

A BIG DISTURBANCE IN SLOVENIA IN FEBRUARY 2014 CAUSED BY SEVERE ICING

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ABSTRACT

Severe icing has caused a big disturbance in Slovenia in February 2014. Paper outlines the circumstances which lead to severe icing, main problems which was caused by severe damage over the big territory and extreme duration of disturbance. The conclusions and possible solutions for disturbances to mitigate in future are given in paper.

INTRODUCTION

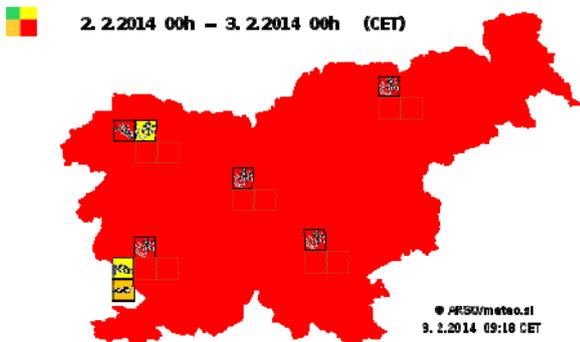
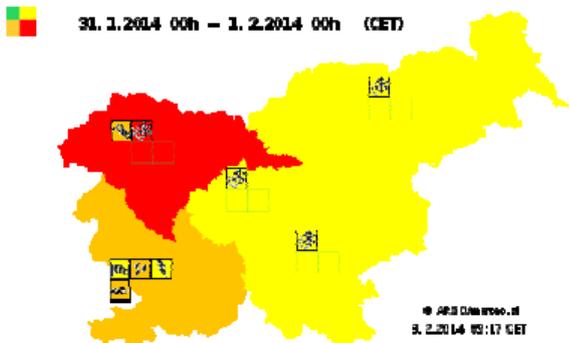
Weather conditions

At the end of the Jan 2014 the storm was caused severe icing, covering the almost all of Slovenia and it was RED alarm for extreme weather conditions with freezing rain. Increased rainfall, which in many places to freeze in contact with the ground and facilities, has led to a massive breakage. In some places the layer of ice reached a thickness of several centimetres, which has been an increasing burden on many trees and power lines. Ice was caused main damage on the overhead lines. First days of storm is shown on picture:

Damage

This was centenary damage. The territory affected was almost all the country. The consequences were catastrophic. State authorities have announced emergency situations.

Damage occurred at transmission overhead lines (400 kV, 220kV 110kV), distribution overhead lines (110kV, 20kV) and LV (up to 1kV) lines in common length of over 1000km. About 5000 substations 20/0,4kV were affected. There were over 250.000 citizens out of electrical power. Some of them were completely out of supply for more than 10 days. After that for some parts with totally destroyed network only emergency electricity from diesel generators was available till the end of April. In total over 100 diesel generators up to 1MVA were used. At the peak over 1500 workers from electro distribution companies and others (civil protection, firefighters, army, volunteers, construction companies, foreign expert workers etc.) were working at the same time to bring the supply of electric power at least to the cities and bigger settlements. The estimated damage on electricity distribution network is 70 mio €



Rates of weather risk are shown in colours, red colour of the highest level.





Almost immediately the communications were dropped, because the base stations of GSM were out of power, after a while batteries at stations runs out and there were no information on situation.

At failure on 110kV lines FM signal is gone to. There was no remote control. It must be all worked manually.

GENERAL

The elimination of damage

Fault handling is carried out in order from high to low voltage.



For some important HV overhead lines there were temporary used the modular EMERGENCY

RESTORATION STRUCTURES (ERS) to bring the supply of electricity to transformer stations 110kV/20kV. The use of the emergency restoration structures (ERS) in the broken system of high voltage overhead power lines, allows quick and effective recovery in extreme weather conditions damaged towers. In the case of bad weather destroyed the high voltage overhead power line is replaced with ERS. This temporary solution allows you to activate damaged line in a very short time. The advantage of this solution of recovery allows the owner of the high voltage overhead power line systematically preparation of permanent recovery from problem analysis, development of new documentation, a quality preparation of construction and construction of new high voltage overhead power towers and allows regular inspections and remove detected faults on high voltage overhead power line towers or consoles (brackets). Elektro Ljubljana d.d. has usefully accepted the advantages of using ERS [1].

