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Workshop on quality assurance for the implementation of an instrument flight procedure

29 March -2 April 2021





Quality assurance introduction

Doc. 9906, Vol. 1





1. Key definitions
2. Instrument Flight Procedure Process
3. IFP supporting processes
4. Process description
5. Step-by-step description



- ❑ **Consultation.** Conference between two or more people to consider a particular question.
- ❑ **Conceptual design.** High level graphical and/or textual description of the designer's interpretation of the stakeholders' requirements.
- ❑ **Designer.** Person adequately trained who performs the design of an instrument flight procedure (IFP).
- ❑ **Flight procedure design.** The complete package that includes all the considerations that went into the development of an IFP.
- ❑ **Flight procedure design process.** The process which is specific to the design of instrument flight procedures leading to the creation or modification of an IFP.



- ❑ **Review.** An activity undertaken to determine the suitability, adequacy and effectiveness of the subject matter to achieve established objectives" (ISO 9000:2000 "Quality management systems –Fundamentals and vocabulary", section 3.8.7).
- ❑ **Validation.** Confirmation through the provision of objective evidence that the requirements for a specific intended use or application have been fulfilled (Annex 15). The activity whereby a data element is checked as having a value that is fully applicable to the identity given to the data element, or a set of data elements that is checked as being acceptable for their purpose.
- ❑ **Verification.** Confirmation through the provision of objective evidence that specified requirements have been fulfilled (Annex 15).The activity whereby the current value of a data element is checked against the value originally supplied.



Key points: Clear difference should be made between "Review", "validation" and "Verification".

- 👉 **Key point 1:** Review is done against the established objectives by the relevant stakeholders.
- 👉 **Key point 2:** Through verification current data values are checked against the original data.
- 👉 **Key point 3:** Through validation, evidence shall be given that data element is fully applicable as being acceptable for their purpose.
- 👉 **Key point 4:** Approval which is often confused with "Validation" is not curiously defined in Doc. 9906, but is explained in the step by step process. Approval is the CAA responsibility.



Instrument Flight Procedure Process

African Flight Procedure Programme (AFPP)

- ❑ Flight procedure design is not a stand-alone process; it should be:
 - ☞ Coordinated with all stakeholders;
 - ☞ Integrated in the State airspace design process and account air traffic flows, separation issues, airspace user requirements, etc.
- ❑ The process:
 - ☞ Covers the entire lifespan of the IFP;
 - ☞ Encompasses 16 steps from the initiation to the periodic review;
 - ☞ Supported by the other Doc. 9906 volumes.
- ❑ It is recommended to review the process periodically to ensure continuous improvement.



Instrument Flight Procedure Process

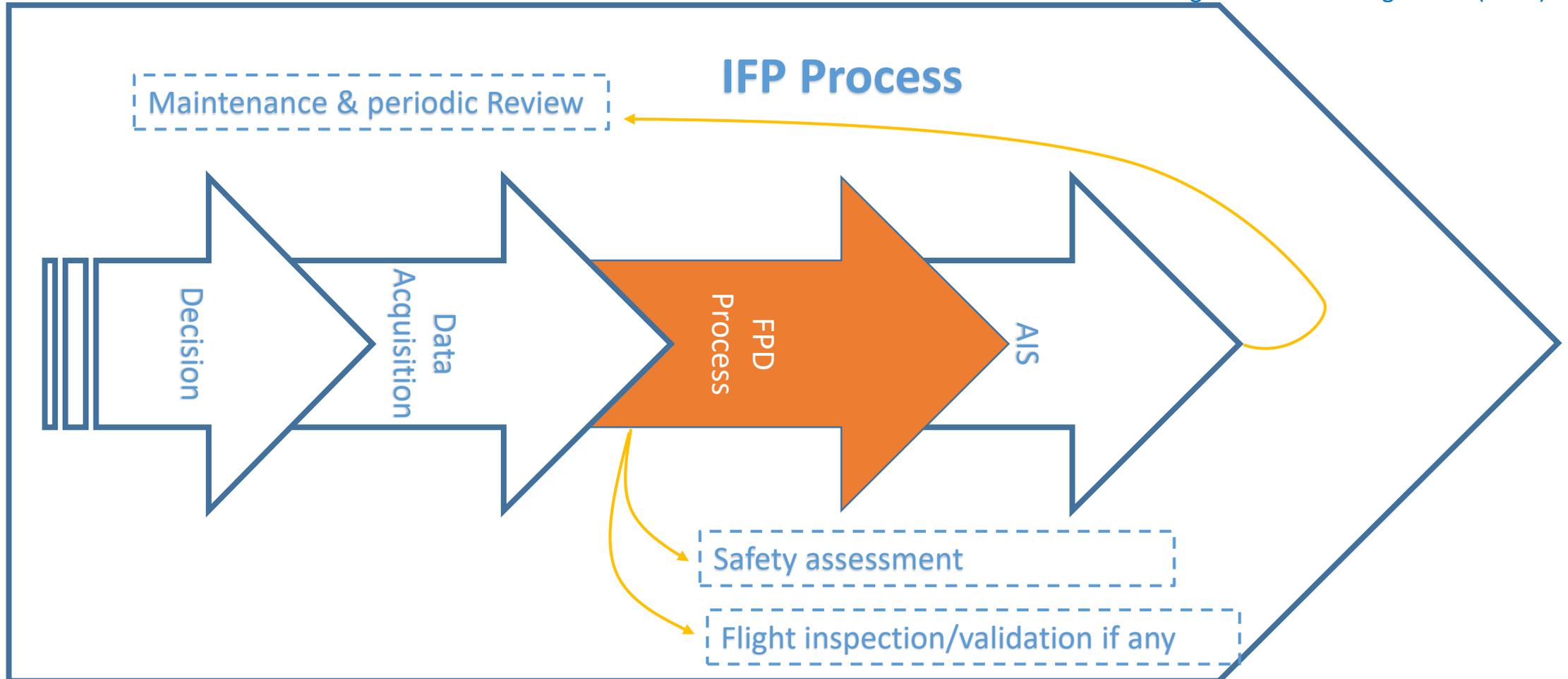
African Flight Procedure Programme (AFPP)

- ❑ **Quality record.** Objective evidence which shows how well a quality requirement is being met or how well a quality process is performing.
- ❑ Use of quality records:
 - ☞ They are normally audited in the quality evaluation process;
 - ☞ They may be used together with the other steps elements for the instrument flight procedure approval.



