Safety Study
Summary Report for ATSEP inclusion in ICAO Annex 1

Prepared by: International Federation of Air Traffic Safety Electronics Association

September 2025

The full text of the ATSEP SAFETY STUDY for inclusion in ICAO Annex 1 can be found at the links below:

https://www.atsep.eu/ifatsea-safety-study-atsep/

&

https://ifatsea.box.com/s/zxk1taulrx8s7ngb44z4hsdyzsht940r

Overview

Who are ATSEP?

Air Traffic Safety Electronics Personnel (ATSEP) are the technical experts who keep the equipment and systems behind air traffic control running. This includes communications, navigation, and surveillance systems that Air Traffic Safety Electronics Personnel (ATSEP) are the technical specialists responsible for the integrity, availability, continuity, and performance of CNS/ATM systems integral to the safe management of air traffic.

As stated in the study:

"**ATSEP** are responsible for the provision of critical communication, navigation, and surveillance services, which enable safe and performant Air Navigation Services (ANS). High availability, accuracy, continuity, integrity, and resilience of these services are essential factors in aviation safety."

Their role extends to ensuring that the equipment and information used by pilots and Air Traffic Controllers (ATCOs) operate without interruption, particularly for safety-critical functions such as Performance-Based Navigation (PBN) and Low Visibility Operations supported by systems like Instrument Landing Systems (ILS).ts and air traffic controllers rely on for safe flights.

Why are they important?

If these systems fail, the risks of accidents like mid-air collisions or runway incidents increase significantly. ATSEP prevent outages, keep systems reliable, and are the first to respond when something goes wrong. They now also play a frontline role in defending aviation systems against cyberattacks.

What is the problem?

Currently, **ATSEP** are not officially recognized under ICAO's global licensing rules (Annex 1). Some countries license them nationally, but there is no consistent international standard. This lack of recognition means training quality varies, and in some cases, training is reduced due to cost pressures.

On the contrary on the other side of ground CNS managed by ATSEP, aircraft Avionics Engineers of CNS airborne equipment are included In the ICAO Annex 1 for Personnel and currently required to be licensed which consists an oxymoron.

Why ATSEP licensing matters

- A global licensing system would ensure ATSEP everywhere meet the same high standards.
- It would allow ATSEP to work across borders more easily.
- It would improve safety, reduce costly system failures, and strengthen cybersecurity defences.

Economic considerations

Most countries already have ATSEP training programs aligned with ICAO guidance, so adopting a global license would not add any new costs.

In fact, better-trained ATSEP could prevent major system outages that cost airlines, airports, and passengers millions of euros.

What IFATSEA recommends

- ICAO should officially include ATSEP in Annex 1 as licensed professionals.
- Cybersecurity should become a required part of ATSEP training.
- Countries should support this change for a safer, more reliable, and more resilient aviation system.

Role of ATSEP and CNS/ATM System Importance

Air Traffic Safety Electronics Personnel (ATSEP) are responsible for the safe operation, maintenance, and management of CNS/ATM systems — the backbone of air traffic management. They ensure the availability, continuity, accuracy, and integrity of communication, navigation, and surveillance services that underpin safe and efficient aircraft operations.

"Unreliable CNS services lead to various consequences, ranging from flight delays to severe incidents or accidents, increased pilot and controller workload, and high occupational stress."

Failures in these systems have broad impacts, affecting national economies, passenger safety, and the environment through increased fuel burn and emissions caused by inefficient routing.

Discussion

Introduction

ATSEP are a specialized group of aviation professionals tasked with maintaining the functionality, integrity, and safety of ground-based CNS/ATM systems. These systems

form the technological backbone of global air navigation, ensuring safe separation of aircraft, effective Communication with air traffic control, and timely Navigation and Surveillance data.

The purpose of this study is to explore and articulate:

- The increasing safety-critical role of ATSEP
- Gaps in regulatory and operational recognition
- The growing importance of cybersecurity in ATM systems
- The benefits of establishing a global licensing framework

Therefore, as aviation faces rapid change due to digitalization, automation, Cybersecurity and cross-border system integration, the role of ATSEP becomes even more significant.

1. IFATSEA's Advocacy and ICAO Collaboration

IFATSEA has advocated for ATSEP inclusion in ICAO Annex 1 for over two decades. The organization has submitted working papers to several ICAO General Assemblies, supported updates to ICAO Doc 10057, and engaged in technical discussions with member states.

