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Chapter 24

Evolution of the Soviet Space Industry*

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Introduction

Most of the available reports and publications about the histories of particular projects, institutions or personalities of the ex-Soviet space program tend to emphasize the role of a respective institution or personality in the overall program. This is explainable in a situation, when the basis of the original documentation, available to researchers, remains extremely narrow, and personal memoirs remain the predominant source of information.

This paper represents an attempt to survey the overall evolution of the Soviet rocket and space industry (which demands combining and cross-checking of fragments, available from a variety of individual sources). It is focused at the company/Chief Designer level and is to be accompanied by another report, focused on higher levels.[1]

The paper tracks the basic evolution of the Soviet rocket and space industry after 1946, when an original set of institutions was established. The framework of the report does not pretend to be a comprehensive description of the full genealogy of the Soviet space industry. However, analysis of the "genealogical trees" of the original enterprises allows the revelation of typical features of development of the rocket and space industry in the Soviet Union.

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Formation of the Soviet Rocket Industry

As a background remark, it is worth remembering some principal features of Soviet society, which substantially influenced the development of the Soviet rocket and space industry from its very beginning.

The Soviet Union was a strictly hierarchical society with a single pyramid of power controlling all aspects of its life. Despite the presence of formal bodies, representing different branches of power (i.e., the government—Council of Ministers, the parliament—the Supreme Soviet, the legal branch—the Supreme Court), ultimate control was executed from just one place: the Politburo (or Presidium) of the Central Committee of CPSU. All industrial and scientific enterprises belonged to the state, which could reallocate resources and manpower in any way, which top Communist Party authorities would direct.

Remembering that, it is not so surprising that, unlike the United States, France, or Britain, the birthday of the rocket industry of the Soviet Union is known precisely. It was on 13 May 1946, when Joseph Stalin signed a Decree of the Council of Ministers of the USSR # 1017-419ss, "Issues of jet armament."[2]

That Decree formulated the first program for the development of missile technology in the USSR, and allocated responsibilities for segments of that program among the Ministries. In accordance with that Decree, a number of industrial enterprises were established or reorganized within a few months, thus forming an original set-up of the Soviet rocket industry:

- Science and Research Institute #88 (NII-88) was established at the Ministry of Armaments (MV) to become the principal developer of liquid-fueled ballistic missiles.
- NII-885 was established at the Ministry of Electric Industry (later, the Ministry of Industry of Communications Means).
- Special Design Bureau at Kompressor Plant (of the Ministry of Machine-building and Instrument Engineering), which since 1941 had developed unguided solid-propellant missile launchers, was reorganized into the State Union Design Bureau on Special Machine-building (GSKB spetsmash) and was made responsible for launch complexes, fueling and ground support equipment.
- The Ministry of Aviation industries was made responsible for liquid rocket engines and aerodynamic testing (as well as for winged missiles), and already possessed the earlier established OKB-456 on liquid rocket engines and NII-1, former RNII, which was transferred from the People's Commissariat of Ordnance in 1944.
- NII-10 of the Ministry of Ship-building Industry (MSP) was additionally tasked to develop gyroscopes for missiles.[3]

Another special feature of the early history of the Soviet rocket industry is that responsibility for the development of liquid-fueled missiles was given to the Ministry of Armaments, i.e. to artillery industry, rather than to the aviation industry.

The reason was two-fold. First, leaders of the aviation industry did not desire an extra job—and extra risk of punishment for a quite possible failure. (The aviation industry already had received the task to develop jet aviation and cruise missiles, so ballistic missiles appeared much less relevant and a more risky addition to the task list). On the other hand, the principal force interested in LRBMs was a command of so called Guard Mortar Units—special artillery units, armed with unguided missiles (known as "katyushas"), which were widely deployed in the Soviet Army during World War II. Hence, it proved logical that the Ministry of Armaments, which was responsible for production of artillery pieces, accepted the LRBM challenge after the Ministry of Aviation Industry rejected it.

However, because of this peculiarity, the rocket and aviation industries in the Soviet Union began developing separately. The influence of that remains obvious even 50 years after: because of the original separation there is essentially no true *aerospace* industry in the former Soviet Union. With very few exceptions, all industrial companies are *either* in missiles and space, *or* in the aviation business.

