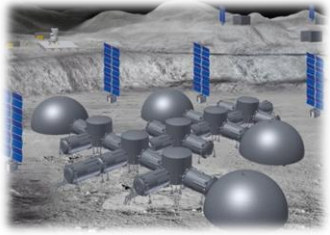
Industrial-and-Research Lunar Base

STRATEGY OF LUNAR BASE CREATION

Phase №1 Preparatory: creation of international cooperation, investigation of the Moon by unmanned spacecraft, creation of space transport systems and Lunar Base components.

Phase №2 Base of Minimal Configuration*: delivery of the first base's modules and preparation of take-off and landing area.*

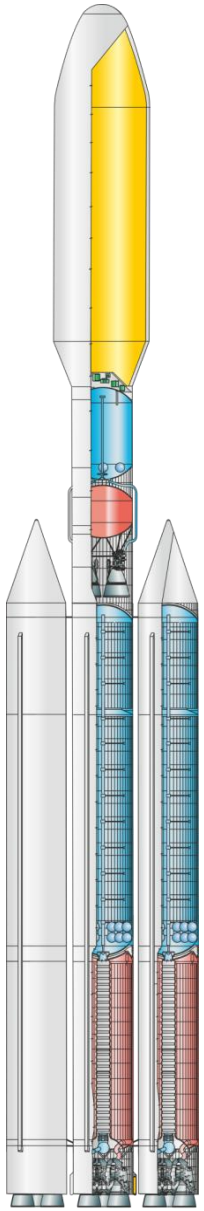
Phase №3 Base Expansion: Lunar Base equipping, investigation of the Moon surface.



Phase №4 Transfer to Production: creation of closed life support system, production base and observatory.

Phase №5 Permanent Base: ensuring permanent stay and life activity of humans on the Moon.

PHASES OF CREATION	2020	2030	2040	2050	2060 →
Phase №1 Preparatory					
Phase №2 Base of Minimal Configuration					
Phase №3 Base Expansion					
Phase №4 Transfer to Production					
Phase №5 Permanent Base					



Krypton ILV ensures payload injection into reference Earth orbit.

Krypton ILV Technical Characteristics

Maximal lift-off mass, t	2374
Propellants	kerosene + liquid oxygen
Number of stages	2 + 4 liquid boosters
Lift-off thrust of engines, tf	3770
Length, m	up to 78
Diameter of stage case/PLF, m	3.9 / 6.2
Payload mass into LEO, t	91.5
Payload mass into lunar trajectory, t	30.5 (с РБ)
Payload mass to lunar surface, t landing mass, t payload mass, t	 10 - 10.5 8 – 8.5

RD815
first stage engine

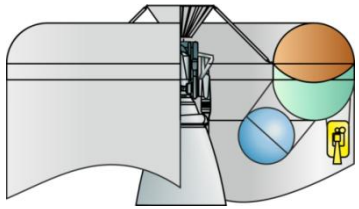
Krypton ILV is created on the basis of Mayak-C3.9 ILV using Yuzhnoye-developed engines.

RD835
second stage engine

Booster stage ensures transport system acceleration to velocity of reaching the Moon.

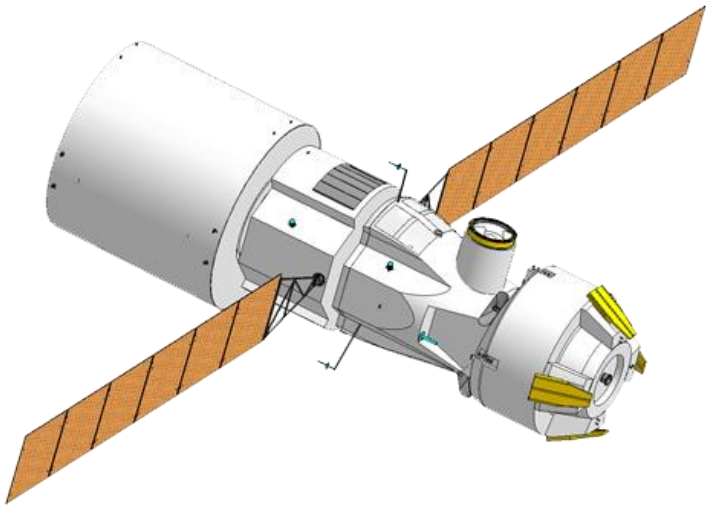
Technical Characteristics	
Total mass without payload, t	60
Propellants	liquid oxygen + kerosene
Engine thrust, tf	50
Length, m	9.6
Diameter, m	3.9
PL mass in trajectory to the Moon, t	30.5

Circumlunar space tug ensures circumlunar manoeuvers and corrections.



