

Extended Diversion Time Operations Workshop



Alternate

Destination

ETP1

ETP2

Departure

Module 6 *Maintenance Considerations*



ICAO

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AIRBUS





Module 1
Course Introduction

Module 2
EDTO Foundation

Module 3
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Module 5
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Considerations

Module 6
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Considerations

Module 7
Continued Surveillance

Module 8
Implementing EDTO
Regulations

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Assessment

Module 10 – Wrap Up



At the end of this module, participants will understand the maintenance requirements supporting EDTO operations.

Doc 10085: Extended Diversion Time Operations (EDTO) Manual



Chapter 4: EDTO maintenance and reliability requirements

- 4.1 General
- 4.2 EDTO maintenance programme
- 4.3 EDTO maintenance procedures manual (EMPM)
- 4.4 EDTO configuration, maintenance and procedures (CMP) document
- 4.5 Aeroplane maintenance programme for EDTO
- 4.6 EDTO significant systems
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Doc 10085: Extended Diversion Time Operations (EDTO) Manual



Chapter 4: EDTO maintenance and reliability requirements

- 4.10 Reliability programme
- 4.11 Propulsion system monitoring
- 4.12 Verification programme
- 4.13 Dual maintenance limitations
- 4.14 Engine condition monitoring programme
- 4.15 Oil consumption monitoring programme
- 4.16 APU in-flight start monitoring programme
- 4.17 Control of the aeroplane's EDTO status: EDTO release statement
- 4.18 EDTO training



Part I —

EDTO Maintenance and Reliability Requirements

Part II —

Operator's EDTO maintenance Program

Part III —

Documentation and Training

Part IV —

Summary

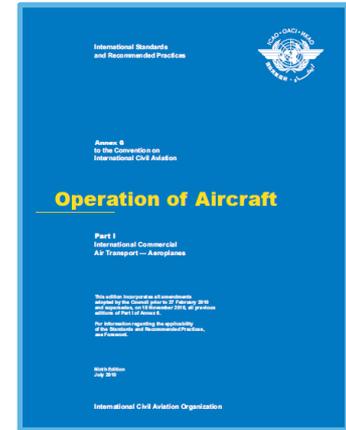
Part V —

Practical Exercise

Annex 6, Part 1 (4.7.2.6):

4.7.2.6 The State of the Operator shall, when approving maximum diversion times for **aeroplanes with two turbine engines**, ensure that the following are taken into account in providing the overall level of safety intended by the provisions of Annex 8:

- a) reliability of the propulsion system;
- b) airworthiness certification for EDTO of the aeroplane type;
- and
- c) **EDTO maintenance programme.**





EDTOM

Chapter 4 – Section 4.1.1

4.1.1.1 As explained in Section 2.1.5, there are **no additional EDTO airworthiness certification, maintenance procedures or maintenance programme requirements for aeroplanes with more than two engines.**

Although an operator may consider as good practice for its operations with aeroplanes with more than two engines some elements detailed in the following sections of this chapter, these are primarily intended for, and applicable to, **EDTO operations of twin-engine aeroplanes only.**



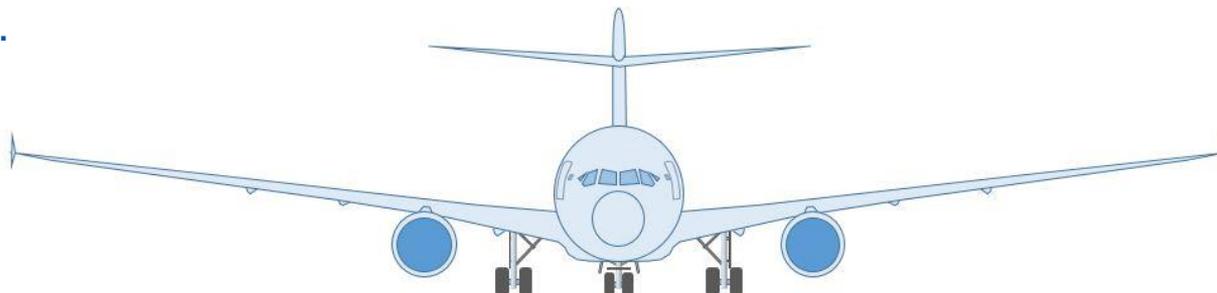
Accordingly the information and guidance in this Module 6 are primarily intended for and applicable to EDTO operations of twin-engine aeroplanes only



EDTOM Chapter 4 – Section 4.2.1

The term Operator’s “**EDTO maintenance programme**” means the **maintenance related elements** (maintenance tasks, organization manuals, procedures, etc.) that must be implemented by the operators to support their EDTO operations.

In this context, the **aeroplane’s maintenance programme for EDTO** is **one element** of the operator’s **EDTO maintenance programme**.





Question 6.1 :

The aeroplane's maintenance programme for EDTO is one element of the operator's EDTO maintenance programme. Which of the following is NOT part of the operator's EDTO maintenance programme.

- Oil consumption monitoring
- Dual maintenance limitations
- Parts control programme
- Mechanics licensing
- Reliability programme



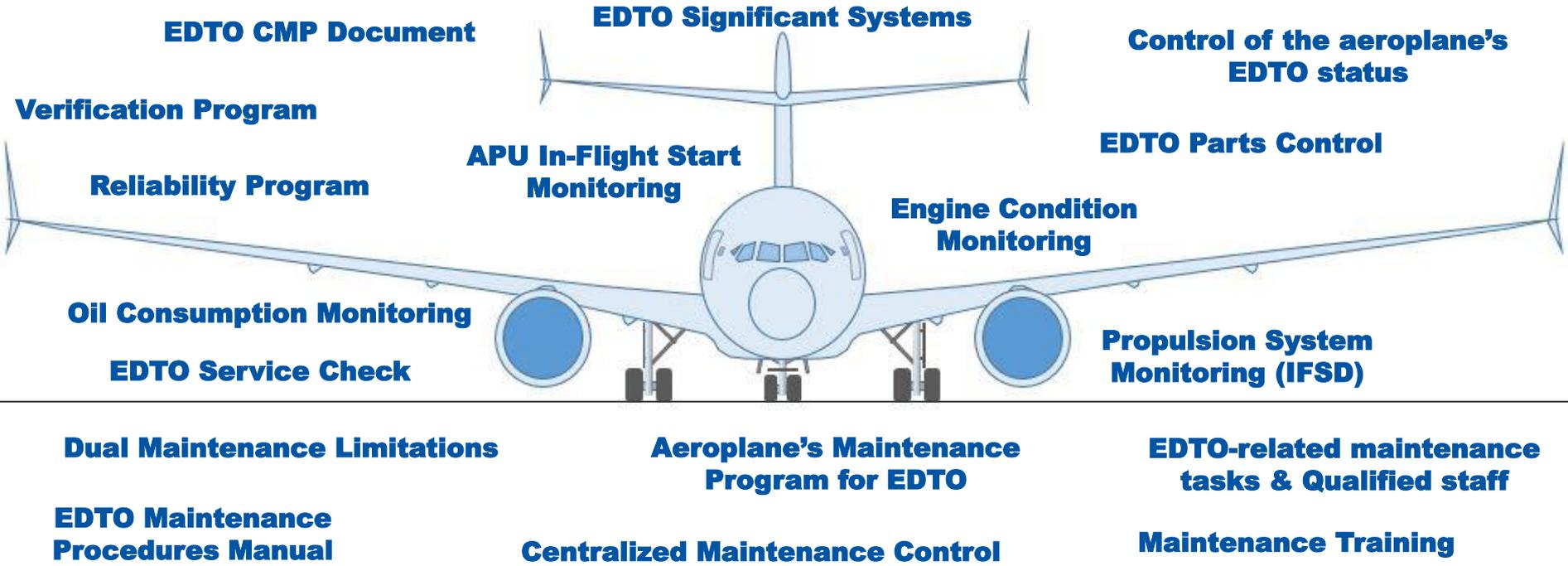


Part I —	EDTO Maintenance and Reliability Requirements
Part II —	Operator's EDTO maintenance Program
Part III —	Documentation and Training
Part IV —	Summary
Part V —	Practical Exercise

Operator's EDTO maintenance Program

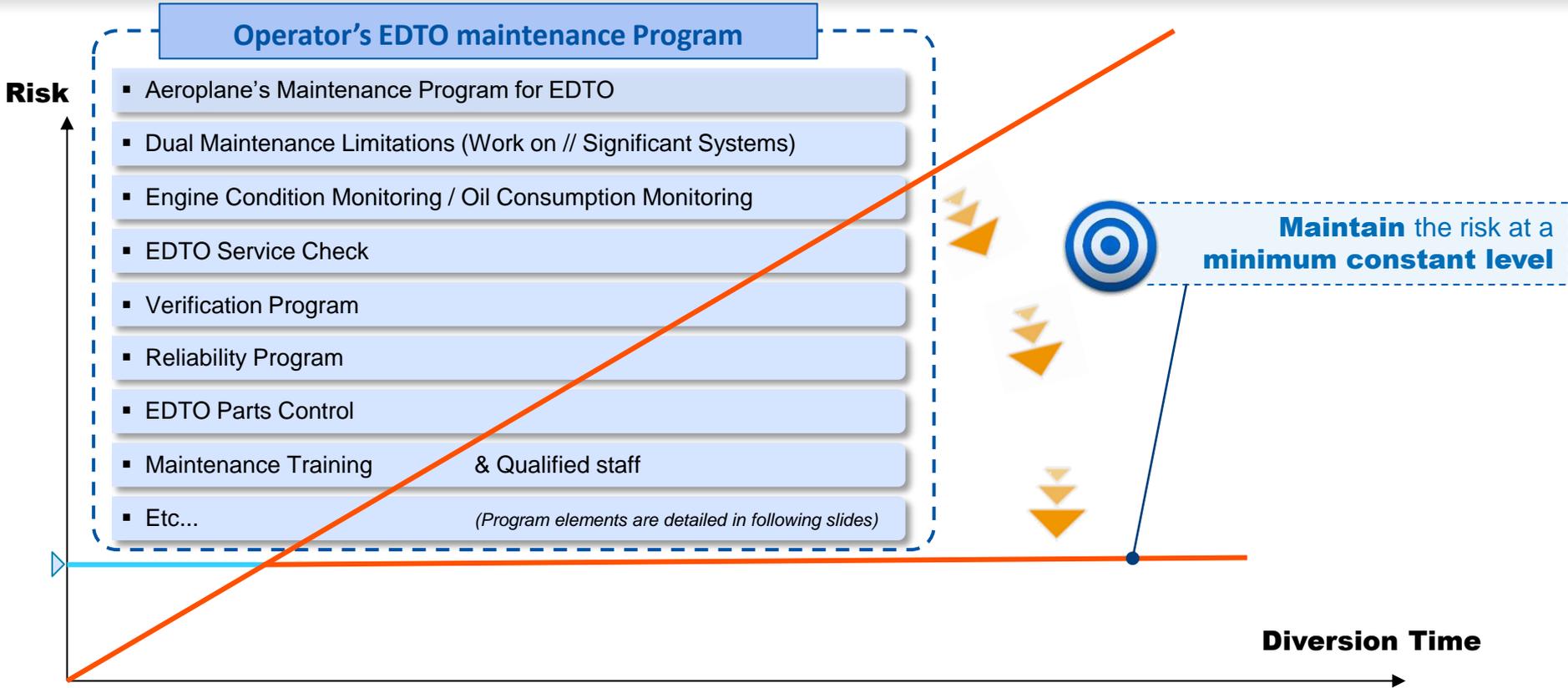
Elements of the program

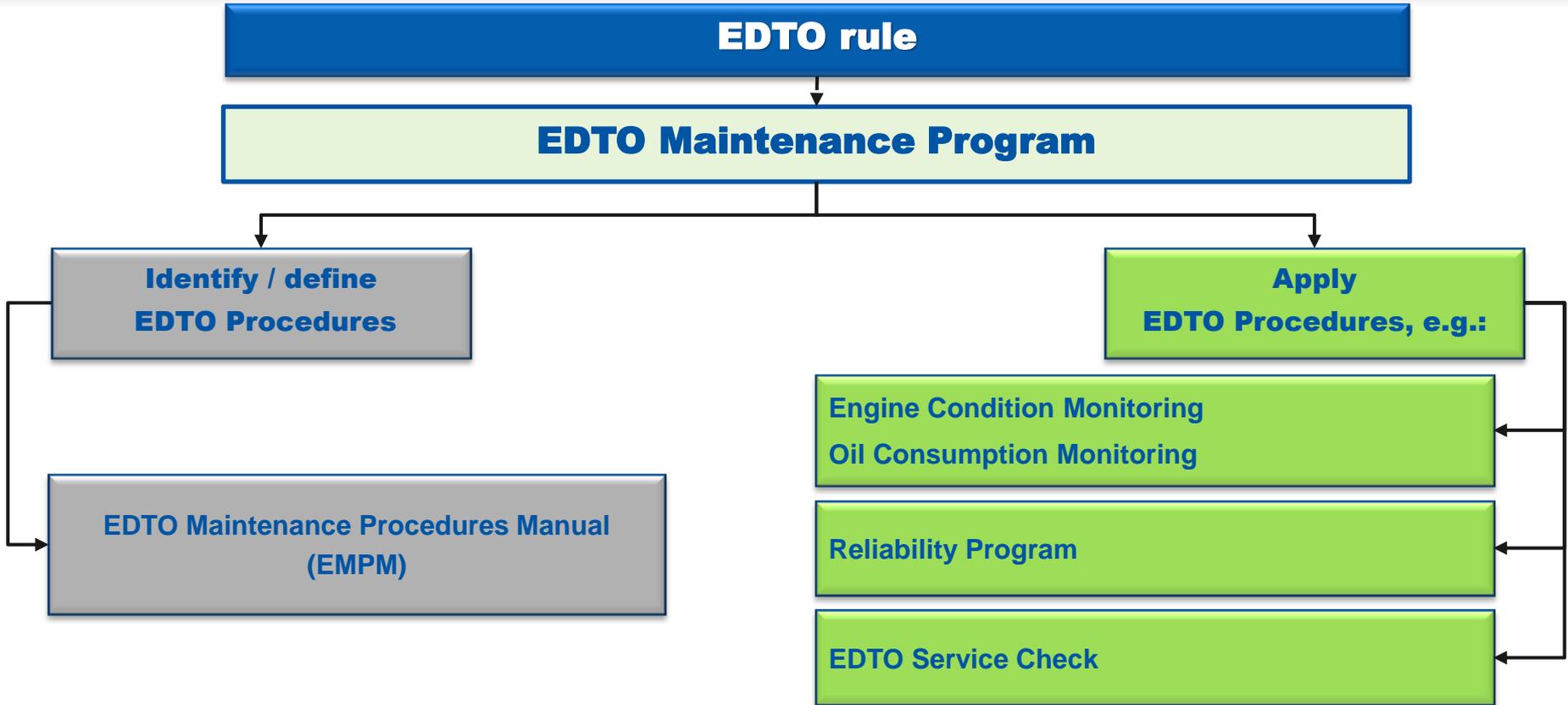
The **EDTO Maintenance Program** must identify the manufacturer's or operator's **Instructions for Continued Airworthiness (ICA)** for EDTO and be approved by the State of the operator in the frame of the EDTO operational approval. The program should contain and detail the following elements:



Operator's EDTO maintenance Program

Overall objective





The typical elements of an operator's EDTO maintenance programme are identified below :



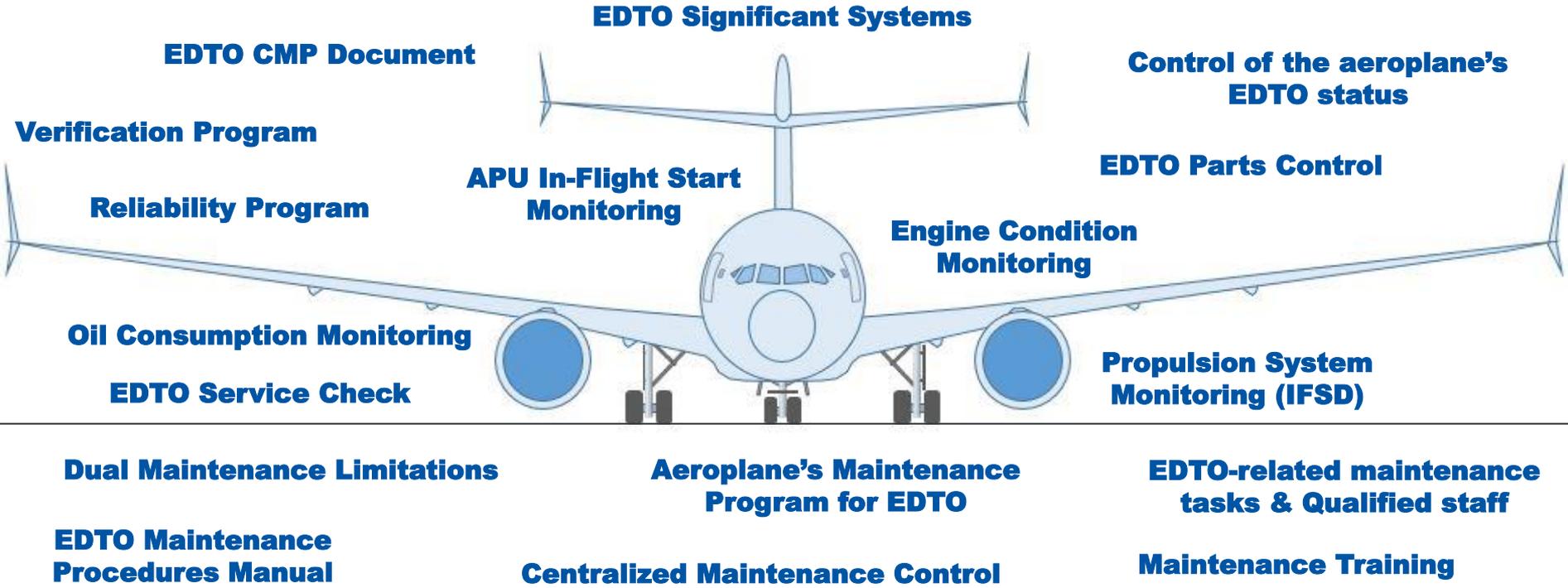
- EDTO maintenance procedures manual (see EDTOM §4.3)
- EDTO CMP document (see EDTOM § 4.4)
- Aeroplane maintenance programme for EDTO (see EDTOM § 4.5)
- EDTO significant systems (see EDTOM § 4.6)
- EDTO-related maintenance tasks/EDTO qualified staff (see EDTOM § 4.7)
- Parts control programme (see EDTOM § 4.8)
- EDTO service check (see EDTOM § 4.9)
- Reliability programme (see EDTOM § 4.10)
- Propulsion system monitoring (see EDTOM § 4.11)
- Verification programme (see EDTOM § 4.12)
- Dual maintenance limitations (see EDTOM § 4.13)
- Engine condition monitoring programme (see EDTOM § 4.14)
- Oil consumption monitoring programme (see EDTOM § 4.15)
- APU in-flight start monitoring programme (see EDTOM § 4.16)
- Control of the aeroplane's EDTO status: EDTO release statement (see EDTOM § 4.17)
- EDTO training (see EDTOM § 4.18).



Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :





Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :



EDTO Significant Systems



Both Aeroplane Manufacturers and Operators have to develop an EDTO Significant Systems List

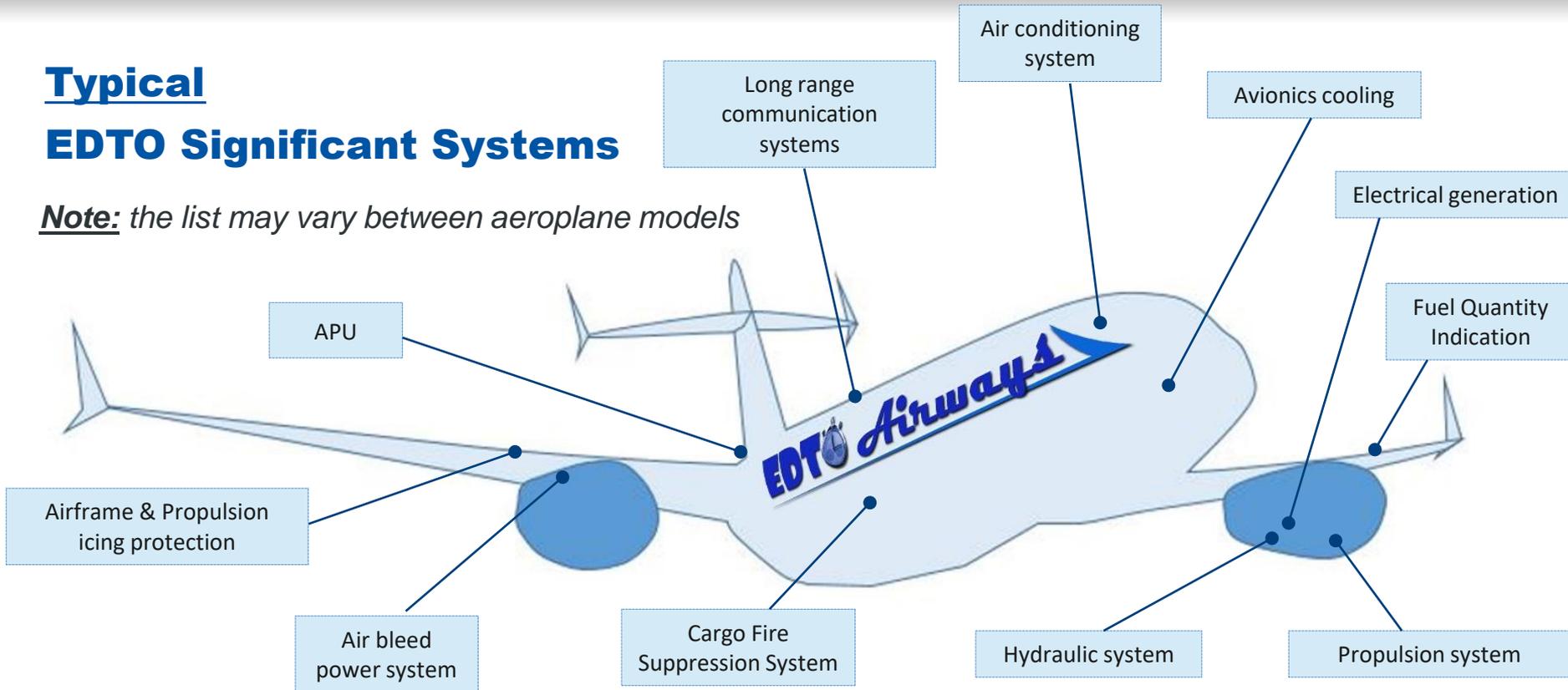
Recall : A system is identified as “**EDTO Significant**” when it has a unique influence for EDTO, i.e. it specifically participates to the EDTO philosophy : "Preclude and Protect the diversion“.

