Part V

Chapter 2—Airframe Emergency Procedures

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1 Failure of a PFCU

(*a*) *Indication*

Warning light comes on.

(*b*) *Immediate action*

Switch off the affected sub-unit. This action does *not* cancel the warning light.

(*c*) *Subsequent action*

One attempt may be made to restart the sub-unit. If the warning light stays on, switch off the sub-unit and leave it off.

2 Overheating of a PFCU

(*a*) *Indication*

Overheat warning indicator shows white.

(*b*) *Immediate action*

Switch off the affected PFCU.

(*c*) *Subsequent action*

When the magnetic indicator shows black, wait five minutes and switch on the PFCU. If the magnetic indicator again shows white, switch OFF and leave OFF.

3 Control surface trim runaway

(*a*) *Indication*

Marked change of aircraft trim.

(*b*) *Immediate action*

(i) Release trimmer and call "Trim runaway".

(ii) Take stick force and alert other pilot to assist if necessary.

(iii) Reduce speed if necessary.
(iv) Retrim on alternative switch.

(*c*) *Subsequent action*

AEO trips circuit breaker of faulty trimmer on panel AJ or AV.

Circuit Breaker	*1st Pilot Panel*	*Co-Pilot Panel*
Console Selector Trim Switch Master .	AV	AJ
„ „ „ „ Rudder .	AV	AJ
„ „ „ „ Aileron .	AV	AJ
„ „ „ „ Elevator .	AV	AJ
Control Column Elevator Trim Switch .	AJ	AV

NOTE: The Master circuit breaker cuts out the associated console switch only, leaving the other pilot's spectacle switch operative.

4 Control surface trim failure

(*a*) *Indication*

No response to trim selection.

(*b*) *Action*

(i) Make no further selections of the affected control until its circuit breaker has been checked.

(ii) If tripped, reset the circuit-breaker.

(iii) Make a trial operation of the trim at low airspeed.

(iv) If the control still fails to operate, or again causes the circuit-breaker to trip, break the circuit and use the alternative trim.

NOTE: If a trim runaway occurs, the circuit breaker must be tripped immediately and the alternative trim used for the remainder of the flight.

5 Yaw damper failure

(*a*) *Indications*

Yawing oscillations or yaw trim force.

(*b*) *Action*

Switch hydraulic yaw damper to STANDBY and standby yaw damper ON. If the indications continue switch the hydraulic yaw damper OFF, this action cuts the feedback circuit and allows the rudder to run 4° in one direction or the other. The standby yaw damper should be switched to STANDBY and the rudder trim used to neutralise the rudder; this will slightly offset the rudder pedals; the standby yaw damper should then be switched ON and hydraulic yaw damper left OFF.

6 Auto-mach trim failure

(*a*) *Indications*

(i) *Sticking in one position of extension*

Gradual change from nose-up to nose-down trim force as speed is increased in the operative speed range.

(ii) *Moving to fully extended or retracted*

Sudden nose-up or nose-down trim change.

(*b*) *Immediate action*

Reduce speed to below 0·85M and switch off.

(*c*) *Subsequent action*

(i) Retract the actuator in small increments by selecting control switch to RESET in short "blips".

(ii) If the indicator remains black do not increase speed above 0·87M.

7 Cabin pressure failures

(*a*) *Loss of cabin pressure*

(i) *Indications*

Warning lights come on. Horn sounds if cabin altitude exceeds 42,000 feet.

(ii) *Immediate action*

NOTE: Flood flow, if set to AUTO, operates automatically, but will cycle once cabin altitude reduces to below 26,500 feet.

Warn crew assume manual control by switching off master flood flow switch and increase or decrease mass flow by selections between FLOOD and LESS AIR.

(iii) *Subsequent action*

Check for leaks and that all cabin pressurisation system switch selections are correct. When no longer required, select the flood flow reset switch to RESET until the indicator goes black.

(*b*) *Over-pressurisation*

(i) *Indications*

Cabin altimeter reads lower than correct figure for altitude.

(ii) *Immediate actions*

1 Warn crew.
2 Level out, if climbing.
3 Do not exceed 30,000 feet.
4 Dump excess pressure to obtain correct cabin altimeter reading.
5 Select COMBAT, if on CRUISE.

(iii) *Subsequent actions*

If over-pressurisation persists switch off the starboard isolation cock and then maintain cabin pressure by alternate on/off switching of the port isolation cock. The port engines bleed isolation cocks may be switched off and the cabin pressure maintained by alternate on/off switching of either one of these switches.

