УДК 621.311

G.I. Lagutin, A.N. Malysh

Ivan Kozhedub Kharkiv National Air Force University, Kharkov

MODERN PROBLEMS OF ENERGY SUPPLY FOR THE COMBAT OPERATIONS

The goal of this article is analyses of ways for reducing generator set fuel required for training, moving, and sustaining military forces, weapons, and equipment demand on the battlefield for military operations on the combat operations experience basis.

Keywords: *operational energy, military power supply units, alternative power generation, smart distribution system, energy efficient structures.*

Preface

Problem. The mission of the National defence forces of Ukraine is to protect the Ukrainian people and advance the nation's interest. Today, the top priority in meeting that mission is to prevail in anti-terrorist operation [1]. To protect our interests across the wide spectrum of challenges, the Ukraine will need a broad portfolio of military capabilities with maximum versatility [2]. Ukrainian armed forces will have to be as adaptable and agile as they are lethal and robust [3]. To build and sustain modern Ukrainian military forces, they must use its recourses wisely, and that includes our energy and fuel resources [4].

Modern challenges to Ukrainian national security are increasingly complex, requiring a broad range of military operations and capabilities – and a large and steady supply of energy. At the same time, at the operational and tactical level, fuel logistics have proven vulnerable to attack in recent conflicts [5].

Operational energy is the energy required for training, moving, and sustaining military forces, weapons, and equipment for military operations [6]. As long as military forces rely on large volumes of energy, particularly petroleum-based fuels, the vulnerability and volatility of supplies will continue to raise risks and costs for the armed forces [7].

Objective of the article. The goal of this article is analyses of ways for reducing generator set fuel required for training, moving, and sustaining military forces, weapons, and equipment demand on the battlefield for military operations on the combat operations experience basis.

Statement of the main material

According to "Report of the defense science board task force on us department of defense energy strategy", generators are the Army's single largest user of fuel on the battlefield during wartime (tab. 1).

Table 1

Army fuel consumption in peacetime and wartime (million gallons per year)

Category	Peacetime	Wartime
Combat Vehicles	30	162
Combat Aircraft	140	307
Tactical Vehicles	44	173
Generators	26	357
Non-Tactical	51	51
Total	291	1040

It is possibly to be proposed three principal ways to a stronger force [8].

1. **Reduce the demand for energy in military operations.** Today's military missions require large and growing amounts of energy with supply lines that can be costly, vulnerable to disruption, and a burden on warfighters. The military forces needs to: reduce the overall demand for operational energy; improve the efficiency of military energy use in order to enhance combat effectiveness; and reduce military mission risks and costs.

2. **Expand and secure the supply of energy to military operations.** Most military operations depend on a single energy source, petroleum, which has economic, strategic, and environmental drawbacks. In addition, the security of the energy supply infrastructure is not always robust. This includes the civilian electrical grid, which powers some fixed installations that directly support military operations. The military forces needs to diversify its energy sources and protect access to energy supplies in order to have a more reliable and assured supply of energy for military missions.

3. **Build energy security into the future force**. Current operations entail more fuel, risks, and costs

than are necessary, with tactical, operational, and strategic consequences. Yet the Department's institutions and processes for building future military forces and missions do not systematically consider such risks and costs. The Department needs to integrate operational energy considerations into the full range of planning and force development activities.

Reducing demand, expanding supply, and building an energy-secure force will mean a military that uses less energy, has more secure energy sources, and has the energy resources it needs to protect the Ukrainian country during anti-terrorist operation.

The **positive outcomes for the Ukrainian armed forces** include [9]:

– saving lives now lost moving and protecting fuel on the battlefield;

– improving the range, endurance, and reliability of ground, air, and naval forces and information assets;

– lightening the logistics load and reducing the vulnerability of fuel supply lines;

– refocusing some combat forces and capabilities from supply lines and fuel logistics to operational missions.

It is **three ways for reducing generator set fuel** demand on the battlefield [10].

