



**Civil Aviation Organization of the
Islamic Republic of Iran**

PS752 Accident Investigation

FACTUAL REPORT



July 2020

In the name of God

A. Points to consider while studying the report:

- Many details on the Ukraine International Airlines Flight 752 (PS752) accident flight have been obtained, which were published in two preliminary reports, and they will be discussed in greater detail in the final report. Having disregarded generalizations and some ineffective or less important information and records, this report focuses mainly on the significant facts we have achieved so far; it will specify what exactly happened that the PS 752 was identified by one of the air defense units as a threat and targeted consequently.
- The objective of the investigation of an accident subject to Annex 13 to the Convention on International Civil Aviation shall be the identification of the root causes and prevention of similar incidents and accidents by determining the corrective measures required and implementing them accordingly. This type of investigation is not conducted with the aim of apportioning blame and liability. Although such issues are obviously important and will certainly be addressed by other authorities through other investigations, including judicial measures , in an accident investigation conducted with the aim of improving safety, if the process is diverted to simply apportioning blame or liability, safety goals will be at risk for two major reasons:
 - First, the individuals involved in an accident will naturally be led to defending themselves, hence reducing their cooperation in identifying the factors contributing to the accident. Even worse, others will consider concealing issues concerning them in case of occurrence of an error leading to an accident, so that they can escape blame and avoid liability, and, as a result, will be resorting to hiding such sensitive issues rather than reporting and cooperating to eliminate the areas of concern.

- Second, if the factors contributing to an accident are not well determined and eliminated, the identification of the liable individuals and eliminating them from the system in place will not entail the prevention of similar occurrences. On the contrary, the very factors leading such liable individuals to commit the error, causing the accident, will still be lurking for others; hence, similar accidents will occur through others' negligence in the same area.
- Addressing the details of an accident could be painful to the victims' families. Stating the factors contributing to accidents could also be interpreted as justifying the accident, or making it look natural simply. However, it should certainly be borne in mind that elaborating on the causes of an accident is not supposed to mean it was inevitable. More importantly, no analysis and elaboration on such issues will be in any way worthy of comparison neither to the victims' lost lives, nor to their families' hurt feelings. The PS 752 Accident Investigation Team hereby would genuinely like to extend their heartfelt condolences and sympathies to those involved in the accident and show great respect for their deep feelings and emotions.
- The times mentioned in this report have been extracted from available information. Considering the update rate of this information and the relative velocity of aircraft and missiles, a 3-second tolerance for reported times should be taken into account.

B. Findings and Factual Information

Based on the investigation conducted and evidence verified so far by the investigation team, the following could be presented.

Such information has been obtained and verified through the independent investigation done by the investigation team up to this stage. Therefore, it is possible that upon obtaining new information at any time, the report will be updated. The investigation team had access to the individuals, evidence, records and information required, and the PS 752 accident investigation team has achieved the following results independently.

1. At approximately 00:30 UTC¹., given the change made in the alertness level of Iran's air defense, the military sector informed the civil sector of the country's Airspace Control that only the flights already detected and cleared for flight operations by the defense network could be permitted to start up. Until then, it was, in fact, the civil sector that had been issuing such flight clearances, taking the operational considerations of Air Traffic Management into account, and providing the flight information to the military sector for Civil-Military Coordination. Making such a procedural change and emphasizing the receiving of the go-ahead from the defense sector prior to initiating the flight was implemented with the aim of more ensuring the correct identification of civil flights by the defense network and avoiding targeting them by mistake.
2. At 02:21:28, the PS 752 Ukraine International Flight requested the ATC² unit to start up the aircraft engines.
3. After contacting the Area Control Center, the ATC unit requested clearance for the Ukrainian flight at 02:22:31.

¹ - The reported times in English version of this factual report are given according to Universal Coordinated Time (UTC).

² - Air Traffic Control

4. At 02:23:48, the Area Control Center forwarded the Ukrainian flight's request to the Air Defense Coordination Center, which subsequently issued the clearance accordingly.
5. At 02:40:20, Ukraine International Flight PS 752 received the takeoff clearance from IKA³ ATC tower.
6. The flight proceeded towards the flight route at the planned altitude and trajectory. (Figure 1)

