A350
TECHNICAL TRAINING MANUAL
MAINTENANCE COURSE - T1+T2 - RR Trent XWB
Ice and Rain Protection

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ICE AND RAIN PROTECTION

ICE DETECTION SYSTEM DESCRIPTION (2/3)

General Presentation

The ice detection system has two functions:
- To detect icing conditions and generate cockpit indications
- To give a visual indication of ice accumulation/accretion.

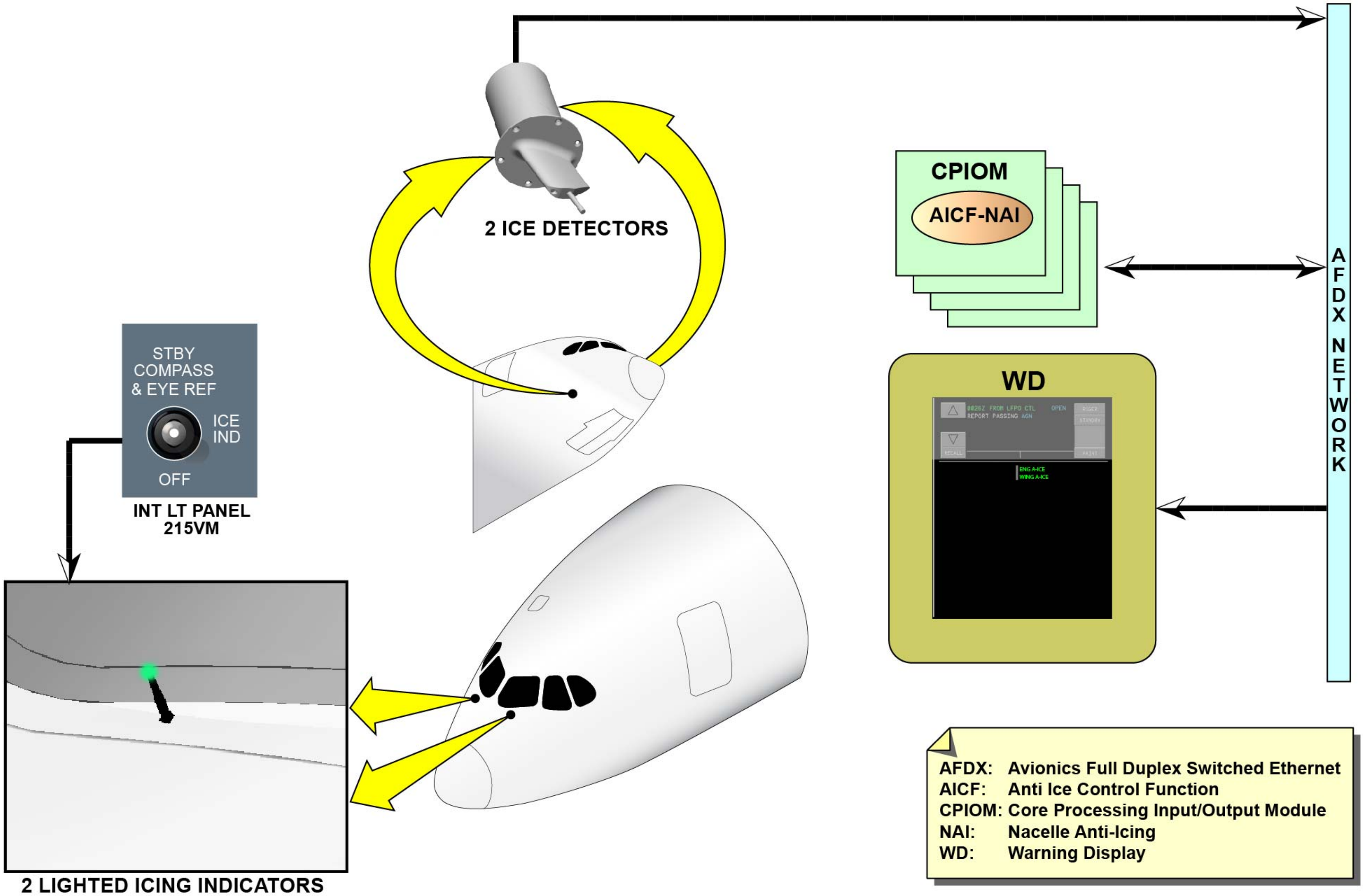
The ice detection system has two subsystems:
- An advisory ice-detection subsystem
- A visual ice-detection subsystem.

The advisory ice-detection subsystem has:
- Two ice detectors, one on each side of the nose fuselage
- Anti Ice Control Function (AICF)-Nacelle Anti-Icing (NAI) applications hosted in four CPIOMs.

Each ice detector senses the icing conditions and sends output signals to the AICF-NAI applications. Then the AICF-NAI applications send messages to the FWS for display on the CDS. This notifies the flight crew that there is ice accumulation and to select the engine NAI protection system and the Wing Ice Protection System (WIPS).

The visual ice-detection subsystem has:
- Two lighted icing indicators, one for the Captain (left side) and one for the First Officer (right side).

The lighted icing indicators are visual devices which allow the flight crew to see the ice accretion. During night flights, the flight crew illuminates the lighted icing indicators with a toggle switch in the cockpit.



GENERAL PRESENTATION

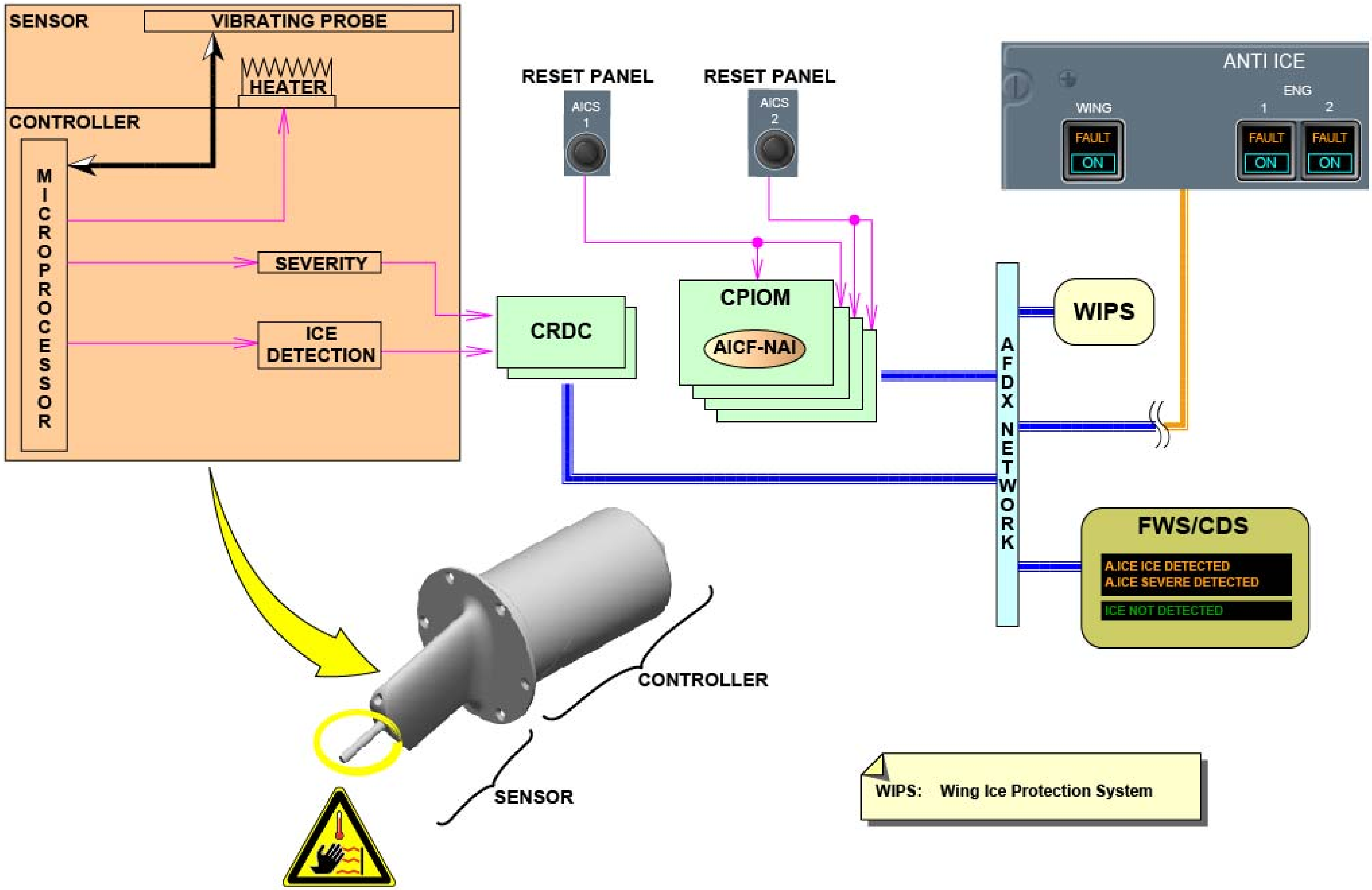
ICE DETECTION SYSTEM DESCRIPTION (2/3)

Ice Detection Function/Description

The ice detectors operate as soon as the aircraft is electrically supplied.
Each ice detector has two parts:
- A sensor, which includes the sensing probe and an internal probe de-icing heater
- A controller to monitor the sensing probe and electrically supply the probe's de-icing heater.

The sensing probe transmits vibration signals at a specific frequency. When there is an accumulation of ice on the sensing probe, the frequency decreases to the ice detection trip point. When the trip point is reached, the probe is heated by the internal heater to prepare to detect again.
The sensing probe is heated using internal heaters. Maintenance crew must exercise caution because they could get burned if the ice detectors are inadvertently touched.
Each ice detector sends two detection signals to the AICF-NAI applications:
- ICE detection
- SEVERE ice detection.

The ice detector sends an ICE detection signal when the accumulation of ice increases and the frequency decreases to the detection trip point. The signal continues for a specific time period (60 seconds) and the sensing probe is heated to prepare for additional detection. If the frequency drops to the detection trip point again during the specified time period, the probe is again heated and the ICE detection signal continues for another specific time period (60 seconds).
When the ice detector sends the ICE detection signal to the AICF-NAI applications, an advisory message, A.ICE ICE DETECTED, is sent by the AICF-NAI applications to the cockpit for display, via FWS/CDS. This advises the crew to turn on the engine NAI if it is not already selected ON. When the engine NAI is selected ON, the message is turned off.
The ice detector will send a SEVERE ice detection signal when the frequency has reached the detection trip point several times (seven times), one after the other. When the ice detector sends the SEVERE ice detection signal to the AICF-NAI applications, the applications send an advisory message A.ICE SEVERE ICE DETECTED to the cockpit, via FWS/CDS. This advises the crew to turn on the WIPS. With the WIPS selected to ON, the SEVERE ice detection signal is reset and it's processing (detection trip point counter) is inhibited as long as the WIPS is ON.
The WIPS has an interface with the AICF-NAI application to confirm whether or not WIPS has been manually selected.
When icing conditions are no longer detected for a period of time (more than 190 seconds) and the ice protection systems continue to operate, the A-ICE NOT DETECTED memo message comes into view.
The ice detection system can be reset using the Anti Ice Control System (AICS) reset switches, AICS1 and AICS2, to reset the AICF-NAI applications.

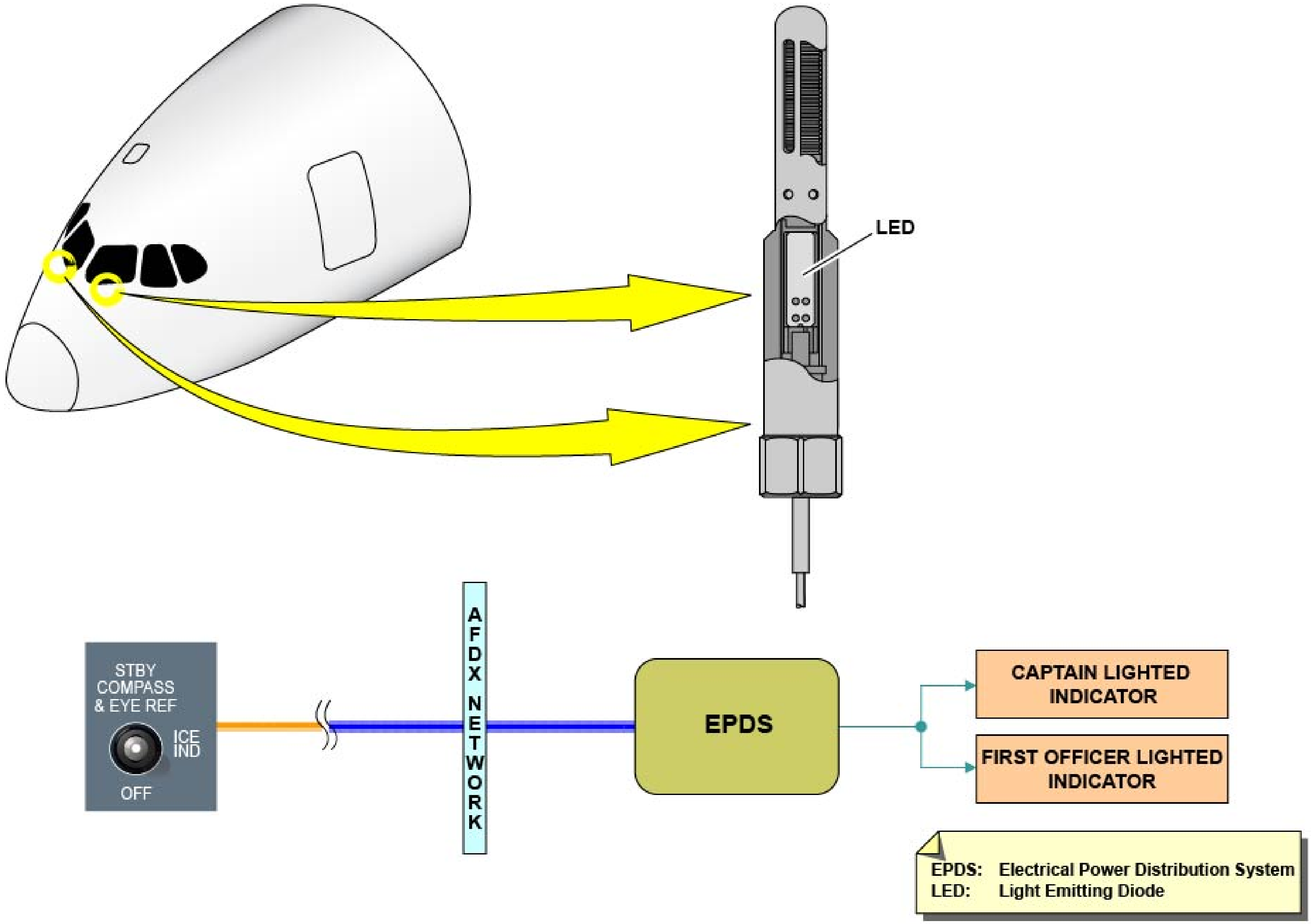


ICE DETECTION FUNCTION/DESCRIPTION

ICE DETECTION SYSTEM DESCRIPTION (2/3)

Lighted Visual Ice Detector Function/Description

Two lighted visual icing indicators give a visual indication of ice accumulation to the flight crew. Both are seen easily by the crew.
Each lighted visual icing indicator has a green Light Emitting Diode (LED) which is manually turned on when ambient brightness is insufficient or during night flights.
The flight crew operates the lighted visual icing indicators with a toggle switch, ICE IND, via the Electrical Power Distribution System (EPDS).
During daytime flights, the crew will see a straight accretion/accumulation of ice. During night time flights, the green LED light source will be masked, indicating ice accumulation.