Despite recognition of the importance of ATSEP, action has been delayed due to the fact that there is no Safety Study/evidence of a benefit coming from ATSEP licensing. Although it was decided that such a study be performed by the ANC, this task never came up in their agenda since many years now. IFATSEA has developed this study and submitted it accordingly.

There are also perceived cost concerns. These concerns are also addressed in the ATSEP SAFETY STUDY.

Nonetheless, the global aviation system is at a crossroads, and failing to act may widen the gap in safety assurance as technological complexity increases. Overlooking the technology needs in the midterm may be the elephant in the room and a showstopper for the implementation of new systems enabling higher automation, AI/ML based and above all Cybersecure. IT experts are not allowed to work on CNS/ATM systems, only ATSEP.

IFATSEA has also collaborated with industry experts and regulators to define a competency framework that under the ATSEP Working Position includes:

- System monitoring and fault response
- Cybersecurity protocols

- Emergency procedures
- Technical communication and reporting

2. Safety and Accident Evidence of ATSEP Safety criticality

2.1 Contribution to Accident Scenarios

As stated in the **EU ECORYS NLR** study on safety criticality of the ATSEP Profession, provided according to the **EUROCONTROL Accident Incident Model (AIM)**, **ATSEP** related failures of CNS/ATM equipment can significantly increase accident risks:

- 17% increase in mid-air collision probability
- 15% increase in runway incursion probability
- 10% increase in taxiway collisions
- 17% increase in wake-induced accidents
- Failure of the Ground Proximity Warning barrier, maintained by ATSEP, raises Controlled Flight into Terrain (CFIT) accident risk by a factor of 50.

It is also stated that "regulation of the ATSEP Profession can provide a safety improvement by 15%" [1]

These figures underline the high safety impact of competent ATSEP activity. Modern systems now rely on continuous surveillance, remote monitoring, and automation, all of which demand higher skill and vigilance from technical personnel.

Consideration of ATSEP licensing was also one of the major recommendations following the Accident Investigation report of the Überlingen midair collision.

The NLR accident report recommendation **(Recommendation 7-3)** strongly advocates for consideration of licensing of ATSEP. Licensing was not approved by management based on cost concerns. Effectively a decision of cost over safety.

[1] * source: EU study by ECORYS and NLR

2.2 Examples of notable Accidents with ATSEP Involvement

- **Uberlingen Mid-air collision (2002):** Communication and surveillance failures highlighting system deficiencies.
- **Linate Airport Runway Incursion (2001):** CNS/ATM system and equipment shortcomings caused catastrophic accident.
- **Korean Air Flight 801 (1997):** CFIT caused partially due to failures in CNS equipment monitored by ATSEP.
- **Swanwick ATC Center Failures (2013, Dec. 2014, April 2018, August 2023, July 2025):** Software glitches and system monitoring failures led to major airspace disruptions and flight delays, with economic and safety implications.
- **Switzerland ATC Black out** (in June 2022 due to technical failure)

3. ATC Performance Degradations from CNS/ATM Failures

ATSEP play a key role in preventing or mitigating ATC performance degradations caused by CNS/ATM system failures:

- **ATSEP** conduct **fault detection and rapid response** to system anomalies, including re-configuring or switchover to backup systems during failures reinstating hardware or software failures to nominal operations.
- Coordination with Air Traffic Controllers ensures awareness and mitigation of operational impacts during outages.
- Emergency maintenance teams are deployed during peak air traffic periods to handle urgent technical issues, minimizing safety risks and operational **delays**.

3.1 ATSEP Responsibilities on CNS/ATM Cybersecurity

ATSEP are the first responders to any Cyber-attack. In fact, they are required 24/7 and on real-time operating CNS/ATM systems to identify whether any anomaly or disruption in the nominal operation is due to a technical failure or a cybersecurity attack. No other profession is mandated and responsible to perform these duties. As

Automation, SWIM and networking architectures and AI/ML are coming in the picture, the cyber risks increase both over networks but also in Signal in space (spoofing and jamming).

As cyber threats increase, ATSEP are now expected to:

- Monitor CNS/ATM system applications cybersecurity status
- Detect and isolate cyber intrusions and address them while maintaining CNS/ATM systems integrity.
- Respond to events in real-time without disrupting operational continuity, thus maintaining Total ANS Performance

The dual challenge of ensuring safety and cybersecurity requires a new framework for professional development and recognition. IFATSEA has submitted many Working Papers to ICAO on addressing Cybersecurity issues in ANSPs.