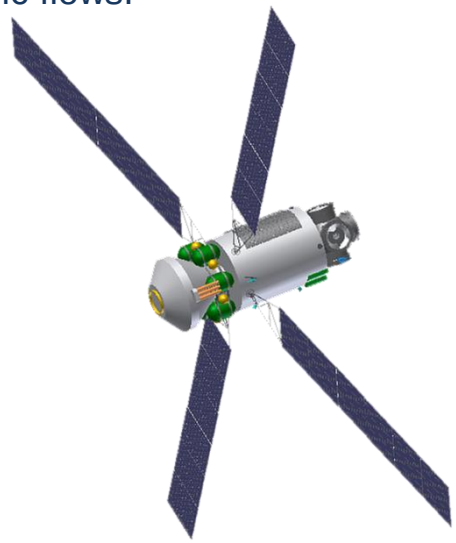
Technical Characteristics	
Total mass without payload, t	9.55
Propellants	NT+UDMH
Engine thrust, tf	7.916
Length, m	2.24
Diameter, m	3.9
PL mass in circumlunar orbit, t	20.9

Manned space vehicle ensures delivery of crew of 4 people to lunar surface and their subsequent return to the Earth.



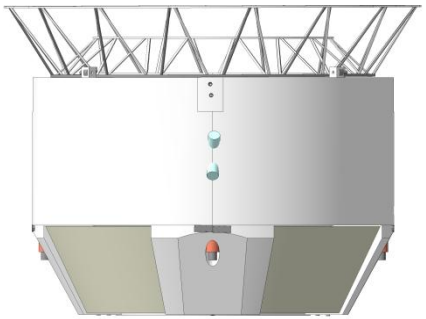
Technical Characteristics	
Earth – Moon propulsion system, t	72.6
Lunar vehicle equipment bay, t	3.2
Lunar vehicle cab, t	2
Landing platform, t	5.9
Take-off module, t	2.7
Moon – Earth propulsion system, t	4.6
Total, t	**91**

Lunar orbital station is intended to ensure remote investigations of surface, control tasks solution, conducting experiments, unloading of cargo-and-passenger traffic flows.



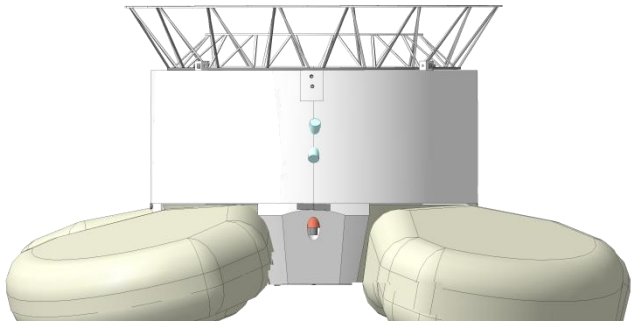
Technical Characteristics	
Orbit altitude, km	100 - 5500
Orbit inclination, deg	~ 87
Electric power supply system power, kW	up to 22
Crew, persons	2-4
Base module, t	10
Emergency rescue module, t	8.2
Total, t	**18.2**

Landing platform is intended to deliver lunar base components from lunar circular orbit to lunar surface (configuration for unmanned missions) and to deliver lunar cab (configuration for manned missions) ensuring their soft landing.



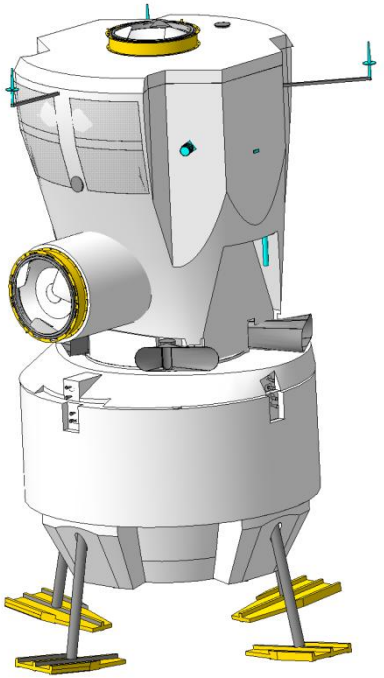
Configuration for unmanned missions

Technical Characteristics	
Propulsion system, t	0.3
Control, measurement, power supply, navigation, communication, thermal control, landing systems, t	0.4
Structure, t	0.7
Propellant, t	8.6
Total, t	**10**

