International Civil Aviation Organization

MIDANPIRG/17 and RASG-MID/7 Meeting

(Cairo, Egypt, 15 – 18 April 2019)

Agenda Item 5.1: Regional Performance Framework for Safety

IMPLEMENTATION PROGRESS OF THE SAFETY ENHANCEMENT INITIATIVES (SEIs)

(Presented by the Secretariat)

SUMMARY

This paper provides an update on the progress achieved for the implementation of the Safety Enhancement Initiatives (SEIs) assigned to the MID Regional Aviation Safety Team (RAST).

Action by the meeting is at paragraph 3.

REFERENCES

- RGS WG/5 Report
- RSC/6 Report

1. INTRODUCTION

1.1 The MID-RAST is one of three RASG-MID Teams. It was established by the first meeting of the RASG–MID Steering Committee (RSC/1) held in Cairo, 18-20 June, 2012 and is responsible for identifying and developing Safety Enhancement Initiatives (SEIs) related to the identified Focus Areas.

2. DISCUSSION

2.1 The MID-RAST is utilizing the RASG-MID Annual Safety Reports and statistical data to support the development of related SEIs/DIPS for the identified focus areas.

Runway and Ground Safety

2.2 The meeting may wish to recall that the RGS WG is supporting the RASG-MID Steering Committee (RSC) and Regional Aviation Safety Team (MID-RAST) in the development, implementation and monitoring of Safety Enhancement Initiatives (SEIs) related to the Runway Safety Focus Area (FA).

2.3 The following SEIs related to RGS have been endorsed by the RASG-MID:

- **MID-RAST/RGS/2**: Development of guidance material and training programmes to support the creation of action Plans by the Runway Safety Team (RST);
- **MID-RAST/RGS/3**: Development of guidance material and training programmes to support Aerodrome Infrastructure and Maintenance Management;
- **MID-RAST/RGS/4**: Aerodrome Safeguarding;
- **MID-RAST/RGS/5**: Wildlife Hazard Management and Controls;
- **MID-RAST/RGS/6**: Laser Attacks;
- **MID-RAST/RGS/7**: Ground Handing Operations and Safety;
- **MID-RAST/RGS/8**: ARFF and Emergency Planning;
- **MID-RAST/RGS/9**: Safety Management;
- **MID-RAST/RGS/10**: Runway Excursions

2.4 A progress report on the implementation of the above-mentioned SEIs is **at Appendix A**. It is to be highlighted that all actions related to 5 out of the 9 SEIs have been completely implemented.

2.5 The meeting may wish to recall that RASG-MID Safety Advisory (RSA) on Laser Attacks was endorsed by the RSC/5 meeting in January 2017 and was circulated to States on 29 March 2017. The meeting may wish to agree that the revised Laser Attack Case-Study at **Appendix B** be published by the ICAO MID Office as a Supplement/Attachment to the RSA-12 to complete the last action related to the SEI MID-RAST/RGS/6.

2.6 With regard to the SEI MID-RAST/RGS/7 on Ground Handing Operations and Safety, the meeting may wish to note that Ground Handling Seminar will be held back-to-back with the RGS WG/6 meeting in November 2019 in Cairo.

2.7 With regard to the SEI MID-RAST/RGS/10 on Runway Excursions, the meeting may wish to note that the ICAO/ACI Symposium on Implementation of the New Global Reporting Format for Runway Surface Condition (GRF2019) was held in Montreal from 26 to 28 March, 2019. The Symposium was an opportunity to present the new ICAO Runway Condition Assessment Requirements and the Global Reporting Format (GRF) and how to use the ICAO Runway Condition Assessment Matrix (RCAM) in order to produce the Runway Condition Code (RWYCC). The meeting may wish to note that the SEI MID-RAST/RGS/10 will be updated in accordance with the outcomes of the Symposium. It is to be highlighted that a Regional Seminar will be organized by the ICAO MID Office in 2020, in order to ensure the effective implementation of the Global Reporting Format (GRF) in the MID Region.

Loss of Control In-Flight (LOC-I)

2.8 Three RASG-MID Safety Advisories (RSAs) were published by the ICAO MID Office as a result of Safety Enhancement Initiatives endorsed by the RASG-MID to reduce the risk of Loss-of-Control Inflight accidents. These Advisories were distributed to MID States' Civil Aviation Authorities for follow-up with airlines registered in their respective Countries.

a) RSA 09 - Airplane States Awareness (ASA) - Low Speed Alerting: to improve flight crew awareness of low airspeed, manufacturers should develop and regulators should ensure implementation of systems that alerts flight crews when airplane reaches its minimum manoeuvring speed. Airline operators to incorporate existing service bulletins from manufacturers that provides low speed alert functionality.

b) RSA 07 - Standard Operating Procedures Effectiveness and Adherence: to ensure that all airline operators publish and enforce clear, concise and accurate flight crew Standard Operating Procedures (SOPs) to reduce the risk of LOC-I accidents.

c) RSA 08 - Airplane States Awareness (ASA) - Training -Flight Crew training (Approach to Stall & Up Set Recovery) Verification and Validation: to improve flight crew proficiency in handling issues that can lead to loss of Airplane State Awareness (ASA). Airline operators should review, incorporate, and adopt the best practices with regards to upset prevention and recovery training and to comply with ICAO amendment 38 to Annex 6 (operations of aircraft) to include upset prevention and recovery training.

2.9 Eight (8) States amended their regulations to include the UPTR requirements as per ICAO amendment 38 to Annex 6 (53%).

Controlled Flight Into Terrain (CFIT)

2.10 The DIP related to CIFT addresses the implementation of PBN Approach procedures to all runways not currently served by precision approach procedures.

2.11 The meeting may wish to note that the RSC/6 meeting was updated on the RAST activities including the status of the progress achieved in the implementation of the DIPs related to LOC-I and CFIT as at **Appendices C** and **D**, respectively. The RSC/6 meeting recalled that the RASG-MID/6 meeting agreed that global priorities (RS, LOC-I and CFIT) should always be addressed within the RASG-MID framework. However, with regard to LOC-I and CFIT, global developments and measures should be followed by the RAST instead of developing new DIPs.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the progress achieved in the implementation of the MID-RAST SEIs, and take actions, as appropriate;

b) review and update, as appropriate, the MID-RAST SEIs; and agree on the way forward;

c) encourage States to use the RASG-MID Safety Advisories, as appropriate, to enhance safety in the Region;

d) agree to circulate the Laser Attack Case-Study at **Appendix B** (supporting the RSA-12) to States; and

e) encourage States to participate in the Ground Handling Seminar which will be held back to back with the RGS WG/6.

APPENDIX A

RAST SEIs Progress Report

	Completed
	In Progress
	Delayed

MID-RAST/RGS/2 : Development of guidance material and training programmes to support the creation of action Plans by the Runway Safety Team (RST)		
Deliverables	**Champion**	**Progress/Remarks**
Develop and issue Stop Bar guidance documentation for consideration of LRSTs	UAE	*Completed*
Organise a Workshop for Regional RST Go-Teams	UAE	*Completed*
Develop and issue regulatory framework supporting establishment of LRSTs	UAE	*Completed*
Develop and issue a model checklist for LRSTs	UAE	*Completed*

MID-RAST/RGS/3 : Development of guidance material and training programmes to support Aerodrome Infrastructure and Maintenance Management		
Deliverables	**Champion**	**Progress/Remarks**
Conduct a MID-Regional Runway Safety Seminar	UAE	*Completed*
Organise a Regional Aerodrome Certification Workshop	UAE	*Completed*
Develop a MID-Region Aerodrome Certification toolkit for States.	UAE	*Completed*
Develop and issue guidance material on periodic surveillance audits of Aerodrome Infrastructure and Maintenance	UAE	*Completed*
Develop and issue guidance material as RSA on proactive oversight of Aerodrome Infrastructure Development	UAE	*In Progress* : To be concluded by 2018.