NOTE 1: If over-pressurisation is caused by *inadvertent* operation of flood flow, switch off the flood flow system and RESET.

NOTE 2: If over-pressurisation is caused by *normal* operation of the flood flow system, manually control pressure by LESS AIR selection.

NOTE 3: If cabin pressurisation occurs at low altitudes, check that the pressure controller ground test lever is flush.

(*c*) *Rapid or explosive depressurisation*

(i) *Indications*

Warning lights illuminate. Horn sounds if cabin altitude exceeds 42,000 ft. Noise of decompression and cabin misting.

(ii) *Immediate action*

Warn crew "Emergency Descent, toggles down." Crew acknowledge. Throttle back, extend airbrakes, descend at 0·93M/330 knots until cabin height is 30,000 ft. or below. Check flood flow is operating ; if necessary select manually.

(iii) *Subsequent actions*

Check selections of ABANDON AIRCRAFT switch, EMERGENCY DECOMPRESSION switch, ENGINE BLEED ISOLATION switches, CABIN AIR ISOLATION switches. Select alternate setting on cabin pressure selector switch. If depressurisation is due to incorrect switching, RESET flood flow.

If the failure is due to puncturing of the cabin walls, use leak stoppers if possible.

NOTE: Maximum cabin height is 42,000 ft. in emergency only.

8 Escape hatch jettisoning

(*a*) *Post-Mod.* 2789

Automatic jettisoning occurs when associated ejection seat *face blind* handle is pulled.

(*b*) To jettison manually, pull up associated ditching handle.

9 Flight with escape hatches jettisoned

(*a*) Flight tests have shown that at speeds of 250 knots and over, with one or both pilots' escape hatches removed, normal intercommunication will be extremely difficult if not impossible. Cabin altitude may exceed actual altitude by up to 2,000 feet.

(*b*) Airflow conditions and buffet level at the pilots' station for speeds in excess of 180 knots are not uncomfortable, but below 180

knots the buffet level and airflow in the cockpit increase abruptly and will become increasingly more severe with a further reduction of speed. Difficulty will be experienced in seeing due to the dust and airflow unless the eyes are protected by the use of goggles. The loss of one or both hatches will not affect the stalling speed, and the normal approach speeds should be used.

(*c*) The inadvertent loss of the pilots' escape hatches may result in damage to the airframe, especially the rear fuselage. Therefore the aircraft should be flown at an airspeed as low as is practicable, i.e. 220 knots and below and only gentle manoeuvres performed until the extent of the damage, if any, is confirmed.

10 Action in the event of complete loss of plenum chamber pressure

(*a*) There is no immediate danger of overheating and this drill should be carried out with care and attention. The object of the load shedding is to reduce all TRU loading evenly. No excessive overheating should take place if the TRU loading is reduced to a maximum of 30A per MV channel and 20A per LV channel, and there is no restriction on flight duration if these maxima are achieved. If the plenum/dinghy hatch is missing airspeed should be restricted to a max. of 240 knots with an optimum of 210 knots or less to avoid possible damage to the airframe aft of the hatch.

(*b*) *Action*

(i) ECM equipments all OFF. Return alternator to main electrical system.

(ii) Load shed selectively, Port and Stbd., as follows, monitoring ammeters:

1 Hydraulic pumps—both OFF—use one when required
2 PFCU's—switch OFF numbers 1, 4, 6, 7, 10
3 Proportioners—BYPASS
4 Fuel pumps—minimum of 3 in a group
5 Inverters—all OFF except flt. instruments
6 NBC and H2S—circuit breaker tripped
7 Scanner stabilisation—OFF
8 VHF/UHF—either set OFF
9 Yaw dampers—Normal to STANDBY/Standby as required
10 Anti-icing—As required
11 External and Internal lights—Minimum
12 ILS—OFF
13 ADF—OFF
14 HF—minimum use then—OFF
15 Ration heater CB's tripped

(iii) Check plenum hatches with periscope.

(iv) If panel BA ammeter loading excessively uneven then parallel at captain's discretion.

11 Nose flap failure

(*a*) *Failure to lower*

(i) If the nose flaps fail to lower at any time when AUTO is selected and the lift co-efficient is high, or when the main flaps are lowered, try lowering by selecting nose flaps OUT. If the nose flaps still will not lower, take action as in (ii) and (iii) below.

