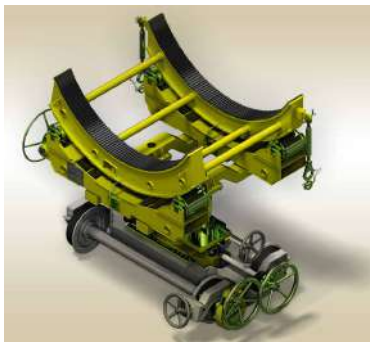




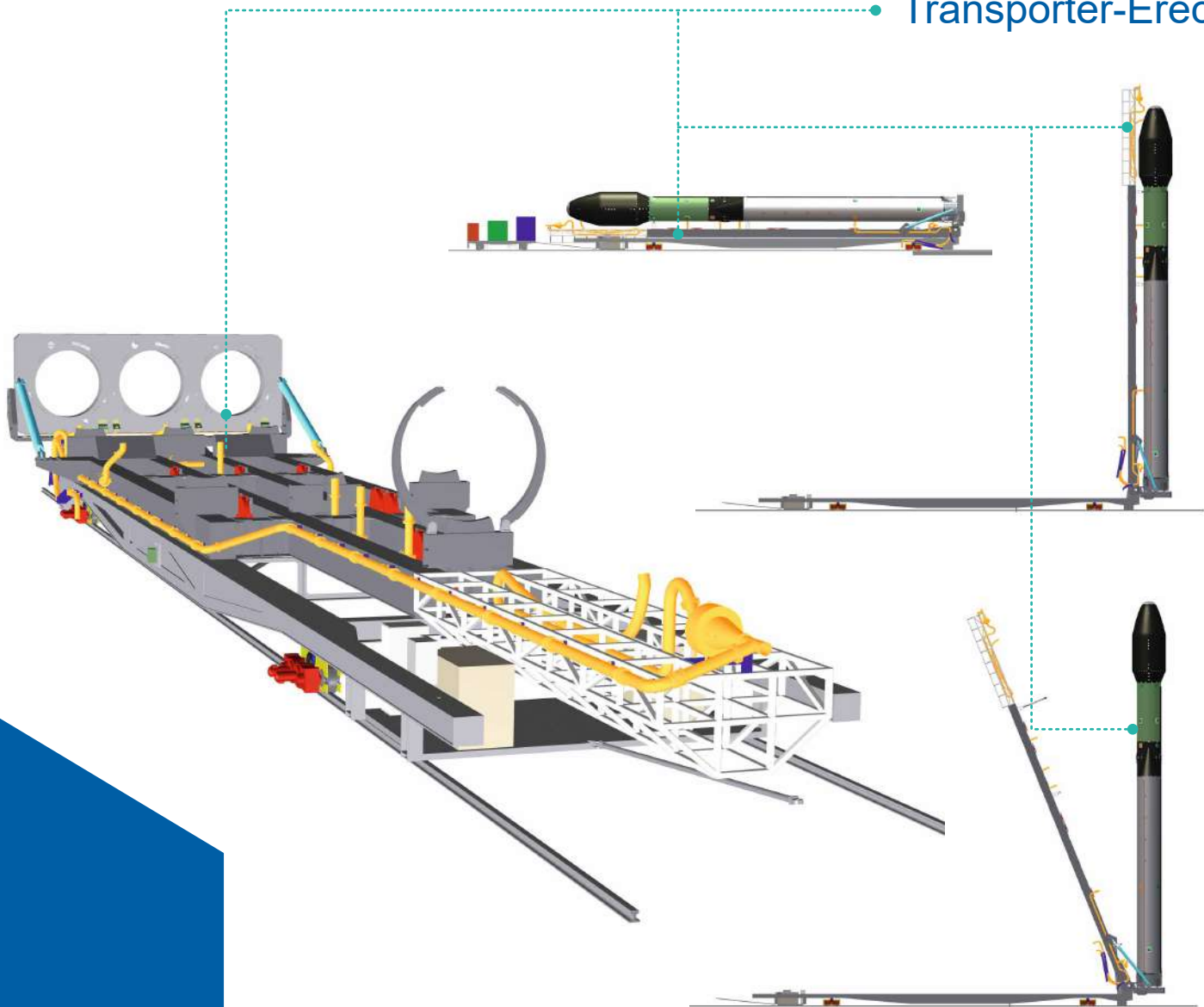
SPACE LAUNCH SYSTEMS



Support Equipment

• Launch Complex Units

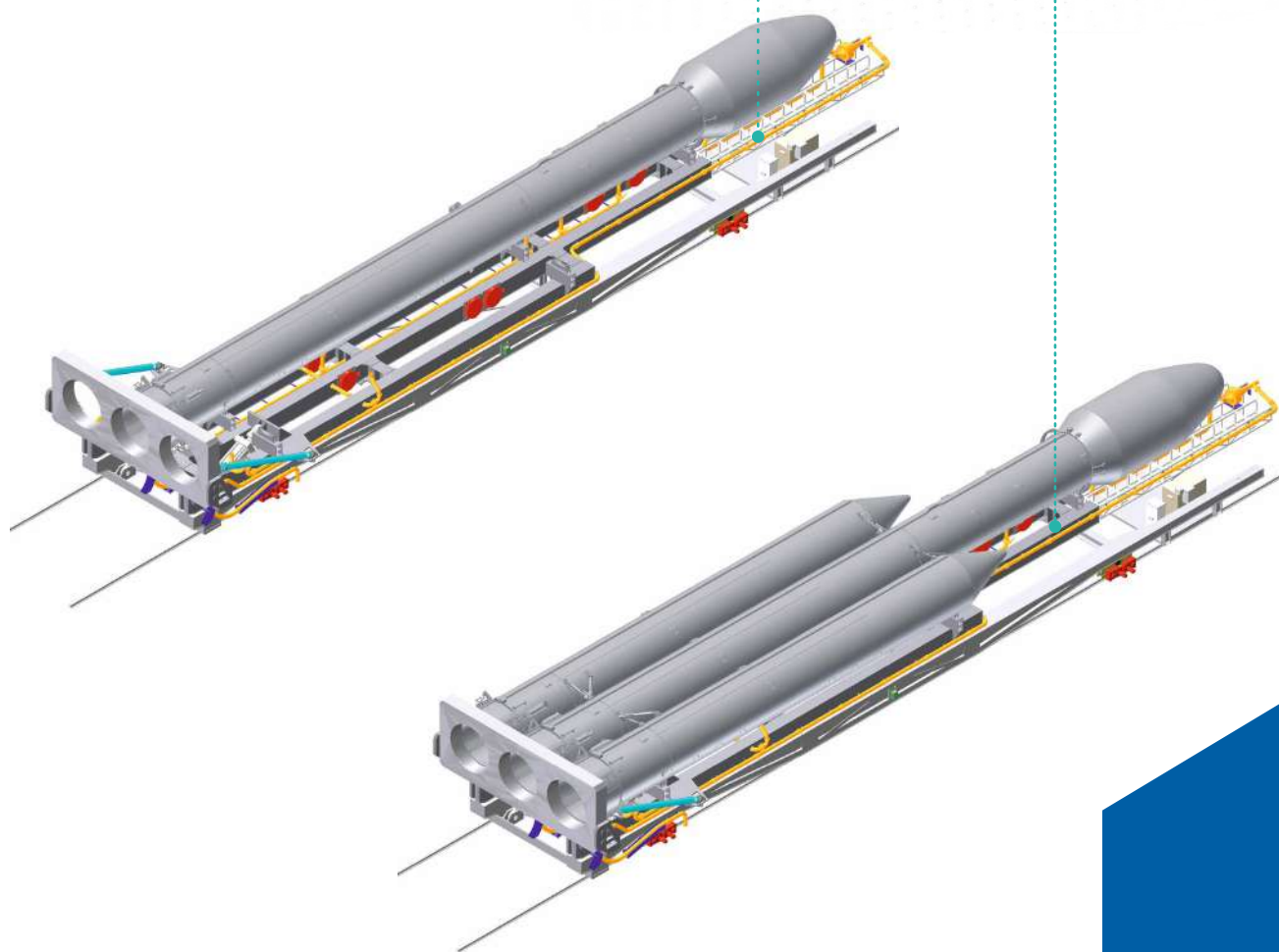
• Transporter-Erector



The transporter-erector is intended for ILV horizontal transportation to the launch complex, ILV erection and holding in vertical position till launch. In case of launch abort, the transporter-erector ensures ILV removal from the launch pad and transportation to the assembly-and-test building (ATB).

● Launch Complex Units

