An analysis of possible tasks of the mountain infantry in supporting operations in underground infrastructure in the mountains

David LUCHNER (Theresan Military Academy)

Abstract: The terrain in Austria is significantly noticeable by its large proportion of mountains, as two thirds of it are covered by the Alps. In order to utilise these circumstances, several buildings were installed in high altitude, put underground, and connected by kilometres of tunnels. As these institutions are of great importance for the population, they can be considered as critical infrastructures which the Austrian Armed Forces might need to protect in the future. Therefore, it is necessary to draw the lines between the mountaineer and subterranean troops to increase cooperation.

Key Words: mountain, pumped storage power plant, surge tank, tunnels, underground

1. Introduction

When we take a look at mountaineer troops fighting in the Austrian Alps, it has always been a fight about the highest altitudes and the peaks. During the stationary First World War though, they started to build themselves fortified stations into the rocks and dug tunnels under the enemy to detonate their positions.[1] Additionally, the Alps are known for several big caves, which might be used during military operations. Hence, one could say that mountaineer troops have long been in contact with subterranean fighting.

Nevertheless, with modern technology enormous underground networks have been created, which stretch several hundreds of kilometers and branch throughout the mountains.[2] Furthermore, long gone are the days when the last mountaineer troops have been fighting enemy forces in the Austrian mountainous areas and long gone is the interaction with subsurface infrastructures.

Thus, it is a necessity that the modern subsurface buildings, the subterranean (specialized) troops and the mountaineer troops are put together. As the Austrian Armed Forces as well as the NIKE Team put their focus on protection operations, the main paper will also share the same center of attention. Nonetheless, the presented infrastructures might also see use in an offensive or defensive military operation.

2. Methods

a. Source of information

In the main paper, all the basics will be presented in the beginning. As the majority of information needed is either hard to be found or not available at all, the main source of knowledge has been provided by intensive talks with experts. Due to the contact with the head of the production of Montafon from the illwerke vkw AG, it has been able to gather all necessary facts in accordance with hydroelectric power plants.

[1] Süddeutsche Zeitung 2019.
[2] Bergwelten 2016.

David Luchner; Burgplatz 1, 2700 Wiener Neustadt, Austria; luchner.david@gmail.com

Furthermore, he did not only provide the plans of the installations but also a deeper insight. Additionally, material has been contributed by interviews with the state office for surveying and geoinformation of Vorarlberg. All pieces of information underwent scrutiny and were put together by the author.

b. Spatial delimitation

Moreover, the whole Austrian territory would have been too large for the bachelor thesis, hence the area of the federal state Vorarlberg is used for finding the various underground infrastructures needed. Undoubtedly, the majority of the elaborated findings will also fit other examples, national and international, and only need to be slightly adapted. The area is divided into two spaces, the low and high mountains. The lower limit of the low mountain range is set at 600 meters altitude. Here in the Western federal states of Austria, in addition to rounded and undulating hills as well as deeply incised valleys, there are still towns as well as industrial facilities, all of which accord to the definition of the Austrian Armed Forces.[3] Civilian sources also mostly use a contour line at 500 meters as a boundary.[4] The beginning of the high mountains is defined by the Austrian Armed Forces at an altitude of 2000 meters.[5]

c. Structure of the main paper

In order to establish a logical line, several research questions have been created. They will be used to bring the readers from a basic starting point to the deeper knowledge of the bachelor thesis. Here they are presented chronologically:

- What underground-related infrastructures can be found in the mountains?
- What is the structure of the Upper Ill plant group and in particular the Obervermuntwerk II?
- What tasks can the mountain-mobile infantry take on in support of the forces deployed underground at Obervermuntwerk II and how must this task force be structured?

At the present time, June 2022, the first research question has been answered completely and the second half. In accordance with the third question, the author has yet only been able to pose theses on the basis of his education, which still need to be subjected to rigorous scrutiny. The results are presented in the third paragraph, divided into subcategories according to the research questions.

