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Seminar on Foundry Production
and Ecology
Minsk (Belarus)
24-28 May 1993

REPORT OF THE SEMINAR

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INTRODUCTION

1. The Seminar on Foundry Production and Ecology was held in Minsk (Belarus) from 24 to 28 May 1993 at the invitation of the Belarus State Polytechnical Academy (BSPA) on behalf of the Government of Belarus.
2. In parallel with the Seminar, the International Exhibition ECOLIT '93 of foundry equipment and systems, with emphasis on environmental protection, was held.
3. Both the Seminar and the ECOLIT '93 Exhibition were held at the newly opened UNISPECTR Centre in Minsk.
4. The Seminar was attended by participants from the following UN/ECE member countries: Austria, Belarus, Bulgaria, Czech Republic, Denmark, France, Germany, Italy, Lithuania, Poland, Romania, Russian Federation, Slovakia, Ukraine, United Kingdom of Great Britain and Northern Ireland and United States of America. Experts from the People's Republic of China, Kazakstan, Republic of Korea and Uzbekistan attended under article 11 of the terms of reference of the Economic Commission for Europe. Experts from the former Yugoslavia presented their contributions at the invitation of the Chairman. In addition to the sponsoring organizations, UN/ECE and UNIDO, the International Organization for Standardization (ISO) was also represented.

OPENING ADDRESSES

5. On 24 May, the International Exhibition ECOLIT '93 was opened by Mr. Nikolai N. Kostikov, Vice-Prime Minister of the Republic of Belarus, and Mr. John A. Kennerley, representative of UN/ECE. Following the opening ceremony, a guided tour of the Exhibition was offered to the participants by the National Organizing Committee for the Seminar (NOC).
6. The Seminar was opened on 25 May by Mr. Vladimir F. Kondratenko, Deputy Chairman of the State Committee on Economy and Planning (GOSEKONOMPLAN) and Chairman of the NOC. He welcomed some 300 participants and observers from 21 countries, as well as the representatives of international organizations. He underlined the importance of the event for the successful continuation of the ongoing economic reforms and restructuring of the engineering industries in particular.
7. Mr. Alexander N. Sychov, Deputy Minister of Foreign Affairs, provided the participants with information on the recent priorities of Belarus regarding international cooperation in the field of industry, with emphasis on the engineering industries.
8. Academician Viktor N. Chachin, Rector of BSPA, welcomed the participants on behalf of the principal host institution. He briefly introduced the historical development and recent structure, and the research and education programmes of the Academy and extended an invitation to visit its foundry and other engineering-related laboratories.

9. Mr. John A. Kennerley, speaking on behalf of Mr. Gerald Hinteregger, Executive Secretary of UN/ECE, thanked the host Government for its continuing support of UN/ECE activities in the field of engineering industries and automation. He believed that both the Seminar and Exhibition would help to attract foreign investors in the further modernization of manufacturing establishments in Belarus and even to launch international projects aimed at improving environmental protection in Belarus and neighbouring countries. Finally, he thanked UNIDO and ISO for their most useful contribution in the preparations for the Seminar.

ELECTION OF OFFICERS

10. Mr. David M. Kukui, Professor and Academician of the Engineering Academy of Belarus and Head of the Foundry Engineering Department at BSPA, was elected Chairman; Ms. Joëlle Ory (France), current Chairperson of the UN/ECE Working Party on Engineering Industries and Automation, and Mr. Vladimir L. Naidek (Ukraine), Director of the Foundry Institute in Kiev, were elected Vice-Chairmen of the Seminar.

PROGRAMME OF THE SEMINAR

11. The main themes selected for technical papers and posters to be presented at the Seminar and to provide guidance to the exhibitors at ECOLIT '93, were decided upon by the second Preparatory Meeting, held at Geneva on 22 October 1992 - see annex I to the present report.