LIGHTED VISUAL ICE DETECTOR FUNCTION/DESCRIPTION

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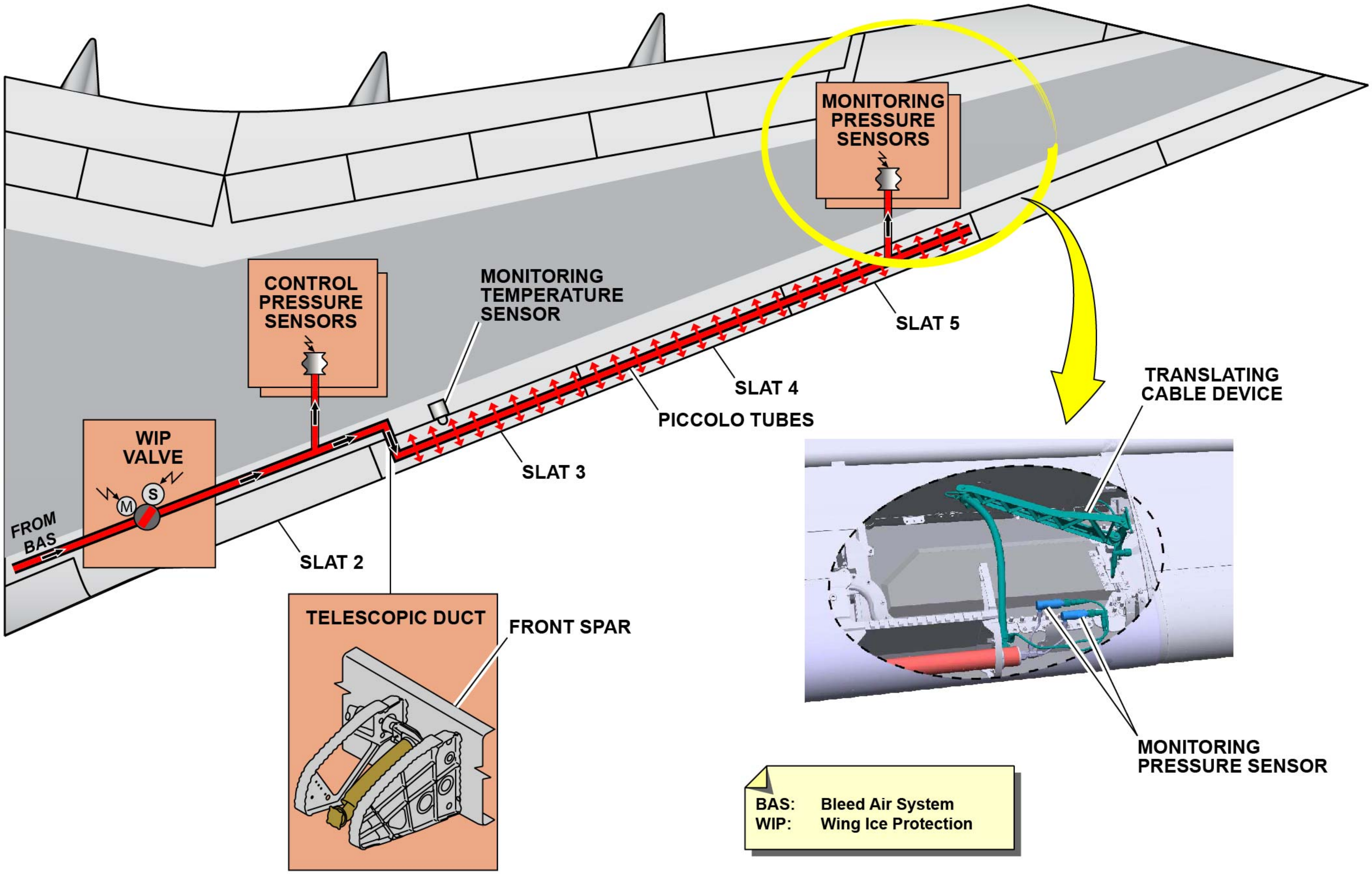
WING ICE PROTECTION SYSTEM DESCRIPTION (2/3)

General Presentation

The Wing Ice Protection System (WIPS) is divided in two identical and symmetrical parts. One part is dedicated to each wing to ensure the wing leading edge, slats three, four and five, are protected against ice while the aircraft is in flight.
The WIPS uses bleed air from the Bleed Air System (BAS).
A wing ice protection valve, one for each wing, modulates the airflow.
The components, per wing, that perform wing anti ice function of the WIPS are:
- One wing ice protection valve which is a modulating and shut off valve.
- Two wing ice protection control pressure sensors that provide air pressure data used to establish air mass flow rate and provide wing ice protection valve position monitoring.
- One wing ice protection monitor temperature sensor (dual element) which measures the temperature of the fixed wing surface. It is used on the ground only for overheat detection (for example, wing ice protection valve leakage).
- Two wing ice protection monitor pressure sensors that monitor the slat air flow through the piccolo tubes, for overpressure/leakage protection, as well as wing ice protection valve position monitoring.
- One translating cable device carries the electrical wiring between the fixed leading edge of the wing and the wing ice protection monitor pressure sensors.
- One telescopic duct, curved duct that carries hot air from the WIPS supply duct to the piccolo tubes. It extends and retracts with slat movement.
- Piccolo tubes release hot air into the FWD area of the moveable slats.



GENERAL PRESENTATION

WING ICE PROTECTION SYSTEM DESCRIPTION (2/3)

Wing Ice Protection System Function and Description

Two WIPS applications, hosted in CPIOMs and associated with two Bleed Air Monitoring applications hosted in Bleed and Overheat Monitoring Units (BOMUs), control and monitor the WIPS. Wing ice protection control pressure sensors send data to the WIPS application using CRDCs. Using this data, the WIPS then calculates air mass flow for positioning the wing ice protection valve and monitoring its position. The two Bleed Air Monitoring applications monitor the system using associated wing ice protection monitor pressure and temperature (dual element) sensors. The BOMUs exchange data with the CPIOM WIPS application using CRDCs.

The WIPS has two control and monitoring channels. Each channel uses one CPIOM and one BOMU. During normal operation, only one channel operates. While one channel operates, the other stays in hot standby mode. During the next flight, the control and monitoring channel that was in hot standby mode operates and the other control and monitoring channel changes to the hot standby mode. This prevents dormant failures from showing for an extended period.

If the CPIOM WIPS application or the BOMU Bleed Air Monitoring application of the active channel fails, the system automatically switches over to the hot standby WIPS application or Bleed Air Monitoring application with no indication in the cockpit. In case of a critical failure (over/under pressure or over-temperature), both the WIPS applications and Bleed Air Monitoring applications will signal the wing ice protection valve to close and shut down the WIPS. Closure of the wing ice protection valve is directly controlled by the BOMU and indirectly by the WIPS application through the CRDCs. Both wing ice protection valves are affected so that the WIPS remains symmetrical.

The WIPS has only a manual mode which is activated using the ANTI ICE WING P/BSW. It is available in flight.

When the P/BSW is selected ON, the Bleed Air Monitoring application electrically energized the wing ice protection valve to open it and the WIPS application modulates the position of the valve.

The WIPS can operate on the ground for testing. The ground test is limited to a short duration (twenty seconds for valve opening and one minute for test completion). The test stops automatically. The WIPS is inhibited for a specific time period (ten minutes) after testing to allow the distribution system to cool down.

The ANTI ICE WING P/BSW is also used to reset the system. For example, over-temperature and under or over pressure conditions.

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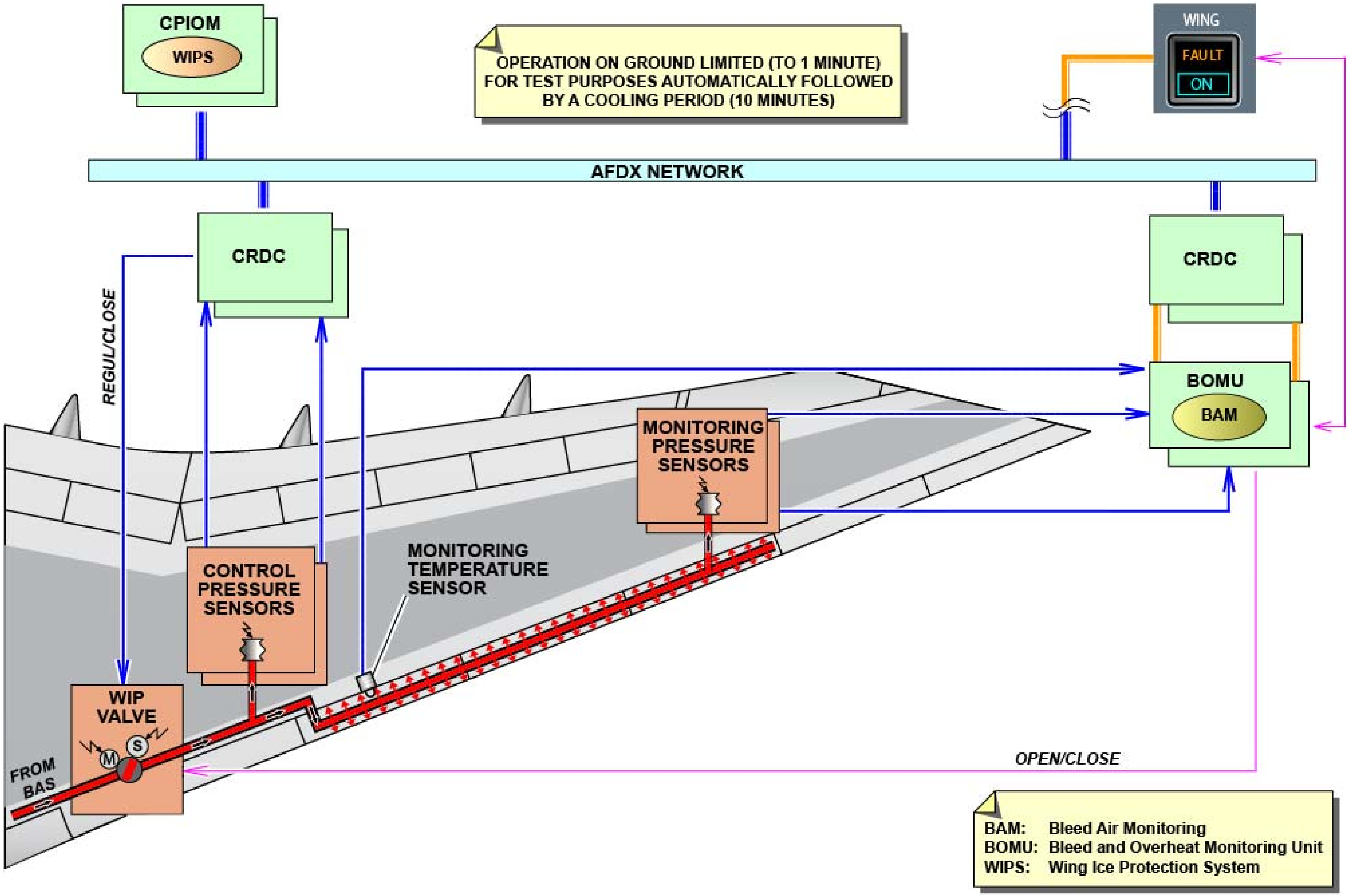

WING ICE PROTECTION SYSTEM FUNCTION AND DESCRIPTION

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WING ICE PROTECTION SYSTEM DESCRIPTION (2/3)

Interfaces

Engine Bleed Air System (EBAS)
The EBAS interfaces with the WIPS to provide the engine bleed air supply temperature to ensure correct positioning of the wing ice protection valve for airflow regulating.
Pack System
The pack system interfaces with the WIPS to provide pack air inlet temperature data to ensure correct positioning of the wing ice protection valve for airflow regulating.
LGERS
The LGERS provides weight on wheels and weight off wheels signal for ground testing and flight/ground information.
OverHeat Detection System (OHDS)
The OHDS is an interface that is used to close the wing ice protection valve in case of an air leak detection by the OHDS sensing elements.
Propulsion Control System (PCS)
The PCS interfaces with the WIPS to close the wing ice protection valve during engine start.
Air Data/Inertial Reference System (ADIRS)
The ADIRS has an interface with the WIPS application and the BOMUs.
The ADIRS provides:
- Pressure altitude to the WIPS application to ensure correct positioning of the wing ice protection valve for airflow regulating.
- Total Air Temperature (TAT) to inhibit the WIPS if the ambient temperature is above a specific level.
- Airspeed to confirm the flight or ground condition (depending on airspeed below or above 80 knots).

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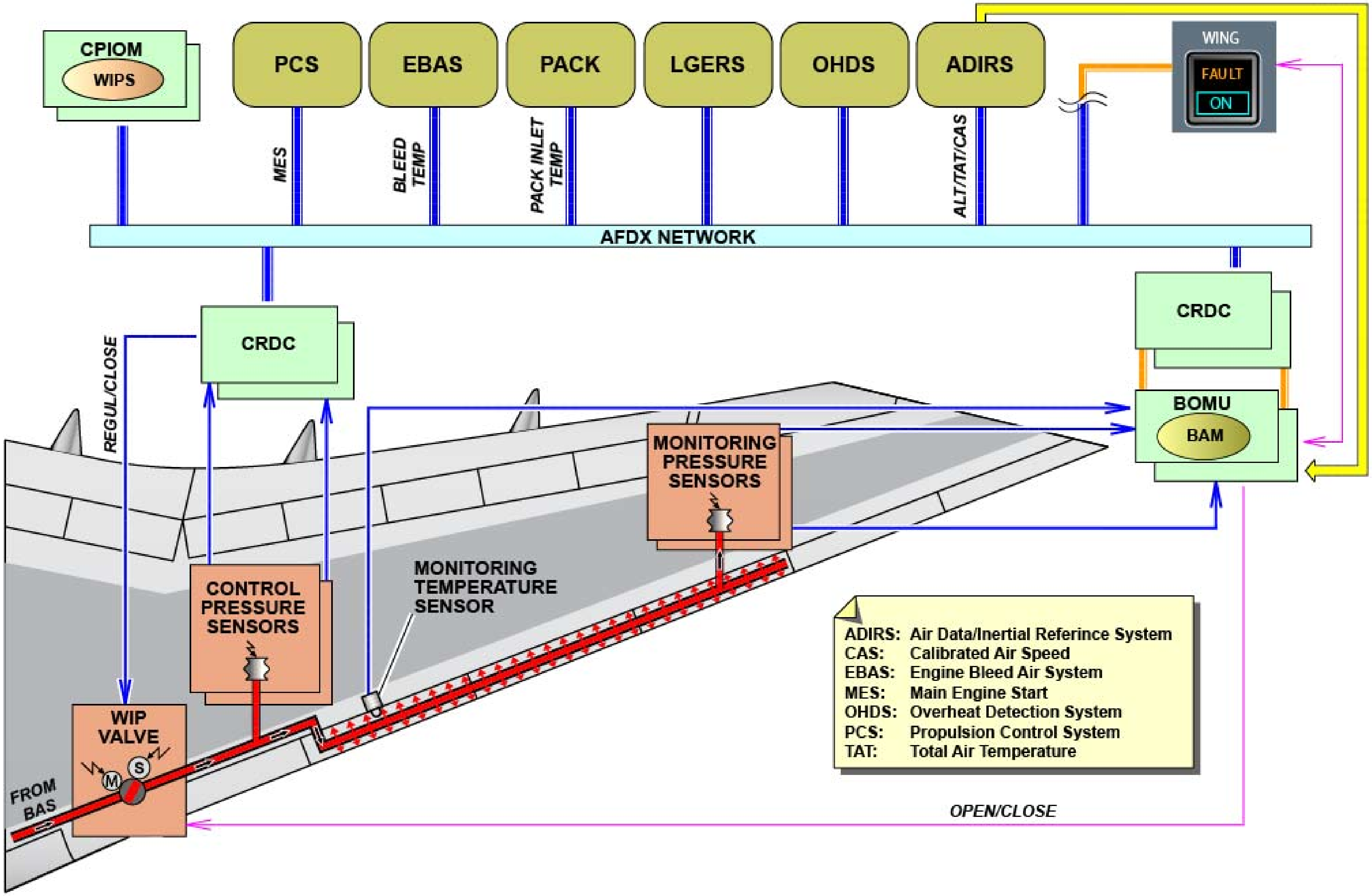

INTERFACES

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WING ICE PROTECTION SYSTEM DESCRIPTION (2/3)

Wing Ice Protection Valve Description

The wing ice protection valve is located on the Leading Edge of the wing, outboard of the engine pylon.
It is electrically controlled and pneumatically actuated. The valve is spring loaded closed.
The valve has a manual override and closed position lock that also serves as a visual position indicator. The wing ice protection valve can be set and locked in the fully closed position by removing the lock pin from the housing and turning the manual lock arm to the closed position. The lock pin is then inserted through the hole on the manual lock arm and torqued to the specified value.
There is a Torque Motor (TM) located on the wing ice protection valve that is controlled by the WIPS application.
The WIPS uses the TM to control the downstream air pressure regulation.
The TM will regulate the downstream pressure by increasing or decreasing the current to it. This is the regulation function.
If the TM current is at zero, the wing ice protection valve will close regardless of the current applied to the Solenoid (SOL).
There is a SOL located on the wing ice protection valve that is controlled by the Bleed Air Monitoring application.
The WIPS uses this SOL, when energized, to open the wing ice protection valve by overcoming the spring force that normally holds the wing ice protection valve closed. This controls the enable and shut off function of the valve.
When the SOL is de-energized, the valve will close, regardless of the current at the TM.