Transporter-Erector ●



The transporter-erector can be developed to be universal in order to ensure operation at the launch complex of ILVs from light to heavy classes.

Specified lifetime – not less than 15 years.

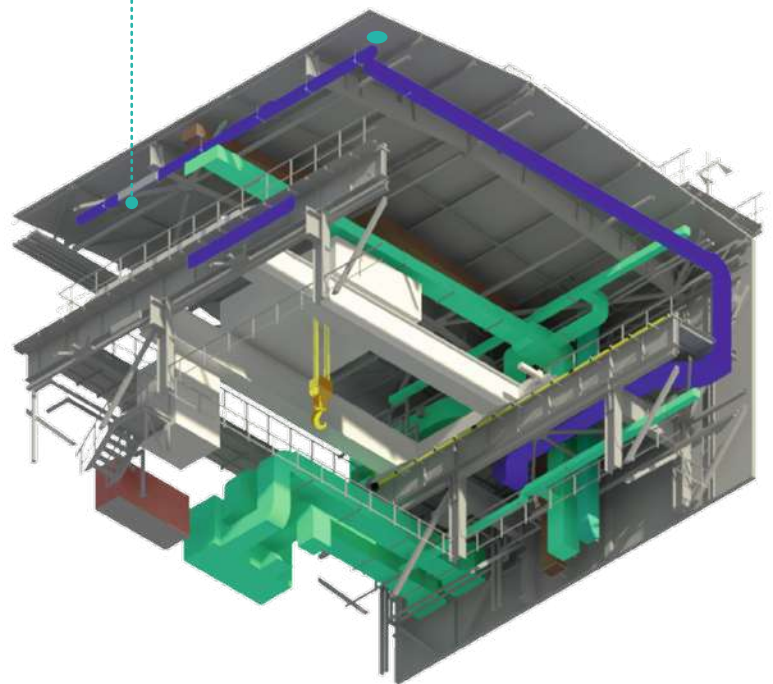
● Launch Complex Units

● Service Tower



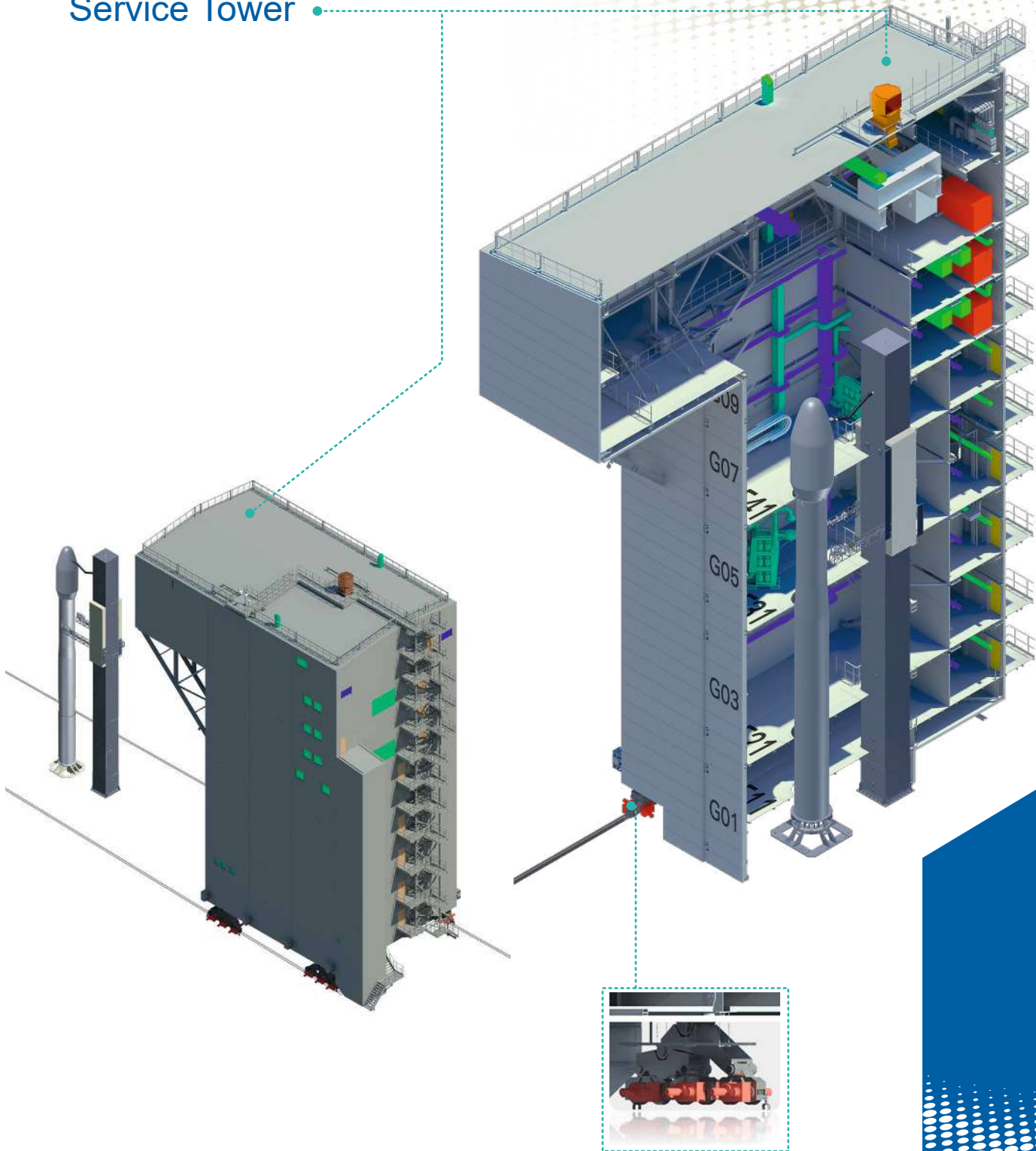
Intended to ensure ILV vertical assembling on the launch pad, maintenance and prelaunch processing of launch complex support equipment and assembled ILV and for launch abort operations.

