

Contract 71-137/2007

DRIVE SYSTEM FOR HIGH ENERGY PERMANENT MAGNETS SYNCHRONOUS MOTORS FOR URBAN ELECTRICAL TRACTION

Key words:

Drive, motor, synchronous, magnets, traction

Project summary:

The project is in conformity with the objectives of the 4th Program regarding the development of new products and technologies destined to transports and automobile production (7.5) from the 7th research direction of the project. The specific objective of the proposed project is: "Products and technologies that increase the means of transport energetic efficiency and reduce the pollution effects" (7.5.1.).

Synchronous motor driving for electric traction vehicles, was not realised till now at a national level, in the railway or urban traction field. Permanent magnets synchronous motors have known in the last two decades a continuous development thanks to the technical and economical performances. The advantages of permanent magnets synchronous motors related to power factor raised to function in load and the superior efficiency caused by the lack of losses from the inductor, are well known. Permanent magnets synchronous motors became established especially in distinctive applications such as the main drive or advance drive of machine-tools and industrial robots, the drive of naval and lifting equipment, or in military technique. All these performances also established them in special applications related to the electric drive of motor vehicles. At international level we situate ourselves at the stage where the variable direct voltage regulator and direct current motors have been replaced, for the new application, with the drive for traction in alternating current with asynchronous or synchronous motors. It is known that the synchronous motors are used successfully to drive the high-speed train made in France, TGV. It is preferred that the supplier of equipment for traction in alternating current were a native supplier because of the high requests of maintenance and because of the lower costs, conditions that cannot be assured conveniently by foreign companies. More over, the necessary flexibility for the software maintenance of the control drive by modification or adding new equipment functions in its interaction with the more and more crowded traffic conditions of the capital, represents an important issue that shows the drive equipment should be under control of a Romanian company. Synchronous motor drive proposed for development is in agreement with the most actual tendencies of electric traction, for the production of urban low floor vehicles (trolley bus, tram, underground), that need power motors of at most 200 kW, of small sizes and very viable due to the high energy of permanent magnets. The drive is made with the technique field of control (FOC) that needs a big power of calculation for the micro control switchgroup which is made of processors DSP that are available on the market, at this time at very low prices. The main investment for the producer company is represented by the companies of hardware and software development for the processors. This way the human factor has a very big importance in this field. The degree of the control accuracy is very big due to the high frequency of the control clock DSP, and due to the high resolution of the position encoder fixed on the ax of the traction motor. The precise control, resulted from the clear accuracy of the mathematics calculation, that generate the command pulses for the traction inverter, makes the viability of the equipment very powerful and increase the distance between the periods of vehicles revision. That leads to the increase

of the availability degree of the vehicles in the means of transport fleet. The concrete objectives of the offered research theme, are related to the aim of obtaining, in 33 months from the start of the research, some research results based on our own projects obtained through investigations on representative experimental projects. That could lead to the possibility to start, very fast, the production of equipment and products for the drive of the trolley busses. These concrete objectives were decomposed in the project in six big stages, that are accomplished with the aid of specific activities.

The project is relevant to the drive and to the high energy permanent magnets synchronous motors for electrical traction field. The result of the research will materialize in complex products that will increase the energetic efficiency of means of transport and will implicitly reduce the pollution effects.

The team work that will participate to the activities of the project is very heterogeneous, being composed of specialists in: electric machines, electronics of high power, electromagnetic projection, mechanical projection, quality engineering, and technical-economical analyses. All the partners engaged in the project have an important experience in the field of the offered theme, and they have also collaborated and they still do it, in projects of common interest. The members of the corporation are: ICPE-ME The Research Institute for Electrical Machines – Coordinating Partner, ICPE-SAERP – The First Partner, Polytechnic University of Bucharest – The Second Partner, Romanian Electrotechnical Committee – The Third Partner.

Relevance of the project:

The main objective of the project is the obtaining of the traction equipment (frequency inverter) and the one of the synchronous traction motor and their setting on a vehicle (trolley bus), to test the dynamic driving performances.

