

CHAPTER 8

LAUNCH SITE OPERATION

8.1 Briefing to Launch Site Operation

Launch Site Operation mainly includes:

- LV Checkouts and Processing;
- SC Checkouts and Processing;
- SC and LV Combined Operations.

The typical working flow and requirements of the launch site operation are introduced in this chapter. For different launch missions, the launch site operation will be different, especially for combined operations related to joint efforts from SC and LV sides. Therefore, the combined operations could be performed only if the operation procedures are coordinated and approved by all sides.

SC/LV Combined Operations are conducted in technical center and launch center. LM-3C provides two SC/LV integration methods, i.e. Encapsulation-on-pad and Encapsulation-in-BS3. Details about the two methods are described in paragraph 8.3.

8.2 LV Checkouts and Processing

LM-3C launch vehicle is transported from CALT facility (Beijing, China) to XSLC (Sichuan Province, China), and undergoes various checkouts and processing in Technical Center and Launch Center of XSLC. The typical LV working flow in the launch site is shown in **Table 8-1**.

Table 8-1 LV Working Flow in the Launch Site

	No.	Item	Working Period	Accumulative Period
T E C H N I C A L	1	To Unload LV from the Train and Transfer LV to LV Test Building (BL1).	1 day	1 day
	2	Unit Tests of Electrical System	7 days	8 days
	3	Tests to Separate Subsystems	3 days	11 days
	4	Matching Test Among Subsystems	4 days	15 days
	5	Four Overall Checkouts	4 days	19 days
	6	Review on Checkout Results	1 day	20 days
	7	LV Status Recovery before Transfer	2 days	22 days
	8	To Transfer LV to Launch Center	1 days	23 days
L A U N C H C E N T E R	9	LV Vertical Integration on the Launch Tower	2 days	25 days
	10	Tests to Separate Subsystems	3 days	28 days
	11	Matching Test Among Subsystems	3 days	31 days
	12	The first and second overall checkouts	2 days	33 days
	13	To Transfer SC and Fairing to Launch Center Separately, SC/LV Integration, Fairing Encapsulation	1.5 days	34.5 days
	14	SC Testing	1.5 days	36 days
	15	The Third Overall Checkout (SC Involved)	1 day	37 days
	16	The Fourth Overall Checkout	1 day	38 days
	17	Review on Checkout Results	1 day	39 days
	18	Functional Check before Fueling, Gas Replacement of Tanks	2 days	41 days
	19	N ₂ O ₄ /UDMH Fueling	1 days	42 days
	20	LOX/LH ₂ Fueling	0.5 day	42.5 days
	21	Launch	0.5 days	43 days
Total			43 days	43 days

After SC is transferred to Launch Center, some of SC and LV operations can be performed in parallel under conditions of no interference.

The working flow for Encapsulation-in-BS3 method is similar to the typical one, except for the following part: The SC and Fairing are integrated in BS3, and the encapsulated fairing is transported to the Launch Pad to mate with LV.

8.3 SC/LV Combined Operations

8.3.1 Summary

The SC/LV combined operations are conducted in Technical Center and in Launch Center. LM-3C provides two operation methods, i.e. Encapsulation-on-pad and Encapsulation-in-BS3.

The typical working procedure of Encapsulation-on-pad method is as follows:

1. The payload adapter and fueled SC are mated in BS3 of the technical center;
2. The SC/adapter stack is put into the clean SC container, which is then shipped to launch center;
3. The SC container and fairing are hoisted to the 8th floor of the service tower in the launch center. A clean area (big closure) is established here on the tower following the arrivals of SC container and fairing.
4. The SC/LV integration is performed on the 8th floor of the Service Tower.
5. The fairing is finally encapsulated inside the clean area. Air-conditioning to the fairing starts following encapsulation.

The typical working procedure of Encapsulation-in-BS3 method is as follows:

1. The payload adapter and fueled SC are mated in BS3 of the technical center;
2. The fairing encapsulates the SC/Adapter stack in BS3;
3. The fairing, encapsulating the SC/Adapter stack, is lifted to a special transfer vehicle, which transfers the fairing to launch center;
4. The encapsulated fairing is mated with LV on the 8th floor of the service tower in the launch center.

8.3.2 SC/LV Combined Operation for Encapsulation-on-pad Method

8.3.2.1 SC Container

SC Container is a dedicated container used for transferring SC from Technical Center to Launch Center. The available space of SC container is 3980mm in diameter, 7450mm high and 92.6 m³ in volume. The SC container is composed of a base pad and five cylindrical sections, which can be assembled together. Two guide poles are equipped outside the SC container. The core of wall is made of aluminum, and the outer surface and inner surface of the wall are covered by thermal-proof materials. See **Figure 8-1**. This SC Container is only used for Encapsulation-on-pad method. LM-3C also provides small SC Container for selection.

The characteristics of the SC container are listed as follows:

- SC/Adapter stack is fastened inside the SC container;
- Dry N₂ is filled to the SC container, the SC is protected by positive pressure;
- The temperature inside the SC container is 24±6°C during transportation from BS3 to Service Tower;
- SC container is of thermal-proof function.
- Temperature, humidity, noise and accelerations, etc. inside the SC container can be measured and recorded during transportation process.

