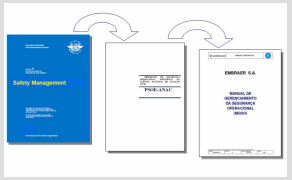
Embraer Experience with SMS Implementation

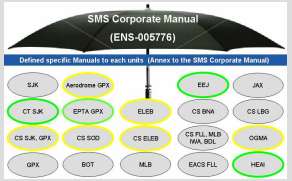
December 12, 2014

TOPICS

SMS Comprehensiveness

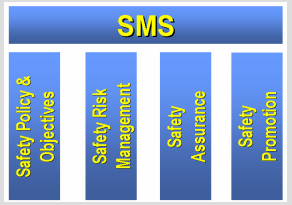


SMS Requirements

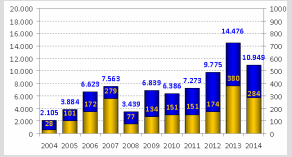


SMS Implementation – Status

SMS Implementation – Highlights

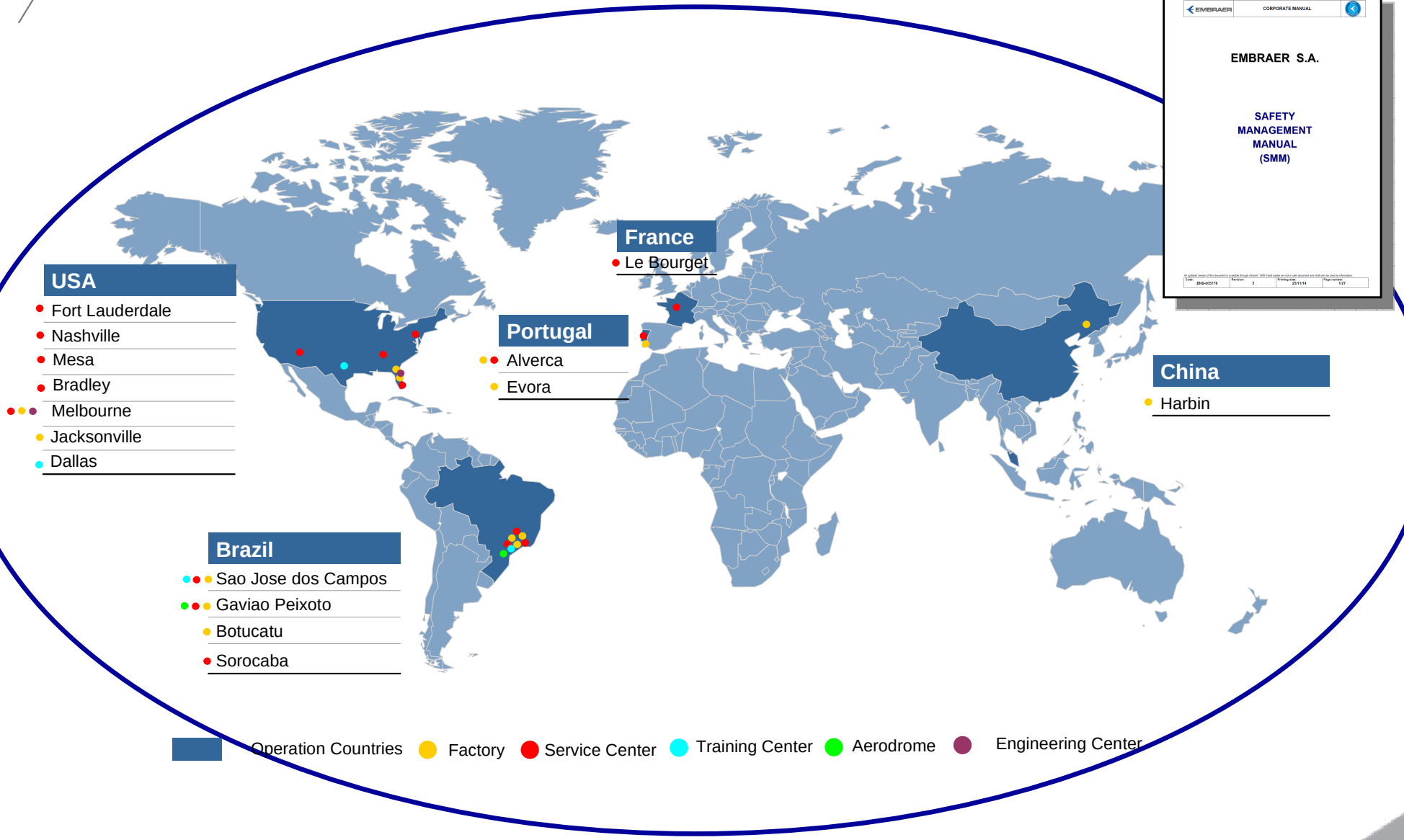


Embraer SMS – Part 21 D&M

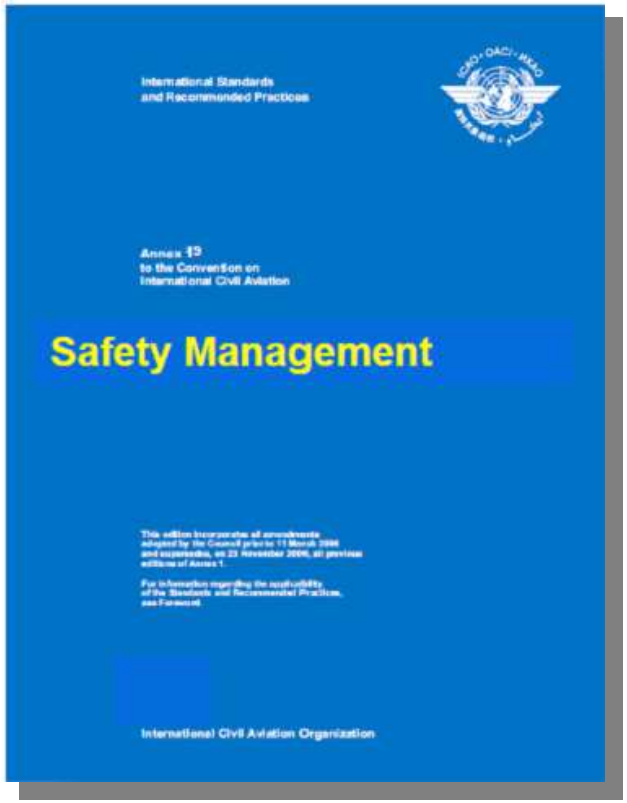


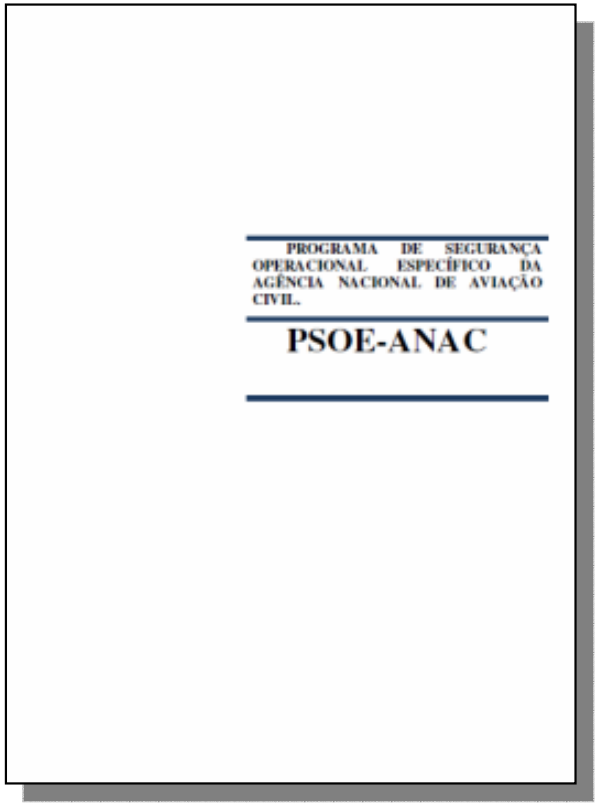
Challenges & Conclusion

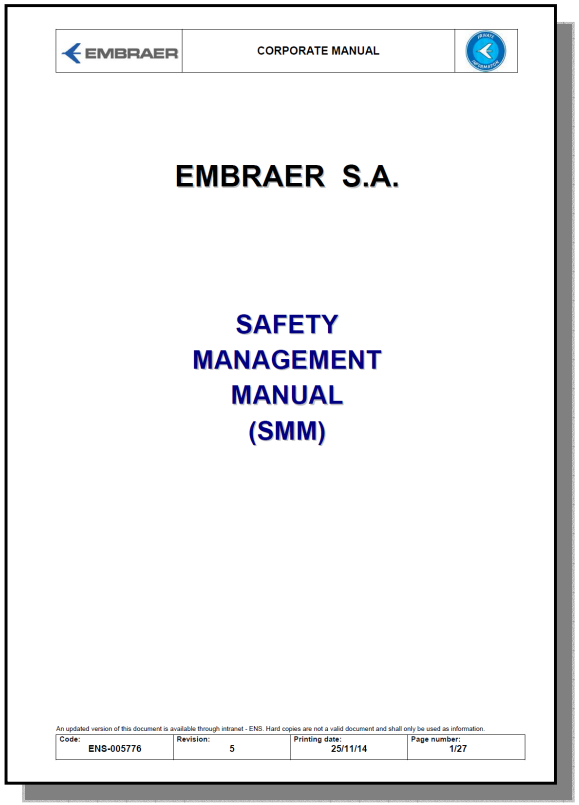
SMS Embraer – One Standard for all Regions



