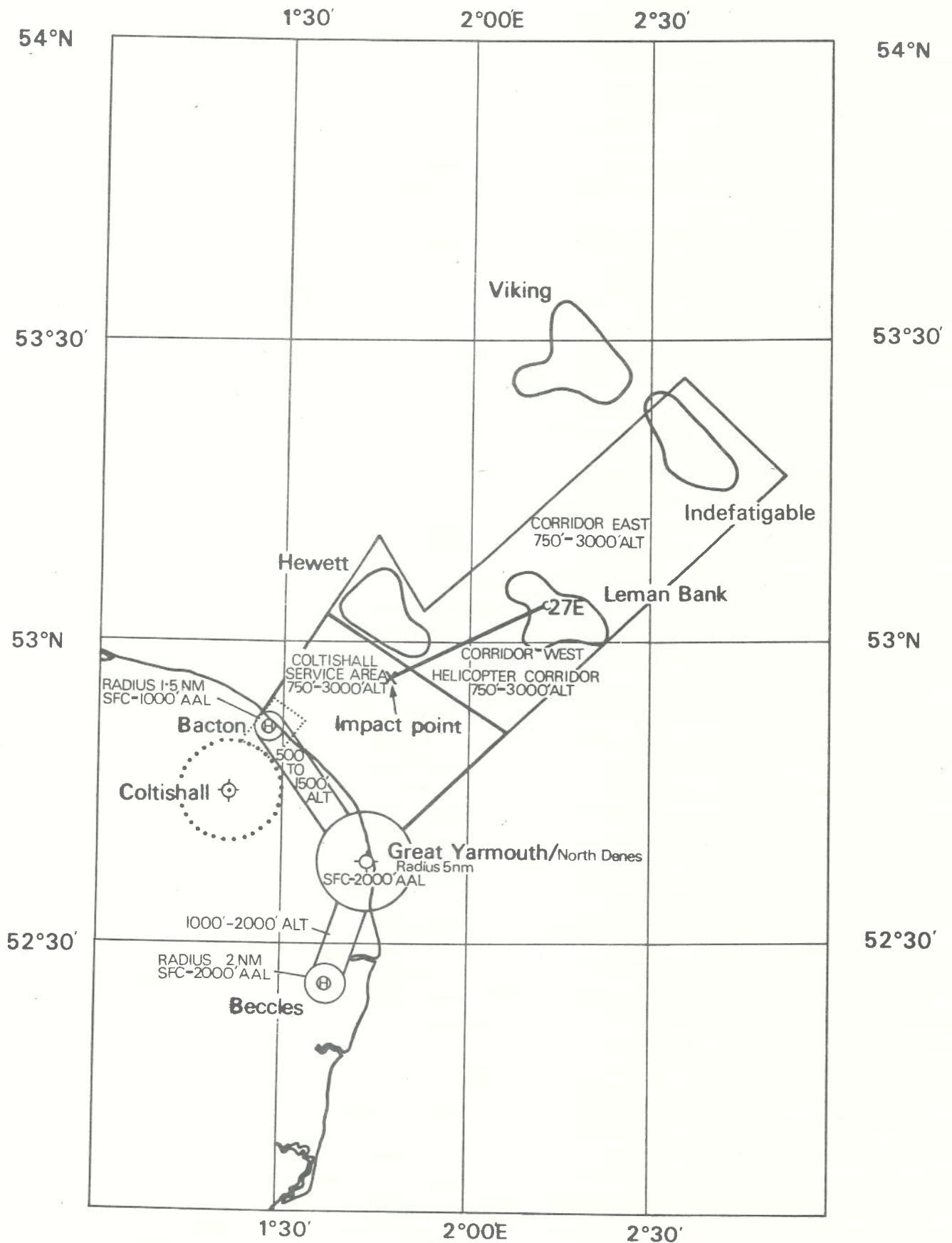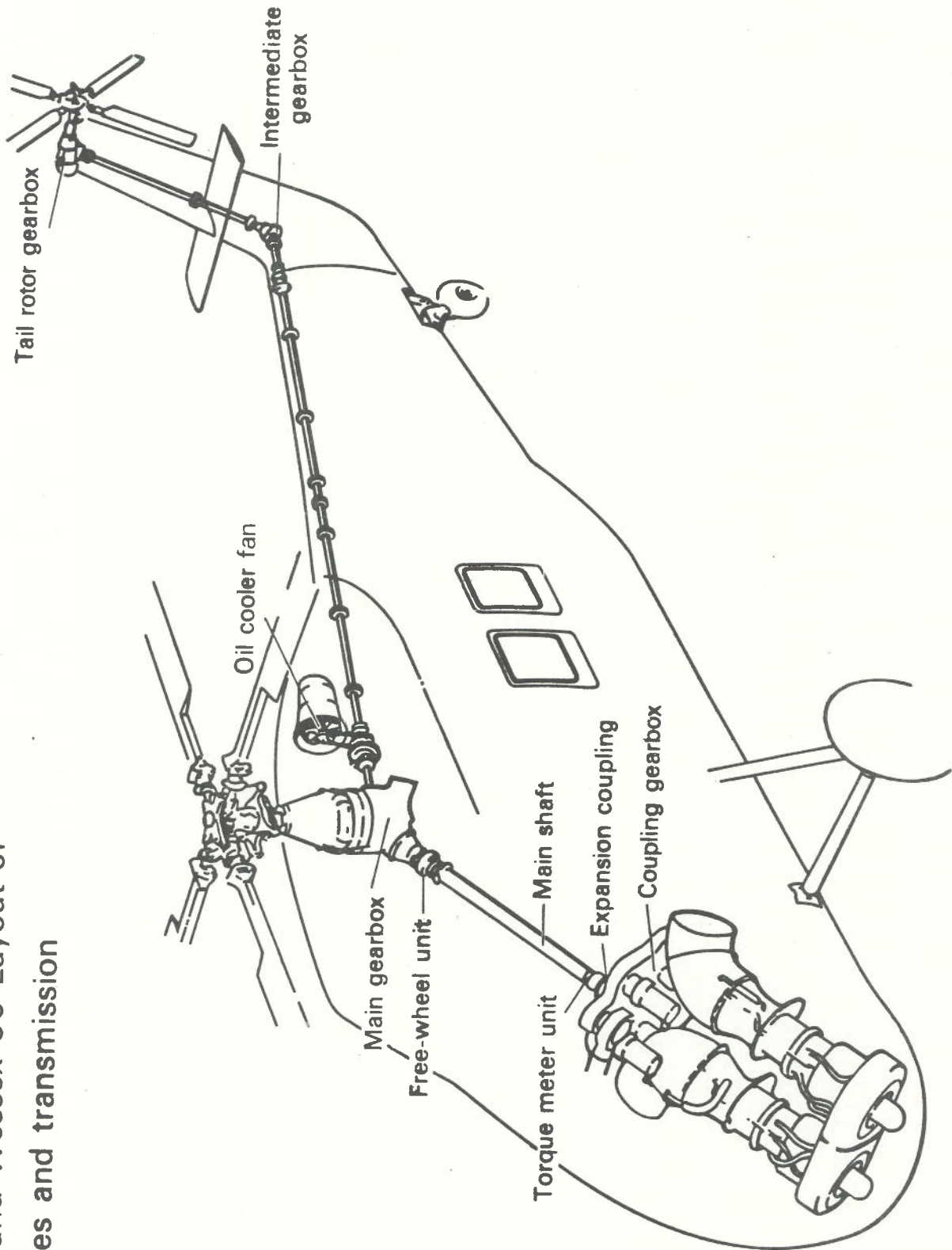# Map of G-ASWI's operating area showing last flight leg