Instrument Flight Procedure Process

African Flight Procedure Programme (AFPP)





□ The main outputs of the process

- ☞ The conceptual design, including planned implementation dates, and resources needed to achieve the task;
- ☞ The FPD, including the procedure layout, the relevant calculation outputs, coordinates and a textual description of the intended procedure;
- ☞ The validation and verification reports for the IFP;
- ☞ The approval of the procedure by the regulatory authority;
- ☞ The documentation throughout the various stages from the input through the publication process;
- ☞ Finally, the released AIP publication (charts, texts, coordinates, path terminators, etc.).

□ FPD and IFP processes are supported by two related-processes:

☞ The supporting processes:

- Activities performed once: software validation, training, etc.

☞ The upstream and downstream processes that trigger or are triggered by the FPD and IFP processes.





□ The supporting processes

□ Various activities performed prior to the procedure design process:

☞ Use and validation of procedure design software or tools that are encouraged in the quality process:

- Spreadsheets,;
- Commercial CAD software

☞ Training:

- Key element of a QMS;
 - Identification of the training requirements;
 - Making sure that the designers have the required competencies and experience.



□ The upstream and downstream processes

□ Activities that trigger or are triggered by the IFP process:

☞ Data origination:

- Start of the IFP process;
- Stakeholders: State authorities, originating authorities, surveyors, third parties;
- One of the most critical stages of the data chain, as some errors cannot be easily detected.

ICAO documents dealing with data requirements: Annex 15-Aeronautical Information Services, Doc. 9674-WGS-84 Manual).



□ The upstream and downstream processes

□ Activities that trigger or are triggered by the IFP process:

☞ Aeronautical Information Service (AIS):

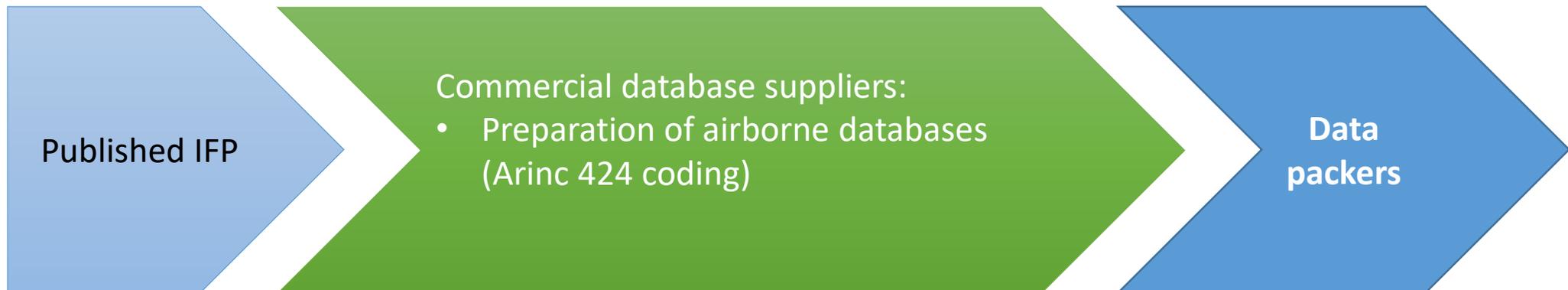
- The procedure design process includes a phase related to the preparation of the elements to be published: draft charts, final pack.
 - The AIS may process the draft charts
 - Important for the designer to checks them back

Recommendation: Relations between FPD Office and AIS Office to be formalized through a quality process or a Service Level Agreement.

□ The upstream and downstream processes

□ Activities that trigger or are triggered by the IFP process:

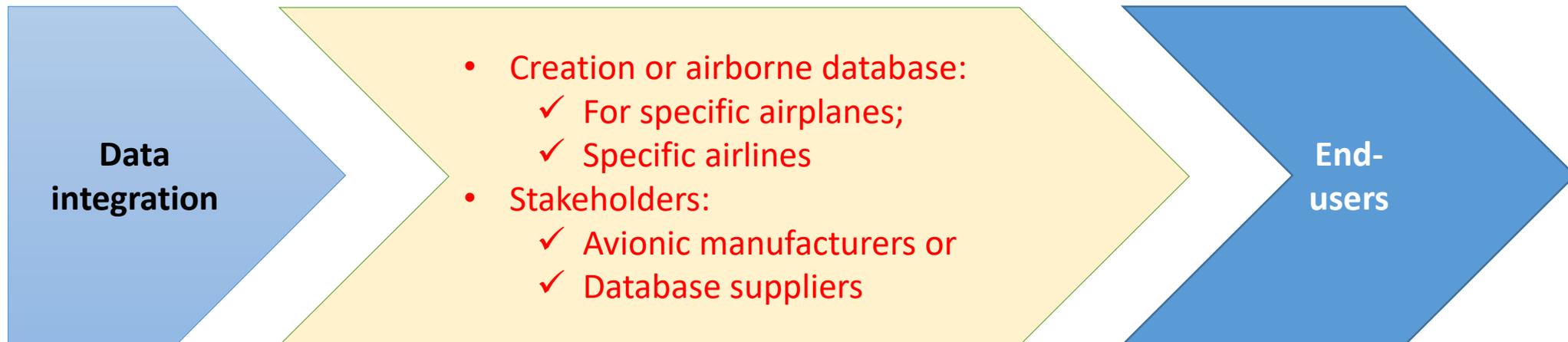
☞ Data integration:



□ The upstream and downstream processes

□ Activities that trigger or are triggered by the IFP process:

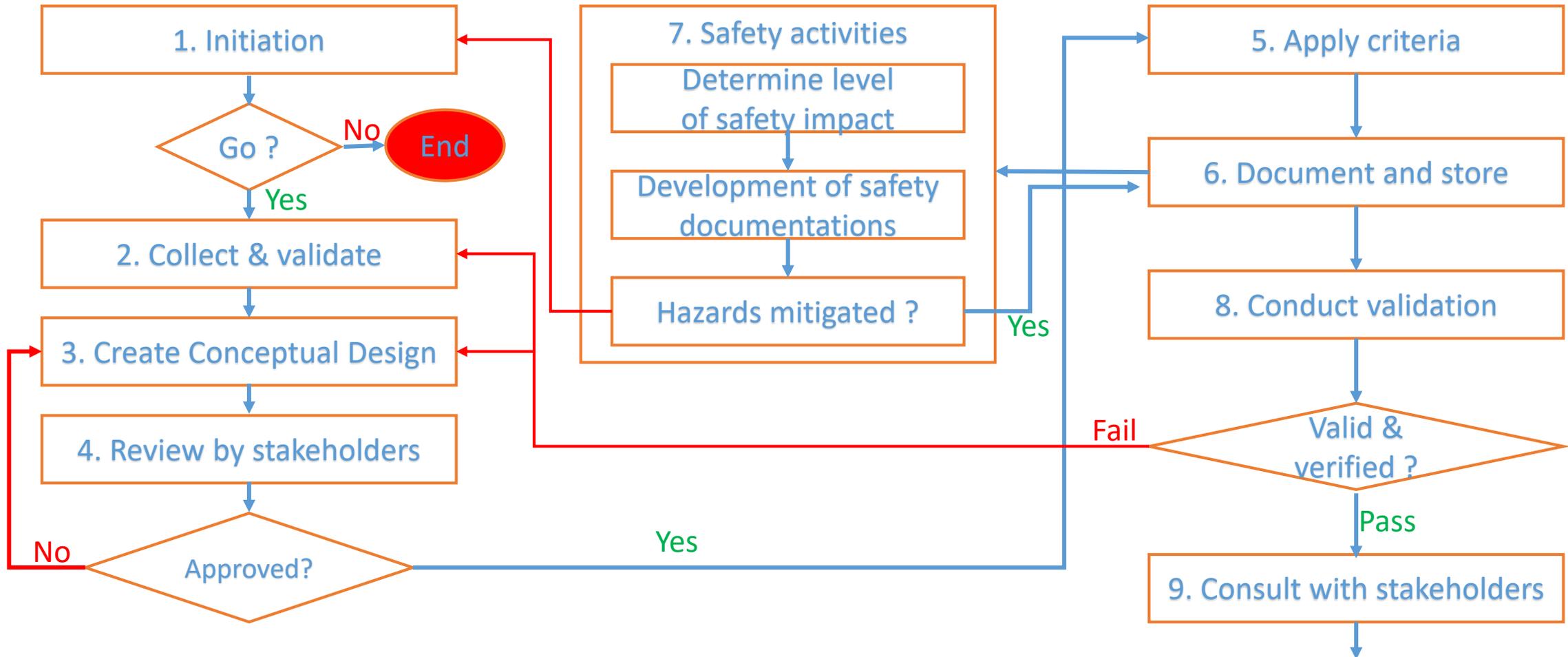
☞ Data packing:





Process description

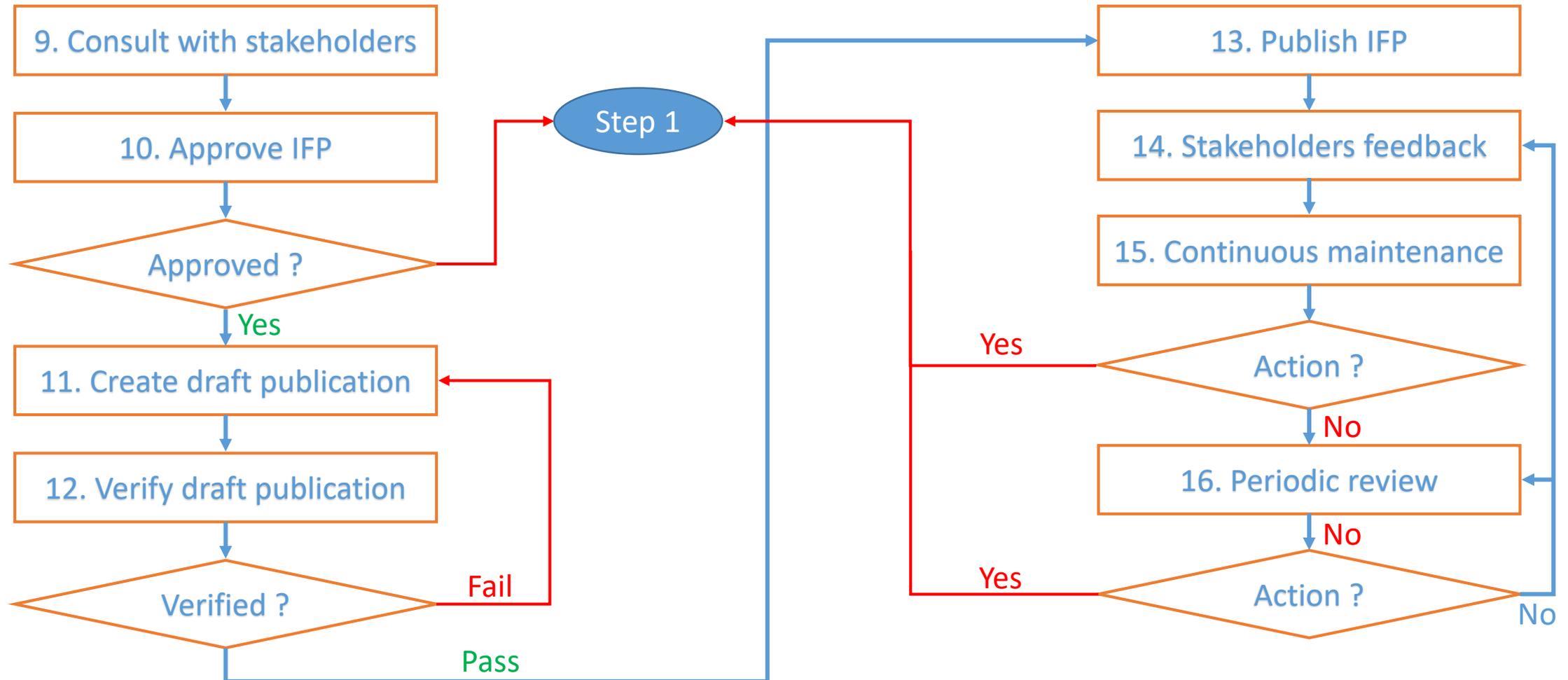
African Flight Procedure Programme (AFPP)





Process description

African Flight Procedure Programme (AFPP)





□ Step 1: Initiation

□ Question : Who triggers the Flight Procedure Design???

- ☞ State aviation authorities
- ☞ Air navigation or air traffic service providers
- ☞ Air operators
- ☞ Airport authorities
- ☞ Aviation associations
- ☞ Municipal/civil/military authorities
- ☞ Environmental authorities
- ☞ Procedure designer
- ☞ Event: new criteria, airspace design, maintenance, etc.
- ☞ Etc.