Specified lifetime – not less than 15 years.



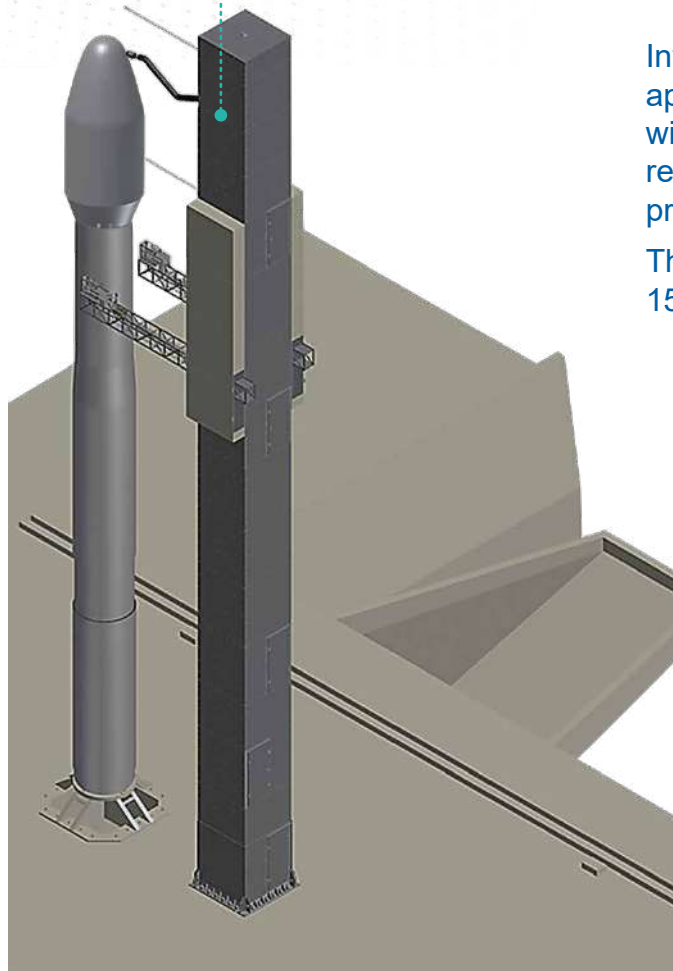
● Launch Complex Units

Service Tower ●



● Launch Complex Units

● Cable Mast/Filling Column



Intended for accommodation, approach to ILV, holding and withdrawal of stationary and removable lines and equipment during prelaunch processing and launching.

The specified lifetime – not less than 15 years.

Basic Specifications*

Lines approach

in manual mode

Lines withdrawal

automatically

Control of lines withdrawal

remote

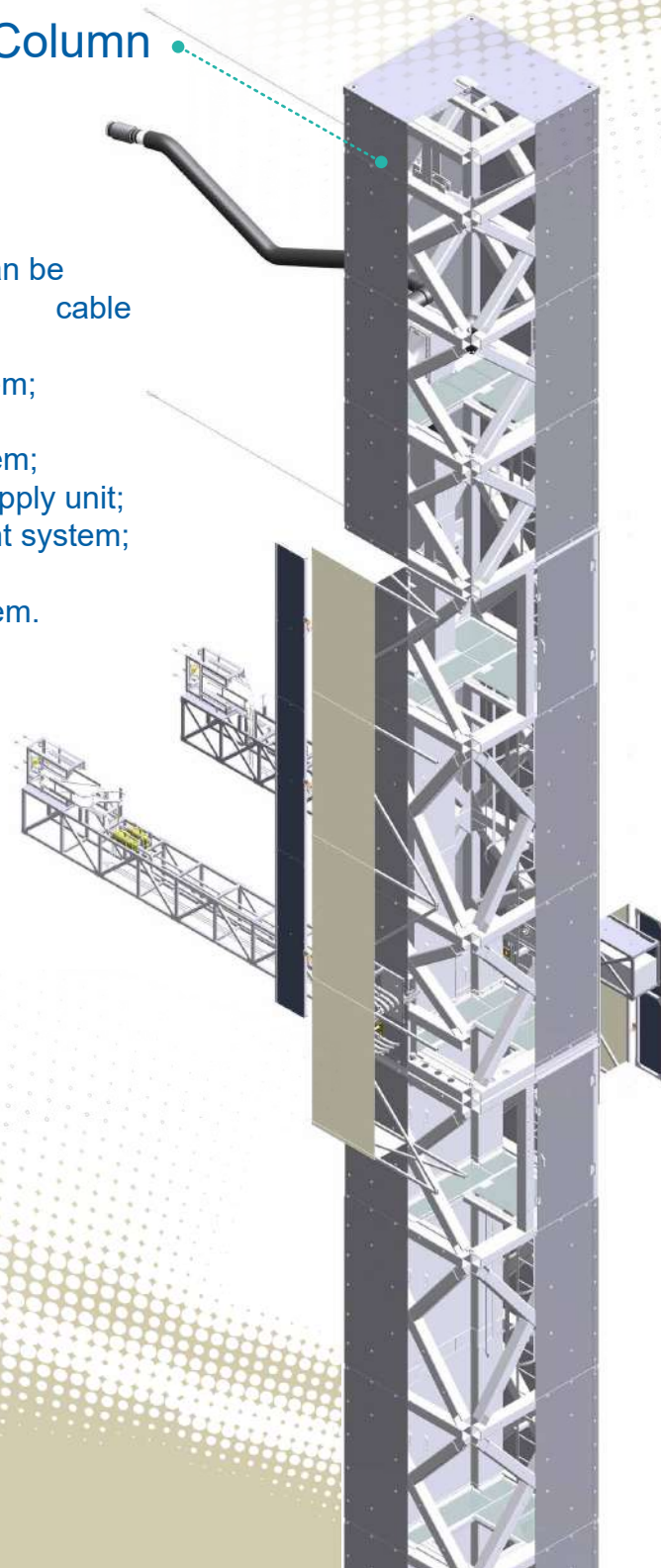
*The data presented are for reference and may vary depending on ILV types.

