WORLD BANK GROUP

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# Environmental, Health, and Safety Guidelines

# AIRPORTS

2026

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## CONTENTS

# 1 INTRODUCTION

1. The Environmental, Health, and Safety Guidelines (EHS Guidelines) are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).[1] They are comprised of the General Environmental, Health, and Safety Guidelines (General EHS Guidelines) and Industry-specific Sector Guidelines (Industry Sector EHS Guidelines). The General EHS Guidelines present common environmental, health, and safety (EHS) issues that potentially apply across industry sectors. The Industry Sector EHS Guidelines present EHS issues specific to each industry sector.

2. When one or more members of the World Bank Group are involved in a project, these EHS Guidelines are applied as described in their respective policies and standards. The Industry Sector EHS Guidelines are designed to be used together with the General EHS Guidelines. For complex projects, multiple Industry Sector EHS Guidelines may be relevant. A complete list of Industry Sector EHS Guidelines can be found at www.ifc.org/ehsguidelines.

3. The EHS Guidelines specify the performance levels and measures that are generally considered to be GIIP and achievable in new facilities by using existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve establishing site-specific targets, with an appropriate timetable for achieving them.

4. The applicability of EHS Guidelines should be tailored to the hazards and risks identified for each project based on results of an impact assessment that considers site-specific variables, such as host country context, assimilative capacity of the environment, and other project-specific factors. The applicability of specific technical recommendations should follow GIIP and be based on the professional opinion of qualified and experienced professionals. When a host country's regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent measures than those in the EHS Guidelines are appropriate due to specific project circumstances, a detailed justification for any proposed alternatives is needed as part of the site-specific assessment and should demonstrate that the alternate performance levels are protective of human health and the environment.

5. The scope of the EHS Guidelines includes environmental, occupational health and safety, and community health and safety aspects. Guidance on social aspects is not included and can be found in relevant Guidance Notes to IFC/MIGA Performance Standards, relevant Guidance Notes to World Bank E&S Standards, and various other World Bank Group good practice publications.

[1] GIIP is defined as the professional skill, diligence, prudence, and foresight that would be reasonably expected from skilled and experienced professionals engaged in the same type of undertaking under the same or similar circumstances globally. The circumstances that skilled and experienced professionals may find when evaluating the range of prevention and control techniques available to a project may include, but are not limited to, varying levels of EHS capabilities and capacities, and financial and technical feasibility.

## 2 APPLICABILITY

6. The EHS Guidelines for Airports cover the planning, construction, expansion, operation, maintenance, and refurbishment of commercial airport facilities, including activities associated with approach, landing, taxiing, take-off, ground operations, and the airport terminal and ancillary facilities. Annex A: General Description of Industry provides a summary of industry activities.

7. Given the interface between airport and airline operations, these guidelines should be read alongside the EHS Guidelines for Airlines, which cover aircraft-related activities during flight, crew operations, and maintenance.[2]

## 3 DESIGN CONSIDERATIONS

8. This section summarizes key EHS aspects related to project siting, design, and engineering for greenfield airports and airport expansions or refurbishments. Design considerations for buildings and ancillary facilities that are common to various industry sectors are detailed in the General EHS Guidelines.

9. Airports are typically composed of two areas:

- Airside: the portion of a terminal restricted to ticketed passengers, ground personnel, and crew, including runways, taxiways, aprons, ramps, and air traffic control (ATC) facilities
- Landside: the portion of a terminal open to the public as well as airline ground staff and security, immigration, and customs personnel; and may include ancillary facilities such as hotels, restaurants, stores, light rail, high-speed trains, and radars[3]

### 3.1 Siting

10. Site selection for new airports or expansions, including ancillary facilities located outside airport boundaries (e.g., radars), should consider current and future conditions, besides general siting aspects, including the following:

- Land use and zoning, including compatibility with surrounding development and the need for airport safeguarding measures[4]
- Population density and growth trends, including planned urban expansion, and nearby noise-sensitive receptors[5]
- Obstacle limitation surfaces (OLS) and airspace protection requirements, including existing or planned vertical structures (e.g., buildings, towers, wind turbines, cranes) that may pose aviation safety risks
- Nearby infrastructure, including roads, railways, energy facilities that may contribute to cumulative impacts (e.g., noise)

[2] Depending on the airport operational model, the entity(ies) responsible for airside activities may vary, with responsibilities falling under the airport operator, airlines, ground handlers, air traffic control agencies, regulatory agencies, or other third parties.
[3] Radars may be outside of the fence but operated by the airport.
[4] For example, in certain jurisdictions, sanitary protection zones are established around airports to restrict new residential development. Zoning is also often used to establish acceptable noise levels (e.g., industrial zones vs. residential zones).
[5] Sensitive receptors are determined in the impact assessment and may include schools, hospitals, elderly homes, places of worship, and vulnerable residences.

- Sensitive areas, which should be avoided, including wetlands, waterbodies, fishponds, landfills, dumpsites or other land uses that may attract wildlife, especially birds, that may collide with aircraft turbines and cause accidents
- Emergency access and response, including siting that allows timely access for fire, rescue, and medical services
- Phased development and expansion potential to minimize safety, environmental, and operational risks associated with construction activities adjacent to active airport operations
- Acute and chronic climate hazards such as flooding, extreme temperatures, storms, sea-level rise, changes in wind pattern, and water stress, in relation to the facility's vulnerability and exposure to climate-related risks

## 3.2 Design

11. Airport facilities should be planned and designed to minimize safety risks to passengers, workers, communities, and the environment and adhere to international, national, and local safety standards and codes.[6] Early integration of EHS considerations into airport master planning and design can reduce long-term operational risks and the need for costly retrofits.
12. Design decisions affecting operational safety should be informed by hazard identification and risk assessment processes consistent with the airport's safety management framework. Airport facilities should be designed to support life and fire safety, including adequate means of egress, fire compartmentation, smoke control, aircraft guiding signs and lighting, and access for emergency and rescue services, consistent with applicable aviation, building, and fire safety standards (see Section 4.3.3).
13. Design should consider the siting and separation of fuel storage, fuelling areas, and maintenance facilities to reduce fire and explosion risks to passengers, workers, and critical infrastructure. Fuel Safety Zones (FSZ) should be planned and designed in consideration of the types of fuels used and stored at the airport (e.g., Jet A-1 fuel, Sustainable Aviation Fuels (SAF), liquid hydrogen storage, battery energy storage systems (BESS)), the hazard risk assessment, and internationally accepted codes.[7]
14. Noise and vibration impacts should be addressed early in the design process. Runway location and orientation (arrival/departure), flight paths, and airside layouts should aim to minimize noise exposure to surrounding communities. Preliminary noise assessments should be undertaken during early planning and refined through detailed studies as the design progresses, in coordination with land-use planning and zoning measures (see Section 5.1.3).
15. Airport buildings and infrastructure should be designed to promote resource efficiency and reduce greenhouse gas emissions during operation, while maintaining operational safety and reliability. This may include energy-efficient building envelopes and systems, passive design measures such as daylighting and natural ventilation where appropriate, and integration of low-emission

[6] ICAO, *Doc 9184 Part I Master Planning*; ICAO, *Doc 9157 Aerodrome Design*; FAA, *Standard Specifications for Construction*; IATA, *World Class Airports;* IATA, *Airport Development Reference Manual*. These are internationally recognized reference materials for the design and construction of airports. ICAO is a UN agency that provides technical guidance through the development of policies and standards and assists member countries to cooperate and share their skies.
[7] Airport Compatibility of Alternative Aviation Fuels Task Force, *Battery and Hydrogen-powered Aircraft.*

technologies that do not interfere with aviation operations. Energy and building performance standards may be used to benchmark design performance.[8]

16. Design of the airport facilities, and in particular of the passenger terminal building, should incorporate universal access and worker welfare considerations. Passenger and worker facilities should provide barrier-free access, clear wayfinding, accessible restrooms, seating, service counters, escalators and lifts as well as worker welfare facilities such as changing rooms, rest and eating areas, and prayer or reflection spaces for terminal and ground personnel.[9]

17. Surface water management features, such as detention ponds and drainage systems, should be designed to manage stormwater while minimizing safety risks and reducing wildlife attraction. Detention systems should drain efficiently between storm events with a retention period of less than 48 hours. Where large stormwater detention ponds are required, they should be designed to minimize risks to communities and wildlife (e.g., drowning hazards, attracting birds). Vegetation and buffer areas should be maintained in a way that does not attract wildlife, thereby reducing wildlife strike risks.[10] Greywater systems should be considered in the design and planning of new airport developments.

18. Changes to the design, layout, equipment, new fuel sources, or operational activities should be assessed using a Management of Change (MOC) procedure. The MOC should provide a systematic assessment of proposed planning and design changes, evaluating potential risks and facilitating the integration of new components with existing infrastructure and legacy environmental issues, such as soil contamination. Details on MOC can be found in the General EHS Guidelines.

## 4 CONSTRUCTION AND OPERATIONAL CONSIDERATIONS

19. This section provides a summary of sector-specific EHS risks typically associated with the construction and operational phases and provides guidance for mitigation and management measures. Where there are unique aspects to the construction, refurbishment, and decommissioning of this industry sector, guidance is also included. Recommendations for EHS issues and management common to the construction, refurbishment, and decommissioning phases of various sectors are provided in the General EHS Guidelines.

### 4.1 Environment

20. Key environmental issues for this industry sector include the following:

- Energy efficiency
- Air and greenhouse gas (GHG) emissions
- Climate resilience and adaptation

[8] ICAO, *Greenhouse Gas Management*; ISO, *50001:2018;* ISO, *52000-1:2017—Part 1;* ISO, *52000-2:2017*; IEC, *Low-voltage Electrical Installations.*
[9] ICAO, *Transport Persons with Disabilities.*
[10] ICAO, *Water Management at Airports.*

- Noise and vibration
- Waste management
- Hazardous materials management
- Water management
- Biodiversity management
- Lighting

### 4.1.1 Energy Efficiency

21. Airports are energy-intensive due to continuous operations, high passenger volumes, and diverse airside and landside activities. Key energy uses include the following:

    - Airside: runway and airfield lighting; aircraft auxiliary power units (APU) and ground energy systems (AGES); ground support equipment and vehicles (used by airport operators, ground-handlers, and firefighting services); and maintenance hangars
    - Landside: terminal lighting; heating, ventilation and air conditioning (HVAC) systems; baggage handling systems; terminal bridges; escalators and lifts; terminal facilities (e.g., food services, retail, lounges, waiting areas) and electrically powered transit, such as light rail or high-speed trains

22. Energy efficiency measures beyond those described in the General EHS Guidelines include the following:[11]

    - Implement airport-wide energy management with clear roles for operators and tenants, track and review energy performance across airside and landside operations.
    - Conduct periodic energy audits and implement metering and sub-metering, when feasible, to identify major sources of power demand, performance gaps, and opportunities for energy efficiency and demand management.
    - Maintain and upgrade ground vehicles, equipment, and building systems to improve energy efficiency over their operational life, including through retrofitting, scheduled replacement, and electrification where feasible.
    - Explore options to incorporate renewable energy sources, such as captive solar panels.

