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Agenda Item 8: Any other business

**DRAFT GUIDANCE ON
REQUIRED NAVIGATION PERFORMANCE 4 (RNP4) OCEANIC AND REMOTE
OPERATIONAL APPROVAL**

(Presented by the United States of America)

SUMMARY

This paper presents the current DRAFT FAA Order on *Required Navigation Performance 4 (RNP4) Oceanic and Remote Operational Approval*. This document is subject to further editorial changes, but it is not expected that the criteria will change.

ORDER
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
GUIDANCE

**SUBJ: REQUIRED NAVIGATION PERFORMANCE 4 (RNP-4) OCEANIC AND
REMOTE OPERATIONAL APPROVAL**

1. PURPOSE.

The purpose of this order is to provide airworthiness requirements, continuing airworthiness requirements, policy and direction for obtaining operational approval of RNP-4 Oceanic and Remote area capability. This order enables an applicant to be approved as capable of meeting the Navigation Performance and Functional requirements for RNP-4 oceanic and remote areas. These requirements are specified in other documents such as Aeronautical Information Publications (AIP) and the International Civil Aviation Organization (ICAO) Regional Supplementary Procedures Document (DOC 7030). Additional Communication and Surveillance capabilities may be required.

2. DISTRIBUTION.

This order is distributed to the director level in Washington headquarters and the Centers; to all regional administrators; to the branch level in the Flight Standards Service, and Aircraft Certification Service; to the branch level in the regional Flight Standards divisions, and Aircraft Certification directorates; to all regional International Aviation Officers; to all Flight Standards, Aircraft Certification, and International Aviation field offices.

3. CANCELLATION.

4. BACKGROUND.

As part of a worldwide effort to implement the ICAO Air Navigation Plan for CNS/ATM systems (DOC 9750), separation standards are being reduced in Oceanic regions that will require a navigation standard of RNP-4. To support this effort, the Informal Pacific Air Traffic Service Coordination Group (IPACG) and the Informal South Pacific Air Traffic Service Coordination Group (ISPACG), are starting the development of plans to implement 30 Nautical Mile (NM) lateral and/or longitudinal separation on the South Pacific (SOPAC), North Pacific (NOPAC) and Central East Pacific (CEPAC) routes based on approval of an RNP-4 capability for the total route of the flight. In accordance with ICAO Annex 6, operators will be required to obtain RNP-4 operational approval. RNP-4 implementation will provide benefits in terms of efficient use of airspace, more optimum routings, reduced delay, increased traffic flow capacity, increased flexibility, reduced costs, reduced separation standards and increased safety.

5. RELATED PUBLICATIONS. (Current Version)

a. FAA Documents.

- (1) 14 CFR Part 121, Appendix G.
- (2) Advisory Circular (AC) 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors.
- (3) AC 20-138A, Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment.
- (4) FAA Order 7110.82, Monitoring of Navigation/Altitude Performance in Oceanic Airspace.
- (5) FAA Order 8400.10, Air Transportation Operations Inspector's Handbook.
- (6) FAA Order 8700.1, General Aviation Operations Inspector's Handbook.
- (7) Handbook Bulletin for Air Transportation (HBAT) 95-09, Guidelines for Operational Approval of Global Positioning System [GPS] to Provide the Primary Means of Class II Navigation in Oceanic and Remote Areas of Operation.

b. Other Documents.

- (1) Copies of the following may be obtained from Document Sales Unit, ICAO, 999 University Street, Montreal, Quebec, Canada H3C 5H7:
 - (a) Manual on Required Navigation Performance (RNP), ICAO DOC 9613-AN/937.
- (2) Copies of the following may be purchased from NOAA, N/ACC3, Distribution Division, Riverdale, MD 20737:
 - (a) United States Government Flight Information Publication - Chart Supplement - Alaska.
 - (b) United States Government Flight Information Publication - Chart Supplement - Pacific.
- (3) Copies of RTCA documents may be purchased from RTCA, Inc., 1828 L Street NW, Suite 805, Washington, DC 20036.
 - (a) DO 236A, Minimum Aviation System Performance Standards (MASPS): Required Navigation Performance for Area Navigation.
 - (b) DO 283, Minimum Operational Performance Standards for Required Navigation Performance for Area Navigation.
 - (c) DO 200A, Standards for Processing Aeronautical Data.

(4) Copies of Aeronautical Information Manual (AIM) may be purchased from the U.S. Government Printing Office, P.O. Box 371954, Pittsburgh, PA 15250-7954.

6. APPLICABILITY.

- a. This guidance applies to all operators conducting operations under Title 14 of the Code of Federal Regulations (14 CFR) parts 91, 121, 125 and 135.
- b. The requirements are consistent with 14 CFR part 91, sections 91.703(a)(1) and (a)(2), which require each certificate holder, operating a civil aircraft of U.S. registry outside of the United States, to comply with ICAO Annex 2 when over the high seas, and to comply with the regulations of a foreign country when operating within that country's airspace.

7. OPERATIONAL APPROVAL PROCESS.

Aircraft must be qualified, and the operator must be approved before conducting flight in RNP airspace or routes with reduced separation minima. To obtain operational approval, aircraft eligibility must be determined, appropriate flight-crew procedures for the navigation systems to be used must be identified by the applicant; database use and operating procedures must be evaluated. Appropriate operations specifications or a letter of authorization (LOA) may be issued, as applicable to the operator.

a. Pre-application Meeting. Operators will schedule a pre-application meeting with either the Certificate Holding District Office (CHDO) or the Flight Standards District Office (FSDO). At this meeting, the operator informs the FAA of its intentions to request RNP-4 Oceanic or Remote area approval. The FAA provides the operator with the requirements for this operational approval.

b. Operators seeking RNP-4 operational approval should contact FAA offices as follows:

(1) Parts 121, 125, and 135 Operators. Notify the Certificate Management Office (CMO) or CHDO which holds its operating certificate of its intent to request approval for RNP-4 operations. RNP-4 authorizations for air carriers will be addressed through issuance of approved operations specifications. The operations specifications will identify conditions or limitations (e.g., navigation systems or procedures required, routes or areas authorized). A sample letter of request is provided in Appendix 2, figure 1.