● Launch Complex Units

Cable Mast/Filling Column

The following ground lines can be accommodated on the cable mast/filling column:

- of the oxidizer filling system;
- of the fuel filling system;
- of the thermostating system;
- of the control pressure supply unit;
- of the range measurement system;
- of the control system;
- of the measurement system.



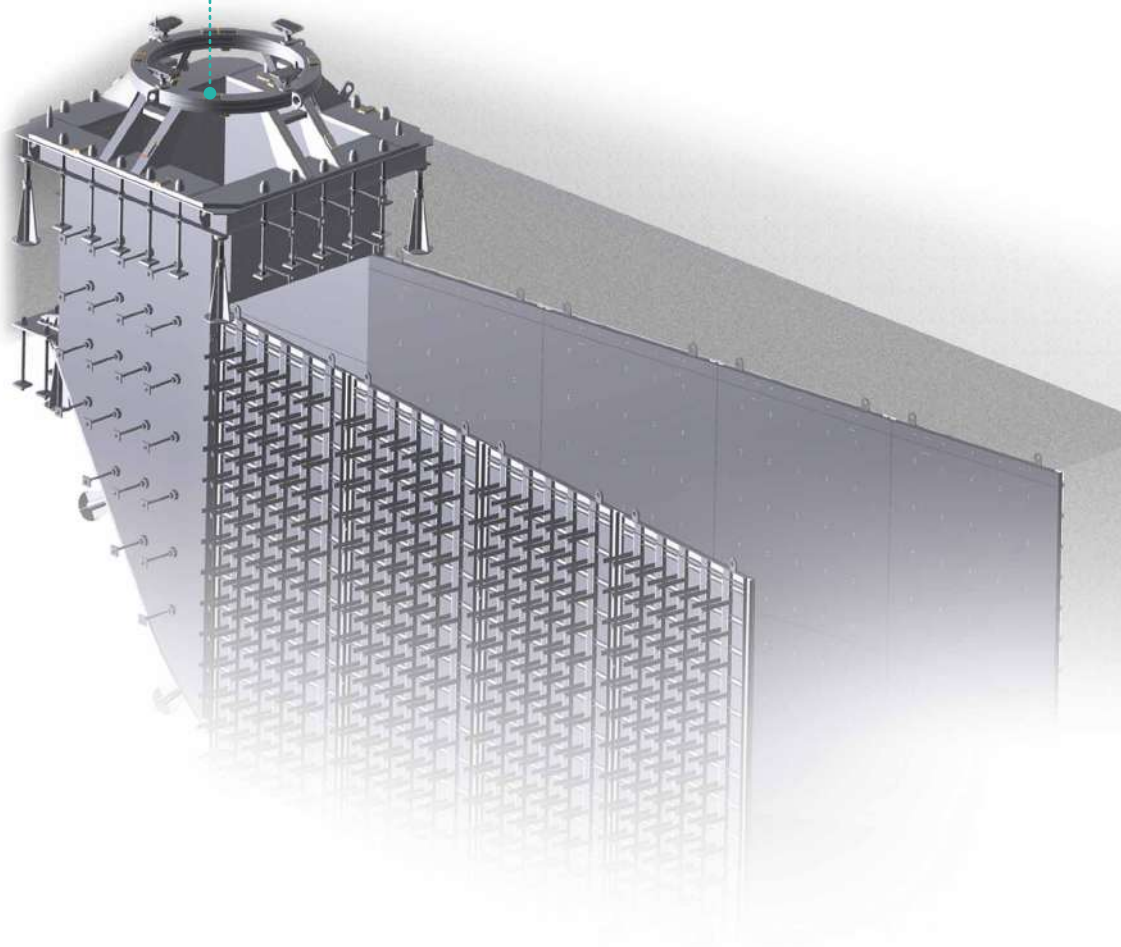
● Launch Complex Units

● Launch Pad

Intended for ILV installation on it, ILV prelaunch processing and launching and for launch abort operations.

Specified lifetime – not less than 15 years.

Service life – not less than 200 cycles.



● Launch Complex Units

Filling Lines Automatic Mating Device

Intended to ensure automatic mating (unmating) and holding in mated condition of the fuel (oxidizer) filling system filling and drain lines to respective rocket's lines.

Specified lifetime – not less than 15 years.



Basic Specifications*	
Duration of mating (unmating) to rocket, min, max	3
Leak test	available
Service life, cycles, min	200

* The data presented are for reference and may vary depending on ILV types.

