EU-WIDE NETWORK CODES: PROCESS, ROLE OF DSOS AND POSSIBLE IMPACTS

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ABSTRACT

The 3rd Energy Package stipulates the implementation of network codes in the EU member states. These codes are expected to help overcome the major challenges of the electric system: accommodating a significant amount of renewable energy sources (RES), preserving security of supply, and market integration. They are elaborated in a formal process (part 1) and will cover a wide spectrum of stakeholders' activities (part 2). Distribution system operators (DSOs), as pivotal stakeholders in the electric system's structural paradigm shift, are closely committed to the process, contributing with their comments to its improvement (part 3). The network codes address issues with direct strategic impact on their business (part 4).

This article analyses the development of the network codes from a DSO perspective, with a focus on the draft technical codes that were most advanced at the time of writing.

ORIGIN AND DEVELOPMENT OF CODES

The so-called Third Energy Package empowers the European associations of Transmission System Operators (ENTSO-E and ENTSO-G) to prepare network codes laying down binding European-wide rules for the electricity and gas markets. "*The network codes should be developed for cross-border network [...] and market integration issues, without prejudice to the Member States' right to establish national codes which do not affect cross-border trade*" [1]. The codes will cover capacity allocation and congestion management, system operation, grid connection and network tariffs, taking into account regional specificities as appropriate. The European Commission (EC) so far foresees 14 codes [2].

As requested by the February 2011 European Council, the emphasis should be placed on those network codes necessary for the completion and proper functioning of the internal energy market and supporting cross-border trade by 2014. Further high-level objectives include maintaining security of supply, delivering benefits to customers and reaching the EU RES targets.

Network Code Development Process

While ENTSO-E is the primarily responsible party for drafting the network codes, the European Agency for the Cooperation of Energy Regulators (ACER) provides the overarching framework. Once the EC approves the Framework Guideline developed by ACER, ENTSO-E is requested to submit network code(s) in line with the relevant Framework Guideline to ACER within a reasonable period of time (less than one year). The Agency then provides a 'reasoned opinion' on the code within three months and submits the draft to the EC once satisfied. The code then goes through the 'comitology' process coordinated by the EC (an approval procedure with scrutiny) (art. 8 of Regulation 714/2009) [3]

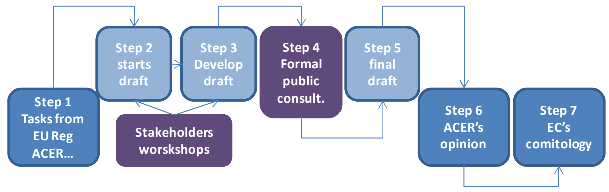

Fig.1 Network code development according to the 3rd Package (ENTSO-E) [3]

Eventually it becomes EU legislation (most likely a directly binding EU Regulation), taking precedence over national laws, relevant national grid codes and international standards and regulations. ENTSO-E is tasked with monitoring and analysing the implementation of the network codes and their effect on the harmonisation of applicable rules aimed at facilitating market integration.

AREAS COVERED

Out of the nine network codes that are already in the drafting process, six codes will have a direct impact on DSOs, namely the technical 'grid connection' and 'system operation' codes.

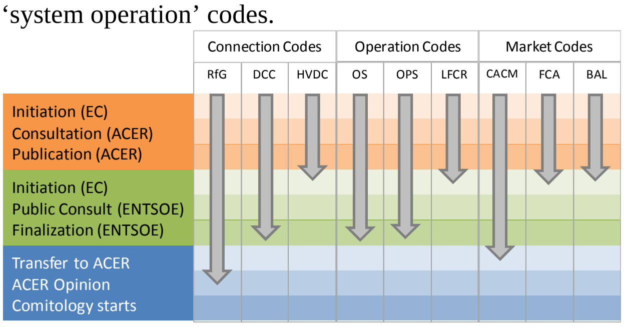

Fig. 2 Timeline for network code development (ENTSO-E)

Grid Connection codes

Requirements for all Generators (RfG) is a 'pilot code' defining rules for new and existing generators of at least 800W installed capacity. The comitology process is expected to start in early 2013. Compliance with this code will be a precondition for connection to the grid.

The **Demand Connection Code (DCC)** compiles three kinds of requirements: for TSO-connected consumers, for TSO-connected DSOs, and for appliances capable of providing Demand Side Response (DSR).

Both codes introduce an obligation for system operators to assess the compliance of network users with requirements defined for connecting installations, including electrical safety.

Two other network codes are to be developed within ACER's Framework Guidelines on Electricity Grid Connections: one on HVDC connections and one on connection procedures.

System Operation codes

The codes developed within the **Framework Guidelines on Electricity System Operation** should provide criteria for the quality of system operation and harmonise TSOs' roles, responsibilities and methods in order to govern the coordinated operation of the pan-European power system.

The **Operational Security** code is expected to harmonise operational security standards, improve the quality of system operation and promote the coordination of operational activities in light of the challenges of continent-wide power transfers and integrating large volumes of RES. It includes security principles, congestion management, voltage control, information exchange, short circuit currents and angle stability.

