



Agenda Item 3

**CNS Developments
3.4 GNSS Implementation**

**FOLLOW-UP TO ASPECTS RELATED WITH THE
GNSS IMPLEMENTATION IN THE CAR REGION**

(Presented by the Secretariat)

SUMMARY
This working paper presents an analysis, guidelines and proposals for the follow-up of the recommended actions for the GNSS implementation in the CAR Region.
<i>Strategic Objective</i> <i>This paper is related to strategic objectives A and D.</i>
References: • Annex 10, Volume I • Report of the AN-Conf/11 • GREPECAS/12, 13 and 14 Reports • Global Air Navigation Plan, Doc 9750 AN/968 • Regional Air Navigation Plan, Doc 8733 • Global Navigation Satellite System (GNSS) Manual. Doc 9849 AN/457, First Edition – 2005 • Manual on Testing of Radio Navigation Aids, Volume II – Testing of Satellite-based Radio Navigation Systems. Doc 8071. Fifth Edition 2007

1. Introduction

1.1 The Eleventh Air Navigation Conference (AN-Conf/11), held in Montreal from 22 September to 3 October 2003, drafted Recommendation 6/1 — *Transition to satellite-based air navigation*, which, among other aspects, urges that ICAO continue to develop as necessary provisions which would support seamless GNSS guidance for all phases of flight and that air navigation service providers move rapidly, in coordination with airspace users, with a view to achieving, as soon as possible, worldwide navigation capability to at least APV I performance; and States and airspace users take note of the available and upcoming SBAS navigation services providing for APV operations and take necessary steps towards installation and certification of SBAS capable avionics.

1.2 The Global Air Navigation Plan (Doc 9750), through strategy GPI-21 – *Navigation Systems*, establishes the strategy to enable the introduction and evolution of performance-based navigation supported by a robust navigation infrastructure providing an accurate, reliable and seamless global positioning capacity. **Appendix A** to this paper shows the aforementioned GPI-21 strategy.

1.3 The Air Navigation Plan for the Caribbean and South American Regions (Doc 8733), Volume II, FASID, Table CNS 3 presents the Navigation systems regional plan. This plan was prepared by the Third Caribbean/South American Regional Air Navigation Meeting (CAR/SAM/3) held in Buenos Aires (Argentina), 5–15 October 1999. This Plan includes the GNSS, GBAS and SBAS augmentation requirements. **Appendix B** to this paper includes the CAR Region section of the Plan.

1.4 The GREPECAS/12 Meeting, held in Havana, Cuba from 7 to 11 June 2004, drafted Conclusion 12/45 – *Amendment to the “Regional Guidelines for the transition to the Global Navigation Satellite Systems (GNSS)” and the “Regional Strategy for the introduction and application of non visual aids to approach, landing and departure”*. These guidelines and regional strategy are presented in **Appendixes C and D**, to this paper.

1.5 Furthermore, the GREPECAS/12 and GREPECAS/13 Meetings, the latter held in Santiago, Chile from 14 to 18 November 2005, followed up the studies for a CAR/SAM Regional SBAS solution that is being carried out by the Projects RLA/00/009 and RLA/03/902; as a result of this revision, the GREPECAS drafted Conclusion 13/84 – *Studies for a CAR/SAM Regional SBAS Solution*, which essentially urges States, Territories and International Organizations to continue introducing the GNSS in an evolutionary and coordinated manner, according to the ICAO global plan; conducting the studies for a regional SBAS solution consistent with the requirements and characteristics of the CAR/SAM Regions; and applying other augmentations, also taking into account that added benefits should help to justify the cost of reaching the ultimate goal of migrating to the GNSS once ground-based aids are dismantled

1.6 Additionally, GREPECAS drafted Conclusion 13/85 – *Foster the use of GNSS in diverse sectors of the States*, which urges States/Territories/International Organizations to foster the use of GNSS in diverse sectors of their respective States and disseminate the results of the studies on the solution of SBAS augmentation.

1.7 The GREPECAS/14 Meeting, through Decision 14/55 guided that SBAS solutions proposed for the CAR/SAM Regions, should be capable of achieving at least APV I capability.

1.8 Also, GREPECAS/14 drafted Conclusion 14/56 – *Progressive Deactivation of NDB Stations*, which urged States, Territories, International Organizations and airspace users to analyse the service provided by each NDB station, its function, procedural existence with other aids such as VOR/DME, GNSS-RNAV, as well as the aircraft capacity/development that operate in the concerning airspace in order to develop progressive deactivation of NDB Stations without affecting safety.

1.9 Recently, ICAO issued the Conclusions of the study of cost-allocation of the global navigation satellite systems (GNSS), as well as a proposal for amendment to the SARPs related to the GNSS implementation and evolution. Additional information on these aspects is presented in IP/04 of this Meeting. ICAO is also expected to update the SBAS SARPs in 2008.

2. Discussion

2.1 Taking into account the guidance provided by the ICAO Council, in accordance with the strategic objectives of the Organization, the defined strategy for these systems contained in the Global Air Navigation Plan as well as the relevant GREPECAS conclusions, and in order to accomplish benefits related to safety and efficiency through a larger application of the GNSS standards and recommended practices (SARPs), this working paper proposes actions for the Meeting in order to promote the GNSS implementation according with the existing GNSS systems and equipment.

Progressive implementation of GNSS elements specified by ICAO

2.2 For the introduction of new GNSS navigation services, a State should evaluate navigation systems against four essential criteria: accuracy, integrity (including time-to-alert), continuity of service and availability of service. Chapter 4 of the Global Navigation Satellite System (GNSS) Manual, Doc 9849, clearly explains the provision of services with GNSS, including the performance characteristics and the operational potential of GNSS augmentation systems. Chapter 5 of the mentioned Manual, provides guidance on aspects related to the GNSS implementation.

2.3 PANS-OPS, Doc 8168, Volumes I and II criteria for GNSS terminal, non-precision approach and departure operations have been developed in line with avionics performance obtained with a basic GNSS receiver.

