RESULTS REGARDING MONITORING OF THE RISKS IN THE ROMANIA-BULGARIA CROSS-BORDER AREA

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Abstract: In the period 2011-2014 was developed the cross-border project RO-BG MIS ETC 166 ”Joint Risk Monitoring during Emergencies in the Danube Area Border ”.The objectives were:1. Conceiving and realization of photovoltaic system for anti-hail units power supply system.2. Conceiving and realization of automatic control system for the rockets launch ramp.3. Conceiving and realization the monitoring system of information necessary for the efficient operation of the equipments part of antihail units. Some of the equipment will be taken in mass production by SC Electromecanica Ploiesti, authorized for the production of the assemblies to the national antihail system.
Keywords: risk, monitoring, cross border, hail.

1. INTRODUCTION

Each Command Center is connected with several local launch units for antihail rockets, usually located in isolated areas where it isn’t electricity distribution networks. For local three-phase electricity supply, we designed a system that uses primary energy obtained from photovoltaic panels.

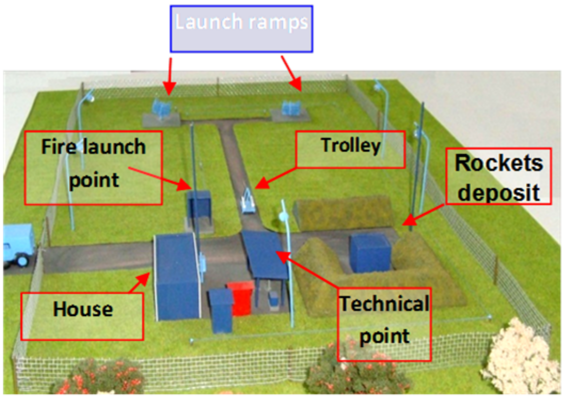


Fig. 1. The model of the local launch unit.

The Command Center transmits to local units the coordinates of the cloud containing hail and local operator will manually positions the missile launch ramp. Within the project it has developed a positioning system with three-phase synchronous motors which allows automatic positioning taking in account the coordinates transmitted from the center control point or local operator input via a touch screen. Given the importance of compliance with firing coordinates transmitted from the center control point to the local units, it was realized a monitoring system for the following: the transmitted information, the information received, and other information related to the ramp position, launched missiles, launch time.

2. PHOTOVOLTAIC SYSTEM FOR POWER SUPPLY OF CONSUMERS OUT OF ANTI HAIL UNITS

Starting from general structure of power supply to consumers in the hail protection units (Figure 2) , have been identified categories of consumers, power and average lifetime, and was calculated the needed electricity for one day (Table 1).

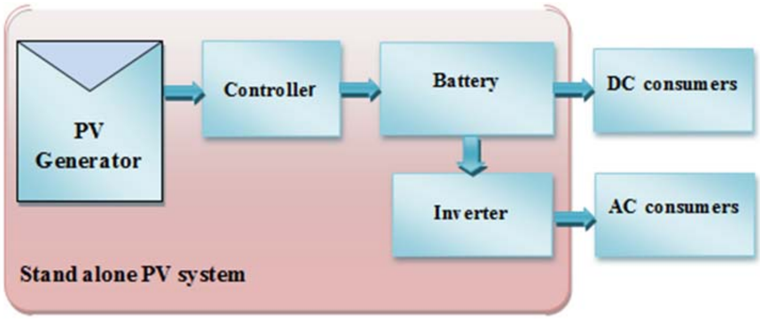


Fig. 2. Structure of power supply system.