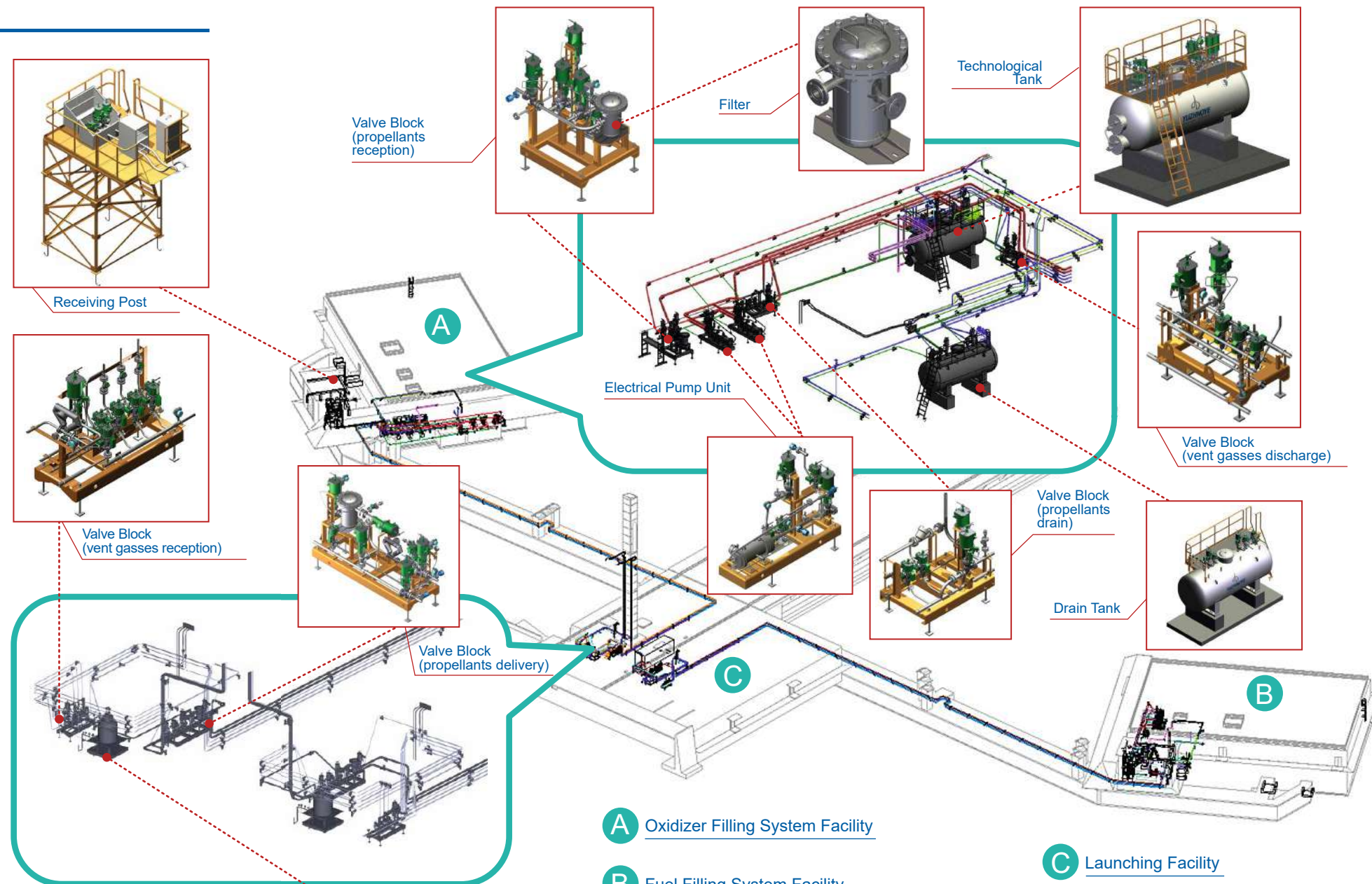
● Filling Systems

● ILV Rocket Propellants Stationary Filling Systems

They ensure:

- propellants reception from delivery means and storage;
- propellants preparation in respect of temperature, amount of dissolved gases, amount of dissolved water;
- propellants filtration during reception from delivery means and during ILV tanks filling;
- ILV filling in automatic mode according to specified timeline which excludes the presence of personnel during filling;
- propellants weight measuring during ILV tanks filling;
- reception of vent gases from ILV tanks during filling.

The specified lifetime – not less than 15 years.



A Oxidizer Filling System Facility

B Fuel Filling System Facility

C Launching Facility

Basic Specifications*

Volume of filled propellants, m ³	0.03 to 1000
Accuracy of propellants temperature maintaining at filling system outlet, °C	± 2

* The data presented are for reference and may vary depending on ILV types.



Measuring Scale Installation

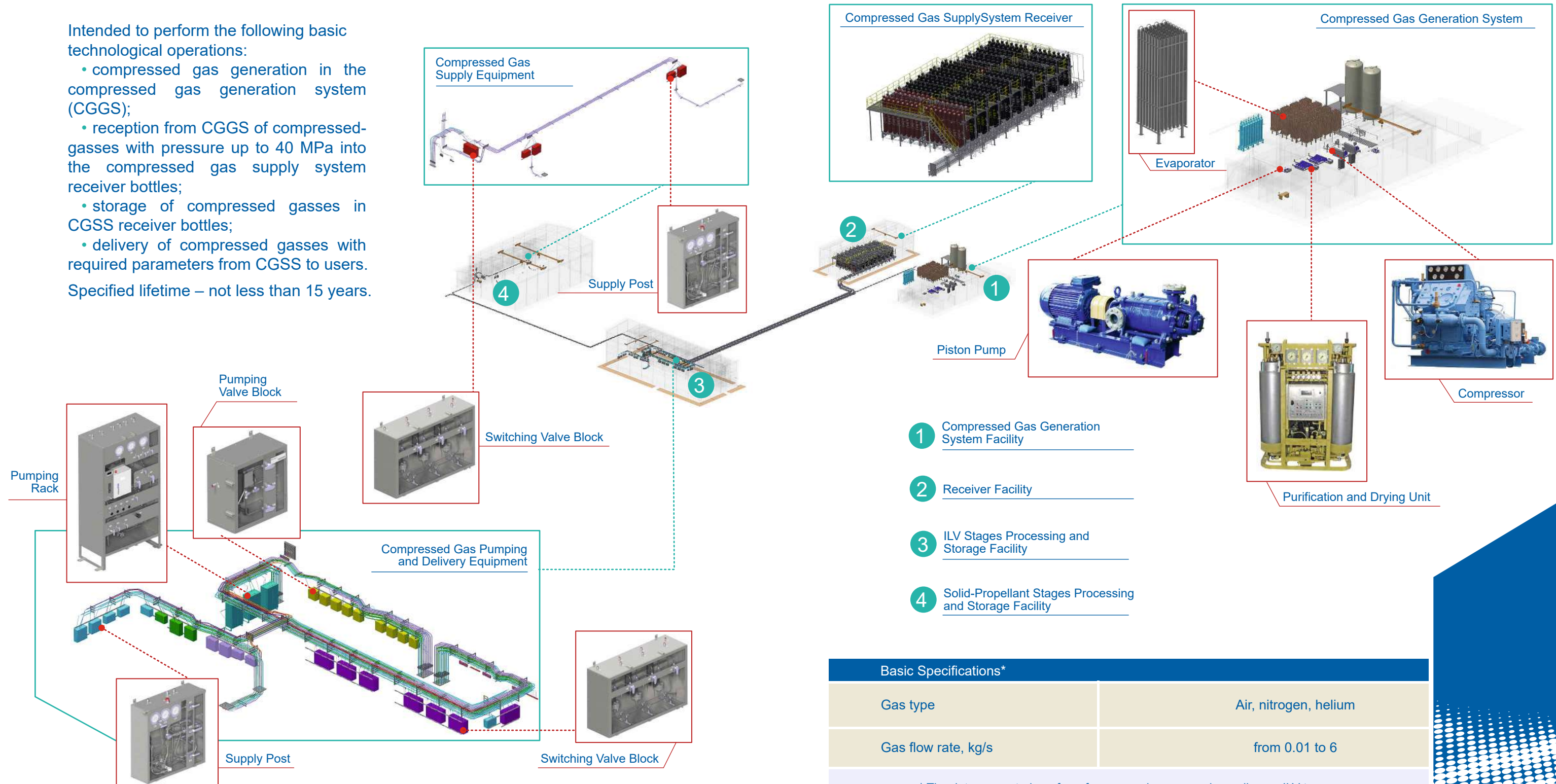
Concentration of dissolved gases,	
kg /m ³	0.04 to 0.75
• nitrogen	0.001 to 0.03
• helium	0.3
Weight measuring error, not more,	20