2.4 In accordance with paragraph 3.7.2 of Annex 10, Volume I, the GNSS shall using various combinations of the following elements installed on the ground, on satellites and/or on board the aircraft:

- a) Global Positioning System (GPS) that provides the Standard Positioning Service (SPS);
- b) Global Navigation Satellite System (GLONASS) that provides the Channel of Standard Accuracy (CSA) navigation signal;
- c) aircraft-based augmentation system (ABAS);
- d) satellite-based augmentation system (SBAS);
- e) ground-based augmentation system (GBAS);
- f) ground-based regional augmentation system (GRAS); and
- g) aircraft GNSS receiver.

2.5 Additionally, among other provisions, the Table 3.7.2.4-1 of Annex 10, Volume I, establishes the signal-in space performance requirements for the following typical operations:

- a) En-route (oceanic/continental low density)
- b) En-route (continental)
- c) En-route, Terminal
- d) Initial approach, Intermediate approach, Non-precision approach (NPA), Departure
- e) Approach operations with vertical guidance (APV-I)
- f) Approach operations with vertical guidance (APV-II)
- g) Category I precision approach

2.6 The *Global Navigation Satellite System (GNSS) Manual* also provides information on the implementation aspects of GNSS in order to assist States in the introduction of GNSS operations. The Manual is therefore aimed at air navigation service providers responsible for fielding and operating GNSS elements, and at regulatory agencies responsible for approving the use of GNSS for flight operations. Additionally, it provides GNSS information to aircraft operators and manufacturers. The Manual is to be used in conjunction with the relevant provisions in Annex 10, Volume I.

2.7 The *Manual on Testing of Radio Navigation Aids* Doc 8071, Volume II — *Testing of Satellite-based Radio Navigation Systems* contains guidance on testing of satellite-based radio navigation systems including in-flight inspections of the augmentation systems.

2.8 Additionally, Annexes 11 and 15 now contain provisions related to the GNSS.

Implementation and updating of the Regional Navigation Plan

2.9 According to its evolution, the GNSS implementation should be carried out in accordance to the GPI-21 strategy established in the Global Air Navigation Plan and GREPECAS guidelines. The Meeting should begin to develop proposals to update the information in Table CNS 3 of the FASID, introducing the progressive deactivation of NDB and VOR stations of the CAR Region, but in a short term maintaining the GNSS use, autonomous systems and conventional ground radio aids.

Development of a progressive deactivation plan of NDB stations

2.10 As a follow-up to GREPECAS Conclusion 14/56, the Meeting is proposed to contribute to the development of a Plan for the progressive deactivation of NDB stations. For this purpose, **Appendix E** to this paper presents the GREPECAS recommendation to do so. It is expected that the Meeting participants from the States, Territories, International Organizations and airspace users, present contributions for this task by analysing the service provided by each NDB station, its function, the existence of procedures with other aids such as VOR/DME and GNSS-RNAV, as well as the aircraft capacity/development that operate in the concerning airspace.

Follow-up to the amendments, the new GNSS-related SARPs and ICAO guidelines

2.11 The Meeting is proposed to note that it is extremely important that the GNSS evolution implementation and the performance-based navigation are carried out in accordance with the strategy established by the Global Air Navigation Plan and the ICAO SARPs and guidance.

2.12 Taking into account GREPECAS Conclusion 13/85, as well as the ICAO guidance on provisional policies regarding GNSS cost-allocation presented in Appendix A to IP/04, States/Territories/International Organizations should implement available GNSS basic services; promote GNSS use in several sectors of their corresponding country and disseminate the results of the studies for the implementation of GNSS augmentation solutions, in order to seize the benefits and to contribute to the future understanding of the need to share costs between all the users in a State.

Follow-up to the studies, trials and results of the regional projects related with the GNSS, RLA/00/009 and RLA/03/902

2.13 In addition, this paper proposes the follow-up to the studies and results of the regional projects RLA/00/009 and RLA/03/902, as well as the experiences obtained by States and other regions on the implementation of GNSS. The website of the Project RLA/03/902 is: www.rlasacsa.com

Action Plan for the follow-up of the GNSS implementation

2.14 Based on the background and analysis contained in the previous paragraphs, the Meeting is proposed to review and recommend to States/Territories/International Organizations the implementation of the GNSS Action Plan contained in **Appendix F** to this working paper.

3. Suggested Actions

3.1 The Meeting is proposed to:

- a) take note of the information contained in this working paper;
- b) recommend the progressive implementation of GNSS elements, taking into account the background and guidelines provided in paragraphs 2.1 to 2.8 of this paper;
- c) commence the development of a progressive deactivation of NDB stations, taking into account the contents of paragraphs 2.9 and 2.10, as well as using the table contained in Appendix E to this paper;
- d) review and propose amendments to the FASID Table CNS 3;
- e) follow-up the GNSS-related SARPs and amendments as well as the GNSS-related ICAO guidelines;
- f) review and recommend actions to continue the implementation of GNSS basic services and follow-up the regional studies for the implementation of the SBAS and other augmentation systems;
- g) follow-up the activities and results of the studies and trials of the regional projects RLA/00/009 and RLA/03/902, which are related to the GNSS implementation;
- h) based on the proposal contained in paragraph 2.14 and on the preliminary proposal presented in Appendix F to this paper, review and recommend an action plan for the GNSS follow-up and implementation; and
- i) consider and recommend other actions deemed appropriate.

APPENDIX A

(Extract from Chapter 1 of the Global Air Navigation Plan, Doc 9750 AN/968)

(GPI-21) NAVIGATION SYSTEMS

Scope: Enable the introduction and evolution of performance-based navigation supported by a robust navigation infrastructure providing an accurate, reliable and seamless global positioning capability.

Related ATM objectives: WGS-84; NPA; Precision approach; Required navigation performance

Description of strategy

1.90 Airspace users need a globally interoperable navigational infrastructure that delivers benefits in safety, efficiency and capacity. Aircraft navigation should be straight-forward and conducted to the highest level of accuracy supported by the infrastructure.