Table 1. **The characteristics of the electrical equipment of a local anti hail unit**

Consumers	Nominal power, [W]	Lifetime, [h/day]	Electricity needed, [Wh/day]
Radio station	30	1	30
Warhead missile launchers	12×1,2	0,3	4,36
Servodrive of ramp orientation	2x60	0,5	60
Development system with microcontroller	20	1	20
Lighting - saving bulb - fluorescent bulb	 11 2×13	 2 8	 22 208
Electric cooker	2100	1	2100
Microwave oven	1500	0,2	300
Refrigerator	200	5	1000
TV	150	2	300
Satelit antena	30	2	60
Radio	20	6	120
Notebook	100	4	400
Total electricity needed [Wh/day]			**4625**

Measurements were made on the solar potential of Craiova and chose two photovoltaic modules TSM type with maximum power Pmax = 195 [Wp], the current at maximum power Imp = = 5.31 [A], the voltage at the maximum power Vmp= 36.7 [V]. We chose two batteries SB 12/185 with rated voltage 12 [V] and the nominal capacity of 185 [Ah] (Figure 3). DC consumers are supplied directly from one of the two batteries or both batteries and AC consumers 220 V, 50 Hz are supplied through an inverter type VFX3024E having 3 kVA power, nominal input DC voltage 24 V, nominal power output continuously at 25°C 3000 [VA], AC voltage / frequency 230 / 50 Hz, (Figure 3).

Fig. 3. The inverter-battery ensembles.

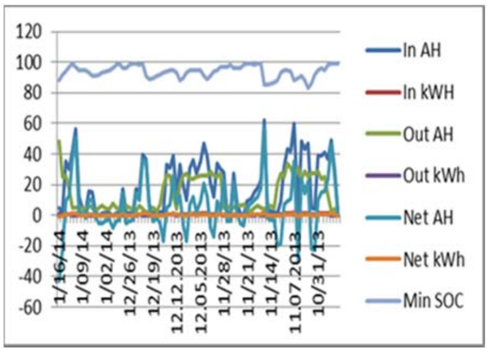
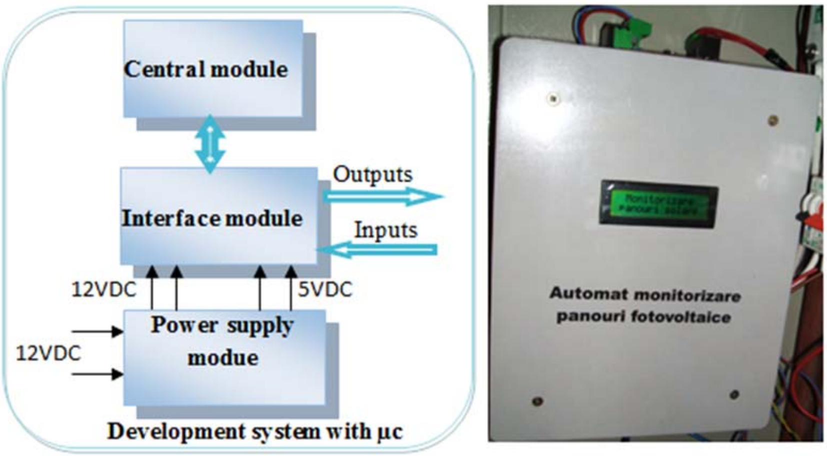


Fig. 4. Experimental results.



a) b)

Fig. 5. Development system for monitoring power flow:a)block diagram; b)applied prototype.

For the management of power flow from photovoltaic panels, energy consumption and the reserve of energy stored in batteries so as to ensure in all circumstances, the energy required to launch of anti hail rockets, was elaborated the algorithm of the hierarchy of consumers and was designed a system for power flow control (Figure 5). For the proposed solution was obtained OSIM Patent 126 005 B1.

3. AUTOMATIC POSITIONING SYSTEM OF THE LAUNCH PAD FOR THE HAIL SUPPRESSION MISSILES

The launch pads for the hail suppression missiles (fig. 6), manufactured by Electromecanica Ploiești, are manually positioned, and the viewing of the azimuth angle is done with a very low accuracy. In order to reduce the posioning time and to increase the accuracy, one proposed a drive system for the automatic positioning of the launch pad.