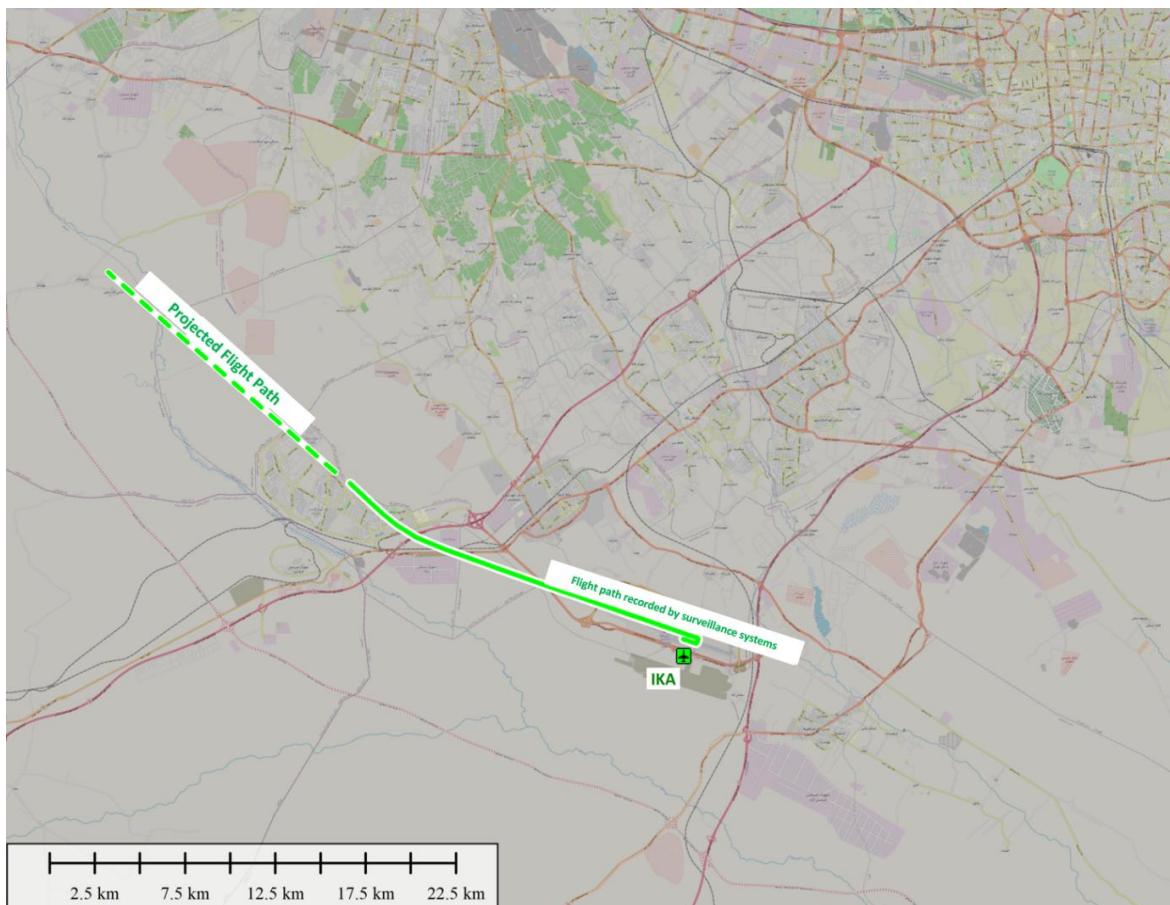


Figure 1- PS752 recorded flight path

7. ⚠⁴ After the relocation of one of the air defense units of Tehran, clearly causing a change in its heading, a failure occurred due to a human error in following the procedure of system north alignment. As a result, a 107-degree error was induced in the system. As such, while the PS752 aircraft was flying, the direction of objects and targets detected by this system was being observed with an increase

³ - Imam Khomeini international Airport

⁴ - Symbol ⚠ indicates that a key event or error is being formed.

of 107 degrees by the operator. Such a functional failure initiated a hazard chain, which, of course, could be controlled providing other planned measures are implemented.

8. At 02:43:56, the air defense unit operator detected a target at his 250-degree azimuth, flying on a 52-degree course. At the same time, after takeoff, the PS 752 had been flying towards the defense system from a 143-degree azimuth. The aircraft was passing a 309-degree course.
9. At 02:44:21, the operator notified the specifications of the detected target to the Coordination Center over the communication network (note paragraph 10 on the communication status). The target was, in fact, the very PS 752 flight departing from IKA, detected by the system as a target approaching Tehran from approximately the southwest. (Figure 2)