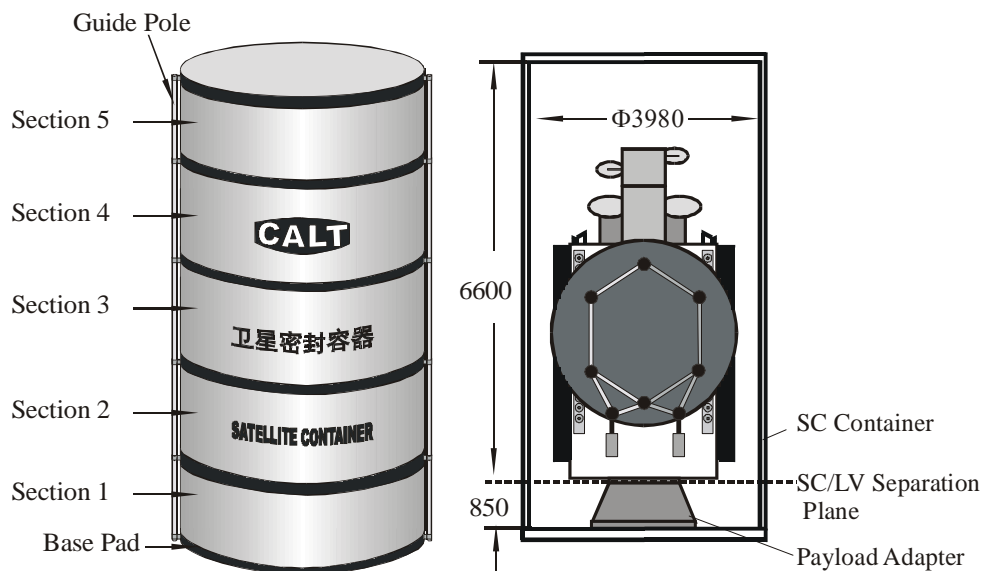


Figure 8-1 SC Container Configuration

8.3.2.2 SC/LV Integration in Technical Center (Encapsulation-on-pad Method)

The payload adapter and SC are mated in BS3 after SC is fueled and weighed. SC team carries out all the SC operations. CALT is responsible for mating SC with the payload adapter, and installing SC/LV separation devices. The following describes the working procedure:

1. CALT to bolt payload adapter on the technological stand and to install SC/LV locked separation springs;
2. SC team to lift up the SC, CALT to mate SC with payload adapter;
3. CALT to install clampband system and to engage SC/LV In-Flight Disconnectors (IFD); CALT and SC team to test and verify IFD; CALT to unlock the separation springs.
4. CALT to unbolt the payload adapter from the technological stand; After SC team and CALT's approval, SC team to lift up and move the SC/Adapter stack to the base pad of the SC container; CLTC to bolt the adapter with the base pad, and SC team to verify SC's status;
5. CLTC to integrate SC container;
6. CALT to seal the SC container and to fill dry N₂ into the SC container; The SC container is ready for transfer to Launch Center.

Environmental Sensors are already installed on the inner side of the container, which can measure and record the inner environmental parameters in real-time during transfer to the Launch Center.

The SC/LV integration process in BS3 for Encapsulation-on-pad method is shown in **Figure 8-2**.

8.3.2.3 SC Transfer (Encapsulation-on-pad Method)

CLTC is responsible for using special vehicle to transfer SC container to the Launch Center. Following working procedures are then performed:

7. CLTC to lift the SC container, which already contained SC/Adapter stack, onto the special vehicle and to fasten the SC container with ropes.
8. CLTC to drive the special vehicle from BS3 to Service Tower in Launch Center;
9. CLTC to release the SC container from the transfer vehicle; CLTC to lift the SC container up to the 8th floor of the Service Tower;

See **Figure 8-3** and **Figure 8-4**.

8.3.2.4 SC/LV Integration in Launch Center (Encapsulation-on-pad Method)

The SC/LV integration in Launch Center includes:

- To mate Payload adapter with LV third stage;
- To encapsulate the fairing.

CALT is responsible for LV third stage/Adapter integration and fairing encapsulation in the clean big closure, and SC team is responsible for SC lifting. Following working procedures are performed.

10. CLTC to close all the doors of the 8th floor and upper floors to form the clean area; CLTC to open the SC container when the environmental conditions, including temperature, humidity and cleanness, reach the SC requirements.
11. CLTC unstacks the SC container;
12. SC team to install the slings on the SC; CLTC to unbolt the payload adapter from the base pad of the SC container;
13. SC team to hoist and move the SC/Adapter stack to the above of the LV third stage by using of the crane of 8th floor; CALT to mate the payload adapter with LV third stage;
14. SC team to remove the SC slings; SC team to do SC pre-flight checkouts; CALT to encapsulate the two halves of the fairing after SC and LV sides confirm that SC and LV is ready for fairing encapsulation;
15. CALT to remove the fairing fixture and complete the integration. CALT and CLTC to connect SC ground umbilical connectors and fairing air-conditioning system; CLTC to open the big closure and lift the SC container down to the ground.

SC team can only perform simple operations and checkouts to the SC through access door of the fairing after encapsulation.

See **Figure 8-5**.