Further Evolution (Expansion)

As the missile program advanced, the industry began to expand. In a market economy such an expansion would be by virtue of the Government placing more orders for missiles, thus stimulating industry contractors to develop their capabilities or to switch them from aircraft to missiles. In the administrative system of the Soviet Union, this was done in other ways.

In some cases, a "plain" expansion occurred, when new facilities were constructed for newly emerging or expanding programs. That was the case, for example, with missile and space factories, constructed in late 1950s near Krasnoyarsk, and now known as Krasmash and NPO of Applied Mechanics. This approach, however, was the exception rather than the rule.

More commonly, as some program demonstrated promising capabilities, the officials responsible for it managed to persuade higher authorities to add additional facilities to the program. To understand the typical modes of that "Soviet-type expansion" let us consider further the evolution of the principal original rocket companies.

NII-88, established as a lead organization on development of ballistic missile technology, very soon grew too big to hold all of the program inside. Its first formal "off-spring," however, appeared yet at the very beginning (see Fig-

ure 1). In 1946 Branch #1 was established at Gorodomlya Island, where German scientists were located until their repatriation in 1950-53.[4] The facility at Ostashkov (apparently associated with the former NII-88 Branch #1) in 1958 became an independent enterprise, now known as Zvezda.[5] In 1947 construction was ordered on Branch #2, a test base for rocket engines near Zagorsk. It was constructed in 1948 and later became an independent NII-229, now known as NII of Chemical Machine-building (NII Khimmash).

In 1956 Experimental Design Bureaus #1 (on LRBM) and #2 (on liquid rocket engines), which existed within NII-88 for a long time, were separated to become independent entities: OKB-1 and OKB-2, headed by Chief Designers Sergey P. Korolyov and Alexey M. Isayev, respectively.[6] The rest of NII-88 continued to evolve in the same way, spawning new enterprises:

- NII of Measuring Technology (NIIIT) in 1966
- Agat Organization in 1973
- NII of Material Studies (NIIMV), now Kompozit NPO, in 1975.

Thus, in 30 years the original NII-88, now known as the Central Science and Research Institute of Machine-building (TsNIImash), gave birth to 7 independent organizations, which together formed the so-called "Podlipki bush" of space companies.

The mainstream of NII-88 development appears quite simple and straightforward. It fits the concept of the straight development of a growing enterprise with the separation of divisions as they become too big to manage.

This simple mode was, however, facilitated by the circumstance that main production-related fragments (and associated big-ticket programs) left NII-88 with OKB-1 and OKB-2 in 1956. A further evolution of **OKB-1**, represented in Figure 1b, displays much more involved behavior.

A wide-spread belief about Korolyov extensively spawning branches of his OKB and generously giving out to them portions of his own all-inclusive agenda, proves to be just one part of the story. Along with that mode of expansion an equal role was played by a mode which could be referred to as "seeding." This means loading already available enterprises with the work of a Lead Developer's (here Korolyov's) projects.[7] In this mode a newly engaged enterprise remained formally independent, but in fact the Lead Developer did obtain some influence on a new co-developer or manufacturer (and thus increased its own "weight," though to a lesser extent than in the case of a full-scale acquisition of that company).

In the history of Soviet rocket industry "seeding" was first demonstrated long before the separation of OKB-1 from NII-88.

As early as in 1947 Plants #66 and 385 in the Urals were assigned to the serial production of missiles and in December of 1947 the Serial Design Bureau #385 (SKB-385) was established to supervise that. Sometime between 1950 and 1955 SKB-385 was promoted to a "Leading" bureau, i.e. was allowed to de-

velop its own projects. It was not until 1955, when SKB-385 was "loaded" with the serial production of the R-11 missile, developed at OKB-1 of NII-88, and Viktor Makeyev, the Lead Designer of the R-11, was appointed as a Chief Designer of SKB-385. Thus, in terms of organizational genealogy the former SKB-385 (now known as "Makeyev KB" State Rocket Center) is not a direct descendant of Korolyov's OKB-1, but rather is an "adopted child."

