4 FDAP DATA ANALYSIS

4.1 FDA PROGRAM COMPONENTS

Flight data is an integral basis of flight analysis. Flight data is downloaded/automatically transferred from the aircraft or manually downloaded. This data is further analyzed for anomalies, events, and trends as part of the FDA program. Processes are in place to minimize the chance of data loss and ensure timely download of DFDR data in case QAR data becomes corrupt or missing.

4.1.1 Airborne Data Acquisition System

4.1.2 Data Download and Airborne System Maintenance and Support

All aircraft are equipped with wireless QAR / QAR or equivalent device for easy retrieval of the recorded data. The Technical Service Department ensures regular maintenance and automatic transfer of data to ground based stations or if not transferred automatically, it will be downloaded and upload the same to a shared drive at base stations. The data is accessed by the Safety Office and uploaded on the computers where GE Aerospace's WASABI is installed.

Procedure

1. QAR/ FDR Data of B787-9 aircraft is extracted at night halt/layover stations and uploaded to the FTP Server in the folder of the respective station.
2. Safety personnel copies the data uploaded by each base station onto the corresponding folder (arranged by station name) in the dedicated computer's local hard drive. After archiving the data stored in the local drive is permanently deleted from the local drive.
3. Data of B787-9 aircraft is also automatically transferred to FTP server by the WQAR as per data transfer queue defined by Technical Service Department .

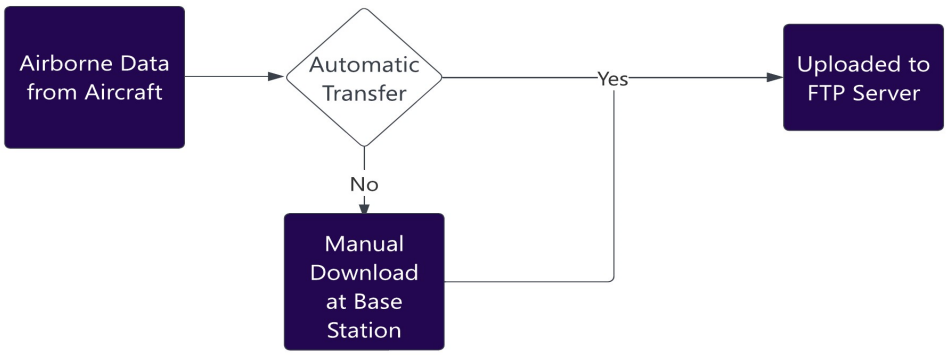

Figure 3 QAR Data download flow chart

4.1.3 Ground Data Replay and Analysis System (GDRAS)

FDA Exceedance analysis involves converting digitally recorded flight data into readable format and running through filters with the help of GE Aerospace FDAP System. Exceedance limits of various parameters for deviation from flight manual limits, standard operating procedures, and other aircraft related documents, have been configured in the software. The deviations beyond the selected alerts as detected by the software shall be reviewed and recorded by FDA Analyst. The recorder manufacturer supplies details of parameter recordings for configuring in software.

4.1.4 Flight Data Analysis – Service Provider

Riyadh Air has contracted Flight Data Analysis services from GE Aerospace and will be using their Safety Insight software for the analysis of flight data., The GE Safety Insight service enables the decoding of flight data into a logical layer of global flight parameters, allowing Riyadh Air safety teams to evaluate and analyze data against a comprehensive library of measurements and safety events, including powerful analytics processing capabilities. It provides a secure environment to ingest, cleanse, analyze, and report flight data.

4.1.5 Other Equipment

As the GE Aerospace Safety Insight offers a web-based solution for proactively managing risk in flight operations in support of Riyadh Air FDAP, it can be accessed using the FOQA/FDM desktops/Laptops by authorized personnel.

The GE Aerospace 's WASABI (Wide Area Store-and-forward Aviation Binary Interchange) data collection protocol will be installed on a local machine (Desktop / Laptop) available at safety office for automatic transfer of raw data files to the Safety Insight software.