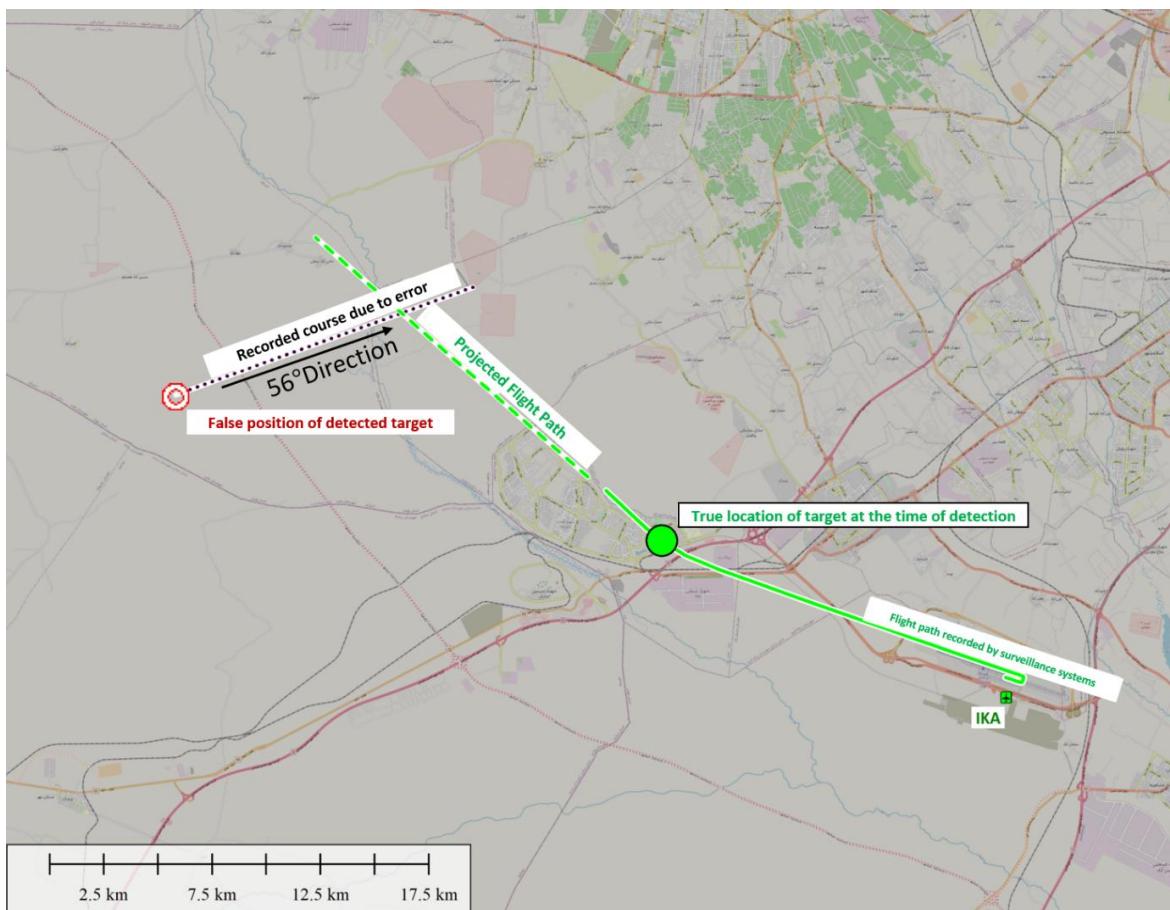


Figure 2- The true location of the aircraft at the time of detection and the false location and course due to north alignment error

Note: Only the true location and direction will hereinafter be stated in this report.

10.  The recorded information indicates that the mentioned defense system's notification was not communicated successfully. Another link in the chain of events was formed at this point.
11.  The system operator began analyzing the observable information and categorized the detected target as a threat. Although the likelihood of identifying the target for a threat was considerably raised due to his lack of awareness of the 107-degree error, yet still if at this point he had identified the target as a passenger aircraft, the missile would not have been launched. The wrong identification is another link in the chain of events.
12.  At 02:44:41, without receiving any response from the Coordination Center, the air defense unit operator fired a missile at the threatening target he had detected. Under the applicable procedures, if the defense system operator cannot establish communication with the Coordination Center and does not receive the fire command, they are not authorized to fire. This measure had been planned as another error prevention layer, which was not implemented either. The fourth link leading to the firing of the missile was now formed.
13. At the time of firing the first missile, the aircraft was flying at a normal altitude and trajectory. The aircraft ATC transponder and ADS-B⁵ signals were received properly.
14. The missile radio fuse was activated when the aircraft had reached the last position recorded by the dependent surveillance systems⁶. The activation occurred at 02:44:59. (Figure 3)

⁵ - Automatic Dependent Surveillance- Broadcast

⁶ - Air traffic surveillance system could be categorized as dependent and non-dependent systems. In dependent systems, the location of targets is defined by cooperation of the target via replies to transmitted radio waves or broadcast of target location. In non-dependent systems, the location is mainly detected by receiving the reflection of transmitted radio waves. Here, after the activation of missile fuse, the airplane signals used by dependent surveillance system was terminated.

