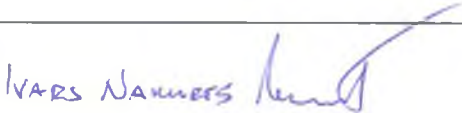
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"Methods and measures to enhance resilience against electric power outage in urban vital societal functions"	

MEREPUV

Working Paper from SFRS

/State Fire and Rescue Service/

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1. Introduction

This Working Paper from SFRS in cooperation with Valmiera city was prepared for the project “Methods and measures to enhance resilience against electric power outage in urban vital societal functions”; MEREPUV; 783153 — MEREPUV — UCPM-2017-PP-AG and co-funded by European Union Civil Protection finance instrument.

The main goals of the project are:

- To evaluate the main risks regarding the possible effects of power outage in the city as well as the direct and indirect consequences to the healthcare services;
- To prepare city risk and vulnerability assessment.

Four scenarios were chosen in the project based on the duration of the power outage:

- Scenario 1: Electrical power outage 24 hours;
- Scenario 2: Electrical power outage 74 hours;
- Scenario 3: Electrical power outage 1 week;
- Scenario 4: Electrical power outage 1 month.

All of four scenarios are based on the one event when 14 years ago, in City of Valmiera power was not available for four hours. The probability of the scenario is evaluated by the calculation and expressed in per cent value.

- Scenario 1: low probability: 10-40 per cent likely in 50 years;
- Scenario 2: very low probability: 0-10 per cent likely in 50 years;
- Scenario 3: very low probability: 0-10 per cent likely in 50 years;
- Scenario 4: very low probability: 0-10 per cent likely in 50 years.

The assessment is done within the framework of the so-called bow tie model. The model is adapted and specified on basis of purpose, analytical object and main questions to be examined in the assessments. The following risk elements are assessed:

- Probability
- Vulnerability
- Consequences
- Uncertainty

The necessary information of the power outages impact on the health system in Valmiera city was gathered in qualitative terms at expert meetings when discussing the scenarios. During meeting experts discussed several topics, such as:

- Stakeholder mapping;
- Existing situation regarding power supply;
- Health healthcare services at LTD “Vidzemes slimnīca”;
- Other supply services vulnerabilities.

2. About power outages in Latvia

2.1. Facts about reliability in deliverance of power in Latvia

In terms of reliability in deliverance of power in Latvia, Ministry of Economy states that regular survey and defect detection procedures of power lines are carried out with internal and external regulatory enactments. In order to reduce the risk of the damage occurrence to the distribution grid, both the gradual rebuilding of the electricity grid and the regular maintenance measures for electrical installations shall be carried out. Since year 2011, the share of naked power lines in the overall length of the distribution grid has been reduced by 16% (from 64% in year 2011 to 48% in year 2018), using such technical solutions as the construction of cable lines, insulated lines, overhead cables, which significantly reduce the electricity grid's vulnerability on weather effects. Improvements are implemented by strong emphasis on the possibility of unbundling the electricity networks of cities and rural areas in order to reduce the risk of disruption in cities and major villages where the majority of the population is concentrated. Special automatization programme, by using remotely controlled power switches, allows to identify damaged power lines and localize damaged sections.

The maintenance of the electrical line routes follows the 4-6 year route cleaning cycle (freeing the routes from trees and shrubs). Every year routes are cleaned for an average of 4500 km, using different technologies.

The amendments to the Protection Zone Law adopted by 18.04.2013 have extended power line protection zones to forest areas for power lines with a voltage of 10-20 kV to 30 metres from the axis of the line. Amendments to the Protection Zone Law and to Cabinet of Ministers Regulation No 982 on "Procedures for the Determination of Protection Zone for Energy Infrastructure Objects" introduce a framework for the felling of potentially threatening trees in the protection zone. The implementation of the felling of dangerous trees significantly reduces risks to power lines.