CALT'S PROPRIETARY

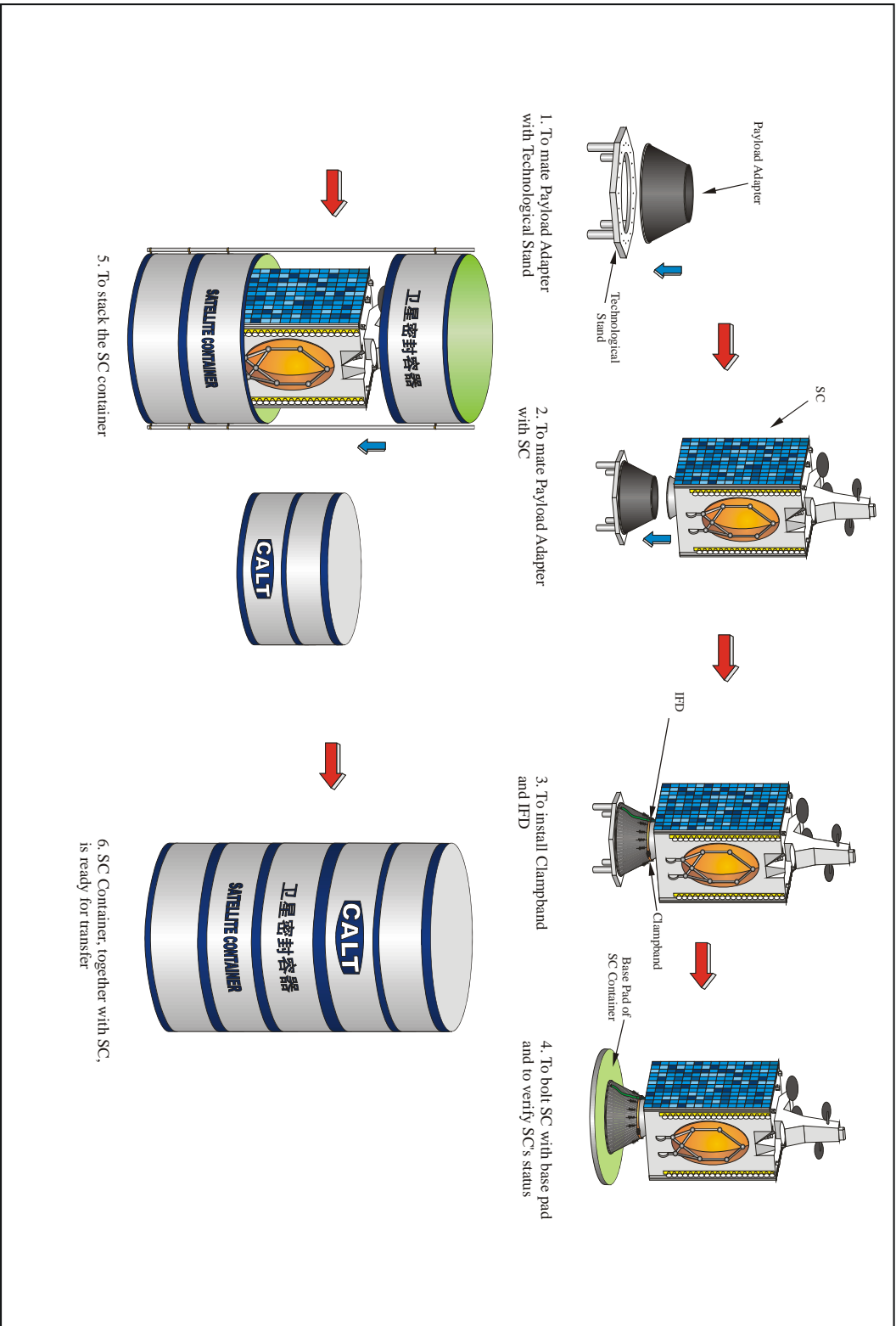


Figure 8-2 SC/IV Integration in Technical Center (Encapsulation-on-pad)