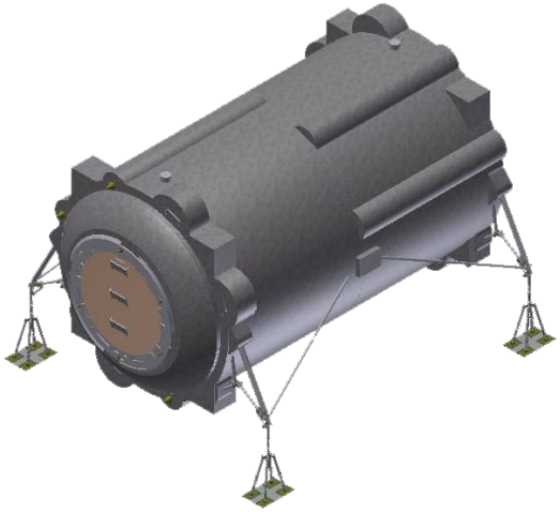


Technical Characteristics	
Propulsion system, t	0.2
Control, measurement, power supply, navigation, communication, thermal control, landing systems, t	0.5
Structure, t	0.2
Propellant, t	5
Total, t	**5.9**

Configuration for manned missions

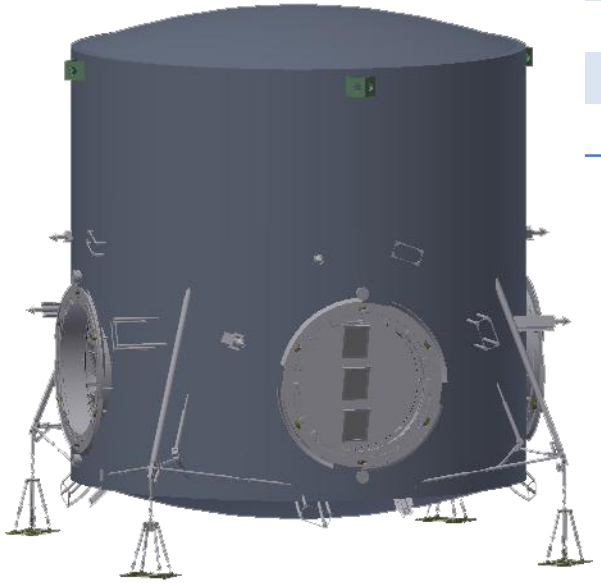


LUNAR MODULES TYPE DESIGN

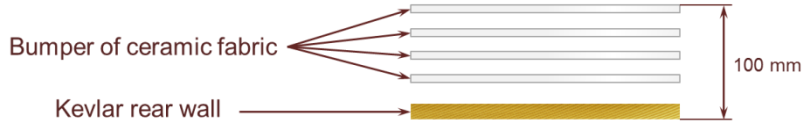


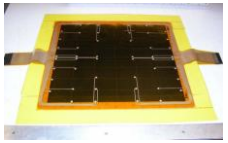
When creating the Lunar Base, it is planned to use sealed cylindrical modules of two basic types: vertical and horizontal. The basic type module design is meant to be load-bearing structure of cylindrical type with type internal volume.

Technical Characteristics of Type Module	
Horizontal orientation	
Mass, t	2.9
Length, m	6
Diameter, m	3
Vertical orientation	
Mass, t	4.8
Height, m	6
Diameter, m	5



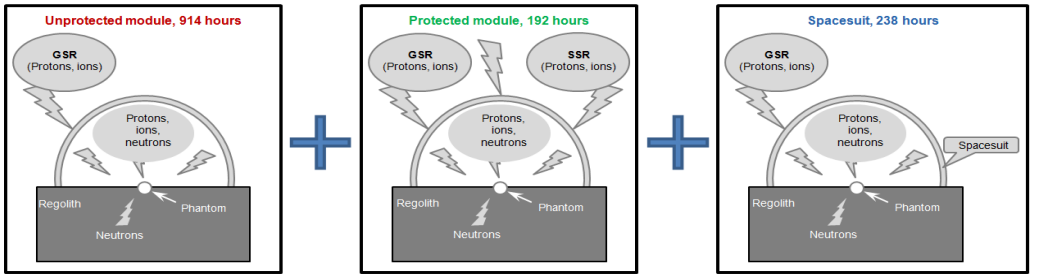
Modules are equipped with protection from micro meteorites