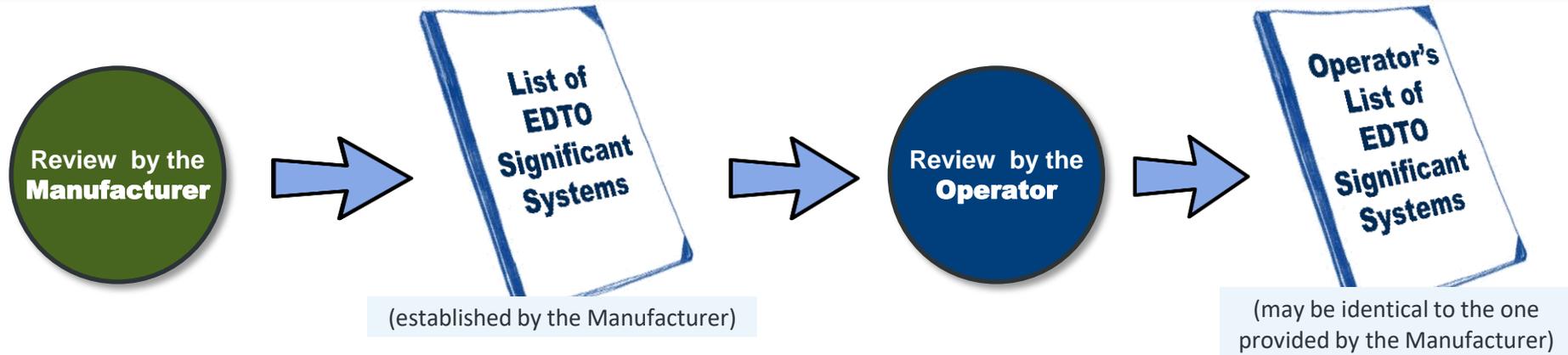
Accordingly, a EDTO Significant System is either:

- A system whose functional failure may **cause a diversion**, or
- A system which is specifically more important to **ensure a safe EDTO diversion and landing** for the contemplated maximum diversion time.

Typical EDTO Significant Systems

***Note:** the list may vary between aeroplane models*

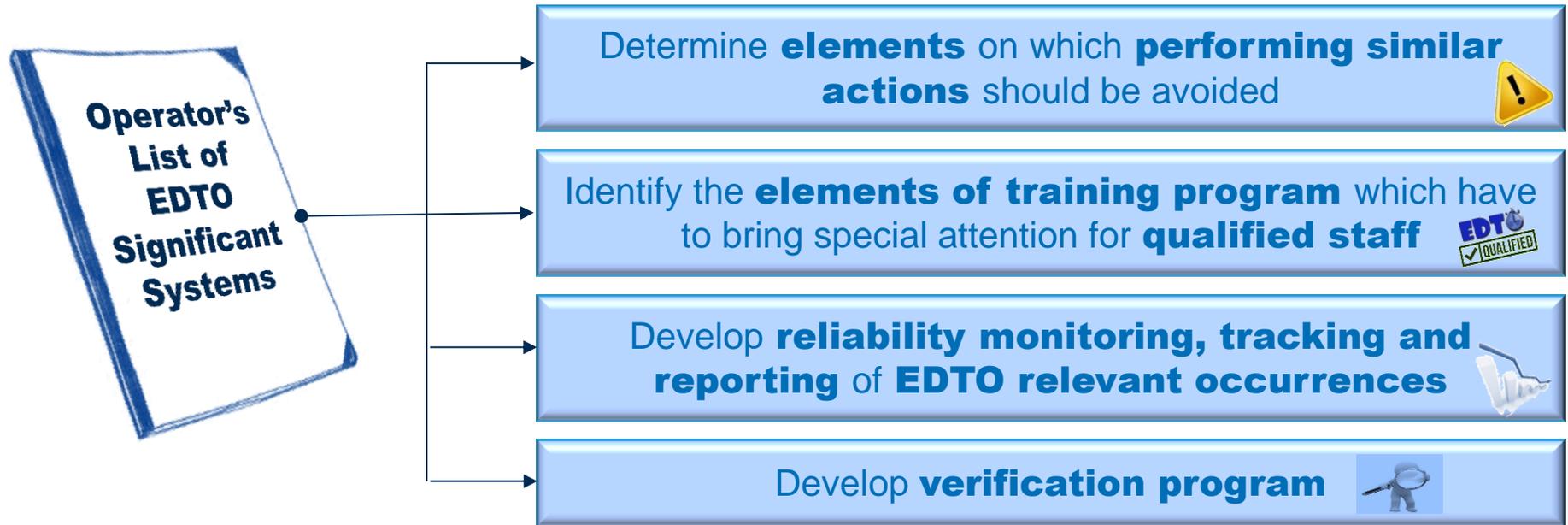




The list of EDTO Significant Systems is a fundamental element of the Operator's EDTO Maintenance Program, as the list is needed for establishing :

- The **Reliability monitoring and tracking** program, and the **reporting** of EDTO relevant events
- Most of the elements of the EDTO Maintenance Program (e.g. **Verification Program, Dual Maintenance Restrictions**, elements of **Training Program** which must bring special attention on **Qualified Maintenance Personnel, EDTO Service Check**, etc...) – *see next slide*

The list of EDTO Significant Systems is an input for the following elements of the EDTO Maintenance Program



Example of a list of EDTO Significant Systems: WonderPlanes WP-911 series

WonderPlanes

WP-911 series EDTO Significant Systems List

The following list defines the WP-911 systems / functions which are EDTO significant, as per the following criteria:
Note: The Group 1 & 2 classification is based on the definitions provided in CASA and FAA EDTO rules. This classification is necessary only for the aircraft manufacturer when conducting the EDTO reliability demonstration under the early EDTO method, i.e. as the means of accurate condition activities. This classification should have no impact on the Operator's procedures and policies for the consideration of EDTO Significant Systems. All Systems in the list below should be tracked as "EDTO Significant" in the Reliability Program and may be reported as "EDTO relevant" in case of failure.
 Systems marked as "dual" should be treated as "EDTO Parallel Systems" for dual maintenance. (Refer to enclosed Data Maintenance Matrix for additional guidelines)

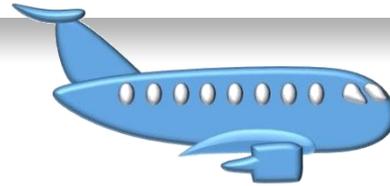
AIA Chapter	AIA Sect / Descr.	Group	EDTO Significant Functions of the selected system(s)	Rationale for selecting EDTO Significant Systems/Functions	Regulatory Reference EASA / FAA	Dual	Additional information on typical "EDTO Relevant" events to be reported
21 - Air Conditioning	21-26	2	Auxiliary Equipment Ventilation	Integrity of the auxiliary system during an EDTO diversion			Complete loss of auxiliary cooling
	21-21	2	WP-911 Pass. Cabin Air Distribution and Recirculation				
	21-22	2	WP-911-2000 ¹ Main Deck and Cockpit Ventilation				
	21-91	2	Cockpit Air Ventilation				
	21-91	2	Pressure Control and Monitoring	Minimize occurrence of depressurization which leads to an EDTO diversion as depressurized FL 0 has substantial impact on fuel consumption and exposure to more severe outside atmospheric conditions (icing)	AMC 20-6 Rev 2 Ch II.8.3 (a) / Ch II.8.3 (b) / AMC 20-6 Rev 1 §§ 8.3 and 8.3.c / FAR §K25.12		- Loss of pressurization - Loss of temperature control - Loss of ventilation - Loss of pack
	21-51	2	Flow Control and Indicating	Minimize occurrence of loss of cockpit and cabin or cabin area temperature and ventilation control during an EDTO diversion			
	21-52	2	Air Conditioning (Pack)				
22 - Auto Flight	22-53	2	Pack Control and Indicating				X
	21-63	2	Cockpit and Cabin Temperature Control				
	22-10	2	Autopilot	Autopilot is considered as important to maintain acceptable pilot workload over an EDTO diversion			
	22-30	2	Autobrake	Autobrake is considered as important to maintain acceptable pilot workload over an EDTO diversion			
	22-70	2	Flight Management System	FMS fuel prediction functions are considered more important for management of an EDTO flight (provide additional in flight fuel monitoring function) - Radio alt FMS functions used for diversion decision making (EDT, ECR, ...)	AMC 20-6 Rev 2 Ch II.7.5 and Ch II.7.7 / AMC 20-6 Rev 1 §§ 6.5 and 6.6 b / FAR §K25.12	X	Loss of systems / function
	22-81	2	Flight Control Limit (FCL)	See 22-70			
	22-82	2	Multipurpose Control and Display (MCDU)	See 22-70			
23 - Communication	23-11	2	HF System	One HF (voice) is required for all EDTO flights	AMC 20-6 Rev 2 Ch II.7.7 / AMC 20-6 Rev 1 § 6.7 / FAR §K25.12		Non recoverable total loss of long range voice communication in flight
	23-26	2	SATCOM System	One SATCOM (voice) is required for EDTO beyond 180 min	AMC 20-6 Rev 2 Ch II.2.2.3.11 / AMC 20-6 Rev 1 § 10.2.3.11 / FAR §K25.122		
	23-23	2	CDS (for A/C not fitted with SDD)	Spurious warning can cause diversion	AMC 20-6 Rev 2 Ch II.8.3 (a) / AMC 20-6 Rev 1 § 8.3 / FAR §K25.12		Failure of spurious/ false detection (except false engine, spurious warning)

Operators are required to identify systems that are significant to their EDTO operations.

- Manufacturers may usually provide guidance on EDTO Significant Systems for operator use.
- In most cases, the list from the Operator is identical to that of the Manufacturer
- It is not expected that items from the list of the Manufacturer are removed

The list from the Operator is approved or validated by the local authority and included in the **EDTO Maintenance Procedures Manual**.

24 - Electrical Power	24-21	1	AC Main Generation	1	AC Main generation function(s)	The 2 IDGs and associated GCU, the APU Gen and associated GCU and the CSM/G constitute 4 independent electrical power sources for EDTO (including EDTO beyond 180 min)	X	Failure of IDG(s), APU Gen, CSM/G
	24-23	1	AC Auxiliary Generation	1	AC Auxiliary generation function		X	
	24-24	2	AC Emergency Generation	2	AC Emergency generation function		X	



Question 6.2 :

On the aeroplane above, the EDTO dispatch with APU inoperative is allowed for 10 days as per the MMEL. Furthermore, there is no configuration or maintenance standards related to the APU in its EDTO CMP document, nor any APU related P/N that are not approved for EDTO in the EDTO Parts List. Is it correct to say that the APU may therefore be removed from the EDTO Significant System list of this aeroplane?

- Yes
- No





Operator's EDTO maintenance Program

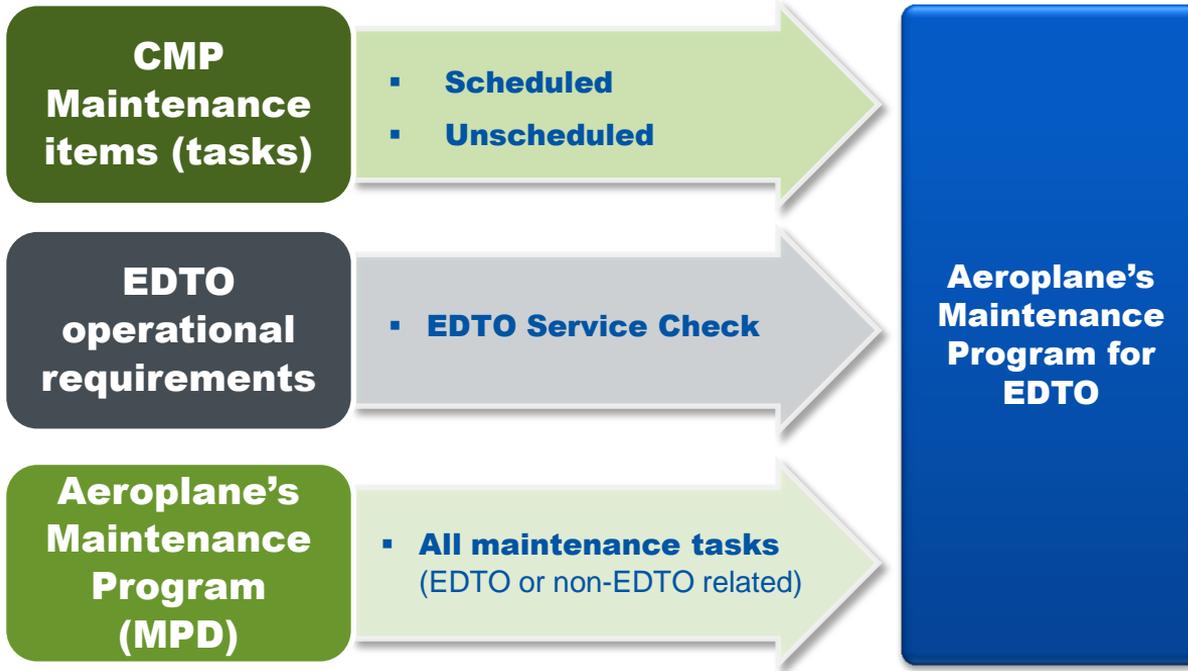
Review of program's elements

Review of the elements of the EDTO maintenance Program :





Elements of the Aeroplane's maintenance program for EDTO :



The aeroplane should be maintained in accordance with the **aeroplane's maintenance program for EDTO** as long as it is operated on EDTO flights.

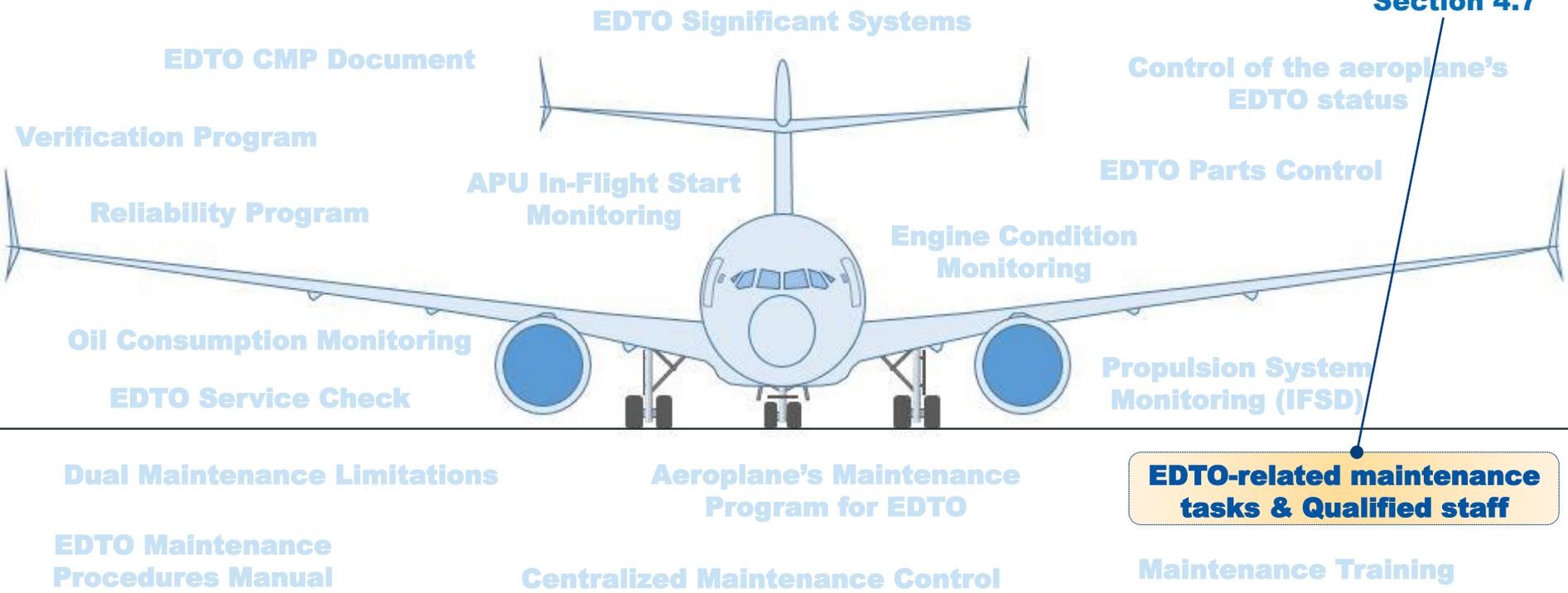
- It is not mandatory to comply with the aeroplane's maintenance program for EDTO while the aircraft is not operated on EDTO.
- However, compliance with the aeroplane's maintenance program for EDTO becomes mandatory as soon as the EDTO operations are resumed

Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

 **EDTOM**
Section 4.7



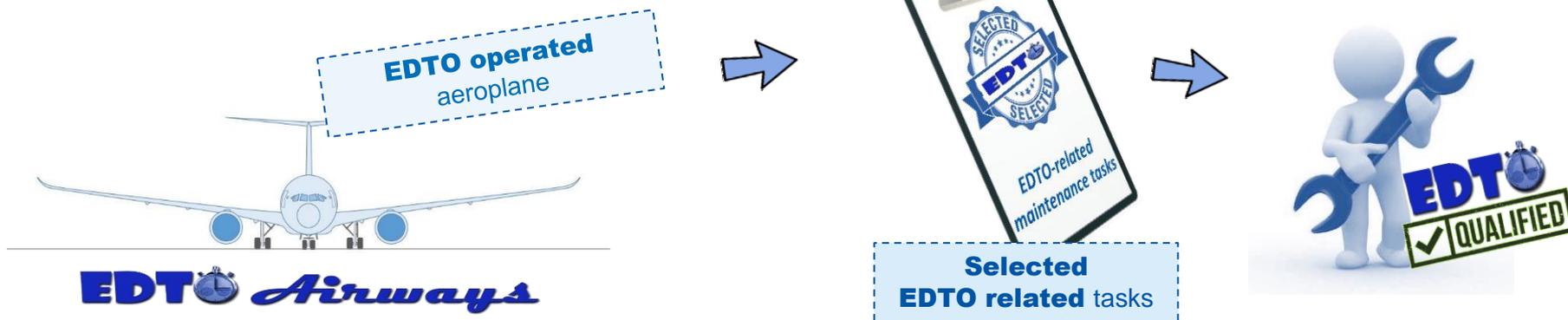
Criteria for EDTO qualification :

- An **EDTO qualified staff** is a person who has received an **EDTO training**
- **Criteria to be met** for being rated as an EDTO qualified staff, as well as for the currency of such qualification, should be detailed in the EDTO Maintenance Procedures Manual (**EMPM**)
- Selected EDTO related maintenance tasks should be accomplished by an **EDTO qualified staff**
- **Purpose** : promote EDTO awareness by ensuring only EDTO qualified maintenance personnel accomplish **selected EDTO related tasks**



Identification of EDTO-related maintenance tasks :

- The maintenance tasks related to EDTO are typically tasks impacting EDTO significant system(s)
 - Note: Tasks or sub-tasks which are not impacting any EDTO significant system(s) should not be considered as EDTO-related tasks even tasks supporting the overall verification process.
- The operator should select from the list of **EDTO-related tasks** those tasks which must be accomplished by **EDTO qualified staff**.



Identification of EDTO-related maintenance tasks :



- The **selected EDTO-related tasks** should be identified on the routine work / task cards, parceled together and identified as an **EDTO package**
- It is not mandatory for the Operator to identify EDTO related tasks in their maintenance program. If the Operator choose to **NOT** identify the EDTO related tasks, then **ALL** tasks should be accomplished by EDTO qualified maintenance personnel.
- The selected EDTO-related tasks should be retained for their **EDTO relevance** and could include the installation, testing and/or servicing of airframe and propulsion systems identified in the **EDTO significant systems list**
 - The filtering / selection process for identification of these selected EDTO-related tasks should be developed by the operator
 - *See next slide for an example of such filtering process*

More info on
NEXT
slide ! 



