Kalle Kauttu

ENVIRONMENTAL RISK SURVEY IN METAL INDUSTRY

Degree Programme in Environmental Engineering
2014

samk
Satakunnan ammattikorkeakoulu
Satakunta University of Applied Sciences

YMPÄRISTÖRISKIKARTOITUS METALLITEOLLISUUDESSA

Kauttu, Kalle
Satakunnan ammattikorkeakoulu
Environmental Engineering koulutusohjelma
Tammikuu 2015
Valvoja: Koski, Saara; Laatu, ympäristö ja työsuojelupäällikkö, Luvata Pori Oy
Ohjaaja: Dersten, Riitta; Lehtori, SAMK
Sivumäärä: 46
Liitteitä: 3

Asiasanat: ympäristö, riski, hallinta, kartoitus, tuotantoprosessi

---

TIIVISTELMÄ

Tämän opinnäytetyön tarkoituksena oli kartoittaa Luvata Pori Oy:n tehdasalueen ympäristöriskit ja laatia kartoituksen pohjalta toimintasuunnitelma sekä ohje viranomaistiedottamisesta poikkeustilanteissa. Tuotantoon liittyvien riskien lisäksi kartoitettiin mahdolliset tehdasalueeseen kohdistuvat ympäristöriskit, kuten luonnonilmiöt. Tarkoituksena oli saattaa kaikki Luvata Pori Oy:n toimintaan liittyvät ympäristöriskit yhteen helposti ymmärrettävään kokonaisuuteen.

Opinnäytetyön tarkoitus oli tehostaa yhtiön ympäristöriskien hallintaa. Työn tarve perustui ympäristönsuojelulakiin (527/2014) ja sen määrittelemiin yleisiin velvoitteisiin, jotka koskevat jokaista yritystä. Näitä velvoitteita ovat muun muassa selvilläolovelvollisuus, velvollisuus ehkäistä ja rajoittaa ympäristön pilaantumista, ennaltavarautumisvelvollisuus, maaperän ja pohjaveden pilaamiskielto, sekä kemikaalien käyttöä koskevat velvollisuudet.

Tuotannon ympäristöriskien kartoittaminen koostui olemassa olevien tietojen päivittämisestä, uusien riskien kartoittamisesta osastojen vastuuhenkilöiden kanssa, sekä yhtiön intranetistä löytyvän aineiston tutkimisesta. Ympäristöriskejä analysoitaessa hyödynnettiin yhtiön aikaisemmin käyttämää analyysimallia ja kaikki riskit analysoitiin samaa menetelmää käyttäen. Lisäksi uusille riskeille määriteltiin ennaltaehkäisevät toimenpiteet ja joillekin jo tiedossa olevien riskien ehkäiseviin toimenpiteisiin tehtiin parannusehdotuksia.

Tuotannon ympäristöriskien lisäksi kartoitettiin myös ulkoiset ympäristöriskit, kuten voimakkaan sääilmiöt. Näiden kartoittamisessa ja analysoinnissa hyödynnettiin useita eri analyysimalleja. Riskit käytiin perusteellisesti läpi ja niiden todennäköisyys arvioitiin, sekä kirjattiin ylös onnettomuus toimenpiteet realististen riskien osalta.

Opinnäytetyössä saadut tulokset antavat selkeän kuvan yhtiön ympäristöriskeistä ja sen toiminnasta ympäristöasioissa. Osittain tulosten pohjalta ja yhtiön tietokantoja hyväksi käyttäen laadittiin myös toimintaohjeet onnettomuustilanteita varten, sekä ohjeet viranomaistiedottamisesta näissä tapauksissa.

ENVIRONMENTAL RISK SURVEY IN METAL INDUSTRY

Kauttu, Kalle
Satakunnan ammattikorkeakoulu, Satakunta University of Applied Sciences
Degree Programme in Environmental Engineering
January 2015
Supervisor 1: Koski, Saara; Quality, Environment and Safety Manager, Luvata Pori Oy
Advisor: Dersten, Riitta; Lecturer, SAMK
Number of pages: 46
Appendices: 3

Keywords: environmental, risk, management, survey, production process

---

ABSTRACT

The purpose of this thesis was to make an environmental risk survey of the industrial area of Luvata Pori Oy and to draw up an action plan for accidents or other exceptional situations. Instructions about reporting to the officials were also included. In addition to the risks caused by production processes, external risks, such as natural phenomena, to the area were also analyzed and included into this thesis. The purpose was to combine all environmental risks related to the company's operations into easily available and understandable form.

The thesis was done in order to ensure the company's environmental management performance. The need for this thesis was based on the environmental protection act (527/2014) and on the general responsibilities defined by it that apply on every company. These responsibilities consist of obligation of awareness, prevention and limiting of environmental pollution, prediction as well as a ban of contaminating soil and ground water, and obligations related to handling of chemicals et cetera.

The environmental risks related to the production were surveyed by updating existing information, searching for new risks with the help of department representatives, and using the company's internal databases. Analyses of these risks were done with the analysis methods already in use in the company. Preventative measures were defined for the newly discovered risks and some improvement suggestions were given to the existing ones.

In addition to risks related to production, external risks like powerful weather phenomena were also assessed. In order to research them a number of analyzing methods were used. External risks were examined thoroughly and their probabilities were assessed. Preventive measures were written down for risks that were realistic.

The results from this thesis give a clear picture of the company's environmental risks and its conduct with environmental matters. Instructions for operation and communication with the officials in case of an accident were constructed using the results of this thesis and the company's internal databases.

CONTENT

PORI AND KIRJURINLUOTO AREA. (WEB PAGE OF FINLAND'S ENVIRONMENTAL ADMINISTRATION 2014)

1 INTRODUCTION

The purpose of this thesis was to survey the environmental risks of Luvata Pori Oy industrial area. Action plan was drawn out to give instructions on how to deal with these risks and how to prevent them. Environmental risks were defined as all risks to the environment caused by the production process of Luvata Pori and also risks to Luvata pori industrial area by natural phenomena, such as heavy rains, thunderstorms and a significant increase in the water level of Kokemäenjoki river. Instructions about reporting to the officials were also included in this thesis.

Luvata Pori Oy's own databases and knowledge of their staff were greatly utilized in making of this thesis. The survey consisted of researching literature and interviews of department representatives. Part of the project was to update existing information but the largest work was to survey the external risks and their effects to the plant as well as the production of the action and reporting plan. In order to survey the risks, methods previously applied by Luvata Pori Oy were used. Some of the retrieved information had to be left out of this thesis due to confidentiality agreement. Also due to the confidentiality agreement all the environmental risk templates made for this thesis are only for the use of the company and they were not published. See appendix 1 for hypothetical example of an environmental risk template made for this thesis. It does not refer to any production process of the company.

The thesis was done in order to ensure the company's environmental management performance. The need for this thesis was based on the environmental protection act (527/2014) and on the general responsibilities defined by it that apply on every company. These responsibilities consist of obligation of awareness, prevention and limiting of environmental pollution, prediction as well as a ban of contaminating soil and ground water, and obligations related to handling of chemicals et cetera. This document will be used to manage environmental risks of the company and to properly inform the government official about environmental matters at Luvata Pori Oy.

2 LUVATA PORI OY

Luvata Pori Oy is a part of Luvata Group which is an international company in the metal industry. Luvata operates in 13 countries in Europe, North- America and Asia. The company's products and applications range from heat exchanger technology and superconductors to resistant-welding technology for automotive industry et cetera. (Website of Luvata Oy 2014.)

Luvata Pori Oy has approximately 330 employees and worldwide Luvata employs almost 6300 professionals. Luvata Pori Oy consists of many different production departments each with production processes and methods of their own. This is the reason why a risk survey and action plan specified to each department is vital.

Luvata pori has an environmental permit and ISO 14001 environmental certificate. Luvata follows environmental rules and regulations issued to it by the Finnish officials. Regular emission analyses are carried out and reported to the officials as regulated. Exceptions are also written down in an online environmental diary which makes it easier to manage emissions internally.