2.2. Facts about incidents of previous power outages in terms of duration and most common causes

In the end of year 2010 during the night from 25th to 26th of December an active cyclone was storming the territory of Latvia, bringing heavy rainfall in the form of rain, hail and wet snow. In the western part of the country, rain fall increased water levels in rivers basins and leading to flooding in the lower areas. The flooding and increased water levels in rivers posed a local threat to electrical installations, thereby the shutdown of individual electrical installations was arranged. As air temperatures fell, the freezing rain in the eastern part of the country caused considerable icing, a strong snowfall continued for several days. As a result of snow and icing, falling trees cause extensive breakdown of the distribution grid in the several municipalities. Electricity supply disruptions affected several tens of thousands of households. JSC "Sadales tīkls" has been doing repairs of damage since the morning of December 26th, but due to adverse weather conditions, the peak of damage to the grid was

reached on 1st January 2011. When without electricity was 4 188 distribution transformer substations causing 66 646 households left without power. On 1th of January, the JSC “Sadales tīkls” shall announce an emergency situation in the distribution grid. On 6th of January Cabinet of ministers declares Emergency Situation due to the long-term electricity supply disruptions. Repair works of damages under intense working conditions continues until 25th of January In general, disruption in the distribution grid lasts 1 month. Basically affected areas outside the cities. On 17th of January in one of the municipality the power outages disrupted the operation of Thermogenic plant, which caused a rupture in the heat track.

Damage to this magnitude has been identified as a result of snowfall and icing. A similar extent of electricity supply has been experienced following the damage caused by the hurricane on 9 January 2005. The night-time storm on 29 October 2013 caused damage to the distribution grid, which caused electricity supply to be disrupted by around 100 thousand households, causing further damage in neighbouring Estonia.

2.3. Expected societal development

Massive damage to the power distribution grid leaves a significant impact on one of the basic needs – electricity supply. Interruptions in electricity supply may lead to a cascade effect to other basic needs: water supply, heating, communication provision, housing maintenance and safety, health care. Risks can be reduced by the use of autonomous power generators to ensure the operation of critical infrastructure facilities. Disruption of electricity supply may result in a disruption or a total disruption of the heating of households and public buildings outside urban areas, which should result in the use of other heating sources.

3. About municipalities' responsibilities in case of power outages

According to Civil Protection and Disaster Management Law¹, disasters related to energy generation or transport infrastructure of energy and energy resources are coordinated by the Ministry of Economics. Coordination of disaster is carried out by involving the authorities that are subordinate to the Ministry or local government (hereinafter - the disaster management subject) in co-operation with other ministries, State and local government authorities shall perform the following disaster management coordination tasks:

- 1) to assess the risk;
- 2) based on risk assessment, to determine the preventive, preparedness, response and elimination of consequences measures, draw up planning documents for the development of the respective field, laws and regulations and other documents;
- 3) based on risk assessment, to identify and plan resources for disaster management.

Since power outage can drive and have previously caused disasters in municipalities heat and water supply system, therefore responsibilities in case of power outage emergencies have to be seen in multiple dimensions.

Ministry of Economics have delegated JSC "Sadales tīkls" to coordinate and to be Institution which is official also leader of rescue works in case of disaster related with damage to distribution grid.

Municipalities have no direct tasks to deal with the power outages in their administrative territory, but according to the Law On Local Governments², to organise supply of water and heat for residents is autonomous functions of municipalities. This requirement also applies in the event of a disaster and the force of this requirement is strengthened in Civil Protection and Disaster Management Law. Civil Protection and Disaster Management Law states disasters within the administrative territory of a municipality related to accidents in heating supply, water supply system are coordinated by the municipality.

One of the tool for municipalities to fulfil coordination of disaster is the civil protection commission of the co-operation territories. The aim of the Commission's work is to coordinate actions in the event of disaster and disaster threats and to promote civil protection, disaster management or disaster management coordination. The Commission consists of representatives of several sectors, including expert from JSC "Sadales tīkls".

In case of a major energy emergency municipalities will receive support from the State Energy Centre for the elimination of the disaster and the liquidation of the consequences caused by it. For more information about the State Energy Centre see By-laws of the State Energy Crisis Centre³.