Question 6.3 :

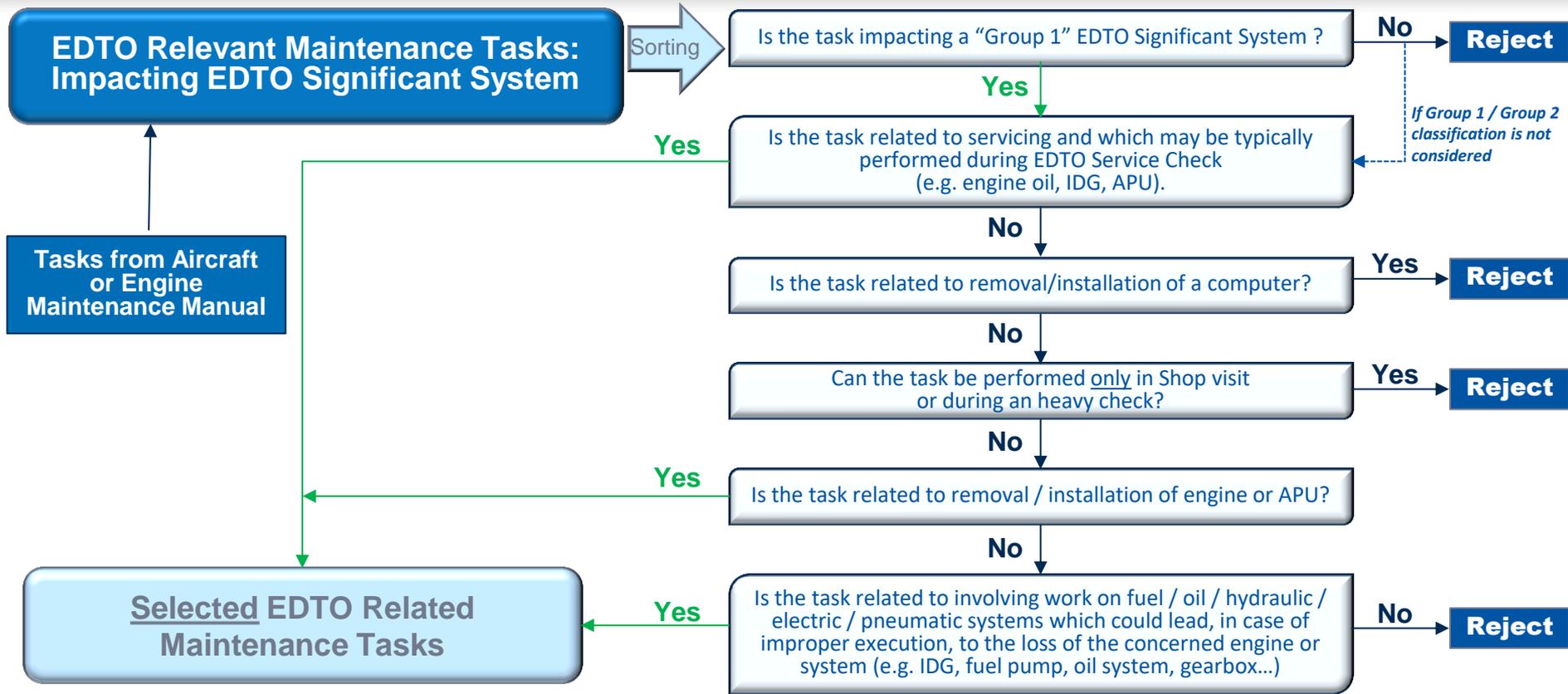
Out the following tasks, which should be identified as an EDTO-related task that must be accomplished by EDTO qualified staff ?

- Removal / installation of a computer identified as EDTO Significant
- Removal / installation of IDG
- Overhaul of the High Pressure Turbine module of the engine



EDTO-related maintenance tasks

Example of EDTO-related tasks selection process

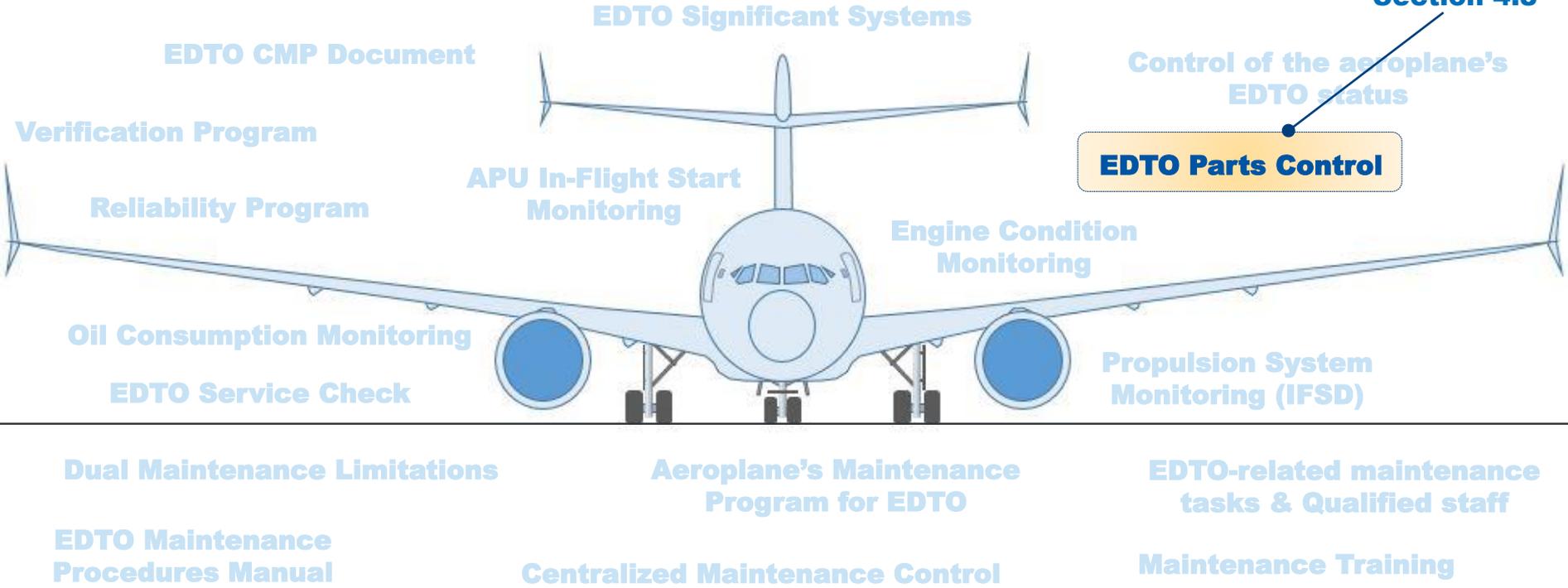




Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :



The required EDTO configuration of the aeroplane is defined by the applicable EDTO CMP Document :

CMP Configuration items

- Minimum Standard of system / component
- Additional system / component



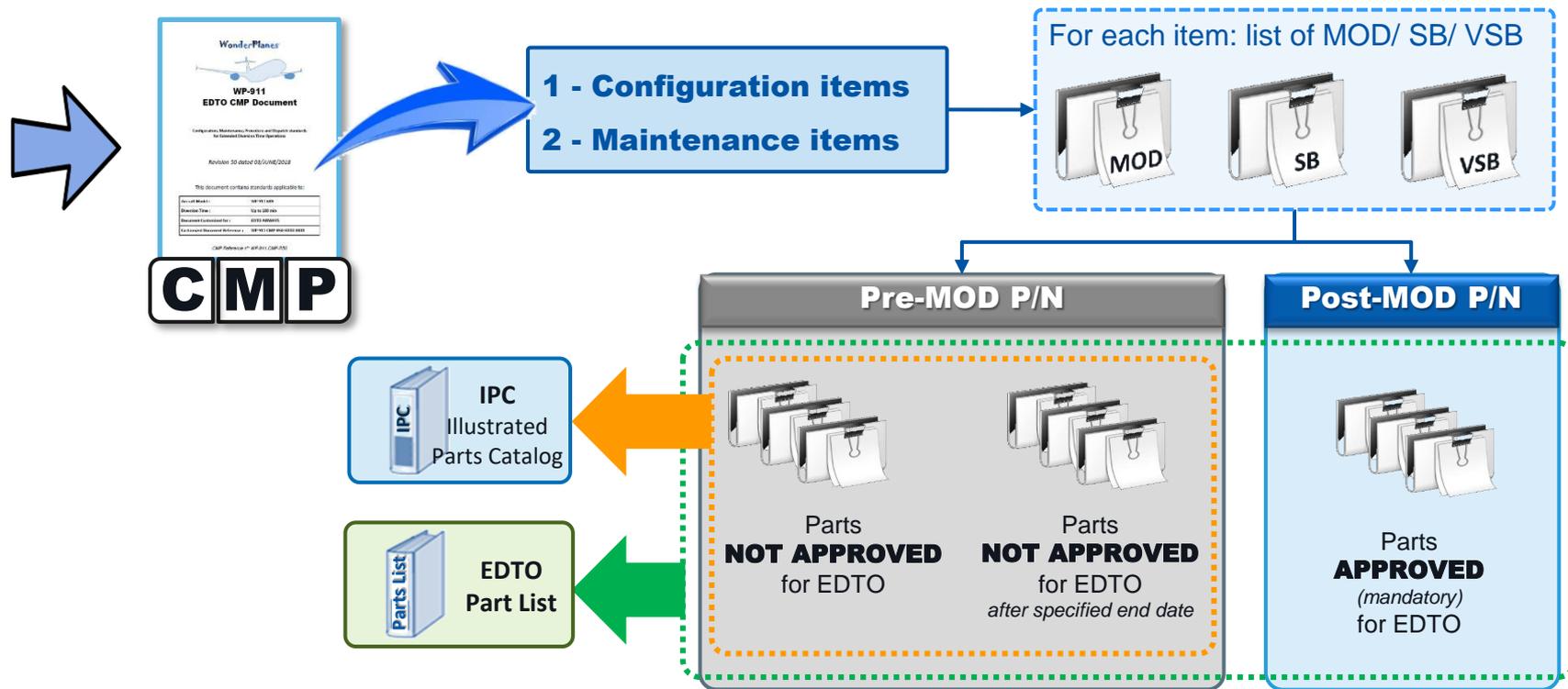
- **Recall** : the aeroplane must be **configured, maintained** and **operated** in accordance with the **EDTO CMP Document**, which means that the aeroplane should be configured as per the EDTO CMP standards as long as it is operated on EDTO flights.
- Accordingly a Parts Control program must be put in place before start of EDTO.

The purpose of the EDTO Parts Control Program is to ensure compliance with EDTO CMP configuration standards

- The EDTO Parts Control Program should ensure that:
 - **Parts approved** (*required*) **for EDTO** are obtained and used; and
 - **Parts not approved** (*authorized*) **for EDTO** are not used
- The EDTO Parts Control Program is therefore the mean to maintain the EDTO Type Design configuration, relying on:
 - EDTO CMP document instructions
 - EDTO Parts List and Illustrated Parts Catalog (**IPC**)



EDTO CMP Document leads to updates of EDTO Parts List and IPC





ATA 36	WonderPlanes	WP911 / WP911SP+ Series - EDTO PARTS LIST	CMP Ref: WP-911-CMP-R51	CMP revision 51
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CMP item	Subject	Aircraft applicability	Solutions (Mod, SB, VSB, ...)	P/N	Pre Mod P/N	Post Mod P/N	EDTO up to 180min	EDTO beyond 180min	Notes
36-1-0000-005	Pressure Transducer	All	Mod 202028 OR Mod 203309 SB 36-3043	GA55-49-12	X		OK	NAFE	
				ZRA1410030	X		OK	NAFE	
				ZRA1990030	X		OK	NAFE	
				APTE-182-30BARG		X	OK	NAFE	
				ZRA380-00		X	OK	NAFE	
				ZRA691-00		X	OK	OK	

P/N not approved for EDTO beyond 180 min

36-11-06-10-EQUIPEMENT INSTL Zone(s) : 453,463				
FIG - ITEM	PART NUMBER	NOMENCLATURE	FIN ACCESS/PANEL	UNIT PER ASSY
** ON A/C 001-002, 051-051				
***	ZRA380-00	.TRANSDUCER-PRESSURE SEE 36-11-16-01 001C FOR DET		
		NOT APPROVED FOR EDTO BEYOND 180 MIN		

EMB SB 36-3039 for A/C 003-008, 053-057, 501-511				
10B	070C	ZRA691-00	.TRANSDUCER-PRESSURE SEE 36-11-16-01 001D FOR DET Additional Spares	8HA1
			EMB SB 36-3039 (ON A/C 003-008, 053-057, 501-511) POST SB 36-3039 (ON A/C 101-102) (Ref. SIL 36-051)	001

No EDTO note → P/N approved for EDTO

The EDTO information in the Illustrated Parts Catalogue (IPC) should reflect the related restrictions or instructions from the EDTO CMP Document

- Accordingly, the **EDTO identifiers** related to a given P/N in the IPC may typically be :

- NOT APPROVED FOR EDTO
- NOT APPROVED FOR EDTO AFTER DD/MMM/YYYY
- NOT APPROVED FOR EDTO AFTER SB xx-xxxx (and/or MOD XXXX) IS INSTALLED

- All other parts in IPC **without** an EDTO identifier are considered to be **approved (or authorized) for EDTO**

36-11-06-10-EQUIPEMENT INSTL Zone(s) : 453,463				
FIG - ITEM	PART NUMBER	NOMENCLATURE	FIN ACCESS/PANEL	UNIT PER ASSY
** ON A/C 001-002, 051-051				
***	ZRA380-00	.TRANSDUCER-PRESSURE SEE 36-11-16-01.001C FOR DET		
		NOT APPROVED FOR EDTO BEYOND 180 MIN		

Assessment and provisioning of EDTO Parts

- Material Services Department should ensure that correct parts are available
- Borrowed or purchased parts should be cleared through the MCC or Material Services Department

The Assessment of

- EDTO MEL requirements
- CMP Document-Configuration Standards / Parts List
- Reliability Data
- Area of operation / Route structure

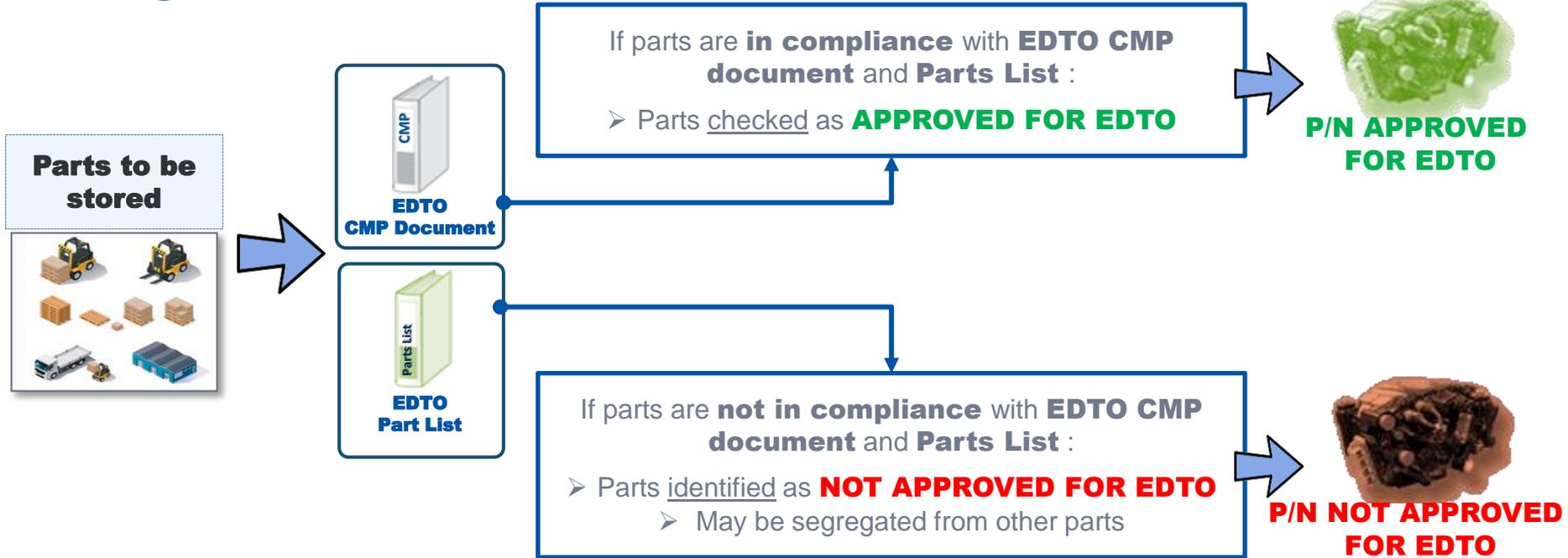


allows to define :

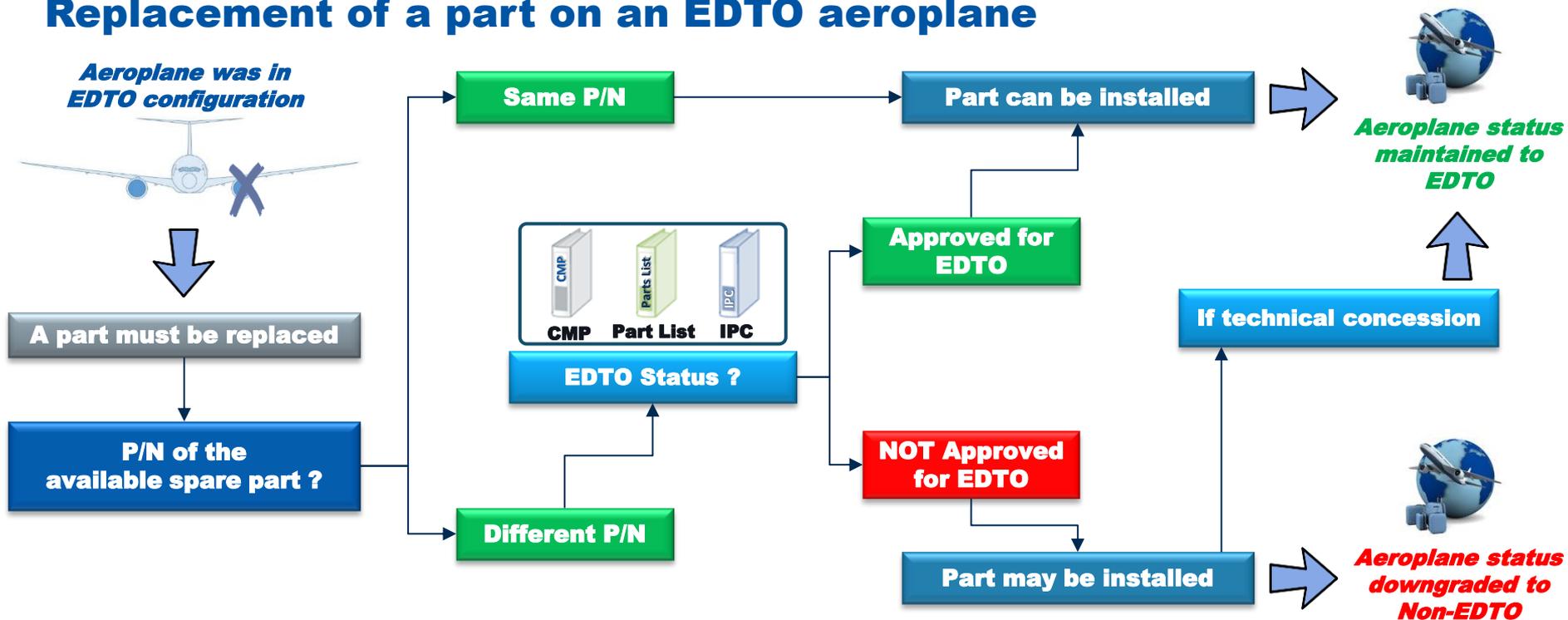
Provisioning of EDTO parts

- For **Main Base** and **Outstations**
- In **EDTO Flight Kit** if needed
(*dependent of type/area of operation*)

Storage of EDTO Parts



Replacement of a part on an EDTO aeroplane

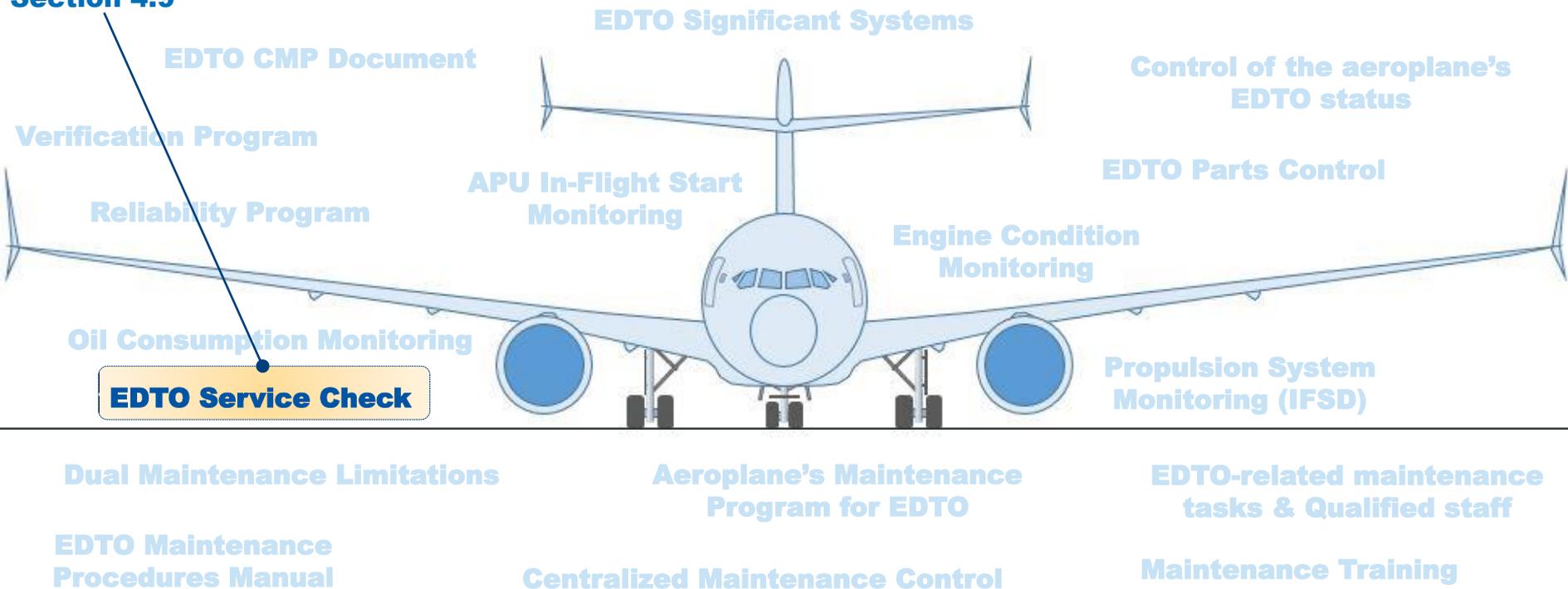


Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

EDTOM
Section 4.9

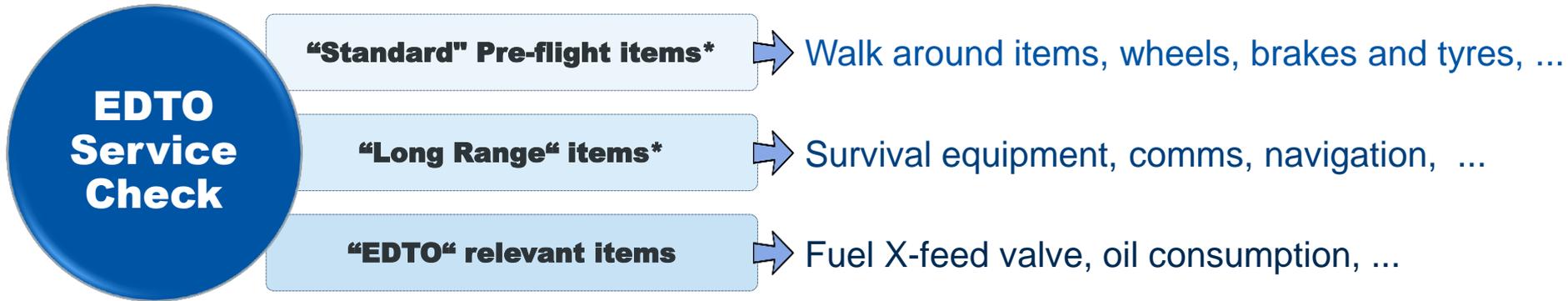




Objective: Verify the condition of the EDTO Significant Systems of the Aeroplane prior to the EDTO flight

