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RS-2014-
KA126867

보안 과제(), 일반 과제(√) / 공개(√), 비공개() 발간등록번호(11-B552989-001020-01)

항공안전기술개발사업 제8차 연도 최종보고서

R&D / RS-2014-KA126867

4세부

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초정밀 GPS 보정시스템 (SBAS) 개발 구축 4세부 - KASS 성능적합증명 수행

최종보고서

2024. 5. 24.

주관연구기관 / 항공안전기술원
공동연구기관 / 한국정보통신기술협회

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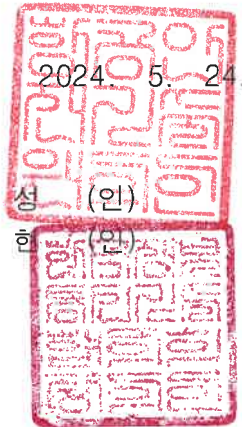
제출문

제 출 문

국토교통부 장관 귀하

국토교통부 항공안전기술개발사업의 초정밀 GPS 보정시스템(SBAS) 개발·구축 - 4세부 'KASS 성능적합증명 수행'(연구개발 기간 : 2017.03. ~ 2023.12.) 과제의 최종보고서를 제출합니다.

주관연구기관명 : 항공안전기술원 (대표자) 이 대 성 (인)
공동연구기관명 : 한국정보통신기술협회 (대표자) 손 승 현 (인)



주관연구기관책임자: 배 동 환
공동연구기관책임자: 김 기 두

국토교통부소관 연구개발사업 운영규정 제37조에 따라 최종보고서 열람에 동의합니다.

< 요약 문 >

사업명	항공안전기술개발사업	총괄연구개발 식별번호 (해당 시 작성)	RS-2014-KA087579				
내역사업명 (해당 시 작성)	초정밀 GPS 보정시스템(SBAS) 개발·구축	연구개발과제번호	RS-2014-KA126867				
기술 분류	국가과학기술 표준분류	EA1105	50%	EA1106	20%	EA1308	30%
	부처기술분류 (해당 시 작성)	EA1105	50%	EA1106	20%	EA1308	30%
총괄연구개발명 (해당 시 작성)	초정밀 GPS 보정시스템(SBAS) 개발 구축						
연구개발과제명	KASS 성능적합증명 수행						
전체 연구개발기간	2017.03.01. ~ 2023.12.31						
총 연구개발비	총 4,696,000 천원 (정부지원연구개발비: 4,696,000 천원, 기관부담연구개발비 : 천원, 지방자치단체: 천원, 그 외 지원금: 천원)						
연구개발단계	기초[] 응용[<input checked="" type="checkbox"/>] 개발[] 기타(위 3가지에 해당되지 않는 경우)[]	기술성숙도 (해당 시 기재)		착수시점 기준() 종료시점 목표()			
연구개발과제 유형 (해당 시 작성)							
연구개발과제 특성 (해당 시 작성)							
연구개발 목표 및 내용	최종 목표	○ 해외 인증 협정 체결을 통한 인증기술 습득 및 한국형 SBAS 시스템 (KASS) 성능적합증명 수행					
	전체 내용	○ (성능적합증명 검사) KASS 시스템이 성능적합증명 검사 기술기준 및 ICAO 표준을 준수하여 제작되었는지 검토하여 성능적합증명 검사 종합 결과서를 산출 ○ (KASS 운영지침자료 검사 지원) KASS 운영지침자료에 “운영기관이 시스템 성능과 안정성을 보장하도록 운영할 수 있는 절차·지침이 적절히 반영되었는지” 검사 ○ (EASA 인증협력) EASA가 KASS 개발산출물을 검토할 수 있도록 지원하여 EASA의 적합성확인서(SoC) 확보하고, EASA 검사 절차 및 EGNOS 사례를 기반으로 인증기술 습득					
	2단계 (해당 시 작성)	목표					
		내용					
3단계 (해당 시 작성)	목표						
	내용						
연구개발성과	<ul style="list-style-type: none"> • KASS 성능적합증명 종합결과보고서 1종 • KASS 시스템에 대한 EASA 적합성확인서(SoC) 1종 						
연구개발성과 활용계획 및 기대 효과	<ul style="list-style-type: none"> • 활용 계획 <ul style="list-style-type: none"> - KASS 시스템에 대한 안전성 및 신뢰성 확보 - 항행안전시설 인증체계 및 관련 규정 개선 추진 • 기대 효과 <ul style="list-style-type: none"> - (기술적 측면) EASA와의 협력을 통해 항행안전시설 및 미래 항행시스템에 대한 국제적 수준의 인증 기술 발전 기반 마련 - (사회·경제·산업적 측면) 향상된 위성항법 성능 제공으로 UAM, 항공, 철도, 자동차 및 모바일 위치기반 서비스를 활용하는 다양한 산업·서비스 분야에서 경제를 활성화 하고 국민 편의 제공 						
연구개발성과의							

비공개여부 및 사유 (해당 시 작성)												
연구개발성과의 등록·기탁 건수	논문	특허	보고서 원문	연구 시설· 장비	기술 요약 정보	소프트 웨어	표준	생명자원		화합물	신품종	
	7건	-	3건	-	-	-	-	생명 정보	생물 자원		-	정보
연구시설·장비 종합정보시스템 등록 현황	구입 기관	연구시설· 장비명		규격 (모델명)	수량	구입 연월일	구입가격 (천원)	구입처 (전화)	비고 (설치장소)	ZEUS 등록번호		
	-	-		-	-	-	-	-	-	-		
국문핵심어 (5개 이내)	항행안전시설			성능적합증명		위성기반 보강항법시스템		KASS		적합성확인서		
영문핵심어 (5개 이내)	CNS/ATM			Quality Inspection Certificate		Satellite Based Augmentation System		Korea Augmentation Satellite System		Statement of Compliance		

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1. 연구개발과제의 개요

1) 연구개발의 개요

가. SBAS(Satellite Based Augmentation System) 개요

- 전 세계적으로 안보와 경제·산업 발전을 위해 경쟁적으로 인공위성을 활용한 위성항법시스템(GNSS, Global Navigation Satellite System) 기술을 개발·구축 중
 - 현재까지 6개국 12개의 시스템이 구축되어 운영 중이며, 우리나라를 비롯한 호주, 아프리카 등에서도 위성기반 보정시스템(SBAS, Satellite Based Augmentation System), 지역위성항법시스템(RNSS, Regional Navigation Satellite System) 개발·구축을 계획하고 있음

[표 1. 국가별 위성항법시스템 구축 유형(2023년 12월 기준)]

순번	국가	개발·구축 시스템	구축연도	위성개수	유형
1	미국	GPS (Global Positioning System)	1993	31	범지구위성항법시스템 (GNSS)
2		WAAS (Wide Area Augmentation System)	2003	3	위성기반 보정시스템 (SBAS)
3	유럽	EGNOS (European Geostationary Navigation Overlay System)	2011	3	위성기반 보정시스템 (SBAS)
4		GALILEO	2020	28	범지구위성항법시스템 (GNSS)
5	중국	BEIDOU	2020	35	범지구위성항법시스템 (GNSS)
6		SNAS (Satellite Navigation Augmentation System)	시험중	3	위성기반 보정시스템 (SBAS)
7	일본	MSAS (MTSAT Satellite-based Augmentation System)	2020	1	위성기반 보정시스템 (SBAS)
8		QZSS (Quasi-Zenith Satellite System)	2017	4	지역위성항법시스템 (RNSS)
9	러시아	GLONASS	2011	27	범지구위성항법시스템 (GNSS)
10		SDCM (System for Differential Corrections and Monitoring)	2014	3	위성기반 보정시스템 (SBAS)
11	인도	GAGAN (GPS Aided GEO Augmented Navigation)	2015	3	위성기반 보정시스템 (SBAS)
12		IRNSS (Indian Regional Navigation Satellite System)	2017	7	지역위성항법시스템 (RNSS)

- SBAS는 항공기의 안전한 운항을 위하여 위성항법시스템 신호의 보정정보 및 무결성 정보를 제공하도록 국제민간항공기구(ICAO, International Civil Aviation Organization)가 국제 표준으로 정한 시스템으로 성능기반 항행체계(PBN, Performance Based Navigation)의 핵심 요소임
- ICAO의 SBAS/GBAS Procedure Design 웨비나(2023.11.3. 개최)에 따르면 유럽 EC에서는 2024년 1월부터 PBN 절차가 가능한 IFR(Instrument Flight Rules) 장비를 탑재할 것을 요구하고 2030년부터 CAT-1은 SBAS를 전면 활용하는 계획을 발표하며 그 효용성과 필요성이 점점 높아지고 있음
- SBAS는 국제 민간 항공기구(ICAO, International Civil Aviation Organization)에서 국제표준으로 정한 시스템이며 GPS 위치오차를 실시간으로 정확하게 보정하여 정지궤도 위성을 통해 사용자에게 정보를 제공하여 정확성, 가용성, 무결성, 연속성 등의 성능을 향상시키는 시스템임.

- SBAS 구축의 주 목적은 항공 안전을 향상시키는 것으로, SBAS는 GPS의 정확성, 무결성, 신뢰성, 가용성 등 성능을 향상시키고 위치정보 송신에 오류나 문제가 생겼을 경우 경보를 발생시키는 등 항법 기능을 강화시킴.
- SBAS는 GPS 신호를 수집·전달하는 기준국, 보정신호를 생성하는 통합운영국, 보정신호를 전국에 송신하는 위성통신국 및 SBAS 위성 등의 하위시스템으로 구성되어 있으며 각 요소들의 역할은 [표 1]과 같음.

[표 2. SBAS 주요 구성요소들의 역할]

하위시스템	기능	하위시스템	기능
통합운영국	데이터 수집 및 분석 시스템 감시 및 제어 시스템 유지보수 원격 운영 및 기타 여러 기능	기준국	데이터 수집 및 저장 수집 데이터 상태 체크 장비 상태 체크 알림 메시지 생성 수집 데이터 송신 알림 메시지 송신
중앙처리국	GPS 데이터 수집 및 전처리 위성궤도·시각보정정보 결정 전리층 보정정보 무결성 정보 결정 SBAS 메시지 결정 SBAS 네트워크 시간 결정	위성통신국	SBAS 신호생성기능 시각동기기능 SBAS·GPS 신호수신기능 중앙처리국 선택기능 GEO·GPS 무결성 감시기능 GEO 위성 접속기능 지상통신망 접속기능 구성장비 C&M 기능

나. KASS(한국 초정밀 GPS 보정 시스템) 성능적합증명의 필요성

- 이미 미국, 유럽, 일본, 인도 등의 우주강국은 자국 내 SBAS 구축을 완료하여 운용중이며 한국은 APV-I급 SoL 서비스 제공을 목표로 한국형 SBAS인 KASS(Korea Augmentation Satellite System) 개발에 착수함.
- 한국에서 KASS를 성공적으로 개발·구축하기 위해서는 시스템의 성능을 보장하기 위해 반드시 인증을 받아야 함.
 - SBAS와 같은 안전과 직결되는 시스템은 검사기관의 검사 후 국토교통부의 운영 검사를 거쳐 최종 승인을 받아야 정상적인 항공용 서비스(SoL, Safety of Life) 활용이 가능함.
- 본 과제의 최종 목적은 KASS 성능적합증명(System Certification)으로, 개발 단계부터 검사를 통해 KASS 시스템이 ICAO 기술기준 및 국제적으로 인정되는 SW 기술기준 적합성을 확인하여 KASS 시스템이 국제적인 기술기준에 맞게 적절히 개발되었는지 확인하는데 있음

[표 3. APV-I급 서비스의 성능요건]

구 분		APV-I급 SIS 성능요건
정확성 95%	수평방향 95%	16m (52ft)
	수직방향 95%	20m (66ft)
무결성		$1-2 \times 10^{-7}$ in any approach
경보 시간		10s
연속성		$1-8 \times 10^{-6}$ per 15s
가용성		0.99 to 0.99999
경보 한계	수평방향	40m (130ft)
	수직방향	50m (164ft)

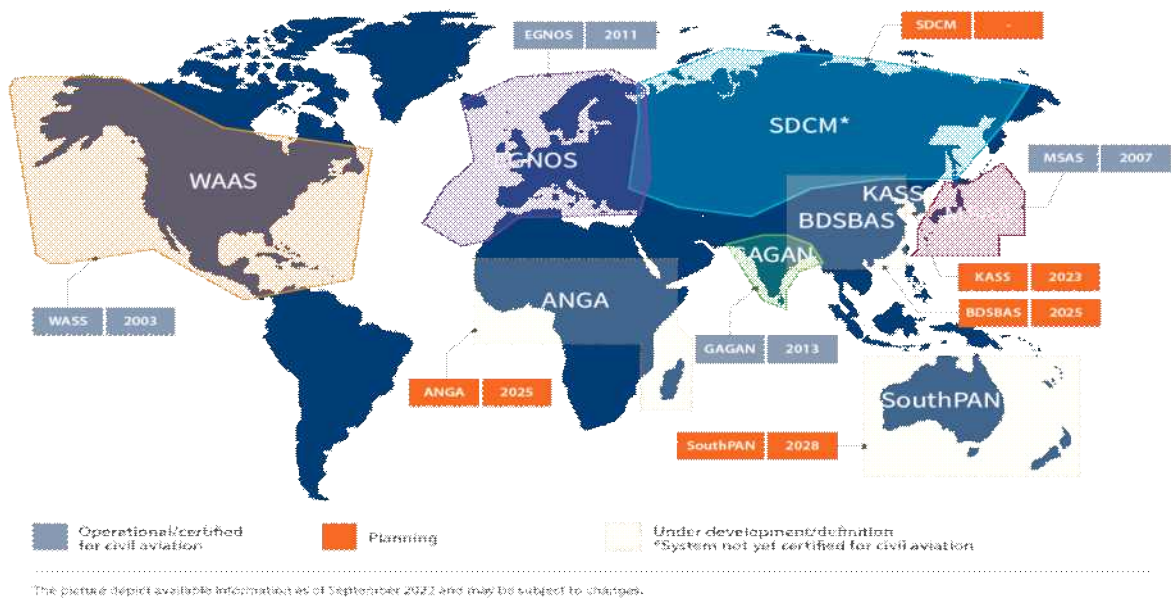
* 출처 : ICAO Annex vol.1 Signal-in-space performance requirement, 3-70

다. EASA 인증협력의 필요성

- KASS와 같은 SBAS 시스템의 경우, 핵심 원천 기술을 미국과 유럽에서만 보유하고 있어 미국 또는 유럽의 인증당국 지원 없이 핵심 기술 부분에 대해 검증하기가 사실상 불가능함
- 이에 본 과제에서는 국토부-EASA간 인증협정(MOA, Memorandum of Agreement) 체결 지원을 통하여 선진 인증기술을 습득하고, EASA와 인증 협력 및 공동 검사를 통해 국내 성능적합증명 검사 결과뿐만 아니라 EASA의 KASS 적합성 확인서(SoC, Statement of Compliance)를 확보하고자 함
 - 국토부-EASA 인증협정 체결 시 국내 인증전문가 양성을 위한 EASA의 전문 인증교육 등 국내 인증 전문가를 양성하기 위한 SBAS 인증기술단 교육 포함
 - 검사기관과 EASA는 각각 독립적으로 각 기관에서 적용하는 기술기준 또는 규정을 활용하여 검사를 수행하며, 지속적인 협력 회의를 통해 상호 검사 결과 및 검사에 필요한 사항을 논의하여 각 검사에 반영

2) 연구개발 대상의 국내외 현황

가. 국외 주요 위성기반보강시스템(SBAS)



[그림 1. 국외 주요 위성기반 보강항법시스템(SBAS) 아키텍처(EUSPA, Sep 2022 기준)]

(1) 미국의 WAAS(Wide Area Augmentation System)

① 개발 개요

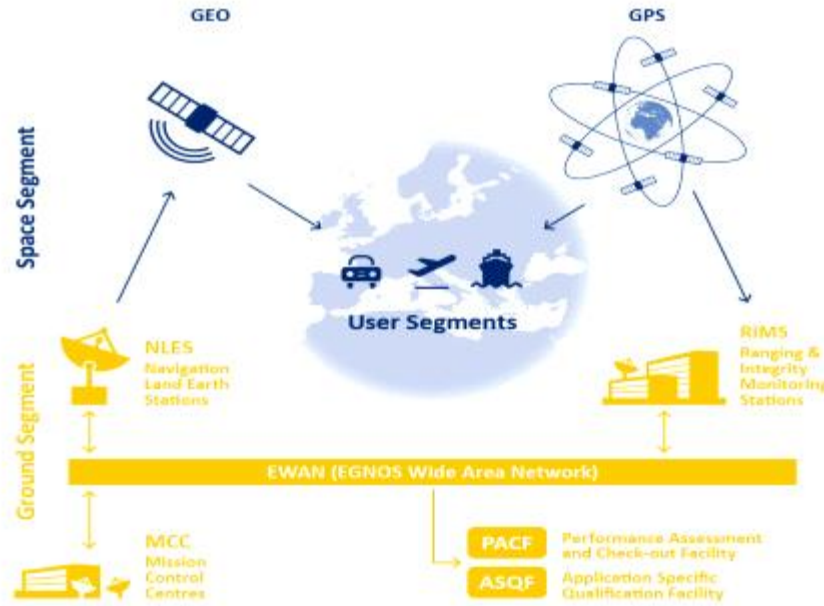
- 미국 Raytheon사에서 개발한 광역보정시스템으로 LPV(Localizer Performance with Vertical guidance)-200급 성능의 서비스를 제공 중임.
- 정지궤도위성으로 INMARSAT(Artemis) 위성을 이용함.

② 개발 시 적용 표준 및 규격

- 성능 표준 : ICAO SARPs in Annex 10, Volume 1 및 RTCA DO-229C
- 시스템 개발 검토 절차 표준: MIL-STD-1521B
- 시스템 개발 보증 표준: SAE ARP-4754
- 시스템 안전성 평가 표준: MIL-STD-882, SAE ARP-4761

- 소프트웨어 개발 표준: RTCA DO-178B, 개발 이후 Non-Airborne 대상 RTCA DO-278A
- 하드웨어 개발 표준: FAA-G-2100G, 수신기에 대해 RTCA DO-254 추가적용
- 전자 장비 일반 요구사항 규격 : FAA-G-2100G
- 보안 규정 : FAA Order 1370.82 등

(2) 유럽의 EGNOS(European Geostationary Navigation Overlay Service)



[그림 2. 유럽 EGNOS 아키텍처]

* 출처 : EGNOS Safety of Life(SoL) Service Definition Document, p.14

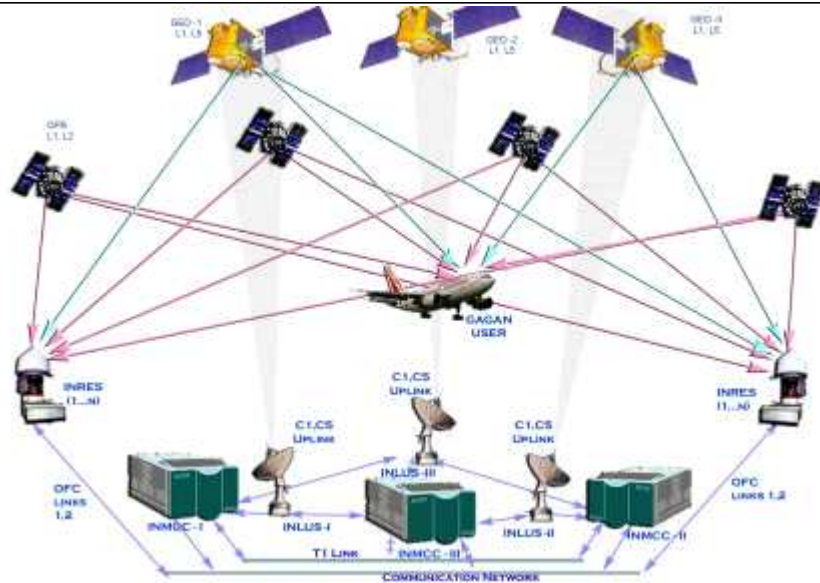
① 개발 개요

- 유럽연합(EU, European Union)에서 개발한 광역보정시스템으로 APV(Approach with Vertical Guidance)급 성능의 서비스와 최근 내륙 중심 일부 지역에 LPV-200 (CAT-1 근접 수준)급 성능의 서비스를 제공 중임.
- 정지궤도위성으로 INMARSAT 위성을 이용하며, 현재 유럽 전역의 위치 확인, 내비게이션 서비스 개선을 위해 보정 데이터 및 무결성 정보를 사용자에게 제공함으로써 GPS를 보강함.
- 현재 EGNOS는 새로운 정지궤도위성(GEO) 레인징 알고리즘 연구개발을 수행하여 이중주파수를 이용한 CAT-I 수준의 서비스 제공을 목표로 하고 있음.

② 개발시 적용 표준 및 규격

- 소프트웨어 개발 표준: EUROCAE ED-12B
- 규정적합성: EC No.552/2004, No.1070/2009
- 시스템 개발 요구조건: EC No.1035/2011
- 제품보증 및 안전성 규정 적합성: Tailored ECSS-ST-10C, ECSS-ST-20C, ECSS-Q-ST-30C, ECSS-Q-ST-40C, ECSS-Q-ST10-09C

(3) 인도의 GAGAN(GPS Aided Geo Augmented Navigation)



[그림 3. 인도 GAGAN 아키텍처]

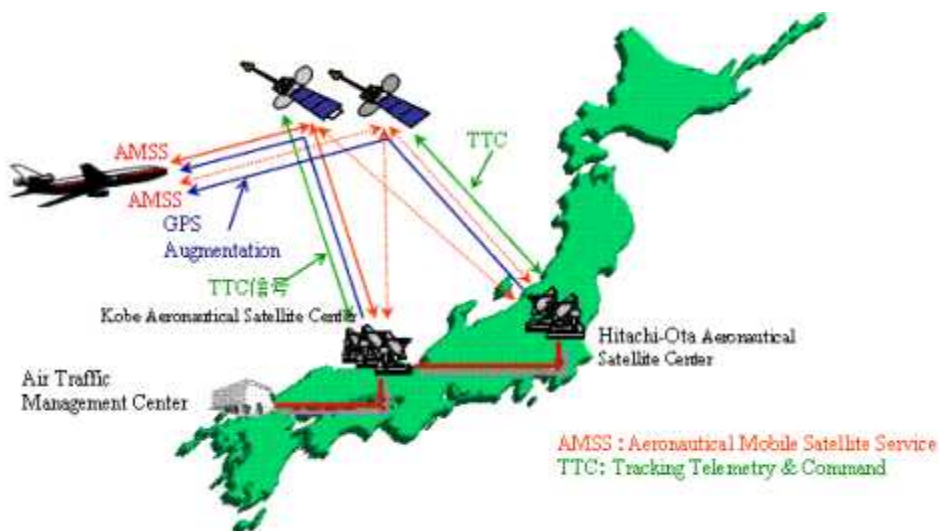
① 개발 개요

- 인도에서 구축한 광역보정시스템으로 미국 WAAS의 기술을 도입함.
- 기개발되어 운영 중인 시스템 기반으로 현지화를 수행해 일정, 예산 관련 위험성을 최소화함.
- 3개의 정지궤도위성으로 구성된 우주 부문과 15개의 기준국(INRES, Indian Reference Stations), 2개의 중앙제어센터(INMCC, Indian Master Control Center), 3개의 업링크국(INLUS, Indian Land Uplink Station)으로 구성된 지상 부문으로 구성됨.

② 개발시 적용 표준 및 규격

- 구축시 적용 기준은 미국의 WAAS와 동일함.
- SBAS 메시지 데이터 포맷은 ICAO 규정을 따르며 항공용 SBAS 수신장비에 RTCA MOPS DO-229D의 최소성능 요구사항이 적용됨.

(4) 일본의 MSAS(MTSAT Satellite-based Augmentation System)



[그림 4. 일본 MSAS 아키텍처]

① 개발 개요

- 일본에서 구축한 광역보정시스템으로 미국 WAAS의 기술을 도입함.
- 기개발되어 운영 중인 시스템(WAAS) 기반으로 현지화를 수행해 일정, 예산 관련 위험성을 최소화

- MSAS는 정지궤도위성으로 MTSAT 위성을 이용하며, 네 개의 지상국(GMS, Ground Monitor Station)이 GPS와 MTSAT 위성의 신호를 수집해 두 개의 통합운영국(MCS, Master Control Station)에 전달해 정밀 보정 및 무결성 알고리즘 계산을 수행하여 그 값을 MTSAT에 재발송함.

② 개발시 적용 표준 및 규격

- RNP 0.3 HPL, APV-I VPL급 성능으로 현재 공항에서 RNAV/RNP 절차 활용이 가능함.
- 구축시 적용 기준은 미국의 WAAS와 동일함.
- 자국내 업체(NEC)를 통한 국외 기개발 업체(Raytheon)를 활용해 구축 및 개발함.
- 일본의 교통성, 기상청이 공동개발한 MTSAT을 사용해 항공기에 보정정보를 제공함.
 - 일본은 2005년과 2006년에 MTSAT-1R 및 MTSAT-2 정지궤도위성을 발사했으며 MTSAT-1R은 2015년 12월에 소모되어 운용이 중단되었고 MTSAT-2는 2019년까지 운용 완료 예상, 이후 QZS(Quasi-Zenith Satellite) GEO-1 위성 사용이 예정되어 있음.

나. 국외 위성기반 보강항법시스템(SBAS) 인증 사례

(1) 미국의 WAAS

① 인증 개요

- 미국 WAAS는 미연방항공청(FAA)에서 설계내용, 기술적 성능, 운영 성능 및 각종 평가를 통해 자체적으로 검증하였으며, 개발 단계에서의 시스템 인증(Certification)과 운영 단계에서의 운영개시검사(Commissioning)로 구분해 인증을 수행함.
- 인증을 위해 별도의 검사 영역을 구분하지 않았으나, 내부적으로 시스템 설계 및 성능 검증을 실 운영환경에서 전문 검사기관(MITRE) 주도로 수행하고, 시설 및 운영준비 측면의 검증은 기존 항행 안전시설 인증경험이 풍부한 인증당국(FAA)에서 직접 검증함.

② 인증 수행 활동 세부사항

- WIPP(WASS Integrity Performance Panel)는 인증을 위해 FAA 주관으로 구성 및 운영된 기술 검토 그룹이며 위험 모델 정의, 탐지 알고리즘 및 HMI 분석을 통한 보증 활동을 수행함.
 - WIPP는 WAAS 무결성 설계 및 검토, 무결성에 관한 충분한 증명과 설계를 향상시킬 다양한 그룹을 구성하고 최종 설계안을 제시하는 등의 역할을 수행함.
- 시험 시 모든 측정 데이터를 항상 저장하고, 저장된 데이터를 활용하여 시뮬레이션 수행, 지속적으로 추적 데이터를 관리함.
- IRB는 FAA가 WIPP이 제안한 기술적 솔루션에 대한 독립적인 평가를 위해 구성해 운영함.
- MITRE는 시스템 측면의 검사를 하고, 개발기관은 인증을 받기 위해 시스템 측면이 아닌 시설 및 운영 측면의 검사자체 시험을 수행함.
- 인증당국인 FAA는 TFT 형태의 'In-Service Decision JRC'를 구성하여 별도 인증을 위한 시험을 수행함.

(2) 유럽의 EGNOS

① 인증 개요

- EC(European Commission), ESA(European Space Agency), Eurocontrol로 구성된 ETG(European Tripartite Group) 주도로 Thales Alenia Space 중심의 개발 컨소시엄에서 유럽 독자적으로 개발하였으며 유럽 독자적으로 인증을 수행함.

② 인증 수행 활동 세부사항

- 유럽연합(EU, European Union) 가입국은 EU 규정에 따라 EU의 SES(Single European Sky) 규정의 권한(authority)을 이행하기 위한 조직인 NSA(National Supervisory Authority)를 갖추어야 함.

- EGNOS 인증시 인증당국(NSA)은 유럽 규정(EU Regulation)에 따라 시스템 및 서비스 측면의 검사를 수행한 후 인증을 부여하였음.
- ESSP는 서비스 개시를 위해 운용검증(Safety Case Part B)을 수행하고 인증에 필요한 인증 데이터를 인증당국인 NSA에 제출하여 인증을 요청함.
- NSA는 프랑스, 독일, 스페인 등 EU가입 8개국으로 구성된 위원회로 ESSP가 인증과 관련된 EU 규정에 따라 요구사항을 준수 또는 확보하였는지 확인하고 NSA French에서 인증 업무를 수행함.
 - NSA 인증 활동에는 SCIAT(Safety Case and Interoperability Assessment Team)과 CT(Certification Team)가 도움을 제공함.
 - SCIAT는 시스템 관련 규정에 따라 EGNOS 시스템의 안전성 및 상호운용성을 입증하는 업무를 수행, CT는 서비스 규정에 따라 EGNOS 서비스 제공기관의 조직을 인증함.

(3) 인도의 GAGAN

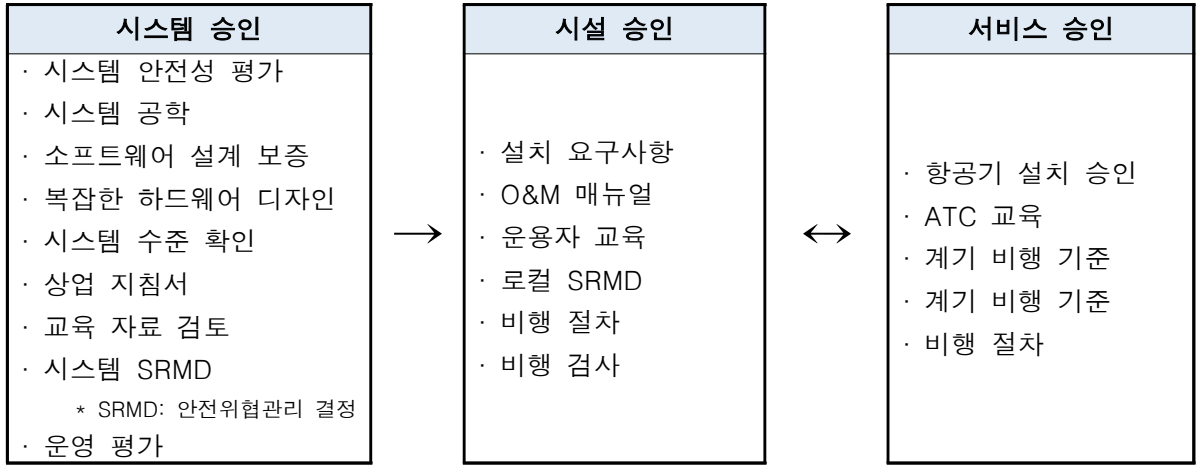
① 인증 개요

- 미국에서 인증된 WAAS를 구매, 모든 시스템을 국외에서 도입하여 구축 및 인증을 수행함.
- System Approval(도입한 시스템 검증) 단계 / Facility Approval(설치 및 설치 후 성능확인) 단계 / Service Approval(운영 환경 검사) 단계로 인증을 수행함.
- 안전성 분석 방법 및 절차 자료는 WAAS 개발사(Raytheon)에서 반출이 불가해, 해당 내용 검토를 위해 GAGAN의 검사 인력이 Raytheon에 수개월 상주하며 검증함.

② 인증 수행 활동 세부사항

- 시스템 승인, 시설 승인, 서비스 승인 단계를 거쳐 인증을 수행함.
- 일정 및 예산 관련 위험을 최소화하고 정부-기개발 업체간 직접 소통하는 장점이 있으나, SBAS 시스템 개발 기술 획득 및 보유가 제한적이고 자국 업체 참여가 불가능하다는 단점이 있음.
- 인도의 지리적 특성으로 인한 전리층 이상현상이 잦아 무결성 보장이 힘든 상황으로, GAGAN과 WAAS의 차이점 및 무결성 측면의 잠재적 영향에 맞춰 문서를 분류하고 검토 비중을 조절함.
 - 적도 부근에 위치한 인도는 전리층에서 지자기 이상현상, 플라즈마 버블현상, 신틸레이션(scintillation) 현상이 자주 발생함.
- WASS의 WIPP와 동일한 기술검토팀을 구성하여 델타 인증을 수행함.
 - 기술검토 그룹 TRT 구성: 개발업체(Raytheon) 위원장 및 인도항공국(DGCA) 대표, 인도공항공사(AAI), 인도우주연구소(ISRO) 등으로 구성되어 GAGAN의 안전성 인증에 대한 검토, 인증 사후 관리 및 시스템 평가 등을 수행함.
 - 델타 인증은 WAAS 시스템 도입에 따른 유사성을 반영하여, WAAS에서 수행된 인증·분석 중 대다수를 그대로 적용하는 것으로써 불필요한 문서 중복 및 관리 비용을 절감하기 위함이며 WAAS와 Fault Trees 비교, 델타 HMI 위험에 영향을 미치는 알고리즘 등의 차이점을 비교·분석함.
- GAGAN 인증 절차 및 델타 인증 수행시 시스템 기준은 수용하는 한편 승인 절차는 시스템 승인, 시설 승인, 서비스 승인의 세 가지 주요 활동을 포함함.
 - 시스템 승인 프로세스는 요구사항을 확인하는 절차이며 시설 승인에는 운용 테스트 및 평가 도구 개발, 오프라인 모니터링 도구 및 표준에 대한 성능개개 변수 테스트 등이 포함됨. 서비스 승인은 지상 및 비행 유효성 확인 프로세스를 통해 수행되며 절차 개발 및 테스트와 관련됨.

[표 4. GAGAN 승인 세부 절차]



(4) 일본의 MSAS

① 인증 개요

- MSAS는 1993년 전자항법연구소(ENRI)에서 GNSS 관련 연구를 시작으로 일본 국토교통성 항공국(JCAB) 주도로 미국 WAAS 개발사(Raytheon) 협력 하에 NEC에서 개발한 SBAS임.
- 인증당국(JCAB)은 WAAS 인증검사를 수행한 MITRE 협력을 받아 인증을 수행하고 검사기관(ENRI, 전자항법연구소)에서는 개발기관과 별도로 성능검사, 상호운용성 검사 등을 수행하였음.

② 인증 수행 활동 세부사항

- WAAS의 WIPP와 동일한 기술검토팀을 구성하여 델타 인증을 수행함.
 - 기술검토 그룹 TRT 구성: 개발업체(Raytheon), 스탠포드 대학 전문가, ENRI 및 MITRE 대표로 구성되어 MSAS 구성 및 환경에 대한 무결성 알고리즘 적용을 검토함.
 - 델타 인증은 WAAS 시스템 도입에 따른 유사성을 반영하여, WAAS에서 수행된 인증 분석 중 대다수를 그대로 적용하는 것으로서 불필요한 문서 중복 및 관리 비용을 절감하기 위함이며, WAAS와 시스템을 비교하고 무결성 성능에 잠재적 영향을 미치는 요소 등을 사전 확인 및 검토함.

다. 국외 항행안전시설(SBAS 등) 인증 관련 규정

(1) 미국(FAA)

○ FAA가 직접 설치·운영하는 항행안전시설

- 관련 인증 규정 없이, 내부 프로세스 및 기준을 수립하여 진행하며 시설/장비 인증이 아닌 운영승인 개념

○ FAA 아닌 자가 설치·운영하는 항행안전시설

- FAR part 171에 규정된 사항을 준수했는지 확인 후 운영승인
- 일부 재래식 항법시설(8종)에 대해서만 규정됨
- ※ 현재 국내 성능적합증명 대상은 약 25종

(2) 유럽(EASA)

○ 항행안전시설 자체에 대한 인증 규정은 없으며, ANSP (Air Navigation Service Provider, 항행서비스 운영기관)를 인증하는 개념의 제도 운영

- ANSP 인증을 위한 자료검토 시, 개발기관에서 작성한 시스템 설계 및 시험 문서 등을 일부 참고

- 유럽 전역 대상 서비스 운영기관은 EASA가 인증하고, 특정 국가 내 서비스 운영기관은 각 국 authority가 인증 수행함

○ ANSP 인증 관련 규정

- (EC)No.552/2004 : 유럽 ATM 환경에 따른 상호운영성 요구사항
- (EC)No.482/2008 : 항행시설 개발·운영 소프트웨어 안전 보증
- (EU)No.1035/2011 : ANSP 인증받기 위해 갖춰야 할 요구사항
- (EC)No.1034/2011 : EASA(또는 각 국 authority)가 ANSP 인증심사 및 관리감독을 하기 위한 절차

3) 연구개발 수행 개요

가. KASS 개념 및 목표

- 한국형 정밀 GPS 위치보정시스템(KASS)은 세계에서 7번째로 개발되는 SBAS로 우리나라 지형 및 환경을 고려하여 SBAS 국제표준에서 제시하는 정확성과 신뢰성의 항법 정보를 제공하는 시설
 - 2014년 10월부터 2023년까지 시스템 개발·구축하여 모든 사용자를 대상으로 하는 공개 서비스 (Open Service) 및 항공용 사용자를 대상 APV-1급 성능의 항공용 서비스를 서비스 지역에 제공하는 것을 목표로 하였음



[그림 5. KASS 개념도 및 구축 사진]

- KASS 시스템은 다음과 같은 6개의 대단위 하위시스템으로 구성됨

[표 5. KASS 하위시스템 구성 및 역할]

하위시스템	구축계획	주요역할
기준국(KRS, KASS Reference Station)	7개소 이상	GPS, GEO 신호 수집
중앙처리국(KPS, KASS Processing Station)	2개소(4기)	보정정보 및 무결성 정보 생성
위성통신국(KUS, KASS Uplink Station)	2개소(3기)	KPS에서 생성된 정보를 GEO로 전송
통합운영국(KCS, KASS Control Station)	2개소(2기)	KASS 시스템 현황 모니터링 및 통제
정지궤도위성(GEO, Geostationary Satellite)	2기(임차)	KUS에서 받은 정보를 수신자(항공기 등)에 방송
광역통신망(WAN, Wide Area Network)	하위시스템 전체 연결	하위시스템 간 데이터 전송

○ KASS 시스템의 기본 원리는 다음과 같음.