### 4.1.2 Air and Greenhouse Gas (GHG) Emissions

23. Airport air emissions arise primarily from fuel combustion and fugitive emissions. Common pollutants include sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$), particulate matter ($PM_{10}$ and $PM_{2.5}$), ozone, in addition to GHGs, including carbon dioxide ($CO_2$), methane

[11] USGBC, *LEED Operations and Maintenance*; ACI, *Sustainability Strategy for Airports*; TRB, *Energy Use Benchmarking Tool*. The LEED reference provides a guide for existing buildings that are undergoing improvement works with limited construction. The ACI reference includes energy management strategies. For benchmarking of airport energy use, refer to TRB Benchmarking Tool.

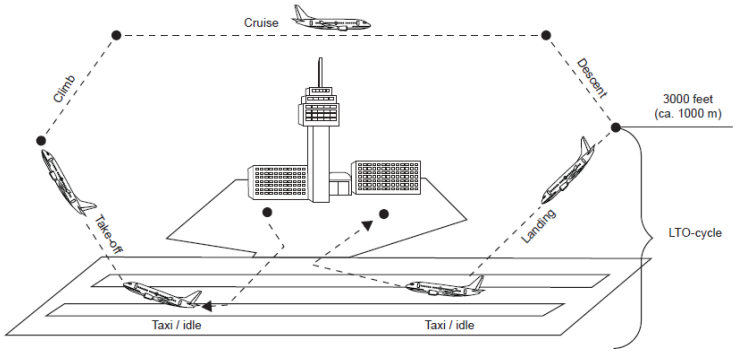
($CH_4$), nitrous oxide ($N_20$), and industrial gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride ($SF_6$), and nitrogen trifluoride ($NF_3$). Emission standards are discussed in Section 5.1.2. Other emissions from purchased energy are described in the General EHS Guidelines.

24. Emission sources are categorized as the following:[12]

- Aircraft emissions during landing and take-off (LTO)
- Aircraft ground handling emissions
- Stationary infrastructure
- Vehicle traffic

25. The LTO cycle involves flight activities below 3,000 feet (914.4 meters), including final approach, landing, taxiing, take-off, and initial climb, each with specific thrust settings. Models use these phases and engine performance data to estimate emissions (see Figure 4-1).[13]

Figure 4-1 Aircraft LTO cycle




26. Aircraft emissions during LTO can be reduced by the following:

- Optimize arrival and departure procedures through scheduling, single engine taxiing, reduced thrust operations, and improving Air Traffic Management (ATM).[14]
- Promote the increased use of sustainable aviation fuel (SAF).[15]

[12] ICAO, *Airport Air Quality Guidance*.
[13] ICAO, *Aircraft Engine Emissions Databank*.
[14] ICAO, *Doc 10177*. Examples of ATM measures include Area Navigation (RNAV), Required Navigational Performance (RNP), and Continuous Descent Operations (CDO).
[15] SAF can be produced from materials including used cooking oil, waste materials, non-food crops, algae, and recycled plastic. Increased adoption of SAF is limited by several factors: the need for aviation fuel to meet strict quality standards, adequate infrastructure to transport SAF to airports without contamination, and strong demand from airline operators to support growth of the SAF supply chain.

- Offer incentives to aircraft operators such as discounted landing fees for low-emission aircraft.

27. Ground handling emissions can be reduced by a combination of the following:

    - Participate in Airport Collaborative Decision-Making (A-CDM) to optimize aircraft movement predictability.[16]
    - Meet national vehicle emissions standards or use electric vehicles for passenger ground transport and aircraft handling.
    - Use ground power units (GPUs) instead of auxiliary power units (APUs) to power parked aircraft without consuming fuel.
    - Employ alternative fuels (CNG, LNG, LPG, hydrogen, Li-ion cells) or emission traps in ground support equipment (GSE), with supporting recharge or refueling infrastructure.

28. Stationary source air emissions can be reduced by the following measures:

    - Incinerate waste at permitted facilities operating under international standards for pollution prevention and control.
    - Manage fugitive air emissions from fuel storage and handling (see also EHS Guidelines for Crude Oil and Petroleum Product Terminals).

29. Vehicle emissions can be reduced by the following:

    - Perform regular equipment and vehicle maintenance and emissions testing.
    - Offer preferential parking and charging electric vehicles.
    - Provide incentives for sustainable public and personal transport options (e.g., encourage airlines to develop through-ticketing agreements with public transport operators).
    - Use battery-powered aircraft tugs and other electric ground vehicles such as baggage and cargo tugs, belt loaders, platform trucks, and deicing trucks.

30. Additional GHG reduction measures include the following:[17]

    - Minimize aircraft movement on the ground.
    - Use electric GPUs to minimize jet engines idling while on the apron.
    - Install SAF supply infrastructure.
    - Use renewable energy for conveyors, escalators, and travelators.

[16] EUROCONTROL, *Specifications for Airport CDM*. Most schemes allow for the exchange of accurate departure information, which can minimize aircraft taxiing to the runway and reduce airfield congestion.
[17] ICAO, *Greenhouse Gas Management.* This collection outlines actions for energy efficiency, renewable energy, operational measures, reduction targets, monitoring, and reporting.

31. GHG quantification to evaluate reduction measures should follow internationally recognized, sector-specific methodologies.[18]

### 4.1.3 Climate Resilience and Adaptation

32. Airports, like other infrastructures, are exposed to acute climate hazards, such as flooding, extreme temperatures, and intensified storms, as well as chronic hazards including sea level rise, changing wind patterns, water stress, and icing. These can damage infrastructure, disrupt operations, and trigger additional impacts such as increased emergency scenarios (e.g., flooding leading to uncontrolled releases of hazardous materials) or operational changes (e.g., more frequent flight diversions to alternate airports, increasing noise and air emissions).

33. When an assessment of climate change vulnerability is warranted, it should be location-specific, and tailored to the airport's operational capacity. It should address hazards that are relevant to the environment, workforce, and the public, and inform site-specific master plans, emergency preparedness procedures, and operational mitigation strategies.[19] Adaptation and resilience measures should be considered in renovations and upgrade plans.

34. Options to reduce climate vulnerability and maximize adaptation in new facilities, expansions or refurbishment, should be risk-based and consider implementation viability. Examples include:[20]

- Temperature: Cool runways with recycled water, increase vegetation or irrigated green space, minimize asphalt surface, extend runway length, use pale external wall colors.
- Precipitation: Increase drainage capacity, procure snow and ice removal equipment, add runway drainage grooves, install green roofs to minimize runoff, develop water storage to address supply shortages, use rainwater catchment for washdown and firefighting.
- Storms: Implement early warning systems, improve weather data quality, elevate critical infrastructure such as electricity and data cables to avoid flooding, install back-up power such as solar panels and generators, provide airside lightening shelters.
- Sea level rise: Preserve or restore natural barriers such as mangroves, install levees or seawalls, upgrade drainage and pumping capacity, elevate buildings during refurbishment or expansion.

### 4.1.4 Noise and Vibration

35. Noise and airborne vibration are closely linked, and measures to mitigate noise generally also mitigate airborne vibration.

36. The primary noise sources at airports are aircraft during LTO cycles and taxiing (see Figure 4-1). Low frequency noise during these phases can cause perceptible vibration levels with effects such as windows rattling. Other sources include ground operations (e.g.,

[18] ICAO, *Greenhouse Gas Management;* ISO, *14091:2021;* ACA, *Application Manual*; ACI, *ACERT*; TRB, *Airport GHG Emissions Inventory*. The ACA is one of the most widely used framework for GHG emission in the airport sector.
[19] ISO, *Adaptation to Climate Change*; ICAO, *Climate Change Risk Assessment*; ICAO, *Climate Resilient Airports*; ACI, *Airports' Resilience and Adaptation.*
[20] ICAO, *Key Steps;* ICAO, *Key Climate Change Vulnerabilities;* ICAO, *Menu of Adaptation Options*; Burbridge and Deitz, "Chapter 4."

passenger buses, mobile lounges, fuel trucks, tugs, aircraft and baggage tractors, and dolly carts); aircraft APUs; and engine testing. Ground-borne vibration is limited, and mitigation measures are described in the General EHS Guidelines.

37. Aircraft noise can affect nearby communities, ranging from a nuisance to disruption of quality of life and health, depending on receptor sensitivity and tolerance or "annoyance" level.[21]

### Noise Assessment

38. Potential aircraft noise impacts should be identified through objective and measurable assessment tools, commonly done through noise contours and indices, such as numerical noise modelling, and compared to selected metrics and thresholds, typically defined by national regulations. In the absence of locally regulated noise thresholds, airports should define site-specific thresholds that consider those established in other jurisdictions (see Annex B, table B1 for a description of various noise metrics and table B2 for examples of noise thresholds from various jurisdictions). The selection should be based on a site-specific assessment that considers factors like airport traffic volume, size and configuration, noise receptor locations, and any applicable or existing zoning and land use planning regulations. Selected thresholds should be justified based on the airport-specific conditions and objectives.[22]

39. The noise modelling should be conducted early in the planning stage for new developments or expansions and should be updated throughout the airport's life cycle in coordination with any applicable regulators and local authorities, including those responsible for current and future zoning or land-use planning. Current and future traffic scenarios should be assessed, using parameters such as the following:[23]

    - Airport and surrounding area details, including elevation, topography, vegetation, structures, and infrastructure, prevalent wind direction, runway length and orientation, landing and departure paths
    - Representative periods of traffic data, including fleet mix, traffic volumes, and expected flight schedules or operating hours
    - Aircraft noise characteristics from standard performance databases[24]
    - Flight tracks during LTO cycles and runways use[25]

40. Modelling results identify the location and number of receptors, including sensitive receptors, exposed to aircraft noise around the airport and provide annual average noise exposure levels. These are typically depicted in day and night contour maps to indicate

[21] WHO, *Environmental Noise Guidelines*; ECAC, *Doc 29;* EU *Directive 2002/49/EC.* Surveys conducted in Europe and the US have studied the level of annoyance that people experience from noise, which are presented in "annoyance curves" (e.g., Schultz curve). The term "highly-annoyed people" usually represents <15% of people most annoyed by aircraft noise, based on survey responses.
[22] ICAO, *Aircraft Noise Management.* This resource provides an internationally agreed approach to identify a specific noise problem and tailored measures to manage the impacts. Airports determine threshold levels for defined metrics to establish noise objectives and intervening actions.
[23] ECAC, *Doc 29*; EUROCONTROL, *IMPACT*; FAA, *Aviation Environmental Design Tool*. Numerical modelling applies mathematical prediction methods to generate aircraft noise estimates, which are displayed as noise contour maps. Various commercial software packages can implement these methods.
[24] EASA, *Aircraft Noise and Performance*. This resource provides detailed data on aircraft noise levels and performance characteristics including aircraft types; noise levels (in decibels) during different flight stages; and performance parameters such as fuel consumption, flights speeds, and climb rates that affect aircraft efficiency and environmental impacts.
[25] Airport authorities typically record detailed trajectories, runway usage, and aircraft types for all arrivals and departures, while commercial services can provide flight tracking data. For large airports, modelling may cover areas several kilometers from the airport, requiring flight track information over those distances.

the extent and magnitude of aircraft noise impact. The contours occur in 3-5 decibels (dB) increments, compared to selected noise thresholds to guide mitigation options.[26]

### Noise Management

41. Based on the results of the noise assessment, airports should develop a noise management strategy that incorporates identified noise impacts, thresholds, and mitigation actions. The International Civil Aviation Organization (ICAO) Balanced Approach is considered GIIP for managing aircraft noise and is based on four pillars: [27]

    - Noise reduction at source: Integrate noise reduction technology in aircraft design, retrofit existing aircraft, and certify aircraft. Airport operators may mandate aircraft certification to meet specific standards and incentivize efficient aircraft for lower charges.