The next stage contains the verification for certification and the multiplication of this type of vehicles. Thus, this type of urban traction characterised by a high viability could be used in the future, in Romania, being fitted for both types of vehicles of rail way tram or underground.

The concrete elements that will essentially support the solution from scientific and technical point of view are related to:

- (a) the realization of a construction that can assure the energetic performances (the energetic efficiency, power factor), the functional ones (maximum starting current, pull-out torque, maximum voltage, current for the brake system respectively, etc.), the unidirectional ones (service, power, unidirectional speed of rotation etc.), in conformity to the imposed standards.
- (b) the guarantee of a high degree of functioning assurance by thermal framing of the motors, in conformity with the insulation class of insulant material and with the mode of cooling.
- (c) the guarantee of the conditions related to the new international prescriptions regarding the admitted level of noise (the level of acoustic pressure)
- (d) The creation of the software needed to command the inverter, the hardware platforms, for DSPs of the process (Digital Signal Processor) and the accommodation of the existent control elements of vehicle management (brake-traction control, comfort control, and passenger binacle assurance, assurance control for the apparition of dangerous voltage on the body, doors control, parking brake, display system, and direction display, etc.).

The research theme is in conformity with the general objectives of the 4th Program “Partnerships in the priority fields” of PNCDI II regarding a better collaboration between different entities of research-development and innovation, and economic agents, having as a goal the solving of the identified

problems. A partnership is stimulated and supported in a priority field to increase the CD productivity. *The derived objective* of the presented project is the *development of new products with a high added value*.

The including of the project in the *specific objectives* of the 4th Program is also taken into consideration, regarding the *development of innovator products and technologies destined transportation and automobile production* (7.5.) from the 7th research direction of the program. In this direction the specific objective of the proposed projects is identified in the 7.5.1 paragraph of the set of information of the 4th program: “Products and technologies that increase the means of transport energetic efficiency and reduce the pollution effects”.

The project takes into consideration the creation of initial conditions to obtaining a new product (drive system for synchronous motor for traction), in perfect conformity with the European energetic politics and with the technical conditions imposed on the international market for motors of specialized c.a. (traction).

Project description - scientific and technical description including the degree of novelty and the possibility of implementation of results:

The brief presentation of the S/T current stage in the field, at a national and international level, according to the project theme (max ½ page)

Vehicles driving with electric traction by synchronous motors was not accomplished till now at *national level* in the railway field or urban traction. The current stage is well represented by vehicles driven by variable direct voltage regulator and direct current motors created in IGBT technology, (see ASTRA-IKARUS 415 T, 203 pieces, and IRISBUS – AGORA trolley busses, also made by ASTRABUS 100 pieces, current contract 2007, 41 pieces delivered, both of them having the force diagram and the afferent equipment at ICPE SAERP SA BUCURESTI). At *international level*, we are in the stage where the variable direct voltage regulators and direct current motors have been replaced, for the new contracts, by traction drive in alternating current with asynchronous and synchronous motors (synchronous motors are successfully used for the driving of the high speed train TGV, made in France).

The advantages of permanent magnets synchronous motors drive, that are certain and also tested by modern driving practice, are the following:

- strong mechanical robustness corroborated with reasonable price of the initial investment;
- good dynamic performances, big breakaway torque, and also the possibility of braking in generator functioning conditions, when the braking is recuperative;
- high assurance in functioning due to the lack of sliding contacts, that traditionally generated deficiencies;
- possibility of operating without auxiliary incorporated transducer, excepting the command encoder of the intelligent source of commanded current inverter type.

At international level, this type of motors are produced, motors destined to the vehicles electric traction using high energy permanent magnets of NdFeB type, equipped with energy transducer or rotational frequency transducer of encoder type, supplied by automatic pilot from specialized inverters made with electronic switch of IGBT type (eg: Companies: Blocher, Montanari Indramat, Bosch, Muirhead, Siemens, and others.).