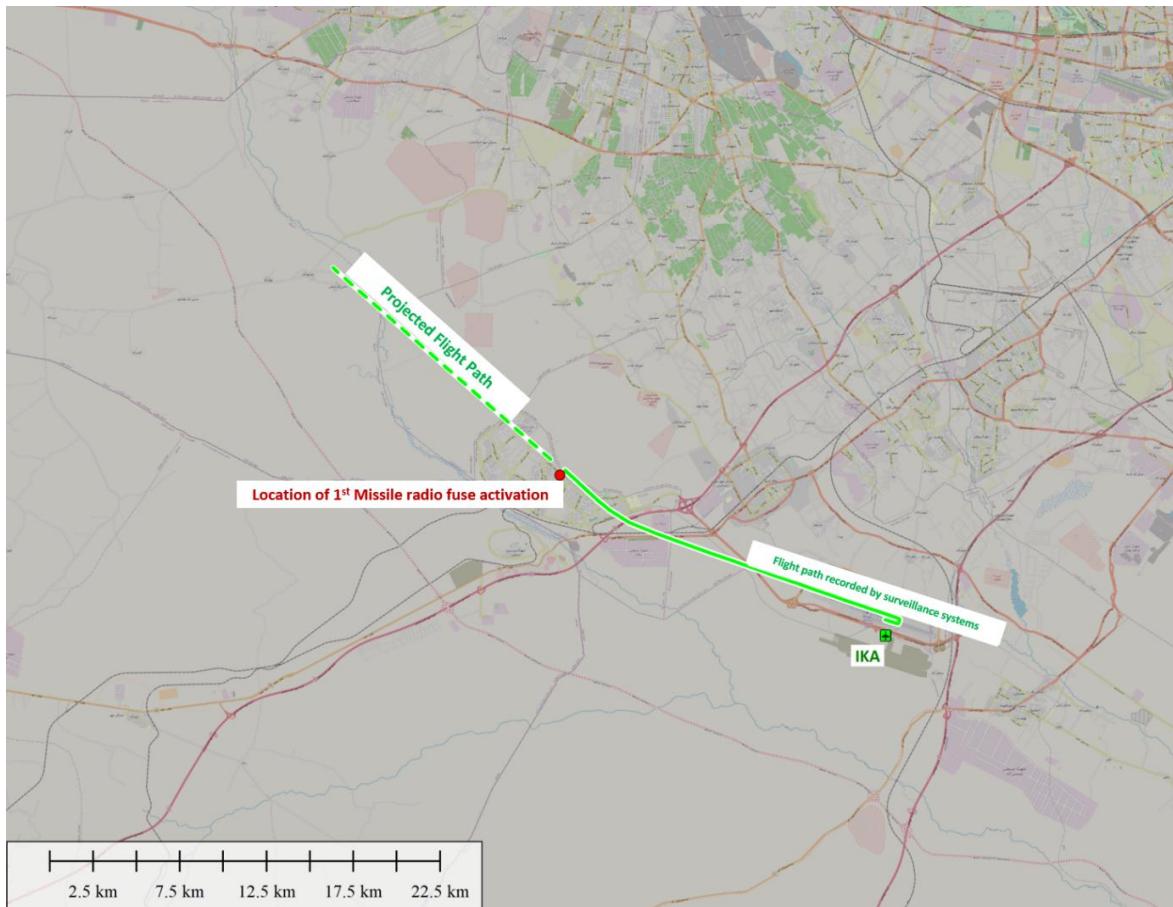


Figure 3-The location of the first missile radio fuse activation

15. At 02:44:58, the last information received from the aircraft included the Secondary Surveillance Radar (SSR) transponder and Automatic Dependent Surveillance-Broadcast (ADS-B), after which the receiving of such signals was terminated. This time corresponds to the first missile radio fuse activation. From then on, the aircraft position was only being recorded by the Primary Surveillance Radar (PSR). (Figure 4)