Damage monitoring and breakage registration system

Scenario of lunar expedition crew exposure to space radiation conditions

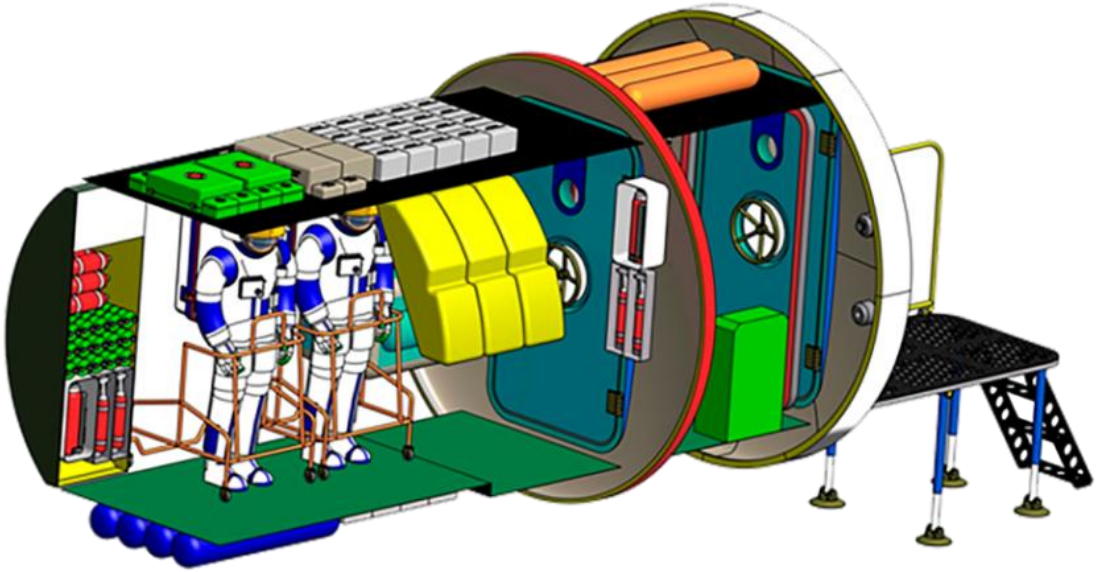


SCR – solar cosmic rays

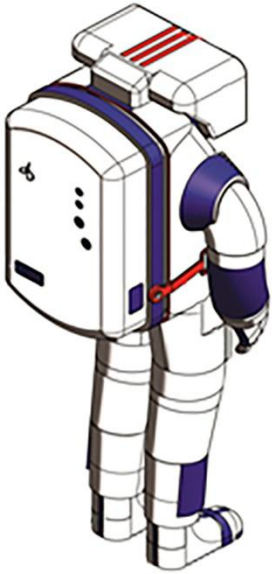
GCR – galactic cosmic rays

Accommodation module is equipped with **additional anti-radiation protection**. It is used by crew as shelter in case of solar burst.

Airlock module serves for communication of Lunar Base internal rooms to lunar surface ensuring passage of personnel and transfer of different cargos (equipment).