➔ Identify / assess defects and confirm EDTO status of the Aeroplane

The EDTO Service Check is developed considering the following items:



**note: these items are usually part of the “basic” (non-EDTO) line checks*



Objective: Verify the condition of the EDTO Significant Systems of the Aeroplane prior to the EDTO flight

➔ Identify / assess defects and confirm EDTO status of the Aeroplane

Accordingly the EDTO Service Check typically consists of the following tasks / actions :

EDTO Service Check

Verification of the **condition** of EDTO Significant Systems through review of applicable **maintenance records** (Log Book)

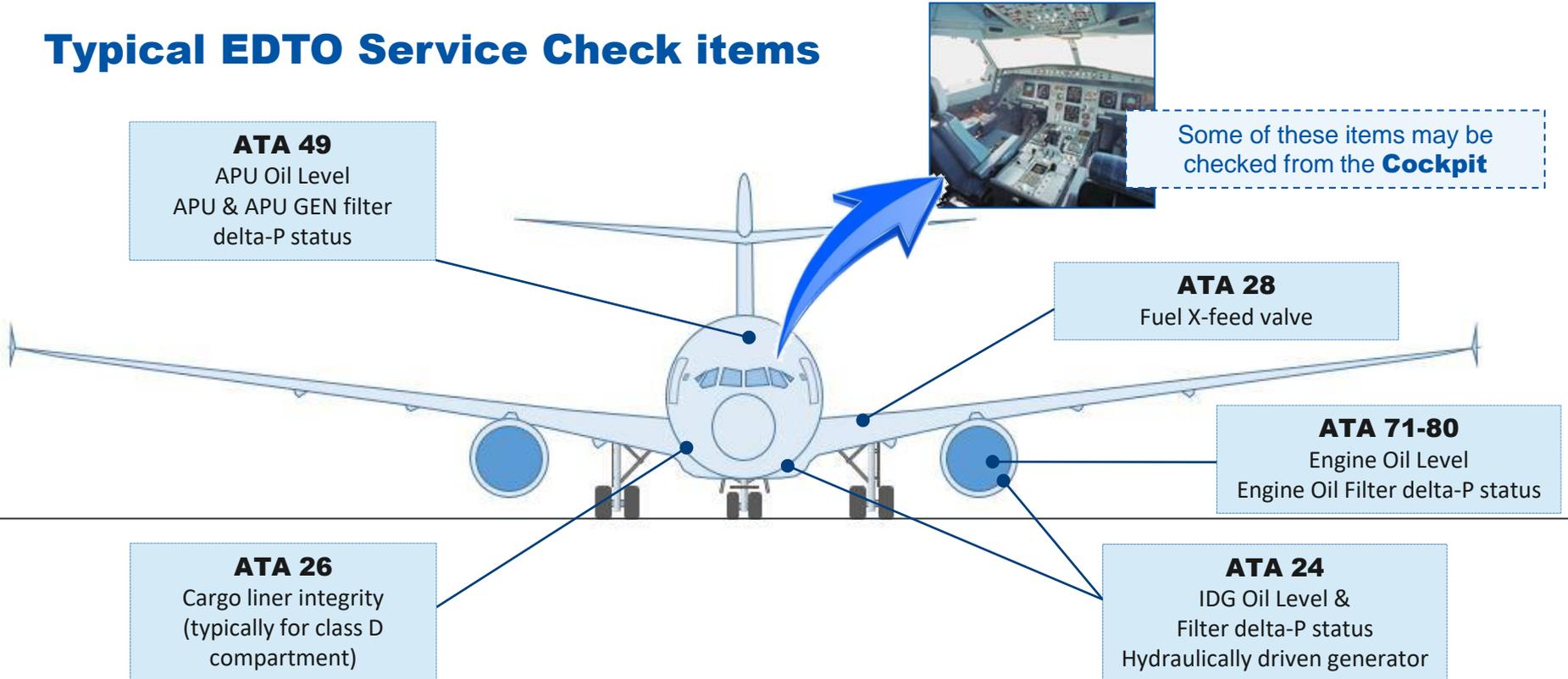
Inspecting the interior and exterior (as for non-EDTO flights)

Verifying the Engine and APU **oil level**, calculating & recording **rate**

Note : The EDTO Service Check should be signed-off by an EDTO Qualified Mechanic



Typical EDTO Service Check items





Acceptability of Cockpit checks* instead of visual (physical) checks

- Adequate consideration of the following factors make it possible to increase the number of legs and flight hours between physical checks :
 - The reliability of today's A/C systems and engines
 - The accuracy of the indicating system
 - The low level oil consumption

**Note : Cockpit checks could be performed by the Flight Crew, in coordination with MCC*

Example of implementation :

Main base (departure point) : physical checks

Intermediate point (transit) : cockpit based service checks

Destination (extended transit) : physical checks + cockpit check for APU parameters



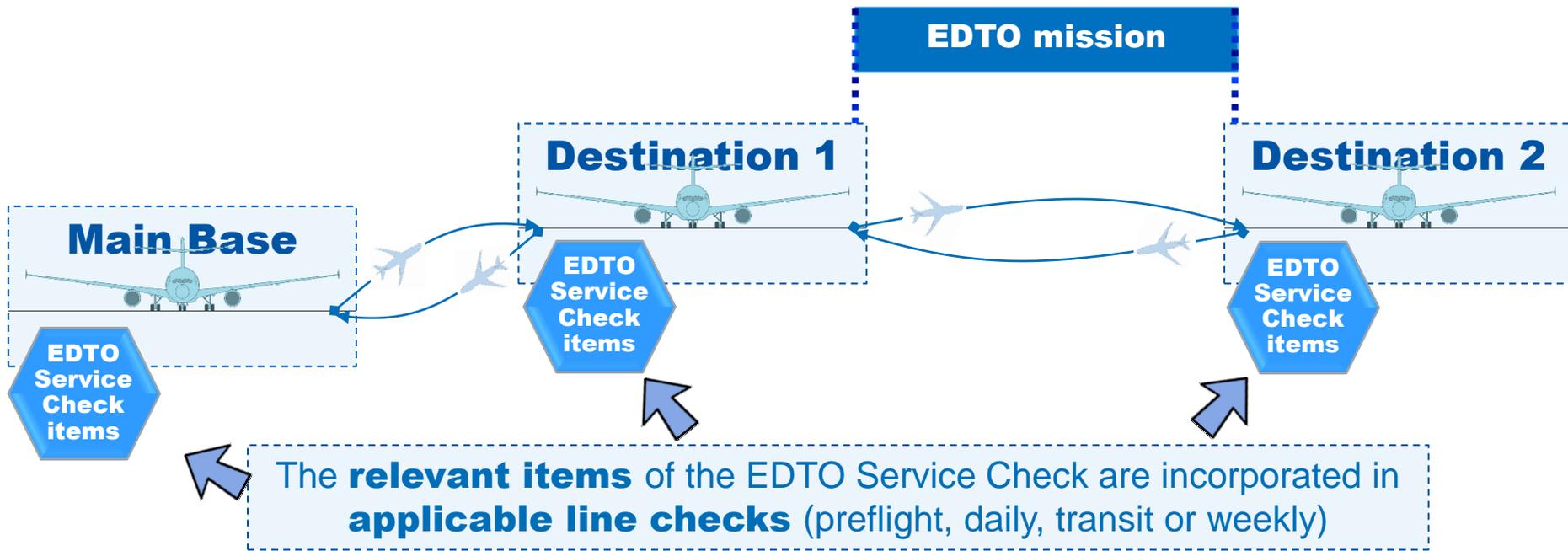
Basic implementation of EDTO Service Check

The same EDTO Service Check is performed before every flight



This approach of **single** EDTO pre-departure service checks may not be compatible with the flight program typically when the mission is a sequence of EDTO / non-EDTO legs.

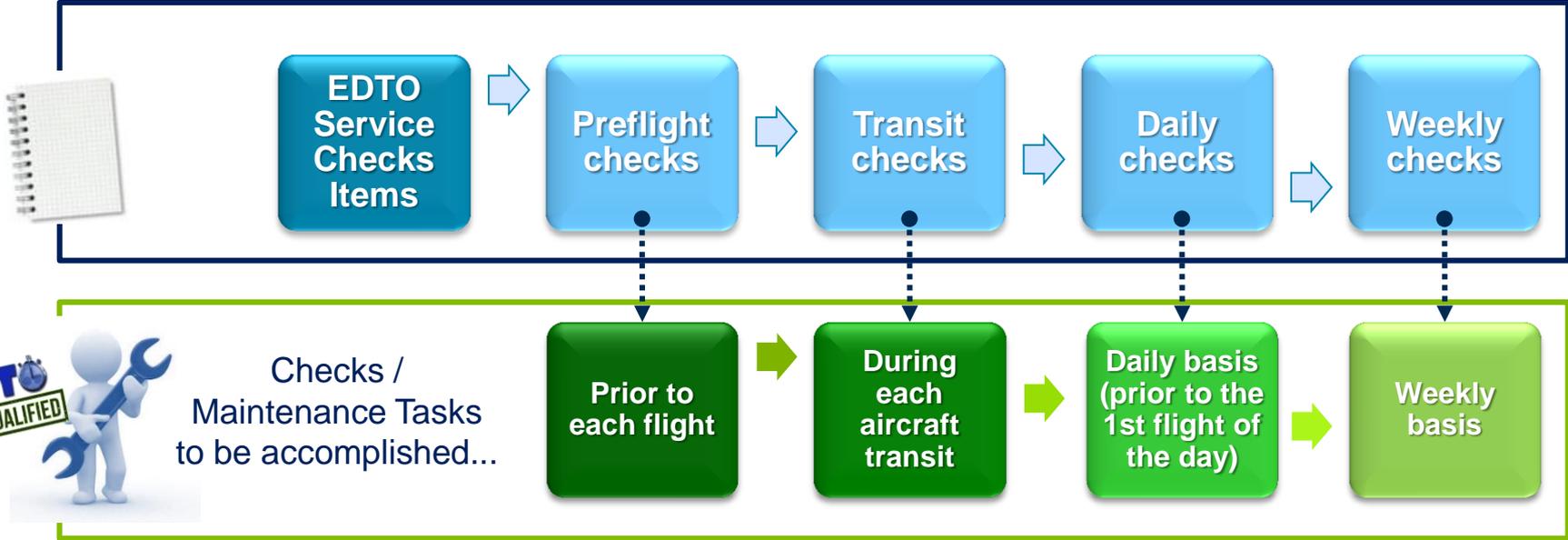
Alternative implementation of EDTO Service Check



EDTO Service Check policy

The regulation allows introducing the **EDTO Service Check items in the existing line checks**. In this case the single EDTO pre-departure service check is replaced by an **EDTO Service Check policy**

Operator's Maintenance Program

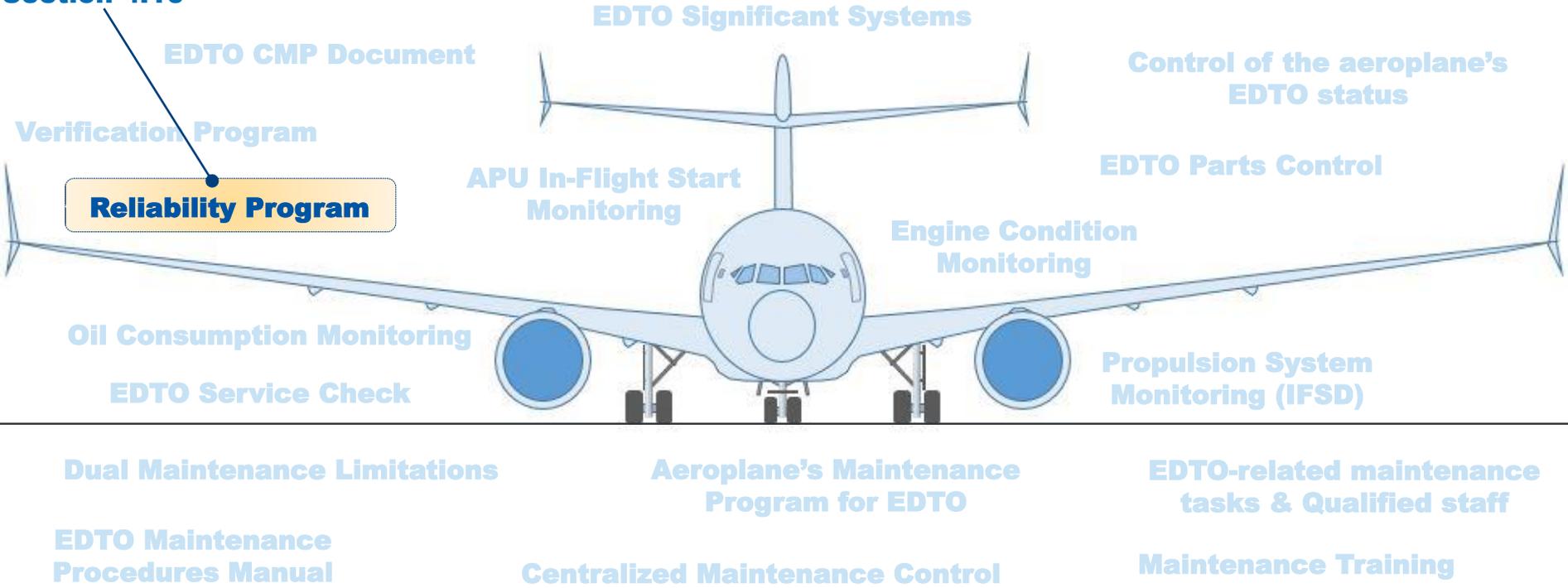


Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

EDTOM
Section 4.10



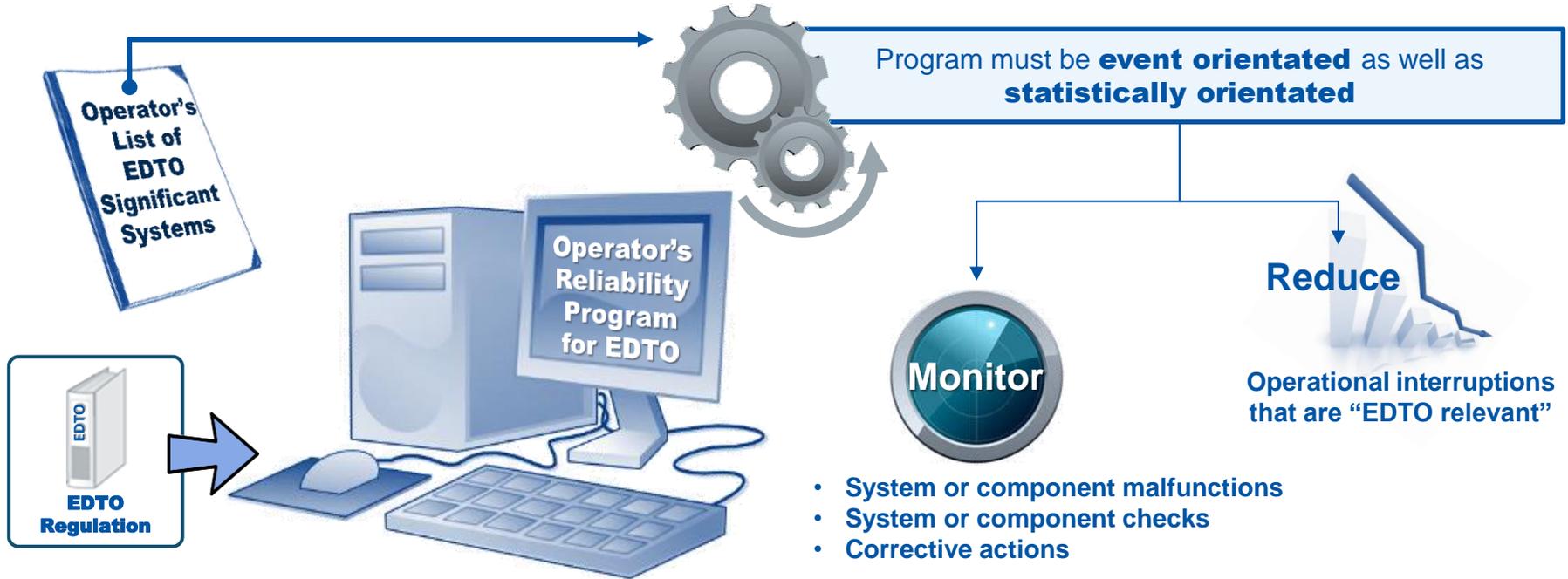


Question 6.4 :

What is the primary purpose of the Reliability Program for EDTO ?

- Allow early identification and prevention of EDTO related problems
- Ensure that the IFSD rate is not exceeded
- Monitor MTBF of EDTO Significant Systems
- Reduce operational interruptions that are “EDTO relevant”







The objective is to allow early identification and to prevent re-occurrence of EDTO related problems i.e. typically involving EDTO Significant Systems.



- The program should enhance the operational reliability and/or the Continuing Analysis and Surveillance System program already in place.
- The program must also be **event oriented**, as EDTO relevant events must be investigated reported:
 - EDTO relevant events must **be reported** to the State of the Operator within required time – typically 72 to 96 hours

EDTO reportable events typically include :



TECHNICAL LOGBOOK					
PILOT REMARK	ITEM	STATUS	ACTION	ACCOMP. BY	
15	15	OPEN CLOSED		SIGNATURE	
ITXG1 overheat actions disconnected			Aircraft dispatched per MEL	[Signature]	



- IFSD
- Diversions or In-flight turnbacks
- Un-commanded engine power changes or surges
- Inability to control engines or to obtain desired thrust
- Failures related to EDTO Significant Systems
- Any other events detrimental to safety of EDTO operations

Through its EDTO Reliability Program, the Operator should record and report EDTO flight statistics and incidents to its Authority



The EDTO incident report should typically include :

- General data : Date and Time of the event, Aeroplane registration and serial number, Flight number, departure, arrival, ...
- Failure description : ATA, warnings, flight phase...
- Corrective action taken : Maintenance actions carried out, ...

Additional Information that may also be provided :

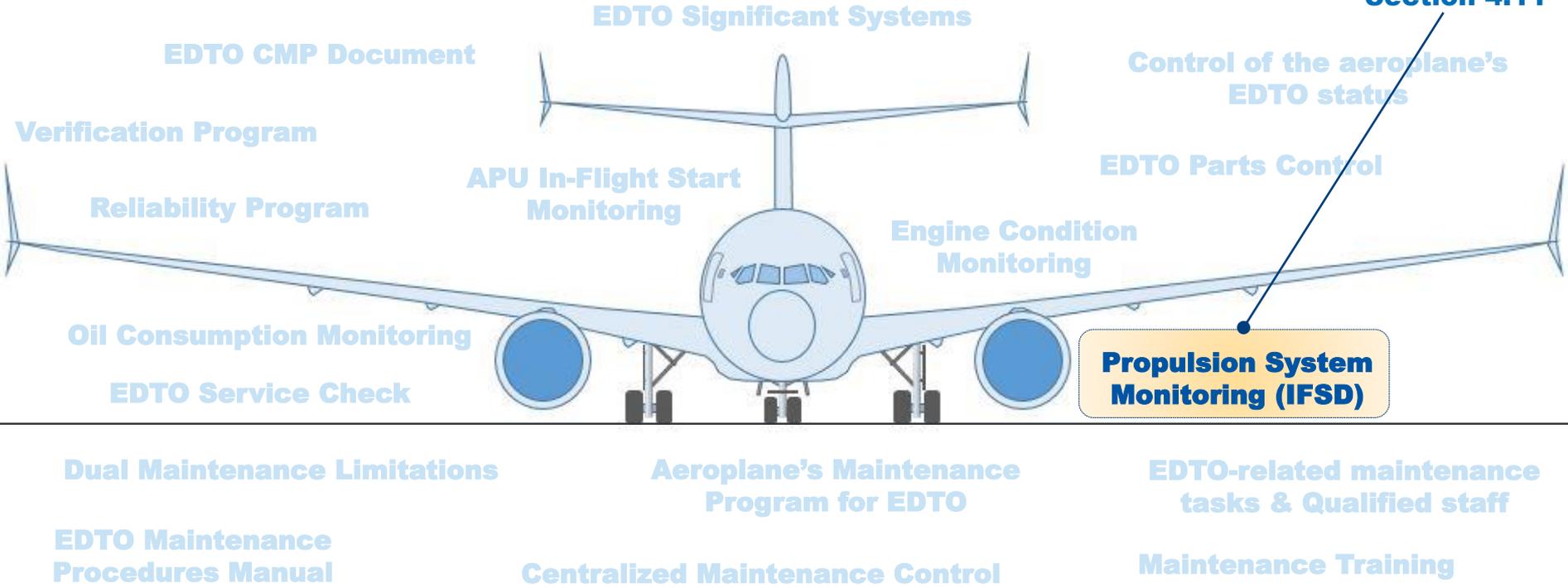
- Engine type, serial number position, time since new or since last shop visit, ...
- A/C Systems or Component / Computer : Time since installation, P/N, ...
- In case of IFSD: Engine configuration, Weather, Symptoms leading up to the event, ...