Table 1. The limits of emissions to water of Luvata Pori Oy from 1.1.2011. The limit value is calculated as an average every quarter for every calendar day. The amounts are kilograms per day. (Internal database of Luvata Pori Oy.)

Metal	Cu	Zn	Ni	Cr(tot)	Cr(+6)
Amount (kg/day)	4	2	1	0,5	0,01

3 TERMINOLOGY

3.1 Environment

Environment is a combination of different physical and biological elements that affect a life of an organism. Different kinds of environments exist such as aquatic, terrestrial and man-made environments. (Kemp 1998, 127.) There are countless ways to define environment but in this thesis it means all natural and man-made surrounding the production plant of Luvata Pori Oy. In this case the concept of environment can be limited to Satakunta area.

3.2 Environmental risk

Environmental risk refers to a risk that is harmful for the environment. The consequences of this risk are usually considered to have an effect on soil, water, or air but it can also have an effect on human health, living conditions and comfort, climate, flora, organisms, biodiversity, community structure, buildings and landscape. Often only the directs effects are considered when dealing with environmental risks but it is very important that also the indirect and long- term effects are also taken into consideration. Environmental risk can be caused by both continuous and momentary emissions. (Mäkelä, Soininen & Oksa 2008, 3.)

In this thesis environmental risk describes all kinds operations at Luvata Pori which could have some harmful effects to the environment. Said effects can be directed to soil, water, air or man-made infrastructure.

3.3 External environmental risk

The term external environmental risk is used to describe a natural phenomenon or other incident caused by nature or human that could potentially have a harmful effect on the Luvata Pori production plant and can in turn result in an environmental risk.

These kinds of risks could be heavy rains, strong thunderstorm, onsite traffic or a sudden rise of the water level of Kokemäenjoki-river.

3.4 Environmental risk analysis

Environmental risk analysis, as risk analysis in general, is the starting point of risk prevention and management. The principal aim of these analyses is to produce information for decision making where the acceptance level of said risks is decided. All possible environmental risks are recognized and analyzed in the process so that they can be prevented or managed if needed. (Wessberg 2007, 34.)

The analysis method used in this thesis had already been in use at Luvata Pori Oy. The purpose of this analysis was to find out the probability, gravity, possible consequences and preventive measures of a risk. During the risk survey a risk number was calculated for all environmental risks that were found. The number was calculated with the following formula: effect of the risk * probability of the risk. Both of these variables were assessed in a scale of 0-5 so that the maximum risk number would have been 25. The received risk number acted as an indicator of the probability of said risk.

3.5 Recyclable metals

Luvata Pori recycles metals very efficiently. Almost all metal which is not suitable as an end product will be recycled back in to the production processes. Small amounts of these excess metals are sold also.

3.6 Pickling

Metal pickling refers to the removal of the oxides and metallic impurities which are left on the surface of the metal object after the grease removal by acid bath. Parts of the impurities on the surface of the metal are dissolved into the acid and part can be removed through development of hydrogen. Acids used for pickling are sulfuric acid,

hydrochloric, phosphoric, nitric, hydrofluoric acid or their mixtures. There is a particular risk for injury because of the corrosiveness of the acids. (KAMAT – tietokortti 2007, 1.)

3.7 Water systems

Luvata Pori Oy uses both factory water and municipal water in its processes. Factory water is taken from Kokemäenjoki – river with two pipes which are 630 and 450 millimeters in diameter. The length of the pipework is approximately 4.5 kilometers. From these pipes water is distributed to all departments of the factory. Water pumped from the river is purified mechanically and it is used as a coolant in production processes. Cooling is done primarily indirect which means that it is done with heat exchangers. This means that the water is not in contact with the materials being cooled. The cost of the water pumped is divided between the departments according to their consumption. The environmental manager provides the information about the consumption of factory water to the officials when needed.

Municipal water is used primarily for sanitation purposes but also for processes that require especially clean water, as a backup cooling system and very small amounts in internal reuse. Municipal water is taken with two main lines and the length of the pipe work is approximately 2 kilometers. Consumption of municipal water is measured by five main measuring points and their results are reported to city of Pori once a month. Municipal water is directed into the sanitation sewer after use from where it is delivered to the city's water treatment plant. (Internal database of Luvata Pori Oy)

3.8 Sewerage and other exiting of water

The industrial area has five sewer lines that go through the area and end up in Kokemäenjoki - river. The sewage system has a number of oil separation wells and pump wells which are connected to a joint alarm and drain system. The alarms from this system are transmitted to specified persons in each department of Luvata Pori Oy. Used factory water and municipal water used as coolant are directed to the river via this sewage system through the measuring points. Factory water also exits the

area by evaporation from different pools and cooling tower. The amount of evaporating water is however very small compared to the whole amount.

3.9 VAHTI – system

A control and load information system called VAHTI is an environmental protection information system built by Finland's environmental administration. The system has records of emissions in water, air and waste accrued by the organizations that are environmentally obliged. VAHTI system is part of the environmental protection database consonant to the environmental protection act and it has been in use since the 1970's. (Web page of Finland's environmental administration 2014.)

3.10 Safety pool

A safety pool is a pool which is usually installed below a container or a machine that contain some harmful liquid or other substance. Safety pool acts as a backup container for the substance in case of a leak or a malfunction. Safety pools are fitted for their purpose and can be made from plastic or metal. They can also be acid or corrosion proof if necessary.

4 ENVIRONMENTAL RISK MANAGEMENT

4.1 Environmental management system

Due to its scope and multidimensionality, it is very hard to give an unambiguous explanation for environmental management system. However, the term is still used commonly and it includes various features. At its simplest the system has to recognize the goals, find out if reaching those goals is possible and develop and implement a way to reach those goals. (Barrow 1999, 3.) The environmental management system is built around these basic steps and it consists of planning, development, measurements et cetera. After the changes have been implemented their effects must be monitored and measured in order to confirm results. Environmental management system is vital for any organization to improve their efficiency.

4.2 ISO 14000 standards

ISO 14000 standards provide the structure of the environmental management system. Standards were established in 1994 to ensure that different organizations could reach their environmental goals if their operations. ISO 14000 consists of twenty different standards that cover everything from notation to life cycle assessment. Management system enabled by the standards strengthens the ability of organizations to improve and monitor their performance in environmental matters which in turn improves their competitiveness on the market. (Bhat 2010, 387.)

Luvata Pori Oy has ISO 14001 certificate and also an environmental permit granted by Finland’s environmental administration. As a part of its environmental management system, the company has an interactive environmental logbook. Every abnormality is recorded in this logbook and it can be read in the internal database.

4.3 Environmentally aware operation

Environmentally aware operation aims to achieve an optimal usage of natural resources without harming the environment or the quality of the product. This goal can be reached if the use of natural resources is effective, emissions are minimized and the whole lifecycle of the production is taken into consideration, not only manufacturing but also distribution, waste handling, recycling and final disposal. In order to achieve environmentally aware action one must have a systematic approach to product design, production design and distribution. Production is intended to be kept as environmentally friendly as possible during the whole lifecycle of the product. An ideal situation is to achieve so called “zero-level” where waste is not accrued at all but all materials are utilized in some way or they are recycled. (Madu 2007, 42.)

Luvata Pori Oy operates as environmentally friendly as possible. All accrued waste is processed properly and is either recycled or delivered for disposal according to regulations. The company recycles nearly all of its left over metals back into the processes so there is very little waste. All emissions from production processes are intended to be prevented and they are monitored properly. For example frequent samples are taken from exiting sewage water and results are reported to the officials according to agreements.

Every department has an appointed responsible person who is responsible for the chemicals, waste management, and environmental and energy efficiency of his/her department. These persons make sure that these points are handled correctly provided that the department has need for said actions.

4.3.1 Drainage water monitoring

Water exiting from the plant to the river is monitored constantly. Measuring devices provide real-time information about the flow rate, temperature and pH of every sewage line. Every sewage line has an automatic sampling device that takes samples from the exiting water regularly.

4.3.2 Aggregate sample analysis

The sewage water going to the river is analyzed for pH, Nickel, Copper, Zinc, Chrome and Sulfur content two times per week from the aggregate samples. Arsenic and Selenium contents are determined from the sewers 1-3.

