

# Transport and Housing Bureau - Hong Kong

## Phased Transition Approach for Air Traffic Management System and Overall Transition Readiness for ATC Replacement System

Reference THB(T)SE Q040/2015

### PFI Stage 1 Assessment

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## Executive Summary

1. The Hong Kong Government has commissioned the construction and implementation of a new Air Traffic Management System (ATMS). The new ATMS being installed at the new Air Traffic Control Centre (ATCC) of CAD Headquarters is intended to replace the existing system installed at Air Traffic Control Complex commissioned in 1998.
2. NATS was first engaged by the Transport and Housing Bureau of the Hong Kong Special Administrative Region Government to assess system and staff readiness of the new ATMS based on a “snapshot” review in December 2015 under a “big-bang” implementation. NATS suggested in the study the possibility of a Phased Functional Implementation (PFI) of the new ATMS. CAD accepted NATS’ recommended PFI and is using a two-phase transition scheme. Stage 1 of PFI is based on the initial operational transition of the North Aerodrome Control Tower (N-TWR) for limited hours per scheduled day with gradual extension to the remaining positions and adjustment of operational period. This is followed by a similar approach at the new ATCC for various airspace sectors, culminating in the complete transition to full Air Traffic Control (ATC) service with both the N-TWR and the new ATCC covering 24x7 operations (in Stage 2).
3. To support THB and CAD, NATS has been employed to provide independent assessment of the operational readiness of the ATMS system, and also to review and confirm the practicality of the overall PFI scheme and the readiness of the PFI Stage 1 (this report).
4. This study includes an assessment of the overall practicality of the PFI scheme, the readiness of the operational transition of the PFI Stage 1 Configuration, and also an update on the progress made by CAD on NATS’ recommendations during the “snapshot” review back in December 2015 (Reference 1). The report is based on documentation made available to NATS between the end of the “snapshot” review up to end April 2016 (with supplementary information provided in early May 2016) and previous documentation and familiarity with the system established in conducting “snapshot” review.
5. Overall, NATS notes that there is a volume of high quality, detailed work providing a significant body of evidence to support all major aspects of the planned PFI. As such NATS believes CAD has an overall robust plan and approach to its ATMS transition. Particular areas of good practice include:
  - a. CAD’s overall approach to ATC training, planning, and rostering which are thorough and provide a comprehensive body of evidence; and
  - b. The ATMS safety case and associated documentation which provide a comprehensive risk assessment and assurance process to undertake the PFI scheme.
6. NATS has made two recommendations to support CAD’s planning and delivery of the PFI. These two recommendations are made as a result of this report which is accepted by CAD and corresponding actions have been in place to address them:-
  - a. **Recommendation 2.1:** To support the senior management team to maintain and manage the overall progress through the PFI scheme, a single graphic of overall progress (reporting progress, successes, risks and issues) across the people, process, technology, communications and safety assurance should be



operations in phases, and help minimise the risk of providing full functional services in October/November 2016.

11. Phased introductions of major system changes are used as standard practice within NATS, utilising 'shadowing' and live 'operational services', within a defined and well-controlled operating environment (COE) under the International Civil Aviation Organisation (ICAO) Safety Management Regime.
12. NATS compliments CAD on the amount of work carried out to a detailed level in preparation for PFI. NATS believes CAD has an overall robust, achievable plan and approach to the phased transition of the new ATMS. The body of evidence provided to NATS has demonstrated that CAD is addressing the PFI scheme in a practical and complete manner. As CAD has presented the progress, claim and supporting documentation for the overall PFI practicality according to the CAE model, NATS is satisfied that CAD is on track to commence in June 2016.

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## SECTION 1: Introduction

### 1.1 Document Scope

The Hong Kong Government has commissioned the construction and implementation of a new Air Traffic Management System (ATMS). The new ATMS being installed at the new Air Traffic Control Centre (ATCC) of CAD Headquarters is intended to replace the existing system installed at Air Traffic Control Complex commissioned in 1998.

CAD's operational readiness and transition strategy has evolved, and as a result CAD is now planning on the basis of a phased transition. The phased transition scheme, hereafter called Phased Functional Implementation (PFI), is based on the initial operational transition of the North Aerodrome Control Tower (N-TWR) for limited hours per scheduled day with gradual extension to the remaining positions and adjustment of operational periods (Stage 1). This is followed by a similar approach at the new ATCC for various airspace sectors, culminating in the complete transition to full Air Traffic Control (ATC) service with both the N-TWR and the new ATCC covering 24x7 operations (Stage 2).

