



Safety recommendation no. 518

Date of the publication	20.03.2017
Number of the final report	2294
Safety deficit	<p>On 3 June 2015, an airprox occurred between a commercial aircraft and a hot-air balloon within the terminal control area (TMA) of Zurich Airport. The commercial aircraft was approaching Zurich Airport using radar vectoring. The hot-air balloon had entered the terminal control area several times without clearance from an air traffic control centre because the balloon pilot was insufficiently aware of the risks he was posing even if only entering into such airspace by a short distance. Because the transponder was switched on, the hot-air balloon was in theory visible to air traffic control. However, the display on the air traffic controllers' monitors was so inconspicuous that the unauthorised entry went unnoticed until the airprox.</p> <p>Similar safety deficits were established as part of the investigations into the following near misses:</p> <ul style="list-style-type: none">– The investigation into a near miss involving a commercial aircraft and a glider in the TMA of Zurich Airport on 11 August 2012 identified the pilot's lack of risk awareness regarding unauthorised entry into class C airspace as the direct cause.– The same near miss revealed the following systemic risks: an airspace structure around Zurich Airport with a low fault tolerance and a limited obligation to use a transponder which makes it harder to detect unauthorised entry into the terminal control area.– The investigation into a near miss between a sport aircraft and a hot-air balloon in the TMA of Bern Airport on 15 September 2012 showed that it was primarily caused by the balloon pilot's lack of awareness regarding the balloon's spatial position relative to the airspace structure.– Another contributing factor to the same near miss was that the pilot was not carrying a transponder and was therefore undetectable by air traffic control. <p>All of these airproxes have the following elements in common: The respective pilots had sufficient knowledge of the airspace structure itself and, using the means available, would have been able to respect the boundaries of the terminal control area or to contact air traffic control to ask for permission to enter, if necessary. However, they were of the opinion that marginal entries into terminal control areas were not a problem, because there were sufficient safety margins. These were incorrect assumptions. Contrary to their beliefs, Swiss airspace is characterised by very small safety margins as – in order to restrict light and sport aviation as little as possible – the distances between areas where aircraft under visual flight rules</p>

(VFR) are allowed to move freely and areas where predominantly large aircraft are guided according to instrument flight rules are reduced as much as possible. To accommodate the needs of light and sport aviation however, the boundaries of airspace must consistently be adhered to, because otherwise considerably dangerous situations can arise instantly. Furthermore, even if airspace users are sufficiently aware and demonstrate great discipline, minor mistakes might still happen occasionally, and because even minor mistakes can have very serious consequences, a system should be sought that provides a certain resilience when mistakes happen. If unauthorised entry into a controlled airspace were detectable by air traffic control at an early stage, corrective action could be taken in good time.

In principle, a number of strategies are available to reduce this safety deficit:

- a. Airspace remains as it is, but the crews' awareness regarding the low tolerance for mistakes is raised, and it is ensured that all aircraft are suitably displayed to the air traffic controllers, by the latest when an aircraft enters the controlled airspace. It should also be ensured that the systems, such as those which are fitted to large aircraft to warn of airproxes and to avoid collisions, can take over their role as the last safety net.
- b. No operational or technical measures for decreasing the collision risk are taken but the airspace in which large aircraft in particular are guided according to instrument flight rules is enlarged to create bigger safety margins. These additional buffer zones must be designed big enough that large aircraft cannot be endangered, even if light aircraft and sport aircraft which cannot be detected by air traffic control make navigational mistakes.