3.2 Cybersecurity and Emerging Threats

As CNS/ATM systems evolve into interconnected and digital architectures, cybersecurity risks grow:

- ATSEP functions now include cyber event response, distinguishing technical faults from cyber-attacks and mitigating risks promptly.
- Growing use of remote towers, virtual ATC Centers and centralized service architectures increases cyber vulnerability.
- Cybersecurity incidents can cause safety-critical losses or degrade ATC system availability affecting overall aviation safety.

3.2 Examples of Outages and economic Impact

- **Swanwick ATC Voice Communication System failures (2013, 2014):** Software errors caused rerouting and cancellation of flights, disrupting airspace capacity and generating safety concerns.

- **Power Supply Failures (Belgocontrol 2015, ACC Zagreb 2014):** Water damage and power inconsistencies led to complete shutdown of ATC systems, affecting hundreds of flights and requiring neighbor ACC interventions.
- **Multiple Global Failures (2010-2024):** Numerous software, radar, power, and communication failures globally have caused flight delays, cancellations, and degraded ATC performance. Some notable outages:
  - FAA NOTAM system failure (2022)
  - Austrian and Dutch system outages causing extended delays
  - Radar outages in Europe and Asia (Phillipines)
  - Cybersecurity incidents affecting frequencies and data integrity

Impact includes increased controller workload, degraded separation assurance, risk of safety-critical incidents, and major economic costs estimated in the hundreds of millions of euros.

4. Professional Challenges for ATSEP

Several operational challenges influenced by the increasing complexity of CNS/ATM systems include:

- The growing need for cybersecurity awareness as ATSEP are first responders against cyber threats in ATM networks.
- Limited staffing levels and budget constraints reduce the capacity to maintain and upgrade systems effectively.
- Increasing system automation requires higher technical competency, leading to needs for continual training and certification.
- The physical and cognitive demands of managing faults and outages during peak traffic create stress and fatigue risks that may impact performance and safety.
- The introduction of Automation and AI/ML will require a higher scientific profile background for ATSEP entry qualifications. The demanding job profile of ATSEP is currently not attractive to new engineers who can find more rewarding jobs in other non-safety critical industries.

5. Regulatory and Training Framework

Currently, ICAO Annex 1 does not formally include ATSEP, despite the existence of ICAO Doc 10057, which outlines training guidance.

ICAO Doc 10057 provides guidelines for competency-based training and assessment, including cybersecurity aspects, **but is not yet a regulatory requirement globally**.

A higher level of ATSEP Training is required for all ANSPs by regulation in Europe (EU 377/2017). EASA and EC regulations (EU 2018/1139, EU 2017/373) recognize the safety-critical nature of ATSEP and mandate rigorous training and qualification programs in EU states.

Some countries have national regulations in place, but the lack of international alignment creates disparities and undermines safety in the global Total aviation system.

However, the rigor and depth of ATSEP Training globally, is very often subject to cuts due to cost as they **are not mandated by ICAO**. This issue has been identified by IFATSEA and concerns raised accordingly.

Training Modernization

ICAO Doc 10057 and EU 373/2017 provide foundational guidance, but updates are needed to:

- Expedite to proactively include cybersecurity as a mandatory competency with updated tasks (PTLP)
- Integrate risk-based thinking
- Software Safety Assurance
- AI/ML principles to be able to identify AI/ML hybrid algorithms failure modes
- Emphasize cross-domain coordination (e.g., with CERTs and infrastructure operators)

Systemic Integration

ATSEP must now collaborate with air traffic controllers, pilots, engineers, and cybersecurity specialists in order to address new failure modes due to virtualization. Their training and professional standards must also reflect this interdisciplinary context.

6. Economic and Environmental Impact

CNS/ATM system outages and degradations:

- Increase operating costs through delays, cancellations, and reroutes causing excess fuel consumption and CO2 emissions.
- Result in loss of passenger confidence and airline revenue, estimated in hundreds of millions annually in some regions.
- Enhance the necessity for investment in ATSEP training, system redundancy, and proactive fault management to improve system resilience and operational efficiency.

Operational disruptions linked to ATSEP related failures carry heavy financial and reputational costs:

The 2014 Swanwick ACC incident caused cancellations affecting 230,000 passengers, exemplifying the economic scale of system failures.

Improved licensing and workforce mobility through harmonized ATSEP regulation would help attract and retain qualified personnel, enhancing operational reliability and reducing cost impacts on airlines and passengers.

7.1 Economic Feasibility

Introducing a global licensing framework **will not impose major new costs.**

Most countries already have ATSEP ICAO 10057 aligned training, certification, and oversight systems in place. Aligning these under a standardized ICAO framework would reduce duplication and enhance interoperability.

