THE NORNED CABLE: CONNECTING TWO ELECTRICITY REGULATORY SYSTEMS

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Abstract

Norway and the Netherlands have been engaged in the construction of several interconnectors in Northern Europe and are at the forefront of a new era to develop a North Sea offshore grid. NorNed as the first of these projects, was an important 'test case' from a technical as well as a legal perspective. Even after two decades there is still much to be learned from the history of NorNed and its ongoing operations. NorNed was the first regulated interconnector to be realized in Europe, and the regulatory challenges were considerable. The solutions adopted to address these challenges remain of value today to ensure that cross border network development does not get left behind in the energy transition.

1 Introduction

Since 1988, the European Energy Law Seminar has been organized by the Dutch Energy Law Association (NeVER), in cooperation with the University of Groningen's Centre of Energy Law and Sustainability and the University of Oslo's Scandinavian Institute of Maritime Law. Martha Roggenkamp was instrumental in establishing and organizing the seminar over all these years. At the time Martha worked at the Institute for International and

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European Energy Law in Leiden. Martha had the brilliant idea to foster a co-operation between Dutch and Norwegian energy lawyers. As her colleague at the time in Leiden, Leigh Hancher was privileged to join in the fun.

It was in the first years of this seminar that Astrid Brunt learned to know Martha, and indeed it was at these seminars that the two authors of this contribution first met. The friendships have endured over all these years. Martha was always present with a warm welcome for the participants arriving at Huis Ter Duin in Noordwijk aan Zee, and later in Den Haag. The seminar also provided the first meeting place for some of the lawyers and experts who came to be involved in the realization of the NorNed cable. This short chapter analyses some of the many legal challenges faced in that complex process.

2 NorNed as a regulated interconnector

The focus of this chapter is primarily on the regulatory challenges involved in realizing a cross-border project. NorNed is a so-called 'regulated interconnector': it is subject to the respective national electricity market regulatory frameworks of both the Netherlands and Norway. In contrast, many interconnectors in the EU have been realized under a temporary or partial exemption from some of the principal rules on which these regulatory regimes are based. However, at the time the NorNed cable project was launched, this regulatory framework was not yet fully developed at national and European level. Some basic rules as well as an exemption from the 'regulated interconnector' model was first introduced at European level in 2003.[2] With the reforms introduced by the Treaty of Lisbon, the interconnection of energy networks is now an objective enshrined in Article 194(1) TFEU, and the realisation of this objective has subsequently spawned a dense and highly technical web of regulation.

The NorNed's original technical feasibility study was concluded in 1992.[3] The construction contracts were awarded in 2000[4], but the liberalization and restructuring of the national power sectors in both Norway and the Netherlands led to renegotiations and inevitably, delays. The cable was finally completed on 6 May 2008. When the EU adopted its third energy market package in 2009, the NorNed interconnector was an important facilitator for European day-ahead and intraday electricity market integration.

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2 Regulation 1228/2003 of the European Parliament and of the Council of June 26, 2003, on conditions for access to the network for cross- border exchanges in electricity, Official Journal of the European Union, 2003, L 176/1.

3 Skog, J.E., van Asten, H., Worzyk, T., Andersrød, T., Norned – World's longest power cable, CIGRÉ session, Paris, 2010, paper reference B1-106.

4 Hitacci, ABB power grids references, https://www.hitachienergy.com/fr/fr/references/hvdc/norned

The project was awarded TEN-E status generating 5 M€ TEN-E financial support to be allocated for electrode design and evaluation of reliability and availability, including submarine cable tests. The project was also one of the few to receive extra TEN-E funding (4,215 M€) for the construction costs of the cable.[5]

3 NorNed as a showcase of sustainability and liquidity

NorNed is a 580 km HVDC (High Voltage Direct Current) interconnection between Feda in Norway and Eemshaven in the Netherlands. When it was put into operation on 6 May 2008, it was the longest interconnector in the world, and the first link between the Nordic and continental (Dutch) power systems open to the power market. NorNed consists of two distinct parts, namely the ACDC converter stations at both ends of the route and the cable system. It is a mass-impregnated, non-draining, paper-insulated HVDC cable, with three different cable designs: one for the onshore Dutch costal line to the converter station, another for the shallow waters near the Dutch coastal line, and a third design for the deep waters. The Dutch land fall for the cable was given special attention. The cable had to cross the outer dike which is part of a vital floodwater protection system. The authorities posed very stringent requirements on the reinstatement of the dike after installation. The most problematic part was the trenching of the first 40 km of two-core cable across the protected Wadden Sea.[6]

