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SYNCHRONOUS INTERCONNECTION OF UKRAINIAN AND MOLDOVAN POWER SYSTEMS TO THE CONTINENTAL EUROPEAN ENTSO-E POWER SYSTEM

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Abstract – *This paper presents the main steps for the synchronous interconnection of Ukrainian and Moldovan power systems to the Continental European ENTSO-E power system and the feasibility study recently accomplished.*
The first step in this process was the feasibility study. The overall objective of this study was to identify the main elements needed to make possible the synchronous interconnection and to recommend the main measures to be taken in order to overcome the main technical, organizational and legal possible obstacles.
Keywords – *synchronous interconnection, inter-area stability, frequency regulation, real-time operation*

1. STEPS TOWARDS SYNCHONOUS INTERCONNECTION

The steps and measures towards the synchronous interconnection of other power systems with the power system of Continental Europe are established by ENTSO-E internal regulations.
First, the requesting TSO(s) choose one or several neighbouring TSO(s) from Continental Europe to be its supporting party/parties at ENTSO-E. Nevertheless, the requesting TSO(s) can also ask any other TSO from Continental Europe to take over this role.
The chosen TSO (the "supporting party") submits a preliminary application to ENTSO-E for system extension. The preliminary application has to mention the identity of the TSO(s) who request(s) the synchronous interconnection and has to describe, among others, the geographic borderlines involved, the electrical equipment at the borderlines, the estimated loads and generation capacity involved, etc.
ENTSO-E, through one of its working groups, examines the preliminary application and makes the preparations for Terms of references for a feasibility study.
Based on the results of the feasibility study and on other necessary analyses ENTSO-E decides about the continuation of the procedure for the extension. In case the decision is positive, a contract (Connection Agreement) has to be entered into between:
• the supporting party,
• the requesting TSO(s), and
• at least two TSOs from Continental Europe, different from the supporting party.
The Connection Agreement specifies the rights and obligations of the parties with respect to the next steps in the extension process. It has to contain at least:
• the ENTSO-E rules to be complied with, especially those related to the secure operation and the frequency control;
• the geographic and electrical delimitation of the extension;
• the methods to be used for checking the compliance;
• the detailed technical conditions for the extension (the "Catalogue of Measures") to be implemented by the requesting TSO(s) to ensure that the extension contributes to the quality and security of operation of the interconnected transmission system in the Continental Europe synchronous area. The Catalogue of Measures must be defined, in accordance with the Operation Handbook and technical recommendations of ENTSO-E.
The Connection Agreement must contain the commitment of the requesting TSO(s) to comply with the Operation Handbook and the relevant network codes and guidelines and to implement the measures written in the Catalogue.
After the Connection Agreement is signed the requesting TSO(s) (in our case Ukrenergo and Moldelectrica) has to implement the measures in the Catalogue and ENTSO-E through one project group, supervises and guides them in this process, as stated in the Contractual Agreement.
After all the measures are implemented, tests in isolated operation and interconnection tests must be prepared and performed. After the assessment of the tests results it is decided about the trial interconnected operation of the transmission system of the requesting TSO(s) with the interconnected transmission system of the Continental Europe synchronous area. The synchronous trial operation is monitored and the compliance with the conditions set out in the Connection Agreement is verified.
Before taking the decision on permanent synchronous operation a final feasibility assessment is performed, the main part of which represents checking whether the requesting TSO(s) are in a satisfactory way compliant with the standards of the Operation Handbook, the

relevant network codes and guidelines, and in particular whether all critical non-compliances have been removed.
In this moment the feasibility study for synchronous interconnection of Ukrainian and Moldovan power systems to the Continental European ENTSO-E power system is accomplished and the two requesting TSO(s) analised the results and confirmed they want to continue the process.