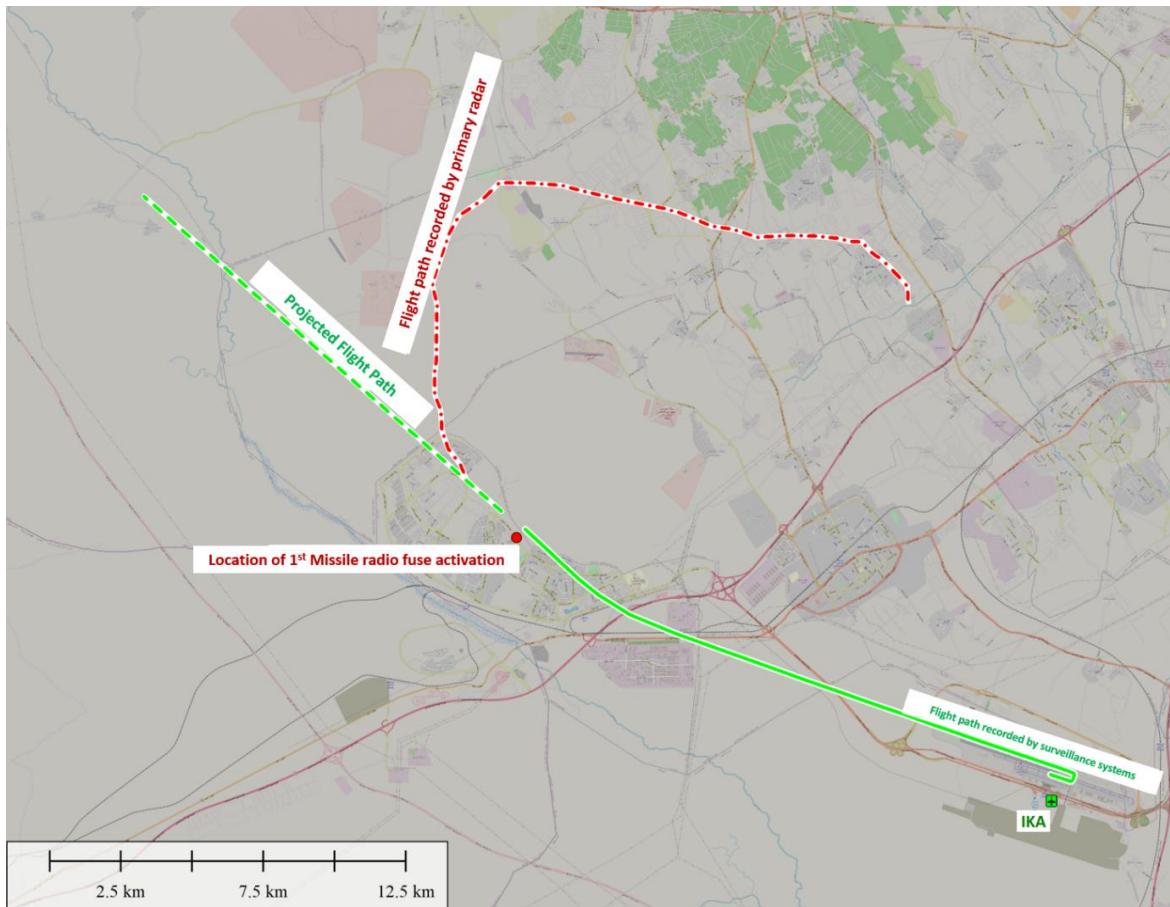


Figure 4- Termination of SSR/ADS-B signal and recording the remainder of the flight path by PSR

16. After the first missile radio fuse was activated, the air defense unit radar still locked on the target, and the defense system kept detecting and tracking it.
17. By observing the continuity of trajectory of detected target, the second missile was fired at the aircraft by the operator of defense system at 02:45:11.
18. At 02:45:24, the last communication between the missile and the defense system was recorded in a place close to the aircraft route. After that, the defense system showed a message indicating the strike had failed, with the aircraft clearing from the radar lock-on after some time. (Figure 5)

