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ISCAP APPEAL NO. 2009-068, document no. 15
DECLASSIFICATION DATE: November 13, 2014

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28 June 1968

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The Soviet Union is expected to conduct, in the very near future, an earth orbital mission in their manned space program. Such a mission will involve one and probably two Soyuz spacecraft launched by the SL-4. A spectacular first will be achieved and may be related to a manned orbiting platform or space station having a lifetime of up to 30 days. (S)

01.01

2. High Altitude Acclimatization and the Cosmonaut Training Program (U)
Major Butcher (TDPTR)

A review of the available open-source literature suggests that Soviet physiologists have accepted Alpine acclimatization as a method of improving human tolerance to all forms of stress, especially to the physical stresses involved in space flights and in the testing of high performance aircraft. Such outstanding Soviet physiologists as N. A. Agadzhanyan, L. A. Bryantseva, and G. A. Davydov have recommended a 40-50 day sojurn for Soviet cosmonauts in the mountains (3000-5000 m) prior to prolonged space flights.

In view of the very heavy demands on the time of Cosmonaut trainees it is difficult to understand how the Soviets can justify a 40-50 day period for acclimatization alone. It is logical, however, to assume that any acclimatization of Soviet cosmonauts would be conducted at a training site, or perhaps a "space village" that possessed extensive training facilities. The existence of such a "space village" at high altitude for the training of cosmonauts cannot be confirmed by the materials reviewed. It is known, however, that extensive Soviet studies of acclimatization have been carried out near Tuya Ashu Pass (3000 m) and on Mt. Elbrus (5396 m). These sites could be considered as possible locations for "space villages" or training sites.

Both Soviet and U.S. researchers are trying to elucidate the cellular mechanisms involved in acclimatization and in the development of the acclimatized state in the laboratory. The latter objective involves the use of chambers and perhaps the use of drugs to enhance the adaptive responses of acclimatization.

The literature does not reveal any precise reason for the Soviet claimed superiority of mountain exposure over chamber exposure in the development of the acclimatized state in man claimed by the Soviets. The reputed superiority of mountain exposure as the method choice of acclimatization needs further study.

U.S. or free world physiologists do not accribe to Alpine acclimatization the degree of importance given by leading Soviet physiologists. Precise reasons for the unusual importance attached to Alpine acclimatization in the cosmonaut training program were not evident and no important "breakthroughs" were apparent in the available Soviet literature. However, it is clearly apparent that the Soviets are conducting an intensive research effort in all aspects of natural and artificial acclimatization to low oxygen tension. When compared to the U.S. scientific interest in acclimatization to high altitudes as a practical segment of astronaut training, the Soviet program appears to be out of proportion to the anticipated results

or benefits. However, the recent establishment of a Hypoxia Commission with N. A. Sirotinin (the father of Soviet Alpine physiology) as director and it's placement under the Academy of Sciences, indicates the very high level of Soviet interest in this problem.

(The overall classification of this item is ~~CONFIDENTIAL~~.) (~~Group 3 -- Downgraded at 12 year intervals; not automatically declassified.~~) (NO FOREIGN DISSEM, except UK, Can, Aus, NZ and NATO.)

01.03

3. Atmospheric Sampling by Venera-4 (U)
1/Lt Edward B. Feinberg (TDPTR)

New intelligence information reveals that the analysis of the gases in the Venusian atmosphere was carried out by two distinct methods rather than by the single method reported previously. The new information allows much more detailed evaluation to be made of the announced results of the Venera-4 experiment.

The descent module of the Soviet Venera-4 spaceprobe carried eleven gas analyzers which sampled the Venusian atmosphere. Operating in two groups, five of the analyzers were used at a height of 26km, and the remaining six at 19km. The gas analyzers employed two distinct measuring techniques: amplitude and threshold. In the amplitude (or abundance) technique, the actual amount of a substance present is determined. In the threshold technique, all that can be determined is if the amount of the substance present is greater or less than a certain preselected value, but the actual abundance cannot be found by a single measurement of this type.