Operator's EDTO maintenance Program

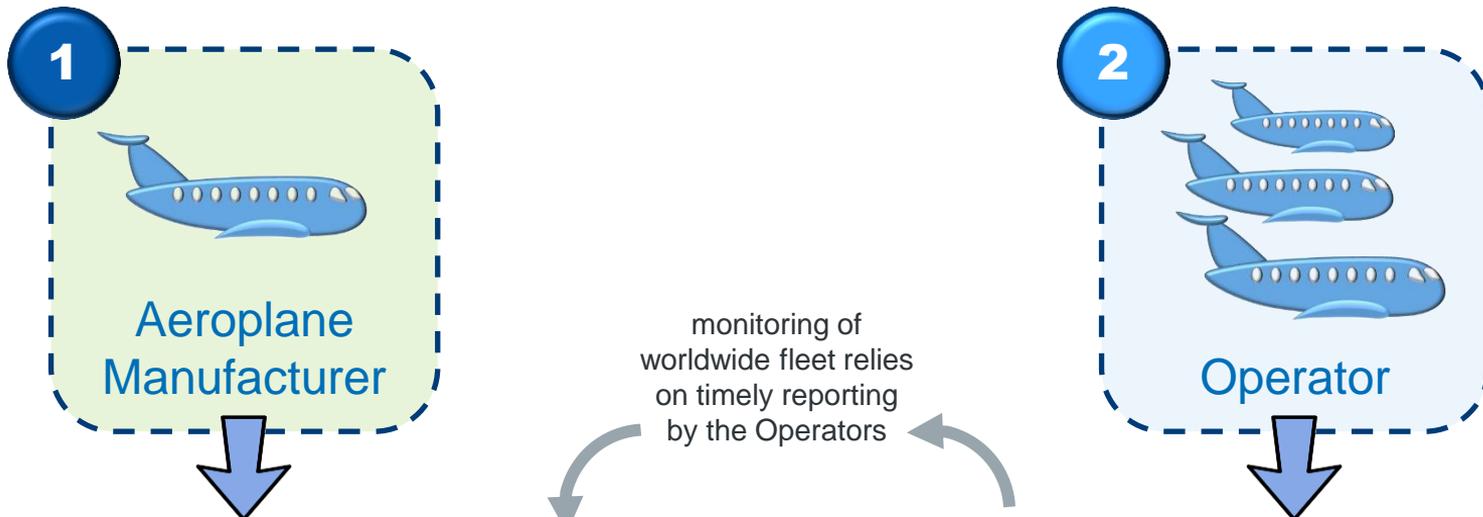
Review of program's elements

Review of the elements of the EDTO maintenance Program :





Recall : the engine reliability is tracked at two levels :



Monitoring of Worldwide fleet

If necessary, corrective actions are defined to restore reliability

Monitoring of Operator's fleet

The main purpose is to allow for early identification of Operator's specific issues



Question 6.5 :

Which one of the following engine shutdown events should **NOT** be counted as an IFSD in the computation of the IFSD rate for EDTO ?

- Shutdown during climb prior to EDTO sector
- Shutdown due to a bird strike
- Shutdown after touchdown of an EDTO flight
- Shutdown during cruise on a non-EDTO flight
- Shutdown during a maintenance test flight





Purpose of the IFSD Rate reporting and tracking :



Monitoring of Operator's fleet

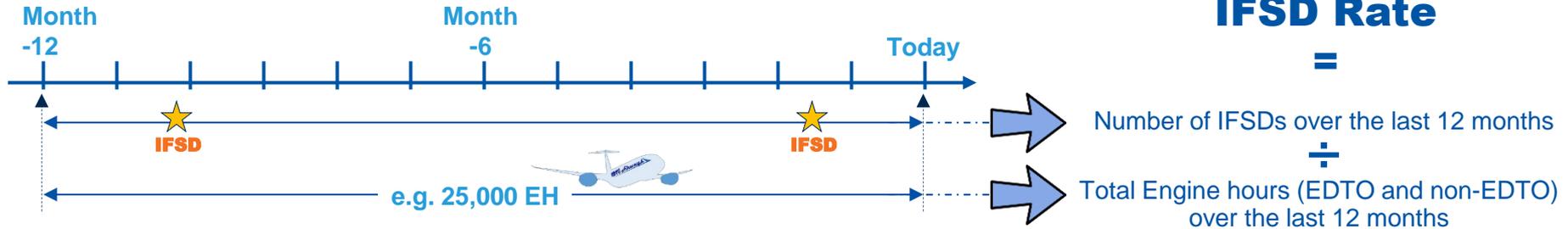
The main purpose is to allow for early identification of Operator's specific issues

- Track the airline's IFSD rate and monitor worldwide rate
- Determine the cause of the IFSD
- Develop, implement and verify corrective action
- Prepare report for Authority





Computation of IFSD Rate : 12 month rolling average



In the example above, the ISFD rate is 2/25,000 EH = **0.08 / 1,000 EH**

The operator should monitor its **fleet IFSD rate** versus the **applicable target rate**.

- May be slightly higher than the “type design” IFSD rates to account for fleet size effect, like in FAA ETOPS rule (*see extract copied here*)
- For small fleet it is also recommended to perform systematically an event-oriented analysis, as statistic analysis of IFSD may not be relevant (*see next slides*)

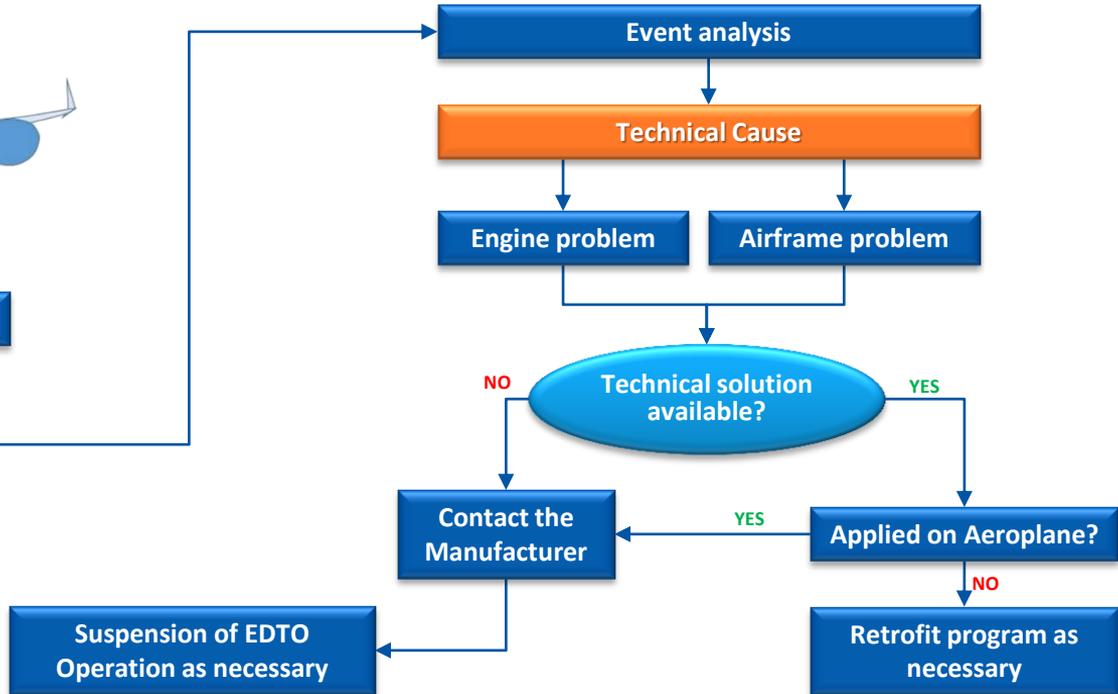
“Operational” IFSD rate	“Type Design” IFSD rate	EDTO Authorization
0.05/1000	0.05/1000	Up to 120 Min
0.03/1000	0.02/1000	Beyond 120 min. Up to, and including 180 min
0.02/1000	0.01/1000	Greater than 180 min



Example of an IFSD for a technical cause



*State of Operator
decision in coordination
with State of Design*

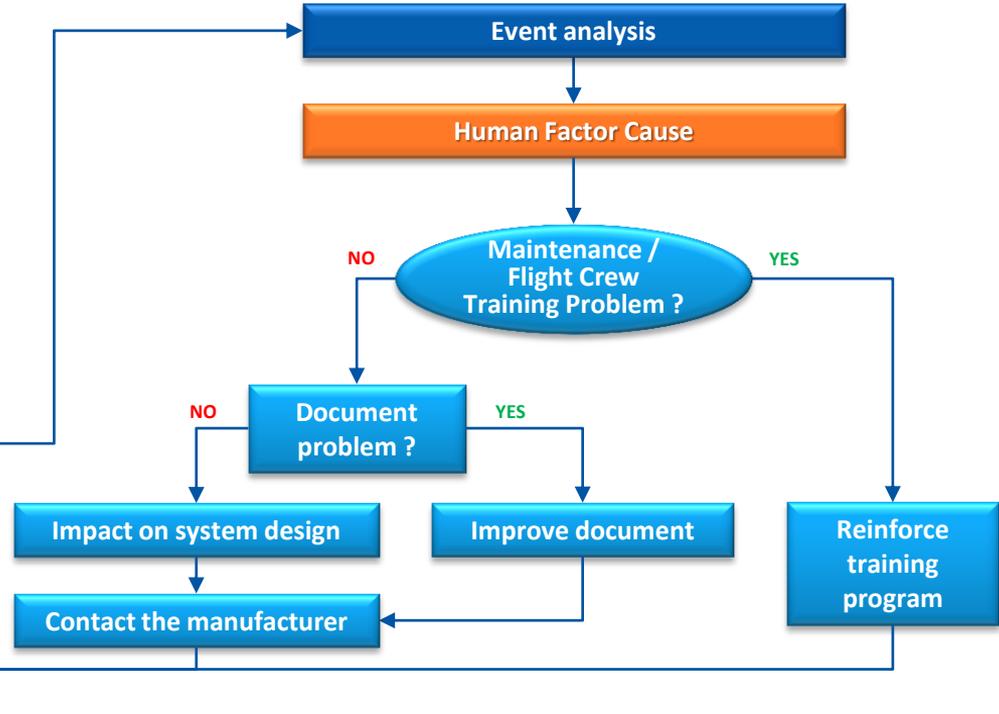




Example of an IFSD for a Human Factor issue



*State of Operator
decision in coordination
with State of Design*



Operator's EDTO maintenance Program

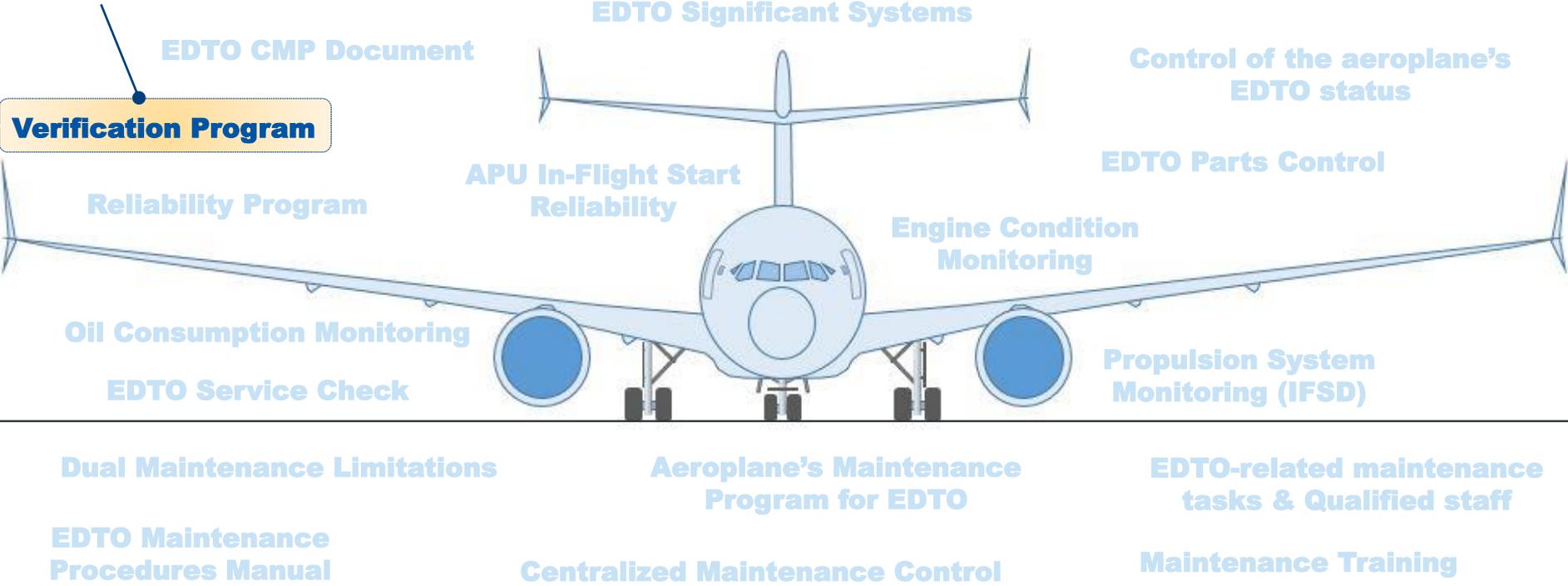
Review of program's elements

Review of the elements of the EDTO maintenance Program :

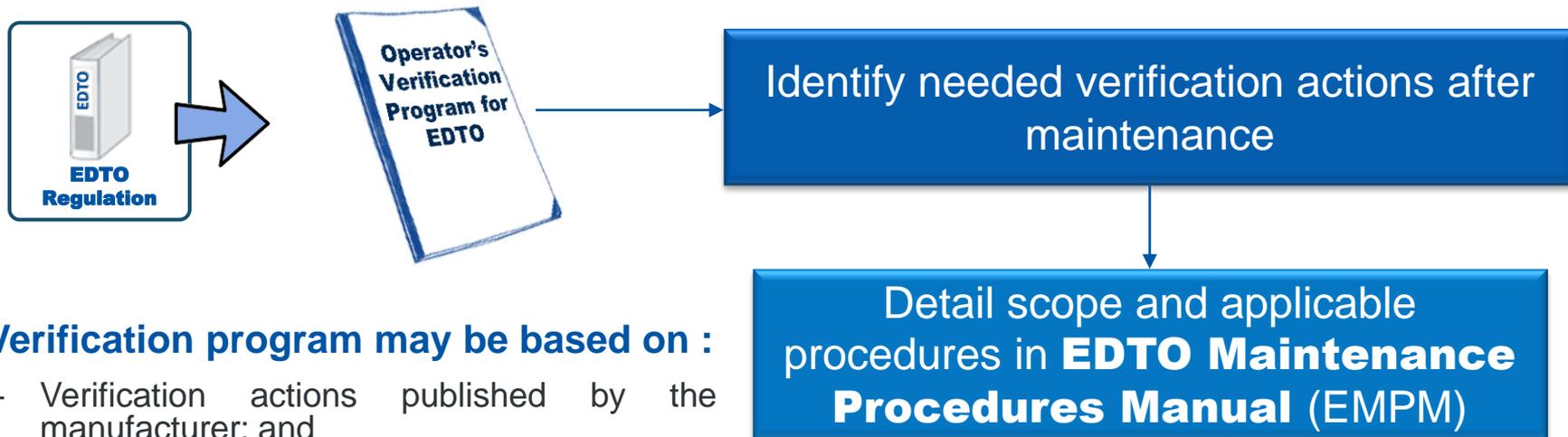
EDTOM

Section 4.12

Verification Program



The EDTO operator should implement a Verification Program to ensure positive corrective action after EDTO relevant failures.



Verification program may be based on :

- Verification actions published by the manufacturer; and
- Engineering Judgment



Purpose is to ensure positive corrective action on IFSD or EDTO significant system failures and in particular to confirm corrective action in specific areas, such as:

- Engine failure (e.g. IFSD)
- Failure of an EDTO Significant System
- Adverse trends
- Any prescribed event that could affect EDTO operation



The program must ensure prompt corrective action and verify that the corrective action has effectively resolved the problem.



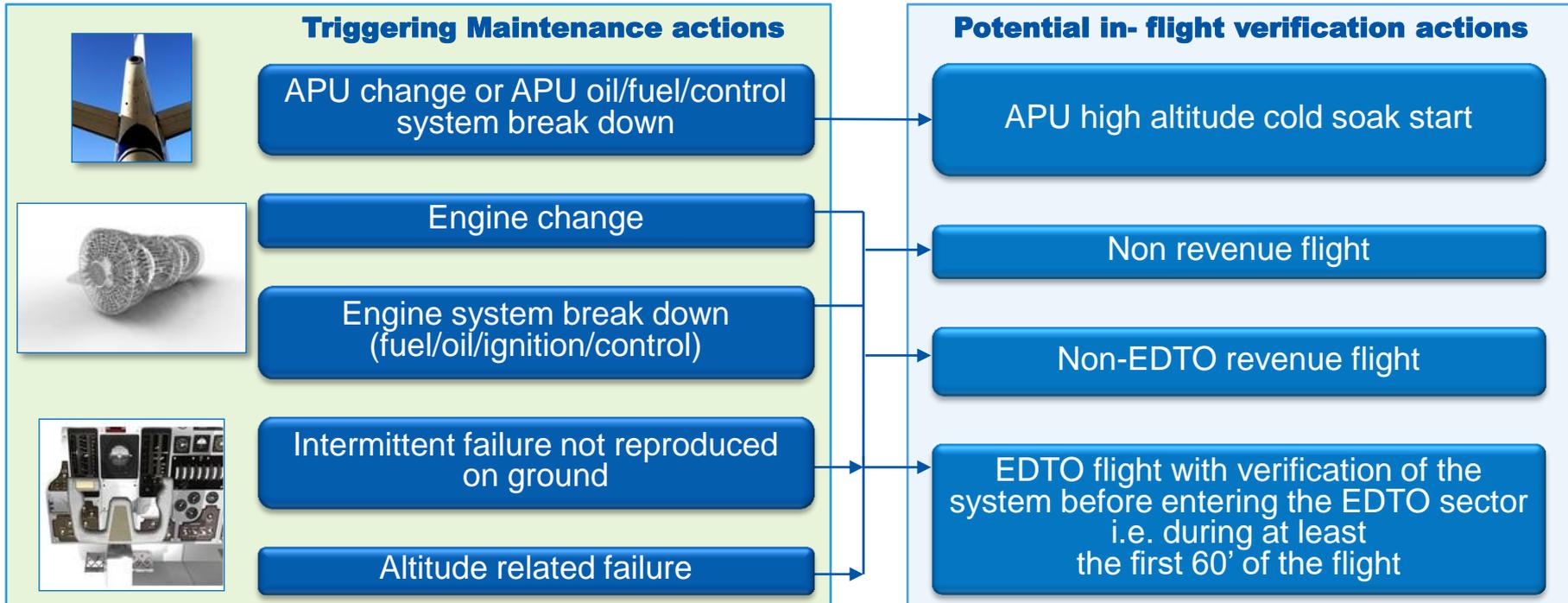
All maintenance actions must be verified to ensure that the problem has been corrected.

Acceptable **verification techniques** should be listed in the Verification program, and typically include :

- BITE **Tests**
- **Functional Checks**
- **Operational Checks**
- **Other ground tests** – Examples: Fault Isolation Manual (FIM), Airplane Maintenance Manual (AMM), or airline-specific procedures
- **Verification flight**, however required only when the discrepancy in question cannot be verified on the ground (*see next slides*)
 - When required, the verification flight should be coordinated through the operator's Maintenance Control Center and described in the **EMPM**

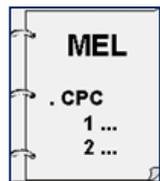


Examples where an in-flight verification may be needed





This WP-911 has arrived with a defect related to cabin pressurization



Check in the MEL to defer the rectification of the defect

NO GO item

Fix the problem before the departure ?

YES

Yes, but...