The static torque has been estimated analytically (fig. 7), then it has been experimentally determined (fig. 8) for the launch pad built by Electromecanica Ploiești.

1 – Launch girder, 2 – Shelf, 3 – Azimuth/elevation cradle, 7 – Azimuth axis, 8 – Leg, 9 – Azimuth scale, 11 – Foot paw, 12 – Azimuth transducer, 21 – Distribution block

Fig. 6. The mechanical structure of the hail suppression missile launch pads.

The analytical determination of the static torque has been done considering a conical pivot bearing (fig. 7), subjected to a vertical loading.

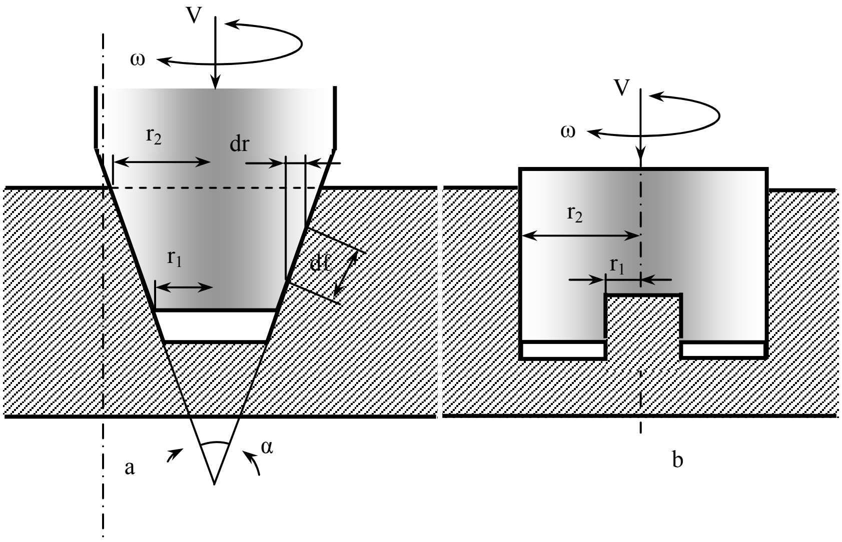


Fig. 7. Explanation for calculating the torque by using a conical pivot.

In steady state, the power requested by the rotating mechanism is:

$$P_r = \frac{\left(M_f + M_v\right)\Omega}{\eta},$$

where:

Ω - the maximum angular speed of the rotating mechanism, M_f - friction component, M_v – a wind corresponding component

The methodology of determining the static torques assumes measuring the actual torque values, while the missile system is moving. In order to measure the static torques, one used a torque wrench with a scale graded in kilograms-force, on one hand, and a torque wrench scaled directly in N·m, on the other hand (fig. 8). In the first case, the force was transformed from kilograms in Newtons, through a further calculation.

The measurement was carried out at the ends of the pad's moving parts (the end of the launch girder), both for azimuth and elevation, but also at the rotational axis, by means of the torque wrench (fig. 8). Knowing the length of the lever arm, one calculated the torque value in the specific measurement unit, namely Newton-meter (N·m).

Fig. 8. The torque wrench used during the experiment.

Therefore, for the azimuth, the static torque determined at the rotational axis is:

$$M_{sA} = F_{sA} \cdot d_A = 1{,}47 \cdot 9{,}81 \cdot 0{,}52 = 7{,}5\ \mathrm{N \cdot m},$$

F_{sA} – the static force necessary for rotating the launch pad in the azimuth direction;

d_A – the lever arm of the tangential traction force.