The five experiments run at 26km were for CO_2 (threshold and amplitude), N_2, O_2, and H_2O. At 19km the experiments involved CO_2 (threshold and amplitude), N_2, O_2 plus H_2O, and H_2O (threshold and amplitude). The type of experiment is indicated where known. In addition, analysis indicates that the O_2 experiment at 26km was probably of the threshold type.

The Venusian atmosphere was found to consist primarily of CO_2 with small amounts of water, oxygen, and possibly nitrogen or other inert gases. The Soviets concluded, from their data, that there is about 1% of O_2 present, but this is completely incompatible with earthbased spectroscopic data. U.S. experts feel that, in the case of O_2 in the Venusian atmosphere, the spectroscopic data are much more secure than the Venera-4 data, so that the Soviet O_2 experiments are suspect.

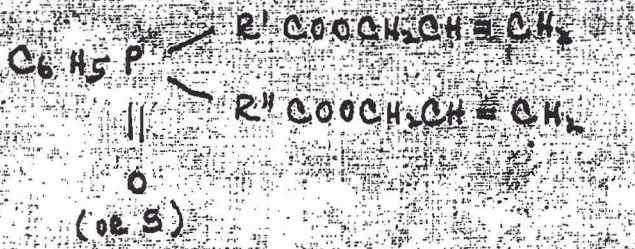
This is new information. Previous to this time, it was reported that the Venera-4 gas analyzers operated on a partial pressure technique only. (The overall classification of this item is CONFIDENTIAL.) (Gp 3 - Downgraded at 12 year intervals; not automatically declassified.) (NO FOREIGN DISSEM, except UK, Can, Aus, NZ and NATO.)

01.07

6. New Soviet Heat- and Hydrolysis-Resistant Phosphorus-Based Polymeric Transparencies (U)
F. G. Jacocks (TDPTA)

In about 1960, it was reported that practically all Soviet work directed toward producing high-temperature-resistant phosphorus-based polymeric transparencies was being discontinued because of the sensitivity of these compounds to hydrolysis. It has recently been reported that the Soviets have succeeded in producing high-transparency polymers which are thermally stable up to 536-554°F, have a micro-hardness of 24,174-30,573 psi and have excellent resistance to water, organic solvents, and 10% caustic solution. These compounds give promise of providing transparent materials which may be used on high-performance aircraft and aerospace vehicles in such applications as glazing for canopies, windows, ports, navigation domes and other locations where severe operating conditions exist.

A Soviet report published in October 1967 has revealed that hard, solid, heat-resistant, highly transparent phosphorus-based polymers have been prepared by block polymerization of the oxides and sulfides of bis-(2-carballyloxyethyl)-, bis-(2-carballyloxypropyl)-, and (2-carballyloxyethyl) (2-carballyloxypropyl) phenyl-phosphines of the general formula:



under nitrogen, with tertiary butyl peroxide as an initiator, at 100-160°C (212-320°F).

Thermal decomposition began at 287-300°C (550-570°F) and decomposition was complete at 400-405°C (750-760°F). Within the range of thermal stability, the polymers retained high transparency and resistance to deformation. Micro-hardness was 17-21.5 kg/mm^2 (24,170-30,570 psi), and the resistance to water, organic solvents, and 10% caustic (NaOH) solution was excellent.

Graphs and tables which provide details of these performance characteristics are attached.

This work was performed at the Institute of Organic and Physical Chemistry imeni A. Ye. Arbuzov, Academy of Science, SSSR. The principal author, G. M. Vinokurova, has worked in phosphorus-containing polymers; secondary and tertiary phosphines and derivatives for many years. She has had 19 publications since 1960. S. G. Fattakhov is only slightly known, and only four publications are available on his work.

It should be noted that in 1965, an East German patent (No. 31,467) was issued for a glass which had the composition: P_2O_5 53-78%, Al_2O_3 5-20%, and CdO 12-38%. Its refractive index was 1.50-1.58 and its Abbe Number was 60-68. Refractive indices were increased by adding La_2O_3 18%, Ta_2O_5 and Nb_2O_5 12% and thorium, tungsten and titanium oxides in undisclosed amounts. This material was an oxide-type of glass, however, rather than the organic polymeric compound which is the subject of paragraph [illegible] [illegible] still of interest to the [illegible] [illegible] The overall classification of this [illegible] [illegible] downgraded at 12 year intervals; not automatically [illegible] (NO FOREIGN DISSEM, except UK, Can, Aus, NZ and NATO.)