□ Each State should define the initiation process within its legislation.



□ Step 1: Initiation

□ Justification and benefits shall be stated:

- ☞ Reason of the change: safety, efficiency, environment, etc.
- ☞ Nature: revision or new IFP?
- ☞ Expected benefits
- ☞ Expected users
- ☞ Required operational implementation date
- ☞ Consequences of not achieving the implementation date

□ Objectives of the change to be identified vs ICAO strategic objectives:

- ☞ Safety, Capacity & Efficiency, Security & Facilitation, Economic Development, Environmental Protection.



□ Step 1: Initiation

- **Approval of the request to be submitted to the imitator for review;**
- **Question to be considered in the review:**
 - ☞ The available resources;
 - ☞ the expected benefits and the urgency of the requirement
- **The review should ensure that the change:**
 - ☞ fulfils the expected operational requirements;
 - ☞ meets the needs of the airspace users;
 - ☞ complies with the requirements of relevant government departments (such as Transport and Environment);
 - ☞ is achieved within the proposed timescale;
 - ☞ is adequately resourced; and
 - ☞ does not conflict with any other airspace plans.

☐ Step 1: Initiation

Output

Documented managerial decision to process or stop the design

Quality records

Nil

Reference

ISO 90001:200:§ 7.2.1, §7.2.2, §7.3.1 and §7.3.2



□ Step 1: Initiation key steps

- 👉 Outputs to be documented;
- 👉 Nomination of Project manager (in ANSP?) & one focal point per stakeholder
- 👉 Project Manager at the Regulator level?
- 👉 Procedure designer identified;
- 👉 Contracts signed (if working with 3rd party);
- 👉 Scope is defined;
- 👉 Develop a Checklist to be followed-up by Project Manager.

□ Step 2: Collect and validation all data

- The designer must collect the following and incorporate them into the design documentation:
 - ☞ **Terrain data:** electronic raster (DTM, DSM) and associated accuracy, paper map etc
 - ☞ **Obstacle data:** man-made and natural with their coordinates and elevation; (Sources : AIP, Data Survey)
 - ☞ **Aerodrome data** (e.g. ARP and runways): coordinates and elevation, lighting, magnetic variation and rate of change, weather statistics, altimeter source;
 - ☞ **Aeronautical data:** airspace structure, classifications (controlled, uncontrolled, airspace Class), airways/air routes, altimeter transition altitudes/flight levels, neighboring instrument procedures,
 - ☞ **Navaid data:** coordinates, elevation, service volume, frequency, identifier,
 - ☞ **Existing significant points** to local navigation.



Step 2: Collect and validation all data

African Flight Procedure Programme (AFPP)

□ The data should be validated with regards to:

☞ **Currency:** are they still in use or current?

☞ **Accuracy:** electronic raster (DTM, DSM) and associated accuracy, paper map etc .

☞ **Reference geodetic datum and effective dates .**

□ Data source and supplier status:

☞ All data sources must be identified;

☞ If a supplier does not have an approved QMS, the supplied data must be considered to be of unknown quality characteristics and mitigation shall be found.



Step 2: Collect and validation all data

African Flight Procedure Programme (AFPP)

User requirements

The following users requirements should be accounted:

☞ **Air traffic Control:**

- Compatibility with the existing ATS procedures;

☞ **Users:**

- Need to shorten trajectories;
- Enhanced guidance;
- Availability of vertical guidance;
- Lower minima; and
- Enhanced flyability.



Step 2: Collect and validation all data

African Flight Procedure Programme (AFPP)

☐ User requirements

☞ Airspace design:

- Constraints given by existing airspaces;
- Requirements for additional / restructured airspace; and
- Danger / restricted and prohibited areas.

☞ Environmental constraints:

- Avoidance of populated areas
- Avoidance of sensitive areas (such as chemical, nuclear or other facilities); and
- Noise abatement procedures, when applicable.



Step 2: Collect and validation all data

African Flight Procedure Programme (AFPP)

□ Planning

- A planning should be established with regards to the complexity of the airspace structure and additional constraints:
 - ☞ Need for training on the ANSP side for the integration of the new traffic flows;
 - ☞ Implementation schedule of new CNS/ATM systems; and
 - ☞ Requirements of the airline operators.



Step 2: Collect and validation all data

African Flight Procedure Programme (AFPP)

Output

Summary of stakeholder requirements and all collected and validated data (Files)

Quality records

Nil

References

Refer to Doc. 9906, vol. 1, § 6.3 Process description



Step 3 - Create conceptual design

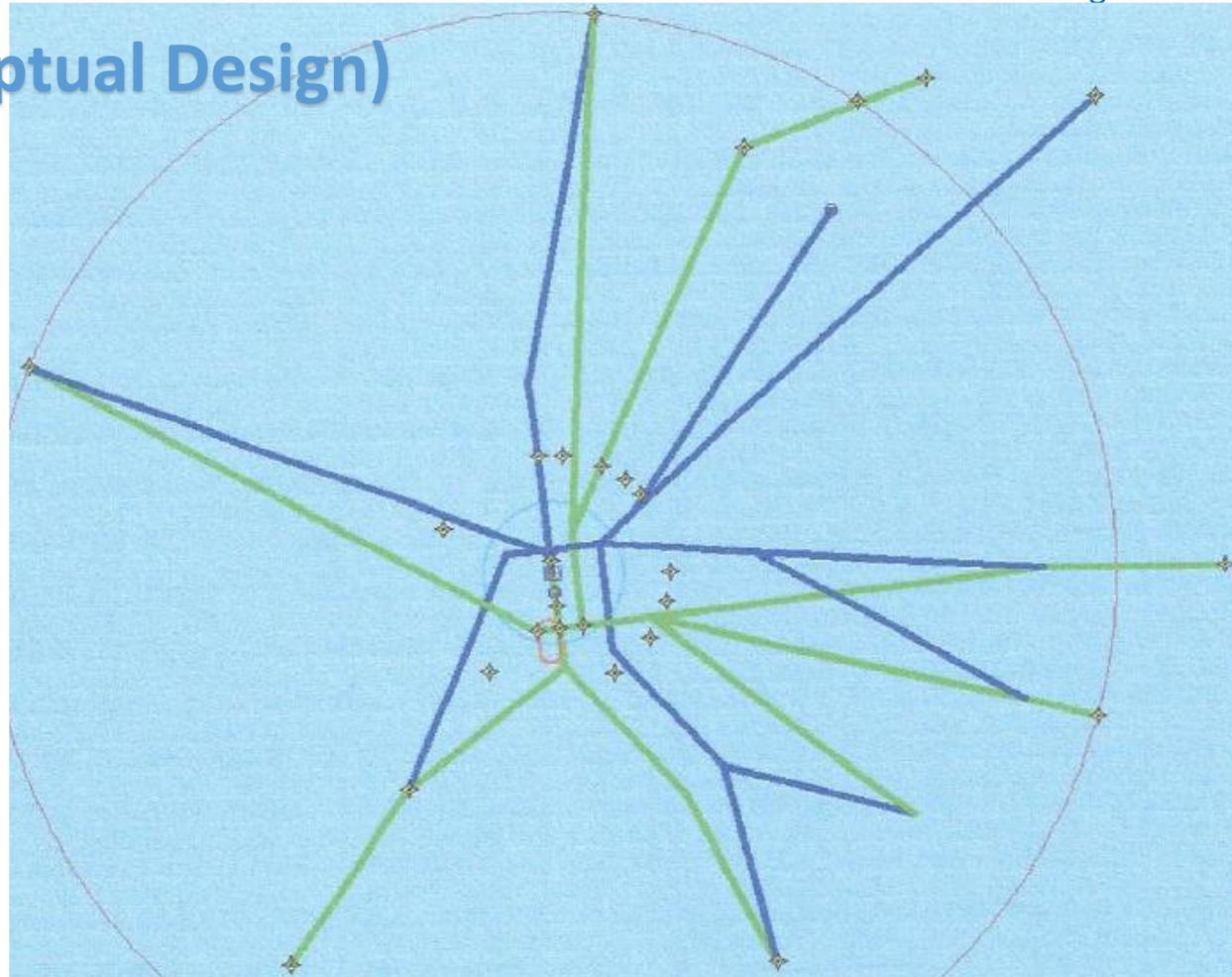
African Flight Procedure Programme (AFPP)