3. Results

a. Underground related infrastructures in the mountains

This first paragraph aims to give the readers a justified reason, why the mountaineer troops have to train together with subterranean forces. Hence it is necessary to point out the valuable buildings which lie underneath the mountains. In the region of Vorarlberg, there are three main categories. The first one is the tunnels, which are part of the road or railway system. In the low and high mountains, these tunnels add up to a total length of 43 kilometres, not including the Arlberg Tunnel. The Arlberg Tunnel with its 14 kilometres length is the longest road tunnel in Austria, additionally equipped with numerous escape passages and assembly rooms. Furthermore, there is a neighbouring railway tunnel with a length of 10.6 kilometres.[6]

Secondly, there are some hotel regions which have created an underground network, for example Oberlech. In this little village living from ski tourism, the whole street network was put underground. Thus, a system was created consisting of about 1 500 metres of tunnels, a 1000 m^2 turnaround hall and a total of 3200 m^2 of handling halls.[7]

Thirdly, energy generation from hydropower has a long tradition in Vorarlberg and is one of the most distinctive sectors of the energy industry. Of greatest importance for covering energy consumption is the

[3] Bundesministerium für Landesverteidigung.
[4] Spektrum 2022.
[5] Bundesministerium für Landesverteidigung.
[6] oesterreichferien 2022.
[7] docplayer 2022.

illwerke vkw AG, which produce around 75 per-cent of Vorarlberg's electricity.[8] Especially in the case of the modern pumped storage power plants with cavern powerhouses and surge chambers, it can be seen that the entire water course is laid out via a network of pressure tunnels and pressure shafts that is several kilometres long and branched out. Only a small percentage of the water course is still above ground travelling through penstocks.[9] While it has been demonstrated in detail that the illwerke vkw AG are valuable for the region of Vorarlberg, they are also greatly important in the international energy network, as the pumped storage power plants and the reservoirs can function as giant batteries. Thus, they can store the energy of the international electricity network and give it back into the system when needed.

These three categories offer transportation (tunnels), income as well as international recognition (hotels) and energy (hydropower stations) to the population and are therefore considered as critical infrastructures. Moreover, several other underground installations can be found in the mountains, mainly mines and military properties. Internationally speaking, one of the most developed underground networks in the mountains is the Swiss National Redoubt. Additionally, there are several large cave systems under the Alps. Nonetheless, these options will only be mentioned in the main paper, while the author will continue to focus on the hydroelectric power plants of the illwerke vkw AG due to its importance and Austrian heritage.[10]

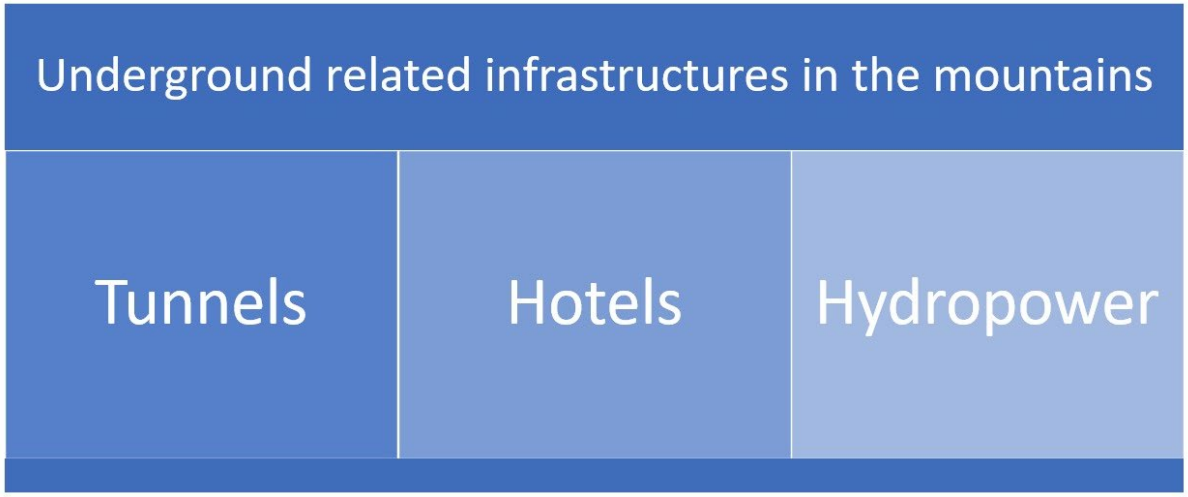

Figure 1: Three main categories of underground related infrastructures in the mountains covered in the main paper.[11]

b. The structure of the Upper Ill plant group and the Obervermuntwerk II

At present, the Upper Ill plant group of illwerke vkw AG consists of thirteen power plants and four reservoirs. This plant group takes in the company's most powerful power stations. Additionally, in the coming years, they are planning on building the yet largest pumped storage power plant of Austria. Furthermore, the following illustration shows the interaction between the individual installations. These are connected to each other several times underground so that the water flow can be perfectly adapted to the conditions. Consequently, illwerke vkw AG can decide from which location the water flows or is pumped to which power plant or reservoir. It should also be mentioned that some inflows are sourced from the province of Tyrol.[12]

[8] Kleinwasserkraft Österreich 2022.
[9] illwerke vkw 2022.
[10] Observation of the author
[11] Created by the author
[12] Vorarlberger Architektur Institut 2017.

