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Organization for Security and Co-operation in Europe

Office of the Co-ordinator of OSCE
Economic and Environmental Activities **Vienna, 27 June 2014**

Background paper

Expert Workshop on

"Sharing Best Practices to Protect Electricity Networks from Natural Disasters"

Vienna, July 2nd 2014

The MC Decision on "Protection of Energy Networks from Natural and Man-made Disasters" (MC.DEC/6/13) adopted in Kiev last year, i.a. "Tasks the Office of the Co-ordinator of OSCE Economic and Environmental Activities to identify opportunities for co-operation with international organizations and regional organizations and agencies in the field of protection of energy networks against natural and man-made disasters and to facilitate discussions on possible areas for co-operation".

The expert workshop to implement this tasking has the objective to contribute to enhancing the capacities of OSCE participating States to fulfil their commitment with regard to MC.DEC/6/13 by raising awareness of and facilitating the dialogue and knowledge sharing on the protection of electricity networks from natural disasters. It will bring together participating States and Partners for Cooperation, and representatives of international organizations and institutions, specialized agencies, the business sector (including Transmission Systems Operators) as well as academia.

The workshop will explore the state of the art and existing best-practices for protecting electricity networks from natural disasters. During this workshop the questions of vulnerability and resilience of electricity networks to single and multiple risks of natural hazards will be discussed. This will include all phases of the resilience design process such as risk assessment, risk communication and implementation of risk mitigation measures. Resilience refers to the capability of a system, in this case the electricity transmission network, to recover its functionality after the occurrence of a disruptive event. Looking at the vulnerability of electricity networks, the entire disturbance process, from prevention of risks and mitigation of possible negative consequences to the response and recovery in the acute crisis phase, will be discussed.

*) Correction due to change of distribution status, text remains unchanged

In line with the above referenced MC decision and to allow a more focused debate, the scope of the workshop will be limited to electricity networks - leaving aside nuclear, gas and oil infrastructure - and their vulnerabilities to natural disasters.

The natural disasters which will be discussed and which are relevant to electricity networks are the following: geophysical disasters such as earthquakes, volcanoes and landslides as well as climate-related disasters such as hydrological (floods, landslides, avalanches), meteorological (storms) and climatological (extreme temperatures, droughts).

The discussion will not only include risk assessments but also risk mitigation and management and therefore relevant operational and technological risks such as emergency preparedness and operations, interconnection reliability operations and coordination, planning and internal control as well as grid integration of renewable energy, capacity allocation and congestion management.

The workshop will provide insights on good practices, knowledge and experience from different countries and stakeholders across the entire process of protecting electricity networks, which includes the following elements:

- Risk assessment to identify threats, to assess vulnerabilities, to identify and quantify potential losses
- Risk preparedness and prevention including technical and physical protection measures and planning
- Risk preparation such as organizational measures, capacity building and internal controls
- Risk response, including intervention such as early warning and monitoring mechanisms, and recondition such as back-up supply and provisional repair
- Risk recovery which is connected with reconstruction, financing, repairing and restoring

Background:

The energy sector, in general, and the electrical power transmission systems in particular, are essential to the national economies and well-being of modern societies. These systems consist of three parts: generation, transmission and distribution; all these components are inter-connected through transmission lines arranged within a high dimensional network, including large amount of edges and nodes.

Security of energy supply is influenced by reliability of these systems. Their vulnerability can have implications for national security. Around 59% of all power system blackouts in the United States and Canada, for example, are caused by natural hazards[1]. The risk of natural disasters such as floods, droughts, earthquakes, tsunami, make these networks extremely vulnerable.

Disruption or damage to electricity networks, especially today when they have become complex and interconnected, may affect millions of people, causing loss of life, multiple

[1] Task-Force, "Final report on the august 14, 2003 blackout in the United States and Canada: Causes and recommendations," U.S.–Canada Power System Outage Task Force, Technical Report, April 2004.

environmental impacts and a cascade of interlinked economic losses. Examples of accidents caused by natural disasters indicate that the scale and long-term consequences can go far beyond national borders. Earthquakes and related tsunamis as well as climate-related disasters such as hurricanes, floods, landslides or hail storms, most of the time, result in a serious physical damage to critical infrastructure making it almost impossible for a single country to cope[2]. The societal impacts of blackouts are determined in terms of power outage, number of days, weather conditions, nature of affected area, size and density of population, housing characteristics, industrial and economic activities. Therefore, discussion about vulnerability and resilience of critical components becomes essential in regions with significant natural hazards.

The issue of protecting electricity networks is additionally influenced by new emerging requirements for the grid infrastructure needed for on-going energy transition which is driven by concerns of climate change and energy security. The European climate policy goals, for example, require a reduction of at least 80% of all CO2 emissions by 2050, eventually leading to the full decarbonisation of the power sector[3]. At the same time, price volatility and competition on global markets for energy sources create additional incentives for national governments to develop available renewable energy resources.

To continue with the example of Europe: it is a fact that the existing electricity grid architecture has to be adapted to cope with increasing volumes of renewable electricity[4]. The generation of renewable power is generally concentrated in European regions with relatively low load, and then needs to be transmitted to high load and storage sites, sometimes over distances of several hundred kilometers. The majority of the European transmission systems is 30-40 years old, and needs to be replaced, upgraded and even expanded which makes them more vulnerable to natural hazards[5]. In some regions, grids are already pushed to the limits of their capacities due to rapid expansion of electricity from wind generation[6]. Around 42,000 km of transmissions lines need to be upgraded or constructed to secure market integration, security of supply and to accommodate the renewable expansion planned for 2020[7].

The new requirements on electricity transmission infrastructure as well as an increasing interconnection on the electricity markets and growing volumes of transmitted electricity impact vulnerability of electricity grids. Additionally, a higher share of renewable energy generation can lead to more exposure to climate risks, with the potential of increasing dependency from solar radiation, wind velocities and river run-offs regimes. New forms of

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[2] The largest blackouts in history such as 2012 in India (670 mio people affected), 2005 in Indonesia (100 mio), 1999 in Brazil (97 mio), 2009 in Brazil and Paraguay (87 mio), 2003 in US and Canada (55 mio), 2003 in Italy, Switzerland, Austria, Slovenia and Croatia (55 mio) show the need to protect electricity networks from natural disasters.

[3] European Commission, 2010. Energy 2020. A strategy for competitive, sustainable and secure energy. COM(2010) 639 final, Brussels, November, 2010.

[4] IEA, 2002. Security of Supply in electricity markets. Evidence and Policy Issues. Paris: International Energy Agency (IEA) / Organisation for Economic Cooperation and Development (OECD).

[5] Ecofys, 2008. Study on the comparative merits of overhead electricity transmission lines versus underground cables. Study for the Department of Communications, Energy and Natural Resources, Ireland, May 2008.

[6] EWEA, 2005. Large Scale integration of wind energy in the European power supply: analysis, issues and recommendations. European Wind Energy Association (EWEA) Brussels.

[7] Entso-E, 2010. Ten-year network development plan 2010-2020. European Network of Transmission System Operators for Electricity (ENTSO-E), Brussels.

electricity networks architecture, such as smart grids to balance intermittency of renewable energy sources, and super grids to transfer large volumes of electricity over long distances, raise additional questions about the vulnerability of electricity grids to climate change, and how to make the changing electricity networks more resilient.