MOTT MACDONALD

# Expansion of Hong Kong International Airport into a Three-Runway System

## Airport Operation related Emissions Control Plan

April 2023

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## Airport Operation related Emissions Control Plan

April 2023

Mott MacDonald Hong Kong Limited
registered in Hong Kong no. 236497

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**This Submission of Airport Operation related Emissions Control Plan**

**has been reviewed and certified by**

**the Environmental Team Leader (ETL) in accordance with**

**Condition 2.24 of Environmental Permit No. EP-489/2014, Section 2.2.3.3 of the Updated EM&A Manual and Condition 1.9 of Environmental Permit No. EP-489/2014.**

**Certified by:**

Terence Kong
Environmental Team Leader (ETL)
Mott MacDonald Hong Kong Limited

Date 18 April 2023

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By Email

Airport Authority Hong Kong
HKIA Tower, 1 Sky Plaza Road
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Lantau, Hong Kong

Attn: Mr. Lawrence M L Tsui, Principal Manager. Environmental Compliance

24 April 2023

Dear Sir,

**Contract No. 3102**
**3RS Independent Environmental Checker Consultancy Services**

**Airport Operation related Emission Control Plan**

Reference is made to the ET's submission of Airport Operation related Emission Control Plan under Condition 2.24 of the Environmental Permit No. EP-489/2014 and Section 2.2.3.3 of the Updated EM&A Manual, which is certified by the ET Leader on 18 April 2023.

We would like to inform you that we have no comment on the captioned submission. Therefore, we write to verify the captioned submission in accordance with the requirement stipulated in Condition 1.9 of Environmental Permit No.EP-489/2014.

Should you have any query, please feel free to contact the undersigned at 3922 9141.

Yours faithfully,
AECOM Asia Co. Ltd.

Roy Man
Independent Environmental Checker

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# Glossary

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|---|---|
| **3RS** | Three-runway System |
| **AAHK** | Airport Authority Hong Kong |
| **AET** | Autonomous Electric Tractor |
| **AOEC** | Airport Operation related Emissions Control |
| **APU** | Auxiliary Power Unit |
| **AQOs** | Air Quality Objectives |
| **AQMS** | Air Quality Monitoring Station |
| **ASRs** | Air Sensitive Receivers |
| **AVL** | Airside Vehicle Licence |
| **DEP** | Director of Environmental Protection |
| **e-GSE** | Electric-powered Ground Service Equipment |
| **EIA** | Environmental Impact Assessment |
| **EIAO** | Environmental Impact Assessment Ordinance |
| **EM&A** | Environmental Monitoring and Audit |
| **EP** | Environmental Permit |
| **EPD** | Environmental Protection Department |
| **EV** | Electric Vehicle |
| **FGP** | Fixed Ground Power |
| **GSE** | Ground Services Equipment |
| **HKIA** | Hong Kong International Airport |
| **HKUST** | Hong Kong University of Science and Technology |
| **I-2RS** | Interim Two-Runway System |
| **LPG** | Liquefied Petroleum Gas |
| **MM** | Mott MacDonald |
| **$NO_2$** | Nitrogen Dioxide |
| **NOx** | Nitrogen Oxides |
| **NRMM** | Non-road Mobile Machinery |
| **PCA** | Pre-conditioned Air |
| **RHO** | Ramp Handling Operator |
| **T2** | Terminal 2 |

# 1 Introduction

## 1.1 Background

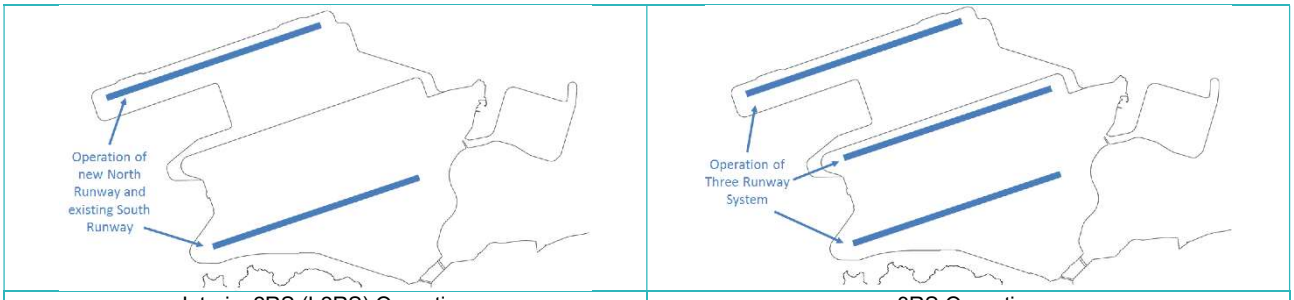
Under the Environmental Impact Assessment Ordinance (EIAO), the Environmental Impact Assessment (EIA) Report and the Environmental Monitoring and Audit (EM&A) Manual (Register No.: AEIAR-185/2014) prepared for the "Expansion of Hong Kong International Airport into a Three-Runway System" (hereafter referred to as the "3RS Project" or the Project) have been approved by the Environmental Protection Department (EPD), and an Environmental Permit (EP) (Permit No.: EP-489/2014) has been issued for the Project.

The Project is planned to be located on a new land formation area immediately north of existing Hong Kong International Airport (HKIA) in North Lantau, covering a permanent footprint of approximately 650 ha. As stated in the approved EIA for the 3RS Project (hereafter as "3RS EIA Report"), the Project primarily comprises:

- New third runway with associated taxiways, aprons and aircraft stands;
- New passenger concourse building;
- Expansion of the existing Terminal 2 (T2) building; and
- Related airside and landside works, and associated ancillary and supporting facilities.

As presented in the approved 3RS EIA Report, the runway operational configuration will be implemented in phases as shown in **Figure 1.1** below. Upon completion of the new third runway and associated taxiways and with operation familiarisation of the third runway started on 8 July 2022 and formal commencement of operation started since 25 November 2022, the previous north runway is temporarily closed for modification works. During this period as described in the approved 3RS EIA Report, the existing South Runway and the new third runway (which is designated as the new North Runway) is currently in operation, which is hereafter referred to as the interim two-runway system (I-2RS) operation. Upon completion of all essential infrastructure and facilities, the airport will be operated under the 3RS, which is hereafter referred to as the 3RS operation.

**Figure 1.1: Runway Operation Configuration**




| Interim 2RS (I-2RS) Operation | 3RS Operation |
|---|---|

The operational phase air quality impact assessment undertaken as part of the 3RS EIA had assessed the potential air quality impact on air sensitive receivers (ASRs) identified within 5km from the project boundary based on the highest aircraft emission scenario under normal operating conditions of the Project in accordance with the EIA Study Brief requirements.

As summarised in Section 5.3.7.1 of the approved 3RS EIA Report, no non-compliance against the Air Quality Objectives (AQOs) has been predicted at all the identified ASRs during the operation of the Project. Nevertheless, the Airport Authority Hong Kong (AAHK) has been implementing a number of measures and initiatives aimed at further reduction in air emissions from airport activities and operations at HKIA, and these efforts are expected to continue in the current I-2RS and subsequent 3RS operation. Pursuant to EP Condition 2.24, this Airport Operation related Emissions Control (AOEC) Plan is prepared to detail the measures to be taken to minimise and control the emissions due to the airport operation and AAHK is required to deposit this

AOEC Plan with the Director of Environmental Protection (DEP, or hereafter referred to as the Director) no later than 3 months before the operation of the Project.

Mott MacDonald (MM) has been appointed by AAHK as the Consultant to provide consultancy services for the 3RS Project, which include, among others, the preparation of this Plan.