First of all, renewable and alternative power generation that reduces fuel consumption by generating power through a combination of renewable, traditional and alternative power generation. For example, it is possibly a transportable hybrid electric power station (fig. 1) that utilizes both renewable and traditional energy sources: wind turbines, solar panels, diesel generators and batteries in order to provide both continuous and back-up power.

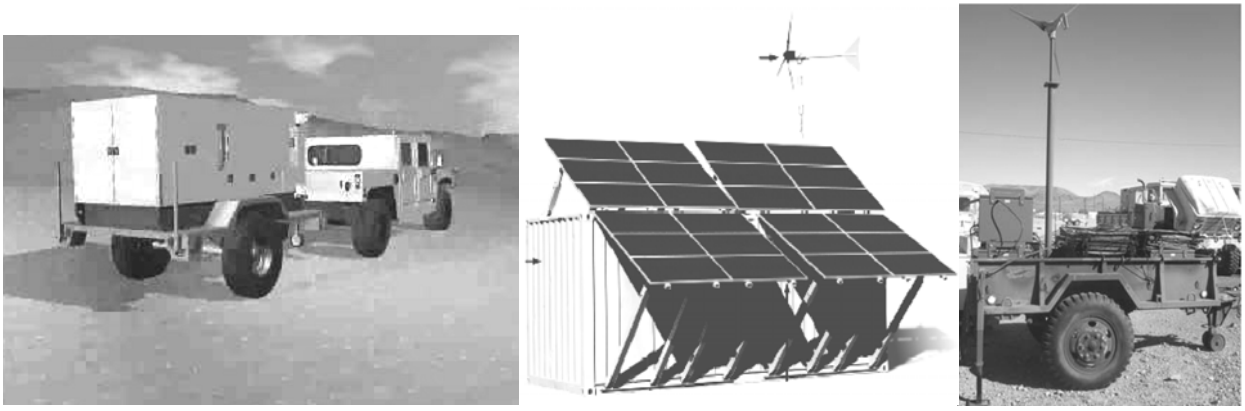

Fig. 1. Transportable hybrid electric power station

The hybrid electric station can provide renewable power that can be combined with conventional fossil fuel power to enhance mission capability while providing constant reliable power. Nevertheless while the system proved effective in reducing fuel consumption, it was not ideal for harsh combat conditions. Tactical garbage to energy refinery (fig. 2) is another example of reducing generator set fuel demand.

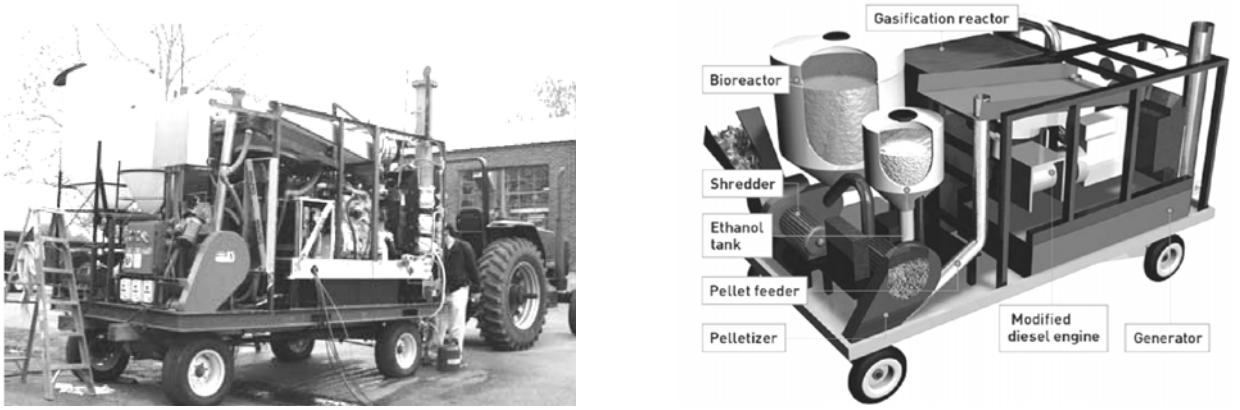

Fig. 2. Tactical garbage to energy refinery

It is bio-refinery hybrid power system that converts solid waste such as paper, plastic, packaging and food waste into electricity via a standard diesel generator. This one incorporates two complementary tech-