¹ Civil Protection and Disaster Management Law in English <https://likumi.lv/ta/en/en/id/282333-civil-protection-and-disaster-management-law>

² Law On Local Governments in English <https://likumi.lv/ta/en/en/id/57255-on-local-governments>

³ By-laws of the State Energy Crisis Centre in English <https://likumi.lv/ta/en/en/id/58439-by-laws-of-the-state-energy-crisis-centre>

4. Cities assessments

4.1. Scenario: Electrical power outage 24 hours

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as low: 10-40 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Water supply

Water supply system pipes are equipped with generators that are able to provide fully functioning water supply system for 24 hours. Water purification system has additional diesel generators that can provide its functioning. Water abstraction pumps are not supplied with additional power sources which results in the fact that drinkable water will only be available from the water container which could provide the city with drinkable water for 24 hours.

Heat production

In the case of power outage to the city, heat production would be interrupted because of the block of the pipe operation including boiler houses and circulating heat networks. In result of inertia, heat supplement would be available in the heat networks for two hours. In case the temperature would be less than -10 degrees Celsius, heat networks would freeze in 24 hours.

Provision of public transport. Fuel availability.

It is possible to provide the public transportation system with the available fuel. There are no additional emergency situation fuel reserves available for the city. Fuel tanks are equipped with generators to provide the functioning of the pumps. In addition, it is possible to connect the generator from the technical help truck.

Provision of public order.

Valmiera Municipal police is responsible for the functioning of Operative Information centre, public order and, if necessary, informative function for the local inhabitants. In the case of power outage, the functioning of Valmiera Municipal police will be interrupted by the outage of fuel for the operative transportation, the limited communication opportunities (phones and walkie-talkies will be available only till the end of current charge) and disruption of the video surveillance system.

Impact on health services

“Vidzeme Hospital” is equipped with two power input lines (total power supplement 2400 kW) that can replace each other. In the case of one local power disruption, all the necessary power can be supplied from the other power input line. In case of more immense power supplement emergency – electro energy is not provided to the hospital.

The existing uninterruptible power supply blocks (UPS systems) would be able to provide the functioning of the most necessary medical equipment with the necessary power only up till two hours.

“Vidzeme Hospital” is equipped with diesel generator (300 kW) with 12 hours working time taking into account the available fuel reserves. This generator would provide the functioning of intensive care department, resuscitation department and children care department. The fact that these departments have experienced several important reconstructions must be taken into account because the diesel generators have not been tested since their installation so it is not that reliable source. The testing process of these diesel generators is almost impossible because of the fact that the hospital is treating patients 24/7.

The generator could provide the necessary light equipment in selected departments of the hospital as well as the functioning of some of the medical appliances. It must be taken into account that full light equipment will not be provided in all the hospital as well as the functioning of elevators and operating of inner water and heat supplement system.

In the case of power outage there are some additional diesel generators available at Valmiera city for example at Power Distribution network or SFRS. It would be necessary to provide “Vidzeme Hospital” with additional generator connection points as well as to install a separate power wiring.

Power outage would have a significant impact not only to the medical appliances but also to other critically important fields:

- Catering. Food reserves are strategically made for a week (Food is supplied to hospital once in a week). It is stored in freezers which would stop working after the case of

power outage. The cooking processes wouldn't be possible because the main source of energy for most of the technological appliances in the kitchen is electricity. Critically important will be necessity for the hot water.

- Communication. Inner communication at "Vidzeme Hospital" would be provided using the fixed inner phone networks. Mobile and other communication would depend on the national mobile network activities.
- Heat. The outside heat supplement system in case of lower temperature than -10 Celsius will freeze in 24 hours. The inner circulation will not be provided. In winter, if the power supply is not restored within 24 hours, the hospital will need to be evacuated.
- Autonomous heating system is not installed.
- Transportation. The provision of transport services is related to the inner fuel reserves. Of course, the availability of communications to coordinate transport will also be important. It is possible to involve the resources of army and National Guard in order of evacuation. Evacuation of the critical patients would be done organised in cooperation and would depend on other hospital availability as well as the availability of the transport.

In case of power outage up to 24 hours "Vidzeme Hospital" can provide:

- Emergency medical care for critical patients
- Availability of the doctors

Ambulatory and unurgent specialist availability and consultations will be limited. The standard of patients recovering in the stationary care won't be available, because it will not be able to provide the necessary conditions including catering, heat and water supply.