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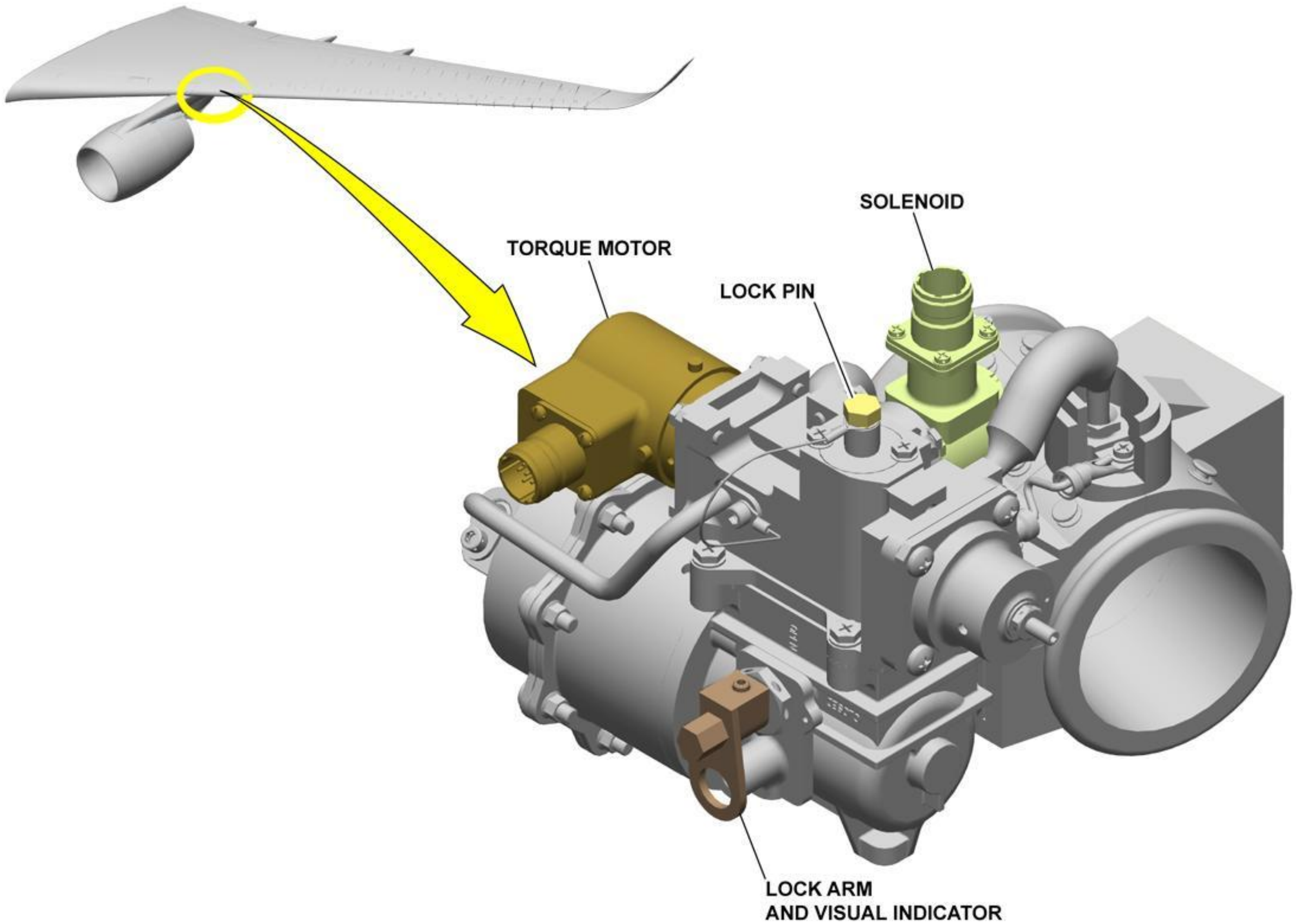


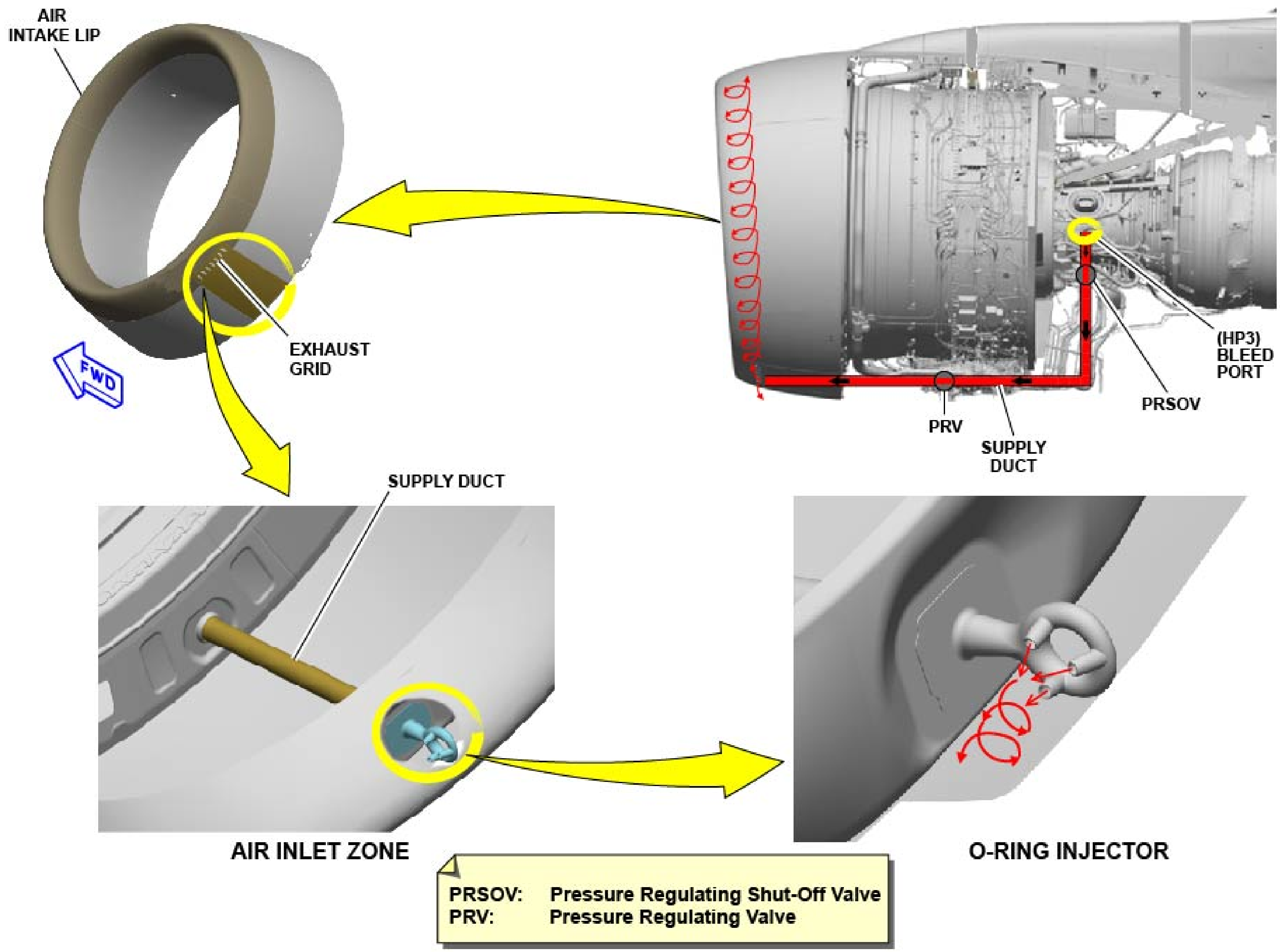
WING ICE PROTECTION VALVE DESCRIPTION

ENGINE NACELLE ANTI ICE PROTECTION SYSTEM DESCRIPTION (2/3)

General Presentation

The engine Nacelle Anti-Icing (NAI) protection system prevents ice build-up by using hot bleed air from the engine compressor (HP3) bleed port. Ice build up on the engine inlet could adversely affect the engine operation or cause a serious loss of power. There is one independent system for each engine.
The hot bleed air in each system flows through:
- A Pressure Regulating Shut-Off Valve (PRSOV)
- A Pressure Regulating Valve (PRV)
- Supply ducts and an o-ring injector.

The hot bleed air goes through supply ducts, which run from the HP (three) bleed port to the engine air intake lip, using an o-ring injector to introduce the air. The air is then evacuated overboard through an exhaust grid. There are panels to access the o-ring injector and supply ducts for inspection and/or replacement of components.
The o-ring injector has three nozzles. The nozzles are positioned so that the air will flow in a swirling motion. This design results in a better transfer of heat and a better flow of the fresh/hot air mix; thus helping to prevent overheat issues.



GENERAL PRESENTATION

ENGINE NACELLE ANTI ICE PROTECTION SYSTEM DESCRIPTION (2/3)

Engine Nacelle Anti Ice Function/Description

Anti Ice Control Function-Nacelle Anti-Icing (AICF-NAI) Application

The Anti Ice Control Function-Nacelle Anti-Icing (AICF-NAI) applications control and monitor the system through the Engine Interface Function (EIF) applications and the Electronic Engine Control (EEC). Two AICF-NAI applications, associated to two EIF applications are dedicated to each engine for redundancy.
When the engine NAI P/B is selected ON, the AICF-NAI applications will illuminate the "ON" light on the P/BSW. Utilizing a CDS interface, a memo will be displayed on the zone below the PFD and on the Warning Display (WD). Also, an indication (NAI) will be displayed on the Engine Display (ED) page (top right).
AICF-NAI applications are reset using the Anti Ice Control System (AICS) reset SWs.

Valves

Each of the two independent engine NAI systems has two valves, a PRSOV and a PRV, installed in series on the ducting (HP3).
The PRSOV acts as a shut-off valve. It is installed in the core zone. The PRSOV also acts as a backup pressure regulator when the PRV has failed.
The PRV primarily regulates the bleed air pressure and is located in the fan zone. A pressure transducer (dual channel), at the exit of the PRV, monitors the system by providing high or low air pressure values to each channel of the EEC.
The PRSOV is controlled by muscle air pressure (from HP3 compressor) and two solenoids that are installed on a bleed valve controller (located under a gas generator fairing).
The PRV is controlled by muscle air pressure (from HP3 compressor) and a single solenoid that is on the valve.
When electrical power is lost or when bleed air is not available, both valves are failsafe open.

Operation

The engine anti-ice protection system has a manual ON/OFF control. The system is manually activated on the ground or in flight by an action on the ENG ANTI ICE P/BSWs. There is one ENG ANTI ICE P/BSW for each engine to activate the engine NAI protection system.
The position of each ENG ANTI ICE P/BSW is sent to two CPIOM AICF-NAI applications. Based on the position of the ENG ANTI ICE P/BSW, the related AICF-NAI applications send the activation/deactivation command for the valves to the related EIF applications via the AFDX.
Next, the commands are transmitted to the EEC for the opening, closing and/or pressure regulating of the valves.
In normal operation:
- When the ENG ANTI ICE P/BSW is selected, both PRSOV solenoids ("shut-off" and "regulation" solenoids) and the PRV solenoid are de-energized.
The PRSOV is fully open by an air muscle pressure and the supplied air pressure regulation is done by the PRV.
- When the ENG ANTI ICE P/BSW is deselected, the PRSOV "shut-off" solenoid is electrically energized by the EEC and the "regulation" solenoid is de-energized. The PRV solenoid is de-energized.
The PRSOV is closed (shut-off function) and the PRV is failsafe spring loaded open.
In case of pressure regulation problem:
- The PRSOV "shut-off" solenoid is de-energized and the "regulation" solenoid is electrically energized by the EEC. The PRV solenoid is electrically energized by the EEC.
The PRSOV is open and does also the pressure regulation function. The PRV is full open and can no more do the pressure regulation

function. Pressure regulation function of the PRSOV is a backup of the PRV function.

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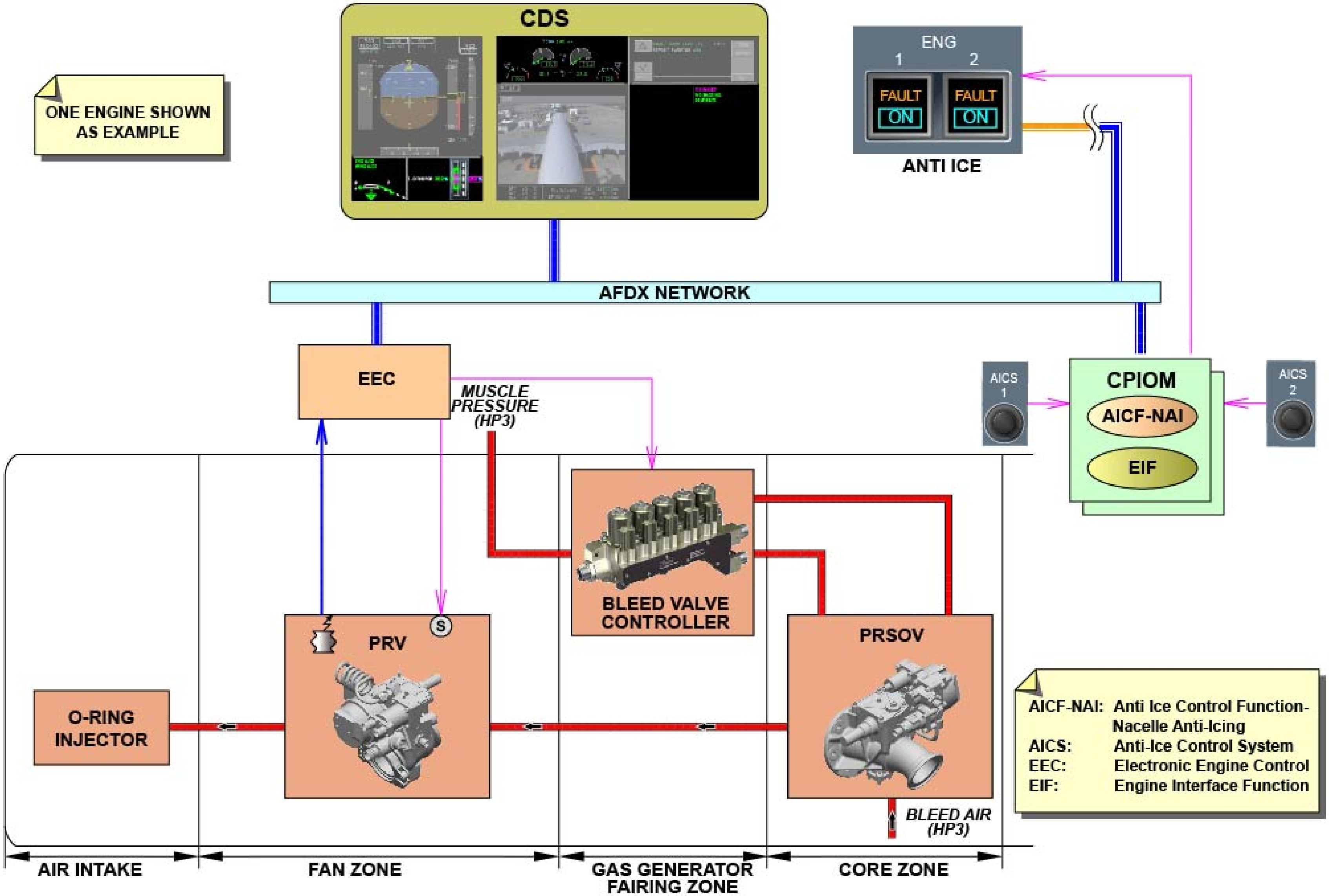

ENGINE NACELLE ANTI ICE FUNCTION/DESCRIPTION - ANTI ICE CONTROL FUNCTION-NACELLE ANTI-ICING (AICF-NAI) APPLICATION ... OPERATION

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ENGINE NACELLE ANTI ICE PROTECTION SYSTEM DESCRIPTION (2/3)

