2. With an engine running at a stated RPM setting, e.g., ground idle, when the associated pump is brought on line
3. During Power Transfer Unit (PTU) start
4. Time histories should be recorded with no hydraulic user demands. Time histories should differentiate between:
   a. Where all accumulators are being charged.
   b. Where accumulators considered to be other than basic to pressure generation circuit, e.g., brake accumulator, have been previously charged.

10.2.3

For the case of a system being supplied by two pumps, a plot or estimate of pump outlet decay rate when one ceases delivery due to:

- Depressurizing pump
- Shutting pump supply valve
- Seizure of engine or pump

  Note: If relevant, show how decay time is affected by engine RPM.

10.2.4

A time history of system pressure for operation of each service, e.g., flight controls, landing gear. Plots should be appended as relevant, i.e., with one/two pump operation, engine RPM, PTU, airspeed, etc.

10.2.5

Steady state pressures for each system with no hydraulic user demand, for different hydraulic system configuration: one/two pump operation, fed from PTU, fed from RAT, etc.

10.2.6

Time histories of hydraulic pressure decays for each system as a result of engine shutdowns, including engine windmill operation during flight reconfiguration (takeoff to clean, clean to landing).

11.0 ELECTRICAL POWER SYSTEM

11.1 Simulation Modeling Data

The following information should be provided:

1. A block diagram of the power supply systems, transformer/rectifier/static inverter units and busbars; the drawing should show the position and nature of the sensing elements for cockpit controls and indicators, busbar coupling arrangements and transfer systems and a listing of circuit breakers and the systems they protect.
2. A detailed system description covering aspects of control logic such as interlocks between main generator supply and ground power source.
3. Voltage and frequency values at which contactors open and close.
4. A detailed description of the generator automatic protection systems, giving precise threshold or sensitivity of each fault sensing circuit, length of any associated time delays and latching conditions.
5. A detailed description of the working and characteristics of the generator drive unit (e.g., constant speed unit).
6. Data in the form of time histories or equations, relating installed generator drive oil temperatures for significant generator load and any other relevant parameter
7. If the production airplane is provided with a battery charger unit, supply details of all operating modes.
8. A detailed load analysis, for both ac and dc systems, to include both maximum and typical load conditions.
9. Battery voltage versus charge level, all batteries.
10. Ram air turbine or other emergency generator characteristics of volts and frequency versus airspeed.
11. Load shedding logic and priority tables.
12. Where the airplane wiring diagrams/system schematics show the use of electronic equipment the data listed in Section 2.3 should be provided.

11.2 System Verification

The following test results should be provided:

1. A record of the sequence of electrical events from the initiation of an engine start through to all load being carried by the engine generators. Such record should show alternative switching routines if they are possible.
2. A time history of the current and terminal voltage at the battery during start of the APU, and of the main engines if electrical start is used.
3. Listings of which systems, indicator lights, etc., are connected to each major bus, to allow verification of power available logic in each user system.
4. Load shedding scenarios, where there are noticeable effects in the cockpit.

12.0 MISCELLANEOUS SYSTEMS

12.1 General

For the miscellaneous systems in this section, the information provided should be in sufficient detail to enable the FSTD manufacturer to develop a simulation model and to produce the verification procedures for each system. This information should include full data on all controls and indicators as well as a technical description of each system.

In addition to the requirements listed for the systems of this section, the requirements of Section 2.3 should also be met for electronic equipment as used in these systems.

12.2 ICE Protection System

12.2.1

The thermal anti-ice system is defined as all subsystems powered by the pneumatic system. The following information should be provided:

1. Detail system and component descriptions, schematic diagram, appropriate sections of electrical and pneumatic diagrams.
2. Flow, pressure and temperature characteristics of the air source if not defined in the engine APU or pneumatic simulations.
3. Switching points and hysteresis of all pressure and temperature switches.
4. Rates of ice removal.
5. Steady state duct temperatures and pressures (if indicated) as a function of air supply temperature and flow rate.
6. Transient duct temperatures and pressures (if indicated) as a function of air supply characteristics and valve switching.
7. Operating times of valves and actuators.
8. Pressure/flow characteristics of modulating valves.