(2) Part 91 Operators. Contact their local FSDO to start the process for RNP-4 authorization. The responsible FSDO will issue the LOA, authorizing RNP-4 Oceanic or Remote Operations. The LOA will identify conditions or limitations (e.g., navigation systems or procedures required, routes or areas authorized). A sample letter of request is provided in Appendix 2, figure 2.

c. Determining Eligibility of Aircraft. Aircraft and navigation system types currently in use in oceanic or remote area operations may qualify for RNP-4 based on one or more provisions of existing certification criteria. Additional aircraft certification will be necessary if the operator chooses to claim additional performance beyond that originally

certified or stated in the Airplane Flight Manual (AFM) and if the operator cannot demonstrate the desired performance through data collection. Navigation performance must consider the navigation infrastructure used in original certification.

d. **Airworthiness Requirements.** RNP-4 operations require that the aircraft navigate with a cross-track navigation error no greater than +/- 7.4 km (+/- 4 NM) for 95 percent of the total flight time. This includes Position Estimation Error (PEE), Flight Technical Error (FTE), Path Definition Error (PDE) and Display System Error (DSE). The aircraft along-track positioning error must be no greater than +/- 7.4 km (+/- 4 NM) for 95 percent of the time.

8. **APPLICATION.**

a. **Content**

(1) **Aircraft Eligibility Documents.** AFM, AFM Supplement or suitable Aircraft Evaluation Group (AEG) documentation.

(2) **Description of Aircraft Equipment.** A configuration list detailing pertinent components and equipment.

(3) **Operational Training Programs and Operating Practices and Procedures.**

(a) Air carrier operators must submit training syllabi (e.g., initial, upgrade, recurrent) and other appropriate material to the FAA showing incorporation of operational practices and procedures. Training for other personnel must be included where appropriate (e.g., dispatchers, maintenance). Practices and procedures must be standardized using the guidelines of Chapter 12.

(b) Part 91 operators must confirm that they will operate using the practices and procedures identified in Chapter 12.

(4) **Operational Manuals and Checklists.**

(a) **Part 121, 125, 135 Operators.** The appropriate manuals and checklists must be revised to include information/guidance on standard operating procedures detailed in Chapter 12. Appropriate manuals must include navigation equipment operating instructions and any procedures established to operate in a specific area of operations (e.g., contingency procedures). Manuals and checklists should be submitted for review as part of the application process.

(b) **Part 91 Operators.** Submit appropriate documentation providing information/guidance on standard operating procedures detailed in Chapter 12.

(5) **Past Performance.** An operating history including any events or incidents related to Gross Navigation Errors (GNE) and any rectified by changes in training, procedures, maintenance, or the aircraft/navigation systems used.

(6) Minimum Equipment List (MEL). Those portions of the MEL required for operational approval must be reviewed and addressed.

(7) Maintenance. A maintenance program for approval in accordance with this Order.

b. FAA Review of Application for Content. When all the application requirements are met the FAA will accept the application and begin the evaluation process.

9. FAA EVALUATION of PROPOSAL

a. Aircraft Eligibility Groups.

(1) Group 1. Aircraft with formal certification and approval of RNP integration accounting for oceanic/remote operations in the AFM. The AFM will address demonstrated RNP levels and any related provisions applicable to its use (e.g., navaid sensor requirements).

(2) Group 2. Prior Navigation System Certification Aircraft are those that can equate their certified level of performance, under previous standards, to the RNP-4 criteria. The standards listed in subparagraphs (a) to (d), below, can be used to qualify an aircraft under Group 2. Other standards may also be used if they are sufficient to ensure that the RNP-4 requirements are met. If other standards are to be used, the FSDO or CMO should consult with AFS-400 to determine the appropriate operational approval and limitations

(a) Global Navigation Satellite Systems (GNSS) As Primary Navigation. Aircraft having GNSS as the **PRIMARY** Long Range Navigation System (LRNS) for oceanic and remote operations approval must meet performance requirements. AFM(s) should indicate if the GNSS system installation meets these requirements. Dual independent GNSS equipment is required and an approved dispatch fault detection and exclusion (FDE) availability prediction program must be used. The maximum allowable time for which FDE capability is projected to be unavailable is 25 minutes. Maximum outage times will be included as a condition of the operational approval. (See FAA Handbook Bulletin [HBB] for Air Transportation [HBAT], number HBAT 95-09, Guidelines for operational Approval of GPS to Provide the Primary Means of Class II Navigation in Oceanic and Remote Areas of Operation).

NOTE: If predictions indicate that the maximum allowable FDE outage will be exceeded, the operation must be rescheduled when FDE is available.

(b) Multisensor Systems Integrating GPS. GPS Integrity Provided by Receiver Autonomous Integrity Monitoring (RAIM). Multisensor systems integrating GPS with RAIM and FDE that are approved under AC 20-130A, Airworthiness Approval of Navigation or Flight Management Systems Integrating Multiple Navigation Sensors, or equivalent, providing +/- 4 NMI, 95% accuracy, meet performance requirements.

(c) **Aircraft Autonomous Integrity Monitoring (AAIM)**. AAIM uses the redundancy of position estimates from multiple sensors, including GNSS, to provide integrity performance that is at least equivalent to RAIM. These airborne augmentations may be certified in accordance with TSO C-115B. An example is using an inertial navigation system or other navigation sensors as an integrity check on GPS data when RAIM is unavailable but GPS positioning information continues to be valid.