## 1.2 EP Requirements

This AOEC Plan has been prepared to fulfil the EP Condition 2.24, which is reproduced below:

*The Permit Holder shall, no later than 3 months before the operation of the Project, deposit 3 hard copies and 1 electronic copy of an Airport Operation related Emissions Control Plan with the Director, detailing the measures to be taken to minimize and control the emissions due to the airport operation including but not limited to adopting fuel-efficient airside vehicles, promoting increased use of electric vehicles and electric ground services equipment, banning all idling vehicles on the airside and utilizing clean diesel and gasoline at the airfield.*

## 1.3 Updated EM&A Requirements

In addition to the requirements set out under EP Condition 2.24 as presented above, AAHK has made a commitment in Section 2.2 of the Updated EM&A Manual to undertake air quality monitoring and audit (AQM&A) on a regular basis during the 3RS operation. As described in Section 2.2.3.3 of the Updated EM&A Manual, the detailed AQM&A requirements should be presented as part of the AOEC Plan and this is set out in **Annex I** of this Plan.

## 1.4 Structure of this Plan

Following this introductory section, Section 2 has summarised AAHK's emissions reduction strategies and actions taken to minimise and control airport operation related emissions. Further details of the measures that are already implemented, in progress or planned for implementation at HKIA are set out in Section 3.

# 2 Emissions Reduction Strategies and Actions

## 2.1 Introduction

Background air quality in Hong Kong including the districts near HKIA has been improving and these are well reflected via the air quality monitoring data obtained in recent years at HKIA's air quality monitoring stations (AQMS) and also at EPD's air quality monitoring station in Tung Chung. Relevant data can be found in Appendix A of Annex I.

Yet, in line with the Government's strategy of shifting the focus to enhancing air quality to foster a healthier and more liveable environment for the community, AAHK has been implementing a number of additional measures and initiatives aimed at further reduction in air emissions from the daily operations and activities at HKIA.

The emissions reduction strategies and actions that have been planned by AAHK for implementation at HKIA and that fulfil the requirements of EP Condition 2.24 are summarised below.

## 2.2 Emissions Reduction Strategies

AAHK is responsible for the operation and development of HKIA where various operational functions are outsourced to franchisees, tenants and government departments. Therefore, AAHK's approach to air quality management has been to reduce air emissions that are under AAHK's direct control (i.e., emission related to AAHK's operations, vehicles and equipment), and to facilitate emissions reduction which AAHK can guide or influence. The latter includes airside vehicles operated by our business partners at HKIA and also aircraft movements on the ground.

To facilitate the identification of major sources of air pollutants in HKIA's operation and evaluation of possible measures that may be implemented to further minimise and control emissions, AAHK has engaged and worked with the Hong Kong University of Science and Technology (HKUST) since 2007 to analyse the available air quality data, and also identify and study the main sources of air emissions associated with HKIA's operation. These consultancy studies have allowed AAHK to gain a better understanding of the air quality performance of different aspects of airport operations, and have facilitated the development of relevant emissions reduction actions by AAHK in the past years, focusing on those additional measures and initiatives that AAHK may take to reduce air emissions that are under AAHK's direct control, guide or influence in relation to the airport operation and these are further described below.

## 2.3 Emissions Reduction Actions

As described in Section 5.3.7.1 of the approved 3RS EIA Report, while no non-compliance against the AQOs is predicted at the identified ASRs, AAHK has been implementing a number of measures and initiatives aimed at further reduction in air emissions from airport activities and operations. These measures are aligned with the requirements set out under EP Condition 2.24. The key measures and initiatives are summarised below and the relevant details are presented in Section 3:

- Banning of idling vehicles and Ground Services Equipment (GSE) with running engines on airside of HKIA since 2008;
- Banning the use of auxiliary power units (APU) on aircraft at frontal stands since 2014;
- Introduction and gradual implementation of AAHK's Airside Vehicle Electrification Programme since 2012;

- Introduction and gradual implementation of AAHK's GSE Pooling Scheme, with the use of electric-powered GSE (e-GSE) where models are commercially available in the market since 2018;
- Installation of Electric Vehicle (EV) and e-GSE charging infrastructure on airside of HKIA to meet the operational needs of EV and e-GSE;
- Phasing out of old, non-fuel efficient airside vehicles via defining relevant airside vehicle licence related requirements and the implementation of the above-mentioned AAHK's Airside Vehicle Electrification Programme; and
- Provision of biodiesel and liquefied petroleum gas for use by vehicles on the airside of HKIA, and continue to explore the use of alternative low carbon fuels by the vehicles and GSE at HKIA.

# 3 Airport Operation Related Emissions Control Measures

## 3.1 Introduction

This section presents details of the airport operation related emissions control measures that are implemented, in progress, or planned for implementation at HKIA. The measures planned by AAHK align with those required under the EP Condition 2.24.

## 3.2 Banning Idling Engines

As described in Section 5.3.7.1 of the approved 3RS EIA Report, except for certain vehicles and operations that are exempted, AAHK introduced a ban of idling vehicle engines on the airside since May 2008. The ban covered idling vehicles and Ground Services Equipment (GSE) with running engines on the airside, and the airport community was consulted before the introduction of the ban.

On the other hand, AAHK has implemented a ban on use of Auxiliary Power Units (APU) on aircraft at frontal stands since December 2014 to reduce emissions from burning of jet fuel. Without compromising aircraft's needs for electrical power and cabin cooling when parked, AAHK installed fixed ground power (FGP) and pre-conditioned air (PCA) systems at frontal stands (see **Photo 3.1**) for use by airport business partners, organised trials and developed operational procedures to support the implementation of the APU ban. AAHK also provided mobile PCA units for use at remote stands for reducing air emissions.

**Photo 3.1: Aircraft connected to FGP and PCA at parking stands**

## 3.3 Promoting Increased Use of Electric Vehicles

AAHK developed and implemented an Airside Vehicle Electrification Programme and developed a relevant implementation roadmap to reduce air emissions associated with the airport operation. The Programme consists of three phases and targets the following listed vehicle types:

- Phase 1 – saloon vehicles;
- Phase 2 – remaining Class 1 vehicles with gross vehicle weight of up to 3 tonnes (i.e., non-saloon type private cars)
- Phase 3 – airside vans, mini-buses and buses

### 3.3.1 Phase 1

In 2012, AAHK announced an Airside Saloon Vehicles Replacement Plan and rolled out a relevant Airside Electric Vehicle (EV) Incentive Scheme to facilitate the phase out of old diesel/ petrol powered saloon vehicles in the airside. Under the Plan, AAHK announced a policy change on the airside vehicle licensing regime by specifying that:

- All newly registered saloon vehicles must be of EV type from July 2013;
- Fossil fuel powered saloon vehicles will not be issued with an airside vehicle licence (AVL) if the vehicle reaches 9 years of age or after June 2017, whichever comes earlier.

Working with the airport business partners, the first phase of the Airside Vehicle Electrification Programme was successfully completed, with all saloon cars replaced with EV models since 2017 (see **Photo 3.2**).

**Photo 3.2: Electric saloon vehicles operating at airside of HKIA**


### 3.3.2 Phase 2

Phase 2 of the Airside Vehicle Electrification Programme focuses on replacement of all airside fossil fuel powered private vehicles with a gross weight of less than 3 tonnes with EV models, with the following targeted timeline:

- All newly registered private vehicles with a gross weight of less than 3 tonnes must be EV models from July 2019;
- Existing fossil fuel powered private vehicles with a gross weight of less than 3 tonnes will not be issued with an AVL if the vehicle's licence issued by Transport Department or its AVL reaches 7 years from the first issuance date from January 2021;

- All AVLs issued to fossil fuel powered private vehicles with a gross weight of less than 3 tonnes will be expired from end December 2022.

Phase 2 of the Airside Vehicle Electrification Programme commenced in July 2019 as planned with end December 2022 adopted as the targeted date for completion of programme. Yet, there were some EV supply problems that were experienced as a result of the COVID-19 pandemic and the targeted date for completion of the Phase 2 Programme was updated to end 2023.