- 국내 지상의 기준국(7개소)에서 각각 GPS 신호를 수신하고 항법 메시지를 추출해 중앙처리국(2개소)에 전송함.
- 중앙처리국은 GPS 오차정보를 보정하고 GPS 신호의 이상 여부를 알려주는데 필요한 보정 및 무결성 정보를 생성하여 위성통신국으로 전달함.
- 위성통신국은 SBAS 신호(SBAS 메시지)를 생성해 정지궤도위성으로 송신하고, 정지궤도위성은 관련 정보들을 전 국토에 일괄 방송함.
- 이 때, 항공기나 자동차 등에 설치된 수신기는 GPS 신호와 SBAS 신호를 동시에 수신하여 정확한 자기 위치를 확인할 수 있으며 만약 신호에 오류가 있을 경우에는 SBAS 자동경보시스템이 사용 금지를 알리는 경보를 10초 이내에 제공함.



[그림 6. KASS 시스템의 원리]

○ KASS 구축 및 운영을 통한 기대효과

- 항공기 위치파악 오류로 인한 항공기 사고가 발생할 확률이 감소

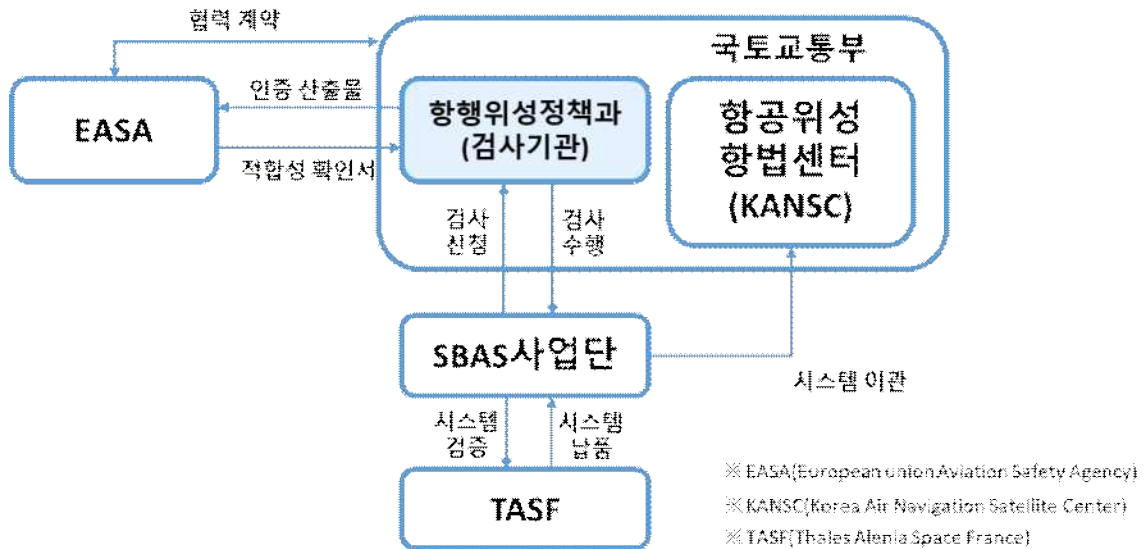
- 연료 절감 및 항공기 지연·결함 감소로 인해 상당한 경제적 효과
- 항공기/자동차/철도/선박 등의 다양한 운송수단의 정밀한 위치를 추정하는 것이 가능해(17~37m → 1~3m) 안전도가 향상되고 이에 따른 수용 능력이 증대하여 편익 창출
- 위성항법 보강시스템을 이용한 고부가 가치 산업과의 연계가 가능해 경제 산업 발전
- GPS 교란으로 항법시스템에 문제가 발생하면 자동경보로 즉시 대응해 국가 안보 향상 및 국방력 증강에 기여
- 위치기반 서비스 분야의 정보통신기기 성능을 개선하고 노약자, 미아, 응급환자의 위치 추적을 통해 구조기관 연계 등

나. KASS 성능적합증명(인증)의 필요성

- 안전한 미래 항공교통 체계를 위한 국가 인프라 구축 및 인증기술 기반이 필요함.
 - 성공적인 항행안전시설 인프라 구축을 위해서는 개발된 SBAS의 안전성 확보를 위한 인증이 필수적임.
 - 개발/설치, 운영 등 전 단계에 대한 인증기술 기반 확보가 시급함.
- SBAS의 안전성이 보장되지 않을 경우, 상용 서비스가 불가하여 큰 손실이 예상됨.
 - 시스템 결함 발생시 대규모 인명피해가 우려되며, 항공 뿐 아니라 국방, 교통, 측지 등 다양한 산업 분야 활용 예정이므로 막대한 경제·사회적 손실 초래가 예상됨.
 - 항공기 운항 안전성을 확보하기 위해 성능적합증명을 수행하고 이에 대한 평가 및 관리가 수반되어야 함.
- 국제민간항공기구(ICAO)의 차세대 항행안전시설 개발 및 구축에 발맞춰 항법서비스 선진화가 필요함.
 - 위성항법서비스 제공국인 미국, 유럽, 일본 등 몇몇 선진국의 향후 항행안전시설 독점이 우려되며 이에 대한 대책 마련이 시급함.
 - 국제사회에서 위치정보 기술개발 경쟁이 치열하게 벌어지고 있으며 우리나라도 차세대 항행안전시설 인증체계 및 역량 확보를 통해 항공선진국 반열에 진입하는 것이 시급함.
- 항행안전시설 관련 국제 협력의 발판 마련이 절실함.
 - 항공산업 및 항행서비스 제공은 국내외 다양한 나라와의 교류와 관련되기 때문에 SBAS와 같은 항행안전시설의 표준화 및 인증과 관련한 기술 보유국 간 긴밀한 협력이 필요함.
 - SBAS는 해당 지역의 이용을 위해 구축되었지만, 시스템 호환 시 전 지구적 범위에서 적용이 가능할 것이며, 이에 대한 중요성을 인정한 미국, 유럽, 일본 등 우주개발 선진국의 SBAS 관계 기관은 이미 IWG(Interoperability Working Group)와 같은 주기적인 모임을 개최 중.
 - SBAS 기술 보유국들은 SBAS 서비스 범위 확대 및 성능 향상을 위해 기준국 네트워크를 지속 확장 중임.

다. KASS 성능적합증명 수행 체계

- KASS 성능적합증명은 인증당국인 국토교통부에 성능적합증명 신청자인 SBAS사업단이 검사 신청을 제출함으로써 시작되었으며, 본 과제 관련 기관들의 관계도를 아래 그림과 같이 도식함.



[그림 7. KASS 성능적합증명 수행 관련 기관 관계도]

- KASS 성능적합증명 수행은 국토교통부 고시 제2022-51 호(항행안전시설 성능적합증명 검사 규정)에 근거하여 검사가 수행되며 적용된 상세 기준은 아래 표와 같음
 - 본 과제에서는 제3조①항에 따른 검사를 'SBAS 기술기준 검사', 제3조③항에 따른 검사를 '소프트웨어 기술기준 검사'로 정의

[표 6. KASS 성능적합증명 검사 적용 기준]

조문	적용 기준
제3조①항	<ul style="list-style-type: none"> • 항행안전무선시설 설치 및 기술기준(국토교통부 고시[제2022-786호]) 중에서 SBAS 기술기준(기능·성능·인터페이스 등)을 적용 • ICAO SARPs 부속서 10, 1권 (개정 86판) 적용
제3조③항	<ul style="list-style-type: none"> • 신청자 선택에 따라 EUROCAE ED-12B (RTCA DO-178B) 적용

- EASA에서는 KASS 시스템 인증에 적용 가능 유럽 규정(RB, Regulatory Basis)을 기술기준으로 하여 KASS 시스템의 적합성을 검사 후 적합성확인서(SoC)를 발급
 - 적용 가능 유럽 규정(RB)에는 다음과 같은 주요 규정이 있음

[표 7. EASA 검사분야 및 관련 규정]

규정명	검사분야	규정 내용
(EC) 552/2004	상호운용성	유럽 ATM 네트워크의 상호운용성
(EC) 482/2008	안전성	항행서비스제공자(ANSP)의 소프트웨어 안전성 보증
(EU) 1034/2011		항공교통관제(ATM) / 항행서비스(ANS) 안전감독
(EU) 1035/2011		항행서비스(ANS) 제공을 위한 공통 요구사항

- (EC) 552/2004, 유럽 ATM 네트워크의 상호운용성

Regulation (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community, and in particular Article 80(2) thereof,

Having regard to the proposal from the Commission(1),

Having regard to the opinion of the European Economic and Social Committee(2),

Having regard to the opinion of the Committee of the Regions(3),

Acting in accordance with the procedure laid down in Article 251 of the Treaty(4), in the light of the joint text approved by the Conciliation Committee on 11 December 2003,

Whereas:

(1) In order to create the Single European Sky, measures should be adopted in relation to systems, constituents and associated procedures with the objective of ensuring the interoperability of the European air traffic management network (EATMN) consistent with the provision of air navigation services as provided for in Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the Single European Sky (the service provision Regulation)(5) and the organisation and use of airspace as provided for in Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2003 on the organisation and use of the airspace in the Single European Sky (the airspace Regulation)(6).

(2) The report of the High Level Group on the Single European Sky has confirmed the need to establish technical regulation on the basis of the "new approach" in accordance with the Council resolution of 7 May 1985 on a new approach to technical harmonisation and standards(7) where essential requirements, rules and standards are complementary and consistent.

(3) Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 (the framework Regulation)(8) lays down the framework for the creation of the Single European Sky.

(4) The report of the High Level Group has confirmed that even though progress has been achieved during the last few years towards seamless operation of the EATMN, the situation still remains unsatisfactory, with a low level of integration between national air traffic management systems and a slow pace in the introduction of new concepts of operation and technology necessary to deliver the additional required capacity.

(5) Enhancing the level of integration at Community level would result in better efficiency and lower costs for system procurement and maintenance and in improved operational coordination.

(6) The predominance of national technical specifications used in procurement has led to fragmentation of the systems market and does not facilitate industrial cooperation at Community level; as a result, industry is particularly affected since it needs to

considerably adapt its products for each national market; these practices render development and implementation of new technology unnecessarily difficult and slow down the introduction of new operational concepts that are required to increase capacity.

(7) It is therefore in the interest of all those involved in air traffic management to develop a new partnership approach allowing the balanced involvement of all parties and stimulating creativity and the sharing of knowledge, experience and risks; such partnership should aim at defining, in cooperation with industry, a coherent set of Community specifications that can fulfil the widest possible range of needs.

(8) The internal market is a Community objective and therefore measures taken under this Regulation should contribute to its progressive development in this sector.

(9) It is therefore appropriate to define essential requirements which should apply to the European air traffic management network, its systems, constituents and associated procedures.

(10) Implementing rules for interoperability should be drawn up for systems whenever necessary to complement or further refine the essential requirements; those rules should also be drawn up where necessary to facilitate the coordinated introduction of new, agreed and validated concepts of operation or technologies; compliance with those rules should be permanently maintained; those rules should rely on rules and standards developed by international organisations such as Eurocontrol or ICAO.

(11) The development and adoption of Community specifications concerning EATMN, its systems and constituents and associated procedures is an appropriate means of defining the technical and operational conditions necessary to meet the essential requirements and relevant implementing rules for interoperability; compliance with published Community specifications, which remains voluntary, creates a presumption of conformity with the essential requirements and the relevant implementing rules for interoperability.

(12) Community specifications should be established by the European standardisation bodies in conjunction with the European Organisation for Civil Aviation Equipment (Eurocae) and by Eurocontrol, in accordance with general Community standardisation procedures.

(13) The procedures governing the assessment of conformity or suitability for use of constituents should be based on the use of the modules covered by Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures and the rules for the affixing and use of the CE conformity marking, which are intended to be used in the technical harmonisation directives⁽⁹⁾; as far as necessary, these modules should be expanded to cover specific requirements of the industries concerned.

(14) The market concerned is of small size and consists of systems and constituents used almost exclusively for air traffic management purposes and not intended for the general public; it would be therefore excessive to affix the CE mark to constituents as, on the basis of the assessment of conformity and/or suitability for use, the manufacturer's declaration of conformity is sufficient; that should not affect the obligation on manufacturers to affix the CE mark to certain constituents in order to certify their compliance with other Community legislation relating to them.

(15) The putting into service of air traffic management systems should be subject to verification of compliance with the essential requirements and relevant implementing rules for interoperability; use of Community specifications creates a presumption of conformity with the essential requirements and relevant implementing rules for interoperability.

(16) The full application of this Regulation should be accomplished by means of a transitional strategy designed to attain the objectives of this Regulation while not creating unjustified cost-benefit barriers to preservation of the existing infrastructure.

(17) Within the framework of the relevant Community legislation, due account should be taken of the need to ensure:

- harmonised conditions with regard to the availability and efficient use of radio spectrum necessary for the implementation of the Single European Sky, including electromagnetic compatibility aspects,
- protection of the safety-of-life services from harmful interference,
- efficient and appropriate use of frequencies allocated to and managed exclusively by the aviation sector.

(18) Council Directive 93/65/EEC of 19 July 1993 on the definition and use of compatible technical specifications for the procurement of air traffic management equipment and systems⁽¹⁰⁾ is limited to obligations of awarding entities; this Regulation is more comprehensive in that it addresses obligations of all actors, including air navigation service providers, airspace users, industry and airports, and provides both for rules applicable to all and for the adoption of Community specifications which, while being voluntary, creates a presumption of conformity with the essential requirements. Therefore, Directive 93/65/EEC, Commission Directive 97/15/EC of 25 March 1997 adopting Eurocontrol standards and amending Council Directive 93/65/EEC on the definition and use of compatible technical specifications for the procurement of air-traffic-management equipment and systems⁽¹¹⁾ and Commission Regulations (EC) No 2082/2000 of 6 September 2000 adopting Eurocontrol standards and amending Directive 97/15/EC⁽¹²⁾ and (EC) No 980/2002 of 4 June 2002 amending Regulation (EC) No 2082/2000 should be repealed after a transitional period.

(19) For reasons of legal certainty it is important to ensure that the substance of certain provisions of Community legislation adopted on the basis of Directive 93/65/EEC remains in force unchanged. The adoption under this Regulation of the implementing rules corresponding to such provisions will necessitate a certain amount of time,

HAVE ADOPTED THIS REGULATION:

CHAPTER I GENERAL PROVISIONS

Article 1 Objective and scope

1. Within the scope of the framework Regulation, this Regulation concerns the interoperability of the EATMN.
2. This Regulation shall apply to the systems, their constituents and associated procedures identified in Annex I.
3. The objective of this Regulation is to achieve interoperability between the different systems, constituents and associated procedures of the EATMN, taking due account of the relevant international rules. This Regulation aims also at ensuring the coordinated

and rapid introduction of new agreed and validated concepts of operations or technology in air traffic management.

CHAPTER II ESSENTIAL REQUIREMENTS, IMPLEMENTING RULES FOR INTEROPERABILITY AND COMMUNITY SPECIFICATIONS

Article 2 Essential requirements

The EATMN, its systems and their constituents and associated procedures shall meet essential requirements. The essential requirements are set out in Annex II.

Article 3 Implementing rules for interoperability

1. Implementing rules for interoperability shall be drawn up whenever necessary to achieve in a coherent way the objectives of this Regulation.

2. Systems, constituents and associated procedures shall comply with the relevant implementing rules for interoperability throughout their lifecycle.

3. Implementing rules for interoperability shall in particular:

(a) determine any specific requirements that complement or refine the essential requirements, in particular in terms of safety, seamless operation and performance; and/or

(b) describe, where appropriate, any specific requirements that complement or refine the essential requirements, in particular regarding the coordinated introduction of new, agreed and validated concepts of operation or technologies; and/or

(c) determine the constituents when dealing with systems; and/or

(d) describe the specific conformity assessment procedures involving, where appropriate, notified bodies as referred to in Article 8, based on the modules defined in Decision 93/465/EEC to be used to assess either the conformity or the suitability for use of constituents as well as the verification of systems; and/or

(e) specify the conditions of implementation including, where appropriate, the date by which all relevant stakeholders are required to comply with them.

4. The preparation, adoption and review of implementing rules for interoperability shall take into account the estimated costs and benefits of technical solutions by means of which they may be complied with, with a view to defining the most viable solution, having due regard to the maintenance of an agreed high level of safety. An assessment of the costs and benefits of those solutions for all stakeholders concerned shall be attached to each draft implementing rule for interoperability.

5. Implementing rules for interoperability shall be established in accordance with the procedure under Article 8 of the framework Regulation.

Article 4 Community specifications

1. In pursuit of the objective of this Regulation, Community specifications may be established. Such specifications may be:

(a) European standards for systems or constituents, together with the relevant procedures, drawn up by the European standardisation bodies in cooperation with Eurocae, on a mandate from the Commission in accordance with Article 6(4) of Directive 98/34/EC of the European Parliament and of the Council of 22 June 1998 laying down a procedure for the provision of information in the field of technical standards and regulations⁽¹³⁾ and pursuant to the general guidelines on cooperation between the Commission and the standardisation bodies signed on 13 November 1984; or

(b) specifications drawn up by Eurocontrol on matters of operational coordination

between air navigation service providers, in response to a request from the Commission in accordance with the procedure referred to in Article 5(2) of the framework Regulation.

2. Compliance with the essential requirements and/or the implementing rules for interoperability shall be presumed for systems, together with the associated procedures, or constituents that meet the relevant Community specifications and whose reference numbers have been published in the Official Journal of the European Union.

3. The Commission shall publish the references to the European standards referred to in paragraph 1(a) in the Official Journal of the European Union.

4. The references to Eurocontrol specifications referred to in paragraph 1(b), shall be published by the Commission in the Official Journal of the European Union in accordance with the procedure referred to in Article 5(2) of the framework Regulation.

5. Where a Member State or the Commission considers that conformity with a published Community specification does not ensure compliance with the essential requirements and/or implementing rules for interoperability which the said Community specification is intended to cover, the procedure referred to in Article 5(2) of the framework Regulation shall apply.

6. In the case of shortcomings of published European standards, partial or total withdrawal of the standards concerned from the publications containing them, or amendments thereto, may be decided upon in accordance with the procedure referred to in Article 5(2) of the framework Regulation after consultation of the committee set up under Article 5 of Directive 98/34/EC.

7. In the case of shortcomings of published Eurocontrol specifications, partial or total withdrawal of the specifications concerned from the publications containing them, or amendment thereof, may be decided upon in accordance with the procedure referred to in Article 5(2) of the framework Regulation.

CHAPTER III VERIFICATION OF COMPLIANCE

Article 5 EC declaration of conformity or suitability for use of constituents

1. Constituents shall be accompanied by an EC declaration of conformity or suitability for use. The elements of this declaration are set out in Annex III.

2. The manufacturer, or its authorised representative established in the Community, shall ensure and declare, by means of the EC declaration of conformity or suitability for use, that he has applied the provisions laid down in the essential requirements and in the relevant implementing rules for interoperability.

3. Compliance with the essential requirements and the relevant implementing rules for interoperability shall be presumed in relation to those constituents that are accompanied by the EC declaration of conformity or suitability for use.

4. The relevant implementing rules for interoperability shall identify, where appropriate, the tasks pertaining to the assessment of conformity or suitability for use of constituents to be carried out by the notified bodies referred to in Article 8.

Article 6 EC declaration of verification of systems

1. Systems shall be subject to an EC verification by the air navigation service provider in accordance with the relevant implementing rules for interoperability, in order to ensure that they meet the essential requirements of this Regulation and the implementing rules for interoperability, when integrated into the EATMN.

2. Before a system is put into service, the relevant air navigation service provider shall establish an EC declaration of verification, confirming compliance, and shall submit it to the national supervisory authority together with a technical file. The elements of this

declaration and of the technical file are set out in Annex IV. The national supervisory authority may require any additional information necessary to supervise such compliance.

3. The relevant implementing rules for interoperability shall identify, where appropriate, the tasks pertaining to the verification of systems to be carried out by the notified bodies as referred to in Article 8.

4. The EC declaration of verification shall be without prejudice to any assessments that the national supervisory authority may need to carry out on grounds other than interoperability.

Article 7 Safeguards

1. Where the national supervisory authority ascertains that:

(a) a constituent accompanied by an EC declaration of conformity or suitability for use, or

(b) a system accompanied by the EC declaration of verification,

does not comply with the essential requirements and/or relevant implementing rules for interoperability, it shall, with due regard to the need to ensure safety and continuity of operations, take all measures necessary to restrict the area of application of the constituent or the system concerned or to prohibit its use by the entities under the responsibility of the authority.

2. The Member State concerned shall immediately inform the Commission of any such measures, indicating its reasons and, in particular, whether in its opinion non-compliance with the essential requirements is due to:

(a) failure to meet the essential requirements;

(b) incorrect application of the implementing rules for interoperability and/or Community specifications;

(c) shortcomings in the implementing rules for interoperability and/or Community specifications.

3. As soon as possible, the Commission shall consult the parties concerned. After such consultation, the Commission shall inform the Member State of its findings and of its opinion as to whether the measures taken by the national supervisory authority are justified.

4. Where the Commission establishes that the measures taken by the national supervisory authority are not justified, it shall request the Member State concerned to ensure that they are withdrawn without delay. It shall forthwith so inform the manufacturer or its authorised representative established in the Community.

5. Where the Commission establishes that non-compliance with the essential requirements is due to incorrect application of the implementing rules for interoperability and/or the Community specifications, the Member State concerned shall take appropriate measures against the originator of the declaration of conformity or suitability for use or the EC declaration of verification and shall inform the Commission and the other Member States thereof.

6. Where the Commission establishes that non-compliance with the essential requirements is due to shortcomings in the Community specifications, the procedures referred to in Article 4(6) or (7) shall apply.

Article 8 Notified bodies

1. Member States shall notify the Commission and the other Member States of the bodies they have appointed to carry out tasks pertaining to the assessment of conformity or suitability for use referred to in Article 5, and/or the verification referred to in Article 6, indicating each body's area of responsibility and its identification number

obtained from the Commission. The Commission shall publish in the Official Journal of the European Union the list of bodies, their identification numbers and areas of responsibility, and shall keep the list updated.

2. Member States shall apply the criteria provided for in Annex V for the assessment of the bodies to be notified. Bodies meeting the assessment criteria provided for in the relevant European standards shall be deemed to meet the said criteria.

3. Member States shall withdraw notification of a notified body which no longer meets the criteria provided for in Annex V. It shall forthwith inform the Commission and the other Member States thereof.

4. Without prejudice to the requirements referred to in paragraphs 1, 2 and 3, Member States may decide to appoint organisations recognised in conformity with Article 3 of the service provision Regulation as notified bodies.

CHAPTER IV FINAL PROVISIONS

Article 9 Revision of Annexes

In case of any technical or operational developments, adjustments may be made to Annexes I and II in accordance with the procedure referred to in Article 5(3) of the framework Regulation.

Article 10 Transitional arrangements

1. Starting from 20 October 2005, the essential requirements shall apply to the putting into service of systems and constituents of the EATMN, if not otherwise specified by the relevant implementing rules for interoperability.

2. Compliance with the essential requirements shall be required for all systems and constituents of the EATMN currently in operation by 20 April 2011, if not otherwise specified by the relevant implementing rules for interoperability.

3. Where systems of the EATMN have been ordered or binding contracts to that effect have been signed

- before the date of entry into force of this Regulation, or, where appropriate,
- before the date of entry into force of one or more relevant implementing rules for interoperability,

so that compliance with the essential requirements and/or the relevant implementing rules for interoperability cannot be guaranteed within the time limit mentioned in paragraph 1, the Member State concerned shall communicate to the Commission detailed information on the essential requirements and/or implementing rules for interoperability where uncertainty of compliance has been identified.

The Commission shall enter into consultation with the parties concerned, after which it shall take a decision in accordance with the procedure referred to in Article 5(3) of the framework Regulation.

Article 11 Repeal

Directives 93/65/EEC and 97/15/EC and Regulations (EC) Nos 2082/2000 and 980/2002 shall be repealed on 20 October 2005.

Article 12 Entry into force

This Regulation shall enter into force on the twentieth day following that of its publication in the Official Journal of the European Union.

This Regulation shall be binding in its entirety and directly applicable in all Member

States.

ANNEX I LIST OF SYSTEMS FOR AIR NAVIGATION SERVICES

For the purpose of this Regulation the EATMN is subdivided into eight systems.

1. Systems and procedures for airspace management.
2. Systems and procedures for air traffic flow management.
3. Systems and procedures for air traffic services, in particular flight data processing systems, surveillance data processing systems and human-machine interface systems.
4. Communications systems and procedures for ground-to-ground, air-to-ground and air-to-air communications.
5. Navigation systems and procedures.
6. Surveillance systems and procedures.
7. Systems and procedures for aeronautical information services.
8. Systems and procedures for the use of meteorological information.

ANNEX II ESSENTIAL REQUIREMENTS

Part A: General requirements

These are network-wide requirements that are generally applicable to each one of the systems identified in Annex I.

1. Seamless operation

Air traffic management systems and their constituents shall be designed, built, maintained and operated using the appropriate and validated procedures, in such a way as to ensure the seamless operation of the EATMN at all times and for all phases of flight. Seamless operation can be expressed, in particular, in terms of information-sharing, including the relevant operational status information, common understanding of information, comparable processing performances and the associated procedures enabling common operational performances agreed for the whole or parts of the EATMN.

2. Support for new concepts of operation

The EATMN, its systems and their constituents shall support, on a coordinated basis, new agreed and validated concepts of operation that improve the quality and effectiveness of air navigation services, in particular in terms of safety and capacity.

The potential of new concepts, such as collaborative decision-making, increasing automation and alternative methods of delegation of separation responsibility, shall be examined taking due account of technological developments and of their safe implementation, following validation.

3. Safety

Systems and operations of the EATMN shall achieve agreed high levels of safety. Agreed safety management and reporting methodologies shall be established to achieve this.

In respect of appropriate ground-based systems, or parts thereof, these high levels of safety shall be enhanced by safety nets which shall be subject to agreed common performance characteristics.

A harmonised set of safety requirements for the design, implementation, maintenance and operation of systems and their constituents, both for normal and degraded modes of operation, shall be defined with a view to achieving the agreed safety levels, for all

phases of flight and for the entire EATMN.

Systems shall be designed, built, maintained and operated, using the appropriate and validated procedures, in such a way that the tasks assigned to the control staff are compatible with human capabilities, in both the normal and degraded modes of operation, and are consistent with required safety levels.

Systems shall be designed, built, maintained and operated using the appropriate and validated procedures, in such a way as to be free from harmful interference in their normal operational environment.

4. Civil–military coordination

The EATMN, its systems and their constituents shall support the progressive implementation of civil/military coordination, to the extent necessary for effective airspace and air traffic flow management, and the safe and efficient use of airspace by all users, through the application of the concept of the flexible use of airspace.

To achieve these objectives, the EATMN, its systems and their constituents shall support the timely sharing of correct and consistent information covering all phases of flight, between civil and military parties.

Account should be taken of national security requirements.

5. Environmental constraints

Systems and operations of the EATMN shall take into account the need to minimise environmental impact in accordance with Community legislation.

6. Principles governing the logical architecture of systems

Systems shall be designed and progressively integrated with the objective of achieving a coherent and increasingly harmonised, evolutionary and validated logical architecture within the EATMN.

7. Principles governing the construction of systems

Systems shall be designed, built and maintained on the grounds of sound engineering principles, in particular those relating to modularity, enabling interchangeability of constituents, high availability, and redundancy and fault tolerance of critical constituents.

Part B: Specific requirements

These are the requirements that are specific to each one of the systems and that complement or further refine the general requirements.

1. Systems and procedures for airspace management

1.1. Seamless operation

Information relating to pre–tactical and tactical aspects of airspace availability shall be provided to all interested parties in a correct and timely way so as to ensure an efficient allocation and use of airspace by all airspace users. This should take into account national security requirements.

2. Systems and procedures for air traffic flow management

2.1. Seamless operation

Systems and procedures for air traffic flow management shall support the sharing of correct, coherent and relevant strategic, pre–tactical and tactical, as applicable, flight information covering all phases of flight and offer dialogue capabilities with a view to achieving optimised use of airspace.

3. Systems and procedures for air traffic services

3.1. Flight data processing systems

3.1.1. Seamless operation

Flight data processing systems shall be interoperable in terms of the timely sharing of correct and consistent information, and a common operational understanding of that information, in order to ensure a coherent and consistent planning process and resource-efficient tactical coordination throughout the EATMN during all phases of flight. In order to ensure safe, smooth and expeditious processing throughout the EATMN, flight data processing performances shall be equivalent and appropriate for a given environment (surface, terminal manoeuvring area (TMA), en-route), with known traffic characteristics and exploited under an agreed and validated operational concept, in particular in terms of accuracy and error tolerance of processing results.

3.1.2. Support for new concepts of operation

Flight data processing systems shall accommodate the progressive implementation of advanced, agreed and validated concepts of operation for all phases of flight.

The characteristics of automation-intensive tools must be such as to enable coherent and efficient pre-tactical and tactical processing of flight information in parts of the EATMN.

Airborne and ground systems and their constituents supporting new, agreed and validated concepts of operation shall be designed, built, maintained and operated, using appropriate and validated procedures, in such a way as to be interoperable in terms of timely sharing of correct and consistent information and a common understanding of the current and predicted operational situation.

3.2. Surveillance data processing systems

3.2.1. Seamless operation

Surveillance data processing systems shall be designed, built, maintained and operated using the appropriate and validated procedures, in such a way as to provide the required performance and quality of service within a given environment (surface, TMA, en-route) with known traffic characteristics, in particular in terms of accuracy and reliability of computed results, correctness, integrity, availability, continuity and timeliness of information at the control position.

Surveillance data processing systems shall accommodate the timely sharing of relevant, accurate, consistent and coherent information between them to ensure optimised operations through different parts of the EATMN.

3.2.2. Support for new concepts of operation

Surveillance data processing systems shall accommodate the progressive availability of new sources of surveillance information in such a way as to improve the overall quality of service.

3.3. Human-machine interface systems

3.3.1. Seamless operation

Human-machine interfaces of ground air traffic management systems shall be designed, built, maintained and operated using the appropriate and validated procedures, in such a way as to offer to all control staff a progressively harmonised working environment, including functions and ergonomics, meeting the required performance for a given environment (surface, TMA, en-route), with known traffic characteristics.

3.3.2. Support for new concepts of operation

Human-machine interface systems shall accommodate the progressive introduction of new, agreed and validated concepts of operation and increased automation, in such a

way as to ensure that the tasks assigned to the control staff remain compatible with human capabilities, in both the normal and degraded modes of operation.

4. Communications systems and procedures for ground-to-ground, air-to-ground and air-to-air communications

4.1. Seamless operation

Communication systems shall be designed, built, maintained and operated using the appropriate and validated procedures, in such a way as to achieve the required performances within a given volume of airspace or for a specific application, in particular in terms of communication processing time, integrity, availability and continuity of function.

The communications network within the EATMN shall be such as to meet the requirements of quality of service, coverage and redundancy.

4.2. Support for new concepts of operation

Communication systems shall support the implementation of advanced, agreed and validated concepts of operation for all phases of flight.

5. Navigation systems and procedures

5.1. Seamless operation

Navigation systems shall be designed, built, maintained and operated using appropriate and validated procedures in such a way as to achieve the required horizontal and vertical navigation performance, in particular in terms of accuracy and functional capability, for a given environment (surface, TMA, en-route), with known traffic characteristics and exploited under an agreed and validated operational concept.

6. Surveillance systems and procedures

6.1. Seamless operation

Surveillance systems shall be designed, built, maintained and operated using appropriate and validated procedures in such a way as to provide the required performance applicable in a given environment (surface, TMA, en-route) with known traffic characteristics and exploited under an agreed and validated operational concept, in particular in terms of accuracy, coverage, range and quality of service.

The surveillance network within the EATMN shall be such as to meet the requirements of accuracy, timeliness, coverage and redundancy. The surveillance network shall enable surveillance data to be shared in order to enhance operations throughout the EATMN.

7. Systems and procedures for aeronautical information services

7.1. Seamless operation

Accurate, timely and consistent aeronautical information shall be provided progressively in an electronic form, based on a commonly agreed and standardised data set.

Accurate and consistent aeronautical information, in particular concerning airborne and ground-based constituents or systems, shall be made available in a timely manner.

7.2. Support for new concepts of operation

Increasingly accurate, complete and up-to-date aeronautical information shall be made available and used in a timely manner in order to support continuous improvement of the efficiency of airspace and airport use.

8. Systems and procedures for the use of meteorological information

8.1. Seamless operation

Systems and procedures for the use of meteorological information shall improve the consistency and timeliness of its provision and the quality of its presentation, using an

agreed data set.

8.2. Support for new concepts of operation

Systems and procedures for the use of meteorological information shall improve the promptness of its availability and the speed with which it may be used, in order to support continuous improvement of the efficiency of airspace and airport use.

ANNEX III CONSTITUENTS

EC declaration

- of conformity
- of suitability for use

1. Constituents

The constituents will be identified in the implementing rules for interoperability in accordance with the provisions of Article 3 of this Regulation.

2. Scope

The EC declaration covers:

- either the assessment of the intrinsic conformity of a constituent, considered in isolation, with the Community specifications to be met, or
- the assessment/judgment of the suitability for use of a constituent, considered within its air traffic management environment.

The assessment procedures implemented by the notified bodies at the design and production stages will draw upon the modules defined in Decision 93/465/EEC, in accordance with the conditions set out in the relevant implementing rules for interoperability.

3. Contents of the EC declaration

The EC declaration of conformity or suitability for use and the accompanying documents must be dated and signed.

That declaration must be written in the same language as the instructions and must contain the following:

- the Regulation references,
- the name and address of the manufacturer or its authorised representative established within the Community (give trade name and full address and, in the case of the authorised representative, also give the trade name of the manufacturer),
- description of the constituent,
- description of the procedure followed in order to declare conformity or suitability for use (Article 5 of this Regulation),
- all of the relevant provisions met by the constituent and in particular its conditions of use,
- if applicable, name and address of notified body or bodies involved in the procedure followed in respect of conformity or suitability for use and date of examination certificate together, where appropriate, with the duration and conditions of validity of the certificate,
- where appropriate, reference to the Community specifications followed,
- identification of signatory empowered to enter into commitments on behalf of the manufacturer or of the manufacturer's authorised representative established in the Community.

ANNEX IV SYSTEMS

EC declaration of verification of systems
Verification procedure for systems

1. Contents of EC declaration of verification of systems

The EC declaration of verification and the accompanying documents must be dated and signed. That declaration must be written in the same language as the technical file and must contain the following:

- the Regulation references,
- name and address of the air navigation service provider (trade name and full address),
- a brief description of the system,
- description of the procedure followed in order to declare conformity of the system (Article 6 of this Regulation),
- name and address of the notified body which carried out tasks pertaining to the verification procedure, if applicable,
- the references of the documents contained in the technical file,
- where appropriate, reference to the Community specifications,
- all the relevant temporary or definitive provisions to be complied with by the systems and in particular, where appropriate, any operating restrictions or conditions,
- if temporary: duration of validity of the EC declaration,
- identification of the signatory.

2. Verification procedure for systems

Verification of systems is the procedure whereby an air navigation service provider checks and certifies that a system complies with this Regulation and may be put into operation on the basis of this Regulation.

The system is checked for each of the following aspects:

- overall design,
- development and integration of the system, including in particular constituent assembly and overall adjustments,
- operational system integration,
- specific system maintenance provisions if applicable.

Where involvement of a notified body is required by the relevant implementing rule for interoperability, the notified body, after having carried out the tasks incumbent upon it in accordance with the rule, draws up a certificate of conformity in relation to the tasks it carried out. This certificate is intended for the air navigation service provider. This provider then draws up the EC declaration of verification intended for the national supervisory authority.

3. Technical file

The technical file accompanying the EC declaration of verification must contain all the necessary documents relating to the characteristics of the system, including conditions and limits of use, as well as the documents certifying conformity of constituents where appropriate.