Fault rectification is confirmed

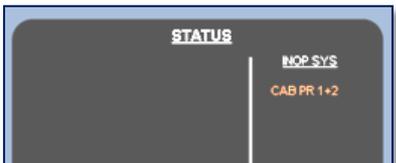
Item closed / Fault cleared

EDTO status confirmed in logbook

Fault rectification requires verification

Inform the maintenance control: an in-flight verification is needed

Record in the A/C logbook and provide a notice to the flight crew



EDTO Status					
Diversion Time (minutes)					
<input checked="" type="checkbox"/>	180	<input type="checkbox"/>	120	<input type="checkbox"/>	60
Verification flight required (Y/N) :				N	



Aeroplane is EDTO capable and may be released on EDTO

EDTO Status					
Diversion Time (minutes)					
<input checked="" type="checkbox"/>	180	<input type="checkbox"/>	120	<input type="checkbox"/>	60
Verification flight required (Y/N) :				Y	



Verification Program

In flight verification example (2/2)

	Diversion Time (minutes)		
EDTO Status	<input checked="" type="checkbox"/> 180	<input type="checkbox"/> 120	<input type="checkbox"/> 60
Verification flight required (Y/N) :			Y

Aeroplane is EDTO capable



The aeroplane is dispatched on EDTO with request for in-flight verification



OR

	Diversion Time (minutes)		
EDTO Status	<input type="checkbox"/> 180	<input type="checkbox"/> 120	<input checked="" type="checkbox"/> 60
Verification flight required (Y/N) :			N

Status is downgraded to non-EDTO
MCC & Flight Ops must be informed



	Diversion Time (minutes)		
EDTO Status	<input checked="" type="checkbox"/> 180	<input type="checkbox"/> 120	<input type="checkbox"/> 60
Verification flight required (Y/N) :			N

EDTO status is confirmed and Aeroplane may be dispatched on EDTO



After the flight, if the fault is cleared

STATUS	MCP SYS
--------	---------

After the flight, if the fault is NOT cleared

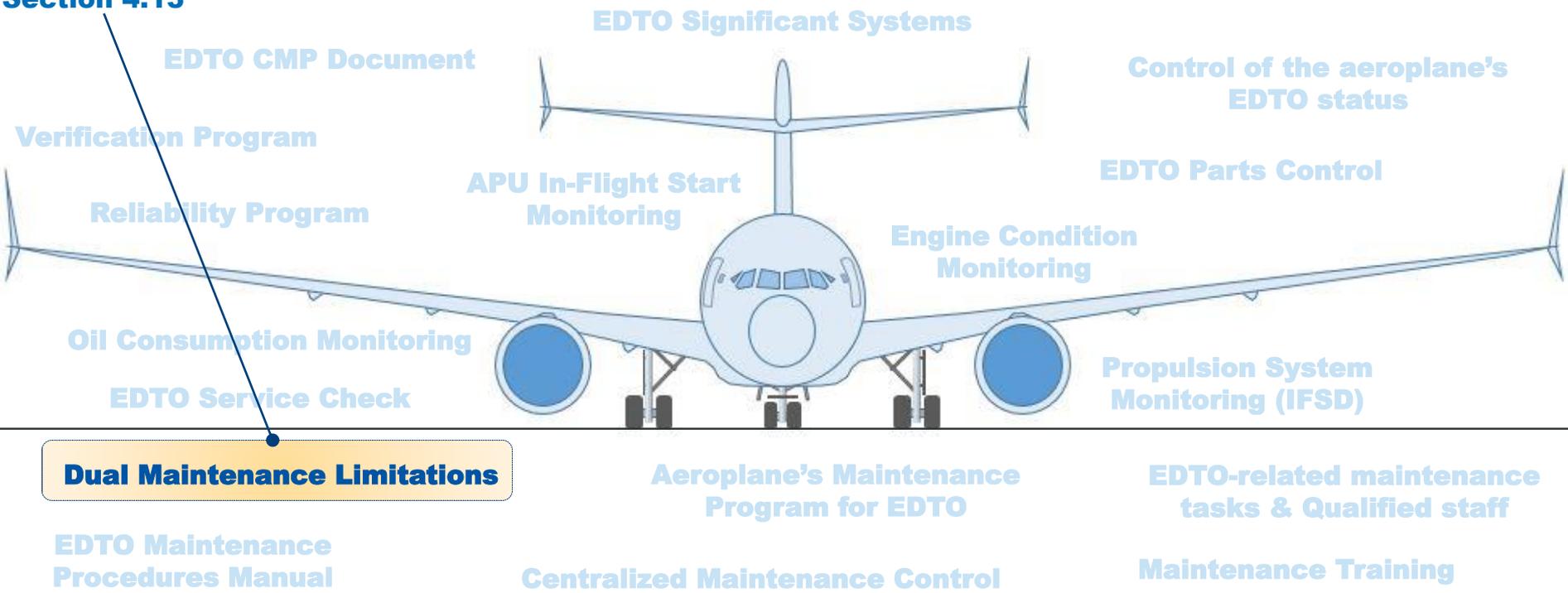
STATUS	MCP SYS CAB PR 1+2
--------	-----------------------

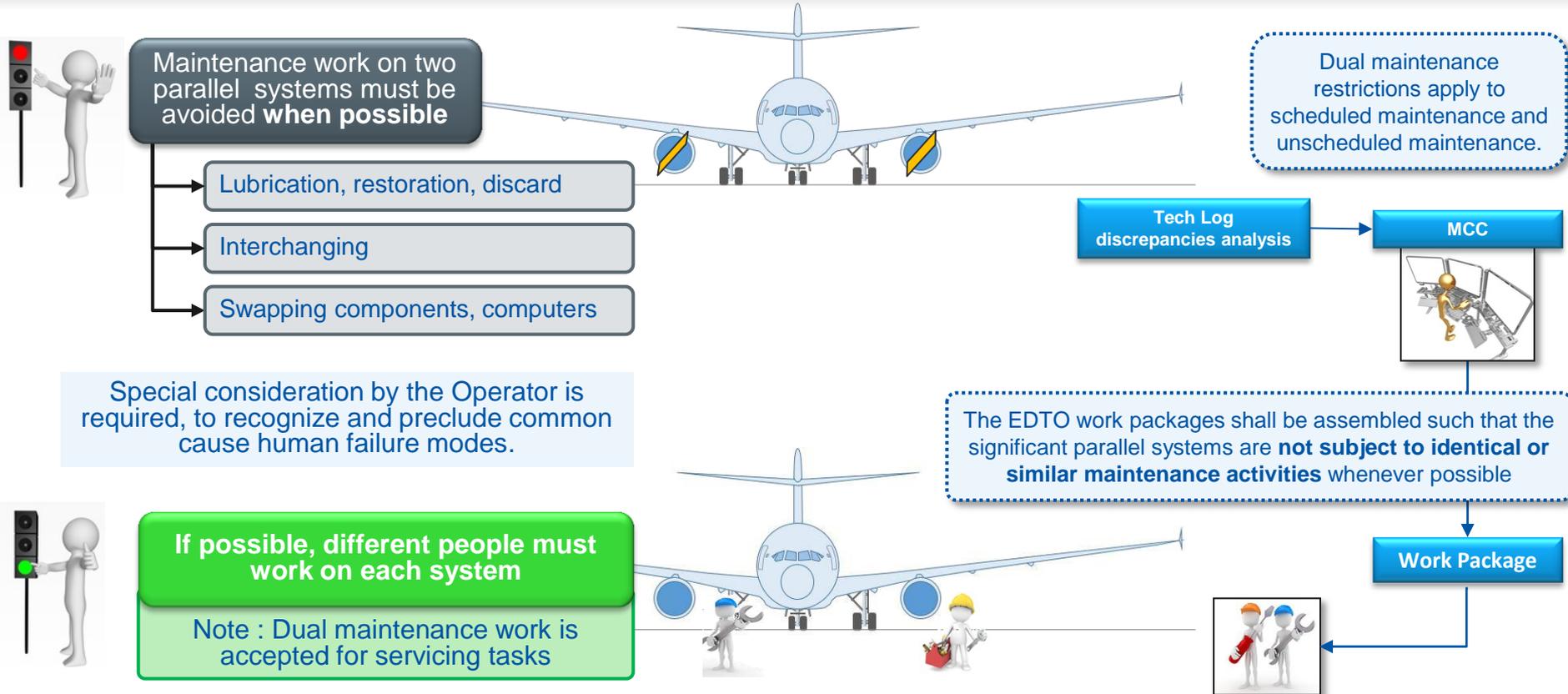
Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

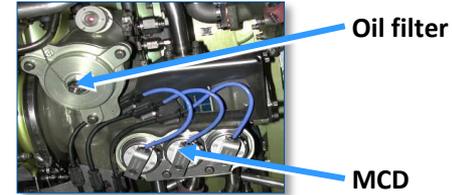
EDTOM
Section 4.13







Purpose of dual maintenance limitations



Purpose of Dual Maintenance Limitations is to ensure that actions are not performed on the same element of **identical, but separate, EDTO Significant Systems** during the same routine or non-routine visit.

Examples of **dual maintenance** on the “same” EDTO Significant System are:

- Removal of both engine oil filters
- Removal of both chip detectors
- Replacement of left and right Integrated Drive Generator (IDG)

Note : *dual maintenance may also be referred to as identical maintenance, multiple maintenance, and simultaneous maintenance.*



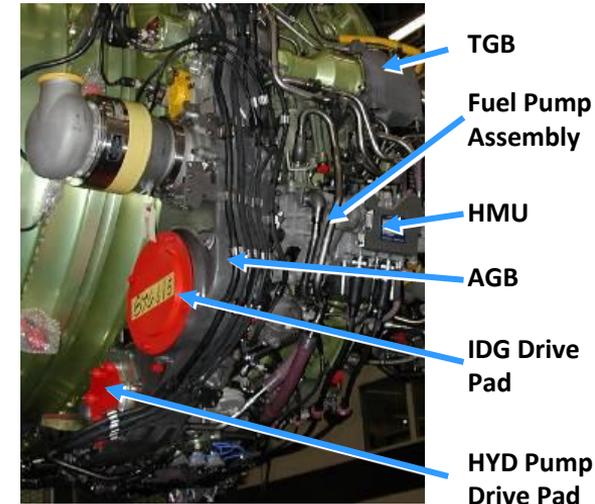
Dual maintenance on “substantially similar” EDTO Significant Systems

It specifically addresses maintenance actions on engine driven components on both engines.

Main concern is that such simultaneous maintenance actions, although on different equipment, may potentially affect both engines.

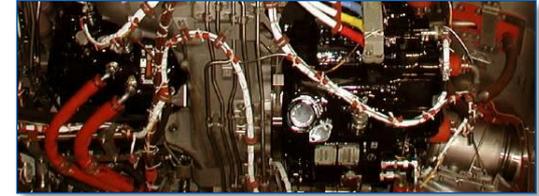
An example of dual maintenance on “substantially similar EDTO Significant Systems may include:

- Replacement of the Number One IDG and the Number Two Engine Driven Pump



As explained, the operator's program should :

- Schedule concerned work at different checks
- Divide concerned work into separate work packages



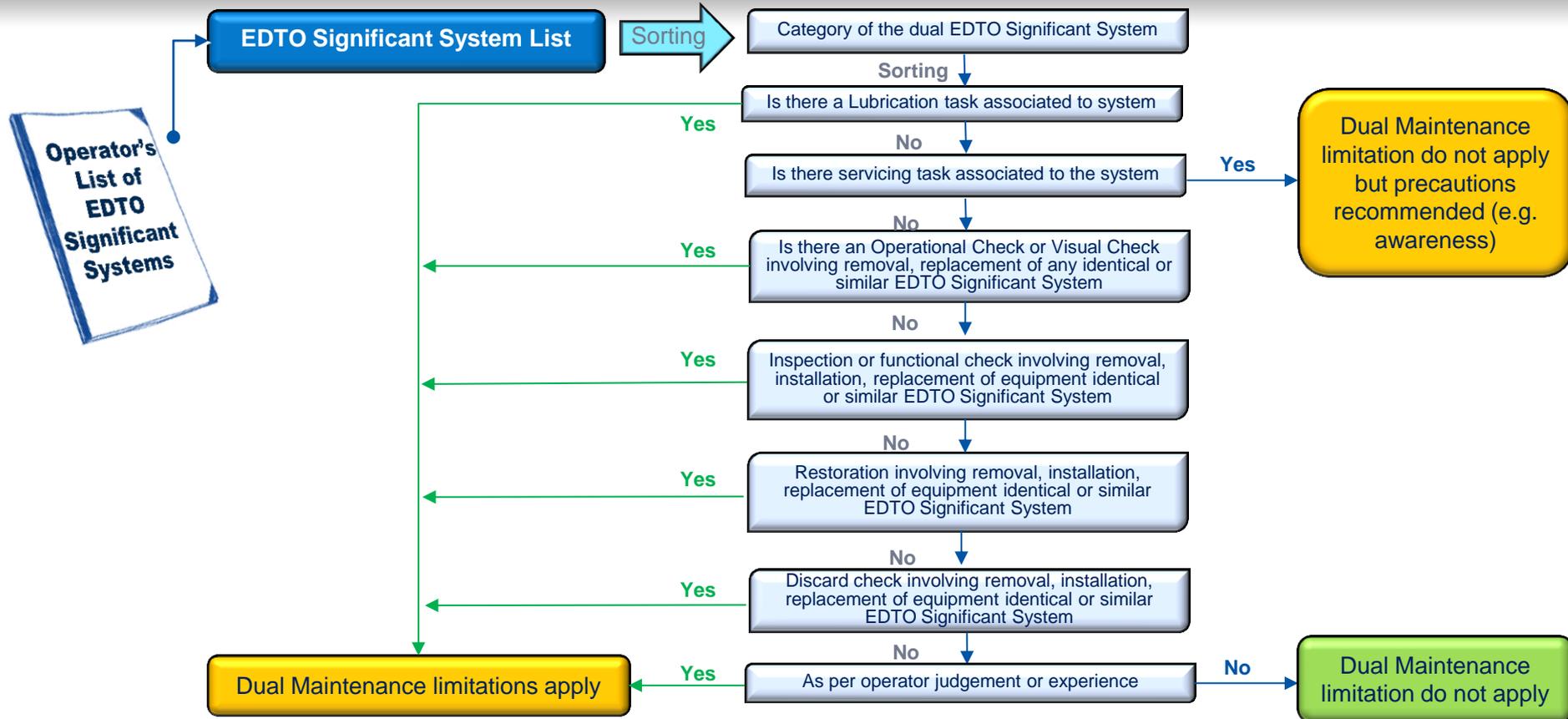
Manufacturers may provide **guidance** (e.g. dual maintenance matrix) to support the Operators **in identifying tasks** that may be subject to **dual maintenance limitations**. See also next page for a typical flowchart for dual maintenance task identification.

If **Dual Maintenance cannot be avoided**, the following are possible options :

- Use different technicians
- Utilize an inspector or supervisor to inspect the work being performed
- Perform sufficient verification tests on both systems

Dual Maintenance Limitations

Selection of EDTO Dual Maintenance Tasks





Question 6.6 :

Simultaneous removal/installation of the IDG and of the APU GEN is performed before the EDTO dispatch of the aeroplane. Is this subject to dual maintenance limitations ?

- Yes
- No

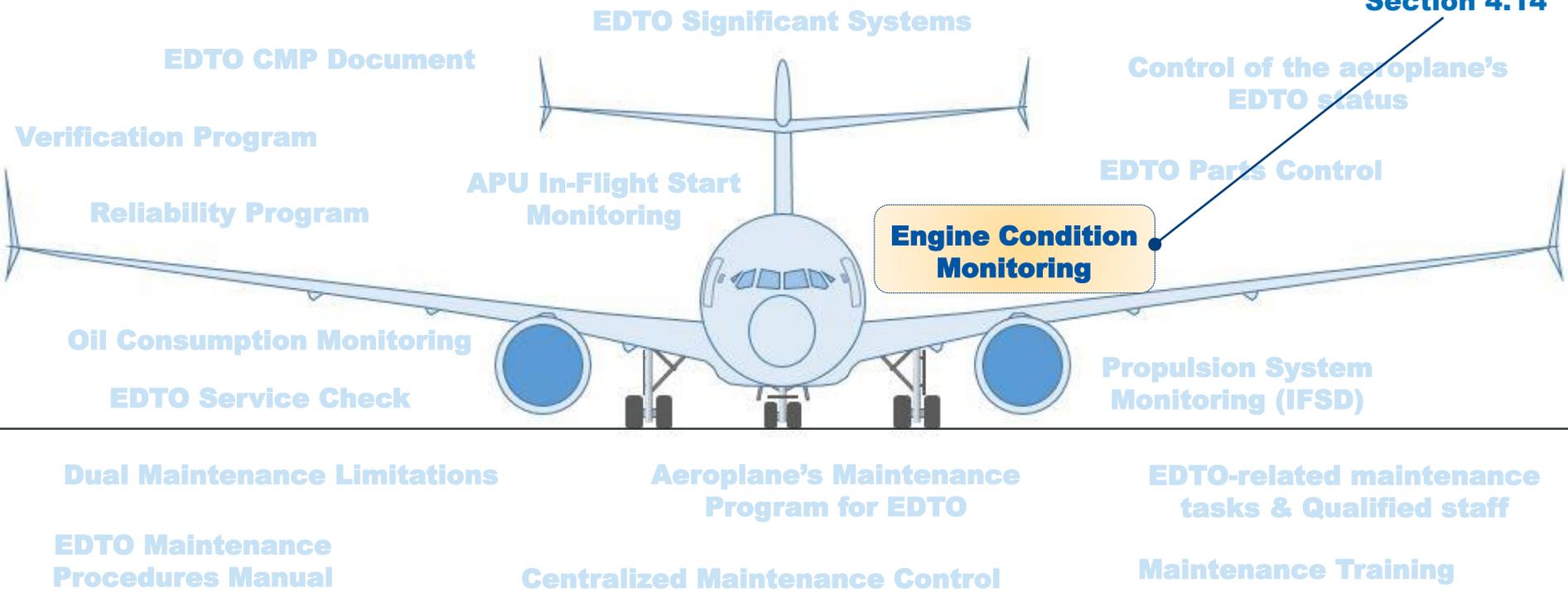


Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

 **EDTOM**
Section 4.14





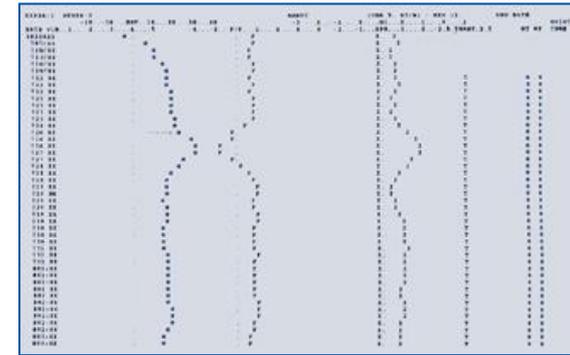
An Engine Condition Monitoring (ECM) must be implemented to support EDTO operations.

Purpose of ECM is to detect early deterioration of engines and to allow for corrective action to be taken before diversion capability is affected.

Typical process:

- Engine data is collected during stable cruise portion of the flight, either automatically or manually as programmed by operator
- Powerplant Engineering enters data into computer or by engine manufacturer with agreement
- Any trends noted can alert engineering to pending problems

Note : it is expected that ECM reports are produced and reviewed on a reasonably frequent basis.



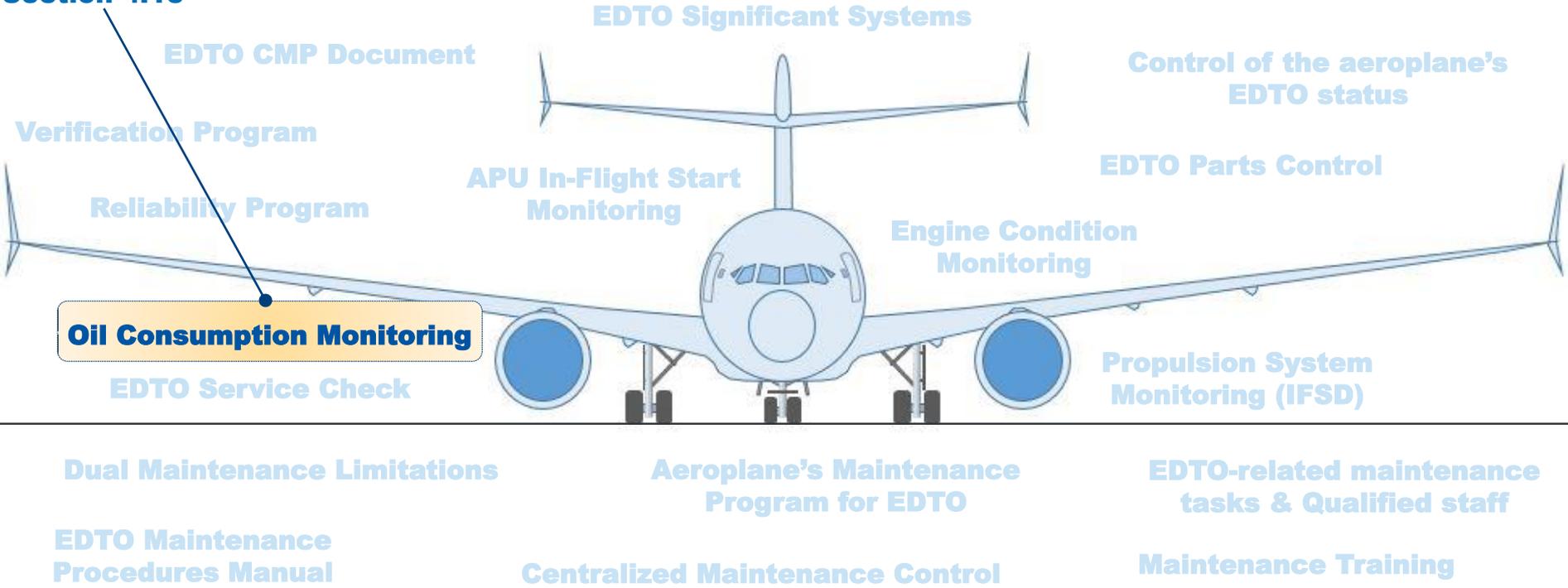
Sample Report

Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

EDTOM
Section 4.15





An Oil Consumption Monitoring program must be implemented to support EDTO operations.



APU Oil consumption Monitoring



Engine Oil consumption Monitoring

The engine and APU oil consumption monitoring program must :

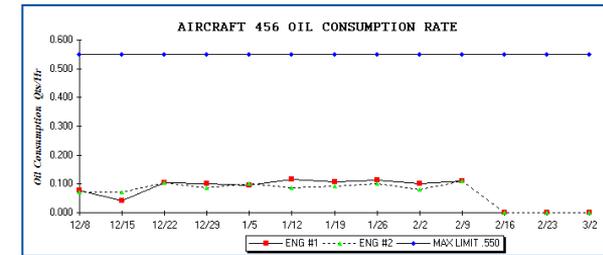
- Be sensitive to oil consumption trend (oil added with reference to a running average).
- Define responsibilities and interfaces.
- Provide a procedure for oil analysis if considered meaningful – Refer to **EDTO CMP Document** and/or **engine manufacturer instructions** to confirm if such procedure is required for EDTO.



An Oil Consumption Monitoring program must be implemented to support EDTO operations.

The purpose of the engine and APU oil consumption monitoring program is to :

- Determine baseline oil consumption rate for each engine and APU
- Identify excessive oil use on previous flight
- Determine any medium/long-term increasing trends in oil consumption rate and not exceed the maximum allowable



Oil consumption monitoring is an EDTO operational requirement to ensure consumption rates established by the engine manufacturer are not exceeded. Investigation and correction of consumption rate problems could prevent failures such as IFSD or loss of APU.

- Note : It is not a requirement to develop target consumption rate for EDTO, however the maximum rate must be able to support a single engine diversion

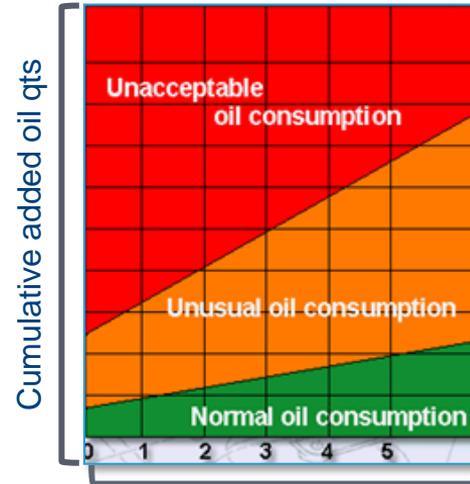


The Oil Consumption rates are usually provided in the AMM

Guidance is provided on computation of oil consumption rates, trouble-shooting and dispatch conditions



Example



Max engine Oil consumption permissible (Trouble-shooting initiated)

Advise Maintenance Control (Log Book comment entered)

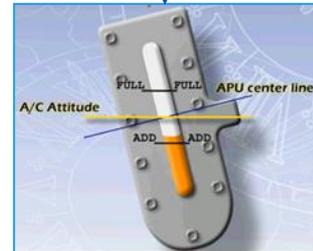
Minimum Time period over which consumption should be calculated

Oil Consumption Monitoring

Examples of APU and Engine oil level readings

Example of engine Oil quantity indication

Example of APU Oil quantity indication



Engine oil tank sight glass reading

APU oil tank sight glass reading

Refer to "EDTO Service Check" section for policy regarding cockpit checks vs physical readings

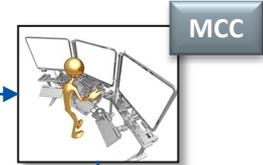
The **oil consumption** is checked as part of the **EDTO Service Check**.



