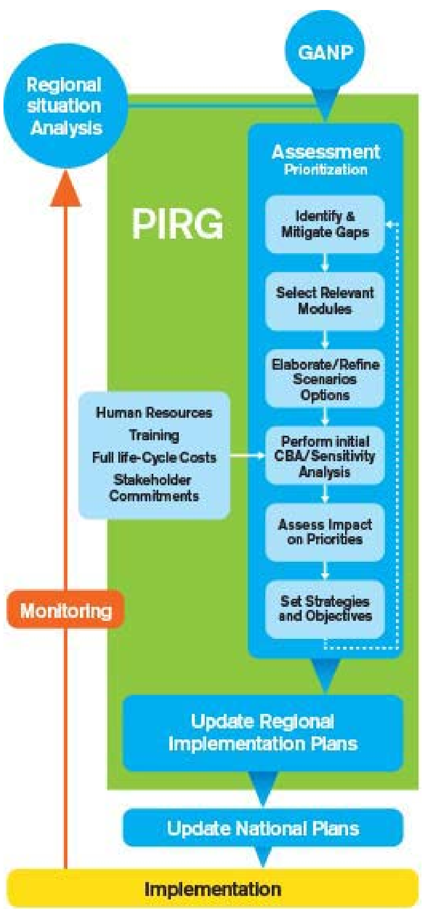
# AFI Region
# AIR NAVIGATION REPORT

## 1. INTRODUCTION........................................................................................................
### 1.1 OBJECTIVE..................

According to the Global Air Navigation Plan (GANP), PIRGs should report, on an annual basis, the progress and effectiveness of ICAO regions and States against the priorities set out in their respective regional and State air navigation plans, using a consistent reporting format, to ICAO. It is envisaged that this would assist regions and States adjust their priorities to reflect actual performance and address any emerging air navigation issues.

GANP states that the regional national planning process should be aligned and used to identify those ASBU Modules which best provide solutions to the operational needs identified. Depending on implementation parameters such as infrastructure constraints and the resources available, regional and national implementation plans will be developed in alignment with the GANP. Such planning requires collaborative decision making between stakeholders (regulators, airspace users, air navigation service providers and aerodrome operators) in order to obtain commitments to effective implementation.

The AFI Region Air Navigation Report, therefore, presents an overview of the planning and implementation progress, including for the Priority 1 and 2 of ASBU Block 0 Modules within the ICAO AFI Region during the reporting year 2017. The implementation progress covers the 48 ICAO AFI States.



## 1.2 BACKGROUND................

The Global Air Navigation Plan (GANP) is the strategy to achieve a global interoperable air navigation system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable and meets national security requirements. In order to ensure a safe, secure, efficient and seamless global ATM system that is environmental sustainable, its basic objective therefore is to provide a framework for global planning, harmonization of services and procedures, enhancement of global interoperability and data.

ICAO reviews the GANP every three years. Each new edition of the GANP is first reviewed by the ANC before endorsement by the Council. The next session of the ICAO Assembly would then approve the edition as the future strategic direction for global air navigation.

ICAO also monitors the progress and effectiveness of ICAO regions against the priorities set out in their respective regional and State air navigation plans. This is done through annual reporting to ICAO, using consistent reporting format.

The 37th Session of the ICAO Assembly directed the Organization to increase its efforts to meet the global needs for airspace interoperability while maintaining its focus on safety. To this end, ICAO established a framework for global harmonization and interoperability of airspace named the aviation system block upgrades (ASBUs)

The regional planning and implementation process is facilitated through formulation of regional Air Navigation Plans (ANPs) which are developed and maintained through the Planning and Implementation Regional Groups (PIRGs). The plans set forth in detail the facilities, services and procedures required for international air navigation within a specified area. The AN region for AFI is as depicted below, comprising of the following States;

Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

Considering the difficulties being encountered in obtaining accurate and timely information on the status of implementation of ANP requirements from States, APIRG in its 21 meeting, agreed that Air Navigation reports for AFI region be developed and produced on annual basis. The reports would be based on available information, including air navigation deficiency list, global/regional reports, survey results, studies, gap analysis, etc.

It is with this background that APIRG has endeavored to produce this first edition of the Air Navigation Report for the AFI region.

## 1. 3 Scope

## 1.4 AFI AIR TRAFFIC FORECAST......

## 1.5 COLLECTION OF DATA............

### 1.5 COLLECTION OF DATA

The necessary data for the AFI Air Navigation Report was collected mainly through the APIRG Subsidiary Bodies, the AFI eANP Volume III, State Letters and surveys.

The main challenges faced by the AFI Regional Offices are related mainly to the level of responses on State letters and surveys conducted by the Regional Offices to collect information/data, that was significantly low, about 15% (mostly from the ESAF Region) of State responded State letters.

### 1.6 STRUCTURE OF THE REPORT......

## 2. STATUS OF IMPLEMENTATION.........................................................................

## AVIATION SYSTEM BLOCK UPGRADES

### 2.1 AFI REGION ASBU BLOCK 0 MODULES PRIORITIZATION....................................

ASBU Block 0 is composed of Modules containing technologies and capabilities which have already been developed and being implemented since 2013. The Fourth Edition of the Global Air Navigation Plan introduces ICAO's ASBU methodology and supporting technology roadmaps based on a rolling fifteen-year planning horizon. Although the GANP has a global perspective, it is not intended that all ASBU modules are to be applied around the globe. Some of the ASBU modules are specialized packages that should be applied where specific operational requirements or corresponding benefits exist. The APIRG has determined that out of the eighteen ASBU Block 0 Modules, 9 are considered as priority 1 and 9 as priority 2 for the AFI Region.