The following documents shall be included as a minimum:

- indication of the relevant parts of the technical specifications used for procurement that ensure compliance with the applicable implementing rules for interoperability and, where appropriate, the Community specifications,
- list of constituents as referred to in Article 3 of this Regulation,
- copies of the EC declaration of conformity or suitability for use with which the above mentioned constituents must be provided in accordance with Article 5 of this Regulation accompanied, where appropriate, by a copy of the records of the tests and examinations carried out by the notified bodies,

- where a notified body has been involved in the verification of the system(s), a certificate countersigned by itself, stating that the system complies with this Regulation and mentioning any reservations recorded during performance of activities and not withdrawn,
- where there has not been involvement of a notified body, a record of the tests and installation configurations made with a view to ensuring compliance with essential requirements and any particular requirements contained in the relevant implementing rules for interoperability.

4. Submission

The technical file must be attached to the EC declaration of verification which the air navigation service provider submits to the national supervisory authority. W

A copy of the technical file must be kept by the provider throughout the service life of the system. It must be sent to any other Member States which so request.

ANNEX V NOTIFIED BODIES

1. The body, its Director and the staff responsible for carrying out the checks may not become involved, either directly or as authorised representatives, in the design, manufacture, marketing or maintenance of the constituents or systems or in their use. This does not exclude the possibility of an exchange of technical information between the manufacturer or constructor and that body.
2. The body and the staff responsible for the checks must carry out the checks with the greatest possible professional integrity and the greatest possible technical competence and must be free of any pressure and incentive, in particular of a financial type, which could affect their judgment or the results of their inspection, in particular from persons or groups of persons affected by the results of the checks.
3. The body must employ staff and possess the means required to perform adequately the technical and administrative tasks linked with the checks; it should also have access to the equipment needed for exceptional checks.
4. The staff responsible for inspection must have:
 - sound technical and vocational training,
 - satisfactory knowledge of the requirements of the inspections they carry out and adequate experience of such operations,
 - the ability required to draw up the declarations, records and reports to demonstrate that the inspections have been carried out.
5. The impartiality of the inspection staff must be guaranteed. Their remuneration must not depend on the number of inspections carried out or on the results of such inspections.
6. The body must take out liability insurance unless its liability is assumed by the Member State in accordance with national law, or the Member State itself is directly responsible for the inspections.
7. The staff of the body must observe professional secrecy with regard to all information acquired in carrying out their tasks under this Regulation.

- (EC) 482/2008, 항행서비스제공자(ANSP)의 소프트웨어 안전성 보증

[표 9. (EC) 482/2008]

COMMISSION REGULATION (EC) No 482/2008 of 30 May 2008

establishing a software safety assurance system to be implemented by air navigation service providers and amending Annex II to Regulation (EC) No 2096/2005

THE COMMISSION OF THE EUROPEAN COMMUNITIES,

Having regard to the Treaty establishing the European Community,

Having regard to Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky (the service provision Regulation) (1), and in particular Article 4 thereof,

Whereas:

(1) Pursuant to Regulation (EC) No 550/2004, the Commission is required to identify and adopt the relevant provisions of the Eurocontrol Safety Regulatory Requirements (ESARRs), taking into account existing Community legislation. ESARR 6 entitled 'Software in ATM systems' provides a set of safety regulatory requirements for the implementation of a software safety assurance system.

(2) Commission Regulation (EC) No 2096/2005 of 20 December 2005 laying down common requirements for the provision of air navigation services (2) states in the last sentence of Recital 12 that 'The relevant provisions of ESARR 1 on safety oversight in ATM, and of ESARR 6 on software in ATM systems, should be identified and adopted by way of separate Community acts.'

(3) Annex II to Regulation (EC) No 2096/2005 requires providers of air traffic services to implement a safety management system as well as safety requirements for risk assessment and mitigation with regard to changes. Within the framework of its safety management system, and as part of its risk assessment and mitigation activities with regard to changes, a provider of air traffic services should define and implement a software safety assurance system to deal specifically with software related aspects.

(4) The prime software safety objective to be met for functional systems that contain software is to ensure that the risks associated with the use of software in the European Air Traffic Management network systems (EATMN software) have been reduced to a tolerable level.

(5) This Regulation should not cover military operations and training as referred to in Article 1(2) of Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the framework Regulation) (3).

(6) Annex II to Regulation (EC) No 2096/2005 should therefore be amended accordingly.

(7) The measures provided for in this Regulation are in accordance with the opinion of the Single Sky Committee,

HAS ADOPTED THIS REGULATION:

Article 1 Subject-matter and scope

1. This Regulation lays down the requirements for the definition and implementation of a software safety assurance system by air traffic service (ATS) providers, entities providing air traffic flow management (ATFM) and air space management (ASM) for general air traffic, and providers of communication, navigation and surveillance (CNS) services.

It identifies and adopts the mandatory provisions of the Eurocontrol Safety Regulatory Requirement — ESARR 6 — entitled 'Software in ATM Systems' issued on 6 November 2003.

2. This Regulation shall apply to the new software and to any changes to the

software of the systems for ATS, ASM, ATFM, and CNS.

It shall not apply to the software of airborne constituents and to space-based equipment.

Article 2 Definitions

For the purposes of this Regulation, the definitions in Article 2 of Regulation (EC) No 549/2004 shall apply.

The following definitions shall also apply:

1. 'software' means computer programmes and corresponding configuration data, including non-developmental software, but excluding electronic items, namely application specific integrated circuits, programmable gate arrays or solid-state logic controllers;
2. 'configuration data' means data that configures a generic software system to a particular instance of its use;
3. 'non-developmental software' means a software not developed for the current contract;
4. 'safety assurance' means all planned and systematic actions necessary to provide adequate confidence that a product, a service, an organisation or a functional system achieves acceptable or tolerable safety;
5. 'organisation' means either an ATS provider, a CNS provider or an entity providing ATFM or ASM;
6. 'functional system' means a combination of systems, procedures and human resources organised to perform a function within the context of ATM;
7. 'risk' means the combination of the overall probability, or frequency of occurrence of a harmful effect induced by a hazard and the severity of that effect;
8. 'hazard' means any condition, event, or circumstance which could induce an accident;
9. 'new software' means a software that has been ordered or for which binding contracts have been signed after the entry into force of this Regulation;
10. 'safety objective' means a qualitative or quantitative statement that defines the maximum frequency or probability at which a hazard can be expected to occur;
11. 'safety requirement' means a risk-mitigation means, defined from the risk-mitigation strategy that achieves a particular safety objective, including organisational, operational, procedural, functional, performance, and interoperability requirements or environment characteristics;
12. 'cutover or hot swapping' means the approach of replacing European air traffic management network (EATMN) system components or software while the system is operational;
13. 'software safety requirement' means a description of what is to be produced by the software given the inputs and constraints, and if met, ensures that EATMN software performs safely and according to operational need;
14. 'EATMN software' means software used in the EATMN systems referred to in Article 1;
15. 'requirements validity' means the confirmation by examination and provision of objective evidence that the particular requirements for a specific use are as intended;
16. 'achieved with independence' means, for software verification process activities, that the verification process activities are performed by a person(s) other than the developer of the item being verified;
17. 'software malfunction' means the inability of a programme to perform a required function correctly;
18. 'software failure' means the inability of a programme to perform a required function;
19. 'COTS' means a commercial available application sold by vendors through public

catalogue listings and not intended to be customised or enhanced;

20. 'software components' means a building block that can be fitted or connected together with other reusable blocks of software to combine and create a custom software application;

21. 'independent software components' means those software components which are not rendered inoperative by the same failure condition that causes the hazard;

22. 'software timing performances' means the time allowed for the software to respond to given inputs or to periodic events, and/or the performance of the software in terms of transactions or messages handled per unit time;

23. 'software capacity' means the ability of the software to handle a given amount of data flow;

24. 'accuracy' means the required precision of the computed results;

25. 'software resource usage' means the amount of resources within the computer system that can be used by the application software;

26. 'software robustness' means the behaviour of the software in the event of unexpected inputs, hardware faults and power supply interruptions, either in the computer system itself or in connected devices;

27. 'overload tolerance' means the behaviour of the system in the event of, and in particular its tolerance to, inputs occurring at a greater rate than expected during normal operation of the system;

28. 'correct and complete EATMN software verification' means all software safety requirements which correctly state what is required of the software component by the risk assessment and mitigation process and their implementation is demonstrated to the level required by the software assurance level;

29. 'software life cycle data' means the data that is produced during the software life cycle to plan, direct, explain, define, record, or provide evidence of activities; this data enables the software life cycle processes, system or equipment approval and post-approval modification of the software product;

30. 'software life cycle' means:

(a) an ordered collection of processes determined by an organisation to be sufficient and adequate to produce a software product;

(b) the period of the time that begins with the decision to produce or modify a software product and ends when the product is retired from service;

31. 'system safety requirement' means a safety requirement derived for a functional system.

Article 3 General safety requirements

1. Whenever an organisation is required to implement a risk assessment and mitigation process in accordance with applicable Community or national law, it shall define and implement a software safety assurance system to deal specifically with EATMN software related aspects, including all on-line software operational changes, and in particular cutover or hot swapping.

2. The organisation shall ensure, as a minimum, that its software safety assurance system produces evidence and arguments that demonstrate the following:

(a) the software safety requirements correctly state what is required by the software, in order to meet safety objectives and requirements, as identified by the risk assessment and mitigation process;

(b) traceability is addressed in respect of all software safety requirements;

(c) the software implementation contains no functions which adversely affect safety;

(d) the EATMN software satisfies its requirements with a level of confidence which is consistent with the criticality of the software;

(e) assurances are provided confirming that the general safety requirements set out in

points (a) to (d) are satisfied, and the arguments that demonstrate the required assurances are at all times derived from:

- (i) a known executable version of the software;
- (ii) a known range of configuration data;
- (iii) a known set of software products and descriptions, including specifications, that have been used in the production of that version.

3. The organisation shall make available the required assurances, to the national supervisory authority, demonstrating that the requirements provided for in paragraph 2 have been satisfied.

Article 4 Requirements applying to the software safety assurance system

The organisation shall ensure, as a minimum, that the software safety assurance system:

1. is documented, specifically as part of the overall risk assessment and mitigation documentation;
2. allocates software assurance levels to all operational EATMN software in compliance with the requirements set out in Annex I;
3. includes assurances of:
 - (a) software safety requirements validity in compliance with the requirements set out in Annex II, Part A;
 - (b) software verification in compliance with the requirements set out in Annex II, Part B;
 - (c) software configuration management in compliance with the requirements set out in Annex II, Part C;
 - (d) software safety requirements traceability in compliance with the requirements set out in Annex II, Part D;
4. determines the rigour to which the assurances are established; the rigour must be defined for each software assurance level, and increase as the software increases in criticality; for that purpose:
 - (a) the variation in rigour of the assurances per software assurance level must include the following criteria:
 - (i) required to be achieved with independence;
 - (ii) required to be achieved;
 - (iii) not required;
 - (b) the assurances corresponding to each software assurance level must give sufficient confidence that the EATMN software can be operated tolerably safely;
5. uses feedback of EATMN software experience to confirm that the software safety assurance system and the assignment of assurance levels are appropriate. For that purpose, the effects from a software malfunction or failure reported according to the relevant requirements on reporting and assessment of safety occurrences shall be assessed in comparison with the effects identified for the system concerned as per the severity classification scheme established in Section 3.2.4 of Annex II to Regulation (EC) No 2096/2005.

Article 5 Requirements applying to changes to software and to specific software

1. For any changes to the software or for specific types of software such as COTS, non-developmental software or previously used software for which some of the requirements of Article 3(2)(d) or (e) or of Article 4(2), (3), (4) or (5) cannot be applied, the organisation shall ensure that the software safety assurance system provides, through other means chosen and agreed with the national supervisory authority, the same level of confidence as the relevant software assurance level whenever defined.

Those means must give sufficient confidence that the software meets the safety objectives and requirements, as identified by the safety risk assessment and mitigation process.

2. In the assessment of the means referred to in paragraph 1, the national supervisory authority may use a recognised organisation or a notified body.

Article 6 Amendment to Regulation (EC) No 2096/2005

In Annex II to Regulation (EC) No 2096/2005, the following section is added:

‘3.2.5 Section 5 Software safety assurance system

Within the operation of the safety management system, a provider of air traffic services shall implement a software safety assurance system in accordance with Commission Regulation (EC) No 482/2008 of 30 May 2008 establishing a software safety assurance system to be implemented by air navigation service providers and amending Annex II to Regulation (EC) No 2096/2005 (4).

Article 7 Entry into force

This Regulation shall enter into force on the 20th day following that of its publication in the Official Journal of the European Union.

It shall apply from 1 January 2009 to the new software of EATMN systems referred to in Article 1(2), first subparagraph.

It shall apply from 1 July 2010 to any changes to the software of EATMN systems referred to in Article 1(2), first subparagraph, in operation by that date.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

ANNEX I Requirements applying to the software assurance level referred to in Article 4(2)

1. The software assurance level shall relate the rigour of the software assurances to the criticality of EATMN software by using the severity classification scheme set out in Section 4 of point 3.2.4 of Annex II to Regulation (EC) No 2096/2005 combined with the likelihood of the occurrence of a certain adverse effect. A minimum of four software assurance levels shall be identified, with software assurance level 1 indicating the most critical level.

2. An allocated software assurance level shall be commensurate with the most severe effect that software malfunctions or failures may cause, as referred to in Section 4 of point 3.2.4 of Annex II to Regulation (EC) No 2096/2005. This shall, in particular, take into account the risks associated with software malfunctions or failures and the architectural and/or procedural defences identified.

3. EATMN software components that cannot be shown to be independent of one another shall be allocated the software assurance level of the most critical of the dependent components.

ANNEX II

Part A: Requirements applying to the software safety requirements validity assurance referred to in Article 4(3)(a)

1. Software safety requirements shall specify the functional behaviour in nominal and downgraded modes, of the EATMN software, timing performances, capacity, accuracy, software resource usage on the target hardware, robustness to abnormal operating conditions and overload tolerance, as appropriate.
2. Software safety requirements shall be complete and correct, and compliant with the system safety requirements.

Part B: Requirements applying to the software verification assurance referred to in Article 4(3)(b)

1. The functional behaviour of the EATMN software, timing performances, capacity, accuracy, software resource usage on the target hardware, robustness to abnormal operating conditions and overload tolerance, shall comply with the software requirements.
2. The EATMN software shall be adequately verified by analysis and/or testing and/or equivalent means, as agreed with the national supervisory authority.
3. The verification of the EATMN software shall be correct and complete.

Part C: Requirements applying to the software configuration management assurances referred to in Article 4(3)(c)

1. Configuration identification, traceability and status accounting shall exist such that the software life cycle data can be shown to be under configuration control throughout the EATMN software life cycle.
2. Problem reporting, tracking and corrective actions shall exist such that safety related problems associated with the software can be shown to have been mitigated.
3. Retrieval and release procedures shall exist such that the software life cycle data can be regenerated and delivered throughout the EATMN software life cycle.

Part D: Requirements applying to the software safety requirements traceability assurances referred to in Article 4(3)(d)

1. Each software safety requirement shall be traced to the same level of design at which its satisfaction is demonstrated.
2. Each software safety requirement, at each level in the design at which its satisfaction is demonstrated, shall be traced to a system safety requirement.

- (EU) 1034/2011. 항공교통관제(ATM)/항행서비스(ANS) 안전감독

[표 10. (EU) 1034/2011]

COMMISSION IMPLEMENTING REGULATION (EU) No 1034/2011 of 17 October 2011

on safety oversight in air traffic management and air navigation services and amending Regulation (EU) No 691/2010

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky ('the service provision Regulation') (1), and in particular Article 4 thereof,

Having regard to Regulation (EC) No 551/2004 of the European Parliament and of the

Council of 10 March 2004 on the organisation and use of the airspace in the single European sky ('the airspace Regulation') (2), and in particular Article 6 thereof, Having regard to Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (3), and in particular Article 8b thereof,

Whereas:

(1) Pursuant to Regulation (EC) No 216/2008, the Commission, assisted by the European Aviation Safety Agency ('the Agency'), is required to adopt the relevant implementing rules to provide a set of safety regulatory requirements for the implementation of an effective air traffic management (ATM) safety oversight function. Article 8b of Regulation (EC) No 216/2008 requires these implementing rules to be developed based on the regulations adopted pursuant to Article 5(3) of Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky ('the framework Regulation') (4). This Regulation is based on Commission Regulation (EC) No 1315/2007 of 8 November 2007 on safety oversight in air traffic management and amending Regulation (EC) No 2096/2005 (5).

(2) There is a need to further define the role and functions of competent authorities based on the provisions of Regulations (EC) No 216/2008, (EC) No 549/2004, (EC) No 550/2004, and (EC) No 552/2004 of the European Parliament and of the Council of 10 March 2004 on the interoperability of the European Air Traffic Management network ('the interoperability Regulation') (6). These regulations include requirements on the safety of air navigation services. While providers are responsible for the safe provision of air navigation services, Member States should ensure effective supervision through competent authorities.

(3) This Regulation should not cover military operations and training, as provided for in Article 1(2) of Regulation (EC) No 549/2004 and Article 1(2)(c) of Regulation (EC) No 216/2008.

(4) Competent authorities should conduct safety regulatory audits and reviews in accordance with this Regulation as part of the proper inspections and surveys required by Regulations (EC) No 216/2008 and (EC) No 550/2004.

(5) Competent authorities should consider using the safety oversight approach of this Regulation in other areas of oversight as appropriate in order to deliver efficient and coherent supervision.

(6) Air navigation services, as well as air traffic flow management (ATFM) and airspace management (ASM), use functional systems that enable the management of air traffic. Therefore any changes to functional systems should be subject to a safety oversight.

(7) Competent authorities should take all necessary measures in case a system or a constituent of a system does not comply with the relevant requirements. In this context, and in particular when a safety directive has to be issued, the competent authority should consider instructing the notified bodies involved in issuing the Declaration referred to in Article 5 or 6 of Regulation (EC) No 552/2004 to conduct specific investigations with regard to that technical system.

(8) Annual safety oversight reporting by competent authorities should contribute to the transparency and accountability of safety oversight. Such reports should be addressed to the Commission, the Agency and the Member State nominating or establishing the competent authority. Furthermore, annual safety oversight reports should be used in the context of regional cooperation, standardisation inspections under Regulation (EC) No 216/2008 and international safety oversight monitoring. The content of the reports should include relevant information with regard to the monitoring of safety performance,

compliance with applicable safety regulatory requirements by supervised organisations, the programme of safety regulatory audits, the review of the safety arguments, changes to functional systems implemented by supervised organisations in accordance with procedures accepted by the competent authority and safety directives issued by such authority.

(9) Pursuant to Article 10(1) of Regulation (EC) No 216/2008 and Article 2(4) of Regulation (EC) No 550/2004, competent authorities should make appropriate arrangements for close cooperation with each other to ensure adequate supervision of air navigation service providers which provide services relating to the airspace falling under the responsibility of a Member State different from the Member State which issued the certificate. Pursuant to Article 15 of Regulation (EC) No 216/2008, competent authorities should exchange in particular appropriate information about the safety oversight of organisations.

(10) The Agency should further evaluate the provisions of this Regulation, in particular those related to the safety oversight of changes, and issue an opinion to adapt such changes towards a total system approach, taking into account the integration of these provisions into the future common regulatory structure for civil aviation safety and the experience gained by stakeholders and competent authorities. The Agency's opinion should further aim at facilitating the implementation of the State Safety Programme (SSP) of the International Civil Aviation Organisation (ICAO) within the Union as part of this total system approach.

(11) The safe execution of some of the network functions set up according to Regulation (EC) No 551/2004 requires that the entity involved should be subject to certain safety requirements. These requirements, which aim to ensure that such entity or organisation operates in a safe manner, are laid down in Commission Regulation (EU) No 677/2011 of 7 July 2011 laying down detailed rules for the implementation of air traffic management (ATM) network functions and amending Regulation (EU) No 691/2010 (7). These are organisation safety requirements which are very similar to those general requirements laid down in Commission Implementing Regulation (EU) No 1035/2011 (8), but adapted to the safety responsibilities of the network functions. In order to support a total system approach for safety regulation in the field of civil aviation, the execution of these requirements needs to be overseen in the same manner as air navigation service providers are overseen.

(12) In its recommendations of July 2007, the High Level Group for the Future European Aviation Regulatory Framework highlighted the need to separate regulatory oversight from the provision of services or functions. In line with this principle, Article 6 of Regulation (EC) No 551/2004 provides that the entity nominated to perform the network functions needs to be subject to appropriate oversight arrangements. Since the Agency already carries out the independent safety oversight function of the pan-European ATM/ANS providers in accordance with Article 22a of Regulation (EC) No 216/2008, it would be fully in line with the European aviation safety policy to entrust it with supporting the Commission in performing the same tasks concerning the European network functions.

(13) Regulation (EC) No 1315/2007 should therefore be repealed.

(14) Commission Regulation (EU) No 691/2010 of 29 July 2010 laying down a performance scheme for air navigation services and network functions and amending Regulation (EC) No 2096/2005 (9) should be amended in order to be adapted to this Regulation.

(15) The measures provided for in this Regulation are in accordance with the opinion of the Single Sky Committee,

HAS ADOPTED THIS REGULATION:

Article 1 Subject matter and scope

1. This Regulation establishes requirements to be applied to the exercise of the safety oversight function by competent authorities concerning air navigation services, air traffic flow management (ATFM), airspace management (ASM) for general air traffic and other network functions.

2. This Regulation shall apply to the activities of competent authorities and qualified entities acting on their behalf regarding the safety oversight of air navigation services, ATFM, ASM and other network functions.

Article 2 Definitions

For the purposes of this Regulation, the definitions in Article 2 of Regulation (EC) No 549/2004 and Article 3 of Regulation (EC) No 216/2008 apply. However, the definition of 'certificate' in Article 2(15) of Regulation (EC) No 549/2004 does not apply.

The following definitions also apply:

- (1) 'corrective action' means an action to eliminate the cause of a detected non-conformity;
- (2) 'functional system' means a combination of systems, procedures and human resources organised to perform a function within the context of ATM;
- (3) 'Network Manager' means the impartial and competent body entrusted pursuant to Article 6(2) or (6) of Regulation (EC) No 551/2004 to perform the duties described in that Article and this Regulation;
- (4) 'network functions' means the specific functions described in Article 6 of Regulation (EC) No 551/2004;
- (5) 'organisation' means either an air navigation service provider or an entity providing ATFM or ASM or other network functions;
- (6) 'process' means a set of interrelated or interacting activities which transforms inputs into outputs;
- (7) 'safety argument' means the demonstration and evidence that a proposed change to a functional system can be implemented within the targets or standards established through the existing regulatory framework consistently with the safety regulatory requirements;
- (8) 'safety directive' means a document issued or adopted by a competent authority which mandates actions to be performed on a functional system to restore safety, when evidence shows that aviation safety may otherwise be compromised;
- (9) 'safety objective' means a qualitative or quantitative statement that defines the maximum frequency or probability at which a hazard can be expected to occur;
- (10) 'safety regulatory audit' means a systematic and independent examination conducted by, or on behalf of, a competent authority to determine whether complete safety-related arrangements or elements thereof, related to processes and their results, products or services, comply with required safety-related arrangements and whether they are implemented effectively and are suitable to achieve expected results;
- (11) 'safety regulatory requirements' means the requirements established by the Union or national regulations for the provision of air navigation services or ATFM and ASM functions or other network functions as well as concerning the technical and operational competence and suitability to provide these services and functions, their safety management, as well as systems, their constituents and associated procedures;
- (12) 'safety requirement' means a risk mitigation, defined from the risk mitigation strategy that achieves a particular safety objective, including organisational, operational, procedural, functional, performance and interoperability requirements or environmental characteristics;
- (13) 'verification' means confirmation through the provision of objective evidence that

specified requirements have been fulfilled;

(14) 'pan-European ATM/ANS' means an activity which is designed and established for users within most or all Member States and which may also extend beyond the airspace of the territory to which the Treaty applies.

Article 3 Competent authorities for oversight

For the purpose of this Regulation and without prejudice to the mutual recognition of air navigation service providers certificates in accordance with Article 7(8) of Regulation (EC) No 550/2004 and Article 11 of Regulation (EC) No 216/2008, competent authorities for oversight shall be:

(a) for organisations having their principal place of operation and, if any, their registered office located in a Member State while providing air navigation services in the territory of that Member State, the national supervisory authority nominated or established by that Member State;

(b) for organisations for which under the agreements concluded among Member States in accordance with Article 2 of Regulation (EC) No 550/2004, the responsibilities for safety oversight have been allocated differently from point (a), the competent authorities nominated or established under those agreements. These agreements shall comply with the requirements of Article 2(3) to (6) of Regulation (EC) No 550/2004;

(c) for organisations providing ATM/air navigation services in the airspace of the territory to which the Treaty applies and having their principal place of operation and, if any, their registered office located outside the territory subject to the provisions of the Treaty, the European Aviation Safety Agency ('the Agency');

(d) for organisations providing pan-European ATM/ANS as well as for all other network functions in the airspace of the territory to which the Treaty applies, the Agency.

Article 4 Safety oversight function

1. Competent authorities shall exercise safety oversight as part of their supervision of requirements applicable to air navigation services as well as to ATFM, ASM and other network functions, in order to monitor the safe provision of these activities and to verify that the applicable safety regulatory requirements and their implementing arrangements are met.

2. When concluding an agreement on the supervision of organisations active in functional airspace blocks which extend across the airspace falling under the responsibility of more than one Member State or in cases of cross-border provision, Member States concerned shall identify and allocate the responsibilities for safety oversight in a manner which ensures that:

(a) specific points of responsibility exist to implement each provision of this Regulation;

(b) Member States have visibility of the safety oversight mechanisms and their results;

(c) relevant information exchange is ensured between the overseeing authorities and the certifying authority.

Member States shall regularly review the agreement and its practical implementation in particular in the light of achieved safety performance.

3. When concluding an agreement on the supervision of organisations active in functional airspace blocks or in cross-border activities in which the Agency is the competent authority for at least one of the organisations in accordance with Article 3(b), the Member States concerned shall coordinate with the Agency so as to ensure that points (a), (b) and (c) of paragraph 2 are met.

Article 5 Monitoring of safety performance

1. Competent authorities shall provide regular monitoring and assessment of the levels of safety achieved in order to determine whether they comply with the safety regulatory requirements applicable in the airspace blocks under their responsibility.

2. Competent authorities shall use the results of the monitoring of safety in particular to determine areas in which the verification of compliance with safety regulatory requirements is necessary as a matter of priority.

Article 6 Verification of compliance with safety regulatory requirements

1. Competent authorities shall establish a process in order to verify:

(a) compliance with applicable safety regulatory requirements prior to the issue or renewal of a certificate necessary to provide air navigation services including safety-related conditions attached to it;

(b) compliance with any safety-related obligations in the designation act issued in accordance with Article 8 of Regulation (EC) No 550/2004;

(c) ongoing compliance of the organisations with applicable safety regulatory requirements;

(d) implementation of safety objectives, safety requirements and other safety-related conditions identified in:

(i) declarations of verification of systems, including any relevant declaration of conformity or suitability for use of constituents of systems issued in accordance with Regulation (EC) No 552/2004;

(ii) risk assessment and mitigation procedures required by safety regulatory requirements applicable to air navigation services, ATFM, ASM and the Network Manager;

(e) the implementation of safety directives.

2. The process referred to in paragraph 1 shall:

(a) be based on documented procedures;

(b) be supported by documentation specifically intended to provide safety oversight personnel with guidance to perform their functions;

(c) provide the organisations concerned with an indication of the results of the safety oversight activity;

(d) be based on safety regulatory audits and reviews conducted in accordance with Articles 7, 9 and 10;

(e) provide competent authorities with the evidence needed to support further action, including measures foreseen by Article 9 of Regulation (EC) No 549/2004, Article 7(7) of Regulation (EC) No 550/2004 and by Articles 10, 25 and 68 of Regulation (EC) No 216/2008 in situations where safety regulatory requirements are not being complied with.

Article 7 Safety regulatory audits

1. Competent authorities, or qualified entities as delegated by them shall conduct safety regulatory audits.

2. The safety regulatory audits referred to in paragraph 1 shall:

(a) provide competent authorities with evidence of compliance with applicable safety regulatory requirements and with implementing arrangements by evaluating the need for improvement or corrective action;

(b) be independent of internal auditing activities undertaken by the organisation concerned as part of its safety or quality management systems;

(c) be conducted by auditors qualified in accordance with the requirements of Article 12;

(d) apply to complete implementing arrangements or elements thereof, and to processes, products or services;

- (e) determine whether:
 - (i) implementing arrangements comply with safety regulatory requirements;
 - (ii) actions taken comply with the implementing arrangements;
 - (iii) the results of actions taken match the results expected from the implementing arrangements;
 - (f) lead to the correction of any identified non-conformities in accordance with Article 8.
3. Within the inspection programme required by Article 8 of Implementing Regulation (EU) No 1035/2011, competent authorities shall establish and update at least annually a programme of safety regulatory audits in order to:
- (a) cover all the areas of potential safety concern, with a focus on those areas where problems have been identified;
 - (b) cover all the organisations, services and network functions operating under the supervision of the competent authority;
 - (c) ensure that audits are conducted in a manner commensurate to the level of risk posed by the organisations' activities;
 - (d) ensure that sufficient audits are conducted over a period of 2 years to check the compliance of all these organisations with applicable safety regulatory requirements in all the relevant areas of the functional system;
 - (e) ensure follow up of the implementation of corrective actions.
4. Competent authorities may decide to modify the scope of pre-planned audits and to include additional audits, wherever that need arises.
5. Competent authorities shall decide which arrangements, elements, services, functions, products, physical locations and activities are to be audited within a specified time frame.
6. Audit observations and identified non-conformities shall be documented. The latter shall be supported by evidence, and identified in terms of the applicable safety regulatory requirements and their implementing arrangements against which the audit has been conducted.
7. An audit report, including the details of the non-conformities, shall be drawn up.

Article 8 Corrective actions

1. Competent authorities shall communicate the audit findings to audited organisations and shall simultaneously request corrective actions to address the non-conformities identified without prejudice to any additional action required by the applicable safety regulatory requirements.
2. Audited organisations shall determine the corrective actions deemed necessary to correct non-conformities and the time frame for their implementation.
3. Competent authorities shall assess the corrective actions as well as their implementation as determined by audited organisations and accept them if the assessment concludes that they are sufficient to address the non-conformities.
4. Audited organisations shall initiate the corrective actions accepted by competent authorities. These corrective actions and the subsequent follow-up process shall be completed within the time period accepted by competent authorities.

Article 9 Safety oversight of changes to functional systems

1. Organisations shall only use procedures accepted by the relevant competent authority when deciding whether to introduce a safety-related change to their functional systems. In case of air traffic service providers and communication, navigation or surveillance service providers, the relevant competent authority shall accept these procedures in the framework of Implementing Regulation (EU) No 1035/2011.

2. Organisations shall notify the relevant competent authority of all planned safety-related changes. To this effect, competent authorities shall establish appropriate administrative procedures in accordance with national law.

3. Unless Article 10 applies, organisations may implement notified changes following the procedures referred to in paragraph 1 of this Article.

Article 10 Review procedure of the proposed changes

1. Competent authorities shall review the safety arguments associated with new functional systems or changes to existing functional systems proposed by an organisation when:

(a) the severity assessment conducted in accordance with Annex II, point 3.2.4 of Implementing Regulation (EU) No 1035/2011 determines a severity class 1 or a severity class 2 for the potential effects of the hazards identified; or

(b) the implementation of the changes requires the introduction of new aviation standards.

When competent authorities determine the need for a review in situations other than those referred to in points (a) and (b), they shall notify the organisation that they will undertake a safety review of the notified changes.

2. Reviews shall be conducted in a manner commensurate with the level of risk posed by the new functional systems or by the proposed changes to existing functional systems.

Reviews shall:

(a) use documented procedures;

(b) be supported by documentation specifically intended to provide safety oversight personnel with guidance to perform their functions;

(c) consider the safety objectives, safety requirements and other safety-related conditions that are related to the changes under consideration identified in:

(i) declarations of verification of systems referred to in Article 6 of Regulation (EC) No 552/2004;

(ii) declarations of conformity or suitability for use of constituents of systems referred to in Article 5 of Regulation (EC) No 552/2004; or

(iii) risk assessment and mitigation documentation established in accordance with applicable safety regulatory requirements;

(d) identify additional safety-related conditions associated to the implementation of the changes, wherever needed;

(e) assess the acceptability of safety arguments presented, taking account of:

(i) the identification of hazards;

(ii) the consistency of the allocation of severity classes;

(iii) the validity of the safety objectives;

(iv) the validity, effectiveness and feasibility of safety requirements and any other safety-related conditions identified;

(v) the demonstration that the safety objectives, safety requirements and other safety-related conditions are continuously met;

(vi) the demonstration that the process used to produce the safety arguments meets the applicable safety regulatory requirements;

(f) verify the processes used by organisations to produce the safety arguments in relation to the new functional system or changes to existing functional systems under consideration;

(g) identify the need for the verification of ongoing compliance;

(h) include any necessary coordination activities with the authorities responsible for the safety oversight of airworthiness and flight operations;

(i) provide notification of the acceptance, with conditions where applicable, or the

non-acceptance, with supporting reasons, of the change under consideration.

3. The introduction into service of the changes under consideration in the review shall be subject to acceptance by competent authorities.

Article 11 Qualified entities

1. When a competent authority decides to delegate to a qualified entity the conduct of safety regulatory audits or reviews in accordance with this Regulation, it shall ensure that the criteria used to select an entity amongst those qualified in accordance with Article 3 of Regulation (EC) No 550/2004 and Article 13 of Regulation (EC) No 216/2008 include the following:

(a) the qualified entity has prior experience in assessing safety in aviation entities;

(b) the qualified entity is not simultaneously involved in internal activities within the safety or quality management systems of the organisation concerned;

(c) all personnel concerned with the conduct of safety regulatory audits or reviews are adequately trained and qualified and meet the qualification criteria of Article 12(3) of this Regulation.

2. The qualified entity shall accept the possibility of being audited by the competent authority or any body acting on its behalf.

3. Competent authorities shall maintain a record of the qualified entities commissioned to conduct safety regulatory audits or reviews on their behalf. Such records shall document compliance with the requirements contained in paragraph 1.

Article 12 Safety Oversight capabilities

1. Member States and the Commission shall ensure that competent authorities have the necessary capability to ensure the safety oversight of all organisations operating under their supervision, including sufficient resources to carry out the actions identified in this Regulation.

2. Competent authorities shall produce and update every 2 years, an assessment of the human resources needed to perform their safety oversight functions, based on the analysis of the processes required by this Regulation and their application.

3. Competent authorities shall ensure that all persons involved in safety oversight activities are competent to perform the required function. In that regard they shall:

(a) define and document the education, training, technical and operational knowledge, experience and qualifications relevant to the duties of each position involved in safety oversight activities within their structure;

(b) ensure specific training for those involved in safety oversight activities within their structure;

(c) ensure that personnel designated to conduct safety regulatory audits, including auditing personnel from qualified entities, meet specific qualification criteria defined by the competent authority. The criteria shall address:

(i) the knowledge and understanding of the requirements related to air navigation services, ATFM, ASM and other network functions against which safety regulatory audits may be performed;

(ii) the use of assessment techniques;

(iii) the skills required for managing an audit;

(iv) the demonstration of competence of auditors through evaluation or other acceptable means.

Article 13 Safety directives

1. Competent authorities shall issue a safety directive when they have determined the

- existence of an unsafe condition in a functional system requiring immediate action.
2. Safety directives shall be forwarded to the organisations concerned and contain, as a minimum, the following information:
- (a) the identification of the unsafe condition;
 - (b) the identification of the affected functional system;
 - (c) the actions required and their rationale;
 - (d) the time limit for compliance of the required actions with the safety directive;
 - (e) its date of entry into force.
3. Competent authorities shall forward a copy of the safety directive to the Agency and any other competent authorities concerned, in particular those involved in the safety oversight of the functional system, and to the Commission.
4. Competent authorities shall verify the compliance with applicable safety directives.

Article 14 Safety oversight records

Competent authorities shall keep and maintain access to the appropriate records related to their safety oversight processes, including the reports of all safety regulatory audits and other safety-related records related to certificates, designations, the safety oversight of changes, safety directives and the use of qualified entities.

Article 15 Safety oversight reporting

1. Competent authorities shall report annually on safety oversight actions pursuant to this Regulation. The annual safety oversight report shall also include information on the following:
- (a) organisational structure and procedures of the competent authority;
 - (b) airspace falling under the responsibility of Member States which established or nominated the competent authority, if applicable, and organisations falling under the supervision of that competent authority;
 - (c) qualified entities commissioned to conduct safety regulatory audits;
 - (d) existing levels of resources of the competent authority;
 - (e) any safety issues identified through the safety oversight processes operated by the competent authority.
2. Member States shall use the reports produced by their competent authorities when submitting their annual reports to the Commission as required by Article 12 of Regulation (EC) No 549/2004.
- The annual safety oversight reports shall be made available to the Member States concerned in the case of functional airspace blocks, to the Agency and to the programmes or activities conducted under agreed international arrangements to monitor or audit the implementation of the safety oversight of air navigation services, ATFM, ASM and other network functions.

Article 16 Information exchange between competent authorities

Competent authorities shall make arrangements for close cooperation in accordance with Articles 10 and 15 of Regulation (EC) No 216/2008 and Article 2(4) of Regulation (EC) No 550/2004 and exchange any appropriate information to ensure the safety oversight of all organisations providing cross-border services or functions.