12. The programme of the Seminar was divided into six working sessions, as follows:

- | | | |
|-----|------------------------|--|
| (a) | Tuesday, 25 May 1993 | Morning working session |
| | Discussion leader: | Mr. G. Anisovitch (Belarus) |
| | Papers presented : | 1, 2, 3, 4, 5, 6, 7 (for list of papers see annex II to the present report; for list of posters see annex III) |
| (b) | Tuesday, 25 May 1993 | Afternoon working session |
| | Discussion leader: | Mr. S. Zhukovski (Russian Federation) |
| | Papers presented : | 8, 9, 10, 11, 12, 13, 14, 20 |
| (c) | Wednesday, 26 May 1993 | Morning working session |
| | Discussion leader: | Mr. P. Jelinek (Czech Republic) |
| | Papers presented : | 19, 18, 16, 55, 21, 56, 22 |
| (d) | Wednesday, 26 May 1993 | Afternoon working session |
| | Discussion leaders: | Mr. A. Buckle (UNIDO) and Mr. V. Korolev (Belarus) |
| | Papers presented : | 23, 25, 26, 27, 28, 31 |

- (e) Thursday, 27 May 1993 Morning working session
Discussion leader: Mr. V. Naidek (Ukraine)
Papers presented : 33, 34, 35, 37, 38, 39, 41, 42
- (f) Thursday, 27 May 1993 Afternoon working session
Discussion leader: Mr. R. Rajeswaran (UNIDO and ISO)
Papers presented : 50, 43, 44, 46, 47, 48, 51, 52, 53, 54

SUMMARY OF THE DISCUSSIONS AND CONCLUSIONS

13. It was recognized that foundry production, together with traditional, metal-removal processes and welding, still constituted the natural technological basis of mechanical engineering industries. In spite of the tremendous recent improvement of technology, quality of castings, the development of new materials, and the mechanization and automation of foundry processes, foundries continued (like the chemical industry, steelplants and power stations) to be the most significant polluters of the environment (emissions to the atmosphere, water pollution, land contamination by toxic and other wastes).

14. At the same time, in a broader sense, human health and safety issues, including the risk of accidents and injuries, and the exposure to chemical, physical and biological hazards at work, had become priority problems calling for the improvement of legislation and standardization.

15. Most of the papers presented provided new and sometimes unique information on the results of research, testing and the introduction of new technologies and materials, processing methods, and the economic analysis of investment and operational costs. On the other hand, not all of the contributions complemented the specific techno-economic topic of the Seminar by adequate consideration of the related environmental consequences. In this context, it was felt that the Seminar should be followed up by a workshop, project or other joint international activity focused exclusively on the environmental issues involved in the field.

16. It was unanimously agreed that the idea of associating the Seminar with the ECOLIT '93 Exhibition had allowed for useful informal discussions between designers, producers and suppliers and users of foundry equipment and the measuring, monitoring and controlling instruments and systems which could improve the environmental, health and safety situation in foundries.

17. The Seminar forum, the informal discussions at ECOLIT '93, the technical visits offered by the NOC, as well as the panel discussions with members of the Government, concentrated on the specific challenges faced by Belarus in the implementation of economic reforms and the restructuring of industry. A number of proposals for further bilateral and multilateral international cooperation, both at the government level or between individual firms and companies, were considered and might result in concrete contracts and agreements.

RECOMMENDATIONS

18. Participants in the Seminar, aware of the current economic and technological problems in the field and their social and environmental impact in the region, and in the Republic of Belarus and its neighbouring countries in particular, agreed on the following recommendations to be considered by the ECE Working Party on Engineering Industries and Automation (see paragraphs 19-22 below).

19. The Seminar and associated Exhibition ECOLIT '93 had provided a useful opportunity to consider a broad range of issues related to the reduction of the environmental problems associated with foundry production, in particular, in the countries of central and eastern Europe.

20. As an immediate follow-up to the Seminar, a series of workshops (working groups) on certain of the high-priority issues raised during the Seminar should be organized in Belarus and in other interested ECE member countries. The workshops (working groups) should bring together a limited number of leading specialists (some 30-40), in order to prepare practical solutions to the critical issues related to the modernization and pollution abatement of foundry production plants in the countries of central and eastern Europe.