This document assesses the overall readiness and practicality of the operational transition of the N-TWR within the PFI scheme by reviewing, including but not limited to, the aspects of safety, ATC procedures, contingency procedures, training, maintenance and supporting safety documentation covered under the ATMS Safety Case Report and the relevant safety documents supporting transition readiness of PFI.

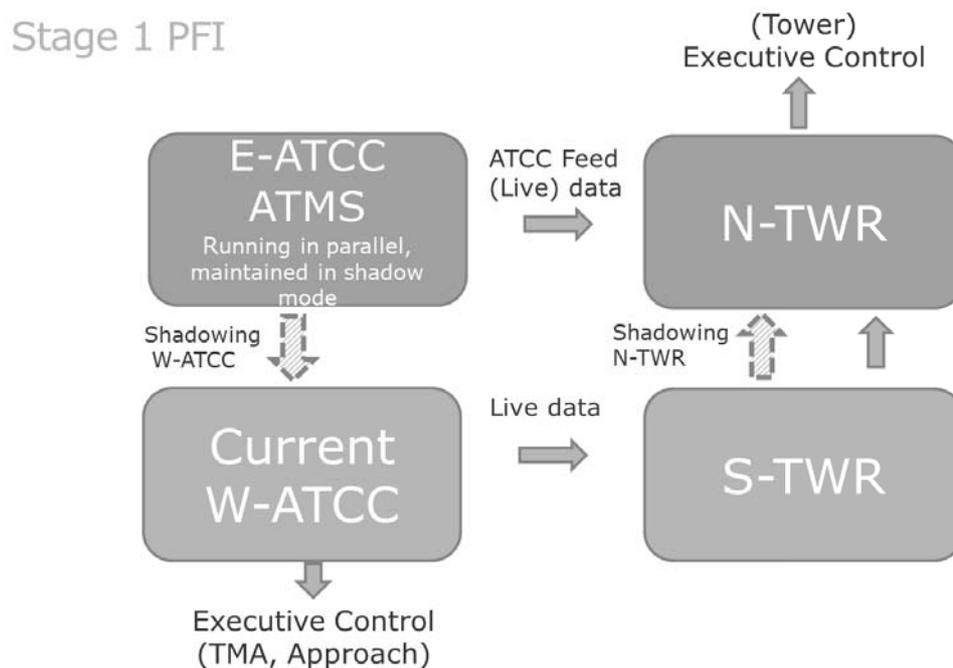
This document represents the Stage 1 assessment for the Tower Phased Functional Implementation. Section 2 provides the high level description of the PFI Stage 1 Configuration, and Section 3 provides the detailed assessment of the different elements of the Stage 1 configuration. Section 4 concludes the report and provides the outcomes and best practice guidance.

## SECTION 2: PFI Configuration

### 2.1 Stage 1 High Level Description

The phased transition strategy to the new ATMS is based on two Stages. This document focuses on the PFI Stage 1 configuration.

The PFI Stage 1 configuration allows ATC executive control to be provided by the North Tower (N-TWR), whilst the area control executive control is provided by the existing Area Control Centre (ACC). In order to provide the data to the N-TWR, the new ATMS is running in parallel to the current ACC, with ATC staff inputting data to the new ATMS to ensure that the system and staff in the N-TWR have the appropriate data to provide the service. In this configuration the current South-Tower (S-TWR) provides the hot standby (contingency) to the N-TWR i.e. S-TWR is on 'shadowing' mode during the designated hours on scheduled days. In order to enter this configuration there are clear entry criteria and exit criteria. This configuration is summarised in Figure 1 below.



**Figure 1**

Within the PFI Stage 1 configuration, a number of sessions are planned, with the precise timing and nature of those sessions under active review (depending on the defined entry criteria such as meteorological conditions).

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## SECTION 3: Analysis of PFI Stage 1 Configuration

### 3.1 Methodology

The analysis is based on documentation made available to NATS between the end of the “snapshot” review of Phase 1 study in December 2015 and up to end April 2016 (with supplementary information provided in early May 2016) and previous documentation and familiarity with the system established in delivery of Phase 1 study.

Within the analysis NATS was tasked to respond to the following 4 key aspects:

- The overall practicality of the PFI Scheme;
- Integrity and Validation of Safety Documentation in support of PFI (including the ATMS Safety Case);
- ATC / Engineering Procedures and Contingency; and
- ATC / Engineering Training.