Article 17 Transitional provisions

1. Actions initiated before the entry into force of this Regulation on the basis of Regulation (EC) No 1315/2007 shall be managed in accordance with this Regulation.

2. The authority of a Member State which has had the responsibility for the safety oversight of organisations for which the Agency is the competent authority in accordance with Article 3 shall transfer to the Agency the safety oversight function of these organisations 12 months after the date of entry into force of this Regulation, except in the case of the safety oversight of the Network Manager where the transfer, if any, to the Commission, assisted by the Agency, shall be made on the date of entry into force of this Regulation.

Article 18 Repeal

Regulation (EC) No 1315/2007 is repealed.

Article 19 Amendment to Regulation (EU) No 691/2010

In Annex IV to Regulation (EU) No 691/2010, point 1.1(e) is replaced by the following:

‘(e) NSA safety reports as referred to in Articles 7, 8 and 14 of Commission Implementing Regulation (EU) No 1034/2011 (10) as well as NSA reports on resolution of safety deficiencies identified that are subject to corrective action plans;

Article 20 Entry into force

This Regulation shall enter into force on the 20th day following its publication in the Official Journal of the European Union.

This Regulation shall be binding in its entirety and directly applicable in all Member States.

- (EU) 1035/2011, 항행서비스(ANS) 제공을 위한 공통 요구사항

[표 11. (EU) 1035/2011]

COMMISSION IMPLEMENTING REGULATION (EU) No 1035/2011 of 17 October 2011

laying down common requirements for the provision of air navigation services and amending Regulations (EC) No 482/2008 and (EU) No 691/2010

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union,

Having regard to Regulation (EC) No 550/2004 of the European Parliament and of the Council of 10 March 2004 on the provision of air navigation services in the single European sky (the service provision Regulation) (1), and in particular Articles 4, 6 and 7 thereof,

Having regard to Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (2), and in particular Article 8b(6) thereof,

Whereas:

(1) Pursuant to Regulation (EC) No 216/2008, the Commission, assisted by the European Aviation Safety Agency (the Agency), is required to adopt implementing rules for the provision of air traffic management and air navigation services (ATM/ANS) throughout the Union. Article 8b(6) of that Regulation requires those implementing rules

to be based on the regulations adopted under Article 5(3) of Regulation (EC) No 549/2004 of the European Parliament and of the Council of 10 March 2004 laying down the framework for the creation of the single European sky (the framework Regulation) (3).

(2) The provision of air navigation services within the Union should be subject to certification by Member States or the Agency. Air navigation service providers which comply with the common requirements should be granted a certificate in accordance with Article 7 of Regulation (EC) No 550/2004 and Article 8b(2) of Regulation (EC) No 216/2008.

(3) The application of the common requirements laid down pursuant to Article 6 of Regulation (EC) No 550/2004 and Article 8b of Regulation (EC) No 216/2008 should be without prejudice to Member States' sovereignty over their airspace and to the requirements of the Member States relating to public order, public security and defence matters, as set out in Article 13 of Regulation (EC) No 549/2004. The common requirements should not cover military operations and training, as provided for in Article 1(2) of Regulation (EC) No 549/2004 and Article 1(2) of Regulation (EC) No 216/2008.

(4) The definition of common requirements for the provision of air navigation services should take due account of the legal status of air navigation service providers in the Member States. Furthermore, when an organisation pursues activities other than the provision of air navigation services, the common requirements should not apply to such other activities or to resources allocated to activities outside the provision of air navigation services, unless provision is made to the contrary.

(5) The application of the common requirements to air navigation service providers should be proportionate to the risks linked with the specific features of each activity such as the number and/or the nature and characteristics of processed movements. Should certain air navigation service providers elect not to avail themselves of the opportunity to provide cross-border services within the single European sky, a competent authority should be entitled to allow those providers to comply commensurately with, respectively, certain general requirements for the provision of air navigation services and certain specific requirements for the provision of air traffic services. Consequently, the conditions attached to the certificate should reflect the nature and the scope of the derogation.

(6) In order to ensure the proper functioning of the certification scheme, Member States should provide the Commission and the Agency with all relevant information on the derogations granted by their competent authority in the context of their annual reports.

(7) The different types of air navigation service activities are not necessarily subject to the same requirements. It is therefore necessary to adjust common requirements to the special features of each type of activity.

(8) The onus of proving compliance with the applicable common requirements should lie with the air navigation service provider, for the period of validity of the certificate and for all the services covered by it.

(9) In order to ensure the effective application of the common requirements, a system of regular supervision and inspection of compliance with those common requirements and with the conditions specified in the certificate should be established. The competent authority should examine the suitability of a provider prior to issuing a certificate and should assess the ongoing compliance of the air navigation service providers it has certified on a yearly basis. Consequently, it should establish and update annually an indicative inspection programme covering all the providers it has certified, on the basis of an assessment of the risks. That programme should allow the inspection of all relevant parts of the air navigation service providers within a reasonable time frame. When assessing the compliance of designated providers of air traffic services and meteorological services, the competent authority should be entitled to check relevant requirements stemming from the international obligations on the Member

State in question.

(10) Peer reviews of national supervisory authorities could further a common approach to the supervision of air navigation service providers throughout the Union. The Commission, in cooperation with the Member States and the Agency, may arrange these peer reviews, which should be coordinated with the activities undertaken within the framework of Articles 24 and 54 of Regulation (EC) No 216/2008 and any other international monitoring and oversight programmes. This would avoid duplication of work. In order to allow the exchange of experience and best practice during a peer review, the experts should preferably be from a competent authority.

(11) Eurocontrol has developed Safety Regulatory Requirements (ESARRs) which have been of the highest importance for the safe provision of air traffic services. In accordance with Regulation (EC) No 550/2004, the Commission should identify and adopt the relevant provisions of ESARRs in Union regulations. The ESARRs incorporated in Commission Regulation (EC) No 2096/2005 of 20 December 2005 laying down common requirements for the provision of air navigation services (4) form the basis of these implementing rules.

(12) When adopting Regulation (EC) No 2096/2005, the Commission concluded that it was not appropriate to repeat the ESARR 2 provisions on reporting and assessment of safety occurrences in ATM, which are covered by Regulation (EU) No 996/2010 of the European Parliament and the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (5) and by Directive 2003/42/EC of the European Parliament and of the Council of 13 June 2003 on occurrence reporting in civil aviation (6). However, new provisions on safety occurrences should be introduced in order to require a competent authority, as defined by this Regulation, to check whether providers of air traffic services, and also providers of communication, navigation or surveillance services, meet the arrangements required to cover the reporting and assessment of such occurrences.

(13) It should be recognised in particular that, firstly, safety management is that function of air navigation services which ensures that all safety risks have been identified, assessed and satisfactorily mitigated, and that, secondly, a formal and systematic approach to safety management and management systems, towards a total system approach, will maximise safety benefits in a visible and traceable way. The Agency should further evaluate the safety requirements of this Regulation and integrate them into a common regulatory structure for civil aviation safety.

(14) Until the Agency has drawn up the implementing measures transposing the relevant standards of the International Civil Aviation Organisation (ICAO) into Union implementing measures, acceptable means of compliance, certification specifications and guidance material, air navigation service providers should operate in compliance with the relevant ICAO standards. With a view to facilitating the cross-border provision of air navigation services, and until the finalisation of the work of the Agency to draw up the relevant measures transposing the ICAO standards, the Member States, the Commission and the Agency, acting in close cooperation with Eurocontrol where relevant, should work towards minimising the differences notified by Member States in the application of ICAO standards in the field of air navigation services in order to reach a common set of standards between Member States within the single European sky.

(15) Different national arrangements as to liability should not prevent air navigation service providers from entering into agreements on the cross-border provision of services, once the air navigation service providers have set up arrangements to cover losses for damages arising from liabilities under the applicable law. The method employed should comply with the requirements of national law. Member States which allow the provision of air navigation services in all or part of the airspace under their responsibility without certification in accordance with Regulation (EC) No 550/2004 should cover the liabilities of those air navigation service providers.

(16) The Agency should further evaluate the provisions of this Regulation, in particular those related to the safety assessment of changes to the provision of air navigation services by the certified organisation and engineering and technical personnel, and issue an opinion to adapt them towards a total system approach, taking into account the integration of these provisions into a future common regulatory structure for civil aviation safety and the experience gained by stakeholders and competent authorities in the field of safety oversight.

(17) Regulation (EC) No 551/2004 of the European Parliament and of the Council of 10 March 2004 on the organisation and use of the airspace in the single European sky (the airspace Regulation) (7) requires that specific functions called network functions are to be set up to allow optimum use of airspace and scarce resources, while allowing users maximum access to airspace as well as the ability to operate preferred trajectories. As provided for in Regulation (EC) No 551/2004, Commission Regulation (EU) No 677/2011 of 7 July 2011 laying down detailed rules for the implementation of air traffic management (ATM) network functions and amending Regulation (EU) No 691/2010 (8) lays down the rights, obligations and responsibilities of the entity involved in the provision of those functions.

(18) For the safe execution of certain network functions, the entity involved is subject to certain requirements. These requirements aim to ensure that the entity or organisation operates in a safe manner and they are laid down in Annex VI Regulation (EU) No 677/2011. These are organisation safety requirements which are very similar to the general requirements for the provision of air navigation services laid down in Annex I to this Regulation but adapted to the safety responsibilities of the network functions.

(19) Regulation (EC) No 2096/2005 should therefore be repealed.

(20) Commission Regulation (EC) No 482/2008 of 30 May 2008 establishing a software safety assurance system to be implemented by air navigation service providers and amending Annex II to Regulation (EC) No 2096/2005 (9) and Commission Regulation (EU) No 691/2010 of 29 July 2010 laying down a performance scheme for air navigation services and network functions and amending Regulation (EC) No 2096/2005 laying down common requirements for the provision of air navigation services (10) should be amended in order to be adapted to this Regulation.

(21) The measures provided for in this Regulation are in accordance with the opinion of the Single Sky Committee established by Article 5 of Regulation (EC) No 549/2004,

HAS ADOPTED THIS REGULATION:

Article 1 Subject matter and scope

This Regulation lays down the common requirements for the provision of air navigation services.

However, unless Annex I or II makes provision to the contrary, those common requirements shall not apply to:

- (a) activities other than the provision of air navigation services by a provider of such services;
- (b) resources allocated to activities outside the provision of air navigation services.

Article 2 Definitions

For the purposes of this Regulation, the definitions in Article 2 of Regulation (EC) No 549/2004 and Article 3 of Regulation (EC) No 216/2008 apply. However, the definition of 'certificate' in Article 2(15) of Regulation (EC) No 549/2004 does not apply.

The following definitions also apply:

- (1) 'aerial work' means an aircraft operation in which an aircraft is used for specialised

services such as agriculture, construction, photography, surveying, observation and patrol, search and rescue or aerial advertisement;

(2) 'commercial air transport' means any aircraft operation involving the transport of passengers, cargo or mail for remuneration or hire;

(3) 'functional system' means a combination of systems, procedures and human resources organised to perform a function within the context of ATM;

(4) 'general aviation' means any civil aircraft operation other than aerial work or commercial air transport;

(5) 'national supervisory authority' means the body or bodies nominated or established by Member States as their national supervisory authority pursuant to Article 4(1) of Regulation (EC) No 549/2004;

(6) 'hazard' means any condition, event, or circumstance which could induce an accident;

(7) 'organisation' means an entity providing air navigation services;

(8) 'operating organisation' means an organisation responsible for the provision of engineering and technical services supporting air traffic, communication, navigation or surveillance services;

(9) 'risk' means the combination of the overall probability, or frequency of occurrence of a harmful effect induced by a hazard and the severity of that effect;

(10) 'safety assurance' means all planned and systematic actions necessary to provide adequate confidence that a product, a service, an organisation or a functional system achieves acceptable or tolerable safety;

(11) 'safety objective' means a qualitative or quantitative statement that defines the maximum frequency or probability at which a hazard can be expected to occur;

(12) 'safety requirement' means a risk-mitigation means, defined from the risk-mitigation strategy that achieves a particular safety objective, including organisational, operational, procedural, functional, performance, and interoperability requirements or environment characteristics;

(13) 'services' means either an air navigation service or a bundle of such services;

(14) 'pan-European air navigation service' means an air navigation service which is designed and established for users within most or all Member States and which may also extend beyond the airspace of the territory to which the Treaty applies.

(15) 'air navigation service provider' means any public or private entity providing ANS for general air traffic, including an organisation having applied for a certificate to provide such services.

Article 3 Competent authority for certification

1. For the purpose of this Regulation, the competent authority for the certification of air navigation service providers shall be:

(a) for organisations having their principal place of operation and, if any, their registered office located in a Member State, the national supervisory authority nominated or established by that Member State;

(b) for organisations providing air navigation services in the airspace of the territory to which the Treaty applies and having their principal place of operation and, if any, their registered office located outside the territory subject to the provisions of the Treaty, the Agency;

(c) for organisations providing pan-European air navigation services in the airspace of the territory to which the Treaty applies, the Agency.

2. The competent authority for safety oversight shall be the authority determined in accordance with Article 3 of Commission Implementing Regulation (EU) No 1034/2011 (11).

Article 4 Granting of certificates

1. In order to obtain the certificate necessary to provide air navigation services, and without prejudice to Article 7(5) of Regulation (EC) No 550/2004, organisations shall comply with:

- (a) the general requirements for the provision of air navigation services set out in Annex I;
- (b) the additional specific requirements set out in Annexes II to V according to the type of service they provide.

2. A competent authority shall verify an organisation's compliance with the common requirements before issuing a certificate to it.

3. An organisation shall comply with the common requirements no later than at the time at which the certificate is issued pursuant to:

- (a) Article 7 of Regulation (EC) No 550/2004;
- (b) Article 8b(2) and Article 22a(b) and (c) of Regulation (EC) No 216/2008.

Article 5 Derogations

1. By way of derogation from Article 4(1), certain air navigation service providers may elect not to avail themselves of the opportunity to provide cross-border services and may waive the right to mutual recognition within the single European sky.

They may, in those circumstances, apply for a certificate which is limited to the airspace under the responsibility of the Member State referred to in Article 7(2) of Regulation (EC) No 550/2004.

2. In order to make an application as referred to in paragraph 1, a provider of air traffic services shall provide services or plan to provide them only with respect to one or more of the following categories:

- (a) aerial work;
- (b) general aviation;
- (c) commercial air transport limited to aircraft with less than 10 tonnes of maximum take-off mass or less than 20 passenger seats;
- (d) commercial air transport with less than 10 000 movements per year, regardless of the maximum take-off mass and the number of passenger seats; 'movements' being counted as the sum of take-offs and landings and calculated as an average over the previous three years.

In order to make such an application, an air navigation service provider other than a provider of air traffic services shall have a gross annual turnover of EUR 1 000 000 or less in relation to the services it provides or plans to provide.

Where, owing to objective practical reasons, an air navigation service provider is unable to provide evidence that it meets those qualifying criteria, the competent authority may accept analogous figures or forecasts in relation to the ceilings defined in the first and the second subparagraphs.

When submitting such an application, the air navigation service provider shall submit to the competent authority, at the same time the relevant evidence regarding the qualifying criteria.

3. The competent authority may grant specific derogations to applicants who fulfil the qualifying criteria of paragraph 1, commensurately with their contribution to ATM in the airspace under the responsibility of the Member State concerned.

Those derogations may relate only to the requirements set out in Annex I.

However, no derogation shall be granted for the following requirements:

- (a) technical and operational competence and capability (point 1);
- (b) safety management (point 3.1);
- (c) human resources (point 5);
- (d) open and transparent provision of air navigation services (point 8.1).

4. In addition to the derogations provided for in paragraph 3, the competent authority may grant derogations to applicants who provide aerodrome flight information services by operating regularly not more than one working position at any aerodrome. It shall do so commensurately with the applicants' contribution to ATM in the airspace under the responsibility of the Member State concerned.

Those derogations may relate only to the following requirements of point 3 of Annex II:

(a) safety management responsibility and external services and supplies (point 3.1.2(b) and (e));

(b) safety surveys (point 3.1.3(a));

(c) safety requirements for risk assessment and mitigation with regard to changes (point 3.2).

5. No derogations shall be granted from the requirements in Annexes III, IV or V.

6. In accordance with Annex II of Regulation (EC) No 550/2004, the competent authority shall:

(a) specify the nature and the scope of the derogation in the conditions attached to the certificate by indicating its legal basis;

(b) limit the validity of the certificate in time, where considered necessary for oversight purposes;

(c) monitor whether the air navigation service providers continue to qualify for the derogation.

Article 6 Demonstration of compliance

1. Organisations shall provide all the relevant evidence to demonstrate compliance with the applicable common requirements at the request of the competent authority. Organisations may make full use of existing data.

2. A certified organisation shall notify the competent authority of planned changes to its provision of air navigation services which may affect its compliance with the applicable common requirements or with the conditions attached to the certificate, where applicable.

3. Where a certified organisation no longer complies with the applicable common requirements or, where applicable, with the conditions attached to the certificate, the competent authority shall, within one month of the date of discovering the non-compliance, require the organisation to take corrective action.

That decision shall immediately be notified to the relevant organisation.

The competent authority shall check that the corrective action has been implemented before notifying its approval to the relevant organisation.

Where the competent authority considers that corrective action has not been properly implemented within the timetable agreed with the organisation, it shall take appropriate enforcement measures as provided for in Article 7(7) of Regulation (EC) No 550/2004 and Article 10, Article 22a(d), and Articles 25 and 68 of Regulation (EC) No 216/2008, while taking into account the need to ensure the continuity of air navigation services.

Article 7 Facilitation of compliance monitoring

Organisations shall facilitate inspections and surveys by the competent authority or by a qualified entity acting on the latter's behalf, including site visits and visits without prior notice.

The authorised persons shall be empowered to perform the following acts:

(a) to examine the relevant records, data, procedures and any other material relevant to the provision of air navigation services;

(b) to take copies of or extracts from such records, data, procedures and other material;

- (c) to ask for an oral explanation on site;
 - (d) to enter relevant premises, lands or means of transport.
- Such inspections and surveys, when conducted by a competent authority or by a qualified entity acting on their behalf, shall be carried out in compliance with the legal provisions of the Member State in which they are to be undertaken.

Article 8 Ongoing compliance

The competent authority shall, on the basis of the evidence at its disposal, monitor annually the ongoing compliance of the organisations which it has certified.

To that end, the competent authority shall establish and update annually an indicative inspection programme which covers all the providers it has certified and which is based on an assessment of the risks associated with the different operations constituting the air navigation services provided. It shall consult the organisation concerned as well as any other competent authority concerned, if appropriate, before establishing such a programme.

The programme shall indicate the envisaged interval of the inspections of the different sites.

Article 9 Safety regulation of engineering and technical personnel

With regard to the provision of air traffic, communication, navigation or surveillance services, the competent authority or any other authority designated by a Member State to fulfil this task shall:

- (a) issue appropriate safety rules for engineering and technical personnel who undertake operational safety-related tasks;
- (b) ensure adequate and appropriate safety oversight of the engineering and technical personnel assigned by any operating organisation to undertake operational safety-related tasks;
- (c) on reasonable grounds and after due enquiry, take appropriate action in respect of the operating organisation and/or its technical and engineering personnel who do not comply with the requirements of point 3.3 of Annex II;
- (d) verify that appropriate methods are in place to ensure that third parties assigned to operational safety-related tasks comply with the requirements of point 3.3 of Annex II.

Article 10 Peer review procedure

1. The Commission, acting in cooperation with the Member States and the Agency may arrange peer reviews of national supervisory authorities in accordance with paragraphs 2 to 6.

2. A peer review shall be carried out by a team of national experts and, where appropriate, observers from the Agency.

A team shall be comprised of experts coming from at least three different Member States and the Agency.

Experts shall not participate in peer reviews in the Member State where they are employed.

The Commission shall establish and maintain a pool of national experts, designated by Member States, which shall cover all aspects of the common requirements as listed in Article 6 of Regulation (EC) No 550/2004.

3. Not less than three months before a peer review, the Commission shall inform the Member State and the national supervisory authority concerned of the peer review, the date on which it is scheduled to take place and the identity of the experts taking part in it.

The Member State whose national supervisory authority is subject to review shall approve the team of experts before it may carry out the review.

4. Within a period of three months from the date of the review, the review team shall draw up, by consensus, a report which may contain recommendations.

The Commission shall convene a meeting with the Agency, the experts and the national supervisory authority to discuss that report.

5. The Commission shall forward the report to the Member State concerned.

The Member State may, within three months from the date of receipt of the report, present its observations.

Those observations shall include, where relevant, the measures which the Member State has taken or intends to take to respond to the review within a given timescale.W

Unless otherwise agreed with the Member State concerned, the report and the follow-up shall not be published.

6. The Commission shall inform the Member States through the Single Sky Committee of the main findings of these reviews on an annual basis.

Article 11 Transitional provisions

1. Air navigation service providers holding a certificate issued in accordance with Regulation (EC) No 2096/2005 on the date of entry into force of this Regulation shall be deemed to hold a certificate issued in accordance with this Regulation.

2. Applicants for an air navigation service providers' certificate which submitted their application before the date of entry into force of this Regulation and were not already issued with a certificate on that date shall show compliance with the provisions of this Regulation before the certificate is issued.

3. Where organisations, for which the competent authority will be the Agency in accordance with Article 3, have applied to a national supervisory authority of a Member State for the issue of a certificate before the date entry into force of this Regulation, the national supervisory authority shall finalise the certification process in coordination with the Agency and transfer the file to the Agency upon the issue of the certificate.

Article 12 Repeal

Regulation (EC) No 2096/2005 is repealed.

Article 13 Amendment to Regulation (EC) No 482/2008

Regulation (EC) No 482/2008 is amended as follows:

(1) in Article 4(5), the reference to 'Regulation (EC) No 2096/2005' is replaced by a reference to 'Commission Implementing Regulation (EU) No 1035/2011 (12)'.
(2) Article 6 is deleted;

(3) in Annex I, in points 1 and 2, the reference to 'Regulation (EC) No 2096/2005' is replaced by a reference to 'Implementing Regulation (EU) No 1035/2011'.

Article 14 Amendment to Regulation (EU) No 691/2010

In Regulation (EU) No 691/2010, Article 25 is deleted.

Article 15 Entry into force

This Regulation shall enter into force on the 20th day following its publication in the Official Journal of the European Union.

This Regulation shall be binding in its entirety and directly applicable in all Member

States.

ANNEX I General requirements for the provision of air navigation services

1. TECHNICAL AND OPERATIONAL COMPETENCE AND CAPABILITY

Air navigation service providers shall be able to provide their services in a safe, efficient, continuous and sustainable manner consistent with any reasonable level of overall demand for a given airspace. To this end, they shall maintain adequate technical and operational capacity and expertise.

2. ORGANISATIONAL STRUCTURE AND MANAGEMENT

2.1. Organisational structure

Air navigation service providers shall set up and manage their organisation according to a structure that supports the safe, efficient and continuous provision of air navigation services.

The organisational structure shall define:

- (a) the authority, duties and responsibilities of the nominated post holders, in particular of the management personnel in charge of safety, quality, security, finance and human resources related functions;
- (b) the relationship and reporting lines between different parts and processes of the organisation.

2.2. Organisational management

2.2.1. Business plan

Air navigation service providers shall produce a business plan covering a minimum period of five years. The business plan shall:

- (a) set out the overall aims and goals of the air navigation service provider and its strategy towards achieving them in consistency with any overall longer term plan of the air navigation service provider and with relevant Union requirements for the development of infrastructure or other technology;
- (b) contain appropriate performance targets in terms of safety, capacity, environment and cost-efficiency, as may be applicable.

The information listed in points (a) and (b) shall be consistent with the national or functional airspace block performance plan referred to in Article 11 of Regulation (EC) No 549/2004 and, as far as safety data is concerned, consistent with the State Safety Programme referred to in Standard 2.27.1 of Annex 11 to the Convention on International Civil Aviation, Amendment 47B from 20 July 2009 as applicable.

Air navigation service providers shall produce safety and business justifications for major investment projects including, where relevant, the estimated impact on the appropriate performance targets referred to in point (b) and identifying investments stemming from the legal requirements associated with the implementation of the Single European Sky ATM Research Programme (SESAR).

2.2.2. Annual plan

Air navigation service providers shall produce an annual plan covering the forthcoming year which shall specify further the features of the business plan and describe any changes to it.

The annual plan shall cover the following provisions on the level and quality of service, such as the expected level of capacity, safety, environment and cost-efficiency, as may be applicable:

- (a) information on the implementation of new infrastructure or other developments and a statement how they will contribute to improving the performance of the air navigation service provider, including level and quality of services;

- (b) performance indicators consistent with the national or functional airspace block performance plan referred to in Article 11 of Regulation (EC) No 549/2004 against which the performance level and quality of service may be reasonably assessed;
- (c) information on the measures foreseen to mitigate the safety risks identified in the safety plan of the air navigation service provider, including safety indicators to monitor safety risk and, where appropriate, the estimated cost of mitigation measures;
- (d) the air navigation service provider's expected short-term financial position as well as any changes to or impacts on the business plan.

2.2.3. Performance part of the plans

The air navigation service provider shall make the content of the performance part of the business plan and of the annual plan available to the Commission on request under the conditions set by the competent authority in accordance with national law.

3. SAFETY AND QUALITY MANAGEMENT

3.1. Safety management

Air navigation service providers shall manage the safety of all their services. In doing so, they shall establish formal interfaces with all stakeholders which may influence directly the safety of their services.

Air navigation service providers shall develop procedures for managing safety when introducing new functional systems or changing the existing functional systems.

3.2. Quality management system

Air navigation service providers shall have in place a quality management system which covers all air navigation services that they provide, according to the following principles.

The quality management system shall:

- (a) define the quality policy in such a way as to meet the needs of different users as closely as possible;
- (b) set up a quality assurance programme that contains procedures designed to verify that all operations are being conducted in accordance with applicable requirements, standards and procedures;
- (c) provide evidence of the functioning of the quality management system by means of manuals and monitoring documents;
- (d) appoint management representatives to monitor compliance with, and adequacy of, procedures to ensure safe and efficient operational practices;
- (e) perform reviews of the quality management system in place and take remedial actions, as appropriate.

An EN ISO 9001 certificate, issued by an appropriately accredited organisation, covering the air navigation services of the provider shall be considered as a sufficient means of compliance. The air navigation service provider shall accept the disclosure of the documentation related to the certification to the competent authority upon the latter's request.

Air navigation service providers may integrate safety, security and quality management systems into their management system.

3.3. Operations manuals

Air navigation service providers shall provide and keep up-to-date operations manuals relating to the provision of their services for the use and guidance of operations personnel.

They shall ensure that:

- (a) operations manuals contain the instructions and information required by the operations personnel to perform their duties;
- (b) relevant parts of the operations manuals are accessible to the personnel concerned;

(c) the operations personnel are expeditiously informed of amendments to the operations manual applying to their duties as well as of their entry into force.

4. SECURITY

Air navigation service providers shall establish a security management system to ensure:

(a) the security of their facilities and personnel so as to prevent unlawful interference with the provision of air navigation services;

(b) the security of operational data they receive or produce or otherwise employ, so that access to it is restricted only to those authorised.

The security management system shall define:

(a) the procedures relating to security risk assessment and mitigation, security monitoring and improvement, security reviews and lesson dissemination;

(b) the means designed to detect security breaches and to alert personnel with appropriate security warnings;

(c) the means of containing the effects of security breaches and to identify recovery action and mitigation procedures to prevent reoccurrence.

Air navigation service providers shall ensure the security clearance of their personnel, if appropriate, and coordinate with the relevant civil and military authorities to ensure the security of their facilities, personnel and data.

The safety, quality and security management systems may be designed and operated as an integrated management system.

5. HUMAN RESOURCES

Air navigation service providers shall employ appropriately skilled personnel to ensure the provision of air navigation services in a safe, efficient, continuous and sustainable manner. In this context, they shall establish policies for the recruitment and training of personnel.

6. FINANCIAL STRENGTH

6.1. Economic and financial capacity

Air navigation service providers shall be able to meet their financial obligations, such as fixed and variable costs of operation or capital investment costs. They shall use an appropriate cost accounting system. They shall demonstrate their abilities through the annual plan as referred to in point 2.2.2 as well as through balance sheets and accounts as practicable under their legal statute.

6.2. Financial audit

In accordance with Article 12(2) of Regulation (EC) No 550/2004, air navigation service providers shall demonstrate that they are undergoing an independent audit on a regular basis.

7. LIABILITY AND INSURANCE COVER

Air navigation service providers shall have in place arrangements to cover their liabilities arising from applicable law.

The method employed to provide the cover shall be appropriate to the potential loss and damage in question, taking into account the legal status of the organisation and the level of commercial insurance cover available.

An air navigation service provider which avails itself of the services of another air navigation service provider shall ensure that the agreements cover the allocation of liability between them.

8. QUALITY OF SERVICES

8.1. Open and transparent provision of air navigation services

Air navigation service providers shall provide air navigation services in an open and transparent manner. They shall publish the conditions of access to their services and establish a formal consultation process with the users of air navigation services on a regular basis, either individually or collectively, and at least once a year.

Air navigation service providers shall not discriminate on the grounds of the nationality or identity of the user or the class of users in accordance with applicable Union law.

8.2. Contingency plans

Air navigation service providers shall have in place contingency plans for all the air navigation services they provide in the case of events which result in significant degradation or interruption of their operations.

9. REPORTING REQUIREMENTS

Air navigation service providers shall be able to provide an annual report of their activities to the relevant competent authority.

That annual report shall cover their financial results without prejudice to Article 12 of Regulation (EC) No 550/2004, as well as their operational performance and any other significant activities and developments in particular in the area of safety.

The annual report shall include as a minimum:

- (a) an assessment of the level of performance of air navigation services generated;
- (b) the performance of the air navigation service provider compared to the performance targets established in the business plan referred to in point 2.2.1, reconciling actual performance against the annual plan by using the indicators of performance established in the annual plan;
- (c) provide an explanation for differences with the targets, and identify measures for closing any gaps during the reference period referred to in Article 11 of Regulation (EC) No 549/2004;
- (d) developments in operations and infrastructure;
- (e) the financial results, as long as they are not published separately in accordance with Article 12(1) of Regulation (EC) No 550/2004;
- (f) information about the formal consultation process with the users of its services;
- (g) information about the human resources policy.

Air navigation service providers shall make the content of the annual report available to the Commission and the Agency on request and to the public under the conditions set by the competent authority in accordance with national law.

ANNEX II Specific requirements for the provision of air traffic services

1. OWNERSHIP

Providers of air traffic services shall notify to the competent authorities referred to in Article 7(2) of Regulation (EC) No 550/2004:

- (a) their legal status, their ownership structure and any arrangements having a significant impact on control over their assets;
- (b) any links with organisations not involved in the provision of air navigation services, including commercial activities in which they are engaged either directly or through related undertakings, which account for more than 1 % of their expected revenue; furthermore, they shall notify any change of any single shareholding which represents 10 % or more of their total shareholding.

Providers of air traffic services shall take all necessary measures to prevent any situation of conflict of interests that could compromise the impartial and objective provision of their services.

2. OPEN AND TRANSPARENT PROVISION OF SERVICES

In addition to point 8.1 of Annex I and where a Member State decides to organise the provision of specific air traffic services in a competitive environment, that Member State may take all appropriate measures to ensure that the providers of these specific air traffic services shall neither engage in conduct that would have as its object or effect the prevention, restriction or distortion of competition, nor shall they engage in conduct that amounts to an abuse of a dominant position in accordance with applicable national and Union law.

3. SAFETY OF SERVICES

3.1. Safety management system (SMS)

3.1.1. General safety requirements

Providers of air traffic services shall, as an integral part of the management of their services, have in place a safety management system (SMS) which:

- (a) ensures a formalised, explicit and proactive approach to systematic safety management in meeting their safety responsibilities within the provision of their services; operates in respect of all their services and the supporting arrangements under its managerial control; and includes, as its foundation, a statement of safety policy defining the organisation's fundamental approach to managing safety (safety management);
- (b) ensures that everyone involved in the safety aspects of the provision of air traffic services has an individual safety responsibility for their own actions; that managers are responsible for the safety performance of their respective departments or divisions and that the top management of the provider carries an overall safety responsibility (safety responsibility);
- (c) ensures that the achievement of satisfactory safety in air traffic services shall be afforded the highest priority (safety priority);
- (d) ensures that while providing air traffic services, the principal safety objective is to minimise its contribution to the risk of an aircraft accident as far as reasonably practicable (safety objective).

3.1.2. Requirements for safety achievement

Within the operation of the SMS, providers of air traffic services shall:

- (a) ensure that personnel are adequately trained and competent for the job they are required to do, in addition to being properly licensed if so required and satisfying applicable medical fitness requirements (competency);
- (b) ensure that a safety management function is identified with organisational responsibility for development and maintenance of the SMS; ensure that this point of responsibility is independent of line management, and accountable directly to the highest organisational level. However, in the case of small organisations where a combination of responsibilities may prevent sufficient independence in this regard, the arrangements for safety assurance shall be supplemented by additional independent means; and ensure that the top management of the service provider organisation is actively involved in ensuring safety management (safety management responsibility);
- (c) ensure that, wherever practicable, quantitative safety levels are derived and are maintained for all functional systems (quantitative safety levels);
- (d) ensure that the SMS is systematically documented in a manner which provides a clear linkage to the organisation's safety policy (SMS documentation);
- (e) ensure adequate justification of the safety of the externally provided services and supplies, having regard to their safety significance within the provision of its services (external services and supplies);
- (f) ensure that risk assessment and mitigation is conducted to an appropriate level to ensure that due consideration is given to all aspects of the provision of ATM (risk assessment and mitigation). As far as changes to the ATM functional system are

concerned, point 3.2 shall apply;

(g) ensure that ATM operational or technical occurrences which are considered to have significant safety implications are investigated immediately, and any necessary corrective action is taken (safety occurrences). They shall also demonstrate that they have implemented the requirements on the reporting and assessment of safety occurrences in accordance with applicable national and Union law.

3.1.3. Requirements for safety assurance

Within the operation of the SMS, providers of air traffic services shall ensure that:

- (a) safety surveys are carried out as a matter of routine, to recommend improvements where needed, to provide assurance to managers of the safety of activities within their areas and to confirm compliance with the relevant parts of the SMS (safety surveys);
- (b) methods are in place to detect changes in functional systems or operations which may suggest any element is approaching a point at which acceptable standards of safety can no longer be met, and that corrective action is taken (safety monitoring);
- (c) safety records are maintained throughout the SMS operation as a basis for providing safety assurance to all associated with, responsible for or dependent upon the services provided, and to the competent authority (safety records).

3.1.4. Requirements for safety promotion

Within the operation of the SMS, providers of air traffic services shall ensure that:

- (a) all personnel are aware of the potential safety hazards connected with their duties (safety awareness);
- (b) the lessons arising from safety occurrence investigations and other safety activities are disseminated within the organisation at management and operational levels (lesson dissemination);
- (c) all personnel are actively encouraged to propose solutions to identified hazards, and changes are made to improve safety where they appear needed (safety improvement).

3.2. Safety requirements for risk assessment and mitigation with regard to changes

3.2.1. Section 1

Within the operation of the SMS, providers of air traffic services shall ensure that hazard identification as well as risk assessment and mitigation are systematically conducted for any changes to those parts of the ATM functional system and supporting arrangements within their managerial control, in a manner which addresses:

- (a) the complete life cycle of the constituent part of the ATM functional system under consideration, from initial planning and definition to post-implementation operations, maintenance and decommissioning;
- (b) the airborne, ground and, if appropriate, spatial components of the ATM functional system, through cooperation with responsible parties;
- (c) the equipment, procedures and human resources of the ATM functional system, the interactions between these elements and the interactions between the constituent part under consideration and the remainder of the ATM functional system.

3.2.2. Section 2

The hazard identification, risk assessment and mitigation processes shall include:

- (a) a determination of the scope, boundaries and interfaces of the constituent part being considered, as well as the identification of the functions that the constituent part is to perform and the environment of operations in which it is intended to operate;
- (b) a determination of the safety objectives to be placed on the constituent part, incorporating:
 - (i) an identification of ATM-related credible hazards and failure conditions, together with their combined effects;

- (ii) an assessment of the effects they may have on the safety of aircraft, as well as an assessment of the severity of those effects, using the severity classification scheme set out in Section 4;
- (iii) a determination of their tolerability, in terms of the hazard's maximum probability of occurrence, derived from the severity and the maximum probability of the hazard's effects, in a manner consistent with Section 4;
- (c) the derivation, as appropriate, of a risk mitigation strategy which:
 - (i) specifies the defences to be implemented to protect against the risk-bearing hazards;
 - (ii) includes, as necessary, the development of safety requirements potentially bearing on the constituent part under consideration, or other parts of the ATM functional system, or environment of operations;
 - (iii) presents an assurance of its feasibility and effectiveness;
- (d) verification that all identified safety objectives and safety requirements have been met:
 - (i) prior to its implementation of the change;
 - (ii) during any transition phase into operational service;
 - (iii) during its operational life;
 - (iv) during any transition phase until decommissioning.