21. It was felt that several countries represented at the Seminar would be in favour of launching a regional project, possibly within the framework of the United Nations Development Programme (UNDP) Regional Programme for Europe, aimed at further improving international cooperation regarding research and development, modernization of production facilities, safety and legislation, as well as relevant environmental aspects relating to foundry production in the countries of central and eastern Europe. The elaboration and launching of such a regional project could be undertaken in two stages (phases):

- (a) The first preliminary phase would include the preparation of a feasibility study and draft project document by interested organizations, institutions and government authorities. The draft would then be circulated to interested Governments and national authorities for their suggestions, following which it would be redrafted and considered at a meeting of experts and representatives of concerned organizations. Once agreement was reached on the project document, it would be formally circulated to Governments and concerned organizations together with an invitation to them to indicate their willingness to participate in, and contribute to the project (either financially or through in-kind support);
- (b) In the second phase, the project, once approved by a minimum of five net beneficiaries of UNDP assistance, could be formally submitted to UNDP with a request for its support of the project. After approval of the project by UNDP, a steering committee, with representatives of the participating countries and/or organizations, should be formed and the project launched.

22. It was also suggested that one or more study tours should be organized, possibly by the UN/ECE and other interested international organizations in Belarus and/or in the neighbouring countries. These would allow for an in-depth study of the problems currently faced by individual private and state-owned enterprises, research and training establishments, and other institutions involved in foundry production, which were being subjected to change and adaptation in order to conform to new environmental regulations and constraints.

OTHER BUSINESS

23. Two panel discussions were held: on 25 May with Vladimir I. Kurenkov, Chairman of the State Committee on Industry and Interdepartmental Production, and on 26 May with Sergei S. Ling, First Vice-Prime Minister and Chairman of GOSEKONOMPLAN. Foreign participants in the Seminar were informed of the results of the economic reform including the creation of (to date) 260 joint enterprises. Some 67% of exports were destined for the Russian Federation. In this respect it was noted that Belarus was characterized (being also a net importer of raw materials) as an "assembly shop" for the former USSR. During the discussions, representatives of western companies summarized the prevailing obstacles still limiting both the access of Belarus to western markets and the relatively slow flow of western investments to the country.

24. A brief description of the technical visits offered to the participants by the NOC is included in annex IV to the present report.

25. Annex V contains a list of the main exhibitors to ECOLIT '93.

26. Participants in the Seminar and in the ECOLIT '93 Exhibition placed on record their appreciation and thanks to the Government of Belarus, the National Organizing Committee, the Belarus State Polytechnical Academy, and the UNISPECTR Centre, for the excellent facilities provided and the warm hospitality extended.

Annex I

MAIN THEMES FOR THE SEMINAR AND ECOLIT '93 EXHIBITION

1. Techno-economic aspects of the introduction and use of environmentally sound casting technologies
 - 1.1. New low-waste technologies and equipment for the production of castings using single sand moulds and special methods
 - 1.2. New low-toxic materials for moulds and core mixtures and anti-burn coatings
 - 1.3. Technologies and equipment for recycling and reuse of waste resulting from foundry production
 - 1.4. Concepts for the reconstruction of foundry shops in ECE member countries, in particular in central and eastern Europe, on the basis of economic and ecological analyses
2. Methods for the monitoring and control of pollutants discharged by foundries
 - 2.1. Methods for the control of harmful substances in the air, water and solid waste at the foundry shop level, including surrounding and disposal areas
 - 2.2. Methods for monitoring gas emissions at different stages of the production of castings and discharges into the environment on the part of foundries
 - 2.3. Designing of air- and water-cleaning systems for new foundry shops as well as for reconstructed and modernized foundries
 - 2.4. Technology and know-how for air and water purification for foundry shops
3. Socio-economic issues related to foundry production
 - 3.1. Labour and environmental protection standards and legislation for foundry production
 - 3.2. Educational and training programmes and schemes related to foundry production and ecology

