THE FAA HELICOPTER OPERATIONS DEVELOPMENT PROGRAM

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FIFTH EUROPEAN ROTORCRAFT AND POWERED LIFT AIRCRAFT FORUM
SEPTEMBER 4 – 7TH 1979 - AMSTERDAM, THE NETHERLANDS

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ABSTRACT

Efficient rotorcraft operations place special requirements on air traffic, communications, and navigation systems, and the criteria for safe flight. Recognizing this, the FAA has established a Helicopter Operations Development Program with the objective of improving all elements of the National Airspace System to enable helicopters to employ their unique capabilities efficiently.

The program seeks to identify new systems and procedures that can be implemented quickly as well as defining new concepts for the future. It includes investigations to support new airworthiness standards for handling qualities, flight in icing conditions, and new systems which enhance performance in IMC . Navigation and communications systems suitable for use by low-flying aircraft, will be tested, and the program includes definition of weather information systems particularly suited to rotorcraft operators.

The program has been underway for about a year and some near-term benefits are being realized but the effort is planned to continue for at least four (4) more years.

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1. Introduction

In the summer of 1978, the FAA established a new program which was called the Helicopter Operations Development Program. The objective of the program is stated very simply: "To improve the National Airspace System so that helicopters can employ their unique capabilities efficiently." In this context, the National Airspace System is a broad term that includes all elements of aviation activity; for example, it includes the airways, radars, navigation and communications facilities, landing sites and terminals. It also includes helicopters, pilots, rules, procedures, airworthiness standards, training programs - everything.

We intend to eliminate any criticism from helicopter advocates that helicopters are being treated like unwanted intruders in the aviation system - intruders who must conform with a grand system designed for fixed-wing aircraft - and if they do not conform then they must stay out of the system.

2. The need for a new program

The need for this program is well recognized by helicopter enthusiasts, but not so well recognized by others. Until recently very few helicopters were equipped to fly suitably in instrument meteorological conditions (IMC), and very few operators in the United States were interested in doing so. Because of the helicopters' characteristics, it has been most suitable to fly low below the clouds, and slow so that special VFR rules could allow continued operation in poor weather. But now, new helicopters are being equipped with stability augment systems, autopilots, flight directors, area navigation equipment and other advanced avionics; they can fly faster and farther; and maintenance costs per flight hour are going down dramatically. The operators who pay for these new capabilities want their full benefit to include regular IMC operations.

Recently there have been many reports that describe the rapid growth of the helicopter industry. Some of the significant statistics for the United States are these: The number of civil helicopters in the United States has been increasing at a rate of 12 to 17% in recent years. There are about 7000 in the United States today, representing about 70% of the world's fleet. By the mid 1980's, we expect that number to double and possibly half of this added fleet of helicopters will be certified for IMC operation.

This growth is due to two principal factors: one, of course, is the increased capability and lower operating cost of the new helicopters; the other is the great demand for helicopters for logistic support of the offshore oil and gas industry. There are more than fifty helicopter operators supporting the offshore oil industry in the United States. The largest of these has about 300 helicopters which makes that company second only to United Airlines as the largest aircraft operator in the United States. That one helicopter company carried over two and a half million souls across the beach along the Gulf of Mexico during a recent twelve-month period - and the business is expanding.

Until recently our helicopter operators carried out their competitive business with great individuality and independence - each with different interests - not asking for service from the FAA (and sometimes resenting whatever contact they were obliged to have with the FAA). But today they have developed a general realization that FAA could help them if it provided good services for traffic control, navigation, communications, and weather information. So they have formed associations, coordinated their requirements, and presented unified demands for improved FAA services. This, in itself, represents a new level of maturity in the helicopter industry which justifies special attention by the Government.

The problems that require new effort can be classified into two general categories: certification problems and operational problems.

3. Certification problems

With respect to certification, we need to define new criteria for certifying helicopters that incorporate improved characteristics. Until recently, we in the FAA have not had any formally published criteria for certifying helicopters for IFR operations. Some informal guidelines were used in the past and they were acceptable when it was rare to see an application for approving a helicopter for IFR operation. But those informal guidelines are no longer acceptable when IFR applications are being submitted frequently in different regions of the country.