* The data presented are for reference and may vary depending on ILV types.

Compressed Gas Generation and Supply Systems

Intended to perform the following basic technological operations:

- compressed gas generation in the compressed gas generation system (CGGS);
 - reception from CGGS of compressed-gasses with pressure up to 40 MPa into the compressed gas supply system receiver bottles;
 - storage of compressed gasses in CGSS receiver bottles;
 - delivery of compressed gasses with required parameters from CGSS to users.
- Specified lifetime – not less than 15 years.



- 1 Compressed Gas Generation System Facility
- 2 Receiver Facility
- 3 ILV Stages Processing and Storage Facility
- 4 Solid-Propellant Stages Processing and Storage Facility

Basic Specifications*	
Gas type	Air, nitrogen, helium
Gas flow rate, kg/s	from 0.01 to 6

* The data presented are for reference and may vary depending on ILV types.

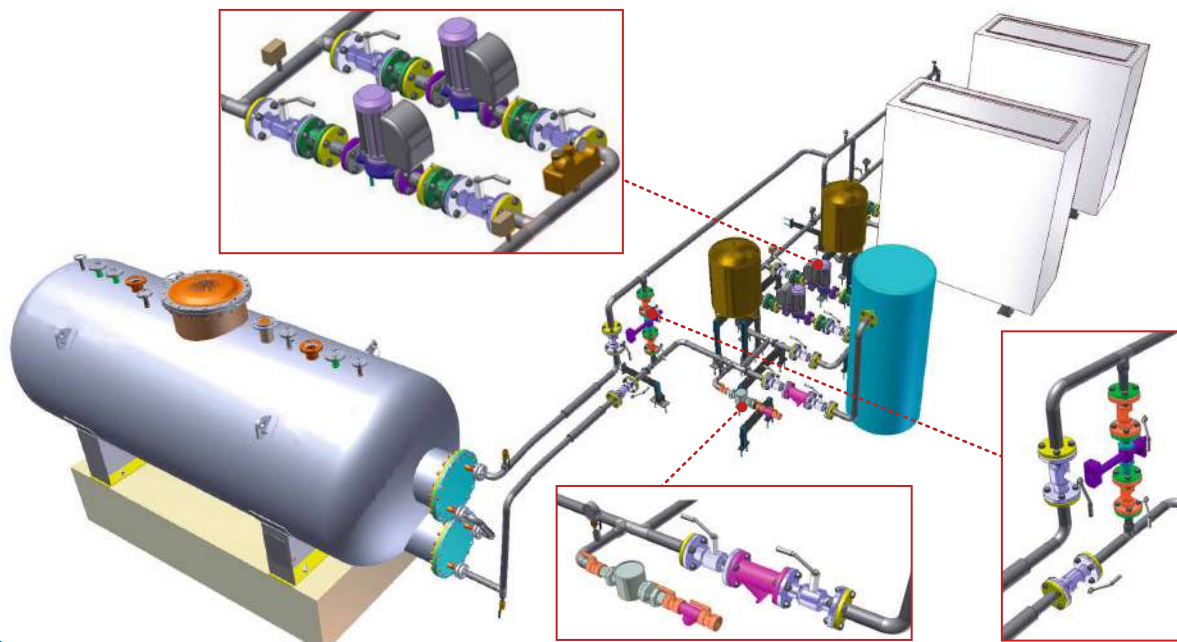
● Thermostating Systems

● Propellants Thermostating Systems

The systems maintain specified temperature characteristics of propellants inside filling tanks prior to ILV tank filling operations.

The system operates in automatic mode according to the preset program that excludes personnel presence during propellants thermostating operation.

Specified lifetime – no less than 15 years.



Basic Specifications*

Propellant cooling time, no more, h

24

Accuracy of propellant cooling up to final temperature, °C

±1

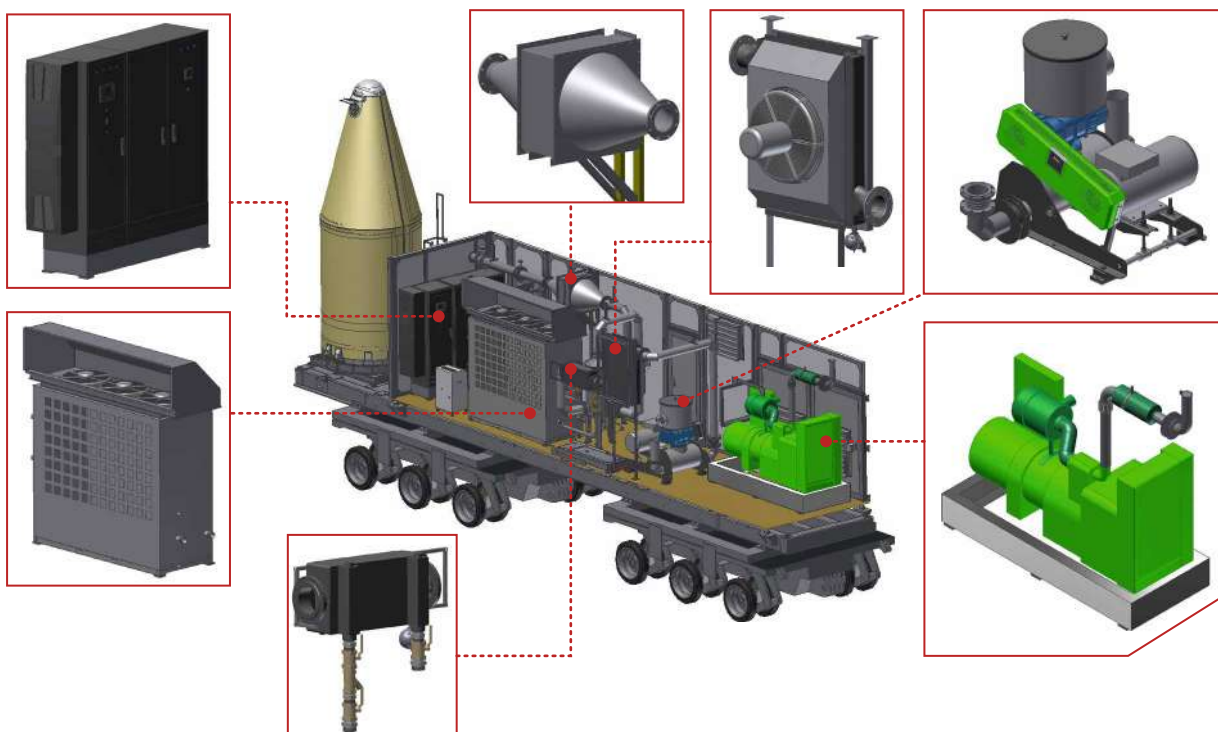
* The data presented are for reference and may vary depending on ILV types.

