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Vyacheslav Danilenko – Background, Research, and Proliferation Concerns

By Mark Gorwitz

In the debate about the November 11 International Atomic Energy Agency (IAEA) safeguards report, some have falsely implied that Vyacheslav Danilenko did not know anything about nuclear weapons, or that he worked solely on nanodiamonds from the beginning of his research career, even though he worked at Chelyabinsk-70 for almost thirty years.[1] The open source record demonstrates that these statements are incorrect and that Danilenko was involved in developing and using inwardly converging high pressure explosions and diagnostic systems to measure their effectiveness vital to the development of Soviet nuclear weapons. As such, the open source record supports that when he assisted Iran in the 1990s, he was an ex-Soviet nuclear weapons expert. Given his background, Danilenko should have had reason to believe that his knowledge and expertise related to high explosive compression in nuclear weapons could be misused by the Iranians, even if he limited himself to advising on strictly non-nuclear weapon applications.

In his statement to the IAEA Danilenko denied helping Iran build nuclear weapons but he admitted that he could not exclude that the information he provided was used for other purposes. Despite his denials, the IAEA suspects he helped Iran more than he has admitted so far.

All-Russian Scientific Research Institute of Technical Physics (VNIITF)

In 1954 the Russian government decided to establish a backup nuclear design bureau in the Ural Mountains dedicated to the research and development of nuclear weapons. The facility was located over a thousand kilometers from Design Bureau 11 at Sarov in case this facility was ever lost in a conflict. A number of leading scientists headed up this new effort including E.N. Avrorin, E.I. Zababakhin, and K.K Krupnikov. Zababakhin headed the new institute which now bears his name.[2] Feoksitistov states that over a third of the staff from Design Bureau 11 joined the new facility, named the All-Russian Scientific Research Institution of Technological Physics (VNIITF) at Chelyabinsk-70.

It is believed that V.V. Danilenko's career at Chelyabinsk-70 began in the late 1950s but the exact date when he came to the laboratory is uncertain. He became a member of the gas dynamics research group where gas dynamics refers to "the entire range of research pertaining to explosion physics, shock and detonation waves and non-standard gas dynamic flows."[3] Explosion physics deals primarily with the compressibility of a substance and has important applications to the design of nuclear explosives and weapons.

236 Massachusetts Avenue, NE, Suite 305 Washington, DC 20002
TEL 202.547.3633 • FAX 202.547.3634
E-MAIL isis@isis-online.org • www.isis-online.org

By the early 1950s a number of different methods were available for the determination of the detonation parameters of explosive materials and in 1953 Yu Khariton asked a number of leading scientists to write an overview of the methods available in this important area.[3] The range of experimentally investigated pressures exceeded by an order of magnitude the range which had been reached by U.S. researchers. The actual design of the shock compression devices used in these studies was not revealed until the 1990s.[4] Thus, Danilenko was exposed to advanced methods of detonation directly applicable to nuclear weapons.

In a 2004 article Danilenko wrote that Zababakhin first authorized the possibility of diamond synthesis via the shock compression of graphite in 1960 and that the detonation synthesis of nanodiamonds was discovered in July 1963.[5] The early studies were done by M.N. Pavlovskii, K.K. Krupnikov, A.N. Dremin, and S.V. Pershin. Danilenko, K.V. Volkov and V.I. Elin were working at VNIITF. They obtained nanodiamonds from shock-compressed graphite in spherical and cylindrical ampoules.[5] Danilenko has stated that he worked on the detonation synthesis from 1960-1963 but he has not revealed what else he worked on during his time at VNIITF.[5]

It is possible through a careful reading of Russian articles that have been published in recent years to understand the research being done by the gas dynamics group at VNIITF during the period of the 1960s and 1970s. In 1959, Zababakhin was involved in studying the convergence of a spherical shock wave in systems made up of alternating layers of low and high-density.[6] He established the principle that "self-similar layer systems significantly enhance energy accumulation."

Gas Dynamics Group's Work on Nanodiamonds

Danilenko himself wrote that scientists from the gas dynamics group, including "K.V. Volkov, V.I. Elin, [and he], carried out the pioneering work in diamond synthesis from 1960-1965" owing to the initiative and support of Zababakhin.[7] It is very likely that Danilenko was involved in these later shock compression studies that played an important role in the Russian nuclear program. The data obtained by the gas dynamics group on aluminum, lead, and other materials were critical in the formulation of more accurate models for predicting the equations of state of materials that are important to the design of nuclear weapons.[8] A 1998 conference paper clarifies the role that carbon phase states play in the study of high explosives (HE) and said "carbon phase state in detonation products depends on their temperature and pressure and affects to detonation parameters of explosives because distinct carbon phases have different thermodynamic properties. Therefore, knowledge of carbon phase state in detonation products is important for accurate prediction of HE detonation characteristics." [9]

In the earliest Russian shock compression studies the "electrocontact method made possible comparative investigations of different [explosive] lens systems."[10] There were a number of different variants of these lenses which made it possible to create varying velocities and achieve different levels of compression.[4] Gas dynamic studies played an important role in establishing how different materials behaved under conditions of compression and temperature and determining the dynamic compressibility of materials such as plutonium and uranium.

Danilenko was able to publish some of the results of these experiments in 1987. His first published paper was on the effects of nonideal detonation on impelled plate energy.[11] In simple terms, this study looked at the relationship between detonation energy and initiation method. His second paper published in 1989 was on using the electrical contact method in shock studies.[12] This study was a

marked improvement over the sensors used in early shock waves studies. Electrocontact sensors measure the times of shock waves' passage through gauge length reference points and allow for the determination of "time intervals between the times of actuation of several sensors positioned along the shock wave path in the specimen or along the path of the free surface."[12] In describing Danilenko's design Y.V. Batkov and others stated that the electrocontact technique has been recently improved in order to enhance the accuracy and reliability of measured free-surface velocity.[10] Danilenko published his earliest papers on nanodiamond synthesis around this same period of time.[13]

Conclusion

Based on an open source review, Danilenko as a member of the gas dynamics group at VNIITF, would have been exposed to or involved in a number of nuclear weapons relevant areas of research and development. His experiments on the detonation synthesis of nanodiamonds would have been of direct importance to understanding the detonation properties of condensed explosives. His research would have also directly exposed him to the design of shock compression experiments and the techniques and methods of measuring experimental results. That knowledge would have been invaluable to researchers in the field. That Danilenko was hired by Dr. Seyed Abbas Shahmoradi, then leader of Iran's Physics Research Center, responsible for its nuclear weaponization program demonstrates just how relevant Danilenko's expertise was to Iran's weaponization efforts.

Open source reporting does not reveal how much of this information was shared with Iranian researchers during the period of his interaction with them. His expertise and research in the shock compression arena would have complimented research being carried out by various other Iranian organizations and helped spur advancements in nuclear weapon research and development that otherwise would have taken years of dedicated research to accomplish.

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