The dynamic torque the motor must provide in order to accelerate the upper part of the launch pad (composed by the azimuth/elevation cradle, shelfs and launch griders loaded with a maximum of 8 missiles) is:

$$M_{dA} = J_A \cdot \varepsilon_A = J_A \cdot \frac{\Delta\omega_A}{\Delta t_A},$$

where

J_A – is the total moment of inertia of the superior part of a loaded launch pad:

$$J_A = m_A \cdot r_A^2 = 250 \cdot (0,52)^2 = 67,6 \text{ kg} \cdot \text{m}^2,$$

where

m_A – the mass of the upper part of the loaded launch pad, $m_A = 250$ kg ,

r_A – is the average radius of the upper part of the launch pad, $r_A = 0,52$ m .

The power needed to drive the motor over the azimuth direction is:

$$P_A = M_A \cdot \omega_A = 244,1 \cdot 0,35 = 85,44 \text{ W}.$$

A synchronous motor with permanent magnets is chosen, manufactured by Parker, the BSM 55-0070-3 model, having the following parameters: rated power - P_N = 188 W, rated torque - M_N = 0,45 Nm, rated speed - n_N = 4000 rot/min.

The gear chosen for driving the azimuth axis is a worm gear with a transmission ratio $i_A = 100$, also ensuring a blocking for the upper part of the launch pad in the shooting position.

A similar procedure has been followed for the elevation direction, and a synchronous motor with permanent magnets from Control Techniques, serial number 055E2B300BACRA063110, was chosen. The motor has the following parameters: rated power, P_N = 330 W, rated torque M_N = 1,05 Nm, rated speed n_N = 3000 rot/min. The gear chosen for driving the elevation axis is a worm gear with a transmission ratio $i_I = 500$. The worm gears, together with the the positioning control of the servo-motors (an antagonistic torque is developed every time the launch pad is displaced from the prescribed position) are implicitly ensuring a blocking of the launch pad in the shooting position.

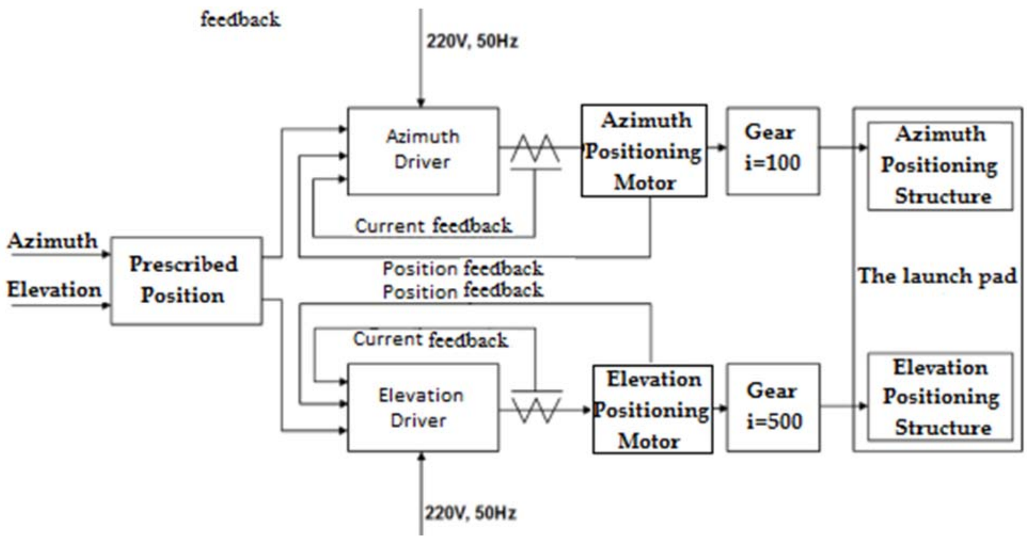


Fig. 9. Structural diagram of the drive system used in positioning the launch pad.

In figure 9 is presented the positioning system structure, in figure 10 the realized experimental model, and in fig. 11 the block used in prescribing the shooting coordinates (touch screen type). The coordinates can be introduced manually or transmitted directly from the hail suppression control unit. The intelligent drivers allow an adaption of the actual viewing conditions to the working conditions and a visualisation of the specific electrical quantities.

