SOURCES OF ELECTRIC ENERGY FOR LOGISTIC MEANS IN ISO 1C CONTAINERS

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Abstract

Nowadays a use of renewable sources of electric energy is still a live topic. Utilization of renewable sources of electric energy gets into mobile equipment and surely it would be beneficial in ISO 1C containers being used as mobile logistic means. Using non-conventional sources the mobile repair means would not be dependent only on an external electricity supply system, or on an electric supply plant, but it would have own alternate solution for production of electric energy.

Keywords: Electric power station, renewable source, photovoltaic collector, logistic container

1 Introduction

In a constant increasing consumption of energy and gradual depletion of non-renewable sources the ratio of renewable sources of energy (OZE) regularly increases. The following energy sources are considered to be renewable:

- sun,
- water,
- wind,
- biomass, biogas, bio-oil,
- geothermal energy,
- energy of the sea – high and low tides, sea streams, sea waves, land-swell.

Water and wind energy is used the most; they have low operational costs to a production of electric energy.Their current part in a world installed power capacity is about 22%. The most expensive is a direct transformation of solar radiation into electric energy – photovoltaic. Utilization of biomass is expensive mainly due to a transportation of mass scattered in a large area. Use of geothermal energy for a production of electricity in a large scale is not feasible, because temperature of springs is not sufficient for production of heated steam for a turbine. Other perspective sources of energy can be taken into account. It relates e.g. utilization of bituminous slate and tarred sand, use of land-swell, high and low tides, sea streams, difference in temperatures of surface waters in tropics and colder water in deeper levels as well as utilization of energy of waste.Helium is considered as a fuel of future. Energetic gases (e.g. propane and butane) will be used more. Research of fuel elements and biological transformation of energy goes on hopefullyusing micro-organisms for production of methane and hydrogen.

Table 1 *Informative overview of electric energy sources and its part in a total amount produced in Slovakia [2]*

Nuclear production (in %) 53,8	Annual output* (2012, in TWh) 7,4244	Installed output** (2012, in MW) 1940
Production in thermal power plants (in %) 18,1	Annual output (2012, in TWh) 2,4978	Installed output (2012, in MW) 3418
Production from water (in %) 15,1	Annual output (2012, in TWh) 2,0838	Installed output (2012, in MW) 2534
Production from solar energy (in %) 2	Annual output (2012, in TWh) 0,2760	Installed output (2012, in MW) 524
Other production (in %) 11	Annual output (2012, in TWh) 1,3248	Installed output (2012, in MW) 15

Even though Slovakia has committed itself to increase a ratio of electricity being produced from renewable sources, meanwhile it happens only very slowly. Water power plants lag behind due to drought and a solar business is decelerated by government. So the most electricity is still produced by nuclear power plants.

2 Electric sources for mobile repair means in ISO 1C containers

Electric source stations (EZA) in ISO 1C containers are assigned for a production and distribution of electric energy, as a back-up energy source to provide with operation of electric equipment in field conditions. They contain a drive unit, power station for a production of electric energy, a transformer station and a cable supply network. The energy generating block is installed in the ISO 1C container, it is sound- and thermal isolated, temperature tempering and airing is provided with an in-built exhaust fan and through openings for airing with closing blinds. The container floor is designed as a leak-proof case to seize a potential leakage of operational liquids. The container includes also a cable stock for distribution cables and accessories of the energy supply block. The ISO 1C container is equipped with large door with a visor and detachable panels for an easy access for a daily maintenance. [4]

Fig. 1 *Electric supply station MP-250, P_n =200 kW (ISAF Afghanistan military operation)*

2.1 Requirements for electric supply sources for mobile repair assets

One of most important requirement for electric power sources for mobile repair assets is their applicability in macro climate area with a climate N 14 (STN 03 8206):

- Temperatures ranging from -35 °C up to +55 °C,
- Relative humidity of air up to 30% at temperature +25 °C,
- Speed of air flow up to 20 $m.s^{-1}$ from all directions,

Atmospheric precipitations in form of rain with intensity 3 $mm.min^{-1}$ falling 30°angle-wise in all directions [4].