MID-RAST/RGS/4 : Aerodrome Safeguarding		
Deliverables	**Champion**	**Progress/Remarks**
Safeguarding Guidance Toolkit	Egypt	*Completed*
Regional Safeguarding Workshop	Egypt	*Completed*

MID-RAST/RGS/5 : Wildlife Hazard Management and Controls		
Deliverables	**Champion**	**Progress/Remarks**
RSA for Regulatory Framework & Guidance Materials	Sudan	*Completed*
Wildlife Hazard Management Plan Template	Sudan	*Completed*
Wildlife Management Control Workshop	Sudan	*Completed*

MID-RAST/RGS/6 : Laser Attacks		
Deliverables	**Champion**	**Progress/Remarks**
RSA for Guidance Material	Egypt	*Completed*
Amended RSA-12	Egypt	*Completed*
ICAO to issue State Letter to promulgate regulations on Laser Attacks	Egypt	*Completed*
RSA with Case Studies	Egypt	*Completed : to be circulated to States*

MID-RAST/RGS/7 : Ground Handing Operations and Safety		
Deliverables	**Champion**	**Progress/Remarks**
RSA for Aerodrome Apron Management	UAE	*In Progress* : Advisory Circular on Apron Management Safety provided by UAE to be reviewed by the States.
Seminar on Ground Handling (Safety)	ICAO MID	*In Progress* : Ground Handling Seminar will be held back to back with the RGS WG/6.

MID-RAST/RGS/8 : ***ARFF and Emergency Planning***		
Deliverables	**Champion**	**Progress/Remarks**
Develop a survey on ARFF/AEP level of implementation	Egypt	*In Progress*
Present Survey Results to RGS WG for consideration of other required actions	Egypt	*In Progress*

MID-RAST/RGS/9 : Safety Management		
Deliverables	**Champion**	**Progress/Remarks**
Organize SMS Training/Workshop	ICAO	*Completed*
Develop Aerodrome SMS Compliance and Effectiveness Toolkit	UAE	*Completed*
Present Toolkit at the Aerodrome SMS Workshop	UAE	*Completed*

MID-RAST/RGS/10 : Runway Excursions		
Deliverables	**Champion**	**Progress/Remarks**
RSA for Monitoring and Reporting Runway Surface Conditions	FAA	*Delayed: follow-up actions will be taken based of the outcome of the GRF2019.*
State Letter urging States to report the incidents on Annual Basis to the ICAO MID Office in conjunction with MID-ASRT.	ICAO	*Delayed: follow-up actions will be taken based of the outcome of the GRF2019.*

APPENDIX B

MID-Region

Case Study on Laser Attacks related to RASG-MID SAFETY ADVISORY – 12

Date of Issue:	December 2016
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Owner:	RASG-MID

These guidelines are developed by the Laser Attacks team - Runway and Ground Safety Working Group (RGS WG), as part of MID-RAST/RGS/6 DIP deliverables, based on the work of NANSC under supervision of the Egyptian Civil Aviation Authority in collaboration with the ICAO MID Regional Office.

Disclaimer

This document is intended to provide guidance for civil aviation regulators, aerodrome operators, air traffic service providers and aircraft operators regarding establishment of Laser Attacks incidents database and a model case study for laser attacks in order to mitigate the risk of laser attacks pointed at an aircraft/ATC tower. Especially, during critical phases of flight, which can cause Loss of Control In-flight (LOC-I) or going around.

This document has been compiled by members of aviation industry to enhance runway safety. It is not intended to supersede or replace existing materials produced by the National Regulator or in ICAO SARPs. The distribution or publication of this document does not prejudice the National Regulator's ability to enforce existing National regulations. To the extent of any inconsistency between this document and the National/International regulations, standards, recommendations or advisory publications, the content of the National/International regulations, standards, recommendations and advisory publications shall prevail.

TABLE OF CONTENTS

TABLE OF FIGURES

INTRODUCTION

BACKGROUND

Laser (Light Amplification by Stimulated Emission of Radiation) illumination increase every year all over the world. Including the MID Region as reported in **ICAO** annual safety report 2014, also a **CANSO** survey has shown laser attacks are on the increase, moreover, **FAA** had the same results.

In the last three years, there has been an increasing number of laser-beam attacks affecting daily night operations at 3 airports, especially during critical phases of flight (**90**% of laser illumination was during **approach phase** at Alpha airport). Hand-held laser-beam attacks affected aircraft and ATC Tower CAP; moreover, Laser illumination, dazzling light and fireworks negatively impacts flight safety, creates hazards. And the safety of pilots eyes, aircraft operations and passengers alike.

Handheld lasers vary in strength, colour and wavelengths (400-700 nm). That is why class and colour classify Lasers. While the FAA says the lasers cause a safety concern, no accidents or aborted take-offs or landings have been reported yet. However, in worst-case scenario, Laser attacks can cause (Go around or, Loss of control in critical positions "LOC-I "or, Damage pilot's eyes).

As a response to that issue, I created a data base of laser beam attacks for 3 years. And as a sample, I started with the main three airports Alpha, Bravo and Charlie. Moreover, I interviewed a random sample of laser pens traders to know the different causes of the phenomenon. There were 230 reported incidents of laser illumination (218 at Alpha, 10 at Bravo, and 2 at Charlie airports) during the study period (3 years for Alpha and 2 years for bravo and Charlie. Total of 7 years), plus (16 dazzling lights, 4 fireworks. Plus 3 laser attacks on ATC Tower) on Alpha airport.

- Occurrence Register at Alpha airport during 3 years shown below:

Location / Incident type	Arrival			On ground			TOWER CAP		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
Laser Beam	126	60	32	3	NIL	1	1	1	1
Dazzling Light	12	2	2						
Intense Fireworks	1	NIL	3						

Table 1: Occurrence Register at Alpha Airport for 3 Years

- Occurrence Register at Bravo and Charlie airports during two years as shown below:

Location / Incident type	Bravo		Charlie	
	Year 1	Year 2	Year 1	Year 2
Laser Beam	3	7	1	1

Table 2: Register at Bravo and Charlie Airports during 2 years

The main sources of laser are Hand held laser and outdoor Laser light shows inside clubs at night events.
We initiated a plan includes a variety of mitigation methods consists of control and recovery methods, with timetables, procedure for pilots and ATCOs (checklists), Moreover, training and active reporting system at Alpha airport, hazard identification, safety analysis, system gaps, and risk assessment. My study confirms ICAO results because the majority of attacks were during approach phase at Alpha airport during year one.

Finally, we may be able to gradually reduce number of laser-beam incidents, and reduce the severity of a laser beam event when it occurs. Laser incidents reduction percentage during 3 years was almost 70 %. Although, the target was 10% per year at Alpha airport.

PURPOSE

The purpose of this case study is to propose model for practical application by CAA to provide ATCO and pilot best practices (checklists). Applying ICAO protection zones by Plotting the LFFZ, LCFZ, and LSFZ at Alpha airport with AUTOCAD. Provide effective coordination between all stakeholders by establishing Local Laser Working Group (LLWG). How to manage and control risk by identifying hazards and assesse risk with Root cause and gap analysis. Establishing data base to provide trends for Alpha/Bravo/Charlie airports. Finally, to provide Mitigation Measures and Safety recommendations to achieve Safe operations at Alpha airport. Then rolling out the plan progressively to airports across country. As a start Charlie and Bravo Airports. Data provided in this case study may be used parallel with guidance materials provided by CAA to establish training campaign for pilots, awareness campaign for ATCO and Public awareness campaign. Also, it may be used as an oversight audit tool by CAA.

Chapter 1

RISK MANAGEMENT

1.1 CAUSAL FACTOR:

1. The lasers are too easily available at low cost, although it is illegal to aim a laser at an aircraft.
2. Laser pens are useful and fun, but they are all too often misused.
   - One is misuse by the general public.
   - Antisocial or criminal persons.
3. Beam diversion is very low. Laser beam often fills an entire cockpit at thousands of feet away.
4. People still do not understand how potentially dangerous this is.
5. Lack of awareness and training for pilot/ATCOs, lack of recovery methods.
6. Lack of proper procedure for pilots and ATCOs.
7. Insufficient regulations, laws.
8. Lack of coordination between different stakeholders.
9. Street sellers show off the power of laser pointers by pointing at an aircraft in front of the buyers/children to impress them with their products.
10. Use of lasers in outdoor light shows.

1.2 Hazard Identification:

1.2.1 Primary hazard:

1- Distraction.
2- Glare.
3- Temporary Flash blindness.
4- Eye injuries.

1.2.2 Methods:

A) Reactive:

- Safety reporting (service providers).

B) Proactive Hazard Identification Methods Through:

The proactive approach is required, so that the hazard is recognized and addressed before it could turn into an occurrence.

- Safety monitoring. (Data base for 3 years).
- Safety trends analysis. (ANSP) 3 years (Time, Location, Color, Type...).
- Safety assessment. (ANSP).
- Surveys.

1.2.3 Hazard Sources Identification:

The main sources of laser are:

1-Hand held laser and.

2- Laser light shows in clubs at night events.