Supporting points, in the form of questions, being used to assess these aspects within the study are detailed in Appendix A. Where applicable the review is also supported by information and evidence from previous activities from the Operational Readiness Review of ATMS undertaken in December 2015. Each of these points will be discussed in Section 3.2, highlighting key findings from the documentation review, and associated points that need clarification from CAD as well as CAD’s corresponding responses, which include clarification, additional information and/or action from CAD.

The review was achieved through assessing the following:

- Safety and related safety documentation;
- ATC procedures;
- Resourcing Plans;
- Contingency Procedures;
- Training;
- Maintenance and Engineering procedures; and
- Documents supporting transition readiness of PFI.

NATS has assessed the integrity, reasonableness, implementation of CAD’s responses and, if outstanding, the potential impact for such items on PFI Stage 1 and the overall PFI scheme. This information is provided under the “Summary of Documentation Review” column. The assessed result of such items is registered under the “Status” column.

### 3.2 Overall Practicality of PFI Scheme

Ref	Question	Summary of Documentation Review	Status
S1.1	Are Resourcing Plans for all (ATC) required positions in place?	<p><b>Consideration:</b> A staffing plan, with detailed arrangements, for PFI sessions has been produced. Detailed plans are in place for PFI Stage 1 sessions.</p> <p><b>Assessment:</b> NATS views that the plans are in place and the ATC staffing plan is robust.</p>	CLOSED
S1.2	Are Resourcing Plans for all (Engineering) required positions in place?	<p><b>Consideration:</b> An Engineering resource plan equivalent to the ATC Resource Plan for PFI has been produced. The information provided for Engineering resource relates to the manpower resources required to support the transition and technical staff needed for PFI sessions in Stage 1.</p> <p><b>Assessment:</b> NATS views that the plans are in place and the ATC staffing plan is robust.</p>	CLOSED
S1.3	Are there problem raising and tracking linked to the appropriate phase of implementation ?	<p><b>Consideration:</b> The CAD Transition Review meeting includes both ATC and engineering representation. NATS also notes that a single database is employed, which CAD manages and prioritises issues associated with PFI for information integrity, timeliness and correctness.</p> <p><b>Assessment:</b> NATS views that such a process is in place and effective.</p>	CLOSED
S1.4	Is there a lesson learning review process in place for each PFI?	<p><b>Consideration:</b> The process is in place to review and manage lessons learnt, if any. This includes high level success criteria and specific success criteria defined for each session.</p> <p><b>Assessment:</b> NATS views that such a process is in place and effective.</p>	CLOSED
S1.5	Does the plan of activity have clear scope, timing and deliverables / success criteria?  <i>(Does the plan of activity have clear equipment and test dependencies, scope, timing and deliverables / success criteria?)</i>	<p><b>Consideration:</b> There are details of the processes to be used for the PFI Stage 1 – these cover the pre-PFI activities and the processes used to confirm equipment availability and readiness. The processes include Engineering representation via the Responsible Officer (RO) of equipment (AESD/ATMD), the engineers and procedures.</p> <p>In relation to the equipment and test dependencies, the ability of the ATMS to be used for shadowing and provision of feed data is supported by previous shadowing experience.</p> <p>It is recognised that some of these documents are by nature “living documents” and require base lining and/or updates for PFI Stage 1.</p> <p>The confidence in the ATMS to support the Tower EFPS functionality for PFI Stage 1 and other functionality is further improved by subsequent software builds verification, validation evidence and additional test evidence.</p> <p>There are a number of on-going minor technical aspects being tracked and resolved in subsequent build verification tests via regular meetings on the Phased Transition Approach, which are part of the established processes.</p> <p><b>Assessment:</b> CAD is in action to ensure that documents that are “living” by nature are finalised, updated if necessary, and</p>	IN PROGRESS AND ON TRACK FOR PLANNED STAGE 1 PFI

		communicated before commencement of the PFI Stage 1 Configuration, as per normal CAD process. Noting the comprehensive nature and overall readiness of these documents, NATS is satisfied that the item is on course to closure subject to the final review prior to commencement of PFI to be registered in the updated Report.	
S1.6	<p>Does the plan of activity have clear scope, timing and deliverables / success criteria?</p> <p><i>(Does the plan of activity have clear scope, timing and deliverables / success criteria for completion of safety assurance)</i></p>	<p><b>Consideration:</b> The processes for entering and establishing the PFI Stage 1, which include checks to ensure the required safety management activities, have been satisfactorily completed. It is recognised that some of these documents are by nature “living documents” and require base lining and/or amendment for PFI Stage 1.</p> <p><b>Assessment:</b> CAD is in action to ensure that documents that are “living” by nature are finalised, updated if necessary, and communicated before commencement of the PFI Stage 1 Configuration, as per CAD established process. By the degree of completeness of such documents, NATS is satisfied that the item is on course to closure subject to the final review prior to commencement of PFI.</p>	<p>IN PROGRESS AND ON TRACK FOR PLANNED STAGE 1 PFI</p>