3.2.3. Section 3

The results, associated rationales and evidence of the risk assessment and mitigation processes, including hazard identification, shall be collated and documented in a manner which ensures that:

- (a) complete arguments are established to demonstrate that the constituent part under consideration, as well as the overall ATM functional system are, and will remain tolerably safe by meeting allocated safety objectives and requirements. This shall include, as appropriate, specifications of any predictive, monitoring or survey techniques being used;
- (b) all safety requirements related to the implementation of a change are traceable to the intended operations/functions.

3.2.4. Section 4 Hazard identification and severity assessment

A systematic identification of the hazards shall be conducted. The severity of the effects of hazards in a given environment of operations shall be determined using the classification scheme set out in the following table, while the severity classification shall rely on a specific argument demonstrating the most probable effect of hazards, under the worst-case scenario.

Severity class	Effect on operations
1 (Most severe)	Accident as defined in Article 2 of Regulation (EU) No 996/2010 of the European Parliament and of the Council (1).
2 (Serious)	incident as defined in Article 2 of Regulation (EU) No 996/2010.
3 (Major)	incident associated with the operation of an aircraft, in which the safety of the aircraft may have been compromised, having led to a near collision between aircrafts, with ground or obstacles.
4	incident involving circumstances indicating

(Significant)	that an accident, a serious or major incident could have occurred, if the risk had not been managed within safety margins, or if another aircraft had been in the vicinity.
5 (Least severe)	No immediate effect on safety.

In order to deduce the effect of a hazard on operations and to determine its severity, the systematic approach/process shall include the effects of hazards on the various elements of the ATM functional system, such as the air crew, the air traffic controllers, the aircraft functional capabilities, the functional capabilities of the ground part of the ATM functional system, and the ability to provide safe air traffic services.

Risk classification scheme

Safety objectives based on risk shall be established in terms of the hazard's maximum probability of occurrence, derived both from the severity of its effect, and from the maximum probability of the hazard's effect.

As a necessary complement to the demonstration that established quantitative objectives are met, additional safety management considerations shall be applied so that more safety is added to the ATM system, whenever reasonable.

3.2.5. Section 5 Software safety assurance system

Within the operation of the SMS, a provider of air traffic services shall implement a software safety assurance system in accordance with Regulation (EC) No 482/2008.

3.3. Safety requirements for engineering and technical personnel undertaking operational safety related tasks

Providers of air traffic services shall ensure that technical and engineering personnel including personnel of subcontracted operating organisations who operate and maintain ATM equipment approved for their operational use have and maintain sufficient knowledge and understanding of the services they are supporting, of the actual and potential effects of their work on the safety of those services, and of the appropriate working limits to be applied.

With regard to the personnel involved in safety-related tasks including personnel of subcontracted operating organisations, providers of air traffic services shall document the adequacy of the competence of the personnel; the rostering arrangements in place to ensure sufficient capacity and continuity of service; the personnel qualification schemes and policy, the personnel training policy, training plans and records as well as arrangements for the supervision of non-qualified personnel. They shall have procedures in place for cases where the physical or mental condition of the personnel is in doubt.

Providers of air traffic services shall maintain a register of information on the numbers, status and deployment of the personnel involved in safety related tasks.

That register shall:

- (a) identify the accountable managers for safety-related functions;
- (b) record the relevant qualifications of technical and operational personnel, against required skills and competence requirements;
- (c) specify the locations and duties to which technical and operational personnel are assigned, including any rostering methodology.

4. WORKING METHODS AND OPERATING PROCEDURES

Providers of air traffic services shall be able to demonstrate that their working methods and operating procedures are compliant with the standards in the following annexes to the Convention on International Civil Aviation as far as they are relevant for the provision of air traffic services in the airspace concerned:

- (a) Annex 2 on rules of the air in its 10th edition of July 2005, including all amendments up to No 42;
- (b) Annex 10 on aeronautical telecommunications, Volume II on communication procedures including those with PANS Status in its sixth edition of October 2001, including all amendments up to No 85;
- (c) Annex 11 on air traffic services in its 13th edition of July 2001, including all amendments up to No 47-B.

ANNEX III Specific requirements for the provision of meteorological services

1. TECHNICAL AND OPERATIONAL COMPETENCE AND CAPABILITY

Providers of meteorological services shall ensure that the meteorological information, necessary for the performance of their respective functions and in a form suitable for users, is made available to:

- (a) operators and flight crew members for pre-flight and in-flight planning;
- (b) providers of air traffic services and flight information services;
- (c) search and rescue services units;
- (d) aerodromes.

Providers of meteorological services shall confirm the level of attainable accuracy of the information distributed for operations, including the source of such information, whilst also ensuring that such information is distributed in a sufficiently timely manner, and updated as required.

2. WORKING METHODS AND OPERATING PROCEDURES

Providers of meteorological services shall be able to demonstrate that their working methods and operating procedures are compliant with the standards in the following annexes to the Convention on International Civil Aviation as far as they are relevant for the provision of meteorological services in the airspace concerned:

- (a) Annex 3 on meteorological service for international air navigation in its 17th edition of July 2010, including all amendments up to No 75;
- (b) Annex 11 on air traffic services in its 13th edition of July 2001, including all amendments up to No 47-B;
- (c) Annex 14 on aerodromes in the following versions:
 - (i) Volume I on aerodrome design and operations in its 5th edition of July 2009, including all amendments up to No 10-B;
 - (ii) Volume II on heliports in its 3rd edition of July 2009, including all amendments up to No 4.

ANNEX IV Specific requirements for the provision of aeronautical information services

1. TECHNICAL AND OPERATIONAL COMPETENCE AND CAPABILITY

Providers of aeronautical information services shall ensure that information and data is available for operations in a form suitable for:

- (a) flight operating personnel, including flight crew, as well as flight planning, flight management systems and flight simulators;
- (b) providers of air traffic services which are responsible for flight information services, aerodrome flight information services and the provision of pre-flight information.

Providers of aeronautical information services shall ensure the integrity of data and confirm the level of accuracy of the information distributed for operations, including the

source of such information, before such information is distributed.

2. WORKING METHODS AND OPERATING PROCEDURES

Providers of aeronautical information services shall be able to demonstrate that their working methods and operating procedures are compliant with the standards in:

- (a) Commission Regulation (EU) No 73/2010 (1);
- (b) the following Annexes to the Convention on International Civil Aviation as far as they are relevant for the provision of aeronautical information services in the airspace concerned:
 - (i) Annex 3 on meteorological service for international air navigation in its 17th edition of July 2010, including all amendments up to No 75;
 - (ii) Annex 4 on aeronautical charts in its 11th edition of July 2009, including all amendments up to No 56;
 - (iii) without prejudice to Regulation (EU) No 73/2010, Annex 15 on aeronautical information services in its 13th edition of July 2010, including all amendments up to No 36.

ANNEX V Specific requirements for the provision of communication, navigation or surveillance services

1. TECHNICAL AND OPERATIONAL COMPETENCE AND CAPABILITY

Providers of communication, navigation or surveillance services shall ensure the availability, continuity, accuracy and integrity of their services.

Providers of communication, navigation or surveillance services shall confirm the quality level of the services they are providing and shall demonstrate that their equipment is regularly maintained and where required calibrated.

2. SAFETY OF SERVICES

Providers of communication, navigation or surveillance services shall comply with the requirements of point 3 of Annex II on the safety of services.

3. WORKING METHODS AND OPERATING PROCEDURES

Providers of communication, navigation or surveillance services shall be able to demonstrate that their working methods and operating procedures are compliant with the standards of Annex 10 on aeronautical telecommunications to the Convention on International Civil Aviation in the following versions as far as they are relevant for the provision of communication, navigation or surveillance services in the airspace concerned:

- (a) Volume I on radio navigation aids in its sixth edition of July 2006, including all amendments up to No 85;
- (b) Volume II on communication procedures including those with PANS status in its sixth edition of October 2001, including all amendments up to No 85;
- © Volume III on communications systems in its second edition of July 2007 including all amendments up to No 85;
- (d) Volume IV on surveillance radar and collision avoidance systems in its fourth edition of July 2007, including all amendments up to No 85;
- (e) Volume V on aeronautical radio frequency spectrum utilisation in its second edition of July 2001, including all amendments up to No 85.

- 인증 협력 계약 이후에 위 유럽 규정은 (EU) 2017/373 규정으로 위 병합되었으나, 내용 면에서 이전 규정 적용에 영향이 없음

라. 연구개발 최초 목표 변경

- 과업제안서에 제시된 목표를 실제 성능적합증명 및 EASA 협력계약 내용에 맞춰 좀 더 명확하게 표현
 - 세부 목표 변경 비교표

[표 12. 최초 및 변경 목표 비교]

최초 목표	변경 목표	변경 사유
설계검증	성능적합증명 검사	실제 동일 과업이지만, 성능적합증명 제도에서 실제 사용하는 용어 위주로 표현을 변경하고 성과물을 명확히 기재
운영검증	운영지침자료 검사	대내외 환경 변화로 인해 당초 계획된 방향의 운영검증 수행이 어려워 유관기관 간 회의를 통해 연구내용 변경 * 관련근거1 : 「KASS 성능적합증명 일정 및 운영 검증 방안 논의 회의 결과 알림」 (항공안전기술원 보안항행인증실-56, 2022.1.19.) * 관련근거2 : 「KASS 성능적합증명 계획 및 운영 검증 방안 검토 후속회의 개최 알림」 (항공안전기술원 보안항행인증실-1284, 2021.12.14.) * 관련근거3 : 「KASS 성능적합증명 일정 및 운영 검증 방안 검토회의 개최 알림」 (항공안전기술원 보안항행인증실-1566, 2021.12.27.)
SoC확보	EASA 인증협력	실제 동일 과업이지만, SoC 확보 외 기술자문 등 부가 업무도 포함할 수 있는 포괄적인 제목으로 변경

2. 연구개발과제의 수행 과정 및 수행 내용

1) 연구개발 수행절차

가. 과업별 연구수행 절차

- (성능적합증명 검사) KASS 시스템이 성능적합증명 검사 기술기준 및 ICAO 표준을 준수하여 제작되었는지 검토하여 성능적합증명 검사 종합 결과서 산출
 - KASS 완성품 초안이 개발 완료되는 KASS TRR(Test Readiness Review) 시점을 기준으로 검사 내용을 구분하여 2단계로 구성

[표 13. 단계별 목표 비교]

단계	기간	단계별 목표
1단계 (설계개발 검사)	2017.08.~ 2023.03	<ul style="list-style-type: none"> · SBAS 기술기준 적합성 검사 <ul style="list-style-type: none"> - 기술기준 항목별 적용성 여부 및 입증방법 합의 - 신청자가 제출한 입증계획서 검토 <ul style="list-style-type: none"> : 입증자료에 대한 SBAS 기술기준 및 추적성 : 입증자료에 제시된 상세 입증방법 타당성 확인 - 신청자가 제출한 입증결과서 검토 <ul style="list-style-type: none"> : 시스템 통합기능/성능/인터페이스 시험결과 및 시스템 성능 분석결과, 제시된 결과의 타당성 등 확인 : FAT, TRR, ORR/SQR 등 개발 주요 일정 기준으로 산출된 결과서 검토 - 시스템이 아닌 하위 레벨에서 입증이 필요한 기술기준에 대한 입회시험 수행 · 개발산출물 검사 <ul style="list-style-type: none"> - 검사 결과에 대한 추적관리 수행 · 소프트웨어 기술기준 적합성 검사 <ul style="list-style-type: none"> - 하위시스템별 개발보증등급 적합성 확인, 소프트웨어 입증계획서 승인, 현장감사 수행, 소프트웨어 달성보고서 승인
2단계 (완성품 검사)	2023.04.~ 2023.12.	<ul style="list-style-type: none"> · SBAS 기술기준 항목별 검사 및 적/부 판정 · 개발보증등급 최종 달성 확인 · 1단계 검사 미결사항 추적관리

- (운영지침자료 검사) KASS 운영지침자료에 “운영기관이 시스템 성능과 안정성을 보장하도록 운영할 수 있는 절차·지침이 적절히 반영되었는지” 검사
 - KASS 시스템 개발과 함께 산출된 운영지침 항목이 KASS 운영매뉴얼에 적절히 반영되었는지 확인하여 KASS 시스템의 안전과 관련된 운영 절차 완화방법이 구현되었음을 검사
 - 세부 검사 절차

[표 14. KASS 운영지침자료 검사 절차]



- (EASA 인증 협력) EASA가 KASS 개발산출물을 검토할 수 있도록 지원하여 EASA의 적합성확인서 (SoC) 확보하고, EASA 검사 절차 및 EGNOS 사례를 기반으로 인증기술 습득
 - (EASA 적합성 확인 검사) EASA는 자체 검사를 통해 총 4건의 검사보고서를 국내 검사기관에 제공하고 KASS 적합성확인서(SoC)를 같이 발급

[표 15. EASA 단계별 검사보고서]

보고서	제출 일자	보고서 목표
규격검토보고서	2018.06.28	시스템 최상위 요구사항이 RB(Regulation Basis) 및 ICAO 기술기준을 준수하도록 설정되었는지 검토
설계검토보고서	2022.02.21	시스템 최상위 요구사항에 따라 시스템 설계·분석이 이루어졌는지 검토
개발검토보고서	2023.12.13	설계·분석 결과에 따라 시스템이 개발 및 검증되었는지 검토
통합시스템 검토보고서	2024.02.20	시스템 최상위 요구사항 및 RB, ICAO 기술기준에 최종 부합하는지 검토 (실 운용환경 기반)

- (EASA 기술자문을 통한 인증 협력) 월간화상회의 등 다양한 방식을 통해 KASS 주요이슈, SBAS 배경지식, EGNOS 사례 등에 대한 자문 수행

[표 16. EASA 기술자문 및 검사 협력 내용]

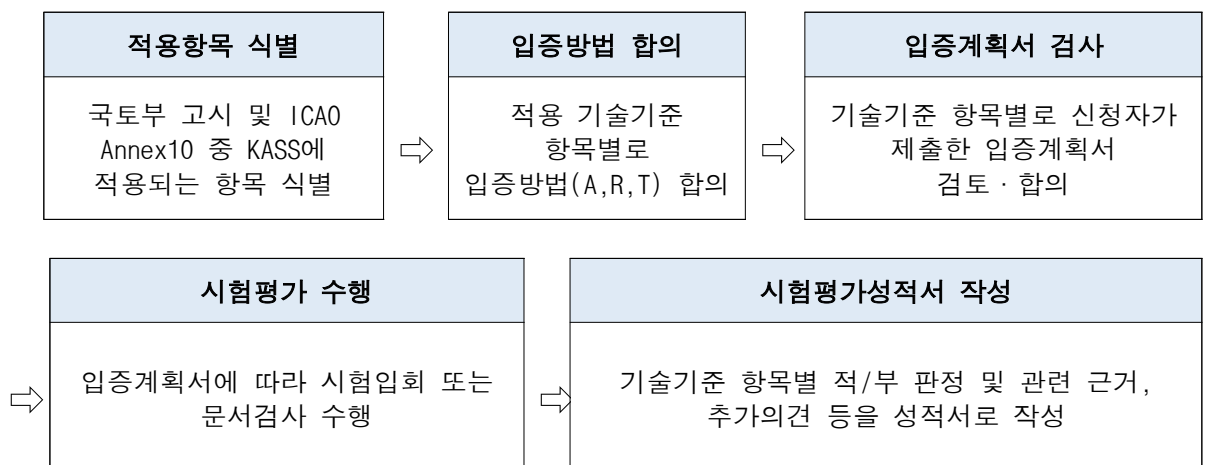
유형	실적
월간화상회의	월간화상회의 총 64회
연간대면회의	연간대면회의 총 5회
현장 검사 지원	보안산출물 현장 검사 지원 3회 : SiS 성능분석자료 검사 지원 2회 : 전자H/W 개발보증 검사 지원 1회
수시 이메일 자문	약 150회의 이메일 수/발신

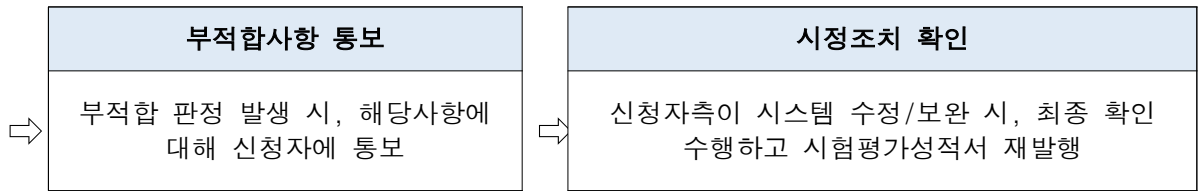
나. 성능적합증명 검사 세부 수행 절차

- (SBAS 기술기준 검사) 국토교통부 고시 제2022-51호(항행안전시설 성능적합증명 검사 규정) 제3조 1항에 따른 항행안전무선시설 설치 및 기술기준과 ICAO SARPs Annex 10, Vol.1 (Amd 86) 중 KASS에 적용 가능한 항목을 식별하여 검사 수행

- 세부 검사 절차

[표 17. SBAS 기술기준 검사 절차]





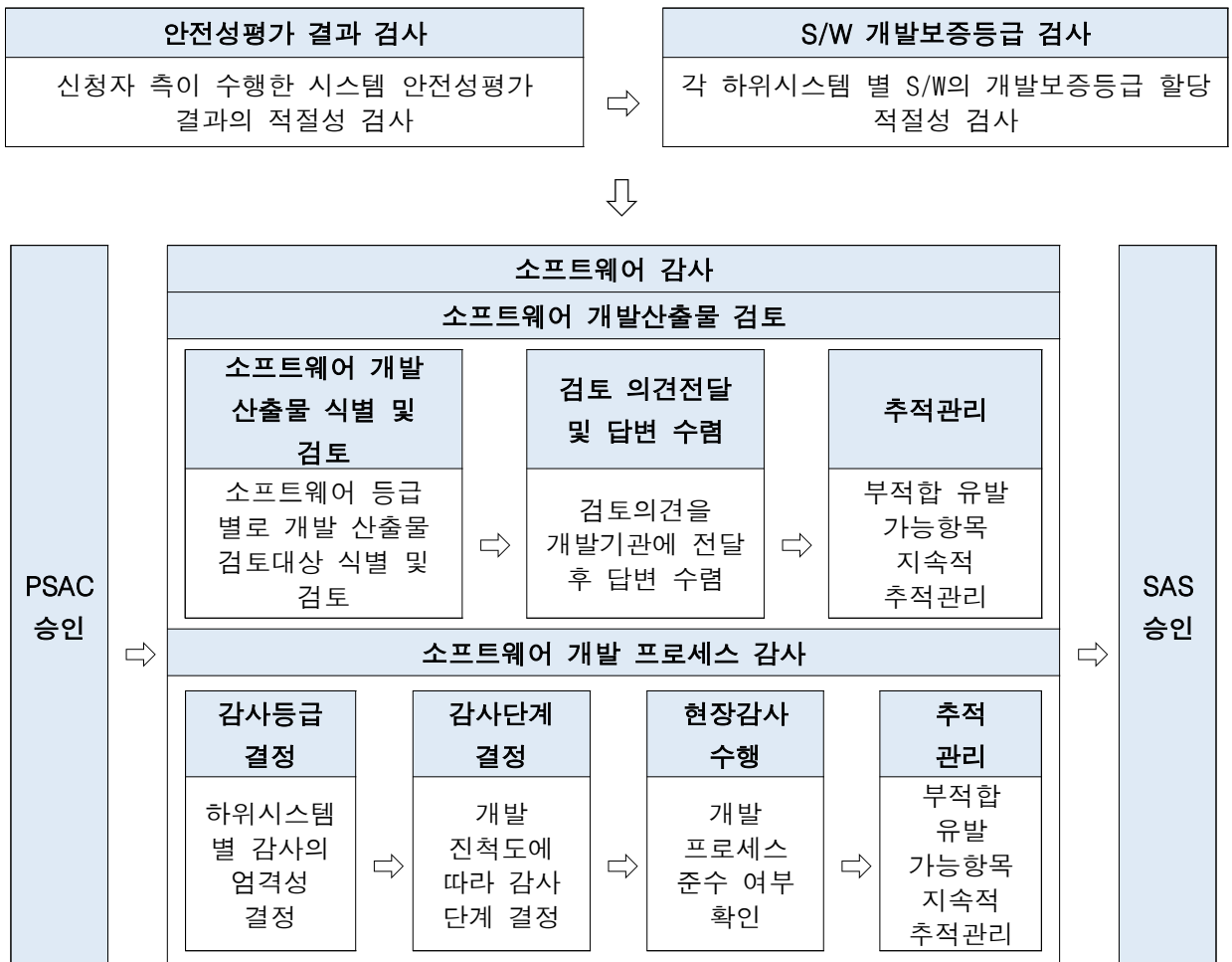
※ 개발·구축 일정을 고려한 개발 단계별 기술기준 검사 최초 적용

[표 18. 단계별 SBAS 기술기준 검사 항목]

개발 단계	SBAS 기술기준 검사 항목
KASS FAT*, KASS SAT** * FAT(Factory Acceptance Test) ** SAT(Site Acceptance Test)	하위시스템 수준에서 적합성 확인이 필요한 항목 검사 수행 - KASS 위성통신국 신호생성부(KUS-SGS) - KASS GEO 탑재체 ↔ KASS 위성통신국 무선주파수부(KUS-RFS)
KASS TRR* * TRR(Test Readiness Review)	KASS 일반 기능·성능시험
KASS TRR ~ KASS SQR* * SQR(System Qualification Review)	KASS SiS 성능시험
KASS SQR	KASS 시스템 최종 형상 영향 평가 및 재시험/재평가

- (소프트웨어 기술기준 검사) 국토교통부 고시 제2022-51호(항행안전시설 성능적합증명 검사 규정) 제 3조 3항에 따라 소프트웨어를 포함하고 있는 KASS에 적용 가능한 미국 또는 유럽의 공인화된 항공 관련 소프트웨어 개발 기술기준인 EUROCAE ED-12B(RTCA DO-178B와 동일)를 적용
 - 세부 검사 절차

[표 19. SW 기술기준 검사 세부 절차]



- * PSAC(Plan for Software Aspects of Certification, 소프트웨어 인증계획서)
- * SAS(Software Accomplish Summary, 소프트웨어 달성요약서)
- ※ 유럽의회의 열람제한문서(FEEO, For European Eyes Only) 설정에 따라 현장감사 시, 소프트웨어 인증산출물에 대한 검토 병행 수행

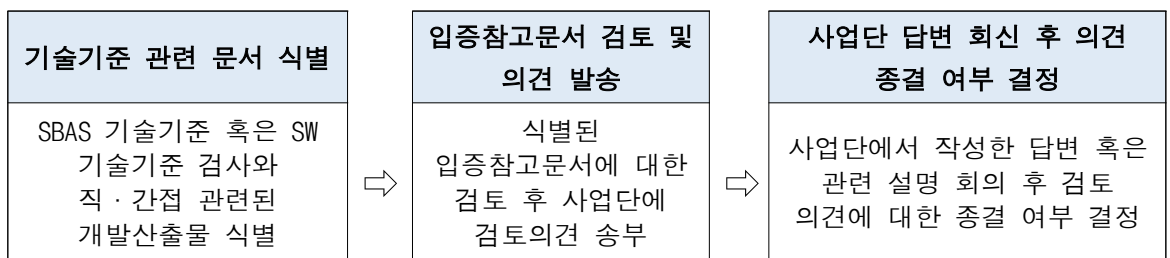
[표 20. SW 기술기준 검사 세부 절차]

SW 인증산출물	EC FEEO	검사 수행방법
소프트웨어 인증계획서	미해당	국내 제공
소프트웨어 개발계획서	해당	현지 데이터룸 검토
소프트웨어 검증계획서	해당	현지 데이터룸 검토
소프트웨어 형상관리계획서	해당	현지 데이터룸 검토
소프트웨어 품질보증계획서	해당	현지 데이터룸 검토
소프트웨어 요구사항 표준	해당	현지 데이터룸 검토
소프트웨어 설계 표준	해당	현지 데이터룸 검토
소프트웨어 코딩 표준	해당	현지 데이터룸 검토
소프트웨어 요구사항서	해당	현지 데이터룸 검토
소프트웨어 형상 목록	미해당	국내 제공
문제 보고서	해당	현지 데이터룸 검토
소프트웨어 형상관리 기록	해당	현지 데이터룸 검토
소프트웨어 달성 요약서	미해당	국내 제공
소프트웨어 설계서	해당	현지 데이터룸 검토
소프트웨어 검증 케이스 및 절차	해당	현지 데이터룸 검토
소프트웨어 검증 결과	해당	현지 데이터룸 검토
소프트웨어 품질보증 기록	해당	현지 데이터룸 검토
소프트웨어 환경 형상 목록	미해당	국내 제공

○ (인증 참고문서 검사) KASS 완성품 초안 개발 전 혹은 기술기준 적합성 인증 과정에서 검토가 필요한 KASS 개발산출물을 인증참고문서로 식별하여 검토 수행

- 세부 검사 절차

[표 21. 인증참고문서 검사 절차]



- 인증참고문서 식별 결과

[표 22. 유형별 입증참고문서 분류 결과]

유형	문서 개수	검토의견 개수
계획/관리	19	260
규격/요구사항	23	303
설계/구현	24	296
시험/검증	17	226
기타	2	62
총계	85	1,147

2) 연구개발 수행방법

가. SBAS 기술기준 검사

- 국토교통부 고시 제2022-51호(항행안전시설 성능적합증명 검사 규정) 제3조 1항에 따라 아래 기술기준에 대해 KASS에 적용 가능한 기술기준을 항목 을 도출
 - 항행안전무선시설 설치 및 기술기준(국토교통부 고시[제2022-786호]) 중에서 SBAS 기술기준(기능·성능·인터페이스 등)
 - ICAO SARPs Annex 10, Vol.1 (Amd 86) 중에서 SBAS 기술기준(기능·성능·인터페이스 등)

[표 23. KASS 기술기준 세부 내용]

세부 내용
<p>3.7.2.1.1 위성항법시설(GNSS)은 항공기에 위치 및 시간 데이터를 제공한다. 주. 이러한 데이터는 GNSS 수신기가 장착된 항공기와 위성이나 지상의 다양한 신호원들 사이의 의사거리 측정값에서 유도된다.</p> <p>3.7.2.2.1 GNSS 항법 서비스는 지상 시설, 위성, 항공기에 탑재된 다음 각호 장비들의 다양한 결합으로 제공되어야 한다. d) SBAS (참조 3.7.3.4)</p> <p>3.7.2.3.1 공간 기준. GNSS에 의해 이용자에게 제공되는 위치 정보는 전 세계 측지시스템(이하 “WGS-84”라 한다) 좌표를 적용하여야 한다. 주1. WGS-84 표준 및 실무지침(SARPS)은 ICAO 부속서 4, 2장, 부속서 11, 2장, 부속서 14, 1권 및 11권 2장, 부속서15, 3장에 설명하고 있다. 주2. 다만, WGS-84 좌표와 다른 것을 사용하는 GNSS 장비는 적절한 전환 파라미터가 적용되어야 한다.</p> <p>3.7.2.3.2 시간 기준. GNSS에 의해 이용자에게 제공되는 시간정보는 세계표준시(이하 “UTC”라 한다)를 기준으로 하여 시간 척도로 표현되어야 한다.</p> <p>3.7.2.4.1 GNSS 구성요소들과 장애가 없는 GNSS 이용자 수신기의 결합은 표 3.7.2.4-1(3.7절 후반에 위치)에서 정의된 공간신호 성능 요구조건을 충족시켜야 한다.</p>

Typical operation	Accuracy horizontal 95% (Notes 1 and 3)	Accuracy vertical 95% (Notes 1 and 3)	Integrity (Note 2)	Time-to-alert (Note 3)	Continuity (Note 4)	Availability (Note 5)
En-route	3.7 km (2.0 NM)	N/A	$1 - 1 \times 10^{-7}/h$	5 min	$1 - 1 \times 10^{-4}/h$ to $1 - 1 \times 10^{-6}/h$	0.99 to 0.99999
En-route, Terminal	0.74 km (0.4 NM)	N/A	$1 - 1 \times 10^{-7}/h$	15 s	$1 - 1 \times 10^{-4}/h$ to $1 - 1 \times 10^{-6}/h$	0.99 to 0.99999
Initial approach, Intermediate approach, Non-precision approach (NPA), Departure	220 m (720 ft)	N/A	$1 - 1 \times 10^{-7}/h$	10 s	$1 - 1 \times 10^{-4}/h$ to $1 - 1 \times 10^{-6}/h$	0.99 to 0.99999
Approach operations with vertical guidance (APV-I)	16.0 m (52 ft)	20 m (66 ft)	$1 - 2 \times 10^{-7}$ in any approach	10 s	$1 - 8 \times 10^{-4}$ per 15 s	0.99 to 0.99999

3.7.3.4.1 성능. 하나 이상의 다른 GNSS 구성요소와 장애 없는 수신기들과 결합된 SBAS는 3.7.2.4항에서 규정한 정확도, 무결성, 연속성, 가용성 요건들을 만족하여야 한다.

주. 다중 공항을 포함하는 서비스 영역 내에서 제공되는 항법의 정확성, 무결성, 연속성, 가용성을 증가시켜 기본위성군을 보완한다.

3.7.3.4.2 기능.

SBAS는 다음 각호의 기능 중 하나 이상을 수행해야 한다.

주. 모든 기능을 제공하는 경우, 코어위성군과 조합된 SBAS는 CAT-I 정밀접근을 포함하여 출발, 항로, 터미널, 접근절차를 지원할 수 있다. 달성할 수 있는 성능 수준은 SBAS에 통합된 기반시설과 해당 지역의 전리층 조건에 따라 달라진다.

b) GNSS 위성 상태 : GNSS 위성 health 상태 결정 및 송신 (부록 B, 3.5.7.3항)

c) 기본적인 차동 보정 : 위성으로부터 의사거리 측정에 적용하게 될 GNSS 위성 궤도정보 (ephemeris) 및 시계 보정(단기, 장기)을 제공 (부록 B, 3.5.7.4항)

d) 정밀 차동 보정 : 전리층의 보정 결정 및 송신 (부록 B, 3.5.7.5항)

3.7.3.4.3 서비스 영역

SBAS 서비스 영역은 SBAS가 3.7.2.4항의 요건 및 승인된 운영을 충족시키는 SBAS 통달 범위 내의 한정된 영역이어야 한다.

3.7.3.4.4.1 반송파 주파수

반송파 주파수는 1,575.42 MHz 여야 한다.

주. 2005년 이후 상위 GLONASS 주파수가 비워지면 이러한 주파수 중 일부를 사용하여 다른 유형의 SBAS가 도입될 수 있다.

3.7.3.4.4.2 신호 스펙트럼

신호 스펙트럼은 방송출력의 최소한 95퍼센트는 L1 주파수 중심에서 $\pm 12\text{MHz}$ 대역폭 내에 포함되어야 하고, SBAS 위성에 의해 송신된 신호의 대역폭은 최소한 2.2MHz이어야 한다.

3.7.3.4.4.3 신호 전력 레벨

각 SBAS 위성은 5도 이상의 양각에서 위성이 관측되는 지상 근처의 모든 장애물이 없는 위치에서 3dBi 선형안테나로 수신된 RF 신호의 수준이 전파 방향과 직교하는 모든 안테나에 대해 -161dBW ~ -153dBW 범위가 되도록 충분한 전력으로 항법 신호를 방송해야 한다.

3.7.3.4.4.4 편파

방송 신호는 우선회 원형 편파여야 한다.

3.7.3.4.4.5 변조

송신되는 순서는 초당 500 심볼률의 항법메시지와 1,023비트의 PRN 코드의 모듈로-2 덧셈이 되어야 하고, 이후에 초당 1.023메가칩의 비율로 반송파에 BPSK 변조되어야 한다.

3.7.3.4.5 SBAS 네트워크 시간 (SNT)

SBAS 네트워크 시간(SNT)과 GPS 시간 간의 차이는 50나노초를 초과하지 않아야 한다.

3.7.3.4.6 항법 정보

위성으로부터 송신된 항법 정보는 다음 각 호의 사항을 결정에 필요한 정보를 포함하여야 한다.

주. 데이터 구조 및 내용은 각각 부록 B 3.5.3항 및 3.5.4항에서 제시하고 있다.

- a) SBAS 위성 송신 시간
- b) SBAS 위성 위치
- c) 모든 위성에 대해 보정된 위성 시간
- d) 모든 위성에 대해 보정된 위성 위치
- e) 전리층 전파 지연 영향
- f) 사용자 위치 무결성
- h) 서비스 레벨 상태

3.7.4.1 GNSS는 부록 B 3.7항에서 정의된 간섭 환경에서 3.7.2.4항 및 부록 B 3.7항에서 정의된 성능 조건에 부합하여야 한다.

주. 1,559 - 1,610 MHz 주파수 대역에서 작동하는 GPS와 GNSS는 ITU에 의해 무선향행위성서비스(RNSS) 및 항공무선향행서비스(ARNS)를 제공하는 것으로 분류되고, RNSS를 위한 특별 스펙트럼 보호 상태가 주어진다. GNSS와 그 보강시스템에 의해 지원될 정밀접근유도를 위한 성능 목표를 달성하기 위해서, RNSS/ARNS가 1,559 - 1,610MHz 대역에 유일하게 전 세계적으로 배정되어 유지되도록 의도되었고, 국가 및/또는 국제 규정을 통하여 이 주파수 및 인접 주파수 대역에 있는 시스템으로부터 전파 방사가 확실히 통제된다.

3.5.2.1 반송파 주파수 안정성

위성 전송 안테나 출력단에서 반송파 주파수의 단기 안정성(알랜 분산의 제곱근)은 1~10초 동안에 5×10^{-11} 보다 좋아야 한다.

3.5.2.2 반송파 위상 잡음.

변조 주파수의 위상 잡음 스펙트럼 밀도는 0.1 라디안(1시그마)의 정확도로 반송파를 추적할 수 있는 10 Hz의 단축 잡음 대역폭의 위상 동기 루프와 같아야 한다.

3.5.2.3 불요파 방사

불요파 방사는 모든 주파수에서 비변조 반송파 출력에서 적어도 40dB 이하가 되어야 한다.

3.5.2.4 코드/반송파 주파수 응집성

코드 위상 변화율과 반송파 주파수 간의 단기(10초 미만) 주파수 차이는 5×10^{-11} (표준편차) 미만이어야 한다. 장기에 대해(100초 미만), 코드 칩 수에 1540을 곱한 반송파 사이클로 변환된 방송 코드 위상의 변화와 사이클 단위의 방송 반송파 위상의 변화 사이의 차이는 하나의 반송파 사이클(표준편차) 이내에 있어야 한다.

주. 이 조항은 위성 전송 안테나의 출력에 적용하고, 지상으로의 전송 경로에서 이온층 굴절로 인한 코드/반송파 발산은 포함하지 않는다.

3.5.2.5 상관 손실

신호 번조 및 파형 왜곡의 불완전성으로 인해 복원된 신호 전력의 손실은 1dB을 초과하지 않아야 한다.

주. 신호전력 손실이란 2.046 MHz 대역폭에서의 방송 전력 대비 1칩 상관 간격 및 2.046 MHz 대역폭을 가진 손실 및 잡음이 없는 수신기에 의해 복원된 신호 전력 간의 차이를 의미함

3.5.2.6 최대 코드 위상 편차

방송 신호의 최대 비정정 코드 위상은 동등한 SBAS 망 시각(SNT)과 $\pm 2^{-20}$ 초 이상 차이가 나지 않아야 한다.

3.5.2.7 코드/데이터 밀집성

각 2ms 심볼은 모든 다른 코드 에포크와 동기되어야 한다.

3.5.2.8 메시지 동기화

현재 메시지의 첫 비트에 따른 첫 심볼의 시작점은 SNT의 1초 에포크와 동기화하여 SBAS 위상에서 방송되어야 한다.

3.5.2.9 길쌈 부호화

초당 250비트의 전송 자료는 제한 길이가 7인 길쌈 부호화를 이용하여 비트당 2 심볼의 속도로 인코딩하여 초당 500 심볼을 생성하여야 한다. 길쌈 부호화 논리 배열은 각 4ms 자료 비트 기간의 전반부에 대해 선택된 G3 출력을 사용하여 그림 B-11에서 설명된 것처럼 되어야 한다.

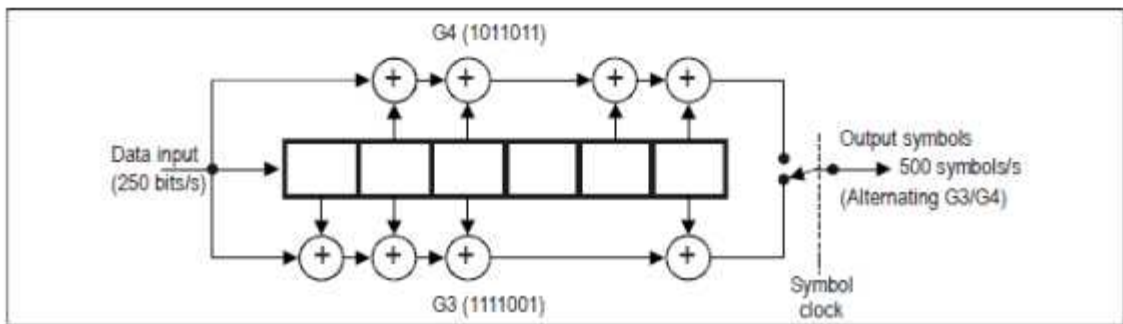


Figure B-11. Convolutional encoding

3.5.2.10 위성식별부호(PRN)

각 PRN 코드는 2개의 1,023비트 선형 패턴인 G1과 G2를 모듈로-2 덧셈한 1,023비트의 골드 코드이어야 한다. G2i 시퀀스는 표 B-23에서 설명하는 것처럼 관련된 정수 칩 수만큼 G2 시퀀스를 지연시켜 형성되어야 한다.