1.3 Hazard Severity/ Probability:

1.3.1 1Hazard Consequence:

Laser attacks can cause:

A- Go around or.

B- Loss of control in critical positions "LOC-I".

C- Temporarily damage pilot's vision.

D- Collision with ground obstacle or aircraft.

1.3.1.2 Severity/Impact: (Who might be harmed?)

A-Effect on operations: may cause go around or loss of control or collision with an aircraft or ground obstacle.

B-Effect on aircrew: physical discomfort and increase in workload, and delay.

C-Effect on ATC service: slight increase in air traffic controller workload.

The criteria for determining the severity was (Phase of flight, Laser factors, beam environment, situational factor, pilot factor, operational factors, day or night …) as illustrates below.

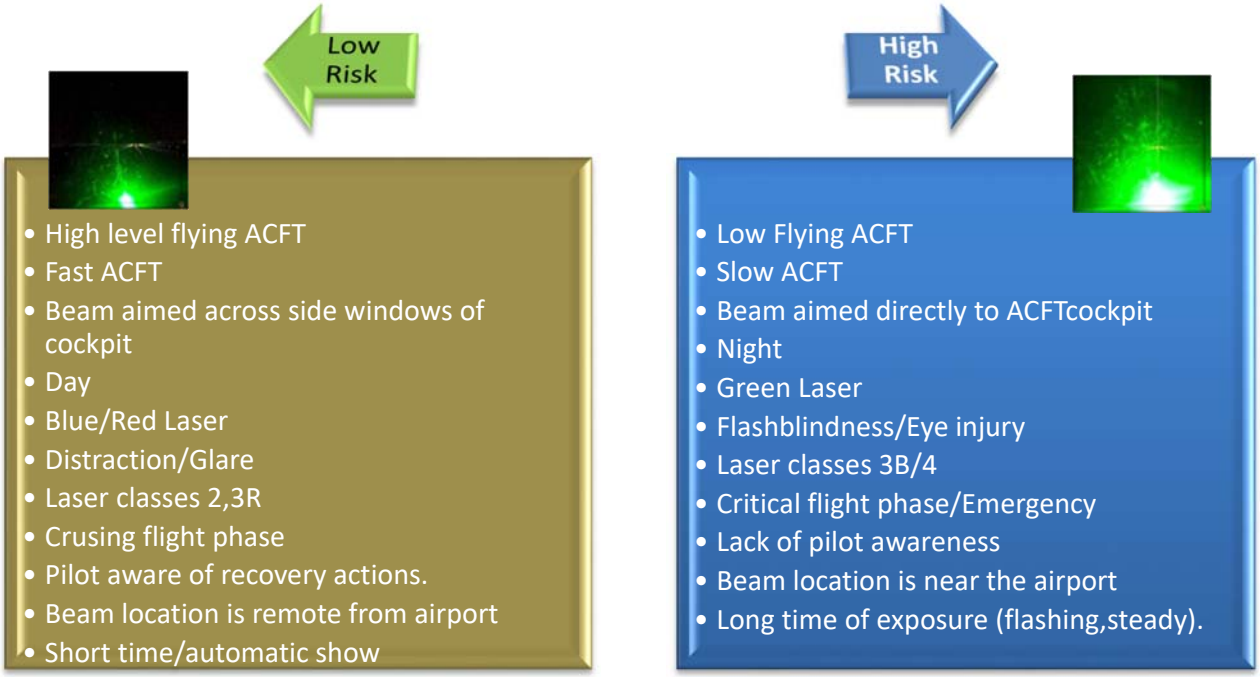


Figure 1: Factors Affecting Severity

1.3.2 Hazard probability:

The annual percentage of laser illumination did not cross 1% of all traffic at the three main airports. By the way these three airports represent approximately 60-70% of all country annual traffic.

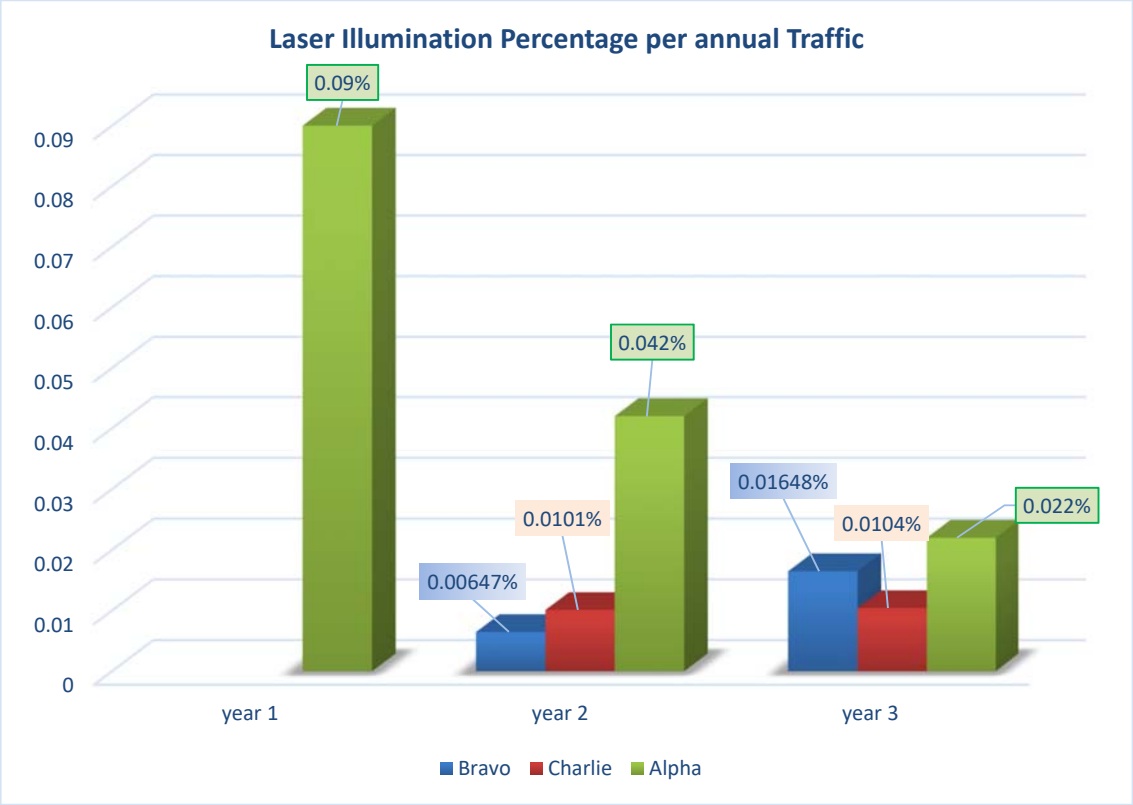


Figure 2: Laser Illumination Percentage per Annual Traffic during 3 Years at Alpha/Bravo/Charlie.

1.4 Risk Assessment at 3 Main Airports:

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

Alpha
136 in year 1
64 in year 2
32 in year 3

Bravo
3 in Year 1
7 in Year 2

Charlie
1 in Year 1
1 in Year 2

Table 3: Risk Assessment at 3 Main Airports

- **Alpha: Alpha airport.** **Bravo: Bravo Airport.** **Charlie: Charlie airport.**

1.4.1 Risk Volume:

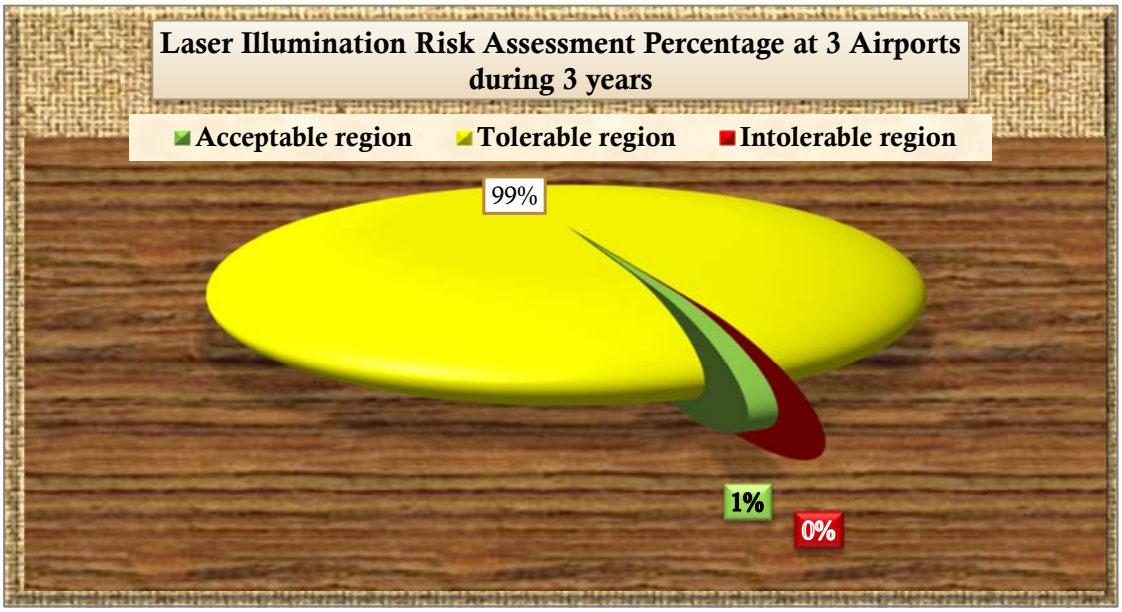


Figure 3: Risk Assessment Percentage in Egypt at 3 Main Airport during 3 years

- High risk or Intolerable risk= 0%, Tolerable risk= 99%, Acceptable risk =1% during 2013-2015.