They must be made so that several kinds of distribution systems can be connected to them:

- TN – C, 3 + PEN, 400/231 V – the most used four-conductor distribution system,
- TN – S, 3 + PE + N, 400/231 V – distribution system being used in the world,
- TT, 3 + PE + N, 400/231V –a distribution system, which is not much used, however it appears in electric distribution systems of special equipment,
- IT, 3 + PE + N, 400/231 V –isolated system being used mainly for special or medical equipment and in electric equipment for island electric power facilities [4].

3 Technical terms for electric supply sources in ISO 1C container

Source or a set of sources of electric energy must be able to manage a load by supplying with stable frequency and voltage. An increased intake at their commissioning is to be taken into consideration for inductive and capacity types of impedance, e.g. for series engine a starting input power is 1 up to 1,5 multiple of a common input power, for inductive or asynchronous engines the starting input power is generally 2,5 up to 5 multiple. More exactly we can define a starting input power by measuring an input power of a load at starting and consequently a current output during an operation with an inductive ampere-meter. Therefore it is needed to

choose a proper output so that a starting output does not exceed a maximum output of a source of electric energy supply. Otherwise due to a lack of output the appliances; mainly engines may overheat during too long start due an insufficient output of the source and to be damaged. In addition, it is necessary to consider a presupposed frequency of switching off and on of this kind of load and to choose accordingly to choose a source of a set of sources of electric power with a sufficient output reserve as well.

Table 2 *Current numbers of containers used by Slovakia in NATO operations*

Ser.	Container type	Number of pcs in MKM operations		
		ISAF	UNFICYP	ALTHEA
1.	MP 250 Power station	2	-	-
2.	Refrigerator ISO 1C container	2	-	-
3.	Surgical ambulance – field container	1	-	-
4.	Accommodation 1-bed ISO 1C container	4	-	-
5.	Accommodation2-bed ISO 1C container	5	-	-
6.	Accommodation4-bed ISO 1C container	34	-	-
7.	Sanitary, social ISO 1C container	6	-	-
8.	Office, autonomous ISO 1C container	5	-	-
9.	ISO 1CX container, tank-collector	6	-	-
10.	ISO 1CX container, potable water tank	6	-	-
11.	Modular, final ISO 1C container 3-hedron	6	-	-
12.	Storage ISO 1C container	36	5	3
13.	COPS CM-/PAB/-6B container,	2	1	-
14.	COPS CM-/PAB/-6A container	2	1	-

3.1 Technical equipment of mobile container assets

Technical equipment of mobile repair facilities may vary depending on assignment of a particular repair means. To design a set of electric energy sources in ISO 1C container, it is necessary to know an installed output; it means a summary of outputs of all appliances in assigned rooms including presupposed output of appliances.

Table 3 *Electric parameters of some logistic container workplaces*

Container designation	Voltage system	Max. input power (kW)/ Output of a source itself (kW)	
Accommodation, 2 bed – ISO 1C container	TN.S 3+N+PE 400/230V AC 50Hz	Total	5,50
		Without a source itself	
Accommodation, 4 bed – ISO 1C container	TN.S 3+N+PE 400/230V AC 50Hz	Total	5,50
		Without a source itself	
Briefing, modular 3 wall – ISO 1C container	TN.S 3+N+PE 400/230V AC 50Hz	Total	7,50
		Without a source itself	
ISO 1C container – office	TN.S 3+N+PE 400/230V AC 50Hz	Total	6,00
		Without a source itself	
ISO 1C container – social	TN.S 3+N+PE 400/230V AC 50Hz	Total	18,20
		Without a source itself	
ISO 1C container – a tank for potable water	TN.S 1+N+PE 1x 230V, 50Hz	Total	1,25
		Without a source itself	
ISO 1C container – surgical ambulance	TN.S 3+N+PE 400/230V AC 50Hz	Total	9,50
		Without a source itself	
ISO 1C container – refrigerator for a deceased person	TN.S 3+N+PE 400/230V AC 50Hz	Total	5,10
		Without a source itself	
ISO 1C container – refrigerator, two-chamber	TN.S 3+N+PE 3x 400V, 50Hz	Total	4,80
		Without a source itself	
ISO 1C container – mobile repair shop, „A" type	TN.S 3+N+PE 400/230V AC 50Hz	Total	15,00
		El power station MP 56, 400/230V, 50Hz	5,10

In Table 3 we can see an overview of particular container workplaces, their output, voltage system and source of electric energy. Input power includes a corrective coefficient, which reduces a needed input power. A standard recommends these coefficients:

Number of appliances supplied /rooms	2	3	4	5	6	7	10	16	20
Coefficient	0,77	0,66	0,60	0,56	0,53	0,50	0,45	0,40	0,38

The designer and developers can state own coefficients based on their experience and knowledge.