Westland Wessex 60-Layout of
engines and transmission

Tail rotor gearbox

Intermediate gearbox

Oil cooler fan

Main gearbox

Free-wheel unit

Main shaft

Torque meter unit

Expansion coupling

Coupling gearbox

Westland Wessex 60

Rotor speed during entry to autorotation following total power loss
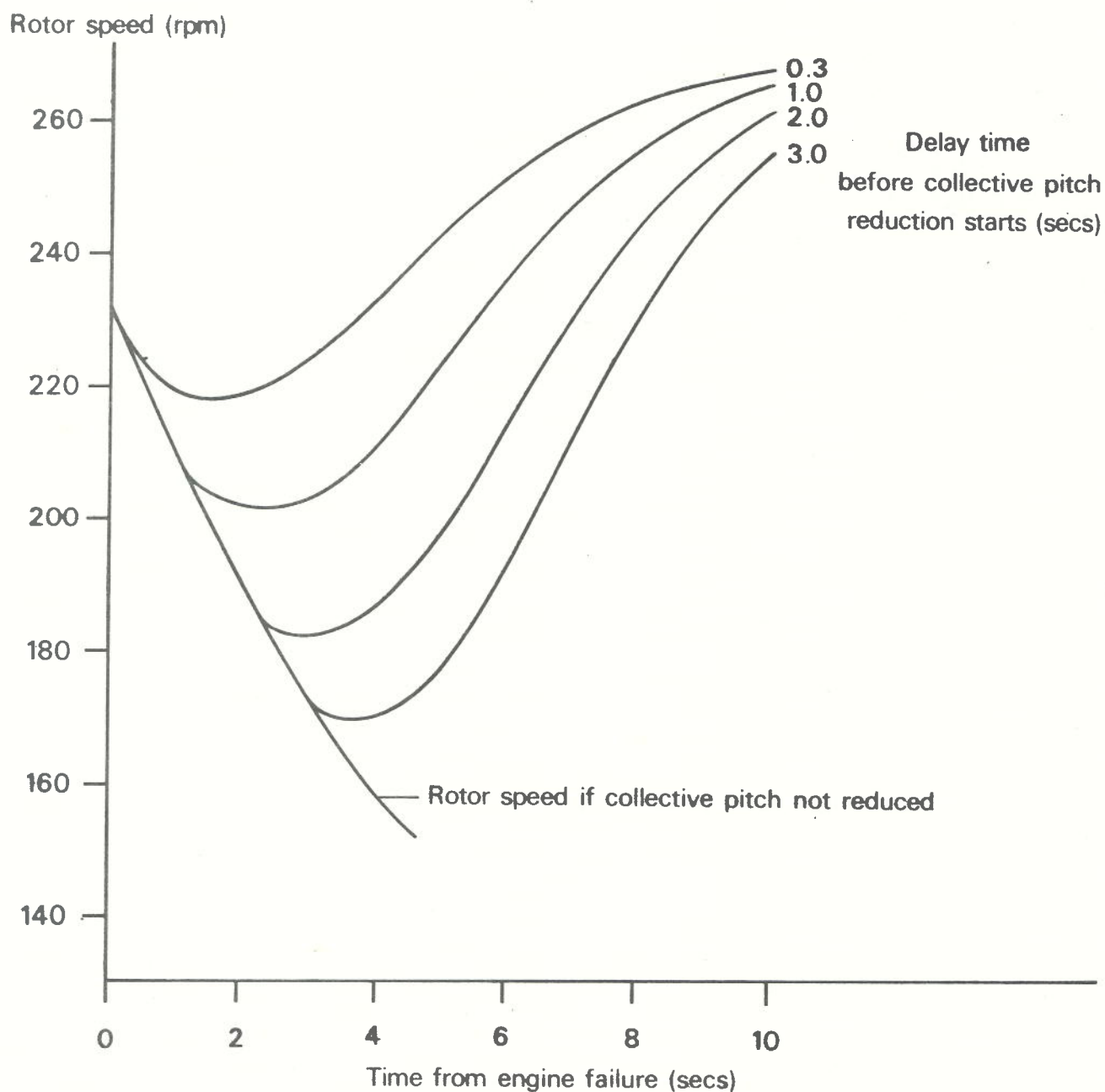
100Kts at start, ISA sea level

Deceleration at -5ft/sec^2 to 65Kts

13,500 LB aircraft weight

No blade stall representation

Collective pitch control travelling time 0.75 secs.