(ii) *Manoeuvring*

The speeds at which the CL warning lights will come on may vary due to the tolerance in the setting of the pressure ratio switch, and to extraneous aerodynamic effects such as rolling motion or rate of increase of incidence. Pre-stall buffet will occur at approximately 15-25 knots below the CL warning speed. Whilst manœuvring, therefore, maintain speed above that at which the CL lights operate.

The table on next page lists the ranges of speeds at which the CL warning lights will come on with the undercarriage, nose flaps and main flaps retracted.

Wt. (lb)	*IAS—1G Flight*	*IAS—1½G Flight*
100,000	155–170	185–200
110,000	160–175	195–210
120,000	165–180	200–220
130,000	170–190	210–230
140,000	175–195	215–240
150,000	185–205	225–250
160,000	190–210	230–255
170,000	195–215	240–265
180,000	200–220	245–270

(iii) *Circuit and landing*

For the circuit and landing, 10 knots must be added to the recommended speeds shown on the approach speed chart. Gentle turns with as little acceleration as possible must be used, therefore the downwind leg must be wide and the turn to the crosswind leg delayed. If lower speeds are used pitch-up may be experienced as the aircraft nears the ground if a complete failure of the nose flaps to lower has occurred, or a combined pitch-up and severe wing drop if both nose flaps on one side only have failed to lower.

(*b*) If the nose flaps fail to retract automatically proceed as follows:

(i) Select nose flaps IN.

(ii) If they fail to retract, the aircraft must not be flown at speeds above 0·75M and the limiting IAS.

(iii) Flight with the nose flaps extended will increase the drag and have a corresponding effect on range characteristics.

12 Hydraulic system failures

NOTE 1: This drill lays down the action to be taken in the event of known hydraulic malfunctions. Other faults due to extraordinary causes, i.e. stray earths, loose leads, etc., cannot be covered by check list drills.

NOTE 2: The order in which the drill is written is considered to indicate the most probable sequence of events. By referring to the index below the drill may be started at the appropriate paragraph and, should subsequent faults develop, followed to its logical conclusion.

NOTE 3: The following is a list of situations as nominated in the drill:—

(*a*) During take off
(*b*) No. 1 pump peaking (Sortie U.K. Area)
(*c*) No. 1 pump peaking (Overseas Flights)
(*d*) No. 1 pump failure or float switch operation before let-down
(*e*) Aircraft unclean—range considerations
(*f*) No. 1 pump fails or float switch operates during let-down procedure
(*g*) Airbrakeless let-down procedure
(*h*) No. 2 pump fails/float switch operates during let-down procedure
(*j*) Cold soak procedure

(*a*) *During take off*

If either float switch light illuminates or either pump fails:—

1. Both pumps OFF at once
2. Reduce to circuit speed, select unaffected pump—AUTO
3. Undercarriage—DOWN (leave down)
4. Nose flaps—OUT
5. Flaps—TAKE OFF—Pumps—OFF
6. Reduce to landing weight, serviceable pump AUTO for final landing

If unaffected pump fails or float switch operates (see sub-para. (*h*))

(*b*) *No. 1 pump peaking (Sortie U.K. Area)*

1. No. 1 pump OFF
2. *Do not try No. 2 pump*
3. Aim to complete planned sortie
4. No. 1 pump may be selected to AUTO whenever hydraulic services are required throughout the flight
5. If No. 1 pump fails or its float switch operates:—
   (i) Before let-down (see sub-para. (*d*))
   (ii) During let-down (see sub-para. (*f*))

(*c*) *No. 1 pump peaking (Overseas flights)*

1. No. 1 pump OFF
2. *Do not try No. 2 pump*
3. If possible proceed to home base

4. Reduce height to appropriate flight level below 42,0000 feet
5. Do not operate bomb doors or airbrakes (unless vital for aircrew safety). Select nose flaps—IN
6. If No. 1 pump fails or its float switch operates: —
   (i) Before let-down (see sub-para. (*d*))
   (ii) During let-down (see sub-para. (*f*))

(*d*) *No. 1 pump failure or float switch operation before let-down*

1. Switch pump OFF
2. *Do not use No. 2 pump*
3. Descend to a flight level below 40,000 feet
4. Abandon sortie
5. Return to base or select suitable airfield
6. Plan airbrakeless descent to approx. 25,000 feet (see sub-para. (*g*))
7. If the aircraft is unclean at the time of failure (see sub-para. (*e*))