1.91 To meet those needs, the progressive introduction of performance-based navigation must be supported by an appropriate navigation infrastructure consisting of an appropriate combination of global navigation satellite systems (GNSS), self-contained navigation systems (inertial navigation system) and conventional ground-based navigation aids.

1.92 GNSS provides standardised positioning information to the aircraft systems to support precise navigation globally. One global navigation system will help support a standardisation of procedures and cockpit displays coupled with a minimum set of avionics, maintenance and training requirements. Thus, the ultimate goal is a transition to GNSS that would eliminate the requirement for ground-based aids, although the vulnerability of GNSS to interference may require the retention of some ground aids in specific areas.

1.93 GNSS-centered performance-based navigation enables a seamless, harmonised and cost effective navigational service from departure to final approach that will provide benefits in safety, efficiency and capacity.

1.94 GNSS implementation will be carried out in an evolutionary manner, allowing gradual system improvements to be introduced. Near-term applications of GNSS are intended to enable the early introduction of satellite-based area navigation without any infrastructure investment, using the core satellite constellations and integrated multisensor airborne systems. The use of these systems already allows for increased reliability of non-precision approach operations at some airports.

1.95 Medium/longer term applications will make use of existing and future satellite navigation systems with some type of augmentation, or combination of augmentations required for operation in a particular phase of flight.

APPENDIX B
(CAR/SAM ANP – FASID)

IV-CNS 3-1

Table CNS 3 — Tableau CNS 3 — Tabla CNS 3

TABLE OF RADIO NAVIGATION AIDS
AIDES DE RADIONAVIGATION
TABLA DE AYUDAS PARA LA RADIONAVEGACIÓN

EXPLANATION OF THE TABLE

Column

- 1 Name of the country, city and aerodrome and, for route aids, the location of the installation.
- 2 The designator number and runway type:

NINST — Visual flight runway
NPA — Non precision approach runway
PA1 — Precision approach runway, Category I
PA2 — Precision approach runway, Category II
PA3 — Precision approach runway, Category III
- 3 The functions carried out by the aids appear in columns 4 to 8 and 10 to 12.

A/L — Approach and landing
T — Terminal
E — En route
- 4 ILS —Instrument landing system. Roman numerals I, II and III indicate the acting category of the ILS I, II or III. (I) indicates that the facility is implemented.

The letter “D” indicates a DME requirement to serve as a substitute for a marker beacon component of an ILS.

Note.— Indication of the category refers to the performance standard to be achieved and maintained, in accordance with pertinent specifications in ICAO Annex 10, and not to specifications of the ILS equipment, since both specifications are not necessarily the same.

An asterisk (*) indicates that the ILS requires a Category II signal, but without the reliability and availability which redundant equipment and automatic switching provide.
- 5 Radio beacon localizer, be it associated with an ILS or to be used as an approach aid at an aerodrome.
- 6 Radiotelemetrical equipment. When an “X” appears in column 6 in line with the VOR in column 7, this indicates the need that the DME be installed at a common site with the VOR.
- 7 VOR — VHF omnidirectional radio range.
- 8 NDB — Non-directional radio beacon.

- 9 The distances and altitude to which the VOR or VOR/DME signals are required, indicated in nautical miles (NM) or thousands of feet, or the nominal coverage recommended of the NDB, indicated in nautical miles.
- 10, 11 GNSS — global navigation satellite system (includes GBAS and SBAS).
- GBAS (ground-based augmentation system) implementation planned to be used in precision approach and landing CAT I, CAT II, CAT III.
- SBAS (satellite-based augmentation system) implementation planned to be used for route navigation, for terminal, for non precision approach and landing. An “X” indicates service availability; exact location of installation will be determined.
- Note. — GPS receiver is under standard rules and ABAS (aircraft-based augmentation system).*
- 12 Remarks
- Note.— Columns 5 to 12 use the following symbols:*
- D — DME required but not implemented.
 DI — DME required and implemented.
 X — Required but not implemented.
 XI — Required and implemented.

EXPLICATION DU TABLEAU

Colonne

- 1 Nom du pays, de la ville et de l’aérodrome et, dans le cas des aides de route, emplacement de l’installation
- 2 Numéro d’identification et type de la piste:
- NINST — Piste à vue
 NPA — Piste avec approche classique
 PA1 — Piste avec approche de précision, catégorie I
 PA2 — Piste avec approche de précision, catégorie II
 PA3 — Piste avec approche de précision, catégorie III
- 3 La fonction des aides est indiquée dans les colonnes 4 à 8 et 10 à 12.
- A/L — Aide d’approche et d’atterrissage
 T — Aide de région terminale
 E — Aide de route
- 4 ILS — Système d’atterrissage aux instruments. Les chiffres romains I, II et III indiquent la catégorie de service active de l’ILS. La lettre «I» entre parenthèses (I) indique que le moyen est mis en œuvre.
- La lettre «D» indique un besoin relatif à un DME destiné à servir en remplacement d’une radioborne de l’ILS.
- Note.— L’indication de la catégorie concerne les performances à atteindre et à maintenir conformément aux spécifications de l’Annexe 10 de l’OACI et non aux spécifications de l’équipement installé, qui ne sont pas forcément les mêmes.*