### 3.3.3 Phase 3

Subject to the availability and reliability of electric commercial vehicles in the market, AAHK has planned to progressively phase out the existing fleet of vans, mini-buses and buses operating at the airside of HKIA and replace them with electric models commencing from 2024. This process has already started early for operating buses when AAHK introduced the use of 10 electric passenger buses and also 6 electric staff buses for use at HKIA since July 2020 (see **Photo 3.3**).

AAHK has also been spending efforts to identify opportunities that may allow increased use of electric vehicles. In end December 2019, after testing for more than one and a half years, AAHK has become the first airport in the world that has applied the use of autonomous electric tractor (AET) technology into live airport operations for baggage delivery (see **Photo 3.4**).

**Photo 3.3: Electric airside passenger buses currently in operation at HKIA**

**Photo 3.4: Autonomous electric tractor introduced for use at HKIA for baggage delivery**

## 3.4 Promoting Increased Use of Electric Ground Services Equipment

With a view to improving operating efficiency and reducing air emissions, AAHK rolled out a GSE Pooling Scheme at HKIA in July 2018. The Scheme enables ramp handling operators (RHOs) serving client airlines to rent critical GSE, of which 95% are electric-powered GSE (e-GSE), from AAHK. The Scheme consists of three phases. Phase 1 was already fully implemented while Phase 2 has already commenced since April 2022. When Phase 3 of the Scheme is fully implemented upon commencement operation of the 3RS, AAHK will own up to about 1,000 units of GSE, with at least 95% as e-GSE, and become the world's first international airport to adopt GSE Pooling to such a scale. Examples of e-GSE introduced for use at HKIA are illustrated in **Photo 3.5**.

### 3.4.1 Phase 1

The GSE Pooling Scheme was first conceived when AAHK initiated a review of aircraft ramp handling processes, which included an in-depth analysis of arrival baggage delivery performance in 2016. The findings revealed timely provision of GSE is one of the most important factors affecting HKIA's service standards. Likewise, the deployment of GSE from flight to flight across the apron increasingly led to traffic congestion during peak periods throughout the day. This not only affected the on-time performance of arriving baggage and departing flights, but also led to increased air emissions, especially when the RHOs have been using many aged diesel-powered GSE.

Under the new AAHK's ownership model, all critical GSE are standing by at every parking stand and the need for mobilizing GSE is minimized. This not only brings benefits in terms of reduced emissions and energy use, but also reduced unnecessary traffic on apron road and traffic congestion. Moreover, with 95% of GSE being electric-powered, exposures of workers and other receptors to NOx, particulates and other pollutants are significantly reduced.

Phase 1 of the GSE Pooling Scheme was implemented at Midfield Apron and this was extended to cover North Satellite Concourse and remote bays at West Apron subsequently. Under Phase 1, AAHK procured and owned over 250 GSE, of which 95% are electric-powered GSE, for rental use by RHOs. In addition to procuring

the GSE, AAHK also funded the installation of chargers, established two GSE maintenance workshops, provided training, and developed a detailed GSE Pooling Scheme Operations Handbook to provide guidelines to the relevant partners for operation of the Scheme.

### 3.4.2 Phase 2

A contractor has been recruited by AAHK for implementation of Phase 2 of the Scheme that took place at the apron area of Terminal 1 since April 2022. Critical GSE for passenger aircraft turnaround, including conveyor belt loaders, lower deck loaders, etc. will be acquired under Phase 2 of the Scheme and all of the GSE are targeted to be of the electric type. When fully implemented, the total size of the GSE fleet owned by AAHK in the Phases 1 and 2 GSE Pooling Scheme will be scaled up to over 500.

### 3.4.3 Phase 3

Phase 3 of the GSE Pooling Scheme will be implemented at the planned Terminal 2 Concourse (formerly known as Third Runway Concourse) for the 3RS operation. It is expected that most of the GSE procured will be of the electric types when increasing number of reliable e-GSE models are available in the market.

**Photo 3.5: Electric GSE provided by AAHK at airside of HKIA**



## 3.5 Development of Airside EV and e-GSE Charging Infrastructure

From the implementation of the first phase of AAHK's Airside Vehicle Electrification Programme in 2012, AAHK has been progressively enhancing its EV charging infrastructure. Currently, there are already more than 400 number of normal EV chargers and also more than 30 number of quick EV chargers installed for use at the airside of HKIA. The total number of EV chargers are planned to be increased to over 1,300 to support the 3RS operation by 2030.

On the other hand, to facilitate the increased use of e-GSE at HKIA, including the effective operation of the e-GSE procured by AAHK for use in AAHK's GSE Pooling Scheme, AAHK has been increasing the number of e-GSE chargers for use at HKIA. Currently, there are already more than 180 e-GSE chargers installed for use at the apron area of HKIA and the total number is expected to be increased to more than 400 in 2025.

## 3.6 Adopting Fuel-efficient Airside Vehicles

The Air Pollution Control (Non-road Mobile Machinery) (Emission) Regulation (hereafter referred as the "NRMM Regulation") came into operation on 1 June 2015, where all NRMMs, except those exempted, are required to comply with prescribed emission standards, via a permitting system. All airport vehicles operating at the airside of HKIA, including vans, buses and GSEs are classified as NRMMs and are subject to permitting control under the Regulation.

As all vehicles within the airside of HKIA are required to obtain an AVL, AAHK took the opportunity to revise its AVL requirements to dovetail with the requirements stipulated under the NRMM Regulation. For ensuring compliance with the NRMM Regulation, AAHK will only issue AVL to those airside vehicles (equipped with compression-ignition or positive-ignition engine) if it bears a valid approval or exemption label issued under the NRMM Regulation. Besides, issued AVL will be repealed on the date when the approval or exemption is revoked under the NRMM Regulation.

Besides, as already described in **Section 3.3** above, AAHK has developed a roadmap and specified relevant requirements to promote the increased use of EV and the required phase out of old, non-fuel efficient vehicles. The key measures introduced include:

- Fossil fuel powered saloon vehicles were not issued with an AVL when the vehicle reached 9 years of age or after June 2017, whichever came earlier;
- Existing fossil fuel powered private vehicles with a gross weight of less than 3 tonnes were not issued with an AVL when the vehicle's licence issued by Transport Department or its AVL reached 7 years from the first issuance date from January 2021;
- All AVLs issued to fossil fuel powered private vehicles with a gross weight of less than 3 tonnes will be expired by end December 2023 as the targeted date as described in **Section 3.3.2**.

## 3.7 Utilizing Clean Diesel and Gasoline at the Airfield

Currently, to promote the use of cleaner fuel, biodiesel and also liquefied petroleum gas (LPG) fuelling points are already made available by AAHK at the airside of HKIA for use by vehicles.

For the longer term, while AAHK has developed relevant implementation roadmap and formed relevant policies and requirements to promote the increased use of EV and e-GSE in the airport operation, it is expected that there will still be some vehicle types, including commercial vehicles, service vehicles, medium and heavy goods vehicles, etc., and also specific GSE types for which relevant electric models are still at an early stage of development and hence are not yet commercially available for use. While AAHK will continue to identify and explore the possible use of zero emission vehicles for the above-mentioned vehicle types, to meet the operational need of these vehicles while taking into account the need to further reduce air emissions, including carbon emissions, AAHK has planned to undertake trials to test the use of alternative low carbon fuels for vehicles and GSE at HKIA and will introduce their use at HKIA if the trial results are successful.

## 3.8 Summary

**Table 3.1** has summarised the various measures and initiatives that are implemented, in progress or planned for implementation at HKIA. The listed measures, including those that have been implemented, will be applicable to both the current I-2RS and subsequent 3RS operation. The implementation schedule of those measures that are in progress or planned for implementation, including the target completion dates, have also been presented as part of the summary table to facilitate the subsequent monitoring of progress.