Other damage was handled as normal. But the number of faults and the impossible circumstances were causing a lot of **problems**.

Problems

How to solve such damage and problems? The main problems which we will focus on are:

- Activation of workers
- Operation of staffs
- The number of active workers
- Cooperation with foreign workers
- Public response
- Availability and condition of work equipment
- Availability and condition of personal protective equipment
- Transportation
- Availability of material
- The availability of the communication system (FM, GSM)
- Record-keeping of the works, material consumption and needs for the final remediation of defects (plan)
- Keeping records of aggregates, fuel consumption and consumers connected on aggregates
- The issue of volunteers and retirees
- The organization of nutrition and rest
- Contractual relationship and written agreements with hired workers
- Documents for safe work
- Compliance with security measures and rules
- Other

Activation of workers

Responding to the call of workers has been tremendous

and immediate. Already within 10 minutes of the call in some areas. It has proved belonging to companies and monitoring events.

Operation of staffs

The staffs were created at the level of the unit and at the level of companies. It varies, depending on the extent of the emergency. Some staffs have worked very independent, later connected to a higher level. The important role in the local coordination was knowledge of the terrain. It is noted, that such extent damage needs a clear and coordinated management and operation of active Distribution Control Centres. In particular, local distribution control centres.

The number of active workers

There were activated all available workers, including non-technical staff who helped in locating errors. Foreign workers (civil protection, firefighters, military, construction contractors, foreign technical groups, cutters, aid from other electro distribution companies, aid from abroad) are at the most affected area exceeded 500% of own workforce. In the first week at the field worked over 1500 workers at the same time (distribution and foreign workers.)

Cooperation with foreign workers

Cooperation with foreign workers was good, especially the locally based contractors, who were familiar with the terrain. A particular problem has occurred with foreign-speaking workers because of communication barriers (workers from Slovakia). At the tender selected contractors do not necessarily know the terrain, so it means more work. It has been shown the lack of our own staff, which would dominate the terrain, as they were needed to lead both own and foreign groups.

The fact is that without foreign aid would not cope with such a scope of work.

Public response

Public response was mostly positive, compassionate, with individual exceptions. There was a big difference between urban and rural population, since the latter are more tolerant and willing to help.

Availability and condition of work equipment

Work equipment was basically sufficient. Since it was also engaged by nonprofessional staff, which usually does not have adequate equipment for field work, highlighted the lack of.

Availability and condition of personal protective equipment (PPE)

Workers have been well equipped with personal protective equipment. If it was necessary they have been additionally equipped. It was shown good organization and operation of safety and health Department.

Transportation

In view of the extremely demanding conditions, the road was officially closed. It would also need some more special technical vehicle equipment. In such situations should be all vehicles with four-wheel drive. We would need more real off-road vehicles with winches.

Availability of material

The availability of the material in the first days of the occurrence of the disturbance was poor. It was weakness of minimum stocks. In parts the situation was resolved by material intended for investment, where there has been the plan. Later, the supply of the materials runs OK. Supply would better run if it operates through a central warehouse, which would be well stocked.

The availability of the communication system (FM, GSM)

Almost immediately many communications were dropped, because some GSM base stations were out of power supply. At first it was only possible to use satellite phone communication.

At failure on 110 kV lines there was no longer FM signal and optical telecommunication and consequently no FM communication and remote control. After a while the batteries at the transformer stations were discharged and there were no information on situation of SCADA. It was necessary to manually check the position of switches and work all manually. Also, it was not possible to use data links for exchanging sending information. Practically there were some parts of several days (10) without communication with the rest of the world.