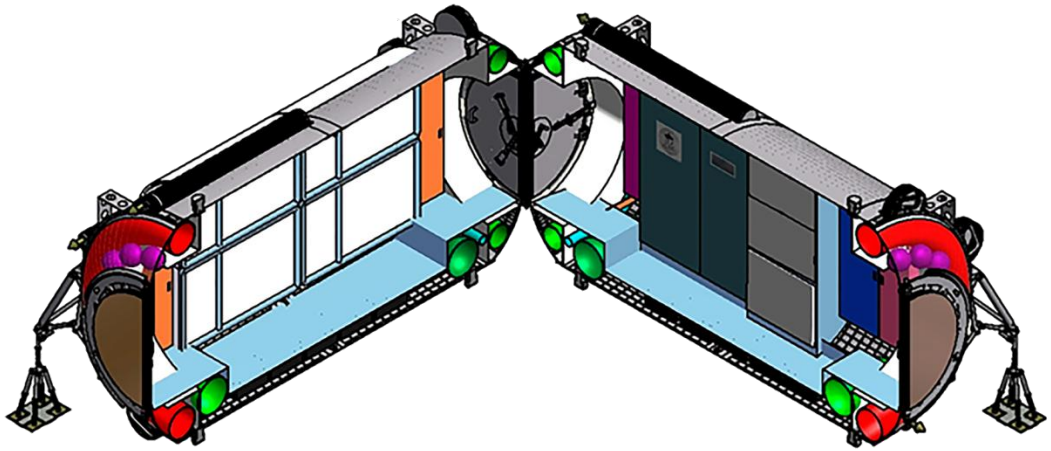


Special spacesuit

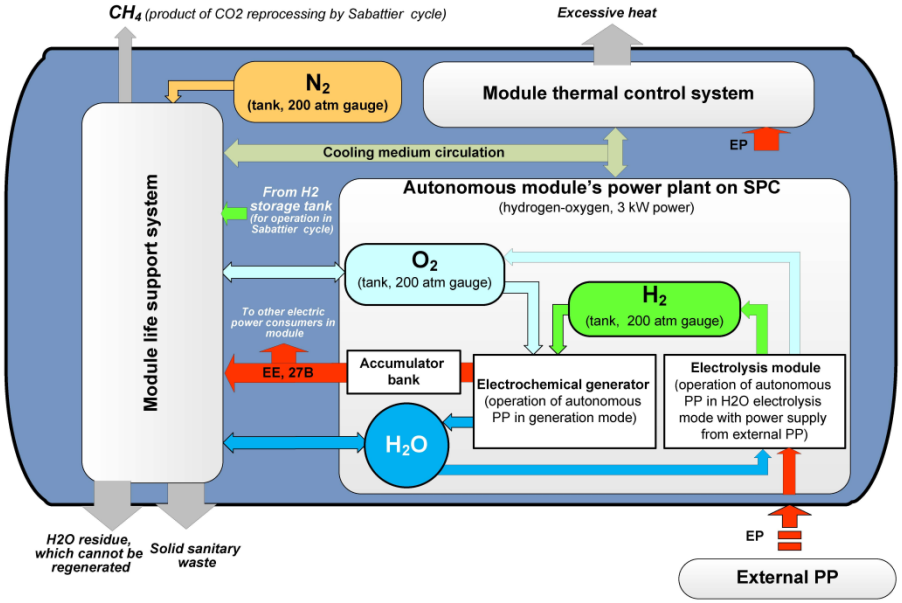


One of the main elements of entire Lunar Base equipment is spacesuit for walking out and operation on lunar surface. The spacesuit is an integral part of airlock module purpose designed equipment.

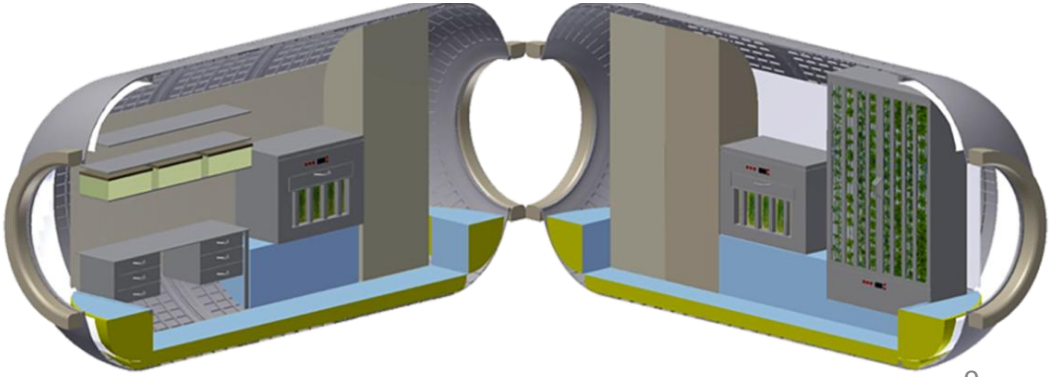
Accommodation module is intended to provide for leisure activity, rest, and to satisfy required everyday sanitation needs of crew members.