- Un astérisque (*) indique que l'ILS doit produire un signal de catégorie II, mais sans la fiabilité et la disponibilité qu'assurent la redondance de l'équipement et la commutation automatique.
- 5 Radiophare d'alignement de piste, qu'il soit associé à un ILS ou utilisé comme aide d'approche à un aérodrome.
- 6 Équipement de télémétrie. Un «X» dans la colonne 6 et un VOR dans la colonne 7 indiquent que le DME doit être coïmplanté avec le VOR.
- 7 VOR — Radiophare omnidirectionnel VHF
- 8 NDB — Radiophare non directionnel
- 9 Distance et altitude requises des signaux VOR ou VOR/DME, respectivement en milles marins (NM) et en milliers de pieds, ou couverture nominale recommandée du NDB, en milles marins.
- 10, 11 GNSS — Système mondial de navigation par satellite (comprend le GBAS et le SBAS)
- GBAS (système de renforcement au sol) prévu pour les approches de précision et les atterrissages CAT I, CAT II, CAT III.
- SBAS (système de renforcement satellitaire) prévu pour la navigation de route, la navigation en région terminale et les approches et atterrissages classiques. Un «X» indique que le service est assuré; l'emplacement exact de l'installation sera déterminé ultérieurement.
- Note.— Le récepteur GPS est visé par des règles standard et par l'ABAS (système de renforcement embarqué).*
- 12 Remarques
- Note.— Les abréviations suivantes sont utilisées dans les colonnes 5 à 12:*
- D — DME requis mais non installé
 DI — DME requis et installé
 X — Requis mais non installé
 XI — Requis et installé

EXPLICACIÓN DE LA TABLA

Columna

- 1 Nombre del país, ciudad y aeródromo y, para las ayudas en ruta, el emplazamiento de la instalación.
- 2 Número de designador y tipo de pista:
- NINST — Pista de vuelo visual
 NPA — Pista de aproximación que no es de precisión
 PA1 — Pista de aproximación de precisión, Categoría I
 PA2 — Pista de aproximación de precisión, Categoría II
 PA3 — Pista de aproximación de precisión, Categoría III
- 3 La función efectuada por las ayudas figura en las Columnas 4 a 8 y 10 a 12.

A/L — Aproximación y aterrizaje

T — Terminal

E — En ruta

- 4 ILS — Sistema de aterrizaje por instrumentos. Los números romanos I, II y III indican la categoría de actuación del ILS, I, II o III. (I) indican que la instalación está en servicio.

La letra “D” indica que se requiere un DME para sustituir a un componente de radiobaliza de un ILS.

Nota.— La indicación de la categoría se refiere a la norma de performance que ha de alcanzarse y mantenerse, de conformidad con las especificaciones pertinentes del Anexo 10 de la OACI, y no con las especificaciones del equipo ILS, ya que ambas especificaciones no son necesariamente las mismas.

Un asterisco (*) indica que el ILS requiere una señal de Categoría II, pero sin la fiabilidad y disponibilidad que proporcionan el equipo de reserva y la conmutación automática.

- 5 Localizador de radiofaro, asociado a un ILS o para utilizarlo como ayuda de aproximación en un aeródromo.

- 6 Equipo radiotelemétrico. Cuando figura una “X” en la Columna 6 junto con el VOR de la Columna 7, quiere decir que el DME debe instalarse en un sitio común con el VOR.

- 7 VOR — Radiofaro omnidireccional en VHF.

- 8 NDB — Radiofaro no direccional.

- 9 Las distancias y altitud a las cuales se requieren señales VOR o VOR/DME indicadas en millas marinas (NM) o miles de pies, o la cobertura nominal recomendada del NDB indicada en millas marinas.

- 10, 11 GNSS — sistema mundial de navegación por satélite (incluye GBAS y SBAS).

GBAS (sistema de aumentación basado en tierra) según lo previsto se utilizará en las aproximaciones y aterrizajes de precisión de CAT I, CAT II y CAT III.

SBAS (sistema de aumentación basado en satélites) según lo previsto, se utilizará en navegación en ruta, terminal, y aproximaciones y aterrizajes que no son de precisión. La “X” indica disponibilidad de servicio; se determinará el emplazamiento exacto de la instalación.

Nota.— El receptor GPS se ajusta a reglas uniformes y ABAS (sistema de aumentación basado en la aeronave).

- 12 Observaciones

Nota.— En las Columnas 5 a 12 se utilizan los símbolos siguientes:

D — DME requerido pero no en servicio.

DI — DME requerido y en servicio.

X — Requerido pero no en servicio.

XI — Requerido y en servicio.

[illegible]

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CAR/SAM FASID

[illegible]

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
PARRITA PAVAS/Tobias Bolaños Intl. CUBA CAMAGUEY/Ignacio Agramonte Intl. CAYABO CAYO LARGO DEL SUR/Vilo Acuña Intl. CIEGO DE AVILA/Maximo Gomez Intl. HABANA/Jose Martí Intl. HOLGUIN/Frank Pais Intl. MANZANILLO NUEVA GERONA NUEVAS SANTIAGO DE CUBA/Antonio Maceo Intl. VARADERO/Juan Gualberto Gomez Intl. DOMINICA MELVILLE HALL/Dominica ROSEAU/Canefield	NINST	T E E	II*	XI	XI XI	XI XI	XI	125/45 100	X X	X X X	
		A/L A/L T			XI XI	XI XI		170/45		X X	
		E						100		X	
		A/L			XI	XI				X	
CAYO LARGO DEL SUR/Vilo Acuña Intl. CIEGO DE AVILA/Maximo Gomez Intl. HABANA/Jose Martí Intl. HOLGUIN/Frank Pais Intl. MANZANILLO NUEVA GERONA NUEVAS SANTIAGO DE CUBA/Antonio Maceo Intl. VARADERO/Juan Gualberto Gomez Intl. DOMINICA MELVILLE HALL/Dominica ROSEAU/Canefield	12 NPA	E E E	II*	XI	XI XI	XI XI	XI	170/45 170	X X	X X	
		A/L/T/E			XI XI	XI XI		190/45		X	
		A/L A/L T			XI XI	XI XI		170/45		X X	
		A/L			X XI	XI XI		85/45		X	
CAYO LARGO DEL SUR/Vilo Acuña Intl. CIEGO DE AVILA/Maximo Gomez Intl. HABANA/Jose Martí Intl. HOLGUIN/Frank Pais Intl. MANZANILLO NUEVA GERONA NUEVAS SANTIAGO DE CUBA/Antonio Maceo Intl. VARADERO/Juan Gualberto Gomez Intl. DOMINICA MELVILLE HALL/Dominica ROSEAU/Canefield	05 NPA	E	II*	XI			XI	170	X X		
		E			X	XI		190/45		X	
		E									
		E			X	XI					
CAYO LARGO DEL SUR/Vilo Acuña Intl. CIEGO DE AVILA/Maximo Gomez Intl. HABANA/Jose Martí Intl. HOLGUIN/Frank Pais Intl. MANZANILLO NUEVA GERONA NUEVAS SANTIAGO DE CUBA/Antonio Maceo Intl. VARADERO/Juan Gualberto Gomez Intl. DOMINICA MELVILLE HALL/Dominica ROSEAU/Canefield	09 NPA	A/L	I	X	XI XI	XI XI	XI		X		
		A/L			XI XI	XI XI					
		A/L T E			XI XI	XI XI		170/45 70		X X X	
		A/L			XI XI	XI XI		160/45		X X X	
CAYO LARGO DEL SUR/Vilo Acuña Intl. CIEGO DE AVILA/Maximo Gomez Intl. HABANA/Jose Martí Intl. HOLGUIN/Frank Pais Intl. MANZANILLO NUEVA GERONA NUEVAS SANTIAGO DE CUBA/Antonio Maceo Intl. VARADERO/Juan Gualberto Gomez Intl. DOMINICA MELVILLE HALL/Dominica ROSEAU/Canefield	24 NPA	T E	I	X	XI XI	XI XI	XI		X		
CAYO LARGO DEL SUR/Vilo Acuña Intl. CIEGO DE AVILA/Maximo Gomez Intl. HABANA/Jose Martí Intl. HOLGUIN/Frank Pais Intl. MANZANILLO NUEVA GERONA NUEVAS SANTIAGO DE CUBA/Antonio Maceo Intl. VARADERO/Juan Gualberto Gomez Intl. DOMINICA MELVILLE HALL/Dominica ROSEAU/Canefield	24 NPA		I	X	XI XI	XI XI	XI		X		