1.5 Risk control strategy:

- ✓ Avoidance: ATC can avoid landing on high risk runways during events.
- ✓ Reduction: we cannot eliminate laser illumination risk. But we can mitigate it by several means. 99% of the problem in country can be mitigated by our mitigation measures below.
- ✓ Sharing Risk: share risk between (Aircraft Manufacturer, aircraft operator, Air Navigation Service Provider, and Civil Aviation Authority).

1.5.1 Control Measures: *(for more information see full mitigation measures page 35).*

a) In the air: Pilots shall use laser beam checklist.

b) On ground:

1- ATC shall use ATC laser beam checklist after the first incident report.

2- CAA shall terminate or increase beam divergence or change the direction of laser beam away from runways extensions during events.

3- Restrict sale and import of laser beam class 3B, 4.

4- Create new prevention law.

1.6 FISHBONE ANALYSIS:

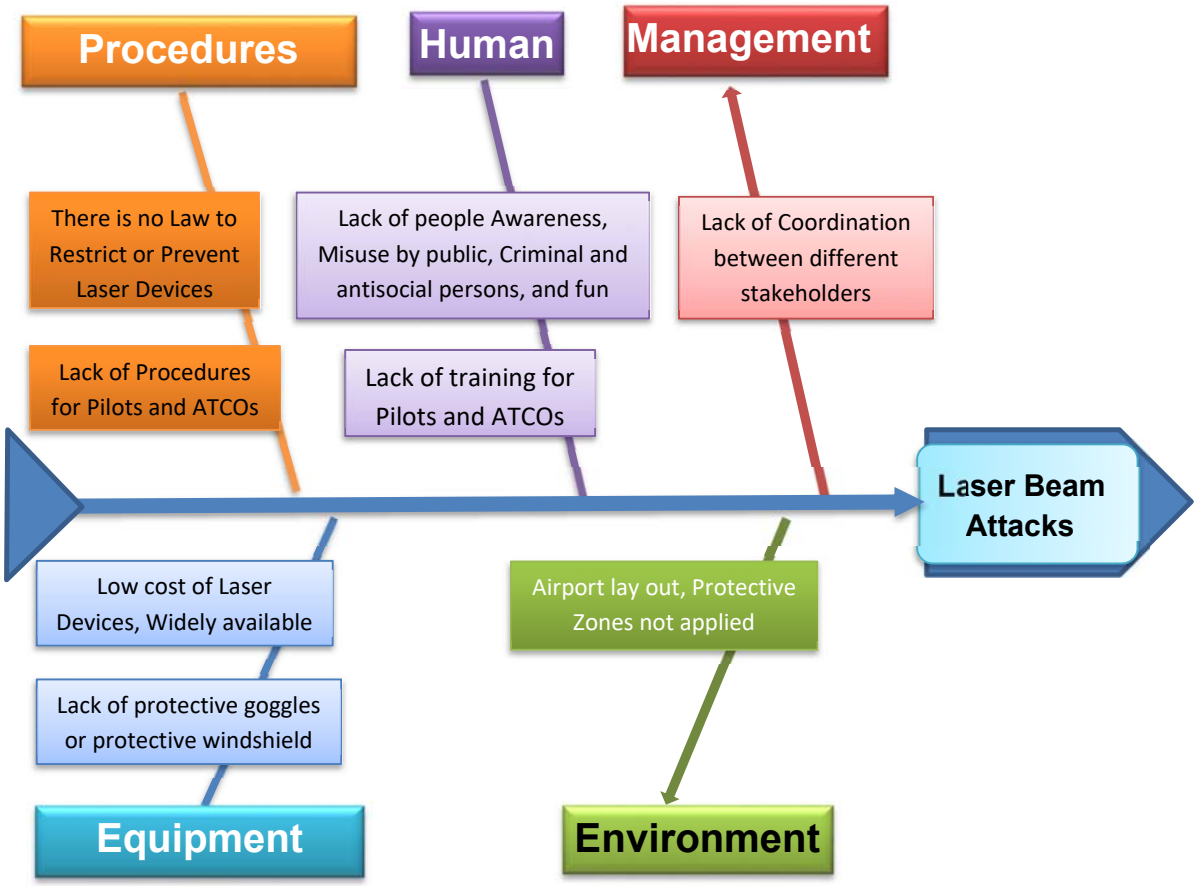


Figure 4: Fishbone Analysis

1.7 GAP ANALYSIS IN REPORTING SYSTEM:

- Part of pilots' community are respondent bias in reporting system.
- Police cannot catch laser attacker because there is no criminal law, more over lack of public awareness.
- Pilots don't provide ATC with sufficient information about an incident report, which would include the location, direction, beam colour, length of exposure (flash or intentional tracking), and effect on the crew, and laser location by GPS.
- There is no direct fast way of communication between pilots and police, public and police. Such as mobile applications, hot lines like 911.
- 9 questionnaires were initiated during year two and 13 questionnaires during year three as a survey by me (ATC).including the worst possible scenario, that equals almost half of incident during year three. That is why part of pilots' community are bias in reporting system.

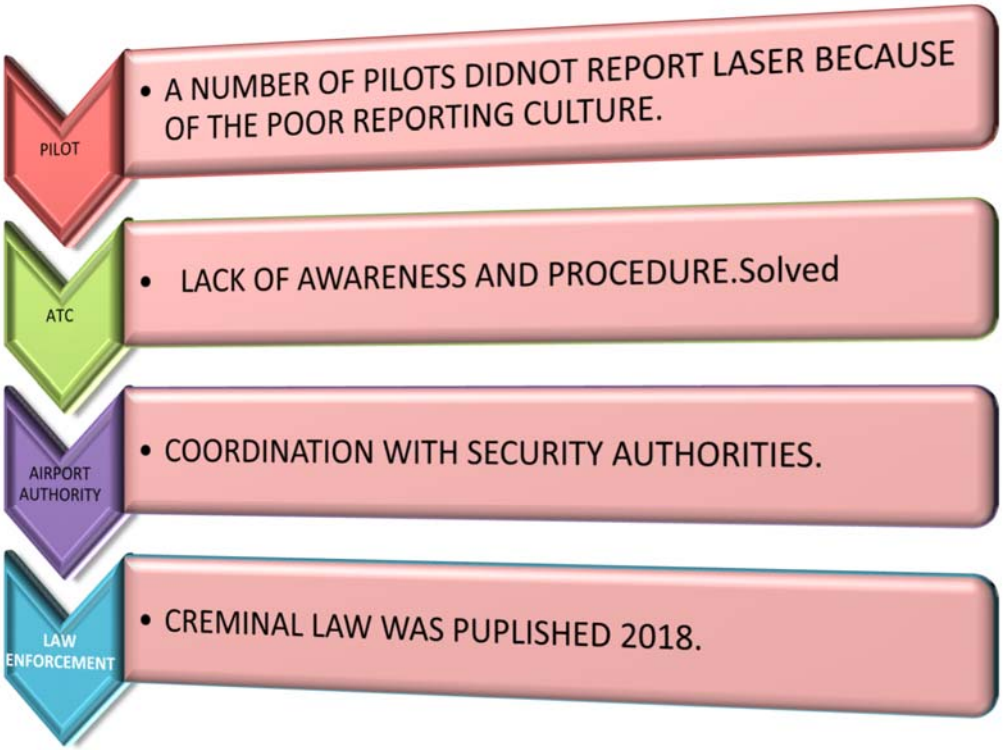


Figure 5: Gap Analysis in Reporting System

Chapter 2

ATCO & PILOT PROSPECTIVE PROCEDURES/BEST PRACTICES

2.1 Proposal for ATC Laser Check list

▪ ACTION BY ATCO	Yes	NO
1- Inform & update information to supervisor to relay information to CRISIS, APP…	☐	☐
2- Coordinate with APP (when pilot requests) to Diverge ACFT from the cleared flight path, or to use different runway or ask for holding until the area has been secured and the threat has ceased. Or restrict flying in a portion of airspace.	☐	☐
3-Use (ATIS) to warn incoming ACFT. Phrase "*UNAUTHORIZED LASER ILLUMINATION EVENT*."+ General positional location and altitude".	☐	☐
4- Cooperate with law enforcement officials investigating the event.	☐	☐
5- Report to safety office.	☐	☐
6- Issue NOTAM.	☐	☐