4.2 COLLECTION AND INITIAL SCREENING/FILTERING OF DATA

1. The data transferred from aircraft are un-archived and transferred to Safety Server.
2. These folders are then archived in the following format by safety personnel: RX-ABCDDMMYYYYHHMMSSM.zip where 'RX-ABC' represents the registration of the aircraft, 'DDMMYYYY' represents the date when the data is being archived, 'HHMMSS' represents the time when the data is being archived and 'M' is a fixed constant.
3. The archived data is then copied into the backup drive, with the backup folders arranged by year, month, and date respectively.
4. The raw data for each aircraft is available in the Back-up drive for a minimum period of 5 years.
5. Each day the QAR / DFDR database is updated. The database named "FDIMU YYYY" is an Excel Workbook (stored in a secured server) with different worksheets for each day where YYYY represents the year. The following columns are updated:
    a. Aircraft Registration
    b. Station (from which data has been uploaded)
    c. Date (as per the modification of the last file in the folder)
    d. First File Number
    e. Last File Number
    f. Remarks
6. This database is maintained for traceability and to ensure data continuity. It is to be monitored that the First file number for a particular registration exceeds the Last file number of the same registration from the day when data was last received by one.

4.3 DATA TRANSFER

After archiving, the data is copied into the "Autonomous" folder whose location is mapped in the GE Aerospace 's WASABI data collection protocol. The data is then automatically extracted from this folder by Safety Insight software when the automatic analysis command is given.

Safety Insight software runs the raw data file and triggers events as defined in the software's event detection algorithm.

Following is the process for completing this:

1. **Archiving Process**:
    a. **After Flight Data Monitoring (FDM) Analysis**: Following the initial analysis of flight data, the results are archived for record-keeping and further reference.
    b. **Copying Data to the "Autonomous" Folder**: The archived data is copied into the designated "Autonomous" folder. This folder serves as a centralized location for data that is ready for further automated processing.
2. **Mapping Location in Analysis Software**:
    a. **Configuration in Analysis Software**: The location of the "Autonomous" folder is mapped within the Safety Insight software using WASABI. This mapping ensures that the software knows where to retrieve data for subsequent automated analysis.
3. **Automatic Extraction and Analysis**:
    a. **Triggering Automatic Analysis Command**: The Safety Insight software is equipped with the capability to automatically extract and analyze data. This process is initiated by issuing a command for automatic analysis.
    b. **Retrieving Data from "Autonomous" Folder**: Upon receiving the automatic analysis command, the software retrieves data from the pre-defined "Autonomous" folder.
    c. **Raw Data File Processing**: The Safety Insight software processes the raw data file retrieved from the "Autonomous" folder, utilizing its algorithms and functionalities.
    d. **Event Detection Algorithm**: The Safety Insight software incorporates an event detection algorithm designed to identify specific events or exceedances in the flight data.
    e. **Automated Event Triggering**: As the Safety Insight software runs the raw data file, it automatically triggers events based on the defined criteria within the event detection algorithm.

4.4 EVENT ANALYSIS

In compliance with GACA regulations, entire data of a flight shall be analyzed to determine if any flight parameter had exceeded the laid down limit. For the flights in which exceedances are detected, a detailed analysis of flight data shall be carried out to check whether the flight was handled as per the Standard Operating Procedures.

As there are more accidents during approach and landing phases, detailed analysis of the approach and landing phases of all flights shall be carried out, to detect any deviations from the normal approach profile and whether the approach was stabilized or not.

Guidelines for completing an event analysis are as follows:

1. **Overall Data Analysis**:
    a. **Flight Parameter Exceedances**: The entire data of each flight is subject to analysis to identify any flight parameters that have exceeded the prescribed limits.
    b. **Detailed Analysis for Exceeding Flights**: For flights with identified parameter exceedances, a comprehensive and detailed analysis is conducted to assess adherence to Standard Operating Procedures (SOPs).
2. **Emphasis on Approach and Landing Phases**:
    a. **Focus on High-Risk Phases**: Recognizing the higher risk during approach and landing phases, specific emphasis is placed on analyzing these segments of all flights.
    b. **Stabilized Approach Assessment**: Detailed analysis of approach and landing phases includes assessing whether the approach was stabilized, conforming to defined criteria for stability.
3. **Specific Airport and Runway Analysis**:
    a. **Airport and Runway Performance**: Data related to landings is analyzed with a focus on specific airports and runways. This analysis covers the performance of limited airfields to ensure conformity with SOPs for those specific locations.
    b. **Runway-Specific Considerations**: The analysis accounts for runway-specific factors, considering variations in layout, length, and conditions that may impact the landing performance.
4. **Special Takeoff Procedure Analysis**:
    a. **Airfields with Special Takeoff Procedures**: For airfields where special takeoff procedures are established, the FDM analysis scrutinizes whether the takeoff profile aligns with the prescribed special procedures.

b. **Record Keeping for Training Purposes**: Results of the analysis, especially deviations from special takeoff procedures, are recorded separately. This information serves as valuable training material for new pilots.