4. International cooperation

- 4.1. International cooperation in the development of safe and efficient equipment for foundries and appropriate production methods to ensure the protection of the environment
- 4.2. Implementation of international legal acts, regulations and agreements on safety and the protection of the environment related to foundry production, with emphasis on economies in transition

Annex II

LIST OF PAPERS PRESENTED *

No.	Title	Author(s)	Country or organization
1	Effect of molten metal-moulding sand interaction on the degree of sand mixture contamination	M. Holtzer	Poland
2	Remaking of sodium slag from precise casting foundry in lead refinery	B. Nicolich R. Krstich B. Novakovich	Former Yugoslavia
3	Practice of casting production in frozen moulds	V. Gruzman	Russian Federation
4	Development of casting production technology in frozen moulds and cores promotes the solution of ecological problems of foundry production	P. Jelinek E. Fleming V. Bednarova	Czech Republic Germany Czech Republic
5	SEIATSY - method of mould compacting by air flows with pressing	C. Mushna M. Mushna	Germany
6	Impulse compacting - ecologically clean mould making **	A. Botov A. Isagulov V. Egorov S. Miroshnichenko S. Aleshkin	Kazakhstan
7	Vertical continuous casting for engineering industries	V. Grinberg V. Tutov	Belarus
8	Systems of dust disposal in foundry production	M. Franz	Denmark
9	DISA - quality, efficiency and ecology	C. Kofler	Denmark

* Summaries and complete texts of papers were included in the Proceedings of the Seminar published by BSPA and distributed among participants.

** A joint presentation with poster P-18 (see annex III).

No.	Title	Author(s)	Country or organization
10	Properties of sodium silicate bonded sand with LD converter slag hardener	Chang Ock Choi	Korea, Republic of
11	Technical lignin-sulphonates and binders - the most promising materials for obtaining expendable moulds and cores	A. Syomik V. Artemiev	Ukraine
12	High-energy treatment of foundry materials	Y. Evstifeev Y. Erminidi	Kazakstan
13	Ecology of carbon anti-burn additives for mould mixtures	V. Markov Y. Tovpyshka A. Kotik P. Mikhalyov N. Kolemasova T. Akshonova	Russian Federation
14	Polutoxic dangers during lead refining and casting	B. Nicolich M. Barach Z. Popovich	Former Yugoslavia
15	Magnetohydrodynamic equipment for ecologically pure technologies *	V. Polishchuk V. Dubodelov V. Seredenko V. Portechko	Ukraine
16	State and trends of construction of electric furnaces in consideration of the environment protection requirements	V. D. Schnider	Germany
17	Modern foundry shops with high-duty furnaces equipped with controlling facilities *	D. Pfennig	Germany
18	Trends in the development of foundry equipment	D. Trauzeddel	Germany
19	Modern technology of induction melting in foundries	V. Shumikhin	Ukraine

* Not presented.

No.	Title	Author(s)	Country or organization
20	Reduction of environmental pollution using a coreless cupola	Z. Popovich S. Nikolajevich K. Raic T. Volkov	Former Yugoslavia
21	Electromagnetic stirring with low energy consumption in continuously cast ingots	M. Murgas A. Pokusa M. Podolski	Slovakia
22	Possibility of decreasing energy consumption in electro-slag remelting of steel	M. Murgas M. Pokusova I. Berta	Slovakia
23	An overview of environmental health and safety legislation facing foundries - European influence	J.G. Morley	United Kingdom and UNIDO
24	Appropriate, safe and efficient equipment and production methods, which are environmentally sound *		UNIDO
25	Advanced induction furnace technology for iron and iron metal	H. Zeiger	Germany
26	Problems of gasifiable pattern moulding	I. Skhinski Y. Hvastunin V. Lozenko	Ukraine
27	Combined technology of producing ferro-carbon alloys with the use of production wastes containing non-ferrous oxides	S. Lekah	Belarus
28	Improvement of properties of alumino-silicon alloys through treatment by flux FRAMOG	A. Rabinovich S. Sovichev L. Dudenkova	Russian Federation

* Not presented.