Table 4 Proposal for ATC Laser Check List

2.2 Tower Laser Beam Model

NO	A/C Call sign	Type	DEP	ARR	DME/ALT	RWY	Flight phase	Colour	Time	Date
1			☐	☐						
2			☐	☐						

Table 5 Tower Laser Beam Model

2.3 Proposal for Pilot Laser Checklist

▪ ACTION BY PILOTS	YES	NO
1- Look away and Shield eyes from the light source.	☐	☐
2- Use Laser protective eyewear	☐	☐
3- Background lights maximum on PM pilot's discretion.	☐	☐
4- COMMUNICATE with the other crewmember to determine visual condition and status of the aircraft.	☐	☐
5- Transfer control of the aircraft to another pilot.	☐	☐
6- ENGAGE autopilot and coupler for approach and manual landing.	☐	☐
7- If aircraft has auto-land capability, crew may elect to auto-land.	☐	☐
8- CONTACT ATC to report laser incident and request priority. If necessary, declare an emergency.	☐	☐
9- Avoid rubbing eyes. And seek medical help when required after landing.	☐	☐
10-ALLOW eyes to regain visual function and check aircraft instruments for any deviations from assigned flight profile when visual function returns.	☐	☐
11-Continue to CROSS CHECK and verify instrument indications for visual legibility during approach and landing.	☐	☐
12-DISENGAGE autopilot and coupler as per company policy	☐	☐
13-Manoeuvre or position the aircraft such that the laser beam no longer illuminates the flight deck. After coordination with ATC.	☐	☐
14- Ask ATC for different runway for landing.	☐	☐
15- Execute missed approach procedures.	☐	☐

Table 6 Proposal for Pilot Laser Checklist

Pilots precautions:

1. Read laser NOTAMS of destination airport.
2. Expect Laser Activity during night operations. Especially during months (January, February, May, June), and hours from (16:00z to 23:59).
3. Expect Laser attacks during approach and Landing Phases and within LFFZ, LCFZ zones.

Chapter 3

TRENDS

3.1 Laser Attacks in MID Region per Year

3.1.1 Laser attacks reported at MID State Per year (Source: IATA)

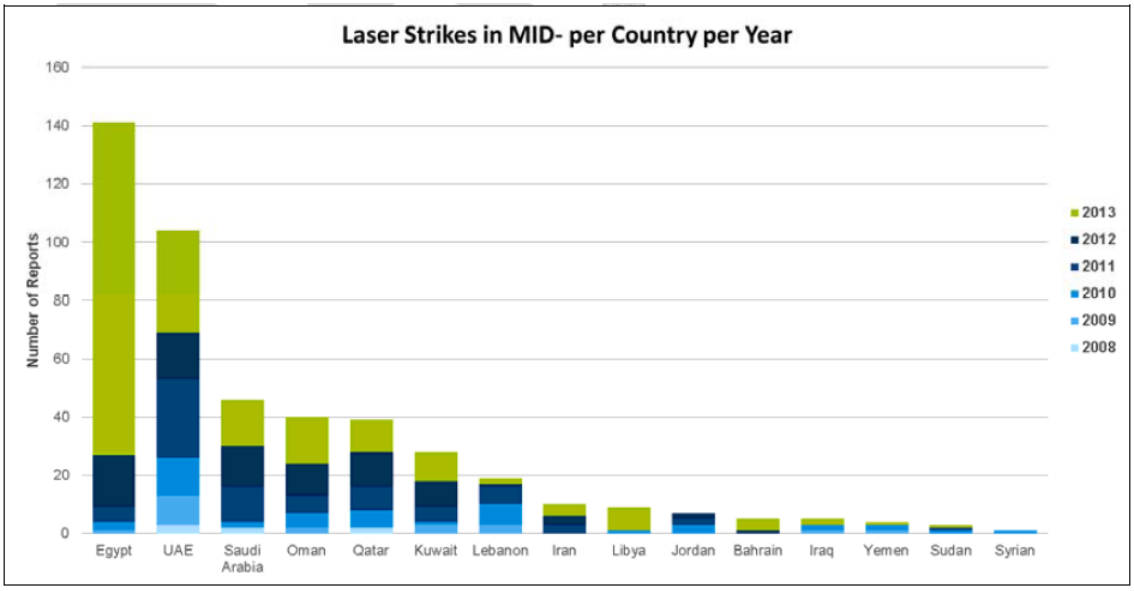


Figure 6: Laser Attacks Reported at MID State per Year (IATA)

No index entries found.**3.1.2 Pie Chart 3 years comparison (Alpha airport):**

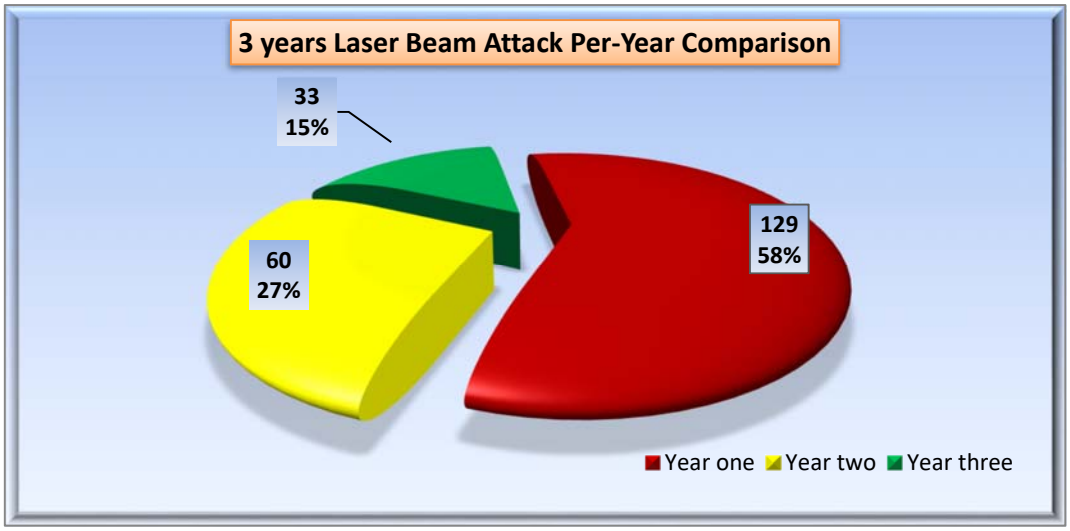


Figure 7: Pie Chart Comparison at Alpha Airport during 3 years

3.1.3 Laser attacks reduced to 15% during year three due to several reasons:

A) Pilots and ATCO awareness.

B) Few Pilots have PPE, or got proper training, and procedures. Like (Air Liner).

C) ICAO meetings and seminars was very useful to highlight the importance of establishing database, etc.….

D) Foreign airliners switches off exterior lights to avoid spotting by laser attackers (**Stealth mod**). Few pilots requested that from ATCO during final Approaches, although it is against normal procedures.

E) A number of pilots did not report laser events (*Acceptance of risk as normal*). They think the risk is within accepted level. Moreover, some of them lost hope in solving this problem, In addition, they were attacked by laser for many years, and knew some recovery actions. Some pilots thinks it is a waste of time and effort, or it is not important to report incidents like laser illumination, and a quit number don't have *the safety reporting culture*.

F) I noticed that during winter (December year two), when temperature drops sharply and up normally, or during thick fog, we did not receive any reports of laser activity.

G) Appling ICAO recommendations such as creating LLWG, this was the first step in identifying the risk and to help solving the problem.