(*e*) *Aircraft unclean—range considerations*

1. No. 1 pump OFF—*do not select ON*
2. With both pumps OFF, attempt to clean up aircraft by selecting: —
   Airbrakes—NORMAL IN
   Bomb doors—NORMAL CLOSED
3. If aircraft remains unclean calculate fuel required to reach destination
4. If essential to reduce drag select: —
   No. 2 pump—AUTO
   When aircraft is clean, pump—OFF
5. When approaching destination (see sub-para. (*g*)) for airbrakeless let-down

(*f*) *No. 1 pump fails or float switch operates during let-down procedure*

Before airbrakes extended

1. No. 1 pump OFF
2. (See sub-para. (*g*) 3)

After airbrakes extended

1. Both pumps OFF until ready for undercarriage DOWN
2. Select nose flaps—IN
3. No. 2 pump AUTO—undercarriage DOWN
4. Power—as required
5. Nose flaps OUT
6. Flaps TAKE OFF
7. Airbrakes IN
8. No. 2 pump OFF
9. For final landing No. 2 pump AUTO
10. Select full flap. Pump OFF
11. On touch-down select usable pumps to AUTO

(3–11: No. 2 pump fails or float switch operates (see sub-para. (*h*))

(*g*) *Airbrakeless let-down procedure*

1. Calculate position at which to commence slow descent to approx. 25,000 feet in area of descent point
2. Inform controlling authority of intentions
3. At 25,000 feet select nose flaps IN, reduce to 185 kts.
4. No. 2 pump AUTO—undercarriage DOWN—pump OFF. (The effect of cold soaking on micro switches may delay the indication of 3 greens (see sub-para. (*j*) for cold soak procedure))
5. At descent point No. 2 pump AUTO
6. Main flap TAKE OFF—nose flaps OUT—pump OFF
7. Commence descent at 180 kts.
8. Leave pumps OFF until final approach
9. When full flap required—No. 2 pump AUTO—when flap down switch OFF
10. On touch-down select usable pumps to AUTO

(4–8: No. 2 pump fails or float switch operates (see sub-para. (*h*))

(*h*) *No. 2 pump fails/float switch operates during let-down procedure*

1. Continue airbrakeless let-down
2. Inform A.T.C. " Unable to taxy, require towmaster "
3. Select one serviceable pump to AUTO, leave other pump OFF until landing
4. *Make emergency selections only*
5. When U/C locked down select—NORMAL DOWN
6. When flaps are at TAKE OFF, select nose flaps—OUT
7. If possible reduce fuel state to 8,000 lb. for landing
8. If the U/C was lowered before the system went into emergency the effect of return fluid may make nosewheel steering available for landing. This fluid would be put to better use in topping up the brake accumulators

   Plan not to use nosewheel steering
9. On touch-down co-pilot will call out brake pressures. At 3,000 PSI the AEO will select usable pumps to AUTO
10. *Do not taxy*

(*j*) *Cold soak procedure*

If three greens are not obtained: —

1. When the hydraulic pump in use goes " off load " select it OFF
2. Continue descent without flap
3. At check height select one serviceable pump to AUTO
4. When three greens are obtained, make flap selections as appropriate to the hydraulic situation.

13 Oxygen failures

(*a*) *Anoxia*

This can occur at any altitude in excess of 10,000 ft. In the event of anoxia:

(i) Check regulator (doll's eye and pressure gauge). Select EMERGENCY pressure and 100% oxygen.

(ii) Check mask tube and connections.

(iii) If in doubt change to alternative supply.

(iv) If there is still no oxygen supply, operate the emergency oxygen set and descend to a cabin altitude of 10,000 feet.

(v) On training flights, if alternative supply used, reduce aircraft altitude to 45,000 ft.

(*b*) *Decompression sickness*

In the event of decompression sickness:

(i) Immediately reduce cabin altitude to below 10,000 ft.

(ii) Check oxygen regulator and connectors and select EMERGENCY pressure.

(iii) Land as soon as possible.

(iv) Arrange for Medical Officer to meet the aircraft on landing.

(*c*) *Hyperventilation*

This can occur at any altitude. The commonest cause of hyperventilation is anoxia.

(i) Check that anoxia is not present.

(ii) Select EMERGENCY pressure, to check oxygen flow and return to normal.

(iii) Control the rate and depth of breathing.

(*d*) *Oxygen magnetic indicator failure*

If the oxygen magnetic indicator fails to operate, but breathing is not impeded, check that the pressure regulator valve indicates normal pressure (200-400 PSI) and select 100% oxygen. If breathing remains unimpeded the magnetic indicator only is at fault and the sortie may be continued. A further check may be made by pressing in the EMERGENCY switch and checking that breathing pressure is increased.