● Thermostating Systems

● Transport Thermostating Systems

The systems provide air (with specified parameters) supply to Payload Unit with SC.

Specified lifetime – no less than 15 years.



Basic Specifications*	
Supplied air temperature range, °C	from plus 10 to plus 25
Dewpoint temperature, no higher, °C	2
Air flow rate, m ³ /h	from 400 to 1000
Air cleanliness, class	6,7 ISO
Specified temperature maintenance accuracy, no worse, °C	±2

* The data presented are for reference and may vary depending on ILV types.

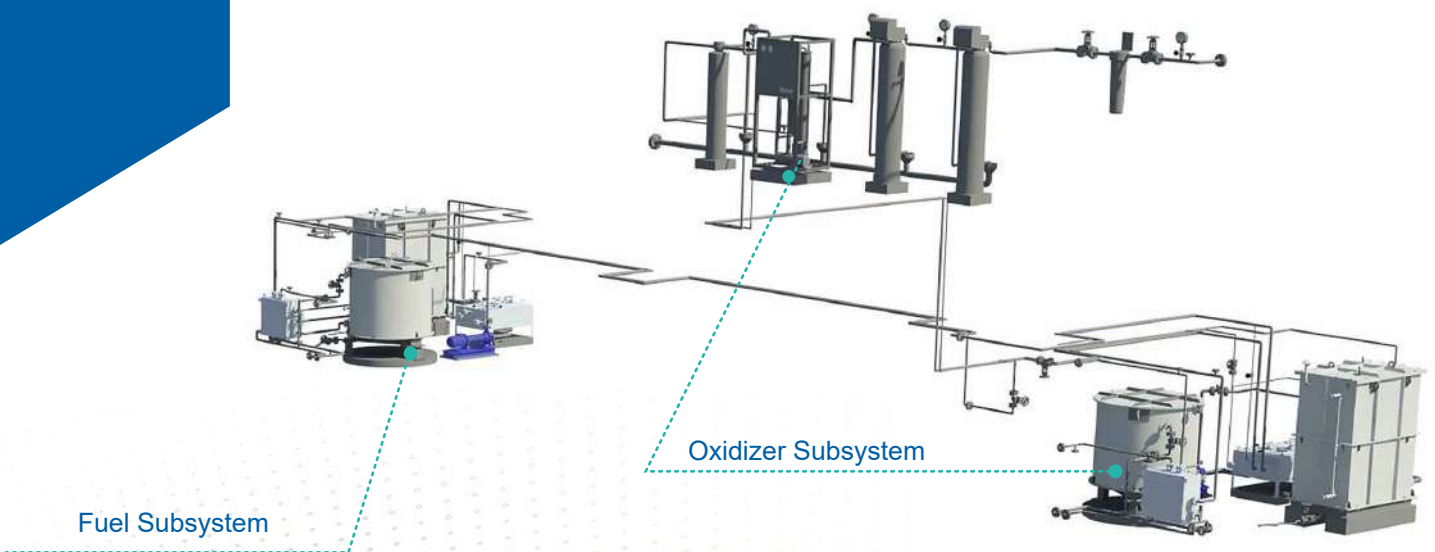
● Neutralization Systems and Units

- SC Removable Equipment and Filling Support Equipment (FSE) Neutralization System

It is intended to neutralize the SC removable equipment and FSE, supplied by the Launch Services Customer, to safe concentration of harmful substances.

The system consists of the SC removable equipment and oxidizer/fuel FSE neutralization subsystems.

Specified lifetime – no less than 15 years.



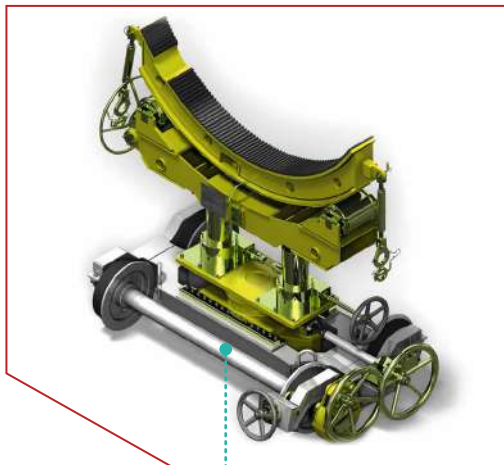
- Mechanical Support Equipment

- Installation Assembly
Dollies (IAD)

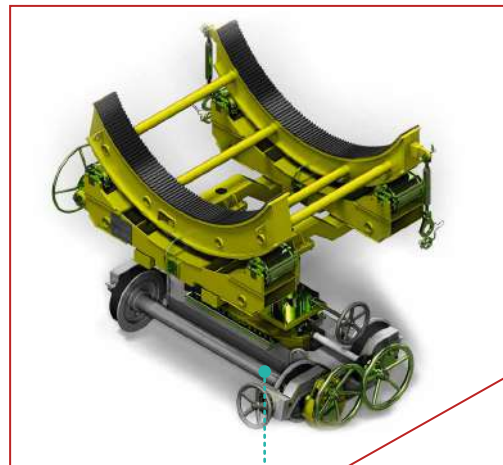
IAD are intended for assembly (disassembly) of launch vehicle parts as well as removable temporary covers. IAD can be made in different size and configuration both with manual and electric drives.