3.1.4 Pie Chart during 2 years comparison (Bravo):

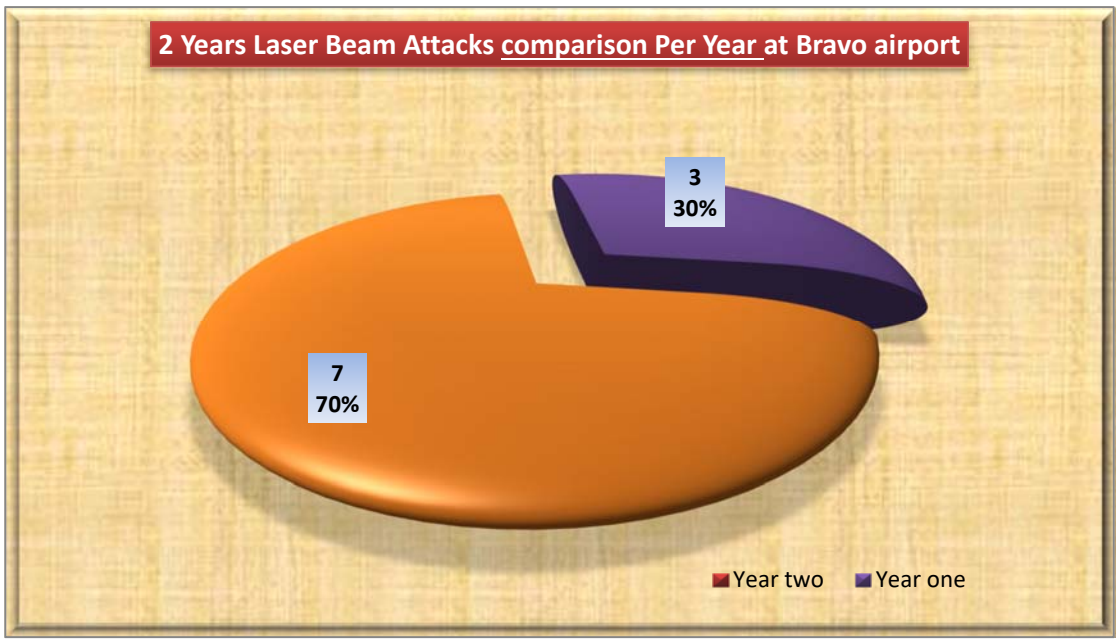


Figure 8: Bravo Laser Attacks Comparison during 2 Years

3.1.5 Pie Chart 2 years comparison (Charlie):

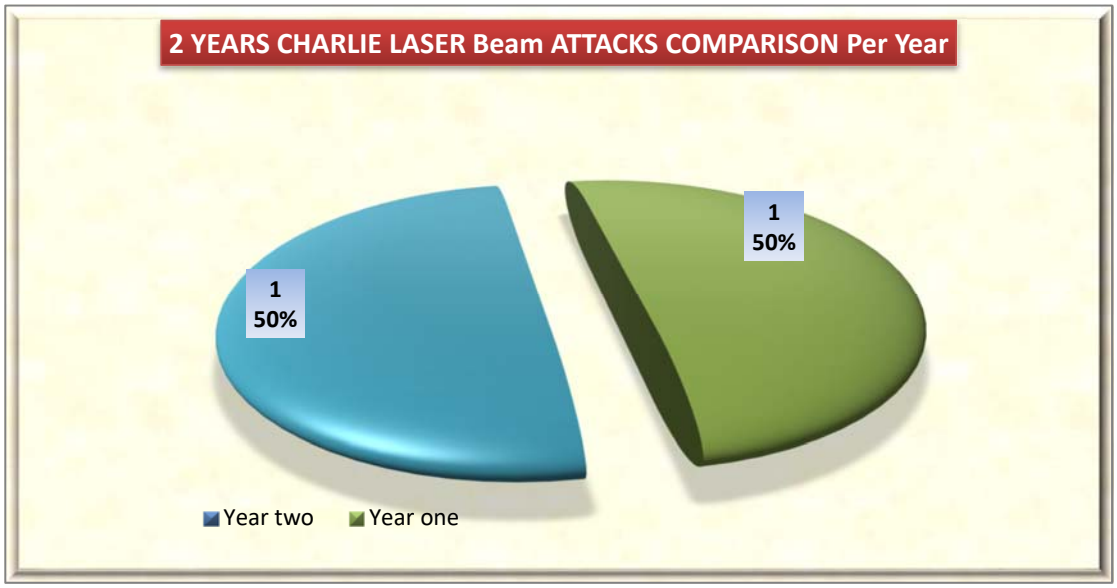


Figure 9: Pie Chart Comparison during 2 Years at Charlie Airport.

3.2 Laser Attacks per Month:

3.2.1 Laser attack incidents (Per Month) reported at Alpha Airport during 2 years.

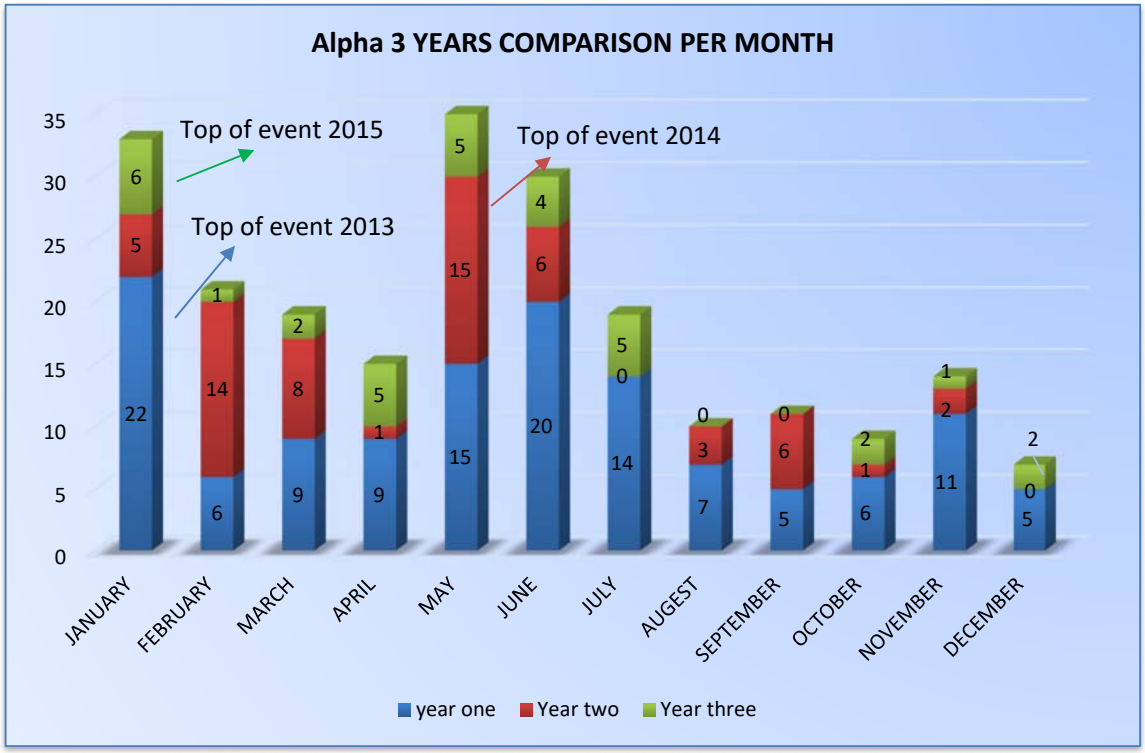


Figure 10: Laser Attacks per Month at Alpha Airport

Top of events are during Official Holidays, summer holidays and National events.
1) Top of event were during January Year one and three, while it were during May year two.
* In my opinion, the numbers may be temporarily reduced, although laser attacks increase every year all over the world.

I think numbers will decrease after applying most of mitigation methods. However laser-beam incident severity will reduce quickly, by using Recovery methods like laser-beam best practices (Pilot/ATC checklists), and training campaigns.