## Table 3.1: Airport Operation related Emissions Reduction Measures at HKIA

| Measures | Sections containing the details | Status | Implementation Schedule |
|---|---|---|---|
| **Banning Idling Engines** | | | |
| Banned idling vehicles and GSE with running engines on the airside since May 2008, except for certain vehicles and operations that are exempted. | Section 3.2 | Implemented | Completed |
| Banned the use of APU on aircraft at frontal stands since December 2014. | Section 3.2 | Implemented | Completed |
| **Promoting Increased Use of Electric Vehicles** | | | |
| Completed Phase 1 of AAHK's Airside Vehicle Electrification Programme, with all saloon cars replaced with EV models since 2017. | Section 3.3.1 | Implemented | Completed |
| Implementing Phase 2 of AAHK's Airside Vehicle Electrification Programme that focuses on replacement of all airside fossil fuel powered private vehicles with a gross weight of less than 3 tonnes with EV models. | Section 3.3.2 | In progress | Targeted for completion by end of 2023 |
| Implementing Phase 3 of AAHK's Airside Vehicle Electrification Programme that focuses on phasing out the existing fleet of vans, mini-buses and buses operating at the airside of HKIA with EV models, subject to their market availability and reliability. | Section 3.3.3 | Planned | 2024 – 2030* |
| **Promoting Increased Use of Electric Ground Services Equipment** | | | |
| Completed Phase 1 of AAHK's GSE Pooling Scheme that was implemented at Midfield Apron and extended to cover North Satellite Concourse and remote bays at West Apron. | Section 3.4.1 | Implemented | Completed |
| Implementing Phase 2 of AAHK's GSE Pooling Scheme that will take place at the apron area of Terminal 1. | Section 3.4.2 | In progress | 2022 – 2023 |
| Implementing Phase 3 of AAHK's GSE Pooling Scheme at the planned Terminal 2 Concourse (formerly known as Third Runway Concourse). | Section 3.4.3 | Planned | 2024 – 2030* |
| **Development of Airside EV and e-GSE Charging Infrastructure** | | | |
| Completed installation of EV and e-GSE charging facilities to support the implementation of Phase 1 of both the AAHK's Airside Vehicle Electrification Programme and GSE Pooling Scheme. | Section 3.5 | Implemented | Completed |
| Installing additional EV and e-GSE charging facilities to support the implementation of Phases 2 and 3 of both the AAHK's Airside Vehicle Electrification Programme and GSE Pooling Scheme. | Section 3.5 | In progress | Targeted for completion by 2030** |
| **Adopting Fuel-efficient Airside Vehicles** | | | |
| Revised AVL requirements to dovetail with the requirements stipulated under the NRMM Regulation | Section 3.6 | Implemented | Completed |
| Phasing out old, non-fuel efficient vehicles | Section 3.6 | In progress | Targeted for completion by 2030 |
| **Utilizing Clean Diesel and Gasoline at the Airfield** | | | |
| Provision of biodiesel and liquefied petroleum gas for use by vehicles at the airside of HKIA | Section 3.7 | Implemented | Completed |
| Explore the use of alternative low carbon fuels for vehicles and GSE at HKIA | Section 3.7 | In progress | Ongoing |

* Exact target completion dates of Phase 3 of both the Airside Vehicle Electrification Programme and GSE Pooling Scheme would be subject to the availability and reliability of electric commercial vehicles and GSE in the market.

** Exact target completion date for full development of the airside EV and e-GSE Charging Infrastructure would be subject to the implementation programme of Phase 3 of both the Airside Vehicle Electrification Programme and GSE Pooling Scheme.

# Annex

# I. Operational Air Quality Monitoring and Audit Plan

MOTT MACDONALD

# Expansion of Hong Kong International Airport into a Three-Runway System

## Operational Air Quality Monitoring and Audit Plan

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# Glossary

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|---|---|
| **2RS** | Two-Runway System |
| **3RS** | Three-Runway System |
| **AAHK** | Airport Authority Hong Kong |
| **AMO** | Airport Meteorological Office |
| **AOEC** | Airport Operation related Emissions Control |
| **APUs** | Auxiliary Power Units |
| **AQM&A** | Air Quality Monitoring and Audit |
| **AQMS** | Air Quality Monitoring Station |
| **AQOs** | Air Quality Objectives |
| **ASRs** | Air Sensitive Receivers |
| **DEP** | Director of Environmental Protection |
| **EIA** | Environmental Impact Assessment |
| **EIAO** | Environmental Impact Assessment Ordinance |
| **EM&A** | Environmental Monitoring and Audit |
| **EP** | Environmental Permit |
| **EPD** | Environmental Protection Department |
| **FSP** | Fine Suspended Particulate |
| **GSE** | Ground Services Equipment |
| **HKIA** | Hong Kong International Airport |
| **HKO** | Hong Kong Observatory |
| **I-2RS** | Interim Two-Runway System |
| **IATA** | International Air Transport Association |
| **ICAO** | International Civil Aviation Organization |
| **LTO** | Landing and Take-off |
| **NO** | Nitric Oxide |
| **$NO_2$** | Nitrogen Dioxide |
| **NOx** | Nitrogen Oxides |
| **MGVs** | Medium Goods Vehicles |
| **MM** | Mott MacDonald |
| **$PM_{2.5}$** | Particulate Matter 2.5 |
| **$PM_{10}$** | Particulate Matter 10 |
| **RSP** | Respirable Suspended Particulate |
| **T2** | Terminal 2 |

# 1 Introduction

## 1.1 Background

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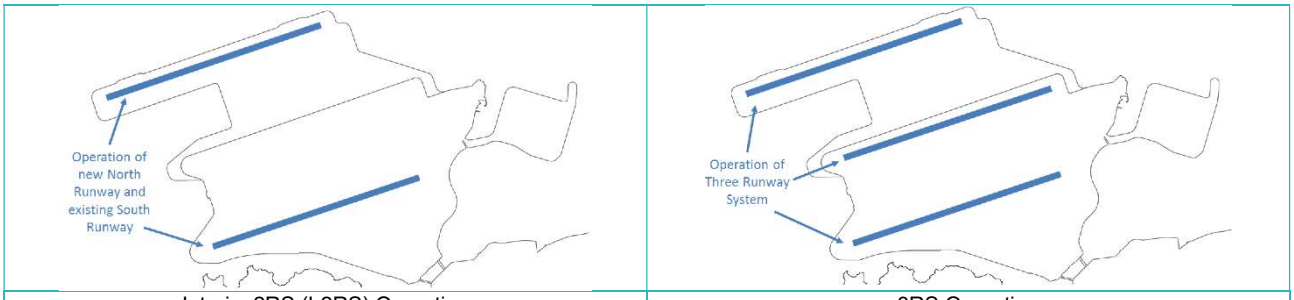
The Project is planned to be located on a new land formation area immediately north of existing Hong Kong International Airport (HKIA) in North Lantau, covering a permanent footprint of approximately 650 ha. As stated in the approved 3RS EIA, the Project primarily comprises:

- New third runway with associated taxiways, aprons and aircraft stands;
- New passenger concourse building;
- Expansion of the existing Terminal 2 (T2) building; and
- Related airside and landside works, and associated ancillary and supporting facilities.

As presented in the approved 3RS EIA Report, the runway operational configuration will be implemented in phases as shown in **Figure 1.1** below. Upon completion of the new third runway and associated taxiways and with operation familiarisation of the third runway started on 8 July 2022 and formal commencement of operation started since 25 November 2022, the previous north runway is closed temporarily for modification works. During this period as described in the approved 3RS EIA Report, the existing South Runway and the new third runway (which is designated as the new North Runway) is currently in operation, which is hereafter referred to as the interim two-runway system (I-2RS). Upon completion of all essential infrastructure and facilities, the airport will be operated under the 3RS, which is hereafter referred to as the 3RS operation.