Contribution of the project to the development of the knowledge in the specific field, including

the degree of novelty and the complexity of the proposed solutions

Synchronous motor drive proposed for development is in agreement with the most actual tendencies in electric traction for the production of urban low floor vehicles (trolley bus, tram, underground), that need power motors of at most 200 kW, of small sizes and very viable due to the high energy of permanent magnets. The drive is made with the technique field of control (FOC) that needs a big power of calculation for the micro control switchgroup which is made of processors DSP that are available on the market, at this time at very low prices. The main investment for the producer company is represented by the companies of processors hardware and software development. This way, the human factor has a very big importance in this field. The degree of the control accuracy is very big due to the high frequency of the control clock DSP, and due to the high resolution of the position encoder fixed on the ax of the traction motor. The precise control, resulted from the clear accuracy of the mathematics calculation that generate the command pulses for the traction inverter, makes the viability of the equipment very powerful and increase the distance between the periods of vehicles revision. That leads to the increase of the availability degree of the means of transport fleet.

General and specific objectives of the project

General objectives of the research theme are in agreement to the general objectives of the 4th Program “Partnership in the priority fields” of PNCDI II regarding a better collaboration between different entities of research-development and innovation, and economic agents, having as aim the solving of the identified problems. A partnership is stimulated and supported in a priority field, to increase the CD productivity. *The derived objective* of the presented project is the *development of new products with a high added value*.

The project has also taken into consideration the specific objects of the 4th Program regarding the *development of innovative products and technologies destined to transports and automobile production* (7.5.) from the 7th research direction of the program. In this direction the specific objective of the proposed project is identified in the 7.5.1 paragraph of the information set of the 4th Program: “Products and technologies that increase the means of transport energetic efficiency and reduce the pollution effects”.

The concrete objectives of the offered research theme, are related to the aim of obtaining, in 33 months from the start of the research, some results based on our own projects obtained through investigations on representative experimental projects. This could lead to the possibility to start, very fast, the production of equipment and products for the drive of the trolley busses. These concrete objectives were decomposed in the project in six important stages, that are accomplished with the aid of specific activities (see the project workplan).

Next are presented the activities that illustrate them, as well as details of the activities correlated to the proposed objectives.

Detailed description of activities coherent with the proposed objectives.

Problems proposed for solving (Activities)

Detailed description of activities correlated with the proposed objectives.

Year 2007 (3 months)

- Management of the project; communication and coordination between partners
- Preliminary study and the technical analyses taking into consideration the situation of using the drive system for permanent magnets synchronous motors for urban electrical traction. The current situation at national and European and world level.

- European standardization analysis in the field (energetic performances, trial methods)
- During the project (activity scheduled for each stage) the coordinating partner will assure the efficient communication between all the partners, will deliver the partners all the problems proposed to be solved, in conformity to the plan, will monitorize the working activities and will centralize the results obtained for each activity. It will also follow the observance of the fixed terms and the stage budget.
- Preliminary study and critical analysis of the theme at national and international level (permanent magnets synchronous motors used for traction, used constructive conceptions, the reflection of the theme in patented solution, the current situation in the country production, available electric and magnetic materials)
- The comparative presentation of the solutions in the production process, of the electrotechnical materials used and the proposal of new solutions to increase the electromechanical conversion efficiency.
- Aspects regarding the European and national standardization in the field of traction motors and drive equipment (performances, correlation dimensions-power-rotational frequency, verification methods and necessary equipment, nominal values)

Year 2008

- Complex experiments of a reference model: permanent magnet synchronous motor and drive. The assignment of the projection theme for the experimental model.
- Application methods in 3D numeric analysis (FEM) in poly “claw “ and permanent magnets structures applying to the experimental model project of traction synchronous motor.
- Drive system projection. The projection of the experimental model for the permanent magnets synchronous motor used for traction.
- Young graduates attraction and formation
- Projection theme choice in conformity to the conclusions obtained after testing the reference models, (the definition of a series of typodimesion, gauges, rotational frequencies), taking into consideration the economical criterion of substantial exploitation cost reductions equivalent to the power conversion loss and the production costs (consume reduction of prime materials)
- The establishing of the solution from constructive and functional point of view and the theoretical substantiation of the adopted technical solution.
- Electromagnetic projection using advanced numerical methods (FEM analysis, multicriterion analysis, interdependence of dimensions, material properties, performances)
- Analysis of diminution of parasite pulsation torque method and the reluctance and effect upon total loss in the process of electrical power conversion
- Drive system experimental projection and high energy permanent magnets of rare soils synchronous motor
- Round table with the young graduates` participation