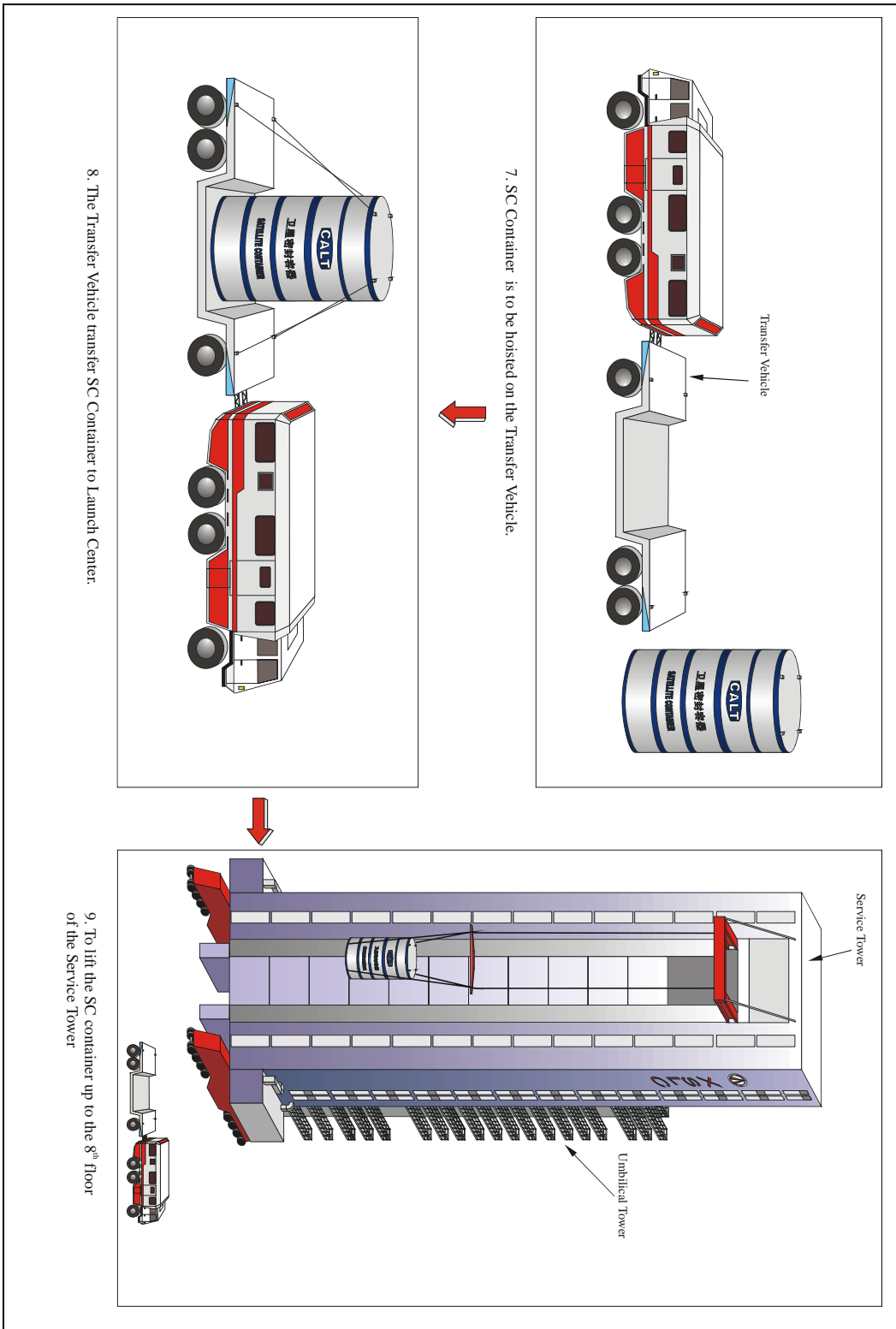


Figure 8-3 SC Transfer (Encapsulation-on-pad)