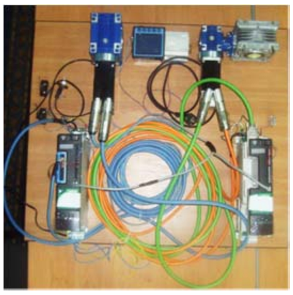


Fig. 10. The experimental model.

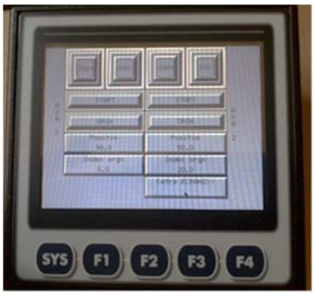


Fig. 11. The block used in prescribing.

4. MONITORING SYSTEM OF THE INFORMATION BETWEEN THE COMMAND CENTER AND LAUNCH ANTIHAIL ROCKETS UNITS

Integrated information system for monitoring information has two subsystems (fig. 12): the subsystem for taking the decision of launching and the decision support subsystem for launch. It is observed (Figure 13) that the system monitor information transmitted from the control unit to local units and vice versa from local unit to the control unit.

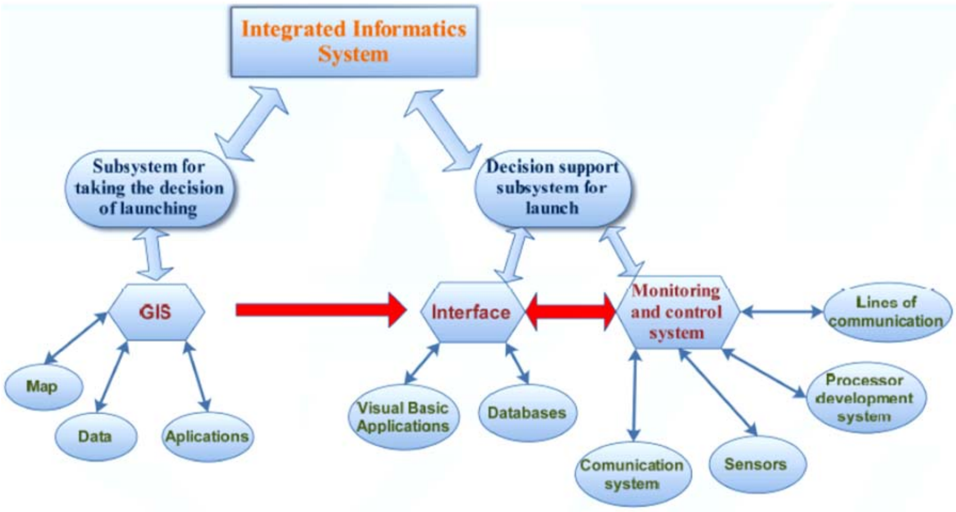


Fig. 12. The main components of the informatic system for monitoring.

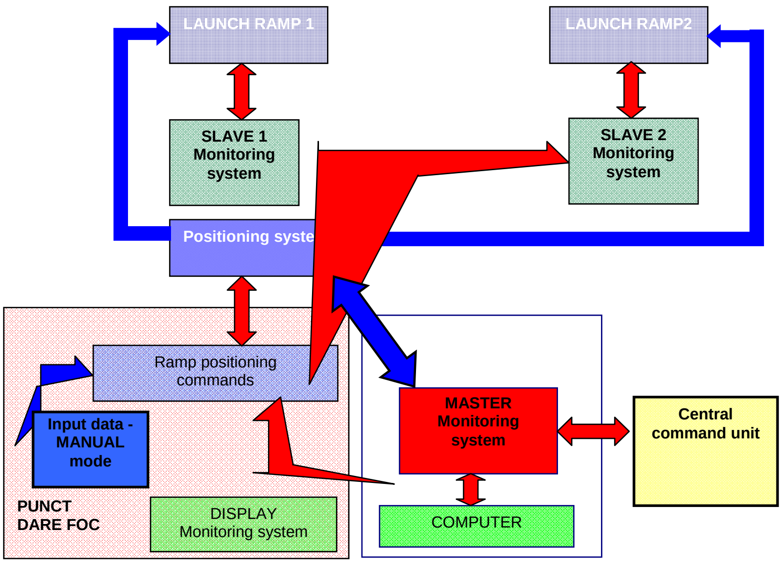


Fig. 13. Explanatory regarding the link with ramps and positioning system.