4.5 EVENT CLASSIFICATION

1. Low Severity Events (Yellow)
    a. Low severity events are statistically important and provide trends for an airline. Low severity incidents will only be used for analysis, no gatekeeper review is required.
    b. A low severity event could be combined with a Medium or High severity event to form a combination Event which would require further analysis and actions.
2. Medium Severity Events (Amber)
    a. Medium severity events are statistically important and provide trends for an airline.
    b. A Medium severity event is analyzed and could be combined with a Low or Medium or High severity event to form a Combination Event which would require further analysis and actions.
    c. Events falling into this category require the attention of the Gatekeeper and where required even a subject matter expert.
3. High Severity Events (Red)
    a. High severity events are statistically important and provide trends for an airline.
    b. A High severity event may require a specific validation and analysis.
    c. Events falling into this category require the attention of the Gatekeeper and where required even the Director of Flight Crew.

4.6 GUIDANCE ON DEFINING CUSTOM EVENTS

Some of the events are specific to a special procedure or an airport. Such events shall be configured into FDAP software based on SOPs by the FDAP manager. If required, help from the software provider may be taken to define the event in the system.

1. **Identification of Special Events**:
    a. **SOP-Driven Events**: Special events specific to SOPs or airports are identified, considering factors that require dedicated monitoring.
    b. **Collaboration with Director of Safety:** The Director of Safety collaborates with the relevant stakeholders, including SOP creators, to clearly define and understand the criteria for these special events.
    c. **Software Provider Collaboration**: If needed, collaboration with the FDAP software provider is initiated to seek assistance in configuring these events into the system.
2. **Configuration and Setup**:
    a. **Flight Data Specialist's Role**: The Flight Data Specialist takes the lead in configuring the identified special events into the FDAP software based on the established SOPs.
    b. **Collaboration with Software Provider**: Assistance from the software provider is sought, if necessary, to ensure accurate and effective configuration of these events within the FDAP system.
3. **Testing Phase**:
    a. **Duration of Testing**: A dedicated testing period of 15 days (about 2 weeks) is allocated after the configuration of special events in the system.
    b. **Outcome Analysis**: Regular analysis is conducted during the testing phase to assess the specific and desired outcomes of the configured special events.
    c. **FDAP Review Group Involvement**: Results of the testing phase are shared with the FDAP Review Group for their assessment and input.
4. **Production Deployment**:
    a. **FDAP Review Group Verification**: The FDAP Review Group verifies the outcomes of the special events based on the testing phase results.
    b. **Transition to Live Environment**: Once verified, the configured special events are deployed into the live environment for active monitoring during regular flight operations.
5. **Periodic Review in Production**:
    a. **Ongoing Accuracy Assessment**: A periodic review is carried out to ensure the ongoing accuracy and relevance of the configured special events in the live environment.

b. **FDM Review Group Oversight**: The FDAP Review Group continues to oversee and assess the performance of special events, providing feedback for potential adjustments.

6. **Continuous Improvement**:

a. **Feedback Loop Integration**: Insights gained from the periodic reviews contribute to a continuous improvement loop, allowing for refinement of special events and associated monitoring criteria.

b. **Iterative Enhancement**: The iterative process ensures that the FDM system evolves to meet changing requirements, SOPs, or any adjustments in the aviation environment.

7. **Documentation and Reporting**:

a. **Detailed Documentation**: The entire process, including identification, configuration, testing, production, and periodic reviews, is thoroughly documented for reference and auditing purposes.

b. **Reporting to Stakeholders**: Reports on the outcomes, feedback, and performance of special events are communicated to relevant stakeholders, ensuring transparency and accountability.

4.7 SETTING THRESHOLDS

The Safety office shall establish threshold values in consultation with the FDAP review Group including the Flight Operations Department for exceedance for each aircraft type in operation. The final threshold limits shall be signed off, and some shall be incorporated into the Flight Data Analysis Program software.

The threshold limits shall be in conformity with the operational documents and SOPs.

