# CHAPTER 9

# SAFETY CONTROL

This chapter describes the range safety control procedure and the criteria to minimize the life and property lose in case of a flight anomaly following lift-off.

## 9.1 Safety Responsibility and Requirements

XSLC designates a range safety commander, whose responsibilities are:

- To work out "Launch Vehicle Safety Control Criteria" along with the LV designer according to the concept of the safety system;
- To know the distribution of population and major infrastructures in the down range area;
- To guarantee that the measuring equipment provide sufficient flight information for safety control, i.e. clearly show the flight anomaly or flying inside predetermined safe range; and
- To terminate the flight according to the "Launch Vehicle Safety Control Criteria" if the launch vehicle behaves so unrecoverably abnormal that the launch mission can never completed and a ground damage is possible.

## 9.2 Safety Control Plan and Procedure

### 9.2.1 Safety Control Plan

Even though a flight anomaly occurs, the launch vehicle will not be destroyed by the ground command during the first 15 seconds following lift-off. The launch vehicle will go 400 meters from the launch pad during the 15 seconds to protect the launch facilities.

The destruction to the launch vehicle can be conducted from 15 seconds of flight to the second stage shut-down.

### 9.2.2 Safety Control Procedure

The destruction of the launch vehicle will be performed by the Command Destruction System (CDS) and Automatic Destruction System (ADS) together.

(1) Command Destruction System

The ground tracking and telemetry system will acquire the flight information independently. If the flight anomaly meets the destruction criteria, the safety commander will select the impact area and send the destruction command. Otherwise the ground control computer will automatically send the command and remotely destroy the launch vehicle.

(2) Automatic Destruction System

The launch vehicle system makes the decision according to flight attitude. If the attitude angle of Launch Vehicle exceeds safety limits, the control system will send a destruction signal to on-board explosive devices. After a delay of 15 sec., the Launch Vehicle will be exploded. The range safety commander can use the delayed 15 seconds to select the impact location and send the destruction command. If the range safety commander could not find a suitable area within 15 seconds, the launch vehicle will be exploded by ADS.

The objective of choosing impact location is to make the launch vehicle debris drops to the area of less population and without important infrastructures.