Cascading effects and impact on other vital societal functions

Evaluating the results and impacts of power outage on health care services and other vital societal functions, no significant impact was found. Limited first aid services or other health care services will encourage the population (especially people with children or relatives that need regular medical assistance) to move to regions where these services are provided which could escalate to the possible deficit of specialists and valuable resources (transportation, fuel) that would be essential to prevent the power outage. In the scenario of 24-hour power outage this possibility is evaluated as very low.

Consequences for societal values

Results of power outage in health care system would have serious consequences on societal values like:

- Life and health of local inhabitants. After evaluating the impacts of power outage for 24 hours it is assessed that it will not lead to additional deaths that are related with the health care and emergency services because all the important medical services including medical appliances will be provided. In the case of a 24-hour power outage, communication and transport facilities will be able to ensure public access to health services. The provision of health care services will not be provided in full amount, but by focusing on providing assistance in the most critical cases.
- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. No significant increase in the demand for health services is expected.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
- In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.

The following measures have been identified that could effectively reduce vulnerability to power outages:

- Fuel reserves for diesel generators
- Testing of the available alternative power systems
- Development of an alternative power supply system for the provision of inner heat supply

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;

4.2. Scenario: Electrical power outage 72 hours

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as very low: 0-10 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population. Detailed information available in chapter 4.1.

Water supply

Drinkable water supplies will run out in the city within the first 24 hours. Due to the limited fuel reserves, no additional drinking water will be available.

Heat production

Within 24 hours the heat supply networks will be frozen and will not be usable.

Provision of public transport. Fuel availability.

It will be possible to provide the public transportation system with the available fuel reserves. There are enough reserves for one week.

Provision of public order.

Critical level of operations in communication and notification systems. There is a serious risk that the available communication systems will not be usable. This will make it impossible to communicate with the public (cannot call, get information, etc.)

Impact on health services

Detailed information available in chapter 4.1.

The fuel reserves for running the diesel generator will end in the first 12 hours. If no solution is found for the supply of additional fuel reserves, the hospital will be closed. Evacuation of patients will be required.

If additional fuel reserves would be provided, the generator could provide the functioning of intensive care department, resuscitation department and children care department.

Provision of warm food won't be available for the patients as well as there will be no water and heat supply. As a result, the hospital will have to stop and start evacuation.

Full health care delivery will not be possible. Transfer of the critical phase patients to other health care facilities in other nearby regions should be started. The flow of incoming patients should be directed to other nearby hospitals.

Cascading effects and impact on other vital societal functions

Limited first aid services or other health care services for 72 hours will encourage the population (especially people with children or relatives that need regular medical assistance) to move to regions where these services are provided which could escalate to the possible deficit of specialists and valuable resources (transportation, fuel) that would be essential to prevent the power outage.

Consequences for societal values

Results of power outage for 72 hours in health care system would have serious consequences on societal values like:

- Life and health of local inhabitants. After evaluating the impacts of power outage for 72 hours it is assessed that some problem situations might arise that are related with the health care and emergency services because the provision of the important medical services including medical appliances will not be possible. The city of Valmiera will not be able to provide a full range of health care services without external assistance
- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of motion. 72-hour power outage would bring much higher demand for a variety of health care services based on the lack of water, food and possible frostbites.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available. Water supply interruptions can cause an outbreak of diseases.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.

In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.

- Communication will become problematic. The possibilities of using the means of communication will be limited. Exchange of information will be difficult.
- The availability of transport services due to lack of fuel reserves may be impaired.

The following measures have been identified that could effectively reduce vulnerability to power outages

- Fuel reserves for diesel generators
- Testing of the available alternative power systems
- Development of an alternative power supply system for the provision of inner heat supply

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;
- Creating an alternative communication (notification) system;
- Developing alternatives for water supply.

4.3. Scenario: Electrical power outage 1 week

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as very low: 0-10 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population. Detailed information available in chapter 4.1.

Water supply

Drinkable water supplies will run out in the city within the first 24 hours. Due to the limited fuel reserves, no additional drinking water will be available.

Heat production

Within 24 hours the heat supply networks will be frozen and will not be usable.