Determinations are done according to the following standards:

- Chrome: SFS-EN ISO 11885, 2009
- Copper: SFS-EN ISO 11885, 2009
- Nickel: SFS-EN ISO 11885, 2009
- Zinc: SFS-EN ISO 11885, 2009; SFS-EN ISO 15587-2, 2002
- Selenium: SFS-EN ISO 17294-1;2006; SFS-EN ISO 17294-2;2005
- pH: SFS 3021, 1979
- Arsenic: SFS-EN ISO 17294-1;2006 ja SFS-EN ISO 17294-2;2005

4.3.3 Communications

Abnormalities are recorded in to the company's environmental logbook. In addition to this the water emission report is reported monthly to the City of Pori and on – site partners via e-mail. Reporting to the government officials is done using the VAHTI – system. Environmentally significant emissions are reported to the officials case by case immediately when they occur.

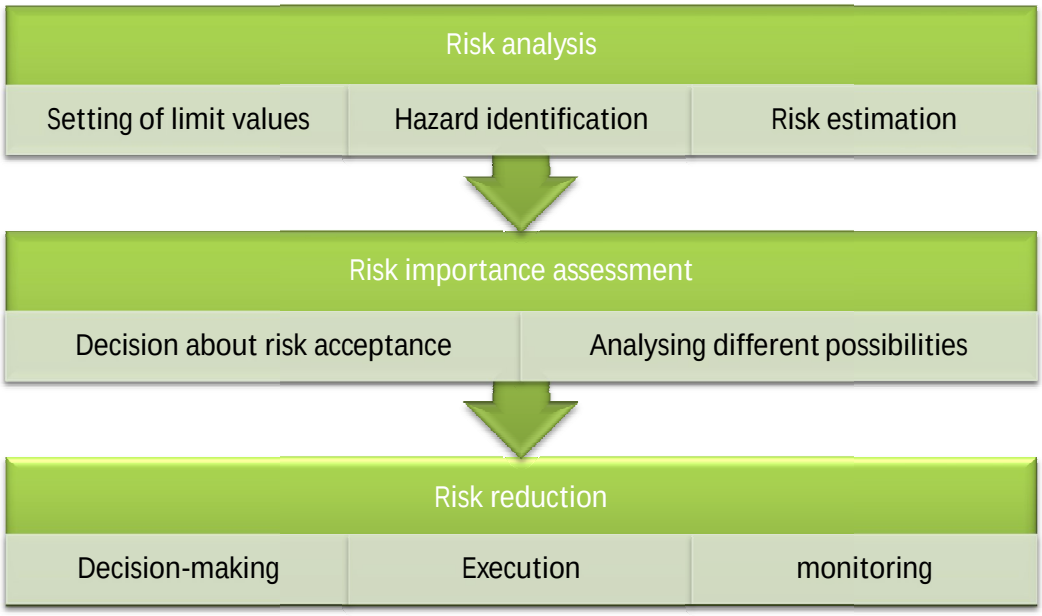
4.4 Environmental risk management

The basic principle of risk management is that every action involves a risk. However it is possible to reduce the probability of this risk and the severity of its consequences. Risks can also be avoided by recognizing hazards and by operating in such a way that the hazards will not become reality. For example, hazards from handling a dan-

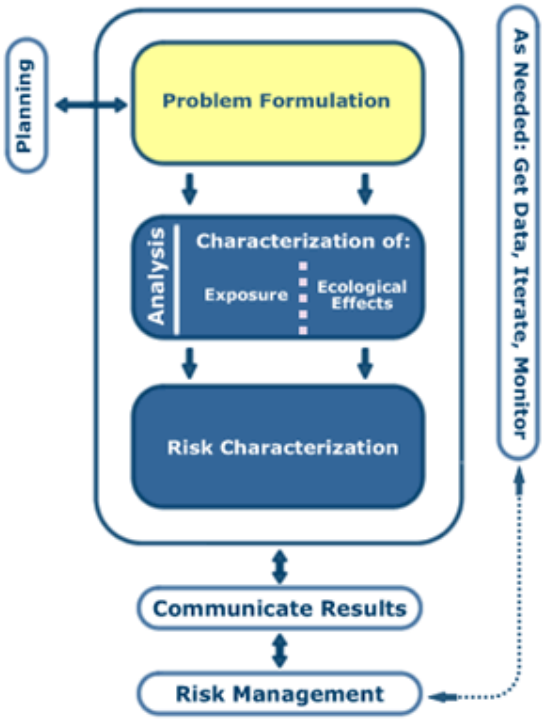
gerous chemical can be avoided by switching the chemical into some safer substance. If the risk is impossible to be avoided for some reason it should be affected in such a way which makes the risk happen as rarely as possible. Responsibilities of risks have to be settled with agreements and every known risk has to have a responsible person or party. (Mäkelä, Soininen & Oksa 2008, 4-5.)

Regardless of the risk management system used, hazardous risks have to be first recognized so that management and prevention would be possible. Risk identification has to be dealt with systematically because it can be extremely hard and time consuming. Risk anticipation is vital for any company and organization. When the situation presents itself, it is important to have the risk management procedures already in place so that they do not have to be though about on the spot. Environmental risk analysis is a good tool for environmental risk management, prevention of said risks and also for minimizing and limiting consequences of already happened risks. (Mäkelä, Soininen & Oksa 2008, 5-6.)

Main elements of environmental risks management are assessment, decision making and control of occasional emissions. Risk analysis provides information for handling of these aspects. A certain risk acceptance level must also be determined in the analysis that is a corner stone for investment and resource decisions. (Mäkelä, Soininen & Oksa 2008, 6.)



Picture 1. Areas of risk management (Website of Occupational Health and Safety Administration 2014)



Picture 2. Phases of risk assessment (Website of United States Environmental protection agency 2014)

4.5 Waste management

Major part of modern waste and environmental regulations in Finland are based on directives of European Union. One of the most important principles of waste management is waste hierarchy. In this hierarchy waste management consists of these steps:

- Reduction of waste
- Re – use
- Recycling and composting
- Energy recovery
- Disposal

By following these steps it can be ensured that waste is generated as little as possible and that all the energy is recovered from it. All materials are intended to be recycled and disposal should be the last method. With these simple steps can organizations minimize the effects of their operations on the environment. (Hand 2006, 2-3.)

Luvata Pori Oy follows said steps in its activities. Prevention of waste generation is the company's primary target and utilization of waste materials is the leading principle of waste management in the company. A harmful substance or a material is replaced with something less harmful when possible. Generation of waste is minimized with precise material and raw-material use. When designing a process or a product, waste generation is taken into consideration. Produced waste is intended to be utilized and thus prevent it from ending up in a landfill site. The wastes are primarily utilized as material and secondarily as energy. The waste handling of Luvata Pori Oy is done by Lassila & Tikanoja Oy according to partnership principle. All departments have appointed a person responsible for the practical waste management, reporting and internal transportation in their department.

As with other environmental protection actions, waste management and disposal is also subject to license. In the environmental permit granted for Luvata Pori Oy, all responsibilities for waste handling and disposal are determined and the company operates according to them. Waste generation has to be recorded and the records have

to be kept for three years. The supervisory authority of environmental permit is Southwest Finland's Centre for Economic Development, Transport and the Environment.

4.6 Communication

Communication in risk situations is extremely important in order to minimize consequences and to restore normality. In case of an accident or a dangerous situation communication has to function both internally and externally. Functional internal communication decreases response times and makes it eases the swift handling of the situation.

Preventive communication contributes to risk prevention. External communication eases cooperation with the officials and improves also the cooperation with them in case of an accident, emergency and preventive actions.

There is no all-inclusive point of view for risk communication. Things related to it such as sending and receiving of messages, conflict management and decision making are organization- specific. It is important to understand the different premises in order to choose the best practices for each organization. The field of communications is also in constant change due to advancement of technology et cetera. Organizations have to follow the trend in order to keep their communication procedures up to date. (Lundgren, McMakin 1998, 13-14.)