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CAR/SAM FASID

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
DOMINICAN REPUBLIC											
BARAHONA/María Montés Intl.	12 NPA	A/L			XI	XI	XI			X	
CABO ROJO		E E			XI	XI		200/45 210		X X	
HERRERA/Herrera Intl.	01 NPA 19 NPA	A/L A/L				XI	XI			X X	
LA ROMANA/La Romana Intl.	NINST						XI			X	
PUERTO PLATA/Gregorio Luperon Intl.	08 NPA 26 NPA	A/L A/L T E			XI	XI XI XI	XI		X X		X X
PUNTA CANA/Punta Cana Intl.	09 NPA	A/L			X	XI	XI			X	
PUNTA CAUCEDO		T E E			XI XI	XI XI	X X	200/45 365		X X X	
SANTIAGO/Cibao Intl.	NINST									X	
SANTO DOMINGO/De las Américas Intl.	17 PA1 35 NPA	A/L	II* D (I)		XI	XI	XI		X X		
EL SALVADOR											
SAN SALVADOR/EI Salvador Intl.	07 PA1 25 NPA	A/L T E E	II*	X	XI XI XI	XI XI XI		200/45 235	X X		X X X
SAN SALVADOR/Ilopango Intl.	15 NPA	A/L T E		XI	XI XI	XI XI	XI X		X	X X	
FRENCH ANTILLES (France)											
FORT-DE-FRANCE/Le Lamentin, Martinique	09 PA1 27 NPA	A/L A/L T E	II* D		XI XI XI	XI XI XI		200/45	X X		X X

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
POINTE-A-PITRE/Le Raizet, Guadeloupe	11 PA1 29 NPA	A/L T E E	II* D		XI XI XI	XI XI XI	 XI	 200/45 250	X X		
SAINT-BARTHELEMY/ Saint-Barthelemy, Guadeloupe	NINST									X	
SAINT-MARTIN/Grand Case, Guadeloupe	NINST									X	
GRENADA											
CARRIACOU/Lauriston Intl.	NINST									X	
SAINT GEORGES/Point Salines	10 PA1 28 NPA	A/L T E	II*		XI	XI XI XI	XI	 200/45	X X		
GUATEMALA											
CHINAUTLA		T E			X X	X X		100/45		X X	
FLORES/Flores Intl.	10 PA1	A/L E	I D		XI XI	XI XI	X	75/45	X	X	
GUATEMALA/La Aurora	01 NPA 19 PA1	A/L A/L T E E	II* D	X	XI	XI XI XI	 XI	 110/45 200	X X		
IZTAPA		E					X	100		X	
PUERTO BARRIOS/Puerto Barrios	NINST	E					XI	70		X X	
RABINAL		E					X	200		X	
SAN JOSE/San Jose	15 NPA	A/L T E			XI XI XI	XI XI XI				X X	
HAITI											
CAP HAITIEN/Cap. Haitien Intl.	NINST				XI	XI				X	

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
PORT-AU-PRINCE/Port-au-Prince Intl.	09 PA1 27 NPA	A/L A/L T	II* D		XI XI	XI XI			X X		
OBLEON		E			XI	XI		200/45		X	
HONDURAS											
COPAN RUINAS		E					X	55		X	
LA CEIBA/Golosón Intl.	06 NPA	A/L E E			XI XI	XI XI	XI	200/45 110	X	X	
ROATAN		T E			XI XI	XI	XI	60 180/25	X	X	
SAN PEDRO SULA/La Mesa Intl.	03 NPA 21 PA1	A/L A/L T E E	I D		XI	XI XI XI	XI	200/45 300	X X	X X	
TEGUCIGALPA/Toncontín Intl.	01 PA1 19 NPA	A/L A/L T E E	I		X XI XI	X XI XI	XI	300	X X	X X	
JAMAICA											
KINGSTON/Norman Manley Intl.	12 PA1 30 NPA	A/L T E E	II* D		XI XI XI	XI XI XI	XI	200/45 400	X X	X X X	
MONTEGO BAY/Sangster Intl.	07 PA1 25 NPA	A/L T E E	II* D		XI XI XI	XI XI XI	XI	200/45 325	X X	X X X	
MEXICO											
ACAPULCO/Gral. Juan N. Alvarez Intl.	10 PA1 28 PA1	A/L A/L T E E	II* II*	X X	XI XI XI	XI XI XI		200/45	X X	X X X	
AGUASCALIENTES	NPA	A/L E			XI	XI				X	

