev 2011, is acute 2, chronic 3, not harmful to the marine environment.

SECTION 15: REGULATORY INFORMATION

15.1: Safety, health and environmental regulations/legislation specific for the substance or mixture

National Regulations: Control of Lead at Work Regulations 2002

15.2: Chemical safety assessment

A chemical safety report/chemical safety assessment has not been carried out on this material.

SECTION 16: OTHER INFORMATION

Directive 67/548/EEC:	R40: Limited evidence of a carcinogenic effect R48/20/22: Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed R60: May impair fertility. R61: May cause harm to the unborn child. R52/53: Harmful to aquatic organisms, may cause long-term adverse effects in the aquatic environment
Directive EC 1272/2008:	H351: Suspected of causing cancer. H360: May damage fertility or the unborn child. H373: May cause damage to organs through prolonged or repeated exposure. H412: Harmful to aquatic life with long lasting effects.
Revision(s):	Sections 2.1, 2.2, 11.1, 12.1 and 14 updated to reflect change in classification based on new data from transformation/dissolution tests which show in general metal ion release rates for e.g. Zn, Pb, Cd, that are lower than from the soluble metal compounds with known hazard profile

ABBREVIATIONS:

CAS	Chemical Abstracts Service
Carc.	Carcinogenicity
Cat.	Category
CLAW	Control of Lead At Work
CLP	Classification, Labelling, and Packaging
DNEL	Derived No Effect Level
DSD	Dangerous Substances Directive
DPD	Dangerous Preparations Directive
EC	European Commission

EEC	European Economic Community
EINECS	European Inventory of Existing Commercial chemical Substances
EU	European Union
Inhal.	Inhalation
MARPOL	International Convention for the Prevention of Pollution From Ships
Muta.	Mutagenicity
No.	Number
PBT	Persistent, Bioaccumulative, and Toxic
PNEC	Predicted No Effect Concentration
REACH	Registration, Evaluation, Authorization and Restriction of Chemical substances
Repr.	Reproduction
SDS	Safety Data Sheet
Sens.	Sensitization
STEL	Short Term Exposure Limit
STOT-RE	Specific Target Organ Toxicity - Repeat Exposure
TWA	Time Weighted Average
vPvB	very Persistent, very Bioaccumulative

DISCLAIMER OF LIABILITY

To the best of our knowledge, the information contained herein is accurate. The data in this MSDS relates only to the specific material designated herein, and are to be used for this product only, and does not relate to use in combination with any other material or in any process. If the product is used as a component in another product, this information may not be applicable. Final determination of suitability of any material is the sole responsibility of the user. As the conditions of handling and use are beyond our control, we assume no liability for damages incurred by use of this material or reliance on this data. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that may exist. Users of this product should satisfy themselves that the conditions and methods of use assure the product is used safely. No representations or warranties, either expressed or implied, of any nature are made hereunder with respect to the information contained herein. It is the responsibility of the user to comply with any and all federal, state, or local laws and regulations that may exist. Nothing contained herein is to be construed as a recommendation for use in violation of any applicable laws or regulations.

End of Safety Data Sheet

FORM FOR CARGO INFORMATION FOR SOLID BULK CARGOES

SOMINCOR
Sociedade Mineira de Neves Corvo, S.A.

FORM FOR CARGO INFORMATION
for Solid Bulk Cargoes

BCSN Zinc concentrates	
Shipper : Somincor - Neves Corvo Mine	Transport document Number 102/2014
Consignee : Boliden Kokkola Oy	Carrier – Wagenborg Shipping
Name/means of transport – MV Hudsonborg Port/place of departure – Setubal/Portugal	Instructions or other matters
Port/place of destination Kokkola / Finland	
General description of the cargo Neves Corvo Zinc Concentrates	Gross mass (kg/tonnes) abt 5.500 metric Tons
Specifications of bulk cargo, if applicable: Stowage factor: 0.41 cubic meters / metric ton Angle of repose, if applicable: n/a Trimming procedures: Spout trimmed	
Group of the cargo ☐ Group A & B X Group A ☐ Group B ☐ Group C	For cargoes which may liquefy (Group A and Group A & B cargoes) Transportable Moisture Limit 11.90 % Moisture content at shipment 10.84%
Relevant special properties of the cargo (e.g., highly soluble in water) Classification according to IMO MARPOL ANNEX V: Harmful to the marine environment X - Not harmful to the marine environment	Additional certificate(s)* X Certificate of moisture content and transportable moisture limit ☐ Weathering certificate ☐ Exemption certificate X Other - SDS *If required
DECLARATION I hereby declare that the consignment is fully and accurately described and that the given test results and other specifications are correct to the best of my knowledge and belief and can be considered as representative for the cargo to be loaded.	Name/status, company/organization of signatory SOMINCOR SOC. MINEIRA DE NEVES-CORVO, SA Place and date Setúbal, 04.03.2014 Signature on behalf of shipper

APPENDIX D

RESPONSES AFTER INSPECTION

A concept of this report was submitted to the parties involved in accordance with the Dutch Safety Board Act. (Rijkswet Onderzoeksraad voor veiligheid). These parties were asked to check the report for errors and lack of clarity. The preview version of this report was submitted to the following parties:

- First mates next of kin.
- Royal Wagenborg b.v. (shipping company).
- Somincor-Sociedade Mineira de Neves-Corvo, S.A.

Royal Wagenborg b.v. availed themselves of the option of commenting.

The Board has adopted corrections of factual inaccuracies, additions in terms of detail and editorial comment (insofar as is relevant). The relevant parts of the text have been amended in the final report. One comment has not been adopted by the board:

'It is not known to us, and very unlikely the check of the sailor has been actually performed. We cannot find it in our reports. It would be unlogical that the first mate, after few minutes, would still have been inside the stairwell, close to the entrance door. It would mean that, after this check, he would almost not have changed position. The second mate was under the impression that this check had been performed by the sailor, but this must be seen as a misunderstanding.'

Reaction Dutch Safety Board:
The Board holds information that shows the check has been performed by the sailor.

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