Interaction of life support system, autonomous power plant, and thermal control system

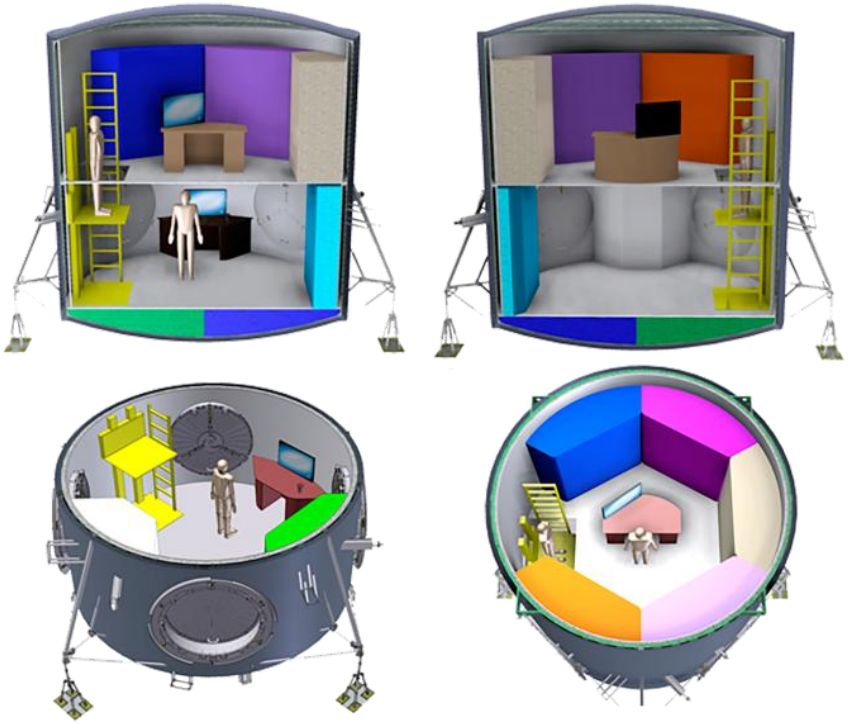


Vivarium module is intended for gradual transfer of Lunar Base to self-provision with own resources in respect of life support systems.



LUNAR BASE MODULES

Production-and repair module – module for crew to perform repair operations and maintenance of lunar equipment.



Command module of vertical orientation – module to control operation of all other modules and communication with the Earth.

On the first floor, the crew's community room is located, on the second floor – workplaces.

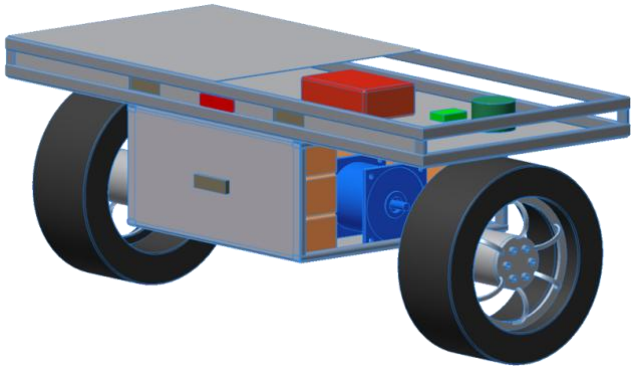
Besides, on the basis of type lunar module design, the following has been developed:

- **storage module;**
- **research-and-experimental module**

LUNAR VEHICLES

Lunar vehicle consists of one and more base modules which ensure vehicle's required carrying capacity depending on number of modules.

Vehicle's design provides for its equipping with attached implements.



General view of base vehicle	Wheel arrangement	Unladen mass, t	Total mass, t	Carrying capacity, t	Swivel wheels
	3x2	1.2	3.2	2	Front axle
	4x4	2	6	4	Front axle
	6x6	3	9.6 (8.4)	6.6 (5.4)	Front axle (front and rear axles)
	8x8	4	12 (9.6)	8 (5.6)	Front and rear axles (all axles)
	10x10	5	15.6 (13)	10.6 (7)	Front and rear axles (all axles)

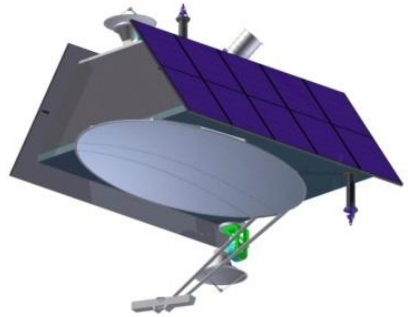
Scientific research rover is intended to support research expeditions on lunar surface by crew of 2-4 persons with cruising range of up to 500 km.