3.2 An example of an application of a renewable source of electric power for an ISO 1C container – mobile repair shop of, A type

A main source of electric power in a proposed ISO 1C container is an external electric power distribution system, in case of its unavailability a diesel electric power station with an auxiliary source for the both systems the photovoltaic collectors are proposed. The photovoltaic system can store electric energy in accumulators or to distribute it directly to the electric power networks. In such a case it relates a so called hybrid systems. The system itself features by more complicated regulation that is due to optimization of all power sources. During some months significantly less electric energy can be obtained from photovoltaic system, therefore it is needed to propose sources of electric energy also for such operation. The most useful is to distribute a system with an auxiliary source of electric power, which covers a need in electric energy in periods with insufficient solar radiation. Photovoltaic system serves as an auxiliary source of electric power to an external electric power and a power station system, with regard to its output it is suitable only for supplying of single-phase electric devices. Electric power supplied by a photovoltaic system can be used in a direct-current form to resupply the accumulator batteries through a regulator of charging. In case those accumulators are charged, then the electric power is supplied directly into an electric distributor. It is exactly the way, the photovoltaic system works with a generator system that is replacing an external electric system. All these important functions and many other functions in charging of accumulators can be provided. e.g. by voltage convertor and a regulator of charging e.g. of Multiplus 24/3000/70 type. Draft of a flow chart of a renewable source of electric power for the ISO 1C Container – a mobile repair shop asset of "A" type is illustrate je depicted in Fig. 2.

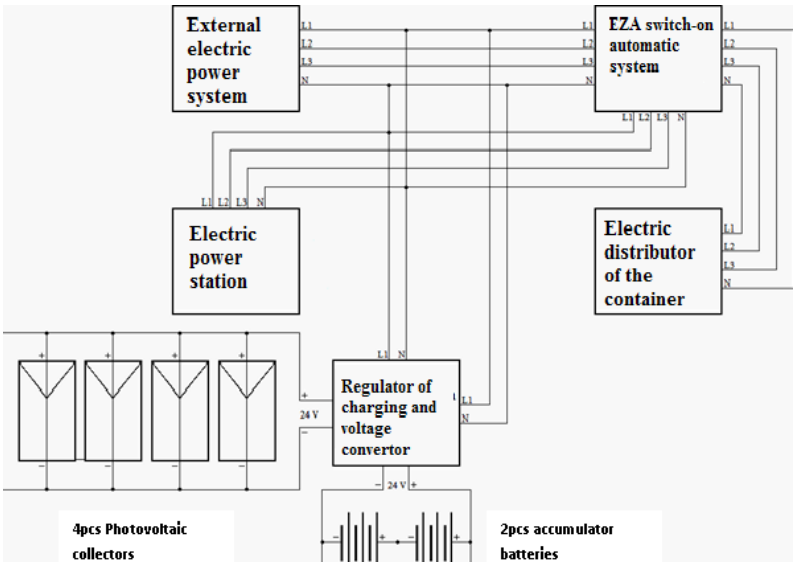

Fig. 2 *Draft of a flow chart for a renewable source of electric power for ISO 1C container – a mobile repair shop*

4 Conclusion

A spurt growth of a commercial deployment of power technologies using renewable sources in recent years shifts this power alternative to the focus of economic and political attention. Through a combination of an external electric power system, in case when diesel power stations with auxiliary source are unavailable, a hybrid system of sources of electric power is proposed that is convenient for mobile container assets. Mobile container logistic assets, where a source of electric power is an electric source power station is easily detectable due to their noisiness, generated heat and exhaust gases. On contrary, use of photovoltaic system is noiseless, with no generated heat and no exhaust gases, whereby the costs for their operation are minimal. In a proposed set of

sources of electric power, if necessary, only photovoltaic system can be used that is however limited by its output. This set of sources of electric power is proposed for currently produced mobile container assets with a possibility to use comparable container workplaces and systems.

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