'Fuel Reserves for Aircraft'

from Captain J. D. Proctor

THE Working Party on Fuel Reserves for aircraft recommends that a major statistical attack should be made by a qualified body with the aid of an electronic computer on the problem of how to rationalize fuel reserves. I.C.A.O's Standing Committee on Performance did much to standardize the risk of an aircraft hitting the ground on take-off and on landing, hence increasing profitability without prejudicing safety. Might not I.C.A.O. set up a committee to tackle fuel reserves on similar lines?

I think that even now, in advance of such a major undertaking, fuel reserves might be rationalized a little if certain information were available to flight planners and crews. For instance, Durst has given the accuracy of forecast mean equivalent head winds for a few routes (this *Journal*, 13, 288); if it were given for a wider selection of routes, perhaps the fuel reserve carried for 'navigational error' could be roughly specified as the extra fuel needed to cope with 95 per cent (say) of the errors expected in forecast M.E.H.W. The use of extra fuel en-route for other causes is much less frequent (on piston-engined aircraft anyway) and could generally be covered by change of destination or by use of fuel nominally carried for diversion. If Durst's meteorological calculations are supported by aircraft operators' experience, it would appear that the usual present rule (to compute reserve for 'navigational error' as a percentage of route fuel required regardless of season, region and distance) is very wide of the mark: a bigger reserve is needed over the North Atlantic in winter than in summer, over the North Atlantic than over the equator, at high than at low altitudes, and a bigger percentage on short flights than on long flights.

Blind landing is not likely to become general for many years, but the fuel reserve to cover the risk of diversion to an alternate due to below-minimum weather at destination could be rationalized a little if information on airfield weather was provided in standard form. For instance it might be possible to state that in certain hours of the day in certain months an airfield has had no below-minimum weather for at least ten years (I found that meteorological records indicated this to be true for Nicosia, 0800 to 1700 G.M.T., April to August, 1944 to 1954); in other cases it might be possible to state that a certain destination and its alternate(s) are never simultaneously 'out', or that this is so provided the landing forecast or perhaps the 'actual' so many hours earlier are better than certain limits. Given such information airlines could develop rules for specifying alternates, computing fuel reserves and deciding whether to delay departure, which should help to standardize the risk of an aircraft running out of fuel and improve regularity and efficiency and perhaps profitability. I suspect that present practice leads to wildly unequal risks.

Even when blind landing becomes general, ATC holding will probably still be a big user of fuel reserves, particularly in bad and moderate weather near major airports when traffic is heavy. ATC authorities should provide statistics of holding with respect to airport, time of day, season and perhaps weather conditions and day of the week. Possibly ATC could even forecast ATC holding as met. offices forecast terminal weather.

Simple statistics on the accuracy of terminal weather forecasts would help captains and flight planners when deciding on fuel reserves and would help captains in the air when considering diversion.

Before practical people would use any of this meteorological information, it would have to be shown that it was not contradicted by the actual behaviour of aircraft. The information would have to be in standard form to be easily appreciated and might be used in this sort of way: if a pilot's base were London Airport and he read that the frequency of below-minimum weather at his destination Niamey at his E.T.A. was one-tenth of the frequency at London, he would know that his fuel reserves need not be very generous; on the other hand, if he read that the frequency of unforecast below-minimum weather at his E.T.A. at night in winter at Gander was three times that at his base, and moreover that on 40 per cent occasions of below-minimum weather at Gander the weather was also below-minimum at the nearest alternate, he would know that his fuel reserves must cover diversion to a more distant alternate. Before fuel reserves were reduced below their normal values, very careful consideration would have to be given to the possibility that reserve fuel ostensibly carried to cover a contingency now considered a risk small enough to be ignored might in fact sometimes be used to cover a different contingency. Increased workload on the crew and possibly the need for more accurate navigation and for better communication of weather reports would also need consideration. If statistics were available on the frequency of failure of two engines of four-engined aircraft, a rational decision could be made whether to carry sufficient fuel to cover the contingency.

To comment on some minor points of the Working Party's Report:

(i) I imagine the probability of ATC holding when an engine has failed is very small.

(ii) The accuracy of the aircrew's estimate of fuel remaining at any time depends partly on the accuracy.

(iii) The accuracy of the aircrew's estimate of fuel remaining at any time depends partly on the accuracy of previous refuelling and partly on the accuracy and suitability of the aircraft's instruments indicating fuel used, fuel remaining and/or rate of flow, and/or on the accuracy of power/fuel consumption information.

(iv) Landings are effected at first attempt if at all at a rate nearer 99 per cent than 95 per cent.