2. FEASIBILITY STUDY - INTRODUCTION

The feasibility study for synchronous interconnection of Ukrainian and Moldovan power systems to the Continental European ENTSO-E power system was made by a consortium of TSOs from Continental Europe: EMS (Serbia), PSE (Poland), MAVIR (Hungary), ESO EAD (Bulgaria) and Transelectrica was the consortium leader. For leagal and regulatory issues Bernard Energy Advocay (BEA) from Belgium joined the consortium [1].
The study was funded by The Joint Operational Programme Romania-Ukraine-Republic of Moldova 2007-2013 which is financed by the European Union through the European Neighbourhood and Partnership Instrument and co-financed by the participating countries in the programme.
The beneficiaries are The Ministry of Economy of Republic of Moldova and its partners: The Ministry of Energy and Coal Industry from Ukraine and The Ministry of Economy, Trade and the Businness Environment of Romania.
The study was done in good cooperation with experts from Ukrenergo and Moldelectrica who delivered necessary input data and information and who provided clarifications and feedback to the consortium members.
Some of the Consortium tasks were supported by a couple of external experts from EKC (Serbia), Instytut Energetyki and Energopomiar (Poland), companies subcontracted by EMS and PSE.
The study was made in very short time, from November 2014 to January 2016.
The Terms of Reference were established by ENTSO-E and the activity was organised on four working groups: Steady state analyses, Dynamic analyses, Operational issues and Legal and regulatory issues.
The main objectives of the Study are:
• to investigate the possibility of Ukrainian and Moldovan power systems to be operated in parallel with the Continental European synchronous area respecting its technical operational standards;
• to investigate the degree of implementation of ENTSO-E's technical operational standards in the Ukrainian and Moldovan power systems;
• to analyze the difference in relevant legislation in the field of energy between Ukraine and Moldova and the European Union ("EU") countries.
The essential precondition for any extension of the Continental European synchronous area is to keep its reliability at least at the present level. Based on several available reports and analysis, including as delivered by the participating parties from Moldova and Ukraine, the Study makes various recommendations from technical, regulatory and operational point of view for the possible future integration of the Ukrainian and Moldovan power system; it being understood that the Consortium can only suggest recommendations and that it will be later up to the various appropriate bodies, including ENTSO-E, to decide and agree on the needed measures. The Study is to be considered as a preliminary step to be followed by others such as an official assessment by ENTSO-E, a cost-benefit analysis and/or socio-economic analysis, political or State positions, various agreements including but not limited to relevant connection agreement with the Ukrainian and/or Moldovan TSOs and the relevant ENTSO-E TSOs, etc.

3. STATIC STUDIES (LOAD FLOW STUDIES)

This study analyzed with a complete AC modelling, the synchronous operation of interconnected power systems of Ukraine and Moldova with continental part of ENTSO-E interconnection.
The figure below shows tie-lines between ENTSO-E Continental European power system and Ukrainian and Moldovan power systems (tie-lines in interface area):
• tie-line between Poland and Ukraine (750 kV line Rzeszow-Khmelnytska)
• tie-lines between Romania and Moldova (400 kV lines Isaccea – Vulkanesti and Succeava – Balti).
Since one part of Ukrainian power system (Burshtin Island) is disconnected from the rest of Ukrainian power system and synchronously connected to the main ENTSO-E grid, the figure also shows connection between Burshtin Island and the rest of the Ukrainian power system.
• 220 kV lines Stryi – Rozdyl – Lviv;
• bus bar couplers in Zakhidnoukrainska (750 kV and 330 kV) and Burshtin (330 kV) stations.
The existing 220 kV OHL Zamosc (PL) – Dobrotvirska (UA) connects the Dobrotvirska Power Plant with Polish system. Currently this line is utilized for supplying Poland from Dobrotvirska Power Plant, basing on the market rules. Since both systems do not operate synchronously, Dobrotvirska substation is decoupled, such as 1-2 units of Dobrotvirska Power Plant are separated from Ukrainian system and connected only to the Polish system through that line. Due to the network constraints (static and dynamic) the maximum import capacity is about 220 MW.

