THE MODERNIZATION OF CIVIL ROTORCRAFT CERTIFICATION SYSTEM IN KOREA

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Abstract
The ROK MND have successufly developed two types of military helicopters in last two decades, in cooperaation with Airbus Helicopters. Though these rotorcrafts were basically developed to conduct various tactical duties, their civil derivatives were also developed for cost-effective operation. Since it is apparant that these rotorcrafts will apply for their STC and RTC respectively, the demand to harmonize the civillian rotorcraft certification system was clearly recognized in ROK. Therefore, the KIAST(Korea Institute of Aviation Safety Technology) have been conducting a project since 2017, to improve the civil rotorcraft certification system. This document is providing the general overview of this effort.

1. INTRODUCTION

1.1. Military-biased aerospace industry

The aerospace industry in ROK (Republic of Korea: South Korea) used to be biased to the military sector and therefore it is not surprising to find that the most of indigeous aircrafts were developed for ROK MND(Ministry of National Defence). Since the ROK Armed Force have their own type certification system, these aircrafts were certified by the ROK DAPA (Defence Acquisition project Administration). Figure 1 presents the list of domestic fixed wing aircraft types, which were developed for the ROKAF (Repulic of Korea Air Force) and certified by the DAPA. (From the top, KT-100, KT-1, T-50, A-50)

Figure 1. Indigeous aircrafts for ROKAF [3]

1.2. Korean military helicopter program

The ROK MND is operating more than 800 helicopters to improve the mobility of their troops over the complicatd terr ain and therefore being ranked as the world 4th largest military helicopter operator. Though ROK MND is used to operate foreign designed helicopters in last few dacades, by virtue of domestic aerospace industry maturity & reasonable volume of internal demand, they have developed two types of military helicopters as followings.

1.2.1. KUH-1 Surion

The KUH-1(Surion) is the first type of domestic military helicopter, which was developed by KAI (Korea Aerospace Industries, LTD.), ADD (Agency for Defence Development), and KARI (Korea Aerospace Research Institute) in cooperation with Airbus Helicopter to replace outdated utility helicopters in ROK Armed Forces, in particular McDonnell-Douglas 500MD & Bell UH-1. It is twin-engined transport utility helicopter with many derivatives for various tactical roles, such as troop transport, medical evacuation, and air assault operation.

Figure 2. KUH-1 Surion [4]

The development of KUH-1 was initiated in June 2006 and the first prototype conducted its maiden flight in 2010 and began to be deployed to ROK

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Armed Forces in December 2012. In response to the demand for various roles, KAI have developed many derivatives of KUH-1 for ROK Army, Marines, Navy, Air Force, Coast Guard and Police as *Figure 3*.

Figure 3. The derivatives of KUH-1(Surion) [1]

1.2.2. LAH/LCH program

The LAH/LCH is the second domestic helicopter development program, which is conducted by KAI in cooperation with Airbus Helicopters. This program is aiming to develop two types of helicopters, which are designated for miilitary and civlian application, respectively.

The LAH (Light Armed Helicopter) is developed to replace aging armed helicopter 500MD and attack helicopter Bell AH-1. The airframe of LAH is developed by KAI and sharing the rotor and drive train with Airbus EC155B1.

Figure 4. LAH prototype [8]

The LCH (Light Civil Helicopter) is the Korean production of Airbus EC155B1, while EC155 B1 STC (Supplemental Type Certification) is another type of helicopter with 56-domestic components, which are integrated into the airframe.

Figure 5. LCH prototype [6]

1.3. Civil derivatives of the military helicopter

Though ROK is operating more than 1,000 of helicopters, almost 80% of them are military aircrafts, while the other 20% are imported as civil vehicles.

Therefore, due to the lack of indigeous civil rotorcraft type, there was insufficient demand to modernize the type certification system for civil helicopters. However, the terrain of Korean aerospace industry have changed in last decade due to the success of KUH program and LAH/LCH program .

Since it becomes apparent that the civil derivatives of KUH-1 and LCH will apply for RTC (Restricted Type Certification) and STC respectively, KIAST have to speed up streamlining the rotorcraft certification system.

Currenlty a small number of KUH-1 derivatives are already deployed for the public aircraft operation such as, territorial water control, search and rescue (SAR), forest preservation & wildlife protection, etc.

Figure 6. Aerial firefighting version of KUH-1 for KFS [7]

2. DETAILED TASK

This project have 4 major tasks as followings.