12.2.2

For electrical ice protection systems, the following information should be provided:

1. Detailed system description, including a typical ice removal scenario.
2. Electrical and system schematic diagrams.
3. Description of operation of ice detector heads and probe heaters.
4. Layout and description of operation of all controls and indicators.
5. Details of system test features, electrical power demands and duty cycles.

12.3 Stall Warning System

The following information should be provided:

1. Description and schematic of the stall warning system and its test features.
2. Drawings showing installation details of the stick shaker mechanism.
3. Complete data on the operation of the stick shaker and pusher mechanisms.
4. Define angles of attack at which stick shaker activates and deactivates.
5. Define angles of attack at which warning horn and/or light activate or deactivate.

6. Define angles of attack at which stick pusher activates or deactivates.
7. Define rate at which stick pusher operates and the maximum force it can develop at the pilot's hand radius.
8. Transfer function of any filtering or phase advance applied to the angle of attack signal before its comparison to the warning trigger point.
9. Define electronic and aural characteristics of warning horn.

12.4 Fire, Smoke and Overheat Warning Systems

The following information should be provided:

1. A detail description, system schematic and electrical diagrams of the system, including its fire detection, suppression and test subsystem.
2. Capacity, nominal pressure/low pressure set points and discharge time for each type of fire bottle used.
3. Electronic and aural characteristics of fire warning horn/bell.

12.5 Ground Proximity/Terrain Awareness Warning System/Runway Alerting System

This section describes special requirements for airplanes equipped with a Ground Proximity Warning System (GPWS), enhanced GPWS, Runway Alerting System, or a Terrain Awareness Warning System (TAWS).

The following information should be provided:

1. Wiring diagrams and system schematics.
2. System description document, pilot operations manuals and maintenance manuals covering the following:
   a. System performance specification
   b. Alert and warning mode envelope limits and inhibition logic
   c. Description of all operating and test modes
   d. Graphical representations of test patterns
3. Recording of aural effects, frequency and mark/space ratio of the sound generator used to produce the warnings.
4. For terrain and runway functions, data base information should be provided as per the Harmonisation Requirements of ARINC 610.
5. Interface Control Document (ICD).

12.6 Engines/Systems Status Displays and Crew Alerting Systems

This section describes special requirements for airplane equipped with EICAS, ECAM or the instrument and alerting displays of an Electronic Instrument System (EIS) or Integrated Display System (IDS).

The following information should be provided:

1. Operating manuals covering the display as well as the associated control display panels.
2. Wiring diagrams showing interconnections between displays, symbol generators, message computers, electronic instrument units or equivalent and any other surrounding avionic equipment.
3. The complete message list and message logic (preferably on digital media), display logic and signal processing, including the following:

a. Definition of the colours used on all objects
b. Specification of all pages, including object size and position
c. Colour photographs of the display pages, showing all objects
d. Character font definition
e. Page switching and priority logic
f. Symbol definition
g. Signal filtering and re-scaling

4. Description of transients when display modes or power sources are changed.
5. Logic diagram relating display symbology to the input signals, including logic behind each volatile that can be displayed for all pages of system schematics, indicators, etc.
6. Interface control document (ICD).

For the requirements of the other related systems, refer to the appropriate section for that system.

12.7 Windshear Alerting System

For the detection and warning aspects of this system, the following data is required:

1. List of equipment installed in the airplane.
2. Wiring diagrams and schematic diagrams for all associated equipment.
3. Operations, overhaul and maintenance manuals.
4. Flight-deck aural and visual warning activation thresholds for a representative selection of test cases.
5. Interface control Document (ICD).

The guidance aspects of this system are detailed in the section entitled “Augmented and Automatic Flight Control Systems”.

12.8 Other Warning Systems

For all warnings not defined above, the following information should be provided as necessary for the particular configuration:

1. System wiring diagrams and schematic system diagram for all associated equipment.
2. Frequency and mark/space ratio of any square wave generator (interrupter) used to produce discontinuous warnings.
3. Settings of microswitches, giving pre-takeoff out-of-position warnings, and make clear whether actuated in response to control lever movement or as a function of surface position.
   a. For landing gear warning switches define whether actuated by position of gear or door, or by engagement of gear/door lock.
   b. Points on throttle quadrant, measured from a known datum, at which each warning switch operates. If any significant backlash on switch actuation exists, quote for both advancing and retarding throttle.
   c. Cabin height at which cabin altitude warning is given. If a warning is not cancelled, at which cabin height does the aneroid device reset for a descending cabin.

d. Define the electrical and audio characteristics and record all aural warning effects.