Record-keeping of the works, material consumption and needs for the final remediation of defects (plan)

Record keeping was different across companies. At the beginning it was worse, but later at least roughly regulated. Common to all it was that at the time of disturbance there were not enough adequate staff to collect and record defects. The manners of keeping records were different (different IT support, strategy...). Another problems appeared by additional requirements of information of ministries, agencies, DSO, and other bureaucratic formations. They requested information, but sometimes even they did not know what they would like and why. Due to the large volume of defects and damage in most companies supplementary budget plans were made.

Keeping records of aggregates, fuel consumption and consumers connected on aggregates

Mostly there were problems in the monitoring of aggregates and fuel consumption. There have been some failures on aggregates and had to be removed as soon as possible. Here, too, there was no pre-defined what information and what level they should be collected. In retrospect it was difficult to obtain information. Another problem was due to rental of aggregates and their

migrations at locations according to the needs. To establish a reporting system for installed aggregates, we needed a few days.

The issue of volunteers and retirees

The response of volunteers and retirees was good. But it raises the question of safety and responsibility for the execution of tasks. Mostly we have used them for easy and less difficult work.

The organization of meals and rest

Food was well organized with warm meals and drinks. Due to small number all the workers were worked all day and they were overburdened. In any case, the lack of rest caused fatigue and increased risk at work and workers must stop.

Contractual relationship and written agreements with hired workers

Some of external contractors have been regulated by contracts and with written agreements. Engaged were also workers with whom we had not concluded contracts and written agreements. Because in certain areas agreements were not even possible to print, there was no power supply, nor was there time for this work. But these were contractors trained to work with electrical equipment and in the past has worked for electrical distribution companies.

The issue of written agreements should be resolved before the arrival of hired workers on the ground. One option may be pre-prepared form of a written agreement for provider of workforce to collect data of workers.

Documents for safe work

At first phase - defect localization, documents for safe work were abandoned. As soon as the workers started work organized they also began to issue documents to work safely. In areas where there was the break-up of the electricity system, have started to issue documents for safe work with the restoration of the 110 kV power. Safety instructions and measures were nevertheless carried out in accordance with the instructions. For each switch manipulation were used voice communications (FM), which enables recording in Distribution Control Centre.

Compliance with security measures and rules

Depending on the difficulty of the terrain, impossible weather conditions and to officially ban on movement in the forest, we can say that we were at the edge of safety rules. Otherwise, the safety instructions and measures implemented in accordance with the instructions as far as possible.

The Emergency plan should be worked out with proposal that it provide safety of workers, to protect them and help them in case of injuries.

Other

Emergency situations shows the necessity of territorial organization and the services, because in such cases it is shown how important a good knowledge of the terrain and facilities is.

CONCLUSIONS

To improve the responsiveness and performance in crisis situations it is necessary to:

- improve and obey the hierarchy of crisis staffs
- prepare local operation control centres for activation in crisis
- increase the number of skilled workers during normal operation, who can guide and lead leased workers in crisis
- improve fleet of vehicles and equipment
- reorganise central distribution warehouse large enough to supply the main material and organize logistics for delivery of necessary material
- prepare written agreements for leased workers in advance
- exclude selection for subcontractors for such cases from public tenders and make them more acceptable
- lay as many as possible cable network
- work in accordance with the safety rules in crisis situations
- develop methods and content of record keeping in crisis situations
- identify what work can be carried out by volunteers and retirees
- arrange a way of providing rest on too few workers
- maintain and develop independent communication system (FM or similar)
- regulate the coordination and communication of the civil protection organization and distribution companies at the national level
- keep press releases in crisis Staff Administration Company - relief of local emergency headquarters

But there is a fact: that kind of natural disasters will come again and cannot be prevented. We only can make it less painful by being prepared to unexpected and trained for faster restoration of the system.

REFERENCES

- [1] Tomaz Pungartnik, 2013, " EMERGENCY RESTORATION STRUCTURES (ERS) ACCEPTABLE SOLUTION IN THE MAINTENANCE OF HIGH VOLTAGE OVERHEAD LINES ", 10. conference HRO CIGRÉ Cavtat, 6. – 10. november 2011.