As part of the investigations into the two near misses in 2012, the Swiss Transportation Safety Investigation Board consulted the public concerned as prescribed by law to be able to issue safety recommendations which are broadly supported and easy to implement. The majority of the public that were consulted back then were in favour of a technical-operational solution and the STSB subsequently issued safety recommendation no. 466, which would constitute a relatively easy and inexpensive possibility for improvement: "In cooperation with the supervisory authorities of neighbouring countries, the Federal Office of Civil Aviation should, where appropriate, define airspace surrounding Swiss airports in which only aircraft equipped with a functioning and activated transponder are allowed to fly (transponder mandatory zones – TMZ). These TMZ should include the control areas and terminal control areas and contain vertical or horizontal buffer zones with regard to this airspace." When contacting almost the same public involved as part of the investigation into the serious incident in question which happened around three years after the near misses in 2012, the STSB found out that hardly any concrete measures have yet been taken to decrease the abovementioned risk of collision between large aircraft and light and sport aircraft which mistakenly enter terminal control areas. The public involved blamed each other for the safety deficits still existing and the slow implementation of improvements. The Swiss Transportation Safety Investigation Board refrains from commenting on the actions of the public involved. However, the STSB urgently points out once again that the well-known risks of collision between large aircraft and light and sport aircraft still exist because the complex Swiss airspace is not very forgiving of mistakes and the safety nets of air traffic control and of commercial aircraft can become ineffective as it is not mandatory to carry a transponder. Therefore, the Swiss

Transportation Safety Investigation Board once more recommends, in line with safety recommendation no. 466, introducing transponder mandatory zones to protect control zones and terminal control zones. In line with the different strategies outlined above, which are possible to reduce the current safety deficit and thus support a holistic method of resolution, the STSB issues the two additional safety recommendations below.

Safety recommendation	For the operation of aircraft that can pose a danger to large aircraft, the Federal Office of Civil Aviation (FOCA) should make it obligatory, without exception, for the former to carry an operational and active transponder when flying over Swiss territory. Here, attention should be paid to the greatest possible degree of compatibility with the most commonly used traffic alert and collision avoidance systems. Together with air traffic control, FOCA should define technical and operational general conditions which enable optimum use of this requirement for a transponder for the benefit of air traffic control.
Addressees	BAZL Bundesamt für Zivilluftfahrt; BAZL Bundesamt für Zivilluftfahrt
Stage of the implementation	Not implemented. FOCA initially considered a nationwide obligation for all aircraft which may pose a danger to large aircraft to carry an operational and activated transponder as disproportionate, in particular because large aircraft can operate in all airspace classes and a moderate extension of today's obligation to carry a transponder is already planned as part of the current partial revision of the VRV-L2 revision. However, it was discovered last year that most aircraft are now equipped with a transponder. Therefore, FOCA will organize a review of implementation in 2018. Last year, the GS-DETEC tasked FOCA with redesigning the airspace structure in Switzerland and, with this, its aviation infrastructure, using a clean sheet approach. According to FOCA, this task is being carried out with high priority as part of the AVISTRAT-CH New Airspace and Aviation Infrastructure Strategy programme. FOCA expects the first results in form of a vision for the Swiss airspace and the aviation infrastructure to be available in 2020. FOCA does not want to make a decision on a potential partial implementation of safety recommendation no. 518 until the relevant strategic guidelines are available.
Investigation report concerning the safety recommendation	<u>Schlussbericht</u>



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Safety deficit	On 3 June 2015, an airprox occurred between a commercial aircraft and a hot-air balloon within the terminal control area (TMA) of Zurich Airport. The commercial aircraft was approaching Zurich Airport using radar vectoring. The hot-air balloon had entered the terminal control area several times without clearance from an air traffic control centre because the balloon pilot was insufficiently aware of the risks he was posing even if only entering into such airspace by a short distance. Because the transponder was switched on, the hot-air balloon was in theory visible to air traffic control. However, the display on the air traffic controllers' monitors was so inconspicuous that the unauthorised entry went unnoticed until the airprox.
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Similar safety deficits were established as part of the investigations into the following near misses:

- The investigation into a near miss involving a commercial aircraft and a glider in the TMA of Zurich Airport on 11 August 2012 identified the pilot's lack of risk awareness regarding unauthorised entry into class C airspace as the direct cause.
- The same near miss revealed the following systemic risks: an airspace structure around Zurich Airport with a low fault tolerance and a limited obligation to use a transponder which makes it harder to detect unauthorised entry into the terminal control area.
- The investigation into a near miss between a sport aircraft and a hot-air balloon in the TMA of Bern Airport on 15 September 2012 showed that it was primarily caused by the balloon pilot's lack of awareness regarding the balloon's spatial position relative to the airspace structure.
- Another contributing factor to the same near miss was that the pilot was not carrying a transponder and was therefore undetectable by air traffic control.