Similarly, Plant #186 in Dniepropetrovsk, which began operations in 1944, was loaded with the serial production of OKB-1's missiles in 1951. The adjacent SKB-586 is, however, rarely listed among "Korolyov's descendants"—apparently because a competing "school" was established there with the appointment of Mikhail K. Yangel as a Chief Designer in 1954.

After 1956 the major milestones in OKB-1 expansion were:

- Loading of the former State Aviation Plant #1 with the serial production of the R-7 ICBMs, beginning in 1957. To supervise the production at the Plant, the Serial Design Department #25 was organized. In 1960 this Department became OKB-1 Branch #3 and eventually, in 1974, the Central Specialized Design Bureau (TsSKB).
- In 1959 the OKB-1 Branch #2 was established at the newly constructed Plant #1001 (now the Krasnoyarsk Machine-building Plant, or Krasmash). It was originally intended to supervise serial production of the R-9 ICBMs. However, as early as in 1960 its principal original business changed to the R-14 LRBM, developed by Yangel, and in 1961 Branch #2 was transformed into an independent OKB-10.[8]
- The same 1959 OKB-1 acquired an adjacent artillery Design Bureau, headed by Grabin. It was switched to the development of new, solid-propellant LRBMs and then ICBMs. However, very soon after the death of Korolyov the solid-propellant thematics were given away by his successor Vasiliy P. Mishin to NII-1 of the Ministry of Defense Industry.[9]
- In 1974 Mishin, accused of the failure of the Moon program, was removed from the post of Chief Designer of the Bureau, which under him changed the name from OKB-1 to the Central Design Bureau of Experimental Machine-building (TsKBEM). Viktor P. Glushko, the Chief Designer of OKB-456, was appointed instead. However, since Glushko would not leave his own Bureau, a new company was formed: Energia NPO, including both TsKBEM and OKB-456. The conglomerate existed until Glushko's death in 1989 and then split into original parts, which got the names Energia NPO and Energomash NPO respectively.

The history of OKB-1 illustrates how an expanding missile industry gradually attracted enterprises from aviation-related facilities.[10]

The history of the Design Bureau under Chief Designer Vladimir N. Chelomey gives a remarkable example of a seemingly more conventional evolution of an aviation company towards missile and space-related tasks.

First of all, it is necessary to note, that there were two Design Bureaus, headed by Chelomey.[11] The first was established in 1944 at Plant #51 (former Polikarpov's) with a mission to make a V-1-like cruise missile. That OKB, however, was disbanded in 1953 under pressure from more influential competitors. Nevertheless, in 1954, a new small Special Design Group (SKG) was established to resume development of cruise missiles (with folding wings). In 1952 the SKG was promoted to full status. This group soon (in 1955) became a full-scale Experimental Design Bureau—OKB-52—and was given the Reutov Mechanical Plant.[12] This company resides there now under a name of NPO Mashinostroyenia. In the meantime, however, it experienced a dramatic evolution, with a fast rise and subsequent fall (see Figure 2).

In 1958-59 the OKB-52 began to expand its operations into the ballistic missile and space field—and to expand itself. In 1958 NII-642 was attached to OKB-52 as a Branch. In October 1960 OKB-23, headed by Vladimir M. Myasishchev until then, became another Branch of OKB-52. The Khrunichev Plant was assigned to OKB-52 as a production facility for its ICBMs. Finally, OKB-301, formerly headed by Semyon A. Lavochkin, was also attached to OKB-52 in late 1962.

The role of personal relations is clearly observed in the history of the Chelomey OKB. First, Chelomey's original OKB, based at Plant #51, was taken over upon the insistence of Artem I. Mikoyan, who began a competitive project, but had a very influential partner—Sergo L. Beria, the son of the Minister of Security Lavrentiy P. Beria. Perhaps, having learned that lesson, Chelomey in the late 1950s appointed the son of Nikita S. Khrushchev, Sergey, as his Deputy. Most people outside of OKB-52 believe that that was instrumental in getting a favorable attitude of the top state management and, in particular, made it easier to acquire new Branches.