SMS Requirements







SMS Implementation – Status

Defined specific manuals to each units (Annex to the SMS Corporate Manual)

SJK	Aerodrome GPX		EEJ	JAX
CT SJK	EPTA GPX	ELEB	CS BNA	CS LBG
CS SJK, GPX	CS SOD	CS ELEB	CS FLL, MLB IWA, BDL	OGMA
GPX	BOT	MLB	EACS FLL	HEAI

SMS Implementation – Highlights

Air Safety Committees

Strategic

Operational

SMS Implementation – Highlights

Embraer Executive Jets (EEJ) Flight Department IS-BAO* Level 1

international business aviation council

ibac

IBAC Principal Office
Suite 16.33
999 University Street
Montreal, Quebec
H3C 5J9 Canada
Tel: (514) 954-8054
Fax: (514) 954-6161
info@ibac.org
www.ibac.org

Corporate Secretary:
1200 Eighteenth St. NW
Suite 400
Washington, DC
20036 USA
Tel: (202) 783-9000
Fax: (202) 331-8364
boine@ibac.org

"The recognized forum for leveraging strengths of Members to enhance the safety, acceptance and economic contribution of business aviation globally."

January 27, 2014

Mr. Frederico Curado
Chief Executive Officer
Embraer S.A.
Av. Brigadeiro Faria Lima, 2170
Sao Jose dos Campos, SP 12227-901
Brazil

Dear Mr. Curado:

On behalf of the International Business Aviation Council, I am pleased to congratulate you and the members of Embraer Executive Jets on achieving International Standard for Business Aircraft Operations (IS-BAO) registration. This is a significant accomplishment of which your organization can be extremely proud.

Your management and personnel invested considerable time and personal effort to develop and implement this world-class business aviation code of practice. IS-BAO is modeled on the ISO 9000 family of standards. It requires development of programs, systems, processes and procedures to meet safety and security standards. The organizational, maintenance, operational, training and security requirements are based on international standards and industry best practices. The foundation of IS-BAO is the development of a safety management system to assess and mitigate the risks encountered in your flight operations. An independent audit validated the entire process undertaken by your staff.

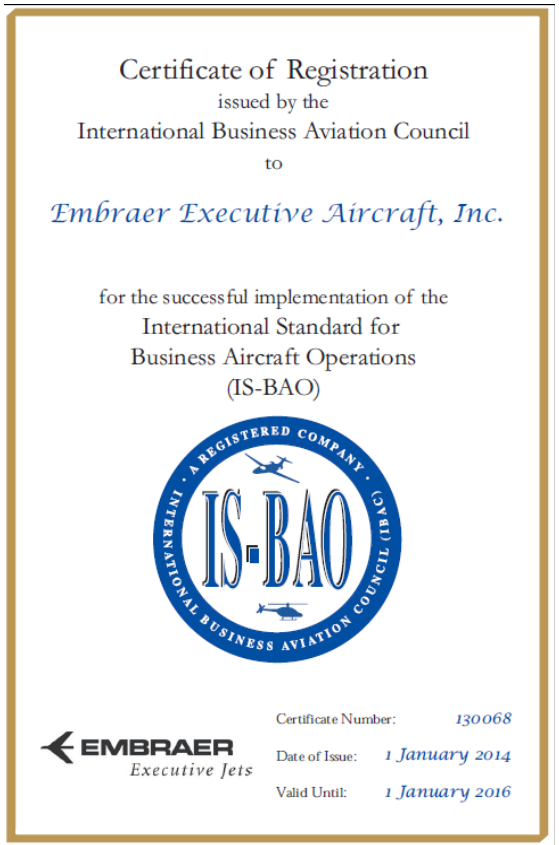
In achieving this registration milestone, Embraer Executive Jets has joined the expanding list of flight departments and operators around the world that have taken the initiative to implement the IS-BAO to manage the safety, security, efficiency and effectiveness of their operations.

Congratulations again on this significant achievement.

Sincerely,

Kurt H. Edwards
Director General

Protocolo DIP PFC → MT
Data 11 / 02 / 14



Certificate of Registration
issued by the
International Business Aviation Council
to

Embraer Executive Aircraft, Inc.

for the successful implementation of the
International Standard for
Business Aircraft Operations
(IS-BAO)

A REGISTERED COMPANY · INTERNATIONAL BUSINESS AVIATION COUNCIL (IBAC) ·
IS-BAO

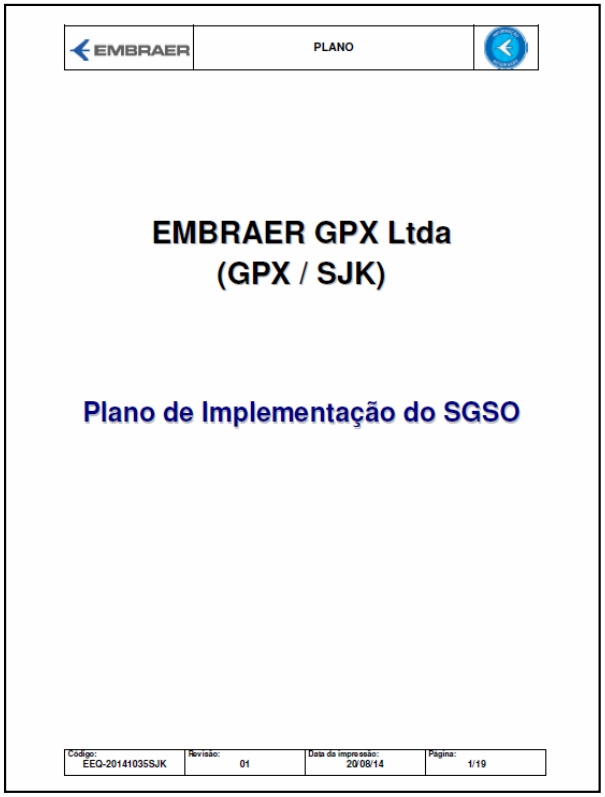
EMBRAER
Executive Jets

Certificate Number: 130068
Date of Issue: 1 January 2014
Valid Until: 1 January 2016

(*) IS-BAO: International Standard for Business Aircraft Operations

SMS Implementation – Highlights

Implementation Plan (Service Centers) approved by ANAC


EMBRAER | PLANO

EMBRAER GPX Ltda
(GPX / SJK)