The flowchart of the control system is shown in **Figure 9-1.**

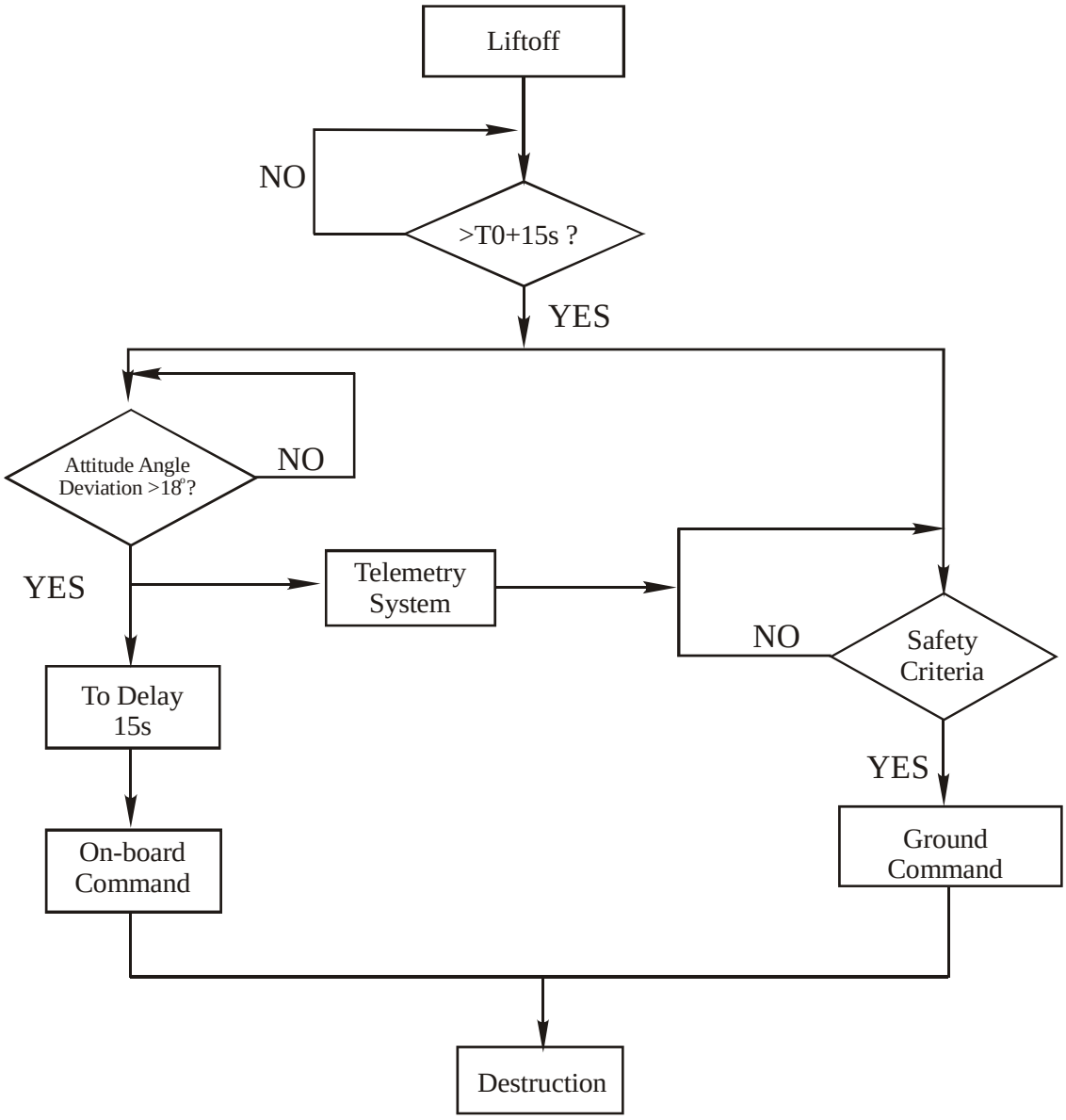


**Figure 9-1 Flowchart of Control System**

## 9.3 Composition of Safety Control System

The range safety control system includes on-board segment and ground segment. The on-board safety segment works along with the onboard tracking system, i.e. Tracking and Safety System. The on-board safety control system consists of ADS, CDS, explosion system, tracking system and telemetry system.

The ground safety control system consists of ground remote control station, tracking station, telemetry station and communication system.

The flight data that the safety control system needs include: flight velocity, coordinates, working status of LV subsystems, safety command receiving status, working status of onboard safety control system, as well as safety command to destroy the LV from ground.

## 9.4 Safety Criteria

The range safety criteria are the regulation used to destroy the launch vehicle. It is determined according to the launch trajectory, protected region, tracking equipment, objective of flight, etc. See **Figure 9-2**.

### 9.4.1 Approval Procedure of Range Safety Criteria

The range safety criteria vary with different launches, so the criteria should be modified before each launch. Normally the criteria is drafted by XSLC, reviewed by CALT and CLTC and excised by the safety commander.

### 9.4.2 Common Criteria

- If all the tracking and telemetry data disappear for 5 seconds, the launch vehicle will be destroyed immediately.
- If the launch vehicle flies toward the reverse direction, the safety commander will select a suitable time to destroy the launch vehicle considering the impact area.
- If the launch vehicle flies vertically to the sky other than pitches over to the predetermined trajectory, it will be destroyed at a suitable altitude.
- If the launch vehicle shows obvious abnormal, such as roll over, fire on some parts, it will be destroyed at a suitable time.
- If the engines of launch vehicle suddenly shut down, the launch vehicle will be destroyed immediately
- If the launch vehicle exceeds the predefined destruction limits (including attitude being unstable seriously), it will be destroyed at a suitable altitude considering the impact area.

### 9.4.3 Special Criteria

- If the launch vehicle is horizontally closer than 400m away from the launch pad, the launch vehicle will not be destroyed to protect the launch site.
- If the launch vehicle leaves the normal trajectory and flies to the Technical Center during 15~30 seconds and Z≥400m, the launch vehicle will be destroyed immediately to protect the Technical Center, here Z is the distance between launch vehicle and the normal launch plane.
- If launch vehicle is flying out of the safety limit for 30~60seconds, it will be destroyed immediately to protect MCCC.

## 9.5 Emergency Measures

Before the launch takes place, people will be evacuated from some related facilities and area according to the predetermined plan.