After the removal of Nikita Khrushchev in 1964 Chelomey's influence diminished and all the branches were gradually taken away by competitors or separated themselves. For example, Lavochkin OKB-301 regained independence and was in 1965 loaded with the interplanetary probes job, passed from OKB-1.

To complement the previous consideration, concentrated on prime contractors (or "Lead Developers," in Russian terms), let us discuss the evolution of NII-885, the institute which was established to develop guidance systems.

NII-885 originated in 1938 with a mission to develop systems of radio control for military articles. In 1946 the Institute was assigned to the Ministry of Electric Industry and renamed (for a very short while) the NII of Special Technology.

NII-885 was based on the grounds of Plant #1 of the People's Commissariat of Defense (later Ministry of Armed Forces), which used to manufacture military telephones and telegraph equipment and later became the Experimental Plant of NII-885. After 1946 the Institute quickly grew and in 1952-54 a number of "non-profile" divisions (long-range communications, computers, etc.) were

shed to become independent bodies and to allow NII-885 to concentrate on the development of missile guidance systems (Figure 3).[13]

In 1963 the Institute, which for a long time had fought the leadership of radio guidance (headed by Chief Designer Mikhail Ryazanskiy) and of inertial guidance (headed by lower-ranked Nikolay A. Pilyugin), separated into two parts: NII of Instrument Engineering (NIIP) and NII of Automatic Instrument Engineering (NIIAP).

In 1978 Radiopribor NPO was formed on the basis of NIIP and the Radiopribor plant. In 1992 the NPO returned to the Radiopribor Plant and NII, which is now called the Russian NII of Space Instrument Engineering (RNIIKP).

The last of the original companies listed earlier—**GSKB Spetsmash**—has an apparently straightforward history. After the Bureau, originally established in 1941 as SKB of the Kompressor Plant, was reorganized in August 1946; it continues to develop launch complexes for missiles and only once changed its name to the current Design Bureau of General Machine-building (KBOM).[14]

Conclusion

This study demonstrates that the evolution of the Soviet rocket and space industry is more complicated than is usually imagined. Several typical features could be extracted from the histories of the considered companies:

- Lead Developers of rockets and space systems demonstrate more aggressive expansion, while narrower focused institutions develop more smoothly.
- The expansion of industrial enterprises occurred primarily in the form of administrative acquisitions or resubordinations.

  A typical form was a takeover of an existing company and its conversion into a Branch of an acquirer.

  A less violent mode utilized loading of a new company with the work for a project developed by a Lead Developer.

  In some cases (typical for the Stalin epoch), appealing facilities could be taken over by an influential company, while a previous collective would be thrown away.