Operational Planning and Scheduling are tasks conducted prior to the real-time operation. They include outage planning, day ahead congestion forecast, rules on security calculations including intraday/extended real-time contingency analysis, but also commercial and TSO scheduling processes.

Load Frequency Control & Reserves, being developed in parallel with the network code on balancing, covers all control aspects, namely frequency containment reserve, frequency restoration reserve and reserve replacement, including rules for defining and calculating reserve requirements in the future power system.

IMPACTS ON THE DSO BUSINESS

DSO involvement

Four DSO associations have been following the drafting process and coordinating their contributions: CEDEC, EDSO for Smart Grids, EURELECTRIC and GEODE. They represent the diversity of European DSOs in terms of size, area and voltage levels, ownership (public and private) and degrees of RES penetration.

DSOs have proposed amendments to the ENTSO-E proposals, assessed the deviation of the draft requirements from the existing situation, and analysed the technical and economic impacts of the proposed requirements. This involvement represents thousands of man-hours by DSO experts on planning, operation and regulation. It has resulted in partial simplification of the codes and greater flexibility in adapting requirements to national situations. However, many of the codes, at the time of writing, still raise serious concerns about their accuracy, applicability and impact.

ENTSO-E approach and strategic concerns for DSOs

TSOs are in charge of overall system stability, with a long tradition of cross-border cooperation, and are closely involved in market design. They are accustomed to managing a system in which a bulk of highly predictable and reliable, fully observable, nearly fully controllable generation is provided by a limited number of large facilities that are operated by industrial experts and directly connected to the transmission network.

But times are changing. Today, a large amount of new generation capacity is being connected to the distribution networks. A substantial share is only partially observable, controllable, and predictable. This development will be much faster than for transmission assets. In some countries such subsidised generation with zero marginal cost will probably be over-abundant for a significant time period of operation, pushing conventional generation out of the merit order.

With DSR and new appliances such as electric vehicles, consumption will become more flexible and versatile.

Facing uncertain and possibly instable situations, TSOs tend to promote a network code framework that requires:

- Wider tolerance of generators and active consumer appliances towards system perturbation as regards frequency, voltage (RfG, DCC);
- Built in stability-contributing capabilities for generating units and consumption appliances, in some cases required as an autonomous self-stabilising capability (frequency statism) (RfG, DCC);
- Increased observability and direct access to information as often as possible (SysOp codes);
- Stronger requirements for DSOs, namely for reactive power management at the TSO-DSO interface (DCC, SysOp codes);
- Mandatory supply of electrical behaviour models for systems connected to TSOs (DCC).

These requirements describe solutions as defined by the traditional environment, with TSOs retaining their organisational and supervisory status, albeit a much reduced influence on the system that they directly operate and develop, and on the system's overall performance. In this vision a DSO appears schematically as a:

- Passive technical collector of demand, bearing the burden of managing reactive power by its own means with less support from TSOs than in the past.
- Passive compliance data collector and certification watchdog.

This vision is not compatible with the more ambitious vision of DSOs as active local system managers fully in charge of their responsibility area and with the deployment of smart grids solutions. It has thus fuelled the DSOs' concerns and pushed them to become actively involved in the network codes development [4][5].

Moreover, the codes disregard various maturities of national electric systems across the EU regarding RES and flexible demand. While proposing extensive requirements for small isolated systems with high RES penetration (e.g. Ireland) might be sound, applying the same requirements to the largely interconnected continental system with (so far) much lower RES penetration might be an excessive and costly anticipation.

Technical impacts and concerns

The codes, in particular the RfG and DCC, also imply potentially strong technical impacts for DSOs. For instance, requirements for autonomous self-stabilising capabilities for generation and active demand, coupled with a wider tolerance for disturbances, might jeopardise the efficiency of DSO protection schemes and lead to frequent undesired islanding in some distribution networks. TSOs preferentially interpret voltage or frequency perturbations as precursors of large-scale incidents and not as indications of local incidents as would a DSO. That is why they ask generation and active demand to remain connected and to support the system by correcting the deviations, making undesired islanding much more likely in case of a local incident. Alternative protection strategies compatible with this approach have not been developed, and might prove costly.

The DCC includes specific capability requirements for DSOs as regards reactive power transits at the interface. In addition to a generic requirement (a power factor of 0.9 minimum) the code requires that no reactive power is injected when the active transit is low (25 % of import capacity). These two requirements might well prove to be a strong restriction compared to existing situations.

The first implies a shift from the existing tariff regulation scheme, where non-compliance leads to payment, to a capability regulation scheme, where non-compliance leads to connection denial. In some countries, it greatly extends the timeframe of the requirements (from cold season only to year-round) and the strictness of the requirements (from monthly averages to 10-minute measurements, from import restriction of reactive power only in case of active power restriction to any combination of import/export and reactive/active power).

The latter requirement reflects the problems TSOs already experience or anticipate with the increasing length of underground cables on the DSO side and scarcer regulating capability on TSO network. However, this could be addressed by the development of reactors on DSO networks, currently not a trivial industrial product.