Provision of public transport. Fuel availability.

It will be possible to provide the public transportation system with the available fuel reserves. There are enough reserves only for one week.

Provision of public order.

Critical level of operations in communication and notification systems. There is a serious risk that the available communication systems will not be usable. This will make it impossible to communicate with the public (cannot call, get information, etc.)

Impact on critical input factors for health services

Detailed information available in chapter 4.1.

The fuel reserves for running the diesel generator will end in the first 12 hours. If no solution is found for the supply of additional fuel reserves, the hospital will be closed. Evacuation of patients will be required.

If additional fuel reserves would be provided, the generator could provide the functioning of intensive care department, resuscitation department and children care department.

Provision of warm food won't be available for the patients as well as there will be no water and heat supply.

Full health care delivery will not be possible. Transfer of the critical phase patients to other health care facilities in other nearby regions should be started. The flow of incoming patients should be directed to other nearby hospitals.

Cascading effects and impact on other vital societal functions

Limited first aid services or other health care services for 1 week will encourage the population (especially people with children or relatives that need regular medical assistance) to move to regions where these services are provided which could escalate to the possible deficit of specialists and valuable resources (transportation, fuel) that would be essential to prevent the power outage.

Consequences for societal values

Results of power outage for 1 week in health care system would have major consequences on societal values like:

- Life and health of local inhabitants. The interruption of the weekly electricity supply will make it more difficult to provide emergency care or to provide daily care, and the

public will feel the need for water and food. The possibility of freezing should also be considered.

- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. 1-week power outage would bring much higher demand for a variety of health care services based on the lack of water, food and possible frostbites.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available. Water supply interruptions can cause an outbreak of diseases.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
- In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.
- Communication will become problematic. The possibilities of using the means of communication will be limited. Exchange of information will be difficult.
- The availability of transport services due to lack of fuel reserves may be impaired.
-

The following measures have been identified that could effectively reduce vulnerability to power outages;

- Fuel reserves for diesel generators;
- Testing of the available alternative power systems;
- Development of an alternative power supply system for the provision of inner heat supply.

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;
- Creating an alternative communication (notification) system;
- Developing alternatives for water supply.

4.4. Scenario: Electrical power outage 1 month

Probability

Taking into account that the last power outage in Valmiera happened 14 years ago, when power was not available for four hours, the probability of this scenario is evaluated as very low: 0-10 per cent likely in 50 years.

Impact on critical input factors for health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population. Detailed information available in chapter 4.1.

Water supply

Drinkable water supplies will run out in the city within the first 24 hours. Due to the limited fuel reserves, no additional drinking water will be available.

Heat production

Within 24 hours the heat supply networks will be frozen and will not be usable.

Provision of public transport. Fuel availability.

It will be possible to provide the public transportation system with the available fuel reserves. There are enough reserves for one week.

Provision of public order.

Critical level of operations in communication and notification systems. There is a serious risk that the available communication systems will not be usable.

Impact on health services

The availability of services such as water supply and heat supply is important for the provision of health care services without electricity supply. In addition, catering and food supplies, which depend on the functioning of the transport system, are essential for the operation of the hospital. Each of these services is necessary for providing quality healthcare services to the population.

Power outage or one month will reduce the demand for health care services, as some part of the population will choose other cities where healthcare is available. The city will need

emergency care and care for patients who are not transportable. Detailed information available in chapter 4.1.

The fuel reserves for running the diesel generator will end in the first 12 hours. If no solution is found for the supply of additional fuel reserves, the hospital will be closed.

If additional fuel reserves would be provided, the generator could provide the functioning of intensive care department, resuscitation department and children care department.

Provision of warm food won't be available for the patients as well as there will be no water and heat supply. Full health care delivery will not be possible. Transfer of the critical phase patients to other health care facilities in other nearby regions should be started. The flow of incoming patients should be directed to other nearby hospitals provided that functioning communication channels are available.

Cascading effects and impact on other vital societal functions

Power outage for one month will encourage all the population to evacuate to other nearby regions and leave the city.