Acknowledgment

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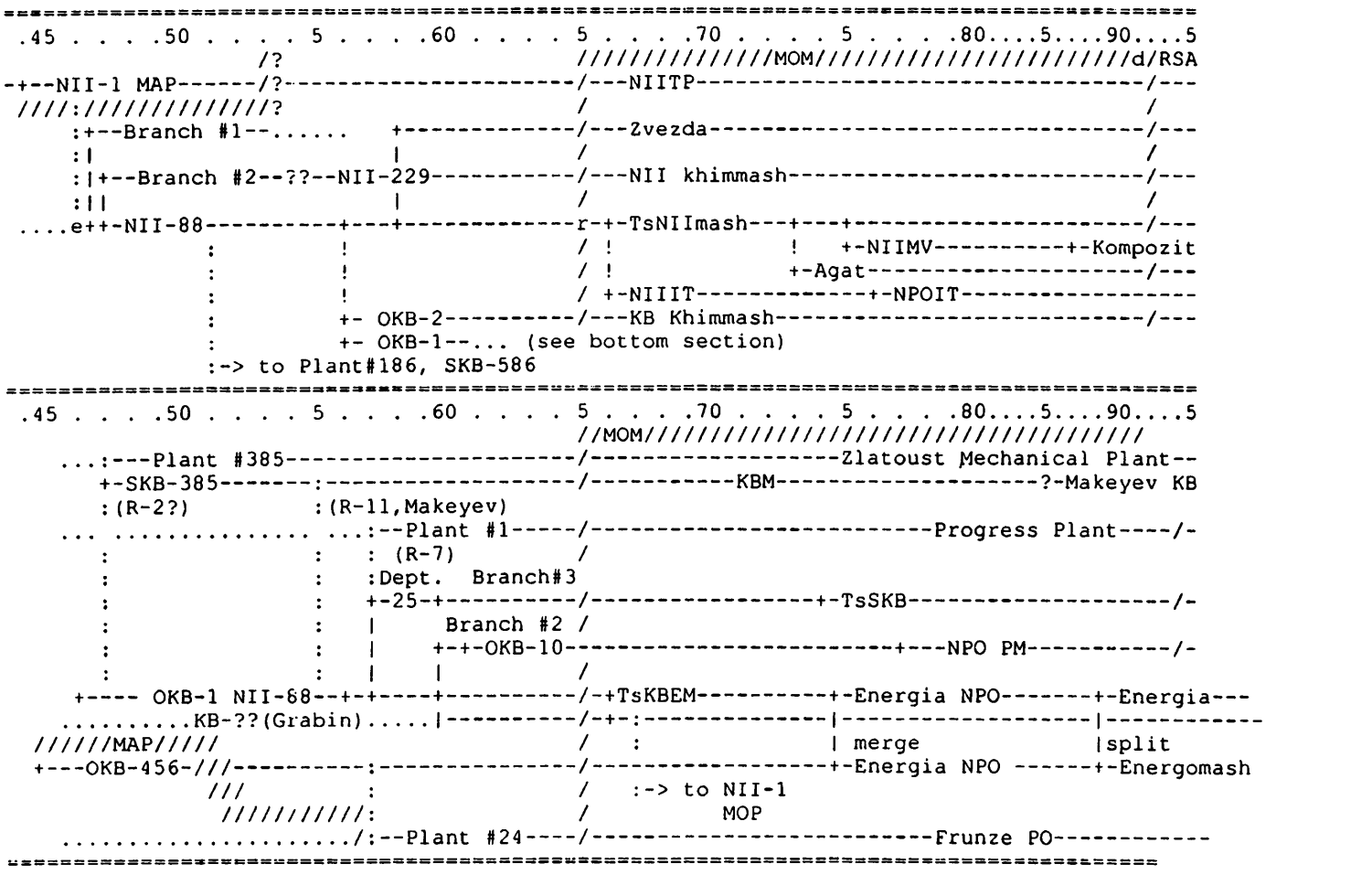

Figure 1. Evolution of NII-88 (top) and OKB-1 (bottom)