Components Description

Pressure Regulating Shut-Off Valve

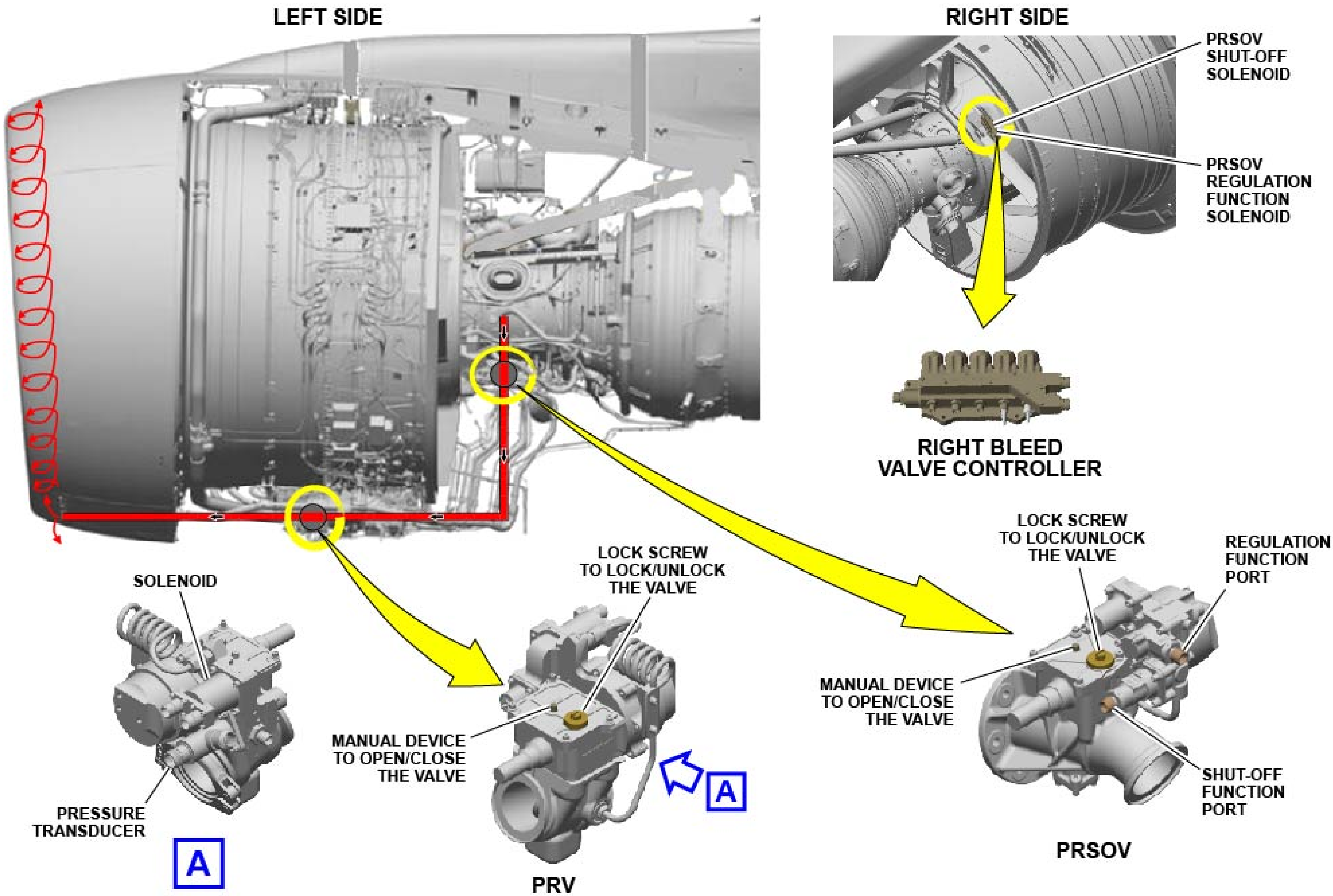
The PRSOV is located in the core zone (left side). Muscle air pressure is supplied or not to the valve by two ports, one for each solenoid, from the valve controller.
There is also a manual device to open/close the valve and a lock screw to lock/unlock the pressure regulating shut-off valve in its position.
The manual device and the lock screw are of a different color than other components on the valve to make it easier to identify when performing maintenance.

Valve Controller

The PRSOV "regulation" solenoid and "shut-off" solenoid are located on the right bleed valve controller; located under the engine gas generator fairing zone (right side). This location was chosen because the temperature is lower here than in the core zone.

Pressure Regulating Valve

The PRV is located on the fan case (lower, left side). A solenoid is installed on the valve to activate the pressure regulation function when de-energized, and maintain open fully the valve when energized, with no pressure regulation. A pressure transducer (dual channel), located at the exit of the valve, is used for monitoring the pressure.
There is also a manual device to open/close the PRV and a lock screw to lock/unlock the valve in its position.
The manual device and the lock screw are of a different color than other components on the valve to make it easier to identify when performing maintenance.



COMPONENTS DESCRIPTION - PRESSURE REGULATING SHUT-OFF VALVE ... PRESSURE REGULATING VALVE

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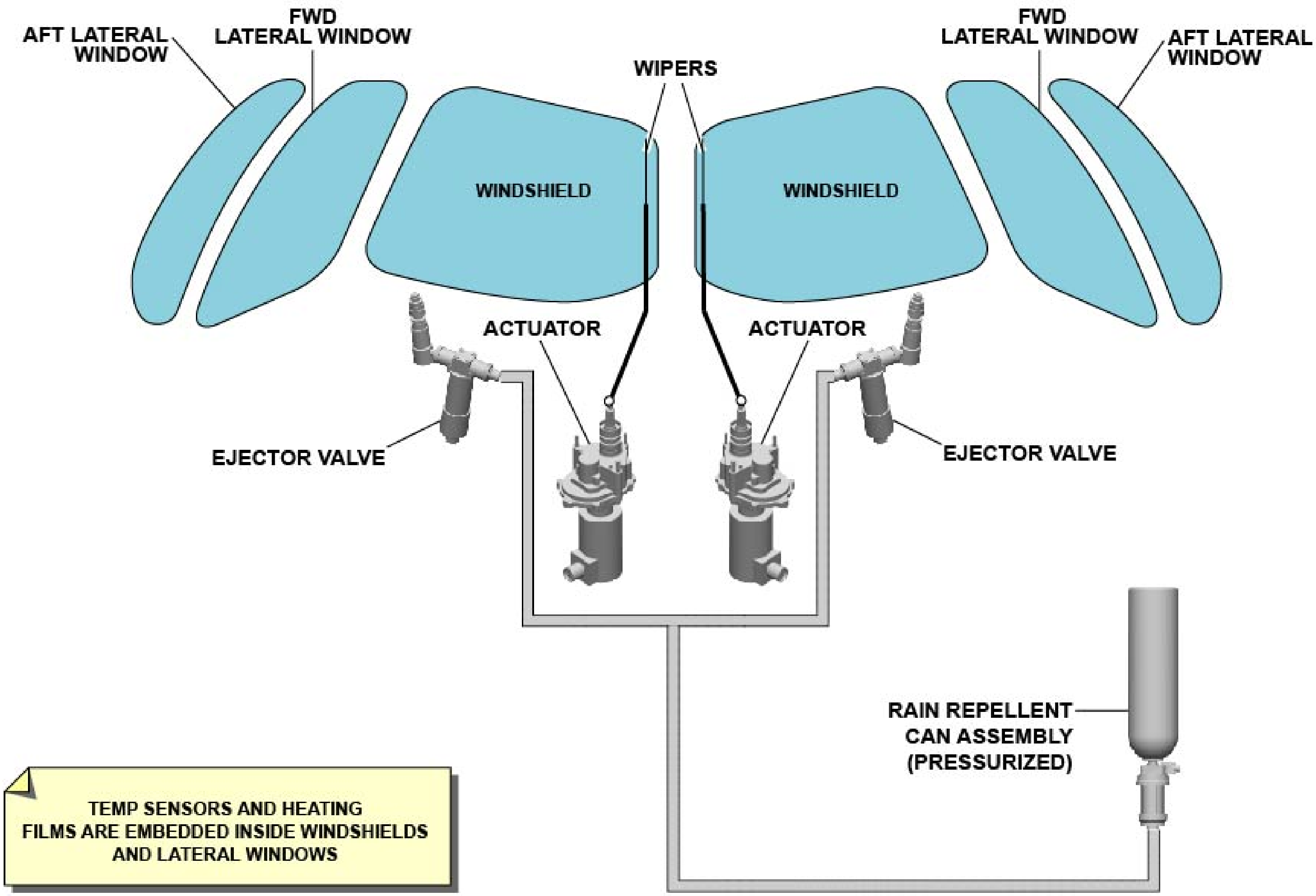
COCKPIT WINDOWS ANTI ICING/DEFOGGING AND RAIN PROTECTION DESCRIPTION (2/3)

General Presentation

The cockpit windshield anti icing and defogging system provides icing and fogging protection of the windshields on the external surfaces. This is accomplished using a heating film and temperature sensors (between plies), internal to the windshields.
The cockpit lateral windows (FWD and AFT) defogging system provides defogging protection to the internal surfaces. This is accomplished using heating films and temperature sensors (between plies), internal to the lateral windows.
These protections operate in flight and on the ground.
The wipers ensure the rain is removed from the windshields for safe operation of the aircraft. Each wiper is independently operated by actuators. The wipers are parked in the vertical position.
The rain repellent system fluid is sprayed on the windshield and provides better visibility to the crew under heavy rain conditions. The rain repellent is contained in a can assembly and independently sprayed on each windshield using ejector valves.



GENERAL PRESENTATION

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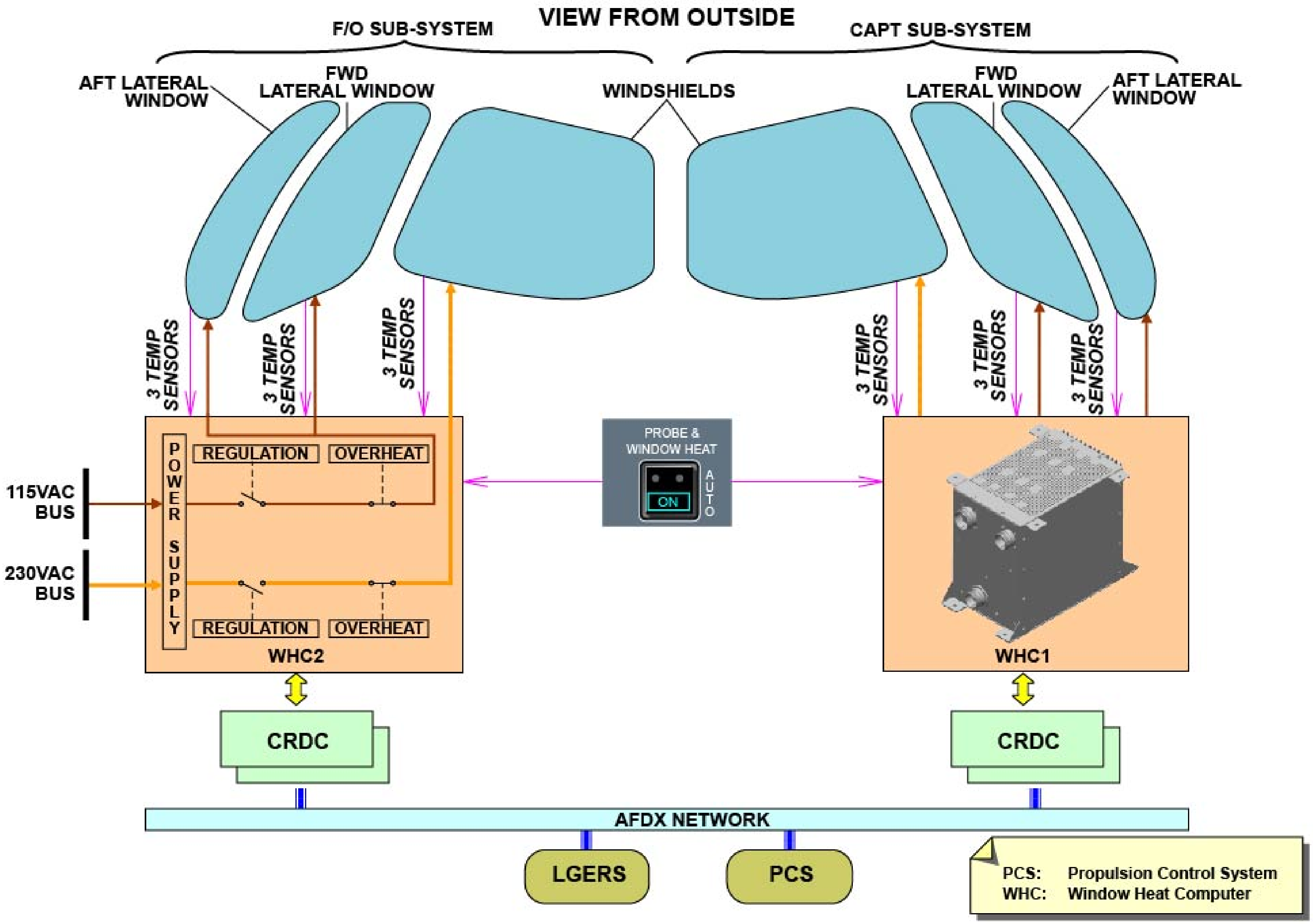
COCKPIT WINDOWS ANTI ICING/DEFOGGING AND RAIN PROTECTION DESCRIPTION (2/3)

Windows Anti Icing/Defogging Function, Description and Interfaces

The windows anti icing/defogging system is divided into two sub-systems (F/O and CAPT). Each sub-system is comprised of one windshield, one FWD lateral window, one AFT lateral window and a Window Heat Computer (WHC).
There are two modes of operation. The first mode is automatic and requires at least one engine running. The second mode is manual operation and requires the PROBE and WINDOW HEAT P/BSW is selected ON.
The anti icing and defogging function of the cockpit windshields is ensured by the heating of one resistive/heating film.
Each windshield's resistive heating film is powered by 230 VAC, provided by the WHC.
There are three temperature sensors near the heating film that continually send information to the WHC for the heating regulation and the overheat protection functions.
The defogging function of the FWD lateral windows is ensured by the heating of several (three) resistive/heating films.
Each of the FWD lateral windows resistive heating films is powered by 115 VAC, provided by the WHC.
There are three temperature sensors near the heating films that continually send information to the WHC for the heating regulation and overheat protection functions.
The defogging function of the AFT lateral windows is ensured by the heating of one resistive/heating film.
Each of the AFT lateral windows resistive heating film is powered by 115 VAC, provided by the WHC.
There are three temperature sensors near the heating film that continually send information to the WHC for the heating regulation and overheat protection functions.
The system has two WHCs. One WHC is dedicated to a side/sub-system, there is one WHC for the F/O side/sub-system and one for the CAPT side/sub-system.
The regulation function is an automatic function. The regulation function operates as follows: the WHC regulates the temperature of the cockpit windows (35 degrees C - 42 degrees C) based on the temperature value it receives from one of the three temperature sensors. The other two temperature sensors are in standby mode.
The overheat function is an automatic function. The overheat function operates as follows: if the temperature of the cockpit windows reaches a specific temperature level (+60 degrees C), the WHC will stop supplying the specific window. If the aircraft is on the ground and the engines are not running, there will be no warning generated by the WHC. Otherwise, the WHC will generate a warning for the corresponding window that is overheating. For each window, the WHC uses temperature values from the three temperature sensors to detect an overheat.
The WHCs interface and exchange data via CRDCs with the AFDX network.
The two WHCs are located in the cockpit:
- WHC1 is located next to the fourth occupant console behind the Captain.
- WHC2 is located next to the coat stowage behind the First Officer.
The WHC interfaces with:
- Propulsion Control System (PCS): the PCS provides the "engine running" signal to the WHC for the automatic operation via CRDCs through the AFDX network
- LGERS: the LGERS will provide a Weight On Wheels (WOW) signal to the WHCs if both engines are not running, to ensure the windows anti icing and defogging systems will continue to operate normally.