**Figure 1.1: Runway Operation Configuration**




Interim 2RS (I-2RS) Operation | 3RS Operation

The operational phase air quality impact assessment undertaken as part of the 3RS EIA had assessed the potential air quality impact on air sensitive receivers (ASRs) identified within 5km from the project boundary based on the highest aircraft emission scenario under normal operating conditions of the Project in accordance with the EIA Study Brief requirements.

As summarised in Section 5.3.7.1 of the approved 3RS EIA Report, no non-compliance against the Air Quality Objectives (AQOs) has been predicted at all the identified ASRs during the operation of the Project. Nevertheless, the Airport Authority Hong Kong (AAHK) has been implementing a number of measures and initiatives aimed at further reduction in air emissions from airport activities and operations at HKIA, and these efforts are expected to continue in the current I-2RS and subsequent 3RS operation.

Besides, pursuant to EP Condition 3.1(vi), Section 2.2 of the EM&A Manual was updated to include details of the air quality monitoring and audit requirements during the operation of the Project, and AAHK had committed

to carrying out regular reviews of the operation phase air quality monitoring results and relevant operation data in order to:

- Monitor the variations in pollutant concentrations and compare these with the operational phase air quality assessment results presented in the 3RS EIA Report;
- Determine the effectiveness of AAHK's measures and initiatives aimed at further reducing air pollutant emissions from airport activities and operations; and
- Identify follow-up actions and/or further investigation that may be undertaken where necessary with a view to further reducing air emissions associated with the operation of the Project.

Details of the operational phase air quality monitoring and audit (AQM&A) programme planned by AAHK are presented in this AQMA Plan.

Mott MacDonald (MM) has been appointed by AAHK as the Consultant to provide consultancy services for the 3RS Project, which include, among others, the preparation of this AQM&A Plan.

## 1.2 Purpose of this Plan

This AQM&A Plan has been prepared to set out details of the operational phase air quality monitoring and audit programme planned by AAHK, and these have taken into account AAHK's commitments set out in Section 2.2 of the Updated EM&A Manual.

## 1.3 Structure of this Plan

Following this introductory section, this AQM&A Plan is structured as follows:

Section 2 Overview of the Proposed Air Quality Monitoring and Audit Programme

Section 3 Regular Review of Air Quality Monitoring Results

Section 4 Regular Review of Emissions Inventory

Section 5 Regular Review of Effectiveness of Measures and Initiatives

# 2 Overview of Proposed Air Quality Monitoring and Audit Programme

## 2.1 AQM&A Program Elements

As described in Section 5.3.7.1 of the approved 3RS EIA Report, no non-compliance against the Air Quality Objectives (AQOs) has been predicted at all of the identified ASRs during the operation phase of the 3RS Project. Nevertheless, AAHK has been implementing a number of measures and initiatives aimed at further reduction in air emissions from airport activities and operations, and these efforts are expected to continue in the current I-2RS and subsequent 3RS operation.

Moreover, in preparing the Updated EM&A Manual, AAHK has made a commitment to undertake air quality monitoring and audit on a regular basis during the 3RS operation. As set out in Section 2.2 of the Updated EM&A Manual, the AAHK's AQM&A programme will consist of following key elements:

- **Regular Review of Air Quality Monitoring Results:**
  - Monitoring data obtained from the three existing air quality monitoring stations (AQMSs) currently operated by AAHK at HKIA, together with that obtained at Tung Chung AQMS operated by EPD will be used in the regular review of air quality monitoring results (Section 2.2.2.2 of the Updated EM&A Manual refers);
  - $NO_2$ is the key parameter for which available monitoring data obtained at AAHK's AQMS together with that obtained at EPD's AQMS in Tung Chung should be regularly reviewed during the operational phase of the Project. The regular review shall also analyse and present the measured NO and NOx concentrations for estimating the pollutant contribution due to airport operations (Section 2.2.2.6 of the Updated EM&A Manual refers);
  - To be prudent, available monitoring data on respirable suspended particulate (RSP) and fine suspended particulate (FSP) should also be included in the regular reviews (also see Section 2.2.2.6 of the Updated EM&A Manual);
  - A detailed examination of the temporal and spatial variations of pollutant levels measured at AAHK's AMSs shall be presented and the analysis shall take into consideration the available monitoring data obtained at EPD's AQMS in Tung Chung. With consideration of the available data including those on meteorological conditions (i.e., wind direction, wind speed, temperature, precipitation, etc.), the review shall also characterise the mean seasonal and diurnal variation of pollutant concentrations, with a view to evaluating the significance of the contribution of air quality impact from airport emissions on the nearby ASRs (Section 2.2.3.1 of the Updated EM&A Manual refers).

- **Regular Review of Emissions Inventory:**
  - The regular review shall include the compilation of an updated inventory of major emission sources, including emissions from aircraft landing and take-off (LTO) cycle associated with the airport operations (Section 2.2.3.1 of the Updated EM&A Manual refers); and

- **Regular Review of Effectiveness of Measures / Initiatives:**
  - The effectiveness of existing measures and initiatives implemented by AAHK aimed at further reducing air pollutant emissions from airport operation shall be evaluated (Section 2.2.3.2 of the Updated EM&A Manual refers).

As summarised above, based on the approved 3RS EIA Report, the Updated EM&A Manual had recommended that the AQM&A programme that AAHK has planned to do will focus on $NO_2$ and NOx, though RSP and FSP may also be covered as a prudent approach. While the AQM&A programme will be delivered as planned by AAHK and the details are presented in **Sections 3** to **5**, it is worth noting that background air quality in Hong Kong including the districts near HKIA has been improving and these are well reflected via the air quality monitoring data obtained in recent years at HKIA's AQMS and also at EPD's AQMS in Tung Chung as summarised below:

- The annual concentrations of $NO_2$ had been reduced from 43-51 $\mu g/m^3$ monitored between years 2008 to 2012 (i.e., exceeding the AQO of 40 $\mu g/m^3$ specified for annual $NO_2$, as reported in Table 5.1.9 of the approved 3RS EIA Report) to 28-40 $\mu g/m^3$ obtained between years 2015 to 2020 (i.e., meeting the above-mentioned AQO as summarised in Table A.1 in **Appendix A**) at EPD's AQMS in Tung Chung; and
- The number of exceedance of the AQOs specified for 1-hour $NO_2$ at EPD's AQMS in Tung Chung had also been reduced from a maximum of 20 reported for year 2010 (i.e., exceeding the allowable exceedance of 18, as also reported in Table 5.1.9 of the approved 3RS EIA Report) to a maximum of 7 reported for years 2015 and 2018 (i.e., much less than the allowable exceedance of 18, as summarised in Table A.2 in **Appendix A**). Years 2019 and 2020 showed no exceedance of the 1-hour AQO for $NO_2$ at EPD's AQMS in Tung Chung.

From Tables A.1 and A.2 in **Appendix A**, it is also worth noting that while the air traffic movements (ATMs) at HKIA in 2020 had been significantly affected as a result of the COVID-19 pandemic, reducing from a total of 420,000 in year 2019 to 161,000 in year 2020 (see: https://www.hongkongairport.com/en/the-airport/hkia-at-a-glance/fact-figures.page) and representing a drop of more than 60% in ATMs, the annual concentrations of $NO_2$ monitored at EPD's AQMS in Tung Chung had only reduced for 15% from 32.9 $\mu g/m^3$ to 27.9 $\mu g/m^3$, reflecting that there are other more significant sources of $NO_2$ at this AQMS though there are also contribution from the HKIA operation.