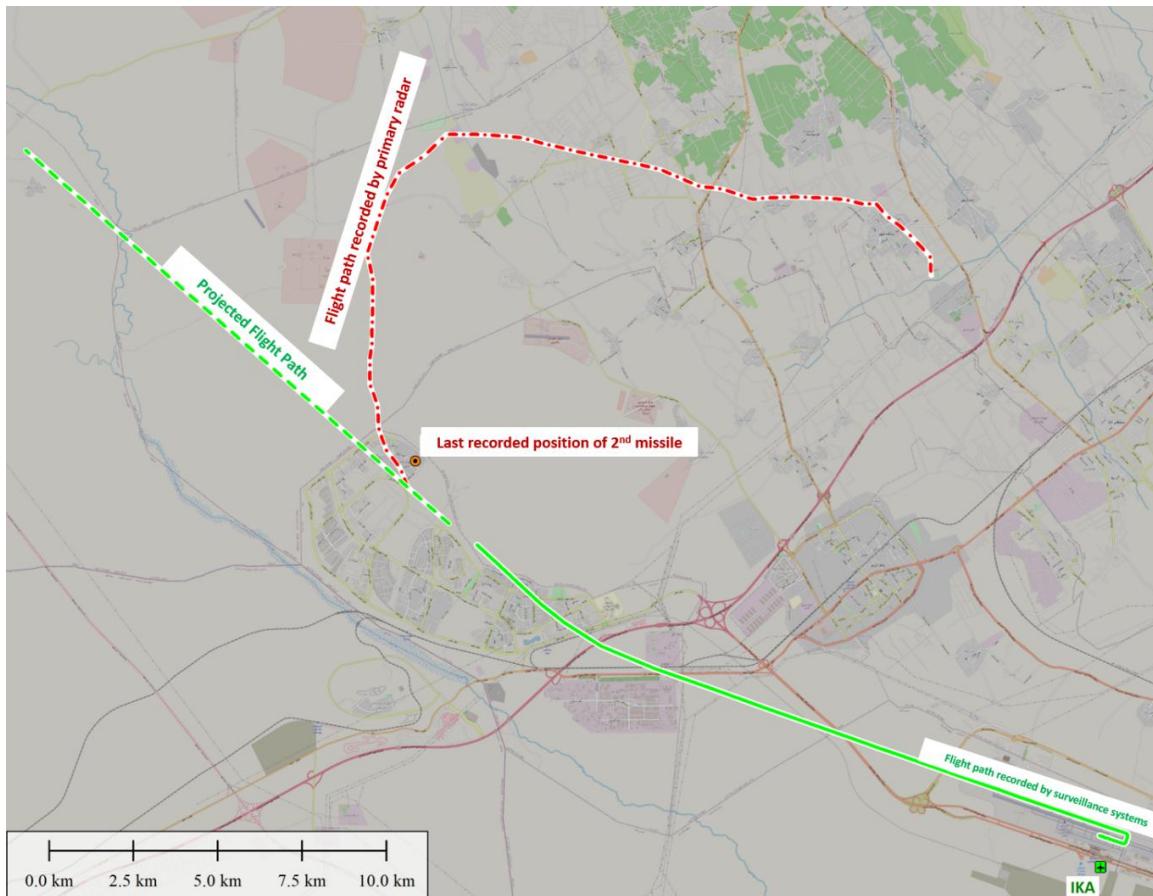


Figure 5- Last position recorded from 2nd missile by air defense unit

19. The aircraft turned to the right, the route of which can be seen in Figure 6. Due to the radio communication disconnection, there is no information on the aircraft altitude during the time when it was being detected by the Primary Surveillance Radar.
20. The evidence shows that at about 02:46:11, a fire broke out on the aircraft, which was intensifying.
21. At 02:48:23, the aircraft crashed into a playground in Khalajabad near Shahedshahr area at the location marked in Figure 6. An explosion occurred the moment the aircraft impacted the ground. The aircraft then kept hitting the ground and bouncing on a route towards the airport, making the aircraft pieces, victims' properties, objects and body remains disintegrate completely in a vast area near a residential complex, recreational and sports park, gardens and the surrounding agricultural land.

A complete overview of the information, as well as the events on the PS752 flight path are depicted in Figure 7.