By planning and organizing communication, it can be ensured that the communication is fluent in both preventive and accident situations when swift communication and other actions are important. An example of preventive communication could be training the staff for extraordinary situations. (Mäkelä, Soininen & Oksa 2008, 6.)

Department and Regional Managers are responsible for the internal communication concerning environmental matters at Luvata Pori Oy. They inform the staff about preventive measures and ensure the safety the work environment through effective

communication and surveillance. In abnormal or accident situations Department and Regional Managers inform Quality, Environment and Safety Manager who then handles the communication with the officials if needed. More detailed instructions about communication with officials are given later in this thesis.

4.7 Operating instructions

A significant part of environmental risk management and risk management in general is a compilation of clear operating instructions for minimizing emissions and in case of accidents. The function of these instructions is to give clear and simple directions to the staff on how the operations of the organization have to enhance environmental performance.

When environmental risks are determined through analyses and risk possible to erase have been erased, starts the assessment of procedures to avoid the risks that are still left. Preventive actions are vital in environmental risk management. Organization has to recognize essential risk areas, draw up instructions for monitoring them and also create operating instructions for failure and accident situations. Primary goal is that the risk would happen as rarely as possible and secondary goal is that when the risk happens its consequences would be as small as possible. (Hovisalmi & Niskala 2009, 33.)

A good management of environmental matter is important to the organizations management. Laws and regulations concerning the operations have to be known and operations have to be done according to them. According to the environmental protection act an organization has to have sufficient clarity of the environmental effects of its operations, environmental risks and the available methods to reduce the harmful effects on the environment. When dealing with environmental matters it is important that they are organized clearly and areas of responsibility have been divided consistently. In order to prevent environmental accidents it is important to ensure that the operating instructions are known and understood throughout the organization. (Hovisalmi & Niskala 2009, 33.)

As a part of this thesis simple operating instructions were been created by using the internal database of Luvata Pori Oy and knowledge obtained from staff interviews. The instructions were made in order to minimize the risks of environmental accidents. The instructions can be found at the end of this thesis.

5 ENVIRONMENTAL RISK SURVEY

In this paragraph, environmental risks of all the departments in Luvata Pori are surveyed. Information from previous survey has been updated and new risks are explained and written down in to the charts. The risks are arranged in the charts from smallest to largest according to risk number. A risk number indicates the seriousness of a risk. It is obtained with a formula: effect of a risk x probability of a risk. Both are evaluated on a scale of 0-5. Some improvement suggestions have been made to certain practices and they are also documented in this paragraph.

5.1 Foundries and Anodes

5.1.1 Foundries

Foundries refer to Oxygen Free- foundry and mixture foundry at Luvata Pori Oy production plant. Various kinds of products are cast in these foundries for further processing by methods from non-stop wire casting to project based mold casts.

Foundries have an **exhaust fume purification system** that reduces emissions considerably. The system filters the exhaust fumes from foundries through a six chamber filter system. There are 1008 filter pipes in the chambers and they are changed to new ones when it is necessary. A particle meter has also been installed into the system to increase the efficiency of the system. If the meter detects an abnormality in the outflow, the conditions of the filters are inspected.

The most severe environmental risk in the foundries is the **recyclable metals** containing oil or emulsions. The risk is that the oil or emulsion leaks to the sewers and ends up in the river. Recycled metals are not stored outside in order to manage this risk and covered trailers are used to transport the recyclable metal containers. The storing of the containers is organized in the raw material storage warehouse and places for each sort are clearly marked.

Foundries use several **pools** where water coolant is accumulated during production and they need to be drained from time to time. The water may contain small amounts

of copper and if the draining of the pool is done carelessly the copper can get to the rainwater sewer. The sediment from the pools is put into containers and the copper is separated mechanically and recycled back to production processes. Luvata Pori Oy's partner handles the final deposition of the remaining waste.

A **clamshell** has been installed into one of the vertical casting lines of the department during the previous year. It is used for loading of the furnace. The clamshell works hydraulically so there is a risk of a leakage in the hydraulic system. There is a leak pool under the hydraulic apparatus but the actual clamshell is not protected. The situation of the clamshell directly on top of the furnace causes some challenges so the leak pool could only be installed on the bottom of the clamshell post. This way the rest of the clamshell would still be without protection but the probability and the quantity of the leakage would be very small.

Every casting system has one or more **cooling systems**. The most common is the water circulation system which can be found in all casting systems in the foundries. The process water circulates in a closed cycle and it is cooled with heat exchangers. Factory water is normally used for cooling but the municipal water can be used as a backup coolant.

Both water networks are connected to the process water cycle and they are protected by magnetic and backup valves. The system gives alarm if the pressure of the process water cycle drops and departments and the whole industrial area can be disconnected from the municipal water network manually.

Foundries have previously used **solvent detergent** for difficult cleaning tasks. This detergent is no longer in use because a washing machine has been acquired to the department. The risk of this detergent leaking into the sewers has therefore been disappeared.

5.1.2 Inductor and chill mould maintenance

Inductor and chill mould maintenance department is responsible of service and maintenance of the inductors used for heating the furnaces and the chill moulds used in the casting processes. Due to the nature of operation in the department there are few environmental risks.

In some cases different maintenance tasks are done near the **sewage drain** and the dust from the work can end up in it. In order to prevent the dust getting in to the river, a settling tank has been installed into the drain. The tank is made from plastic and it is one cubic meter in volume and it prevents the undesired substances from reaching the river. Luvata Pori Oy's partner takes care of emptying the settling tank when necessary. In addition a dust removal vacuum has been installed into the workspace to reduce dusting and to ease the cleaning afterwards.

Viton- seals are stored in the facilities of the department. The seals release toxic and corrosive gases when combusted so extreme caution must be practiced with storing them. (DuPont™ Viton® Handling Precautions 2010, 7.) Seals used in the department are stored in a closed safety container. In case of a fire, the emergency responders must be informed about this risk and the location of the container must be explained to them.

Small amounts of **chemicals and combustible liquids** are stored in the department. All of these substances are kept in a closed metal locker. In order to develop the risk management of the department, a safety pool could be installed under the locker.

5.1.3 Anodes

In the anodes department, copper wire is modified in order to produce anodes for electrolysis. Due to the nature of the process and the methods used, there are no sig-

nificant environmental risks in the department. No oils or chemicals are used, only vaseline.

Factory water is used directly as coolant in the department and municipal water acts as a backup system. Water flows through the machine and ends up in the sewer. The machines have containers where all the copper shredding is gathered. Therefore accumulation of copper and impurities in to the sewer can be prevented by following basic order and alertness. A pool of citric acid has previously been in use in the department but it has been decommissioned. The production of recyclable metals is very low in the department.

5.2 Engineering

Engineering department manufactures special products including flame and electric furnace elements and nuclear waste capsules for final deposition. Work in the department is project based and the raw material are acquired mostly from the company's other departments.

The chemicals used in the department are stored in a proper **storage locker**. The locker has a safety pool and an output for ventilation.

The inner parts of the elements manufactured in the department are cleaned with 12% **citric acid**. The acid is circulated inside the elements and then rinsed with water. The rinsing water has an acid content of two percent when it exits the circulation. The department has appointed an employee who transports used solutions to the waste station. In case of a hose or coupling leak, the acid containing water ends up in a safety pool which is designed to gather the acidic rinsing solutions from the process. The solution is then moved to an acid container and delivered to final deposition.

Different kinds of **coils** are manufactured in the facilities of metal laboratory for the needs of electrical and energy technologies. The coils are coated with a lacquer be-

fore they are put into an oven to dry. The lacquer container has a safety pool underneath it and when the coating is done, the container is covered with a hood and air-conditioned. Other times the container is sealed and air tight. If the lacquer leaked form the container, it would end up in the floor canals from where it could be cleaned. One subject for improvement could be the storing of the lacquer in the facilities.

Recyclable metals produced in the Engineering department are usually taken for baling. However if the metal contains a certain amount of emulsion, it is not suitable for baling process. The containers with this kind of metal are stored in an outside shelter. Next to the shelter is a sewage drain and it is possible that the oil or emulsion leaks from the containers and ends up in the sewer. The drain has an oil separator and an alarm for oil leakage.