## 2.2 EP Submission

The Airport Operation related Emissions Control (AOEC) Plan has been prepared to satisfy the EP Condition 2.24, which is reproduced below. Taking into account the findings of the AQM&A programme, including the regular review of air quality monitoring results and emission inventory, the effectiveness of the measures and initiatives implemented by AAHK aimed at further reducing air pollutant emissions from the airport operation may be reviewed.

*The Permit Holder shall, no later than 3 months before the operation of the Project, deposit 3 hard copies and 1 electronic copy of an Airport Operation related Emissions Control Plan with the Director, detailing the measures to be taken to minimize and control the emissions due to the airport operation including but not limited to adopting fuel-efficient airside vehicles, promoting increased use of electric vehicles and electric ground services equipment, banning all idling vehicles on the airside and utilizing clean diesel and gasoline at the airfield.*

# 3 Regular Review of Air Quality Monitoring Results

## 3.1 Regular Review of Pollutant Concentration Data

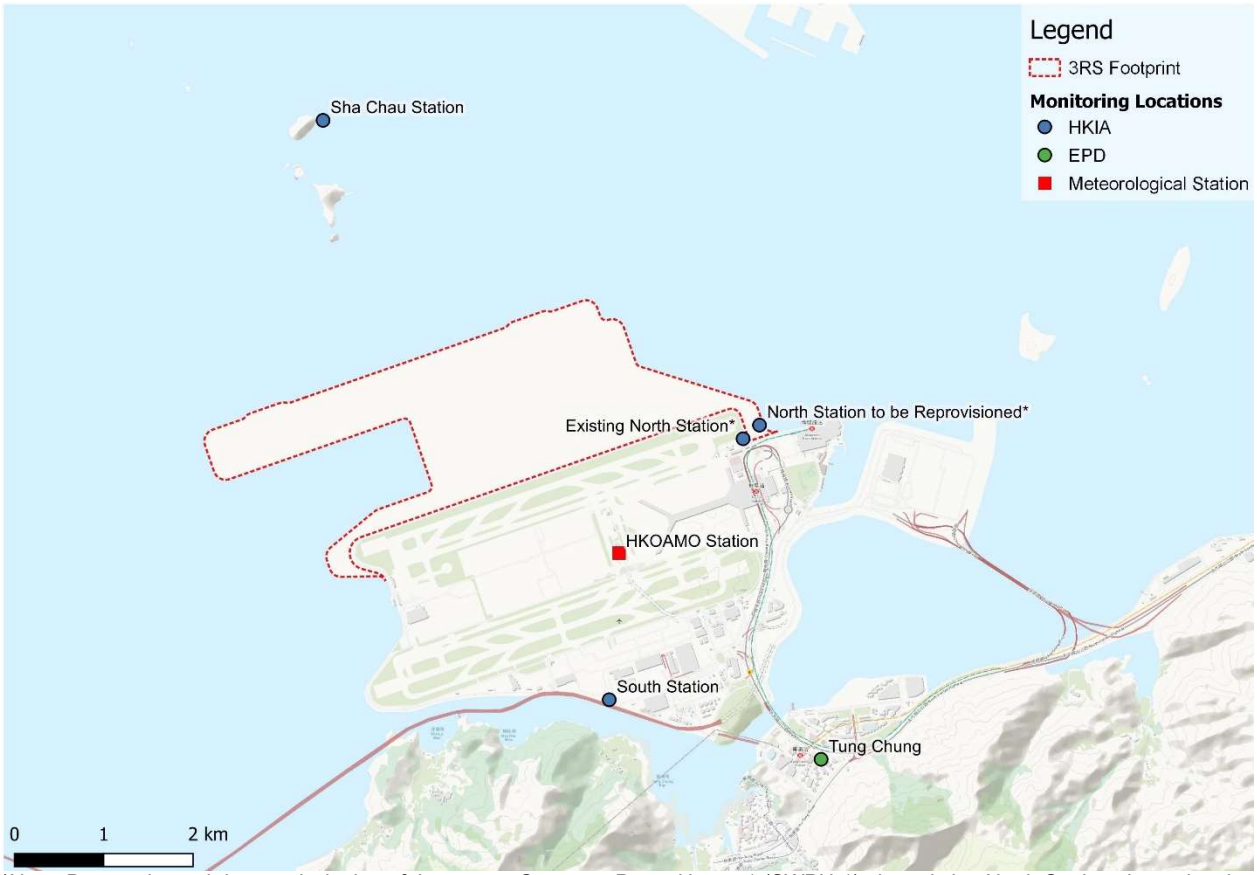
AAHK has made a commitment via the Updated EM&A Manual to undertake regular reviews of $NO_2$, though RSP and FSP may also be covered as a prudent approach.

Pollutant concentration data for the above-mentioned pollutants will be collected using the following existing AQMS operated by AAHK. Their current locations are presented in **Figure 3.1**:

- North Station (PH1) at north of the main terminal building;
- South Station (PH5) at South Perimeter Road; and
- Sha Chau Station (SC) on Sheung Sha Chau island.

In addition to analysing the pollutant concentrations from data obtained from AAHK's three AQMS, pollutant concentrations measured at EPD's AQMS in Tung Chung (also see **Figure 3.1** for its location) will also be included within the analysis. The required data will be obtained from EPD for the review.

**Figure 3.1: Location of Air Quality Monitoring Stations**




*Note: Due to planned decommissioning of the current Seawater Pump House 1 (SWPH-1), the existing North Station situated at the current SWPH-1 is planned to be reprovisioned at the new SWPH-1 in 2024 as shown above.

The existing techniques and equipment used by AAHK's contractor in air quality monitoring have been reviewed by the consultant as the Environmental Team (ET) and these are considered appropriate for use in ongoing measurements of the air pollutant concentrations in the current I-2RS and subsequent 3RS operation.

A summary of the annual mean and hourly data for AAHK's three AQMS at PH1, PH5 and SC as well as EPD's AQMS at Tung Chung will be included as part of the regular reviews. Such data will be analysed to identify any changes in long term trends of the data recorded at these monitoring locations. Annual mean concentrations of $NO_2$, NO, NOx, RSP and FSP recorded at these four AQMS are presented in **Appendix A** for the years 2015 – 2020 to provide an example of the data and how these may be presented.

## 3.2 Temporal and Spatial Analysis

### 3.2.1 Approach

In addition to presenting summary tables of monitored pollutant concentrations as described in **Section 3.1** above, relevant temporal and spatial analysis of the monitored pollutant concentrations using measured data from the three AAHK's AQMS and also EPD's AQMS at Tung Chung will be undertaken on a regular basis as part of the review.

These analysis may focus on investigating into the differences in concentrations between monitoring locations, for example, obtained via subtracting concentrations recorded at Sha Chau Station from those obtained at the South Station under the northern wind direction at the same time. In the event more detailed statistical analysis is required, for example if monitored concentrations show an upward trend, or the simple analysis indicates the airport contribution to pollutant concentrations may be increasing, the following types of interrogation may be undertaken as further analysis:

- Time Variation Graphs - showing the average variation of pollutant concentrations by day of the week and hour of the day combined, hour of the day (diurnal variation), month of the year (seasonal variation) and day of week;
- Polar Plots - pollutant concentrations by wind speed and wind direction to show a graphical representation of the relationship between pollutant concentrations and the meteorological conditions;
- Polar Frequency Plots - to visualise the distribution of wind speeds and directions at each monitoring site showing the variation of pollutant variables;
- Trend Analysis – to calculate the smoothed trend line at each monitoring station in the period since it started operating, in order to see if, and to what extent air quality may be improving.
- De-weathering - to enable the effects of meteorological and temporal factors to be nominally removed to then allow the identification of the changes in concentrations which would, in theory, have been recorded if meteorological conditions and temporal influences had remained constant, thus identifying what changes in concentrations (and thus emissions) have taken place.