    - Land use planning and management: Collaborate with local authorities to integrate noise considerations into land use planning and management. Provide relevant information such as modeling results to inform zoning and building restrictions. These may include buffer areas to prevent residential encroachment and encourage industrial or commercial development around airports, thus reducing the number of people directly exposed to aircraft noise.[28] Where other measures are insufficient, implement noise control programs beyond airport boundaries, such as joint sound insulation initiatives for sensitive receptors.[29]

    - Noise abatement operational procedures: Manage aircraft operations to reduce impacts on sensitive receptors, considering airport physical layout and surroundings, where safety must be prioritized.[30] For example, airport operators promote specific noise abatement LTO procedures to reduce noise impacts at specific locations around the airport, or preferential runways.

    - Operating restrictions: Reduce aircraft noise impacts by limiting or modifying aircraft activity through measures such as capacity caps, nighttime curfews, specific aircraft or runway restrictions, noise quotas, or flight-type limitations. For example, airport operators can work with regulators to prohibit aircraft types with poor noise performance during nighttime hours to minimize sleep disruption for nearby communities.

42. Airport operators have varying degrees of control and influence over the ICAO Balanced Approach elements (e.g., aircraft performance is the responsibility of the airlines and regulators; land use planning is the primary responsibility of local authorities and regulators). Where possible, airport operators should collaborate with relevant stakeholders to influence measures relevant to the airport's context (e.g., consultative committee with air traffic control, local authorities, local communities, and airline operators).

[26] ICAO, *Doc 9911;* ECAC, *Computing Noise Contours*; SAE, *Calculation of Airplane Noise*.
[27] The ICAO Balanced Approach encourages states not to apply operating restriction as first resort but only after considerations of the benefit to be gained by the implementation of the three other principal elements of the Balanced Approach.
[28] ICAO, *Environmental Protection Appendix F;* ICAO, *Doc 9184*. These resources urge states to minimize noise through preventative land use planning.
[29] FAA, *AC 150/5000-9B*; TRB, *Airport Sound Insulation Programs*. Sound insulation is typically considered in jurisdictions like Europe and the US, while its feasibility and effectiveness in emerging markets will depend on the context. These measures may include window/door insulation or ceiling/roof sealing to reduce indoor noise levels.
[30] Procedures and routes in the airport's Aeronautical Information Publication (AIP) are mandatory for airlines, designed to avoid noise-sensitive areas, and are developed in consultation with local authorities and airlines.

Measures should be tailored to each airport, considering cost-effectiveness, safety risks, financial feasibility of associated implementation costs, and other potential secondary effects on other environmental and social aspects. Examples of noise management measures are in table B3.

### *4.1.5 Waste Management*

#### Non-Hazardous Waste

43. Airports generate significant quantities of non-hazardous waste from multiple sources, including passenger terminals, airline catering operations, aircraft cleaning and deplaning, concessionaires, ground handling activities, and periodic construction and refurbishment works.

44. Airport waste management systems for airside, landside, and deplaned aircraft should be developed and implemented according to the waste hierarchy and good practice for waste minimization, planning, and monitoring, consistent with the General EHS Guidelines and GIIP.[31]

45. Licensed waste management operators should be contracted to manage remaining waste streams through final disposal. Airport waste management plans should consider the available disposal capacity of local and regional facilities.

46. Waste from airline operators and cleaning contractors should be segregated and managed as part of their service, with dedicated collection systems, food waste diversion, handling measures and biosecurity controls. Aircraft food waste management should follow applicable local regulations to protect human and animal health, agriculture, and ecosystems. Some jurisdictions require specific handling and disposal methods for international flight catering waste to prevent human and animal disease, pest, and invasive species biosecurity risks. Treatment and disposal methods may include sterilization, rendering, incineration, or disposal in authorized landfills, following regulatory requirements.[32] Landside and airside waste collection and segregation systems should use closed storage bins to minimize exposure of waste or food scraps that may attract wildlife, particularly birds.

47. Airports should identify and appropriately manage special non-hazardous waste streams commonly associated with airport operations, including electronic waste, batteries, bulky or irregular wastes (e.g., packaging, pallets), animal carcasses and other regulated wastes from terminal, maintenance, and support activities, using handling, storage, and disposal routes.

48. Waste generated from construction, refurbishment, and demolition activities should be managed through segregation and, where practicable, reuse or recycling of materials such as concrete, asphalt, metals, and excavated materials, consistent with GIIP for construction waste management at airports.

[31] ICAO, *Waste Management at Airports*; FAA, *Waste Reduction at Airports*. The FAA resource contains a comprehensive list of airport waste streams and case studies on waste management at airports.
[32] IATA, *Cabin Waste Handbook*. ICAO, *Eco-Airport Toolkit*.

49. Waste management arrangements should define responsibilities and coordination mechanisms among airport operators, airlines, ground handlers, concessionaires, and contractors, particularly where waste collection and segregation occur across shared or multi-tenant facilities. Waste management and disposal should be managed by certified waste service contracts.

### Hazardous Waste

50. Airport hazardous waste streams include oils, solvents, and chemicals from activities such as aircraft and ground vehicle cleaning, fueling, maintenance, painting, metalwork, engine testing, de/anti-icing, and vehicle repairs. On-site storage, handling, transport, and final disposal should follow the General EHS Guidelines and national regulations.

51. If airports generate biomedical waste, such as discarded personal protective equipment (PPE) or testing kits necessary during pandemics or epidemics or as part of routine operations, management should follow applicable local regulations and guidance from the EHS Guidelines for Health Care Facilities.[33]

## *4.1.6 Hazardous Materials Management*

52. Airport operations involve storage, transfer, and handling of hazardous materials that may pose risks to workers, passengers, and the environment. In addition to the General EHS Guidelines.

53. Airports store and distribute large volumes of aviation fuel (jet fuel, gasoline, SAF, diesel, hydrogen fuel cells) in tanks, pipelines, and refuelling systems where releases may occur during transfer or due to equipment failure. Mitigation measures include secondary containment for fuel storage and loading areas, leak detection and integrity monitoring for pipelines, impermeable fuelling surfaces with drainage to oil–water separators, bonding and grounding of fuelling equipment, routine inspection of hoses and couplings, and readily available spill response equipment, adhering to relevant industry standards and codes.[34]

54. Fuel piping systems should be calibrated and certified by a competent third party, with records maintained for auditing.

55. Aircraft and pavement deicing and anti-icing typically involves seasonal use of glycol-based fluids that can affect receiving waters. Airports should use controlled deicing areas with dedicated drainage, collect or treat spent fluids where feasible, segregate glycol-contaminated runoff from stormwater systems, and optimize application rates using weather monitoring and precision equipment.

56. Aircraft maintenance activities may involve solvents, paints, hydraulic fluids, lubricants, and battery electrolytes. These materials should be stored in labeled containers within ventilated and bunded areas, with systems for segregation and proper disposal of spent solvents, waste oils, batteries, and contaminated absorbents. Spill containment measures should be implemented.

57. Air cargo operations may temporarily store regulated dangerous goods and should follow acceptance, inspection, and segregation procedures consistent with GIIP.[35] Aircraft rescue and firefighting may involve foams historically containing per- and polyfluoroalkyl

[33] ACI, *Aviation Operations During COVID-19*; ICAO, *Manual on COVID-19*; WBG, *EHS Guidelines Health Care*.
[34] ICAO, *Annex 6 Civil Aviation;* WBG, *EHS Guidelines Crude Oil.*
[35] IATA, *Dangerous Goods Regulations.*

substances (PFAS); airports should transition to fluorine-free foams where feasible and manage legacy stocks to prevent environmental contamination.

58. Hazardous materials management programs including labelling, storage, spill prevention, and emergency response should align with relevant guidance from ICAO and applicable national regulations. Third-party contracts should require proper hazardous materials management and measures to address accidental releases of fuel, fire suppression materials, and de-icing solution.[36]

### *4.1.7 Water Management*

#### Water Consumption

59. Airport water consumption depends on airport capacity and terminal facilities such as restaurants, shops, lounges, washrooms, and maintenance areas. Water conservation and sustainable water supply alternatives should be assessed and monitored as described in the General EHS Guidelines.

60. A baseline of water consumption should be established, with targets to maximize efficiency and monitor progress. New, expanded, or refurbished airport infrastructure should incorporate measures such as rainwater harvesting, water-saving fixtures, separate water meters, and leak detection systems.

#### Wastewater and Stormwater Management

61. Where feasible, greywater from terminals, washrooms, and cleaning services, should be collected, treated, and reused for washdown or irrigation.

62. Stormwater collection systems should include retention and isolation basins, with discharge to treatment plants prior to discharge to the environment. Systems should prevent runoff from fuel and chemical storage, transport and dispensing facilities, workshops, fire training areas, airplane maintenance hangars, de-icing solutions, and ground service vehicle maintenance facilities.[37] Where feasible, these areas should be monitored to prevent contamination.

63. Where practical, aircraft de-icing should be confined to designated areas that allow collection, recycling or disposal of fluids. Biodegradable fluids and mechanical methods such as sweepers and snow ploughs should be used to reduce chemical consumption and discharge. Pre-treating paved surfaces prior to the onset of ice formation facilitates removal.[38] Collecting de-icing fluids in stormwater systems with treatment prior to discharge can reduce impacts on aquatic ecosystems, including oxygen demand and eutrophication from nitrogen (urea) and phosphorus (glycol).

[36] ACI, *Rescue and Firefighting Services*.
[37] ICAO, *Water Management at Airports*.
[38] US EPA, *Airport De-icing Effluent Guidelines*; SAE, *Deicing/Anti-Icing Processes*; ISO, *11076:2020*; ICAO, *De-icing/Anti-icing Operations*.

64. Fire training should be conducted on impermeable surfaces with retaining bunding to contain firefighting agents and contaminated water. Polluted water should be treated before discharge.[39] For existing airports, PFAS-based foams should transition to synthetic fluorine-free foam (F3), as a safer option for human health and the environment.[40]

65. Airports with on-site wastewater treatment systems should use oil separators, ponds, or filtration to remove sediment, pollutants, heavy metals, and hydrocarbons before discharge.[41] Wastewater discharged into sewage networks should meet local wastewater treatment system specifications and limits.

66. Aircraft sanitary wastewater should be discharged to airport sanitary sewerage systems or approved wastewater treatment facilities and should not be discharged to stormwater systems. Wastewater from international flights should be managed in accordance with applicable public health, biosecurity, and wastewater treatment requirements, including pretreatment before entering treatment facilities.[42] Sanitary effluents and stormwater discharges should meet applicable effluent limits or ambient water quality standards.

### *4.1.8 Biodiversity Management*

67. Airport operations can impact biodiversity through light pollution that disrupts circadian rhythms, especially for nocturnal species; noise interference affecting animal communication and birdsong; water contamination; bird-aircraft collisions; wildlife trafficking for the exotic pet trade; and introduction of invasive species or pests from infested plants, fruits, animals, or contaminated soil with no phytosanitary certificate.

