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SKYINSPECT360: ADVANCING RUNWAY INSPECTION TECHNOLOGIES FOR ENHANCED SAFETY AND EFFICIENCY

(Presented by India)

EXECUTIVE SUMMARY

The aviation industry's commitment to safety necessitates continuous improvement in runway inspection methodologies. The SkyInspect360 initiative proposes the integration of advanced technologies—such as drones, robotics, artificial intelligence (AI) and advanced imaging systems—into runway inspection processes. This initiative aims to standardize and modernize inspection practices, enhancing safety, efficiency and operational reliability across global airports.

<i>Strategic Objectives:</i>	This working paper relates to <i>Every Flight is Safe and Secure</i> .
<i>Financial implications:</i>	The activities referred to in this paper will be undertaken subject to the resources available in the 2025–2027 Regular Programme Budget and/or from extrabudgetary contributions.
<i>References:</i>	Annex 14 — <i>Aerodromes</i> Doc 9981, <i>Procedures for Air Navigation Services (PANS) — Aerodromes</i> Doc 9870, <i>Manual on the Prevention of Runway Incursions</i> Doc 9157, <i>Aerodrome Design Manual</i> Circ 355, <i>Assessment, Measurement and Reporting of Runway Surface Conditions</i>

1. INTRODUCTION

1.1 Runway integrity is paramount for aviation safety. Traditional manual inspection methods, while effective, are time-consuming and may pose safety risks to personnel.

1.2 Runway excursions remain a leading aviation safety concern, responsible for nearly 22 per cent of all aviation accidents worldwide. Alarming, 2024 has already seen 20 Airliner runway excursion accidents — with associated costs exceeding \$ 900 million annually.

1.3 In alignment with the vision of the current Global Aviation Safety Plan (GASP) — which aims to achieve and maintain the aspirational goal of zero fatalities in commercial operations by 2030 and beyond. Leveraging technological innovations such as automated surface condition monitoring, artificial intelligence (AI)-powered anomaly detection and real-time data analytics can significantly improve runway safety, minimize operational disruptions and support global efforts toward safer skies.

1.4 To address these challenges, there is a growing need for initiative to transform runway inspection processes through the integration of advanced technologies. By adopting solutions such as high-resolution imaging, sensor-based monitoring, AI-powered anomaly detection and unmanned inspection systems, airports can significantly enhance the accuracy, efficiency and safety of runway assessments.

2. DISCUSSION

2.1 Existing runway inspection technologies and methods

2.1.1 Airports currently employ a variety of technologies and methods for runway inspections, including:

- a) *Manual inspections*: Personnel conduct visual assessments to identify surface damage, debris, and lighting issues. While effective, this method is labor-intensive and may not detect all anomalies.
- b) *Vehicle-based inspections*: Specialized vehicles equipped with sensors traverse Runways to detect surface irregularities and contaminants. This approach improves efficiency but may still disrupt Airport operations.
- c) *Drone inspections*: Unmanned aerial vehicles (UAVs) equipped with high-resolution cameras and sensors capture detailed Runway imagery, enabling rapid identification of surface defects and foreign object debris (FOD). Few airports globally utilizes drones for large-scale Runway inspections, demonstrating their effectiveness in operational settings.
- d) *Robotic systems*: Autonomous robots can are designed to navigate and inspect runway surfaces for runway inspections by detecting issues through advanced sensors.
- e) *Artificial intelligence (AI) and machine learning*: AI-powered systems analyze data from various sensors to predict Runway conditions and identify potential hazards.

2.2 **Challenges in current runway inspection practices**

2.2.1 Despite technological advancements, several challenges persist:

- a) *Operational disruptions*: Traditional inspection methods often require runway closures, affecting airport operations and efficiency.
- b) *Safety risks*: Manual inspections expose personnel to active airside environments, posing potential safety hazards.
- c) *Detection limitations*: Human inspections may overlook subtle defects or FOD, compromising runway safety.
- d) *Data management*: Inconsistent data collection and reporting standards hinder effective analysis and decision-making.

2.3 **The need for adopting new technologies**

2.3.1 Integrating advanced technologies into runway inspections offers several benefits:

- a) *Enhanced safety*: Remote and autonomous inspection methods reduce the need for personnel on active runways, minimizing safety risks.
- b) *Increased efficiency*: Technologies like drones and robotics enable rapid inspections with minimal disruption to airport operations.
- c) *Improved accuracy*: High-resolution imaging and AI analytics facilitate precise detection of surface defects and FOD, leading to timely maintenance actions.
- d) *Standardization*: Adopting uniform technologies and data protocols ensures consistent inspection quality and facilitates data sharing among stakeholders.

2.4 **Proposed framework**

2.4.1 The initiative to modernize and standardize runway inspection technologies under the project name SkyInspect360 initiative with the following framework:

- a) *Technology assessment*: Evaluate current and emerging inspection technologies to identify best practices and suitable solutions for various airport contexts.
- b) *Standardized protocols*: Develop uniform procedures for deploying technologies like drones, robotics, and AI in runway inspections, ensuring compliance with safety and regulatory standards.
- c) *Training and certification*: Implement training programs for airport personnel to effectively operate new technologies and interpret data outputs.
- d) *Data management systems*: Establish centralized platforms for collecting, analyzing, and sharing inspection data, enhancing collaboration and decision-making.

- e) *Pilot Programs*: Initiate pilot projects at select airports to validate the effectiveness of integrated technologies and refine implementation strategies.

3. **CONCLUSION**

3.1 The SkyInspect360 initiative aims to modernize Runway inspection processes by embracing advanced technologies, thereby enhancing safety, efficiency and operational reliability. By adopting this standardized framework, Member States can ensure consistent and effective Runway maintenance practices, contributing to the overall safety and efficiency of global aviation operations.

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