XSLC has the following emergency measures:

- ✧ Emergency commander
- ✧ First aid team
- ✧ Fire fight team
- ✧ Ambulance
- ✧ Backup vehicles
- ✧ Helicopter

Rescue equipment and food, water, oxygen for one-day use are available in the Technical Center and LCC.

All the safety equipment can be checked by the User before using. Any comments or suggestions can be discussed in the launch mission or launch site review.

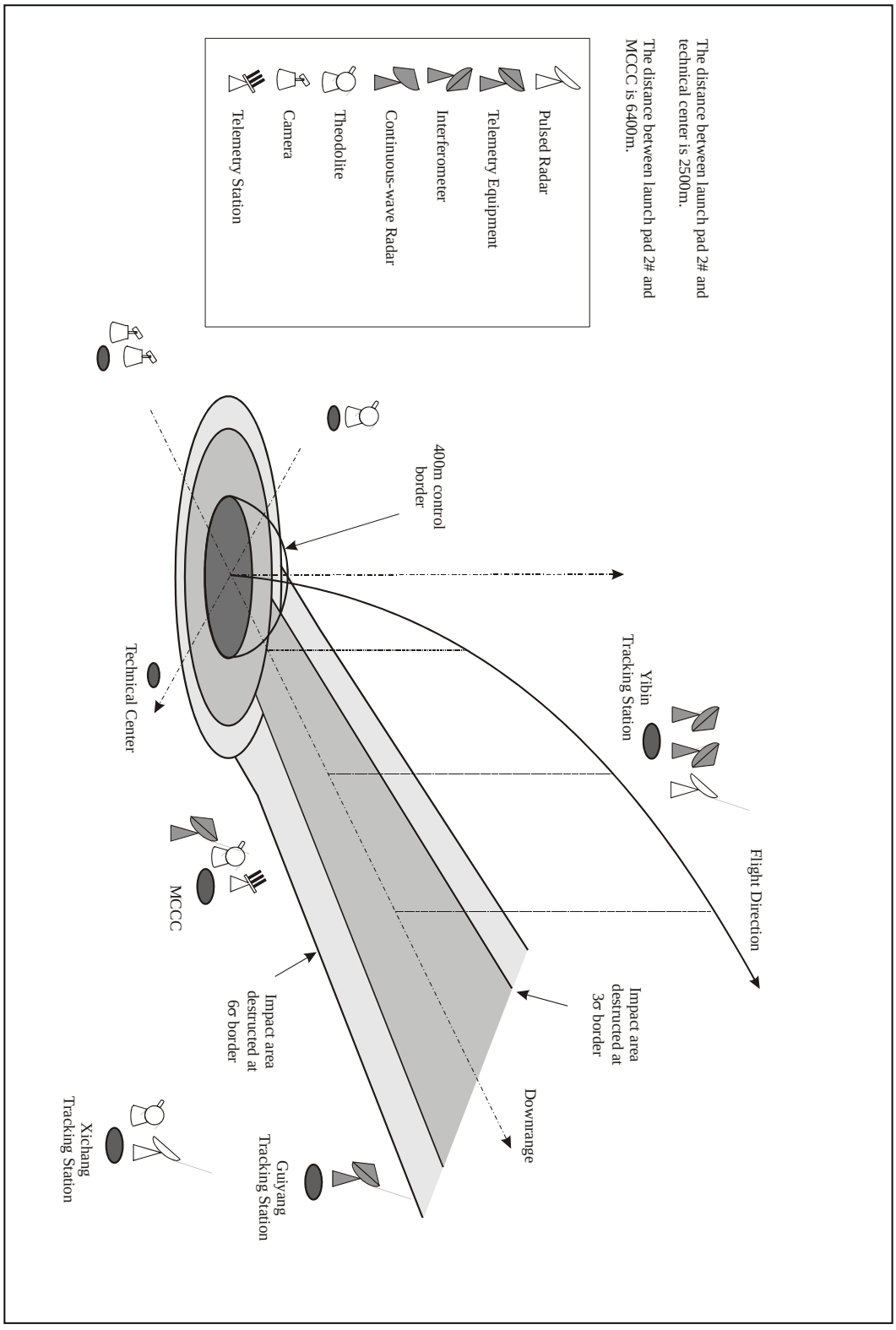


**Figure 9-2 Ground Safety Control System**