** Presented as a poster.

No.	Title	Author(s)	Country or organization
29	Energy- and ecology-related research on furnaces for heating continuously cast blanks **	V. Timoshpolski Y. Feoktistov	Belarus
30	Centralized production of cast blanks in Belarus **	E. Zhirnov A. Melnikov B. Odarchenko M. Saikov	Belarus
31	Technology and installation for obtaining castings with dispersed gate-charging system under electromagnetic pressure	F. Kotlyarski V. Fiksen V. Belik G. Dudarchik V. Dubodelov	Ukraine Belarus
32	Chrono-method of registration of high-speed changes in aggregate and stressed state of materials *	A. Veinik S. Komlik	Belarus
33	Research on the shaping and processing of thinwall shell casting, produced by counter pressure casting process	Huang Liangyn	People's Republic of China
34	Foundry plant and ecology	V. Sivko V. Morogov	Russian Federation
35	Special foundry shop	M. Zhelnis A. Dobrovolskis E. Majauskas	Lithuania
36	Development of power conserving technology for reclamation of non-traditional materials *	S. Tyutyukov E. Arzamastiev S. Litovskikh V. Katayev A. Agaltsev A. Lebedev	Russian Federation
37	Main directions of perfecting horizontal continuous casting of iron	E. Marutskovich	Belarus

* Presented as a poster.

No.	Title	Author(s)	Country or organization
38	Effluents of melting units in foundries	L. Rovin A. Shaginyan	Belarus
39	Cleaning of dust and gas flows in foundries	O. Belyi	Belarus
40	Integrated system of localization and neutralization of harmful gases liberated in the process of making cores in the steel foundry of the Minsk Automobile Works *	Y. Shapovalov S. Deshchits V. Pashkevitch	Belarus
41	High-efficient ecologically clean moulding materials	P. Kovalev Y. Kalinin H. Rovshanov N. Rusak	Belarus Russian Federation Uzbekistan Belarus
42	Direct synthesis of silicates - ecologically clean technology for producing silicate binders with predetermined properties	R. Afanasiev D. Kukui N. Mylnikova I. Bolmantenkova	Russian Federation
43	Standards needs for eco-foundry production	R. Rajeswaran	UNIDO and ISO
44	Characterization of moulding sands as possible sources of atmosphere pollution	W. SolarSKI J. Zawada	Poland
45	Standards and recommendations valid in the measurement of concentrations and intensities of toxic components and in the evaluation of work conditions in the Polish foundry industry *	K. Wlodarczyk M. Gajda B. Czawa	Poland

* Summary only.
** Not presented.

No.	Title	Author(s)	Country or organization
46	Methods of comprehensive assessment of the ecological situation in foundries	D. Kukui A. Lazarenkov	Belarus
47	Main directions of work on decreasing labour-intensive nature and increasing the level of mechanization of casting final treatment	Y. Korolev N. Iasuchenia	Belarus
48	Multi-automated ecologically clean low-waste technologies for producing precision castings in dried moulds and cores	G. Bobriakov V. Obukhov	Russian Federation
49	Chemical and vibration pollution in foundries **	T. Sabau F. Stefanescu L. Sofroni C. Neagu A. Catalina	Romania
50	Ecological aspects of producing mould cores	S. Zhukovski A. Yakobson	Russian Federation
51	Anti-burn easy-knock-out and low-toxic mixtures for large steel mould cores	I. Valissovski V. Romashkin F. Nuraliev	Russian Federation
52	New non-toxic cold-hardened mixtures of organic binders with improved knock-out	P. Borsuk	Russian Federation
53	Development and putting into production of low-toxic and energy-saving cold-box technology with the use of low-toxic binders and liquid hardeners	B. Kurakevich	Belarus

No.	Title	Author(s)	Country or organization
54	Modern technologies for making castings from iron-cased alloys providing for good labour conditions and environment protection applied in the Polish foundry production	Z. Paczek A. Sedzimir I. Tybulczuk	Poland
55	Methods of production and use of mould cores in Germany in the 1990s: Ecological and economic aspects	V. Ehlinghaus S. Ivanov	Germany
56	Thermal regeneration of moulding sands	R. Franke G. Rudo	Germany