Year 2009

- The achievement of drive system experimental model and permanent magnets synchronous motor

- Drive test methodology and elaboration of permanent magnets synchronous motor
- Tests of permanent magnets synchronous motor for traction and drive system
- Achievement of drive system experimental model and permanent magnets synchronous motors for traction
- Elaboration of main technical conditions that need to be respected by the drive equipment and by the synchronous traction motors
- Experimental model test for permanent magnets synchronous motor for traction and drive system in the test platform

Year 2010

- Final conclusions, use of the model
- Results and knowledge at a large scale dissemination
- Property rights management
- Final conclusions elaboration demonstrating the project utility
- Result communication at a large scale, at the level of all the manufacturers in the field in Romania
- Intellectual property rights of the research

Expected S/T results for each proposed activity.

The project takes into consideration the creation of the initial conditions needed for the realization of a new product (drive system for synchronous motor for traction), perfectly according to European energetic politics and technical conditions imposed on the international motor market by c.a. (traction) of general and specialized use

To obtain the imposed performances it is taken into consideration the use of high energy permanent magnets, of rare soils of NdFeB type, to supply the excitation flux of the machine.

The proposed solution is a construction of some ring-shaped magnets with alternative axial magnetization, each of them being included in pairs of polar pieces, of "claw" type. The magnets are axially disposed in a modular construction, on an ax, through some auxiliary pieces that will assure the necessary guidance to configure a new heteropolar structure of the magnetic poles.

Once established the constructive conception of the motor, the scientific objectives of the projection can be distinguished as the following:

- magnetic circuit conceiving and admeasurement in modular construction so that the magnetic field dispersions in the field system (inductor) be strictly controlled and limited to maximum 25-30% from the entire field in load operation conditions.
- the establishment of the optimal saturation level for the different parts of the magnetic circuit (teeth, yokes, narrow parts of the polar pieces, polar filling factor, surface and used magnets volume). It is known that a saturation level, correctly prescribed and realized, has benefic effects upon the control and minimization of the armature effect reaction on the medium point of magnet functioning from no load to load modification in transitory impulse torque;
- reduction of the parasite magnetic fields (due to variable reluctance of the transversal magnetic circuit) that can lead to the exaggerate increase of mechanical torque ripples;

- elimination of the homopolar magnetic fields that generate circulating currents in the synchronous machine bearings that lead to the ball bearing destruction, the increase number of the parasite mechanical torque, and machine superheating;
- admeasurement of the polar pieces that cover the permanent magnets from NdFeB so that the risk of permanent magnets demagnetization be practically excluded in the currents group that may be required and discharged by the drive that controls the motor;
- the construction of the polar pieces, corroborated with the inclination packet of electrical steel stator to obtain at the request level the degree of sinusoidality of t.e.m., to have a correct functioning of the control system, commanded by the encoder.
- studying, emphasising and finding solutions to dimension the electric and magnetic circuit so that the motor be fit from thermal point of view in the presence of a ventilator;
- the solution of the problems in mechanical resistance of the assembly, of the bearings, but also of the protection and seal system against liquid agents in conformity to the concrete requirements of the theme.
- the finding of the optimum technical solution for the winding operation that are to be projected and dimensioned in conformity to some existent patent at the tendered research unity. This solution offers a gain in reducing the cooper consume, and the Joule losses in stator and in reducing the number of parasite torque as well.

The accomplishment of the scientific objectives, definitely defined above will lead to a series of drive equipment for traction synchronous motors, that will easily allow the obtaining of derived typodimensions, diversified in terms of power, torque, and voltage.

To conclude it may be said that the proposed technical solutions sustained by invention patents, can lead to the realization of a new energetically efficient product. This product will be in totally agreement with all the technical conditions imposed by the European norms that need to be accomplished by the internal users as well.