All of these airproxes have the following elements in common: The respective pilots had sufficient knowledge of the airspace structure itself and, using the means available, would have been able to respect the boundaries of the terminal control area or to contact air traffic control to ask for permission to enter, if necessary. However, they were of the opinion that marginal entries into terminal control areas were not a problem, because there were sufficient safety margins. These were incorrect assumptions. Contrary to their beliefs, Swiss airspace is characterised by very small safety margins as – in order to restrict light and sport aviation as little as possible – the distances between areas where aircraft under visual flight rules (VFR) are allowed to move freely and areas where predominantly

large aircraft are guided according to instrument flight rules are reduced as much as possible. To accommodate the needs of light and sport aviation however, the boundaries of airspace must consistently be adhered to, because otherwise considerably dangerous situations can arise instantly. Furthermore, even if airspace users are sufficiently aware and demonstrate great discipline, minor mistakes might still happen occasionally, and because even minor mistakes can have very serious consequences, a system should be sought that provides a certain resilience when mistakes happen. If unauthorised entry into a controlled airspace were detectable by air traffic control at an early stage, corrective action could be taken in good time.

In principle, a number of strategies are available to reduce this safety deficit:

- a. Airspace remains as it is, but the crews' awareness regarding the low tolerance for mistakes is raised, and it is ensured that all aircraft are suitably displayed to the air traffic controllers, by the latest when an aircraft enters the controlled airspace. It should also be ensured that the systems, such as those which are fitted to large aircraft to warn of airproxes and to avoid collisions, can take over their role as the last safety net.
- b. No operational or technical measures for decreasing the collision risk are taken but the airspace in which large aircraft in particular are guided according to instrument flight rules is enlarged to create bigger safety margins. These additional buffer zones must be designed big enough that large aircraft cannot be endangered, even if light aircraft and sport aircraft which cannot be detected by air traffic control make navigational mistakes.

As part of the investigations into the two near misses in 2012, the Swiss Transportation Safety Investigation Board consulted the public concerned as prescribed by law to be able to issue safety recommendations which are broadly supported and easy to implement. The majority of the public that were consulted back then were in favour of a technical-operational solution and the STSB subsequently issued safety recommendation no. 466, which would constitute a relatively easy and inexpensive possibility for improvement: "In cooperation with the supervisory authorities of neighbouring countries, the Federal Office of Civil Aviation should, where appropriate, define airspace surrounding Swiss airports in which only aircraft equipped with a functioning and activated transponder are allowed to fly (transponder mandatory zones – TMZ). These TMZ should include the control areas and terminal control areas and contain vertical or horizontal buffer zones with regard to this airspace." When contacting almost the same public involved as part of the investigation into the serious incident in question which happened around three years after the near misses in 2012, the STSB found out that hardly any concrete measures have yet been taken to decrease the abovementioned risk of collision between large aircraft and light and sport aircraft which mistakenly enter terminal control areas. The public involved blamed each other for the safety deficits still existing and the slow implementation of improvements. The Swiss Transportation Safety Investigation Board refrains from commenting on the actions of the public involved. However, the STSB urgently points out once again that the well-known risks of collision between large aircraft and light and sport aircraft still exist because the complex Swiss airspace is not very forgiving of mistakes and the safety nets of air traffic control and of commercial aircraft can become ineffective as it is not mandatory to carry a transponder. Therefore, the Swiss Transportation Safety Investigation Board once more recommends,

in line with safety recommendation no. 466, introducing transponder mandatory zones to protect control zones and terminal control zones. In line with the different strategies outlined above, which are possible to reduce the current safety deficit and thus support a holistic method of resolution, the STSB issues the two additional safety recommendations below.