The advantages of connecting electric power systems have been apparent from the early days of electric systems: in 1906 the International Electrotechnical Committee was established to standardize electric facilities.[7] By interconnecting different systems, the reliability of both systems is improved, as they can support each other in emergency situations. Reserves can be reduced as they can draw on each other's reserve capacities. When the generation mix differs between the systems, and the timing of peak demand varies, interconnections allow producers to meet demand in the most efficient way. Norway is the 'green battery' of Europe: 90% of Norwegian electricity production is hydropower. In 2021 installed capacity was 33 000 MW producing around 136 TWh per year.[8]

5 European Commission (2004), Brochure Trans-European Energy Networks: TEN-E Priority projects, available at: http://europa.eu.int/comm/energy.

6 See Skog J.E. et al., n.3.

7 Ignacio J.Perez-Arriaga; Regulation of the Power Sector, Springer 2013 ISSN 1612-1287.

8 Official homepage on electricity facts about Norway; https://energifaktanorge.no/en/

The Norwegian hydropower system has a high storage capacity which makes 75% of the production capacity flexible: production can rapidly be increased or decreased at low cost. Water inflow and installed capacity determine how much hydropower the Norwegian system can produce. In the period 1990-2019, annual inflow varied by about 65TWh. In very dry years the Norwegian system will benefit from imports. This was the case already in the winters of 2009/2010 and 2010/2011, so that NorNed provided for security of supply in Norway. NorNed has provided the Dutch system – based on conventional thermal power, wind and solar – with peak production and flexibility. As a result, Dutch fossil-run power plants could run more efficiently since the interconnector became operational. NorNed was expected to reduce Dutch carbon dioxide emissions with almost 1.7 tons a year. Such a reduction was worth EUR 49 million a year in savings according to the EU Emission Trading Scheme.[9]

Additionally, NorNed has contributed to linking and enhancing liquidity in both the Dutch and the Norwegian wholesale markets. The Brattle Group predicted that an annual trade revenue of EUR 55 million to EUR 65 million was realistic if the cable was fully utilized with a capacity of 600 MW.[10] Annual revenues were estimated at EUR 64 million[11], and indeed already after only two months of operation NorNed generated revenues of approximately EUR 50 million for its two current owners: Statnett and TenneT.

4 Drivers for the NorNed interconnector

In 1988, a Norwegian report suggested the Norwegian power balance to show a surplus of 9TWh by 1990.[12] In the late eighties, the power producer Statkraft had the exclusive right to import and export electricity in Norway, but the surplus from export had to be shared with other producers who had a production surplus. Instead of planning a gradual transition to market-based solutions, Norway reorganized the market in one step so that it was open to all customers from the start.

In 1991 the Norwegian Electricity Act entered into force, and Norway had a fully liberalized electricity market as one of the first countries in the world. The Norwegian

9 Nordic Investment Bank (NIB) press release 1 October 2007 https://www.nib.int/cases/new-subsea-link-a-sustainability-showcase.

10 Dte Decision on the application by TenneT for permission to finance the NorNed cable in accordance with section 31 (6) of the Electricity Act of 1998, number 01783_2-76.

11 TenneT press release 9 July 2008 https://web.archive.org/web/20080828080208/http://www.tennet.org/english/tennet/news/veelbelovende_start_voor_nornedkabel.aspx

12 Energidata 1988 'Kraftpriser, kraftmarked og kraftbalanse'.

legislation is based on the principle that electricity production and trading should be market-based, while grid operations are unbundled and strictly regulated. The power market ensures effective use of resources and reasonable prices for electricity, whereas electricity transmission remains a natural monopoly. This model is compliant with the market design later developed under the EU's consecutive energy market packages.

Under the Norwegian Electricity Act, import and export was conditional on a license from the Ministry of petroleum and energy, whereas Statnett was given the task to develop, operate and own all interconnectors. In the early days of the liberalized Norwegian power market there was great interest to connect the Norwegian power system with EU member states. Nevertheless, the absence of a clear regulatory framework in Europe prior to the adoption of the second package of liberalization measures in 2003 did not facilitate the fruition of many interconnector projects.