Viability and risks of the project.

The project is relevant to the field of drive and high-energy permanent magnets synchronous motors for traction. The research results will materialize in complex products that will increase the means of transport energetic efficiency and will also reduce the pollution effects. The intern need increase, that can no longer maintain, should find in the Romanian industry, motor series with technical and qualitative parameters of world level. It would not be a singular case, the one in which an enterprise (not only a small or a medium one) based on a special achievement, had a launching based on the needs in its country and also on the export. *It is difficult to show how the project fits the national politics in the field because at present there are not enough elements identifying such politics.* That is why the project could be one of the taught points that would form the national politics: a product of a world level (or even more) produced for our country and for export as well, in technico-economical competitive conditions. Its final objective is the reduction of the energetic material consuming, and, obviously a reduction of the exploitation costs for the users. Purpose and the objectives of the 4th Program of PNCDI II sustain the statements above for the period 2007-2013. The objective of the present project has a special viability as it perfectly accomplishes the requirements given by PNCDI II, 7th direction (processes materials and innovative products). The objective includes the use of innovative technologies destined to transport and to the vehicle production (7.5.) and complex products that increase the means of transport energetic efficiency and reduce the pollution effects (7.5.1).

The appreciation of the viability project is based on evaluation of the technological and technical risks, economical evaluation and temporal evaluation, as the project is very well organized. A preliminary analysis of these risks reveals on one hand that they are (in a triadic classification) small or medium and the possibility of controlling the work evolution is sufficiently enough. Thus, from the first stages of the work the correct identification of the users technical condition and other aspects related to the product costs and intern and extern market elements, will be taken into consideration.

While appreciating the viability of the project the *experience, the competency, and the anterior achievements of the consortium members* have to be mentioned here. The leader project has an experience of almost 40 years in research, period in which it coordinated numerous research themes, most of them having obtained invention patents. The research stuff of ICPE-ME, that has in endowment a complete platform for experimental testing motors, is the designer of many unified motor series from Romania and the holder of a scientific and patented works portfolio related to this theme. As a partner in the consortium Polytechnic University of Bucharest is well known abroad and holds, among the university research centers, information, means of investigation, significant research equipment. It also has remarkable realizations in the field, based on doctor`s degree papers and scientific works published in prestigious periodical magazines. Likewise, in research activity of the project are involved young graduates and doctors that start to form themselves as scientific researchers. ICPE SAERP SA stuff has an important experience in leadership and realization of national projects in the field of electric drive especially for urban electrical traction drives, as a coordinator and as a partner as well. Finally, one of the consortium partners, Romanian Electrotechnical Committee, is known at international level as an organism that faces the Romanian legislation in the electrotechnical field with the international one.

Detailed work plan, role and responsibilities of each partner per activity (for each activity will be mentioned the human resources effort in person/ months)

The project is aimed to obtain an experimental model tested at the bench tester. At the base of the project there are theoretical researches realized with the aid of elevated means of analysis and synthesis and experimental researches based on models projected, realized and tested by the research stuff.

The implication of the partners, organized in a consortium, is revealed in each stage. The tasks are achieved together; each partner being more involved in tasks that reflects the specific of the partner. Thus, the implication can be detailed as following:

ICPE-ME has responsibilities in issues that refer to: study and technical analysis, the choice of the technical constructive solution, electromagnetic and constructive projection, realization and testing of functional models, activities coordination and interaction with c.a. electrical motors manufacturers, dissemination on a large scale.

ICPE-SAERP has responsibilities in problems related to: study and technical analysis, the choice of the technical constructive solution, drive system projection, realization and testing of functional models, dissemination on a large scale.

PUB (Romanian UPB) has responsibilities in issues that refer to: study and technical analysis, elaboration of specific calculation and analysis methodics, realization of unconventional experimental determinations to identify the specific aspects, participation to the finalization of the research theme projection and of the final technical solutions, dissemination.

REC (Romanian CER) has responsibilities in problems related to: study and analysis regarding the

national and international standardization in the field, elaboration of normative product documents, the proposal of state assistance plan, dissemination.