Plano de Implementação do SGSO

Código:	Revisão:	Data da impressão:	Página:
EEQ-20141035SJK	01	20/08/14	1/19


EMBRAER | PLANO

CENTRO DE SERVIÇOS ELEB
ELEB Equipamentos LTDA
ELEB

Plano de Implementação do SGSO

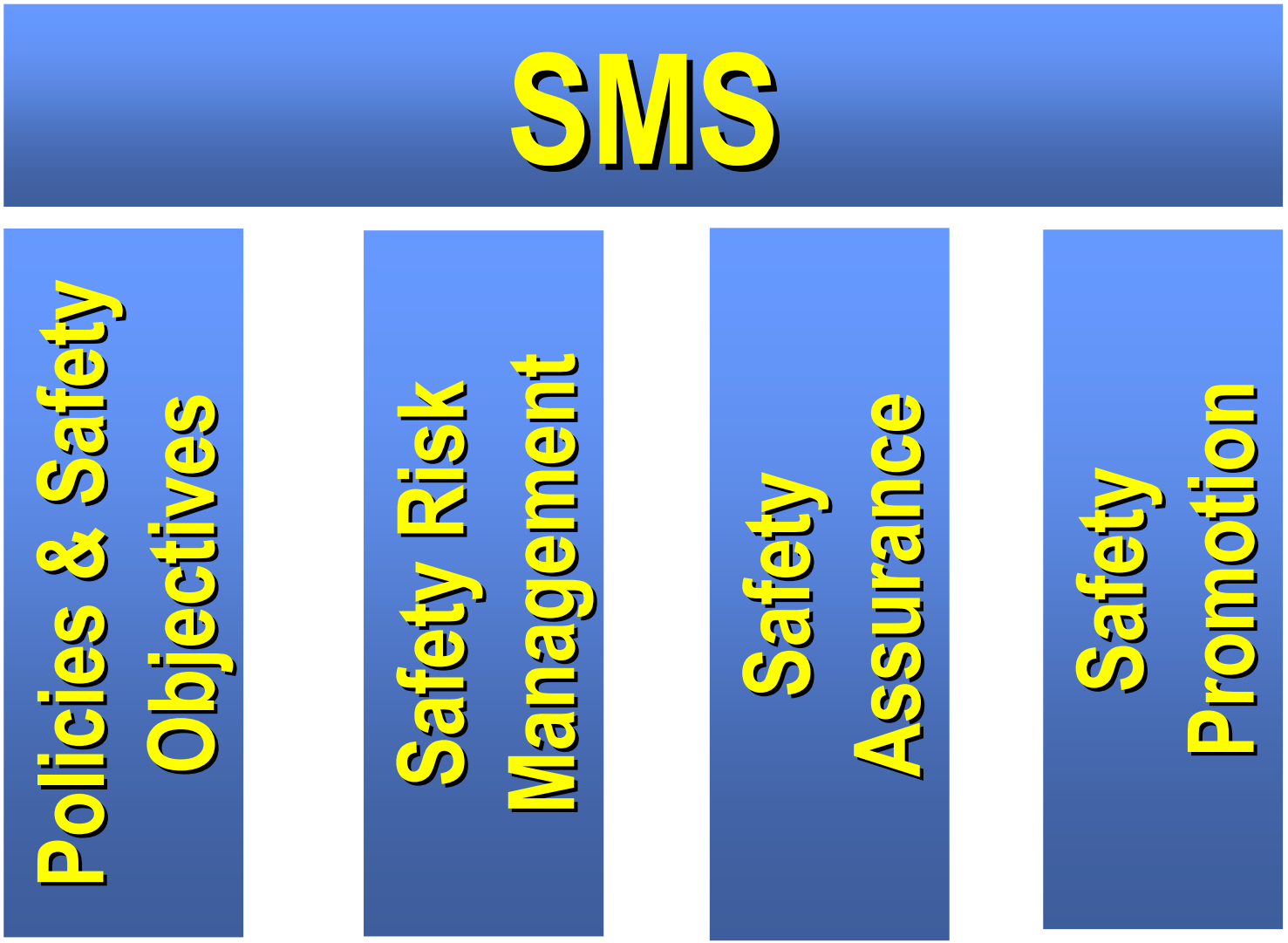
Código:	Revisão:	Data da impressão:	Página:
STQ-132/14	01	06/03/14	1/22

SMS Implementation – Highlights

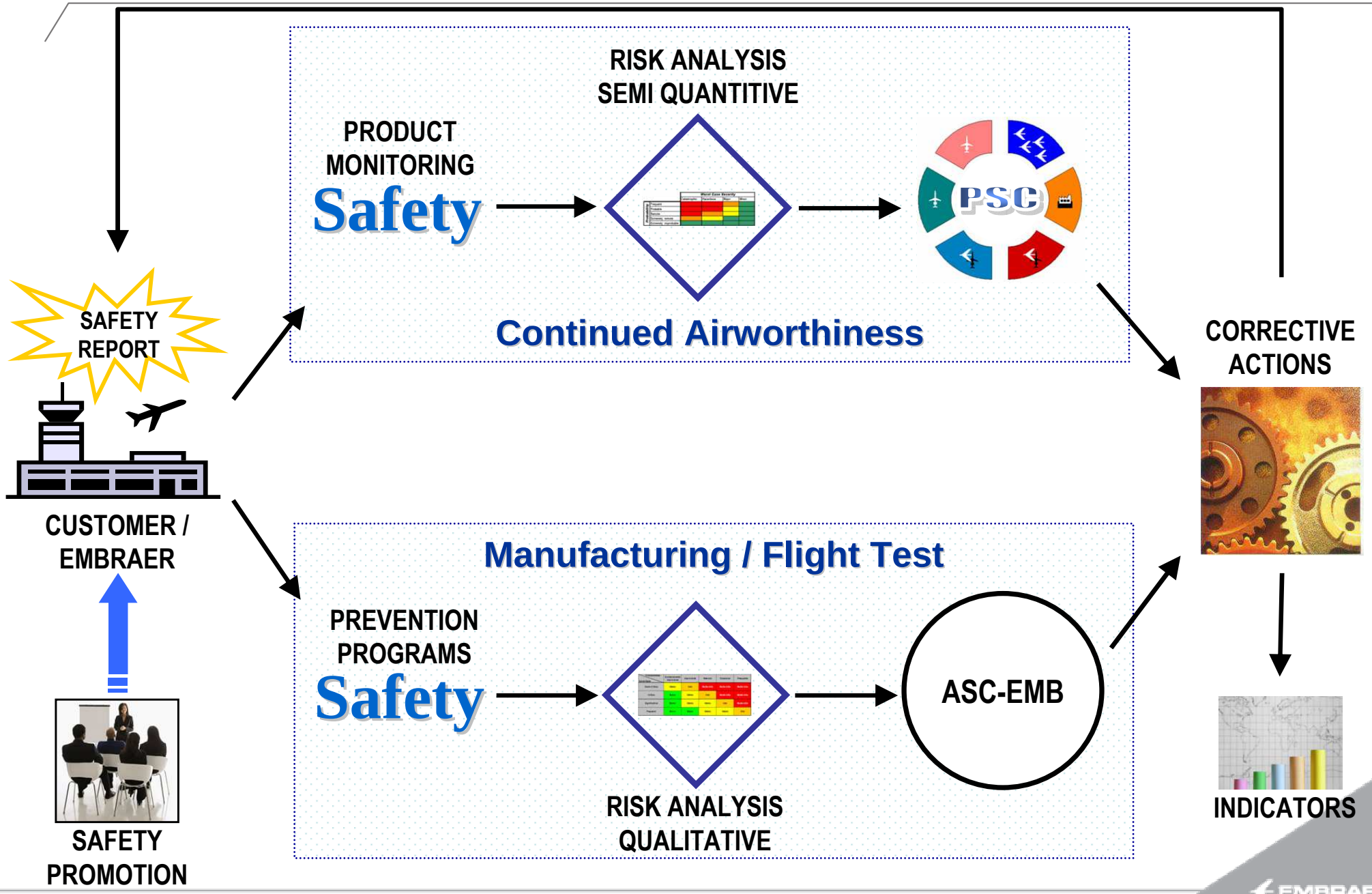
Airbus (France), **Dassault Aviation** (France), **Airbus Helicopters** (France), **Rolls-Royce** (UK), **Lufthansa Technik** (Germany), **Jet Aviation AG** (Switzerland), **Beechcraft** Berlin (Germany), **P3** Voith (Switzerland), **SR Technics** (Switzerland), **Marshall** ADG (UK), **HB** Flugtechnik (Austria)

Embraer SMS - Part 21 Design & Manufacturing (D&M)

Embraer SMS Components



Embraer SMS



RISK ANALYSIS

SEMI QUANTITATIVE

- For events involving system failures, malfunctions or defects on customer aircraft.
- The results are obtained using system safety assessments and historical data.

QUALITATIVE

- For Embraer operated aircraft.
- The results are obtained through subjective analysis, not providing numerical data.