CALT'S PROPRIETARY

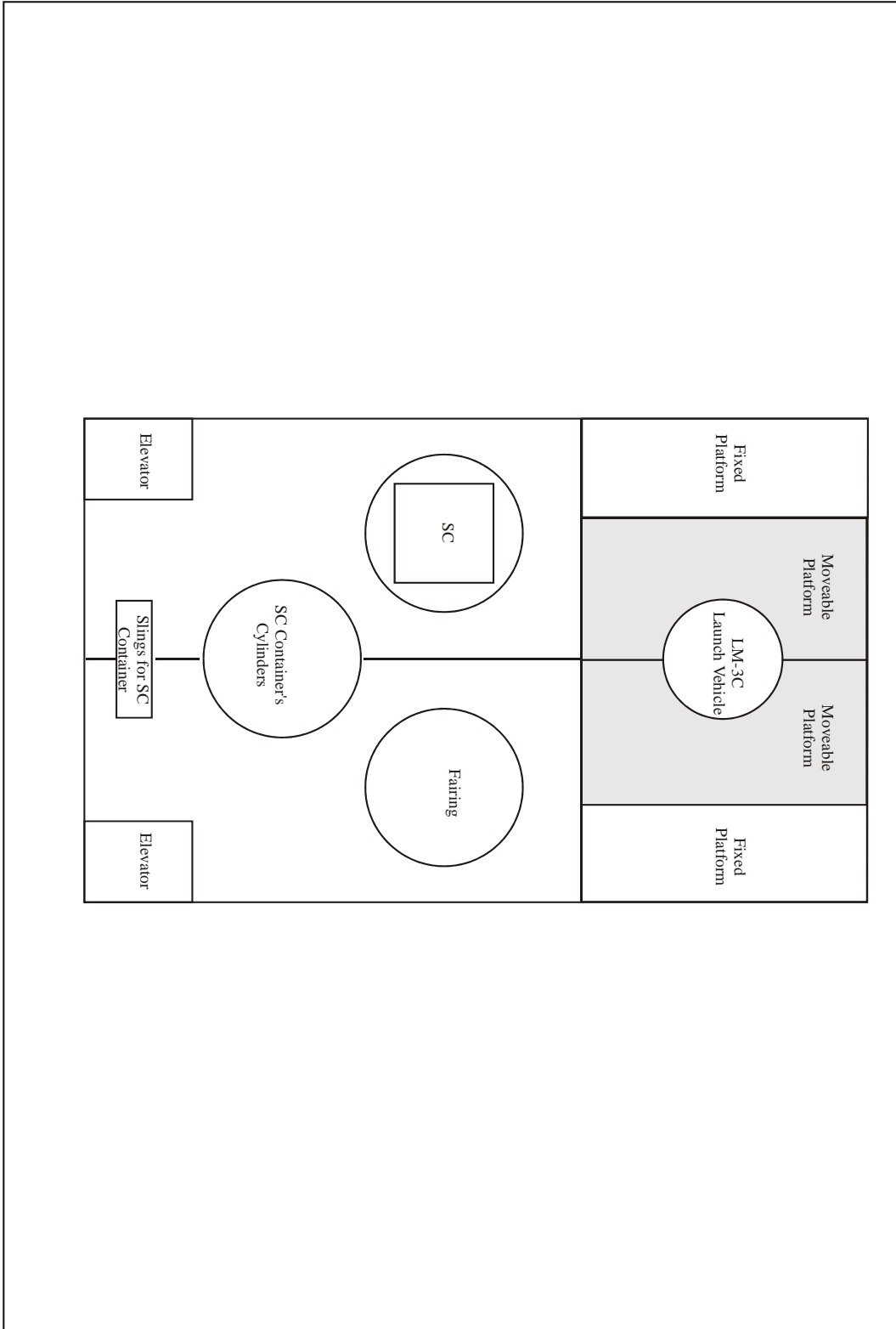


Figure 8-4 Layout of the Clean Area on the 8th Floor of the Service Tower

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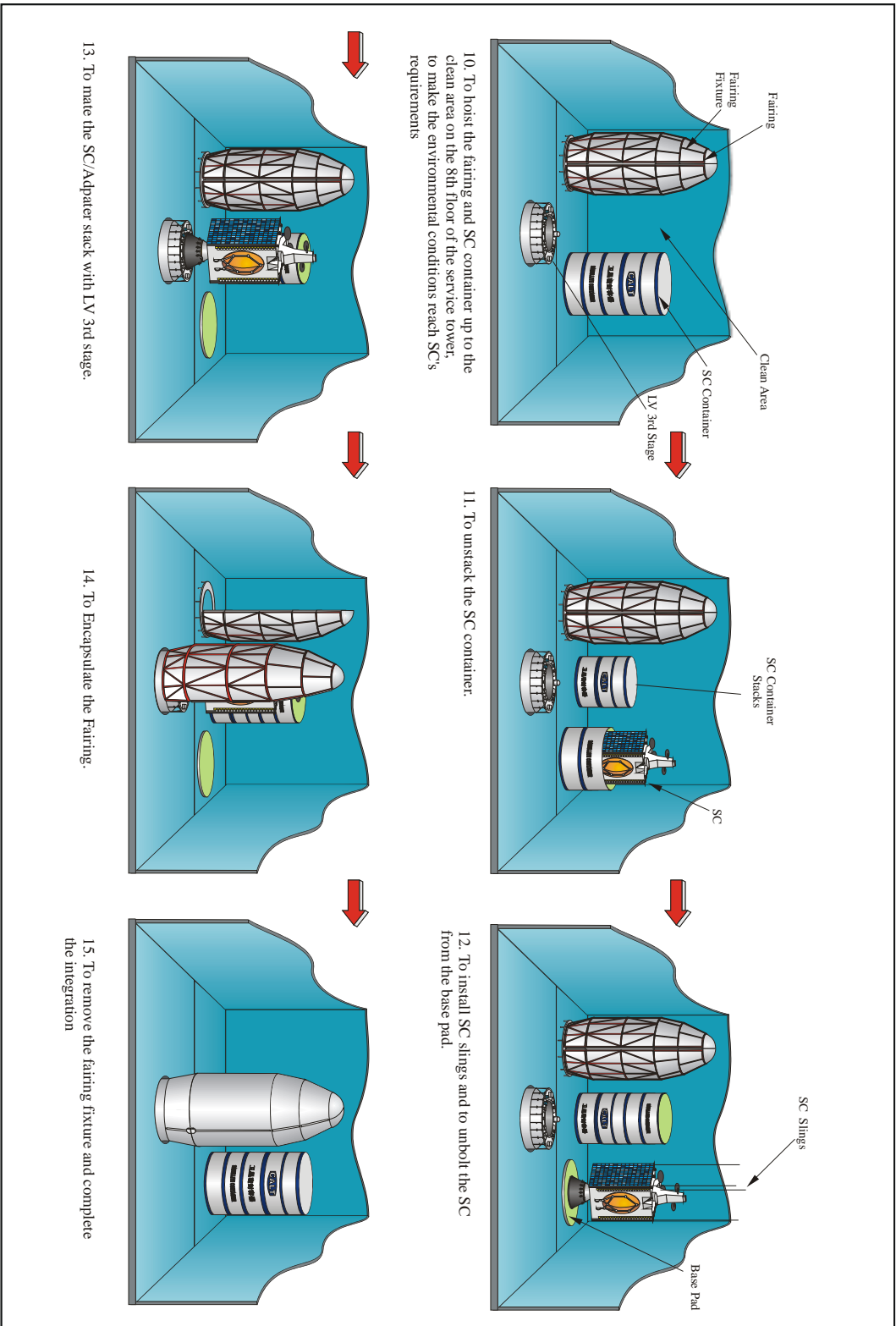


Figure 8-5 SC/LV Integration in Launch Center (Encapsulation-on-pad)

8.3.3 SC/LV Combined Operations for Encapsulation-in-BS3 Method

8.3.3.1 SC/LV Integration in Technical Center (Encapsulation-in-BS3 Method)

SC/LV integration in BS3 of Technical Center includes:

- To mate payload adapter with SC;
- To encapsulate the fairing with SC/payload adapter stack.