Rotor speed (rpm)

260 —

240 —

220 —

200 —

180 —

160 —

140 —

0.3
1.0
2.0
3.0

Delay time
before collective pitch
reduction starts (secs)

Rotor speed if collective pitch not reduced

0   2   4   6   8   10

Time from engine failure (secs)

An Investigation Of The Time Taken To Respond To Total Engine Failure.

The Royal Air Force Institute Of Aviation Medicine

J W Chappelow

Method

This trial was undertaken using the British Airways Sikorsky S—61N simulator at Dyce Airport, Aberdeen*. The procedure was as follows. At the end of a routine training detail the handling pilot was ordered to overshoot. When the pilot had established straight and level flight, the simulator instructor operated a switch which caused simultaneous failure of both engines. The time elapsing between closure of the switch and the collective pitch lever reaching the bottom stop was recorded by the simulator computer.

Results

It was the intention that all subjects would be unaware of the trial before they experienced the double engine failure. Accordingly data from two training captains who may have known about it were rejected leaving 26 usable response times. Data on age and helicopter flying experience were available for 24 and 20 of these subjects respectively. The data are summarised in Table 1. Reaction time data in general have skewed distributions, but the mean and median of these data are 3.08 and 3.07 respectively, indicating only a slight positive skew. Accordingly normalising transformations are considered unnecessary for the present purpose. Correlation coefficients were calculated between response time and each of the other variables. They were with age, 0.0725; with total hours, —0.0175: with S—61N hours, 0.0363, but all were nonsignificant.

TABLE 1:   Summary of data

	Age (years)	Total Helicopter Hours	S—61N Hours	Response Time (seconds)
$\overline{X}$:	33.33	2883	1638	3.08
S:	5.95	1487	898	0.94
N:	24	20	20	26
Max:	43	6000	3000	5.5
Min:	24	550	150	1.5

Discussion

There is a great deal of laboratory data on response times in a wide variety of conditions, but little involving "real world" operating procedures. One airborne study by Helmut Kuehnel (1960) produced average response times of 0.23 sec and 0.33 sec to lateral and longitudinal aircraft disturbances, respectively. In this study, however, the pilot subjects were aware of the nature of the experiment and were waiting attentively for the stimulus to respond. It is not surprising, therefore, that their response times approximate those found in simple reaction time experiments in the laboratory. They indicate an absolute minimum for any response time. Green and Skinner (1981) in a simulator experiment very much like the present one found the time taken to initiate throttle closure in response to a control failure during take-off averaged 2.7 sec (standard deviation, 0.83). Allowing for the fact that the present study involved completion rather than initiation of a response, this result is very close to the present one (3.08 sec, standard deviation 0.94). Thus, on the basis of the available data, a realistic expectation for the time taken by a pilot to respond to an emergency (even one of primary importance) is about three seconds. Given the special conditions pertaining in a simulator exercise, when pilots traditionally expect emergencies, this estimate is probably low rather than high. It does, however, seem to be independent of significant influence, by age or experience. Finally, the results of this trial indicate that there is a small, but not negligible chance (2 – 3 per cent) that a given pilot's response time will exceed five seconds.

References

GREEN, R G & SKINNER, R J (1981) An Experiment to Measure Response Times of Pilots to a Locked Elevator Condition at Rotation Speed. In: Report on the accident to BAe HS 748 G–BEKF at Sumburgh Airport, Shetland Islands, on 31 July 1979. Department of Trade Aircraft Accident Report No. 1/81. London: HMSO.

KUEHNEL, H A (1960) In-Flight Measurement of the Time Required for a Pilot to Respond to an Aircraft Disturbance. Technical Note D–221(15). National Aeronautics and Space Administration, Washington DC.