Work plan is detailed on stages and activities in the following table

Year	Stages / Activities / Partners	Duration Stage (Months)	Role and responsibilities of the partners; human resources effort in person / months			
			Co	P1	P2	P3
2007	First stage – Industrial level research Study and analysis regarding the drive system use of trolley buses of high energy permanent magnets motor	3	7.94	3.35	2.23	2.23
2007	Activity I.1 Management of the project; Partners communication and coordination		0.12	-	-	-
2007	Activity I.2 Preliminary study and technical analysis regarding drive system for permanent magnets synchronous motors use for urban electrical traction. Current situation at national level and at European and world level		7.82	3.35	2.23	-
2007	Activity I. 3 European standardization analysis in the field (energetic performances, verification methods)		-	-	-	2.23
2008	Second stage - Industrial level research Experimental model projection of the traction drive system and permanent magnets synchronous motor	10	5.82	2.70	1.58	0.10
	Activity II. 1 Partners communication and coordination		0.04	-	-	-
	Activity II. 2 Complex experiments of reference model; permanent magnets on synchronous motor and drive. The choice of the projection theme for the experimental model		2.65	-	0.08	-
	Activity II. 3 Implementation of 3D numerical analysis methods (FEM) in poly “claw” and permanent magnets structures for the experimental model project of synchronous motor for traction		-	-	1.50	-
	Activity II. 4 Drive system projection. Experimental model projection of the permanent magnets synchronous motors for traction		3.02	2.70	-	-
	Activity II. 5 Young graduates attraction and forming		0.11	-	-	0.10
2009	Third stage - Industrial level research Realization of the drive system and high energy permanent magnets synchronous motor experimental model	8	10.93	3.35	-	-
	Activity III. 1 Partners communication and coordination		0.04	-	-	-
	Activity III. 2 Realization of the drive system and permanent magnets synchronous motor experimental model		10.89	3.35	-	-
2009	Forth stage - Industrial level research The testing of the model formed of drive system and permanent magnets synchronous motor	6	6.71	2.80	2.29	1.12

	Activity IV. 1 Partners communication and coordination		0.06	-	-	-
	Activity IV. 2 Elaboration of the drive permanent magnets synchronous motor testing methodology		1.45	-	0.34	1.12
	Activity IV. 3 Experimental model testing of permanent magnets synchronous motor for traction and drive system		5.20	2.80	1.95	-
2010	Fifth stage - Industrial level research Final conclusions showing the model functionality. Dissemination of the obtained results towards all the interested factors	6	2.56	1.12	0.67	0.62
	Activity V. 1 Partners communication and coordination		0.06			
	Activity V. 2 Final conclusions specifying the model utility		1.17	0.56	0.45	0.34
	Activity V.3 Dissemination of the results and knowledge on a large scale by publishing and communication		1.06	0.56	0.22	0.22
	Activity V. 4 Management of intellectual property rights		0.27	-	-	0.06
2007-2010	Sixth stage BASE ACTIVITIES – they will be specified at the contract signing / 15% of the total value of the contract	33				

Valorification of results and potential beneficiaries.

The expected results do not appear immediately after finishing the research. Their implementation in the production of motors in Romania, needs not only production preparation costs, but also supplementary investment costs for the final users. Acceleration of the results apparition can be made in a systematical politics with an institutional coercive character imposed by the authorities that govern the energy production and use, as well as environment protection in Romania. Its bases were fixed in agreement to the European Union legislation. The measures have an intensive and extensive character and they are formulated through the European politics where the implementation difficulties are the same.

The result can be quantified from macroeconomic and microeconomic point of view. In a medium period of time is proved the user that replaces the trolley buses asynchronous motors drive with drive system for high energy permanent magnets synchronous motors recuperates the investment in at least 2-3 years. That is because of the lover production costs (materials consume reduction, especially for active materials: cooper, electrotechnical sheet iron, etc.) and because of the energetic performances improvement (and all the consequences related to the environment protection due to NOx emission reduction)

Dissemination of results

The results of research based on experimental models tested at the bench tester, applicable to permanent magnets synchronous motors for traction will be disseminated on a large scale. They will be available to all the motors and drive systems producers in Romania, without preferences, due to the work finance by the state budget. As it is happening to other countries, as well, it is necessary that state institutions interfere with a set of coercive settlements combined with a state assistance base.