Consequences for societal values

Results of power outage for 1 month in health care system would have serious consequences on societal values like:

- Life and health of local inhabitants. After evaluating the impacts of power outage for 1 month it is assessed that it will make impossible to provide emergency care or to provide daily care, and the public will feel the need for water and food. The possibility of freezing should also be considered.
- bring many lethal cases that are related with the health care and emergency services because as well as with lack of food, water and risk of frostbite.
- Public stability. The public's psychological response to the power outage in the given scenario would be closely related to providing security for themselves and for their relatives. The challenges of everyday life will be related to the provision of everyday necessities - home security, food, warmth and availability of information. 1-month power outage would bring much higher demand for a variety of health care services based on the lack of water, food and possible frostbites.
- Due to the water and heat supply interruption deterioration of sanitary and hygienic conditions are expected, it may result in the outbreak of infection cases and diseases e.g. diarrhea. The outbreak of such cases may overload already existing health services.

Identified vulnerabilities, existing efficient barriers and proposals of measures

The following vulnerabilities were identified in the assessment:

- Water circulation in the hospital's internal networks will be interrupted, no warm water will be available. Water supply interruptions can cause an outbreak of diseases.
- Without electric power, it will not be possible to cook warmly, but the food reserves will quickly deteriorate due to a break in the operation of the refrigerators.
- In winter, due to the interruption of heat supply, it will not be possible to provide the all necessary rooms heating during the winter.
- Communication will become problematic. The possibilities of using the means of communication will be limited. Exchange of information will be difficult.
- The availability of transport services due to lack of fuel reserves may be impaired.

The following measures have been identified that could effectively reduce vulnerability to power outages

- Fuel reserves for diesel generators
- Testing of the available alternative power systems
- Development of an alternative power supply system for the provision of inner heat supply

Based on the risk and vulnerability assessment, following measures are proposed:

- Creating or increasing fuel reserves;
- Evaluation of electrical wiring systems to ensure proper backup power supply;
- Creation of new connection points for additional generators;
- Creating a detailed plan for full evacuation of hospital patients
- Creating an alternative communication (notification) system;
- Developing alternatives for water supply.

5. Way forward

In parallel, while city of Valmiera was conducting this assessment, State civil protection system was developed. SFRS created two tools (Potential Hazard Catalogue and Methodology for Risk Assessment) with purpose to educate the disaster management subjects and develop a common approach for the submitted risk assessments. Risks assessment methodology structure used in MEREPUV project is strongly similar to SFRS developed methodology for risk assessment, therefore finding this project can be modified and implemented in national risks assessment.

Since findings of this assessment are closely relevant to main tasks for municipalities in field of civil protection this material and analytical approach can be used by SFRS as a for other municipalities during training for other civil protection commissions of the co-operation territories.

Evaluation, facts and the findings of city of Valmiera assessment as well as possible proposals for measures to improve the prevention of harmful effects in case of power outage, are transferable and usable in other cities, by adjusting parameters of certain areas of impacts. For example, in other cities, water extraction pumps may already be equipped with additional generators to provide full water supply, so there is no need to look for additional ones

Basically, results of city of Valmiera assessment only once more emphasizes the importance and dependence of nation electricity grid for municipalities when ensuring the basic social needs for citizens.

6. Assessment of degree of achievement of project objectives

SFRS responds positively to city of Valmiera's contribution to the project. During the project it was observed that the staff of the city of Valmiera competence develops with every organized expert meeting, high sense of responsibility from Valmiera city side, was an integral part of cooperation. City of Valmiera already at the beginning of the project directly highlighted effects of electrical power outage for urban vital societal functions (accessibility to health services, water and heat provision).

In the course of the project, vulnerabilities for societal functions was accurately described, hence consequences and uncertainties identified and possible improvements to reduce the probable consequences were identified.

In the work with the city of Valmiera vulnerability assessments, contributing participants were introduced with the national civil protection mechanism. The tasks and responsibilities of municipalities for the citizens regarding civil protection were explained. As it was stated in introduction of working paper, cross-sectoral meetings were organized, therefore, it can be argued that overall understanding between different stakeholders with different responsibilities was improved. Almost could claim that these assessments served as a prelude for multi-hazard risk assessment, and it certainly strengthened quality of further developed risk assessments.