- **Goal of Step 3:** once the data collected and validate and taking into account all the constraint, a draft procedure is produced to serve as materiel for discussion with stakeholders:
 - ☞ Only the designer is concerned;
 - ☞ Can be done manually or,
 - ☞ With a software.

Step 3 - Create conceptual design

African Flight Procedure Programme (AFPP)

Output of Step 3 (Conceptual Design)



Step 4: The Designer submit the CD to the stakeholders for **analysis** through a **consultation** (physical or not).



Entry data:

- Work programme (scope of activities, etc.)
- Conceptual design

Outputs:

1. Formally approved Conceptual Design
2. Planned implementation AIRAC date

Step 4 - Review by stakeholders (Cont'd)

African Flight Procedure Programme (AFPP)



Caution! Be realistic on the planning:

- A published IFP needs at least 2 AIRAC cycles to be in force!
- From the initiation to the implementation date it may take more than 12 months for an single aerodrome with no complex traffic.



Step 5 - Apply criteria

African Flight Procedure Programme (AFPP)

INPUTS

- Preliminary work
- Approved Conceptual Design (CD)
- Planned AIRAC date & resources allocated

OUTPUTS

- Draft Flight Procedure (Charts)
- Draft Technical report (Calculations, coordinates, textual description)

PARTIES INVOLVED

- Designer

QUALITY RECORDS

- -

REFERENCES

- **Doc. 8168 and/or**
- **Doc.9905 (RNP AR)**



Step 6 – Document and store

African Flight Procedure Programme (AFPP)

INPUTS

- Draft Flight Procedure (Charts)
- Draft Technical report (Calculations, coordinates, textual description)

OUTPUTS

- Data store FPD bundle (Draft charts, coordinates, textual description, ARINC Coding, etc.)

PARTIES INVOLVED

- Designer

QUALITY RECORDS

- -

REFERENCES

- Doc. 8168 and/or Doc.9905 (RNP AR), Doc. 9906
- Annexes 4 &15
- State's standard and forms



Step 7 - Conduct safety activities

African Flight Procedure Programme (AFPP)

INPUTS

- Draft charts, coordinates, textual description, ARINC Coding, etc.

OUTPUTS

- Formal statement on the significance of change, allowing to determine the amplitude of the safety case that needs to be performed.

PARTIES INVOLVED

- Quality and safety officers & affected stakeholders, supported by
- Designers .

QUALITY RECORDS

- -

REFERENCES

- Eurocontrol ESARR 4.
- Doc 9859.
- ISO 9001:2000 State SMS

Step 8 - Validation and criteria verification

African Flight Procedure Programme (AFPP)

□ Goal:

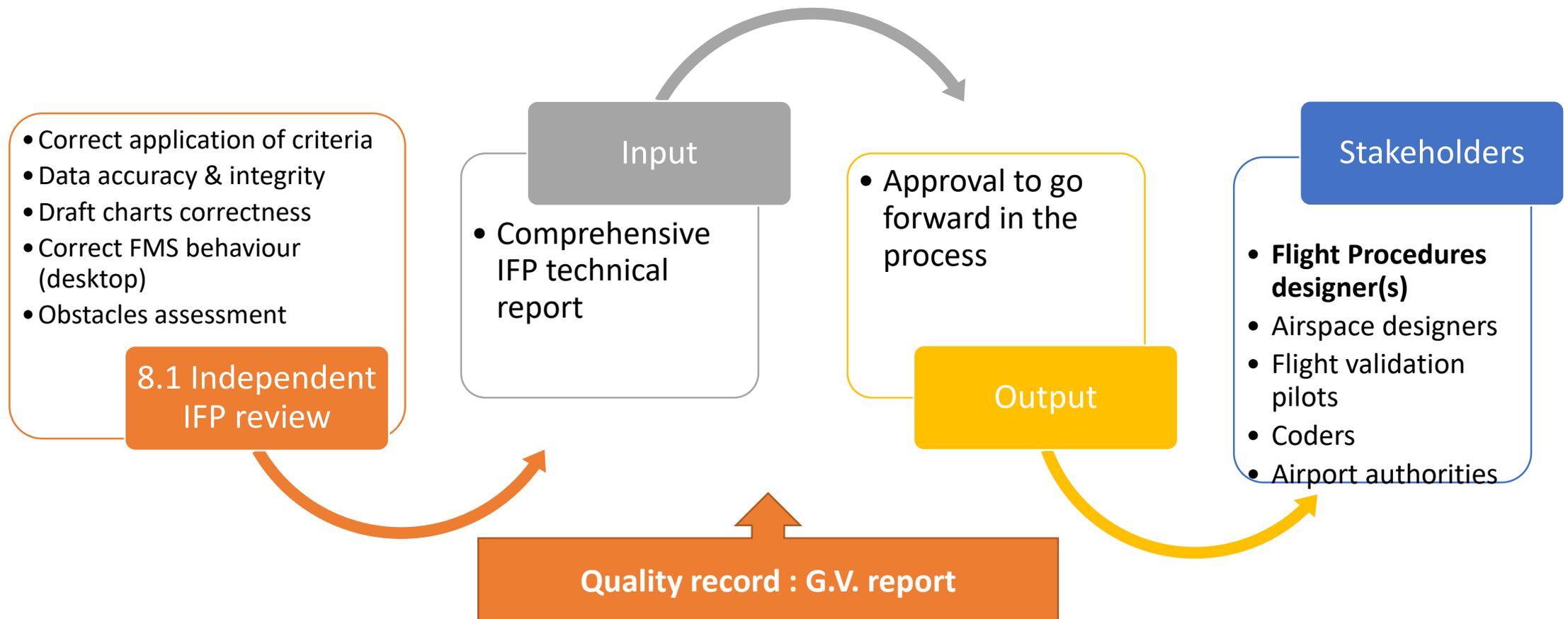
- Obtain a qualitative assessment of the IFP: obstacle, terrain and navigation data, and provide an assessment of the flyability of the procedure.