IAD are the unique equipment making maximum precise supply of beds and article encompassing possible for horizontal integration in design options with manual and electric drives. IAD allow for adjustment in three degrees of freedom.

Specified lifetime – no less than 15 years.



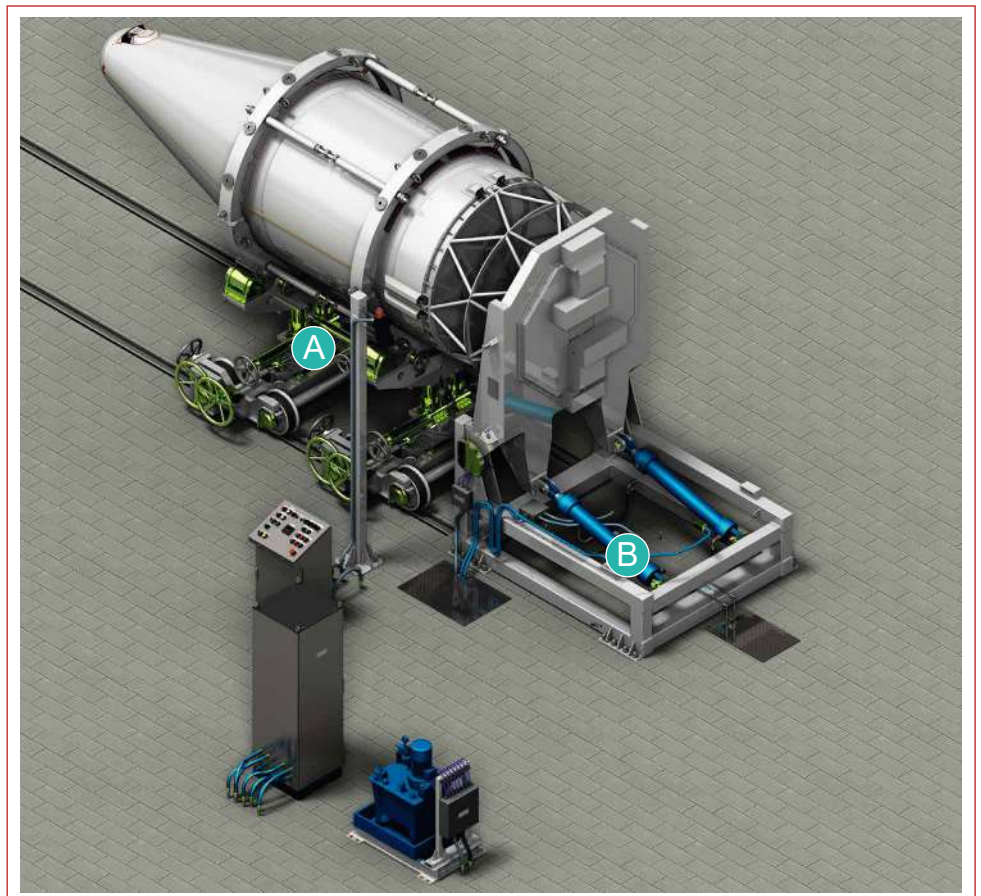
Single-support IAD



Two-support IAD

● Mechanical Support Equipment

- Payload Unit Vertical/Horizontal Integration Mobile and Stationary Stands



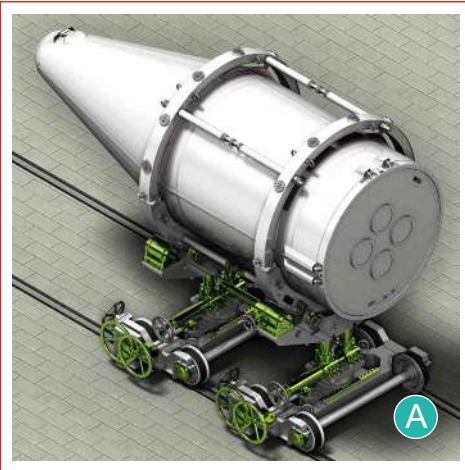
Basic Specifications*

Mobile Stand

Vertical movement, mm	± 100
Lateral movement, mm	± 100
Rotation about longitudinal axis, deg	± 3.5
Mass, kg	4187

* The data presented are for reference and may vary depending on ILV types.

- Mechanical Support Equipment
- Payload Unit Vertical/Horizontal Integration Mobile and Stationary Stands



Mobile Stand

The mobile stand is intended for Payload Unit assembly inside the Assembly Test Building, Payload Unit stationary stand/Payload Unit integration, including Payload Unit operations in case of launch abort.

The mobile stand operates together with stationary, making stationary stand truss/Payload Fairing precise integration possible and allowing for operation both with extended and short Payload Fairing.

Specified lifetime – no less than 15 years.



Stationary Stand

The stationary stand is intended for Payload Unit tilting from horizontal to vertical position and back, Payload Unit assembly, as well as for Payload Unit dismantling in case of launch abort.

It provides automated control of the stand boom rotation, raise and lowering under control of contactless pickups.

Specified lifetime – no less than 15 years.

• Unified Prelaunch and Launch Automated Control System (PL ACS)



It is intended for motoring and control of processes in all operating modes of the Launch Complex, integrating the Ground Complex manufacturing systems and support equipment in the integrated information space. Moreover, the unified prelaunch and launch automated control system provides information support to Operations Manager and launch personnel during standard ILV prelaunch and launch process, as well as in contingency. The ILV prelaunch and launch rehearsal is also provided by the unified PL ACS.

The Ground Complex support equipment is a control and monitoring object, including:

- filling system;
- compressed gas supply system;
- thermostating system;
- launch equipment units;
- vapor and spill neutralization system;
- launch vehicle pneudraulic system elements.

Basic Specifications*

Quantity of control/measurement channels	up to 1000
Equipment power consumption, kW	up to 50
Quantity of operator's workstations, pcs.	up to 12
Number of personnel, no more, persons	3
Duplicated controllers	available
Information communication line duplication	available
Radio channel availability	available
Bilingual interface	available

* The data presented are for reference and may vary depending on ILV types.

● Power Supply Systems

● Ground Facilities Power Supply System

The system is intended to supply the electric energy of required type and quality to ground facilities electrical consumers in all operating modes of the Ground Complex.

It provides electric energy parameter record in real time that enables to analyze input/output parameters at any time of the launch mission and upon its completion as well. Structure of the system and its operation algorithms are designed considering electrical consumers operation timeline that ensures meeting the requirements for qualitative and uninterruptable power supply. The available standby power sources provide failure-free operation with high degree of reliability, and the used design of parts allows for operation in different climatic conditions.





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