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Approved by EKOenergy's Board – Approval valid starting on 23.10.2018

Embretsfoss

Renewal of the approval of the Embretsfoss hydropower plant for the sales of EKOenergy

The Norwegian Embretsfoss power plant has been used for the sales of EKOenergy since the start of the EKOenergy-ecolabel. It was one of the first power plant to be approved for the sales of EKOenergy, on 10 May 2013. Approvals of hydropower plants are valid for 5 years, this means that the Embretsfoss power plant expired on 11 May 2018. The owners and their representative collected all needed documents for the re-approval during the summer.

The hydropower plant : information

Name: *Embretsfoss, consisting of two separate units Embretsfoss 3 (E3) and Embretsfoss 4 (E4).*

Owners: *50% Glitre Energi Kraftproduksjon A/S, 50% E-CO Energi A/S*

Year of construction: *1954 (E3) and 2013 (E4)*

Installed capacity: *18.5 MW (E3) and 50 MW (E4)*

Annual electricity production (on average): *354 GWh*

Fall height: *16.3 meters*

Turbine type: *Kaplan turbines*

General background

Embretsfoss power plant is a hydropower plant on the Drammenselva river, at Åmot in Modum municipality in Buskerud county, Norway. The power plant was put into operation in 1916, utilizing a fall of 16.3 meters. The hydropower plant is a run-of-the-river power plant without a reservoir.

The hydropower production operation in this location started in 1916 with the opening of the original power plant (Embretsfoss 1). Embretsfoss 2 was put into operation in 1921.

The original power plant was demolished in 1954. Nowadays there are two separate operational units

Embretsfoss 3 was put into operation in 1954. It has a Kaplan turbine of 18MW, which now operates only for exploiting flood peaks.

Embretsfoss 4 construction started in 2009 and was put into operation in 2013. It has one of Norway's largest capillary turbines of almost 7 meters in diameter. The power is 51.3 MW.

Total annual production of Embretsfoss 3 and 4 combined is now 335 GWh.

Drammenselva river

Drammenselva's total length is 308 kilometres making it the fifth longest river in Norway. It has a catchment area of about 17,000 square kilometres.

On its way to the sea, Drammenselva passes a series of rapids and waterfalls. The largest are Vikerfoss, Geithusfoss, Kattfoss, Gravfoss, Embretsfoss, Døvikfoss and Hellefoss. There are a number of power plants on the Drammen River several with dams.

Historically, the river has been used for wood rafting and along the river there was industrial development, such as paper industry. Today Drammenselva is used for recreational purposes, and is known for its excellent salmon fishing.

(Source: <https://en.wikipedia.org/wiki/Drammenselva>)

Fish and Gyrodactylus salaris parasite

The Drammenselva is a good salmon river and salmon can migrate up the river until the Døvikfoss Kraftstasjon (a power plant downstream of Embretsfoss). That downstream part is amongst the 8 best salmon rivers of Norway. The river is well researched, by many institus and entities.

Unfortunately the river is infected with the *Gyrodactylus salaris* - parasite, commonly known as salmon fluke. The atlantic Salmon populations are not resistant to this parasite. Catastrophic losses of Atlantic salmon occurred in Norway in the 1970s following the introduction of *G. salaris*. By 2001, the salmon populations of 41 Norwegian rivers had been virtually wiped out in this way. (See also https://en.wikipedia.org/wiki/Gyrodactylus_salaris)

"Today, the whole Drammenselva up to Embretsfoss is considered infected with the salmon parasite. Some side tributaries that are downstream of Embretsfoss are not considered to be infected due to high waterfalls where salmon or other fish with can not climb for most of the year. As part of measures against G. salaris in Drammenselva's bassin, a committee was appointed in 1988 by the county governor in Buskerud with representatives from the fishing interests, the authorities, research and regulatory. (...) Instead of letting the salmon fish die out, fry / smolt are being planted to compensate for expected mortality, as well as preserve the local salmon strain. Thanks to these measures, Drammenselva today has maintained a positive development of salmon population despite the disease. Although the river is infected with Gyrodactylus salaris, there are a considerable number of salmon that survive until smoltification and emigration to the sea.

(Copied from: Enkel bestandskartlegging med elfiskebåt av fiskebestanden nedstrøms Hellefoss i Drammenselva 2015, NaturPartner, Rapport NP 1-2016,

<http://www.naturpartner.com/images/rapporter/NP1-2016%20Enkel%20bestandskartlegging%20med%20elfiskebaat%20i%202015%20av%20fiskebestandene%20nedstroms%20Hellefoss%20i%20Drammenselva.pdf>

Migration over the dam

- There is a fish hatch in the dam. This is built for downstream migrating anadromous fish, primarily salmon smolt.
- The power plant has an eel pass and a collecting bassin. The latter was thought to collect eels and "clean" them with salt water before the eel was released on the waterway. However, the eel pas has been closed under the regulations from the local environmental agency.
- the construction of a salmon staircase at Embretsfoss is planned and land has been allocated for it. The staircase will be built when a solution to the Gyrosmitte problem is present.