각각의 G1 및 G2 시퀀스는 10단 시프트 레지스터의 10단에서의 출력으로 정의되어야 하는데, 여기서 시프트 레지스터에 대한 입력은 시프트 레지스터 다음 단의 모듈로-2 덧셈이다.

- a) G1: 3단, 10단
- b) G2: 2단, 3단, 6단, 8단, 9단, 10단

G1 및 G2 시프트 레지스터의 초기 상태는 “1111111111”이다.

Table B-23. SBAS PRN codes

PRN code number	G2 delay (chips)	First 10 SBAS chips (Leftmost bit represents first transmitted chip, binary)
120	145	110111001
121	175	101011110
122	52	1101001000
123	21	1101100101
124	237	1110000
125	235	111000001
126	886	1011
127	657	1000110000
128	634	10100101
129	762	101010111
130	355	1100011110
131	1012	1010010110
132	176	1010101111
133	603	100110
134	130	1000111001
135	359	101110001
136	595	1000011111
137	68	111111000
138	386	1011010111

3.5.3.1 포맷 요약.

모든 메시지는 메시지 그림 B-12와 같이 메시지 유형 식별자, 프리앰블, 데이터 필드, 순환 중복 검사(CRC)로 구성된다.

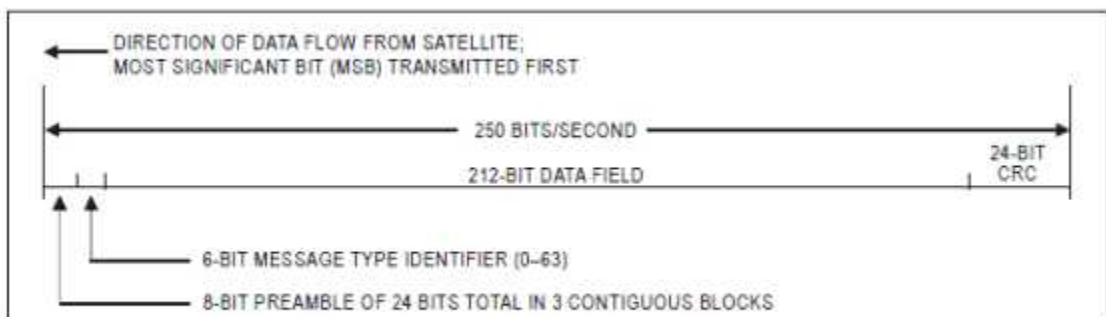


Figure B-12. Data block format

3.5.3.2 프리앰블, 프리앰블은 3개의 연속적인 블록으로 분산된 01010011, 10011010, 11000110 비트 시퀀스로 구성된다. 다른 모든 24비트 프리앰블의 시작은 6초 GPS서브프레임 예폭과 동기화되어야 한다.

3.5.3.3 메시지 타입 식별자. 메시지 타입 식별자는 표 B-24에 정의된 메시지 타입(0~63)을 식별하는 6 비트의 값이어야 한다. 메시지 타입 식별자는 먼저 MSB를 송신해야 한다.

Table B-24. Broadcast message types

Message type	Contents
0	"Do Not Use" (SBAS test mode)
1	PRN mask
2 to 5	Fast corrections
6	Integrity information
7	Fast correction degradation factor
8	Spare
9	GEO ranging function parameters
10	Degradation parameters
11	Spare
12	SBAS network time/UTC offset parameters
13 to 16	Spare
17	GEO satellite almanacs
18	Ionospheric grid point masks
19 to 23	Spare
24	Mixed fast/long-term satellite error corrections
25	Long-term satellite error corrections
26	Ionospheric delay corrections
27	SBAS service message
28	Clock-ephemeris covariance matrix
29 to 61	Spare
62	Reserved
63	Null message

3.5.3.4 데이터 필드. 3.5.6항에서 정의된 대로 데이터 필드는 212비트이어야 한다. 각 데이터 필드의 첫 번째 파라미터는 먼저 MSB를 송신해야 한다.

3.5.3.5 순환 중복 검사(CRC). SBAS 메시지 CRC코드는 3.9에 따라 계산해야 한다.

3.5.3.5.1 CRC코드의 길이는 $k = 24$ bits이어야 한다.

3.5.3.5.2 CRC의 생성 다항식은 다음과 같아야 한다:

$$G(x) = x^{24} + x^{23} + x^{18} + x^{17} + x^{14} + x^{11} + x^{10} + x^7 + x^6 + x^5 + x^4 + x^3 + x + 1$$

3.5.3.5.3 CRC 정보 필드, MX는 다음과 같아야 한다:

$$M(x) = \sum_{i=1}^{226} m_i x^{226-i} = m_1 x^{225} + m_2 x^{224} + \dots + m_{226} x^0$$

3.5.3.5.4 M(x)는 8비트 SBAS 메시지 전문(프리앰블), 6비트의 메시지 타입 식별자, 212비트의 데이터 필드로부터 구성되어야 한다. 비트 M1은 전문(프리앰블)의 송신비트에 대응하도록 SBAS 위성으로부터 전송된 순서대로 배치하고, M226은 데이터 필드의 비트(212)에 대응한다.

3.5.3.5.5 r1이 전송되는 첫 번째 비트이고 r24가 마지막 비트인 CRC 코드 r-비트는 정렬되어야

한다.

3.5.5.6 보호 수준.

수평보호수준(HPL) 및 수직보호수준(VPL)은 다음과 같다.

$$HPL_{SBAS} = \begin{cases} K_{H,NPA} \times d_{major} & \text{for en-route through non-precision approach (NPA) modes} \\ K_{H,PA} \times d_{major} & \text{for precision approach (PA) and approach with vertical guidance (APV) modes} \end{cases}$$

$$VPL_{SBAS} = K_{V,PA} \times d_V$$

where

$d_V^2 = \sum_{i=1}^N s_{V,i}^2 \sigma_i^2$ = variance of model distribution that overbounds the true error distribution in the vertical axis;

$$d_{major} = \sqrt{\frac{d_x^2 + d_y^2}{2} + \sqrt{\left(\frac{d_x^2 - d_y^2}{2}\right)^2 + d_{zy}^2}}$$

3.5.6 메시지 표

각 SBAS 메시지는 표 B-37~53에 정의된 해당 메시지 포맷에 따라 코딩되어야 한다. 이러한 표에 기명된 모든 파라미터들은 MSB를 점유하는 부호 비트를 가진 2의 보수로 표현되어야 한다.

주. 최대 양(+의 값)이 하나 작은 값(표시된 값 빼기 해상도)으로 제한되기 때문에 기명된 파라미터들에 대한 범위는 표시된 것보다 작다.

[표 B-37. 타입 0 "Do Not Use" 메시지]

Table B-37. Type 0 "Do Not Use" message

Data content	Bits used	Range of values	Resolution
Spare	212	—	—

[표 B-38. 타입 1 PRN 마스크 메시지]

Table B-38. Type 1 PRN mask message

Data content	Bits used	Range of values	Resolution
For each of 210 PRN code numbers			
Mask value	1	0 or 1	1
IODP	2	0 to 3	1
<i>Note. — All parameters are defined in 3.5.4.1.</i>			

[표 B-39. 타입 2~5 단기 보정정보 메시지]

Table B-39. Types 2 to 5 fast correction message

Data content	Bits used	Range of values	Resolution
IODF ₁	2	0 to 3	1
IODP	2	0 to 3	1
For 13 slots Fast correction (FC _i)	12	±256.000 m	0.125 m
For 13 slots UDREI _i	4	(see Table B-29)	(see Table B-29)

Notes. —
 1. The parameters IODF_i and FC_i are defined in 3.5.4.4.2.
 2. The parameter IODP is defined in 3.5.4.1.
 3. The parameter UDREI_i is defined in 3.5.4.5.

[표 B-39. 타입 6 무결성 메시지]

Table B-40. Type 6 integrity message

Data content	Bits used	Range of values	Resolution
IODF ₂	2	0 to 3	1
IODF ₃	2	0 to 3	1
IODF ₄	2	0 to 3	1
IODF ₅	2	0 to 3	1
For 51 satellites (ordered by PRN mask number) UDREI _i	4	(see Table B-29)	(see Table B-29)

Notes. —
 1. The parameters IODF_i are defined in 3.5.4.4.2.
 2. The parameter UDREI_i is defined in 3.5.4.5.

[표 B-41. 타입 7 단기 보정정보 저하 요소 메시지]

Table B-41. Type 7 fast correction degradation factor message

Data content	Bits used	Range of values	Resolution
System latency (t_{lat})	4	0 to 15 s	1 s
IODP	2	0 to 3	1
Spare	2	—	—
For 51 satellites (ordered by PRN mask number) Degradation factor indicator (a_i)	4	(see Table B-34)	(see Table B-34)

Notes. —
 1. The parameters t_{lat} and a_i are defined in 3.5.4.7.
 2. The parameter IODP is defined in 3.5.4.1.

[표 B-42. 타입 9 레인지 기능 메시지]

Table B-42. Type 9 ranging function message

Data content	Bits used	Range of values	Resolution
Reserved	8	—	—
$t_{0,GEO}$	13	0 to 86 384 s	16 s
URA	4	(see Table B-26)	(see Table B-26)
X_G	30	$\pm 42\,949\,673$ m	0.08 m
Y_G	30	$\pm 42\,949\,673$ m	0.08 m
Z_G	25	$\pm 6\,710\,886.4$ m	0.4 m
\dot{X}_G	17	± 40.96 m/s	0.000625 m/s
\dot{Y}_G	17	± 40.96 m/s	0.000625 m/s
\dot{Z}_G	18	± 524.288 m/s	0.004 m/s
\ddot{X}_G	10	± 0.0064 m/s ²	0.0000125 m/s ²
\ddot{Y}_G	10	± 0.0064 m/s ²	0.0000125 m/s ²
\ddot{Z}_G	10	± 0.032 m/s ²	0.0000625 m/s ²
$a_{G(0)}$	12	$\pm 0.9537 \times 10^{-6}$ s	2^{-31} s
$a_{G(1)}$	8	$\pm 1.1642 \times 10^{-10}$ s/s	2^{-40} s/s

Note.— All parameters are defined in 3.5.4.2.

[표 B-48. Type 10 저하 매개변수 메시지]

Table B-43. Type 10 degradation parameter message

Data content	Bits used	Range of values	Resolution
B_{irc}	10	0 to 2.046 m	0.002 m
$C_{irc\ isb}$	10	0 to 2.046 m	0.002 m
$C_{irc\ v1}$	10	0 to 0.05115 m/s	0.00005 m/s
$I_{irc\ v1}$	9	0 to 511 s	1 s
$C_{irc\ v0}$	10	0 to 2.046 m	0.002 m
$I_{irc\ v0}$	9	0 to 511 s	1 s
$C_{geo\ isb}$	10	0 to 0.5115 m	0.0005 m
$C_{geo\ v}$	10	0 to 0.05115 m/s	0.00005 m/s
I_{geo}	9	0 to 511 s	1 s
C_{er}	6	0 to 31.5 m	0.5 m
$C_{iono\ step}$	10	0 to 1.023 m	0.001 m
I_{iono}	9	0 to 511 s	1 s
$C_{iono\ ramp}$	10	0 to 0.005115 m/s	0.000005 m/s
RSS _{UDRE}	1	0 or 1	1
RSS _{iono}	1	0 or 1	1
$C_{covariance}$	7	0 to 12.7	0.1
Spare	81	—	—

Note.— All parameters are defined in 3.5.4.7.

[표 B-45. 타입 17 GEO 알마낙 메시지]

Table B-45. Type 17 GEO almanac message

Data content	Bits used	Range of values	Resolution
For each of 3 satellites			
Reserved	2	0	—
PRN code number	8	0 to 210	1
Health and status	8	—	—
$X_{G,A}$	15	$\pm 42\,598\,400$ m	2 600 m
$Y_{G,A}$	15	$\pm 42\,598\,400$ m	2 600 m
$Z_{G,A}$	9	$\pm 6\,656\,000$ m	26 000 m
$\dot{X}_{G,A}$	3	± 40 m/s	10 m/s
$\dot{Y}_{G,A}$	3	± 40 m/s	10 m/s
$\dot{Z}_{G,A}$	4	± 480 m/s	60 m/s
t_{almanac} (applies to all three satellites)	11	0 to 86 336 s	64 s

Note. — All parameters are defined in 3.5.4.3.

[표 B-46. 타입 18 IGP 마스크 메시지]

Table B-46. Type 18 IGP mask message

Data content	Bits used	Range of values	Resolution
Number of IGP bands	4	0 to 11	1
IGP band identifier	4	0 to 10	1
Issue of data — ionosphere (IOD _I)	2	0 to 3	1
For 201 IGPs			
IGP mask value	1	0 or 1	1
Spare	1	—	—

Note. — All parameters are defined in 3.5.4.6.

[표 B-48. 타입 25 장기 위성 오차보정 메시지]

**Table B-48. Type 25 long-term satellite error correction half message
(VELOCITY CODE = 0)**

Data content	Bits used	Range of values	Resolution
Velocity Code = 0	1	0	1
For 2 Satellites			
PRN mask number	6	0 to 51	1
Issue of data (IOD _I)	8	0 to 255	1
δx_i	9	± 32 m	0.125 m
δy_i	9	± 32 m	0.125 m
δz_i	9	± 32 m	0.125 m
$\delta a_{i,10}$	10	$\pm 2^{22}$ s	2^{-31} s
IODP	2	0 to 3	1
Spare	1	—	—

Notes. —
 1. The parameters PRN mask number and IODP are defined in 3.5.4.1.
 2. All other parameters are defined in 3.5.4.4.1.

[표 B-50. 타입 26 전리층 지연 보정 메시지]

Table B-50. Type 26 ionospheric delay message

Data content	Bits used	Range of values	Resolution
IGP band identifier	4	0 to 10	1
IGP block identifier	4	0 to 13	1
For each of 15 grid points			
IGP vertical delay estimate	9	0 to 63,875 m	0.125 m
Grid ionospheric vertical error indicator (GIVEL)	4	(see Table B-33)	(see Table B-33)
IODI _i	2	0 to 3	1
Spare	7	—	—

Note.— All parameters are defined in 3.5.4.6.

[표 B-51. 타입 27 SBAS 서비스 메시지]

Table B-51. Type 27 SBAS service message

Data content	Bits used	Range of values	Resolution
Issue of data, service (IODS)	3	0 to 7	1
Number of service messages	3	1 to 8	1
Service message number	3	1 to 8	1
Number of regions	3	0 to 5	1
Priority code	2	0 to 3	1
δUDRE indicator-inside	4	0 to 15	1
δUDRE indicator-outside	4	0 to 15	1
For each of 5 regions			
Coordinate 1 latitude	8	±90°	1°
Coordinate 1 longitude	9	±180°	1°
Coordinate 2 latitude	8	±90°	1°
Coordinate 2 longitude	9	±180°	1°
Region shape	1	—	—
Spare	15	—	—

Note.— All parameters are defined in 3.5.4.9.

[표 B-52. 타입 63 더미 메시지]

Table B-52. Type 63 null message

Data content	Bits used	Range of values	Resolution
Spare	212	—	—

3.5.7.1.1 필요한 데이터와 방송 간격

표 B-54에 나타난 바와 같이 SBAS는 지원되는 기능에 필요한 데이터를 전송해야 한다. 만약 SBAS 전송데이터가 특별한 기능을 요구받지 않는다면 그 요구사항들은 다른 기능 적용을 지원해야 한다. 제공된 각 데이터 타입의 모든 데이터에 대한 방송 사이의 최대 간격은 표 B-54에 정의된 것과 같아야 한다.

Table B-54. Data broadcast intervals and supported functions

Data type	Maximum broadcast interval	Ranging	GNSS satellite status	Basic differential correction	Precise differential correction	Associated message types
Clock-Ephemeris covariance matrix	120 s					28
SBAS in test mode	6 s					0
PRN mask	120 s		R	R	R	1
UDREI	6 s		R*	R	R	2 to 6, 24
Fast corrections	$I_c/2$ (see Note 4)		R*	R	R	2 to 5, 24
Long-term corrections	120 s		R*	R	R	24, 25
CEO ranging function data	120 s	R				9
Fast correction degradation	120 s		R*	R	R	7
Degradation parameters	120 s				R	10
Ionospheric grid mask	300 s				R	18
Ionospheric corrections, GIVEI	300 s				R	26
Timing data	300 s	R (see Note 3)	R (see Note 3)	R (see Note 3)	R (see Note 3)	12
Almanac data	300 s	R	R	R	R	17
Service level	300 s					27

Notes.—

1. "R" indicates that the data must be broadcast to support the function.

2. "R*" indicates special coding as described in 3.5.7.3.3.

3. Type 12 messages are only required if data are provided for GLONASS satellites.

4. I_c refers to the PA/APV time-out interval for fast corrections, as defined in Table B-57.

3.5.7.1.2 SBAS 무선주파수 감시

SBAS 시스템은 표 B-55에서 제시하는 SBAS 위성 파라미터를 감시하고, 필요 시 식별된 조치를 취해야 한다.

Table B-55. SBAS radio frequency monitoring

Parameter	Reference	Alarm limit	Required action
Signal power level	Chapter 3, 3.7.3.4.4.3	minimum = -161 dBW maximum = -153 dBW (Note 2)	Minimum: cease ranging function (Note 1). Maximum: cease broadcast.
Modulation	Chapter 3, 3.7.3.4.4.5	monitor for waveform distortion	Cease ranging function (Note 1).
SNT-to-GPS time	Chapter 3, 3.7.3.4.5	N/A (Note 3)	Cease ranging function unless URA reflects error.
Carrier frequency stability	3.5.2.1	N/A (Note 3)	Cease ranging function unless σ^2_{UDRE} and URA reflect error.
Code/frequency coherence	3.5.2.4	N/A (Note 3)	Cease ranging function unless σ^2_{UDRE} and URA reflect error.
Maximum code phase deviation	3.5.2.6	N/A (Notes 2 and 3)	Cease ranging function unless σ^2_{UDRE} and URA reflect error.
Convolutional encoding	3.5.2.9	all transmit messages are erroneous	Cease broadcast.

주. SBAS는 다른 데이터가 방송되지 않은 각 시간 슬롯에 빈(null) 메시지(타입 63 메시지)를 방송할 수도 있다.

3.5.7.1.3 "사용금지".

SBAS는 사용자들에게 SBAS 위성의 거리측정 기능 및 방송 데이터를 사용하지 않도록 알리는 것이 필요할 때 "사용금지(Do Not Use)" 메시지(타입 0 메시지)를 방송해야 한다.

3.5.7.3 GNSS 위성 상태 기능.

SBAS가 위성 상태 기능을 제공하는 경우, 그 기능은 이 항목에 포함된 요구사항을 준수해야 한다.

3.5.7.3.2 PRN 마스크 및 데이터 발행-PRN (IODP).

SBAS는 PRN 마스크 및 IODP (타입 1 메시지)를 방송해야 한다. PRN 마스크 값은 데이터가 각 GNSS 위성에 제공되고 있는지의 여부를 표시해야 한다. PRN 마스크에 변경이 있을 때 IODP는 바뀌어야 한다. 타입 1 메시지에 있는 IODP의 변경은 임의의 다른 메시지에 있는 IODP 변경에 앞서 발생해야 한다. 타입 2~5, 7, 24, 25 및 28 메시지에 있는 IODP는 PRN 마스크 메시지(타입 1 메시지)로 방송된 IODP와 동일해야 하며, 이 PRN 마스크 메시지는 데이터가 그 메시지에 제공된 위성을 지정하기 위해 사용되었다.

3.5.7.4 기본 차동 보정 기능.

SBAS가 기본적인 차동 보정 기능을 제공하는 경우, 3.5.7.3에 정의된 GNSS 위성 상태 기능 요건에 추가하여 이 부분에 포함된 요건을 준수해야 한다.

3.5.7.4.1 기본적인 차동 보정 기능의 성능.

활성 데이터의 유효한 조합을 감안하여, 연속 8초 이상 HPL_{SBAS} (3.5.5.6에서 정의됨)을 초과하는 수평 오차의 확률은 영(0) 대기 시간을 갖는 사용자를 가정하면, 시간당 10^{-7} 미만이어야 한다.

주. 활성 데이터는 3.5.8.1.2에 따라 시간이 초과되지 않은 데이터로 정의된다. 이 요구사항은 코어 위성군 및 SBAS 고장을 포함한다.

3.5.7.4.2 장기 보정.

동일한 서비스 제공자로부터 SBAS 위성을 제외하고, SBAS는 PRN 마스크에 표시된(PRN 마스크 값 "1") 각 GNSS 가시 위성(주석 참고)의 장기 보정을 결정하고 방송을 해야 한다. 장기 보정은 장기 보정을 적용한 후 위성 서비스 영역 내의 모든 사용자에게 대해 가시선에 투영된 코어 위성 위치 오차는 256m 이내이어야 한다. 각 GLONASS 위성의 경우, SBAS는 전에 장기적인 수정 결정에 3.5.5.2에 정의 된 위성 WGS-84로 좌표 변환해야 한다. 각각의 GPS 위성의 경우, 방송 IOD는 GPS의 IODE 및 보정(3.1.1.3.1.4과 3.1.1.3.2.2)을 계산하는데 시계 및 천문력 데이터와 관련된 8개의 LSB IODC가 모두 일치하여야 한다. GPS 위성에 의해 새로운 궤도력의 송신 시, 적어도 2분 그리고 4분을 넘지 않게 SBAS는 계속 궤도력을 단기 그리고 장기 오류 보정을 결정하는데 사용해야 한다. 각 GLONASS 위성의 경우, SBAS는 대기 시간 및 3.5.4.4.1에서 정의된 유효 간격으로 구성된 IOD를 계산하고 방송한다.

주. 위성 가시성에 대한 기준은 기준국의 위치 및 그 위치에서 달성된 마스크 각도를 포함한다.

3.5.7.4.3 단기 보정.

SBAS는 PRN 마스크(동일 PRN 마스크 값을 "1")에 표시된 각각의 가시 GNSS 위성에 대한 단기 보정을 결정해야 한다.

IODF = 3을 제외하면, 매번 타입 $j(j = 2, 3, 4$ 또는 $5)$ 의 단기 보정 데이터 메시지를 변경한다. IODFj의 순서는 "0, 1, 2, 0, ..." 이 되어야 한다.

주. 경보 조건이 있다면, IODFj는 3과 같을 것이다(3.5.7.4.5 참조).

3.5.7.4.5 무결성 데이터.

보정이 제공되는 각 위성의 경우, SBAS는 (UDRE_{li} 및 선택적으로 δ UDRE)을 계산하기 위한 타입 27 또는 타입 28 메시지 데이터) 무결성 데이터를 방송해야 하고, 3.5.7.4.1의 무결성 요건이 만족되도록 해야 한다. 단기 또는 장기 보정이 자신의 코드 범위를 초과하는 경우, SBAS는 ("사

용하지 않음”) 위성이 비정상인 것을 표시하여야 한다. 만약 $\sigma_{i,UDRE}^2$ 판별할 수 없는 경우 SBAS 위성은 “모니터링 되지 않음”을 나타내야 한다.

타입 6 메시지가 $\sigma_{i,UDRE}^2$ 방송을 위해 사용된다면:

- a) IODF_j는 $\sigma_{i,UDRE}^2$ 가 타입 j 메시지에서 적용되는 수신된 단기 보정을 위해 IODF_j와 일치시키거나;
- b) $\sigma_{i,UDRE}^2$ 가 시간 초과되지 않은 타입 j 메시지에서 수신된 모든 유효한 단기 보정에 적용된다면 IODF_j는 3이어야 한다.

3.5.7.4.6 열화 데이터.

SBAS는 단기 보정에 대한 해당 시간 초과 간격을 지시하고 3.5.7.4.1의 무결성 요구사항이 충족될 수 있도록 열화 파라미터(타입 7 메시지)를 방송해야 한다.

3.5.7.5 정밀 차동 보정 기능.

SBAS가 정밀한 차동 보정 기능을 제공하는 경우, 3.5.7.4의 기본 차동 보정 기능 요건에 더하여, 이 부분에 포함된 요구 사항을 따라야 한다.

3.5.7.5.1 정밀 차동 보정 기능의 성능.

유효한 활성 데이터의 조합이 주어지면, 관련 경보시간보다 긴 오차가 허용되지 않는 조건의 확률은 대기 시간이 영(0)인 사용자를 가정하는 임의 접근 동안 2×10^{-7} 보다 작아야 한다. 경보시간은 정밀 접근 운용을 지원하는 SBAS의 경우 5.2초, 수직유도접근절차(APV) 또는 비정밀접근(NPA) 운용을 지원하는 SBAS의 경우 8초이어야 한다. 허용 오차 범위를 벗어나는 조건은 (3.5.5.6에 정의된 바와 같이) HPL_{SBAS} 를 벗어나는 수평오차 또는 VPL_{SBAS} 를 벗어나는 수직오차로서 정의되어야 한다. 허용오차를 벗어나는 조건이 탐지되었을 때, 생성된 경보 메시지(타입 2~5, 6, 24, 26, 27 메시지에 있는 방송)는 4초에 총 4회, 경보조건의 초기 경고 후 3회 반복되어야 한다.

주1. 활성 데이터는 3.5.8.1.1에 따라 time-out 되지 않은 데이터로 정의된다. 이 요구 사항은 코어위성군(들) 및 SBAS 고장이 포함되어 있다.

주2. 후속 메시지는 정상적인 업데이트 속도로 전송될 수 있다.

3.5.7.5.2 전리층 격자점(IGP) 마스크.

SBAS는 IGP 마스크와 $IODI_k$ (11개 IGP 대역에 해당하는 타입 18 메시지를 최대 11번)를 방송해야 한다. IGP 마스크 값은 데이터가 각각의 IGP에 대해 제공되고 있는지 여부를 표시해야 한다. IGP 대역 9가 사용되는 경우, 0에서 8까지 대역의 북쪽 55°N의 IGP를 위한 IGP 마스크 값은 “0”으로 설정되어야 한다. IGP 대역 10이 사용되는 경우, 0에서 8까지 대역의 남쪽 55°S의 IGP를 위한 IGP 마스크 값은 “0”으로 설정되어야 한다. $IODI_k$ 는 k번째 대역의 IGP 마스크 값의 변화가 있을 때 변경해야 한다. 새로운 IGP 마스크는 이 관련 타입 26 메시지에서 참조되기 전에 타입 18 메시지에 방송되어야 한다. 타입 26 메시지의 $IODI_k$ 는 해당 메시지에서 제공되는 IGP를 지정하는데 사용되는 IGP 마스크 메시지(타입 18 메시지)의 $IODI$ 와 같아야 한다.

3.5.7.5.3 전리층 보정.

SBAS는 IGP 마스크(IGP 마스크 값은 동일 “1”)에 지정된 IGP에 대한 전리층 보정을 방송해야 한다.

3.5.7.5.4 전리층 무결성 데이터.

보정이 제공되는 각 IGP에 대해, SBAS는 3.5.7.5.1의 무결성 요건이 충족되도록 GIVEI 데이터를 방송해야 한다. 전리층 보정 또는 $\sigma_{i,GIVE}$ 의 코딩 범위를 초과하면, SBAS는 IGP에 대한 상태 “사용하지 않음”(보정 데이터에 지정, 3.5.4.6)을 표시하여야 한다. $\sigma_{i,GIVE}$ 를 판별할 수 없는 경우,

SBAS는 IGP는 “모니터링되지 않음”(GIVEI 코딩에 지정)을 표시하여야 한다.

3.5.7.5.5 열화 데이터

SBAS는 3.5.7.5.1의 무결성 요건이 충족되도록 열화 파라미터(타입 10 메시지)을 방송해야 한다.

3.5.7.6.2 서비스 식별.

서비스 식별 데이터가 방송되는 경우, 데이터는 3.5.4.9 (타입 27 메시지)에 정의되어진 대로 되어야 하고 타입 28 메시지는 방송되지 않아야 한다. 모든 타입 27 메시지의 IODS는 타입 27 메시지 데이터가 변경되면 증가해야 한다.

3.5.7.7.1 SBAS 무선 주파수 모니터링.

SBAS는 표 B-55에 보여진 SBAS 위성 파라미터를 모니터링 해야 하며 지정된 작업을 수행해야 한다.

주. 분석 및 시험에서 이러한 파라미터들이 정해진 한계를 초과할 수 없다는 것을 보여 주지 않는다면, 이 섹션의 무선 주파수 모니터링 요구에 추가하여, 3장 3.7.3.4.2.1.5에 규정된 의사거리 가속도와 3.5.2.2에 규정된 반송파 위상 잡음 및 3.5.2.2의 상관 손실을 모니터링하기 위한 특별한 규정을 만들 필요가 있다.

Table B-55. SBAS radio frequency monitoring

Parameter	Reference	Alarm limit	Required action
Signal power level	Chapter 3, 3.7.3.4.4.3	minimum = -161 dBW maximum = -153 dBW (Note 2)	Minimum: cease ranging function (Note 1). Maximum: cease broadcast.
Modulation	Chapter 3, 3.7.3.4.4.5	monitor for waveform distortion	Cease ranging function (Note 1).
SNT-to-GPS time	Chapter 3, 3.7.3.4.5	N/A (Note 3)	Cease ranging function unless URA reflects error.
Carrier frequency stability	3.5.2.1	N/A (Note 3)	Cease ranging function unless σ^2_{UDRE} and URA reflect error.
Code/frequency coherence	3.5.2.4	N/A (Note 3)	Cease ranging function unless σ^2_{UDRE} and URA reflect error.
Maximum code phase deviation	3.5.2.6	N/A (Notes 2 and 3)	Cease ranging function unless σ^2_{UDRE} and URA reflect error.
Convolutional encoding	3.5.2.9	all transmit messages are erroneous	Cease broadcast.

Notes—

- 1. Ceasing the ranging function is accomplished by broadcasting a URA and σ^2_{UDRE} of “Do Not Use” for that SBAS satellite.*
- 2. These parameters can be monitored by their impact on the received signal quality (C/N₀ impact), since that is the impact on the user.*
- 3. Alarm limits are not specified because the induced error is acceptable, provided it is represented in the σ^2_{UDRE} and URA parameters. If the error cannot be represented, the ranging function must cease.*

3.5.7.7.2 데이터 모니터링.

SBAS는 첨부 D, 8.11에 정의된 추적 성능을 가진 항공기 수신기 차동 처리의 부적절한 동작을 야기시키는 상태를 감시하기 위해 위성 신호를 모니터링해야 한다.

주. 모니터링은 코어 위성군(들)과 SBAS 위성의 고장을 포함하여 모든 고장 조건에 적용한다. 이러한 모니터링은 항공기 요소는 3.5.8과 첨부 D, 8.11로 대체되는 것을 제외하고, RTCA/DO-229C의 요구사항에 적합하다고 가정한다.

3.5.7.7.2.1

지상 서브 시스템은 의사거리 보정을 생성하기 위해 사용되는 모든 수신기에서 가장 강한 상관

피크를 사용해야 한다.

3.5.7.7.2.2

지상 서브시스템은 또한 첨부 D, 8.11에 Early-Late 판별 함수를 사용하여 항공기 수신기에 대해 하나 이상의 부호 변화점을 야기시키는 상태를 검출해야 한다.

3.5.7.7.2.3

모니터 활동은 위성에 대해 "사용하지 않음"으로 UDRE를 설정해야 한다.

3.5.7.7.2.4

SBAS는 서비스 지역 내의 모든 사용자가 사용할 수 있는 모든 활성 데이터를 모니터링해야 한다.

3.5.7.7.2.6

SBAS는 활성 데이터 및 GNSS 공간신호의 조합이 항로~APV-I(3.5.7.4.1)에 대해 허용 오차 범위를 벗어난다면 8초 이내에 경보를 울려야 한다.

3.5.7.8 코어위성군에 대한 견고성.

코어위성군 이상 발생 시, SBAS 일반적으로 추적될 수 있는 정상적인 위성 신호를 사용하여 계속 작동해야 한다.

3.9 순환중복검사(CRC)

○ 성능적합증명 검사기관 운영규정에 따른 기술기준 검사 수행 방법

- 입증방법(MoC, Means of Compliance) 결정

[표 24. 입증방법 및 세부 적용 대상]

입증방법	적용 대상
T(시험)	모든 기술기준에 대한 기본적인 입증방법 KASS 구성요소를 실제 활용하여 기능 동작시킨 후 획득된 데이터 및 결과를 기준으로 적합성 판단
R(검토)	설계서, 외부공인성적서, COTS 규격서, 추적성 자료 등 서류 검사를 통해 적합성 판단
A(분석)	모델링, 예측분석 등 수치계산을 통한 적합성 판단 직접적인 시험환경 구성이 불가하여, 시뮬레이터 등 모사환경에서 시험한 결과를 기준으로 적합성 판단
L(참조)	타 기술기준의 조합으로 입증가능한 경우 적용

* 기술기준 특성에 따라 입증방법 2~3개 중복 적용 가능

- (입증계획서 작성) 정해진 입증방식에 대한 상세계획을 정의한 문서로 각 기술기준별 시험평가 항목(CCL-XXX-XX)에 대한 구체적인 입증방안을 신청자가 작성하여 검사기관에 제출하여 협의

[표 25. 입증계획서 양식]

기술기준 식별번호	시험평가 식별번호	적합성입증방법	작성자										
CCL-XXX	CCL-XXX-XX	Analysis / Review / Test / Link	XXX										
CCL-XXX													
ICAO Annex 10 Vol.1 (6th Edition, July 06 Amd 86, 2011.7.18) (기술기준 - 영문)													
ICAO 부속서 10, 1권 (6차 개정, 86차 수정본, 2011.7.18) (기준기준 - 한글)													
입증계획													
Ex) Test													
1. 시험형상													
2. 구성도													
3. 절차													
4. 적합성 평가기준													
<table border="1" style="width: 100%;"> <thead> <tr> <th style="width: 10%;">No.</th> <th style="width: 90%;">기준</th> </tr> </thead> <tbody> <tr> <td>1</td> <td></td> </tr> <tr> <td>2</td> <td></td> </tr> </tbody> </table>				No.	기준	1		2					
No.	기준												
1													
2													
Ex) Analysis / Review													
1. 입증문서													
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No.	문서명	문서번호	Issue	해당 장·절									
1													
2. 추적성 정보													
3. 적합성 평가기준													
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No.	기준												
1													
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3													

- (시험평가 수행) 합의된 입증계획에 따라 입증에 대한 시험 혹은 평가를 수행하며, 시험의 경우 신청자 측에서 입증계획에 작성된 시험절차에 따라 시험을 수행하고 검사원이 이를 입회하는 입회시험을 주로 수행

※ EC의 FEEO 혹은 시험환경 구성(예: 실제 운영 환경이 아닌 Simulation Test가 필요한 환경) 문제로 프랑스 현지에서 일부 입회시험이 포함되었음



[그림 8. KASS 프랑스 현지 입회시험 현장]

※ 공간신호성능(SiS, Signal in Space)에 대한 분석(Analysis)은 일반적으로 EC에서 열람불가보안문서(FEEO)로 지정한 무결성 및 연속성 파일집(ICOS File)을 주요 입증자료로 제시하였으며, 기존 입증참고문서 검토 내용 중 주요한 항목들을 같이 식별하여 시험·평가를 수행

[표 26. 무결성 및 연속성 파일집 개요]

순번	제목	내용 요약
1	I&COS Part 1 - Feared Event characterisation	위협 이벤트에 각 항목에 대한 특성 분석 결과 요약
2	I&COS Part 2 - User Impact Probabilities	사용자 기준 영향 시나리오를 고려한 성능 분석 결과 요약
3	I&COS Part 3 - User dependant feared events	사용자에 의해 발생 가능한 특정 위협 이벤트 분석 결과 요약
4	I&COS Part 4 - Integrity budget	무결성 예상 성능 산출 결과 요약
5	I&COS Part 5 - Continuity budget	연속성 예상 성능 산출 결과 요약

[표 27. ICOS Dataroom 현지검토 일정]

순번	기간	내용
1회차	2018.10.15 - 19	KASS CDR#1 기준 ICOS 보안문서 검토
2회차	2021.03.22 - 26	KASS CDR#2 기준 ICOS 보안문서 검토
3회차	2023.07.17 - 21	KASS TRR 기준 ICOS 보안문서 검토
4회차	2023.10.17 - 19	KASS SQR 기준 ICOS 보안문서 검토

※ EC의 Dataroom 규정 상 내부 사진 촬영 불가, 유무선/전자통신기기 사용 불가



[그림 9. KASS ICOS 데이터룸 참석 사진]

※ 공간신호성능(SiS)에 대한 실운영 KASS 성능시험은 객관적인 성능 확인을 위해 국내 위성항법 분야 전문가 자문, EASA 실무 협력 회의, 과거 유사 시스템(WAAS, EGNOS) 사례·문헌 조사 등을 종합적으로 고려하여 적정한 시험 기간('23.6~'23.12')을 산출

[표 28. KASS SiS 성능시험 전문가 자문 회의 결과 요약]

<ul style="list-style-type: none"> ○ (안건 1) KASS SiS 성능시험 시 주요 고려사항 <ul style="list-style-type: none"> - KASS SiS 성능에 영향 미치는 최대 사안은 전리층 지연 - 수행된 시험이 서비스 성능을 대표하고 위험 요소를 확인할 수 있도록 시험환경(장소, 장비, 기간, 시나리오 등)을 설정할 필요 有 ○ (안건 2) KASS SiS 성능시험에 필요한 3적정 기간 <ul style="list-style-type: none"> - 전리층 영향성 판단을 위해 봄과 가을을 포함하여 6개월~12개월 범위의 성능시험 필요 ○ (안건 3) KASS SiS 성능시험 관련 기타 고려사항 <ul style="list-style-type: none"> - KASS Baseline이 되는 EGNOS 사례와 EASA 권고를 활용할 필요 有
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※ (예시) 공간신호성능(SiS) 중 하나인 연속성 시험 데이터 처리 합의 결과

[표 29. KASS SiS 연속성 계산 방안 협의 결과(2023.8.16.)]