Therefore an **alert consumption rate** should be specified on the Pre-flight, Daily and Weekly checks sheet

Notify MCC

If the alert level is reached



Determine the serviceability and/or actions required to permit release on the aeroplane

The oil level consumption should be noted in the aircraft maintenance log

Investigation is launched



Oil Consumption Monitoring must be continuous, up to the last flight if oil has been added

This requirement may lead to update existing oil top-up records / tools

“Old style” of oil top up record

Fluid Refill	#1	#2	APU	Names / Visas
Eng Oil				
IDG				

To be updated to allow computation and recording of Oil Consumption rate :

Example of updated format



* = oil quantity at previous maintenance release

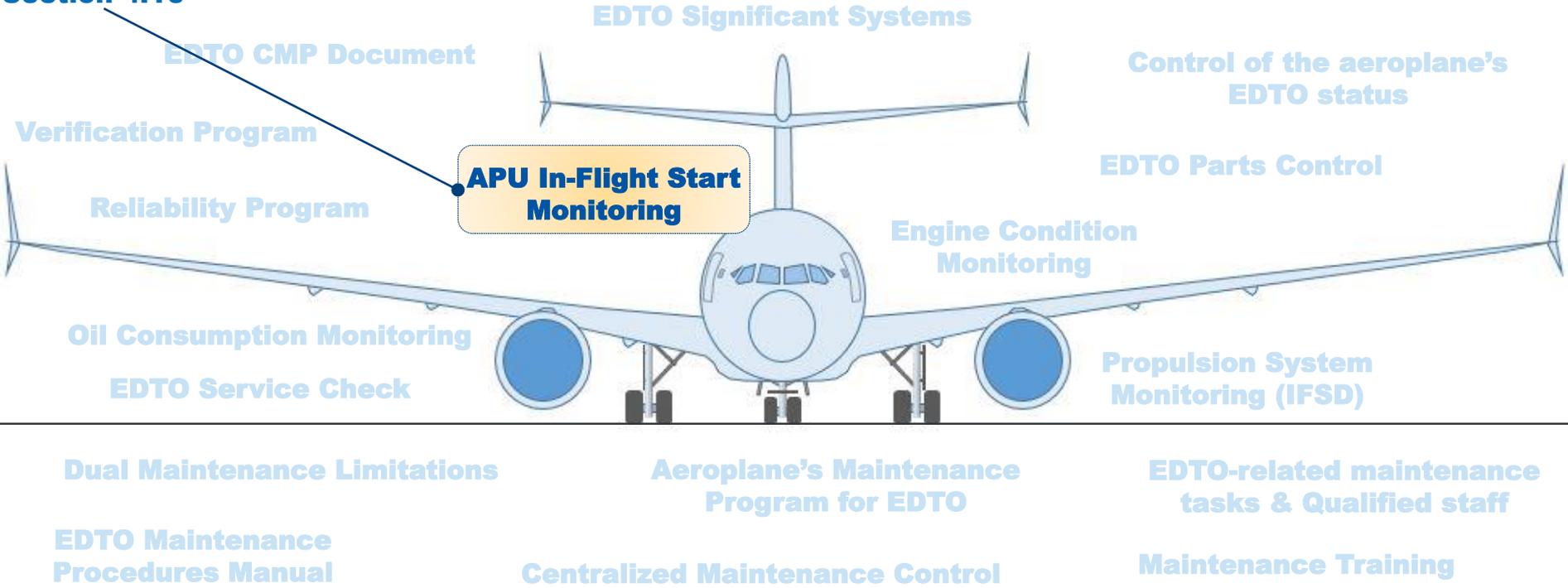
DATE	FLIGHT SEGMENT	OIL QUANTITY (QTS)		DIFF.	BLOCK TIME	ENG OIL CONSUMPTION (QTS/HOUR)
		BEFORE *	AFTER			
22/05	PREVIOUS	ENG 1 - 19	ENG 1 - 18	1	08:01	0.12
		ENG 2 - 19	ENG 2 - 17	2	08:03	0.25
23/05	LAST	ENG 1 - 18	ENG 1 - 17	1	07:30	0.13
		ENG 2 - 17	ENG 2 - 11,5	5.5	07:32	0.73

Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :

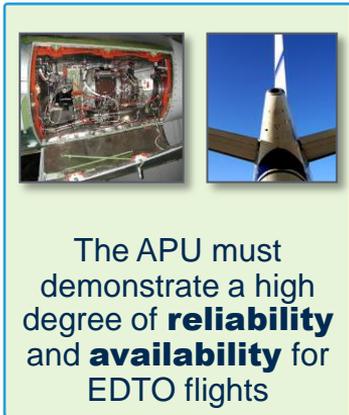
EDTOM
Section 4.16





APU In-Flight Start Monitoring must be implemented by the Operator

The objective is to ensure the APU will continuously provide the performance and reliability **demonstrated** by the manufacturer in the frame of EDTO certification.



- APU must be in EDTO Configuration
- Each aeroplane's APU should be periodically sampled rather than repeatedly sampling the same APU in the Operator's fleet
- Start intervals should be adjusted according to system performance, fleet maturity, Operator's in-service experience and should be approved (validated) by the State of the Operator

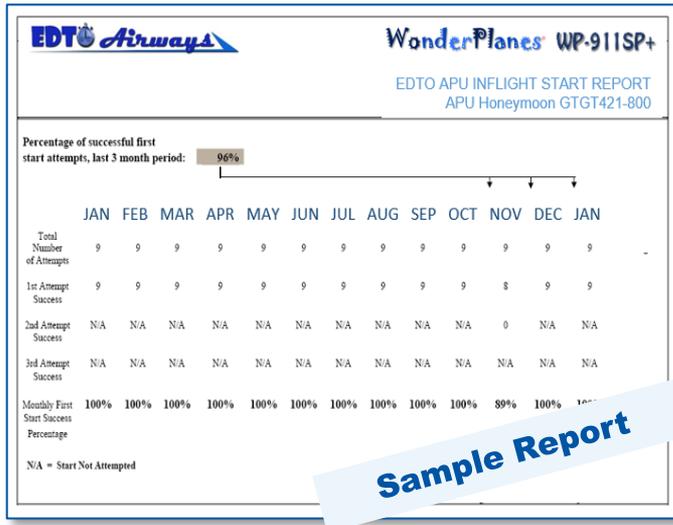


95% success rate is defined for APU In-flight start reliability.



This 95% success rate is demonstrated at time of **EDTO certification of the aeroplane**, and must be **monitored by the EDTO operators** once in service

- Periodic **high altitude cold-soak in-flight start tests** should therefore be performed by the EDTO operators, and related in-flight start statistics be recorded and as applicable be reported.
- A **successful start** is typically when the APU can be started within **3 attempts**
- **Note 1** : This ***in-flight start reliability objective*** is applicable only to “on-demand” APU operations i.e. it is not applicable if the APU must be started prior to entry into EDTO sector.
- **Note 2** : EDTO regulation do not define **APU run reliability**, as it depends on applicable Type Design objectives (typically an MTBF of 1,000 APU hours or more is required)



APU In-flight start reports may be issued to track the reliability.

These reports are reviewed to identify need for corrective actions (e.g. maintenance program update or APU design upgrade)

The EDTO regulations are usually not prescriptive on the frequency of APU In-Flight Start tests, nor on the definition or duration of “cold soak”

- Interval typically ranges **from 1 start test per month per aircraft to 1 per year**, depending on operator’s in-service experience and maturity of EDTO maintenance program
- **Cold soak is usually 2 to 4 hours in cruise**

Recommendation is to perform a high altitude cold soak start test **after every maintenance actions that may impact the start capability of the APU** :

- e.g. APU change, Replacement of Electronic Control Box (ECB), Fuel Control Unit (FCU), ignitors...

Additional guidance or recommendations may be provided by the manufacturer.



Question 6.7 :

APU in-flight start test should preferably be performed (select the most appropriate answer) :

- At the max ceiling of the aeroplane
- Shortly after top of descent of the EDTO Flight
- Shortly after take-off of the EDTO Flight
- Within the EDTO Sector
- During a 2 hour non-EDTO flight





Question 6.8 :

What is the minimum number of APU in-flight start tests that an Operator should perform before the EDTO approval may be granted ?

- 1,000
- 100
- 20
- 5
- 1
- 0





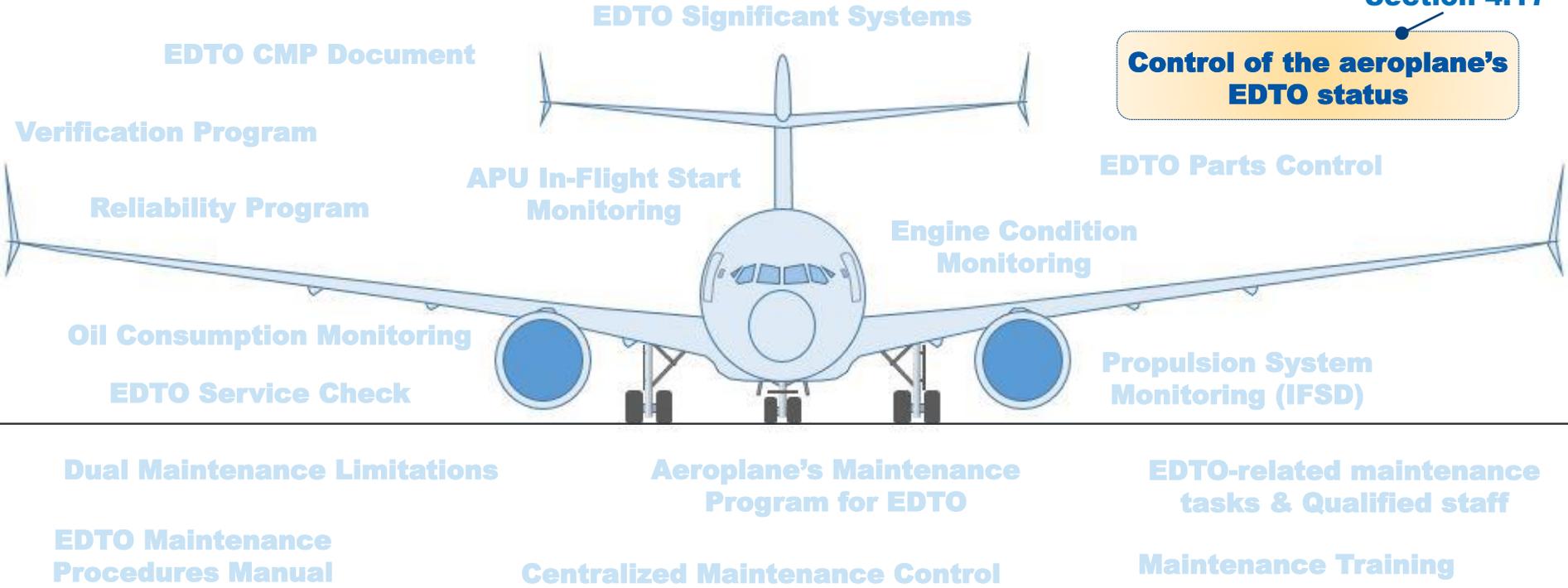
Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :



Control of the aeroplane's EDTO status





The EDTO operator shall develop procedures to continuously control the EDTO status.

Purpose is to :

1. Ensure that Dispatchers and Flight Crews are informed by Maintenance about the **aeroplane's EDTO status**; and
2. Ensure that the aeroplane is scheduled on a flight that does not exceed its **EDTO capability**.



The EDTO status of the aeroplane is assessed and confirmed as part of the maintenance release of the aeroplane

The Technical Logbook may be used as a tool to support tracking of the EDTO status of the aeroplane.

This may be typically done by inserting an EDTO dispatch statement in the log book.



Should clearly reflect the EDTO capability of the aeroplane

Can also be used to record need for in-flight verification

EDTO dispatch status check box



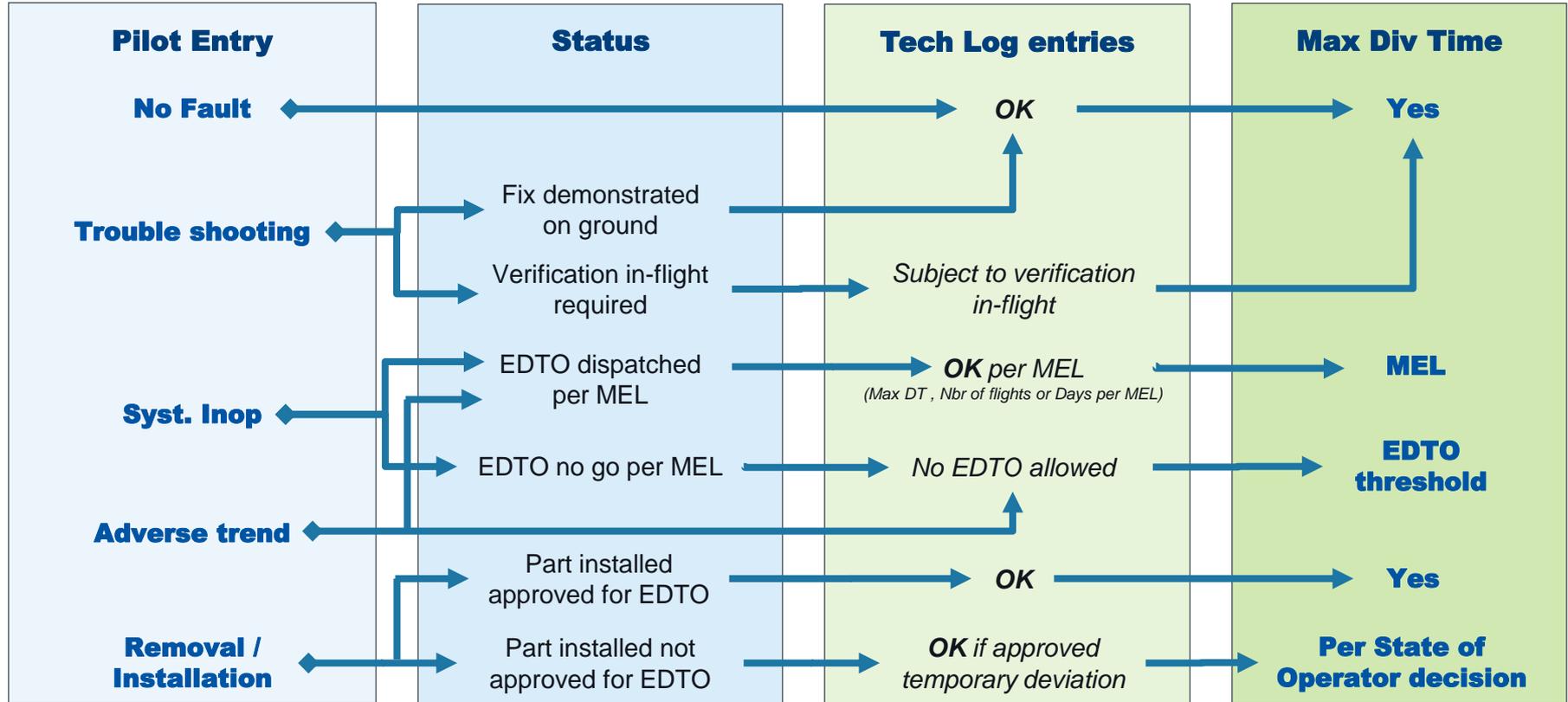
EDTO Status	Diversion Time (minutes)		
	<input checked="" type="checkbox"/> 180	<input type="checkbox"/> 120	<input type="checkbox"/> 60
	Verification flight required (Y/N) :		N

EDTO Airways				AC TYPE: WP-311	AC REG: 8BTO-S19	DDMMYYYY: 23/05/2019	Incoming EDTO Status (minutes) <input checked="" type="checkbox"/> 180 <input type="checkbox"/> 120 <input type="checkbox"/> 60			
STATION: ED-5A	DEP: JFK	ARR: CDG	BLOCK TIME: 07:32	CPT NAME: Múez	LICENSE NBR: #12345	1st OFFICER NAME: Eric	LICENSE NBR: #96543	DEP FUEL (KG): 46000	TOTAL FUEL (KG): 46800	ARR FUEL (KG): 5800
MAX START EGT (°C): ENG 1 - 325	ENG 2 - 323	MAX T OFF EGT (°C): ENG 1 - 250	ENG 2 - 251	APU OIL: OK	UPLIFT Y/N: N	IDG OIL: OK	UPLIFT Y/N: N	OIL QUANTITY (QTS)		
DATE: 22/05	FLIGHT SEGMENT: PREVIOUS	BEFORE: ENG 1 - 1.9	AFTER: ENG 1 - 1.8	DIFF: 1	BLOCK TIME: 08:01	CONSUMPTION (QTS/HOUR): 0.12	23/05: LAST			
		BEFORE: ENG 2 - 1.9	AFTER: ENG 2 - 1.7	DIFF: 2	BLOCK TIME: 08:08	CONSUMPTION (QTS/HOUR): 0.25	23/05: ENG 1 - 1.8			
		BEFORE: ENG 1 - 1.8	AFTER: ENG 1 - 1.7	DIFF: 1	BLOCK TIME: 07:30	CONSUMPTION (QTS/HOUR): 0.13	23/05: ENG 2 - 1.7			
		BEFORE: ENG 2 - 1.7	AFTER: ENG 2 - 11.5	DIFF: 5.5	BLOCK TIME: 07:32	CONSUMPTION (QTS/HOUR): 0.78				
PERFORMANCE RELEASE										
A signature for certifying the completion of maintenance shall constitute a certification required by regulation				Name & Authorization No.		Signature / Stamp				
Station: CDG	Date: 23-May	Time: 05:00								
ITEM	DISCREPANCIES / MALFUNCTIONS	SIGN / STAMP	CORRECTIVE ACTIONS	RELEASED	SIGN / STAMP		QUALITY CHECK			
1	APU no start during descent (see attempt)		APU started on ground No fault found	✓						
2	ENG 2 fault before top of descent		ENG disconnected MMEC 24-52-0EA applied	✓						
3	Left main landing gear service not done at arrival		Left main landing gear service done at arrival	✓						



Control of the aeroplane's EDTO status

Handling of Tech Log entries (de-grading / re-grading)





Question 6.9 :

What is the meaning of the status shown below ?

EDTO Status	Diversion Time (minutes)		
	<input type="checkbox"/> 180	<input checked="" type="checkbox"/> 120	<input type="checkbox"/> 60
Verification flight required (Y/N) :		Y	

- A. The EDTO capability of the aeroplane is reduced to 120 min due to the need for a verification flight
- B. The aeroplane must be dispatched on a 120 min EDTO verification flight
- C. A verification flight is required if the Diversion Time is 120 min or more
- D. The EDTO capability of the aeroplane is 120 min and a verification flight is required



Operator's EDTO maintenance Program

Review of program's elements

Review of the elements of the EDTO maintenance Program :





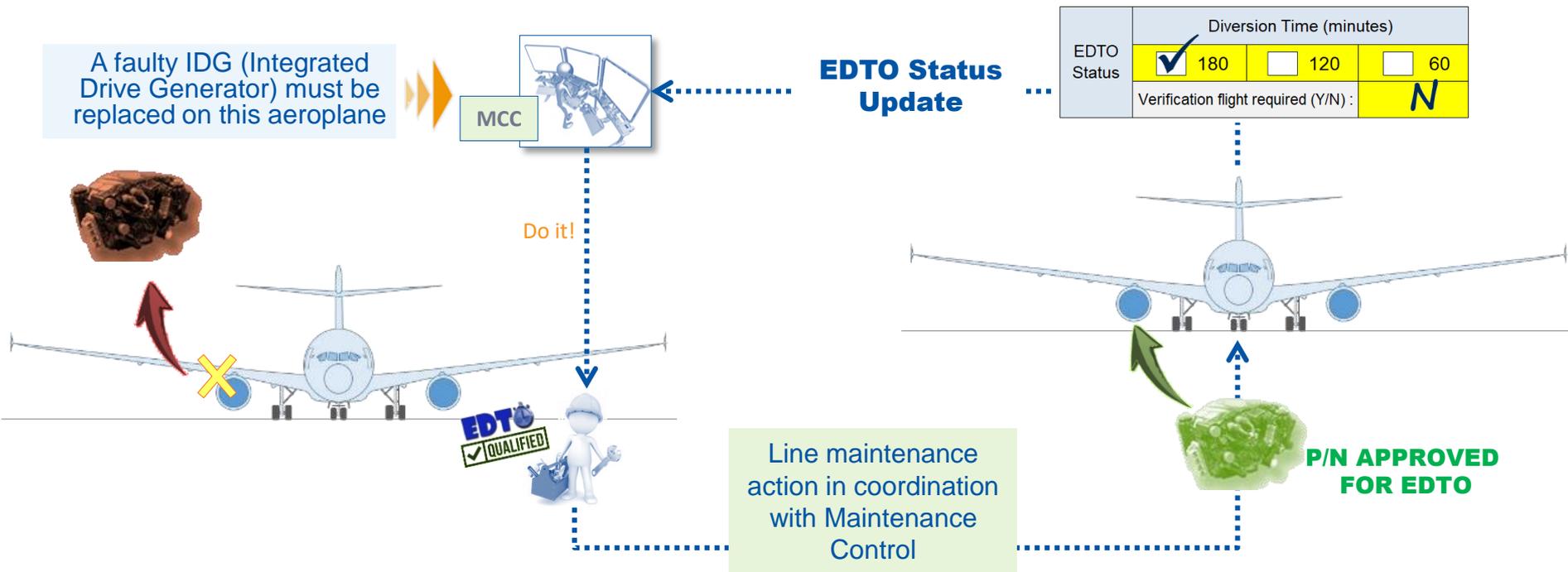
Although there is no EDTO requirements directly related to Centralized Maintenance Control, the EDTO Maintenance Organization should have an entity that manages the day-to-day EDTO operation and ensures EDTO dispatches follow program requirements.

