Smart Energy/Electric Power Production (SE)

Lead Nation (Organization): NATO ESCD, NATO ENSEC COE, MILU Commander - HUN

Contributing Nations: Germany, Hungary, Serbia, United States

Organizations: ACO, MILENG COE, governmental organizations, civilian companies

Personnel (max): 92

Key Objectives:
- Test interoperability of SE equipment in deployed operational environment (innovative solutions provided by industry with mature military technologies being used in operational environment).
- Identify opportunities and demonstrate possible solutions for reducing energy consumption.
- Evaluate related STANAGs and recommend improvements as well as recommend new STANAGs to properly address SE and therefore improve interoperability.
- Identify opportunities for reducing the energy consumption in other logistics units.

Figure B11: National overview – Smart Energy
The Smart Energy (SE) MILU established four areas: SE Camp East, SE Camp West, SE First Aid and SE Water. More than 50 pieces of equipment and expertise was contributed by 14 private companies, the German Bundeswehr (BAAINBw) and the Department of Defense (US Army). The SE MILU that was coordinated by NATO’s Emerging Security Division, was led by Hungary with the NATO Energy Security Centre of Excellence (NATO ENSEC COE) as deputy leader. Additional support was kindly provided by Hungary and Serbia.

The SE MILU responded to a number of scenarios, including diesel generator break down, main power cut, contaminated water and soldiers need energy resupply. It also provided real life support to other MILUs and field camps. SE electricity was provided, for example, to FUEL, IEL, the NMNPBAT (Military Police), the NATO field camp and the VIP tent that the NATO Support and Procurement Agency (NSPA) installed. Equipment for real life support by SE included energy efficient water purification, heat pump cooling, insulated tents, low-energy LED lights, thermal solar showers, mobile island energy production and entire micro grids with energy management systems using diesel, wind and sun to produce electricity. Where such micro grids were installed, the fuel savings was estimated at 30-40%. The total of 450 m² photovoltaic panels that the SE MILU installed produced every day (during 15 hrs daylight) about 1,100 Kilowatt hours diesel-free electricity.

The SE MILU for the first time incorporated private companies into exercise structure and played role as contracted companies during real operations. These companies contributed equipment and expertise worth more than 2 million Euros: Blücher (DEU), ESTechnologies (NLD), G&G Partners (ITA), IDE - INTRACOM Defence Electronics (GRE), Multicon Solar (DEU), PFISTERER (DEU), Renovagen (GBR), Gruppo Rold (ITA), Schall (DEU), SETOLITE (DEU), smartflower (AUT), STEEP (DEU), Thales Defence & Security Inc. (USA) and TIEGEL (DEU).

In addition, a group of 26 experts from public defense agencies and universities evaluated the activities for three days. The event was directed by the NATO ENSEC COE in co-operation with the Austrian Climate and Energy Funds and supported by the NATO Science for Peace and Security (SPS) Programme.

**Assessment by the nationally nominated SMEs – EARC:**

During CL15 Smart Energy SMEs were in charge of evaluating interoperability in terms of power generation, storage, distribution and consumption within the SE MILU, as well as with between the SE MILU and other MILUs.

**EARC Key objectives**

- To test interoperability of SE equipment in deployed operational environment (innovative solutions provided by industry with mature military technologies being used in an operational environment);
- To identify opportunities and demonstrate possible solutions for reducing energy consumption;
- To evaluate SE related STANAGs and identify gaps;
To recommend improvements to STANAGs and, if needed, recommend new STANAGs to improve interoperability;
Identify opportunities for reducing the energy consumption and improving energy efficiency in other MILUs.

**EARC Tasks**
- To observe interoperability of SE equipment;
- To identify gaps (technical and procedural);
- To recommend possible solutions for addressing SE related gaps by improving existing STANAGs or developing new STANAGs.

**EARC Standardization/Interoperability Findings and Recommendations**

The two SE SMEs submitted two ODCR reports to the CL15 EARC ODCR database.

The first ODCR report was related to technical incompatibility of different deployable power generation systems. It was observed that technical incompatibility caused delays in power generation process.

The observations led to the conclusion that insufficient standardization of power generation systems' connectivity may affect the interoperability of energy management controllers deployed by different providers when it is being provided by private companies. To solve this issue, the SE SMEs recommended to include an automatic switch requirement into STANAG 4133 and to update AEP-28.

The second ODCR report addresses technical incompatibility of different deployable power generation systems, which caused delays in power generation process. It was observed that innovative power generation and management systems are not fully compatible with traditional diesel generator based systems in deployed force infrastructure (DFI), affecting energy efficiency and interoperability. It was concluded that integration of micro grids into DFI would provide a means to establish autonomous power generation, storage, distribution and management capacity in combination with traditional fossil fuels systems as a backup for power generation. The SE SMEs recommended to augment the publication ATP-52(B) covered by STANAG 2394 by including micro grid integration principles to DFI and to update AEP-28. In addition, it was recommended to develop a separate publication (STANREC) on micro grid integration within DFI. The SMEs also proposed to consider the establishment of a panel / writing team within MILENG WG to specifically address integration of micro grid technologies into DFI.

**EARC SMEs**
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In this functional area SMEs identified that 1 STANAG needs change and 1 STANAG needs review.