5.2.1 Engineering works

Engineering works has been fused with Engineering department as a result from organizational change in 2012. Therefore same principles than in Engineering department concerning the precautions of hydraulic apparatus, outside areas and oil separation wells are applied.

Recyclable metals and sawing chips are stored in shelters outside the department. In case of a leak, a well is installed in the shelter which gathers the leaked substances where they are recovered for final deposition.

The department has a **storage for flammable liquids** that is air-conditioned and insulated properly. The storage is also equipped with safety pools. Safety pools are also used under oil barrels which are in use in the department.

5.3 Sunwire

Sunwire department manufactures copper wires for solar energy technology. The production methods used are drawing and rolling processes. Due to the nature of the production there are not many environmental risks at the department.

The process emulsion pools have surface level switches, safety pools and copper filtering pools to prevent the emulsion from leaking from the pools. The emulsions used in the department only have 2-7 % oil content. Processes also use isopropanol but its consumption is only approximately five liters per month so the risk from it is insignificant. The recyclable metal produced by the production processes is recycled back to other processes or sold to an off-site partner.

A detergent has previously been used in M02-line. The detergent contains sodium hydroxide and can be hazardous to the environment if it is released. This risk no longer exists in the department since the M02-line is not in use anymore. Therefore the detergent is no longer used in the department.

5.4 Copper factory

5.4.1 Drawing mill

Drawing mill uses many different presses, saws, straightening machines. Pickling is also performed in the department. Due to the nature of the production methods, drawing mill is the most environmentally challenging of all departments but the processes have had little change during recent years. Therefore the environmental risks of the department have stayed the same since the last survey was conducted. All the machines are equipped with safety pools and canals. The main environmental risks are explained here.

Drawing mill has various **cooling systems**. The most common is the water circulation system which can be found in many systems in the department. The process water circulates in a closed cycle and it is cooled with heat exchangers. Factory water is normally used for cooling but the municipal water can be used as a backup coolant.

Both water networks are connected to the process water cycle and they are protected by magnetic and backup valves. The system gives alarm if the pressure of the process water cycle drops and departments and the whole industrial area can be disconnected from the municipal water network manually.

All the **hydraulic devices** of the department are equipped with safety pools and in case of a leak the pressure decrease in the system initiate an alarm and shuts down the pumps. Maintenance team inspects these automatic alarm systems regularly.

The **pickling pools** of a large 2500 ton press use 10% sulfuric acid solution. Below the pools is a safety pool made from an acid proof material. The safety pool has an overfilling censor which gives an alarm if the surface level rises too high. The system also stops the liquid flow into the pool when alarm is initiated.

The department has a large saw to cut the copper elements. The saw has **a rinse pool** with a volume of 10 cubic meters and its liquid is changed once per week. The liquid consist of water and 150-250 liters of detergent. The sediment is collected from the bottom of the pools and is transported for disposal.

Department has also a system of pools for coil pickling. It consists of five pools of which the first contains alkaline detergent, second contains 15-20% sulfuric acid solution and the rest contain rinsing water. The pools are 8.8 cubic meters in volume and they are double layered and have acid proof safety pools under them. There is also an alarm in case of leaks or overflow which shut down any flows and pumps. The safety pools are also equipped with overflow censors.

5.4.2 Profile mill

Profile mill uses rolling and drawing methods in its production processes. The department has numerous drawing and rolling machines as well as annealing furnaces. Department uses oils and emulsions in the processes and oil is also stored in barrels in the department facilities. The leakage of oil is prevented by installing safety pools under all oil barrels.

Profile mill has numerous **gathering pools and containers** on the floor level as well as gathering canals for possible leaks. All liquids flowing on the floor will gather in these pools and end up in large pits under the floor. The pits have surface level censors and they are all connected together. Accumulated liquid is gathered and transported to the waste station. Regular maintenance of the systems ensures their function in all possible situations. In practice it is impossible for any liquid spilled on the floor to end up in a sewer in profile mill.

Rodex-drawing machines use **ethanol** in their processes. Ethanol is stored in three containers each with a volume of one cubic meter. The containers are kept in a locked cage. Ethanol is a flammable substance and can form explosive compositions in high temperatures when mixed with air. Therefore safe containment of ethanol is important. **Pull-through oven** uses hydrogen as a protective gas. Hydrogen is flammable and the necessary precautions are taken to manage this risk.

5.5 Superconductors

This department manufactures superconductors. Rolling and drawing processes are used in the production. Pickling is also done in the department. The biggest environmental challenge is the pickling process where numerous different acids and acid mixes are used. Superconductors department uses only factory water for coolant.

The **emulsions** used in production processes circulate in the systems and they are stored in containers on the floor of the facilities. The volumes range form few cubic

meters to ten cubic meters. The containers are not protected by safety pools due to their location and size. However there are no sewage drains near the containers and in case of a leak the liquid would flow in to the floor canal where it can be retrieved. However there is a theoretical possibility that the emulsion can reach the soil through the cracks if the floor for example. Due to the risk, safety pools should be installed. Even though the volume of the safety pool wouldn't cover the whole volume of the container it could still prevent small leaks and give additional time in case of a larger accident.

The **pickling line** of the department uses a number of different acids and acid mixes. The line consists of several pools which contain either acids or rinsing water. The acids used are nitric acid, sulfuric acid, hydrochloric acid and a mix of nitric and sulfuric acid. The acid contents of the solutions are 10%. Different kinds of elements are pickled in the line. The line has also a closed and air-conditioned cabinet that prevents the fumes from reaching the air.

The pickling line has its own isolated sewage system where the possible flowing liquids are collected. The system is acid proof and when it fills up it is measured for pH. Depending on the result of the pH measurement the liquid is either pumped in an acid container or in the sewer. The space also has a clean water drain but the flowing of harmful liquids into it is prevented by the angle of the floor. All pickling pools are equipped with safety pools.

Acids are stored in proper containers inside the pickling facilities and outside in an acid container. Hydrofluoric acid is also used in the process and it is also stored properly in separate canisters equipped with safety pools.

The process produces **recyclable metals** which are stored outside waiting to be transported to be reused in other production processes. There is a risk that emulsion can leak from the open containers since they are not covered in any way outside. Since the number of the containers outside the department is usually small they could be stored inside or in a covered trailer.

The department has its own **acid well** where all the waste acids form the processes are directed. The well has a volume of three cubic meters and it has an alarm system in case of overflow. The well is emptied when needed. The amount of accumulating waste acids is quite low in this department.

5.6 Other operations

5.6.1 Metal laboratory

Metal laboratory performs quality control of the products of Luvata Pori Oy. Small amounts of acids are used in analyses. The processes practiced in the department pose some environmental risks.
The laboratory uses primarily nitric acid in **pickling.** The pickling pools are equipped with air-conditioning so that the fumes will not get into the inside air. When larger pickling tasks are performed the inside air-conditioning is turned off just in case.

Metal laboratory has an **acid well** where the waste acids are collected. The well has an alarm system which alerts the staff when the well is full and it is emptied. The emptying of the well and transportation of acids are managed by a company partner. The risk of overflowing can be prevented with regular maintenance and inspections.

Product samples are sawed and honed with the department's saws and grinders. **The hone material and saw chips** are gathered into containers and are transported to be recycled into the production processes. Small traces of copper are getting into the sewer from the grinders with the coolant water but the amounts are insignificant.

Laboratory has **acid cabinets** where samples are treated with acids. During the washing of the samples small amounts of acid can get to the sewer. However the samples are rinsing with abundant water which dilutes the acids very effectively. The amounts are also very small. However it would be good to connect the cabinets to the acid well of the laboratory. The amount of rinsing water can cause problems because it would fill the well very fast and it would have to be emptied very often.

Since the laboratory uses acids and other chemicals in its analyses they need to be stored in the department. Solid chemicals are stored properly in **a chemical cabinet** that has clear markings of what it contains and the appropriate warnings. Acids and other liquids are stored in **an acid storage room** next to the pickling facilities. Storage is organized properly and with a right operation it will minimize the environmental risk that the liquids pose.