| PIA | Module Description | Module | Category | Priority |
|---|---|---|---|---|
| PIA1 | **Airport Operations** | | | |
| | Improve Traffic flow through Runway Sequencing (AMAN/DMAN) | B0-RSEQ | O | 2 |
| | Optimization of Approach Procedures including vertical guidance | B0-APTA | E | 1 |
| | Increased Runway Throughput through optimized Wake Turbulence Separation | B0-WAKE | S | 2 |
| | Safety and Efficiency of Surface Operations | B0-SURF | O | 2 |
| | Improved Airport Operations through Airport-CDM | B0-ACDM | E | 1 |
| PIA2 | **Globally Interoperable Systems and Data - Through Globally Interoperable System Wide Information Management** | | | |

| PIA | Module Description | Module | Category | Priority |
|---|---|---|---|---|
| | Increased Interoperability, Efficiency and Capacity through Ground-Ground Integration | B0-FICE | E | 1 |
| | Service Improvement through Digital Aeronautical Information Management | B0-DATM | E | 1 |
| | Meteorological information supporting enhanced operational efficiency and safety | B0-AMET | E | 1 |
| **PIA3** | **Optimum Capacity and Flexible Flights – Through Global Collaborative ATM** | | | |
| | Improved Operations through Enhanced En-Route Trajectories | B0-FRTO | E | 1 |
| | Improved Flow Performance through Planning based on a Network-Wide view | B0-NOPS | D | 2 |
| | Initial capability for ground surveillance | B0-ASUR | D | 2 |
| | Air Traffic Situational Awareness(ATSA) | B0-ASEP | S | 2 |
| | Improved access to Optimum Flight Levels through Climb/Descent Procedures using ADS-B | B0- OPFL | S | 2 |
| | ACAS Improvements | B0-ACAS | E | 1 |
| | Increased Effectiveness of Ground-Based Safety Nets | B0-SNET | D | 2 |
| **PIA4** | **Efficient Flight Path – Through Trajectory-based Operations** | | | |
| | Improved Flexibility and Efficiency in Descent Profiles (CDO) | B0-CDO | E | 1 |
| | Improved Safety and Efficiency through the initial application of Data Link En-Route | B0-TBO | D | 2 |
| | Improved Flexibility and Efficiency Departure Profiles - Continuous Climb Operations (CCO) | B0-CCO | E | 1 |

## 2.2 ASBU Implementation status in the AFI Region……………………………………

### 2.2.1 B0-APTA……………………………………………………………………………………

Assembly Resolution A37-11 urges all States to implement approach procedures with vertical guidance in accordance with the PBN concept. The use of performance-based navigation (PBN) and ground-based augmentation system (GBAS) will enhance reliability and predictability of approaches to runways of international aerodromes, in the absence of non-availability of ground-based navaids (withdrawn for maintenance, awaiting flight calibration, etc.), such as VOR/ILS/DME, thereby increasing the level of safety, accessibility and efficiency of AFI international aerodromes. This is being achieved through the application of Global Navigation Satellite System in most terminal airspace, supported by satellite-based augmentation system where coverage is available.

Based on a survey report dated March 2017 undertaken by a Consultant, of the five modules under Airport Operations, B0-APTA has been one of the most accomplished modules. Feedback received from respondents indicated that 60% of the module has been implemented. This can be directly attributed to the aggressive campaign for the implementation of GNSS-based procedures by ICAO ESAF and WACAF Regional Offices, the AFPP and the industry. Most AFI States have trained their staff in GNSS procedure design including operations approval through numerous workshops/seminars facilitated by ICAO with the support of key stakeholders. The Majority of States have conducted and published the results related to WGS-84 surveys and implemented GNSS procedures in their terminal control areas (TMAs). With a bit of push and commitment from stakeholders, this Module can be fully implemented in the AFI Region by end 2019.

| **ASBU B0-APTA: Planning Targets and Implementation Progress** | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. APV with Baro-VNAV | December 2016 – Service Providers and users |
| 2. APV with SBAS | December 2017 – As per AFI-GNSS Strategy. |

| | |
|---|---|
| 3. APV with GBAS | December 2018 – Initial implementation at some States (service providers) |

| ASBU B0-APTA: Implementation Challenges | | | | |
|---|---|---|---|---|
| **Elements** | **Implementation Area** | | | |
| | **Ground System Implementation** | **Avionics Implementation** | **Procedures Availability** | **Operational Approvals** |
| 1. APV with Baro-VNAV | NIL | Insufficient number of equipped aircraft | Insufficient appropriate training | Lack of appropriate training |
| 2. APV with SBAS | Network infrastructure | Cost of Aircraft equipage | Limited to certain States who have implemented | Lack of knowledge and appropriate training. |
| 3. APV with GBAS | Lack of cost-benefit analysis. Adverse ionosphere | Insufficient number of equipped aircraft | Insufficient appropriate training | Lack of appropriate training. Evaluation of a real operation requirement |

| B0-APTA: Performance Monitoring and Measurement - Implementation Monitoring | |
|---|---|
| **Elements** | **Performance Indicators / Supporting Metrics** |
| 1. APV with Baro-VNAV | Indicator: Percentage of international aerodromes having instrument runways provided with APV with Baro-VNAV procedure implemented (Where the % is defined)Supporting metric: Number of international airports having approved APV with Baro-VNAV procedure implemented |
| 2. APV with SBAS | Indicator: Percentage of international aerodromes having instrument runways provided with APV SBAS procedure implemented |
| 3. APV with GBAS | Indicator: Percentage of international aerodromes having instrument runways provided with APV with GBAS procedure implemented<br>Supporting metric: Number of international airports having APV GBAS procedure implemented. |

| B0-APTA: Performance Monitoring and Measurement - Performance Monitoring | |
|---|---|
| **Key Performance Areas** | **Metrics (if not , indicate qualitative benefits)** |
| Access & Equity | Increased aerodrome accessibility |
| Capacity | Increased runway capacity |
| Efficiency | Reduced fuel burn due to lower minima, fewer diversions, cancellations, delays |
| Environment | Reduced emissions due to reduced fuel burn |
| Safety | Increased safety through stabilized approach paths |