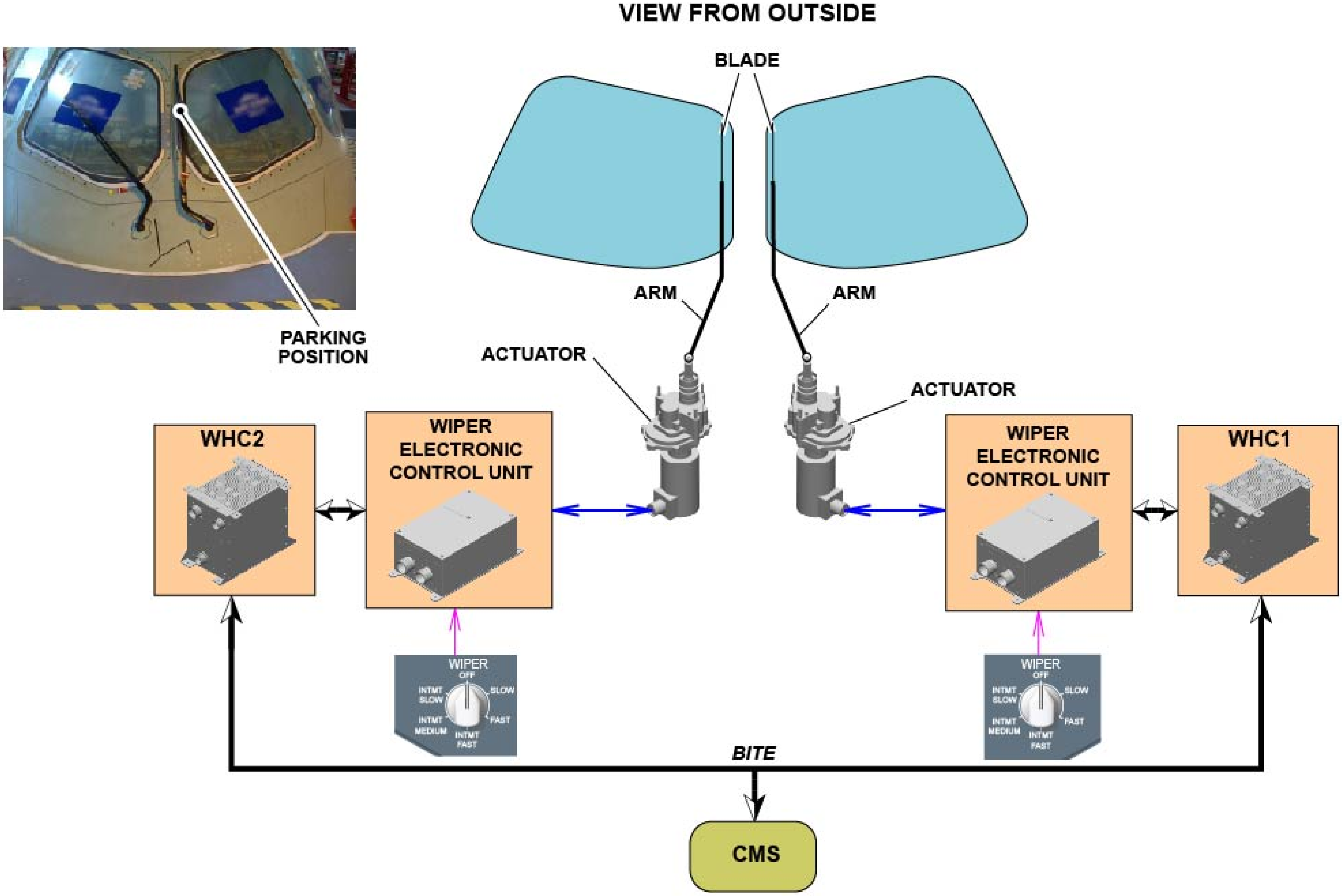
WINDOWS ANTI ICING/DEFOGGING FUNCTION, DESCRIPTION AND INTERFACES

COCKPIT WINDOWS ANTI ICING/DEFOGGING AND RAIN PROTECTION DESCRIPTION (2/3)

Windshield Wiper System Function, Description and Interfaces

The windshield wiper system is the main rain protection system during taxi, take off, approach, holding and landing. The windshield wiper system ensures rain removal from the windshields.
The windshield wiper system is divided into two independently operated, electrically driven, five speed (three intermittent) sub-systems. One for the Captain's windshield and one for the First Officer's windshield.
For each sub-system:
- One wiper actuator drives the arm/blade assembly. The wiper actuator is a single assembly made of a motor and a gearing system. Each wiper operates independently.
- One wiper electronic control unit, which is a separate unit from the actuator, drives the actuator motor. The actuator also sets the parking position of the arm/blade assembly when the rotary switch is set to OFF.
- One wiper arm is connected to the wiper actuator and holds the blade.
- One wiper selector rotary switch provides control of the windshield wiper sub-system.

Because of the shape of the nose fuselage, which does not protect the wiper blades from the direct air stream, the wipers will be vertically parked. This will reduce the force exerted on the wipers.
The wiper electronic control units are located in the avionics bay, on the floor.
The wiper electronic control units do not interface with the CMS. For sensing fault messages to CMS, each wiper electronic control unit has an interface with it's dedicated WHC. The dedicated WHC is interfaced with the CMS.



WINDSHIELD WIPER SYSTEM FUNCTION, DESCRIPTION AND INTERFACES

COCKPIT WINDOWS ANTI ICING/DEFOGGING AND RAIN PROTECTION DESCRIPTION (2/3)

Rain Repellent System Function, Description and Interfaces

The rain repellent system has:
- A can assembly
- A gauge assembly
- Two ejector valves.

The can assembly contains the rain repellent fluid and is pressurized with nitrogen.
The gauge assembly is equipped with a fluid level indication system.
The ejector valve is electrically controlled.
The ejector valves are inhibited when the aircraft engines are shut down.
The "inhibition" signal is sent from the WHCs to the ejector valves when that information is provided from the PCS interface.
The rain repellent fluid sprayed on the windshield gives the flight crew better visibility through the windshields during rain conditions during approach, landing, taxiing and take-off.
The flight crew operates the rain repellent system through two RAIN RPLNT P/BSWs. When the RAIN RPLNT P/BSW is pushed in, the related ejector valve releases the rain repellent fluid through the nozzle and onto the windshield. One operation on the RAIN RPLNT P/BSW is equal to one fluid release cycle.
The gauge assembly monitors the level of the rain repellent fluid in the can assembly.
When the can assembly is empty, the gauge assembly transmits a discrete signal to the WHC2.
Then the WHC2 generates and sends a message to the DOOR/OXYGEN PAGE of the CDS for indication.

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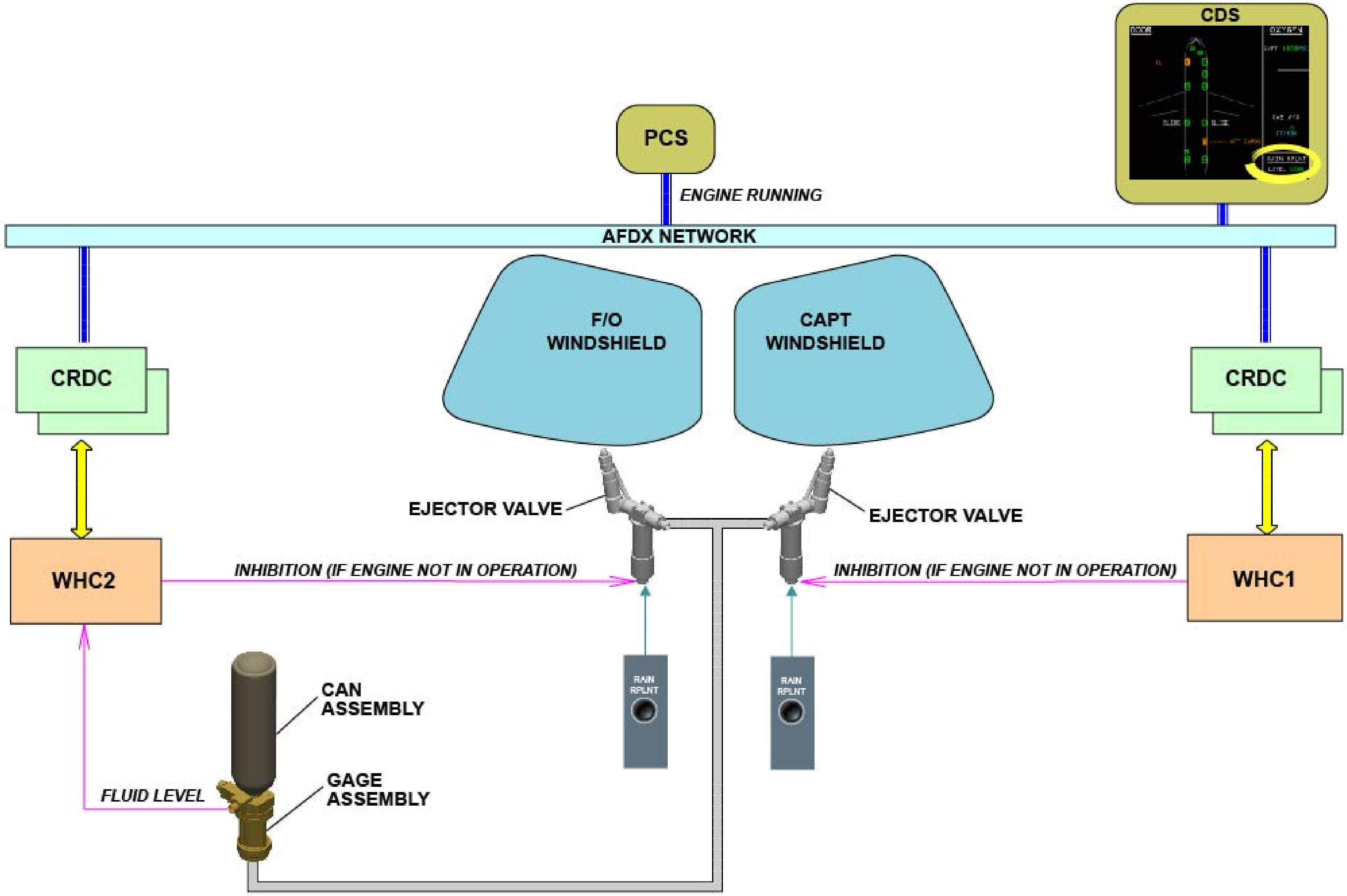


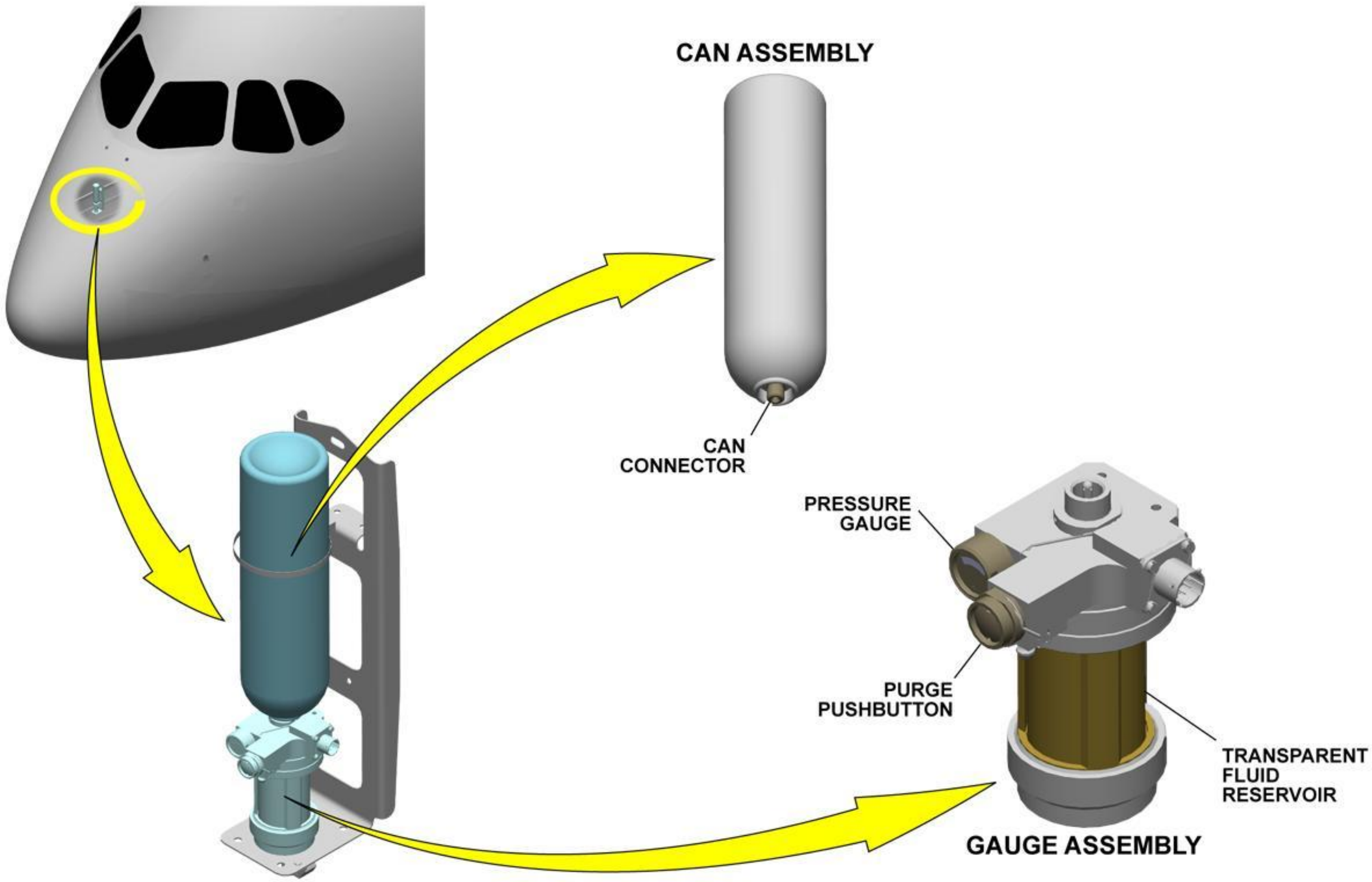
RAIN REPELLENT SYSTEM FUNCTION, DESCRIPTION AND INTERFACES

COCKPIT WINDOWS ANTI ICING/DEFOGGING AND RAIN PROTECTION DESCRIPTION (2/3)

Rain Repellent System Function, Description and Interfaces (continued)

Rain Repellent Components Description

The rain repellent can and gauge assembly are located in the nose electronics bay.
The can assembly is screwed directly on the gauge assembly. The can connector is designed with a self closing device which prevents leakage when not installed on the gauge assembly.
The gauge assembly is made of:
- A pressure gauge that indicates the pressure in the system and thereby the remaining fluid
- A purge pushbutton used in can replacement
- A transparent fluid reservoir.



RAIN REPELLENT SYSTEM FUNCTION, DESCRIPTION AND INTERFACES - RAIN REPELLENT COMPONENTS DESCRIPTION

V1813401 - V01T0M0 - VM30D4WNDHT3001

POTABLE AND WASTE WATER ICE PROTECTION AND FLOOR PANELS HEATING SYSTEMS DESCRIPTION (2/3)

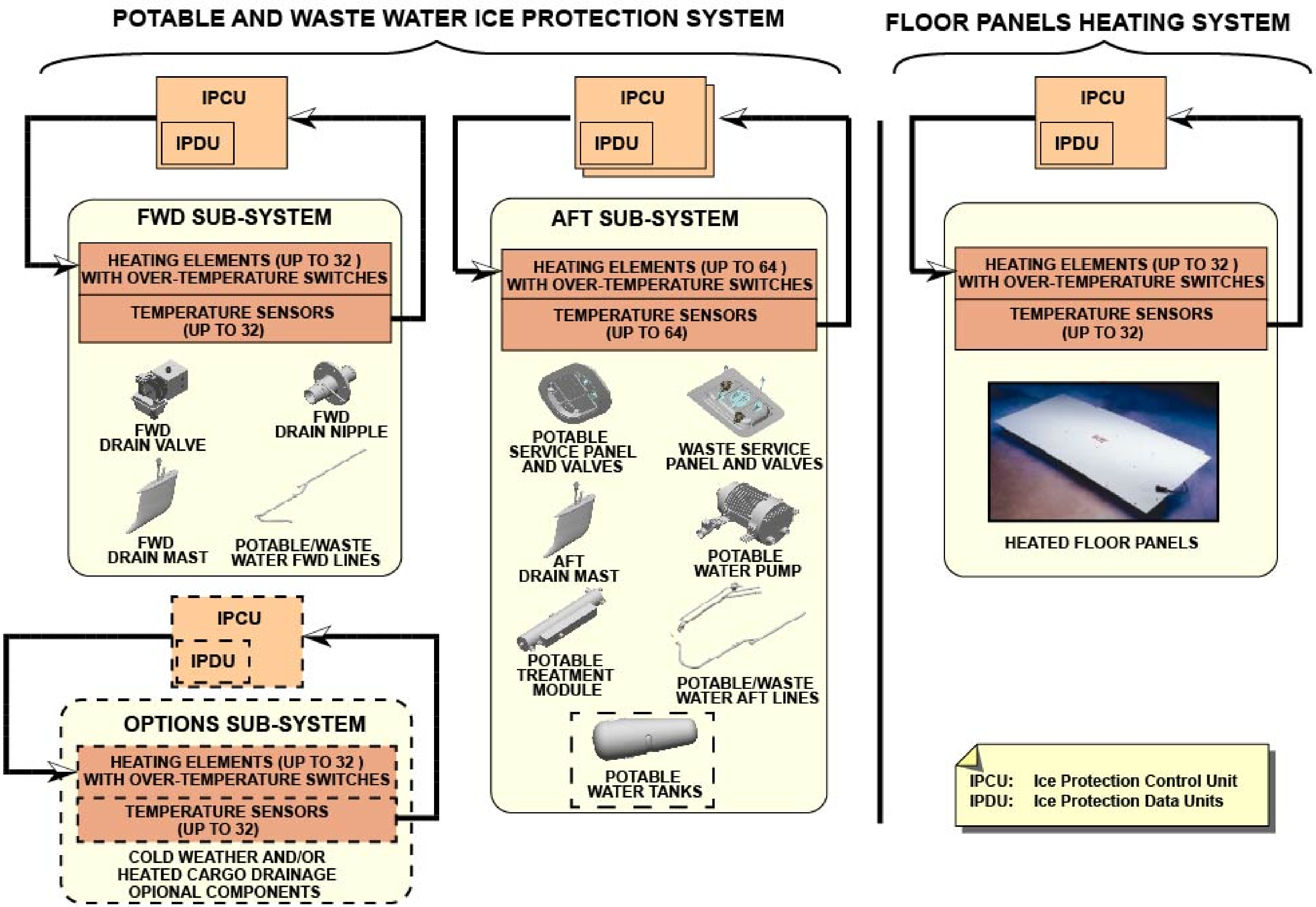
Potable and Waste Water Ice Protection and Floor Panels Heating Presentation

The functions of the potable and waste water ice protection and floor panels heating systems are:
- To protect against water freezing in lines, tanks, valves and other water distribution equipments.
- To prevent some cabin floor panels to get cold during long flights, for more passengers and crew comfort.

