

SAQ in Grimeton, the Only Remaining Pre-electronic Transmitter for Transatlantic Work, now on the Unesco World Heritage List

C. H. Walde

Secretary, Swedish Committee of URSI, info@walde.se

Keywords: SAQ, Grimeton, Alexanderson, alternator, VLF.

Abstract

From late 1924, the Alexanderson alternator and his multiple tuned antenna system at Grimeton, Sweden, were used for VLF communication from SAQ to "Radio Central", Rocky Point, Long Island, USA. During the Second World War and for some years after that, the Royal Swedish Navy used SAQ for traffic to submerged submarines, in retrospect crucial for the survival of the station, still in perfect working order and put on the world heritage list in 2004.

1 Introduction

On July 2nd, 2004, Unesco put SAQ, Varberg Radio in Grimeton, on the Word Heritage List, declaring:

"The Varberg Radio Station at Grimeton in southern Sweden (built in 1922-1924) is an exceptionally well preserved monument to early wireless transatlantic communication. It consists of the transmitter equipment, including the aerial system of six 127-m high steel towers. Though no longer in regular use, the equipment has been maintained in operating condition. The 109.9-ha site comprises buildings housing the original Alexanderson transmitter, including the towers with their antennae, short-wave transmitters with their antennae, and a residential area with staff housing. The architect Carl Åkerblad designed the main buildings in the neoclassical style and the structural engineer Henrik Kreüger was responsible for the antenna towers, the tallest built structures in Sweden at that time. The site is an outstanding example of the development of telecommunications and is the only surviving example of a major transmitting station based on pre-electronic technology."

Ernst F. W. Alexanderson, the foremost one to be honoured, was unfortunately not credited with his full name in the Unesco declaration. Without Alexanderson, designer of the radio equipment and the antenna system, SAQ had never succeeded in attaining world heritage status; this paper will show his role.

SAQ is unique in another way being the only world heritage object that can be visited far away by DX reception.

All references except the world heritage application [2] are of a general nature and difficult to assign to any particular part of the paper. The paper is public domain.



Figure 1: SAQ station building with its six antenna towers in the 1920's. (Gustaf Björkström/Varberg County Museum)

2 It started in the 19th century

First, a bit of early radio history for the younger generations:

In the 1860's James Clerk Maxwell, then at King's College in London, wrote a letter to his cousin saying "I have a paper afloat which, til convinced to the contrary, I hold to be great guns". In the 1870's, he published his theory on electromagnetic waves which was confirmed experimentally by Heinrich Hertz ten years later. Nikola Tesla's work on AC for power and light applications included high frequency alternators and already in the early 1890's he foresaw transatlantic wireless telegraphy employing continuous waves (CW). In May 1895, Alexander Popov demonstrated a receiver to predict arriving thunderstorms. It is rumoured and may well be true that he also had sent wireless signals to ships, a fact then concealed by the Imperial Russian Navy. In September 1895, Guglielmo Marconi, made his first experiments. Being an engineer and entrepreneur, he was the first person to understand that these waves could be used for wireless communication. He became regarded by everybody, including Popov, as the father of radio.

In the beginning, signals were generated by electric sparks. At the turn of the century, CW became possible with the Poulsen electric arc converter and the Goldschmidt, Arco-Slaby, Béthenod-Latour and Alexanderson types of rotary machinery. In the 1920's, transmitting tubes had arrived and the famous Rugby station used these from its start in 1925.

3 Ernst F. W. Alexanderson

Ernst Fredrik Werner Alexanderson (1878-1975) was born in Uppsala, Sweden, graduated at the Royal Technical Institute (KTH) in Stockholm in 1900 and then spent some time at the Technical University in Berlin-Charlottenburg where he got a good basic knowledge of "radio". His future was decided very early by his reading Charles P. Steinmetz's book on the "Theory and Calculation of Alternating Current Phenomena."

Alexanderson went to the United States in 1901 and after a while he paid a visit to Steinmetz at General Electric (GE) who recommended him for a job at GE in Schenectady, New York. There he stayed for the rest of his long and creative life working with practically everything in electricity from AC and DC to television and transistors.

In 1919 he received the Medal of Honor from IRE (Institute of Radio Engineers, 1921 serving as its president) and in 1944 the Edison Medal from AIEE (American Institute of Electrical Engineers); they merged in 1963 to become IEEE.