12.9 Weight and Balance System

The following information should be provided:

1. Schematic drawing showing all major components of the system.
2. System wiring diagrams showing interconnection between transducers, computer and display unit.
3. Operating and maintenance procedures.
4. Effects of wind and ground slope.

12.10 Airplane Condition Monitoring System

This section describes requirements for airplanes equipped with an Airplane Condition Monitoring System (ACMS), Flight Data Acquisition Unit (FDAU) or Aircraft Data Acquisition System (ADAS)

The following information should be provided:

1. System wiring diagrams and schematic system diagrams for all associated equipment.
2. Operations, overhaul and maintenance manuals referring to the systems.
3. Interface control document (ICD).

12.11 Communications Management Systems

This section describes requirements for airplanes equipped with ARINC Communications Addressing and Reporting Systems (ACARS), Air Traffic Services Unit (ATSU), Automatic Dependent Surveillance-B System (ADS-B) and/or Wireless Airport Communication System (WACS) or other systems that perform similar functions.

The following information should be provided:

1. System wiring diagrams and system schematic diagrams for all associated equipment.
2. Operations, overhaul and maintenance manuals referring to the systems, including vendor publications (e.g., Pilot Notes).
3. A description of the message formats or sufficient information to derive them from vendor utilities.
4. Interface control document (ICD).

12.12 Traffic Alert and Collision Avoidance System (TCAS) and Traffic Information System (TIS-B)

The following information should be provided:

1. A list of equipment installed in the airplane.
2. System wiring diagrams and system schematic diagrams for all associated equipment.
3. Details of implementation of ARINC 610 and its revisions.
4. Details of Test modes.

5. Recording of aural effects, frequency and mark/space ratio of the sound generator used to produce the warnings.
6. Interface Control document (ICD).

12.13 Oxygen System

The following information should be provided:

1. Full description and schematic of crew and passenger oxygen system including regulators, masks, etc.
2. Capacity of each oxygen supply bottle in crew and passenger system.
3. Rates of depletion of crew and passenger oxygen bottle pressures when oxygen is being used.
4. Any time delays between operation of any oxygen normal or emergency control switch and illumination of indicator lights.
5. Pressure of oxygen supply.
6. Installation, general arrangement and detailed drawings of the oxygen system within the cockpit area.

12.14 Nitrogen Generation System (NGS)

The following information should be provided:

1. System operation should be described in detail. A description of abnormal system operation including flight compartment indications and effects should be provided. Relevant aircrew publications (e.g., FCOM), airplane maintenance manuals, wiring diagrams and functional schematics are required. This includes control/monitoring schematics and system distribution/connectivity schematics (i.e., plumbing) which clearly identify all components of the system
2. Motor Compressor specification/characteristics
3. Air Separation Module specification/characteristics
4. Valve(s) Operation/Characteristics
5. Heat Exchanger Characteristics
6. NGS controller logic/control laws
7. Sensor(s) information

13.0 FLIGHT INSTRUMENTS

13.1 General

The information provided should be in sufficient detail to allow the FSTD manufacturer to produce simulation models, interface signals and verification procedures, and, where necessary, to develop simulated instrument designs.

13.2 Independently Wired Flight Deck Instruments

For all flight deck instruments which are wired independently into airplane wiring (i.e., not part of a control module), the following information should be provided:

1. Complete list of cockpit instruments stating type, manufacturer part #, quantity and manufacturer.
2. Manufacturer data including equipment type number and all available handbooks.
3. For any synthesized voice system, such as radar altimeter automatic call out system, full details of the audio system and a recording of the sounds produced.
4. In addition to the above items, the requirements of Section 2.3 should also be met for electronic equipment as used in this system.

13.3 Integrated Standby Flight Displays

This section describes special requirements for airplanes equipped with Electronic standby systems, including Integrated Standby Flight Display (ISFD), Integrated Electronic Standby Instrument (IESI) and Integrated Standby Instrument System (ISIS).