**ODCR SE No. 1 – (ODCR CL15 No. 63)
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**Analyst: Rasa PAZARAUSKIENE, NATO ENSEC COE
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Observation SE 1: Technical incompatibility of different deployable power generation systems caused delays in power generation process.

Discussion SE 1: On 10 June, in accordance with CL15 Mil/Mel scenario event No 406-2, Renovagen was requested to take the Roll-Array solar power trailer to the NATO Support and Procurement Agency (NSPA) camp and connect it with EST’s energy system in order to contribute additional power to the NSPA camp (to which EST was already providing power). The speed of deployment of the Renovagen system provided a very quick and convenient way to add extra PV generating capacity to the existing grid. However, the equipment was not able to utilize its battery capacity to deliver extra power or store energy.

These problems occurred because Renovagen’s system was single phase and EST was providing three-phase power. Only flexibility of the EST power generation system in being able to take input power on one phase and balance the energy between phases accordingly facilitated the interoperability and enabled successful completion of this task.

Flexibility to interoperate any single phase and three-phase power generation equipment together is important to enable assets to be fully utilized. Every conventional military power generation system has a standard to be able to deliver single-phase or three-phase power as required. The current standards however, do not allow any other power generation technologies (e.g. solar PVs) to be connected to the traditional generator. There is neither a documented standard regarding connectors for connecting a single phase generator to a three-phase grid.

NATO standard types of power (Single Phase and Three Phase) are provided in STANAG 4133. Technical aspects for harmonization of power generation systems in order to achieve interoperability are explained in AEP-28. This publication gives the advice for power generation design criteria and for operational instructions for electrical systems when interconnection with other power generation equipment is required in order to achieve interoperability. Neither of these publications provides sufficient standardization for the above discussed issues. STANAG 4133 is being revised at the moment. AEP-28 was written in 1996 and has not been revised since then.

**Conclusion SE 1:** Insufficient standardization of power generation system’s connectivity may impact the interoperability of energy management controllers deployed by different providers when it is being provided by private companies.

**Recommendation SE 1:** It is recommended to include an automatic switch requirement into STANAG 4133 (Method of specifying Electrical Power). This kind of switch allows constant power to be readily available throughout the power generation system by allowing multiple systems to be integrated and compensate any power loss. Action Body: MCLSB MILENG WG.
It is also recommended to update AEP-28 (ELECTRICAL POWER SUPPLY IN THE FIELD (1996) due to the interoperability needs and add national data as a SRD. Action Body: MCLSB MILENG WG.

**ODCR SE No. 2 – (ODCR CL15 No. 64)**

**Analyst: Rasa PAZARAUSKIENE, NATO ENSEC COE**

**Observation SE 2:** Innovative power generation and management systems are not fully compatible with traditional diesel generator based systems in Deployed Force Infrastructure (DFI), affecting energy efficiency and interoperability.

**Discussion SE 2:** Every military camp is different, and the optimum power production solution differs according to the location, climatic conditions, local resources, size, function, Force structure, concept of operations, and the phase of the operation. Despite these differences, interoperability and sustainability should be always taken into account during the DFI planning phase.

To be interoperable, a set of aligned power standards should be agreed across the nations to encourage "plug and play" capability development of power generation from renewable energy sources, and improvement of energy storage and management in order to best match energy demands. Sustainability implies the ability to use innovative systems and equipment with low footprint, and local resources if available, including renewable and alternative energy (e.g. solar, wind, fuel cells, and waste-to-energy technology).

To achieve interoperability and sustainability of power generation it is preferable to use microgrids, which could provide autonomous power generation and supply, combined with a mixture of fossil fuel based generators, renewable energy sources, energy storage and HN power, if existing and usable. This would allow one to reduce reliance on the traditional centralized grids in DFI. Power generation is originally the MILENG function and is being addressed in detail by MILENG publication series. Microgrid technology is new and rapidly evolving and therefore is not yet a part of MILENG publications. The next version of STANAG 2394, currently being drafted, should address the main principles of smart grid integration within DFI. There are no other specific standards for integration of this technology developed yet. Therefore, a separate allied publication to specify integration of smart grids should be considered. For this the MILENG WG would be a natural fit as an Action Body, however due to the limited expertise capacity and cross-discipline aspect, a collaborative effort between MILENG, logistics, Energy Security Centre of Excellence (NATO ENSEC COE), and EP experts, including industry, must be coordinated. The best way would be the establishment of a panel or writing team to specifically deal with these issues.

**Conclusion SE 2:** Integration of smart grids into DFI would provide a means to establish autonomous power generation, storage, distribution and management capacity in combination with traditional fossil fuels systems as a backup for power generation. Proper standardization of these technologies is necessary to achieve interoperability.

**Recommendation SE 2:**
1. To augment the publication covered by STANAG 2394, with smart grid integration principles to DFI. Action Body: MCLSB MILENG WG.
2. To update AEP-28 (ELECTRICAL POWER SUPPLY IN THE FIELD (1996) and add national data as a SRD. Action Body: MCLSB MILENG WG.
3. To consider the establishment of a panel / writing team within MILENG WG to specifically address integration of smart grid technologies into DFI. Action Body: MCLSB MILENG WG.
4. To develop a separate publication (STANREC) on smart grid integration within DFI. Action Body: MCLSB MILENG WG to lead a collaborative effort.

(For all and complete ODCRs see ANNEX D.)