The heating of the water systems components and the floor panels is performed electrically during ground and/or flight operations.
Electrical heating is automatic as soon as the aircraft is electrically energized.
The potable and waste water ice protection system is divided in two or three independent subsystems which are:
- FWD subsystem controlled by one Ice Protection Control Unit (IPCU).
- AFT subsystem controlled by two IPCUs.
- Options subsystem controlled by one IPCU if options are installed on the aircraft.

The FWD subsystem prevents water ice buildup in components equipped with heating elements. Components are installed in the FWD part of the aircraft (FWD drain valve and nipple, FWD drain mast, potable and waste water lines).
The AFT subsystem prevents water ice buildup in components equipped with heating elements. Components are installed in the AFT part of the aircraft (potable service panel and valves, waste service panel and valves, AFT drain mast, potable and waste water lines, potable water pump and treatment module, potable water tanks as option).
The options subsystem prevents ice buildup in additional components if the cold weather and/or heated cargo drainage option(s) is/are installed on the aircraft.
The floor panels heating system is an independent system used to heat some cabin floor panels. Heating elements in the cabin floor panels are controlled by one specific IPCU.
The heated cabin floor panels are located in cold areas, near each passenger exit doors (two panels per door) and, as an option, in the AFT galley area.
Each IPCU controls and monitors heating elements (up to 32 per IPCU).
Temperature sensors (up to 32 per IPCU) are used by IPCUs to start or stop the electrical power supply to the heating elements.
In addition, the IPCUs uses configuration data from Ice Protection Data Units (IPDU) to determine when to electrically supply the heating elements (temperature thresholds, flight/ground conditions,...).
The IPDU is plugged into the IPCU. This component stores all the configuration data which are needed for the IPCU to control heating elements.
Examples of configuration data stored are:
- Identification of heating elements to control/monitor.
- Flight/ground configurations when the heating elements have to be operated.
- Temperature thresholds when the heating elements have to be electrically energized or not.

In case of problem and heating elements become too hot, a protection switch, integrated in heating elements, stops the electrical power supply.



POTABLE AND WASTE WATER ICE PROTECTION AND FLOOR PANELS HEATING PRESENTATION

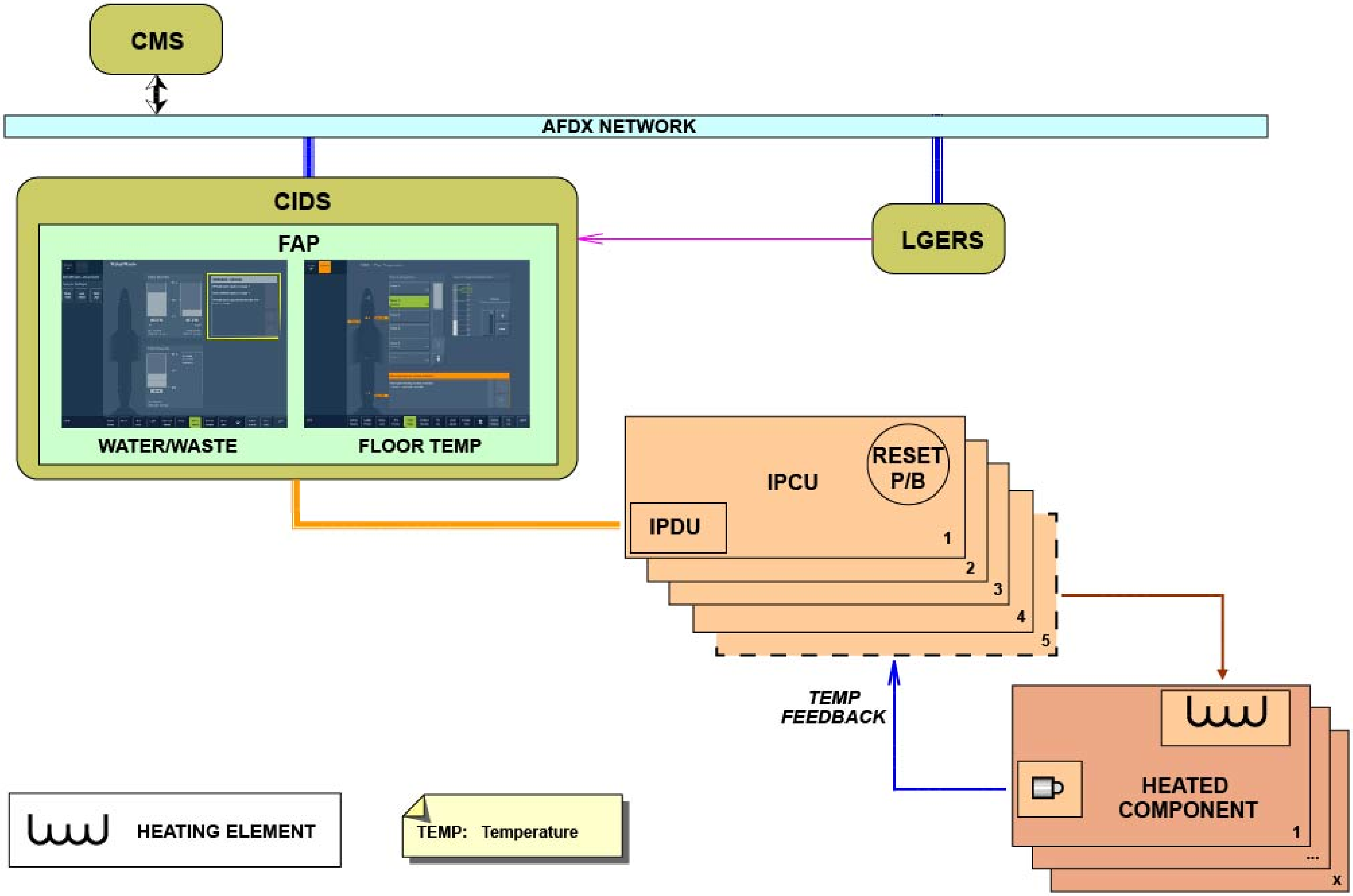
V1813401 - V01T0M0 - VM30D5PTWWP3001

POTABLE AND WASTE WATER ICE PROTECTION AND FLOOR PANELS HEATING SYSTEMS DESCRIPTION (2/3)

Potable and Waste Water Ice Protection and FloorPanels Heating Description/Interfaces

IPCUs monitor the heating elements and are in interface with the CIDS.
Status of the potable and waste water ice protection system and the floor panels heating system are available on specific FAP pages (WATER/WASTE page and FLOOR TEMP page).
The IPCUs are not directly in interface with the CMS. They send fault messages through the CIDS.
Cabin crew can adjust the temperature levels of the floor heated panels with the corresponding FAP page (FLOOR TEMP page).
The IPCUs are in interface with LGERS through the CIDS to know the flight/ground conditions.
With flight/ground conditions and IPDU configuration data, IPCU electrically energizes or not the heating elements.
Some failures detected by the IPCUs are latched. To operate the heating elements after the failures are no longer active, a manual reset of the IPCUs has to be done with a P/B.

V1813401 - V01T0M0 - VM30D5PTWWP3001



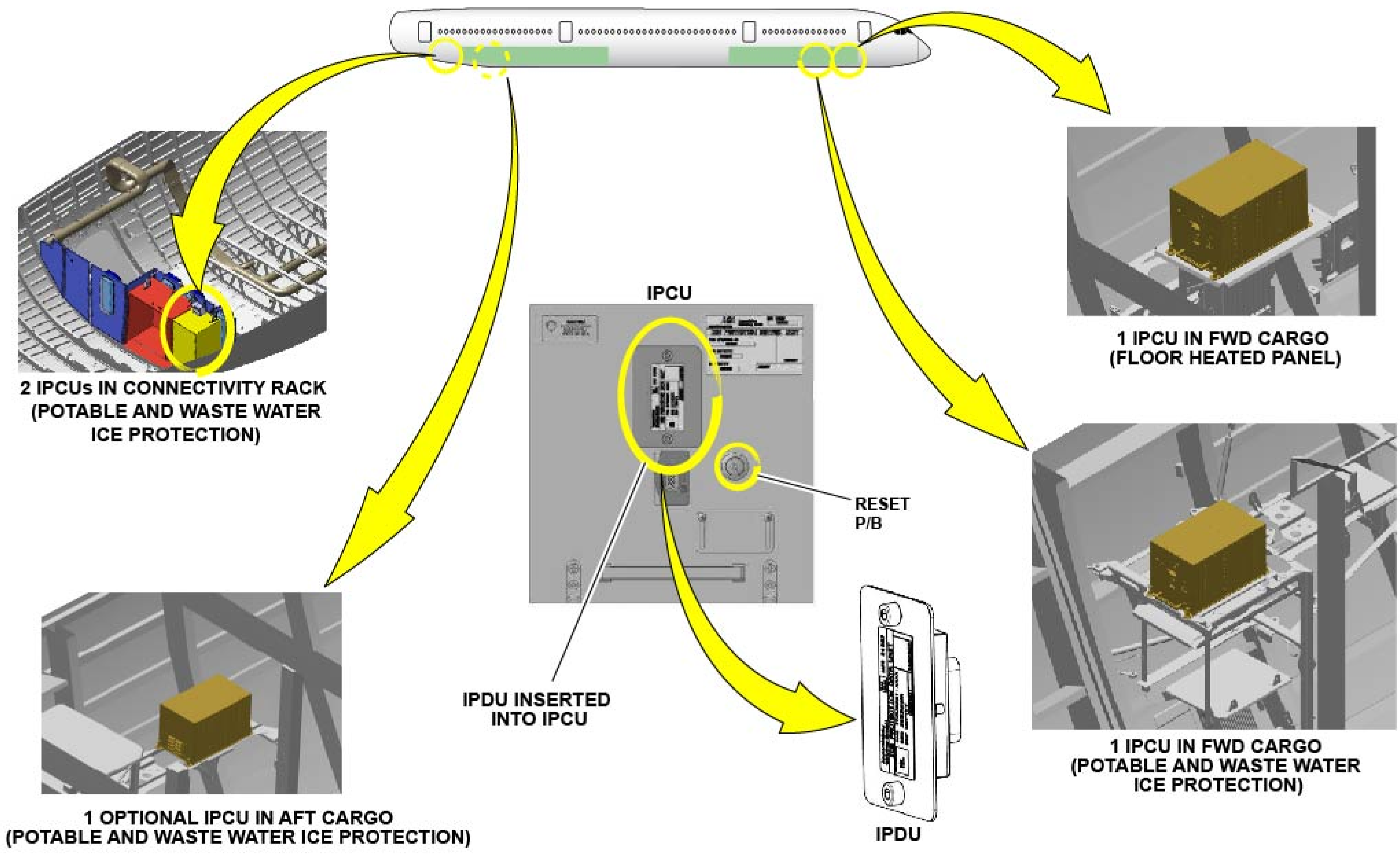
POTABLE AND WASTE WATER ICE PROTECTION AND FLOORPANELS HEATING DESCRIPTION/INTERFACES

POTABLE AND WASTE WATER ICE PROTECTION AND FLOOR PANELS HEATING SYSTEMS DESCRIPTION (2/3)

IPCUs/IPDUs Description

When system latched failures are no longer active, a manual reset is necessary with a P/B located on the front face of IPCUs.
All the IPDUs are LRUs with their own part numbers and Functional Item Number (FIN).
The IPDUs are plugged into the front face of IPCUs.
The configuration data of each IPDU is specific for its heating elements (specific locations). It has to be plugged into a new IPCU in case of IPCU replacement.
For the potable and waste ice protection system:
- Two IPCUs are located in the core rack at the rear of the bulk cargo compartment.
- One IPCU is located in the FWD cargo compartment.
- Based on options (cold weather and/or heated cargo drainage option(s)), another IPCU can be installed in the AFT cargo compartment.

For the floor panels heating system:
- One IPCU is located in the FWD cargo compartment.



IPCUS/IPDUS DESCRIPTION

V1813401 - V01T0M0 - VM30D5PTWWP3001

ICE AND RAIN PROTECTION CONTROL AND INDICATING (2/3)

Ice and Rain Protection - General (2)

The Ice and Rain Protection System controls are located on:
- The INT LT panel for the STBY COMPAS & EYE REF switch,
- The CPT & F/O WIPER panels for the Wiper selectors and Rain Repellent P/Bs,
- The ANTI ICE panel for the WING P/BSW, the ENG 1(2) P/BSWs and the PROBE & WINDOW HEAT P/BSW

There are also the AICS1(2) reset switches on the RESET panels.
The WAI Valves indications are displayed on the BLEED page when the system is in use only.

Ice Detection - Visual Indicators (2)

On the INT LT panel, when the switch is placed to the ICE IND position, two visual icing indicators will illuminate green. This is used as a visual detection method for the flight crew.

Ice Detection - Probes (2)

Each ice detector sends two detection signals to the AICF-NAI applications:
- ICE detection
- SEVERE ice detection.

When the ice detector sends the ICE detection signal to the AICF-NAI applications, the A.ICE ICE DETECTED advisory message is displayed on ECAM. This message advises the crew to turn on the Engine Ice Protection system.
NAI if it is not already selected ON. When the engine NAI is selected ON, the message is turned off.
The ice detector will send a SEVERE ice detection signal when the frequency has reached the detection trip point several times (seven times).
When the ice detector sends the SEVERE ice detection signal to the AICF-NAI applications, the A.ICE SEVERE ICE DETECTED advisory message is displayed on ECAM. This message advises the crew to turn on the WIPS. With the WIPS selected to ON, the SEVERE ice detection signal is reset and it's processing (detection trip point counter) is inhibited as long as the WIPS is ON.
When icing conditions are no longer detected for a period of time (more than 190 seconds) and the ice protection systems continue to operate, the A-ICE NOT DETECTED memo message comes into view.
The ice detection system can be reset using the Anti Ice Control System (AICS) reset switches, AICS1 and AICS2, to reset the AICF-NAI applications.

Wing Ice Protection - Ground Test (2)

The WING ANTI ICE P/Bsw controls the Wing Ice Protection (WIP) valves (one on each wing) which supplies hot air from the Pneumatic system to slats 3, 4 and 5.
The selection of the WIP system is a manual action (ON, OFF, Reset).
When selected ON, the BLEED SD page shows the WING A-ICE white legends with green triangles for WIP valves.
During the WIP test, on the ground, the valve open time is limited (around 1 minute), to prevent damage to the slats.

Wing Ice Protection Fault (3)

In case of disagree between the valve command and its actual position, the affected valve will be displayed amber on the BLEED page.