3.2.2 Laser Attacks During Two Years at Bravo/Charlie Airports:

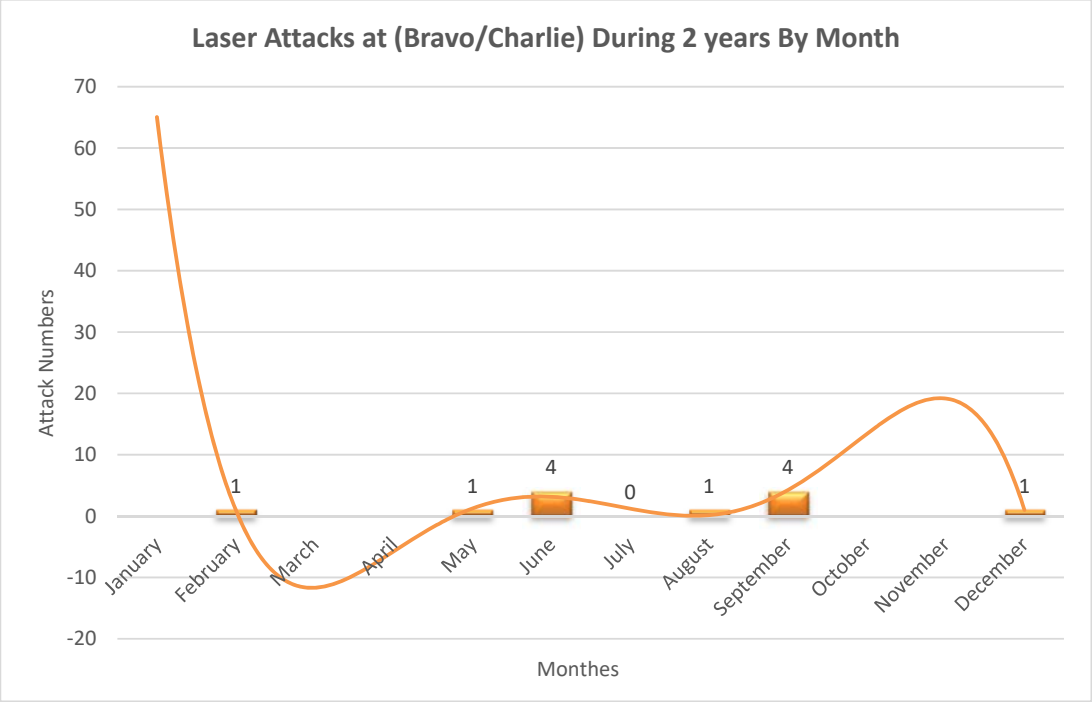


Figure 11: Laser Attacks per Month at Bravo/Charlie during 2 Years

Most of Laser attacks was during summer holidays. Top of events were during June and Septemper.

3.3 Trend per Hour during 3 Years at Alpha airport:

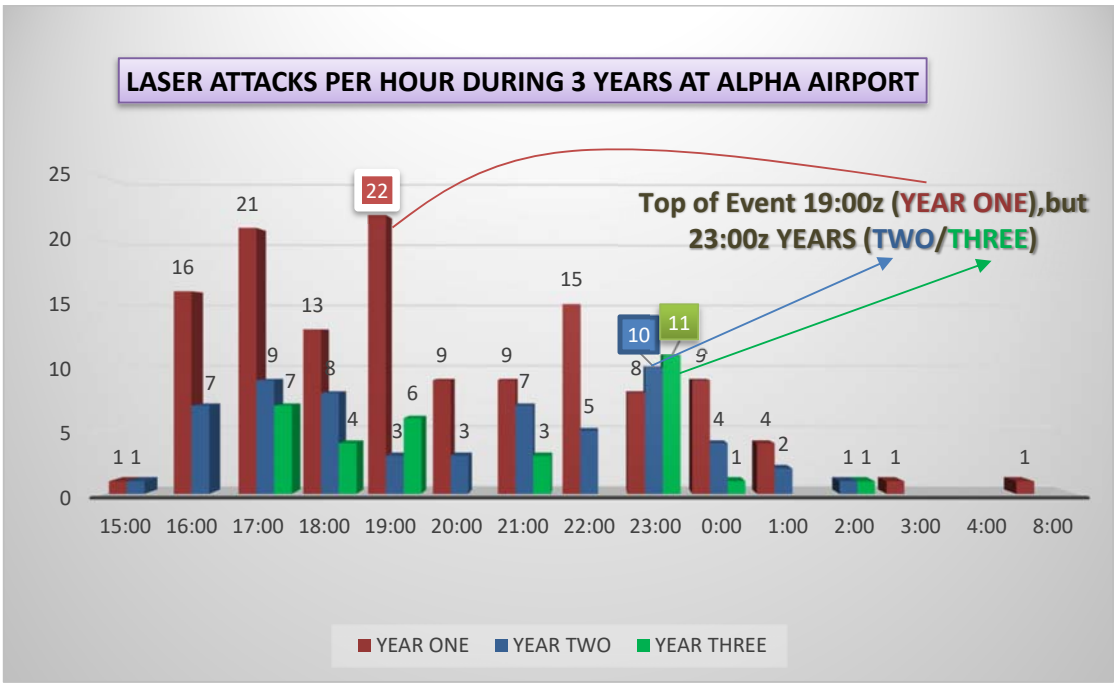


Figure 12: Laser Attacks per Hour at Alpha Airport during 3 Years

A) Day vs. night**:** only one report at year one during day light hours, while 229 during night hours in the study period 3 years. Therefore, it is a **night event**,

B) In addition, Top of event during year one happens at time: 19:00z, and starts to go down.

C) Years two and three comparison: event starts at 16:00z almost end at 01:00z. And top of event for both years were 23:00z.

D) Top of event at Charlie airport 16:21 z and 00:42 z.

E) Top of event at Bravo airport 18:00 z and 19:50 z.

3.4 Laser illumination in relationship with the established ICAO zones:

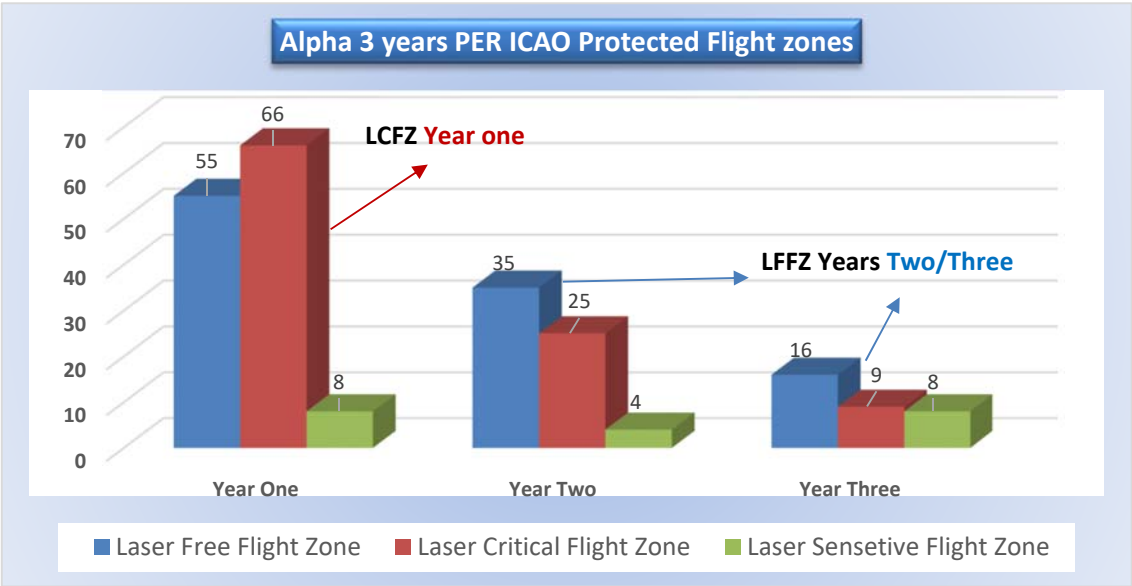


Figure 13: By Laser Protection Zones at Alpha Airport

3.4.1 Trend by ICAO laser Protection zones Alpha airport

- The dimensions are actual. Most attacks are in laser beam free flight zone 48% and laser critical flight zone 47%(during Year One).and as well 55% and 39% respectively during Year Two. And LFFZ was 48% and LCFZ was 27% during Year Three.

- Critical flight phases are within Laser Beam Free Flight Zone.

- LFFZ should have the priority when applying mitigation methods, Then LCFZ.

- The majority of attacks are in first two zones. LFFZ were 47%, LCFZ were 44% and LSFZ were 9 % during 3 Years. Therefore, we should concentrate our efforts on the Free flight zone, for getting fast results, achieving ALS and Implement effective methods for this specific area, by establishing layers of defence. And recovery plane for all stakeholders. Probability decreases in year two and three, but percentage increases at free flight zone.