At the time, wholesale trade in Europe was mainly bilateral or 'over the counter'. In some countries there was also the possibility to trade in auctions organised by power exchanges one day before delivery. Without liquid wholesale markets, new entrants have to turn to competing generators on an individual basis when plants go offline or are still being built. Wholesale market opening increases the availability of a sufficient number of adequate counterparties at the right point in time, at the quantity desired and at predictable prices. To stimulate cross-border exchanges, specific transmission charges associated with exchanging electricity across most of the internal borders of the EU were removed, following the adoption of Regulation 1228/2003. However, there was no common set of rules governing how interconnection capacity was to be made available to the wholesale market, with a variety of explicit or implicit auctions being used at the time across Europe.[13]

There were many initiatives to realize interconnectors from the Norwegian side. The first interconnector to be built under the Norwegian liberalized regime was a 500MW interconnector to Jutland in Denmark, operational since 1993 (Skagerrak3). The company EuroKraft Norge AS consisting of 22 power producers and about 30% of the Norwegian production capacity entered a joint venture with Hamburgerische Elektrisitätswerke AG and applied for an import and export license, but in 1993 the Norwegian license was rejected. In 1995 a new license application was filed, and this time the German company RWE was included in the joint venture. The plan was to build a 600MW HVDC link between Norway and Germany to be operational by 2003. The project was never realized as the German parties terminated the agreement in 1999. Statkraft obtained a

13 European Commission (2004), Study by Frontier economics and Consentec, commissioned by DGTREN, Analysis of cross-border congestion management methods for the EU internal electricity market, Final report, available at: http://europa.eu.int/comm/energy.

Norwegian license in 1993 for a power exchange agreement with Preussen Elektra (later E.ON), establishing the company Viking Cable AS with a view to realizing a 600MW interconnector between Norway and Germany, but E.ON terminated that agreement in 2001.[14] In the meantime, in 2001, the European Commission had issued a comfort letter to the parties.[15] The power exchange agreement ensured investment in the project and to secure the viability of the investment in transmission capacity via the new cable, the notifying parties had submitted (a) that it was necessary to have a long-term arrangement over the same lifespan as a normal power plant, i.e. approximately 25 years, and (b) that full transmission capacity on the Viking Cable had to be available to the investors on demand so that it was not possible to make transmission capacity available to third parties, (i.e., no TPA).

An application for a new link between the two countries -NordLink- was submitted to the Norwegian authorities in 2010, and by 31 March 2021 a 623 km interconnector with a capacity of 1400MW was in operation between Norway and Germany. The owners of the project are KfW, Tennet and Statnett.[16]

Meeus et al. contend that there was clearly a socio-economic benefit of the NorNed project for market parties because the social cost of congestion remains high in Europe.[17] However, it is almost impossible to quantify this benefit. In their view this might explain why TenneT's application for national regulatory approval looked more like a commercial application for a merchant cable instead of an application for a regulated cable to facilitate the market.

5 NorNed's many regulatory challenges

In 1994 the Company Norsk Krafteksport obtained a Norwegian import and export license for a power exchange agreement with its Dutch counterpart, N.V. Samenwerkende electriciteitsproductiebedrijven (Sep). Sep was entrusted with exclusive rights to import of electricity at that time. The Dutch – transmission networks including cables were also owned and managed by Sep. Norsk Krafteksport was a consortium consisting of eight Norwegian power producers including Statkraft. The power exchange contract was concluded between Norsk Krafteksport and Sep, as the producers of electricity, and

14 Statkraft was compensated with 1/3 of the shares in the Baltic Cable between Sweden and Germany and an additional settlement of NOK 1725 million.

15 Notice pursuant to Article 19(3) of Council Regulation No 17 concerning case COMP/E-3/37.921 — Viking Cable (Text with EEA relevance) Official Journal C 247, 05/09/2001 P. 0011 – 0012.

16 Statnett information on NordLink https://www.statnett.no/en/search/?q=NordLink

17 Meeus et al., January 2004, NorNed submarine HVDC cable, KULeuven Electrical Engineering.

the NorNed interconnector agreement for its transportation was between Sep and Statnett.

This project was cancelled in 2004. The Dutch Electricity Act was amended to implement the second package of European internal energy market rules (2003) and introduced further changes to the organization of the Dutch electricity market. The NorNed interconnector project was now taken over by the newly formed Dutch TSO TenneT and the Norwegian TSO Statnett. This transfer included licenses, surveys, studies, and procurement contracts. When Tennet and Statnett – the two national TSOs – took over the project, the lack of symmetry between the Dutch and Norwegian side was removed, and the parties could design a balanced project structure on the basis of a 50/50 joint venture. The parties could also step into beneficial procurement contracts for a HVDC cable system with very low transmission losses and solid state-of-the-art converter stations provided by ABB for NorNed. However, the physical agreed border point, where Statnett owns the northern part of the interconnector and Tennet owns the southern part, was maintained in the revised contractual structure between the parties. Dutch regulation thus stops at the border point and here Norwegian regulation begins.