<p>1. 연속성 정의</p> <p>KASS 서비스 영역 내의 사용자에게 예기치 못한 중단 없이 특정 시간 동안 연속적인 서비스 제공 가능 여부</p>
<p>2. 연속성 연산 방법</p> <ul style="list-style-type: none"> - Sliding Window 기법을 사용

① Sliding Window 크기 설정

- i) 연속성 위해 사건 발생여부를 판단하기 위해 각 항행 구간별(Typical Operation) Sliding Window 크기를 결정하여야 하며, Sliding Window의 크기는 각 항행 구간별 단위 시간에 따라 달라짐
- ii) 연속성은 항공기가 각 항행구간에서 SBAS를 사용하여 각 항행 구간별 단위시간 동안 정상동작함을 의미함
- iii) 항공기의 정상동작 이후, 각 항행 구간의 단위시간 동안 정상동작의 중단((HPL>HAL 또는 VPL>VAL 또는 보호수준 계산 불가)이 발생할 경우를 연속성 위해 사건이라 정의함
- iv) 따라서, 연속성 위해 사건을 식별하기 위한 Sliding Window의 크기는 항공기의 정상동작을 확인하기 위한 시점과 각 항행 구간별 단위시간에 따라 결정함
 - i) En-route부터 NPA의 경우, 3601초 = 1초(Sliding Windows의 availability 판단) + 3600초(Continuity Event발생 여부 판단)
 - ii) APV-I의 경우, 16초 = 1초(Sliding Windows의 availability 판단) + 15초(Continuity Event 발생 여부 판단)

② Continuity Event 발생 여부 판단

- i) Sliding Window의 첫번째 Epoch이 Available 하여야 함
- ii) Sliding Window의 잔여 Epoch 중 하나라도 Outage가 발생할 경우 Continuity Event가 발생한 것으로 간주함

③ 연속성 계산식

=> Continuity Risk = N_E/N_T
 N_E : Continuity Events 개수
 N_T : 총 가용 Window 개수

3. 장기간 연속성 계산 방법

- 1개월 단위로 Continuity Event 개수 도출 : $N_{i,E}$ (여기서, i는 i-번째 달)
- 1개월 단위로 총 가용 Window 개수 도출 : $N_{i,T}$
- 최종 연속성 위해 확률 계산을 위한 N_E 와 N_T 는 다음과 같이 계산됨

$$N_E = \sum_{i=1}^m N_{i,E}$$

$$N_T = \sum_{i=1}^m N_{i,T}$$

여기서, m은 총 개월수를 의미

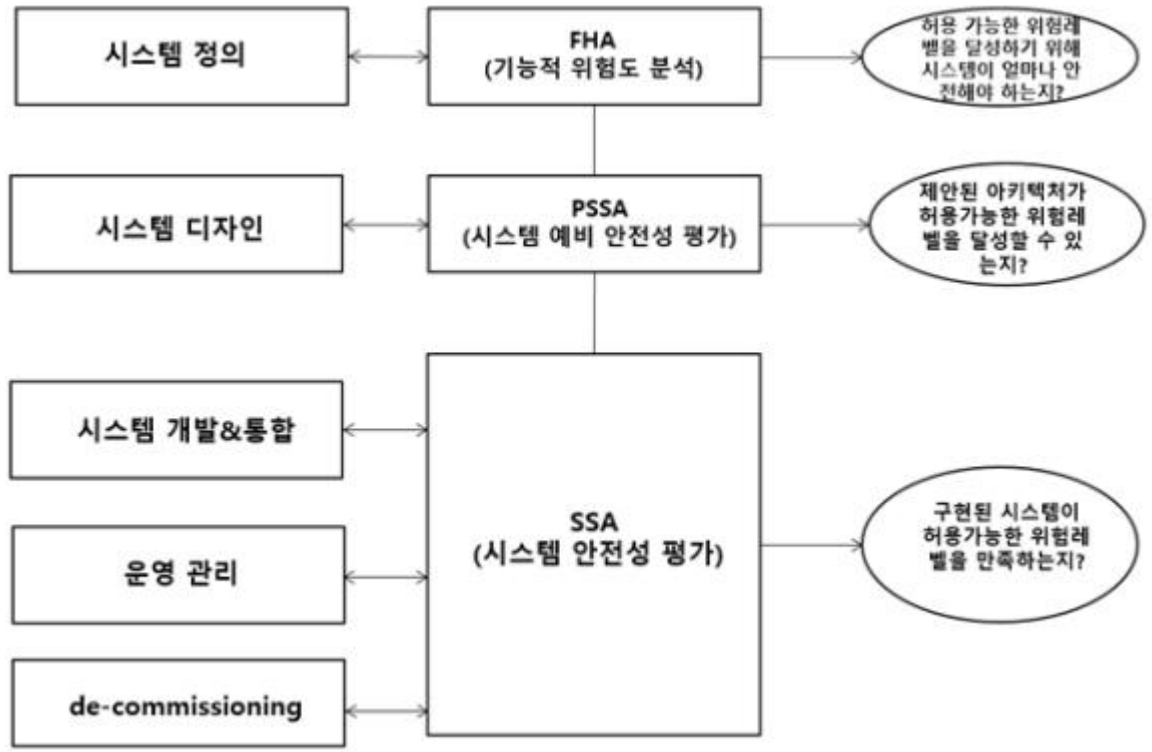
- 계산 방법의 적정성 분석

- 접근 1 : 1일 단위로 Continuity Event 및 가용 Window 계산후, 위 방법에 따라 연속성 위해 확률 계산
- 접근 2 : 1개월 단위로 Continuity Event 및 가용 Window 계산후, 연속성 위해 확률 계산
- 접근 1과 접근 2 사이의 결과 값 차이가 $0.001 \times 10^{-3}/15s$ 이하
- 따라서, 장기간 연속성 위해 확률 계산을 위해 접근 1 방식 사용 가능 판단

- (시험평가성적서 작성) 입증계획에 따라 시험/검토/분석을 수행하여 적합성 판단한 결과를 기록한 문서로 신청자가 아닌 검사기관이 세부 내용을 작성하여 시험주관자인 신청자와 검사원의 수기 서명하여 완료

[표 30. 시험평가성적서 양식]

KASS 성능적합증명 수행 시험평가 성적서				
기술기준 식별번호	CCL-000	시험평가 식별번호	CCL-000-00	
시험항목	(기술기준 제목)	적합성입증방법	000	



[그림 10. 시스템 안전성 평가 개념도]

○ 소프트웨어 현장감사 엄격성(LOI, Level of Involvement) 결정 방법

- S/W 현장감사 엄격성은 하위시스템별 실무개발업체를 대상으로 아래 평가항목에 대한 점수를 산정
- 현장감사 엄격성 결정은 평가항목 점수 및 하위시스템의 DAL에 따라 결정되며, 최종 결과는 아래와 같음

[표 32. 개발보증등급별 점수에 따른 현장감사 엄격성 결정 매트릭스]

점수 범위	DAL A	DAL B	DAL C	DAL D
점수 <= 80	High	High	Medium	Low
80 < 점수 <= 130	High	Medium	Medium	Low
130 < 점수	Medium	Medium	Low	Low

* FAA ORDER 8110.49A - Software Approval Guidelines에 제시된 기준 활용 (High는 최소 2회, Medium은 1-2회, Low는 필요 시 수행)

- 점수계산 매트릭스

[표 33. 현장감사 엄격성 점수 평가 매트릭스]

No.	Criteria	Scale	MIN.	-	MAX.
1. Software Certification Experience of Development Organization					
1.1	Experience with civil aircraft or engine certification.	Number of projects	0 0	5 3-5	10 6+
1.2	Experience with RTCA D0-178B/C.	Number of projects	0 0	5 2-4	10 5+
1.3	Experience with RTCA D0-178 or RTCA D0-178A.	Number of projects	0 0	3 4-6	5 7+

1.4	Experience with other software standards (other than RTCA DO-178 B/C).	Number of projects	0 0	2 4-6	4 7+
2. Demonstrated Software Development Capability of Development Organization					
2.1	Ability to consistently produce RTCA DO-178 B/C software products.	Scale: Ability:	0 Low	5 Med	10 High
2.2	Cooperation, openness, and resource commitments.	Scale: Ability:	0 Low	5 Med	10 High
2.3	Ability to manage software development and subcontractors.	Scale: Ability:	0 Low	5 Med	10 High
2.4	Capability assessments (for example, Software Engineering Institute Capability Maturity Model, ISO 9001-3).	Scale: Ability:	0 Low	2 Med	4 High
2.5	Development team average based on relevant software development experience	Scale: Ability:	0 <2yrs	5 2-4yrs	10 >4yrs
3. Software Service History of Development Organization					
3.1	Incidents of software related problems (as a % of affected products).	Scale: Incidents:	0 >25%	5 >10%	10 None
3.2	Company management' s support of QA managers	Scale: Quality:	0 Low	5 Med	10 High
3.3	Company software quality assurance organization and configuration management process.	Scale: Quality:	0 Low	5 Med	10 High
3.4	Company stability and commitment to safety.	Scale: Stability:	0 Low	3 Med	6 High
3.5	Success of past company certification efforts.	Scale: Success:	0 None	3 >50%	6 All
4. The Current System and Software Application					
4.1	Complexity of the system architecture, functions, and interfaces.	Scale: Complex:	0 High	5 Med	10 Low
4.2	Complexity and size of the software and safety features.	Scale: Complex:	0 High	5 Med	10 Low
4.3	Novelty of design and use of new technology.	Scale: Newness:	0 Much	5 Some	10 None
4.4	Software development and verification environment	Scale: Environment:	0 None	3 Older	6 Modern
4.5	Use of alternative methods or additional considerations	Scale: Standard	0 Much	3 Little	6 None

5. QA managers' Capabilities					
5.1	QA managers' experience with RTCA DO-178B/C.	Scale: Projects:	0 <5	5 5-10	10 >10
5.2	QA managers' authority, autonomy, and independence.	Scale: Autonomy:	0 None	5 Self-starter	10 Outgoing
5.3	QA managers' cooperation, openness, and issue resolution effectiveness.	Scale: Effectiveness:	0 Non-responsive	5 Responsive	10 Cooperative/Open
5.4	Relevance of assigned QA managers' experience.	Scale: Related:	0 None	5 Somewhat	10 Exact
5.5	QA managers' current workload	Scale: Workload:	0 High	5 Medium	10 Low
5.6	QA managers' experience with other software standards (other than RTCA DO-178 B/C).	Scale: Projects:	0 <5	3 5-10	5 >10

- (감사 단계) 개발진척도에 따른 감사 단계를 나타내며, 1(계획), 2(개발), 3(검증 및 확인), 4(완료)의 총 4단계로 구성됨

[표 34. 감사 단계 별 수행 기준]

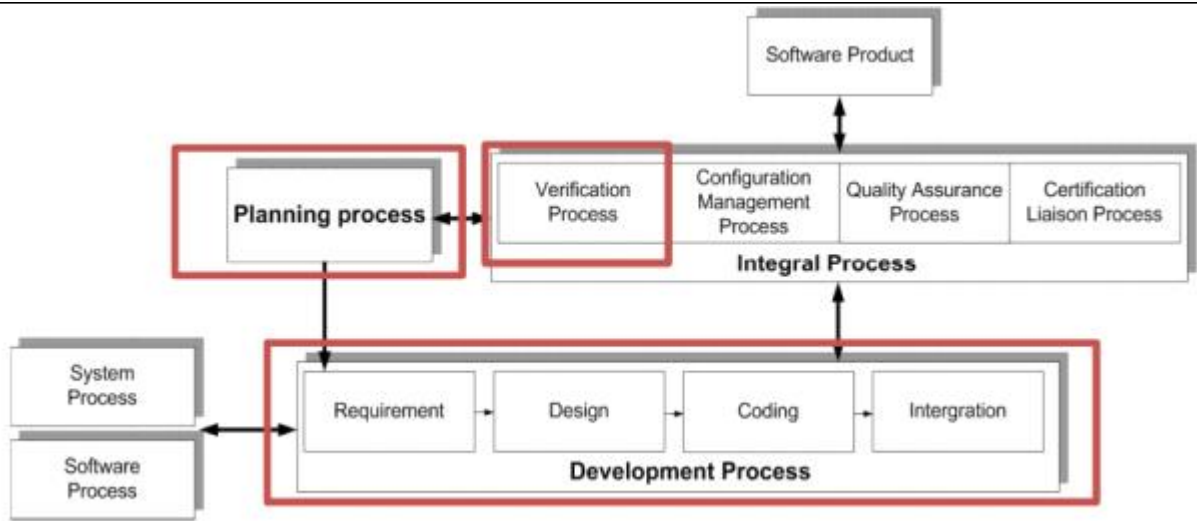
감사 단계	설명
S01* #1	소프트웨어 개발 계획이 완료되었을 때 수행
S01 #2	소프트웨어 요구사항, 설계, 코드 등이 상당 부분 개발되었을 때 수행
S01 #3	소프트웨어 검증 및 시험 데이터의 상당 부분 완료되어 검토되었을 때 수행
S01 #4	소프트웨어 적합성 검토가 완료되어 승인을 위한 준비가 완료되었을 때 수행

* S01(Stage of Involvement)

- (현장감사 수행방법) 소프트웨어 실제 개발 현장을 방문하여 인증계획서에 작성된 절차와 방법에 따라 소프트웨어 개발 및 검증을 수행하고 있는지 인증당국(검사기관)에서 검토 및 확인

- ① (개발사) 시스템 구성 및 설명 수행
- ② (검사기관) 소프트웨어 인증산출물 검토
- ③ (검사기관-개발사) 인터뷰 및 개발과정 시현(Demonstration)
- ④ (검사기관-개발사) 감사보고서 작성 및 리뷰

- (소프트웨어 개발산출물 검사 방법) KASS 소프트웨어 개발이 RTCA DO-178B표준에서 기술하고 있는 목표를 만족하여 개발하는지 검사



[그림 11. ED-12B 기술기준 개념도]

①-1. 소프트웨어 계획 프로세스 활동에 대한 검사 수행

- 시스템 요구 사항 할당
- 소프트웨어 레벨 정의
- 소프트웨어 생명주기 결정
- 소프트웨어 개발 환경 정의

①-2. 소프트웨어 계획 프로세스 산출물에 대한 검토 수행

- PSAC(Plan for SW Aspects of Certification)
- SDP(SW Development Plan)
- SVP(SW Verification Plan)
- SCMP(SW Configuration Management Plan)
- SQAP(SW Quality Assurance Plan)
- SRS(SW Requirements Standards)
- SDS(SW Design Standards)
- SCS(SW Code Standards)

②-1. 소프트웨어 개발 프로세스 활동에 대한 검사 수행

- High-level requirements, Low-level requirements
- Derived high-level requirements, Derived low level requirements
- Software Architecture 및 Source Code
- Integration HW/SW

②-2. 소프트웨어 개발 프로세스 산출물에 대한 검토 수행

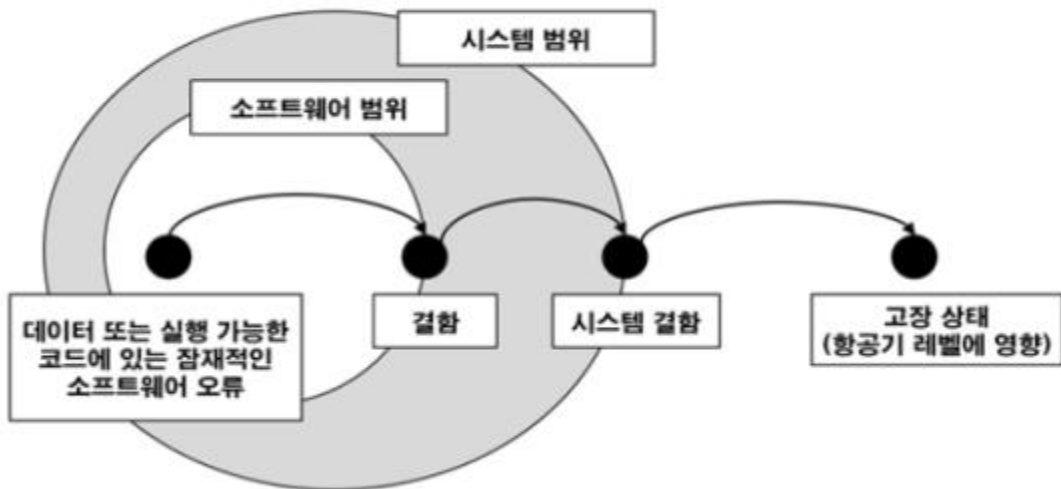
- Software Requirement Data
- Software Design Description
- Source Code
- Executable Object Code

③-1. 소프트웨어 검증 프로세스 활동에 대한 검사 수행

- 소프트웨어 Review & Analyses
- 소프트웨어 테스트
 - Low Level testing
 - SW integration testing
 - HW/SW integration testing
 - SW Requirements-Based Test Coverage Analysis
 - SW Structural Coverage Analysis

③-2. 소프트웨어 검증 프로세스 산출물에 대한 검토 수행

- Software verification cases and procedures (SVCP)
- Software verification results (SVR):
 - Review of all requirements, design and code
 - Testing of executable object code
 - Code coverage analysis
- 소프트웨어 등급에 따라 모든 코드 및 테스트 및 시험결과로 산출된 요구사항으로의 추적성에 대한 분석이 필요



[그림 12. ED-12B의 소프트웨어 오류, 결함, 고장상태 관계도]

- (소프트웨어 최종 승인 방법) 소프트웨어 보증등급 할당의 적절성 확인, 소프트웨어 인증계획서 (PSAC)에 명시한 소프트웨어 목표(Objectives) 최종 달성 여부 확인, 잔여 문제(Problems) 혹은 이슈(Issues)에 대한 최종 평가를 종합 고려하여 소프트웨어 달성요약서(SAS)에 대한 최종 승인 수행

※ 시스템 개발 검증 과정에서 이슈로 식별된 기능 보완, 기존 문제점 개선 등을 이유로 소프트웨어 버전 변경에 따른 소프트웨어 재승인 절차 마련

[표 35. 소프트웨어 프로세스별 세부 목표]

구분	ID	내용
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구분	ID	내용
SW 계획 프로세스	A-1/1	소프트웨어 수명주기 프로세스의 활동들이 정의되었는가?
	A-1/2	전환기준, 상호관계 및 프로세스 간의 순서가 정의되었는가?
	A-1/3	소프트웨어 수명주기 환경이 선택되고 정의되었는가?
	A-1/4	추가적인 고려사항이 포함되었는가?
	A-1/5	소프트웨어 개발표준이 정의되었는가?
	A-1/6	SAS가 PSAC에 따라 준수되었는가?
	A-1/7	소프트웨어 계획이 적절히 적용 및 활용되었는가?
SW 개발 프로세스	A-2/1	상위 요구사항이 개발되었는가?
	A-2/2	파생 상위 요구사항이 정의되었는가?
	A-2/3	소프트웨어 아키텍처가 개발되었는가?
	A-2/4	하위 요구사항이 개발되었는가?
	A-2/5	파생 하위 요구사항이 정의되었는가?
	A-2/6	소스코드가 개발되었는가?
	A-2/7	타겟 컴퓨터에서 실행가능한 목적코드가 만들어지고 통합되었는가?
SW 요구사항 프로세스	A-3/1	상위 요구사항은 시스템 요구사항을 따르는가?
	A-3/2	상위 요구사항은 정확하고 일관성 있는가?
	A-3/3	상위 요구사항은 타겟 컴퓨터와 호환되는가?
	A-3/4	상위 요구사항은 검증 가능한가?
	A-3/5	상위 요구사항은 표준을 준수하는가?
	A-3/6	상위 요구사항이 시스템 요구사항으로 추적 가능한가?
	A-3/7	알고리즘은 정확한가?
SW 설계 프로세스	A-4/1	하위 요구사항은 상위 요구사항을 따르는가?
	A-4/2	하위 요구사항은 정확하고 일관성 있는가?
	A-4/3	하위 요구사항은 타겟 컴퓨터와 호환되는가?
	A-4/4	하위 요구사항은 검증 가능한가?
	A-4/5	하위 요구사항은 표준을 준수하는가?
	A-4/6	하위 요구사항이 상위 요구사항으로 추적 가능한가?
	A-4/7	알고리즘은 정확한가?
	A-4/8	소프트웨어 아키텍처는 상위 요구사항과 호환되는가?
	A-4/9	소프트웨어 아키텍처는 일관성 있는가?
	A-4/10	소프트웨어 아키텍처는 타겟 컴퓨터와 호환되는가?
	A-4/11	소프트웨어 아키텍처는 검증 가능한가?
	A-4/12	소프트웨어 아키텍처는 표준을 준수하는가?
	A-4/13	소프트웨어 파티셔닝의 무결성이 확인(confirm) 되었는가?

구분	ID	내용
SW 코딩 및 통합 프로세스	A-5/1	소스코드는 하위 요구사항을 따르는가?
	A-5/2	소스코드는 소프트웨어 아키텍처를 따르는가?
	A-5/3	소스코드는 검증 가능한가?
	A-5/4	소스코드는 표준을 준수하는가?
	A-5/5	소스코드는 하위 요구사항으로 추적 가능한가?
	A-5/6	소스코드는 정확하고 일관성 있는가?
	A-5/7	소프트웨어 통합 프로세스의 결과물은 완전하고 올바른가?
전체 (Integral) 프로세스	A-6/1	실행가능한 목적코드가 상위 요구사항을 따르는가?
	A-6/2	실행가능한 목적코드가 상위 요구사항에 강건(robust)한가?
	A-6/3	실행가능한 목적코드가 하위 요구사항을 따르는가?
	A-6/4	실행가능한 목적코드가 하위 요구사항에 강건(robust)한가?
	A-6/5	실행가능한 목적코드가 타겟 컴퓨터에 호환되는가?
SW 검증 프로세스	A-7/1	시험 절차가 올바른가?
	A-7/2	시험 결과가 올바르고 불일치사항이 설명되었는가?
	A-7/3	상위 요구사항의 시험 커버리지가 충족되었는가?
	A-7/4	하위 요구사항의 시험 커버리지가 충족되었는가?
	A-7/5	소프트웨어 아키텍처 (MC/DC)의 시험 커버리지가 충족되었는가?
	A-7/6	소프트웨어 구조(결정 커버리지)의 시험 커버리지가 충족되었는가?
	A-7/7	소프트웨어 구조(문장 커버리지)의 시험 커버리지가 충족되었는가?
	A-7/8	소프트웨어 구조(Data Coupling 및 Control Coupling)에 대한 시험 커버리지가 충족되었는가?
SW 형상관리 프로세스	A-8/1	형상 아이템들이 식별되었는가?
	A-8/2	기준선 및 추적성이 확립되었는가?
	A-8/3	문제보고, 변경관리, 변경검토, 형상상태 관리가 확립되었는가?
	A-8/4	저장, 검색, 릴리즈가 확립되었는가?
	A-8/5	소프트웨어 적재관리(load control)가 확립되었는가?
	A-8/6	소프트웨어 수명주기 환경 관리가 확립되었는가?
SW 품질보증 프로세스	A-9/1	소프트웨어 개발 및 통합 프로세스가 승인된 소프트웨어 계획 및 표준을 따르는 것을 보증할 수 있는가?
	A-9/2	소프트웨어 수명주기 프로세스에 대한 전환 기준이 만족됨을 보증할 수 있는가?
	A-9/3	소프트웨어 적합성 검토(conformity review)가 수행되었는가?
인증연계 프로세스	A-10/1	인증 신청자와 인증당국 간의 의사소통과 상호 이해가 확립되었는가?
	A-10/2	MoC가 제안되었고 PSAC에 대한 합의가 이루어졌는가?
	A-10/3	준수상태가 제공되었는가?

다. 운영지침자료 검사 수행 방법

○ (운영 관련 개발산출물 및 검사 항목 식별) 총 8건의 KASS 개발산출물로부터 총 106건의 운영지침자

료 검사 항목 식별

- (운영기관 운영지침자료 식별) 총 10건의 KASS 운영기관 운영지침자료에 각 항목이 적절히 반영되었는지 여부 검토

[표 36. 검사 대상 운영지침자료 문서 목록표]

번호	ID	대상 문서	버전
RD01	KASS-A05-OPE-GL-01	KASS 시스템 운영 및 유지보수 체계 개발 가이드라인	F00_rev2
RD02	KASS-A05-OPE-GL-01-F	KASS 시스템 운영 시나리오	F00
RD03	KASS-A05-OPE-GL-01-J	KASS 시스템 예방정비 항목	F00
RD04	KASS-A05-OPE-GL-01-K	KASS 시스템 예방정비 절차	F00_rev2
RD05	KASS-A05-OPE-GL-01-L	KASS 시스템 유지보수 지원절차	F00_rev1
RD06	KASS-A05-OPE-GL-01-N	KASS 시스템 고장정비 절차	F00
RD07	KASS-A05-OPE-GL-01-Q	KASS 시스템 네트워크 관리	F00
RD08	KASS-A05-OPE-GL-01-W	KASS 시스템 제약사항	F00
RD09	KASS-A05-OPE-GL-01-X	KASS 시스템 기술조직 지침	F00_rev3
RD10	KASS-A07-OPE-GL-01	KASS 서비스제공 체계개발 가이드라인	F00

라. EASA 인증협력 및 적합성 확인 검사 수행 방법

- (국토부-EASA 간 인증협정 지원)
 - EASA 담당자 (Steffens Franks)와 10차례 이메일을 통한 수정·보완사항 협의 (17.2.10~4.5)
 - 유럽항공안전청(EASA)에서 제안한 KASS 인증협력 계약서 및 인증전문가 양성지원을 위한 교육훈련 제공 계약서에 대한 법률자문검토(2개 법무법인) 및 보완협의 완료
 - 인증 기술지원 및 SoC 발급에 대한 계약 및 인증 교육훈련 계약 체결 (17.4.25) 지원



[그림 13. KASS 인증협력 계약 체결식]

- EASA 인증 교육훈련 제공 개요
 - (교육대상) 국내 SBAS 인증관련자(국토부, 검사기관, 항우연, 진흥원) 15명

- (교육기간) 국내 이론교육(2주), 현지 실무교육(1주) 총 3주간
- (교육과정) 유럽인증기준, 시스템과 운영 검증방법, KASS 인증 고려사항 등

○ (EASA 교육훈련) SBAS 인증전문가 양성 전문교육 시행계획 알림 및 평가대상자 추천 요청(국토교통부 항행시설과-1082, 2017.5.16.)

- 유럽항공안전청(EASA) 인증 교육훈련 서비스 제공 계약서의 부속서에 따라 교육훈련 추천자 중 서면평가 결과에 따라 최대 15명 선발
 - (추천조건) 5년이상 장기간 성능적합증명(인증) 업무수행 특성에 따라 ‘항행안전시설 성능적합증명 검사기관 지정절차 등의 규정’ 기술인력 요구사항 부합 추천자
 - (의무조건) SBAS 인증기술단(기관별 추천 선정자)은 KASS 사업 인증완료 시까지 업무전담, 부득이한 경우로 업무중단 시 국토부와 사전 협의 필수
- SBAS 인증기술단 선정평가(국토교통과학기술진흥원 7층 회의실, 2017.5.18.)
 - (평가대상) KASS 성능적합증명(인증) 관계기관 인증 교육훈련 추천자 16명
 - * 국토부(3), 진흥원(1), 항공안전기술원(5), 한국정보통신기술협회(4), SBAS 사업단(3)
 - (평가방법) 국제민간항공기구(ICAO) 부속서10 제1권 GNSS 관련 범위 내 SBAS 관련 영어 서면평가(단답형 16문제, 서술형 4문제)에 따라 최대 15명 선발
 - * 종합평가점수가 70점미만 “탈락” 및 기관별 배정인원에 따른 선정
 - (선정결과) SBAS 인증기술단 선정평가 결과 기준점수(개인평가 70점) 이상자 선정
 - * 국토부(3), 진흥원(1), 항공안전기술원(5), 한국정보통신기술협회(3), SBAS 사업단(3)
- SBAS 인증기술단 구성 및 운영계획 알림(국토교통부 항행시설과-1155, 2017.5.23.)
 - (구성체계) 각 기관별 선정평가 합격자(총15명)를 대상으로 “SBAS 인증기술단” 구성 후 국내 전문교육 및 EASA 인증기술교육 등 중점실시
 - * 인증기술단장(관리총괄), 교육과제책임(교육진행-자료총괄) 및 인증기술단원(개인별 분담임무)의 기관별 역할 구분에 따른 체계적 구성
 - (관리총괄) SBAS 인증기술단장(국토부 인증업무 담당사무관)
 - (교육진행) 교육과제 책임연구원(항공안전기술원 인증과제책임자)
 - (운영계획) 각 기관개인별 역할분담 구성체계에 따라 인증기술단 운영 관리, 교육과정 정보수집·공유 및 교육결과 정리 등 임무수행
- SBAS 인증기술단 국내 전문교육 알림(국토교통부 항행시설과-1156, 2017.5.23.)
 - (추진배경) KASS 개발성능의 국제적 인증을 위하여 유럽항공안전청(EASA) 인증협력 및 국내 인증전문가 대상 교육지원 계약 체결('17.4, 국토부↔EASA)
 - (주요내용) 유럽항공안전청(EASA) KASS 인증기술교육 대비 인증기술단 이해도 향상 및 실력배양 등을 목표로 사전 교육·세미나 개최
 - * 인증기술단 구성기관 별 교육주제를 분담하여 연구·발표 시행 및 국내 GNSS 분야 전문가 초빙 강의 개최
 - 교육 세부일정

[표 37. SBAS 인증기술단 국내 이론 교육 내용]

교육일자	시간	교육 및 세미나 주제	발표자	교육장소
' 17.5.25(목)	09:30~ 12:30	• KASS 개발 구축 이력 공유 • GNSS 인증기준 및 상호운용성	SBAS 사업단 (KARI)	세종대학교 광개토관 108A 강의실 (서울시 광진구)
	14:00~ 17:00	• SBAS 기본개념 • SBAS 핵심 알고리즘	박00 교수 (세종대학교)	
' 17.5.30(화)	09:30~ 12:30	• ICAO/EU 법규 체계 • EU/EC 규정	항공안전 기술원(KIAST)	TTA 9층 대회의실A (경기도 성남시)
	14:00~ 17:00	• 안전성 평가 기법	한국정보통신 기술협회(TTA)	
' 17.5.31(수)	15:30~ 17:30	• GNSS 인프라 구축기술 관련	기00 교수 (서울대학교)	서울대학교 313동 224호 강의실 (서울시 관악구)
' 17.6.1(목)	9:30~ 12:30	• SBAS 활용한 APV 절차	이00 교수 (항공대학교)	국토교통과학 기술진흥원 대회의실 (경기 안양시)
	14:00~ 17:00	• 자체 세미나 정리 • 관계기관 회의	전체 참석자	

- SBAS 인증기술단 위성항행 실무 현장교육 시행 알림(국토교통부 항행시설과-1310, 2017.6.13.)
- (추진배경) 실제 항공업무 현장에서 위성항행 운용현황·관제체계 등을 견학하고 SBAS 서비스 제공에 대한 실무교육을 통하여 SBAS 이해도 증진
- 교육 세부일정

[표 38. SBAS 인증기술단 국내 현장 교육 내용]

교육일자	시간	교육과정	교육강사	교육장소
' 17.6.15(목)	09:30~12:30	• 항공기 위성항행 실제운용 절차 등	아시아나항공 운항교육팀 (안전보안실)	아시아나항공 본사 시뮬레이터실
	15:00~17:00	• 항공교통관제 실제	서울지방항공청 관제과	서울접근관제소 인천관제탑(계류장)
' 17.6.16(금)	09:30~12:30	• 위성항행 비행절차 설계	(주)네브코리아	비행점검센터
	14:00~16:00	• SBAS 비행점검방법 및 절차 등	비행점검센터 비행검사관	비행점검센터

- 유럽항공안전청(EASA) 인증기술 전문교육 시행 (인증기술단 15명)
- 이론교육
- * (대상자) 국토부(3), 진흥원(1), 항공안전기술원(5), 한국정보통신기술협회(3), SBAS 사업단(3)

[표 39. SBAS 인증기술단 국내 EASA 교육 내용]

Week	Day	교육 주제
1주차 (' 17.6.19 ~ 6.23)	1	• 국제 법 체계 : ICAO/EASA • EC 규정 No.216/2008 • EU 규정 No.628/2013 • SES 및 기타 항공 운항 규정 • Case Study
	2	• EU 규정 No.1034/2011 • EU 규정 No.1035/2011 • EU 규정 No.448/2014 • Case Study

	3	<ul style="list-style-type: none"> • EU 규정 No.552/2014 • EC 규정 No.485/2008 • ICAO 및 기타 기관 ATM 규칙 수립 현황 • Case Study
	4	<ul style="list-style-type: none"> • 안전성 평가 기본사항 및 분석 도구 • 안전성 평가 방법론 • Case Study
	5	<ul style="list-style-type: none"> • audit(감사/심사) 개요 • audit 계획 • audit 수행 • audit 완료 이후 활동 • Case Study
2주차 (' 17.6.26 ~ 6.30)	1	<ul style="list-style-type: none"> • 안전성 평가 기법 • 안전성 평가 소개 • 안전성 평가 방법론 • 안전성 평가 도구 • Case Study
	2	<ul style="list-style-type: none"> • ICAO SARPs 소개 • 무선 항행 보조장치에 대한 일반 조항 • GNSS 요구사항 • GNSS 기술 규격 • GNSS SARPs 적용 지침 • Case Study
	3	<ul style="list-style-type: none"> • 상호운영성 소개 • 상호운영성 개념 • 상호운영성 신고서 • 당국의 감독 수행 • Case Study
	4	<ul style="list-style-type: none"> • ATM/ANS 제공자 인증 • 규정 요구사항 • 인증 프로세스 • 합치성 평가 • ATM/ANS 제공자 감독 • 지속적인 감독 프로세스 • Case Study
	5	<ul style="list-style-type: none"> • 변경 절차에 대한 검토 개요 • 변경 분류 • 변경 통보 • 안전성 논의 검토 • Case Study

• 현장교육

* (대상자) 국토부(3), 진흥원(1), 항공안전기술원(5), 한국정보통신기술협회(3), SBAS 사업단(3)

[표 40. SBAS 인증기술단 국외 EASA 교육 내용]

Week	Day	교육모듈	교육 주제
3주차 (' 17.7.3~7.7)	1	EGNOS 운영현황	<ul style="list-style-type: none"> • ESSP 소개 • EGNOS 운영 개요 및 도구 설명 <ul style="list-style-type: none"> - 중앙처리국 관리 도구 - EGNOS 망 관리 도구 - 실시간 성능 감시 도구 - EGNOS 관련시설 견학 및 질의응답
	2	EGNOS 운영 및 추진방안 등	<ul style="list-style-type: none"> • GSA 발표 <ul style="list-style-type: none"> - EGNOS 개발/구축 공동연구기관간의 관계 - 임무 요구조건 - 시스템 설계 안전적합성인증자료집 - 서비스 설명 문서 • DSNA(관제센터) 방문 <ul style="list-style-type: none"> - PBN 및 EGNOS 프로그램 개요 - EGNOS LPV 절차 - EGNOS 절차에 대한 비행확인 및 점검
	3	EGNOS 활용기술 및 실습 등	<ul style="list-style-type: none"> • ESSP 주요 업무 내용 소개 <ul style="list-style-type: none"> - ESSP의 엔지니어링 활동 - EGNOS 시스템 감시 활동 - EGNOS 위성신호 감시 활동 - EGNOS 관련시설 견학 및 질의응답 • 프랑스→독일 이동
	4	인증산출 및 기법 등	<ul style="list-style-type: none"> • EASA 소개 • AOA 절차 • 신규 ATM/ANS 규정 • EGNOS 변경 검토 절차 • SBAS 항공전자 장비 • PBN 소개
	5	교육정리 및 교육수료식	<ul style="list-style-type: none"> • 교육과정 질의·논의·평가 등 교육정리 • 이론 및 현장교육 수료식(EASA 본사)



[그림 14. KASS 인증기술 현장 전문교육(프랑스 DGCA)]



[그림 15. KASS 인증기술 현장 전문교육(EASA)]

- ISO 9001 품질관리시스템 인증심사원 과정 교육시행 알림(국토교통부 항행시설과-1541, 2017.7.12.)
- (추진배경) 유럽항공안전청(EASA) 인증기술 전문교육 시 SBAS 인증 심사사항에 “품질관리” 항목포함에 따라 인증심사원 자격교육 시행필요
- (교육내용) 국제표준화기구(ISO) 국제기준·심사기법 숙지 및 국가공인 인증기관(한국생산성본부)의 인증심사 절차기준 등 인증심사원 자격교육
- 교육 세부일정

[표 41. SBAS 인증기술단 인증심사 교육 내용]

교육일자	교육시간	교육내용	교육시행기관
‘17.7.13(목)	09:00~18:00	<ul style="list-style-type: none"> • ISO 9001 품질경영체계 개요 • ISO 9001 표준 이해 실습 등 	한국생산성본부 인증원
‘17.7.14(금)	09:00~18:00	<ul style="list-style-type: none"> • 매뉴얼 및 절차서 등 작성 • 내부 심사기법과 수행 및 조치 • 심사계획 수립 및 보고서 작성 등 	

- SBAS 인증기술단 EASA 인증기술 전문교육 결과발표 계획 알림(국토교통부 항행시설과-1599, 2017.7.18.)
- (추진배경) EASA 인증기술 전문교육 이수결과에 대한 기술정보 공유 등을 위해 SBAS 인증기술단 구성원 별 교육주제를 분담하여 연구·발표 시행
- (발표일시) ‘17.7.20(목) 10:00~17:00, 한국공항공사 항공보안교육센터(C강의실)
- (발표자) 유럽항공안전청(EASA) 교육수료 SBAS 인증기술단 15명
- (발표내용) ICAO 표준·유럽인증 규정 등 기준, 유럽 안전성 평가 기법, EASA 협업 수행체계 및 KASS 인증대비 국내 적용방안 등 15개 주제
- (성과물) SBAS 인증기술단 인증기술 교육자료집 발간 (2017.7.18.)
 - * Volume 1. 국내 전문교육
 - * Volume 2. 유럽항공안전청(EASA) 인증기술 전문교육

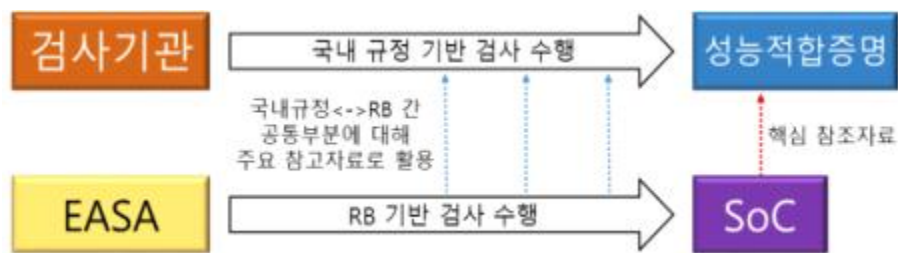
- * Volume 3. 유럽항공안전청(EASA) 인증기술 전문교육(ESSP)
- * Volume 4. 유럽항공안전청(EASA) 인증기술 전문교육 결과정리
- * Volume 5. SBAS 관련 국외 규정집

- (월간/연간 화상회의) 정기 회의를 통해 검사 현안사항 및 EGNOS 등 유럽 항행시스템 인증 시, 고려했던 기술적, 절차적 사안들에 대한 자문 수행
 - 2017년부터 2023년 말까지 총 64건의 월간 화상회의 개최
 - 대면/비대면 화상회의 등을 활용하여 총 4회 개최

[표 42. EASA 연간 대면/비대면회의 주요 안건]

회차	주요 논의 사항	장소
1회 (2019.2)	ICOS, RAMS, Complex HW 등 논의	독일 쾰른
2회 (2019.11)	GIVE coding range 기술기준 해석 등 논의	인천 청라
3회 (2021.03)	연속성 및 설치 감사 일정 등 논의	프랑스 툴루즈/원격
4회 (2022.11)	ICOS 및 단일 GEO, SoC 발급 일정 등 논의	대전 유성

- (단계별 검사보고서 산출 방법) EASA와 국내 검사기관은 각 국의 규정에 따라 각자 검사를 수행
 - 국내 검사기관은 EASA 검사보고서를 국내 검사에 참고자료로 활용 가능
 - 국내 검사기관은 검사방법/절차 및 주요이슈 등에 대해 EASA에 의견요청은 가능하나, 국내 규정 및 환경에 맞게 최종 적합여부 결정 필요



[그림 16. EASA 인증협력 체계도]

- (평가결과 분류) 제한사항(Limitation)과 조건사항(Condition)의 정의
 - * 제한사항 : 부적합 예상항목으로 인한 SBAS 서비스 제약사항
 - * 조건사항 : 시스템 운영 개시 전 충족되어야 하는 운영 상 조치

- (단계별 평가 내용 및 요약) 4단계(규격, 설계, 개발, 통합시스템) 평가 보고서 산출

[표 43. EASA KASS 검사 보고서 결과]

단계	평가 내용	비고
1단계 (규격)	<ul style="list-style-type: none"> ● 총 24종의 개발산출물을 주요 대상으로 평가 ● 52건의 규정 미준수(Findings) 발견, 7건의 제한사항(Limitation) 식별 	2018.6.28. 발행
2단계	<ul style="list-style-type: none"> ● 총 33종의 개발산출물을 주요 대상으로 평가 	2022.2.21.

