# KKU52538
# PART ONE: FEASIBILITY GROUNDING GRID,
# PART TWO: RESULTS OF CORROSION AND SOIL ANALYSIS

**Sweco Sverige AB was assigned to perform a feasibility study of measurements of the degradation of the earthing grid after more than 40 years in service.**

**This study is financed by GINO in collaboration with Energiforsk, Ringhals, SvK and OKG.**

# DEGRADATION OF  GROUNDING GRID

**The available site:**

**The assigned site is at Ringhals HV-switchgear area, next to the nuclear plant.**

**The existing 400 kV-switchgear will be taken out of operation and removed.**

**The earthing grid will also be removed.**

**Thereafter new HV-switchgear will be installed at the same site, using a new earthing grid.**

**The project "MYS" at Ringhals is in charge of removal and installation of the HV-switchgear at site. A contractor is hired.**

**There is an opportunity to make measurements of the earthing grid, in the time gap when the existing switchgear is out of operation and before the earthing grid is removed.**

# DEGRADATION OF GROUNDING GRID

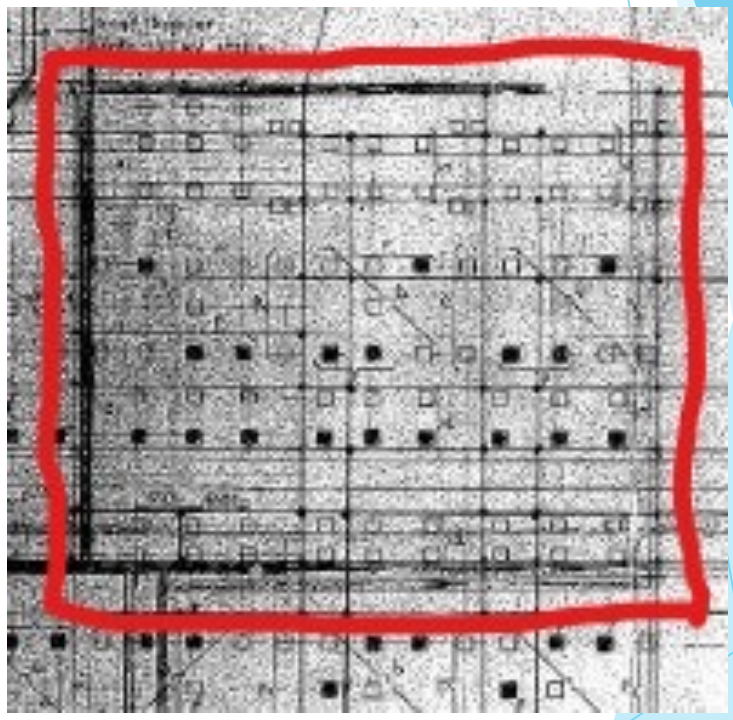
**The available site:**

**40 year-old documentation. Showing grid and foundations.**

**At the site of the switchgear there is a grid of copper 120 mm² in the ground with a square distance of about 5x5 m to 10x15m depending on the location. Within these squares there are smaller squares of cupper 35 mm² .**

**120 mm² copper earth lines from the on-site grid are connected the grounding grid of the Ringhals Power Plant and further on into the water.**

**The part that can be tested is approximately 50 x 50m.**





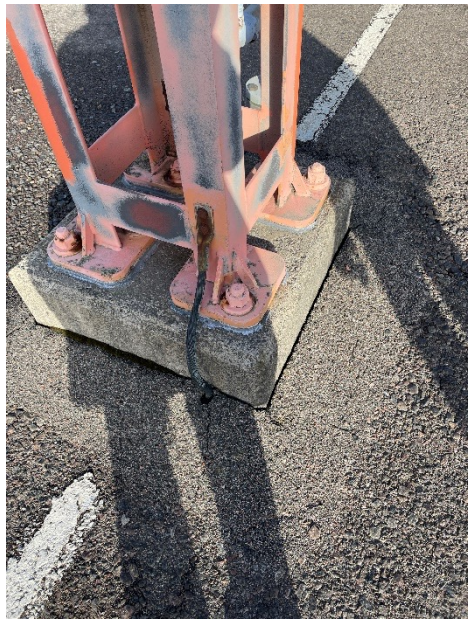
SWECO

# DEGRADATION OF  GROUNDING GRID

**Special considerations:**

**The site is covered by asphalt. In other places gravel is more common.**

**There is a special process of cleaning the isolators of the site by using large amount of fresh water.**





SWECO

# DEGRADATION OF GROUNDING GRID

**What is possible to do regarding:**

**Ongoing projects: The project "MYS" at Ringhals is in charge of removal and installation of the HV-switchgear at site. A contractor is hired. Not possible with delay of time-schedule. Grounding grid-project has to adapt.**

**Time-gap: Short period, a couple of days, in September (first estimate June or July)**

**Technology methods: No perfect method to study the grounding grid from the surface. No time for development.**

**Possibly Ground Penetrating Radar, but mainly as a test of the method. Probably not detailed enough for the purposes of the project.**