Table 1

Constants of Oxides and Sulfides of bis-(2-carballyloxyethyl)-, bis-(2-carballyloxyisopropyl)-, and (2-carballyloxyethyl)(2-carballyloxyisopropyl)phenylphosphine.

Compound	Temp., °C (mm)	d_4^{20}	n_D^{20}
$C_6H_5P(CH_2CH_2COOCH_2CH=CH_2)_2$ (O)	205—206 (0,016)	1,1557	1,5201
$C_6H_5P(CH_2CH(CH_3)COOCH_2CH=CH_2)_2$ (O)	173—174 (0,014)	1,1106	1,5189
$C_6H_5P(O)(CH_2CH_2COOCH_2CH=CH_2)(CH_2CH(CH_3)COOCH_2CH=CH_2)$	195—197 (0,5)	1,1313	1,5250
$C_6H_5P(CH_2CH_2COOCH_2CH=CH_2)_2$ (S)	199—200 (0,016)	1,1624	1,5531
$C_6H_5P(CH_2CH(CH_3)COOCH_2CH=CH_2)_2$ (S)	176 (0,015)	1,1251	1,5428
$C_6H_5P(S)(CH_2CH_2COOCH_2CH=CH_2)(CH_2CH(CH_3)COOCH_2CH=CH_2)$	195—197 (1,0)	1,1488	1,5515

Table 2

Certain Properties of Polymers Obtained on the Basis of Oxides and Sulfides of bis-(2-carballyloxyalkyl)phenylphosphine

Monomer	P, %	Transparency, %	Microhardness, kg/mm^2	Extinction after removal from flame, sec.
$C_6H_5P(O)(CH_2CH(CH_3)COOC_3H_5)_2$	7,70	97,6	21,5	20—30
$C_6H_5P(O)(CH_2CH_2COOC_3H_5)_2$	8,49	97,83	18,5	30—40
$C_6H_5P(O)(CH_2CH_2COOC_3H_5)(CH_2CH(CH_3)COOC_3H_5)$	8,02	97,83	19,3	To me
$C_6H_5P(S)(CH_2CH(CH_3)COOC_3H_5)_2$	8,07	98,67	19,3	5—10
$C_6H_5P(S)(CH_2CH_2COOC_3H_5)_2$	8,84	98,13	18,1	To me
$C_6H_5P(S)(CH_2CH_2COOC_3H_5)(CH_2CH(CH_3)COOC_3H_5)$	8,50	98,34	17,0	20

Note: Action of solvents at room temperature for 96 hours: partially soluble in HCl (sp. gr. 1.19) and in H_2SO_4 (sp. gr. 1.84); no visible effects from water, benzene, chloroform, acetone, dioxane.