(*e*) *Oxygen supply failure*

If the oxygen magnetic indicator fails to operate and breathing becomes impeded, check the oxygen connections. If connections are correct, select 100% oxygen and press the EMERGENCY switch.

If this fails to clear the fault, operate the emergency oxygen supply if cabin altitude is above 10,000 ft. If cabin altitude is below 10,000 ft. loosen the mask from the face and do not operate emergency oxygen supply. The emergency oxygen supply will last for approximately 10 minutes. To continue flight at cabin altitude above 10,000 ft. connect mask to an alternative regulator (sixth seat or bomb aimer prone position).

14 Notes on electrical malfunctions

(a) Bus-bar paralleling

The split bus-bar system is a major safety factor in the electrical system, therefore bus-bars should only be paralleled when they have been proved safe by the use of the appropriate battery and associated volt/ammeter.

(b) The LV *bus-bar reverse current reset switch*

This switch should not normally be used in flight to recover a failed battery but in the event of a complete loss of alternator and battery LV supplies, range considerations or subsequent faults might create an extreme emergency which might justify its use.

(c) Loss of an LV *battery*

If an LV batery is lost and cannot be reset avoid throttling back both engines simultaneously on that side or both alternators may fail also. This is due to the Frequency Sensing Units in the Transformer Rectifier Units moving to the Low Power condition simultaneous with the throttle movement, thus momentarily breaking the TRU LV supply to the bus-bar. As no LV battery supply is available on the bus-bar the subsequent lack of alternator field current will cause both alternators to fail. Non-synchronous movement of the throttle will prevent this by ensuring that one TRU is supplying field current to both alternators whilst the frequency sensing unit of its companion is moving to the Low Power position.

(d) Double alternator failure

In all instances where two alternators fail on one side or are switched off, load shedding should be carried out as listed in the double alternator failure drill. However, the LV battery should not be switched off immediately such an emergency occurs as it is important to retain various indicators and control circuits, the most important of these being, Engine Fire Warning, PFCU indicators, Hydraulic control and indicators and Abandon Aircraft lights. If it is not possible to reset the alternators and a decision is made not to parallel the bus-bars the LV battery will become discharged if left on. Therefore after the immediate emergency is over it is advisable to switch it off and trip the LV feeder circuit breakers on the failed side. If the battery voltage is kept above 19 volts it can be used for important control and indicator circuits as although some indicators will work at very low voltage, control circuits become useless below 17 volts.

15 Load shedding

The following tables list all the MV loads and the main LV loads, which may be shed.

MV *loads*

Switch off appropriate MV Battery to ensure complete load shedding

Port MV *Bus-bar*	*Starboard* MV *Bus-bar*
Nos. 1 and 2—350 Inverters	No. 3—350 Inverter
Flight Instrument Inverter	Green Satin Inverter
No. 1 Hydraulic Pump	No. 2 Hydraulic Pump
Odd PFCU's	Even PFCU's
Red Fuel Pumps	Green Fuel Pumps
H2S Amplidyne	H2S Scanner
Ration Heaters	Ration Heaters
TR Cooling Fan	TR Cooling Fan

Attention is drawn to the small H2S load on both bus-bars which will preclude the use of H2S when either bus-bar has completely shed its loads.

Main LV *Loads*

No. 1 LV *Bus-bar*

Landing lamps
HF
No. 1 VHF/UHF
Starboard Pitot head heater
Panel lights
NBC
H2S
IFF Mk. 10
Radio Altimeter
Navigation lights
Tacan
Main Alternator control
Trim control
PFCU control
Cabin ventilation
Tail anti-icing
Engine anti-icing
Starboard wing anti-icing
Port wing anti-icing
Wing air exit shutters
Trip circuit-breaker 1P 25

No. 2 LV *Bus-bar*

UHF
Panel lights
No. 2 VHF/UHF
Port Pitot head heater
Cabin lights
Trim control
Main Alternator control
Cabin Temperature control
ADF
Engine anti-icing
Tail anti-icing
Port wing anti-icing
Starboard wing anti-icing
Bomb-bay heating
Wing air exit shutters
Controlled AC supplies and flight instruments standby DC
Flying controls
Bombing controls and indicators

NOTE: In the event of double engine or double alternator failure where it is decided not to parallel, the LV battery will be switched off to conserve it after the immediate emergency is over. The hydraulic, fuel PFCU and inverter control circuits will be affected as detailed under these sections.

