

In Memoriam: Professor Pavel Leonidovich Kirillov (Aug. 20, 1927–Oct. 10, 2021)



Professor Pavel Leonidovich Kirillov

Professor Pavel L. Kirillov died on Oct. 8, 2021, on his 95th year after a life as a husband, father, and an internationally renowned scientist, researcher, and educator in the field of nuclear engineering, thermalhydraulics, heat transfer, and two-phase flow. He was passionate and dedicated in everything that he did and leaves an incredible legacy to the profession.

He was born on Aug. 20, 1927 in Russia, and received his M.A.Sc. degree in thermal physics in 1950 (Moscow Power-Engineering Institute (MPEI) (Московский Энергетический Институт (МЭИ)), Faculty of Physics and Power Engineering (Физико-Энергетический Факультет), Ph.D. and Doctor of Technical Sciences degrees—in 1959 and 1969, respectively.

Professor P. L. Kirillov was a Fellow of the International and National Engineering Academies; member of the Russian Nuclear Society and ASME; member of Scientific Councils of the Institute of Atomic Energy by the name of I. V. Kurchatov (ИАЭ им. И.В. Курчатова) (1985–1990) and A.I. Leypunsky Institute for Physics and Power Engineering (IPPE) (Физико-Энергетический Институт (ФЭИ)) (from 1975); member of the Journal Boards of the Atomic Energy (Атомная Энергия) (from 1977) and the ASME *Journal of Nuclear Engineering and Radiation Science* (from 2014).

After graduating from the MPEI (МЭИ) in 1950, Pavel Kirillov has joined the IPPE (ФЭИ) (Obninsk, Russia), currently, State Scientific Centre of the Russian Federation—Leypunsky Institute for Physics and Power Engineering, Joint-Stock Company (IPPE JSC) (Акционерное общество «Государственный научный центр Российской Федерации – Физико-энергетический институт имени А.И. Лейпунского» (АО «ГНЦ РФ—ФЭИ»)) as a junior scientist in 1950 (he participated in construction and operation of the world’s first nuclear power plant in Obninsk, AM-1 (“Atom Peaceful”—1 in Russian abbreviations (Атом Мирный)), which was commissioned at the IPPE on June 27, 1954), and worked there on various positions: Senior scientist (1953–1954); head of laboratory (1954–1969); head of branch (1969–1975); director of thermal-physics division (1975–1995); deputy director of thermal-physics division (1995–2010); advisor of the director of thermal-physics division (from 2010) and of the general director of IPPE JSC.

He was an associate professor (1959–1965); professor (1965–1972); chair of the thermal-physics department (1972–1985); and chair of the nuclear-power-plant department at the Obninsk Branch of the Moscow Engineering Physics Institute (MEPhI) (Обнинский филиал Московского инженерно-Физического Института (МИФИ)) (1985–1992). Professor Pavel Kirillov has prepared a large number of undergraduate and master-degree students; and 15 Ph.D. candidates.

Knowledgeable, friendly and technically informed, Dr. P.L. Kirillov was a role model and mentor to numerous generations of

researchers/scientists in nuclear engineering, thermalhydraulics, heat transfer, and two-phase-flow fields. He is definitely one of the most admired and ingenious researchers in these fields. His many researches and achievements include contributions in such special areas as molten-metals nuclear-reactor coolants; supercritical water; research (BR-10 (Fast Reactor (sodium-cooled)) and BOR-60 (fast experimental reactor (sodium-cooled)); power (BN-350 and BN-600 (fast sodium power reactors)), transportation (lead-bismuth-cooled), and spacecraft (BUK and TOPAZ) nuclear reactors. Professor Kirillov is well respected among his colleagues in the nuclear-engineering community all over the world despite being heavily focused on Russian developments to which he made major contributions. His 2009 text on “Hydrodynamic Calculations” (in Russian) covered and demonstrated his encyclopedic knowledge of fluid flow and heat transfer. The earlier 2007 major text “Thermophysical Properties of Materials for Nuclear Engineering” (in English) sets the standard for excellence, breadth and depth with not only essential basic data and tabulations, but includes fundamental design information for all types of reactors.

For his outstanding work, Professor P. L. Kirillov was awarded with the following honored titles: Honored Scientist of Science and Engineering of the Russian Federation (1988) (Заслуженный деятель науки и техники РСФСР) and Honored Worker of the Atomic Industry of the Russian Federation (2016) (Заслуженный работник атомной промышленности Российской Федерации); and with three state orders and a number of state and jubilee medals.