### 221. B0-CDO -

To use performance-based airspace and arrival procedures allowing aircraft to fly their optimum profile using continuous operations (CDOs). This provides an opportunity to optimize throughput, especially in terminal control areas (TMAs), allowing for fuel efficient descent profiles and increase capacity. Implementation of CDO is slow and is attributed to lack of airspace re-structuring in many terminal areas. The majority of States are planning to implement CDO progressively during 2018-2019

| ASBU B0-CDO: Planning Targets and Implementation Progress | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. CDO implementation | December 2017 |
| 2. PBN STARs implementation | December 2017 |

| ASBU B0-05/CDO: Implementation Challenges | | | | |
|---|---|---|---|---|
| **Elements** | **Implementation Area** | | | |
| | **Ground System Implementation** | **Avionics Implementation** | **Procedures Availability** | **Operational Approvals** |
| 1. CDO implementation | The ground trajectory calculation function will need to able upgraded | NIL | Coordination procedures between ATSUs and Training | In accordance with applicable requirements |
| 2. PBN STARs implementation | Airspace Design | NIL | Coordination procedures between ATSUs and Training | |

| B0-CDO: Performance Monitoring and Measurement - Implementation Monitoring | |
|---|---|
| **Elements** | **Performance Indicators / Supporting Metrics** |
| 1. CDO implementation | Indicator: Percentage of international aerodromes/TMAs with CDO implemented<br>Supporting metric: Number of international aerodromes/TMAs with CDO implemented |
| 2. PBN STARs | Indicator: Percentage of international aerodromes/TMA with PBN STAR implemented<br>Supporting metric: Number of international aerodromes/TMAs with PBN STAR implemented |

| B0-CDO: Performance Monitoring and Measurement - Performance Monitoring | |
|---|---|
| **Key Performance Areas** | **Metrics (if not , indicate qualitative benefits)** |
| Access & Equity | N/A |
| Capacity | Increased terminal airspace capacity |
| Efficiency | Cost savings through reduced fuel burn. Reduction in the number of required radio transmissions. |
| Environment | Reduced emissions as a result of reduced fuel burn. |
| Safety | More consistent flight paths and stabilized approach. Reduction in the incidence of controlled flight into terrain (CFIT) |

### 2.2.1 B0-CCO –

To implement continuous climb operations in conjunction with performance-based navigation (PBN) in order to provide optimized throughput, enable fuel-efficient climb profiles and increase capacity in congested terminal areas. Although CCO is being practiced in many terminal areas with low traffic density, most States are planning to fully implement CCO by 2019, following re-structuring of their terminal airspace to more effectively support PBN operations.

| ASBU B0-CCO: Planning Targets and Implementation Progress | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. CCO implementation | December 2017 |
| 2. PBN SIDs implementation | December 2017 |

| B0-CCO: Implementation Challenges | |
|---|---|
| **Elements** | **Implementation Area** |

| | Ground System Implementation | Avionics Implementation | Procedures Availability | Operational Approvals |
|---|---|---|---|---|
| 1. CCO implementation | NIL | NIL | Coordination procedures between ATSUs and Training | In accordance with applicable requirements |
| 2. PBN SIDs implementation | Airspace Design | NIL | Coordination procedures between ATSUs and Trainings | Approvals of procedures |
| **B0-CCO: Performance Monitoring and Measurement - Implementation Monitoring** | | | | |
| **Elements** | **Performance Indicators / Supporting Metrics** | | | |
| 1. CCO implementation | Indicator: Percentage of international aerodromes with CCO implemented<br>Supporting metric: Number of international airports with CCO implemented | | | |
| 2. PBN SIDs implementation | Indicator: Percentage of international aerodromes with PBN SIDs implemented<br>Supporting metric: Number of international airports with PBN SIDs implemented | | | |
| **B0-CCO: Performance Monitoring and Measurement - Performance Monitoring** | | | | |
| **Key Performance Areas** | **Metrics (if not , indicate qualitative benefits)** | | | |
| Access & Equity | N/A | | | |
| Capacity | Increased Terminal Airspace Capacity | | | |
| Efficiency | Cost savings through reduced fuel burn and efficient aircraft operating profiles. Reduction in the number of required radio transmissions. | | | |
| Environment | Authorization of operations where noise limitations would otherwise result in operations being curtailed or restricted. Environmental benefits through reduced emissions. | | | |
| Safety | More consistent flight paths. Reduction in the number of required radio transmissions. Lower pilot and air traffic control workload. | | | |

### 2.2.1 B0-SURF.......................................................................................................

Advanced Surface Movement, Guidance and Control System (A-SMGCS) should be evolutionary implemented through successive levels of implementation. The main concerns of the Levels 1 and 2 (B0-SURF) as shown in the table below, rely on further improvement of safety.

| Levels | Surveillance | | Control | | Route Planning | Guidance | |
|---|---|---|---|---|---|---|---|
| | Users | Mobiles and areas covered | Users | Conflicts detected | Users | Users | Type |
| 0 | Strict application of SMGCS | | | | | | |
| 1 | | | | | | | |
| | Surveillance | | | | | | |
| | Controller | All vehicles in the manoeuvring area<br>All aircraft in the movement area | | | | | |
| 2 | | | | | | | |
| | Controller | All vehicles in the manoeuvring area<br>All aircraft in the movement area | Control | | | Guidance | |
| | | | Controller | RWY incursions | | Drivers | Airport Static Map & mobile position on a screen as an option |

At the first level, the ATCO will be assisted by a surveillance service which completes its visual observation by displaying on screen the airport traffic control context, position of all vehicles in the maneuvering area, position of all aircraft in the movement area, identity of all aircraft in the movement area and identity of all cooperative vehicles.
Since ATC is responsible for the maneuvering area, the surveillance service should cover all mobiles on this area. In the same way, the surveillance service should also cover aircraft in the apron area as controllers deliver push-back clearances when aircraft are on the apron area. At level 1, aircraft and vehicles are expected to be cooperative, so the surveillance service will automatically provide their identity.