16 Electrical system failures

Failure	*Indication*	*Action*
SINGLE ALTERNATOR FAILURE (Electrical)	1 Power Failure Warning Light ON 2 Appropriate ammeter on panel BA reads zero	1. Check alternator field circuit-breaker (*a*) *If tripped*: (i) Switch OFF (ii) Reset circuit-breaker (iii) Switch ON (*b*) *If not tripped*: 2. *Check* AC *indicators* (*a*) If AC indicator for serviceable alternator on the same bus-bar is horizontal (i) Switch OFF, then ON (ii) If PFWL relights, switch OFF and take no further action (line to line fault) (iii) *Do not trip* AC *circuit-breaker*

Failure	*Indication*	*Action*
SINGLE ALTERNATOR FAILURE (Electrical)—*cont.*		(*b*) If AC indication for *unserviceable* alternator is horizontal, check feeder circuit breaker on panel BB *If tripped*: (i) Switch OFF (ii) Reset the circuit-breaker (iii) Switch ON once only (*c*) *If both* AC *indicators are normal*: 3. Switch OFF the U/S alternator and wait for a period of 30 seconds 4. Switch ON once only (*a*) PFW light goes out and remains out. No further action (*b*) PFW light goes out and immediately comes back on, switch OFF and leave OFF (*c*) PFW light goes out and comes back on after a delay, switch OFF and leave OFF (*d*) PFW light remains on, switch OFF and leave OFF
SINGLE ALTERNATOR FAILURE (Electrical)—*cont.*	1 Low Power Light ON 2 Power Failure Warning Light ON 3 Ammeters on panel BA read zero	1. *If engine* RPM *below 51%* (*a*) Switch OFF and wait for a period of 30 seconds (*b*) Switch ON (i) If PFWL goes out and remains out, no further action (ii) If PFWL relights, switch OFF and leave OFF 2. *If engine* RPM *above 51%* Switch OFF and leave OFF (sheared alternator drive)
DOUBLE ALTERNATOR FAILURE	1 Both Power Failure Warning Lights ON 2 Ammeters on panel BA read zero	1. AEO warns captain 2. Switch OFF the failed alternators 3. Switch OFF appropriate MV battery 4. Select the fuel proportioners in use to BYPASS and reduce LV loads on failed bus-bar where possible as follows: *No. 1* LV: Tacan; HF; No. 1 VHF/UHF; IFF, ILS; Landing lamps; Lighting; Starboard Pitot head heater; Trip circuit breaker 1P 25 *No. 2* LV: UHF; No. 2 VHF/UHF; ADF; Lighting; Port Pitot head heater

Failure	*Indication*	*Action*
DOUBLE ALTERNATOR FAILURE —*cont.*		4. Switch OFF MV loads on failed bus-bars as follows *Port* MV: Odd PFCU's; No. 1 Hydraulic Pump; Nos. 1 and 2—Type 350 Inverters; Flight Instrument (153) Inverter; Red fuel pumps; Bomb-bay "A" pumps; Trip H2S circuit-breaker; Pilots' ration heaters *Starboard* MV: Even PFCU's; No. 2 Hydraulic Pump; No. 3 Type 350 Inverter; Green Satin (153) Inverter; Green fuel pumps; Bomb-bay "B" pumps; Trip H2S circuit-breaker; Crew ration heaters 5. Switch on MV battery and check for zero discharge 6. Reset action on each alternator 7. If unable to recover either alternator, check bus-bars safe to parallel 8. Switch off LV battery and trip LV feeder circuit breakers on that side 9. Use LV battery as required 10. Bus-bars may be paralleled at Captain's discretion NOTE: *No attempt is to be made to recover an alternator with the bus-bars paralleled.*
FOUR ALTERNATOR FAILURE	1 Power failure warning lights on 2 Ammeters on panel BA read zero 3 A fall in all voltmeter readings	1. Shed loads as in items 4 to 17; trip all alternator field circuit breakers and remake individually 2. If unable to regain alternators trip field circuit breakers and, if safe to do so, parallel bus-bars 3. Select airbrakes *as required* 4. Switch OFF both hydraulic pumps 5. Switch OFF half PFCU's 6. Select all proportioners to BY-PASS 7. Leave three fuel pumps ON, all others OFF 8. NORMAL yaw damper STANDBY—standby yaw damper *as required* 9. Switch OFF all inverters except the Flight Instruments (153) inverter 10. Trip NBC and H2S circuit-breakers 11. Switch OFF scanner stabilisation 12. Switch OFF the VHF set not in use 13. Minimum use of HF then trip circuit-breakers 14. Switch all lighting to minimum requirements