68. Key mitigations include the following:

- Wildlife deterrence: Prevent wildlife access to airport grounds by using boundary fencing, bird flappers on overhead power lines, spikes on building ledges, laser beam and acoustic systems, falconry, gas canons, pistols, or trained dogs to disperse roosting birds. Manage vegetation that may attract fauna.[43]
- Biosecurity cooperation: Collaborate with authorities' routine baggage and airfreight inspections to prevent animal trafficking, exotic species transport, and illegal entry of pests and invasive species that can pose biosecurity threats and/or damage local ecosystems.[44]
- Bird strikes with aircraft: (see Section 4.3.4)

### *4.1.9 Lighting*

69. Airport lighting is essential for airport operation and safety during low visibility and at nighttime, supporting aircraft LTO and taxiing, as well as safe vehicle and pedestrian landside and airside movement. Lighting requirements are tightly regulated to allow pilots to distinguish visual cues, avoid obstacles, and detect runway lighting without glare or interference. Light spill to adjacent areas

[39] ACI, *Rescue and Firefighting Services.*
[40] FAA, *Fluorine-Free Foam Firefighting.*
[41] FAA, *Hazardous Wildlife Attractants*; ICAO, *Water Management at Airports.*
[42] ICAO, *Annex 14 Aerodromes I.*
[43] ICAO, *Wildlife Management Doc 9137P3.*
[44] ACI, *Combatting Wildlife Trafficking Handbook.*

should be controlled to reduce light pollution affecting wildlife habitats or nearby residential or commercial properties. Guidance for outdoor airport lighting should be considered alongside energy efficiency measures (see Section 4.1.1).[45]

## 4.2 Occupational Health and Safety

70. This section presents sector-specific considerations for worker occupational health and safety (OHS) in airports. OHS hazards common across sectors and related to construction activities are discussed in the General EHS Guidelines.

71. Airport-specific OHS hazards include the following:

- Operational safety: risks to personnel during airport operations, construction, expansion, or rehabilitation
- Physical hazards: risks from baggage/cargo handling, extreme weather, aircraft noise, ground vehicle operations, engine run-ups, aircraft pushback, and ground maneuvers
- Chemical hazards: exposure to flammable and hazardous substances such as de-icing chemicals, hydraulic fluids, jet fuel, cleaning products, fire suppressants, and exhaust fumes
- Biological hazards: exposure to infectious agents (bacteria, viruses, and fungi), vector-borne diseases, and biosecurity threats

### *4.2.1 Operational Safety*

72. Airport operations should be managed in a safe and efficient way by implementing a safety management system (SMS), aligned with GIIP and local safety regulations.[46] The SMS should be tailored to the airport's size, complexity, and operational nature, covering airside and landside activities, incorporating ongoing risk assessment and risk management measures, contractor requirements, and joint health and safety committees to address interface aspects such as signage and communication tools.[47] Induction training should be provided for all tenant and contractor staff. The airport operator's safety team, third-party providers, or qualified external auditors should perform regular operational safety audits to verify SMS effectiveness.[48]

73. A MOC procedure should be used to assess safety hazards arising from changes to airport layout, operations, flight schedules, transportation routes, or developments such as airport expansions and refurbishments.

#### Construction Safety in Operational Airports

74. Construction (including expansions and rehabilitation) in operational airports should address complex safety issues in airside and landside operations using clear communication protocols and coordinated schedules.[49] A construction health and safety

[45] IES, *RP-37-22*.
[46] ICAO, *Navigation Services Doc 9981;* ICAO, *Safety Management Doc 9859*.
[47] ISO, *31000:2018*. The ISO resource provides a framework for the development of a risk management system. Operators and service providers that are not directly managed by the airport operator company include retail, logistics, maintenance, hotels, and catering.

[48] ICAO, *Annex 19 Safety Management*; FAA, *AC 120-92D*.
[49] ACI, *Managing Operations During Construction*; FAA, *AC 150/5370-2G*. These resources assist airport operators in complying with Title 14 Code of Federal Regulations (CFR) Part 139, Certification of Airports.

management plan should be prepared, including a MOC to assess and update plans, procedures, and the emergency response plan (ERP) for construction activities.[50]

75. Key considerations include the following:

- Phase construction activities to minimize disruption to aircraft maneuvering, runways, taxiways, and gates.
- Communicate with passengers and airport users, and train workers on new emergency response procedures.
- Control dust, foreign object debris (FOD), and litter in airside areas.
- Install safety barriers, fencing, signage, and lighting to separate operational and construction zones.
- Use the HAZID (Hazard Identification) tool to identify hazards in construction phase (use of heavy machinery, excavations, and structural integrity), the operational phase (aircraft operations, fuel handling, baggage systems, and passenger safety), and security/emergency threats (fire, terrorism, natural disasters).[51]
- Conduct a pre-startup safety review (PSSR) before commissioning new or refurbished facilities.
- Implement construction traffic management plans to segregate operational traffic through dedicated routes, one-way systems, speed limits, lane barriers, and physical separation of vehicles and pedestrians.

## Emergency Response Planning

76. An ERP should be developed, tested, and revised following each training or actual emergency to minimize loss of life and maintain operational continuity in emergencies such as fires, explosions, aircraft incidents, terrorist attacks, pandemics, extreme weather events, or multiple simultaneous emergencies.

77. In addition to the ERP guidance provided in the General EHS Guidelines, airports should develop and maintain an ERP that is commensurate with the scale and nature of operations and reflects the principal hazards associated with airport activities, including aircraft emergencies and fuel-related incidents. The ERP should consider the following elements:[52]

- Airport rescue and firefighting (ARFF)[53] capability, including the airport ARFF category as determined by aircraft characteristics and activity levels, and its implications for response times, personnel, equipment, and extinguishing media. Any changes or limitations in ARFF capability should be considered in operational planning, contingency arrangements, and communication procedures.

[50] FAA, *Construction Safety Phasing Plan*.
[51] Examples of tools to identify hazards include a risk matrix, bowtie model, and job safety analysis.
[52] ICAO, *Airport Emergency Planning 9137P7*. This resource includes guidance on the preparation of airport emergency plans, roles and responsibilities, emergency operations centers, walking casualties, communication, and emergency exercises.
[53] Also referred to as Rescue and Firefighting Services (RFFS) in ICAO documents.

- Defined organizational roles, responsibilities and coordination arrangements of airport emergency services and external responders, and coordination with air traffic control, local and regional authorities, and public emergency agencies
- Planning for off-airport emergencies (e.g., overwater or in densely populated areas) should be included, where response may be led by external services
- Activation and escalation procedures, including criteria for activating the ERP, ARFF, escalation, coordination and stand-down
- Preparedness arrangements, including emergency contacts information, mutual aid agreements and planning, and interagency communication protocols, resource inventories, and arrangements for periodic training exercises and drills
- Emergency access and situational awareness, supported by mapped airport locations of emergency operations centers, command posts, incident command systems (ICS), and surrounding area maps and other tools to aid rapid emergency response and coordination
- Continuity of operation plans (COOP), also known as business continuity plans (BCP)

78. Other emergencies, such as fire and explosion, runway overshoot, aircraft emergencies during LTO, or off-airport accidents can significantly impact airport safety and should be considered when planning for emergency response.[54]
79. The ERP should identify and address risks related to construction activities, such as expansions or rehabilitations, for operating airports, and incorporate specific measures for such stage.
80. In jurisdictions with a risk of unexploded ordinances (UXO) on or near airports, qualified specialists should conduct a UXO survey to obtain the necessary clearance prior to beginning any work.

### *4.2.2 Physical Hazards*

#### Baggage and Cargo Handling

81. Design of baggage and cargo halls should clearly separate vehicles and pedestrians using physical barriers and surface markings to indicate routes. Vehicles should have audible and visual warning systems to alert personnel and passengers during baggage or cargo transfers.
82. General ergonomic, repetitive motion, and manual handling issues are outlined in the General EHS Guidelines. Airport-specific ergonomic and safe baggage and cargo handling measures include the following:

[54] ICAO, *Rescue and Firefighting 9137P1.*

- Minimize manual handling with ground support equipment (GSE) such as belt loaders, carts, dollies, trollies, and aircraft steps; consider automated baggage and cargo handling systems, where feasible.
- Tag baggage over 23 kilograms as "heavy" and use equipment such as extending belt loader (EBL) technology or mobile belt conveyors to reduce the vertical distance that baggage and cargo are moved.[55]
- Employ medically fit personnel; provide lifting technique training, PPE, and appropriate workwear.[56]
- Install guards, safety interlocks, and emergency shutdown systems to protect against mechanical hazards.

### Occupational Noise

83. High noise exposure from aircraft engines and ground support equipment can cause noise-induced hearing loss (NIHL) to airside operations personnel. Preventative measures include the following:

- Demark virtual noise zones around aircraft parking bays to exclude non-essential personnel until engines are shut down.
- Implement a hearing conservation program (HCP) with noise level monitoring, health surveillance, audiometric testing, hearing protection devices (HPDs), training, and recordkeeping.[57]
- Minimize noise through low-noise equipment, acoustic barriers, and worker isolation.

### Ground Vehicle Traffic

84. Ground vehicle operations and airside vehicles pose a hazard to workers, people, and aircraft passengers and crew. Safety measures to prevent traffic-related incidents include the following:[58]

- Implement a traffic management plan for ground vehicle operations
- Establish surface markings, physical barriers, signs, and lighting for safe pedestrian circulation and vehicle maneuvering
- Fit vehicles with safety features such as flashing amber beacons, communication devices, audible and visual reversing alarms, guards, and emergency stop or shut off features
- Conduct daily inspections to detect dropped objects or debris on taxiways and aprons
- Train personnel in the operation and maintenance of ground support vehicles, maintaining airside situational awareness, supervising ground operations, and following safe operating procedures

[55] IATA, *Ground Operations Manual*; ACGIH, *TLVs® and BEIs®*; HSE, *Manual Handling Assessment Charts*; US CDC NIOSH, *Revised Lifting Equation*. These resources provide guidance on recommended lifting loads, lifting charts, and instruction manuals.
[56] Benjamin Alli, *Fundamental Principles in OHS;* HSE, *Ergonomics at Work*. The *Fundamentals* reference sets out the roles and responsibilities of the authorities and employers regarding the right to a safe place of work. The HSE resource provides a brief guide to managing ergonomics in the workplace.
[57] US DOL OSHA, *Hearing Conservation*; US CDC NIOSH, *Preventing Occupational Hearing Loss*; WHO, *World Report on Hearing*; HSE, *Noise at Work*.
[58] FAA, *Ground Vehicle Operations*; IATA, *Ground Operations Manual.* These resources cover airport traffic issues and GIIP on supervising roles and responsibilities.

## Run-ups

85. Engine run-ups are essential for detecting malfunctions or technical issues before an aircraft becomes airborne. This activity, performed by pilots, can pose risks to airport personnel, including carbon monoxide exposure, FOD, fire, noise, jet blast, and prop wash. Safe engine run-up procedures should be developed jointly with carriers and should designate run-up areas, limit personnel access, and adhere to the manufacturer's specifications and the airport's operating procedures.

86. FOD from weathering pavement, debris, and equipment poses serious safety risks to personnel and aircraft. A FOD management program should be implemented for prompt removal of debris.[59]

## Ground Manoeuvres

87. Safe airside ground manoeuvres require robust communication involving pilots, ground handlers, and air traffic control, supported by dedicated pushback drivers, intersection spotters, and coordinated dispatch.