At Level 2, it is not envisaged to extend the provision of the surveillance function to pilots and drivers because the required technologies such as ADS-B/TIS-B will not yet be thoroughly available. As a consequence, the surveillance function will be the same at Level 1 and 2.

| ASBU B0-ASUR: Planning Targets and Implementation Progress | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. Implementation of ADS-B | June 2018 – Users and service provider |
| 2. Implementation of Multilateration | June 2018 – Users and service provider |
| 3. Automation system (Presentation) | June 2017 – Users and service provider |

| ASBU B0-ASUR: Implementation Challenges | | | | |
|---|---|---|---|---|
| **Elements** | **Implementation Area** | | | |
| | **Ground System Implementation** | **Avionics Implementation** | **Procedures Availability** | **Operational Approvals** |
| 1. Implementation of ADS-B | Lack of ADS-B systems implementation due to recent implementation of conventional surveillance systems | Lack of ADS-B implementation in general aviation, and old commercial fleet | Lack of procedures | Lack of inspector s with appropriate capability |
| 2. Implementation of Multilateration | Facilities of remote stations. Establishment of communications networks | NIL | NIL | Lack of inspector s with appropriate capability |
| 3. Automation system (Presentation) | Lack of any automation functionality | NIL | NIL | NIL |

| B0-ASUR: Performance Monitoring and Measurement - Implementation Monitoring | |
|---|---|
| **Elements** | **Performance Indicators / Supporting Metrics** |
| 1. Implementation of ADS-B | Indicator: Percentage of international aerodromes with ADS-B implemented<br>Supporting metric: Number of ADS-B implemented |
| 2. Implementation of Multilateration | Indicator: Percentage of Multilateration system implemented<br>Supporting metric: Number of Multilateration system implemented |
| 3. Automation system (Presentation) | Indicator: Percentage of ATS units with automation system implemented<br>Supporting metric: Number of automation system implemented in ATS units |

| B0-ASUR: Performance Monitoring and Measurement - Performance Monitoring | |
|---|---|
| **Key Performance Areas** | **Metrics (if not, indicate qualitative benefits)** |
| Access & Equity | N/A |
| Capacity | Typical separation minima are 3 NM or 5 NM enabling an increase in traffic density compared to procedural minima. TMA surveillance performance improvements are achieved through high accuracy, better velocity vector and improved coverage. |
| Efficiency | N/A |
| Environment | N/A |
| Safety | Reduction of the number of major incidents. Support to search and rescue |

### 2.2.1 B0-ACDM.......................................................................................

ASBU B0-ACDM has been established to Improve airport operations through Airport Collaborative decision making. This would enhance the planning and management of airport operations and allows their full integration in air traffic management using performance targets compliant with those of the surrounding airspace.

Airport CDM (A-CDM) is about partners working together and making decisions based on more accurate and higher quality information, where every bit of information has the exact same meaning for every partner involved. More efficient use of resources, and improved event punctuality as well as predictability are the targeted results. Put simply "It ensures that the right partners get the right information at the right time".

| **ASBU B0-ACDM: Planning Targets and Implementation Progress** | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. Airport – CDM | December 2015 – Airport Operator, ANSPs, aircraft operators |
| 2. Aerodrome certification | December 2015 – State CAA |
| 3. Airport planning | December 2017 – Airport Operators |
| 4. Heliport operation | December 2017 – State CAA |
| 5. SMS implementation | December 2014 – Aerodrome Operators |
| 6. Development of regulations and technical guidance material for runway safety | December 2014 – State CAA |
| 7. Development and implementation of runway safety programmes and reduce runway-related accidents and serious incidents to no more than eight per year. | December 2014 – State CAA |

| **ASBU B0-ACDM: Implementation Challenges** | | | | |
|---|---|---|---|---|
| **Elements** | **Implementation Area** | | | |
| | **Ground System Implementation** | **Avionics Implementation** | **Procedures Availability** | **Operational Approvals** |
| 1. Airport – CDM | Interconnection of ground systems of different partners for Airport – CDM | NILNIL | Lack for coordination procedures. Lack of commitment from all stakeholders | NILNIL |
| 2. Aerodrome certification | Lack of effective implementation of Annex 14 SARPs | NILNIL | Lack of procedures. Lack of training | Lack of adequately trained inspectors |
| 3. Airport planning | NILNIL | NILNIL | Lack of procedures | Lack of adequately trained inspectors |
| 4. Heliport operation | Lack of regulations | NILNIL | Lack of procedures | Lack of trained inspectors |
| 5. SMS implementation | NILNIL | NILNIL | Lack of States regulations. Lack of training | Lack of high level management commitment |
| 6. Development of regulations and technical guidance material for runway safety | NILNIL | NILNIL | Lack of States regulations | Lack of high level management commitment |
| 7. Development and implementation of runway safety programmes and reduce runway-related accidents and serious incidents to no more than eight per year. | NILNIL | NILNIL | Lack of standards from ICAO. Lack of States regulations. Lack of training. | Lack of high level management commitment |

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|---|---|---|---|---|
| | | | | |

| | |
|---|---|
| **B0-ACDM: Performance Monitoring and Measurement - Implementation Monitoring** | |
| **Elements** | **Performance Indicators / Supporting Metrics** |
| 1. Airport – CDM | Indicator: Percentage of international aerodromes with Airport – CDM Supporting metric: Number of international aerodromes with Airport – CDM |
| 2. Aerodrome certification | Indicator: Percentage of certified international aerodromes<br>Supporting metric: Number of certified international aerodromes |
| 3. Airport planning | Indicator: Percentage of international aerodromes with Master Plans<br>Supporting metric: Number of international aerodromes with Master Plans |
| 4. Heliport operation | Indicator: Percentage of Heliports with operational approval<br>Supporting metric: Number of Heliports with operational approval |
| 5. SMS implementation | Indicator: Percentage of aerodrome operators having implemented SMS |
| 6. Development of regulations and technical guidance material for runway safety | Indicator: |
| 7. Development and implementation of runway safety programmes and reduce runway-related accidents and serious incidents to no more than eight per year. | Indicator: Percentage of aerodromes with local runway safety teams (LRST) |
| **B0-ACDM: Performance Monitoring and Measurement - Performance Monitoring** | |
| **Key Performance Areas** | **Metrics (if not, indicate qualitative benefits)** |
| Access & Equity | Enhanced equity on the use of aerodrome facilities |
| Capacity | Enhanced use of existing implementation for gate and stands (unlock latent capacity). Reduced workload, better organization of the activities to manage flights. Enhanced aerodrome capacity according to the demand. |
| Efficiency | Improved operational efficiency (fleet management); and reduced delay. Reduced fuel burn due to reduced taxi time and lower aircraft engine run time. Improved aerodrome expansion in accordance with Master Plan |
| Environment | Reduced emissions due to reduced fuel burn |
| Safety | N/A |

### 2.2.1 B0-FICE............................................................................................................