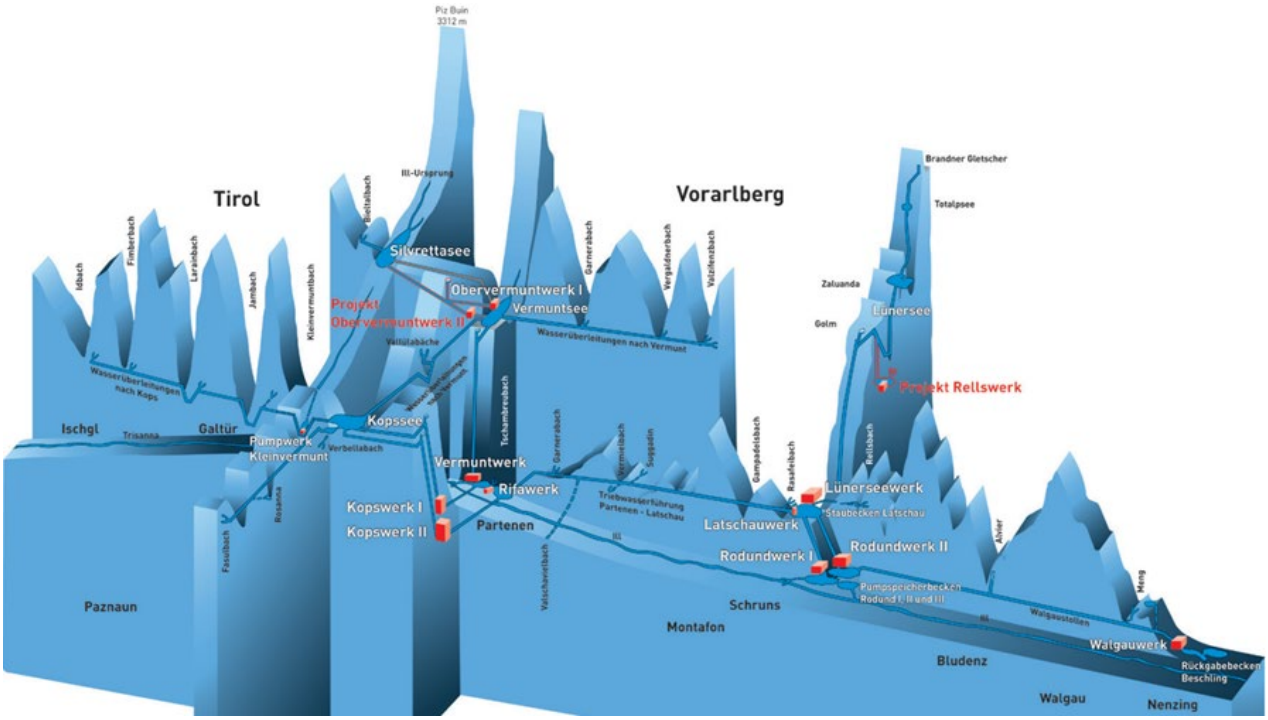

Figure 2: Schematic representation of the Upper Ill plant group with the power plants, reservoirs, and water pipelines without the Lünerseewerk II.[13]

Due to the significant impact of the Upper Ill plant group on the Austrian economy and international electricity network, it might pose a suitable target for an opposing force of any nature. Hence, the Austrian Armed Forces might need to conduct a protection operation to deny any unwanted manipulations. Since pressure shafts and tunnels are located several meters behind solid rock and are themselves disguised, they are not further assessed for access by unauthorised persons or hybrid enemy forces. All the more important are all portals that provide a connection between the earth's surface and the flow of water which might enable the interference or destruction of energy generation and conversion. This results in the following possible targets of attack, which will be explained in the whole paper in more detail: Reservoirs, sluice gates, surge tanks, ventilation shafts, power plants and transformer stations.[14]

These various installations are the basis of the structure of the Upper Ill plant group. In the main paper, these categories of buildings underwent a thorough inspection to figure out which ones are the most vulnerable and profitable to destroy. A possible attack will be demonstrated with the Obervermuntwerk II soon. Furthermore, to fully grasp the size of the Upper Ill plant group, the correct positions and altitude of the different power plants and reservoirs were put in an online atlas by the author.