Mitigating measures

Are there other measures identified to minimise the impact of this power plant? Yes

- Together with the building of the Embretsfoss 4, the heavily polluted surroundings have been cleaned up. Large amounts of contaminated masses have been transported and deposited in a proper manner. The area has become a green open-air area.
- The power plant operator has a cooperation with the fishing associations in the area, and they contribute annually to the work of these fishing associations, in addition to the one-off payment they made when Embretsfoss 4 was built. The annual payment includes the cultivation and planting of fry.
- In connection with the construction of Embretsfoss, an artificial spawning area was made parallel to the river run to facilitate the trout finding reproduction areas. This spawning area gets a lot of water during the spawning season and more "normal" amounts of water otherwise.

Conclusion - Decision

The Drammenselva is a natural river with a salmon population. The salmon population is affected by Gyrodactylus salaris disease and in agreement with the environmental authorities no migration past the dam is allowed.

EKOenergy's environmental concerns have been taken into account in the construction and the operation of the power plant: the constructon of E3 and E4 has not led to new impoundment, there is a continuous flow, fish migration is taken into account, although in this case this means that the dam is used to block the further spreading of the Gyrodactylus salaris parasite.

There is presence of natural reproduction areas, both downstream and upstream.

The river is actively studied by researchers from many institutes and agencies and the power plant operator contribute to this work.

The power plant can be used for the sales of EKOenergy. This decision is valid until 22 October 2023

References

<https://www.nve.no/energiforsyning-og-konsesjon/vannkraft/vannkraftdatabase/vannkraftverk/?id=76>

<https://www.nve.no/kdb/sc729.pdf> (copy of the permit, in Norwegian)

https://no.wikipedia.org/wiki/Embretsfoss_kraftverk (general overview of the power plant, in Norwegian)

Nye Embretsfoss kraftverk - Virkning på ørretbestand og forslag til tiltak, Åge Brabrand, Jan Heggnes, Jostein Sageie og Arne Robert Svendsen

<https://www.nhm.uio.no/forskning/publikasjoner/lfi-rapporter/196.pdf>

Also interesting: Modum-prosjektet: Undersøkelse av fisk, bunndyr og driv i snarumselva og drammenselva, Buskerud Fylke, i forbindelse med endret regulering.

Lars Saeter, Åge Brabrand & Zofia Dzikowska <https://www.nhm.uio.no/forskning/publikasjoner/lfi-rapporter/103.pdf>

Annexes

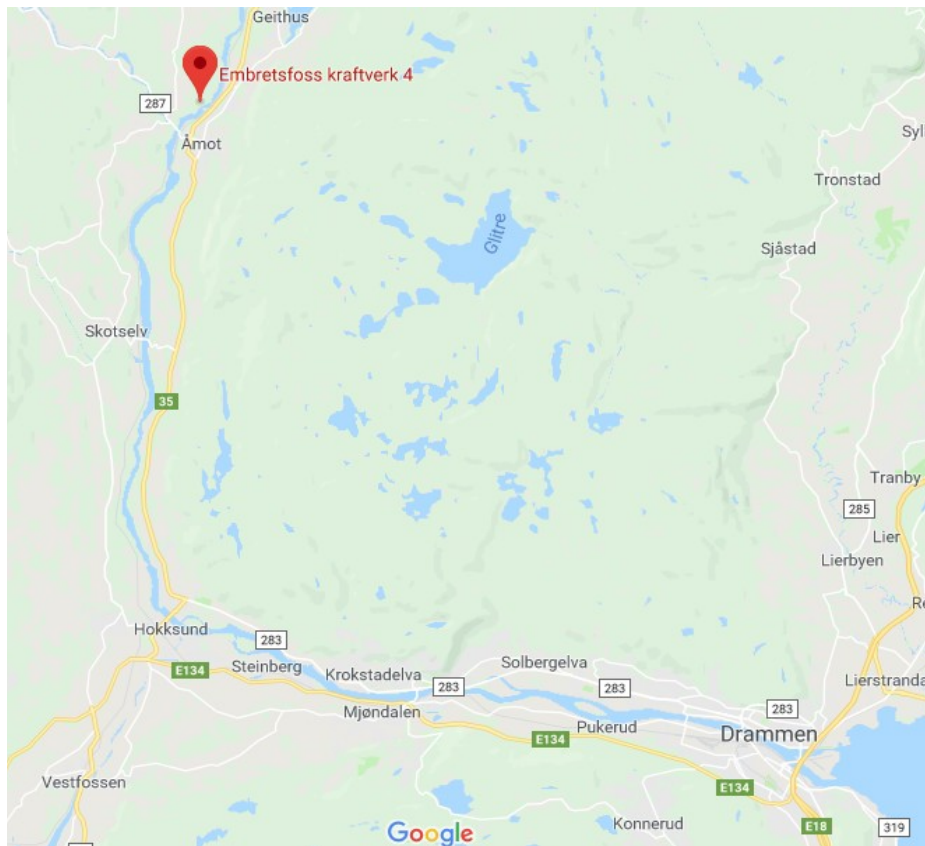


Figure1. Embretsfoss location'