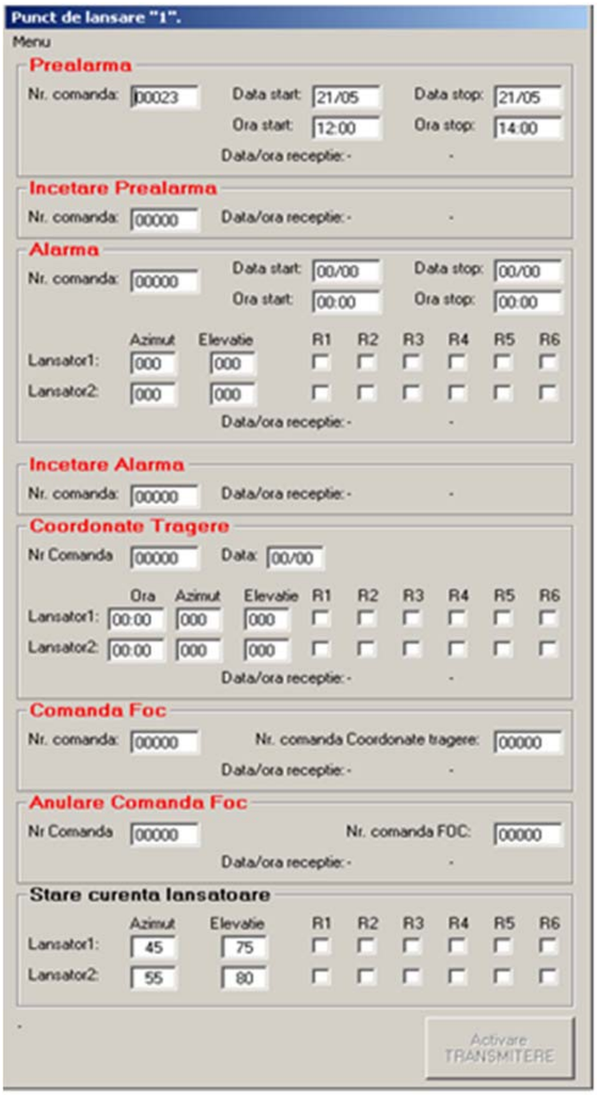


Fig. 14. Explanation regarding the information displayed.

The specific hardware consists of module MASTER and two modules SLAVE which provides communication between the local launch unit and central control unit.

The information acquired are displayed to the central control unit (Figure 14) and refers to the status of the system (Pre-alarm, alarm, waiting), launch coordinates transmitted from the control unit, the real coordinates of the ramps, launch beams that are placed missiles, date and time of the shooting order and also date and time for the execution of the order.

5. CONCLUSIONS

By carrying out the cross-border project MIS 166 ETC it was ensured the upgrading of the equipments fo r the Romanian antihail system.

Based on experimental results obtained, Electromecanica Ploiesti agreed to takeover the suggested solutions and adapting them to the produced equipments.

For the University of Craiova, CITT, this project resulted in a research base that can be used in other national research or cross-border research.

The project results were included in the book "Complementary equipments for the Romanian antihail system" that can be used by other research teams.

REFERENCES

[1] Alboteanu Laurentiu, Cercetări privind utilizarea energiei solare pentru alimentarea consumatorilor electrici din staţiile antigrindină izolate, Teza de doctorat, 2009.