Alexanderson was elected a member of the Royal Swedish Academy of Engineering Sciences in 1924 and of the Royal Swedish Academy of Sciences in 1934. He was awarded decorations, honorary doctorates and, at 94, his 345th patent.



Figure 2: Alexanderson in his youth at GE. (Telemuseum)

4 The alternator and multiple tuned antenna

Just after the turn of the century, Alexanderson began to design HF alternators based on the idea of Reginald A. Fessenden who used one for his broadcasting experiments at Christmas Eve 1906 when voice, singing and music bewildered the radio officers of ships along the US east coast

The design of the 200 kW alternators for VLF were ready in 1918. Including the very impressive multiple tuned antenna, they were manufactured by General Electric and sold by the Radio Corporation of America (RCA) around the world. The network included 18 transmitters in continental USA, Hawaii, Wales, Poland and Sweden (2 for SAQ, owned by the Royal Swedish Telegraph Board).

Two alternators with an output power of 200 kW could be used one at a time or in parallel. The rotating disc of the motor-generator was 1.6 m in diameter and the air gap 1 mm. At 2,100 rpm, the rotor peripheral velocity was 180 m/s illustrating the seriousness of the mechanical problems. The towers carried twelve 2,200 m long wires that connected the six vertical antenna elements from the top of each tower. (Technical details are available from SAQ.)

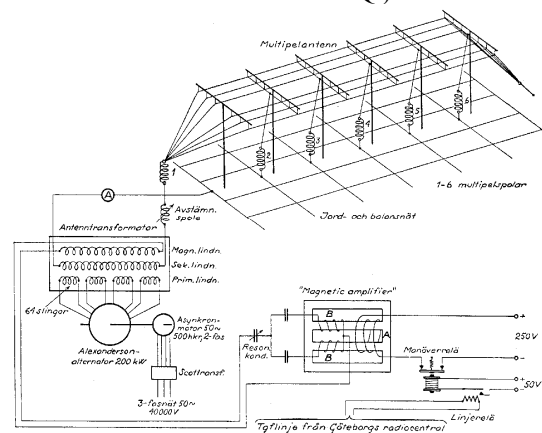


Figure 3: The SAQ circuit diagram from the 1933 Handbook of the Royal Swedish Telegraph Board.

In October 1924, the first message from SAQ, i. e. "Varberg Radio" at Grimeton on the Swedish west coast, was sent to the "Radio Central" of RCA at Rocky Point, Long Island, USA. The wavelength was about 18,000 m, soon changed to a frequency of 17.2 kHz. The commercial service "via RCA" started December 1st, 1924.

The receiving station SAK and its 13 km long antenna was at Kungsbacka between Varberg and Gothenburg. The building remains as a private dwelling-house.

On July 2nd, 1925, the station was inaugurated by King Gustaf V sending a telegram to US president Calvin Coolidge praising the new link to America. He also praised "the democratic shelter under which millions of Swedes had found new homes."

5 Grimeton in danger, but saved

SAQ was in service slightly beyond the Second World War 1939-1945. After that period, the alternator and its antenna system stood a very small chance of surviving because intercontinental communications had been taken over by HF radio. However, the Royal Swedish Navy needed the SAQ VLF alternator and its efficient antenna system to send messages to submerged submarines and, without being aware of our cultural foresight, we remunerated the maintenance costs, predominantly for the painting of the antenna towers. When the author worked with that leasing business, his first SAQ visit in 1951 – at the age of 16 – came to his mind. From that occasion I recall the exotic places displayed at the antenna feed-throughs, but not the two alternators, one of them to be scrapped in 1960.

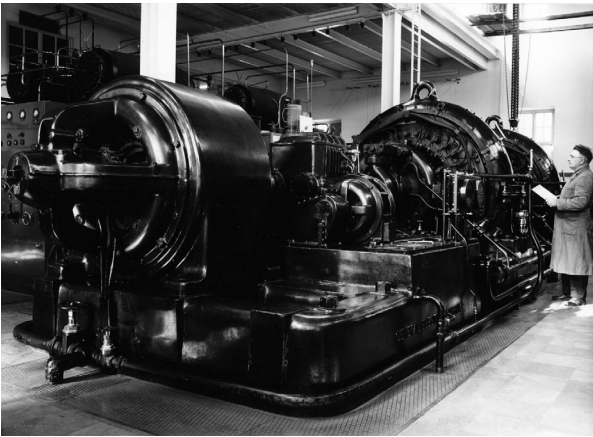


Figure 4: The alternators at SAQ in 1951. (Telemuseum)

The naval interest decreased and in 1995 the Radio Services of Swedish Telecom decided to close SAQ, still very well maintained and in perfect working order. As people prepared themselves to listen to the last transmission, other people started a resistance movement. As our first victory, we succeeded in getting a few months of postponement.