Embraer SMS

RISK ANALYSIS
SEMI QUANTITIVE

PRODUCT
MONITORING
Safety

PSC

Continued Airworthiness

SAFETY
REPORT

CUSTOMER /
EMBRAER

SAFETY
PROMOTION

CORRECTIVE
ACTIONS

INDICATORS

Manufacturing / Flight Test

PREVENTION
PROGRAMS
Safety

ASC-EMB

RISK ANALYSIS
QUALITATIVE

Product Safety Monitoring

ESTABLISH MONITOR PARAMETERS

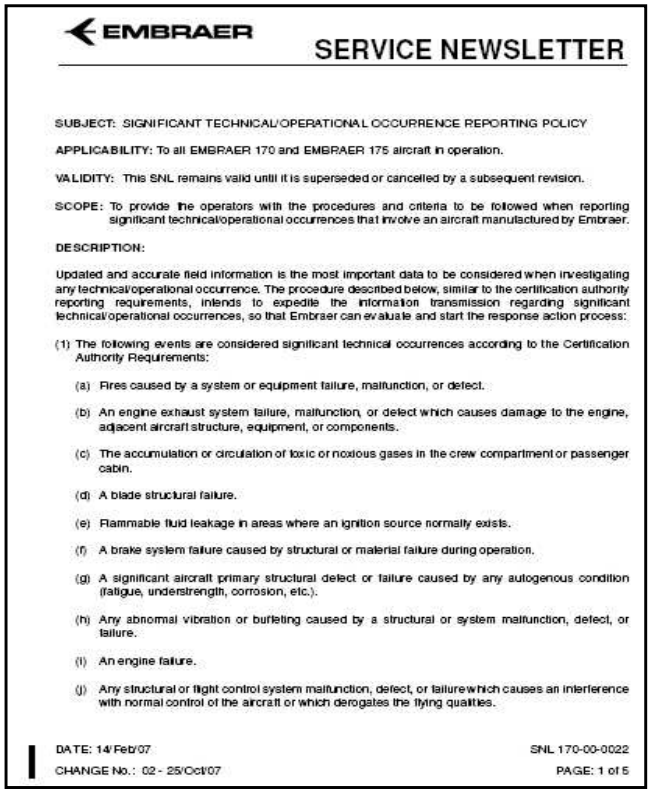
MONITOR FOR EVENTS

ASSESS EVENT & RISK

DEVELOP ACTION PLAN

ACTION PLAN DISPOSITION

Service Newsletters gives reporting guidelines to the operators, with the procedures and criteria to be followed when reporting significant occurrences. A work instruction provides reporting guidelines to Embraer Technical Representatives.



EMBRAER

SERVICE NEWSLETTER

SUBJECT: SIGNIFICANT TECHNICAL/OPERATIONAL OCCURRENCE REPORTING POLICY

APPLICABILITY: To all EMBRAER 170 and EMBRAER 175 aircraft in operation.

VALIDITY: This SNL remains valid until it is superseded or cancelled by a subsequent revision.

SCOPE: To provide the operators with the procedures and criteria to be followed when reporting significant technical/operational occurrences that involve an aircraft manufactured by Embraer.

DESCRIPTION:

Updated and accurate field information is the most important data to be considered when investigating any technical/operational occurrence. The procedure described below, similar to the certification authority reporting requirements, intends to expedite the information transmission regarding significant technical/operational occurrences, so that Embraer can evaluate and start the response action process:

(1) The following events are considered significant technical occurrences according to the Certification Authority Requirements:

(a) Fires caused by a system or equipment failure, malfunction, or defect.

(b) An engine exhaust system failure, malfunction, or defect which causes damage to the engine, adjacent aircraft structure, equipment, or components.

(c) The accumulation or circulation of toxic or noxious gases in the crew compartment or passenger cabin.

(d) A blade structural failure.

(e) Flammable fluid leakage in areas where an ignition source normally exists.

(f) A brake system failure caused by structural or material failure during operation.

(g) A significant aircraft primary structural defect or failure caused by any autogenous condition (fatigue, understrength, corrosion, etc.).

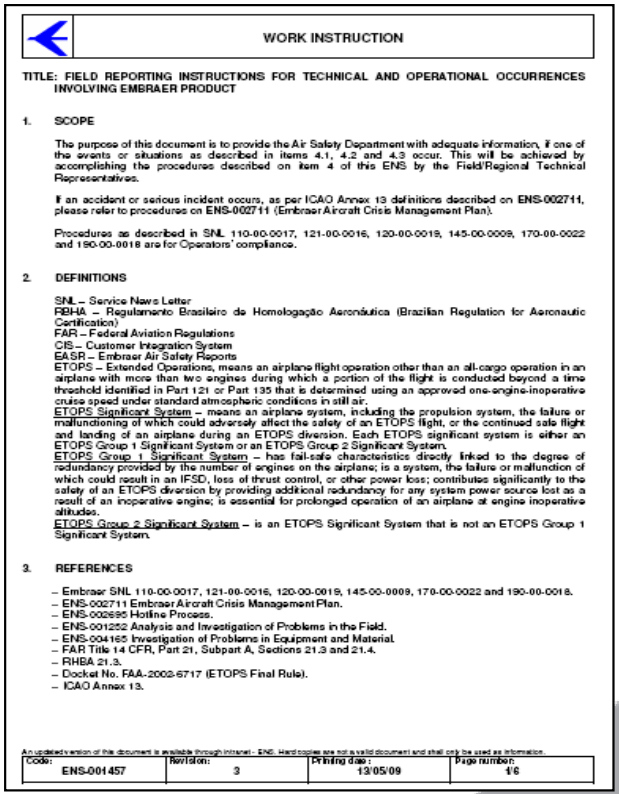
(h) Any abnormal vibration or buffeting caused by a structural or system malfunction, defect, or failure.

(i) An engine failure.

(j) Any structural or flight control system malfunction, defect, or failure which causes an interference with normal control of the aircraft or which derogates the flying qualities.

DATE: 14/Feb/07 SNL 170-00-0022

CHANGE No.: 02 - 25/Oct/07 PAGE: 1 of 5



WORK INSTRUCTION

TITLE: FIELD REPORTING INSTRUCTIONS FOR TECHNICAL AND OPERATIONAL OCCURRENCES INVOLVING EMBRAER PRODUCT

1. SCOPE

The purpose of this document is to provide the Air Safety Department with adequate information, if one of the events or situations as described in items 4.1, 4.2 and 4.3 occur. This will be achieved by accomplishing the procedures described on item 4 of this ENS by the Field/Regional Technical Representatives.

If an accident or serious incident occurs, as per ICAO Annex 13 definitions described on ENS-002711, please refer to procedures on ENS-002711 (Embraer Aircraft Crisis Management Plan).

Procedures as described in SNL 110-00-0017, 121-00-0016, 120-00-0019, 145-00-0009, 170-00-0022 and 190-00-0018 are for Operators' compliance.

2. DEFINITIONS

SNL – Service News Letter
RBHA – Regulamento Brasileiro de Homologação Aeronáutica (Brazilian Regulation for Aeronautic Certification)
FAR – Federal Aviation Regulations
CIS – Customer Integration System
EASR – Embraer Air Safety Reports
ETOPS – Extended Operations, means an airplane flight operation other than an all-cargo operation in an airplane with more than two engines during which a portion of the flight is conducted beyond a time threshold identified in Part 121 or Part 135 that is determined using an approved one-engine-inoperative cruise speed under standard atmospheric conditions in still air.
ETOPS Significant System – means an airplane system, including the propulsion system, the failure or malfunctioning of which could adversely affect the safety of an ETOPS flight, or the continued safe flight and landing of an airplane during an ETOPS diversion. Each ETOPS significant system is either an ETOPS Group 1 Significant System or an ETOPS Group 2 Significant System.
ETOPS Group 1 Significant System – has fail-safe characteristics directly linked to the degree of redundancy provided by the number of engines on the airplane; is a system, the failure or malfunction of which could result in an IFSD, loss of thrust control, or other power loss; contributes significantly to the safety of an ETOPS diversion by providing additional redundancy for any system power source lost as a result of an inoperative engine; is essential for prolonged operation of an airplane at engine inoperative altitudes.
ETOPS Group 2 Significant System – is an ETOPS Significant System that is not an ETOPS Group 1 Significant System.

3. REFERENCES

– Embraer SNL 110-00-0017, 121-00-0016, 120-00-0019, 145-00-0009, 170-00-0022 and 190-00-0018.
– ENS-002711 Embraer Aircraft Crisis Management Plan.
– ENS-002695 Hotline Process.
– ENS-001252 Analysis and Investigation of Problems in the Field.
– ENS-004165 Investigation of Problems in Equipment and Material.
– FAR Title 14 CFR, Part 21, Subpart A, Sections 21.3 and 21.4.
– RHBA 21.3.
– Docket No. FAA-2003-5717 (ETOPS Final Rule).
– ICAO Annex 13.

An updated version of this document is available through Intranet - ENS. Hard copies are not a valid document and shall only be used as information.