Annex III

LIST OF POSTERS

No.	Title	Author(s)	Country
P-1	Development of an efficient low-power consuming system of sand mould regeneration	V. Odinochko D. Kukui N. Nevar S. Savitski	Belarus
P-2	Method of analysis and quality management of castings	A. Chichko V. Sobolev I. Rafalski	Belarus
P-3	Machines for low-pressure casting	B. Higer	Russian Federation
P-4	Technological aspects of producing high-resistance cast iron moulds	S. Gurin	Belarus
P-5	Ecologically clean technology for refining aluminium-based alloys	A. Andrushevich	Belarus
P-6	Ecologically safe binders for the mass production of castings	D. Kukui N. Mylnikova I. Bolmantenkova	Belarus
P-7	Unit systems for the purification of noxious releases from melting furnaces	L. Rovin	Belarus
P-8	Economically alloyed steel for casting parts for crushing and grinding equipment	G. Fedorov E. Platonov A. Kuzmenko V. Berezanski	Ukraine
P-9	Behaviour of water glass mixtures in the process of moulding - elaboration of effective and ecologically clean methods of moulding	D. Kukui S. Rovin	Belarus
P-10	A set of devices for optimizing the process of core hardening	Y. Ledyan D. Kukui	Belarus
P-11	Special magnetodynamic equipment for ecologically pure casting technologies	V. Dubodelov	Ukraine

No.	Title	Author(s)	Country
P-12	Magnetodynamic proportioners of molten metals - an ecologically pure technology	V. Polishchuk	Ukraine
P-13	Technology for the preparation and casting of aluminium-based alloys in magnetodynamic installations	V. Seredenko G. Portechko	Ukraine
P-14	Low-waste technology for shaped steel castings production	S. Kondratyuk	Ukraine
P-15	Casting mould design potential	Z. Itkis V. Smolko	Russian Federation
P-16	Continuous casting of the lead grid improves storage battery production technology	E. Baranovski V. Ilyushenko	Belarus
P-17	Introduction of the vacuum-film casting method	A. Muinov	Uzbekistan
P-18	Prospects for the development of impulse moulding	I. Matveyenko V. Kamenski	Russian Federation
P-19	An improved magnesium-phosphate self-hardening mixture and its characteristic properties	L. Turkina	Russian Federation
P-20	Application of microwave radiation in processes for drying cores and casting materials	A. Klyshko V. Golubev S. Shnitko V. Melnikov J. Shalkevitch M. Demin I. Grudnitski	Belarus
P-21	Cast steel grit as a packing in electromagnetic filters for the cleaning of fluid or gaseous media	S. Zatulovski L. Mudruk N. Kiryakova V. Garashchenko	Ukraine
P-22	New plasma process for treating casting steel	N. Svidunovitch A. Verbitsky V. Vashkevitch	Belarus

No.	Title	Author(s)	Country
P-23	Producing Hadfield steel by the new method	N. Svidunovitch V. Vashkevitch A. Verbitsky	Belarus
P-24	Foundry wet dust arrester installation	V. Levsch R. Vologa T. Rakhmanov	Uzbekistan
P-25	Methodology of ecological education at technical universities	V. Palchevski	Belarus
P-26	Computer-aided development of ecologically sound casting technologies	D. Kukui B. Dudetski Y. Fried	Belarus
P-27	Increased precision and lower metal content - a way to protect the environment	N. Bekh A. Volkomi A. Trukhov	Russian Federation

Annex IV

TECHNICAL VISITS

Three technical visits were organized on Friday, 28 May, as follows:

- (1) The Minsk Tractor Manufacturing Association, the producer of the well known "Belarus" series of tractors. More than 250,000 castings a year - the highest number in Belarus - are produced by this Association. At present, a major reconstruction of the Association's foundries is under way aimed at implementing modern casting processes. In recent years, automated GISAG (Germany) and DISA (Denmark) production lines have been installed in the foundries, and melting and core-making bays have been reconstructed. The tour of two foundries, the precision casting shop and the principal assembly line was guided by Deputy Chief Engineer Mr. V. Kharytonovitch.
- (2) The Scientific and Research Institute of Foundry Production is a leading organization for the development of mould, core and cast production equipment as well as casting cleaning systems for mass production. Participants visited several laboratories and experimental production facilities. Discussions focused on the involvement of the Institute in the field of environmental protection.
- (3) The foundry chairs and laboratories of the Belarus State Polytechnical Academy (BSPA), the leading scientific and research departments dealing with the development of new foundry materials, alloys, foundry technologies, the regeneration of mould mixtures, and effluent gas and dust cleaning systems. BSPA also organized a workshop in which the representatives of Heinrich Wagner Sinto GmbH took an active part. Representatives of international organizations were informed about the activities of the Academy by its Vice-Rector, Mr. Mikhail S. Vysotsky.

Annex V

LIST OF MAIN EXHIBITORS TO ECOLIT '93

1. Huttenes Albertus GmbH, Wiesenstrasse 23/64, D-4000 Dusseldorf, Germany
2. Beardsley & Piper, Division of Pettibone Corp.; 5501 W. Grand Avenue, Chicago, Illinois 60639, United States of America
3. Belarus Optico-Mechanical Works; Makaenko Street 23, 220012 Minsk, Belarus
4. Belarus State Polytechnical Academy; Prospect Skoriny 65, 220027 Minsk, Belarus
5. BELNIILIT - Belarus Research Institute of Foundry Engineering; Mashinostroitelei Street 28, 220083 Minsk, Belarus
6. Bobrujsk Engineering Works; K. Marx Street 35, Bobrujsk, Belarus
7. Cardan Shafts Works; Stchastново Street 38, 205650 Grodno, Belarus
8. DISA - Dansk Industri Syndikat AS; 17 Herlev Hovedgade, DK-2730 Herlev, Denmark
9. Forging and Foundry Machinery Works; Zapadnyi Promyshlennyi Uzel, 225710 Pinsk, Belarus
10. FORMTEC GmbH; Altenberger Strasse 72, D-8239 Schmiedeberg, Germany
11. FURTENBACH; Franz W. Furtenbach Strasse 1, A-2700 Wiener Neustadt, Austria
12. GISAG Anlagenbau GmbH; Konneritz Strasse 43, Leipzig, Germany
13. Gomel Foundry Works; Barykina Street 240, 246020 Gomel, Belarus
14. HWS - Heinrich Wagner Sinto Machinery GmbH; Postfach 1464, D-5928 Bad Laasphe, Germany
15. HYDROBEL - Joint Belarus-American Enterprise; Timiryazeva Street 29, 220073 Minsk, Belarus
16. Otto Junker GmbH; Postfach 1180, D-5107 Simmerath-Lammersdorf, Germany
17. Kaunas State Foundry Works; Kolontos Street 11/49, Kaunas, Lithuania

18. LITMASH -- Minsk Foundry Machinery Works; Mashinostroitelei Street 30, 220083 Minsk, Belarus
19. Luninec Electric Motors Works; Krasnaya Street 179, 225650 Luninec, Belarus
20. Minsk Automobile Works; Sotsialisticheskaya Street 2, 220831 Minsk, Belarus
21. Minsk Heat Equipment Factory; Timiryazeva Street 29, 220038 Minsk, Belarus
22. Minsk Tractor Manufacturing Association; Dolgobrodskaya Street 29, 220668 Minsk, Belarus
23. Mogilev Automobile Works; Vitebski Prospect 31, Mogilev, Belarus
24. Smorgon Foundry Mechanical Works; 231000 Smorgon, Grodno Region, Belarus
25. Volkovysk Foundry Equipment Factory; Proletarskaya Street 31, 231900 Volkovysk, Belarus
26. "Zavod avtoagregatov" (power units for automotive industries); 213760 Osipovitchi, Belarus