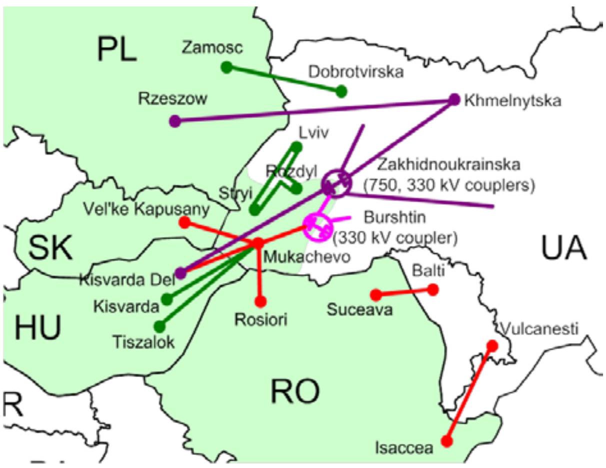

Fig. 1. Tie-lines in the interface area

In the past, when the Central-East Europe operated synchronously with IPS/UPS, this line worked in the same manner as today, not parallel with other interface lines. Taking into account abovementioned conditions it was agreed that this line would be switched off in the analyses.
Power flows, voltage profile and power margins have been analyzed in detail verifying the N-1 criterion. Calculations have been made using PSS/E and DSA Tools.
Studies have been based on models and data for the year 2020 considering two cases (Winter Peak load – WP, and Summer off Peak load – SoP).
Sensitivity analyses have been made to determine maximum power exchange in the following directions:
UA+MD → SEE + IT (via new HVDC IT-ME)
UA+MD → SI + AT + IT (without new HVDC IT-ME)
UA+MD → Eastern DE (TSO 50Hz)
Eastern DE (TSO 50Hz) → UA+MD
UA+MD → PL + SK + HU + RO + CZ
PL + SK + HU + RO + CZ → UA+MD
UA+MD → PL + SK
UA+MD → SK + HU
UA+MD → HU + RO
At the end of static studies, three phase short-circuit calculation was made, with main purpose to provide general overview of influence of this connection to level of short-circuit currents.
For purpose of this study it was necessary to create proper models with satisfied accuracy. Special attention had to be paid to power systems in the area of interest: Ukraine and Moldova, border countries between Ukraine, Moldova and the rest of ENTSO-E (HU, PL, RO, SK) and countries which were on transit paths for analyzed exchange scenarios (AT, CZ and SEE countries without Turkey). Modeled area consists of interconnection of ENTSO-E Continental Europe and Ukraine and Moldova as shown in the figure below.
Models from the following sources were used: ENTSO-E provided the Ten Years Network Development Plan model for Continental Europe, SECI project (South East Cooperative Initiative supported by USAID) provided updated models of SEE (AL, BA, BG, HR, GR, ME, MK, RO, RS, SI) and model of Turkey; TSOs from Hungary, Poland, Slovakia, Czech Republic, Ukraine and Republic of Moldova gave updated national models.

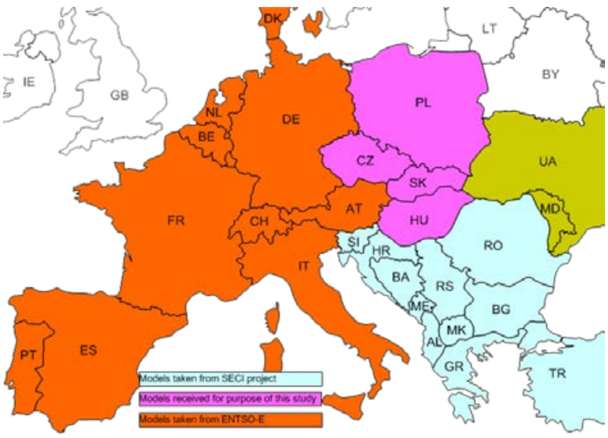

Fig. 2. Network models

Synchronous operation of Ukraine and Moldova with continental grid of ENTSO-E, in case without any additional exchange excepting the present one with Burshtin Island, will result with significant loop flows. Total loop flow is around 790 MW (in Winter Peak 2020) or 455 MW (in Summer Off-Peak 2020). The greatest amount of loop flow is assigned to grid of UA. Roughly it is expected that total value of loop flow in UA divides into three main parts:

- 20-25% flows through RO and then back to UA via MD
- 25-30% flows through PL and back to UA via SK
- Around 50% flows through PL and spreads through CEE and SEE countries and flows back to UA (8-10% flows back to UA from HU and around 40% flows back to UA through RO and MD). These loop flows have influence on branch loadings. In case of PL, DE and MD average loadings are increased, while in the rest of the area of interest (including UA) average loadings are decreased. We have to mention that these changes are not critical (don't introduce any risk).

Synchronous operation of Ukraine and Moldova with continental grid of ENTSO-E slightly increases voltage profile of the interconnection. The most significant changes appear in networks of border countries (HU, RO, SK) as well as in BA, BG, HR, RS, SK and SI. Increase of voltages in 220 kV network is not as great as in 400 kV network, but still should be mentioned.
This general increase of voltages as well as decreased branch loadings in significant part or area of interest leads to decrease of losses in system. Total decrease of active power losses is more than 0.50%. Losses of reactive power are decreased by around 0.40%. However, in some countries there is increase of losses (as result of significant loop flows which result with increased level of branch loadings), such as MD (more than 27.08%) and PL (around 0.30% in Winter Peak 2020).
Calculated maximum secured total exchange from Ukraine and Moldova to ENTSO-E is 1,000 –2,350 MW, depending on regime and direction of exchange. Calculated maximum secured total exchange from ENTSO-E to Ukraine and Moldova to is 1,400 – 2,000 MW, depending on regime and direction of exchange.
Results from short-circuit calculations have shown that there is no critical influence of connection of UA/MD to the Continental Europe power system to the level of SC currents. However, there is significant influence to the level of short-circuit currents in nodes close to connection point, so detailed analysis with checking calculated values against typical breaking capabilities is highly recommended.

4. STABILITY STUDIES

The stability studies were divided into two major groups:

- Transient stability analysis
- Steady state analysis

The transient stability analyses are split into two parts, i.e. regional and wide area stability analyses. The regional analyses covered the interface area (Ukraine, Moldova, Romania, Slovakia, Hungary and Poland). Time domain simulations were performed to verify the regional transient stability behavior of the interconnected system.

In this scope Critical Fault Clearing Times for most important elements for the area of networks under consideration were calculated. The longest clearing time for which the generator will remain in synchronism is referred to as the critical clearing time. The study included the analysis of the transient stability during and after three phase short circuits, this being the most severe case, concerning the capability to maintain synchronism of the parallel operation. The relevant scenarios regarding power exchange, schedule of power production, network topology were determined in cooperation with UA/MD expert team. The scenarios used in this analysis were based on power flows elaborated in frame of static studies.
As global transient stability we understand dynamic phenomena in a power system occurring after disturbances which may have effect on a large part or entire system performance.
The investigations performed during the Study of global transient stability for the interconnected systems have concerned three types of disturbances:

• Tripping of large generators in various part of the system.
• Faults on the inter-tie lines between ENTSO-E Continental Europe system and UA/MD system.
• Switching on and off the inter-tie lines.