Code:	Revision:	Printing date:	Page number:
ENS-001457	3	13/05/09	1/6

Product Safety Monitoring

ESTABLISH MONITOR PARAMETERS

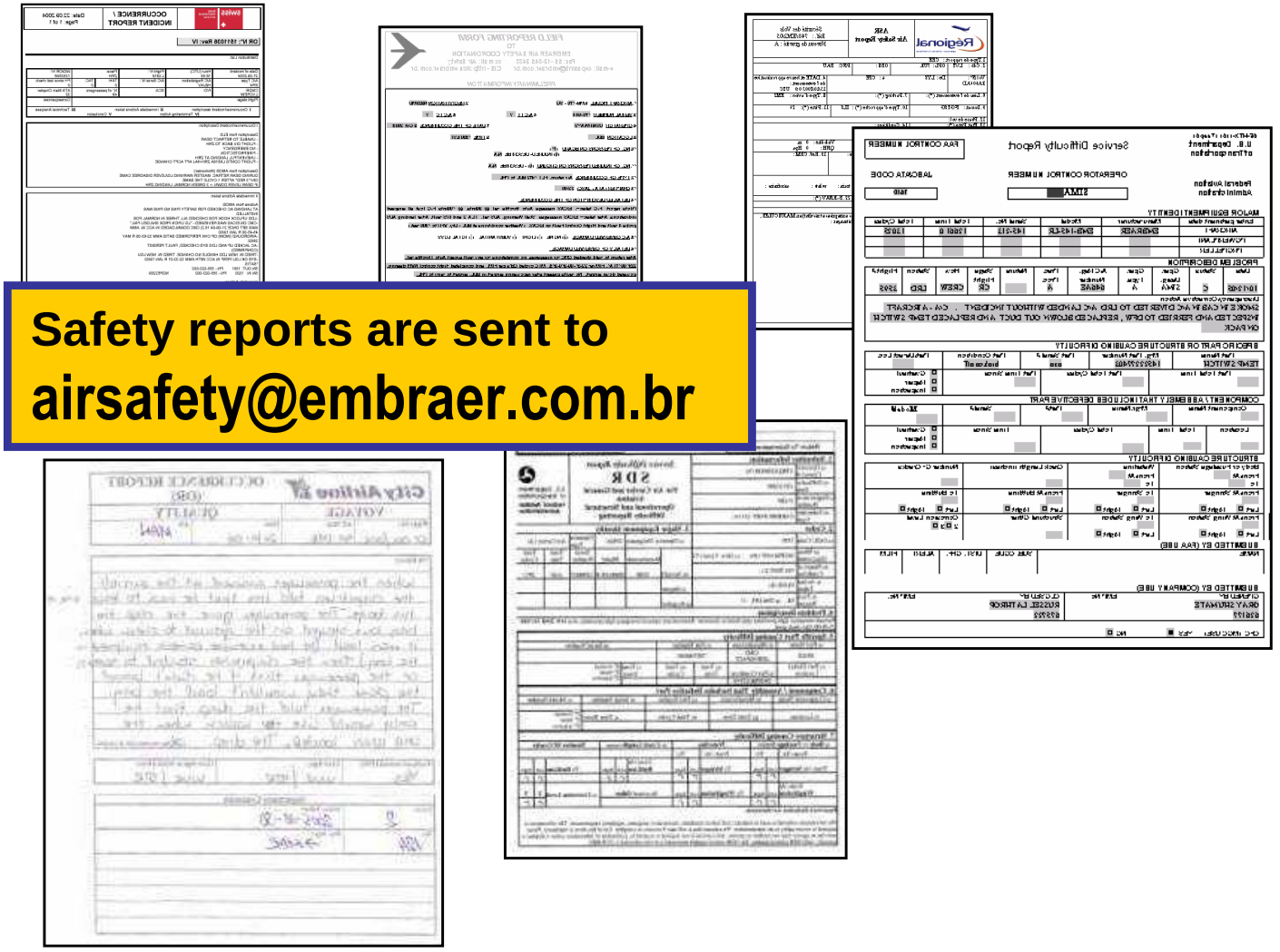
MONITOR FOR EVENTS

ASSESS EVENT & RISK

DEVELOP ACTION PLAN

ACTION PLAN DISPOSITION

Safety reports are sent to airsafety@embraer.com.br



Product Safety Monitoring – Example ERJ-145

ESTABLISH MONITOR PARAMETERS

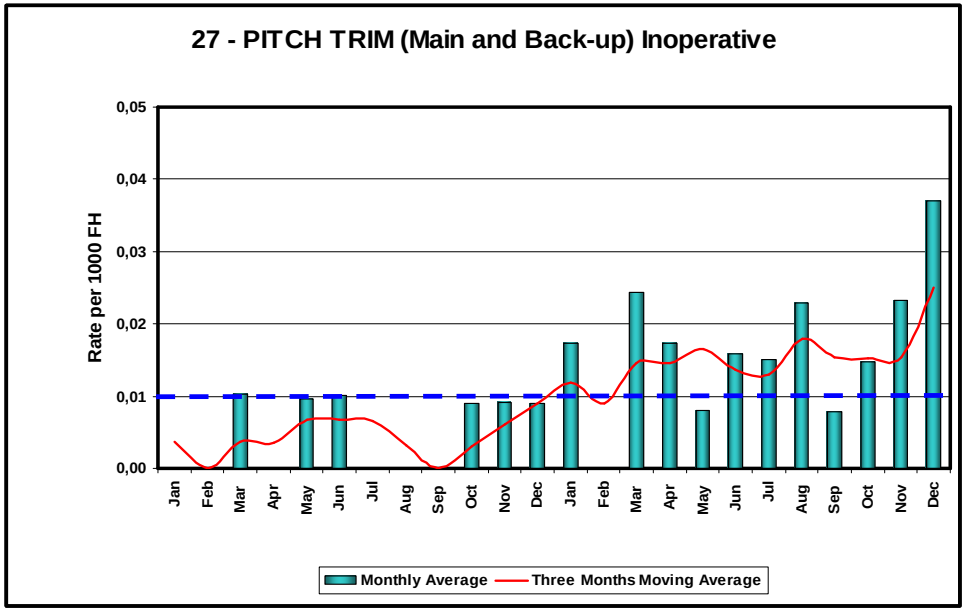
MONITOR FOR EVENTS

ASSESS EVENT & RISK

DEVELOP ACTION PLAN

ACTION PLAN DISPOSITION

Example: ERJ-145 reports monitoring identified an unusual rate of dual pitch trim shutdowns (main and backup channels).



Product Safety Monitoring

ESTABLISH MONITOR PARAMETERS

MONITOR FOR EVENTS

ASSESS EVENT & RISK

DEVELOP ACTION PLAN

ACTION PLAN DISPOSITION

Identified issues are subjected to a risk assessment involving Air Safety, Engineering, Customer Support, Airworthiness, Operations and other related areas.

Risk Treatment

Risk – Potential effect of the hazard, expressed as combination of consequence and Likelihood.

Hazard – Existing source of potential damage, injury or adverse, effects

Risk Assessment

Qualitative

Risk probability	Risk severity				
	Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely improbable 1	1A	1B	1C	1D	1E

Semi Quantitative

Reported Condition:	Severity (s)	Probability(p)	s . p
Pitch Trim Main and Backup inoperative in cruise flight	2	4	8

Conditions that may increase severity:	Severity (s)	Probability(p)	s . p
Pitch Trim Main and Backup inoperative as soon as airborne, trimmed nose-up	2	3	6

Severity (s)	Probability Level (p)
1 - Minor	5 – Frequent (1 to 10–3)
2 – Major	4 – Probable (10–3 to 10–5)
3 – Hazardous	3 – Remote (10–5 to 10–7)
4 – Catastrophic	2 – Extremely remote (10–7 to10–9)
	1 - Extremely improbable (≤10–9)

RI	ACTION
1 to 5	Monitoring
6, 7, 8	System Review
9, 10, 11	Risk Reduction
>= 12	Immediate Risk Reduction

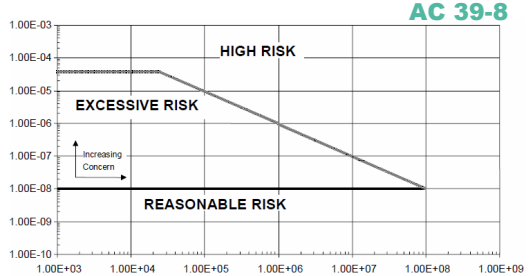
Worst Case Highest value of (s x p)→	8
✚	
Level of Control (High =0, Med =1, Low =2)	1
Preliminary Risk Index **RI =**	**9**