Failure	*Indication*	*Action*
FOUR ALTERNATOR FAILURE—*cont.*		15. Switch OFF all heater and anti-icing switches except pitot head heaters 16. Trip ILS and ADF circuit-breakers 17. Trip ration heater circuit-breakers 18. IFF to emergency if required No. 2 type 350 inverter ON *N.B. 1* The Captain must be prepared to order "Abandon Aircraft" at any time
FOUR-ENGINE FLAME-OUT		*N.B. 2* If the emergency is due to four-engine flame-out item 1 should not be actioned until the engine speed has decreased to 25% RPM. The airbrakes should not normally be extended whilst attempting to maintain alternator output under low windmill RPM
LV BATTERY FAULT	1 Magnetic indicator goes white	1. Warn pilot not to throttle back engines on failed side simultaneously 2. Check the appropriate Battery Master circuit-breaker 3. Switch OFF battery, wait 30 seconds, switch ON again. Observe LV volt/ammeter (*a*) If indicator goes black then white switch OFF and leave OFF (*b*) If indicator remains white no further action possible, magnetic indicator unserviceable
MV BATTERY FAULT	1 Magnetic indicator goes white	1. Switch OFF then ON (*a*) If indicator remains white, no further action, presume battery on line, check fuse (*b*) If indicator goes black then white no further action possible, suspect excessive charge
SPECIAL FEEDER FAILURE	1 Magnetic indicator white 2 LV Battery magnetic indicator white	1. Check LV and MV battery indicators 2. All proportioners to BYPASS (*a*) If battery indicators black, continue as normal, indicator unserviceable (*b*) If battery indicators white warn pilot to avoid simultaneous throttle movement on failed side, no further action possible 2. *Emergency use of 1P8/2P8 switch* The emergency position of the special feeder switch may only be used as follows: (*a*) In the event of engine fire on failed side (1P8 PORT 2P8 STARBOARD), the fire button should be pressed whilst the failed special feeder switch is selected to the alternative position

Failure	*Indication*	*Action*
SPECIAL FEEDER FAILURE—*cont.*		(*b*) Immediately prior to touch-down if crash landing (*c*) In dispersal, if no external supplies available, select alternative position on special feeder switch in order to close HP cocks of engines on failed side
LOSS OF PLENUM CHAMBER PRESSURE IN FLIGHT	1 A negative reading on the pressure gauge 2 Cooling fan light(s) illuminate or flicker 3 Possible noise if hatch strikes aircraft	1. ECM equipments all OFF. Return alternator to main electrical system 2. Load shed selectively, Port and Stbd., as follows, monitoring ammeters: (*a*) Hydraulic pumps—both OFF—use one when required (*b*) PFCU's—switch OFF numbers, 1, 4, 6, 7, 10 (*c*) Proportioners—BYPASS (*d*) Fuel pumps—minimum of three in a group (*e*) Inverters—all OFF except flt. instruments (*f*) NBC and H2S—circuit breaker tripped (*g*) Scanner stabilisation—OFF (*h*) VHF/UHF—either set OFF (*j*) Yaw dampers—Normal to STANDBY/Standby as required (*k*) Anti-icing—As required (*l*) External and Internal lights—Minimum (*m*) ILS—OFF (*n*) ADF—OFF (*o*) HF—minimum use then—OFF (*p*) Ration heater C/B's tripped 3. Check plenum hatches with periscope 4. If panel B.A. ammeter loading excessively uneven then parallel at captain's discretion
OVERVOLTING ON MV OR LV BUS-BARS (more than 125V or 35V)	1 MV Voltmeter reads more than 125V 2 LV Voltmeter reads more than 35V	1. Check on ammeters which alternator is carrying the heaviest load 2. Switch OFF the alternator with the greatest load (*a*) If voltage returns to normal no further action (*b*) If still overvolting, switch ON the first alternator, switch OFF the other. If voltage now normal no further action 3. If overvolting persists: (*a*) Switch OFF both alternators (*b*) Carry out load shedding drill as for double-alternator failure (*c*) Reset each alternator individually once only (*d*) For subsequent action see para. 14