The payload adapter and SC are mated in BS3 after SC is fueled and weighed. SC team carries out all the SC operations. CALT is responsible for mating SC with payload adapter and installing SC/LV separation devices. Following describes the working procedure:

1. CALT to bolt payload adapter on the technological stand, and to install SC/LV locked separation springs;
2. SC team to lift up the SC to mate it with payload adapter; CALT to install clampband system and to engage SC/LV In-flight Disconnectors (IFD); CALT and SC team to test and verify IFD; CALT to unlock the separation springs.
3. CALT to unbolt the payload adapter from the technological stand; After SC team and CALT's approval, SC team to lift up the SC/adapter stack, and CALT to mate it with LV transition adapter; SC team to remove the SC slings;
4. CALT to encapsulate the fairing, which is supported by the fairing fixture.
5. CALT to remove the fairing fixture and to install the hoisting basket.

See **Figure 8-6** and **Figure 8-7**.

8.3.3.2 SC Transfer (Encapsulation-in-BS3 Method)

CLTC is responsible for transferring the encapsulated fairing from BS3 to Launch Center.

Following working procedures are performed:

6. CLTC to lift the encapsulated fairing onto the special vehicle and to fasten the fairing with ropes; CLTC to connect the air-conditioning to the fairing if necessary; CLTC to drive the vehicle from BS3 to Launch Service Tower;
7. CLTC to release the encapsulated fairing from the transfer vehicle; CLTC to install slings to the encapsulated fairing under the Launch Service Tower; CLTC

to lift the fairing onto the 8th floor of the tower;

See **Figure 8-7**.

8.3.3.3 SC/LV Integration in Launch Center (Encapsulation-in-BS3 Method)

The encapsulated fairing will be mated with the LV third stage on the service tower.

Following working procedures are performed:

8. CALT to hoist the encapsulated fairing to the above of the LV third stage;
9. CALT to joint the bottom of the fairing with LV third stage; CLTC to remove the hoisting basket outside the fairing; CLTC to connect the SC umbilical connectors and SC air-conditioning.

See **Figure 8-8**.

8.3.4 SC Preparation and Checkouts

- CALT and CLTC are responsible for checking and verifying the umbilical cables and RF links. If necessary, SC team could witness the operation.
- LV accessibility and RF silence time restriction must be considered, when SC team performs operation to SC.

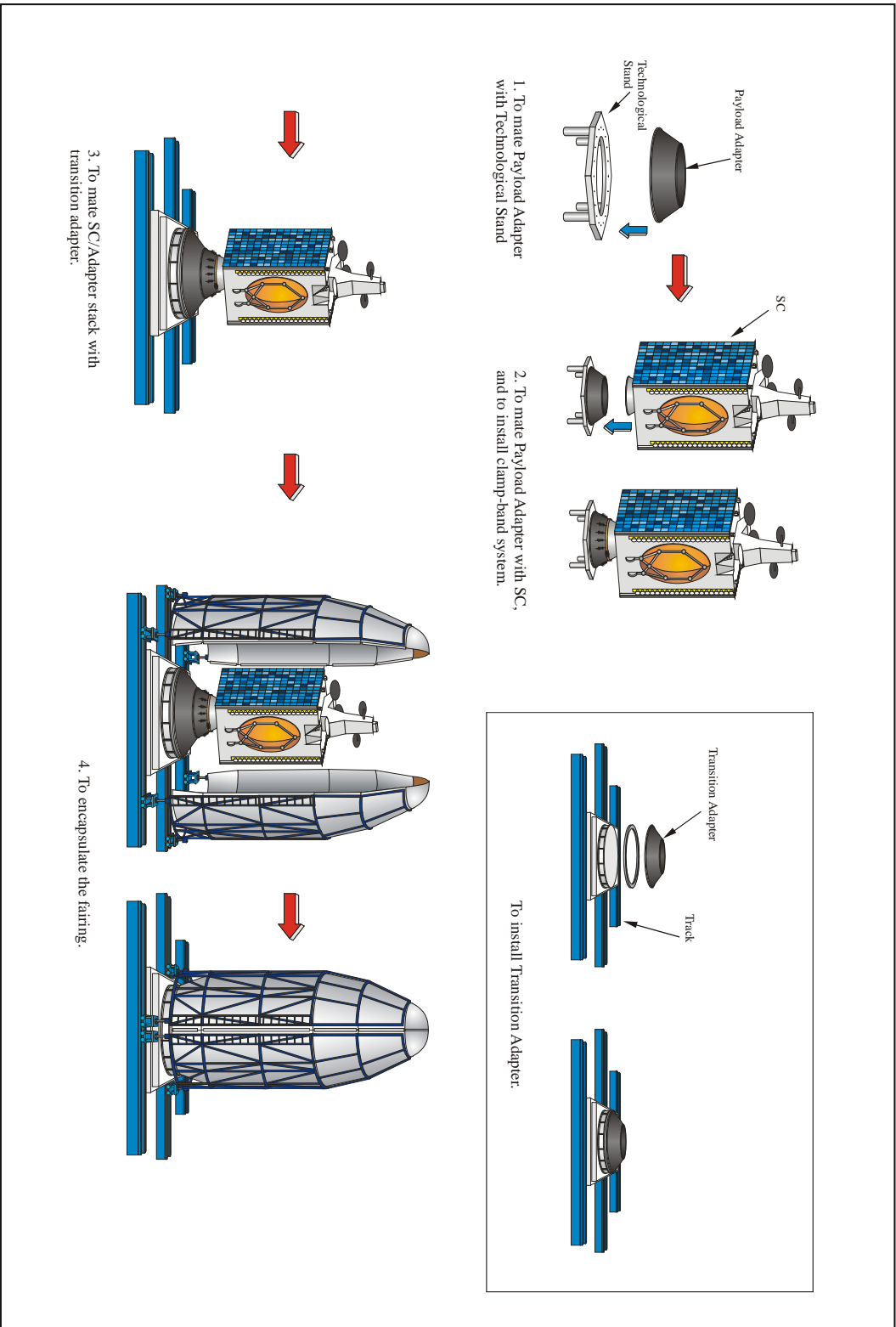


Figure 8-6 SCLV Integration in Technical Center (Encapsulation-in-BSS)