The following information should be provided:

1. Operating Manuals and performance Specifications
2. System Wiring diagrams showing interconnection between the unit and any other avionics equipment and Interface Control Document (ICD)
3. Description of transients when display modes or power sources are changed
4. Information relating display symbology to the input signals and operator controls
5. Specification of all display pages including the following
   a. Object size and position
   b. Definition of the colors used on all objects
   c. Color photographs of the display pages showing all objects
6. In addition to the above items, the requirements of Section 2.3 should also be met for electronic equipment as used in this system

13.4 Air Data Computer and Pitot Static Systems

For the air data computer and pitot-static systems, the following data should be supplied:

1. A list of all the systems installed in the airplane which obtain data from the ADC.

2. A description/specification and schematics of the air data systems and pitot/static system, including switching or alternate systems. These should show the pressure sources of all dependent equipment and instrumentation.
3. Data on pitot and static system errors including the effects of source position, icing, ground effects and stall, and the corrections computed by the ADC.
4. Data on pitot and static system transient effects due to switching to alternative systems, airplane rotation rate, flight in ground effect, etc.
5. Details of all computed parameters including throughput delay and the algorithms employed.
6. In addition to the above items, the requirements of Section 2.3 should also be met for electronic equipment as used in this system.

13.5 Angle of Attack System

The following data should be provided.

A description/specification and schematics of the Angle of Attack system. Data on angle of attack including the relation of the vane angle of attack and the angle of attack computed by the ADC.

The fidelity for this detailed level of simulation should cover at least the following static/dynamic effects (including any hysteresis), for left and right vanes:

1. The basic electrical calibration of the alpha vane.
2. The gear up vane calibration curve as a function of body angle of attack, flap settings, and Mach number.
3. The effect of landing gear extension/retraction.
4. The effect of pitch, roll, and yaw rates.
5. The ground effect.
6. Minimum airspeed for reliable angle of attack indication.

13.6 Electronic Flight Instrument System (EFIS)

In addition to the above requirements, this section describes special requirements for airplanes equipped with EFIS displays. The following data should be provided:

1. Operating manuals covering the display unit as well as the associated display panels.
2. System wiring diagrams showing interconnection between EFIS displays, symbol generators, electronic instrument units or equivalent, and any other surrounding avionic equipment.
3. Description of transients when display modes or power sources are changed.
4. Logic diagram relating display symbology to the input signals.
    a. Specification of all pages including the following:
    b. Object size and position
    c. Definition of the colors used on all objects
    d. Color photographs of the display pages, showing all objects
    e. Character font definition
    f. Symbol definition

5. The contribution of this equipment to the airplane transport delay/latency response time for pitch and roll attitude (EFIS, PFD) and heading (compass, navigation display) should be provided as described in Section 1.6.
6. In addition to the above items, the requirements of Section 2.3 should also be met for electronic equipment as used in this system.

13.7 Supplementary Guidance System

The following systems are considered in this section: Head Up Display (HUD), Para Visual Display (PVD), Enhanced Vision and/or Synthetic Vision. The following information should be provided:

1. System wiring diagrams and schematic system diagrams for all associated system components and interfaces with other systems.
2. Operations, overhaul, and maintenance manuals covering all flight deck functions. This should include a description of the control panel and user interface, selectable menus and functions, and controllable parameters as well as display formats and symbology.
3. Description of the expected response of the hardware to FSTD functions as defined in the ARINC 610 and subsequent revisions, so that impact on training can be assessed.
4. Data to enable the display to be repeated at a remote location as required in ARINC 610.
5. Information to assist in the integration of the HUD with the visual system, including:
   a. HUD Field-of-view and collimation details
   b. Characteristics of image generation
   c. Calibration (bore-sighting) procedures, including a description of any special alignment tools
6. For enhanced vision systems information on the sensor(s) including:
   a. Type of sensor.
   b. Frequency range or waveband of sensitivity.
   c. Resolution.
   d. Field of view.
   e. Scan angle.
   f. For turret mounted sensors: gimbal limits, turret speed, turret acceleration and turret stabilization modes.
   g. Video output standard to the display computer as well as sample recordings of the input video to the display.
   h. Good quality video recordings/still digital images of the displayed sensor imagery along with a correlated out-the-window view of the same image for different operating conditions of the system including: light, medium and heavy rain, snow, smoke, smog, taxiway/runway markings and ground traffic/clutter including other airplanes.
   i. The data should be provided in day, dawn, dusk and night under clear visibility and limited visibility conditions and for both summer and winter where the altitude, date, time, visibility and other conditions are annotated in the recording. The supporting video should enable