In addition to the laboratory facilities the department has **a factory hall** that contains a press and a drawing machine. The machines are hydraulic so there is a risk of hydraulic oil leaking on the floor. The machines are used very rarely and if there is a leak, the oil would flow into the floor canals where it can be retrieved.

5.6.2 Central warehouse

Central warehouse stores a number of different materials some of which can pose an environmental risk. The warehouse has zero sewage drains which minimize the risk of harmful substances getting into the river. Storing of harmful materials is taken care of properly.

Flammable materials are stored in a separate fire safe storage room. The room is equipped with grounded storage shelves, fire extinguishers and safety pools. In addition the room has proper air-conditioning and the employees are instructed to wear proper protection when operating in the room. A list of the stored materials is placed on the door outside the storage room.

Outside the storage facilities is a shelter where primarily full **nitric acid containers** are stored. A safety pool is installed under the shelter and there are no sewage drains in the immediate proximity of the shelter. However there is a theoretic possibility that the safety pool overflows during heavy rain because the shelter does not provide much protection from horizontal rain. In this case it is possible that the acid in the safety pool leaks into the soil or the river. This could be prevented by installing a moveable tarpaulin wall to protect the shelter from heavy rains.

5.6.3 Waste station

Luvata Pori Oy has a so called waste station inside the industrial area where all the harmful materials are temporarily stored before they are transported to final disposal. Transportation of the materials outside the industrial area is handled by a partner. Solid materials are transported once per month and the liquid materials when necessary.

The waste station has several safety systems to prevent leakage of the harmful materials. The section of the station where the liquid waste is stored is equipped with safety pools. The other section where the solid materials are stored is connected to the company's oil separation system. Thus the risk for harmful substances ending up into the environment is very small.

The waste station stores the following materials:

- Flammable liquids; solvents. Between 200 and 1500 kilograms.
- Extremely flammable solids; paints. Between 10 and 400 kilograms
- Acidifying wastes; occasional
- Toxic wastes; some chemicals. Storing minimal.
- Oily wastes; solids between 200 and 2000 kilograms and liquids (oily waters, emulsions, waste oil) between 5000 and 40000 kilograms.
- Corrosive materials;
  - Acidic; sulfuric based, between 1000 and 8000 kilograms. Nitric based, between 1000 and 5000 kilograms.
  - Alkaline; between 200 and 3000 kilograms. (Reunavuori email 19.11.2014)

5.6.4 Waterfront pool

The industrial area has a pool next to the river where the sediment from the rainwater drains are occasionally emptied. Liquid and solid materials are separated in the pool and it is emptied when necessary. Overflowing of the pool can pose a risk for the en-

vironment but if the emptying of the pool is being taken care of properly and its use is being monitored the risk is very small.

5.7 Summary

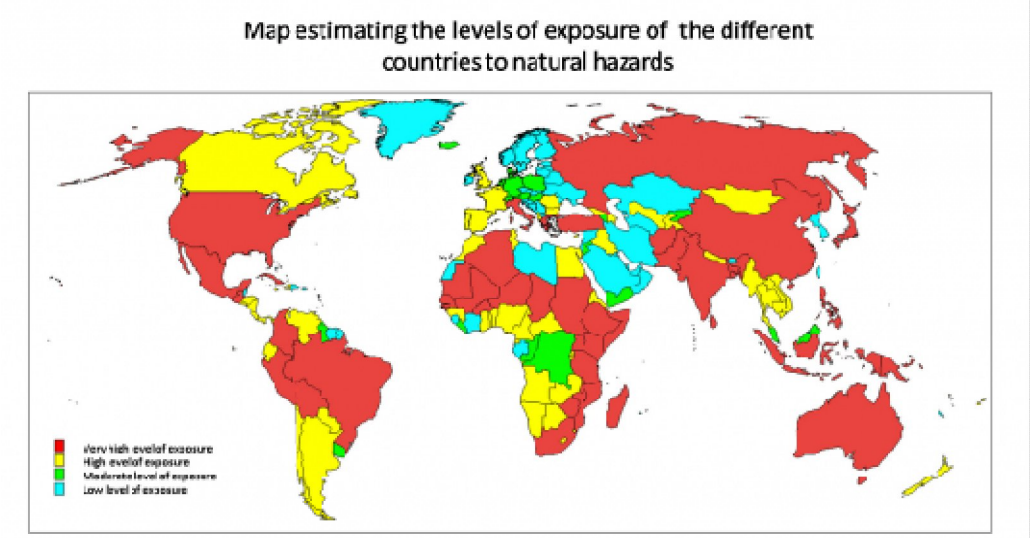
Luvata Pori Oy has a number of environmental risks some of which recur in many departments and also some risks specific to certain departments. All recognized risks are managed with measures explained in the precious chapter and their impacts are minimized. One of the purposes of this thesis was to make a complete documentation of all environmental risks.

6 EXTERNAL ENVIRONMENTAL RISKS

When surveying the external environmental risks, things like, the flooding of the Kokemäenjoki – river, extreme weather conditions, area's fuel station and traffic related to it and traffic and operation of subcontractors in the area, were taken into consideration. Also more implausible natural phenomena due to the geographical location of Finland such as earthquakes, hurricanes and tsunamis were assessed.

6.1 Natural disasters

Due to the geographical location of Finland it is highly unlikely to experience natural disasters such as strong earthquakes, hurricanes or tornadoes, tidal waves or other like these phenomena. Even though there are theories stating that the global climate change may have change the weather conditions worldwide, it does not give reason for Luvata Pori Oy to take any other precautions that it already does. For additional information about natural hazards and their probabilities see appendix 2 for risk table provided by Luvata Pori Oy's insurance company based on an estimation program.



Picture 3. Map estimating the levels of exposure of different countries to natural hazards. Results have been obtained by summing the probability and the weight factor of the danger of each natural phenomenon. Map clearly shows that Finland has very little risk when natural disasters are considered. (Web page of Europena Journal of Geopgraphy 2014)

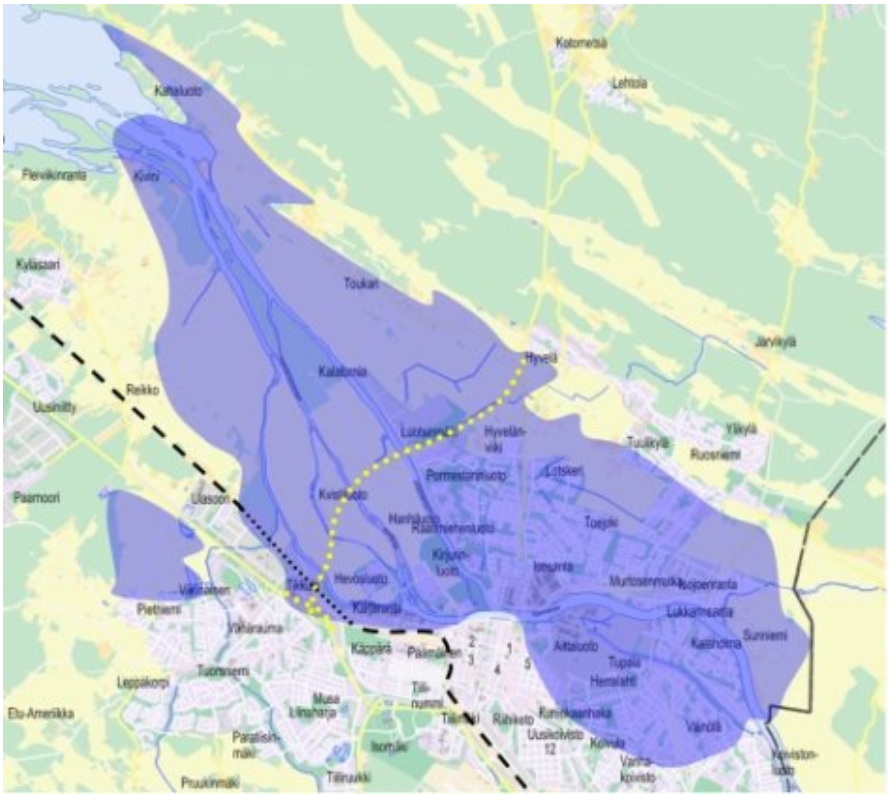
6.2 Flooding of Kokemäenjoki – river

The flooding of the Kokemäenjoki – river is a known risk in the company and its consequences have been wanted to be found out especially due to insurance policies. Large flood all around the world and also in Pori in recent years have brought up questions about the safety of the site during a flood. Last very disastrous flood occurred in the winter of 1974-1975 and a significant flood also in the year 2007. In the latter it rained 100-150 millimeters in three hours and caused 20 million euros worth of damage. (Web page of city of Pori 2014)