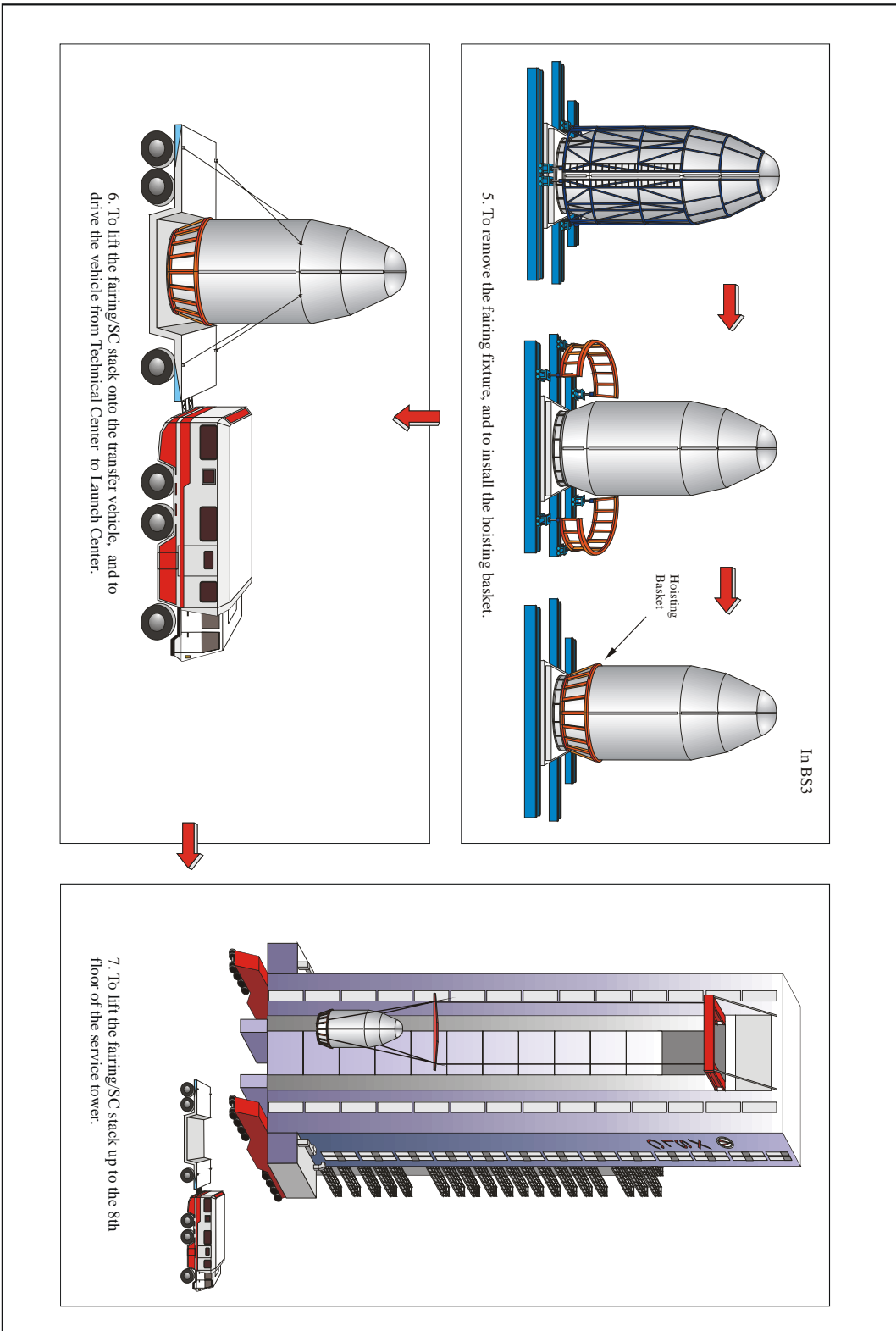


Figure 8-7 SC Transfer (Encapsulation-in-BSS)