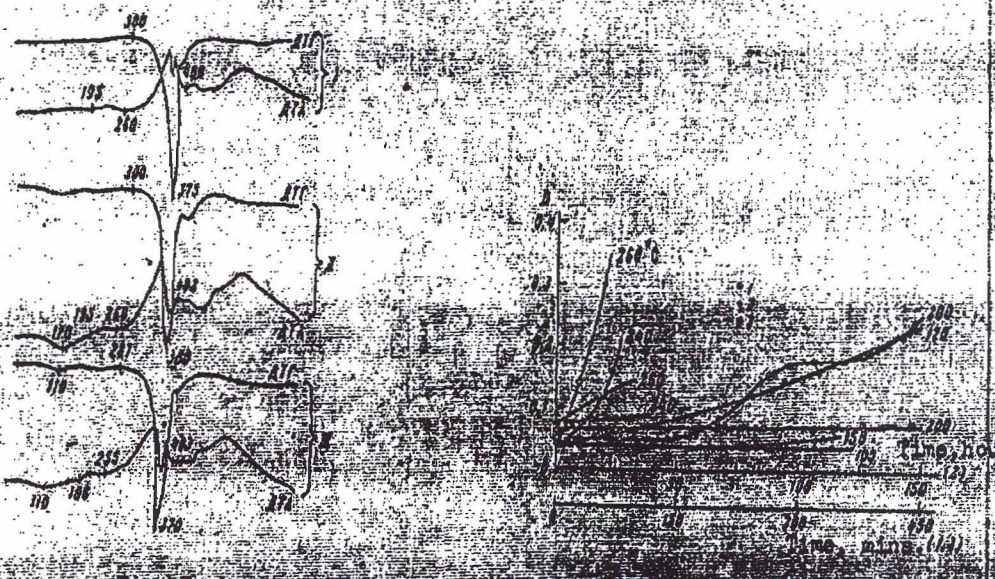


Fig. 1

Fig. 1. Derivative-grams of Sulfides and Oxides of bis-(2-carballyloxyalkyl)phenylphosphine

I. Curves of the sulfide polymer of bis-(2-carballyloxyisopropyl)phenylphosphine

II. Curves of the oxide polymer of bis-(2-carballyloxyisopropyl)phenylphosphine

III. Curves of the oxide polymer of bis-(2-carballyloxyisopropyl) phenylphosphine

Fig. 2. Dependency of Transparency of the oxide and sulfide polymers of bis-(2-carballyloxyisopropyl)phenylphosphine upon Time and Temperature of Heating:

1 and 2 curves for the phosphine oxide polymer

3 curve for the phosphine sulfide polymer

Numbers on curves indicate the temperature (°C.)

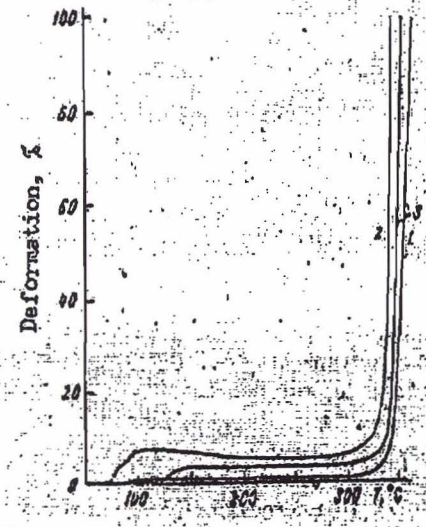


Fig. 3

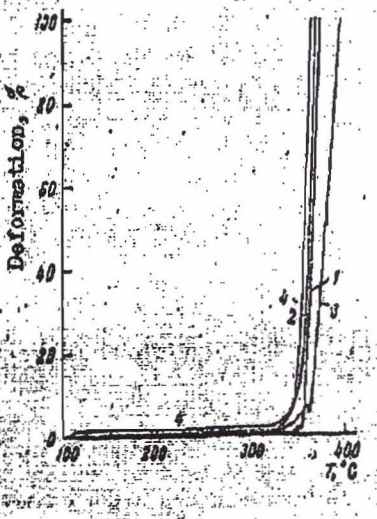


Fig. 4

Fig. 3. TM-curves of the sulfides of bis-(2-carballyloxyalkyl)phenylphosphines:
1 and 2 - curves of the sulfide polymer of (2-carballyloxyethyl)(2-carballyloxyisopropyl)phenylphosphine;
Load: 1 - 3.2 Kg/cm²;
2 and 3 - 32.0 Kg/cm²;
Heating Rate - 2° per minute.

Fig. 4. TM-curves of the oxide polymers of bis-(2-carballyloxyalkyl)phenylphosphines:
1 and 2 - curves of the oxide polymer of bis-(2-carballyloxyethyl)phenylphosphine;
3 and 4 - curves of the oxide polymer of bis-(2-carballyloxyisopropyl)phenylphosphine.
Load: 1 and 2* - 3.2 Kg/cm²;
2 and 4 - 32.0 Kg/cm².
Heating Rate - 2° per minute

*obvious typographical error; should be 1 and 3.