Purpose is to :

- Manage the **daily EDTO operation**; and
- Avoid an airplane being dispatched on an EDTO flight without a confirmed resolution or MEL relief, in particular after the following occurrences :
 - IFSD
 - EDTO Significant System failure
 - Discovery of adverse trends in system performance without corrective action being taken
 - Should be defined in the EDTO Maintenance Procedures Manual



Example of rectification action coordinated through Centralized Maintenance Control (MCC : Maintenance Control Center).

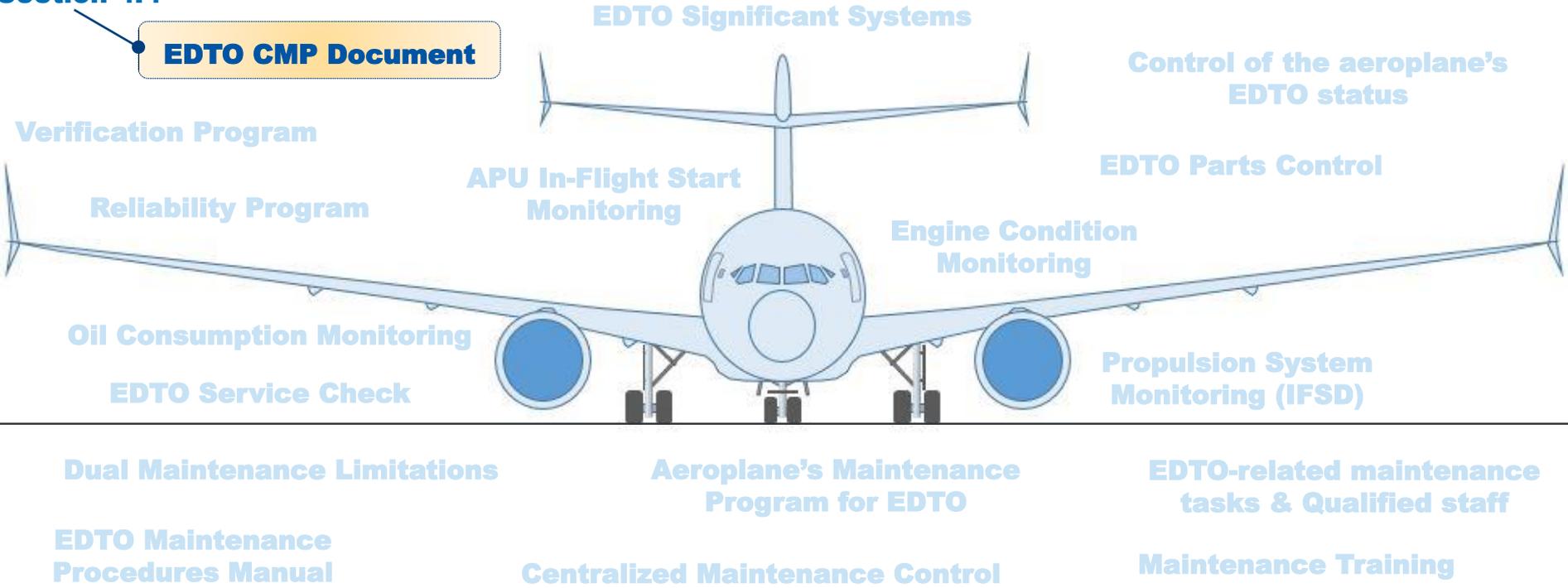




Part I —	EDTO Maintenance and Reliability Requirements
Part II —	Operator's EDTO maintenance Program
Part III —	Documentation and Training
Part IV —	Summary
Part V —	Practical Exercise

EDTOM
Section 4.4

EDTO CMP Document





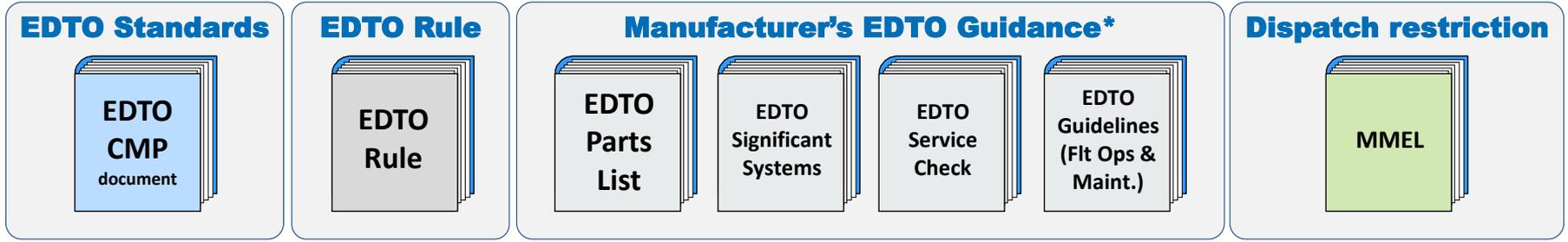
The aeroplane must be configured, maintained and operated in accordance with the standards of the EDTO CMP Document.

The EDTO operator must **ensure** that:

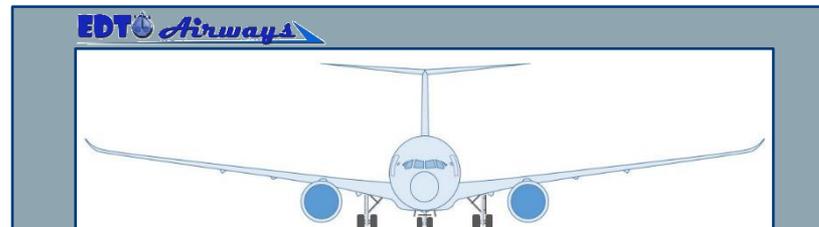
- Configuration features are embodied in the aeroplane and engines
- Maintenance procedures are incorporated into the maintenance program
- Demonstrated capabilities are accounted for in the flight operations program and MEL as required

Continued compliance is required: the programs and manuals of the EDTO operator must continuously reflect the applicable EDTO CMP standards throughout the operational EDTO life of the aeroplane.

EDTO CMP Document standards should be considered in conjunction with other technical documentation or guidance material such as :

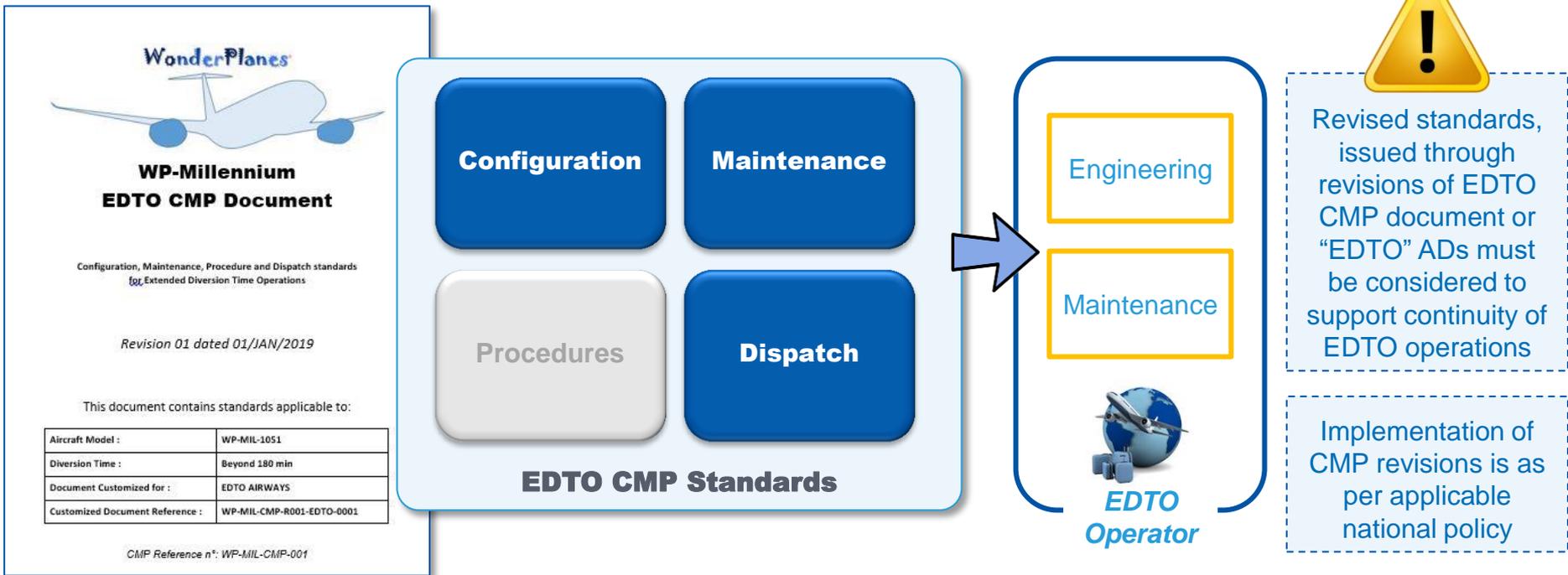


EDTO Maintenance Program



***Note :** List provided for illustration purposes. Manufacturer should be contacted to obtain list and description of available guidance material.

EDTO CMP Document standards impacting the maintenance processes and procedures of the EDTO Operator :





Consideration of EDTO CMP document :

1 - Configuration Standards

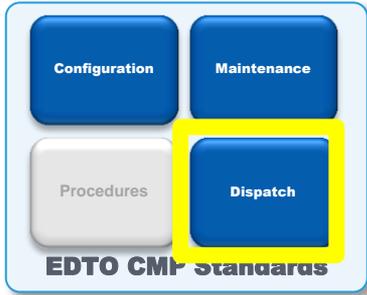




Consideration of EDTO CMP document :

2 - Maintenance Standards





Consideration of EDTO CMP document :

3 – Dispatch Standards





Question 6.10 :

If there is no reference to oil consumption monitoring in the EDTO CMP Document, is oil consumption monitoring required for EDTO ?

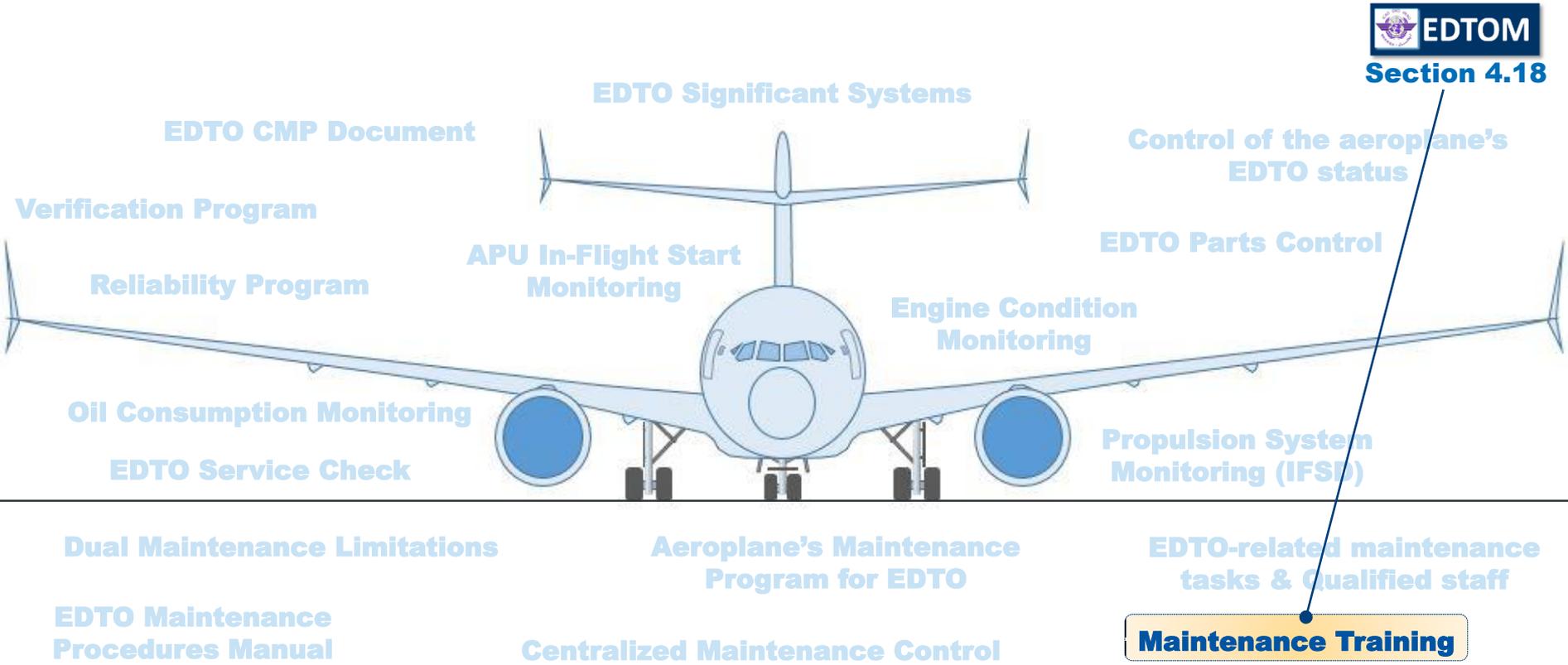
- Yes
- No

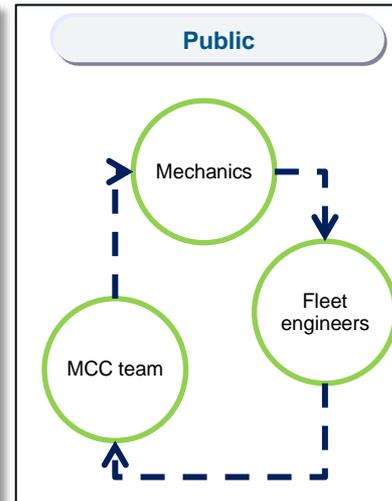
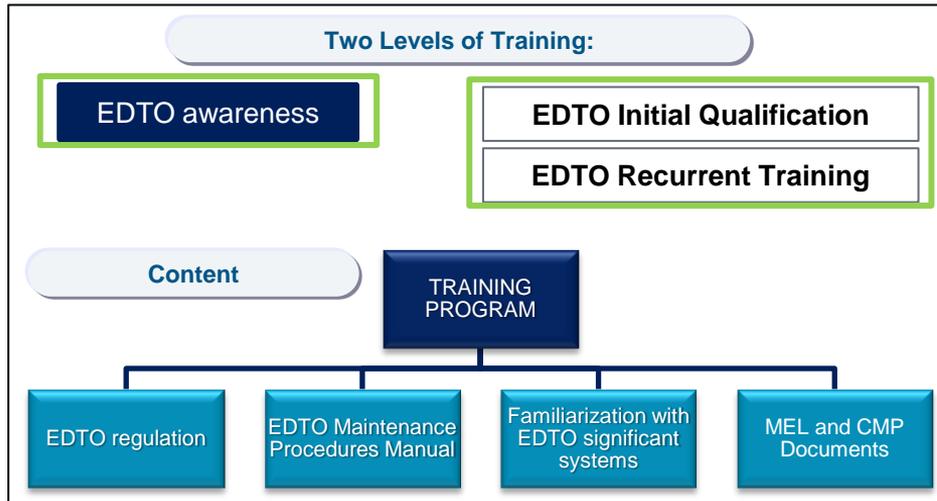




Documentation & Training

EDTO Maintenance Programme





Operator's EDTO Training Program should cover EDTO philosophy and special nature, and it should meet applicable maintenance requirements

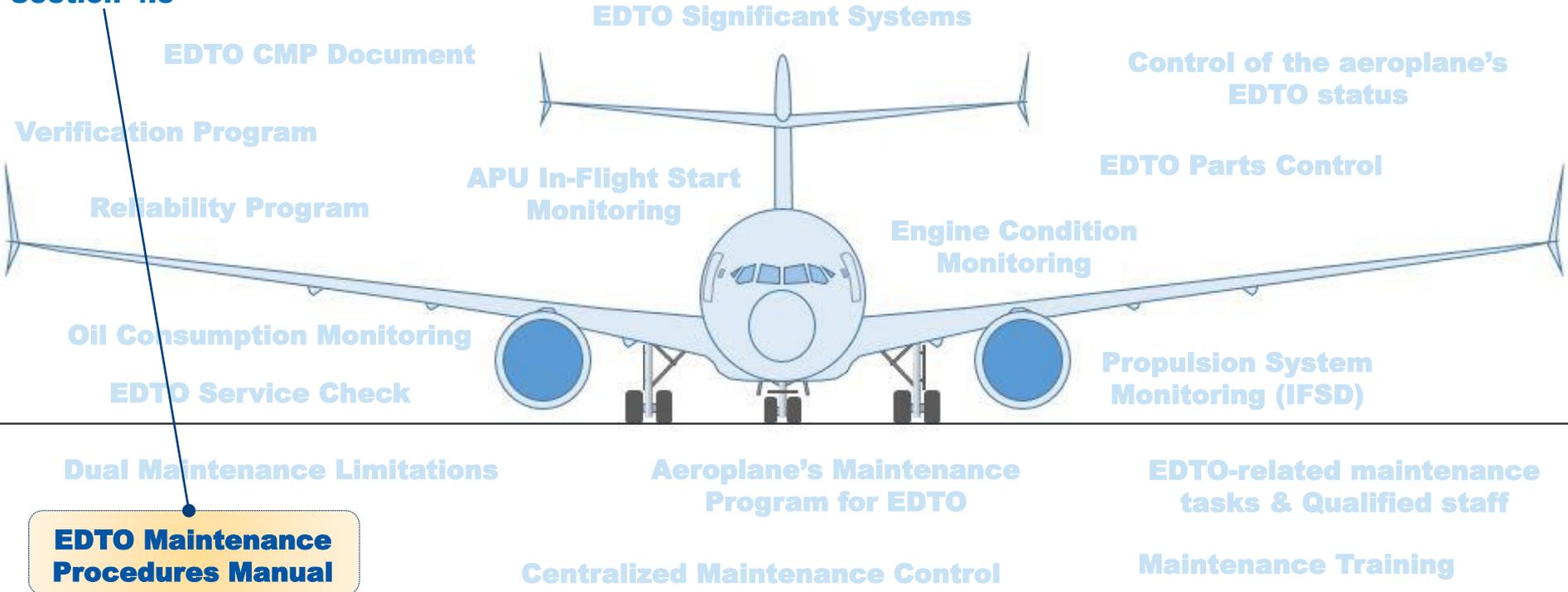
The training should be **airline-specific** and reflect Operator's maintenance procedures and forms.

EDTO qualified maintenance person will typically have:

- Previous experience on airframe/engine used
- Completed operator's EDTO training course
- Performed tasks under qualified supervision



EDTOM
Section 4.3



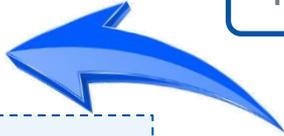


The operator should include EDTO information in the EDTO maintenance procedures manual (EMPM).

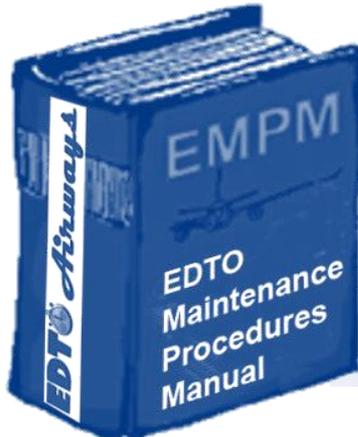
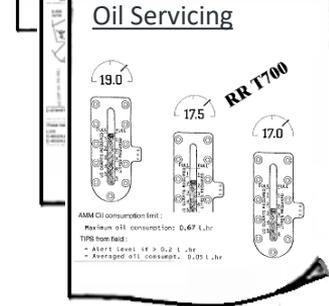
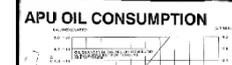
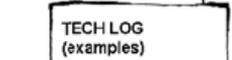
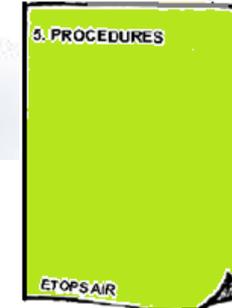
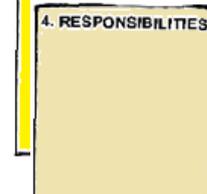
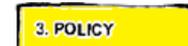
The **EMPM** should identify the operator's EDTO maintenance practices (as detailed in previous sections of this module) supporting the EDTO operations, as well as responsible persons and/or organizations.

- The EMPM contains the Operator's **requirements, policies, procedures, roles** and **responsibilities** for EDTO
- **Note** : this information may be included in relevant part(s) of the basic maintenance procedures manual (MPM) or published as a “stand alone” EMPM.

The EMPM should be subject to **revision control**, and should be reviewed and validated (approved) by the State of the Operator in the frame of the specific approval for EDTO.



SECTIONS + ATTACHMENTS



Reviewed / validated by Authority
Includes approval of substantial changes

Purpose: support implementation and application of required EDTO procedures and processes by all **involved actors**.



- Single source of information
- Easily accessed
- Ensures Awareness



Part I	EDTO Maintenance and Reliability Requirements
Part II	Operator's EDTO maintenance Program
Part III	Documentation and Training
Part IV	Summary
Part V	Practical Exercise



- The objective of EDTO regulations and standards related to Maintenance is to maintain the risk at a minimum constant value.
- Accordingly, **procedures** such as **dual maintenance**, **service check**, **oil consumption** monitoring, **APU in-flight start** tests, **configuration control**, **verification** program and **reliability** program have to be set.
- The EDTO Operator has to define and implement an **EDTO maintenance program** to address the items above.
 - Roles and responsibilities are detailed in the **EMPM**, which describes the **operator's procedures and requirements for EDTO**.
 - It also includes the **training and qualification** of the involved maintenance personnel
- **Coordination** and **communication** between Maintenance and Flight Operations organizations is necessary for safe and reliable EDTO operations.



- Part I — EDTO Maintenance and Reliability Requirements**
- Part II — Operator's EDTO maintenance Program**
- Part III — Documentation and Training**
- Part IV — Summary**
- Part V — Practical Exercise**



EDTO Workshop

End of Module 6 – Maintenance Considerations