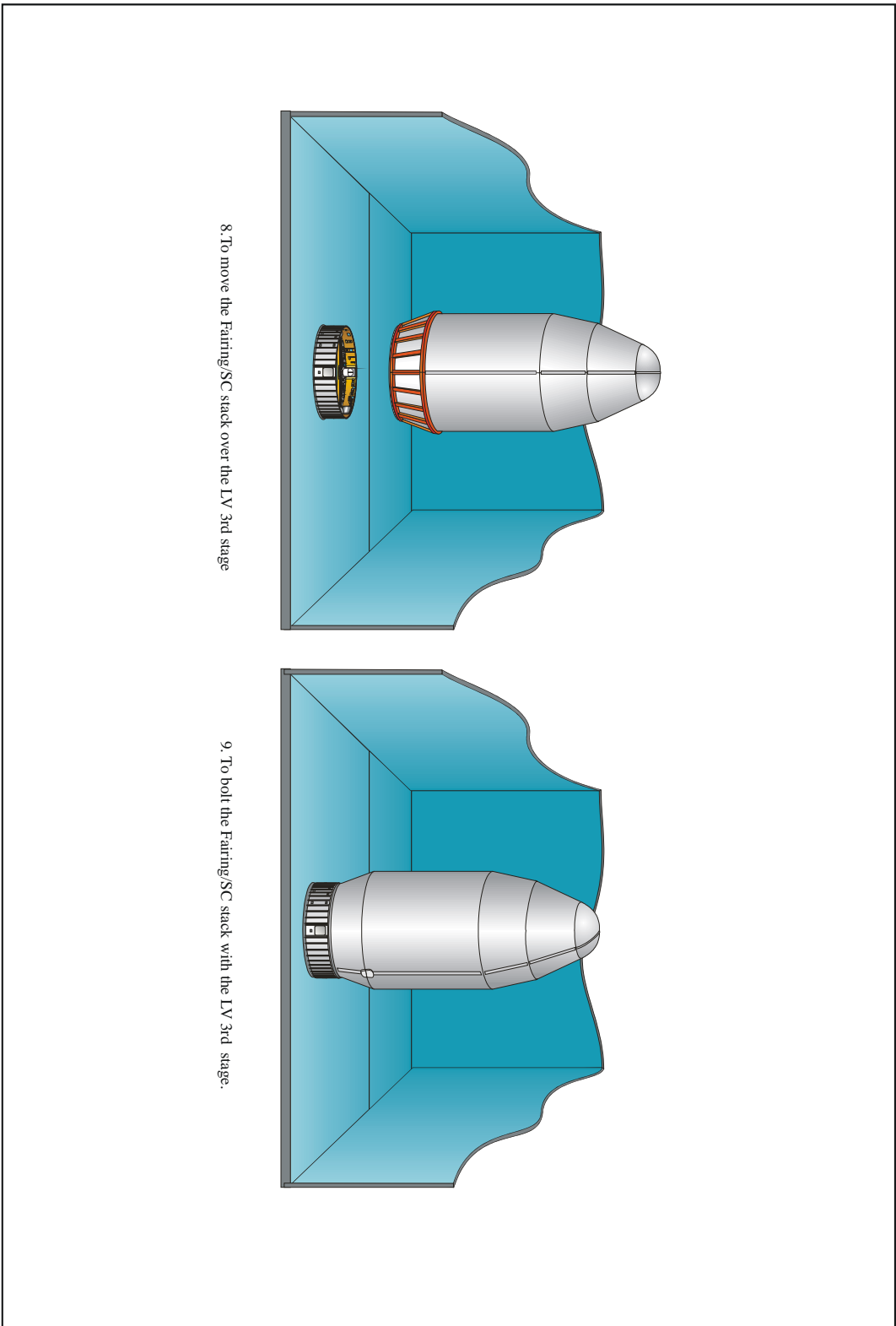


Figure 8-8 SC/IV Integration in Launch Center (Encapsulation-in-BSS)

8.4 Launch Limitation

8.4.1 Weather Limitation

- The average ground wind velocity in the launch area is lower than 10m/s
- The winds aloft limitation: $q \times \alpha \leq 2500 \text{N/m}^2 \cdot \text{rad}$ ($q \times \alpha$ reflects the aerodynamic loads acting on the LV, whereas, q is the dynamic head, and α is LV angle of attack.)
- The horizontal visibility in the launch area is farther than 20km.
- No thunder and lightning in the range of 40km around the launch area, the atmosphere electrical field strength is weaker than 10kV/m.

8.4.2 "GO" Criteria for Launch

- The SC's status is normal, and ready for launch.
- The launch vehicle is normal, and ready for launch.
- All the ground support equipment is ready;
- All the people withdraw to the safe area.

8.5 Pre-launch Countdown Procedure

The typical pre-launch countdown procedure in the launch day is listed below:

No.	Time	Event
1	-7 hours	LV third stage LOX/LH ₂ Fueling
2	-2 hours	LV Control System Power-on & Functional Checkout
3	-60 minutes	LV Telemetry System Power-on & Functional Checkout
4	-45 minutes	Fairing air-conditioning Stopping & Air-conditioning Pipe Disconnecting
5	-40 minutes	Accurately aiming; Loading and Checking Flight Program; Gas pipes for the first and second stages drop-off;
6	-20 minutes	LV third stage Engines Pre-cooling;
7	-13 minutes	LV third stage propellants topping;
8	-15~-12 minutes	SC umbilical disconnection;

		<i>SC Power Switch-over at -15 minutes</i>
		<i>SC Power Switch-over is ready at -13 minutes</i>
		<i>SC Umbilical Disconnection at -12 minutes</i>
9	-10 minutes	SC is ready
10	-3 minutes	Telemetry and Tracking Systems Power Switch-over; LV third stage Propellant Fueling Pipe Disconnection;
11	-2 minutes	Gas Pipe for third stage Disconnection;
12	-90 seconds	Control System Power Switch-over;
13	-60 seconds	Control System, Telemetry System and Tracking System Umbilical Disconnection;
14	-30 seconds	TT&C Systems Starting;
15	-7 seconds	Camera on;
16	0 seconds	Ignition.

8.6 Post-launch Activities

The orbital parameters of the injected orbit will be provided to Customer in half-hours.

The LV flight report will be provided to the Customer in a month after launch.