01.03

7. Isotopic Electric Generators Installed at Meteorological Stations (U)
Lt Col B. M. Smith (TDPSE)

An article in a Russian newspaper reveals that the Soviets have recently begun serial production of Beta type isotopic electric generators. The power sources are programmed for installation at remote meteorological stations. Two have already been installed, one at Beklemishevo, and the other at an observatory located east of Chita.

The Soviets have been engaged in a continuous effort to develop a reliable generator as a power source for observation instruments located in sparsely populated areas. In September 1964, Izvestiya reported a Beta-isotope power supply unit — developed by the All-Union Scientific Research Institute for Radiation Equipment (VNIIRT) — had been successfully used in an automatic radio meteorological installation located at Khimki, north of Moscow. This report was reiterated by the East German press in February 1965. Later the same year, the Soviet electric power source designated Beta-2 won a gold medal at the Leipzig Fair. As recently as September 1967, A. A. Luzov, head of the Laboratory of Space Cosmic Rays of the Siberian Institute of Terrestrial Magnetism, Ionosphere and Wave Propagation, reported that the Sayan Mountain expedition was depending on an isotope power plant for its electric energy.

The thermal power of the generator is reported to be 100 watts, with a reported electrical power output of 10 watts. With the aid of longlife batteries, an output of 150-200 watts can be generated. This would be sufficient to power an automatic meteorological station with an operational radius of 200-600 km. It will have a guaranteed ten year operational period; however, a preventive maintenance inspection is required every three years.

The scientific technology required to support the development of a reliable isotope power source is comparable with the US. A US group designed and built an isotope generator in 1961 for a federal agency. Reported an electrical output of 4.4 watts. The field test supposedly demonstrated an operational capability; however, after two years, maintenance and operational difficulty required that the telemetry and sensor unit be rebuilt.

The Soviets are intent upon improving and expanding their network of scientific observation stations, and can be expected to put these generators to a

wide range of uses. In addition to meteorology and cosmic ray observation stations, they may be set upon the ocean bottom for oceanographic surveys, installed inside active volcanoes, used to power navigational buoys and unmanned light houses, or used as a substitute for solar batteries. Future space projects, such as communication satellites, interplanetary probes, orbiting space stations, or lunar stations will require power sources that are free of any shortcomings, such as those which could effect solar batteries due to unfavorable weather conditions. (The overall classification of this item is ~~CONFIDENTIAL.~~) (~~Gp 3 - Downgraded at 12 year intervals; not automatically declassified.~~) (NO FOREIGN DISSEM, except UK, Can, Aus, NZ and NATO.)

16.02

8. The Venus 4 Thermo-Control System (U)
2/Lt Duane A. Landa (TDPSX)

A new and improved thermo-control system was used on Venus 4. This system appears superior to the thermo-control system used on earlier Soviet interplanetary probes and has improved the reliability of the planetary probe.

At least one probe, Venus 3, failed because of a failure in the thermo-control system. Five days before it impacted the surface of Venus a malfunction in the temperature control system caused various components to overheat and fail. The Venus 2 failure also quite possibly occurred because of temperature control problems.

The thermo-control system used on Venus 3 and other earlier planetary probes employed a forced gas system with hemispherical radiators mounted on the ends of the probe's solar panels. The radiators had light and dark sections for control of heat radiation.

The thermo-control system used on Venus 4 was also a forced gas system with a radiator. The radiator was the base of the 2.3 meter parabolic antenna. The feed for the antenna was attached directly to the radiator base. The radiator was a curved, light-colored, metallic plate with hollow rings protruding on the side opposite of the parabolic antenna.