Thus, the "last SAQ transmission" by the one and only remaining Alexanderson alternator could be heard in September 1995 at the IEE London conference "A Hundred Years of Radio" as well as in the United States. Many radio amateurs and professionals were present at the conference and, signals being heard in the auditorium, they took down the live message received by courtesy of BBC.

Luckily, interest to preserve the station and to maintain it in working order increased and after a very short time the situation was totally reversed. The Swedish National Heritage Board, the County of Halland, the town of Varberg and the Radio Services of Swedish Telecom gave generous support, backed by very hard pressure from radio enthusiasts, radio engineers, radio officers and radio amateurs. Living in the outskirts of Stockholm, the author became sort of SAQ ambassador to the Royal Academy of Sciences and similar organisations in the Swedish capital.

Grimeton Radio was listed as a national industrial monument in October 1996. A year later it was honoured as the foremost one of that year and also put on the list of the most important sites of the country. Protected by Swedish law, the station buildings, the alternator and the multiple tuned antenna of Grimeton Radio will for ever be kept in working order. The 2,200 meter long multiple tuned antenna is an eye-catcher from the west coast railway, from the E6 highway and through submarine periscopes in the Kattegat.

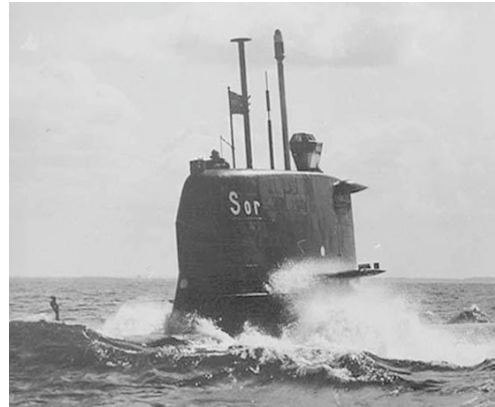


Figure 5: VLF reception antenna ferrites in their radome at the top of the conning tower, aft. (Kockums)

6 Royal support

On the first day of the new millennium, SAQ sent a message from the King of Sweden, H. M. Carl XVI Gustaf, the "etat" keyed by Lars SM6NM (a professional radio officer):

"Seventyfive years ago the first wireless messages were sent from the radio station at Grimeton in Sweden to the United States of America. The new link was supplied with the ultimate in modern radio technology at that time, invented by the Swedish-American Ernst F. W. Alexanderson, USA.

"In that first message from Grimeton seventyfive years ago, my great grandfather King Gustaf V expressed the hope that better communications would strengthen the relations between peoples and nations. To-day the only existing Alexanderson transmitter is again sending a message around the world.

"To-day the unique radio transmitter at Grimeton meets a new millennium. My message to-day is, however, the same as that sent by King Gustaf V seventyfive years ago. With modern technology and means of communication, the possibilities of deepened understanding, peace, democracy and free exchange of opinions between the peoples of the world will increase.

"Finally, I wish A Happy New Year to all of you around the world, who are listening to this transmission!"

The message was reported received by about a hundred listeners in Europe and in the United States, Minnesota being most distant.

September 5, 2001, King Carl XVI Gustaf and Queen Silvia visited Grimeton and sent another "etat" from SAQ to the People of the world, keyed by Carl SM5BF, the author of this paper (not a professional, just an amateur). Sitting there, the royal couple standing, was great. The radiogram read:

"on july 2 1925 my great grandfather inaugurated grimeton radio and on jan 1 2000 saq transmitted my millennium message stop today on our royal tour we send our best wishes from saq = carl gustaf rex silvia regina"