Quantitative

TARAM

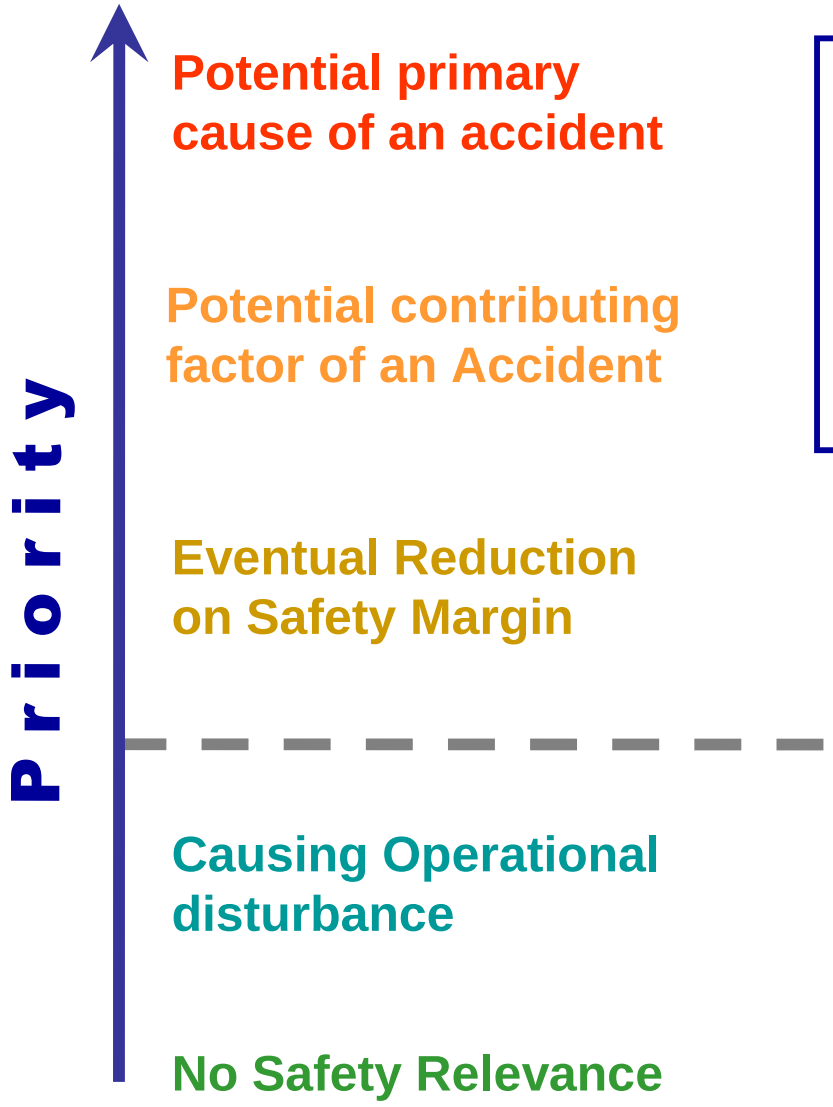
RISK VALUES	Applicable Formula R =Probability x Conditional Probability x Severity	VALUE
Total Uncorrected Fleet Risk (weighted events)	RT = [F x U x Σ x T] x [CP] x [IR] = 3.0E-7 X 8 X 483 x 12775 x 1 x 0.16	2.3
Uncorrected Individual Risk (fatalities per flight hour)	RI = [FI] x [CPI] x [IR] = 3.0E-7 X 1 X 0.16	4.8E-8
90-Day Fleet Risk (fatalities)	R90 = [F x U90 x Σ 90 x 90] x [CP90] x [IR x EO] = 3.0E-7 X 8 X 704 x 90 x 1 x 0.16 x 78	1.9
Control Program Fleet Risk (fatalities)	RC = [F x UC x Σ C x TC] x [CPC] x [IR x EO] = 3.0E-7 X 8 X 704 x 270 x 1 x 0.16 x 78	5.7
Control Program Individual Risk (fatalities per flight hour)	RCI = [FCI] x [CPCI] x [IR] = 3.0E-7 X 1 X 0.16	4.8E-8

AC 39-8



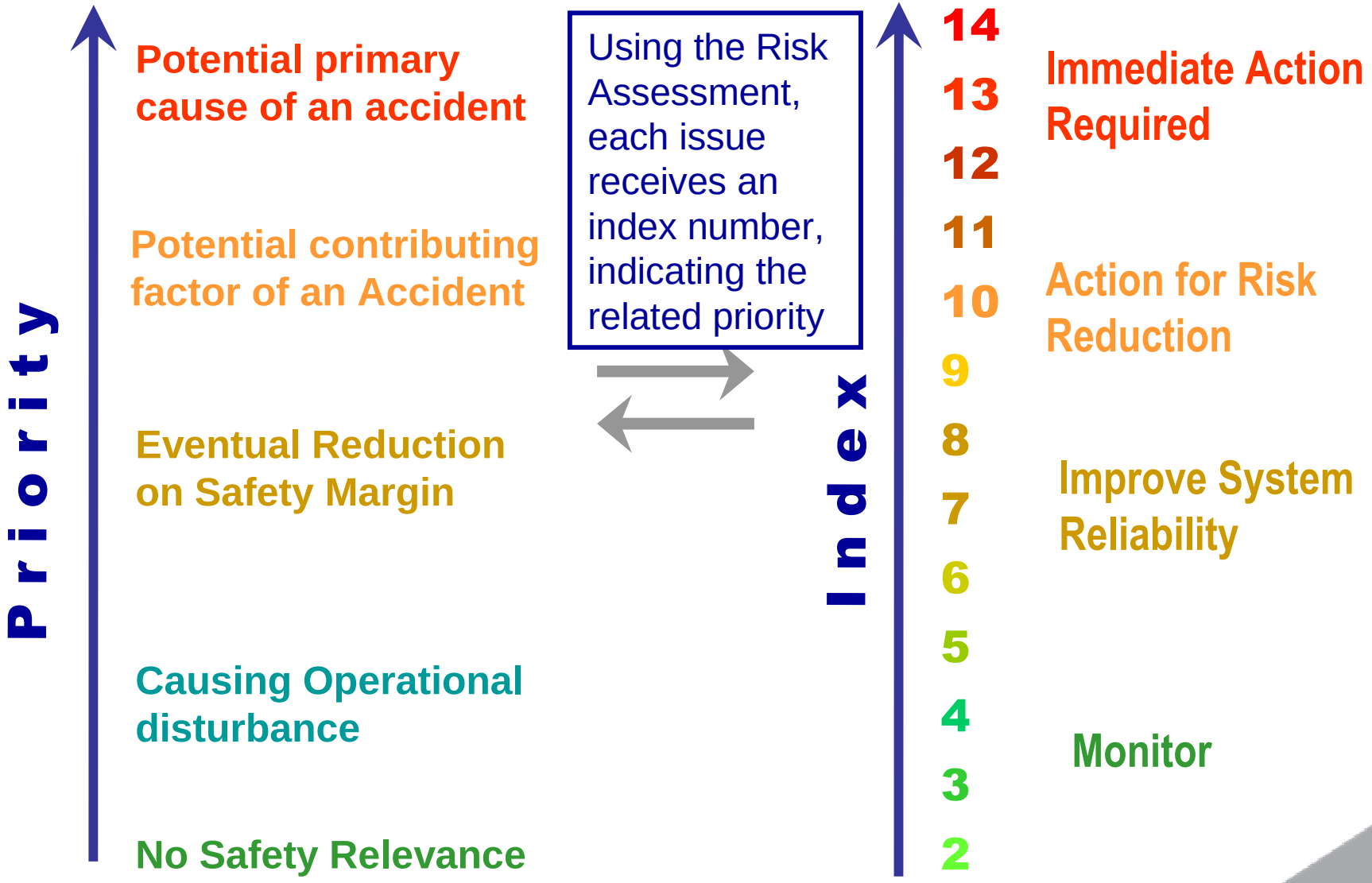
FAA

Traditional Approach



The traditional approach divided the issues into **Safety Concern** and **No Safety Concern** categories. This approach is very subjective and does not establish priorities for the safety related issues.