This way, the researches of the current complex project are going to be disseminated on a large scale towards all the electric machines and drive system producers in Romania. Taking into account the fact that the researches are realized by a consortium made of two research institutes in the field (ICPE-ME

electric machine profile, ICPE-SAERP electric drive respectively), a university center, as a public institution (PUB) and Romanian Electrotechnical Committee (REC as a NGO of private law, non profit, having a research profile), there must be applied the stipulations regarding the state assistance in conformity to the European Council settlements. (Annex 4 of the information package of the 4th PROGRAM). Taking into consideration the invoked stipulations the state assistance is also implied.

The research costs are to be sustained by the program budget and CDSA (CO and P1) co-finance partners.

If, during the research, appear elements and information that need to be classified or intellectually protected it will be done that in conformity to the current settlements.

Project impact:

Taking into consideration the economic, technical, social environmental impact, there have to be mentioned the following aspects:

- the need of competitive electric equipment development, aligned to the technical standard and conditions required by the producers in the world market.
- from an economical point of view, as it results from the project description, in the anterior chapter, the money saved by the motors producers (a reduction of almost 40% of the synchronous machine weight in comparison with the asynchronous motor that it replace) are substantial. This way there is the possibility of creating new perspectives for the production units in the field of electric machines in our country.
- the research aim is to turn to good account the existent scientific potential of the university research centers. This potential will end up in an ample work paper, with certain results regarding the energy use improvement, having good implication on environment protection.
- technical impact is defined by the introduction in production of some series of permanent magnets synchronous motors for electric traction, in the next years, in perfectly agreement with the European and world tendencies.
- the alignment of the drive equipment functioning to the legislative stipulations, more and more acute, regarding the environment protection. Obviously, the implementation costs have to be distributed to all factors, having sometimes a diffuse character as it is seen in the case of the impact on environment. For instance, thanks to energetic performances of the new drive system (improved efficaciousness and power factor), the reduce consume of electric energy signifies less millions of tones of carbon dioxide emitted in the atmosphere. That presents real effects for environment protection by the combustion of a small quantity of primary fuel in stations.
- the accomplishment of the legislation regarding the more and more acute norms for the safety exploitation.
- the opportunity of creating a specialized service to promptly assure a qualified intervention, implying, this way, new specialization of the labour.

Management of the project. Description of the consortium:

Administration of the project has as an essential objective the providing of the needed elements to make the correct decisions regarding the observance of the realization stages of the project in terms of content, quality, terms and implementation costs.

Management of the project will be mainly a task for the experts from the tendered unit that have a rich

experience in issues of electric machine projection. Research team is composed of high-specialized members in the field of optimal projection of the electric machines and electric and electronic equipment for command, monitorization and control, for economic analysis and technological projection.

There are stipulated monthly analyses of the work stages and monitorization of the concordance between the plan and the work, and the implementation of the measures required for the optimization of the activities. There will be taken measures to make public the results, immediately they appear and after they are experimentally verified. In this sense there are scheduled project management activities, communication and coordination activities in the Realization Plan of the Project, for each stage.

Taken into consideration the collaboration to the realization of the project between The Research Institute ICPE-ME and the co-worker organisms (partners), the responsibility of the project managing will be assured by The Research Institute ICPE-ME. The development of the stipulated activities will be periodically analyzed together with the partners and there will be made the necessary corrections aimed to obtain the proposed results.

The teamwork that will take care of the activities is heterogeneous, being made of specialists in electric machines, power electronic, electromagnetic projection, mechanic projection, quality engineering and technique-economic analysis. All the partners engaged in the project have a rich experience in the field of the offered theme, and they also collaborated, and they still do it, at present, in other themes of common interest.