단계	평가 내용	비고
(설계)	● 제한사항 10건, 조건사항 5건 식별	발행
3단계 (개발)	● 총 57종의 개발산출물, 개발사 감사 3건 등을 평가 ● 제한사항 9건, 조건사항 5건 식별	2023.12.13. 발행
4단계 (통합시스템)	● 총 92종의 산출물, 개발/설치 감사 등을 종합 평가 ● 제한사항 10건, 조건사항 6건	2024.2.21. 발행

라. 기타 수행 내용

- 전문가 자문 수행 내역
 - SBAS 관련 기술자문 국외 1건, 국내 13건 수행
 - KASS 성능분석 기간 설정을 위한 SBAS 분야 전문가 자문회의 개최
- KASS 운영 검증을 시험방법 수립을 위한 ICAO, EGNOS, 유럽 Eurocontrol 문서 검토 및 분석 수행

[표 45. EGNOS 및 Eurocontrol EGNOS 운영시험평가 연구보고서 분석 결과]

<p>[EGNOS 정보]</p> <p>1. EGNOS는 European Tripartite Group(Eurocontrol, ESA, EC) 사이의 협약에 의해 개발</p> <p>2. Eurocontrol 역할</p> <ul style="list-style-type: none"> - 임무요구사항 개발 <ul style="list-style-type: none"> * 임무요구사항 : Eurocontrol(관제기구)와 항공사 등이 모여 민간항공 사용자의 요구사항을 정의한 것 - 운영검증 수행 <ul style="list-style-type: none"> * 운영검증 : 임무요구사항 충족여부를 검증 <p>3. ESA 역할</p> <ul style="list-style-type: none"> - 임무요구사항 기반으로 시스템 요구사항 및 상위설계사항 개발 - 기술검증 수행 <ul style="list-style-type: none"> * 기술검증 : 시스템 요구사항 충족여부를 검증 - 개발계약업체 관리 <p>4. EC 역할</p> <ul style="list-style-type: none"> - 자금지원 - 타 교통분야의 요구사항 수렴 및 해당 요구사항 충족여부 검증을 위한 개별 연구 지원 <ul style="list-style-type: none"> * 일반적으로, 타 교통분야는 항공 임무요구사항(가장 엄격) 검증결과를 차용하여 활용 <p>5. 개발계약업체 (TASF)</p> <ul style="list-style-type: none"> - ESA가 제시한 시스템 요구사항 및 상위설계 기반으로 시스템 개발/제작 수행 - ESA가 제시한 시스템 요구사항 및 상위설계 충족시키지 못하는 사항은 ESA 검토/승인 필요 - Thales Alenia Space는 Thales와 Leonardo(구.Finmeccanica)의 합작 회사 - EGNOS 초기에는 Alcatel이 주계약업체였으나 위성사업부문을 Thales로 매각(2006)
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6. EGNOS 운영기관 (ESSP)

- TASF로부터 EGNOS를 이관받아 운영하는 항행서비스제공기관(ANSP)
- ESSP는 시스템 이관받기 전, Handover Review를 2회 이상 수행

7. 유럽항공안전청 (EASA)

- 유럽 ANSP 인증을 담당하는 당국
 - * EGNOS 장비/시설 인증이 아님, ANSP 기관에 대한 인증임
- EGNOS 최초 인증 시점은 EASA 설립 초기
 - * 8개국 NSA(National Supervisory Authority) 연합이 인증 수행하고 EASA는 참관
 - * EASA는 2012년부터 ESSP oversight로 정식 참여

8. 8개국 NSA 연합

- 유럽 주요 8개국의 항공인증당국 연합체로서 실무팀 2개(CT, SCIAT)로 구성
 - * 프랑스, 벨기에, 독일, 이탈리아, 포르투갈, 스페인, 스위스, 영국
- CT(Certification Team) : ESSP 조직 및 운영에 대해 검토
- SCIAT(Safety Case Interoperability Assessment Team) : 시스템의 상호운영 및 안전성에 대해 검토

8. ANSP 인증기준

- 임무요구사항/시스템요구사항과 무관하며 별도 유럽규정으로 존재
- 인증기준에 ICAO Annex10 및 소프트웨어 안전기준 포함
- ICAO Annex10 기준 100% 충족을 요구하는 것은 아님
- ICAO Annex10 기준 미충족 사항에 대한 대응절차 포함하여, 항공용 서비스 안전운영 준비가 확인되면 인증 발급
- 2~3년 주기로 재인증 필요

9. 안전운행을 위해 ANSP는 상시 모니터링 및 사용자 알림 제공

- EGNOS support site를 통해 성능정보 실시간 제공
- NOTAM 발행을 위한 주요사항 제공

10. EGNOS-KASS 담당기관 비교

- EC : 국토교통부 (사업추진 및 재원 마련 담당조직)
- ESA : 항공우주연구원
- Eurocontrol : 국토교통부 (관제 담당 조직)
 - * KASS의 경우, 국토교통부 관제 담당 조직(또는 항공사 등)이 임무 요구사항 수립에 참여하지 않음
- TASF : TASF
- ESSP : 수립 준비 중 (항공우주연구원 주관)
- EASA : 국토교통부(인증 담당 조직) + 항공안전기술원

11. EGNOS 개발은 아래 두가지 phase로 구분

- AOC(Advanced Operational Capability) 개발 : 1996~2004
 - * 초기운영을 위한 목표성능 개발
- FOC(Full Operational Capability) 개발 : 2004~2008
 - * 주항법장비로 활용을 위한 목표성능 개발

12. EGNOS 서비스는 아래 세가지로 구분

- 공개서비스(open service) : 2009.10~
 - * 보정정보 제공을 통해 모든 사용자에게 위성항법 정확도 향상을 제공하는 서비스(무결성 보장 X)
- 항공용서비스(safety-of-life service) : 2011.03~
 - * 보정정보 및 무결성 제공을 통해 항공 사용자가 LPV minima를 운영할 수 있도록 함
- 데이터제공서비스(EDAS, egnos data access service) : 2012.07~
 - * GEO가 아닌 지상통신매체를 통해 EGNOS 제공정보를 활용할 수 있도록 하는 서비스

13. 임무요구사항 (by Eurocontrol)

- En-route, TMA에 대해서는 기존 운영수준을 만족시킨다
 - * 기존 운영수준 : Basic RNAV(RNP5) by DME/VOR
- 비정밀접근 : 기존 NDB, DME 활용보다 더 직접적인 공항 접근 경로(곡선 궤적)를 제공하여 비행시간을 감소시킨다
- APV, CAT-I : 수직위치정보를 활용한 연속적인 하강궤도를 제공하여, 단계적 하강하는 비정밀접근 대비 효율성을 높인다

아직 정밀접근시설(ILS 등)이 설치되지 않는 지역에 유용하며, 특히 레이더/감시장비가 부족한 저밀도 교통 지역은 APV 성능만으로도 유용하게 활용

- 기존 SID(Standard Instrument Departure) 및 STAR(Standard Terminal Arrival Routes)에 대해, 더욱 유연하고 대체가능한 출도착 경로 제공하여 소음 및 공해 문제 저감
- 서비스 제공영역은 ECAC 회원국이 담당하는 모든 FIR을 포함하도록 설정
 - * 해상 지역은 북위 70도, 서경 40도까지
- 결국 RNP 레벨(operation type)에 따라 정확도/무결성/연속성/가용성 요구사항을 설정함
 - * ICAO Annex10 SiS 요구사항 수립 전에 설정되었으며, 사용자 입장에서 성능 목표치이므로 ICAO Annex10 SiS와 상이함

14. 시스템 요구사항 (by ESA)

- ICAO 위성항법 패널을 통해 제시(1998.08)된 SiS 요구사항 초안을 참고하여 설정
 - * SiS 요구사항이 ICAO Annex10 Vol.1 공식 포함된 것은 2001년
- AOC 목표치는 FOC 대비 가용성 및 서비스영역범위가 낮음

15. ICAO SiS 요구사항 초안

- 수평정확도 및 AL : APV 요구사항이 현재 NPA와 동일한 수준, 타 operation type은 현재와 동일

- 수직정확도 및 AL : APV 및 CAT-1 요구사항이 현재와 미세하게 차이
- 무결성/연속성/가용성은 현재와 동일
- 범위로 주어지는 성능(연속성,가용성)은 의도되는 운항종류, 교통량, 공역복잡도, 대체공항 등을 고려하여 각 항공당국이 결정해야 함
- * 현재도 마찬가지로

16. MCC

- 총 4개소에 설치, CPF(KPS)와 CCF(KCS)로 구성

17. NLES(KUS)

- 위성당 2개씩 설치. 1개는 active이고 1개는 hot backup
- NLES 1개는 다시 primary와 secondary로 구분되는데 안전성을 위해 diversion 적용

18. RIMS(KRS)

- AOC 당시에는 22개소부터 시작
- P채널과 I채널을 독립적으로 구성하고 관측치 생성하여 CPF에서 무결성 검증할 수 있도록 함

[Eurocontrol의 EGNOS 운영검증 방안]

1. 운영검증을 위한 Eurocontrol의 전략

- 기본적으로 시험(test)를 통한 검증이 우선됨
- 그러나 확률 목표치 및 서비스영역의 광대함을 감안하면 시험만으로는 검증 불가
- 그러므로 시험을 기반하되 다른 검증방법(분석,검토 등)을 혼합 적용
- 위성 배열이 지속적으로 변화하기 때문에 주로 시뮬레이션 분석으로 성능 검증하지만, 실제 비행시험도 추천됨
- 운영 영향성 고려 필요
 - * 운영 영향성 요소 : 항공기 역학/기동, 항공기 종류, 서비스영역, 다중경로오차, 간섭, 지역 구조특성, 대기영향 등
 - * ESA가 수행하는 기술검증 및 국내 성능적합증명은 SiS를 대상으로 검증하므로 고려하지 않는 요소들임

2. 시험장비

- 수신기는 추후 상용화 예상되는 EGNOS 수신기보다 성능이 좋으면 안됨
- 데이터 분석장비의 소프트웨어는 고신뢰성을 보장하도록 개발되어야 함
- 주계약업체가 구현하는 개발/검증 플랫폼은 ESA에게 일종의 산출물로 제공됨
(KASS 경우, TASF IVQ 플랫폼이 KPO로 이관(물리적 이관보다 소유권/사용권이 주요)되지 않음)

3. 정확도

- 주요 지역은 기준점으로 실측 가능하나, 서비스 전체영역은 시뮬레이션으로 수행
- 서비스 외곽지역 또는 경계지역 진출입에 대한 샘플 시험 가능

- ILS 활용 접근 중 track 대비 SBAS 위치를 비교하여 간접적 확인 가능
- 독립적인 항법 소스(INS, LADGPS, RTK, Laser Tracker 등) 활용하여 비교
 - * en-toure 경우, 위의 독립적인 항법소스 활용 어려우므로 DME/VOR 이용한 비교 수행
- 위성배열변화에 비해 비행시험시간이 짧으므로, 시험자료가 normalised 되어야 함
- 수신기 실시간 위치정보와 raw data 후처리 위치정보 간의 비교
- 시간적 상관도 및 공간적 상관도를 최소화하기 위한 시험 세팅 필요
- 다중경로오차 및 간섭 최고인 공항지역에서 주로 시험

4. 무결성, 연속성, 가용성

- 분석(주), 시험(보조)로 평가해야 함
- 시험에서 시간적 상관도는 마찬가지로 다중경로오차(1시간 간격) 감안 필요
- 전리층 영향 분석에는 2000년도 근처의 solar maximum 데이터 필수
- 무결성 분석은 FTA가 핵심

5. 시험(Test)과 시연(Demonstration) 차이

- 시험 : 모든 조건을 커버할 수 있도록 실측이 수행되는 개념
- 시연 : 분석자료의 정당성을 입증하기 위한 수단으로서 best case, typical case, worst case 등만 시험

6. 위성배열에 따른 상관도

- 시간적 상관도 : 30분 간격이면 독립적 관측치임
- 공간적 상관도 : 위경도 15도(1600km) 이상 차이나야 독립적 관측치임
 - * 위경도 5도 차이나도 상관계수 0.86 정도로 높음

7. 다중경로오차에 따른 상관도

- 시간적 상관도 : 1시간 간격이면 독립적 관측치임
 - * 시간적 상관도가 가장 높은 요소임
- 공간적 상관도 : 20km 간격이면 독립적 관측치임

8. 이온전리층에 따른 상관도

- 시간적 상관도 : 15분 간격이면 독립적 관측치임
- 공간적 상관도 : 경도방향으로 250km 간격이면 독립적 관측치임(위도50도 근방일때)
 - * 지구 자전방향으로 이온전리층 영향이 퍼지므로 주로 경도방향의 상관도를 고려함

9. 통계적 기법

- 정규분포 기반 기법으로 95% 신뢰도 목표는 Z-score=1.96으로 계산
- 정확도 : 필요한 샘플 수는 73이므로 73시간 필요
 - * 시간적 상관도 요소 중 가장 큰 다중경로오차 기준
- 무결성 : 현재 ICAO 성능목표 기준으로 NPA이하(1.38×10^{11} 샘플), APV-I(2.87×10^9 샘플)

필요

- * 매초 무결성 계산되면 시간적 상관도 1초 간격 ok이므로 NPA이하(4382년), APV-I(91.5년) 소요됨
- * 통계적 기법 무시하고 1초당 1샘플로 직산하면 NPA이하(116일), APV-I(58일) 소요됨
- 가용성 : 99% 가용성 목표(결과에 대한 신뢰도는 95%) 기준으로 380샘플 필요하나, 시간적 상관도가 애당초 적용 불가함
- 연속성 : 현재 ICAO 성능목표 기준으로 NPA이하(1.38×10^8 샘플), APV-I(4.8×10^5 샘플) 필요하나, 시간적 상관도가 애당초 적용 불가함
- * 통계적 기법 무시하고 1시간 & 15초당 1샘플로 직산하면 NPA이하(416.6일), APV-I(21.7일) 소요됨
- * outage 이후 복구되면 이후 outage에 대해서는 상관도 없어진다고 볼 수 있음

[ICAO 관련 내용 분석]

1. ICAO Doc8071 Vol.2 (위성항법시설 시험 매뉴얼)

- 3.2.1 SBAS 지상시스템 자체에 대한 시험은 이 매뉴얼에서 다루지 않으며, 시스템제작자의 입증시험 방식에 따라야 한다.
 - * 즉, 본 매뉴얼은 위성항법시설을 활용한 '접근 절차'에 대한 시험이다.
- 3.3.1 위성항법/SBAS의 SiS에 대한 비행시험은 필요하지 않다. 비행시험은 아래와 관련된 내용이다.
 - * RNAV 계기비행절차 검정, 특정 절차에 대한 SBAS 지원 검증, 간섭 시험

2. ICAO Annex10 Vol.1 Attachment D 3.4 (연속성)

- 3.4.3.1 연속성은 접근/착륙 절차 시작때 가용한 것을 가정한 상태에서의 서비스 제공 능력이다. 즉, 미리 예견된 연속성 이벤트는 SiS 성능에 고려하지 않는다.
- 3.4.3.4 SARPs에 제시된 평균 연속성 위협을 충족하지 못하는 지역에서는, 감소된 연속성능에 대비한 운영상의 특정조치가 수립되는 경우 접근절차 발행이 가능하다.

3. ICAO Annex10 Vol.1 Attachment D 3.5 (가용성)

- 3.5.1 신뢰성 있는 항법정보가 제공되는 시간의 비율이다.
 - * 신뢰성 있는 항법정보는 positioning service와 integrity monitoring service가 동시에 제공되고 있다는 의미
- 3.5.3 반복적이고 예측가능한 원인(반복적인 나쁜 위성배치)에 의해 가용성이 낮은 경우는, 해당 기간을 제외하고 운영이 가능하다.
- 3.5.6 가용성의 정확한 측정은 수년(MTBF 및 수리 시간 이상)이 걸리는 일이므로, 가용성은 설계/분석/모델링을 통해 결정되어야 한다.
 - * 가용성 모델은 이온전리층/대류층/수신기 오차 모델을 포함해야 한다.
 - * SiS 성능표의 가용성은 설계 상 가용성에 적용되는 값이다. (시험으로 측정된 가용성 X)

4. ICAO Annex10 Vol.1 Attachment D 9 (상태감시와 NOTAM)

- 9.2 NOTAM 당국에 알려야 할 정보
 - * 서비스 비가용, 서비스 성능저하, 각각의 발생시점과 지속시간

- 9.3. 계획된 이벤트의 경우 72시간 전에 NOTAM 당국으로 알려야 하고, 계획되지 않은 경우 발생 15분 이내 알려야 함

* 알림은 15분 이상 지속되어야 함

5. ICAO Annex10 Vol.1 Attachment Figure F-2

- 비가용 시간에는 계획되지 않은 비가용도 포함. 즉, 원인이 무엇이든 비가용 상태 발생은 가용성을 저하시킴.

3. 연구개발과제의 수행 결과 및 목표 달성 정도

1) 연구수행 결과

(1) 정성적 연구개발성과

항공안전기술원 「항행안전시설 성능적합증명 검사기관 운영규정」 제15조(검사기록의 유지관리)제1항에 의거하여 세부 상세 검사결과와 검사조직이 아닌 자의 접근이 제한되므로 [별첨] 'KASS 성능적합증명 검사자료집' 참고 필요

(2) 정량적 연구개발성과

개발성과	성과목표					해당 기관	정량목표
	질적성과지표	목표치	측정방법	검증방법	가중치		
EASA의 KASS 적합성확인서(SoC)	SoC	확보	확보여부	SoC	50	KIAST	<u>EASA SoC: 1 건</u>
KASS 성능적합증명 종합보고서	종합결과보고서	제출	제출여부	보고서	50	KIAST TTA	<u>보고서: 1 건</u>
계					100		<u>EASA SoC: 1 건</u> <u>보고서: 1 건</u>

2) 연구 달성 내용

가. 연구 개발의 최종 목표 요약

구분	내용
최종 목표	○ 해외 인증 협정 체결을 통한 인증기술 습득 및 한국형 SBAS 시스템(KASS) 성능적합증명 수행
세부 목표	<ul style="list-style-type: none"> ○ (성능적합증명 검사) KASS 시스템이 성능적합증명 검사 기술기준 및 ICAO 표준을 준수하여 제작되었는지 검토하여 성능적합증명 검사 종합 결과서 산출 ○ (운영지침자료 검사) KASS 운영지침자료에 “운영기관이 시스템 성능과 안정성을 보장하도록 운영할 수 있는 절차·지침이 적절히 반영되었는지” 검사 <ul style="list-style-type: none"> * 관련근거1 : 「KASS 성능적합증명 일정 및 운영검증 방안 논의 회의 결과 알림」 (항공안전기술원 보안항행인증실-56, 2022.1.19.) * 관련근거2 : 「KASS 성능적합증명 계획 및 운영검증 방안 검토 후속회의 개최 알림」 (항공안전기술원 보안항행인증실-1284, 2021.12.14.) * 관련근거3 : 「KASS 성능적합증명 일정 및 운영검증 방안 검토회의 개최 알림」 (항공안전기술원 보안항행인증실-1566, 2021.12.27.) ○ (EASA 인증협력) EASA가 KASS 개발산출물을 검토할 수 있도록 지원하여 EASA의 적합성확인서(SoC) 확보하고, EASA 검사 절차 및 EGNOS 사례를 기반으로 인증기술 습득
최종 성과물	<ul style="list-style-type: none"> ○ KASS 성능적합증명 결과 종합보고서 1건 ○ EASA의 KASS 적합성 확인서(SoC) 1건

나. 연구개발 목표 달성 결과

세부 과제명	세부 연구 목표	연구개발 수행 내용	연구 결과
KASS 성능적합증명 수행	KASS 성능적합증명 검사 수행	SBAS 기술기준 적합성 입증방법 식별	완료
		SBAS 기술기준 적합성 입증자료 검토	완료
		KASS 핵심 성능 입증자료 (보안산출물) 현지검사	완료
		소프트웨어 인증계획서(PSAC*) 검토 및 승인 * PSAC(Plan for Software Aspects Certification)	완료
		소프트웨어 기술기준 감사	완료
		소프트웨어 달성요약서(SAS*) 검토 및 승인 * SAS(Software Accomplishment Summary)	완료
		관찰사항 추적관리	완료
		개발산출물 검토의견 추적관리	완료
		KASS APV-1 연속성 성능 관련 분석	완료
		EASA 인증협력	EASA 인증협력 및 계약연장
	지속적 협력		완료
	EASA 검사 보고서 접수 및 검토		완료
	EASA SoC 확보		완료
	운영지침자료 검사	KASS 운영검증 관련 국내·국외	완료

		관련 규정 분석	
		KASS 운영지침 항목 식별	완료
		KASS 운영매뉴얼 반영 여부 검토	완료

(3) 세부 정량적 연구개발성과

[과학적 성과]

□ 논문(국내외 전문 학술지) 게재

번호	논문명	학술지명	주저자명	호	국명	발행기관	SCIE 여부 (SCIE/비SCIE)	게재일	등록번호 (ISSN)	기여율
2021_76 (정규논문 (일반))	항공 시스템용 전자 하드웨어 개발을 위한 미국 및 유럽의 가이드 라인 : RTCA DO-254와 ECSS-Q-S T-60-02C 의 비교 분석 연구	항공우주 시스템 공학회지	김성훈	제16권 제4호	Republic of Korea	항공우주 시스템 공학회	비SCIE	2022 -09-01	EISSN 2508-7150	80%

□ 국내 및 국제 학술회의 발표

번호	회의 명칭	발표자	발표 일시	장소	국명
1	2019년 항공우주시스템공학회 춘계학술대회	김요식	2019.04.26	제주	대한민국
2	2019년 한국항공학회 추계학술대회	배동환	2019.10.24	서울	대한민국
3	2019년 한국항공학회 추계학술대회	최윤정	2019.10.24	서울	대한민국
4	2020년도 항공우주시스템공학회 춘계학술대회	최윤정	2020.07.30	제주	대한민국
5	2020 IPNT Conference	윤동환	2020.11.12	여수	대한민국
6	2021 IPNT Conference	배동환	2021.11.04	강릉	대한민국

□ 보고서 원문

연도	보고서 구분	발간일	등록 번호
2023	KASS 성능적합증명 검사결과서	2023.12.18	KIAST-KASS-PM-02
2023	KASS 시스템 보증검사 종합보고서	2023.12.31	TTA-KASS-PA-0068
2024	EASA 적합성확인서(SoC*)	2024.02.20	Ref.Ares(2024)1312783

* SoC(Statement of Compliance): KASS 시스템이 적용 가능한 유럽 규정(EU Regulation)에 적합한지 확인한 결과서

[인프라 성과]

해당사항 없음

[그 밖의 성과]

해당사항 없음

(4) 계획하지 않은 성과 및 관련 분야 기여사항

해당사항 없음

2) 목표 달성 수준

추진 목표	달성 내용	달성도(%)
○ KASS 성능적합증명 수행	<ul style="list-style-type: none"> ○ (성능적합증명 검사) KASS 시스템이 성능적합증명 검사 기술기준 및 ICAO 표준을 준수하여 제작되었는지 검토하여 성능적합증명 검사 종합 결과서 산출 ○ (운영지침자료 검사) KASS 운영지침자료에 “운영기관이 시스템 성능과 안정성을 보장하도록 운영할 수 있는 절차·지침이 적절히 반영되었는지” 검사 ○ (EASA 인증협력) EASA가 KASS 개발산출물을 검토할 수 있도록 지원하여 EASA의 적합성확인서 (SoC) 확보하고, EASA 검사 절차 및 EGNOS 사례를 기반으로 인증기술 습득 	○ 100%

4. 목표 미달 시 원인분석

해당사항 없음

5. 연구개발성과의 관련 분야에 대한 기여 정도

- KASS 성능적합증명 수행을 통해 ICAO 부속서 10과 같은 국제기준에 따른 시스템 인증 절차 및 검증 방법에 대한 체계적인 표준 프로세스 정립하였으며 이를 통해 타 항행시설에 대한 성능적합증명 검사 및 기술지도에 활용
- 유럽의 인증당국인 EASA와의 인증협력을 통해 선진 기술에 대한 원활한 기술 습득 및 항행안전시설 기술기준, 검사 등에 대한 전반적인 정보 공유를 진행, 이러한 결과로 EASA와의 지속적인 협력·유대관계를 수립함
- KASS 시스템안전성 검사 및 제품보증활동 검사 수행을 통해 축적된 항행안전시스템 관련 국제 표준 및 시스템 보증 검사 기술을, 향후 국내 개발 항행안전 시스템 및 소프트웨어 등에 적용
- 향후 타 분야 (항공, 해양, 철도, 이동통신, 기타 국토교통 분야)의 시스템 및 소프트웨어의 안전성을 확립하기 위한 분석 기술 확보에 기여

6. 연구개발성과의 관리 및 활용계획

1) 연구성과 총괄

해당 기관명	핵심연구성과	정부출연금 (백만원)	민간	실용화 대상 여부*
주관 : 항공안전기술원	1-가. KASS 성능적합증명 검사 결과서	3,796	-	비대상
	1-나. EASA 적합성 확인서		-	비대상
공동 : 한국정보통신기술협회	2-가. KASS 시스템보증검사 종합 결과서	900	-	비대상
합 계				

구 분	1-가
성과명	KASS 성능적합증명 검사결과서
성과개요	KASS 성능적합증명 검사 수행 최종 결과물
관련 키워드	성능적합증명, 시스템 인증
기술 분류	해당사항 없음
성과 유형*	<input checked="" type="checkbox"/> 공법/기법 <input type="checkbox"/> 장비/장치 <input type="checkbox"/> 재료/자재 <input type="checkbox"/> SW <input type="checkbox"/> 시스템 <input type="checkbox"/> 기준/지침 <input type="checkbox"/> 기타
기술수명주기**	<input type="checkbox"/> 기술도입기 <input type="checkbox"/> 기술성장기 <input checked="" type="checkbox"/> 기술성숙기 <input type="checkbox"/> 기술쇠퇴기

구 분	1-나
성과명	EASA 적합성 확인서
성과개요	EASA의 KASS에 적용 가능한 유럽규정을 기술기준으로 설정하여 적합성을 검사한 최종 결과물로 유럽의 전반적인 시스템/운영 인증 절차 및 내용에 대해 습득
관련 키워드	시스템/운영 인증, 유럽 항행서비스 인증체계
기술 분류	해당사항 없음
성과 유형*	<input checked="" type="checkbox"/> 공법/기법 <input type="checkbox"/> 장비/장치 <input type="checkbox"/> 재료/자재 <input type="checkbox"/> SW <input type="checkbox"/> 시스템 <input type="checkbox"/> 기준/지침 <input type="checkbox"/> 기타
기술수명주기**	<input type="checkbox"/> 기술도입기 <input type="checkbox"/> 기술성장기 <input checked="" type="checkbox"/> 기술성숙기 <input type="checkbox"/> 기술쇠퇴기

구 분	1-다
성과명	KASS 시스템보증 검사 종합결과서
성과개요	안전 중요 시스템인 KASS 시스템에 대한 안전성 평가 과정 및 소프트웨어 보증 프로세스의 검사 과정을 통해 안전성 평가 및 소프트웨어 인증 기술을 체계적으로 습득함
관련 키워드	안전성 평가 검사, 소프트웨어 인증/승인, 소프트웨어 보증
기술 분류	해당사항 없음
성과 유형*	<input checked="" type="checkbox"/> 공법/기법 <input type="checkbox"/> 장비/장치 <input type="checkbox"/> 재료/자재 <input type="checkbox"/> SW <input type="checkbox"/> 시스템 <input type="checkbox"/> 기준/지침 <input type="checkbox"/> 기타

기술수명주기**

기술도입기

기술성장기

기술성숙기

기술쇠퇴기

2) 연구개발성과의 향후 5년간(활용보고서 제출기간) 성과활용 목표·계획

□ KASS 성능적합증명 수행 결과 보완 사항에 대한 조치 계획

- KASS 시스템은 타 재래식 항행안전시설과 달리 지속적인 환경 및 구성 모니터링을 통해 업데이트가 필요한 시스템으로 인증당국(국토교통부)을 중심으로 인증 협력을 수행한 EASA 및 KASS 운영기관(항공위성항법센터, 항공우주연구원)과 협력을 통해 안정적인 시스템 운영을 위한 후속 관리 수행

□ 타 항행안전시설 성능적합증명 검사 활용

- 원거리관제처리시설(RCPS, Remote Control Processing System) 성능적합증명 검사에 활용
 - 계류장 관제를 위한 보조 시각기반 관제지원시스템으로 원격관제타워 또는 디지털타워와 관련된 국제 기술기준을 기반으로 성능적합증명 검사를 수행
 - KASS 성능적합증명 수행과 유사한 형태로 ICAO 및 기능·성능 기술기준에 대해서는 항공안전기술원이 검사를 수행하고 소프트웨어 기술기준에 대해서는 한국정보통신기술협회에서 공동 검사 수행
 - KASS 성능적합증명 검사 및 연구 수행을 통해 획득한 인증 기술을 기반으로 인증 수행 경험이 부족한 신청자가 인증에 대응 가능하도록 표준 가이드라인 개발과 인증을 병행 수행 중
- 그 밖에 신규 개발·도입 예정인 항행안전시설 성능적합증명에 대한 문의가 지속되고 있으며, 이번 KASS 성능적합증명 수행을 통해 획득한 인증기술을 적극 활용하고 미국·유럽 등의 선진국가와 지속적인 협력을 통해 국내 항행안전시설 산업 발전을 위해 적극 지원 예정

□ ICAO 등 우리나라 항행안전 기술의 국제표준화 지원

- ICAO 항행안전 패널위원 자문 수행
 - KASS 성능적합증명을 통해 ICAO 부속서 등의 항행안전시설 기술기준에 대한 기반 지식을 확보하였으며, 차세대 SBAS 시스템인 DFMC(Dual Frequency Multi Constellation) SBAS에 대한 기술기준 분석을 기 수행하였음
 - 또한, 2023년 ICAO 항행안전 패널의 국가 공식 자문위원(Advisor)로 선정되어 KASS 성능적합증명을 통해 획득한 인증기술을 기반으로 우리나라 국가 항행안전 기술의 국제 기술기준, 표준화에 적극 지원할 수 있는 환경이 확보되었음
- RTCA/EUROCAE 등 항행안전시설 국제 산업 표준화 지원
 - RTCA/EUROCAE 등은 각 미국/유럽 등에서 항공 관련 기술, 서비스 등에 대한 기술적 기능·성능 기술기준을 수립하고 이에 대한 적합성 입증방법(MoC, Means of Compliance)을 구체화하는 국제 표준 단체임
 - KASS 성능적합증명에도 SBAS의 기술적 기능·성능 기술기준인 RTCA DO-229D 국제 단체표준을 적극 활용하여 적합성 입증방법으로 활용하였으며, 본 과업을 통해 국제 단체표준 수립 및 적용에 대한 기술적, 절차적 기반 지식을 습득하였음
 - 이를 토대로 현재 국제적으로 서비스 추진을 선도하고 있는 UAM 및 관련 첨단 항행안전 산업 분야에 대한 국내 기반 기술을 적극 발굴하고 지원하여 국제단체 표준화하는데 적극 지원

[뒷면지]

주 의

1. 이 보고서는 국토교통부에서 시행한 항공안전기술개발사업 KASS 성능적합증명 수행 연구개발과제 최종보고서이다.
2. 이 연구개발내용을 대외적으로 발표할 때에는 반드시 국토교통부(국토교통과학기술진흥원)에서 시행한 항공안전기술개발사업의 결과임을 밝혀야 한다.
3. 국가과학기술 기밀 유지에 필요한 내용은 대외적으로 발표 또는 공개하여서는 안 된다.