[2] Alboteanu L., Novac Al., Manolea Gh., Nedelcuţ C, Sistem de monitorizare a circulaţiei energiei de la panouri fotovoltaice la consumatori cu priorităti ierarhizate, Brevet nr.126005 B1, publicat în BOPI nr. 6/2012.

[3] Manolea Gheorghe, Şulea Constantin, Informatic system for monitoring the anti-hail networks. functions and architecture, Proc. of VI-th international Conference: Days of the Academy of Technical Science from Romania, Zilele ASTR 2011, Timisoara, Romania, ISSN 2066-6586, septembrie 2011, pp.122-129.

[4] Manolea Gheorghe, Şulea Constantin, Alboteanu Ionel Laurentiu, Monitoring system for the local launch points of the anti-hail units, Analele Universitatii din Craiova, Seria: Inginerie Electrica, ISSN: 1842-4805, Editura Universitaria, Craiova, Romania, nr.35, 2011, pp.192-199

[5] Şulea Constantin, Manolea Gheorghe, Novac Alexandru, Alboteanu Ionel Laurentiu, Sistem pentru monitorizarea unităţilor de lansare al rachetelor antigrndină, Cerere brevet de inventie inregistrata la OSIM Bucuresti cu nr A 00452/20.06.2012

[6] Şulea Constantin,Cercetări privind realizarea unui sistem informatic integrat pentru monitorizarea unităţilor de lansare a rachetelor antigrindină,Teză de doctorat, 2012.

REZULTATE PRIVIND MONITORIZAREA RISCURILOR IN ZONA TRANSFRONTALIERĂ ROMANIA-BULGARIA

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Rezumat: În perioada 2011-2014 s-a derulat Proiectul transfrontalier RO-BG MIS ETC 166 cu titlul ”Joint Risk Monitoring during Emergencies in the Danube Area Border”. Obiectivele propuse au fost: 1.Conceperea si realizarea sistemului fotovoltaic pentru alimentarea unitatilor antigrindina 2.Conceperea si realizarea sistemului pentru controlul automat al rampei de lansare a rachetelor 3.Conceperea si realizarea sistemului de monitorizare a informatiilor necesare pentru controlul si functionarea eficienta a echipamentelor din structura unitatilor antigrindina. Riscurile avute în vedere sunt legate de căderile de grindină. Pentru reducerea efectelor acestora s-a înființat în Romania, în anul 1999, un Sistem național antigrindină format din mai multe Centre de comandă. La Ploiești și la Iași aceste centre sunt funcționale, urmând ca în etapa următoare să fie organizat și Centrul de comandă OLTENIA cu sediul la Craiova. Fiecare Centru de comandă este în legătură cu mai multe unități locale de lansare a rachetelor antigrindină amplasate, de regulă, în zone izolate față de rețeua de distribuție a energiei electrice. Pentru alimentarea locală cu energie electrică trifazată, la parametrii rețelei naționale s-a conceput un sistem care folosește energia primară obținută de la panouri fotovolatice, care va fi prezentat în cadrul lucrării. Centrul de comandă transmite către unitățile locale coordonatele norului care conține grindină, iar operatorul local poziționează manual rampa de lansare a rachetelor. S-a realizat un sistem de poziționare, prezentat în lucrare, cu motoare sincrone trifazate care permite poziționarea automată pornind de la coordonatele transmise de la centrul de comandă sau introduse de operatorul local cu ajutorul unui touch screen. Având în vedere importanța respectării coordonatelor de tragere transmise de Centrul de comandă către unitățile locale, s-a realizat un sistem de monitorizare a informațiilor transmise, a informațiilor recepționate și a altor informații legate de pozția rampei, rachetele lansate, ora de lansare. În cadrul lucrării se va prezenta sistemul de monitorizare. Unele dintre aceste echipamente vor fi preluate în fabricație de serie de către SC Electromecanica Ploiești.