Engine Nacelle Ice Protection (2)

Engine Air Intake Ice Protection/Engine Anti Ice is selected manually, whether the aircraft is on ground or in flight.
The ENGINE ANTI ICE P/Bsw will illuminate blue "ON" or/and amber "FAULT".

Hot air is supplied from the engine compressor (HP3 stage) through a Pressure Regulating Shut Off Valve (PRSOV) and a Pressure Regulating Valve (PRV).

Engine Nacelle Ice Protection Fault (3)

In case of Engine Ice Protection system failure, corresponding warning message is triggered and the FAULT amber light illuminates on the corresponding ENGINE ANTI ICE P/Bsw.

Cockpit Windows Anti-Icing (2)

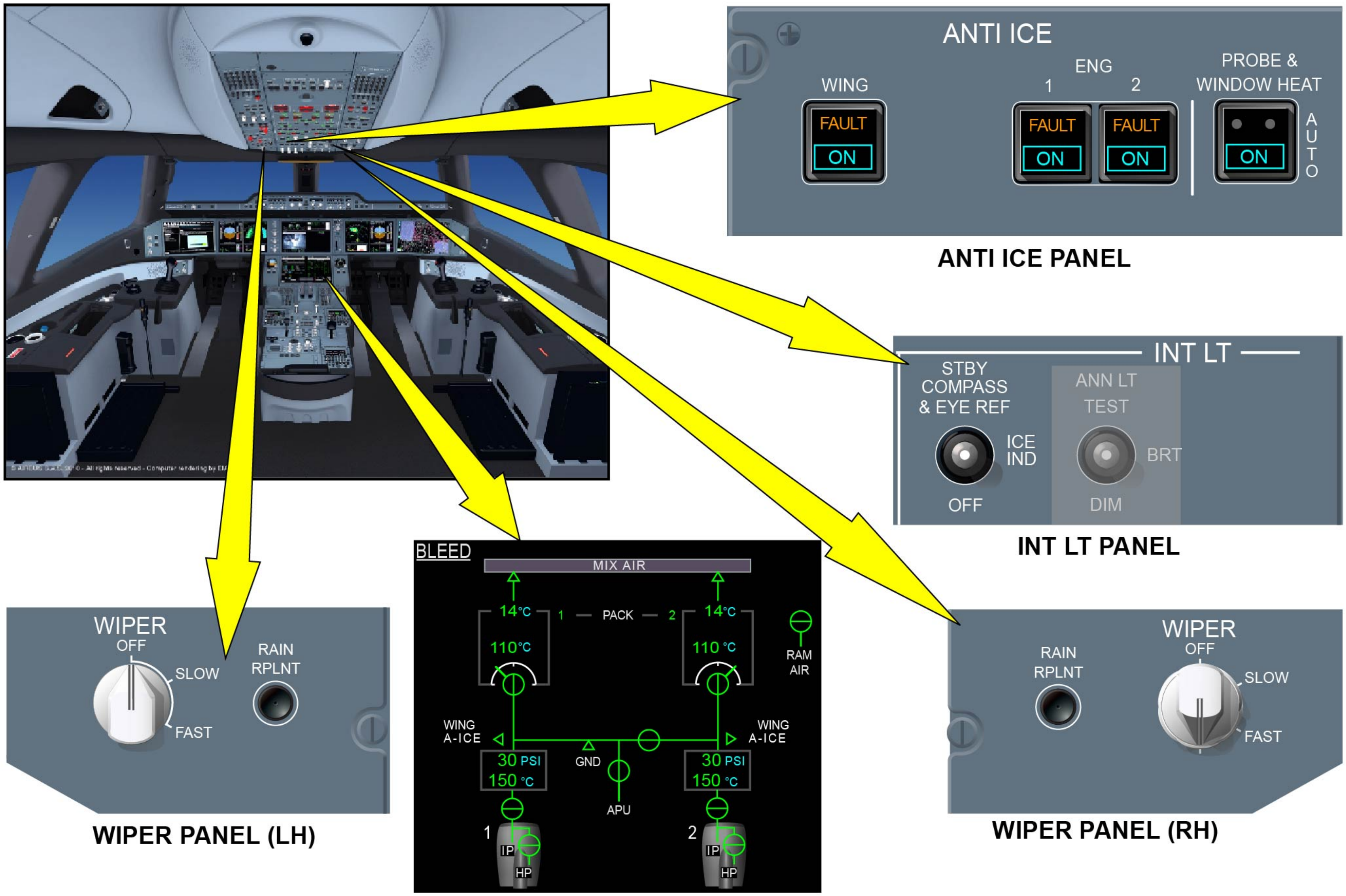
Cockpit windshields, fixed windows and probes are electrically heated.
Normal operation is automatic. Operation starts upon receipt of first engine running signal.
Manual control is available via the PROBE & WINDOW HEAT P/B SW.
The PROBE & WINDOW HEAT P/B SW will illuminate "ON" in blue.

Cockpit Windows Heating Fault (3)

In case of failure of the Cockpit Windows Heating system, corresponding warning message is triggered on WD and the FAULT amber light illuminates on the PROBE & WINDOW HEAT P/BSW.

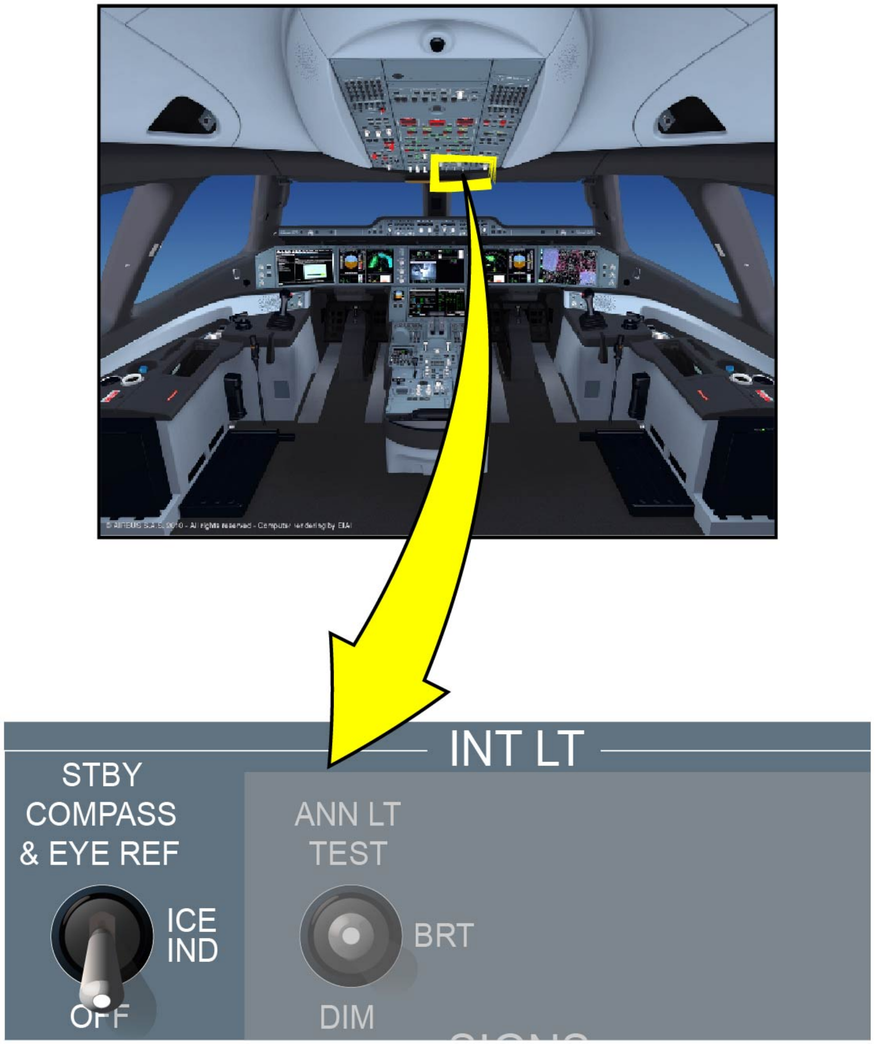
Rain Protection (2)

Two independent wiper systems (Captain and First Officer) controlled by independent rotary selectors.
Intermittent speed selections are optional.
The rain repellent system is inhibited with not engines running.
The rain repellent fluid level is shown on the lower RH side of the DOOR/OXY page.
Normal level is displayed "NORM" in green.
CAUTION:
DO NOT SPRAY RAIN REPELLENT ON A DRY WINDSHIELD.
DO NOT OPERATE THE WIPERS ON A DRY WINDSHIELD.

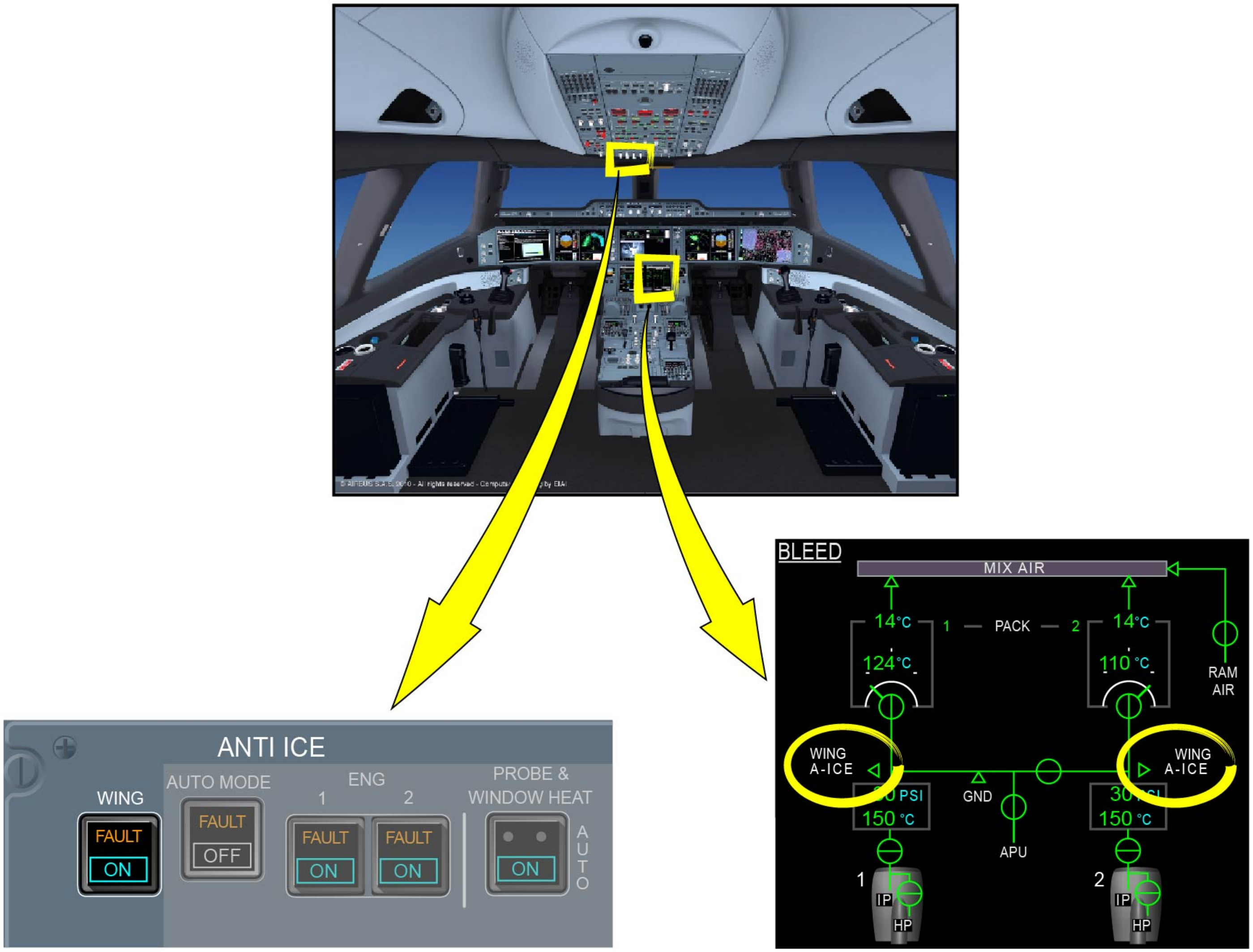


ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

V1813401 - V01T0M0 - VM30I1000003001



ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)