□ Consistence:

- Ground validation (independent review **by a senior designer** (calculations, steps)
- Preflight validation: impact on flight operations by a Flight Validation Pilot, Designer, ATC, Stakeholder.
- Simulator evaluation and/or
- Flight evaluation.

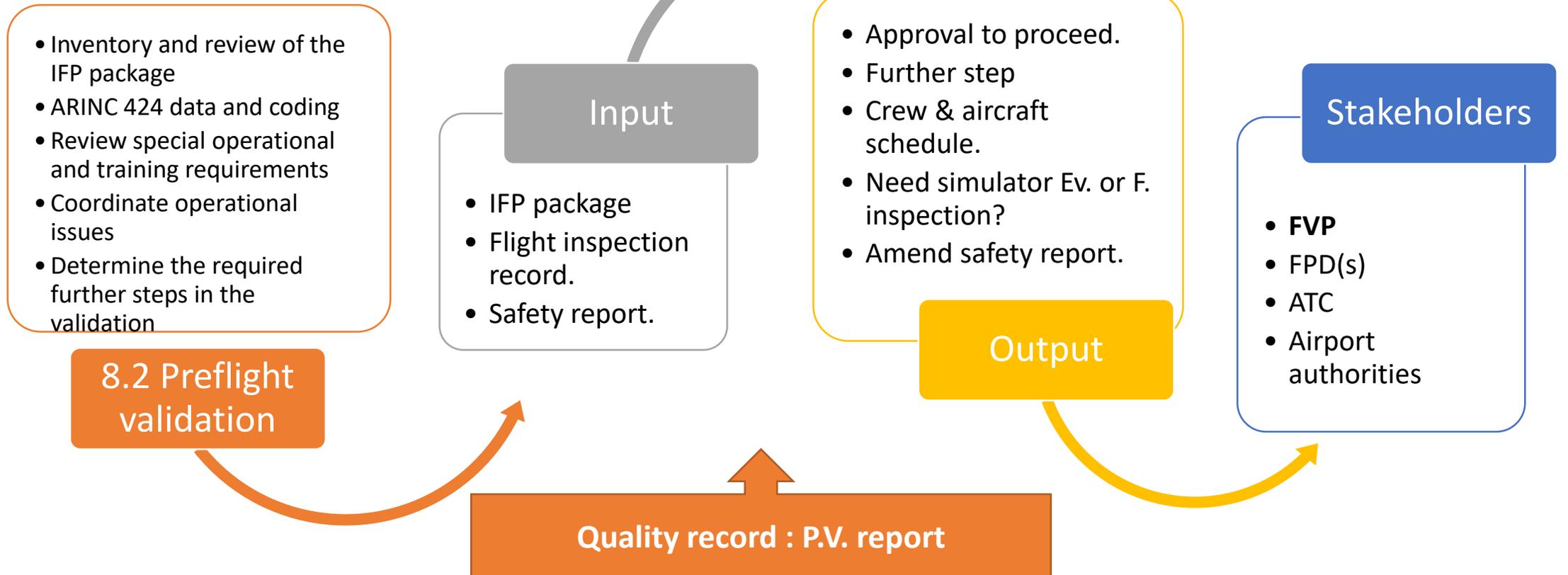


Step 8 - Validation and criteria verification



Step 8 - Validation and criteria verification

Goal: familiarize and identify potential operational issues in the IFP



Step 8 - Validation and criteria verification

African Flight Procedure Programme (AFPP)

Note: Recommended for complex procedures or procedures requiring waiver/mitigation for deviations from design criteria.

- Verify chart depictions and details
- Assess flyability and Human Factors
- Conduct associated validation tasks
- Record flight validation
- Document the results

8.3 Simulator evaluation

Input

- IFP graphical depiction
- ARINC 424 IFP database

- Flyability validation
- Input to final safety assessment report as applicable
- Recorded data
- Findings and operational mitigations