### 3.3 Integrity and Validation of Safety Documentation in support of PFI (including ATMS Safety Case)

Ref	Question	Summary of Documentation Review	Status
S1.7	Have safety documentation and the relevant supporting documents been reviewed for their integrity and validity?	<p><b>Consideration:</b> Safety Case Assessment Reports (SCARS) have been made available and these follow the CAD Safety Management System process. The SCARS undertaken include the record of the Subject Matter Experts (SMEs) involved.</p> <p>There are a comprehensive set of SCARS made available as part of this review. It is noted that confidence is gained as CAD has identified the requisite areas using the related Project and Transition mechanisms and associated forums.</p> <p>The majority of these elements are available for the PFI Stage 1, though they are spread across a large number of documents, which makes the assessment of completeness and robustness challenging.</p> <p>To address this CAD has now developed a single graphical argument for PFI that shows how each element comes together to form a complete picture of the assurance (see Appendix B). This is reflected in Recommendation 2.1.</p> <p><b>Assessment:</b> With the action taken by CAD in the preceding paragraph, NATS views that this item is closed.</p>	CLOSED

### 3.4 ATC / Engineering Procedures and Contingency

Ref	Question	Summary of Documentation Review	Status
S1.8	Are Plans for both Transition into and reversion from PFI sessions robust? (ATC)	<p><b>Consideration:</b> The reversion to the normal system is deemed to be the reverse of the transition, either at the planned time or due to a contingency situation. The ability to revert has been considered in the ATC Operational Transition Plan and the SCARS.</p> <p>The advanced publishing of the specific transition and reversion procedures, such as coordination with approach, CDC and use of the speakers are established normal practice in CAD.</p> <p><b>Assessment:</b> NATS views that such plans are in place.</p>	CLOSED
S1.9	Are Plans for both Transition into and reversion from PFI sessions robust? (Engineering)	<p><b>Consideration:</b> The reversion to the normal system is deemed to be the reverse of the transition, either at the planned time or due to a contingency situation. The ability to revert has been considered in the ATC Operational Transition Plan and the SCARS.</p> <p>CAD has reviewed the overall documentation to ensure that roles and titles for those responsible for calling off the PFI and reverting are clearly defined and consistent.</p> <p><b>Assessment:</b> NATS views that this item is closed.</p>	CLOSED
S1.10	Are the ATC Procedures identified for PFI and implemented as required?	<p><b>Consideration:</b> Safety assurance is provided in SCARS Report Operational Trial of the new ATMS in the North Air Traffic Control Tower</p> <p><b>Assessment:</b> NATS views that this item is closed.</p>	CLOSED

### 3.5 ATC / Engineering Training

Ref	Question	Summary of Documentation Review	Status
S1.11	Are ATC procedures, contingency procedures and ATC training in place?	<p><b>Consideration:</b> OPS Transition procedures will be published in advance to allow controllers to become familiar with them prior to OPS Transition. These procedures will enable controllers to brief themselves, feel comfortable with their ability to perform OPS Transition and have the opportunity to ask questions of the OPS Transition experts prior to the session.</p> <p>Paper copies of these procedures should be provided at all CWPs in case staff need to refer to them during OPS Transition. The Training Plan for the tower controllers has been provided.</p> <p><b>Assessment:</b> NATS views that this item is closed.</p>	CLOSED
S1.12	Are engineering procedures, contingency procedures and engineering training in place?	<p><b>Consideration:</b> Engineering and technical staff have undertaken training courses to maintain and support the systems associated with PFI stage 1; with 21 competent technical staff dedicated to the new ATMS available to support the PFI commencing June 2016.</p> <p>Consideration has been given to providing an Engineering and Technical staff briefing, including PFI Stage 1 specific training or familiarisation for Engineering and Technical staff.</p> <p>CAD has provided the plan for Engineering training (Training Plan 2016 Rev 1 (PFI)) and briefing presentation. Any Temporary Operating Instructions required will be issued and briefed as per CAD established processes.</p> <p><b>Assessment:</b> NATS views that the procedures are in place.</p>	CLOSED

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## SECTION 4: Conclusion, Outcomes and Best Practice Recommendations

Phased introduction of major system changes is a standard practice within NATS using 'shadowing' and live 'operational services' within defined and constrained operating environments (COE). The approach has been applied to

- iFACTS – the introduction of controller tools and removal of paper flight strips to London Area Control;
- New Prestwick Centre – the transition of Area, Terminal, Oceanic and Military Control Operations;
- Electronic Flight Data (EFD) – the introduction of new controller tools and removal of paper flight strips; and
- Prestwick Upper Airspace – the introduction of new Controller tools and Flight Data Processing.