As regards the operational codes, divergences concern the area of responsibility. In the first drafts TSOs claimed direct access to data and control of "significant" DSO-connected generators and demand facilities, thus interfering with DSOs' responsibilities.

Economic consequences

The costs of increased connection requirements would probably be borne by generators and/or consumers. DSOs could face the administrative burden of collecting and certifying the compliance data on dispersed generators and active demand units.

In their first drafts ENTSO-E proposed procedures for compliance certification that were unsuitable for small 'non-professional' customers. Even considering DSOs' call for one-step certification, collection and managing millions of individual pieces of information will prove costly and lengthy, partly due to the 'standardisation gap': the functional requirements in the network codes are not sufficient to provide a smooth conception and product certification when most product and third party certification standards are still missing at EU level. New standards must be developed to implement the codes' requirements [6].

The economic consequences of the operational codes have not yet been assessed in detail. They will depend on the applicability of the codes for DSOs. Whether the codes will apply for all DSOs or only for DSOs with significant penetration of distributed energy resources in their networks will play a crucial role in this respect [7].

Regulatory consequences

The draft network codes for grid connection take a very broad view of cross-border issues. At the same time, the cost-benefit analysis (CBA) for requirements that substantially deviate from the existing situation – required by the Framework Guideline – has not been conducted. ENTSO-E and ACER rely instead on justifications that mostly focus on the extent of risks, complemented with non-exhaustive descriptions of requirements existing at national level.

DSOs have conducted their own analysis of deviations from existing requirements. The results demonstrate that the RfG and DCC codes would result in onerous requirements for DSOs as well as users connected to distribution networks, and that all requirements regarding DSR are new. The lack of CBA for requirements clearly deviating from the present situation is a serious deficiency of the process and a breach of the framework guidelines.

Finally, timely recovery of regulated network operators' costs induced by the codes was proposed by ENTSO-E and supported by DSOs, but was discarded by ACER as a matter of subsidiarity [8].

SOME STRATEGIC QUESTIONS RAISED

Involvement and acceptance of the proposed codes by the entire energy sector is a must to put in place adequate European market and technical rules within the ambitious timeframe proposed [9]. Notwithstanding different perspectives, generators and other industry representatives share most of the DSOs' concerns. The overall absence of consensus thus poses a risk of unpredictable results of the 'comitology' process.

The discussion of the codes has revealed a number of strategic questions about the future electric systems. DSOs have made clear that they are key players in the process of both transforming the electric system and of developing the network codes.

DSOs structured influence at EU level

As of 2012, the four associations representing DSOs at the European level have coordinated their responses to public consultations and interactions with other stakeholders in the drafting process. Speaking with one voice, creating a common representation and regularly meeting with the ENTSO-E teams via 'the DSO technical experts group' represent unprecedented positive steps.

This involvement has led to concrete results, including parametric requirements that respect national situations for the RfG, a more concise version of the DCC, and a clearly voiced commitment to protecting the respective areas of responsibility in the operational codes.

DSO associations have been spreading awareness of the role that DSOs already play in connecting and managing RES and flexible demand, as well as of the future role of the DSO. Their collaboration at EU level should continue. While the need for RES is well-known and commonly accepted, the great challenges of integrating RES into the network and the future DSO role in this regard have yet to receive wide-spread attention. As long DSOs are not perceived as key players for the evolution of the network, taking their concerns on board in the drafting of the network codes will be a challenge.

Interaction between smart grids and codes

Smart grids is a broad concept, including but not limited to active distribution system and congestion management at DSO level, integration of storage, connection of distributed energy resources, and demand side response.

Research and development of smart grids are flourishing in the EU, accounting for more than 60 % of DSO investment in R&D. New European and national projects are launched regularly to test and demonstrate new ways of managing the grid.

This development indicates that DSOs will need to take up a much more significant role in the near future: as networks become ever more interconnected, DSOs will become active system operators involved in demand side and congestion management. Network codes must acknowledge this (re-)orientation and facilitate it. Requiring capabilities for dispersed generators and/or flexible consumers is a step towards 'smartness' as long as the benefits are not captured by a single party.

Taking into account the diversity of distribution networks is another necessity. The type of 'smartness' will depend on the degree of penetration of RES and flexible demand. 'One- size-fits-all' solutions are therefore inappropriate; the European codes should take this reality into account.

Impact on DSO activities

The network codes should set safe rules for all grid users and network operators while being flexible enough to provide DSOs with some leeway to adapt to the rapid changes in their networks.

Yet the present drafts do not sufficiently consider distribution grid peculiarities and the present and future role of DSOs with respect to their network users. The risk is that these codes, designed with the intention of ensuring security of supply, allowing the internal energy market to function, and reaching the EU 20-20-20 targets, may hamper evolutions of the electric system that are necessary to achieve those goals.

Bypassing DSOs to receive direct information from DER connected to DSO networks, imposing requirements on DSO-connected DSR facilities regardless of constraints on the same network, removing from the TSO the responsibility of investing in reactive power control – these developments might well prevent the system from becoming smarter and more open for all users.

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