To improve coordination between air traffic service units (ATSUs) by using ATS Interfacility Data Communication (AIDC) defined by the ICAO Manual of Air Traffic Services Data Link Applications (Doc 9694) in the AFI Region, in the area of Aeronautical Fixed Service (**AFS**) the current character oriented protocols in use in AFTN will be replaced by the digitalized oriented protocol by ATS Message Handling System (**AMHS**) and ATS/DS will be supplemented then replaced by the ATS Inter facilities data communication (**AIDC/OLDI**) enabling automation of coordination.

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### 2.2.1 B0-FRTO............................................................................................................

The GANP, Doc 9750), has established, amongst its Aviation Systems Block Upgrades (ASBU) Modules, B0-FRTO – *Improved operations through enhanced en-route trajectories*: To allow the use of airspace which would otherwise be segregated (i.e. special use airspace) along with flexible routing adjusted for specific traffic patterns. This will allow greater routing possibilities, reducing potential congestion on trunk routes and busy crossing points, resulting in reduced flight length and fuel burn. Block 1 of the Module – *Improved operations through optimized ATS routing*, is the introduction of free routing in defined airspace, where the flight plan is not defined as segments of a published route network or track system to facilitate adherence to the user-preferred profile.

Prior to adoption of the ASBU implementation methodology in the Fourth Edition of the GANP in 2013, the AFI Region had agreed on a number of initiatives to improve the ATS route system.

Among such developments, the Special AFI/08 RAN Meeting, Durban, South Africa 24-29 November 2008 noted that in order to accommodate traffic demand in the AFI Region, APIRG had adopted a number of conclusions related to the implementation of ATS routes. It was further noted that with some exceptions, most of the recommended routes had not yet been implemented. Furthermore, new ATS route requirements had been identified by the aircraft operators. To support the effort, APIRG had identified the need to establish an internationally funded project in the AFI Region (APIRG Conclusion 15/27 refers) however, as of yet, no action had been taken.

In this context and taking into consideration the aviation industry fuel crisis, the meeting was urged to implement in the near-term, an ATS route project in line with the above and at the same time, to take account of the introduction of PBN operations in the region, pursuant to Assembly Resolution A36-23. The meeting also agreed that the PBN Task Force was the most suitable body to address the ATS route structure in the region. Pursuant to outcome of the SP AFI/08 RAN Meeting, the Eleventh Meeting of the Air Traffic Services/Aeronautical Information Service/Search and Rescue Sub-Group (ATS/AIS/SAR SG/11) Nairobi, Kenya, 26 - 30 April 2010, agreed on the establishment of the PBN Route Network Development Working Group (PRND WG), which then held its first meeting in July 2010.

The twelfth meeting of the Air Traffic Services/Aeronautical Information Service/Search and Rescue Sub-Group (ATS/AIS/SAR SG/12), Dakar, Senegal 25-39 July 2011endorsed 31 ATS routes developed by the PRND/WG, 22 of which had already been implemented on temporary basis pending amendment of the AFI ANP, in order to afford users early benefits.

The Twentieth Meeting of the Africa-Indian Ocean Planning and Implementation Regional Group (APIRG/20) Yamoussoukro, Côte d'Ivoire, 30 November to 2 December 2015, noted that the PRND Working Group had completed the primary task of comprehensively improving the route network and by using PBN as an enabler, achieved the following amongst others:

- reduction in the AFI ATS route lengths by about 4797 nautical miles, representing a reduction of an estimated 144 million metric tons of CO2 emissions; and
- development of Fifty-eight (58) iFLEX tracks to provide access to the Atlantic Ocean Random Routing Area, also providing increased flexibility in route profiles from/to the continental route network.

Besides the benefits from operational improvements, the extensive route development initiative in the AFI region also served to support the transition from B0-FRTO to B1-FRTO by introducing a wide choice of ATS routes by users, and for the ATS providers to adapt to facilitating such choices. By 2015, a number of FIRs had indicated readiness to commence trials of B1-FRTO.

The Africa-Indian Ocean (AFI) Planning and Implementation Regional Group Extraordinary Meeting (APIRG/EO) Lusaka, Zambia, 10 to 11 July 2014 agreed to review its organization and working methods by applying project management principles and other methodologies to better support the ICAO performance framework in its planning and implementation activities which should be aligned with the Aviation System Block Upgrades (ASBUs). This included transformation of the Groups tasks from tasks performed by a range of subsidiary bodies to the project management approach.

In this regard, the APIRG/20 Meeting agreed on a number of projects to further its work, which included the following that are related to the implementation of FRTO:

**PBN Airspace Concept (Airspace Design);** whose safety, capacity and efficiency objectives include facilitating other ASBU Modules such as B0-FRTO, B0-CCO and B0-CDO
**AFI Optimized Route Trajectories and Airspace (AORTA),** whose capacity and efficiency objectives include coordinated implementation of Terminal and En-route operations including CCO & CDO, to achieve seamlessness using PBN (B0&B1 –FRTO, En-route, Terminal, CCO, and CDO
**NAVSPEC and Separation Minima Transition (NASMIT**), whose objective to ensure regionally harmonized alignment of aircraft separation minima as per PBN and various ASBU module implementation, to facilitate optimization of benefits from operational improvements; and
**Operational Requirements for CNS (OPREC)**, whose objective is to identify operational requirements from the perspective of users and ATM providers as the basis for and guidance on minimum CNS infrastructure, in order to facilitate coordinated planning and implementation

The Fourth Edition of the GANP (2013-2028) identified PBN as the highest implementation priority and so is the Fifth Edition (2016-2030).