During his work at the IPPE (ФЭИ) and Obninsk Branch of MEPhI (МИФИ), Professor Kirillov has published over 350 technical publications including handbooks, reference books, textbooks, papers, inventions, and reports (see selected publications listed below). His professional contributions and critical thinking continued unabated and he was fully involved in the series of articles summarizing the status of nuclear energy in the world and its future prospects.

Professor Pavel Leonidovich Kirillov was a respected technical leader, mentor, and friend to innumerable students, researchers, scientists, and engineers, and he will be sadly missed by all who had the privilege to know him. He was an outstanding contributor in every aspect of his prolific work and career in the true traditions of technical excellence and critical thinking, and his irreplaceable loss is deeply felt worldwide.

The official information on Professor Kirillov can be found on the following website.¹

On behalf of the ASME J. NERS Editorial Board, colleagues, students, and friends from around the world:

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Selected Publications of Professor P.L. Kirillov

- [1] Pioro, I., Duffey, R. B., Kirillov, P. L., 2021, “Pros and Cons of Commercial Reactor Designs, Section 2: Chapter. Part 1. Current Status of Electricity Generation in the World and Selected Countries.” *Encyclopedia of Nuclear Energy*, 1st ed., Elsevier, UK, pp. 263–287 (in Editor-in-Chief: E. Greenspan, p. 3656).
- [2] Pioro, I., Duffey, R. B., Kirillov, P. L., 2021, “Pros and Cons of Commercial Reactor Designs, Section 2: Chapter. Part 2. Current Status and Future Trends in the World Nuclear-Power Industry and Technical Considerations of Nuclear-Power Reactors.” *Encyclopedia of Nuclear Energy*, 1st ed., Elsevier, UK, pp. 288–303. (in Editor-in-Chief: E. Greenspan, p. 3656).
- [3] Pioro, I., Duffey, R. B., Kirillov, P. L., and Dort-Goltz, N., N., 2020, “Current Status of Reactors Deployment and Small Modular Reactors Development in the World,” *ASME J. Nucl. Eng. Radiat. Sci.*, 6(4), p. 24 (The most read paper in J. NERS in 2021).
- [4] Pioro, I., Duffey, R. B., Kirillov, P. L., Pioro, R., Zvorykin, A., and Machraf, R., 2019, “Current Status and Future Developments in Nuclear-Power Industry of the World,” *ASME J. Nucl. Eng. Radiat. Sci.*, 5(2), p. 27 (The most read paper in J. NERS in 2021).
- [5] Handbook of Generation IV Nuclear Reactors, 2016, Elsevier–Woodhead Publishing (WP), Duxford, UK, p. 940. https://www.gen-4.org/gif/jcms/c_9373/publications
Chapter 1: Pioro, I. L., Duffey, R., Kirillov, P. L., Introduction: A Survey of the Status of Electricity Generation in the World, p. 34.

Appendix A1: Pioro, I. L., and Kirillov, P. L., Additional Materials (Schematics, Layouts, T-s Diagrams and Basic Parameters) on Thermal and Nuclear Power Plants, p. 40.

