THE VENERA-D MISSION CONCEPT, REPORT ON THE ACTIVITIES OF THE JOINT SCIENCE DEFINITION TEAM. D. Senske[1], L. Zasova[2], T. Economou[3], N. Eismont[2], M. Gerasimov[2], D. Gorinov[2], J. Hall[1], N. Ignatiev[2], M. Ivanov[4], K. Lea Jessup[5], I. Khatuntsev[2], O. Korablev[2], T. Kremic[6], S. Limaye[7], I. Lomakin[8], A. Martynov[8], A. Ocampo[9], O. Vaisberg[2], A. Burdanov[10], S. Teselkin[8], V. Vorontsov[8], [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, [2]Space Research Institute RAS, Profsoyuznaya 84/32, Moscow 117997, Russia, [3]Enrico Fermi Institute, University of Chicago 933 East 56th Street, Chicago, IL 60637, [4]Vernadsky Inst. RAS, Kosygin St., 19 Moscow, Russia, [5]Southwest Research Institute 1050 Walnut, Suite 300 Boulder CO 80302, [6]Glenn Research Center, 21000 Brookpark Rd, Cleveland, OH 44135, [7]Univ. of Wisconsin, 1225 W Dayton St Madison, WI 53706, [8]Lavochkin Assoc. 24, Leningradskaya Str. 141400 Khimki, Russia, [9]NASA Headquarters, Washington, DC., [10]TSNIIMASH, Korolev, Russia

Background: The Venera-D mission concept is devoted to the detailed study of the atmosphere, surface, and plasma environment of Venus [1]. Envisioned as launching in the post-2025 timeframe and consisting of an orbiter and lander with advanced, modern instrumentation with potential contributions consisting of an aerial platform/balloon, small long-lived surface stations or a sub-satellite. This mission would build upon the Venera, VEGA, Pioneer Venus, and Magellan missions carried out in the 1970's and 1990's [2,3,4] along with the more recent Venus Express [5]. In January of 2017, the NASA and IKI/Roscosmos Joint Science Definition Team (JSDT) provided its first report.

Venera-D science goals: Specific areas of scientific investigation for Venera-D would focus on the dynamics of the atmosphere with emphasis on atmospheric superrotation, the origin and evolution of the atmosphere, and the geological processes that have formed and modified the surface with emphasis on the mineralogical and elemental composition of surface materials, the chemical processes related to the interaction of the surface and atmosphere, solar wind interaction and atmospheric losses.

Orbiter Goals consist of the following: study of the dynamics and nature of superrotation, radiative balance and greenhouse effect; investigation of the thermal structure of the atmosphere, winds, thermal tides and solar locked structures; measurement of the composition of the atmosphere; study of the clouds, their structure, composition, and chemistry; evaluation of the nature of the 'unknown' UV-absorber; and investigation of the upper atmosphere, ionosphere, electrical activity, magnetosphere, and the escape rate.

Lander Goals focus on the study of the elemental and mineralogical composition of the surface, including radiogenic elements; characterization of the geology of local landforms at different scales; study of the interaction between the surface and the atmosphere; investigation of the structure and chemical composition of the atmosphere down to the surface, including abundances and isotopic ratios of the trace and noble gases; and performing direct chemical analysis of the cloud aerosols.

The JSDT identified areas where important science may not be addressed by the baseline concept and generated a list of potential "contributed" options, ranging (in order of interest) from specific instruments such as a Raman Spectrometer and an Alpha-Proton X-Ray Spectrometer (APXS) to possible flight elements such as a maneuverable aerial platform, small long-lived surface stations, a balloon, and a small subsatellite to fill these "science gaps."

In situ measurements, both in the atmosphere and on the surface, have not been carried out for more than 30 years. Long-duration measurements in the atmosphere (from several weeks to several months) would aid in understanding the processes that drive the atmosphere. A well instrumented mobile platform or balloon that could maneuver to different altitudes in the clouds could help understand the 'puzzles' of the UV-absorber, its nature, composition, vertical and horizontal distribution as well as providing a platform to measure key trace and noble gases and their isotopes, meteorology and cloud properties, composition, etc., depending on the scientific payload. Another high priority augmentation considered would be a small long-lived surface station (possibly 1-5 stations with an operation life time from 60 days to up to one year) and a subsatellite.

Ongoing JSDT activities: The development of the Venera-D concept is now focusing on a detailed study of the mission architecture with additional examination of the science measurements and potential instrumentation. The JSDT will incorporate into its deliberations information from a set of science community modeling workshops (in May 2017 at Glenn Research Center, Cleveland OH, USA and in October 2017 at IKI in Moscow) to identify additional key measurements (and corresponding instruments) that could be achieved by the planned Venera-D mission.

References: [1] Venera-D feasibility study. http://venera-d.cosmos.ru. [2] Sagdeev, R. V., et. al. (1986). *Science*. 231, 1407-1408. [3] Colin, L., et al. (1980), *JGR*, 85, A13, [4] Saunders, R. S. et al. (1992) *JGR* , 97, 13067. [5] Svedhem et al. (2009), *JGR*, 114, E00B33.