The Nineteenth Meeting of the Africa-Indian Ocean (AFI) Planning and Implementation Regional Group (APIRG/19) Dakar, Senegal, from 28 to 31 October 2013 agreed on prioritization in the implementation of the ASBU Modules, in which B0-FRTO was categorised as *Essential*, i.e. those ASBU modules that provide substantial contribution towards global interoperability, safety or regularity and should as such be prioritized for implementation by all States.

| **ASBU B0-FRTO: Planning Targets and Implementation Progress** | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. Airspace planning | December 2018 |
| 2. Flexible use of airspace | December 2016 |
| 3. Flexible routing | December 2018 |

| **ASBU B0-FRTO: Implementation Challenges** | | | | |
|---|---|---|---|---|
| **Elements** | **Implementation Area** | | | |
| | **Ground System Implementation** | **Avionics Implementation** | **Procedures Availability** | **Operational Approvals** |
| 1. Airspace planning | Lack of organized and managed airspace prior to the time of flight. Lack of AIDC WGS-84 Survey | NIL | Lack of Procedures | |
| 2. Flexible use of airspace | NIL | NIL | Lack of implementation FUA Guidance and coordination agreements | |
| 3. Flexible routing | ADS-C/CPDLC | Insufficient number of equipped aircraft / Lack of FANS 1/A. lack of ACARS | Lack of LOAs and procedures | Poor percentage of fleet approvals |

| **B0-FRTO: Performance Monitoring and Measurement - Implementation Monitoring** | |
|---|---|
| **Elements** | **Performance Indicators / Supporting Metrics** |

| | |
|---|---|
| 1. Airspace planning | Not assigned Indicator and metrics |
| 2. Flexible use of airspace | Indicator: Percentage of time segregated airspaces are available for civil operations in the State<br>Supporting metric: Reduction of delays in time of civil flights |
| 3. Flexible routing | Indicator: Percentage of PBN routes implemented<br>Supporting metric: KG of Fuel savings<br>Supporting metric: Tons of CO2 reduction |
| **B0-FRTO: Performance Monitoring and Measurement - Performance Monitoring** | |
| **Key Performance Areas** | **Metrics (if not , indicate qualitative benefits)** |
| Access & Equity | Better access to airspace by a reduction of the permanently segregated volumes of airspace |
| Capacity | Flexible routing reduces potential congestion on trunk routes and at busy crossing points. The flexible use of airspace gives greater possibilities to separate flights horizontally. PBN helps to reduce route spacing and aircraft separations. |
| Efficiency | In particular the module will reduce flight length and related fuel burn and emissions. The module will reduce the number r of flight diversions and cancellations. It will also better allow avoiding noise-sensitive areas. |
| Environment | Fuel burn and emissions will be reduced |
| Safety | N/A |

### 2.2.1 B0-NOPS.............................................................................................

In accordance with ICAO Procedures for Air Navigation Service – Air Traffic Management (PANS-ATM Doc 4444), an air traffic flow management (ATFM) service shall be implemented for airspace where traffic demand at times exceeds the defined ATC capacity.

Doc 4444 defines ATFM as a service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilized to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate ATS authority.

**Difference between ATC and ATFM.** Air traffic controllers as well as air traffic flow managers, strive to provide a safe, orderly, and expeditious flow of traffic on essentially a first come first served basis. The differences lie in the scope, time parameters, tools, equipment, and the communication processes. The separation of aircraft from each other is the responsibility of air traffic controllers, utilizing various tools at their disposal. The objective of ATFM is to enhance the quality of service and the performance of the ATM system, by balancing the demand against capacity; optimising the use of available resources and coordinating adequate responses.

Global Air Navigation Plan (GANP Doc 9750). One of the Aviation Systems Block Upgrades (ASBU) Modules established in the ICAO Global Air Navigation Plan is B0-NOPS, which is described as improved flow performance through planning based on a network-wide view: Collaborative ATFM measure to regulate peak flows involving departure slots, managed rate of entry into a given piece of airspace for traffic along a certain axis, requested time at a way-point or an FIR/sector boundary along the flight, use of miles-in-trail to smooth flows along a certain traffic axis and rerouting of traffic to avoid saturated areas. In Block of the ASBU, B1-NOPS is described as ATFM techniques that integrate the management of airspace, traffic flows including initial user driven prioritization processes for collaboratively defining ATFM solutions based on commercial/operational priorities.

The Fifth Edition of the GANP (2016-2030) identified ATFM among its priorities. However, noting the AFI Regional levels of civil aviation development, the Nineteen Meeting of the APIRG agreed on prioritization in the implementation

of the ASBU Modules, in which B0-NOPSs was categorized as Desirable: Those modules that, because of their strong business and/or safety case, are recommended for implementation almost everywhere. For various reason including the need to focus resources on the Basic Building Blocks of civil aviation implementation, only one State has fully established ATFM, while other are in various stages of planning and implementation.
South Africa, through its Air Traffic and Navigation Services (ATNS), identified air traffic flow and capacity management as vital part of air traffic management in exploiting the full capacity of the air transport system without running the risk of infringing upon safety caused by overload situation.

In this respect, in 2001 ATNS established Central Airspace Management Unit (CAMU), at the Johannesburg ATC Centre located at O R Tambo International Airport in Johannesburg, South Africa, to serve as a multifaceted facility centered around the ATFM concept identified as necessary for the volume of traffic in the two FIRs, Cape Town and Johannesburg in which South Africa provides air navigation services. The CAMU's functions, which include management of the airport slot allocation programme and flexible use of airspace (FUA) in coordination with military and other airspace users, aims to achieve the following objectives:

- reduce ground and en-route delays;
- maximize capacity and optimize the flow of air traffic;
- provide an informed choice between departure delay, re-routing and/or flight level selection;
- alleviate unplanned in-flight re-routing; and Assist ATS Units in planning for and managing future workload in the light of forecast increased traffic flows within South Africa;
- assessing the impact of FUAs and TSAs on the air traffic control system
- provide improved solutions around predicted severe weather;
- balance the demand and capacity of ATC sectors;
- determine the necessity for an airspace/ground delay program and other traffic management initiatives (TMIs) and enact them;
- enabling aircraft operators to operate as close to their preferred trajectories

In addition to the functions managing slot allocation program and flexible use of airspace (FUA) management, the management of air traffic flow and capacity management within South African sovereign and delegated airspace. These include, facilitating military exercises and operations, special and unusual events and any other activity which might require the use of airspace for a particular time period. During the Football World Cup event in South Africa in 2010 for instance, ATFM was successfully used to manage a significantly high volume of traffic. In this instance, more than any time, the CDM processes were extended to adjacent FIRs.

The CAMU is also responsible for the re-routing of traffic, affected by adverse weather and temporary restricted or special use airspace in consultation with the aviation community in a collaborative decision making (CDM) process.