Taking into account the findings of the operational phase air quality assessment presented in the approved 3RS EIA Report when $NO_2$ was identified to be the key parameter of interest as reported above, it is considered that analysis will focus on $NO_2$. However, the regular review shall also analyse and present the measured NO and NOx concentrations to facilitate analysis of pollutant contribution due to the airport operations.

### 3.2.2 Meteorological Data

Hong Kong Observatory (HKO) currently operates an Airport Meteorological Office (AMO) at the airport. The available meteorological data recorded by AMO will be taken into consideration in the detailed statistical analysis of air quality and meteorological datasets.

## 3.3 Review Frequency

As per Section 2.2.2.7 of the Updated EM&A Manual, the $NO_2$, RSP and FSP monitoring data shall be reviewed after the first year of 3RS operation, and then at regular intervals of at least every five years during the first 20 years of operation. The frequency of the reviews may be subject to changes depending on the review results.

# 4 Regular Review of Emissions Inventory

## 4.1 Introduction

In addition to the regular review of monitoring results, AAHK has also made a commitment via the Updated EM&A Manual that the regular review shall include the compilation of an updated inventory of major emission sources, including emissions from aircraft in the landing and take-off (LTO) cycle associated with the airport operations. AAHK will collect relevant information for development of the latest airport emissions inventory as part of the review.

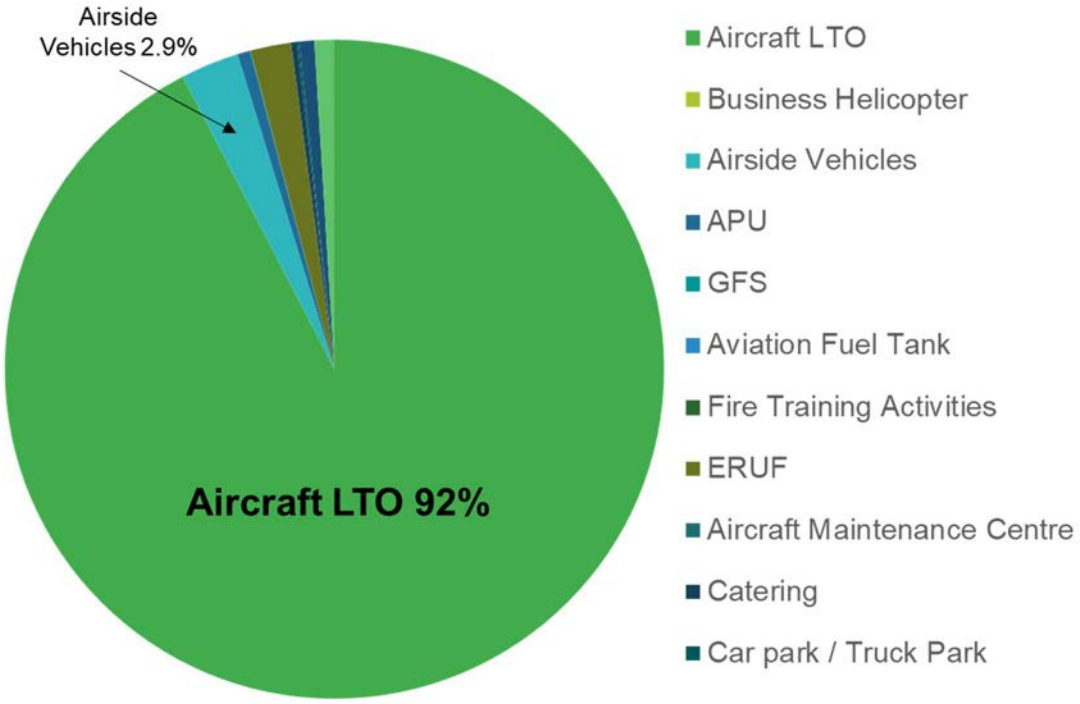
## 4.2 Approach to Emissions Inventory Compilation

The principal application of an updated emission inventory of major emission sources, to be delivered as part of the planned AQM&A programme, is to provide updated airport operation related data regularly to facilitate an evaluation of the effectiveness of the various measures and initiatives that have been implemented, in progress, or planned for implementation by AAHK for further reducing the air pollutants from airport operation.

Based on Table 5.3.59 of the approved 3RS EIA Report, which is reproduced in the form of a pie chart as shown in **Chart 4.1**, the most significant airport-related emission source is from aircraft in the LTO cycle, most notably for NOx where emissions in the aircraft LTO represent 92% of airport-related emissions. Airside vehicles, including ground services equipment (GSE), have been identified to be the next most dominant NOx emissions representing 2.9% of airport-related emissions.

According to Section 2.2.2.5 of the Updated EM&A Manual, NOx is the key air pollutant associated with airport operations. Therefore, to meet the commitment made by AAHK with respect to compiling an updated inventory of major emission sources as presented in Section 2.2.3.1 of the Updated EM&A Manual, it is considered that the periodic updating of the airport-related emissions inventory may focus on the top two highest emission sources, namely, aircraft LTO and airside vehicles, including GSE, which have, in aggregate, already accounted for 94.9% of airport-related NOx emissions.

**Chart 4.1: Summary of 3RS Emission Inventory for Airport Related Activities**




Note: Derived from Table 5.3.59 of the approved 3RS EIA Report.

**Emissions from Aircraft Landing and Take-off**

Regarding the LTO cycle, the regular review shall focus on establishing an updated emissions inventory for a specific emission scenario or for a specific year based on available airport operational data at HKIA. The emission calculations shall be undertaken with consideration of aircraft fleet mix and movement data available for the 3RS operation at HKIA. Similar to the detailed analysis undertaken at the 3RS EIA stage, estimates of take-off time, climb-out time and approach time shall take into account the differences in performance of different aircraft, with consideration of available radar data that could be obtained from the Civil Aviation Department. The taxi-in and taxi-out time of aircraft shall also take into account operational data obtained by AAHK in the 3RS operation. Emissions characteristics of engines shall be derived from the International Civil Aviation Organisation (ICAO) aircraft engine emissions databank. Where data are not available for use in the emissions calculation, relevant assumptions will be made in the analysis.

Emissions for aircraft in LTO cycle (LTO nominally up to 3,000 feet or 914.4 metres above ground level) were calculated in the 3RS EIA Report by using ICAO engine exhaust emission data. The same approach may be used for the updated emissions inventory. This will include the same approach chosen to represent approach, taxi/idle, take-off and climb, as illustrated below:

- Taxi:
  - taxi-out
  - hold at runway head
  - taxi-in
- Take-off:
  - take-off roll (from start-of-roll to wheels-off)
- Climb:
  - initial climb (i.e., wheels-off to throttle-back)
  - climb-out (from throttle-back to 3,000 feet altitude)
- Approach:
  - approach (from 3,000 feet altitude to runway threshold)
  - landing roll (from threshold to runway exit)

**Emissions from Airside Vehicles and GSE**

In addition to the LTO cycle related emissions, progress in reducing emissions from airside vehicles and GSE, for which the details have been presented in the AOEC Plan, may be tracked via the establishment of relevant performance indicators, including number and percentage use of airside electric vehicles and electric GSE, and also total fuel consumption by non-electric airside vehicles and GSE on the airside.

Where further analysis is identified necessary for a specific emission scenario or year via development of an updated emissions inventories of airside vehicles and GSE, relevant airport operational data, including the distribution and characteristics of airside vehicles and GSE used at HKIA for the year of interest in the 3RS operation and vehicle fuel consumption data, etc. will be collected for analysis in development of the updated emissions inventory. Where data are not available, relevant assumptions will be made in the analysis.