**Possible to dig up earthing grid. Send for corrosion analysis.**

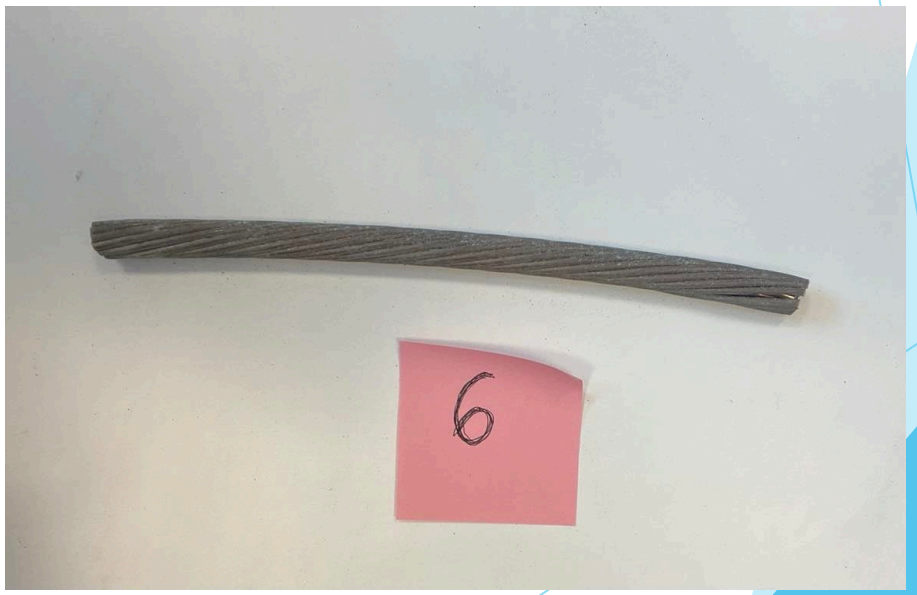
**Possible to take soil samples and analyze for Cu-content.**

# DEGRADATION OF GROUNDING GRID

**Due to limited time gap, we decided to dig up parts of the earthing grid for corrosion analysis and to take soil samples to analyze for Cu-content.**

**Parts of earthing grid. Send to RISE for corrosion analysis**

**Soil samples. Send to a laboratory for analysis (Eurofins Sweden AB)**




SWECO

# DEGRADATION OF GROUNDING GRID

**Chosing a variation of samples:**

**10 samples of earthing grid**

**24 samples of soil in 12 different locations (10 next to earthing grid and 1 m below= 20 ) and 2x2 reference samples. At a 3 m distance to the earthing grid**

**12 samples were sent for analysis.**

| Sample | Kind of sample | Coordinates | Comments |
|---|---|---|---|
| 1 | Earthing and soil | N: 6350202,927<br>E: 326221,762 | |
| 2 | Earthing and soil | N: 6350178,312<br>E: 326203,659 | T-shaped part. Connecting two earth lines. |
| 3 | Soil | Coordinates missing | Might be close to a 130kV cable in the ground. The cable is out of operation nowadays. |
| 4 | Earthing and soil | N: 6350210,39<br>E: 326185,10 | |
| 5 | Earthing and soil | N: 6350201,742<br>E: 326204,284 | |
| 6 | Earthing and soil | N: 6350214,182<br>E: 326208,079 | |
| 7 | Earthing and soil | N: 6350230,573<br>E: 326214,73 | Close to surface |
| 8 | Earthing and soil | N: 6350192,178<br>E: 326234,681 | Close to surface |
| 9 | Soil | N: 6350188,235<br>E: 326234,723 | |
| 10 | Earthing and soil | N: 6350174,11<br>E: 326171,971 | The other side of the “road”.<br>Earthing of a foundation that has a larger diameter the earthing grid. |
| 11 | Earthing and soil | N: 63501173, 722<br>E: 326170, 401 | The other side of the “road”.<br>T-shaped sample where an earthing of a foundation (larger diameter) is connected to the earthing grid. From the same location as sample 10. |
| 12 | Earthing and soil | N: 6350189,845<br>E: 326158,945 | The other side of the “road”.<br>T-shaped sample where an earthing of a foundation (larger diameter) is connected to the earthing grid. |



SWECO

# DEGRADATION OF GROUNDING GRID

**Result corrosion analysis**

**The most relevant evaluation in our case is the local corrosion by evaluating the deepest pits of the samples.**

**The level of local corrosion of all analyzed samples is very low. It corresponds to the corrosion expected and in some cases it is even lower.**

**The clamps of the T-shaped samples (2, 11,12) have a higher rate of local corrosion of up to 22,5 micrometers per year, corresponding to at total of 0,9 mm in 40 years. The clamps are manufactured using other methods than the cables. The alloy used for the clamps may also be different. Mechanical damage during installation might have affected the clamps.**

**The cables are less affected than the clamps. The outer parts are a bit more affected than the inner parts. The outer parts correspond to a corrosion rate of up to 3,5 micrometer per year. The corrosion of the inner parts is negligible.**

# DEGRADATION OF GROUNDING GRID

**Result soil analysis**

**The soil was mainly a coarse gray gravel material mixed with sandy gravel 0-0,5m deep and a lighter sand beneath.**

**12 samples were sent for analysis. 7 samples show an elevated level of copper. 2 of these show a more elevated level. These two samples were taken next to the earthing grid at a depth of 0,3-0,4m. The two reference samples taken at a 3 m distance to the grounding grid do not show elevated levels of copper.**

**The elevated levels of copper could be due to corrosion of the earthing grid.**

# DEGRADATION OF GROUNDING GRID

## Conclusion

**The samples of the earthing grid were not particularly affected by corrosion. The copper content in the samples of soil does not contradict low level of corrosion.**

**The conclusion is that the samples would have lasted another 40-year-period (or more) in the ground during similar conditions without being severely corroded.**