- [6] *Handbook on Thermalhydraulics Calculations in Nuclear Power Engineering*, Vol. 3, P. L. Kirillov, ed., Izdat Publishing House, Moscow, Russia (In Russian).
Volume 1: Kirillov, P. L., Bobkov, V. P., Zhukov, A. V., and Yur'ev, Y. S., 2010, Thermalhydraulics Processes in Nuclear Power Installations, (In Russian), p. 770.
Volume 2: Kirillov, P. L., Zhukov, A. V., Loginov, N. I., Makhin, V. M., Pioro, I. L., and Yur'ev, Y. S., 2013, *Nuclear Reactors, Heat Exchangers, Steam Generators*, P. L. Kirillov, ed., p. 688 (In Russian).
Volume 3: Thermalhydraulic Processes at Transient and Non-Standard Regimes, *Severe Accidents. Containment and Shielding. Codes, Their Abilities, Uncertainties* (In Russian), 2014, P. L. Kirillov, ed., p. 688.
- [7] Formatek Research Center, 2013, *Materials and Processes for Energy: Communicating Current Research and Technological Developments*, Energy Book Series #1, A. Méndez-Vilas, ed., Formatek Research Center, Spain.
Chapter: Pioro, I., and Kirillov, P., Current Status of Electricity Generation in the World, pp. 783–795.
Chapter: Pioro, I., and Kirillov, P., Current Status of Electricity Generation at Thermal Power Plants, pp. 796–805.
Chapter: Pioro, I., and Kirillov, P., Current Status of Electricity Generation at Nuclear Power Plants, pp. 806–817.
Pioro, I., and Kirillov, P., Generation IV Nuclear Reactors as a Basis for Future Electricity Production in the World, pp. 818–830.
- [8] Draganov, A., Saltanov, E., Pioro, I., Kirillov, P., and Duffey, R., 2015, “Power Cycles of Generation III and III+ Nuclear Power Plants,” *ASME J. Nucl. Eng. Radiat. Sci.*, 1(2), p. 10.
- [9] Pioro, I., and Kirillov, P. L., 2014, “Generation IV Nuclear Reactors as a Basis for Future Electricity Generation in the World,” *At. Tech. Abroad (Атомная Техника за рубежом)*, (2), pp. 3–12 (In Russian).
- [10] Richards, G., Harvel, G. D., Pioro, I. L., Shelegov, A. S., and Kirillov, P. L., 2013, “Heat Transfer Profiles of a Vertical, Bare, 7-Element Bundle Cooled With Supercritical Freon R-12,” *Nucl. Eng. Des.*, 264, pp. 246–256.
- [11] Mokry, S., Pioro, I. L., Farah, A., King, K., Gupta, S., Peiman, W., and Kirillov, P., 2011, “Development of Supercritical Water Heat-Transfer Correlation for Vertical Bare Tubes,” *Nucl. Eng. Des.*, 241(4), pp. 1126–1136.
- [12] Kirillov, P. L., Pomet'ko, R. S., Smirnov, A. M., Grabeznaia, V. A., Pioro, I. L., Duffey, R. B., and Khartabil, H. F., 2005, “Experimental Study on Heat Transfer to Supercritical Water Flowing in Vertical Tubes,” *Proceedings of the International Conference GLOBAL-2005 “Nuclear Energy Systems for Future Generation and Global Sustainability*, Tsukuba, Japan, Oct. 9–13, Paper #518, p. 8.
- [13] Aksan, N., Ambrosini, W., Ammirabile, L., Anderson, M., Bae, Y. Y., Chen, Y., Churkin, A., Haenninen, M. J., Jackson, J. D., Kirillov, P. L., 2014, “Heat Transfer Behaviour and Thermohydraulics Code Testing for Supercritical Water Cooled Reactors (SCWRs),” IAEA TECDOC Series, September, Vienna, Austria, Paper No. IAEA-TECDOC-1746, p. 496. <http://www-pub.iaea.org/books/IAEABooks/10731/Heat-Transfer-Behaviour-and-Thermohydraulics-Code-Testing-for-Supercritical-Water-Cooled-Reactors-SCWRs>
- [14] Kirillov, P. L., 2010, “Names and Non-Dimensional Numbers. (Essays About Scientists),” *NITs Regular and Chaotic Dynamic*, Izhevsk, Moscow, Russia, p. 336 (In Russian).
- [15] Kirillov, P. L., and Bogoslovskaya, G. P., 2008, *Heat-Mass-Transfer in Nuclear Power Reactors*, 1st ed., Izdat Publication House, Moscow, Russia, p. 256 (Textbook, (In Russian) (edition in 2000)).
- [16] Kirillov, P. L., Terentieva, M. I., and Deniskina, N. B., 2007, *Thermophysical Properties of Materials in Nuclear Engineering*, Izdat Publication House, Moscow, Russia, p. 200 (In English and Russian).
- [17] Kirillov, P., Pomet'ko, R., Smirnov, A., Grabeznaia, V., Pioro, I., Duffey, R., and Khartabil, H., 2005, “Experimental Study on Heat Transfer to Supercritical Water Flowing in 1- and 4-m-Long Vertical Tubes,” *Proceedings of the International Conference GLOBAL Nuclear Energy Systems for Future Generation and Global Sustainability*, Tsukuba, Japan, Oct. 9–13, Paper No. 518, p. 8.
- [18] Kirillov, P. L., Yur'ev, Y. S., and Bobkov, V. P., 1990, *Handbook on Thermalhydraulics Calculations (Nuclear Reactors, Heat Exchangers, Steam Generators)*, 2nd ed., ed. P. L. Kirillov. Energoatomizdat Publishing House, Moscow, Russia, p. 360 (In Russian).