NATS has completed an assessment of the overall practicality of the PFI scheme, the readiness of the operational transition of the PFI Stage 1 Configuration, and also an update on the progress made by CAD on recommendations made by NATS during the "snapshot" review back in December 2015. The analysis is based on documentation made available to NATS between the end of "snapshot" review up to end April 2016 (with supplementary information provided in early May 2016) and previous documentation and familiarity with the system established in conducting "snapshot" review.

Overall, NATS notes that there is a volume of high quality, detailed work providing a significant body of evidence to support all aspects of the planned PFI. It is also noted that CAD has been addressing the remaining recommendations resulting from the "snapshot" review that do not affect the PFI Stage 1 and are on track for closure. NATS will conduct a further review during Stage 2 assessment as planned. As such, NATS believes CAD has an overall robust plan and approach to their ATMS transition. Particular areas of good practice include:

- CAD's overall approach to ATC training, planning, and rostering which are thorough and provide a comprehensive body of evidence; and
- The ATMS safety case and associated documentation provide a comprehensive risk assessment and assurance process to undertake the PFI scheme.

In noting the areas of good practice NATS has made two recommendations to support CAD's planning and delivery of the PFI.

- a. **Recommendation 2.1:** To support the senior management team to maintain and manage the overall progress through the PFI scheme, a single graphic of overall progress (reporting progress, successes, risks and issues) across the people, process, technology, communications and safety assurance should be created and maintained. NATS believes this will accord greater clarity on CAD's overall status of preparedness, as well as being a method of providing oversight to third party auditors. [NATS notes that CAD has accordingly presented the progress, claim and supporting documentation for the overall PFI practicality in the Claim, Argument, and Evidence (CAE) structure, in Appendix B.]
- b. **Recommendation 2.2:** Previous experience in NATS of running systems in parallel / shadow mode operations has highlighted the importance of maintaining data integrity between two 'live' systems. Discrepancies between the data sets could potentially affect certain functions. NATS believes particular importance should therefore be placed on confirmation that all data supplied to the N-TWR by any 'shadowed function' is in line with the data at S-TWR. To

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support this NATS proposes a specific activity and success criterion within the PFI Stage 1 Configuration plan for a shadowing activity prior to the initial PFI session and a specific objective/success criterion of each PFI session to ensure data integrity across the two 'live' systems is continuously monitored. NATS has noted and is satisfied that:

- i. CAD has been implementing respective supporting equipment, trained staff, as well as procedures to carry out on-going data integrity checks to monitor and maintain data integrity between the two "live" systems; and
- ii. CAD has consolidated the engineering / technical documentation supporting equipment, staffing, procedures and mechanisms for data checking with defined follow-up actions recorded.

The body of evidence provided to NATS has demonstrated that CAD is addressing the PFI scheme in a practical and complete manner. As CAD has presented the progress, claim, argument and supporting documentation for the overall PFI practicality, NATS is satisfied that CAD is on schedule for the PFI Stage 1.

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## References

Reference	Title
1.	Operational Readiness Assessment of the New Air Traffic Management System, D2 Final Report (Issue 1.2, 15/03/2016)

## Appendix A: Stage 1 Analysis

Required Phase 1 Study Scope	Supporting Questions
<b>Practicality of the Overall PFI Scheme</b>	Are Resourcing Plans for all required positions (ATC and Engineering) in place?
	Are there problems raising and tracking linked to the appropriate phase of implementation?
	Does the plan of activity have clear scope, timing and deliverables / success criteria?
	Is there a lesson learning review process in place for each PFI?
<b>Integrity and Validation of Safety Documentation in support of PFI</b>	Have safety documentation and the relevant supporting documents been reviewed for their integrity and validity?
<b>ATC / Engineering Procedures &amp; Contingency</b>	Are ATC / engineering procedures changes identified for PFI and implemented as required;
	Are Plans for both Transition into and reversion from PFI sessions robust?
<b>ATC / Engineering Training</b>	Are ATC / engineering procedures, contingency procedures, ATC and engineering training in place?

## Appendix B: PFI Claim, Argument, Evidence (CAE) Structured Notation

An 'example' generic structure for the PFI Stage 1 N-TWR Operations.