(3) **Group 3**. New Technology – Navigation systems meeting the performance requirements of this Order for operations in airspace designated as Oceanic/Remote Areas RNP-4

b. Maintenance Requirements. Aircraft in Group 1, Group 2, and Group 3 must have an established maintenance program for the individual navigation systems. For others installing navigation systems, the operator will submit those changes appropriate to their existing maintenance manual for review and acceptability.

c. MEL. The MEL must identify the necessary equipment for dispatch into the RNP-4 Oceanic/Remote environment, including two Long Range Navigation Systems (LRNS) and sufficient equipment to provide the performance and functionalities stipulated in paragraph d. and e.

d. Required Performance

(1) **Flight Technical Error (FTE)**. The accuracy with which the aircraft is controlled as measured by the indicated aircraft position, with respect to the indicated command or desired position is the FTE. It does not include blunder errors

(2) **Path Definition Error**. This is the difference between the *defined path* and the *desired path* at a specific point and time.

(3) **Display System Error**. These errors may include error components contributed by any input, output or signal conversion equipment used by the display as it presents either aircraft position or guidance commands (e.g., course deviation or command heading) and by any course definition entry device employed. For systems in which charts are incorporated as integral parts of the display, the display system error necessarily includes charting errors to the extent that they actually result in errors in controlling the position of the aircraft relative to a desired path over the ground. To be consistent, in the case of symbolic displays not employing integral charts, any errors in waypoint definition, directly attributable to errors in the reference chart used in determining waypoint positions, should be included as a component of this error. This type of error is virtually impossible to handle and in general practice, highly accurate, published waypoint locations are used to the greatest extent possible in setting up such systems to avoid such errors and reduce workload.

(4) **Navigation System Error (NSE)**. This is the root sum square of the ground station error contribution, the airborne receiver error and the display system contribution.

(5) **Total System Error (TSE)**. This is system use error. $TSE = \sqrt{(NSE)^2 + (FTE)^2}$

(6) **Position Estimation Error**. This is the difference between true position and estimated position.

(7) **Accuracy +/-7.4 km or +/- 4 NM**. Each aircraft operating in RNP airspace shall have total system error components in the cross-track and along track directions that are less than the RNP value 95% of the flying time. Accuracy is defined relative to a geodesic path along the published route or defined procedure. The three error components that must be considered in complying with the accuracy requirement are the flight technical error (FTE), the position estimation error (PEE), and path definition error (PDE). The accuracy requirement must be met for the specific length of route.

(8) **GNSS Monitor**. The GNSS navigation system must detect the satellite failures before they cause the aircraft to exceed the defined airspace or obstacle clearance area. This requirement is derived from the overall effect of a GNSS failure, and applies to all navigational uses of GNSS. The probability of missed detection of satellite failures must be less than or equal to 10^{-3} , and the effective monitor limit for these failures on the navigation solution, known as the horizontal alert limit (HAL), must consider the other normal errors that may exist during a satellite fault, the latency of the alert, the crew reaction time to an alert and the aircraft response. An acceptable means of compliance is to use a horizontal alert limit (HAL) as follows: Oceanic (RNP 4): 4 NM

e. **Required Functionalities**

(1) ***Progress Data***. *The following functionalities are mandatory:*

- CDI in pilot's 'Field of View' (FOV)
- Track to Fix (TF)
- Direct to Fix (DF)
- Direct to Function
- Course to Fix (CF)
- Parallel Offset
- Fly-by Transition Criteria
- User Interface Displays
- Flight Planning Path Selection
- Flight Planning Fix Sequencing
- User Defined Course to Fix
- Path Steering
- Alerting Requirements
- Navigation Data Base Access
- WGS 84 geodetic reference system

f. **Recommended Functionalities**

(1) ***Navigation Data***. *The following additional functionalities are recommended:*

- Display cross-track error on the CDU
- Display present position in distance/bearing to selected waypoints
- Provide time to waypoints on the CDU
- Along Track Distance
- Display Ground Speed
- Indicated track angle
- Provide automatic navigation aids selection
- Purge radio updates
- Manually inhibit a navaid facility
- Automatic selection and tuning of DME and/or VOR
- Estimate of position uncertainty
- Current RNP type
- Flight Plan Discontinuity
- Navigation Sensor in Use and display of de-graded navigation

g. Automatic Radio Position Updating. Automatic updating is considered to be any updating procedure that does not require crews to manually insert coordinates. Conditions under which Automatic Radio Position Updating may be considered as acceptable for flight in airspace where RNP-4 is required are listed below. Automatic updating may be considered acceptable for operations in airspace where RNP-4 is applied provided that:

- (1) Procedures for automatic updating are included in an operator's training program.
- (2) Crews are knowledgeable of the updating procedures and of the effect of the update on the navigation solution.

h. Investigation of Navigation Errors. Demonstrated navigation accuracy provides the basis for determining the lateral spacing and separation necessary for traffic operating on a given route. Accordingly, lateral and longitudinal navigation errors are investigated to prevent their reoccurrence. Radar observations of each aircraft's proximity to the centerline and altitude before coming into coverage of short-range navaids at the end of the oceanic route segment are typically noted by Air Traffic Service (ATS) facilities. If an observation indicates that an aircraft was not within an established limit, the reason(s) for the apparent deviation from centerline or altitude may need to be determined and steps taken to prevent a recurrence

i. Removal of RNP-4 Authorization. Oceanic Navigation Error Reports (ONER) and Oceanic Altitude Deviation Reports (OADR), for example, are established in FAA Order 7110.82, latest edition and in FAA Order 8700.1, chapter 223. When appropriate, the FAA may consider these reports in determining remedial action. Repeated ONER or OADR occurrences attributed to a specific piece of navigation equipment, may result in withdrawal of operations specifications or rescinding an LOA, for use of that equipment. Information that indicates the potential for repeated errors may require a modification of an operator's training program. Information that attributes multiple errors to a particular pilot crew may necessitate remedial qualifications or airmen certification review.