The steady state analysis covered the entire interconnected power system i.e. ENTSO-E Continental Europe connected with UA/MD. Calculation of eigenvalues, eigenvectors and mode participation factors is realized by means of modal analysis tools. The small signal analysis focuses on inter-area oscillations as well as on significant modes which are local to the interface area. The analysis results show influence of UA/MD connection on existing ENTSO-E CE low frequency inter-area modes. Influence of large power transfers, even far from the interface, are also considered. For stability risks resulting from connection of UA/MD power systems discovered, appropriate countermeasures are also considered as part of this study.
The models for dynamic analyses were prepared for the 2020 winter-peak load and summer off-peak load flows. Data used for building the models had different accuracy. Due to the Study time constraints the entire Western Europe including Italy is modelled using uniform default models of generations according to guidelines elaborated by ENTSO-E (System Protection & Dynamics Subgroup). The input data for Eastern Europe, Balkans and Turkey have the typical accuracy of models used by TSOs in planning dynamic studies. Models of individual generators as well as country or area models were verified and validated before connecting them into the entire ENTSO-E CE model. PMU frequency measurements after sudden loss of 1000 MW generation in Spain were used for tuning and validation of the winter-peak dynamic model.
Inter-area small signal stability of the ENTSO-E CE winter peak dynamic model was validated by comparing its low frequency modes with the inter-area modes obtained in the Study performed for Turkish power system interconnection. It has been found that the frequency and the geographical distribution of the inter-area modes are similar with the mode maps in this Study.
Finally it has been concluded that the prepared models enable credible analysis of frequency and geographical distribution of inter-area modes however in case of damping it is rather the trend (improvement or deterioration) and information obtained from comparison with other already known modes that matters .
Data for Ukraine and Moldova were obtained in form of PSS/E and Power Factory models. Majority of Ukrainian large generators are equipped with nonstandard exciters which have to be modelled by means of user defined models. The elaborated model of Ukraine and Moldova power systems was stable operating as an island. Further deeper validation could not be performed due to lack of any test measurements during island operation.
The transient dynamic study involved all large power plants located in the interconnection neighborhood. Critical fault clearing time (CFCT) was calculated in each country and compared with values of CFCT determined in the model before the interconnection. No risks were identified for safe operation of the investigated power plants on the both sides of the interconnection.
The connection of Ukraine and Moldova changes pattern of low frequency inter-area modes in ENTSO-E CE substantially. Two new low frequency modes with frequencies 0.3 Hz and 0.4 Hz emerge. The modes have relatively poor damping in the winter peak model. In the summer off-peak model mode 0.3 Hz becomes unstable. The connection also negatively influences the already known west-east mode 0.22 Hz decreasing slightly its frequency and damping but the changes are not critical. The already known lowest frequency Turkey mode 0.15 Hz remains undisturbed. Large generators from the Ukrainian nuclear plants participate predominantly in the new modes; they also have visible participation in the west-east mode.
Poor inter-area stability in the winter peak base case are influenced by the results of analyses of exchange scenarios and outages of interconnection lines. The damping further decreases if Ukraine and Moldova export more power to the West. N-1 states of the interconnection cause also deterioration of damping. Disconnection of the Rzeszow – Khmelnytska 750 kV line is critical for the inter-area stability of the interconnected systems.
The results of modal calculations show insufficient inter-area stability of the interconnected systems. In such circumstances the synchronous interconnection is not feasible and countermeasures significantly improving damping of the new inter-area modes are necessary.
Inacceptable damping of the new inter-area oscillations has influenced the results of global transient analysis involving simulations of faults on the interface and loss of large generation. The poorly damped or undamped oscillations of Ukrainian generators against rest of the interconnected systems emerged after disturbances, confirm unsatisfactory level of damping of the new inter-area oscillations.
It has been found that the poor damping performance is the result of lack of damping from large Ukrainian generators which are all equipped with inefficient non-standard exciters. It was proved that changing the settings of exciters for generators in nuclear power plants or using

separate standard power system stabilizers could significantly improve the situation.
It must be clearly stated that due to lack of engineering information regarding above exciters, technical possibility to adopt any of the proposed solutions remains an open question.
The analysis of damping performance of the Ukraine and Moldova exciters has shown importance of availability of on-site tests in process of verification and validation of the models. At the same time it is essential to have access to system measurements (PMU) which could confirm damping performance of system stabilizers or damping feedbacks of excitation systems also for frequencies lower than local oscillations.
The next aspect associated with low frequency inter-area modes is relatively high variability of their damping depending on many various features of system operation what at least partially we have tried to show in the Study. A mode having generally quite satisfactory damping may go unstable in certain conditions. The reason of the variability is very complex nature of low frequency modes involving not only thousands of generators and turbines, their controls and loads but also network topology, size and direction of power transfers on very large area. Considering this complexity the results of inter-area stability should be taken with proper caution - one cannot say that damping of the new modes after applying countermeasures will ensure stable operation of the interconnection. The new modes have similar damping as the existing modes and there are operational experiences with unstable oscillations associated with these existing low frequency inter-area modes.
Within the project investigations of countermeasures were focused on most effective and economically justified solution (modification/tuning existing control systems). If adoption of proposed measures will be problematic or not sufficient and there will be still a need for further damping enhancement, then a feasible solution can be FACTS devices with SVC technology which are very efficient also for very low frequencies. Recent example of using FACTS devices (SVC, STATCOMs) to improve inter-area stability come from Turkey and its goal is to increase damping of the Turkish mode.