Safety recommendation	The Federal Office of Civil Aviation should, where appropriate in collaboration with the supervisory authorities from neighbouring countries, specify simply designed and sufficiently large controlled class C and D airspaces in the areas surrounding Swiss airports, in order to prevent light aircraft and sport aircraft which enter this airspace without clearance from posing any danger to large aircraft in the future.
Addressees	BAZL Bundesamt für Zivilluftfahrt; BAZL Bundesamt für Zivilluftfahrt
Stage of the implementation	Not implemented. Last year, the GS-DETEC tasked FOCA with redesigning the airspace structure in Switzerland and, with it, its aviation infrastructure, using a clean sheet approach. According to FOCA, this task is being carried out with high priority as part of the AVISTRAT-CH New Airspace and Aviation Infrastructure Strategy programme. FOCA expects the first results in form of a vision for the Swiss airspace and the aviation infrastructure to be available in 2020. FOCA is of the opinion that the planned programme could in principle address the safety recommendation in question. However, it takes the view that the danger posed to large aircraft can never be completely ruled out. Only when the relevant strategic guidelines are available, FOCA will decide on a partial implementation of the safety recommendation no. 519.
Investigation report concerning the safety recommendation	<u>Schlussbericht</u>



Safety recommendation no. 520

Date of the publication	12.01.2017
Number of the final report	2294
Safety deficit	<p>On 3 June 2015, an airprox occurred between a commercial aircraft and a hot-air balloon within the terminal control area (TMA) of Zurich Airport. The commercial aircraft was approaching Zurich Airport using radar vectoring. The hot-air balloon had entered the terminal control area several times without clearance from an air traffic control centre because the balloon pilot was insufficiently aware of the risks he was posing even if only entering into such airspace by a short distance. Because the transponder was switched on, the hot-air balloon was in theory visible to air traffic control. However, the display on the air traffic controllers' monitors was so inconspicuous that the unauthorised entry went unnoticed until the airprox.</p> <p>The hot-air balloon was visible on the air traffic controllers' monitors in the pale-brown colour typical of uncontrolled VFR flights. Approximately 12 minutes passed between the first unauthorised entry into the TMA and the closest approximation. During this time none of the three air traffic controllers involved noticed the hot-air balloon's unauthorised entries. An automatic warning system for the air traffic controller in the case of an unauthorised entry of a VFR aircraft into a TMA had been suggested at Skyguide in the past. However, to date this has not been put into effect. Taking into consideration that other airspace violations had been investigated, the STSB is convinced that an effective improvement of air safety could be achieved by introducing a warning system of this kind swiftly.</p>
Safety recommendation	<p>The Federal Office of Civil Aviation, together with Skyguide air traffic control, should develop measures to warn air traffic controllers of unauthorised entry into airspace that mainly serves instrument flight rules traffic.</p>
Addressees	BAZL Bundesamt für Zivilluftfahrt
Stage of the implementation	<p>Implemented. Skyguide has developed a new filter function, VFR Display Priority, for its radar systems. This displays to air traffic controllers only those visual flights which could become relevant to a conflict situation in a given airspace. This filter function also includes the new Area Infringement Warning (AIW) system. Visual flights that take place with the transponder switched on and that enter controlled airspace without permission are displayed in red in order to draw the air traffic controller's attention to the airspace violation. The filter function can be switched on or off by the air traffic controller; the AIW cannot. These new features were introduced at Zurich in March 2017 and at Geneva in July 2017.</p>

Investigation report concerning

the safety recommendation

Schlussbericht