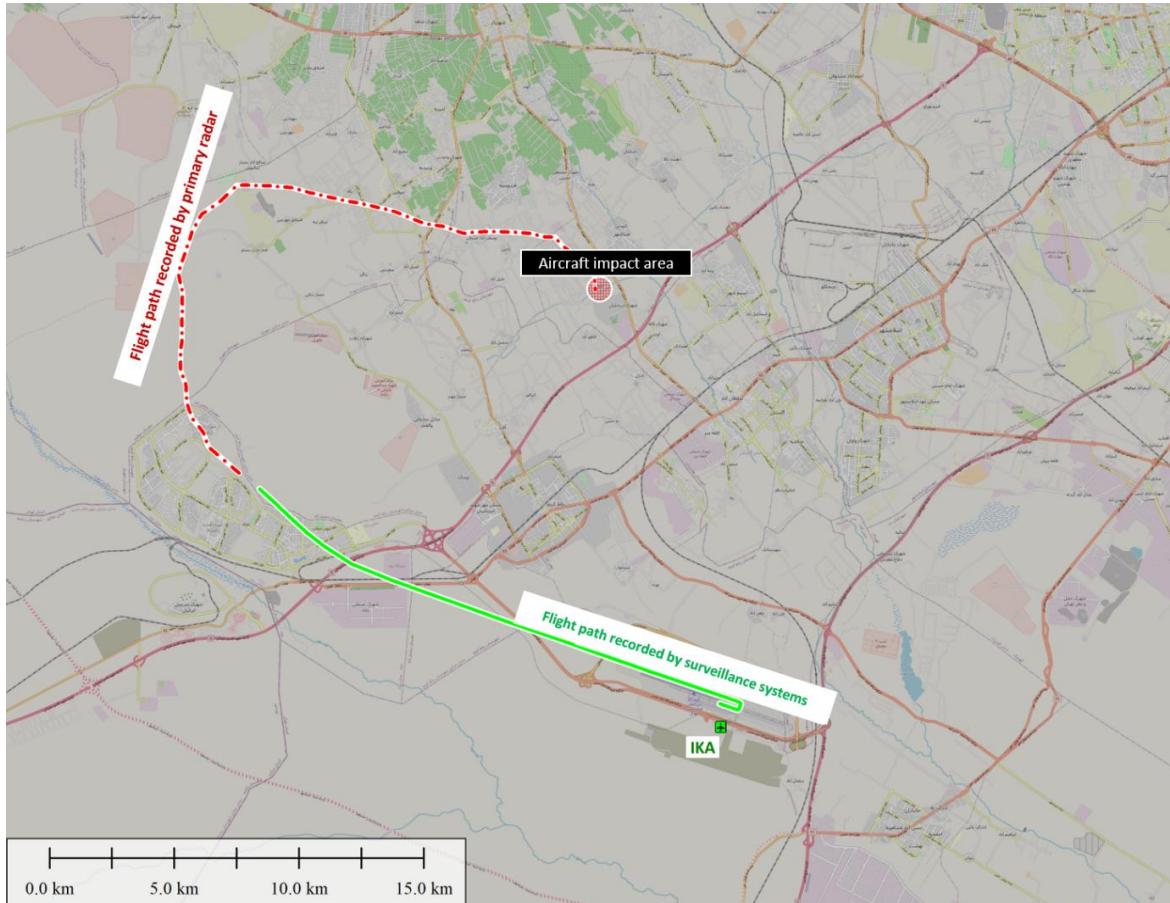


Figure 6- The aircraft impact area

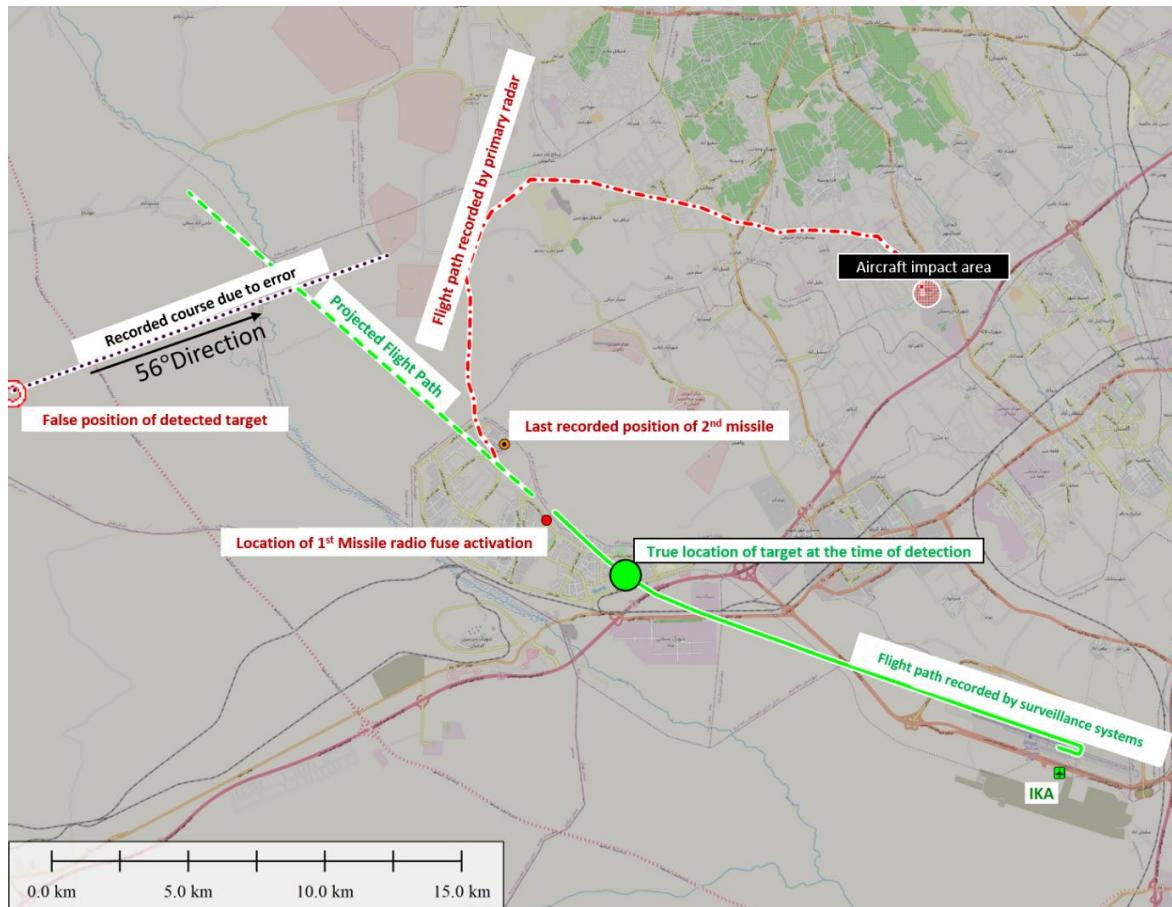


Figure 7- Complete overview of available information about the flight route and key events

22. The aircraft was carrying 176⁷ people on board, nine of whom were the flight crews and the rest passengers. All people on board had already died when the accident site was identified.
23. The effects produced by the explosives on the aircraft fuselage were analyzed, and it was found that they have similarities to the expected ones of the detonation of the defense system warhead.
24. Table 1 is provided regarding the nationality of people on board the aircraft, which is according to the information received from the documents provided while they were purchasing tickets, the documents provided to immigration in IKA border control, and

⁷ One of the passengers on board this aircraft had been pregnant, whose fetus is reported to have been 7 months old. Under the Laws in Iran, the dead fetus is regarded a person; therefore, in judicial investigations, the number of the victims is reported as 177 people.

Two of the passengers who had purchased tickets did not go to the airport, so they were not onboard this aircraft.

the information available in the National Organization for Civil Registration of Iran.

Table 1- Nationality of people on board PS752

	Ukrainian	Afghan	Canadian	German	England	Iranian	Swede	Total
IRAN Civil Registration Authority report	Not Applicable	152	Not Applicable	152				
Travel documents presented at IKA border control	11	10	5	0	0	146	4	176
Travel documents submitted for reservation	11	4	63	3	3	82	10	176

C. Some of the Results and Conclusions

1. When the first missile was fired, the aircraft had been following a normal path. In fact, no condition of PS752 leading to the defense system error has yet been observed. The defense system error arose initially from misalignment of unit north, which was compounded to the extent that led to misidentifying and targeting a commercial aircraft.
2. The activation position of the missile warhead radio fuses as well as the comparison made between these locations and the aircraft path indicate that probably one of the two warheads was able to cause functional damage to the aircraft.
3. Simultaneous with the first warhead radio fuse activation, the aircraft radio signals were terminated, hence the damage to the aircraft by the first missile is most probable. However, since even very unlikely probabilities have the chance to be materialized in aircraft accidents, we need to wait for the end of the investigation for the final conclusion.