5. OPERATIONAL ISSUES

The objective was to analyze the reports on the Ukrainian and Moldovan power systems and the differences between their operational rules and ENTSO-E Operation Handbook (OH). In particular the dispatching organization, operational procedures, WAMS, congestion management (N-1, outage scheduling, DACF, capacity assessment), system control dynamics concerning the required level of primary and secondary reserve and required load matching based on load forecast and availability and dynamic performance of generators, protection systems, defense and restoration plans, delimitation conditions were analyzed. Finally recommendations in order to overcome and/ or minimize the differences between UA/MD operational practices and ENTSO-E rules are made.
Analyses were made, based on the data provided by the Ukrainian and Moldovan transmission system operator (Ukrenergo and Moldelectrica). Within the frame of the project a database of the generating facilities was prepared showing its capability to participate in primary and secondary control.
The power system of Ukraine is partially prepared for synchronous operation with ENTSO-E Continental Europe Synchronous Area. The most important deficiency is absence of deployment of primary reserve due to market rules. Besides, this control is not properly tested, so this is to be considered as a severe non-compliance which cannot be easily removed in short terms. It is stated by Ukrainian representatives that Automatic Generation Control (AGC) system has been tested in modes flat tie-line control and tie-line bias control. Now it works in mode flat tie-line control (only the power exchanges are controlled). AGC system has not been tested in the mode flat frequency control, because the Ukrainian system works synchronously with IPS/UPS.
Based on the present information for power units outages, at the present stage the level and quality of secondary control is satisfactory regarding the exchange power flows control.
Severe non compliances to Operational handbook were detected also for Moldelectrica regarding primary/secondary control. The most important reason is lack of deployment of primary control and absence of secondary controller (AGC). Besides implementation of AGC, Moldova will have to modify the market rules aiming to allow Moldelectrica to purchase primary, secondary and tertiary reserve, as well as to exchange/purchase this reserve with adjacent TSOs, which is relevant for Ukraine too. Moldelectrica will have to invest in order to provide reliable data exchange with adjacent TSOs with requested accuracy and protocols. Also, Moldelectrica could be constituted as a control area and join a Control Block. In that case, some relieves toward Moldelectrica are possible, depending on their agreement on secondary control organization in the Control Block.
As for the real-time operation, the most severe detected non-compliance is lack of real-time calculations of network security.
The real-time data for voltage and reactive power management, in light of inter-TSO coordination, have to be realized.
Under frequency load shedding has to be adapted to the ENTSO-E general scheme for stages and disconnection time delays.
It is advisable, from the best practice point of view, that use of two main protection systems shall be necessary in the interface area at least. The consistent practically use of double batteries and double tripping coils and redundant communication links will be realized in the interface area at least
List of the most critical non-compliances to ENTSO-E Operational Handbook is provided in the study. The main issues that have to be covered in order to reach the expected level of compliance are connected to frequency regulation, real-time operation and special protection systems.

6. LEGAL AND REGULATORY ISSUES

The main objective was to analyze the applicable legal systems in Moldova and the Ukraine and to identify the legal existing differences (between UA/MD and ENTSO-E countries) and make proposal to solve them. In particular it covered the following topics: market organization; ownership infrastructure; TSOs' liability; TSOs' specific tasks and obligations; planning constraints; dissemination of information to the market; compensation for cross-border exchanges of electricity; management of interconnections; capacity allocation mechanisms.