Consortium constitution is the following: ICPE-ME The Research Institute for Electrical Machines – Coordinating Partner, ICPE-SAERP – The First Partner, Polytechnic University of Bucharest – The Second Partner, Romanian Electrotechnical Committee – The Third Partner.

Appreciating the viability of the project, it has to be mentioned, here, the experience, the competence, and the anterior achievements of the consortium members. The manager of the project has sustained a doctor`s degree thesis in the field of the optimal projection of industrial motors. It has a rich managerial experience, as it is the General Manager of the research institute from the beginning to the year 2003. In all this period it also developed an intense research activity being the coordinator of numerous research contracts. In the field of permanent magnets synchronous electric machines it had important contributions demonstrated by the numerous obtained patents and by the work papers made public at national and international level. The research stuff of ICPE-ME, that has in endowment a complete platform for experimental testing motors, is the designer of many permanent magnets synchronous motors and the holder of a scientific and patented works portfolio related to this theme. From the partners of the consortium Polytechnic University of Bucharest is well known at international level, among the others university centers holding investigation means and significant research equipment. The university has also remarkable realizations in the field based on doctor`s degree papers and scientific works published in prestigious periodical magazines. ICPE-SAERP SA stuff has an important experience in leadership and realization of national projects in the field of electric drive especially for urban electrical traction drives, as a coordinator and as a partner as well, in the projects of preadhesion to the structural funds, in IMPACT-2006 Program. (ICPE-SAERP is one of the partners in the Industrial Platform Creation included in the IMPACT-2006 program, as well as ICPE-ME). Romanian Electrotechnical Committee is known at international level as an organism that faces the Romanian legislation in the electrotechnical field with the international one. All the partners have a rich experience in national and international realization of projects, from now on.

The participation of the partners organized in a consortium is made in each stage. The tasks are realized together, with the intense implication of each partner in the specific problems. Thus, the implication

can be detailed as following:

ICPE-ME has responsibilities in issues that refer to: the management of the project, the communication and coordination of the partners, study and technical analysis, the choice of the technical constructive solution for the traction electric motor, electromagnetic and constructive projection, functional model realization and testing, coordination of the activities and interaction with electrical motors manufacturers.

ICPE-SAERP has responsibilities in problems related to: study and technical analysis, the choice of the technical constructive solution for the drive system, participation to the finalization of the project theme and of the final technical solutions, realization and the testing of the experimental model.

PUB (Romanian UPB) has responsibilities in issues that refer to: study and technical analysis, elaboration of specific calculation and analysis methodics, realization of unconventional experimental determinations to identify some specific aspects, participation to the finalization of the project theme and of the final technical solutions.

REC (Romanian CER) has responsibilities in problems related to: study and analysis regarding the national and international standardization in the field, elaboration of normative product documents.

To offer a permanent and recent documentation upon the realizations to other companies producers of traction drive systems, there are planed, as supportive management activities for the project, informing participation to international fairs and conferences, during the project.

Financial, material and human resources:

From the budget program is solicited the sum of 2 000 000 lei to cover the needs in terms of human, material and endowment resources, for the project realization. This sum is solicited on the basis of the realization plan that contains different stages and activities for each stage of industrial research. (the development of new method calculation, the analysis and the optimal synthesis, testing techniques, projection and experiments with models).

Regarding the endowments it is necessary to mention that except the equipment necessarily needed for the synchronous motor testing in conformity to the stipulations of the actual standards (sources, different dimensions of electrical dynamometer equipment, measuring equipment, systems of data acquisition, calculation technique of projection and analysis), are to be bought, in conformity to the legislation, performant equipment for data acquisition and processing, and interfacing with oscilloscope TeKtronix THS 720P computer, including special probes of measuring instruments, dynamic torque transducer of Hottinger-Baldwin type, and the soft specific to the problems related to the project.

This supplementary endowment is minimum, taking into consideration the fact that in the elaboration of the research and development works will be used calculation and testing equipment from the university centers (PUB) that are members of the consortium.

Projet manager: Doctor Inginer Elek DEMETER
E-Mail: eedemeter@yahoo.com, icpemesa@yahoo.com,
Telefon: 0214105288
Fax: 0214106684