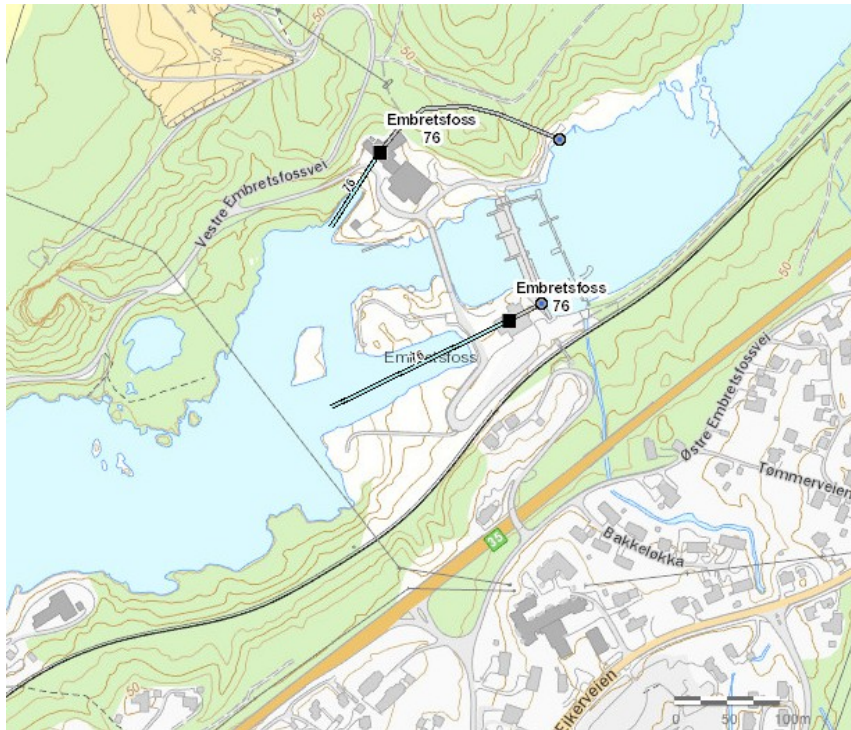


Figure 2. Embretsfoss units E4(north) and E3(south) with their respective tunnels, inflow and outflow. Taken from <https://temakart.nve.no>

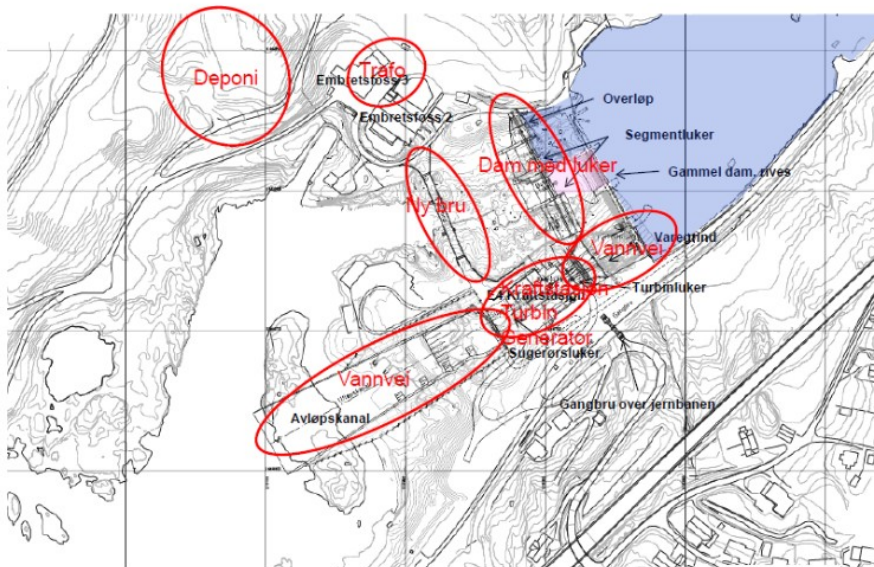


Figure 2: Detailed overview of the power plant area. (source: Life Cycle Data for Hydroelectric Generation at Embretsfoss 4 (E4) Power Station Background Data for Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD), <https://www.ostfoldforskning.no/media/1157/0313.pdf>)