Amongst others, the CAMU uses the following constraints and triggers to initiate various actions implicated in ATFM:

- Fleet Mix – the mix of aircraft influences many aspects of performance and capacity, including approach speeds, in-trail separation requirements, wake vortex separation, runway departure and arrival performance, avionic capability and others.
- Hourly Profile – the timing of scheduled arriving and departing flights throughout the day and even within each hour determines the volume of demand relative to available capacity, and as such, significantly influences the level of delay and congestion.
- User Mix – the type of airline, as it relates to commercial passenger operations, cargo operations, or general aviation activity, influences contact/remote stand assignments at the airport, which in turns influences runway assignment and performance
- Origin/Destination Mix – the location of the origin for arrivals and the destination for departures influences the assignment by ATC of the terminal area arrival fix and the initial departure fix, which also influences runway assignment, particularly when ATC is applying a compass-mode runway assignment methodology.

Typically, ATFM is based on the following phases:

**Strategic Flow Management**, which takes place two days or more prior to the day of operation and includes research, planning and coordination activities. This phase consists of analyzing the evolution of the forecast demand, historical data and the identification of potential new problems and in evaluating possible solutions;

**Pre-Tactical Flow Management** is applied during two days prior to the day of operation and consists of planning and coordination activities. This phase analyses and decides on the best way to manage the available capacity resources and on the need for the implementation of flow measures. One output is the Daily Airspace Plan (DAP) published via the ATNS website (http://www.atns.co.za/atfm/dap) and sent via email to subscribers; and

**Tactical Flow Management** which is applied on the day of the operation. This phase updates the daily airspace plan according to the actual traffic and capacity. The management of the traffic is made through ATC slot allocation and/or ad-hoc rerouting.

The CAMU uses various tools to achieve the objectives. For example, when adverse conditions affect an aerodrome or a part of the airspace, the capacity of that airspace could be negatively affected, resulting in sub-optimized traffic flows through the airspace. Implementation of the following ATFM measures could be triggered by:

- Ground Delay Program (GDP) to delay the flights on the ground and avoid excessive airborne holding or re-routings,
- Airspace Flow Program (AFP) for an airspace constraint,
- Ground Stop (GS) may be declared at an aerodrome when adverse conditions or major facility outages cause demand to exceed capacity to such a degree that gridlock occurs,
- Level capping, a measure in which aircraft are required to operate below a given flight level in order to separate them from another flow,
- Rerouting

The CAMU traffic flow strategies are focused on the three major airports of traffic density areas in South Africa, Johannesburg O R Tambo (FAJS), Cape Town (FACT) and King Shaka (FALE). The system however takes into consideration and duly facilitates traffic into other airports: Durban (FADN), Bloemfontein (FABL), Lanseria (FALA), George (FAGG), Port Elizabeth (FAPE), East London (FAEL), and Kruger Mpumalanga Intl Airport (FAKN).

<table>
<tr><td colspan="5">ASBU B0-NOPS: Planning Targets and Implementation Progress</td></tr>
<tr><td>Elements</td><td colspan="4">Targets and Implementation Progress<br>(Ground and Air)</td></tr>
<tr><td>1. Air Traffic Flow Management</td><td colspan="4">December 2015</td></tr>
<tr><td colspan="5">ASBU B0-NOPS: Implementation Challenges</td></tr>
<tr><td rowspan="2">Elements</td><td colspan="4">Implementation Area</td></tr>
<tr><td>Ground System Implementation</td><td>Avionics Implementation</td><td>Procedures Availability</td><td>Operational Approvals</td></tr>
<tr><td>1. Air Traffic Flow Management</td><td>Funding</td><td>NIL</td><td>Lack of ATFM and CDM procedures. Lack of training</td><td><u>NIL</u></td></tr>
<tr><td colspan="5">B0-NOPS: Performance Monitoring and Measurement - Implementation Monitoring</td></tr>
<tr><td>Elements</td><td colspan="4">Performance Indicators / Supporting Metrics</td></tr>
<tr><td>1. Air Traffic Flow Management</td><td colspan="4">Indicator: Percentage of implemented FMUs<br>Supporting metric: Number of States with ATFM units implemented</td></tr>
</table>

| B0-NOPS: Performance Monitoring and Measurement - Performance Monitoring | |
|---|---|
| **Key Performance Areas** | **Metrics (if not, indicate qualitative benefits)** |
| Access & Equity | Improved access and equity in the use of airspace or aerodrome |
| Capacity | Number of aircrafts in a defined volume or airspace for a period of time. |
| Efficiency | Reduced fuel burn due to better anticipation of flow issues; Reduced block times and times with engines on |
| Environment | . Reduced $CO_2$ emissions per flight |
| Safety | Reduced number of occurrences of undesired sector overloads |

### 2.2.1 B0-ACAS........................................................................................................

| ASBU B0-ACAS: Planning Targets and Implementation Progress | |
|---|---|
| **Elements** | **Targets and Implementation Progress (Ground and Air)** |
| 1. ACAS II (TCAS Version 7.1) | 2013-2018 |

| ASBU B0-ACAS: Implementation Challenges | | | | |
|---|---|---|---|---|
| **Elements** | **Implementation Area** | | | |
| | **Ground System Implementation** | **Avionics Implementation** | **Procedures Availability** | **Operational Approvals** |
| 1. ACAS II (TCAS Version 7.1) | NIL | Equipage | NIL | NIL |

| B0-ACAS: Performance Monitoring and Measurement - Implementation Monitoring | |
|---|---|
| **Elements** | **Performance Indicators / Supporting Metrics** |
| 1. ACAS II (TCAS Version 7.1) | Indicator: Percentage of aircrafts that are equipped<br>Supporting metric: Reduction in number of RA incidents |

| B0-ACAS: Performance Monitoring and Measurement - Performance Monitoring | |
|---|---|
| **Key Performance Areas** | **Metrics (if not, indicate qualitative benefits)** |
| Access & Equity | N/A |
| Capacity | ACAS improvement will reduce unnecessary resolution advisory (RA) and then reduce trajectory deviations |
| Efficiency | N/A |
| Environment | N/A |
| Safety | Reduced number of potential AIR-PROX. ACAS increases safety in the case of breakdown of separation |

## REGIONAL AIR NAVIGATION REQUIREMENTS

## 2.3. STATUS OF IMPLEMENTATION OF AIR NAVIGATION PLAN REQUIREMENTS IN THE AREAS OF ANS AND AERODROMES

## 3.1 STATUS OF IMPLEMENTATION –

### 3.1.1 AERODROME AND AIRSPACE OPERATIONS

The First Meeting of the APIRG Airspace and Aerodrome Operations Sub-Group (AAO SG/1) was held in Dakar, Senegal, from 29 to 31 May 2017 and was attended by forty-six (46) participants from fourteen (14) States and two (2) Regional and International Organizations. The meeting focused on the operationalization of the new APIRG structure and operational methodology and addressed other matters of high priority which includes the development and maintenance of the AFI Air Navigation Plan, the identification and resolution of air navigation deficiencies and the implementation of SARPs and Regional Requirements. A small working group (SWG) was established to complete the items on AAO SG/1 agenda, including APIRG conclusions and decisions applicable to the AAO/SG.