Output

Stakeholders

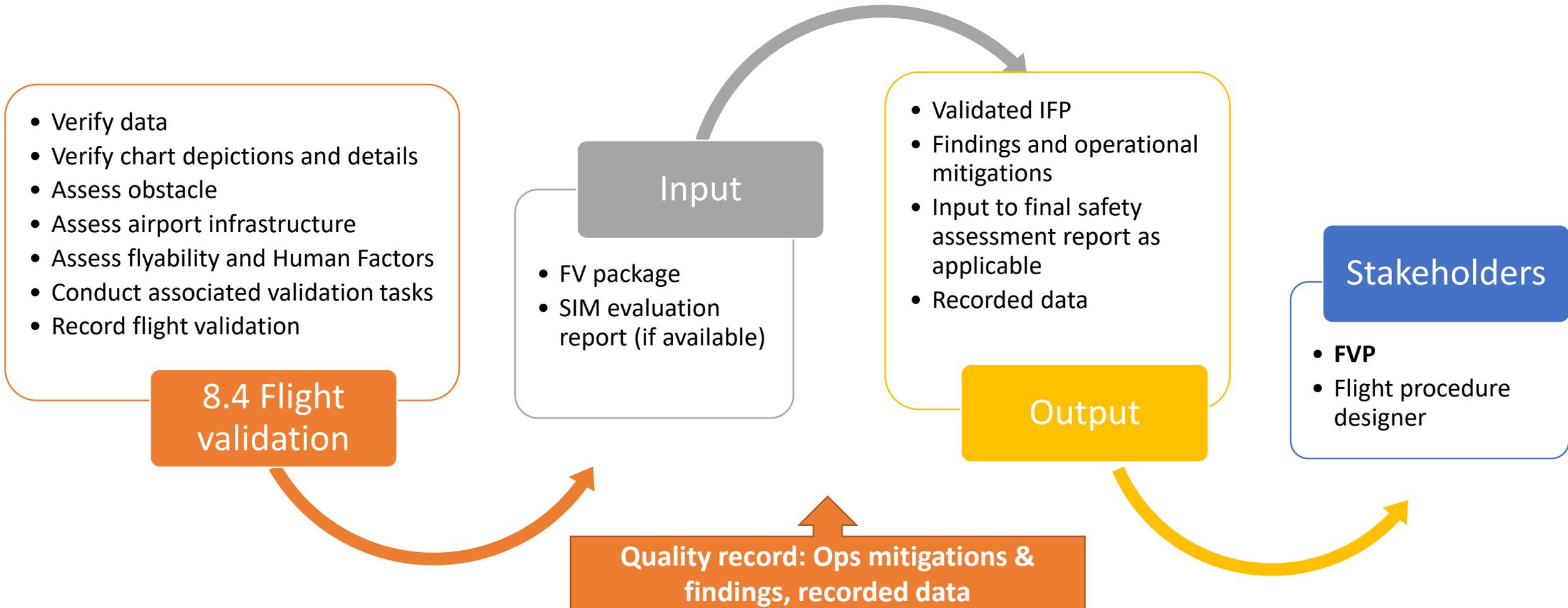
- FVP
- Flight procedure designer

Quality record : FS report, findings & mitigations

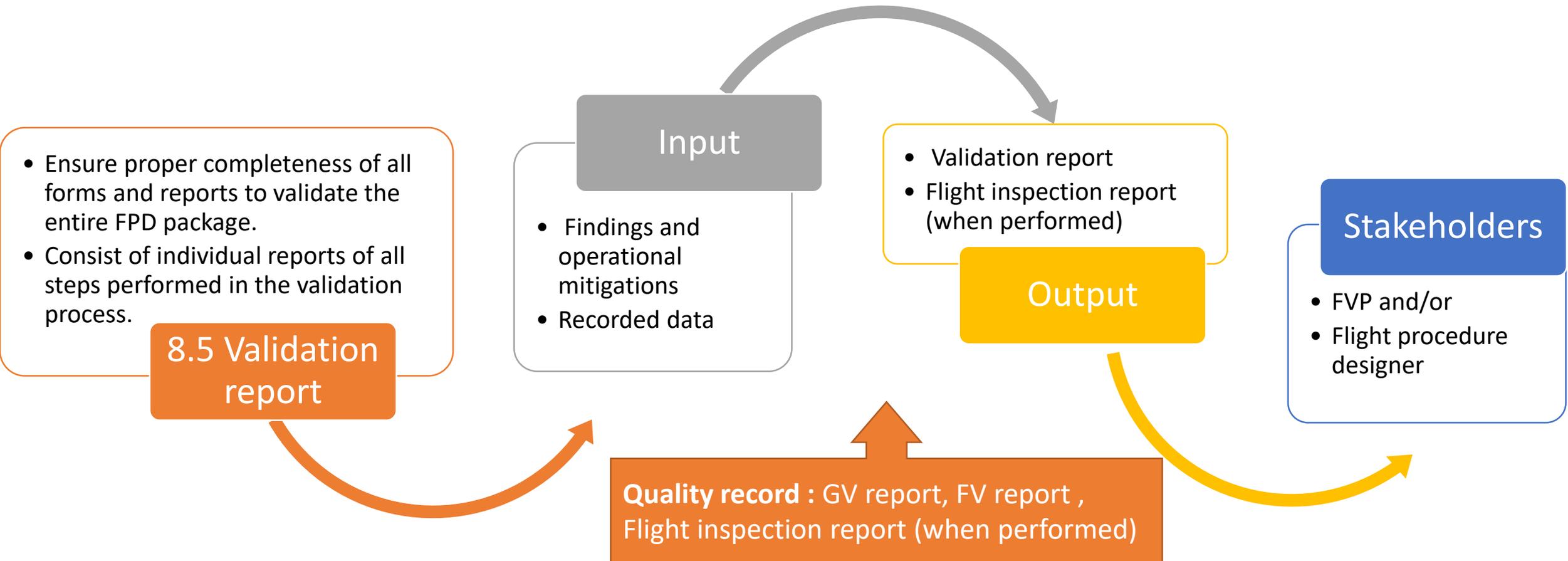
Note: Mandatory for RNP AR

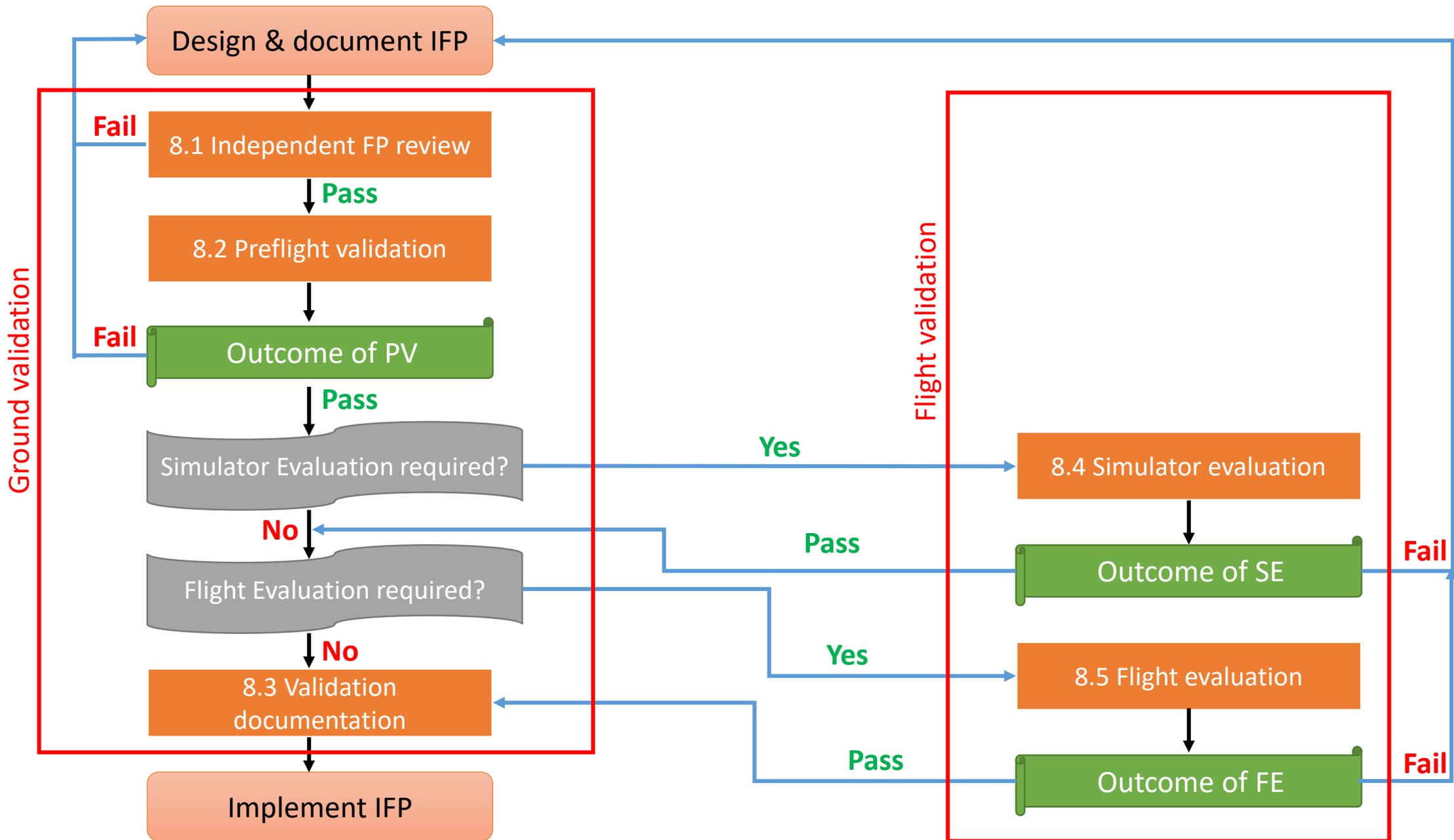
Step 8 - Validation and criteria verification

African Flight Procedure Programme (AFPP)



Step 8 - Validation and criteria verification





Step 8 - Validation and criteria verification

African Flight Procedure Programme (AFPP)



**Warning, achtung,
attention, tahdhir**

- **Validation is not often incumbent to CAA!!!**

Step 9 - Consult With Stakeholders

African Flight Procedure Programme (AFPP)

□ Goal:

- Submit all pertinent information to all relevant stakeholders for consultation in order to have their endorsement.





Step 9 - Consult With Stakeholders

African Flight Procedure Programme (AFPP)

INPUTS

- Validated IFP.

OUTPUTS

- Stakeholders' endorsement

PARTIES INVOLVED

- Designers .
- Relevant stakeholders .

QUALITY RECORDS

- Stakeholders' endorsement.

REFERENCES

- National regulations as appropriate.



Step 10 - Approve IFP

African Flight Procedure Programme (AFPP)

INPUTS

- Validated IFP
- Stakeholders' endorsement

OUTPUTS

- Approved IFP

PARTIES INVOLVED

- Designers .
- Designated authority.

QUALITY RECORDS

- Formal approval of the IFP (new or change).

REFERENCES

- National regulations as appropriate.



Step 11 - Create draft publication

African Flight Procedure Programme (AFPP)

INPUTS

- Approved IFP

OUTPUTS

- Draft publication

PARTIES INVOLVED

- Designers .
- AIS.

QUALITY RECORDS

REFERENCES

- Annex 4 & 15
- ISO 9001:2000



Step 12 - Verify draft publication

African Flight Procedure Programme (AFPP)

INPUTS

- Draft publication
- Validated IFP

OUTPUTS

- Cross-checked draft publication
- Decision for publication release.

PARTIES INVOLVED

- Designers .
- AIS/Aviation authority.

QUALITY RECORDS

REFERENCES

- National/Regional regulation