One of the critical issues to be addressed is the establishment of some definition of minimum acceptable handling qualities for IFR flight and the suitability of systems that are employed to achieve the required handling qualities. What handling quality is required to permit IFR operation with one qualified pilot? How do you evaluate the handling qualities of a helicopter to determine its acceptability? What credit can be given for special systems and equipment such as flight directors, stability augmentation systems, etc.? Of course there are experienced inspectors, test pilots, and engineers who will have no personal difficulty in answering these questions. The problem is that each has a different answer. A manufacturer or any applicant for an airworthiness certificate deserves to know in advance what criteria he must meet to get his application approved, and there should be some similarity in the criteria used by all the different approving authorities.

As a first step toward developing some new IFR certification criteria, we completed a study of the problem and made some preliminary recommendations for certification requirements. Our Flight Standards Service recently issued some new guidelines for IFR certification requirements for helicopters and the study generally substantiates those guidelines. However, there is still more to be done. We are proceeding to evaluate proposed criteria for handling qualities in a joint program with Canada - using their variable stability helicopter for flight tests.

We currently have no published criteria for approving helicopter operations in icing conditions; and, with very few exceptions, helicopters are not authorized to fly into known icing conditions in the United States. Obviously this situation must change if helicopters are to be expected to operate efficiently in wintertime IMC. Manufacturers are already coming forward with ice protection systems on new helicopters, and a common set of criteria and procedures must be defined for approving the use of these systems.

Can new helicopter ice protection systems be expected to function in any icing condition? Probably not. Then what weather information should be reported so that the pilot can be confident that his helicopter can fly safely through? A proposal has been made that weather reports provide such details as moisture content and droplet size and that approval of aircraft ice protection systems be related to those parameters. We have started a series of helicopter flight tests to get data on this relationship, but there is much more to be done. During the last winter season, tests were carried out in a joint Army/FAA program, flying a UH-1H behind a spray rig in a CH-47. Data was collected in natural and simulated icing conditions. The tests showed that the spray rig generated droplet sizes that were not representative of natural conditions but the ice protection equipment tested worked satisfactorily.

We currently permit helicopters to operate in special VFR conditions, and we arbitrarily permit minimum visibility requirements for helicopter instrument approaches to be one-half of those for fixed-wing aircraft. But, as helicopter traffic increases and becomes concentrated in certain areas, and as new avionics are incorporated, should we establish new weather requirements? (Should there be something like Category II and III conditions defined for helicopters?) A frequently heard complaint from helicopter operators is that the current standard weather minima for alternate airports is too restrictive for helicopters. What justification is there to apply different alternate airport weather minima for helicopters? If different minima are justified, what should they be? Questions like these will be addressed in a review of terminal instrument procedures for helicopters.

Some helicopter noise criteria are being established now on the basis of data that has been collected in controlled tests, but the noise made by helicopters is unique and different from airplanes. For this reason, it may be appropriate in the future to describe helicopter noise criteria in some new manner. In addition, manufacturers have said that much more knowledge is needed about helicopter noise phenomena so that efficient designs can be created to meet the published criteria. Today, they say that their noise prediction capability is not accurate; and thus, to be confident that a new paper design will eventually meet the acceptable noise criteria, they must overdesign and spend more money than actually necessary to meet the standard. Our development program includes an effort to improve noise prediction techniques and to provide some guidelines for designers to meet the standards. That work will be started next year.

Another item on our list of certification problems has to do with establishing criteria for crashworthiness. Most people agree that with some deliberate effort, helicopters could be designed to be more crashworthy. Fuel tanks might be better protected and seats might be better designed to withstand some crashes. If we set a standard for crashworthiness, what kind or intensity of a crash should be survivable? Can some form of non-destructive proof be provided to demonstrate compliance with a helicopter crashworthiness standard? We have started to work to define the kinds of ground impact that should be survivable. There are also some computer programs which can be used to analyze the crashworthiness of aircraft structures and we hope to improve those programs to make them suitable for analyzing crashworthiness of helicopters.

4. Operational problems

Undoubtedly, the most significant operational problem with current helicopters stems from the fact that they fly at low altitude and frequently go below the line-of-sight from our current standard radar surveillance, VHF navigation, and VHF communications systems. Obviously, we need some new standard systems to provide for these functions for low-flying aircraft.