Following is the process to accomplish this:

1. **Safety Office Involvement**:
    a. **Threshold Definition Initiation**: The Safety Office initiates the process of defining threshold values for exceedances in consultation with the FDAP Review Group.
    b. **Collaborative Decision-Making**: Collaborative discussions take place to involve key stakeholders in the FDAP Review Group, including representatives from flight operations, safety, and other relevant technical experts.
2. **Consultation with FDAP Review Group**:
    a. **Group Composition**: The FDAP Review Group, comprising of experts from various relevant domains, convenes to discuss and establish threshold values.
    b. **Operational and Technical Inputs**: Operational personnel provide insights into day-to-day flight operations, while technical experts contribute their knowledge on aircraft capabilities and limitations.
3. **Alignment with Operational Documents and SOPs**:
    a. **Reference to Operational Documents**: The threshold values are carefully reviewed to ensure alignment with existing operational documents, including aircraft manuals, guidelines, and company-specific SOPs.
    b. **SOP Conformity**: The established threshold limits conform to the defined procedures and guidelines outlined in the Standard Operating Procedures.
4. **Sign-Off Process**:
    a. **Finalization of Threshold Limits**: The FDAP Review Group finalizes the threshold values after considering all operational, technical and safety aspects.
    b. **Sign-Off by Key Stakeholders**: The final threshold values are subject to sign-off by key stakeholders within the FDAP Review Group, including representatives from the Safety Office.

5. **Incorporation into FDAP Software**:
    a. **Software Integration Planning**: The Safety Office collaborates with the IT or GE team responsible for the Flight Data Monitoring system to plan the integration of the finalized threshold values.
    b. **Software Configuration**: The agreed-upon threshold values are configured into the Safety Insight software to ensure that the system recognizes and monitors exceedances against these parameters.
6. **Continuous Monitoring and Review**:
    a. **Regular System Checks**: The Safety Insight system is regularly monitored to ensure that the configured threshold values are effectively capturing and flagging relevant exceedances.
    b. **Periodic Review by FDAP Group**: The FDAP Review Group periodically reviews the effectiveness of the threshold values, considering any changes in operational practices or aircraft configurations.

4.7.1 Adjustments And Changes to Thresholds

The set limits will be reviewed as and when required but at least once in every year in consideration of following:

1. **Regular Schedule**:
    a. **Annual Review Cycle**: The set limits for exceedances are subject to a comprehensive review at least once every year.
    b. **Flexibility for Triggered Reviews**: Additionally, the review process may be triggered if significant events, changes, or regulatory updates require a more immediate assessment.
2. **Factors Considered in the Review**:
    a. **GACA Regulations**: GACA regulations are thoroughly examined to ensure that the set limits align with current regulatory standards and requirements.
    b. **Operating Experience**: Insights gained from ongoing monitoring activities, including the analysis of exceedances and operational data contribute to the review process.
    c. **Crew Inputs**: Inputs and feedback from the operating crew are considered, as they provide valuable perspectives on the practical aspects of adhering to the set limits during flight operations.
    d. **Manufacturer Recommendations**: Manufacturer recommendations and guidelines related to aircraft performance and limitations are reviewed to incorporate any relevant updates or changes.

e. **SOP Changes**: Changes in Standard Operating Procedures (SOPs) are considered, ensuring that the set limits align with the latest procedures and protocols.

3. **Review Team Formation**:

   a. **Multi-disciplinary Team**: A review team, comprising of representatives from safety, operations, technical experts, and relevant stakeholders, is formed to ensure a comprehensive assessment.

   b. **Involvement of FDM Review Group**: The FDAP Review Group, established earlier, may actively participate in the review, bringing their expertise to the evaluation process.

4. **Collaborative Assessment**:

   a. **Documented Evaluation**: The review process involves a detailed documented evaluation of each factor, examining regulatory compliance, operational experiences, crew inputs, manufacturer recommendations and SOP changes.

   b. **Group Discussions**: Collaborative group discussions are conducted to gather insights, share expertise, and ensure that all perspectives are considered.

5. **Adjustments and Recommendations**:

   a. **Identified Changes**: If required, adjustments to the set limits are identified based on the findings of the review, considering the factors mentioned.

   b. **Recommendations for Approval**: The review team formulates recommendations for any necessary changes, which are then presented for approval.

6. **Approval and Implementation**:

   a. **Final Approval**: The proposed changes to the set limits are subject to final approval by key stakeholders, including safety officers, regulatory compliance officers and relevant management personnel.

   b. **Implementation Plan**: Upon approval, an implementation plan is developed, outlining the steps to integrate the revised set limits into the FDA system.