When researching the effects such a flood could cause to Luvata Pori factory a water level rise – simulator from the Finnish Environmental Administration was utilized. According to this simulator even in the rarest flooding circumstances the water does not rise to the plant side of the river. Due to the landscape and geography of the area the water would accumulate in the area of Saarenluoto in the eastern side of the river and form side channels there. The simulator suggests that the western bank would be left to completely normal state. The most vulnerable areas in case of a major flood would be the center of Pori and the island of Kirjurinluoto. Even the biggest floods would not reach the plant area according to these estimates. (Web page of city of Pori 2014) See appendix 3 for the simulator pictures of the industrial area with different flood levels.

According to the estimation tools used by the company's insurance company, there is a chance of 1:250-500 for such a flood of the river that would be hazardous to the plant area. See appendix 2 for the table of natural hazards and their risk probabilities. These two different sources confirm that the risk of a flood in this area is very small.

Even though the flooding of Luvata Pori industrial area is very unlikely, the company has taken precautions in order to prevent this situation. The sewers are the most vulnerable in case of a flood. The sewer piped leading to the river are equipped with flood hatches which are designed to block the water from rising into the sewers. In the pipelines one, two and four there are automatic flood pumps. In pipeline three there are three pumps constantly running. In pipeline five the risk of water rising is non-existent.



Picture 4. A size of a possible flood area when the situation is similar to the one in the winter of 1974- 1975. The flood area does not reach the industrial area. (Web page of city of Pori 2014)

6.3 Heavy rains

Heavy rains have caused problems in few particular departments in Luvata Pori Oy in the last years. Certain drains and pits have been overflowing during heavy rainfall. The risk involved in these situations is that the water causes harm to the production processes or flushes hazardous matter into the soil or the water system.

The flooding risks have been removed and minimized with different procedures. For example sewer maintenance and modifications few years ago removed the flooding problem of the department. Also in foundries the flooding of the pits has been minimized by installing automatic pump into the flooded space. The function of the pump

has to be ensured however. In addition the personnel can use pumps to empty the pits if needed.

6.4 Traffic of subcontractors

Luvata Pori Oy has a number of partners and subcontractors. Therefore the industrial area has constant traffic and it can be intensive at times. The traffic poses a risk of accident or trespassing which can result in environmental damage.

The industrial area is fenced and the company's partner is in charge of security and access control of the area. The traffic of the area is kept at a minimum and a driving permit is required to gain access to the area. Employees of the companies are not allowed to bring their own vehicles into the area.

Normal traffic rules are obeyed inside the area and the speed limit is 30 kilometers per hour. Every driver is also encouraged to practice extreme caution because the traffic consists of mainly heavy duty vehicles carrying heavy loads.

With these procedures the risk of accidents and trespassing is kept to a minimum and therefore minimizing the environmental risks resulting from them. In case of an accident the factory fire department acts as a primary rescue team but the regional fire department is also called if necessary.

6.5 Fuel station

Industrial area has its own fuel station which is operated by an external company. The area is asphalted which prevents smaller leaks from getting into the soil. Operation in the fuel station has been instructed to all its users and the safety of the station is ensured with safety regulations and instructions. These measures decrease risks to the environment.

6.6 Summary

The risks listed in this paragraph are recognized in Luvata Pori Oy and proper preventive measures have been taken in order to manage these risks. Constant development is done to improve environmental management. During the survey it was noticed that possibly the largest environmental risk to Luvata Pori Oy, the flooding of Kokemäenjoki-river, is not realistic. The research shows that even if Pori would suffer a very large and improbable flood its effects would not reach the industrial area. This is due to its location, soil and water system. If, regardless to all of the results, the water would rise to the sewers of the industrial area, the company will take measures explained in this thesis.

7 OPERATING INSTRUCTIONS

As a part of this thesis an operating instructions have been planned and documented in order to manage and prevent environmental risks and to act properly in a situation of an accident. The main focus of the instructions is on the actions in case of a water emission or an accident. The instructions are kept as clear and simple as possible in order to ensure its reliability. The basic principles of operating instructions have been disclosed in the chapter 4.7. The instructions for abnormalities are always preceded by preventive actions.

Abnormal situations could be different leaks, floods, blockages, chemical dosing mistakes, adjustment mistakes, traffic accidents, power outings, fires as well as process shutdowns and startups. The most common consequence of an abnormal situation is a leak or a water emission. The factory fire department primarily handles the rescue work in the area but the Satakunta fire department is also called when a major accident happens.

Aftercare is performed immediately after the situation is under control again. Aftercare refers to the solving of the reasons which led to the accident and the action taken to prevent it from happening again. All emissions are reported into the environmental logbook and also to the quality, environment and safety manager. The fires are reported to the fire chief.

Table 2. Operating instructions in case of a leak or a water emission.

1. • Alert the gatehouse. Factory fire department is assembed.
   • Inform superior and QES-manager
2. • Prevent a leak with sorbent, sand sacks, sand barrier et cetera
3. • Neutralize acids with lime
4. • Guide the rescue personell and assist if necessary
5. • Aftercare and report

Table 3. Operating instructions in case of a fire

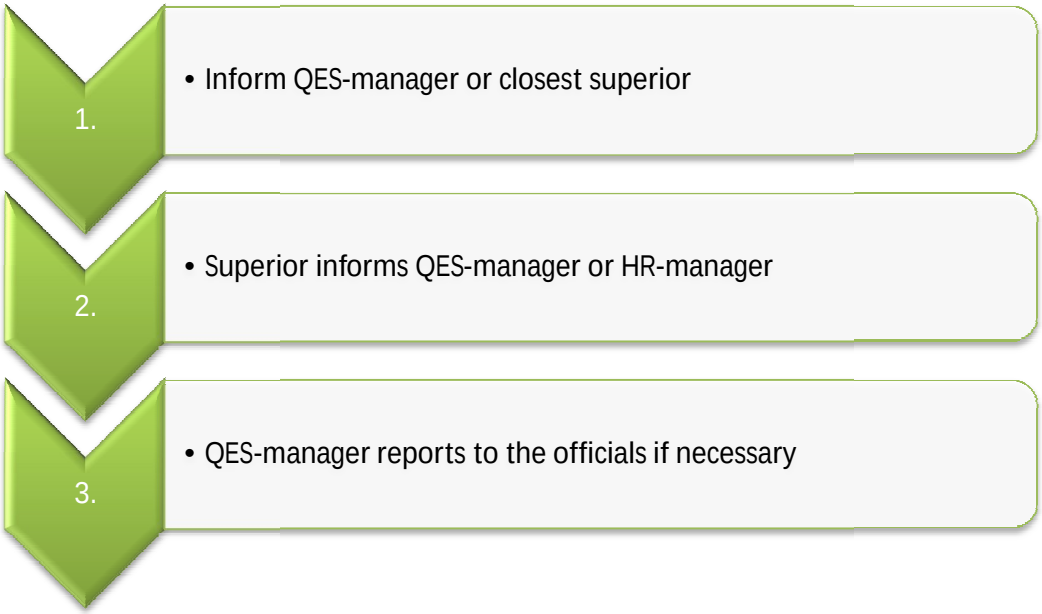
1. • Save
2. • Extinguish
3. • Alert 112, gatehouse and superior
4. • Restrict
5. • Guide
6. • Continue
7. • Cover/move
8. • Aftercare and report

8 INSTRUCTIONS FOR COMMUNICATION

Communicating environmental matters is a vital part of environmental management. Reporting measurement results and abnormalities is important and also required by the officials. In case of an accident the chain of communication has to be understood by the whole personnel in order to commence necessary procedures as fast as possible.