5. Communications

We have begun a review of all developments in communications systems that may be used for over-the-horizon communications; and we intend to pursue the most promising techniques that may be recommended from this review. In looking at our existing air-ground communications services, we discovered that a simple improvement could be made in some of our existing VHF communications facilities. Most of our VHF antennas on the ground are designed for omni-directional service and are quite satisfactory for high-flying, fixed-wing aircraft, but it takes deliberate attention to low-flying helicopter traffic to realize that the ground antennas should be carefully designed and installed to maximize the signal on the horizon in the direction where the helicopters fly. This means high-gain directional antennas should be carefully oriented in both elevation and azimuth and installed on tall towers. This simple solution has already given us excellent VHF communications with helicopters flying at 1000 feet to oil rigs 100 miles off the New Jersey coast.

6. Navigation

Omega and LORAN-C are radio navigation systems designed for long range use and the helicopter operators serving the offshore oil industry are now using these systems with special approval. We have no formally published criteria that permit helicopters to use these systems as the primary navigation aid in controlled airspace. For this reason, we have started a project to develop the necessary criteria. The capability of Omega is very well known, but airborne equipment for civil use of LORAN-C has only recently become available and it promises to be much more accurate.

We have been testing LORAN-C in helicopters on all the principal offshore oil routes around the United States. We have also conducted a series of flight tests along some experimental helicopter routes between Washington, D. C., and Boston, Massachusetts, and LORAN-C was tested to determine its suitability for terminal area guidance on arrival and departure routes. The first set of data from these tests shows that helicopters using LORAN-C should have no difficulty staying within an airway 4 miles wide or even on terminal routes 3 miles wide provided the crew is well trained and attentive in using the equipment in the cockpit. (There were a few incidents which could be classified as finger-trouble in the cockpit.) Our tests have identified the need for some precautions that should be taken with the first sets of airborne LORAN-C equipment now available, and the performance demonstrated on our first non-precision approach did not fall within our requirements for accuracy for such operations; however, more testing is required to draw valid conclusions about the use of LORAN-C on non-precision approaches.

We are also preparing a project to use automatic position reporting equipment that will report LORAN-C position information to ATC for traffic surveillance offshore.

GPS will be the next contender for a low-level navigation system for helicopters and we have plans to test its suitability as soon as possible - that will be in another year or two.

7. Approach and landing

Most of the offshore helicopter operators who can fly on instruments have airborne ground-mapping radars and they have developed their own procedures for making approaches with these radars. The United States operators would like to get some operational benefit by using them as the prime source of approach guidance with low ceiling and visibility. In order to help define some criteria for approving airborne radar approaches, we have conducted a rather extensive series of flight tests. These tests were made using only the airborne radar for guidance, although the radar return was augmented on some tests by corner reflectors and by ground beacons.

The results of our airborne radar tests show that in simple situations offshore, an approach can be safely made to a 200-foot decision height in one-half mile visibility. The ability of pilots to fly a prescribed track on the approach was not equal to that required for normal non-precision approaches; but where accurate tracking is not required, such as in an approach to an isolated offshore oil rig, 200' and one-half mile weather minima should be all right. With multiple targets in the area, target identification is difficult and mistakes are possible. Skill and training is required to do a good job.

One radar set was modified to display a selected bearing cursor on the scope, and additional tests showed that it improved tracking and reduced workload considerably.

Radar approaches to land bases were also tried with the standard radar set. Tests with corner reflectors suggest that they are not too practical for enhancing the ground target. The corner reflectors have to be so large and sturdy that they can be more expensive than active beacons. Tests with ground beacons showed that they are useful to identify the target and range measurements can be made accurately; but the beacon return creates a wide smear on the scope. This large smear makes it more difficult to read accurately the bearing to the target, and it blends with adjacent targets making it somewhat more difficult to use the radar for obstacle clearance. The gain adjustment is even more critical where beacons are used and false beacons can appear in multipath conditions. Within seven-tenths of a mile, the beacon return saturated the radar and no discrete beacon target could be identified at short range. Multiple beacons on the ground revealed other problems.

8. Air traffic control

One of the greatest operational benefits for IFR helicopters may come with new terminal approach and departure criteria. We have begun a study to identify possible changes in the criteria for instrument approach procedures for helicopters. This project involves, first, collating and recording the approach and missed approach capabilities and performance of current helicopters; second, collating and recording all the approach test data that has been accumulated; third, comparing the performance data with existing criteria and with all the proposals for new criteria that we can assemble; fourth, identifying new criteria that we can justify now on the basis of data already available, and finally carrying out a test program to evaluate new proposals for which substantiating data is not now available. This effort is intended to provide recommendations for changing the handbook on Terminal Instrument Procedures (TERPS), and it is likely to continue for several years, but we will recommend various changes in the helicopter approach criteria as soon as they can be substantiated.