Technical Characteristics	
Total mass, kg	up to 8000
Research equipment mass, kg	up to 1000
Wheel arrangement	6x6
Electric power supply system power, kW	up to 27
Average velocity, km/hr	up to 20
Roadway slope angle (design), deg	25
Period of one mission conditioned by LSS, days	14-7

Remote Sensing Spacecraft

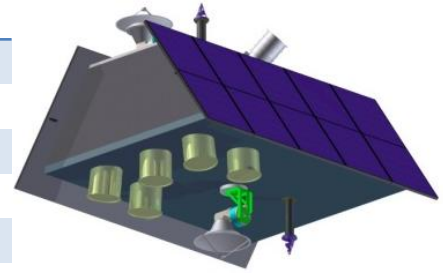
- SC with radar payload

Technical Characteristics	
Total mass, kg	~ 600
Payload mass, kg	~ 160
Circular orbit parameters:	
• altitude, km	250 ± 4 km
• Inclination, deg	90 ± 0.3°
Active lifetime	minimum 2 years

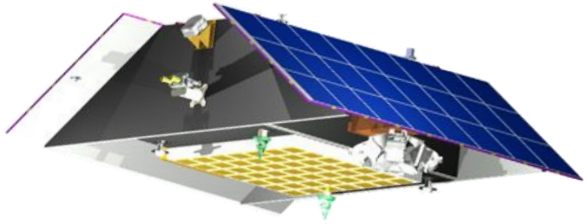


- SC with optical payload

Technical Characteristics	
Total mass	~ 600 kg
Payload mass	~ 200 kg
Circular orbit parameters:	
• altitude	100 ± 4 km
• inclination	90 ± 0.03°
Active lifetime	minimum 2 years

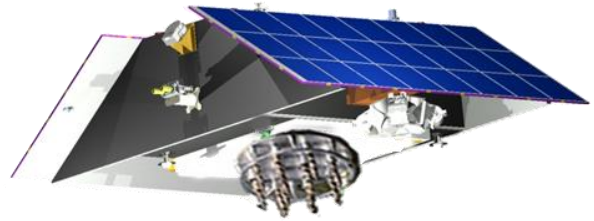


Communication Spacecraft



Technical Characteristics	
Total mass, kg	~400
Payload mass, kg	~65
Circular orbit parameters:	
• altitude, km	~1000
• inclination, deg	~70
Active lifetime, years	minimum 2

Navigation Spacecraft



Technical Characteristics	
Total mass, kg	~ 345
Payload mass, kg	~ 65
Circular orbit parameters:	
• altitude, km	~5500
• inclination, deg	~70
Active lifetime, years	minimum 2

Solar Power Plant is intended to provide Lunar Base with electric power.

It is a source of energy generated due to direct conversion of solar energy.

SPP Parameters	
Power plant output power, kW: • type mode (lunar “day”); • standby mode (lunar “night”); • adaptive mode (lunar “sunsets” and “dawns”)	 10 1-2 1-10
Solar arrays (oriented to the Sun) : • area, m^2; • mass, kg	 100 480
Mass of electrochemical generator including mass of fuel (60 kg hydrogen and 540 kg oxygen) to generate 1 kW/hr, kg	2000
Mass of chemical batteries (reserve electric power source), kg	820
SPP total mass, kg	**4110**

- ***INTERNATIONAL COOPERATION*** towards common global goal contributing to mitigation of conflicts on the Earth and establishment of piece.
- ***COORDINATED STRATEGY*** will help the nations having minor scope of work in space projects to participate in global projects which will allow maximizing return on their investments.

- ***KEY TO REDUCING COSTS OF INTERPLANETARY EXPEDITIONS***.
- ***PLATFORM FOR DEVELOPMENT TESTING OF SPACE HARDWARE AND TECHNOLOGIES.***
- ***IMPETUS FOR DEVELOPMENT OF NEW TECHNOLOGIES*** – main mover of present-day world economies.

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