4.8 EXCEEDANCE DETECTION AND ANALYSIS

If any exceedances have been detected, a detailed analysis of the flight will be carried out by a dedicated Safety Specialist (Flight Data Specialist) to check whether the flight was handled as per the Standard Operating Procedures. If the flight is found to be in the MEDIUM or HIGH severity band, an appropriate report for the same shall be generated giving the actual value of the parameter, the specified limit for the same, the time of the event and the other relevant flight details to Director of Safety for review.

Post validation, correlation and analysis of the exceedance event, suitable remedial actions will be determined. The flight risk shall also be determined after corroborating the various factors in conjunction with the flight profile, Environmental conditions, Aerodrome limitations/SOP's etc.

4.9 REVIEW AND PLAYBACK

The recommended remedial actions prescribed by the Gatekeeper based on detailed analysis will be reviewed and accepted by the Director of Safety. This may include Email to crew for information, crew comments, debrief/counselling, changes in SOP etc.

Exceedance events that require corrective and/or preventative actions may be escalated to a Safety Investigation Panel for further recommendation of suitable remedial actions.

Exceedances generated during the training flights shall be communicated to Crew, Vice President of Flight Operations, Director Flight Crew Training and Standard for analysis and de-briefing with an emphasis on the "Learning curve".

If required, Gatekeeper is responsible to replay the data for the benefit of the crew for better understanding of the event. Only relevant flights are to be replayed for crew. Only one such request per flight will be considered and no duplicate data will be provided to the crew.

4.10 GROUND DATA REPLAY AND ANALYSIS SYSTEM

Riyadh Air is using GE Aerospace Safety Insight software as a ground data replay and analysis system. It is a web-based solution for proactively managing risk in flight operations in support of airline Flight Data Analysis Programs (**FDAP**). The GE Aerospace Safety Insight solution enables the decoding of flight data into a logical layer of global flight parameters, allowing Riyadh Air safety teams to evaluate and analyze data against a comprehensive library of measurements and safety events.

The main product consists of data ingestion, processing analytics, and user interface. The Safety Insight services and features include:

1. A secure hosted infrastructure (Microsoft Azure).
2. GE Aerospace proprietary data collection and transfer software, WASABI, can collect and securely transmitting data to GE's secure servers over HTTPS or via secure file transfer (SFTP) or via Message Queues.
3. Access to an exclusive library of analytics profiles and sophisticated algorithms.
4. Comprehensive extraction and cleansing of flight data via analytic features that automatically flag anomalies and erroneous readings to ensure accurate, useable results, as well as a strong de-identification protocol when required.
5. Complex matching algorithms that automatically fuse flight data with weather data, trajectory correction, navigation, and terrain data at the flight record level. This provides context and insights to understand complex operational problems and drive proven operational results.
6. An advanced integrated database and processing architecture that delivers speed and automation, highly scalable for use across multiple locations easily and quickly expandable to accommodate additional aircraft, aircraft fleets and to facilitate remote user groups.

4.11 TREND ANALYSIS

1. A regular statistical data of general findings and relevant corrective measures, if any, shall be communicated to operational personnel.
2. Statistical Data analysis report shall be prepared quarterly and same shall be disseminated to Flight Operations
3. If any unhealthy trend is observed during the trend analysis, the same shall be discussed during Flight Ops Safety Action Group meetings.
4. If Any Corrective/ Preventive action required to address the FDA Trend, Same shall be addressed by Flight Operations and Action Taken report shall be sent to Safety office.
5. Review of Such corrective actions shall be reviewed periodically.
6. A detailed Flight Operations SPI analysis report shall be prepared by FDAP Cell every month and the same shall be shared with Flight Operations for detailed analysis.
7. As a part of SMS, Safety Promotion Component, the information is shared with all the stakeholders on a regular basis through various platforms mentioned below, but not limiting to:
    a. Safety Newsletters
    b. Flight Operations Safety Action Group Meeting
    c. Fleet Gathering of Pilots
    d. SMS Refresher for Pilots
    e. Safety Bulletins

4.12 DATA RECOVERY

Riyadh Air ensures maximum acquisition of the aircraft raw data. As mentioned in this chapter, data acquisition is being done in two (2) ways: automatic and manual data retrieval. Nonetheless, the manual data retrieval process also serves as a contingency procedure should the wireless ground link fail, hence, complementing the target retrieval of flight data.