Conversely, incidents caused by preventable technical or cyber failures can result in significant financial loss, delays, and safety and security breaches. Moreover **IFATSEA** has identified that there is a very large number of CNS/ATM systems outages. Over 50 major outages have occurred globally. Poor training and lack of ATSEP may have contributed. Thus, the economic and operational benefit from having well trained ATSEP can save millions as an example a recent ATM failure in Europe it was in the range of 200 million Euros as mentioned in the press.

7.2 Operational Benefits

ATSEP licensing would:

- Establish clear global professional standards
- Enable international mobility of ATSEP personnel
- Reinforce quality assurance and accountability in technical service delivery chain
- The aviation system would benefit from harmonized practices and mutual recognition of qualifications, especially in the context of cross-border service provision. Maintaining the Continuity and Availability of CNS/ATM systems minimizes disruptions due to technical degradations and thus saving costs and maintaining Performance.

Moreover, a globally licensed ATSEP workforce would support:

- **Safety:** Reduced operational incidents and human error
- **Interoperability:** Cross-border alignment of ATM systems
- **Resilience:** Strengthened system integrity and threat response
- **Sustainability:** Lower economic and environmental cost through reduced disruptions

ICAO is uniquely positioned to lead this effort through Annex 1 amendment, supported by updates to Doc 10057 and collaboration with regional and national authorities.

8. Conclusion and Recommendations

The study concludes that formal inclusion of ATSEP in ICAO Annex 1 is:

- Justified by safety data and operational realities
- Provides operational, economic, performance and technical benefits
- Necessary to address the growing complexity of digital aviation
- Economically viable and strategically sound

IFATSEA invites the ICAO ANC to evaluate the information presented in this study and consider it as basis for discussions to lead to a decision to proceed with the initiation of inclusion of ATSEP in ICAO Annex 1, pending for over a decade.

The way Forward

- Immediate global standardization and adoption of ATSEP licensing with ICAO Annex 1 amendment. CAO should initiate an Annex 1 amendment process to include ATSEP while noting that it takes over 5 years for the procedure to be concluded (i.e., by 2030 the earliest)
- ICAO Doc 10057 should be updated expeditiously to reflect recent new cybersecurity competencies (in PTLP)
- States and industry stakeholders should be invited to support harmonized implementation
- Development and enforcement of **Key Performance Indicators (KPIs)** linking CNS/ATM outages with ATC performance metrics to quantify and mitigate impacts effectively.
- Increased investment in **ATSEP** workforce development, cybersecurity training, and fatigue management programs.
- Strengthened international cooperation to harmonize regulatory frameworks addressing software dependence and cyber risks in ATM systems.
- The global aviation system stands to gain significantly from this recognition — in Safety, in Resilience, Performance, in Professionalism, and in some respects in Cost reduction.

ICAO should initiate an **Annex 1** amendment process to include **ATSEP** professionals while noting that **it takes over 5 years for the procedure to be concluded (i.e., by 2030 the earliest)**

The global aviation system stands to gain significantly from this recognition in safety, in resilience, Performance, cost reduction and in professionalism.

-THE END-

References:

1. International Federation of Air Traffic Safety Electronics Associations (IFATSEA), *ATSEP Safety Study*, 2024. (https://www.atsep.eu/ifatsea-safety-study-atsep/ & https://ifatsea.box.com/s/zxk1taulrx8s7ngb44z4hsdyzsht940r)

1. ECORYS and NLR, *Study on safety-critical functions and ATSEP roles in ATM*, 2013. (ECORYS STUDY ON SAFETY CRITICAL JOBS Highlights by Theo.pdf | Powered by Box)

2. ICAO Doc 10057, *ATSEP Competency-Based Training and Assessment Manual*, 2023 update.(ICAO Doc 10057 Manual on Air Traffic Safety Electronics en.pdf | Powered by Box)

3. EASA Regulation (EU) 2018/1139 and Implementing Regulation (EU) 2017/373.(OJ:L_202302117:EN:TXT.pdf) (CELEX:32014R0373:EN:TXT.pdf)

4. EUROCONTROL Accident Incident Model (AIM), 2022.(eurocontrol-guidance-applying-e-src-ed1-1.pdf)

5. Accident and Outage Reports for ATS facilities (Swanwick 2013/2014, ACC Zagreb 2014, Belgocontrol 2015, FAA NOTAM system 2022).

6. Cybersecurity and ATM Risk Management Reports, SESAR JU, 2024.