g. **DEFINITIONS:**

(1) CDI in pilot’s Field of View (FOV): A course deviation indicator (CDI) located in the pilot’s primary field of view along the forward flight path, enabling the pilot to perform a natural crosscheck, is required. These displays must be visible to the pilot in the primary field of view. A scalable electronic map cannot substitute for a CDI. A fixed scale CDI is acceptable as long as the CDI demonstrates appropriate scaling and sensitivity for the intended RNP type. Differences in CDI scales from one RNP type to another may require operational procedures to check and affirm the CDI scale against the RNP type. With a scalable CDI, the scale shall derive from the selection of RNP, not from a separate selection of CDI scale. Alerting and annunciation limits must match scaling values. If the equipment uses default RNP types to describe the operational mode (e.g. en route, terminal area and approach), then displaying the operational mode is an acceptable means from which the flight crew may derive the CDI scale sensitivity. The course selector of the deviation display shall have a full-scale deflection required for the flight procedure and track keeping accuracy.

(2) Track to fix: TF leg is a geodesic path between two fixes. The first fix is either the previous leg termination or an IF leg. The termination fix is normally provided by the navigation database, but may also be a user-defined fix.

(3) Direct to fix: DF leg is a geodesic path starting near the area of initiation and terminating at a fix.

(4) Direct-to function: The Direct-To function shall be able to be activated at any time by the flight crew, when required. The Direct-To function shall be available to any fix. The system shall be capable of generating a geodesic path to the designated “To” fix. The aircraft shall capture this path without “S-turning” and without undue delay.

(5) Course to fix: CF leg is a geodesic path terminating at a fix with a specified course at that fix. The inbound course at the termination fix and the fix are provided by the navigation database. If the inbound course is defined as a magnetic course, the source of the magnetic variation needed to convert magnetic courses to true courses is required.

(6) Parallel Offset: The system shall have the capability to fly parallel tracks at a selected offset distance. When executing a parallel offset, the RNP type and all performance requirements of the original route in the active flight plan shall be applicable to the offset route. The system shall provide for entry of offset distances in increments of 1 nautical mile, left or right of course. The system shall be capable of offsets of at least 20 nautical miles. When in use, system offset mode operation shall be clearly indicated to the flight crew. When in offset mode, the system shall provide reference parameters (for example, cross-track deviation, distance-to-go, time-to-go) relative to the offset path and offset reference points. An offset shall not be propagated through route discontinuities, unreasonable path geometries, or beyond the initial approach fix. Annunciation shall be given to the flight crew prior to the

end of the offset path, with sufficient time to return to the original path. Once a parallel offset is activated, the offset shall remain active for all flight plan route segments until removed automatically, until the flight crew enters a Direct-To routing, or until flight crew (manual) cancellation. Parallel offset function shall be available for en route TF and geodesic portion of DF leg types.

(7) Fly-by transition criteria: Navigation system shall be capable of accomplishing fly-by transitions. No predictable and repeatable path is specified, because the optimum path varies with airspeed and bank angle. However, predictable and repeatable boundaries of the transition area are defined. Path definition error is defined as the difference between the defined path and the theoretical transition area. If the path lies within the transition area, there is no path definition error. Fly-by transitions shall be the default transition when the transition type is not specified. The theoretical transition area requirements are applicable for the following assumptions:

- Course changes do not exceed 120 degrees for low altitude transitions (referred as when the aircraft barometric altitude is less than FL195); and
- Course changes do not exceed 70 degrees for high altitude transitions (referred as when the aircraft barometric altitude is equal to or greater than FL195).

(8) User interface displays: General user interface display features must provide for presentation of information, provide situational awareness and be designed and implemented to accommodate human factors considerations. Essential design considerations include:

- Minimizing reliance on flight crew memory for any system operating procedure or task;
- Developing a clear and unambiguous display of system modes/sub modes and navigational data with emphasis on enhanced situational awareness requirements for any automatic mode changes if provided
- Use of context sensitive help capability and error messages (for example, invalid inputs or invalid data entry messages should provide a simple means to determine how to enter “valid” data)
- Fault tolerant data entry methods rather than rigid rule based concepts
- Placing particular emphasis on the number of steps and minimizing the time required to accomplish flight plan modifications to accommodate ATS clearances, holding procedures, runway and instrument approach changes, missed approaches and diversions to alternate destinations
- Minimizing the number of nuisance alerts so the flight crew will recognize and react appropriately when required

- Displays and controls: Each display element used as a primary flight instrument in the guidance and control of the aircraft, for maneuver anticipation, or for failure/status/ integrity annunciation, shall be located where it is clearly visible to the pilot (in the pilot's primary field of view) with the least practicable deviation from the pilot's normal position and line of vision when looking forward along the flight path. For those aircraft meeting the requirements of FAR/JAR 25, it is intended that provisions of certification documents such as AC 25-11, AMJ 25-11 and other applicable documents should be satisfied. All system displays, controls and annunciations shall be readable under normal cockpit conditions and expected ambient light conditions. Night lighting provisions shall be compatible with other cockpit lighting.