5.1 Environmental issues and a changed cable design

Local acceptance and regulatory environmental licenses and concessions are always a challenge for energy infrastructure projects, especially novel ones with a cross-border dimension. For NorNed a substantial number of governmental and other national public approvals, permits, authorizations and licenses were required in each jurisdiction, including license requirements for the planning, building, and construction of the interconnector, many of which had to address related issues such as fishing rights, defense issues, as well as water pollution, nature conservation, and cultural heritage concerns. When NorNed feasibility studies were initially concluded in 1992, the cost estimate and business case was based on a cable design with one conductor and sea electrodes (a so-called monopole scheme), based on the same concept already in use in the Skagerrak, Fennoskan and Kontek HVDC interconnectors.

However, the 580 km NorNed cable was planned to cross the territories of the Netherlands, Germany, Denmark, and Norway. It also had to cross the Dutch Wadden Sea nature reserve, a Unesco World Heritage site. Regulatory approvals were necessary in all jurisdictions crossed by the cable, and in the early phase of the project public consultations revealed strong concerns related to environmental issues, specifically related to the electrolytic process at the electrodes and magnetic field caused by the current in the cable. Thus, the initial monopolar cable concept was abandoned. The cable solution developed in due course for NorNed was a new bipolar concept, a design of two com-

plete single-core cables having common armoring. This concept has very low magnetic fields due to the cancelling effect of identical and opposite currents.

5.2 Regulatory and procurement challenges

The challenges to deliver the NorNed project were considerable both from a technical, market and a regulatory perspective. On the one hand, forecast prices from (Norwegian) electricity suppliers had to be low enough to make a robust business case, and on the other hand the revenue flow had to be sufficient to finance and guarantee a technical design that would meet all reliability, capacity, environmental and safety standards. Adverse experience in the Netherlands with massive cost overruns on major infrastructure projects[18] meant that the project would need to have a firm investment limit on the total costs for completing the planning, engineering, construction, manufacturing, installation, testing and, finally, its commissioning in order for it to be approved by the Dutch regulator – the DTe (Dienst uitvoering en Toezicht energie).

NorNed is designed with two fully insulated 700 MW (2x 580km) DC cables, a design which minimizes cable losses. This is also a design which reduces total cable costs. The project was eventually set up with 80% lump sum contracts. As noted above, the two converter stations and a major part of the cable system was produced by ABB, and ABB submitted an opinion on the risk of cost overrun to the regulators.[19] Transmission companies typically operate at national level, whereas the main cable suppliers to the industry are few and are global in their reach. In 2014, the EU Commission imposed fines totaling EUR 301 639 000[20] on 11 producers of underground and submarine high voltage power cables. For nearly ten years from 1999 on an almost worldwide scale, these suppliers had shared markets and allocated customers between themselves. One could therefore argue that the close scrutiny imposed by the regulators, and the challenging and lengthy processes to realize the NorNed project, supported by a large number of external studies[21], contributed to a competitive procurement for the cable.

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18 Delays and cost overruns are a typical challenge for major infrastructure projects. This is documented by Mace who in a study in 2019 documented that approximately 80% of large infrastructure projects globally experience cost overruns.

19 ABB (2004), Memorandum HVDC transmission project experiences.

20 European Commission press release 2 April 2014 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0917(01)&from=EN

21 DTE decision 31 August 2004, with references to Brattle Group (2004), McKinsey & Company (2004), SKM Energy Consulting (2004), Scandpower (2004), ILEX Energy Consulting (2004) and Tabors Caraminis & associates (2004).

6 The terms of regulatory approval of NorNed in the Netherlands and Norway

Interconnector investments are recognised as highly risky and complex ventures for several reasons. First, in fully liberalised electricity markets, grid and generation investments are decoupled due to the separation of transmission from production and supply ('unbundling'). There is uncertainty on the actual use of the infrastructure; in the worst case, an interconnector can become a stranded asset. Second, cross-border projects are subject to high regulatory uncertainty over time. Changing regulatory frameworks, the introduction of new congestion management mechanisms or the review of regulated tariffs might impact significantly on the return on investment. Third, investors also face uncertainty concerning possibly changing market architectures and energy mixes of the interconnected markets as well as volatile fuel and carbon prices. Finally, potential interconnector investors are further discouraged by the existence of a regulatory gap if there is no single competent authority that decides on cross-border and regional issues. Investors thus face an important risk of project failure when the competent National Regulatory Authorities (NRAs) at each end of the interconnector are unable to agree on key regulatory provisions for a cross-border project, especially if there is no supranational authority to settle the conflict.[22]