The probable operation of the thermo-control system used on Venus 4 is shown in the schematic. The gas in the system is heated as it flows by thermoelectric units within the spacecraft. The excess heat is then radiated to space as the gas flows through the hollow rings in the radiator. The thermostat regulates the temperature by opening and closing the by-pass valve. Closing the bypass valve causes all the gas to flow through the radiator. By controlling the amount of gas allowed

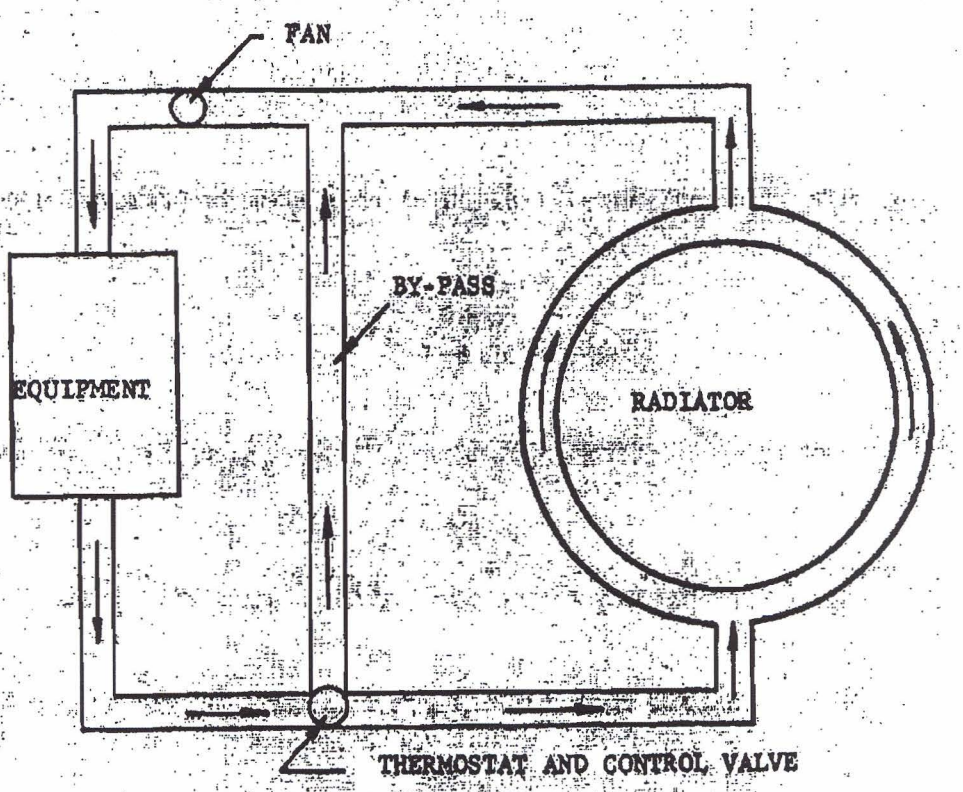


Fig. 1. Venus 4 Thermo-Control Schematic

(FOUO)

to flow through the by-pass valve, a fairly constant temperature can be maintained. The Soviets have stated that the temperature was maintained by varying the gas flow rate. The internal temperature of Venus 4 was maintained between 15 and 25°C.

The thermo-control system used on Venus 4 was a reliable and sufficient system. It operated properly during the four month flight of Venus 4.

(The overall classification of this item is OFFICIAL USE ONLY).

16.02

9. Soviet Manned Space Program (U) 2/Lt C.P. Tobey (TDPSX)

The launching of Soyuz 1 in 1967 terminated the 25 month hiatus in Soviet manned space flights. However, the resulting death of Cosmonaut Komarov apparently initiated a delay in the program which has lasted now for over 13 months. It is evident to both the USSR and the world that much prestige has been lost with regard to this manned space program. To counter this and to regain the diminishing global respect, the Russians are believed to be preparing for a spectacular achievement with their Soyuz-class vehicle. The possibilities of this spectacular being accomplished with a manned earth-orbital mission in the near future are explored in this Tech Brief.

It is believed that the Soviet philosophy and practice has not changed with respect to gaining firsts in space. Long duration missions beyond 14-days have yet to be accomplished. Also available are firsts in the docking of two manned vehicles and crew transfer. Simultaneous extra-vehicular-activity (EVA) by two or more men would additionally add to the Soviet listing of first achievements.

Two sets of Unmanned Soyuz rendezvous flights have taken place since the crash of Komarov's recovery capsule. (Cosmos 186/188, Cosmos 212/213). The testing phase of the craft is now believed complete and there is sufficient reason to expect the next Soyuz-type mission will carry cosmonauts.