All displays and controls must be arranged to facilitate flight crew accessibility and usage. Controls that are normally adjusted in flight shall be readily accessible with standardized labeling as to their function. System controls and displays shall be designed to maximize operational suitability and minimize pilot workload. Controls intended for use during flight shall be designed to minimize errors, and when operated in all possible combinations and sequences, shall not result in a condition whose presence or continuation would be detrimental to the continued performance of the system. System controls shall be arranged to provide adequate protection against inadvertent system shutdown.

(9) Flight planning path selection: The system shall provide the capability for the crew to create, review and activate a flight plan. The system shall provide the capability for modification (for example, deletion and addition of fixes and creation of along-track fixes), review and user acceptance of changes to the flight plans. When this capability is exercised, guidance outputs shall not be affected until modification(s) is/are activated. Activation of any flight plan modification shall require positive action by the flight crew after input and verification by the flight crew.

(10) Flight planning fix sequencing: The system shall provide the capability for automatic sequencing of fixes.

(11) User-defined course to fix: The system shall provide the capability to define a user-defined course to a fix. The pilot must be able to intercept the user-defined course.

(12) Path steering: The system shall provide data to enable the generation of command signals for autopilot/flight director/CDI, as applicable. In all cases a Path Steering Error (PSE) shall be defined at the time of certification, which will meet the requirements of the desired RNP operation in combination with the other system errors. During the certification process, the ability of the crew to operate the aircraft within the specified PSE shall be demonstrated. Aircraft type, operating envelope, displays, autopilot performance, and leg transitioning guidance (specifically between arc legs) should be accounted for in the demonstration of PSE compliance. A

measured value of PSE may be used to monitor system compliance to RNP requirements. For operation on all leg types, this value shall be the distance to the defined path. For cross-track containment compliance, any inaccuracies in the cross-track error computation (for example, resolution) shall be accounted for in the total system error.

(13) Alerting requirements: The system shall also provide an annunciation when the manually entered RNP type is larger than the RNP type associated with the current airspace as defined in the navigation database. Any subsequent reduction of the RNP type shall reinstate this annunciation. When approaching RNP airspace from non-RNP airspace, alerting shall be enabled when the cross-track to the desired path is equal to or less than one-half (1/2) the RNP value and the aircraft has passed the first fix in the RNP airspace.

(14) Navigation database access: The navigation database shall provide access to navigation information in support of the navigation systems reference and flight planning features. Manual modification of the navigation database data shall not be possible. This requirement does not preclude the storage of "user defined data" within the equipment. When data are recalled from storage they shall also be retained in storage. The system shall provide a means to identify the navigation database version and valid operating period.

(15) WGS-84 geodetic reference system: WGS-84 or an equivalent earth reference model shall be the reference earth model for error determination. If WGS-84 is not employed, any differences between the selected earth model and the WGS-84 earth model must be included as part of the path definition error. Errors induced by data resolution must also be considered.

11. OPERATIONAL REQUIREMENTS.

- a. **Navigational Performance.** All aircraft shall meet a track keeping accuracy equal to or better than +/- 7.4 km or ± 4 NM for 95% of the flight time in RNP-4 airspace.
- b. **Navigation Equipage.** All RNP-4 operations in oceanic and remote areas shall have at least dual independent long range navigation systems of integrity such that the navigation system does not provide misleading information.
 - (1) Aircraft Incorporating GPS. AC 20-138() provides an acceptable means of compliance for aircraft that use GPS, but do not integrate the GPS with other sensors. AC 20-130A, describes an acceptable means of compliance for multi-sensor navigation systems that incorporate GPS. Aircraft that intend to use GPS as the only navigation system in RNP-4 airspace (e.g., no IRS or INS), must comply with AC 20-138(), FDE and specific GPS requirements described in this Order.
 - (2) The equipment configuration used to demonstrate the required accuracy must be supportable in RNP-4 oceanic and remote airspace. For example, the statistical benefit of estimating position using INS position data filtered with DME data will not be considered.

(3) The equipment configuration used to demonstrate the required accuracy must be identical to the configuration which is specified in the MEL.

c. Flight Plan Designation. Operators should use the appropriate FAA or ICAO flight plan designation specified for the RNP route flown. The letter “R” should be placed in Block 10 of the ICAO flight plan to indicate that the pilot has reviewed the planned route of flight to determine RNP requirements and the aircraft and operator have been approved by the FAA to operate in areas or on routes where RNP is a requirement for operation. Additional information needs to be displayed in the remarks section that indicates the accuracy capability such as RNP-4 versus RNP-10. It is important to understand that additional requirements will have to be met for Operational Approval in RNP-4 airspace or routes. CPDLC and ADS will also be required when the separation standard is 30 NM lateral and /or longitudinal.

d. Availability of GNSS. At dispatch or during flight planning, the operator should ensure that adequate navigation capability is available en route to enable the aircraft to navigate to RNP-4.

e. Navigation Database. The standards for navigation databases are contained in RTCA document DO-200A and EUROCAE document DO-76. Given that not all current suppliers of navigation databases meet these standards, the operator, as a minimum, must implement navigation database integrity checks using appropriate software tools or approved manual procedures to verify data relating to all waypoints in the subject RNP-4 airspace or routes. These checks are in addition to any checks previously performed by the Aeronautical Information Services, unapproved navigation database suppliers, or navigation equipment manufacturers. The integrity checks need to identify any discrepancies between the navigation database and the published charts/procedures. An approved third party may perform integrity checks. Discrepancies that invalidate a procedure must be reported to the navigation database supplier and affected procedures must be prohibited by an operator’s notice to its flight crew. Aircraft operators should consider the need to continue their own database checks even for products obtained from approved suppliers.