TenneT had based its application for approval of its participation in the project on section 31(6) of the then current Electricity Act. Hence TenneT may utilize the proceeds of the auction of transmission capacity on the cross-border grids to eliminate restrictions on the transmission capacity of these grids or for other purposes, to be determined by the Director of DTe. However, that section 31(1)(a) contained no provisions in relation to the use of the proceeds of auctions, nor in relation to extensions to existing interconnector capacity or in relation to the construction of new interconnection capacity.[23]

The Dutch regulator – then known as DTe – challenged the robustness of the business case for NorNed and required not only internal and external qualitative and quantitative assessments of all the associated risks, but also the adoption of adequate measures to

22 ACER – the European Energy Agency – has only limited powers to adjudicate in case the concerned national regulatory authorities request a decision or they cannot agree within the legally specified deadline.

23 The Minister of Economic Affairs is authorised in accordance with section 6 of the Electricity Act to issue general or special instructions with regard to, for instance, the exercise of the powers assigned to DTe in section 31of the Electricity Act. The Minister of Economic Affairs had not exercised this power.

manage those risks.[24] As it was not possible to quantify the contribution of the NorNed cable to security of supply, the regulator set the net contribution to security of supply at *nil* in his assessment.

In its approval of Tennent's application on 23 December 2004, DTe therefore imposed several requirements and incentives; the capacity on the cable had to be increased to 700MW, the annual maintenance and operational costs were capped, and a minimum 95.62% annual availability was required. Finally, a cap on the Dutch part of the capital costs was set at EUR 318 million. The regulator also included incentives to ensure the timely delivery of the project in his decision approving the project.

Thus, the Dutch scheme incentivises TenneT to maximise the available capacity of the interconnector. The TSO receives a bonus if the target is met and pays a penalty if the target is not met. This bonus (or penalty) is paid from (respectively paid to) the amount of congestion revenues.[25] As a result, not all costs and risks of the interconnector are passed on to network users but remain partially with the owners.

Statnett however included NorNed as a normal interconnector or grid asset in its portfolio. That means that Statnett's cost was part of the capital and operational costs to be included into the tariffs paid by the users in the Norwegian market. The congestion income was and is received by Statnett and is to be used for grid expansion and to cover costs in the rest of Statnett's regulated business. Indeed, NorNed was introduced and financed on Statnett's books in the same way as any other grid investment. The important difference in Norway as opposed to the rest of Europe at that time was that interconnectors generated congestion income but the TSO did not levy connection fees or impose tariffs. The same approach applies to power flow between internal bidding/price zones. In Europe, however, explicit auctions and fees and tariffs for long-term capacity reservations were still the rule.

The ACM, DTe's successor, continues to assess TenneT's adherence to the 2004 decision and to calculate the bonus/malus payments due. In its most recent decision on the year 2020, the ACM has approved TenneT's proposal to set the penalty payment at EUR 1.558.255,-. TenneT is required to add this sum to the revenue earned from auctioning the capacity on the cable.

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24 Netherlands Government Gazette of 23 December 2004, No. 248, page 17; DTe decision on the application by TenneT for permission to finance the NorNed cable in accordance with section 31 (6) of the Electricity Act of 1998 Number: 101783_2-76.

25 See Annex A to decision 101783_2-76 for the conditions imposed If the nominal capacity appears to be lower than 700 MW, TenneT will add an amount of EUR 260,000 per megawatt to the proceeds of the auction. If the nominal capacity appears to be higher than 700 MW, TenneT may withdraw an amount of EUR 260,000 per megawatt from the proceeds of the auction and add this amount to its own funds. This will also give TenneT a positive incentive to ensure that the capacity of the cable is as high as possible, in favour of market parties and grid users.

7 Conclusion

With the development of interconnectors as well as offshore electricity islands, the Netherlands is now also an electricity exporting country. Both Norway and the Netherlands are at the forefront of plans to develop an ambitious North Sea offshore grid. NorNed was an important 'test case' interconnector at a time when European market regulation was still in flux. Many but by no means all aspects of electricity market operations across national borders and across bidding zones are highly regulated on the basis of complex and detailed network codes, guidelines and related terms, conditions and methodologies (TCMs). The purposes for which congestion income can be used by TSOs are now codified in European-wide regulations.

Yet the share of cross-border interconnection across the EU has still not achieved the targets set by the Commission in 2014. Regulatory inventiveness may still be necessary to realise complex multi-jurisdictional projects. Even after two decades there is still much to be learned from the history of NorNed and its ongoing operations, and of course, Martha's annual European Energy Law seminars will continue to offer an ideal forum for sharing this knowledge.