In general, helicopters that go IFR in controlled airspace have been treated like fixed-wing aircraft by traffic controllers, and there are a number of arguments for providing different procedures for controlling helicopter traffic. To illustrate with an example: we had a helicopter arriving IFR at one of our busiest airports not long ago, and on that day the wind was very strong. When the helicopter got in line with the big jets for an ILS approach, the ground controllers discovered the helicopter's ground speed was less than 15 knots. They turned him out of the line twice to let the jet traffic move on. Finally, the helicopter pilot asked the controller to let him make an ILS approach on a different, inactive runway, because he was not going to use the runway for touchdown anyway. The controller approved that idea with great relief and satisfied everyone.

We are now actively studying a variety of ideas for moving IFR helicopter traffic efficiently in the presence of heavy fixed-wing traffic, and we are planning means for controlling the growing helicopter traffic in offshore areas.

An experimental helicopter airway has been established between Washington and Boston and special approaches have been defined at points along that corridor. Arrival and departure routes for helicopters are being defined for the metropolitan areas and they will be published on pilot's charts. Evaluation of helicopter operations along the Northeast Corridor will be carried out for about a year after which we may improve the route and establish similar routes for helicopters in other parts of the country.

Since helicopter flights are usually fairly short range - not usually longer than one hour between stops - any in flight delay can be a significant percentage of the block time and thus cause a signficant increase in cost. Direct point-to-point flights are needed for greatest efficiency. This means area navigation with a compatible area traffic control system is needed to achieve the greatest efficiency for helicopters.

For example, a helicopter pilot should be able to file a flight plan to navigate - directly to his destination and the ATC system should be able to assess that plan immediately for potential traffic conflicts, monitor its progress, and issue modifying instructions where necessary to avoid conflicts.

We have started to study the technical means for implementing this concept as a long term solution. It may be possible to implement it initially in some limited way - perhaps at low altitudes in one limited area - then expand to other areas later. Our initial studies are intended to find the means to overcome the many obstacles that can prevent the concept from being implemented.

In turning a sympathetic ear to the helicopter operators' complaints about air traffic control, we found that some simple actions can be taken to improve helicopter operations. One is to define and publish specific arrival and departure routes for helicopters in terminal areas and the other is to start a training program for both controllers and pilots to acquaint them with practical means for moving helicopter traffic safely and efficiently. Action is being taken on both of these matters.

9. Weather information

The advance of helicopter operations into icing conditions will require better information on actual weather likely to produce ice; consequently, we have started flying a test aircraft into actual icing conditions at low altitudes to collect and record the relevant meteorological parameters and correlate them with ice accretion. (This project is being conducted for the FAA by the Naval Research Lab., using a 4-engine Constellation.) Some data was collected last winter and the project will continue through the next winter season.

There is also a need to find some simple means to obtain weather information at remote sites where helicopters operate. Since many helicopter operations involve flight to locations other than main airports, there is frequently no official weather report for the helicopter's destination. Point-in-space approaches are also being defined to let helicopters descend from IMC conditions many miles from their destination, but the actual weather at these remote points is not reported and may differ from that at the helicopters' destination. To satisfy this requirement, we are developing standard low-cost remote weather observation systems.

10. Heliports

Another area of work that may improve IMC operation of helicopters is the development of a standard lighting system for an all weather heliport. There are guidelines and recommendations for lighting heliports but no standards, and in the absence of a standard, heliports and helipads are lighted in many different ways. Another item that many helicopter pilots have expressed a need for is some type of VASI for a helipad.

To satisfy requirements like these, we are surveying all the latest airport lighting developments and current heliport lighting configurations with the objective of selecting a standard. It is likely that two or more configurations can be found suitable and some evaluation will be needed to select one as the best.

11. Summary

As reflected by all the foregoing discussion, there is much that may be done to improve helicopter operations. There is opportunity for improvement in nearly every functional area. The FAA's Helicopter Operations Development Program has been designed to address all these areas. The program is underway and simple improvements are already being realized, but major changes will have to wait for the long term.