12. TRAINING PROGRAMS, OPERATING PRACTICES AND PROCEDURES

a. Introduction. The following items (detailed in paragraphs b. through e.) should be standardized and incorporated into training programs and operating practices and procedures. Certain items may already be adequately standardized in existing operator programs and procedures. New technologies may also eliminate the need for certain crew actions and if this is found to be the case, then the intent of this section has been met.

b. Flight Planning. During flight planning, the flight-crew should pay particular attention to conditions which may affect operations in RNP-4 airspace (or on RNP-4 routes). These include, but may not be limited to:

- (1) Verifying that the aircraft is approved for RNP-4 operations.
- (2) Verify that the letter “R” is annotated in Block 10 (Equipment) of the ICAO Flight Plan.
- (3) Requirements for GNSS, such as FDE, if appropriate for the operation.
- (4) Accounting for any operating restriction related to RNP-4 approval, if required for a specific navigation system.

c. Preflight Procedures At The Aircraft. The following actions should be completed during preflight:

- (1) Review maintenance logs and forms to ascertain the condition of equipment required for flight in RNP-4 airspace or on an RNP-4 route.
- (2) Ensure that maintenance action has been taken to correct defects to required equipment.
- (3) During the external inspection of aircraft, particular attention should be paid to the condition of navigation antenna and the condition of the fuselage skin in the vicinity of each antenna. A qualified and authorized person other than the pilot, e.g., a flight engineer or maintenance personnel, may accomplish this check.
- (4) Emergency procedures for operations in RNP-4 airspace or on RNP-4 routes are no different than normal oceanic emergency procedures with one exception, crews must be able to recognize and ATC must be advised when the aircraft is no longer able to navigate to its RNP-4 approved capability.

d. En Route.

- (1) At least, two independent Long Range Navigation systems capable of navigating to the RNP should be operational at the oceanic entry point. If this is not the case, then the pilot should consider an alternate routing or divert for repairs.
- (2) Operator in-flight operating procedures must include mandatory crosschecking procedures to identify navigation errors in sufficient time to prevent aircraft from an inadvertent deviation from ATC cleared routes.
- (3) Crews shall advise ATC of any deterioration or failure of the navigation equipment below the navigation performance requirements or of any deviations required for a contingency procedure.

e. Flight Crew Knowledge.

- (1) Commercial Operators should ensure that crews have been trained and are knowledgeable on the subject matter contained in this order, limits of their RNP-4 navigation capabilities, and effects of updating and RNP-4 contingency procedures.
- (2) Part 91 operators should show the FAA that pilots are knowledgeable on RNP-4 operations. For RNP-4 authorization, the applicant must show the FAA that crewmembers are knowledgeable on the material contained in this order. FAA Order 8700.1, General Aviation Inspector's Handbook, Chapter 222, addresses training for part 91 operators. It states that specific training is not required by 14 CFR or by Annex 2 to the ICAO Rules of the Air and gives inspectors latitude in determining pilot qualifications. It further states that on the LOA, the statement, "Crew training conducted by" can be completed with an entry of: none, self, company training or the name of a commercial training course. Training "acceptable" to the FAA is not a prerequisite for issuing an RNP-4 authorization. It is also not a requirement that a part 91 operator provide a certificate of training that says it is FAA approved. What can be considered as acceptable is for an operator to show that crews have adequate knowledge of the RNP-4 operating practices and procedures that are contained in this order.
- (3) FAA inspectors may accept training center certificates without further evaluation.
- (4) FAA inspectors may elect to evaluate a training course before accepting a training center certificate from a specific center.
- (5) FAA inspectors may accept a statement in the operator's application for an RNP-4 LOA that the operator has and will ensure that crews are knowledgeable on RNP-4 operating practices and procedures contained in this order.
- (6) FAA inspectors may accept a statement by the operator that it has conducted or will conduct an in-house RNP-4 training program.

James J. Ballough
Director, Flight Standards Service

APPENDIX 1.

AIRWORTHINESS OF IRU PERFORMANCE

1. IRU Accuracy and Reliability. IRU accuracy and reliability must be analyzed in conjunction with the flight management system interface. An analysis performed on a specific manufacturer's aircraft model is not necessarily applicable to other aircraft operating the same equipment. However, other aircraft may be analyzed using the same or equivalent methodology as proposed herein.

a. The Radial Navigation Error Distribution for IRU's is modeled by a Rayleigh Distribution. The 95% statistic of radial position error will be used when demonstrating compliance. It is assumed that cross-track and along-track errors are Gaussian, independent, and have equal variances.

b. The Radial Position Error will be evaluated for the Range of the Independent Time Variable (time in navigation), as certified for the IRU navigation maximum time (e.g., 18 hours).

c. Time-Dependent Position Error Data will be presented. Other non-inertial error sources will not be considered as part of IRU certification (i.e., flight technical error). Therefore, the maximum time duration of flight operations in RNP-4 airspace will be evaluated and determined as part of the operational approval.

d. The Assessment of Navigation Performance may Employ System Analysis, IRU Error Modeling (Covariance Analysis), and System Simulation. Analytical findings may be validated with empirical data from laboratory testing and aircraft flight testing, as applicable.

2. When credit is required for IRU performance that is superior to the original certification, the existing IRU specification control drawings for the IRU Type Designs should be revised to account for the new tighter tolerance system error budgets. If it has been determined that all IRU's for a given part number meet the minimum requirements of the new performance standard, then the IRU part number may remain the same. When only some of the IRU's for a given part number meet the minimum requirements of the new performance standard, then screening is required and part number updates will be required to identify the IRU's which are compliant to the new performance standard.

3. The AFM or AFM Supplement (AFMS) must be modified to reflect the certification of IRU's to tighter accuracy requirements, consistent with AC 25-4, Inertial Navigation System (INS), paragraph 5b(4). The AFM should provide sufficient time-dependent information so that the maximum time in RNP-4 airspace can be assessed as part of the operational approval.