When an incident occurs, a timely and considered judgement is made by the VPCSSE if the DFDR data is required for an investigation. In such cases, the decision to quarantine the DFDR is taken expeditiously considering that the DFDR unit holds up 25 hours of data recording, hence, eliminating the possibility of the data being overwritten. Validation of processed flight data is performed fervently to eliminate errors and spurious events. This process enables the Safety Department to generate more plausible information that is useful in identifying possible threats and/or violations to the safety of the flights.

In case, due some reasons data is not available for analysis, following are the procedures to be followed:

1. For aircraft in which data is transmitted through WAR, aircraft was flying (as per rostering software) and was not received, an entry is made in the remark's column stating "DATA NOT TRANSMITTED"
2. If the data for an aircraft registration is found to be missing, an entry is made in the remark's column stating, "DATA MISSING".
3. If the station has sent the mail stating data was extracted from the aircraft but was not uploaded to the FTP Server, entry is made in the remark's column stating, "DATA NOT UPLOADED".
4. If the data is uploaded, post the download process the same will be done as per data availability, but not later than 24 hours.
5. If the data uploaded for any registration is found to be corrupt, entry is made in the remark's column stating, "DATA CORRUPT".
6. In all the above-mentioned cases i.e., data missing, data corrupt, data not transmitted, and data not uploaded, the entries in the database are highlighted in yellow.
7. After the data downloaded for a particular day has been extracted into the database, the downloaded data is reconciled with the data that has been downloaded and the mails received from the station.
8. This is done by sorting the data available in the folder for that date, aircraft registration-wise. It is then cross-checked whether the data for all aircraft registrations that were downloaded or for which mail was received are available in the database and archive folder. If not, the missing data is archived again and placed in the Autonomous folder for analysis.
9. Lastly, an email is sent to the station in charge (for maintenance & engineering) of respective stations (and other concerned personnel) by Flight Data Specialist confirming the receipt of the

data uploaded by them. The content of this email is the portion of the database filtered for their respective station name minus the remarks column.

10. For missing data, corrupt data or data not transmitted, a separate email is sent to the respective station containing only the missing data, corrupt data or data not transmitted entries from the database including the remarks column. They are urged to take necessary action and upload the missing/corrupt data at the earliest. Email reminders are sent till the time the data in question is recovered.

11. A consolidated list mentioning the details of all data downloaded from aircraft and missing/corrupt/data not transmitted are sent to LMM, CAM, MCC for coordination and ensuring data retrieval.

12. Once the missing/corrupt data has been recovered, the entries are un-highlighted.

13. A monthly reconciliation of data is carried out for all flights using Safety Insight software and Scheduling software.

SL. No.	Aircraft Registration	Station	Date	First File Number	Last File Number	Remarks

Table 1 QAR Data Recovery Format

4.13 DATA RETENTION

FDAP process involves different types of data files. These are:

Aircraft raw data/DFDR data. This data are the ones acquired from the aircraft through manual downloading or automatically transmitted through Wireless Ground Link.

Type of file	Retention period
Raw Data (FDIMU/WQAR/DFDR)	Five (5) years
Flight Files generated after data processing on GE System	Five (5) years

Table 2 Data Retention Period

4.14 USE OF JUST CULTURE IN FDM PROGRAM

Just Culture, as defined in CSMSM Chapter 1.1.2.1, "is an atmosphere of trust in which people are encouraged, even rewarded for providing essential safety-related information, but in which they are also clear about where the line must be drawn between acceptable and unacceptable behavior."

It also refers to a way of safety thinking and fosters both personal accountability and corporate self-regulation in safety matters. This is applicable to the FDA program as well.

4.15 NON-PUNITIVE SAFETY REPORTING POLICY WITH RIYADH AIR

The Safety Department fully endorses non-punitive reporting system within Riyadh Air as this will develop and foster a culture of mutual trust.

The Department encourages all personnel to take preventive action and report any safety threat noted within their respective workplace in accordance with prescribed reporting procedures. Hence, no disciplinary actions will be taken against the personnel who acted to prevent an injury or reports any risk. Nonetheless, those errors that resulted from an illegal activity or willful misconduct may lead to disciplinary actions taken against the reporter or the personnel involved.