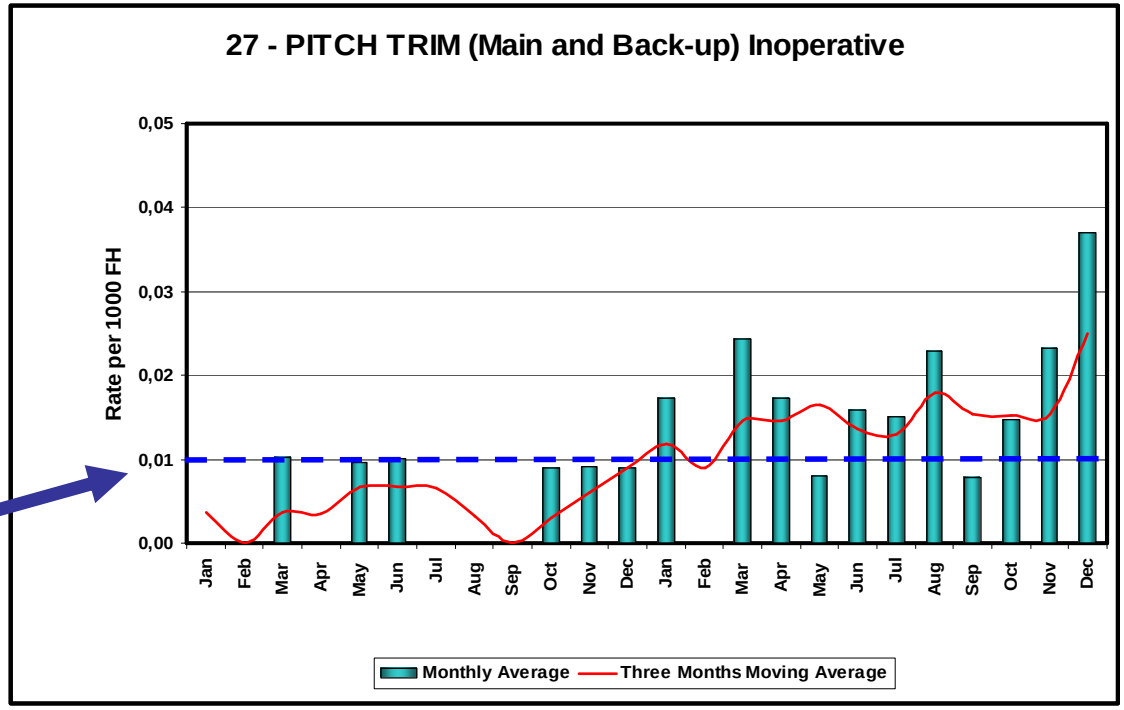
Embraer Risk Assessment Approach



Risk Assessment Based on FAA AC 25.1309

Example: Rate of **dual pitch trim shutdowns** (main and backup channels).

FAA AC 25.1309 reference for a Major Condition



Risk Index Calculation – Example ERJ-145

Severity Classification

1 – Minor
Slight reduction of safety margins
Routine changes of flight plan

2 – Major
Significant reduction of safety margins
Reduction of crew ability to cope with situation
Physical effects / injuries to occupants

3 – Hazardous
Large reduction of safety margins
Crew cannot be relied upon to implement defenses
Injuries / death of small proportion of occupants

4 – Catastrophic
Possible loss of airplane with multiple fatalities

x

Probability Level

5 – Frequent (P ≥ 10-3)

4 – Probable (10-3 to 10-5)
May occur one or more times during the operational life of each airplane of the fleet

3 – Remote (10-5 to 10-7)
Unlikely to occur to each airplane, but may occur several times during the operational life of the fleet

2 – Extremely remote (10-7 to 10-9)
Not expected to occur to each airplane, but may occur a few times during the operational life of the fleet

1 – Extremely improbable (P ≤10-9)
Not expected to occur

+

Level of control

1

=

Risk Index - RI

2 3 4 5 6 7 8 **9** 10 11 12 13 14

Product Safety Monitoring

ESTABLISH MONITOR PARAMETERS

MONITOR FOR EVENTS

ASSESS EVENT & RISK

DEVELOP ACTION PLAN

ACTION PLAN DISPOSITION

The safety priority can be directly perceived by all involved areas of the company, with a proposed reference schedule for action definition and availability.

	IMMEDIATE RISK REDUCTION			RISK REDUCTION			SYSTEM REVIEW
RI	≥ 14	13	12	11	10	9	8
DEFINE ACTION	12 HOURS	2 DAYS	3 DAYS	1 MONTH	2 MONTH	3 MONTH	6 MONTH
ACTION AVAILABILITY	24 HOURS	4 DAYS	1 WEEK	2 MONTH	3 MONTH	6 MONTH	18 MONTH
TIME FOR ACTION ACCOMPLISHMENT	NEXT FLIGHT	50 FH	100 FH	A*	5A*	1C*	2C*

Product Safety Monitoring

The results of the risk assessment, investigation status and actions proposal are presented to the Embraer Product Safety Committee (PSC), composed by representatives of different areas involved with the product.

- ESTABLISH MONITOR PARAMETERS
- MONITOR FOR EVENTS
- ASSESS EVENT & RISK
- **DEVELOP ACTION PLAN**
- ACTION PLAN DISPOSITION

- Commercial Aviation Engineering
- Executive Aviation Engineering
- Airworthiness and Air Safety Assistant
- Customer Support Commercial
- Customer Support Executive
- Flight Tests and Operations

- PSC CHAIRMAN: Product Integrity Vice President
- Chief Engineer

COORDINATION PRODUCT INTEGRITY

- Defense Aviation Programs/Engineering
- Customer Support Defense
- Procurement / Supplies
- Commercial Aviation Programs
- Executive Aviation Programs
- Air Safety

Product Safety Monitoring

The Closing-the-Loop Concept

ESTABLISH MONITOR PARAMETERS

MONITOR FOR EVENTS

ASSESS EVENT & RISK

DEVELOP ACTION PLAN

ACTION PLAN DISPOSITION

Product Safety Monitoring – Example ERJ-145

Example: ERJ-145 Reports monitoring identified an unusual rate of **dual pitch trim shutdowns** (main and backup channels)

- ESTABLISH MONITOR PARAMETERS
- MONITOR FOR EVENTS
- ASSESS EVENT & RISK
- DEVELOP ACTION PLAN
- **ACTION PLAN DISPOSITION**

O.B. N°: 145-005/03
DATE: Dec 08, 2003

OPERATIONAL BULLETIN

EMB145

V - OPERATING INFORMATION:

If a pitch trim dual channel shutd
shall follow the current AFM pr
shown to be controllable with the
all phases of flight.

The pitch trim system can be re
dual channel shutdown event b
Breakers.

EMBRAER EMPRESA BRASILEIRA DE AERONÁUTICA S/A - S.JOSÉ DOS

SERVICE BULLETIN

FLIGHT CONTROLS – REPLACEMENT OF THE HORIZONTAL STABIL
CONTROL UNIT (HSCU) FOR THE NEW PITCH TRIM SYSTEM

1. PLANNING INFORMATION

A. EFFECTIVITY

Aircraft affected:

MODEL	SN
EMB-145( ) and EMB-135( )	145004 thru 145362, 145364 thru 145411, 145413 thru 145461, 145463 thru 145483, 145485 thru 145494, 145496 thru 145504,

SERVIÇO PÚBLICO FEDERAL

DEPARTAMENTO DE AVIAÇÃO CIVIL

BRAZILIAN AIRWORTHINESS DIRECTIVE

EFFECTIVE DATE	AD No.:
28 Nov. 2004	2004-11-01

The following Airworthiness Directive (AD), issued by the Departamento de Aviação Civil (DAC) in accordance with provisions of Chapter IV, Title III of Código Brasileiro de Aeronáutica - Law No. 7,565 dated 19 December 1986 - and Regulamento Brasileiro de Homologação Aeronáutica (RBHA) 39, applies to all aircraft registered in the Registro Aeronáutico Brasileiro. No person may operate an aircraft to which this AD applies, unless it has previously complied with the requirements established herein.

AD No. 2004-11-01 - EMBRAER - Amendment 39-1050.

APPLICABILITY:

This Airworthiness Directive is applicable to all Embraer EMB-145( ) and EMB-135( ) aircraft models in operation.

CANCELLATION / REVISION:

Not applicable.

REASON:

It has been found the occurrence of cases of loss of the pitch trim system due to a simultaneous failure of both channels of the horizontal stabilizer control unit (HSCU), which results in difficulty to control the aircraft when the failure occurs immediately after take-off.

Since this condition may occur in other airplanes of the same type and affects flight safety, a corrective action is required. Thus, sufficient reason exists to request compliance with this AD in the indicated time limit.

