TRAINING TECHNIQUE
TO EXERCISE AT SIMULATOR
THE DIFFICULT FLIGHT STAGES

A.A. Bondarenko, V.I. Zhelonkin, M.V. Zhelonkin, O.I. Tkachenko
* Central Aerodynamic Institute, Zhukovsky, Russia
zhelonkinmishail@mail.ru

Abstract

The training technique for engineering and technical personnel to perform the difficult flight stages at simulator is considered in this paper. The experience that is obtained when working at various flight simulators proves that among the engineers who serve this facility there are not enough trained experts who are able to carry out competently as the pilot-operator the experiment. The researches for selecting and debugging the control systems algorithms and parameters are highlighted among the tasks, which are performed at simulator. Such works require carrying out the considerable amount of researches.

The involvement of professional pilots who are experienced in performance of such fight regimes into training process is associated with a number of complications: it is impossible to engage such experts for a long period; it is possible for trainees to adopt the wrong skills when working at the simulator.

1 Introduction

The purpose of the given paper is to demonstrate the training technique for engineering and technical personnel to perform the difficult flight stages at simulator. The refueling procedure is taken for instance. The enhancement of the control system under investigated flight regime is the main purpose of simulation process. At the same time, the pilot-operator has to master the aircraft handling near the tanker aircraft, the approaching the tanker aircraft refueling drogue, handing the airplane in the course of refueling.

Active use of refueling demands the crews to be highly professional prepared, trained when acting while performing this sensibly complicated maneuver. Moreover, the aircraft designers face the challenge to create such a control system that should essentially enhance the aircraft flight handling characteristics and simplify the piloting process under in-flight refueling.

2 Problem statement

Two airplanes take part in refueling process: the tanker aircraft (Fig. 1) and the recipient plane equipped with the special fuel reception system.
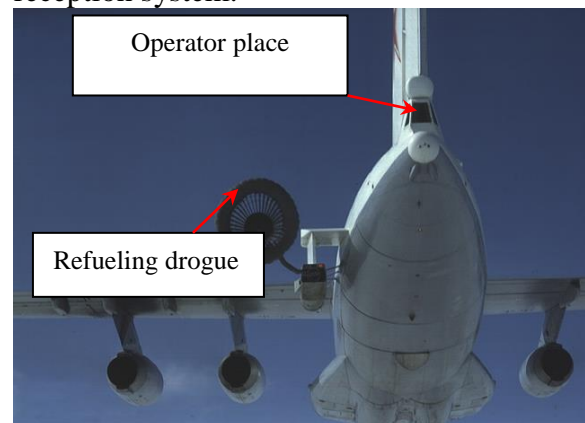

Figure 1: Current tanker aircraft with the aircraft in-flight refueling system in operating state.

In the given paper when simulating the procedure, the in-flight refueling mechanism on flexible hitching is considered in manual control of airplane-recipient both from the larger tanker aircraft, and from the tanker aircraft of same type.

Regardless the factthat two planes take part in the refueling process, the research of algorithms and the estimation of pilot actions are assumed to be carried out only for the airplane recipient. Only one flight simulator is to be used when carrying out this research simulation. The assumptions are as follows:

– The tanker aircraft performs a straight flight at specified altitude and specified speed;
– The tanker aircraft aerodynamics and control system are not simulated. When simulating the tanker aircraft and its components images that are engaged in in-flight refueling are only displayed.

3 Training method

The trainee operator is suggested to perform the exercises of various complexity degrees. In the course of performing such exercises, the operator acquires the correct skills to control the aircraft and to estimate the task performance.

First complexity level exercise: refueling at only longitudinal channel control, without air disturbance, without drogue deviations, the speed is upheld by autothrottle system.

*Purpose***:** to learn how to operate aircraft from the moment of connection with the tanker aircraft until the moment of contact with cone, to get accustomed to spacial positioning of the airplane recipient and the tanker aircraft, to perfect the approachment with the tanker aircraft

Second complexity level exercise: refueling under the control both in the longitudinal channel, and in the lateral one, the speed is upheld by autothrottle system, without air disturbance, without drogue deviations.

Purpose: to learn how to operate in two planes, to learn how to compensate a lateral and longitudinal error.

The record of the refueling process executed by the skilled instructor is shown to the trainee operator in the cockpit.

The operator should pay attention to the change of the tanker aircraft sizes when approaching it, to the spatial positioning of the recipient airplane and the tanker aircraft when approaching, to the spatial positioning of the flight-refueling probe and the drogue.

The operator performs the "Refueling" regime as if be being 100m behind the tanker aircraft.

Airplane position reference conditions for the refueling simulation:

– Distance to tanker aircraft $L_0 = 100$ m;
– Flight altitude in re of tanker aircraft $H_0 = 20$m;
– The recipient-airplane initial speed is equal to that one of the tanker aircraft.

To simplify the handling task the parameters that provide the "Refueling" regime setting are set before the simulation starts which are as follows:

– The control system algorithms conversion into "Refueling" mode;
– The flight-refueling probe switch takes the "Extension" position;
– The autothrottle system switch takes the "IN" position.

The trainee performs 10 … 20 runs.

4 Example exercise

First complexity level exercise.

The Refueling mode "" at control in the longitudinal channel only:

– the basic plane configuration;
– Control in the lateral channel –not given;
– the isolated longitudinal movement mode is set - connect;
– Speed control by autothrottle system – connect;
– Air disturbances –not given;
– Drogue deviations –not given.

The refueling process record made by the skilled instructor is shown to the trainee operator in the cockpit. The operator should pay attention to change of the sizes of the tanker aircraft when approaching it, to position of the

recipient-airplane when approaching the tanker aircraft and to position of the flight-refueling probe in re of the drogue due to the flight-refueling probe extension.

The operator performs the "Refueling" regime as if be being 100m behind the tanker aircraft.

Airplane position reference conditions for the refueling simulation:

– Distance to tanker aircraft $L_0 = 100$ m;
– Flight altitude in re of tanker aircraft $H_0 = 20$m;
– The recipient-airplane initial speed is equal to that one of the tanker aircraft.

To simplify the handling task the parameters that provide the "Refueling" regime setting are set before the simulation starts which are as follows:

– The control system algorithms conversion into "Refueling" mode;
– The flight-refueling probe switch takes the "Extension" position;
– The autothrottle system switch takes the "IN" position.

The trainee performs 10 … 20 runs.

Second complexity level exercise.

"Refueling" mode at total control in all channels:

– the basic configuration of the plane;
– Control in the lateral channel – connect;
– autothrottle system speed control – connect;
– Air disturbances – is not given;
– Drogue deviations – is not given.

The refueling process record made by the skilled instructor is shown to the trainee operator in the cockpit. The trainee operator should learn how to compensate an error both in the lateral plane, and in the vertical one. The operator performs the "Refueling" regime as if be being 100m behind the tanker aircraft.

Airplane position reference conditions for the refueling simulation:

– Distance to tanker aircraft $L_0 = 100$ m;
– Flight altitude in re of tanker aircraft $H_0 = 20$m;
– The recipient-airplane initial speed is equal to that one of the tanker aircraft.

To simplify the handling task the parameters that provide the "Refueling" regime setting are set before the simulation starts which are as follows:

– The flight-refueling probe switch takes the "Extension" position;
– The autothrottle system switch takes the "IN «position.

The trainee performs 10 … 20 runs.

After successful performance of all these exercises the trainee specialist can research independently this topic.

5 Contact Author Email Address

Zhelonkin Michael, engineer. zhelonkinmishail@mil.ru

Copyright Statement