<table>
<tr><th>Failure</th><th>Indication</th><th>Action</th></tr>
<tr><td>HIGH OR LOW VOLTAGE ON LV AND MV BUS-BARS</td><td>1 LV Voltmeter reads 29V to 34V or 24V to 26V
2 MV Voltmeter reads 115V to 120V or 105V</td><td>1. Switch OFF either alternator
2. Trim remaining alternator to 28V LV or 112V MV
3. Switch ON first alternator again
4. Switch OFF the alternator which has been trimmed
5. Trim other alternator to 28V LV or 112V MV
6. Switch ON other alternator
N.B.—If unable to trim any one alternator, switch OFF and leave OFF; if unable to trim either, switch both ON and monitor volt/ammeter for overvolting.</td></tr>
<tr><td>FAILURE OF FLIGHT INSTRUMENT INVERTER</td><td>1 Magnetic Indicator on panel CA shows white</td><td>1. Trip and remake No. 1 Flight Instrument circuit-breaker on panel BB
(a) If indicator changes to black no further action necessary
(b) If indicator remains white no further action need be taken as the No. 3 Type 350 Inverter automatically takes over the loads</td></tr>
<tr><td>FAILURE OF A TYPE 350 INVERTER</td><td>1 Neon indicator(s) on CA flicker or fail</td><td>1. Switch OFF the group of services supplied by the inverter
2. Switch OFF the appropriate inverter (hold in the OFF position for 1 second only)
3. Switch ON the inverter
4. Switch on the associated group of services
(a) If the inverter remains on line no further action is necessary
(b) If the inverter fails again proceed as follows:
(i) Switch OFF services of, and the unserviceable inverter
(ii) Switch OFF the services of, and the alternative inverter to which the load is to be transferred
(iii) Switch the POWER EMERGENCY TRANSPOSE SWITCH to the group required
(iv) Switch ON the serviceable inverter and group of services required
The table below summarised the operations involved in affecting transposition:
<table>
<tr><th rowspan="2">U/S Inverter</th><th colspan="2">Group</th><th rowspan="2">Switch OFF Inverters</th><th rowspan="2">Select</th><th rowspan="2">Switch ON Inverter</th></tr>
<tr><th>Reqd.</th><th>Not Reqd.</th></tr>
<tr><td>1</td><td>A</td><td>B</td><td>1 and 2</td><td>A/B</td><td>2</td></tr>
<tr><td>1</td><td>A</td><td>C</td><td>1 and 3</td><td>A/C</td><td>3</td></tr>
<tr><td>2</td><td>B</td><td>A</td><td>2 and 1</td><td>A/B</td><td>1</td></tr>
<tr><td>2</td><td>B</td><td>C</td><td>2 and 3</td><td>B/C</td><td>3</td></tr>
</table></td></tr>
</table>

Failure	*Indication*	*Action*
LV AND POSSIBLY MV FLUCTUATIONS WITH TWO ALTERNATORS ON BUS-BAR	Fluctuation on LV and MV voltmeters and alternator ammeters	1. Increase loading of affected alternators (e.g. hydraulic pump ON) 2. If fault clears reduce load 3. If fault persists when in LOW power condition increase engine RPM 4. Reduce RPM when fluctuations cease
CHANGING FROM HIGH TO LOW POWER, LV BUS-BAR FALLS TO 23V	LV bus-bar voltmeter reads 23V	1. Increase RPM to HIGH power condition 2. If undesirable to increase RPM continue to use LV at 23V N.B.—This fault is caused by a frozen tap change contact which may clear after a period at low level.

17 Fuel system failures

Failure	*Indication*	*Immediate action*	*Subsequent action*
BOOSTER PUMP FAILURE	Contents remain almost constant in tanks with one pump only. No indication in tanks with two pumps	Check sufficient pumps selected to prevent flame-out	Adjust CG or wing balance by switching off pumps in other tanks
PROPORTIONER FAILURE (*a*) Fuselage prop. when fus. group only in operation	LP warning lights of all four engines	Wing pumps ON	Wing props. NORMAL Check fuselage group for leak/proportioner failure Fuselage prop. to BYPASS All fuselage pumps ON Wing groups OFF, one at a time Maintain individual fuselage contents in approx. proportion
(*b*) Wing prop. when wing groups only in operation (no cross-feed)	LP warning lights of two affected engines	Fuselage group ON	Fuselage prop. NORMAL Check for cause Select failed prop. to BYPASS All pumps ON in affected group Select fuselage group OFF Maintain individual tank contents in approx. proportion
(*c*) Any one prop. when all groups in use	Lack of flow from tanks in affected group	Select affected prop. to BYPASS	Maintain individual tank contents in approximate proportion