88. Pushback operations pose risks between vehicles and aircraft on the airside. The airport operator, in coordination with the apron management service provider, should develop standard pushback procedures for the safe movement of aircraft on aprons and taxiways. This typically include a dedicated pushback driver, personnel at intersections where the aircraft may need to traverse, and close coordination between dispatchers, pilots, and the control tower.[60]

89. Ground personnel should be trained on risks, emergency procedures, and equipment use, including the correct use of PPE, such as high-visibility clothing and hearing protection.

90. Safety markings, signs, and lighting, along with backup power, valid function test certificates, and regular inspections are essential for visibility and safe navigation.[61] Markings should include runway markings for take-off and landing, taxiways, holding positions, stand locations and those critical to instrument landings; ground service vehicle markings for movement, storage, and parking areas; and pedestrian route markings to aircraft stands or terminal buildings. Aeronautical ground lighting should guide pilots at night or in low visibility conditions and highlight obstructions. Airport beacons should support nighttime operations in areas with challenging visibility or navigation.[62]

## Adverse Weather

91. Adverse weather increases risks for vehicles, aircraft, and personnel. Airport operators should maintain shared arrangements with airlines, ground handlers, and service providers to address adverse weather, snow, and low visibility jointly.[63] Preventative measures include grit boxes for icy conditions, protective clothing, sunscreen, hydration, thermal breaks, adjusted shifts, air

[59] IATA, *Ground Operations Manual;* FAA, *AC 150/5210-24A*. These resources provide guidance on the management of FOD issues.
[60] ICAO, *Doc 10121*.
[61] ICAO, *Annex 14 Aerodromes I.* This resource describes the purpose of visual aids.
[62] An airport beacon is the brightest flashing light, typically mounted on a tall structure such as the control tower, to mark the location of the airport when visibility is reduced.
[63] US CDC NIOSH, *Preventing Cold-Related Illness;* US CDC NIOSH, *Preventing Heat-Related Illness*; ICAO, *Annex 3 Meteorological Service*; ICAO, *All-Weather Operations 9365*.

conditioning in vehicles, and maintained HVAC systems. Weather monitoring should provide extreme condition forecasts for operational planning. OHS risks may be exacerbated by extreme weather conditions, as described in the General EHS Guidelines.

### Air Quality

92. Aircraft maintenance often occurs in enclosed spaces equipped with ventilation systems; however, emissions from incomplete combustion of aircraft engines, ground support vehicle engines, use of paints and cleaning products, and hazardous waste management activities can expose workers to volatile organic carbon (VOC) emissions -- including benzene and formaldehyde -- which can aggravate respiratory diseases.

93. Ventilation systems should be designed and operated to limit worker exposure to VOCs and maintain concentrations within applicable regulatory occupational exposure limits and internationally recognized exposure guidelines, applying the more stringent values where differences exist. Appropriate PPE, including respiratory protection where warranted, should be provided for tasks with potential VOC exposure.

94. Workplace air quality monitoring should be continuous, supplemented by periodic spot checks to validate results against permissible exposure limits (PELs) for airborne contaminants.[64] Occupational health screenings should include respiratory function testing.

## *4.2.3 Chemical Hazards*

95. Airport personnel and contractors should be protected from hazardous substances including fuels, de-icing fluids, cleaning detergents, pesticides, asbestos, firefighting chemicals, batteries, and dangerous cargo, such as explosives or radioactive materials (see Section 4.1.6).

96. Airport construction often involves the use of intumescent or fire-retardant paints to meet fire standards. Prolonged exposure during application can lead to long-term health impacts. Adequate protection, use of PPE, and exposure times should be considered.

97. Airport or transportation personnel, particularly those involved in baggage inspections, security screening, and those who may be or become pregnant or breastfeeding, should be trained on exposure risks to chemicals and products and have tailored protections, including for hazardous materials, illegal substances, explosives, flammable materials, and illicit drugs, and in rare cases, chemical warfare agents.[65]

98. Airport ERP should include tiered protocols for accidents involving hazardous substances, with measures for co-located fuel tanks or battery storage systems (off-gassing) at risk of ignition or explosion.

[64] US DOL OSHA, *Air Contaminants*. This resource outlines permissible exposure limits for airborne contaminants.
[65] IATA, *Dangerous Goods Regulations Manual.* This resource provides measures to minimize exposure to hazardous substances.

### *4.2.4 Biological Hazards*

99. Airport personnel and contractors should be protected from biological hazards including pathogens, communicable diseases, contaminated food or water, poor ventilation, medical waste, pandemics, and animal transport.

100. A biosafety program should manage biological hazards from animals, people, or infected plant materials, addressing exposure risks from the following:

- Blood and body fluids
- Plants contaminated by fungi, mold, bacteria, and viruses
- Insect and animal bites
- Animal and bird droppings
- Communicable diseases, including epidemics and pandemics[66]

101. Health and hygiene should be prioritized in common areas, including washrooms, to reduce the risk of disease transmission. Implement PPE and other proactive measures based on current health guidelines. Communicate health protocols to personnel.

## 4.3 Community Health and Safety

102. This section presents sector-specific considerations for community health and safety (CHS) risks in this industry sector. CHS risks and hazards common across industries are described in the General EHS Guidelines.

103. Major CHS risks in this industry sector include the following:

- Noise and vibration from aircraft movements and ground service activities (see Section 4.1.4)
- Disease prevention
- Life and fire safety
- Aircraft emergencies (see also Section 4.2.1)
- Airport security

### *4.3.1 Noise and Vibration*

104. Airport operations generate noise and vibration impacts that may affect surrounding communities. While incidents of hearing impairment from exposure to environmental noise events are relatively low, routine exposure can negatively affect health and

[66] ICAO, *Managing Communicable Disease Guidelines.*

psychosocial well-being. Section 4.1.4 outlines noise management methodologies following the ICAO Balanced Approach, which includes stakeholder dialogues to develop effective noise mitigation measures.[67]

### *4.3.2 Disease Prevention*

105. Due to the high volume of national and international travellers, the movement of people through airports may increase the risk of transmission of communicable diseases, including those causing epidemics or pandemics. General disease prevention measures are included in the General EHS Guidelines.

106. Airport cargo operations may present risks related to the introduction and spread of invasive species, toxic substances and pest-borne diseases, particularly through the transport of food, plant products, and contaminated cargo or containers. These risks may pose threats to local agriculture, natural resources and people.

107. Airport operators should implement risk-based, routine measures aligned with national infectious disease and pest control requirements:

- Coordinate with airlines, medical services, security, customs, immigration, quarantine authorities, agricultural inspection specialists, and local and regional health services.
- Detect and intercept invasive species and toxic substances that could threaten local agriculture and natural resources, through targeted inspections and monitoring.
- Provide timely public health information to passengers through signage, information points, and electronic displays in appropriate languages.
- Implement hygiene measures, including adequate ventilation, routine cleaning and disinfection, accessible hand-hygiene facilities, and contactless passenger processing where practicable.
- Conduct proportionate entry and exit screening, as required by local authorities, which may include health declarations, visual assessment, temperature checks, and traveler guidance on symptom monitoring and reporting.

108. Airports designated as points of entry should establish, maintain, and periodically test a public health emergency contingency plan (PHECP) in coordination with public health authorities and in accordance with national regulations and international standards.[68] Pandemic preparedness and response plans should include the following:[69]

[67] ICAO, *Balanced Approach*.
[68] WHO, *Public Health Emergency Planning.* This resource is an international legal framework that defines Member States rights and obligations in addressing public health-related events, including safeguards of the rights of passengers regarding personal data, informed consent, and non-discrimination in the application of health-measures.
[69] ICAO, *Managing Communicable Disease Guidelines*; ICAO, *Manual on COVID-19;* ICAO, *Doc 9137P3;* ACI, *Guidelines Outbreaks Communicable Disease.*

- Assign clear senior-level responsibility for public health emergency preparedness, response coordination, and communication.
- Establish procedures for inter-agency coordination among airport operators, airlines, public health authorities, medical services, security, customs, immigration, quarantine officials, and transport providers, supported by PHECP communication and training.
- Deploy scalable entry and exit controls, passenger screening, and decontamination measures performed by trained personnel, commensurate with the nature of the public health event.
- Provide designated facilities, separate from public areas, for temporary isolation and assessment of suspected cases.
- Apply public health mitigation measures as directed by relevant authorities, which may include passenger locator forms, face coverings, physical distancing, testing, and quarantine.
- Transfer suspected or confirmed cases safely to designated medical or quarantine facilities, using transport arrangements that help prevent infection for passengers and personnel.

### *4.3.3 Life and Fire Safety*

109. Life and fire safety should be integrated into airport design and during upgrades or refurbishment, and as part of the MOC (see Section 3). Appoint life and fire safety specialists to conduct annual assessments, factoring in traffic forecasts, expected passenger volumes, cargo capacity, on-site chemicals, and fuel. Update assessments whenever traffic patterns or structural changes occur to maintain a responsive safety infrastructure.

110. The high volume of passenger movement and the diverse functions within airport terminals can make fire safety implementation complex. Priority should be given to terminal buildings and associated facilities, including parking areas, passenger transport systems, and baggage and material handling operations. Architectural and engineering design should follow the General EHS Guidelines, with particular emphasis on the following:

- Managing large, open spaces and high occupant loads
- Facilitating swift, secure evacuations
- Accounting for airside – landside separation and compartmentation in arrivals and departure sections
- Using smoke control systems
- Installing robust fire detection and suppression systems (e.g., sprinklers)
- Directing passenger flow to exits, with adequate signage, often leading directly to the airside apron, while maintaining security

111. Dangerous chemicals, flammable liquids, combustible materials, aircraft refueling, battery storage systems, and electrical equipment pose fire and explosion hazards that threaten passengers, workers, the public, and, in extreme cases, nearby communities. A fire hazard analysis and management plan that integrates relevant industry fire standards and codes should be applied throughout the airport's lifecycle.

112. Tank farms for aviation fuel storage should follow national regulations and applicable international industry standards and codes.[70] Establish and maintain standard fire prevention and safety procedures for the design, construction and maintenance of fueling facilities, aircraft fuel servicing and aircraft hangar for fuel storage, delivery, and refueling operations.[71]

113. Identify Fueling Safety Zones (FSZ) and develop operating procedures for their use. FSZ are defined as an area of at least 3 meters in any direction from the center point of fuel vent exits, refueling plugs, aircraft refueling ports, fuel hydrants, fuel hoses, and fueling vehicles, or as required by local regulations.[72] Bond aircraft to refueling vehicles during fueling or defueling to provide a conductive path that equalizes potential between aircraft and fueling equipment. When refueling occurs while passengers are embarking or disembarking, ground equipment should allow for sufficient exits for evacuation.

114. Trained personnel (i.e., airport rescue and firefighting services, ARFF) and appropriate fire extinguishing equipment suitable for at least initial response in the event of fuel fire, should be readily available during aircraft ground servicing. Communication systems should be in place to immediately summon RFFS in the event of a fire or major fuel spill. Response times should be adequate for the airport.[73] Refueling should not take place during lightning or other electrical activity.