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
APAN OTUMBA		T E T E			XI XI	XI XI				X X	
BAHIAS DE HUATULCO/Bahias de Huatulco	07 NPA	A/L			XI	XI				X	
	25 NPA	E			XI	XI				X X	
CAMPECHE/Ing. Alberto Acuña Ongay	16 NPA	A/L			XI	XI				X	
	24 NPA	A/L			XI	XI				X	
CANCUN/Cancun Intl.	12 PA1	A/L	II* D (I)		XI	XI			X X		
	30 NPA	T E			XI XI	XI XI		135/45		X X	
CHETUMAL/Chetumal Intl.	10 NPA	A/L			XI	XI	XI			X X X	
	28 NPA	E			XI	XI	XI			X X X	
CHIHUAHUA/Gral. Roberto Fierro Villalobos Intl.	18L NP	A/L			XI	XI	XI		X		
	36R PA1	A/L T E	II* D		XI XI	XI XI	XI XI		X	X X	
CHOIX		E					XI			X	
CIUDAD JUAREZ/Abraham González Intl.	03 NPA	A/L			XI	XI				X	
	21 NPA	A/L T E			XI XI	XI XI				X X X	
CIUDAD OBREGON	NPA	A/L E			XI	XI		70/45		X	
CIUDAD VICTORIA	NPA	A/L E			XI	XI		80/45		X	
COLIMA	NPA	A/L E			XI	XI				X	
CONCEPCION DEL ORO		E			XI	XI				X	
COZUMEL/Cozumel Intl.	11 PA1	A/L	II*		XI	XI	XI		X X		
	29 NPA	A/L T E E			XI XI	XI XI	XI XI	200/45 230		X X X	

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
CUAUTLA		T E			XI XI	XI XI				X X	
CULIACAN/Fidel Bachigualato	NPA	A/L E			XI	XI				X	
DELICIAS		T E			XI	XI				X	
DURANGO/Pte. Guadalupe Victoria Intl.	03 NPA	A/L E			XI XI	XI XI		145/45		X X	
GUADALAJARA/Miguel Hidalgo Costilla Intl.	10 PA1	A/L	II*	XI	XI	XI			X		
	28 PA1	A/L T E	II*		XI XI	XI XI		125/45	X	X X	
GUAYMAS/Gral. José Maria Yañez Intl.	20 NPA	A/L					XI			X	
HERMOSILLO/Gral. I. Pesqueira Garcia Intl.	05 NPA	A/L			XI	XI				X	
	23 NPA	A/L T E			XI XI	XI XI		105/45		X X X	
IXTAPA -ZIHUATANEJO/ Ixtapa-Zihuatanejo Intl.	NPA	A/L E			XI	XI		105/45		X	
LA PAZ/Gral. Manuel Marquesde de León Intl.	18 PA1	A/L	II*		XI	XI			X		
	36 NPA	A/L T E			XI XI	XI XI		135/45	X	X X	
LEON	NPA	A/L t E								X	
LORETO/Loreto Intl.	34 NPA	A/L E			XI XI	XI XI				X X	
LOS MOCHIS	NPA	A/L E E			XI XI	XI XI		120/45 120		X X X	
MANZANILLO/Playa de Oro Intl.	10 NPA	A/L E			XI X	XI X				X X	
MATAMOROS/Intl.	15 NPA	A/L			XI	XI				X	
	33 NPA	A/L T E			XI XI	XI XI				X X X X	

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
MAZATLAN/Gral. Rafael Buelna Intl.	08 NPA 26 PA1	A/L	II* D		XI XI XI	XI XI XI		200/45	X X	X X	
		T									
		E									
MERIDA/Lic. Manuel Crescencio Rejón Intl.	10 PA1 28 NPA	A/L	II*		XI XI XI	XI XI XI	XI	200/45 200	X X	X X X	
		T									
		E									
MEXICALI/Gral. Rodolfo Sanchez Taboada Intl.	28 NPA	A/L			XI XI XI	XI XI XI		70/45		X X X	
		T									
		E									
MEXICO/Lic. Benito Juárez Intl.	05R PA1 23L PA1	A/L	II* D		XI XI XI	XI XI XI	XI	60/45	X X	X X	
		T									
		E									
MINATITLAN	NPA	A/L			XI XI	XI XI		70/45		X X	
		E									
MONCLOVA	NPA	A/L			XI	XI				X	
		E									
MONTERREY/Aeropuerto Del Norte Intl.	20 NPA	A/L			XI XI	XI XI				X X	
		T									
		E									
MONTERREY/Gral. Mariano Escobedo Intl.	11 NPA 29 PA1	A/L	II* D		XI XI	XI XI		80/45	X X	X X	
		T									
		E									
MORELIA/Gral. Francisco J. Mujica Intl.	05 NPA	A/L			XI XI	XI XI				X X	
		E									
NAUTLA		E			XI	XI		200/45 400		X X	
		E									
NUEVO LAREDO/Quetzatcoatl Intl.	14 NPA 32 NPA	A/L			XI XI	XI XI		60/45		X X X X	
		A/L									
		T									
OAXACA	NPA	E			XI	XI				X	
		T									