Analyses were made, based on the information provided by the Ukrainian and Moldovan transmission system operator (Ukrenergo and Moldelectrica).

Besides the compatibility of legislation, one of the key aspects that may have important legal consequences when considering the synchronous interconnection of electricity systems is how to address the consequences of incidents/accidents/negligence and the resulting liability. Such aspects are typically addressed in contracts such as the former Multilateral Agreement (MLA) originally signed by the UCTE TSOs and later transferred into ENTSO-E, which MLA allows the streamlining of the legal risks and consequences in terms of liability in case of an incident. To the best of experts' knowledge, such agreement does not currently have an equivalent in the Ukraine and/or Moldova.

The possible consequences of the current lack of full implementation in the Ukraine and/or Moldova of the European energy legal system, in particular the Third Energy Package, are another important outstanding point identified. Such consequences may require additional contractual or legal documents, presumably at a high political level, and may involve an international treaty or similar agreement that will certainly be addressed in due time by the relevant political organizations such as the European Institutions and the respective Governments involved. Issues relating to competition law will also have to be addressed in such context.

7. CONCLUSIONS

In this moment the feasibility study for synchronous interconnection of Ukrainian and Moldovan power systems to the Continental European ENTSO-E power system is accomplished and the two requesting TSO(s) analised the results and confirmed they want to continue the process.

From static analyses point of view, synchronous connection of Ukrainian and Moldovan power systems to continental part of ENTSO-E is feasible, with infrastructure (existing and planned) expected in 2020.

From dynamic analyses point of view, the interconnection is not feasible without applying proper countermeasures due to the inter-area instability risks identified in the interconnected model. The source of the instability is insufficient damping for low frequency oscillations at large generators in Ukraine.

The inter-area stability can be improved if one of the proposed countermeasures is applied. The adopted solution have to be verified by manufacturers of existing control systems in power plants in Ukraine and Moldova, especially it refers to the nuclear power plants.

Only after such revision of proposed measures and on-site testing of selected exciters and governors, the final evaluation of efficiency of countermeasures and their influence on small signal inter-area stability of the interconnected systems can be done.

Regarding operational issues, according to the data received and analysis prepared, the Power Systems of Ukraine and Republic of Moldova are partially prepared for synchronous operation with Continental Europe System under OH of ENTSO-E rules. The most severe incompliances can be removed with the fulfillment of the recommendations, as depicted in the study. This will speed up and ease the process of reaching full compliance towards achievement of synchronous interconnection with ENTSO-E Continental Europe System. The main issues that have to be covered in order to reach the expected level of compliance are connected to frequency regulation, real-time operation and special protection systems.

The European energy legal system, in particular the Third Energy Package, should be fully implemented in Ukraine and Republic of Moldova. Information received from UA/MD revealed that, regarding energy, the systems in place in Moldova and the Ukraine are currently not fully compliant with the system applicable in the ENTSO-E countries, although both systems are evolving in the right direction.

The next step in the synchronous interconnection process is to establish the detailed list of technical conditions for the extension (the "Catalogue of Measures") to be implemented by Ukrenergo and Moldelectrica to ensure that the extension contributes to the quality and security of operation of the interconnected transmission system in the Continental Europe synchronous area. The Catalogue of Measures must be defined, in accordance with the Operation Handbook and technical recommendations of ENTSO-E.

REFERENCES

[1] Feasibility study for synchronous interconnection of Ukrainian and Moldovan power systems to the Continental European ENTSO-E power system - February 2016 – written by a consortium composed of CNTEE Transelectrica SA (RO), JP "Elektromreža Srbije" - EMS (RS), MAVIR Hungarian Independent Transmission Operator Company Ltd. (HU), Polskie Sieci Elektroenergetyczne S.A. (PL), Elektroenergien Sistemen Operator ESO-EAD (BG), and Bernard Energy Advocacy – BEA (BE).