115. For airports with battery energy storage systems, conduct a risk assessment to select appropriate locations, prevent the spread of fire between systems or to other areas, and train emergency response teams in battery fire hazards, thermal runaway, and risk of off-gassing.

116. The ERP should include life and fire safety risks as discussed in Section 4.2.1.

### *4.3.4 Aircraft Emergencies*

117. Aircraft emergencies can occur at or near an airport and affect nearby communities, as well as passengers and crew members. The SMS and ERP described in Section 4.2.1 should identify hazards and outline measures for managing emergencies involving communities. These should identify key stakeholders to establish emergency communication systems and training for nearby communities, and to coordinate with local and regional authorities, air traffic control, public emergency agencies, and first responders.

[70] NFPA, *Standard on Airport Buildings;* NFPA, *Flammable and Combustible Liquids*; API, *Standard 650 Oil Storage*. These codes provide a system of classifying flammable liquids on their potential to cause harm and environmental contamination.
[71] ICAO, *Doc 9977 Jet Fuel Supply*; NFPA 407 *Aircraft Fuel Servicing*; NFPA 409, *Aircraft Hangars*.
[72] IATA, *Ground Operations Manual*.
[73] ICAO, *Doc 9137P1 Airport Services Manual (Part 1)*.

## Bird Strikes and Wildlife

118. Birds and other wildlife near airports can strike aircraft turbines during LTO, posing accident risks that may affect communities. Where such risk is present, a wildlife hazard management plan should be developed and implemented and should include the following:[74]

- Inventory bird-attracting sites within and around the airport (e.g., wetlands, waterbodies, landfills and dumpsites).
- Manage local habitats to reduce wildlife attraction (e.g., water-filled pits, ditches, shelters).
- Use wildlife-proof storage and bird deterrent technologies (e.g., spikes, netting, drones, lasers, distress calls, trained birds of prey).
- Deploy radar to detect and monitor bird and bat movement in areas of high strike risk.
- Collaborate with stakeholders to manage surrounding land use, promote wildlife control measures, and conduct off-airport monitoring.

## Runway Safety

119. Runway overshoot, overruns, or incursions pose significant hazards to passengers and communities. Runway End Safety Areas (RESA) within airport boundaries should be established based on runway codes.[75]

120. Airports in densely built-up areas may face restrictions on runway length, RESA, taxiways, and stand numbers, potentially limiting the types of aircraft accommodated. To mitigate risks associated with runway excursions, airport operators should consider the following:

- Construct and maintain runways in accordance with the national regulations and international standards.
- Remove contaminants and FOD, monitor runway friction regularly, and notify air traffic control if levels drop below acceptable thresholds.
- Maintain navigation aids, visual aids, and surface markings per ICAO standards.
- Provide weather and runway condition information through automated systems.
- Install engineered materials arresting systems (EMAS) where RESA requirements cannot be met.

[74] ICAO, *Doc 9137P3 Wildlife Hazard Management*; ICAO, *Doc 9137P7 Airport Emergency Planning*; ACI, *Wildlife Hazard Management Handbook*; FAA, *Hazardous Wildlife Attractants*. These references include planning guidance for the assessment of land use compatibility in the vicinity of airports for wildlife hazard management, with separation distances varying based on the site-specific characteristics and aircraft operations.
[75] ICAO, *Aerodrome Design Doc 9157*.

121. Public Safety Zones (PSZ) outside airport boundaries at runway ends restrict development to reduce population exposure in the event of an accident.[76] Airport operators should collaborate with aviation regulators to determine if a PSZ is required based on its size and characteristics, which may vary based on traffic volume.[77]

122. For existing airports and greenfield developments, airport operators should collaborate with relevant agencies to restrict development or activities that may pose hazards to aircraft operations such as the following:

- Roads and railways near runways
- Crane operations near airports
- Lighting that could impair pilot visibility
- Large buildings with highly reflective surfaces.
- Radiation sources or objects that may interfere with aeronautical communications, navigation, or surveillance systems

### Off-Airport Incidents

123. Off-airport incidents can occur over water or in densely populated areas near the airport. The ERP should consider these risks as described in Section 4.2.1. Local fire and rescue services typically lead these responses but may request specialized airport search and rescue and firefighting support. Airport operators should inform local authorities of the capabilities and training of the airport first responders for these situations.

## *4.3.5 Airport Security*

124. Airports face security threats including terrorism, active shooters, boundary intrusions, and human trafficking. A threat and risk assessment should guide development of a security management plan in collaboration with local and law enforcement authorities. International guidelines, standards, and national aviation laws should be followed.[78]

125. National or state armed forces may be stationed at airports for duties such as counter-terrorism patrols, security during civil unrest, and protection of military aircraft at joint-use airports. Airport operators should assess the risks related to the presence of armed forces and coordinate with the relevant authorities to uphold principles of proportionality in the use of force, following GIIP.[79]

126. Airport security measures should include the following:

- Fixed systems (e.g., closed-circuit televisions (CCTV), motion sensors) and deployment of security personnel
- Screening protocols for passengers, baggage, and cargo

[76] Public Safety Zones are located at either end of the runway. Development is restricted within these zones to minimize the risk to people should an aircraft overshoot the runway.
[77] ICAO, *Doc 9184 Part II*; UK CAA, *Safeguarding of Aerodromes*.
[78] ICAO, *Global Aviation Security Plan*. IFC, *Guidance Note 4*.
[79] IFC, *Guidance Note 4*. Depending on the airport operation model, the entity(ies) responsible for security services may be managed by the airport operator, local, state or national authorities, armed forces, or third parties.

- Controlled access to secure areas and perimeter security patrols
- Collaboration with regulatory authorities and law enforcement to combat human trafficking, including personnel training and public signage[80]
- Procedures to monitor and manage unauthorized unmanned aircraft systems (UAS) or drone activity near airports[81]
- Regular training and updates to security protocols, in collaboration with regulatory authorities
- Training, monitoring, and reporting of security forces to prevent misuse of force or discriminatory practices
- Background checks on security personnel to confirm no past involvement in abuse

127. Airports may use non-ionizing or ionizing radiation scanning equipment such as metal detectors, millimetre wave machines, and cabinet X-ray machines to detect prohibited or dangerous items. Guidance for such equipment should address the maximum dose from a single screening; exposure levels for bystanders, operators, and other employees; required safety features; and operational requirements.[82]

## 5 PERFORMANCE INDICATORS AND MONITORING

128. This section describes relevant EHS performance indicators and industry benchmarks of GIIP for this industry sector. Indicators that are applicable across industries are available in the General EHS Guidelines.

### 5.1 Environmental Performance

129. Environmental monitoring programs should address significant impacts during normal operations and upset conditions, based on direct or indirect indicators applicable to the project. Monitoring should be conducted by trained specialists, use calibrated and maintained equipment, and follow GIIP methods to collect, verify, and analyze data. Results should be compared to applicable standards, and corrective actions should be implemented for any exceedances. Refer to the General EHS Guidelines for more information.

#### *5.1.1 Resource Consumption*

130. Monitoring energy consumption is necessary to identify equipment that is not operating optimally or is used inefficiently. Where possible, install separate metering and sub-metering for airport facilities, concessions, and airlines to track consumption. Energy audits can help identify usage patterns and inform investments in efficiency technologies.

[80] IATA, *Combatting Human Trafficking*; ICAO, *Manual on Combating Trafficking*. These resources reflect the industry commitment to addressing human trafficking. In addition, the UN Protocol to Prevent, Suppress and Punish Trafficking in Persons, Especially Women and Children (Palermo Protocol), Article 3 states that '… "trafficking in persons" shall mean the recruitment, transportation, transfer, harboring or receipt of persons, by means of the threat or use of force or other forms of coercion, of abduction, of fraud, of deception, of the abuse of power or of a position of vulnerability or of the giving or receiving of payments or benefits to achieve the consent of a person having control over another person, for the purpose of exploitation.'
[81] EASA, *Drone Incident Management*; ICAO, *Annex 19 Safety Management,* ICAO, *Safety Management Manual*; Interpol, *Framework for Drone Incident*.
[82] ANSI HPS, *N43.17-2009*; EU, *1999/519/EC*. ANSI is a safety standard for systems that use X-ray or gamma radiation for security screening of people.

131. Monitoring should distinguish energy supplied from the grid, renewable resources, and alternatives such as hydrogen or biomass. Operational records, including fuel consumption for ground vehicles, should be used to track GHG emissions and progress toward efficiency and renewable energy use.

132. Install water meters at strategic locations to collect detailed water use data and inform water conservation strategies. Monitoring should align with water performance targets and detect unaccounted use to reduce losses from leakage.

### *5.1.2 Air Emissions and Air Quality*

133. Ambient air quality standards are typically set by national regulations. Where they do not exist, a regional airshed approach should determine acceptable emissions levels, considering current air quality conditions. In degraded airsheds where air quality parameters exceed the ambient limits, specific air quality management frameworks should be developed to prevent further deterioration.[83]

134. Air quality monitoring should be tailored to airport operational capacity, aircraft movement rates, and the identified sensitive environmental features of the surrounding environment. Monitoring should include pollutants expected from airport operations (see Section 4.1.2).[84] Continuous monitoring within the airport boundary should be done with automatic point monitoring stations that provide high-resolution data. To keep instruments functional, stations should be serviced regularly by trained technicians.

135. When national regulations require intermittent monitoring, airport operators can employ a passive method where diffusion tubes are placed at locations for two to four weeks and sent for laboratory analysis. A standard operating procedure or method statement should describe the chain of custody to maintain data integrity.

### *5.1.3 Noise*

136. Noise monitoring measures ambient noise levels and the effects of operational changes, such as altered take-off and approach paths and aircraft types. Monitoring should occur inside the airport boundary and in nearby communities to assess impacts, review operations, and verify noise abatement measures.[85]

137. Monitoring scope and methodology should reflect airport characteristics, including location, current and projected air traffic traffic, and surrounding land use.[86] Options range from fixed stations in continuous noise and track keeping (NTK) systems to portable short-term measurements over a period of a few weeks to months.[87]

[83] ICAO, *Doc 9184 Part II*; ICAO, *Doc 9889 Air Quality*. These resources describe, respectively, emissions expected at an airport and basic elements of air quality management at airports.
[84] WHO, *Global Air Quality Guidelines*; Greenhouse Gas Protocol, *GHG Corporate Accounting Standard*. These resources provide guidance on air quality standards and GHG emissions.
[85] UK CAA, *CAP1616i: Environmental Assessment Requirements*.
[86] ISO, *20906:2009/Amd 1:2013 Acoustics*. This resource specifies the typical application of a permanently installed noise-monitoring system around an airport.
[87] NTK systems collect noise and flight path information on a continual basis, usually using a network of noise monitoring terminals inside and outside the airport boundaries.

138. Permanent monitoring stations may be placed at runway ends and other key points to track events where thresholds are exceeded. Mobile monitoring stations can be used to confirm fixed-station data, investigate unexpected threshold exceedances, or verify ambient noise levels against specified limits.[88]

### *5.1.4 Effluents*

139. Effluents should be monitored before discharge to verify compliance with applicable limits for discharges to publicly operated sewage or treatment systems or ambient standards for direct releases to surface water bodies.