## 4.3 Review Frequency

As per Section 2.2.2.7 of the Updated EM&A Manual, the updated emission inventories of LTO cycle and also performance indicators/ updated emission inventories of airside vehicles and GSE may be reviewed after the first year of 3RS operation, and then at regular intervals of at least every five years during the first 20 years of operation. The frequency of the reviews may be subject to changes depending on the review results.

# 5 Regular Review of Effectiveness of Measures and Initiatives

## 5.1 Updated EM&A Manual Requirements

As presented in Section 2.2.3.2 of the Updated EM&A Manual, AAHK has committed to evaluating the effectiveness of existing and planned measures and initiatives implemented at HKIA for minimising and controlling the emissions due to the airport operation. These will allow follow-up actions and/or further investigation work to be undertaken, where necessary, with a view to further reducing air emissions associated with the operation of the Project.

## 5.2 Review Process

The AOEC Plan has been prepared in accordance with the EP Condition 2.24. The airport operation related emissions control measures that are already implemented, in progress, or planned for implementation at HKIA, are as summarised in **Table 3.1** of the AOEC Plan, with the following key categories:

- Banning idling engines – implemented;
- Promoting increased use of airside electric vehicles – Phase 1 implemented; Phase 2 in-progress; and Phase 3 planned for implementation;
- Promoting increased use of electric GSE – Phase 1 implemented; Phase 2 in-progress; and Phase 3 planned for implementation;
- Development of airside electric vehicle and electric GSE charging infrastructure – partly completed and partly in progress;
- Adopting fuel-efficient airside vehicles – partly completed and partly in progress;
- Utilizing clean diesel and gasoline at the airfield – partly completed and partly in progress.

As detailed in **Section 4.2** above, relevant performance indicators, including number and percentage use of airside electric vehicles and electric GSE, and also total fuel consumption by non-electric airside vehicles and GSE on the airside, will be established for tracking the process of emissions reduction. Further analysis via development of an updated emissions inventories of airside vehicles and GSE for a specific emission scenario or year would also be undertaken where necessary. Therefore, through the regular review of emissions from airside vehicles and GSE as part of the periodic emission inventory updating exercise, the effectiveness of these measures in reducing emissions associated with airside vehicles and GSE will be monitored.

Taking into account the findings of the AQM&A programme, including the regular review of air quality monitoring results and emissions inventories as presented in Sections 3 and 4 above, the effectiveness and implementation status of the existing and planned measures and initiatives aimed at further reducing air pollutant shall be regularly reviewed for identification of any required follow-up actions and/or further investigation.

## 5.3 Review Frequency

As per Section 2.2.2.7 of the Updated EM&A Manual, the effectiveness of the measures and initiatives will be reviewed after the first year of 3RS operation, and then at a regular interval of at least every five years during the first 20 years of 3RS operation. The frequency of the reviews may be subject to changes depending on the review results.

# Appendices

# A. Data Presentation Examples for Regular Reporting of Monitored Pollutant Concentrations

**Table A.1: Annual Mean Concentrations of Air Pollutants in Years 2015 - 2020**

| Site | Year | Annual Mean Conc. (μg/m$^3$) [a] | | |
|---|---|---|---|---|
| | | $NO_2$ | $PM_{10}$ | $PM_{2.5}$ |
| Sha Chau Station | 2015 | 37.4 | 35.5 | 24.5 |
| | 2016 | 38.1 | 28.0 | 21.0 |
| | 2017 | 39.5 | 26.7 | 22.4 |
| | 2018 | 35.7 | 28.4 | 19.7 |
| | 2019 | 33.4 | 37.1 | 24.1 |
| | 2020 | 29.4 | 33.1 | 20.2 |
| North Station | 2015 | **45.9** | 37.7 | 24.7 |
| | 2016 | **47.3** | 30.5 | 19.7 |
| | 2017 | **45.6** | 35.7 | 24.6 |
| | 2018 | **43.6** | 30.0 | 17.8 |
| | 2019 | **40.4** | 31.4 | 18.4 |
| | 2020 | 35.7 | 23.8 | 15.6 |
| South Station | 2015 | **48.8** | 24.2 | 17.5 |
| | 2016 | **48.6** | 24.7 | 17.4 |
| | 2017 | **51.6** | 28.4 | 18.4 |
| | 2018 | **50.4** | 31.0 | 18.5 |
| | 2019 | **45.6** | 24.1 | 14.0 |
| | 2020 | 38.0 | 21.4 | 12.9 |
| Tung Chung Station | 2015 | 39.8 | 36.2 | 22.0 |
| | 2016 | 35.9 | 32.5 | 21.0 |
| | 2017 | 35.6 | 34.1 | 20.8 |
| | 2018 | 33.1 | 31.3 | 17.5 |
| | 2019 | 32.9 | 30.4 | 19.3 |
| | 2020 | 27.9 | 25.1 | 14.2 |
| **Objective** | | **40** | **50** | **35** [b] |

[a] Exceedances of the objectives are shown in **bold**. Those happening at the North or South Stations are expected as these stations are located close to the emission sources at the airport.

[b] This is the historical AQO for annual $PM_{2.5}$ which was effective from 1 January 2014 to 31 December 2021. The prevailing AQO for annual $PM_{2.5}$ which has become effective since 1 January 2022 is 25 μg/m$^3$.

## Table A.2: Exceedances of the Short term AQOs in Years 2015 - 2020

| Site | Year | Number of Exceedances [a] | | |
|---|---|---|---|---|
| | | 1-hour Mean $NO_2$ | 24-hour Mean $PM_{10}$ | 24-hour Mean $PM_{2.5}$ |
| Sha Chau Station | 2015 | 11 | 6 | 6 |
| | 2016 | 5 | 1 | 1 |
| | 2017 | 9 | 1 | 1 |
| | 2018 | 15 | 0 | 1 |
| | 2019 | 1 | 6 | 3 |
| | 2020 | 0 | 0 | 0 |
| North Station | 2015 | 13 | 6 | 5 |
| | 2016 | 4 | 2 | 0 |
| | 2017 | 14 | 2 | 2 |
| | 2018 | **22** | 2 | 2 |
| | 2019 | 0 | 0 | 0 |
| | 2020 | 0 | 0 | 0 |
| South Station | 2015 | 11 | 2 | 2 |
| | 2016 | 1 | 1 | 1 |
| | 2017 | 1 | 0 | 0 |
| | 2018 | 12 | 1 | 2 |
| | 2019 | 2 | 0 | 0 |
| | 2020 | 0 | 0 | 0 |
| Tung Chung Station | 2015 | 7 | 8 | 5 |
| | 2016 | 0 | 6 | 4 |
| | 2017 | 2 | 5 | 2 |
| | 2018 | 7 | 2 | 2 |
| | 2019 | 0 | 2 | 1 |
| | 2020 | 0 | 0 | 0 |
| Allowable Number of Exceedances over the Corresponding Objective [b] | | **18** | **9** | **9** [c] |

[a] Number of exceedances beyond the allowable number of exceedances are shown in **bold**. Those happening at the North or South Stations are expected as these stations are located close to the emission sources at the airport.

[b] This included the AQO of 200 µg/m$^3$ set out for 1-hour $NO_2$, the AQO of 100 µg/m$^3$ set out for 24-hour $PM_{10}$ and also the historical AQO of 75 µg/m$^3$ from 1 January 2014 to 31 December 2021 set out for 24-hour $PM_{2.5}$. The prevailing AQO sets out for 24-hour $PM_{2.5}$ which has become effective since 1 January 2022 is 50 µg/m$^3$.

[c] This is the allowable number of exceedances under the historical AQO for 24-hour $PM_{2.5}$ which was effective from 1 January 2014 to 31 December 2021. Under the prevailing AQO for 24-hour $PM_{2.5}$ which has become effective since 1 January 2022, the allowable number of exceedances is 35.