Table 1 Four majot tasks

No	Task
1	Internationalization of certification regulations
2	Modernization of certification technology
3	Provision of certification engineer & inspector
4	Technical support for international cooperation

2.1. Internationalization of certification

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regulation

2.1.1. Analysis of the international certification system and amendment of domestic counterpart

In an atempt to modernize the rotorcraft certification system, outdated domestic system was reviewed & amended. Also international systems were researched for potential introduction to the domestic system.

2.1.2. Aircraft Certification System (ACS)

Since the computerized Aircraft Certification System(ACS) was already deployed for fixed wing aircraft certification, KIAST is preparing to update current ACS to expand its application to the rotorcraft certification, so that they can manage & process the rotorcraft certification data as effectivley as that of the fixed wing aircraft.

2.2. Modernization of certification technology

As a part of effort to improve the rotorcraft certification system, KIAST have identified 22 certification technologies to be modernized, as shown in the following table.

Table 2 The certification technologies to be modernized

No	Certification Technologies
1	Additive Manufacturing
2	Fatigue Analysis
3	Fire Protection
4	Icing Protection
5	Lightning Protection
6	Category A
7	Autorotation
8	Instrument Flight Rule (IFR)
9	Composite Part
10	Crashworthiness
11	Main Gear Box (MGB)
12	Inlet Barrier Filter (IBF)
13	Fuel System Crashworthiness
14	High Intensity Radiation Field (HIRF)
15	Active Vibration Control System(AVCS)
16	Fly By Wire(FBW)
17	Health and Usage Monitoring System
18	Safety Assessment
19	Production Quality Control System
20	Avionics H/W & S/W
21	Automatic Flight Control System(AFCS)
22	Bird Strike Protection

2.2.1. Certification guide development

The certification technologies of the applied rotorcraft will be verified by using certification guides, which are desiginated to each individual technology. In order to improve the quality of these documents, KIAST is conducting a number of research projects in cooperation with many research agencies & universities as shown in the following table.

Table 3 Cooperated Reserch Activity

Organization	Research project
Konkuk University	CAT A Flight performance
Gyeongsang National University	Lightning protection
Seoul National University	Icing prevention
	Fatigue analysis of composite rotorcraft blade
Inha University	Additive manufacturing
Korea Testing Laboratory	Composite material test
Defence Agency for Technology and Quality	Case study of military rotorcraft certification
Hyosung & TB carbon	Fabrication & inspection of composite material
KTL, Hyosung, tbc	Develop the material & process specification

2.3. Provision of certification engineer & inspector

Since the human reseource is an important part of certification system, KIAST is conducting the following activities as a part of this project.

2.3.1. Job description development

The job descriptions will be developed for each certification techonology and provided for the certification engineers & inspectors to support their certification activity.

2.3.2. Certication technology development

KIAST is continuously recruting highly qualified & experienced international experts for short term & long term consultation as well as developing their own domestic certification engineers & inspectors. As a part of this effort, KIAST keep disptaching their staffs to the international courses to up to date the latest certification technologies.

2.3.3. Institute for Aircraft Certifcation

In order to provide the rotorcraft certification engineers to the aerospace industry, a training organization (Institute for Aicrraft Certification) will be launched by mid-2021.

In the mean time, a number of on-line & in-class aircraft certification courses are currently under development and these courses will be offered to aerospace professionals via this organization.

The CBT(Computer-Based Training) is on-line

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course, which is develolped to provide the certification knowledge effectively whithout restiction in terms of time and location. The CBT is comprises the lecture & assessment. KIAST is internally tesing the prototype of CBT and will provide the certification to the attendants, who passed the assessement.

Figure 7. Institute for aircraft certification plan

2.4. Technical support for international cooperation

KIAST has been providing technical support for conclusion of BASA(Bilateral Aviation Safety Agreement) of ROK with foreign states involved mutual recognitions of certificates for part 23 light aircraft and TSOA (Technical Standard Order Authorization) part level products.

These activities are including consultation on the strategic establishment of international agreements or arrangements, reviewing the details of the technical cooperation involved, and the agreement /arrangement documents to be concluded.

KIAST also supports the conclusion of WA (Working Arrangment) between the ROK government and EASA to assist Airbus Helicopters EC155 B1 to be manufactured in Korea under the Airbus POA extension.

Figure 8. Technical support on BASA [3]

Currenlty, ROK has BASA with USA on Part 23 light aircraft and TSOA level products and is also discussing with the EASA to get a cooperative working relationship. The conclusion of such agreements and/or arrangement for international cooperation is expected to boost the export of Korean aerospace product abroad.