[13] Vorarlberger Architektur Institut 2017.
[14] Observation of the author

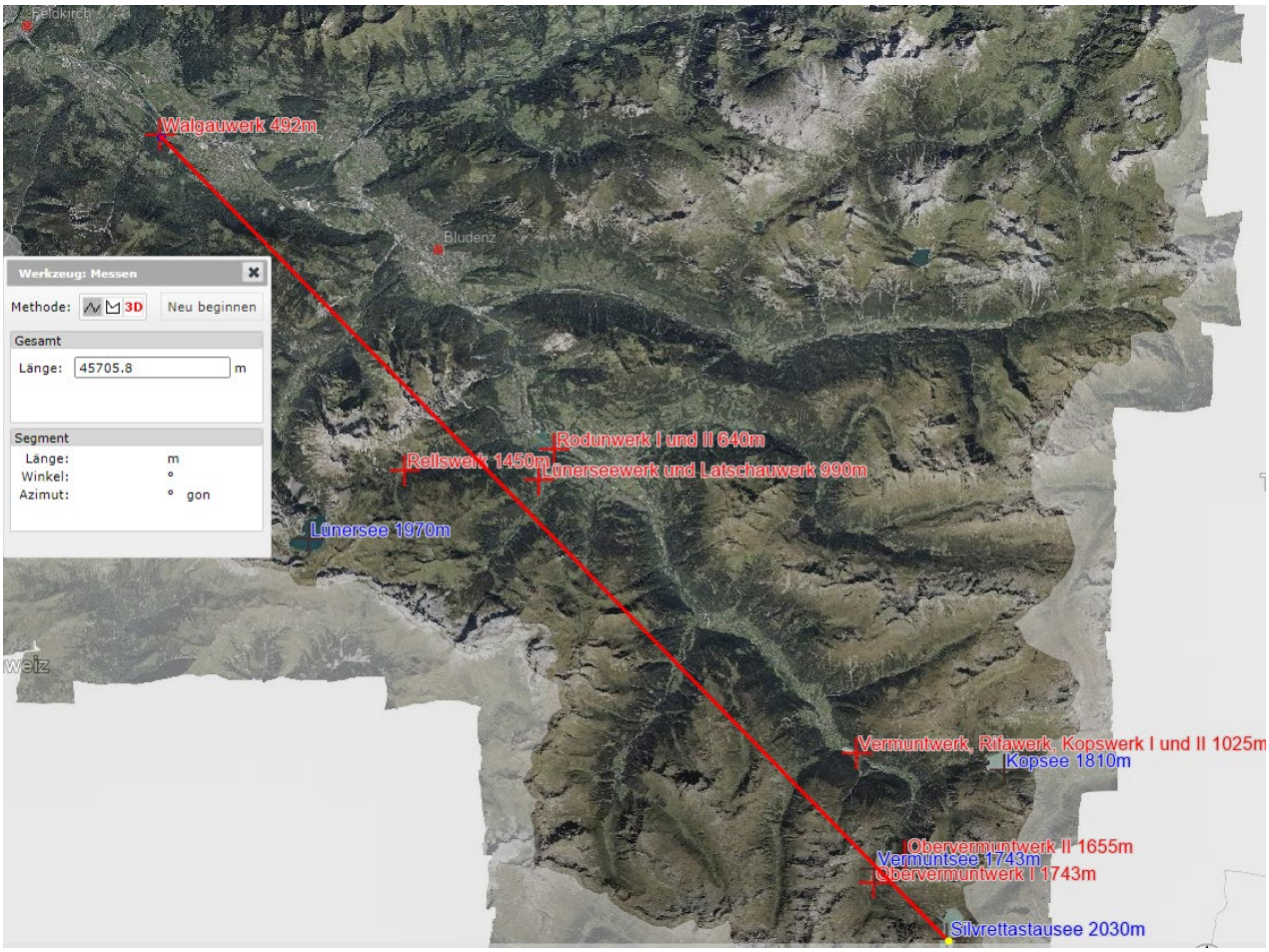

Figure 3: Representation of the power plants and reservoirs of the Upper Ill plant group in the Vorarlberg Atlas by the author.[15]

c. Tasks for the mountain-mobile infantry in support of the forces deployed underground at Obervermuntwerk II

At the time of June 2022, this question has not yet been dealt with. During the military exercise at the "Zentrum am Berg" the upcoming month, the coordination between mountaineer and subterranean troops will be displayed and thoroughly noted. Additionally, in the near future there will be a presentation of the gathered information to a mountaineer officer in order to establish some scenarios.