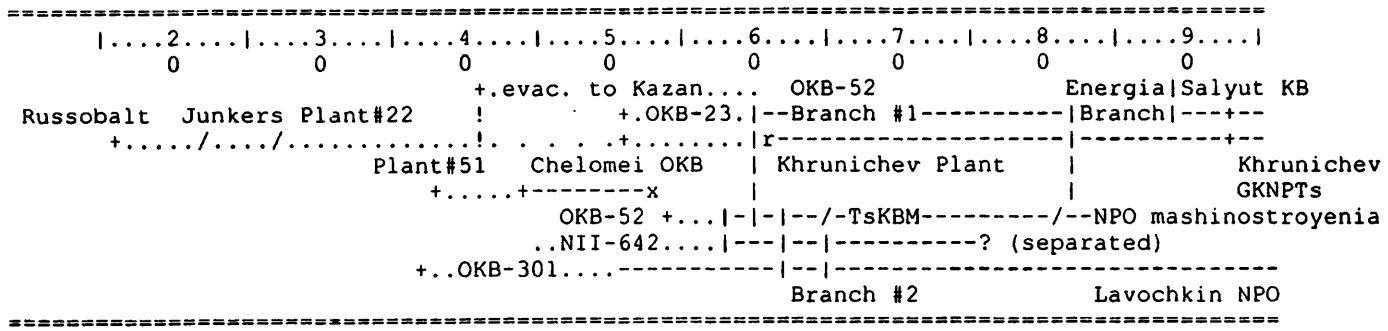

Figure 2. Evolution of enterprises, associated with Chelomei Design Bureau

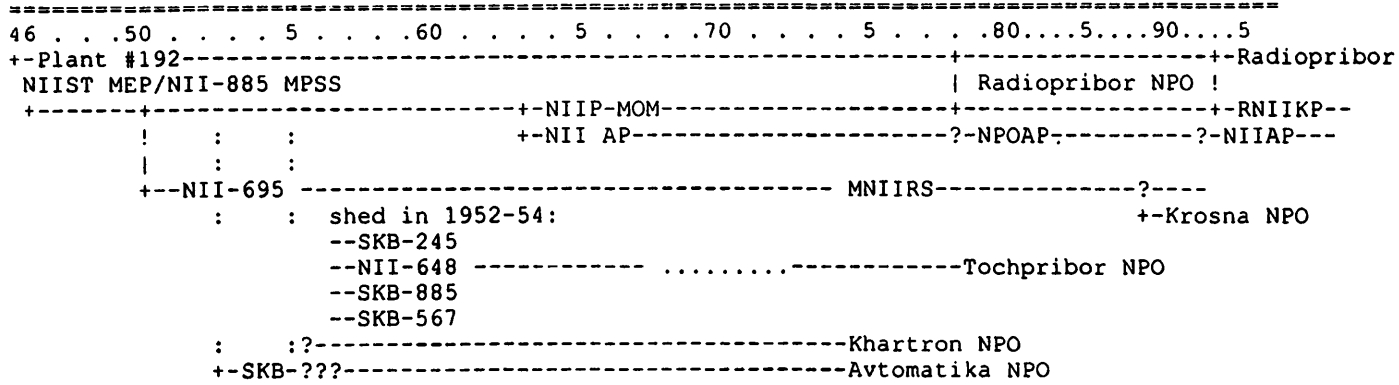

Figure 3. Evolution of NII-885

Notes to Figures 1-3:

+ - appearance, change of name or move
(if specified: e-established; r - renamed; d - disbanded)
--- - missile or space-related activities
... - activities, not related to missiles and space
//// - borders between Ministries
: - "seeding" by a personnel or projects transfer

MAP - Ministry of Aviation Industry
MEP - Ministry of Electric Industry
MOP - Ministry of Defense Industry
MPSS - Ministry of Indistry of Communications Means
MOM - Ministry of General Machine-building
MV - Ministry of Armaments

Reference Notes

[1]Sergey V. Golotyuk, "Evolution of the Management of Soviet Space Activities" — To be presented at 46th IAF Congress.

[2]Published in: *Nezavisimaya Gazeta*, 23 Feb. 1995.

[3]This listing is not complete and includes only the most important enterprises, which later became significantly involved in the space program.

[4]This enterprise deals with gyroscopes and should not be confused with the Zvezda enterprise, of Tomilino, known for ejection seats and spacesuits.

[5]Georgiy S. Vetrov. "Scientific Biography of Academician S. P. Korolyov" to be published (in Russian).

[6]*Ibid.*

[7]"Seeding" usually implies the transfer of both documentation and some personnel, to facilitate mastering a project at a new place. There were also cases, (particularly in early history), when "seeding" of new institutes occurred by just sending group of personnel from established institutions.

[8]Sergey V. Golotyuk "30 years and 1000 satellites later," *Novosti Kosmonavtiki* #17, 1994, pp.42-43 (in Russian).

[9]The same is seen from the available fragment of the evolution of OKB-456. Simultaneously with Aviation Plant # 1 switching to R-7 missile production, the Motor-building Plant 424, also in Samara, was switched to production of R-7 engines, developed by OKB-456.

[10]This is a remarkable example of how the *personal* aspect of history misleads a study of organizational evolution. Another example is the Isayev design bureau, which originally formed as a group in Bolkhovitinov's OKB-293 in Khimki, then joined NII-88 at Podlipki and became an independent entity only in 1956.

[11]Georgiy S. Vetrov, Private communication.

[12]Sergey V. Golotyuk: *From the History of Aviation and Cosmonautics*, issue 62, 1993, IHST, Moscow, p. 42 (in Russian).

[13]History of the Russian Institute of Space Instrument Engineering, Issue 1. Moscow, 1994 (in Russian).

[14]We may not, however, know all the details of the KBOM history yet.