140. Airports may require multiple accessible sampling sites, both above- and below-ground, serving areas such as aprons, fueling compounds, runways, taxiways, de-icing zones, hangars, oil separators, and parking lots. Regulations may specify sampling parameters, frequency, and limits, which can vary seasonally based on the location of the airport.[89]

141. Critical drainage basins should be ranked according to the likelihood of pollutant release, runoff volume, and how quickly a drainage basin will produce runoff (percent impervious surface). Sensitive receptors, including low-flow natural water bodies such as streams, lakes, ponds, and sloughs, should also be considered.

## 5.2 Occupational Health and Safety Performance

142. The working environment should be monitored to identify occupational hazards relevant to the project. Monitoring should be designed and implemented by accredited professionals as part of an occupational health and safety monitoring program, as provided in the General EHS Guidelines.[90] Facilities should record occupational accidents and incidents, and report significant accidents and injuries, including the frequency rates and associated lost time. This data should be benchmarked against internationally published guidelines and standards.[91]

### *5.2.1 Noise*

143. Aircraft engines and ground support equipment can generate noise levels exceeding the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) of 85 dBA outlined in the General EHS Guidelines.[92]

144. Baseline noise level mapping and routine monitoring should be conducted in operational areas, with annual program updates. Indicators for occupational noise management may include the following:

- Percentage of workers exposed to noise levels exceeding the TLV
- Types of noise-related health impacts

[88] The monitoring instrument should be a Type 1 Class A sound-level meter that meets the international standard, or national equivalent, for instrument accuracy, performance, and calibration requirements.
[89] ICAO, *Water Management at Airports*; ICAO, *Planning Manual Part II*.
[90] Accredited professionals may include certified industrial hygienists, registered occupational hygienists, or certified safety professionals or their equivalent.
[91] ICAO, *Safety Management Doc 9859;* ACGIH, *TLVs® and BEIs®*. ACGIH Threshold Limit Values (TLVs) define safe exposure limits for factors including noise, chemical agents, dust, vibration, heat and cold, serving as benchmarks to protect workplace health and safety.
[92] The ACGIH TLV values are guidelines designed for use by industrial hygienists in making decisions regarding safe levels of exposure to various chemical substances and physical agents found in the workplace.

- Adherence to noise control measures
- Number of workers in hearing conservation programs

### 5.2.2 Aviation Fuels

145. Long-term exposure to aviation fuels can harm respiratory and nervous systems and cause skin irritation. Identify the fuel type (e.g., Jet A-1) and make safety data sheets available with occupational exposure limits (OELs).[93] Monitor worker exposure and implement health surveillance programs aligned with national guidelines.

### 5.2.3 Incident Reporting

146. Airports should maintain a robust incident reporting and data management system to support prompt reporting, investigations, and corrective actions. This process should include reviewing the SMS and operating procedures. Performance should be assessed using metrics such as ground service incidents, fires, runway incursions, high consequence near misses (e.g., potential for fatalities, explosions), and other work-related injuries, and compared to statistics from regional or international organizations.[94]

[93] These limits may be expressed as dermal long-term systemic effects in mg/kg/day and inhalation long-term systemic effects in $mg/m^3$.
[94] US DOL BLS, *Fatal Occupational Injuries 2024;* EU OSHA, *Occupational Safety Health Europe;* HSE, *RIDDOR;* ICAO, *Annex 13.* These resources provide statistics on work-related incidents and accidents. Also, ICAO developed a secure portal to collect information on emerging issues and operational safety risk. The provisions of Annex 13 Aircraft Accident and Incident Investigation require states to establish a mandatory occurrence reporting system to facilitate the collection of information on actual or potential safety deficiencies. Annex 13, Attachment C also provides a list of examples of serious incidents that are to be reported. e.g., bird strikes, aerodrome facility incident (fuel spillages), handling of baggage and cargo, and aircraft ground handling incidents.

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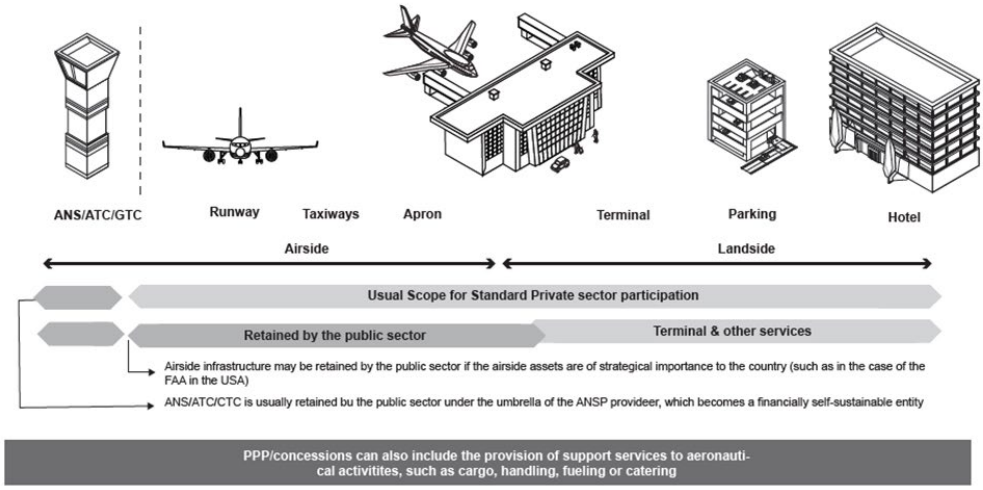
## ANNEX A: GENERAL DESCRIPTION OF INDUSTRY ACTIVITIES

1. Airports typically occupy large areas of land, with one or several runways. Heavy aircraft runways are typically about three kilometers long, and their number and placement determine land requirements. Airports handle commercial airlines as well as air taxis, cargo carriers, business jets, helicopters, and military aircraft. For security, airports are divided into landside and airside areas, with varying access levels for personnel (see Figure A-1).

Figure A-1. Airport airside and landside areas




2. Common airports infrastructure includes taxiways, aprons for passenger and cargo loading/unloading, ground handling areas, and terminal buildings. Facilities generally include air traffic control towers, security buildings, airline offices, aircraft maintenance companies, and cargo handling facilities, depending on airport size.

3. Additional infrastructure may include fuel storage, facilities for heat and power supply, ground vehicle and aircraft maintenance hangers, repair and washing bays, firefighting services, wastewater and stormwater systems, and waste storage areas. Airports are typically equipped with Instrument Landing Systems (ILS) and navigational aids such as distance measuring equipment (DME) or radio beacons.[95]

4. Whether provided by airport operators, airlines, or third-party service providers, aircraft services should include fueling, waste removal, catering, luggage and cargo handling, and apron access. Ground services require trained personnel and specialized equipment. In cold climates, services may include snow and ice removal from runways, taxiways, ramps, and aircraft; de-icing and anti-icing; and supplying aircraft with electricity via ground power units (GPUs) instead of auxiliary power units (APUs) during passenger boarding and deboarding. Airports provide emergency rescue and firefighting services and air traffic control for LTO operations.

[95] Some airports may have additional areas outside of the airport boundaries to host ILS or radar systems.

5. Aircraft may operate using Instrument Flight Rules (IFR) or Visual Flight Rules (VFR). IFR procedures, including Standard Arrival Routes (STAR) and Standard Instrument Departure (SID), vary by destination or origin of the aircraft, aircraft equipment, and certification. Table A1 outlines key features relevant to airport location, planning and design.

6. Ancillary facilities such as hotels, medical services, subways, and railways are outside the scope of this EHS Guideline and should be referenced in the appropriate sector-specific Guideline.

**Table A1. General features of airports**

| | |
|---|---|
| Typical characteristics | • An aerodrome with a demarcated runway for the landing and take-off of fixed-wing aircraft<br>• Infrastructure to guide and move aircraft between runways and parking aprons<br>• Facilities to process passengers, baggage, and cargo |
| Common aerodrome design considerations | • Design the aerodrome to handle the most demanding operational performance and/or largest aircraft expected, including the consideration of runway length (if applicable), wingspan clearance, and infrastructure to process the forecast volumes of aircraft movements, passengers, baggage, and cargo at the targeted minimum Level of Service (LoS)<br>• Secure the airfield boundary to prevent unauthorized access by people, vehicles, animals and objects to safety-critical areas<br>• Provide immigration/customs facilities for international passenger processing, as required by local regulations<br>• Maintain surrounding airspace free of either natural or human-made obstacles to allow safe aircraft operations and prevent aerodrome inoperability due to obstacle growth |
| Specific design considerations | • Runway length sufficient to handle expected aircraft types and payloads to reach planned destinations<br>• Airfield layout for safe aircraft movement between runways and parking aprons, with applicable design standards[96]<br>• Terminal buildings sized and equipped to handle expected volumes of passengers, baggage and cargo<br>• Integration with surface access modes, including public mass transit for high-volume passenger airports<br>• Aircraft noise along arrival and departure routes in relation to sensitive receptors, including residential zones<br>• Additional environmental considerations: air and water quality, conservation areas, sustainability measures (e.g., net-zero policies), and impacts of climate change, such as increased temperatures affecting buildings and pavements<br>• Airfield topography should meet recommended slope tolerances<br>• Obstacle Limitation Surface (OLS) relative to runways should allow safe unobstructed operations |
| Airport components: Airside | • Runways oriented to prevailing winds, accommodating expected aircraft type and volume<br>• Taxiways linking runways to terminals, hangars, and parking areas<br>• Aprons for aircraft parking and passenger/cargo loading and unloading<br>• Air traffic control tower to manage traffic in surrounding airspace<br>• Ground support equipment (GSE), includes a broad category of vehicles and equipment that service aircraft, including towing, maintenance, loading and unloading of passengers and cargo, and aircraft servicing (electric power, fuel, other)[97] |
| Airport components: Landside | • Ground transportation for public and private use, including trains, shuttles, buses, taxis, and rental cars<br>• Hangars for maintenance and storage of aircraft and equipment<br>• Maintenance workshops and paint shops<br>• Emergency service buildings for fire and rescue vehicles, equipment storage, training areas, and emergency facilities such as lightening shelters<br>• Ground staff facilities, including washrooms and seating areas where terminal access is unavailable<br>• Parking areas for airport personnel and the public<br>• Weather stations<br>• Embarking and deplaning gates, with travelators, lifts, escalators, and stairs to immigration halls and baggage claim<br>• Space for ticketing, check-in, security screening, shops, restaurants, waiting areas, lounges, baggage claim, and car rental<br>• Cargo terminals for freight handling in separate buildings<br>• Ancillary facilities such as hotels, restaurants and stores |

[96] ICAO, *Annex 14 Aerodromes I*.
[97] ICAO, *Doc 9889 Air Quality*.