The group also recalled that in adopting the Aviation System Block Upgrades (ASBU) methodology introduced in the 4th Edition of the ICAO Global Air Navigation Plan (GANP, Doc 9750) in 2013, APIRG/19 agreed under Conclusion 19/48 to re-organize its structure and working methods in order to effectively address the implementation by States of the ASBU modules applicable to the AFI Region.

The group noted that due to, inter alia, issues related to operationalization of the new APIRG Structure and working methodology, most APIRG Projects under the AAO/SG (13 for Airspace and 9 for Aerodrome Operations) had not commenced.

On the matter of status of implementation of ASBU modules, the meeting noted with concern that the flow of information from States and organization to the ESAF and WACAF Regional Offices had been significantly low and called on States to ensure timely reporting of progress in both airspace and aerodrome operations.

The group formulated 2 Draft Conclusions and 3 Draft Decisions as part of its outcome.

## 4.1 DEVELOPMENTS RELATED TO ENVIRONMENTAL PROTECTION.................

## 4.2 STATES' ACTION PLAN ON CO2 EMISSION REDUCTION...

A central element of Resolution A39-2 is for States to voluntarily prepare and submit their national action plans for aviation $CO_2$ emission reduction to ICAO. A national action plan is a tool that a State can, amongst others; shows case and communicate both at the national and international level, its efforts to address GHG emissions from international aviation. The plans should incorporate information on activities that aim to address $CO_2$ emissions from international aviation, including national actions, as well as activities implemented regionally or on a global scale in the context of (or as part of) bilateral and regional multilateral agreements.

*STATES THAT HAVE EVER SUBMITTED AND /UPDATED A STATE ACTION PLAN*

| STATE | INITIAL SUBMISSION | UPDATE |
|---|---|---|
| Angola | Jun-16 | |
| Burkina Faso | Jan-16 | |
| Burundi | Jan-16 | |
| Cameroon | Dec-15 | |
| Central African Republic | Apr-16 | |
| Chad | Dec-15 | |

| | | |
|---|---|---|
| Congo | May-16 | |
| Democratic Republic of Congo | Mar-16 | |
| Equatorial Guinea | Mar-16 | |
| Gabon | Apr-16 | |
| Gambia | Aug-15 | |
| Ghana | Jul-15 | Mar-16 |
| Kenya | Jun-12 | Dec-15 |
| Mauritius | Dec-13 | |
| Namibia | Sep- 16 | |
| Nigeria | Oct-15 | |
| Sao Tome and Principe | Mar-16 | |
| South Africa | Sept-16 | |
| Togo | Aug-15 | |
| Uganda | Aug-12 | |
| United Republic of Tanzania | Jun-12 | |
| Zambia | Nov-17 | |

## 4.3 IMPLEMENTATION OF IMPROVED AIR TRAFFIC MANAGEMENT

The driver behind many of the elements of ASBU Block 0 is increased system capacity as well as improved environmental efficiency, in order to accommodate the forecast global increase in air traffic. ICAO's Committee on Aviation Environmental Protection (CAEP) has undertaken a preliminary analysis to estimate the potential range of fuel and CO2 savings that could be delivered by the planned implementation of Block 0 modules in the timeframe of 2013 to 2018. This preliminary analysis provides a high level, conservative estimate of those benefits.

Assembly Resolution A39-2: *Consolidated statement of continuing ICAO policies and practices related to environmental protection — Climate change* indicates that "action plans should include information on the basket of measures to reduce CO2 emissions considered by States, reflecting their respective national capacities and circumstances, and information on any specific assistance needs"

.

The 39th Session of the ICAO Assembly reiterated the global aspirational goals for the international aviation sector of improving fuel efficiency by 2 per cent per annum and keeping the net carbon emissions from 2020 at the same level, as established at the 37th Assembly in 2010, and recognized the work being undertaken to explore a long-term global aspirational goal for international aviation in light of the 2°C and 1.5°C temperature goals of the Paris Agreement. The 39th Assembly also recognized that the aspirational goal of 2 per cent annual fuel efficiency improvement is unlikely to deliver the level of reduction necessary to stabilize and then reduce aviation's absolute emissions contribution to climate change, and that goals of more ambition are needed to deliver a sustainable path for aviation.

Under the four main elements of the basket of measures (technology, operations, aviation alternative fuels and market-based measures), the following categories apply (See Appendix A for more details):

In 2013, a high-level analysis of the potential environmental benefits from seven ASBU Block 0 modules was undertaken by the ICAO Committee on Aviation Environmental Protection (CAEP) which estimated that up to 4 million tonnes of fuel savings could be achieved from planned Block 0 module implementation. I am grateful for the positive State response to the 2013 survey on the implementation of ASBU Block 0, the results of which were published in the 2014 Air Navigation Report available at: http://www.icao.int/airnavigation/pages/Air-Navigation-Report.aspx.

The attached questionnaire will support a comprehensive ASBU Block 0 global environmental analysis currently underway by CAEP. The questionnaire is divided into questions per ASBU Performance Improvement Area, with each module with possible fuel savings individually targeted. For each module, the module's operational improvement is detailed along with questions designed to obtain the information required to advance the work described above.

## 5. SUCCESS STORIES/BEST PRACTICES.................................................................

## 6. CONCLUSION...........................................................................................................

## APPENDICES