3. CURRENT PROJECT OUTCOME

Though this project is not completed yet, some part of project outcomes are distinguished as followings.

3.1.1. Publication of research result

Four universities in Korea are conducting cooperative research projects with KIAST. They are sharing the research result with KIAST, as well as publishing their results to the international journals and conferences.

One of distinguished point of these studies is investigating the potential feasibility of “simulation based certification system” to save the required budget and overcome the lack of consistgency in the experiments.

Gyeongsang National University is in charge of rotorcraft lightning protection research. They are devloping and verifying a code to assess the lightning strike protection level of rotorcraft. The following diagram presents the electrostatic enhanced area distribution which is indispensable to determine the lightning strike zone on the rotorcraft airframe.

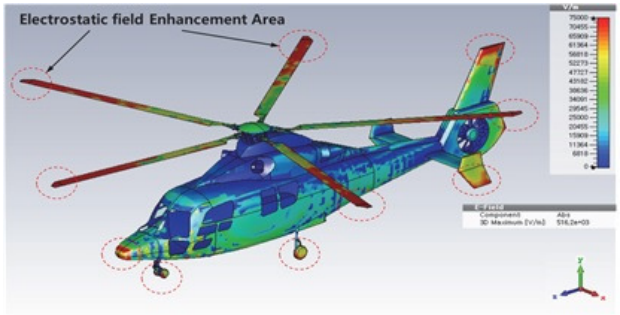

Figure 9.EC-155B Electrostatic enhanced area [3]

Seoul National Univeristy (SNU) is undergoing two individual KIAST funded research projects for the composite rotor blade analysis and the icing protection respectively.

In an attemp to assess the composite blade characteristics, SNU have conducted experiment to assess the reliability of rotor blade structure. The following photos presents the composite matrial specimens for static test (left) and dynamic test (right).

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Figure 10. Composite material specimens for static and dynamic test [3]

The rotorcraft icing characteristic assessment using the icing wind tunnel is requires excessive budget and hard to achieve consistent data. Therefore, SNU have developed a code to simulate the rotorcraft icing characteristics. The following diagram presents simulation result regard to the ice formation on the leading edge of the rotor blade.

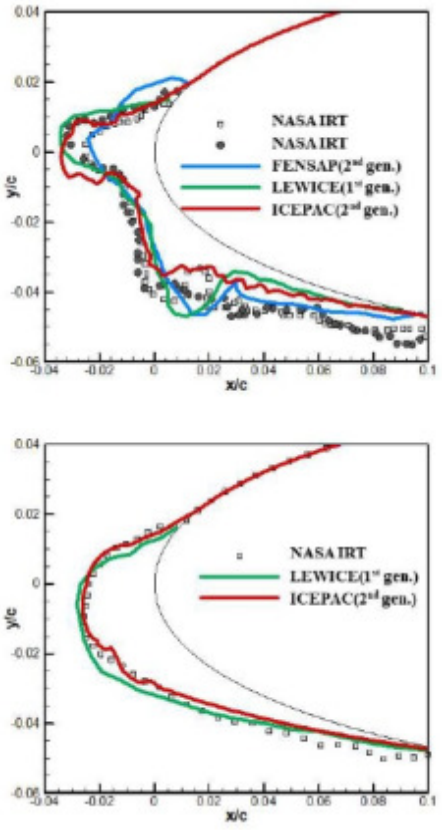

Figure 11. The Icing analysis on the blade leading edge[3]

Inha University and Konkuk University are researching additive manufacturing and Category A flight respectively.

Since the additive manufacturing using 3D printer is one of the latest trend in aerospace industry, its certification standard is not clearly defined so far. Therefore, Inha univesity is focusing on this spearhead technology, while Konkuk university is developing rotorcraft flight dynamics analysis software (M&S) to verify the Category A flight performace.

3.1.2. Certification guide

In 2019, the first batch of certificaton gudes drafts, which is composed of 8 documents, are verified via the assessment panel, which comprises external experts. After 2 months of intense review and corrective action, these documents are approved by the panel. By the end of 2021, all 22 certification guides will be completed .

4. FUTURE PLAN

After the completion of this project by December.2021, KIAST will contiue to further develop & update the rotorcraft certification system as well as providing necessary education & training to the aerospace professionals.

5. ACKNOWLDEGEMENT

This project is conducted under the support of Korea Agency for Infrastructure Technology Advancement (KAIA), which is a non-profit corporation that manages the major government R&D projects in ROK.

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