nologies: bioreactor to convert carbohydrates, sugars, some cellulosic waste into vaporous ethanol and thermochemical gasifier to convert bioreactor residuals into "fuel gas". How it works? The shredder rips up waste and soaks it in water. The sludge is pumped into the bioreactor, and enzymes break it down into carbohydrates and then into simple sugars, which yeast metabolizes into ethanol. The pelletizer compresses undigested waste pellets and feeds them into a gasification reactor that burns them in a low-oxygen, high-temperature environment to produce a composite gas. The ethanol is combined with the composite gas and injected into a diesel generator, where it is mixed with diesel fuel to generate electricity.

Secondly, a smart distribution system (fig. 3) that precisely connects power consuming and producing devices that has real-time or near real-time knowledge of the available power supply and load demands and uses that knowledge and an automated power manager to properly schedule and deliver available energy supplies to intelligent energy consuming devices [11].

This power manager precisely matches supply with demand while minimizing excessive production, shaving peak demands or minimizing unnecessary losses of energy. This is system that provides: plug & play connectivity power sources and electrical loads; intelligent control; power source management; electrical load management such as load shedding, peak shaving, load prioritization and phase balancing.

The last thing, energy efficient structures and technologies reduce energy consumption through minimized air infiltration, low-power devices and efficient environmental control. The main idea of this technology is to provide an insulating layer on the tents to keep the outside air out and the air-conditioning in (fig. 4).

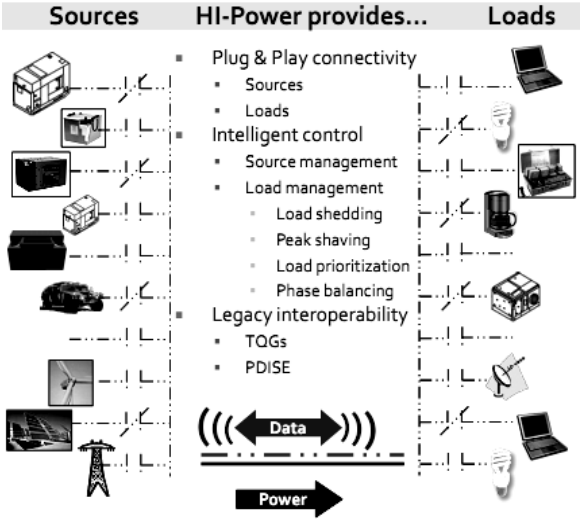

Fig. 3. Smart distribution system

a b

Fig. 4. The tents spray foam insulation: a – before; b – after

The spray foam insulation can be used. It is sprayed onto the tents, and will fill every nook and cranny, creating a uniform monolithic barrier. Besides, flexible electroluminescent lighting surfaces can be used for reduce energy consumption. There are can provide general illumination for shelters; can decrease deployment time, weight, and cube; can be printed on multiple substrates (including fabric); polymer-based lighting surfaces are flexible, durable and safe; puncture of electroluminescent lamp does not cause failure.

Summary

There are two main benefits for the proposed initiatives:

1). Reduced fuel transport saves money and reduces the frequency of vulnerable fuel convoys being exposed to enemy attacks. Spray foam insulation on tents will reduce the demand for fuel in generating power to air-condition the tents. Transportable hybrid electric power stations make use of renewable energy sources to generate power

supply and less fuel is required.

Tactical garbage to energy refinery converts waste to energy, and it conserves diesel fuel. Each month, tactical garbage to energy refinery can save enough gasoline to fill a mid-sized tanker truck. Fewer fuel trucks means fewer convoys subjected to improvised explosive devices (IEDs) along the transportation route.

2). Reduced waste disposal costs. There will be substantial savings on disposal costs if the waste can be converted into electricity.

Bibliography

1. [Електрон. ресурс]. – Режим доступу: http://ukurier.gov.ua/uk/articles/muzhni-zahisniki-ukrayini/.