D. Other points:

1. The sequence of events clearly shows the occurrence of a chain of events initiated by a human error⁸. Up to this point, some important contributing links in the chain of events have been identified, which have led to targeting the aircraft mistakenly⁹. Figure 8 illustrates the chain of key events identified, that if each had not arisen, the aircraft would not have been targeted. It should be noted that some new links may be found by reading out the flight recorders.

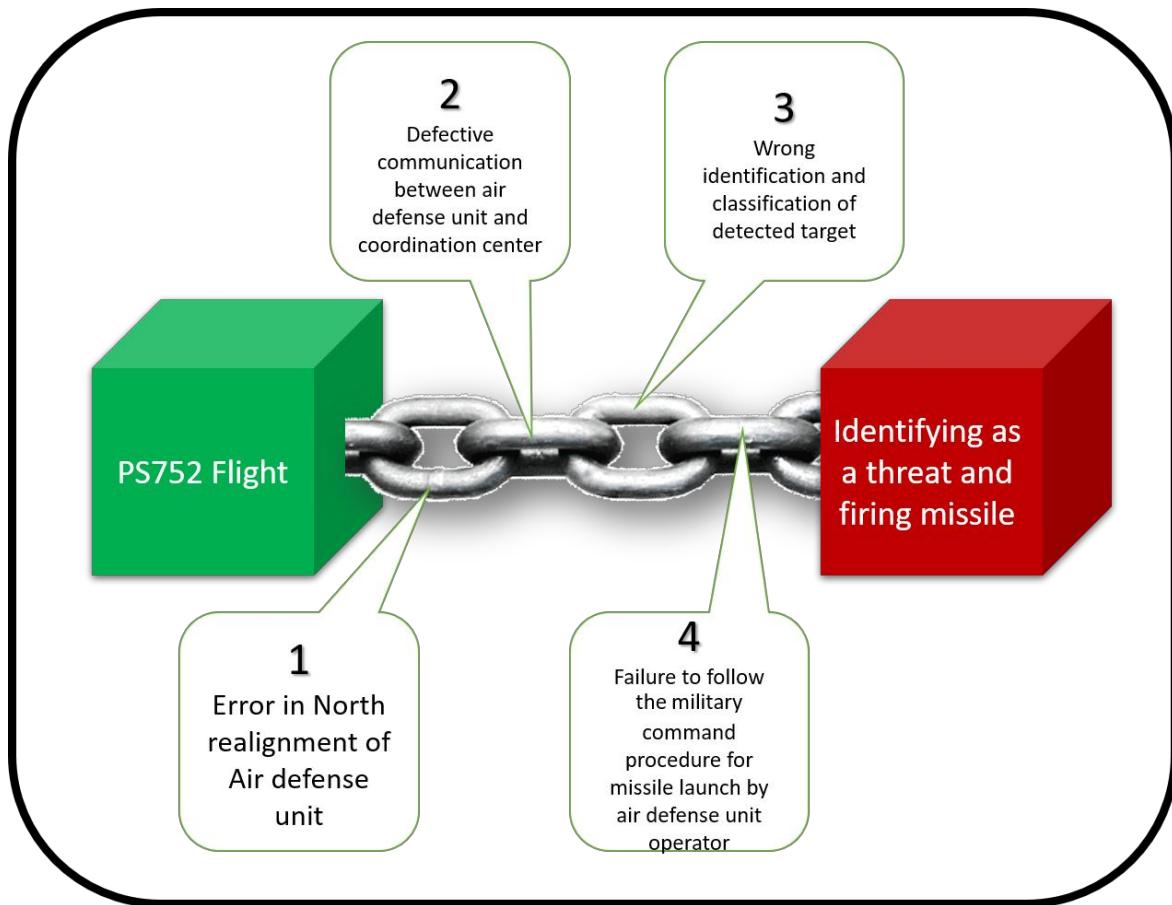


Figure 8- The chain of events leading to targeting the PS752 flight

⁸ -Human error: A human action with unintended consequence.

⁹ - At the time of publishing this report, the measures adopted by Iran's military sector focusing on each one of the links in the accident chain indicate that the likelihood of occurrence of a similar event has been reduced to an improbable level. Therefore, the safety level of airspace for commercial flights from the viewpoint of misidentification is now in normal conditions.



- 2. It should be noted that this report does not entail the final conclusion of the accident investigation. As a matter of fact, the investigation is still in progress.

July 11, 2020

The PS 752 accident Investigator-In-Charge