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
OTUMBA		E T E			XI XI	XI XI		110/45 100		X X	
PACHUCA		T E			XI XI	XI XI		70/45		X X	
POZA RICA	NPA	A/L E			XI	XI		200/45		X	
PUEBLA	NPA	A/L E T			XI	XI				X	
PUERTO ESCONDIDO	NPA	A/L E			XI	XI				X	
PUERTO PEÑASCO		E			XI	XI		105/45		X	
PUERTO VALLARTA/Lic. Gustavo Díaz Ordaz Intl.	04 PA1 22 NPA	A/L A/L T E	II* D		XI XI XI	XI XI XI			X X	X X	
QUERETARO	NPA	A/L E			XI	XI		200/45		X	
REYNOSA/Gral. Lucio Blanco Intl.	31 NPA	A/L T E			XI XI XI	XI XI XI		135/45		X X X	
SALTILLO	PA1	A/L E			XI	XI				X	
SAN JOSE DEL CABO/San Jose del Cabo Intl.	16 NPA 34 NPA	A/L A/L E			XI XI	XI XI				X X X	
SAN LUIS POTOSI	NPA	A/L E			XI	XI				X	
SAN MARCOS		T E					XI			X X	
SAN MATEO		T			XI	XI				X	
SAN QUINTIN		E			XI	XI				X	
SANTA ANITA		T					X			X	
SANTA LUCIA		T E			XI	XI					

[illegible]

Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
PLYMOUTH/W.H. Bramble, Montserrat I.	NINST	A/L					XI			X	
NETHERLANDS ANTILLES (Netherlands)											
KRALENDIJK/Flamingo, Bonaire	10 NPA 28 NPA	A/L A/L E		XI	X XI	XI XI				X X X	
ORANJESTAD/F.D. Roosevelt, Saint Eustatius I.	NINST									X	
PHILIPSBURG/Prinses Juliana, St. Maarten I.	09 PA1 27 NPA	A/L A/L T E E	II* D		XI XI XI	XI XI XI	XI		X X		X X X
WILLEMSTAD/Hato, Curacao I.	11 PA1 29 NPA	A/L A/L T E E	II* D		XI XI XI	XI XI XI	XI XI		X X		X X X
NICARAGUA											
MANAGUA/Augusto César Sandino Intl.	09 NPA 27 PA1	A/L A/L T E E	 II*		 XI XI XI	 XI XI XI	 XI XI		X X		 X X X
PUERTO CABEZAS/Puerto Cabezas	09 NPA	A/L T E			XI XI XI	XI XI XI					X X X
PUERTO RICO (United States)											
AGUADILLA/Rafael Hernandez Intl.	08 PA1 26 NPA	A/L A/L	I		X	X			X		X
BORINQUEN		E			XI (Tacan)	XI					X
DORADO		E					XI	400			X
MAYAQUEZ/Mayaquez	09 NPA	A/L E E				XI XI	XI	145/45 45			X X X
POINT TUNA							XI				
PONCE/Ponce - Mercedita	30 NPA	A/L T E			XI XI XI	XI XI XI		110/45			X X X

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Station/Territory Station/Territoire Estación/Territorio	Rwy type Type de piste Tipo de pista	Function Fonction Función	ILS	L	DME	VOR	NDB	Coverage Couverture Cobertura	GNSS		Remarks Remarques Observaciones
									GBAS	SBAS	
1	2	3	4	5	6	7	8	9	10	11	12
TRINIDAD AND TOBAGO											
PORT OF SPAIN/Piarco Intl. Trinidad I.	10 PA1 28 NPA	A/L A/L T E	II*		XI	XI	XI	200/45 400	X X	X X	
SCARBOROUGH/Crown Point, Tobago I.	11 NPA	A/L E					XI XI	150		X X	
TURKS AND CAICOS ISLANDS (United Kingdom)											
GRAND TURK/Grand Turk Intl.	11 NPA	A/L E		X	XI (Tacan) XI (Tacan)	X X	XI	200/45		X X	
PROVIDENCIALES/Providenciales Intl.	10 NPA 28 NPA	A/L A/L					XI			X X	
SOUTH CAICOS/South Caicos Intl.	NINST									X	
VIRGIN ISLANDS (United Kingdom)											
ROADTOWN/Beef Island	07 NPA	A/L					XI			X	
VIRGIN GORDA/Virgin Gorda	NINST									X	
VIRGIN ISLANDS (United States)											
CHRISTIANSTED/Henry E. Rohlsen, St. Croix	09 PA1 27 NPA	A/L A/L E	II*		XI XI	XI XI	XI	155/45		X X X	
SAINT THOMAS/Cyril E. King	10 PA1 28 NPA	A/L A/L T	I		XI XI	XI XI			X	X X X	

APPENDIX C

(Appendix S to the Report on Agenda Item 3 of the GREPECAS/12 Meeting Report)

**GUIDELINES FOR TRANSITION TO SATELLITE NAVIGATION SYSTEMS IN THE
CAR/SAM REGIONS**

1. GNSS should be introduced in an evolutionary manner, with improvements in GNSS capability generating increasing benefits, and culminating in GNSS supporting all phases of flight. As GNSS evolves, the planning for the removal of ground-based navigation aids should take account of the issues described below:
2. The ground infrastructure for current navigation systems must remain available during the transition period.
3. States/regions can consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance where this can be done without reducing airspace capacity.
4. Before any existing ground infrastructure is considered for removal, users shall be given reasonable transition time to allow them to equip with GNSS to attain equivalent navigation service.
5. As GNSS is introduced for enroute operation, States/regions should coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in all flight information regions along major traffic flows to allow for a seamless transition to GNSS-based navigation
6. In planning the transition to GNSS, the following issues must be considered:
 - a) maintaining or improving the current level of safety;
 - b) schedule for provision and/or adoption of a GNSS service, including aircraft and operator approval processes;
 - c) extent of existing ground-based radio navigation services;
 - d) strategy for transition schedule to GNSS capability (i.e. benefits-driven or mandatory);
 - e) appropriate level of user equipage with GNSS capability;
 - f) provision of other air traffic services (i.e. surveillance and communications);
 - g) density of traffic/frequency of operations;
 - h) mitigation of risks associated with radio frequency interference failures and ionospheric issues;
 - i) design and implementation of procedures; and
 - j) over-all economics and lead times to introduce aircraft avionics requirements.