4. In addition, production and field acceptance test procedures will require an update by the supplier, to ensure that the installed IRU meets the tighter accuracy tolerance required.

5. Operator maintenance procedures will require updating to ensure appropriate monitoring of IRU performance to the new requirements contained in this Order, and replacement of IRU's on aircraft that do not meet the navigation performance of this new criteria.

Appendix 1

6. Procedures for flight operations should be identified and applied to ensure IRU alignment before extended range flights and time-in-navigation for the intended time duration of flight in RNP-4 airspace.

APPENDIX 2.

DOCUMENTATION REQUIRED TO COMPLETE THE NAVIGATIONAL APPROVAL PROCESS

FIGURE 1. SAMPLE LETTER OF REQUEST BY AN AIR CARRIER TO OBTAIN RNP-4 OPERATIONAL APPROVAL

SUBJECT: Request for Required Navigation Performance (RNP) - 4 Approval

TO: Appropriate POI

[Insert Airline Name] request that Operations Specifications approval be issued to conduct en route operations on RNP [insert number] of [insert number] hours between updates on designated routes.

The following [Insert Airline Name] aircraft meet the requirements and capabilities as defined/specified in Federal Aviation Administration Order [insert the number of this Order], dated [insert the date of this Order] for a RNP-4 qualification.

AIRCRAFT COMMUNICATIONS TYPE/SERIES	RNP-4 EQUIPMENT	NAVIGATION EQUIPMENT
B-747-400 by Name and	List Nav Equip by Name and Type/Manuf/Model Type/Manuf/Model	List Com Equip
B-737-500 by Name and	List Nav Equip by Name and Type/Manuf/Model Type/Manuf/Model	List Com Equip
MD-11 by Name and	List Nav Equip by Name and Type/Manuf/Model Type/Manuf/Model	List Com Equip

Note: The above listed aircraft are samples only.

Training of flight-crews has been accomplished in accordance with applicable FAA regulations and guidance material.

* If unlimited time is requested, state: "Unl."

Sincerely,

[insert typed name and signature]

[insert title]

APPENDIX 2.

**DOCUMENTATION REQUIRED TO COMPLETE THE NAVIGATIONAL
APPROVAL PROCESS**

**FIGURE 2. SAMPLE LETTER OF REQUEST BY A GENERAL AVIATION
OPERATOR TO OBTAIN RNP-4 OPERATIONAL APPROVAL**

SUBJECT: Request for a Letter of Authorization (LOA) to conduct Required Navigation Performance (RNP)

TO: Appropriate Flight Standards District Office (FSDO)

Operators must submit requests by letter with a separate page containing the “Format for an LOA to Operate at RNP-4” as shown on the following page.

LOA's

Aviation safety inspectors (ASI) can administratively issue an LOA to any general aviation operator that has an aircraft-navigation system meeting the requirements of this Order. The procedure for the issuance of the LOA is identical to the procedure contained in FAA Order 8700.1, chapter 222, with the exception that the format for the LOA has been modified to meet the specific requirements of an RNP approval. The format to be used is contained on the following page and may be copied or retyped at the convenience of the operator. If the LOA is retyped, inspectors will ensure that every item appearing in the sample, is included in the operator's version.

APPENDIX 2.

DOCUMENTATION REQUIRED TO COMPLETE THE NAVIGATIONAL APPROVAL PROCESS

FIGURE 3. FORMAT FOR AN LOA TO OPERATE AT RNP-4

This letter constitutes approval for the named aircraft to operate or to conduct oceanic/remote area flight on routes specified as RNP-4 routes at the level indicated by the authorized operator or crew listed under the conditions and limitations below.

Aircraft make and model _____ N-Number _____

Aircraft serial number _____ Aircraft color _____

NAVIGATION EQUIPMENT		RNP-4
TYPE/MANUFACTURER/MODEL INSTALLED TIME LIMIT	PART NUMBER	DATE

COMMUNICATION EQUIPMENT		
TYPE/MANUFACTURER/MODEL INSTALLED	PART NUMBER	DATE

Aircraft base of operations (city, state, zip) _____

Name of aircraft owner/operator _____

Crew training conducted by _____

Print name of person responsible for crew operations or agent for service (must be a U.S. citizen) _____

Signature of person responsible for crew operations or agent for service _____

Street address (cannot be a Post Office box) _____

City, state, and zip code _____

FOR FAA USE ONLY (To be completed by issuing office)

This approval is for: RNP-4 under the conditions typed on the back of this authorization.

Authorization Number _____

Aircraft limitations (if applicable) _____

Program Tracking and Reporting Subsystem (PTRS) tracking number _____

Date of Issuance _____ Expiration Date _____

This authorization is subject to the conditions that all operations conducted on an oceanic RNP route are in accordance with the flight rules contained in International Civil Aviation Organization (ICAO), Annex 2, and that all operations outside of the United States comply with section 91.703, and Annex 2. The person responsible for crew operations or agent for service must accept responsibility for complying with the stated regulations by signing this document. This document is considered invalid until signed. If the person signing this document relinquishes responsibility, changes mailing address, or the aircraft changes

Appendix 2

ownership or base of operation, this letter becomes invalid and the signee should immediately notify the issuing office of the change. LOA's can be renewed via letter or fax request submitted at least 30 days before the expiration date, if no changes have been made. If any changes have been made, application for a new LOA must be made in the same manner as that required for the initial LOA.

Office Manager's Signature

APPENDIX 2.