- Applicable Annexes
- Doc. 8168
- ISO 9001:2000



Step 13 - Publish IFP

African Flight Procedure Programme (AFPP)

INPUTS

- Cross-checked draft publication
- Decision for publication release.

OUTPUTS

- AIP charts
- Documentation

PARTIES INVOLVED

- AIS

QUALITY RECORDS

REFERENCES

- Applicable Annexes



Step 14 - Obtain feedback from stakeholders

African Flight Procedure Programme (AFPP)

INPUTS

- AIP charts
- Documentation
- Stakeholders queries/findings

OUTPUTS

- Decision for ongoing activities

PARTIES INVOLVED

- Manager of the design office
- Stakeholders

QUALITY RECORDS

REFERENCES

- Standards for processing aeronautical data (EUROCAE ED76/RTCA DO-200)



Step 15- Conduct continuous maintenance

African Flight Procedure Programme (AFPP)

INPUTS

- Significant change in the FPD environment or safety related design criteria changes
- Documentation

OUTPUTS

- Revision as required.

PARTIES INVOLVED

- Designer
- Regulator
- IFP owner or users as applicable

QUALITY RECORDS

- If modifications, reasons for change

REFERENCES

- Annexes 4 & 15
- Docs. 8168, 9905, 9906 & 9859



Step 16-conduct periodic review

African Flight Procedure Programme (AFPP)

INPUTS

- All changes in design criteria, FPD environment or depiction standards.

OUTPUTS

- Revision as required.

PARTIES INVOLVED

- Designers
- AIS/Aviation authority

QUALITY RECORDS

- Results of the periodic review
- If modifications or amendments, reasons for change

REFERENCES

- Annexes 4 & 15
- Docs. 8168, 9905, 9906 & 9859



Comprehension questions

African Flight Procedure Programme (AFPP)

How many steps do you have in the IFPD comprehensive process?

👉 16 steps.

How many Steps do you follow for the initiation to the publication of an IFP?

👉 13 steps.

Who is responsible for the validation of an IFP:

👉 Generally FPDSP and/or FVSP.

Who is approving the IFP?

👉 State.



Questions:

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