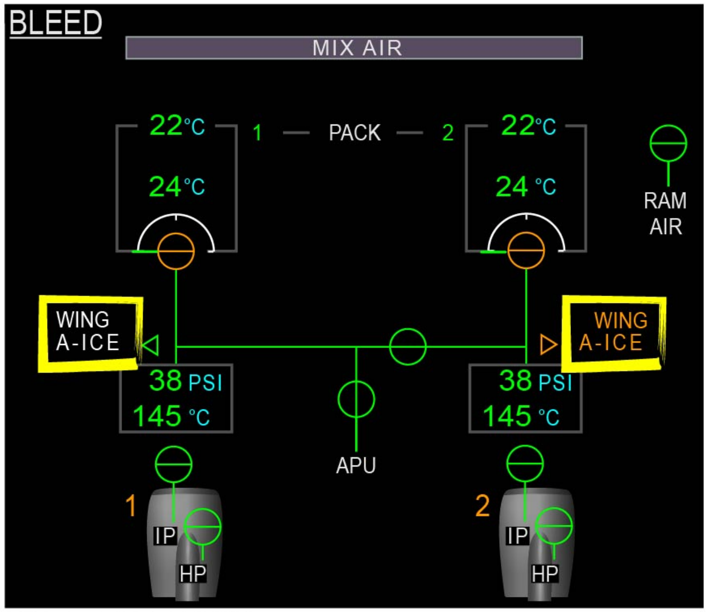
ANTI ICE PANEL

BLEED SD PAGE

ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

V1813401 - V01T0M0 - VM30I1000003001

This SD page shows all available indications but not a system configuration



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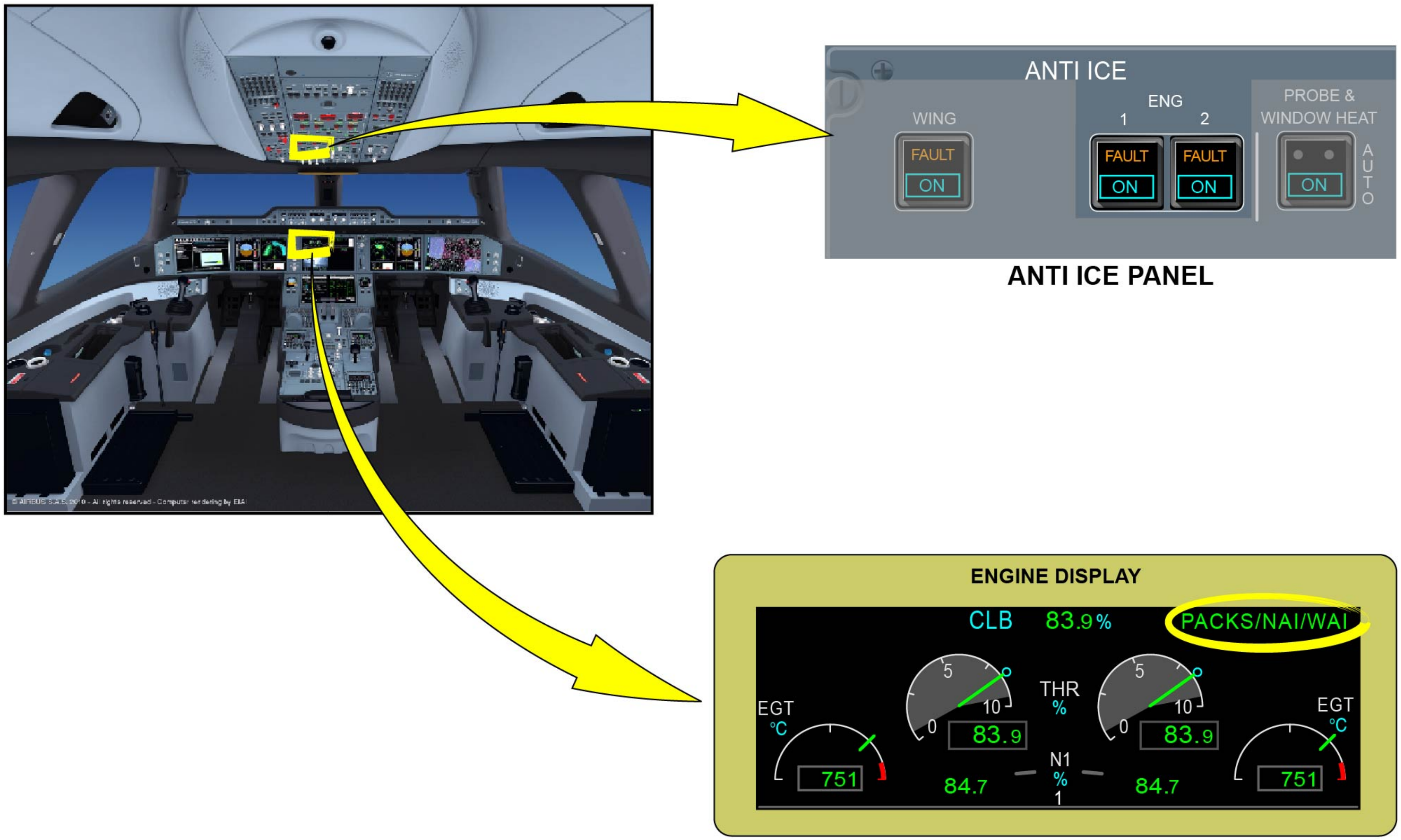
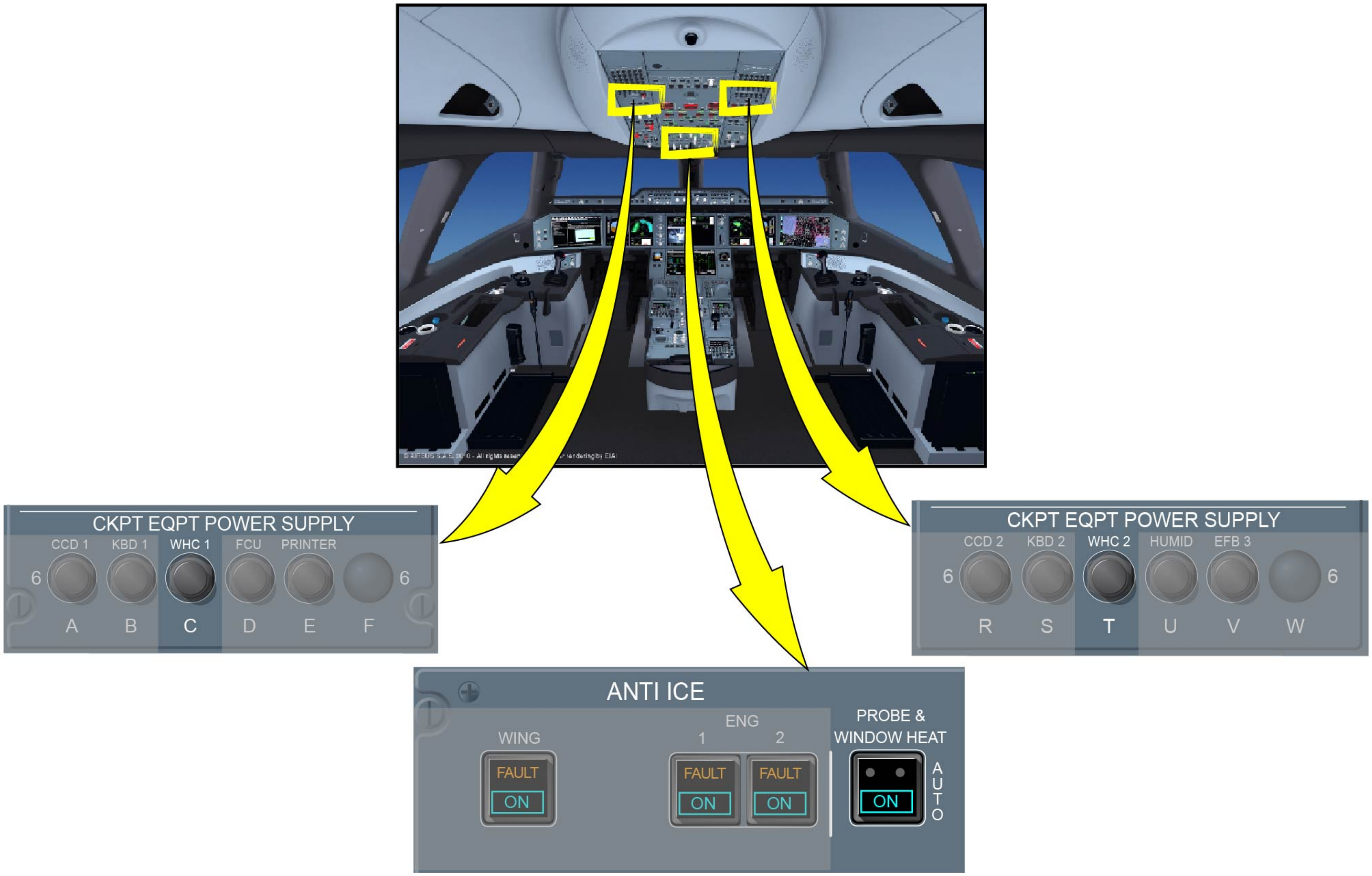
ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)



ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

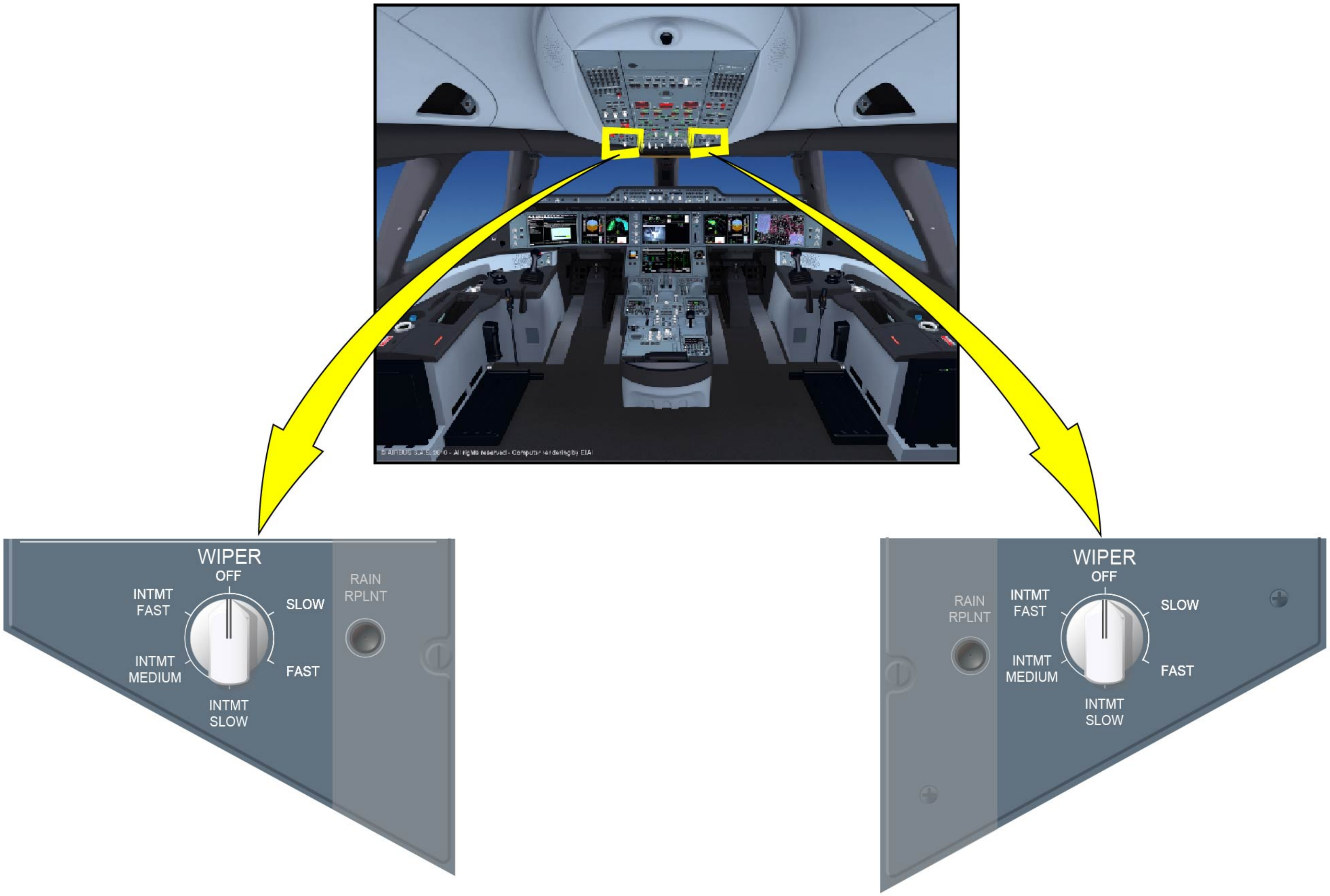
V1813401 - V01T0M0 - VM30I1000003001

ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

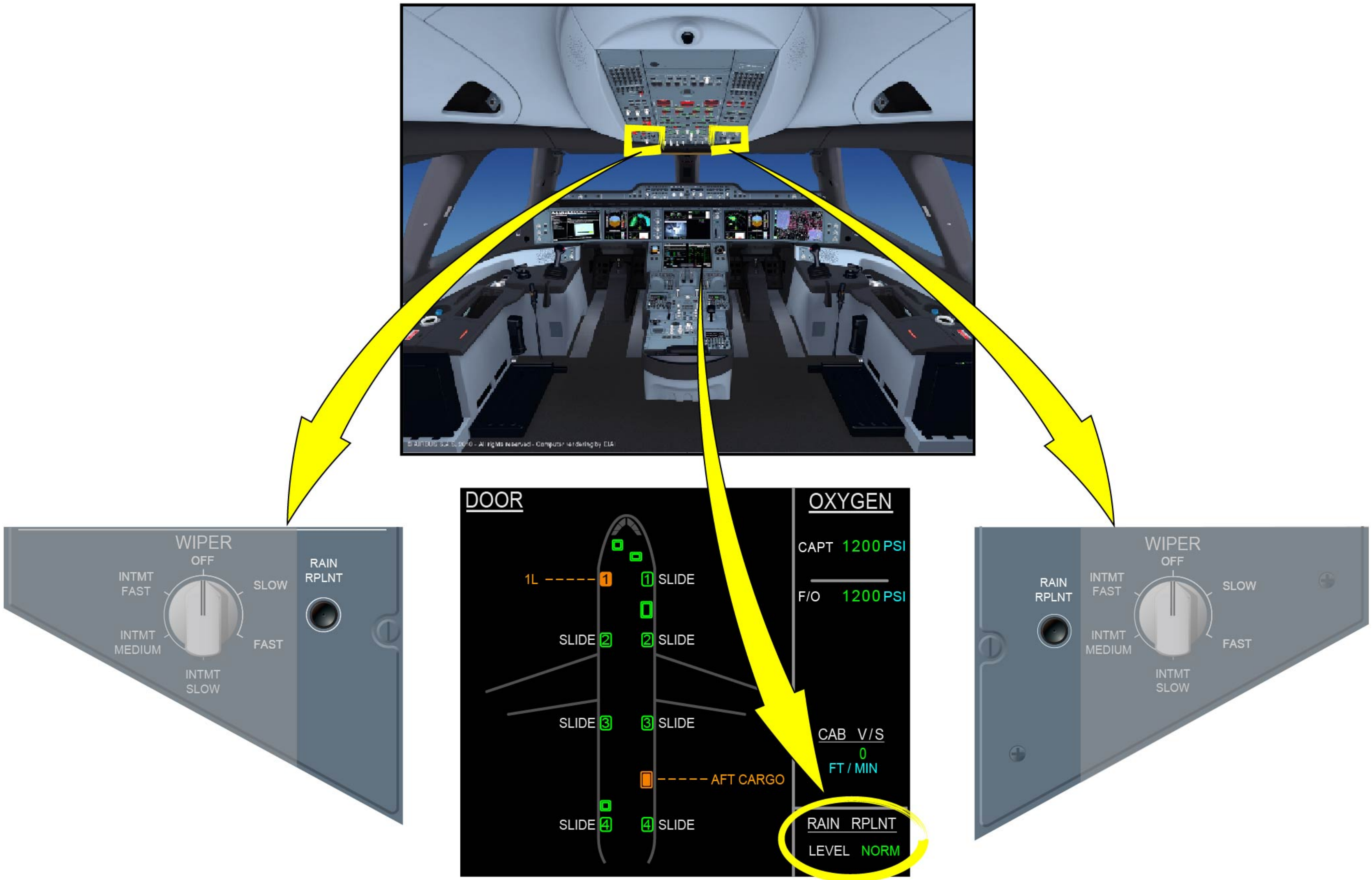


ANTI ICE PANEL

ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

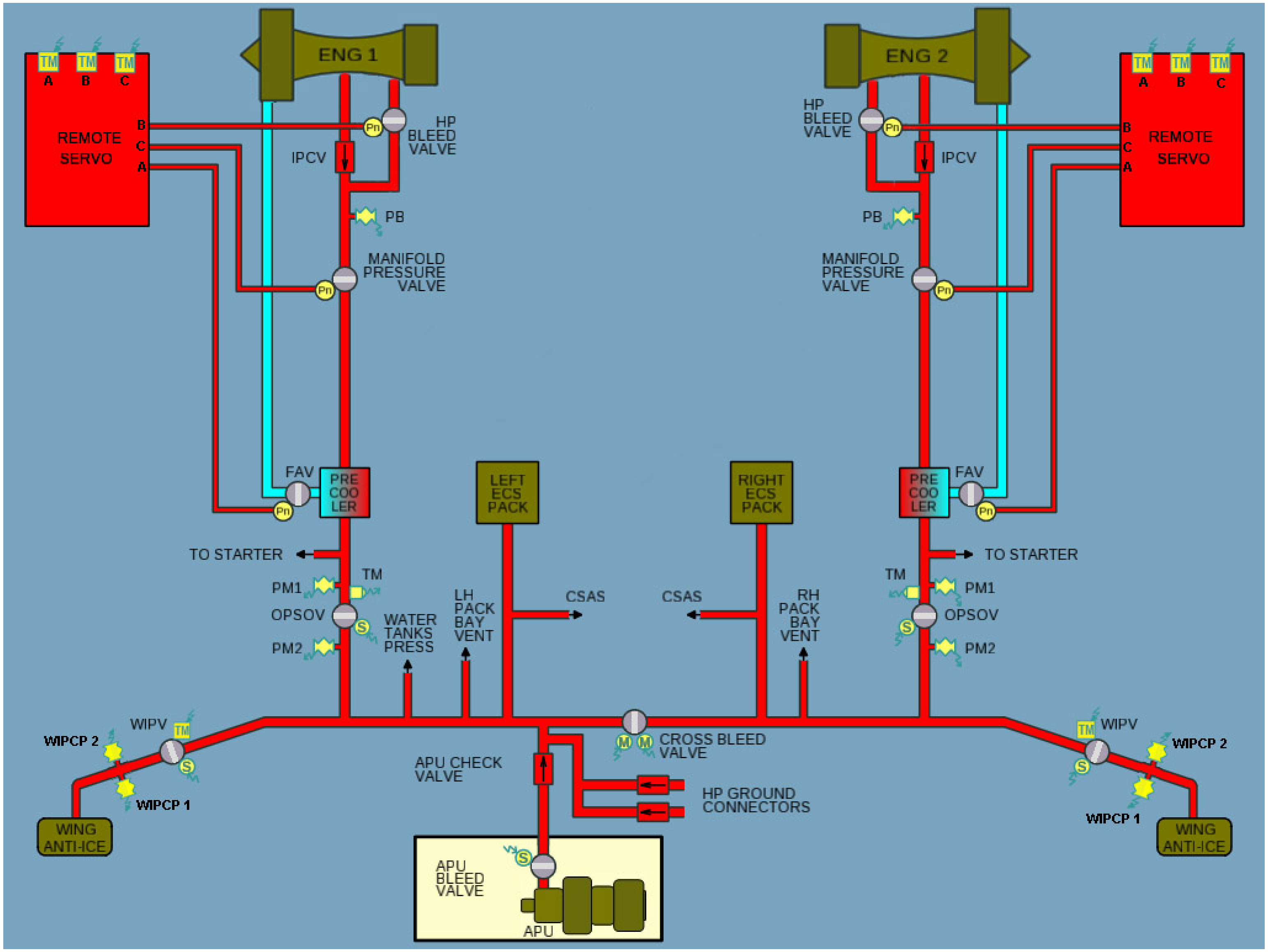


ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)



ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

V1813401 - V01T0M0 - VM30I1000003001



ICE AND RAIN PROTECTION - GENERAL (2) ... RAIN PROTECTION (2)

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