DOCUMENTATION REQUIRED TO COMPLETE THE NAVIGATIONAL APPROVAL PROCESS

FIGURE 4. INFORMATION TO BE INSERTED ON THE BACK OF THE LOA

PRE-FLIGHT SPECIAL REQUIREMENTS: *Note: Operators should list any procedures that are utilized which are pertinent to the accuracy and time limit of the navigation capability (e.g., an approved Fault Detection and Exclusion (FDE) program is required if GPS is to be used - if utilizing a procedure detailed in an another FAA document, that document may be referenced and a copy attached to the application).*

OTHER INFORMATION AS DEEMED NECESSARY BY THE ISSUING FLIGHT STANDARDS DISTRICT OFFICE:

APPENDIX 2.

**DOCUMENTATION REQUIRED TO COMPLETE THE NAVIGATIONAL
APPROVAL PROCESS**

FIGURE 5. FORMAT FOR LETTER TO RENEW LOA

FROM: [*person or department requesting LOA*]
[*company name (if applicable)*]
[*street address*] (P.O. Box not acceptable)
[*city, state, zip code*]

TO: Federal Aviation Administration (FAA)
Flight Standards District Office
[*street address*]
[*city, state, zip*]

Dear Inspector:

Enclosed is a copy of our LOA, which is due to expire within the next 60 days, and a completed form requesting a new LOA for operations in RNP-4 airspace or on RNP-4 routes.

I/we further certify that all authorized crews are qualified to operate in oceanic areas.

Sincerely,

[*person's signature responsible for crew operations or agent for service*]
[*typed name of person responsible for crew operations or agent for service*]
[*title*]
[*date*]

NOTE: The letter should be sent to the office that issued expired LOA.

APPENDIX 3.

**CHECKLIST AND JOB AID FOR THE RNP-4
APPROVAL APPLICATION PROCESS**

OPERATOR FUNCTIONS:

1. **OPERATOR PREPARES AN APPLICATION PACKAGE AS DESCRIBED IN PARAGRAPH 8 OF THIS ORDER.**
2. **OPERATOR SELF-EXAMINATION.** It is advisable that operators become familiar with paragraphs 8 and 9 of this order before contacting the FAA. These sections provide the criteria for approvals by placing aircraft/navigation systems in groups. Having a knowledge of these sections provides the operator with an indication of how much time might be required in obtaining an approval. Group I approvals are administrative and can be granted as quickly as district office workloads will permit. Group II approvals may be made quite rapidly or may take longer depending upon the aircraft/navigation system configurations. Group III approvals will usually involve an extended time for evaluation and an approval may or may not be granted.
3. **OPERATOR SCHEDULES A PREAPPLICATION MEETING.** The operator schedules a pre-application meeting with either CHDO for commercial operators, or FSDO for general aviation.
4. **OPERATOR SUBMITS A FORMAL APPLICATION FOR APPROVAL.** The operator submits a formal application for approval in accordance with the FAA expectations discussed in the pre-application meeting. The formal application should be made in writing in a manner similar to those shown in appendix 2.
 - Figure 1 for Air Carriers
 - Figure 2 for General Aviation
5. **OPERATOR TRAINS CREW.** An RNP-4 airspace or an RNP-4 route is a special airspace. There are no legal requirements for general aviation operators to have specific training for RNP-4 operations; however, ICAO Rules demand that States ensure that the crewmembers are qualified to operate in special airspace. Thus, general aviation operators will be required to satisfy the Administrator that they are qualified.
6. **OPERATORS RECEIVE OPERATION SPECIFICATIONS OR AN LOA.** The operators receive operation specifications or LOA to operate in an RNP-4 airspace or on an RNP-4 route.
7. **CREWS ARE AUTHORIZED TO PERFORM RNP-4 OPERATIONS.** Crews are authorized to perform RNP-4 operations for the time authorized within the parameters established for their navigation system configuration.

INSPECTOR FUNCTIONS:

See Job Aid on the next page.

INSPECTOR'S JOB AID

PTR S CO DE	APPLICANT _____	Para & Pg	INSP INIT.	DATE
	1. Inspector familiarization with the approval process			
1366	2. Set up applicant meeting date			
1366	3. Application meeting: Inspector _____ Applicant orientation to FAA Order 8400.XX Check of Documentation <ul style="list-style-type: none"> -Airworthiness documentation -Current Operation Specifications, if applicable -Current Letter of Authorization, if applicable -Copy of pertinent sections of the Airplane Flight Manual -List of number and type of Long Range Navigation Units (e.g., 3- Litton 92, INS) -Description of Long Range Navigation System integration. -Review of training program - RNP-4 Operations Issues - RNP-4 Contingency Procedures 			
	3. Evaluate Operator's Long Range Navigation System - Determine Eligibility Group Choose one of the following as a means by which approval will be accomplished: <ul style="list-style-type: none"> -The operator has an Airplane Flight Manual (AFM) entry or other documentation from an FAA Aircraft Certification office granting certification approval for RNP-4 or better. (eligibility group 1) -Plan on approving the operator for unlimited RNP-4 navigation if either one or both of the required Long Range Navigation Systems is a GNSS and the unit(s) are integral to the primary steering instrument of the mandatory flightcrew. GPS approval guidance is contained in HBAT 95-09 and FAA Notice 8110.60 -Approve the operator for the RNP value and time specified in the AFM 			
	3. Evaluate Operator's Long Range Navigation System (continued)			

PTR S CO DE	APPLICANT _____	Para & Pg	INSP INIT.	DATE
1442	4. Issue operation specifications or an LOA* to the operator			
1442	5. Complete a Program Tracking and Reporting System (PTRS) report noting the issuance of the RNP-4 authorization for a specified time -The National Use Field is a 9 space Alpha Numeric Field. The following entry must be made in the field: “RNP-4” followed by 3 spaces.			

* *Note FAA Order 8700.1, chapter 222, Guidance for the Issuance of a Letter of Authorization, provides the ASI with details relative to the issuance of an LOA*