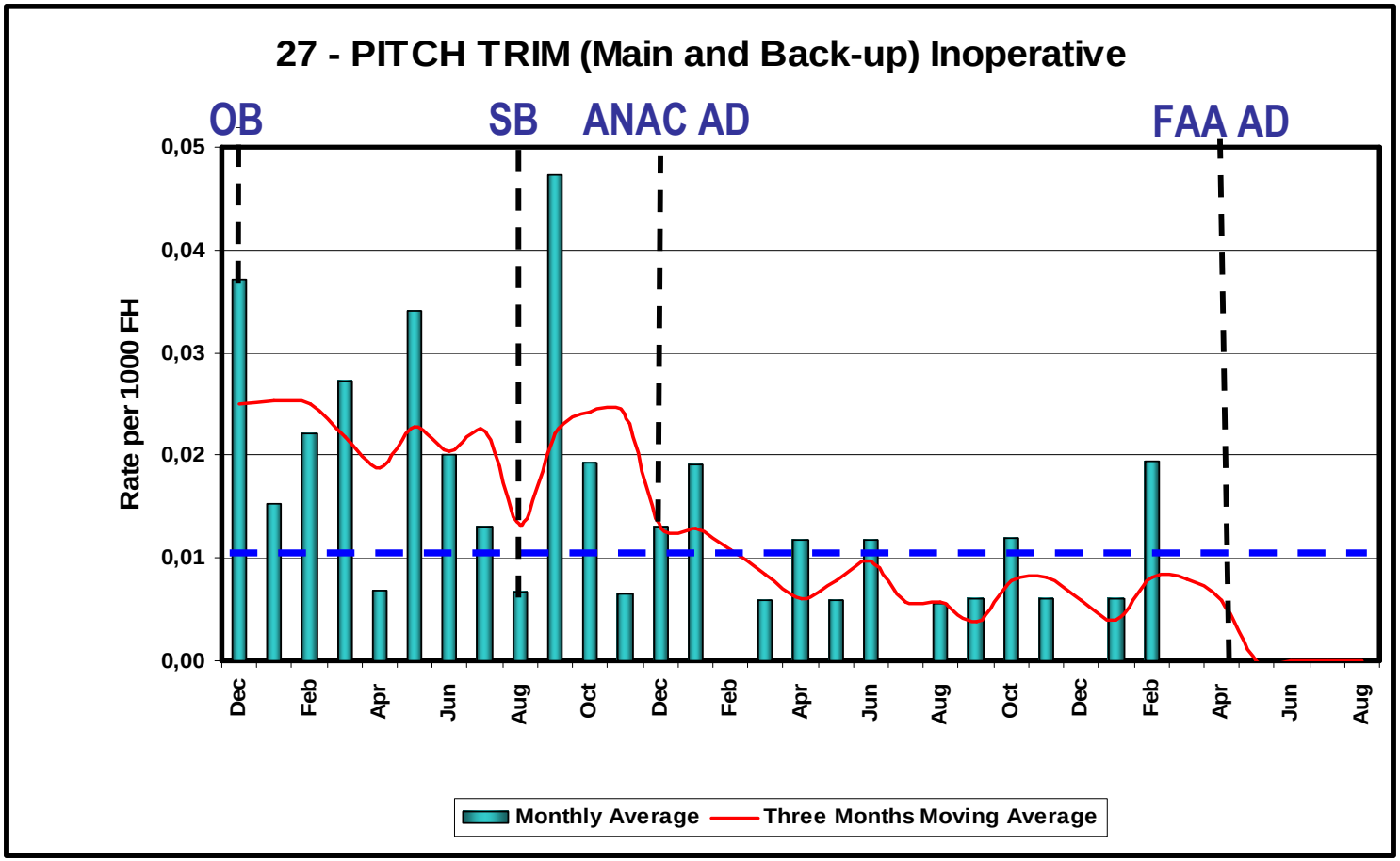
REQUIRED ACTION:

Replacement of the horizontal stabilizer control unit (HSCU) with one bearing a new P/N.

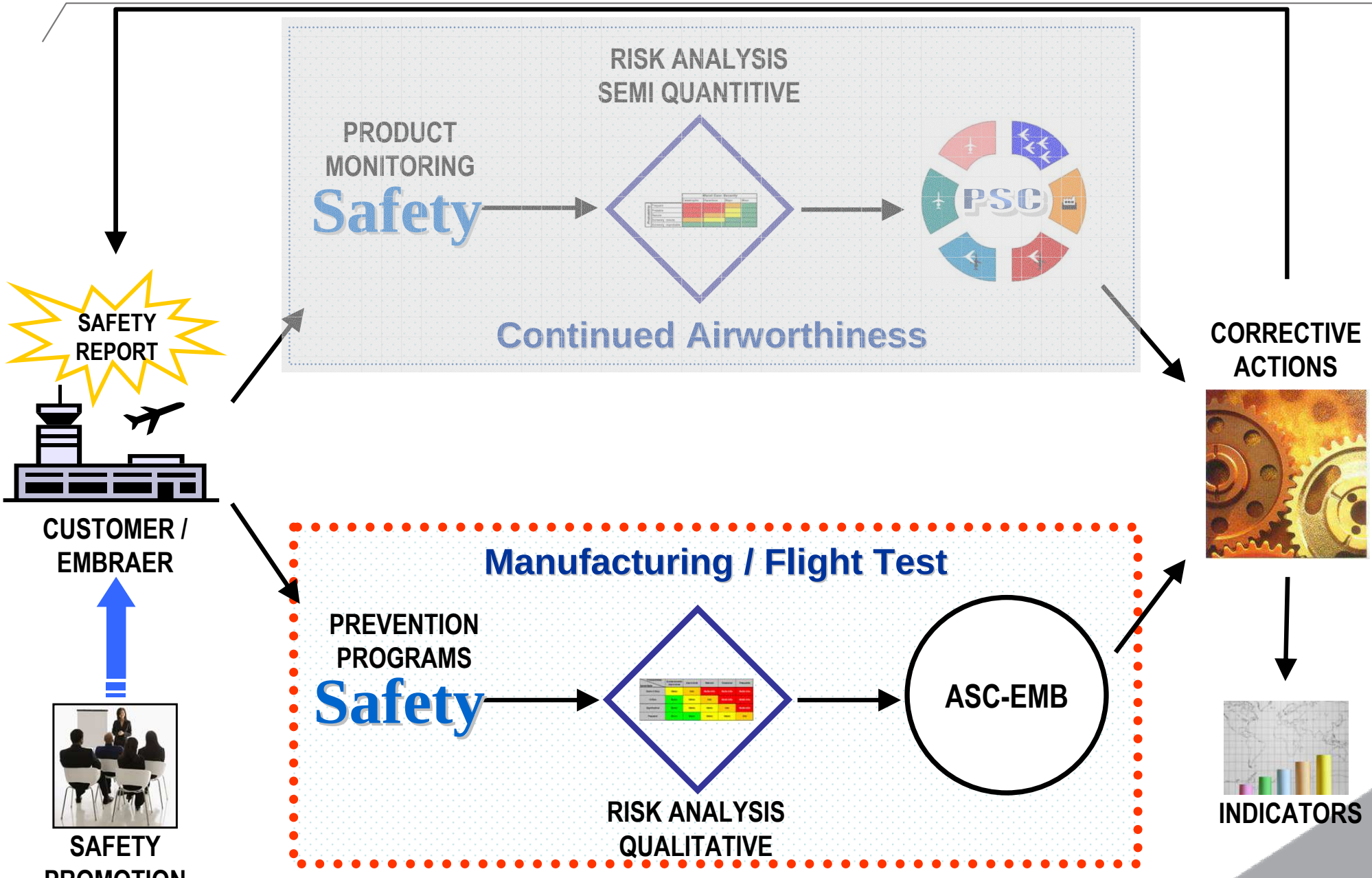
Product Safety Monitoring – Example ERJ-145

Example: ERJ-145 Reports monitoring identified an unusual rate of **dual pitch trim shutdowns** (main and backup channels)

- ESTABLISH MONITOR PARAMETERS
- MONITOR FOR EVENTS
- ASSESS EVENT & RISK
- DEVELOP ACTION PLAN
- **ACTION PLAN DISPOSITION**



Embraer SMS



RISK ANALYSIS – QUALITATIVE

Risk Matrix

Severity / Probability	Catastrophic A	Hazardous B	Major C	Minor D	Negligible E
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2	2A	2B	2C	2D	2E
Extremely Improbable 1	1A	1B	1C	1D	1E

RISK ANALYSIS – QUALITATIVE

Actions deadline matrix

		Risk Mitigation		
Risk Criteria		**Intolerable**	**Tolerable**	**Acceptable**
Actions definitions		**2 days**	**15 days**	**Monitoring**
Actions implemetation		**7 days**	**6 months**	

Safety Promotion

Safety Weeks 2014

- Embraer SJK – **2.145 participations**
- Embraer GPX – **567 participations**
- Embraer BOT – **447 participations**
- Embraer HEAI – **572 participations**
- Embraer MLB – **114 participations**

SMS Challenges

- To assure SMS standardization and integration in all sites, avoiding rework
- To define the time-frame schedule for each region according to the local authorities deadlines
- Complexity and diversity of Embraer operations (Design & Manufacturing, Service Centers, Flight Operations, Flight Tests, Training Centers, Airport, etc)
- To have SMS implemented in the context of a certified Design Organization


Questions


Thank You!
E2
E175-E2
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