2. Лагутин Г.И. Особенности обоснования характеристик и показателей образцов электротехнических средств систем электроснабжения комплексов вооружения и военной техники / Г.И. Лагутин // Системи озброєння і військова техніка. – Х.: ХУПС, 2015. – № 4(44). – С. 21-23.

3. Лагутін Г.І. Аналіз методів визначення характеристик та показників якості систем електропостачання комплексів озброєння та військової техніки / Г.І. Лагутін // Наука і техніка Повітряних Сил Збройних Сил України. – 2015. – № 3(20). – С. 147-151.

4. Лагутин Г.И. Требования к автономным источникам электрической энергии общевойскового назначения с учетом опыта проведения антитеррористической операции // Наука і техніка Повітряних Сил Збройних Сил України. – 2015, № 3(20). – С. 147-151.

5. Lagutin G. I. Military power supply units development prospects on the combat operations experience basis / Г.И. Лагутин // Системи озброєння і військова техніка. – Х.: ХУПС, 2015. – Вип. 3(43). – С. 45-48.

6. Лагутин Г.И. Анализ режимов потребления электрической энергии комплексами вооружения и военной техники / Г.И. Лагутин // Системи озброєння і військова техніка. – Х.: ХУПС. – 2014. – Вип. 3(39). – С. 46-49.

7. Лагутин Г.И. Особенности определения перечня параметров и характеристик систем электроснабжения / Г.И. Лагутин // Збірник наукових праць Харківського університету Повітряних Сил. – Х.: ХУПС, 2014. – Вип. 4(41). – С. 73-76.

8. Energy for the warfighter: operational energy strategy. US Department of Defense. 3700 Defense Pentagon. Washington, DC 20301-3700. 2011.

9. "Energy Infrastructure and Fuels Required to Support Permanent DoD Installations": Office of the Deputy Under Secretary of Defense (Installations and Environment). – Department of Defense Annual Energy Management Report, Fiscal Year 2009, May 2010.

10. [Електрон. ресурс]. – Режим доступу: http://www.acq.osd.mil/ie/energy/library/ aemr_fy_09_may_2010.pdf.

11. [Електрон. ресурс]. – Режим доступу: http://www.eia.gov/forecasts/aeo/pdf/0383er(2011).pdf.

Надійшла до редколегії 31.10.2016

Рецензент: д-р техн. наук, проф. Б.Т. Кононов, Харківський національний університет Повітряних Сил імені Івана Кожедуба, Харків.

СУЧАСНІ ПРОБЛЕМИ ЕЛЕКТРОПОСТАЧАННЯ ДЛЯ ЗАБЕЗПЕЧЕННЯ ВЕДЕННЯ БОЙОВИХ ДІЙ

Г.І. Лагутін, О.М. Малиш

Метою статті є аналіз шляхів зменшення об'єму споживання палива для електроагрегатів, які використовуються для бойової підготовки, маневру та забезпечення військ, озброєння та військової техніки на полі бою під час ведення військових операцій з урахуванням досвіду ведення бойових дій.

Ключові слова: *енергія для забезпечення бойових дій, військові джерела електричної енергії, альтернативні джерела енергії, інтелектуальні системи розподілу електроенергії, енергозберігаючі споруди.*

СОВРЕМЕННЫЕ ПРОБЛЕМЫ ЭЛЕКТРОСНАБЖЕНИЯ ДЛЯ ОБЕСПЕЧЕНИЯ ВЕДЕНИЯ БОЕВЫХ ДЕЙСТВИЙ

Г.И. Лагутин, А.Н. Малыш

Целью статьи анализ путей уменьшения объема потребления горючего для электроагрегатов, используемых для боевой подготовки, маневра и обеспечения войск, вооружения и военной техники на поле боя при проведении войсковых операций с учетом опыта ведения боевых действий.

Ключевые слова: *энергия для обеспечения боевых действий, войсковые источники электрической энергии, альтернативные источники энергии, интеллектуальные системы распределения электроэнергии, энергосберегающие сооружения.*