7 The world heritage

Some of us got world heritage in mind already in 1996. After eight years of heavy work, SAQ was put on the Unesco World Heritage List on July 2nd, 2004, exactly 79 years from the station inauguration. Thanks are due for intense efforts by numerous people all over Sweden including the Swedish Government, the Swedish National Heritage Board, the county of Halland, the town of Varberg, the Radio Services of Swedish Telecom and the supporting non-profit society of Alexander. The Unesco declaration is a major achievement for radio people and a manifestation for a nation like Sweden which is reckoned among the foremost countries in IT and radio communications. [2]

The celebrations started only a few hours after the Unesco decision. The Halland County Governor, Mrs. Karin Starrin, spoke to the crowd from a balcony at the main square in Varberg. On the 2004 "Alexander Day" two days later 1,600 people visited the station to see and hear SAQ transmitting the news. The return channels were amateur radio to SA6Q, email and fax – things change with time.

Swedish Telecom has generously donated SAQ to the World Heritage Foundation of Grimeton adding a very substantial amount for further operation and maintenance. Thanks are due also to the Royal Swedish Navy which earlier put in a lot of money.

The station is in almost mint condition and the towers have recently been completely repainted (1 M€ each).



Figure 6: The well maintained station building is ready for you. (Bengt A. Lundberg, Swedish National Heritage Board)

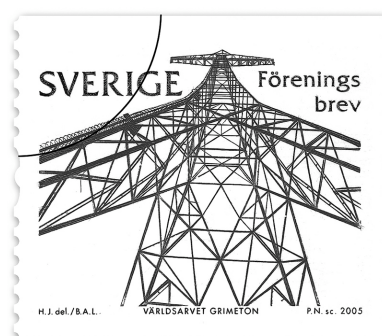


Figure 7: The Grimeton stamp, issued 2005. (Posten AB)

8 How to get there

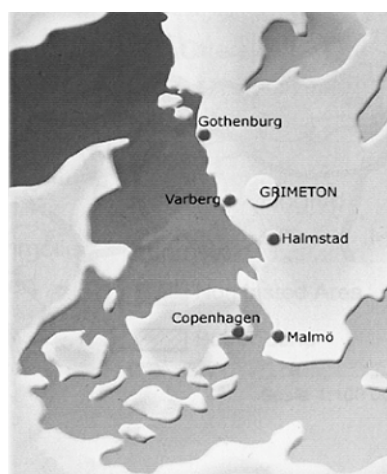


Figure 8: SAQ is very easy to find and reach. (Map: Willy Lindström, Tecknargården, Halmstad)

The visitors' centre opened on July 2nd 2005, exactly 80 years from the SAQ inauguration. It will contain activities to stimulate young people to show interest in natural science and technology. Later, an "Alex's lab" might be created in an additional building. The SAQ website will tell you how and when to go there.



Figure 9: The new visitors' centre (Elsa Dagås)

9 SAQ on air – a tribute to "Alex"

SAQ will go on air once a year on Alexander Day in late June or early July. The cooling water fountains, the clicking relays, the liquid variable resistors and the rumbling 50 ton alternator will recall the atmosphere of the 1920's – please pay tribute to "Alex, the complete chief engineer:"



Figure 10: Dr. h. c. Ernst F. W. Alexanderson

Ernst Alexanderson was inducted posthumously into the US National Inventors Hall of Fame in 1983. He was very well known in USA, less so in his native country. We hope that also Swedish people will catch up when visiting



Figure 11: The SAQ logotype.

Acknowledgements

I am indebted to books, journals and proceedings and to my friends everywhere for support in writing this article and earlier conference papers on SAQ. Special thanks go to Hans Bergfast and Karl-Gustav Strid SM6FJB for their expertise in preparing the world heritage application.

I also like to mention the support from Gunnar Brodin whom I first met at KTH in the 1950's. He became a professor at his alma mater and found an interest in Alexanderson and his work. He ended his career as Marshal of the Realm, i.e. royal court CEO. Coming out of the wings at the royal visit in 2002, wearing his doctor's hat, he substituted for Ernst Alexanderson and delivered the first speech, quite appropriate for our foremost Alexanderson expert. His sudden appearance amazed his immediate superiors, our king and queen, who had not been told in advance.

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www.lst.n.se (County Administrative Board of Halland)
www.alexander.n.se (Alexander Society)
www.grimetonradio.se (SAQ)



Figure 12: The royal couple overlooking Carl Walde SM5BF keying the royal message. (Hans G Larsson, TeliaSonera)