## ANNEX B: NOISE LEVEL METRICS AND THRESHOLDS

**Table B1. Noise metrics**

| Metric[98] | Definition | Comment |
|---|---|---|
| DNL ($L_{dn}$) | A-weighted day/night sound level averaged over 24 hours with 10 dB penalty weighting for noise events at night (i.e., 10pm–7am). Its unit is dB(A).[99] | DNL is the standard noise metric for all US Federal Aviation Authority studies of aviation noise exposure in airport communities. |
| $L_{den}$ | A-weighted noise level based on energy equivalent noise level (Leq) over a full day with a penalty of 10 dB(A) for nighttime noise (10pm–7am) and a penalty of 5 dB(A) for evening noise (i.e., 7pm –10pm). Its unit is dB(A). | Lden is defined in EU Directive 2002/49/EC. |
| $L_{night}$, $L_{day}$, $L_{evening}$ | A-weighted average sound level for day, evening, and night of a year. Jurisdictions commonly use 12-hour daytime periods, 4-hour evening periods, and 8-hour nighttime periods; some use 16-hour day and 8-hour night periods. Starting and ending hours of these periods vary depending on the jurisdiction. Its unit is dB(A). | $L_{night}$, $L_{day}$, $L_{evening}$ are used in the EU Directive 2002/49/EC; see ISO 1996-2:2017 for definitions.[100] |
| Equivalent Sound Pressure Level ($L_{eq,T}$) and $L_{Aeq,T}$ | $L_{eq,T}$ is the time averaged, hypothetical steady sound, which contains the same sound energy as the actual variable sound over the measurement period. Its unit is dB.<br>$L_{Aeq,T}$ is the A-weighted version of time $L_{eq,T}$. Its unit is dB(A). | For example, $L_{eq,16h}$ is a sound pressure level equivalent in energy to a varying sound pressure level measured over a 16-hour period. |
| $L_{max}$, Maximum Sound Level, and $LA_{max}$ | The highest sound level measured during a single noise event (e.g., aircraft take-off) over a short interval (e.g., 125 milliseconds).<br>$L_{max}$ ignores event number/duration and cannot be totalled into a one-hour or a 24-hour cumulative measure of impact. Its unit is dB.<br>$LA_{max}$ is the A-weighted version of Lmax. Its unit is dB(A). | Interpret carefully: short-duration sound spikes may be unrelated to air traffic noise. As it does not provide information about cumulative noise exposure (sound energy of the event), its results may not be comparable. In fact, two events with an identical maximum level may produce different total exposures. For example, event 1 is produced by a heavy aircraft, may last for an extended period, and be perceived as more annoying than event 2 produced by a light aircraft and of a shorter duration. |
| NEF, Noise Exposure Forecast | A single-number noise exposure metric (non-decibel) that considers aircraft type, loudness, frequency, duration, time of occurrence, tone, etc.). | Used in jurisdictions such as Australia and Canada, this metric can predict a community's response to aircraft noise. |
| $L_{WECPNL}$, Weighted Equivalent Continuous Perceived Noise Level | It adopts the weighted equivalent continued noise grade over one night. Its unit is dB. | $L_{WECPNL}$ is the standard metric in China for community noise exposure. |

[98] Brink et al, "Conversion Noise Exposure Indicators," 54–63. This resource provides guidance on conversion among certain metrics.
[99] A-weighted decibels are decibels with the sound pressure scale adjusted to conform with the frequency response of the human ear. A sound-level meter that measures A-weighted decibels has an electrical circuit that allows the meter to have the same sensitivity to sound at different frequencies as the average human ear. There are also B-weighted and C-weighted scales, but the A-weighted scale is the one most commonly used for measuring loud noise.
[100] ISO, *1996-2:2017*.

| Table B2. Examples of noise thresholds from various jurisdictions[101] | | | |
|---|---|---|---|
| **Country** | **Source** | **Threshold for Noise Assessment** | **Comment** |
| Australia | AS2021:2015 | 25 ANEF | Strictest limitations on residential, educational, and healthcare developments in area with ≥40 ANEF.<br>Permit limited residential development with mandatory noise insulation between 30–40 ANEF. Schools and hospitals may need mitigation. |
| Brazil | ANAC, RBAC 1 | DNL 65 dB(A) | DNL 70 to 75 dB may have limited application for residential and commercial use, with required soundproofing measures. Sensitive receptors (hospitals, schools) may be restricted.<br>DNL >75 dB Strict restrictions on residential, commercial, and institutional buildings. |
| Canada | Canadian Aviation Regulations (SOR/96-433) | 25 NEF | 25<NEF<35 is the basis for zoning.<br>New residential not recommended in NEF>30 |
| China | GB 9660-88 | 70 dB(A) $L_{WECPNL}$ | <70 dB(A) $L_{WECPNL}$ for special residential, cultural, and educational areas. Exemption for Grade I area: <75 dB(A) $L_{WECPNL}$ |
| Colombia | Resolution 627 of 7th April of 2006 | 65 dB(A) $L_{day}$ and 55 dB(A) $L_{night}$ | 65 dB(A) $L_{day}$, 7am–9pm<br>55 dB(A) $L_{night}$, 9pm–7am |
| India | MoEFCC REGD. NO. D. L.-33004/99 | 65 dB(A) $L_{day}$ and 60 dB(A) $L_{night}$ | Busy airports (>50,000 aircraft movements/year):<br>70 dB(A) $L_{day}$, 6am–10pm<br>65 dB(A) $L_{night}$, 10pm–6am<br>Non-busy airports (<50,000 aircraft movements/year):<br>65 dB(A) $L_{day}$, 6am–10 pm<br>60 dB(A) $L_{night}$, 10pm–6am<br>"The above specified limits shall have a tolerance limit of 10 dB(A) LAeq." |
| France | Art R 571-66 of the Environmental Code (Version in force since 1January 2016) | 50 dB(A) $L_{den}$ | Three noise zones for spatial planning purposes:<br>Zone 1 > 70 dB(A) $L_{den}$,<br>Zone 2 > 65 dB(A) $L_{den}$,<br>Zone 3 > 55 dB(A) $L_{den}$. |
| Germany | German Act for Air traffic noise Protection from 2007 | 55 dB(A) $L_{day}$ and 50 dB(A) $L_{night}$ | Zone 1 (no new residential and sensitive receptors, existing buildings get compensation for insulation):<br>$L_{day}$ 65 dB(A) for an existing airport<br>$L_{day}$ 60 dB(A) for new/extended airports<br>Zone 2 (restricted construction and use of buildings - sound insulation required, different level of compensation for insulation):<br>$L_{day}$ 60 dB(A) for an existing airport<br>$L_{day}$ 55 dB(A) for new/extended airports |

[101] When a jurisdiction does not have noise thresholds, airport-specific noise metrics and thresholds can be selected and justified using other jurisdictions as references. This table provides examples as of the date of this publication, such examples may change overtime and should be valiadated with their most recent version. Selection of metrics and thresholds should consider specific airport conditions such as airport traffic volume, size of airport and configuration, noise receptors, zoning, and land use planning.

| Table B2. Examples of noise thresholds from various jurisdictions[101] | | | |
|---|---|---|---|
| **Country** | **Source** | **Threshold for Noise Assessment** | **Comment** |
| | | | Zone 1 and Zone 2 (no new residential and sensitive receptors, existing buildings get compensation for insulation):<br>$L_{night}$ 55 dB(A) and LAmax 6 x 57 dB(A) for existing airports<br>$L_{night}$ 50 dB(A) and LAmax 6 x 53 dB(A) for new/extended airports |
| Malaysia | Guidelines for environmental noise limits and control (third edition 2019) | 50 dB $LA_{eq}$ | No new residential developments allowed in area with ≥40 NEF. Malaysian guidelines present the noise threshold in dB $LA_{eq}$ and building restriction and zoning in NEF. |
| Spain | Law 1367/2007 from 19th October | 60 dB(A) $L_{day}$ and 50 dB(A) $L_{night}$ | Sectors of the territory with a predominance of soil for sanitary, teaching and cultural use that requires a special protection against noise pollution:<br>55 dB(A) $L_{day}$, 7am–11pm<br>45 dB(A) $L_{night}$, 11pm–7am |
| Thailand | Environmental Quality Promotion and Conservation Act B.E. 2535 (1992) | 30 NEF | Strictest limitations on residential, educational, and healthcare developments in area with ≥40 NEF. |
| Turkey | Art. 20 from Law 26939 | 65 dB(A) $L_{day}$, 60 dB(A) $L_{evening}$ and 55 dB(A) $L_{night}$ | Areas with both commercial and noise-sensitive buildings:<br>68 dB(A) $L_{day}$, 7am–7pm<br>63 dB(A) $L_{evening}$, 7pm–11pm<br>58 dB(A) $L_{night}$, 11pm–7am<br>Areas with commercial buildings:<br>72 dB(A) $L_{day}$, 7am–7pm<br>67 dB(A) $L_{evening}$, 7pm–11pm<br>62 dB(A) $L_{night}$, 11pm–7am |
| United Kingdom | Cm 8584 Aviation Policy Framework | 57 dB $LA_{eq,16h}$ | Within 63 to 68 dB $LA_{eq}$ new residential developments may require noise insulation. Schools and hospitals may receive government support for mitigation.<br>Strict controls on new residential development apply above 69 dB $LA_{eq}$ with compensation and mitigation for existing buildings. |
| United States | AC 150/5020-1 | DNL 65 dB(A) | DNL 65 to 74 dB is incompatible with residential areas without proper soundproofing.<br>DNL >75 dB considered unacceptable for residential, schools, hospitals, and other noise-sensitive land uses) |

| Table B3. Examples of noise management measures | | |
|---|---|---|
| **Balanced approach pillar[102]** | **Examples of measures typically implemented at airports** | **Considerations** |
| Reduction of noise at source | Renew or retrofit aircraft fleets with noise cancelling features | Responsibility of airlines |
| | Noise limits | Introduction of noise limits for specific aircraft types require support of the relevant authority |
| | Supporting airline operators flying quieter aircraft types/ Discouraging airline operators flying noisier aircraft types | Airport operators can differentiate airport charges based on aircraft noise performance |
| Land-use planning and management | Establish noise zones based on noise contours for spatial planning purposes | Implementation by local authorities/regulator |
| | Implement noise insulation schemes | Implementation by local authorities/regulator and/or airport operators |
| | Provide home relocation assistance | Implementation by local authorities/regulator, although implementation by airport operator is possible |
| Noise abatement operational procedures | Preferred operating direction | Directed by Air Traffic Control authority or Air Navigation Service Provider (ANSP); airport operator can influence |
| | Preferential runways | In direct control of airport, with support of ANSP |
| | Runway alternation schemes | In direct control of airport, with support of ANSP |
| | Limiting use of reverse thrust | Limited use of reverse thrust during specific timeframes can be specified in Aeronautical Information Package (AIP) |
| | Single engine (N-1) taxi operations | Single engine (N-1) taxi operation preferences can be specified in AIP |
| | Displaced runway threshold | Displaced runway threshold can be specified in AIP |
| | Optimal Noise Abatement Departure Procedure (NADP) | Preferred NADP can be specified in AIP, under ANSP |
| | Increased use of continuous descent arrivals/continuous climb operations | Implementation is typically under control of airlines and ANSP |
| | Low power – low drag operations | |
| | (Slightly) steeper descent gradient during approach | |
| | Two-segment approach | |
| | Minimum height requirements | |
| | Performance Based Navigation to avoid (highly) populated areas | |
| | Noise preferential routes | |
| Operating restrictions | Restrict engine run-up, engine testing, and APU runs | Specifically relevant for low-frequency noise |
| | Limit auxiliary/ground power units and pre-conditioned air usage | |
| | Quota count system[103] | |
| | Cap movements (overall or for specific periods) | Last resort measure |

[102] These noise management measures can be considered by airports to mitigate a noise problem. GIIP is to follow the pillars of the ICAO Balanced Approach when considering to implement measures: start with the measures to reduce the noise at source and if required implement additional measures from the other pillars.

[103] Quota count is a system used to limit the amount of noise generated by aircraft movements at nighttime (23:30–06:00).