Comments can be traced back a number of years that refer to the Russian intent to establish a manned orbital platform or space station. One comment boosted three months before the Soyuz 1 mission (April 1967) that the next manned launch would take place in early 1967 and would be a multi-manned space station. Other comments form a picture which indicate the Soviets also plan to launch a 2-man optical telescope (like the Apollo Telescope Mount) in 1968 or early 1969 which would orbit at a height of 100 to 150 miles. (This is similar to those orbits of the Soyuz rendezvous flights). The recent flight of Cosmos 215, which had eight small telescopes, is

believed to be the first step toward accomplishing this type of mission.

It appears that for the very near future, Soyuz and the SL-4 launch vehicle are the primary suspects for a manned earth orbital space station (MEOSS). The SL-12 launch vehicle may have an eventual role in the establishment of a space station; however, FTD does not believe that this vehicle has been scheduled for use in the next manned mission. Available SL-12 vehicles may have been assigned, on a priority basis, to lunar exploration efforts instead of MEOSS missions. This particular launch vehicle has not provided the reliability that has been long afforded with the SL-4 which can be employed here to achieve an immediate spectacular.

The Soyuz spacecraft has demonstrated, on two occasions, the capability to execute minor orbit changes, to rendezvous and to dock. Although it has not been demonstrated, Soyuz is assessed to possess egress facilities that will permit extra-vehicular activities.

The SL-4 launch vehicle is [illegible] enough to lift the 15,000 pound Soyuz [illegible] enough energy to permit it to [illegible] However, should the [illegible] approximately 22 per cent [illegible] demonstrated, then the craft has the capability [illegible] docking and separation [illegible] required to extend the [illegible] maintenance may be accomplished by [illegible] periodic station keeping propulsion [illegible] due to atmospheric drag, or by [illegible] propulsion event that would raise the orbit [illegible] to increase the lifetime to 30 days. On the other hand, should two Soyuz craft remain linked after docking, the fuel remaining in the second spacecraft can be used to extend the orbit lifetime of both vehicles. A 30 day mission could be employed by the combination without an increase [illegible] Both the solar cell power system and the [illegible] life support

system are assessed to be capable of supporting the operations of three men for a 30-day duration.

With these technical capabilities, the Soviets may be prepared to accomplish one of the following missions with the next launch of the Soyuz-class spacecraft:

(1) One is a mission involving two Soyuz craft in which a transfer of crew members could take place. The two craft may be joined for a period just long enough to permit crew exchange. A maximum of six cosmonauts could be involved. Crew transfer could involve simultaneous EVA by men employing the first self contained breathing apparatus for space. The second or visiting Soyuz would remain in orbit for a relatively short time and would return before the first craft completes its mission. Russian spokesmen may refer to the visiting Soyuz as the world's first shuttle craft. Even though the mission duration could feasibly last a full 30 days, it would be an extremely aggressive effort to undertake at this time. In light of their comparatively limited experience with man and his supporting systems in space, the 30-day mission is thought of at this point as a growth potential for future Soyuz flights rather than a realistic target for the next manned launch.

(2) An alternate mission would employ two Soyuz spacecraft which after rendezvous and docking, would orbit in a linked-up configuration lasting from one to possibly four weeks. Such a combination would weigh from 28,000 to 30,000 pounds and may be labeled by the Soviets as the world's first manned orbital platform, a space station. The capacity of the station may be large enough to house six cosmonauts. Scientific operations may involve extensive EVA by two or more cosmonauts.

(3) The possibility exists for the Soviets to launch into low earth orbit an optical telescope weighing less than 15,000 pounds. The unit would be manned by a separately launched Soyuz spacecraft. Soyuz would become the command module providing the living quarters for the research observatory and the telescope would be the detachable experiment package. A station of this type would have a mission lifetime of no less than two weeks. Following a visit by the first Soyuz, another craft may be launched to replace the first thus extending the mission into months. Each Soyuz would provide the orbital maintenance propulsion required.

(The overall classification of this item is SECRET. Gp-1 - Excluded from Automatic Downgrading and Declassification. NO FOREIGN DISSEM, EXCEPT BY CAN AND AUS.)