At the moment, the main idea and thesis going into this project is the deployment of mountaineer troops, patrolling and guarding certain areas, controlling the personal and surveying all access routes. The subsurface troops might be kept as a mobile response force in a central base or divided onto different positions. The size of the Task Force and the various areas of responsibility must be based on the spatial dimension of the plant group as shown in figure 3. Nevertheless, there has not yet been enough research in depth.

4. Conclusion

Summing up, one has to state the necessity of interaction and training between the mountaineer and subterranean troops. As presented with the first research question, lots of critical infrastructures are embedded into the high mountains. As these might be attacked by hybrid forces in the near future (e.g., to create an energy shortage), measures must be taken. Furthermore, it has been shown that in the federal state Vorarlberg the most valuable underground mountainous infrastructure is the Upper Ill plant group, as it contributes to the regional, national, and even international energy network. In order to figure out, how to

[15] Land Vorarlberg 2022.

protect such a large network of various buildings, the different connections of the underground pressure tunnels with the earth's surface were ranked accordingly to the likelihood and impact of an attack and/or destruction in the main paper.

These examples of a possible attack will be demonstrated at the installations of the Obervermuntwerk II and later on be discussed with a mountaineer officer in order to figure out a functioning protection of the network and successful interaction with the subterranean troops. Additionally, while the bachelor thesis puts its focus on the protection of critical infrastructure, the subterranean buildings and tunnels in the mountains might also be used during an offensive or defensive military operation. In the main paper, there will be a short paragraph to sum up possible scenarios and uses but it will be a necessity to take a closer look at these applications with an extra work in the future.

5. Contact

If you want any further information, feel free to get into contact with the author at any time.
E-Mail: luchner.david@gmail.com

Publication bibliography

Bergwelten (2016): Technik in den Alpen: Tunnels. Available on https://www.bergwelten.com/a/technik-in-den-alpen-tunnels, checked on 8/15/2022.

Bundesministerium für Landesverteidigung: Militärlexikon. Wien.

docplayer (2022): Autofrei Tunnelsystem. Available online at https://docplayer.org/40360749-Autofrei-tunnelsystem.html, checked on 5/17/2022.

Gemeinde Lech (2022): Orts- und Tunnelsystem Übersicht. Available online at https://gemeinde.lech.eu/mobilitaet/tunnelsystem-oberlech/orts-und-tunnelplan/, checked on 5/17/2022.

illwerke vkw (2022): Projektidee « Lünerseewerk II". Available online at https://www.youtube.com/watch?v=I6UhyuHc-pM&ab_channel=illwerkevkw, checked on 5/17/2022.

Kleinwasserkraft Österreich (2022): Kleinwasserkraft in Vorarlberg. Available online at URL: https://www.kleinwasserkraft.at/bundeslaender/vorarlberg/, checked on 5/17/2022.

Land Vorarlberg (2022): Vorarlberg Atlas. Available online at http://vogis.cnv.at/atlas/init.aspx?ks=digitaler_atlas_vorarlberg&karte=flora_u_fauna&layout=vogis_atlas&logo=vogis&project=dwBnAHUAXwA1ADcANQAwAGIANAAwAGQANQA5AGMAOQA0ADAANwBjAGEAZgBjAGYAMAAyAGUANAAxAGQAMwA1AGEANAA2ADUAXABXAGUAcgBrAHMAZwByAHUAcABwAGUAIABPAGIAZQByAGUAIABJAGwAbAA%3d&redliningid=p5lcu3j2ogkh4yquryly431q, checked on 6/5/2022.

oesterreichferien (2022): Arlbergtunnel. Available online at https://www.oesterreichferien.info/arlbergtunnel-arlbergpass/#Arlbergtunnel_Laenge, checked on 5/17/2022.

Spektrum (2022): Mittelgebirge. Available online at https://www.spektrum.de/lexikon/geographie/mittelgebirge/5152, checked on 5/16/2022.

Süddeutsche Zeitung (2019): Gemetzel um Gipfel. Available online at https://www.sueddeutsche.de/politik/erster-weltkrieg-in-den-alpen-gemetzel-um-gipfel-1.2491824, checked on 8/15/2022.

Vorarlberger Architektur Institut (2017): Architektur vor Ort № 143 Obervermuntwerk II. Dornbirn: Gaschurn.