Luvata Pori Oy informs external operators about environmental matters regularly in their environmental report. Remarkable environmental events are reported to the press by the human resources manager. Environmental manager reports to the official according to the environmental permit. Emissions and usage control results are reporter every six months to Southwest Finland's Centre for Economic Development, Transport and the Environment (VAHTI-system) and to the city of Pori environmental official. In case of an accident the above-mentioned parties are reported to immediately. Internal abnormalities are reported to the company's environmental logbook. Personnel can also be informed about environmental matters in weekly meetings and company intranet.

Table 4.Instructions for communication in case of an emission or an accident.



9 CONCLUSION

This thesis was done within the middle of September and the middle of December of 2014. During this time all the environmental risks of the company were surveyed and analyzed in order to improve the efficiency of the company's environmental management. Even though most of the retrieved information had to be left out of this document due to the confidentiality agreement, the document served its purpose for the company. This thesis also gives a clear picture about environmental risk management procedure in general. The information disclosed in this thesis can be helpful when conducting similar surveys and analyses.

REFERENCES

Web page of Luvata Pori Oy.[Referred 24.11.2014] www.pori.fi

Internal database of Luvata Pori Oy.

Kemp, D. 1998. Environment Dictionary. Routledge.

Mäkelä, L., Soininen, H. & Oksa, S. 2008. Ympäristöriskien hallinta. Mikkeli: Mikkelin Ammattikorkeakoulu.

Wessberg, S. 2007. Teollisuuden häiriöpäästöjen hallinnan kehittämishaasteet. Espoo: VTT Publications 650.

KAMAT- tietokortti – Metallin happopeittaus. 2007. http://www.ttl.fi/partner/kamat/tietokortteihin/Documents/Metallinhappopeittaus.pdf

Barrow, C. 1999. Environmental Management: Principles and Practices. Routledge. http://site.ebrary.com.lillukka.samk.fi/lib/samk/reader.action?docID=10054835

Web page of Finland's environmental administration. [Referred 20.11.2014] http://www.ymparisto.fi

Bhat, K. 2010. Total quality management : text and cases. Mumbai: Himalaya Pub. House. http://site.ebrary.com.lillukka.samk.fi/lib/samk/reader.action?docID=10415610

Madu, C. 2007. Environmental Planning and Management. Imperial College Press. http://site.ebrary.com.lillukka.samk.fi/lib/samk/reader.action?docID=10188841

Mäkelä, L., Soininen, H. & Oksa, S. 2008. Ympäristöriskien hallinta. Mikkeli: Mikkelin Ammattikorkeakoulu. ISBN 978-951.588-229-5 [Referred 22.10.2014]

Web page of Occupational health and safety administration. [Referred 21.11.2014] Työsuojelu.fi

Web page of United States Environmental Protection Agency. [Referred 11.12.2014] www.epa.gov

Hand, C. 2006. Waste Management: The Changing Legislative Climate. Thorogood.

Lundgren, R. & McMakin, A. 1998. Risk communication: a handbook for communicating environmental, safety and health risks. 2. p. Columbus, Ohio: Battelle Press.

Hovisalmi, S. & Niskala, M. 2009. Ympäristöosaaminen kilpailukyvyksi – toimintamalli ja työkalut. Helsinki: Teknologiainfo Teknova Oy.

DuPont™ Viton ® Handling Precautions for Viton ® and Related Chemicals. 2010. http://www2.dupont.com/Plastics/en_US/pfo/assets/downloads/viton/Handling%20Precautions%20for%20Viton%20and%20Related%20Chemicals.pdf

Reunavuori, J. Lassila & Tikanoja. Recipient: kalle.kauttu@luvata.com. Sent 7.11.2014 klo 9.59.

Web page of European journal of geography. [Referred 21.11.2014] http://cybergeo.revues.org

APPEN
DIX 1

A HYPOTHETICAL EXAMPLE OF AN ENVIRONMENTAL RISK TEMPLATE MADE FOR THIS THESIS

Destination and substance	Risk and reasons	Consequences	Risk number effect x probability	P: Current preventive measures S: Suggested procedures
Storing of recyclable metals in open containers	Recyclable metals and/or emulsions leak from container	Metals and/or emulsion ends up in the water system	3x2=6	P: Storing in a covered shelter. Transportation with covered trailers. S: Intall safety pools under the containers when stored.
Sawing/grinding of metals	Metal dust gets to the sewer with water	Metal dust ends up in the water system	2x2=4	P: Metal dust is gathered with a precipitate collector.
Pickling of metals	Acids used in pickling gets to the sewer	Acids end up in the soil/water system	4x1=4	P: Acids are collected into an acid well which is equipped with proper safety systems.

APPENDIX 2

NATURAL HARARD RISK TABLE FROM CATNET DATABASE ESTIMATION PROGRAM IN THE COORDINATES OF KUPARITEOLLISUUSPUISTO INDUSTRIAL AREA

9. Natural Hazards

The following natural hazards have been identified for the following GPS coordinates: Lat. 61.4585 Long. 21.8619 (Decimal). **Natural Hazards** *(see appendix 4 - Natural hazards Exposure)* Hazard Pointer, Lat. 61.4585 Long. 21.8619 (Decimal)i.

Natural Hazards:	Risk Rate:	Comments:
Earthquake	Low	Zone 0, MM V and below According to Munich Re Natural Hazards database (see appendix).
Volcanic Eruption	None	According to Munich Re Natural Hazards database (see appendix).
Tsunami	None	According to Munich Re Natural Hazards database (see appendix).
Tropical storm	None	According to Munich Re Natural Hazards database (see appendix).
Extratropical Storm	Medium	Zone 2 121 – 160 km/h According to Munich Re Natural Hazards database (see appendix). Winter storms occur in the area, with heavy snow falls. The roof to the rolling mill buildingwas reportedly ripped off in the late 1990´s. Heavy rain in the region, 200mm @ 3hours, in 2007. No damages reported at the Luvata facility.
Storm surge	None	According to Munich Re Natural Hazards database (see appendix).
Tornado	Low	Zone 1 According to Munich Re Natural Hazards database (see appendix).
Hailstorm	Low	Zone 2 According to Munich Re Natural Hazards database (see appendix).
Lighting	Low	1 – 4 strokes per km2 and year According to Munich Re Natural Hazards database (see appendix). Grounded lightning rods are mounted on the highest building (copper foundry) on site.
River flood	1 in 250 – 500 flood zone	The Kokenmäenjoki River is located directly west of the site. Normal elevation difference to the floor level of the site is some 5 meters. Elevation difference to the lowest basement areas in the buildings on site is some 2,5 meters. There are water pumps located in the low basement areas in the buildings on site, the water pumps are located on a 2,5-3 m elevation. There is a power station that regulates the flow of the river some 30 km up stream from where the site is located. There is reportedly no loss history as a result of flooding at the site. According to the Swiss Re Cat Net Database this plant is located in a 1 in 250 – 500 flood zone
Landslide		The banks to the Kokenmäenjoki river are of clay and natural erosion occurs. Reports of erosion affecting the water pumps house were reported

According to Munich Re Natural Hazards database and experience from site management (CatNet for flood)

APPEN
DIX 3

A SERIES OF PICTURES ABOUT THE FLOOD ESTIMATE IN KOKEMÄENJOKI–RIVER. FROM THE PICTURES OF DIFFERENT FLOOD STAGES CAN BE SEEN THAT THE WATER DOES NOT RISE TO THE FACTORY AREA BUT ACCUMULATES ON SAARENLUOTO WHERE IT FORMS A SIDE CHANNEL. A VERY RARE FLOOD SHOWN IN THE LAST PICTURE WOULD CAUSE SIGNIFICANT DAMAGE TO THE CENTER OF PORI AND KIRJURINLUOTO AREA. (WEB PAGE OF FINLAND'S ENVIRONMENTAL ADMINISTRATION 2014)