APPENDIX D

(Appendix T to the Report on Agenda Item 3 of the GREPECAS/12 Meeting Report)

**STRATEGIES FOR THE INTRODUCTION AND APPLICATION OF NON VISUAL AIDS IN
APPROACH, LANDING AND DEPARTURE IN THE CAR/SAM REGION**

- a) Maintain the ILS as the ICAO standard precision approach and landing system as long as necessary and as long as it remains operationally acceptable and economically beneficial, doing everything possible to not deny access to airports to aircraft equipped only with ILS;
- b) implement GNSS with augmentation as required for APV and Category I operations where operationally required and technically feasible and economically beneficial, taking into account GNSS evolution;
- c) promote the development and use of a multi-modal airborne landing capability;
- d) promote the use of APV operations, particularly those using GNSS vertical guidance, to enhance safety and accessibility; and
- e) identify and resolve operational and technical feasibility issues for GNSS with ground-based augmentation system (GBAS) to support Category II and III operations; Implement GNSS for Category II and III operations where operationally required and economically beneficial.

APPENDIX E

(Appendix AF to the Report on Agenda Item 3 of the GREPECAS/14 Meeting Report)

REGIONAL PLAN OF DEACTIVATION OF NDB STATIONS
PLAN REGIONAL DE DESACTIVACIÓN DE ESTACIONES NDB

[illegible]

**ACTION PLAN FOR THE GNSS IMPLEMENTATION FOLLOW-UP - CAR REGION
APPENDIX F**

CAR/WG/1-WP/12

State/Organization:
Estado/Organización:

Date/Fecha:

No.	Strategic Objective/ Objetivo	AN-Conf/11	Global Plan/ Plan Mundial - GPI	Regional Plan/ Plan Regional - FASID	GREPECAS No. Con/Dec/Pa	Target Activity / Actividad Meta	Follow-up Action / Acción de seguimiento	To be developed by / A ser desarrollado por	Deliverable / Entregable	Target date / Fecha límite	Remarks / Observaciones
1	2		3		4	5	6	7	8	9	10
1	A, D	Rec 6/1 b)	GPI-21			<u>Recommendations of the AN-Conf/11 for the transition to satellite-based air navigation</u> Adopt measures to achieve, as soon as possible, worldwide navigation capability to at least APV I performance.		States and air navigation services Providers	Adopted measures		
2	A, D	Rec 6/1 c)	GPI-21			Take note of the available and upcoming SBAS navigation services providing for APV operations.		States and air navigation services Providers	Take note		
3	A, D	Rec 6/1 c)	GPI-21			Take the necessary steps towards installation and certification of SBAS capable avionics.		States and airspace users	Installed and certified avionics		
4	A, D		GPI-21		12/45 a)	<u>New guidelines and regional strategy for the GNSS transition</u> Take into account the "Regional Guidelines for the transition to the GNSS" and the "Regional strategy for the introduction and application of non visual aids to approach, landing and departure"		States and International Organizations	Compliance with the required coverage.		
5	A, D		GPI-21	Tabla CNS 3	13/84 a)	<u>Studies for a CAR/SAM Regional SBAS solution</u> Continue introducing the GNSS in an evolutionary and coordinated manner, according to the ICAO Global Plan.		States and International Organizations	Introduce GNSS		
6	A, D		GPI-21	Tabla CNS 3	13/84 a)	Conducting the studies for a CAR/SAM regional SBAS solution; and applying other augmentations, also taking into account that added benefits should help to justify the cost of reaching the ultimate goal of migrating to the GNSS once ground-based aids are dismantled.		States and International Organizations	Studies carried out		

No.	Strategic Objective/ Objetivo	AN-Conf/11	Global Plan/ Plan Mundial - GPI	Regional Plan / Plan Regional - FASID	GREPECAS No. Com/Dec/Pa	Target Activity / Actividad Meta	Follow-up Action / Acción de seguimiento	To be developed by / A ser desarrollado por	Deliverable / Entregable	Target date / Fecha límite	Remarks / Observaciones
1	2		3		4	5	6	7	8	9	10
7	A, D		GPI-21		13/84 d)	Interested parties in participating in the Project RLA/03/902 should consider the revised rates to join this project.		States and International Organizations	Participation in the Project		
8	A, D		GPI-21		13/85	Foster the use of GNSS in diverse sectors of their respective States and disseminate the results of the studies on the solution of SBAS augmentation.		States and International Organizations			
9	A, D		GPI-21		GRP14 3.6.3.2 0 to 28	Follow-up to the studies and results of the regional projects RLA/00/009 and RLA/03/902 on the SBAS augmentation solution in the CAR/SAM Regions.		States and International Organizations	Consider the results of the studies		
10	A, D		GPI-21		14/55	Take note that the SBAS solutions proposed for the CAR/SAM Regions should be oriented to achieve at least APV I capability.		States and International Organizations	Proposed SBAS solution to at least APV I performance		
11	A, D		GPI-21			<u>Follow-up to the SARPs and ICAO guidelines and policies on GNSS</u> Reply State Letter Ref.: AN 7/1.3.91-07/31 dated 11 May 2007.				24-08-07	
12	A, D		GPI-21		GRP13 pa. 3.6.3.6 1	Follow-up and implement GNSS in accordance to the SARPs and ICAO guidelines.		States and International Organizations	Take note and issue comments		
14	A, D		GPI-21	Tabla CNS 3	14/56 a)	<u>Progressive deactivation of conventional radio aids</u> Analyse the service provided by each NDB station and the existence of procedures with other aids such as VOR/DME and GNSS-RNAV, as well as the aircraft capacity/development that operate in the serviced airspace.		States, International Organizations and airspace users	Conducted analysis		
15	A, D		GPI-21	Tabla CNS 3	14/56 b)	Based on the results of the action in 14/56 a) and on the Table format presented in Appendix AF to the Report on Agenda Item 3 of the GREPECAS/14 Meeting, prepare a progressive deactivation plan of NDB stations.		States and International Organizations	Develop and implement the Plan to deactivate NDB stations.	30-Nov-07	

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