3.5 Laser Attacks per Flight Phase:

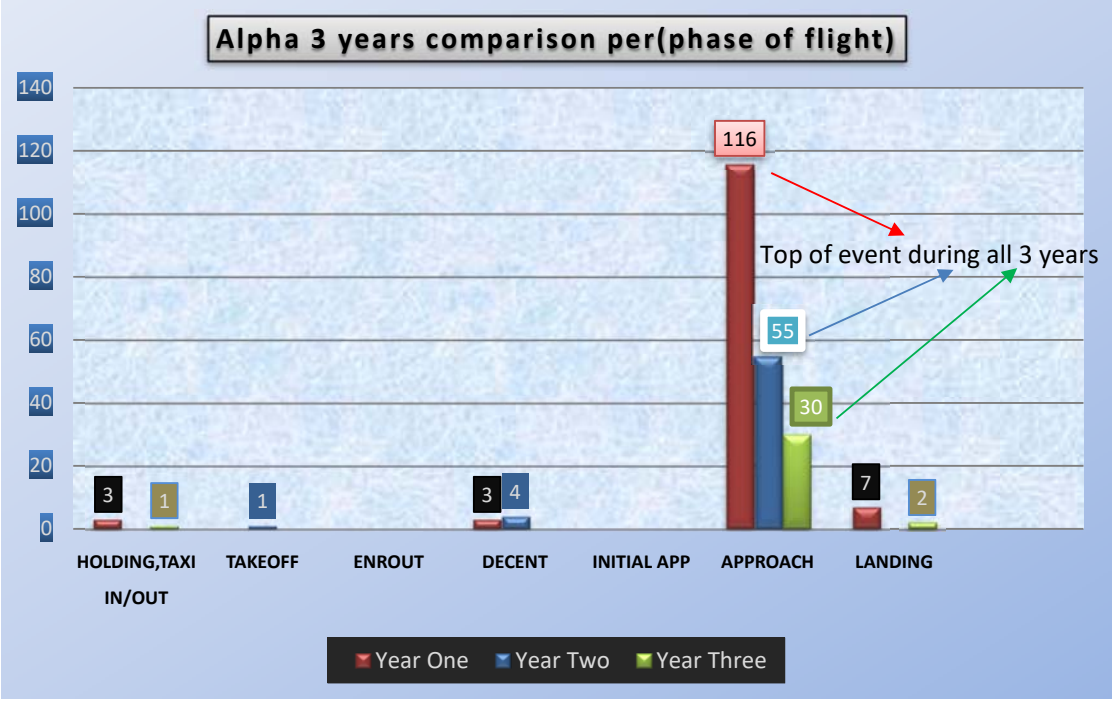


Figure 14: Flight Phase Comparison at Alpha Airport during 3 years

90.50%, of laser illumination occurred during approach, 4% during landing, and 3% during descent and 2% during holding and taxi, 0.5% during take-off. With 3 laser beam attacks on the tower cabin. There are no attacks during any other flight phases during study time 2013-2015.

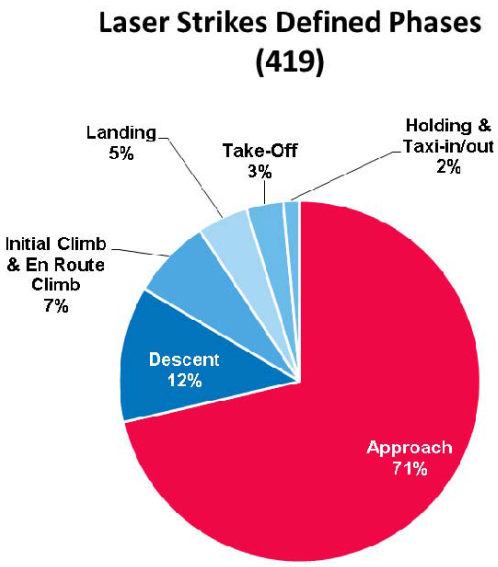


Figure 15: Laser Attacks per Flight Phase (Source IATA)

3.6 Trend for Laser Colour and Visual Effects:

A green laser is more of a visual hazard than an equivalent red or blue laser. Green laser presents 39% and Blue 1%, Unknown colour 50%, Dazzling light 6.5%, fireworks 1.5%, and attacks on Tower cabin with green laser 2%.

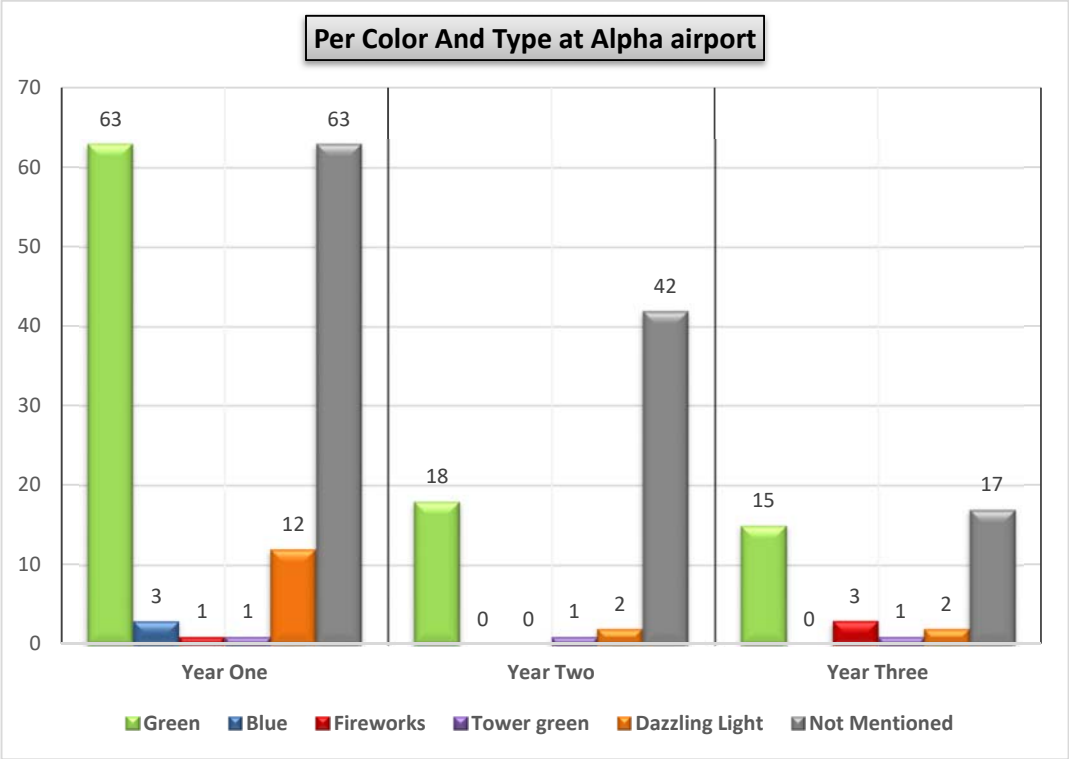


Figure 16: Laser Attacks per Color and Type at Alpha airport

3.6.1 Visual Effects and Hazard Distance by Colour:

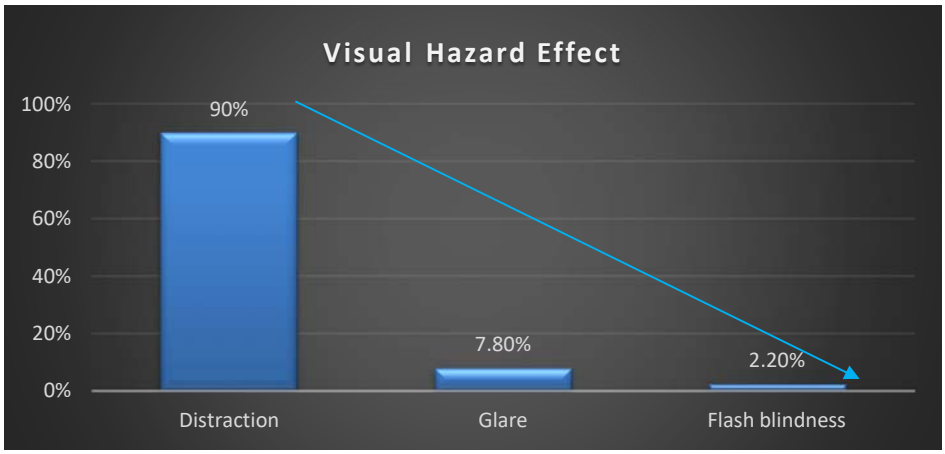


Figure 17: Visual Hazard Effect

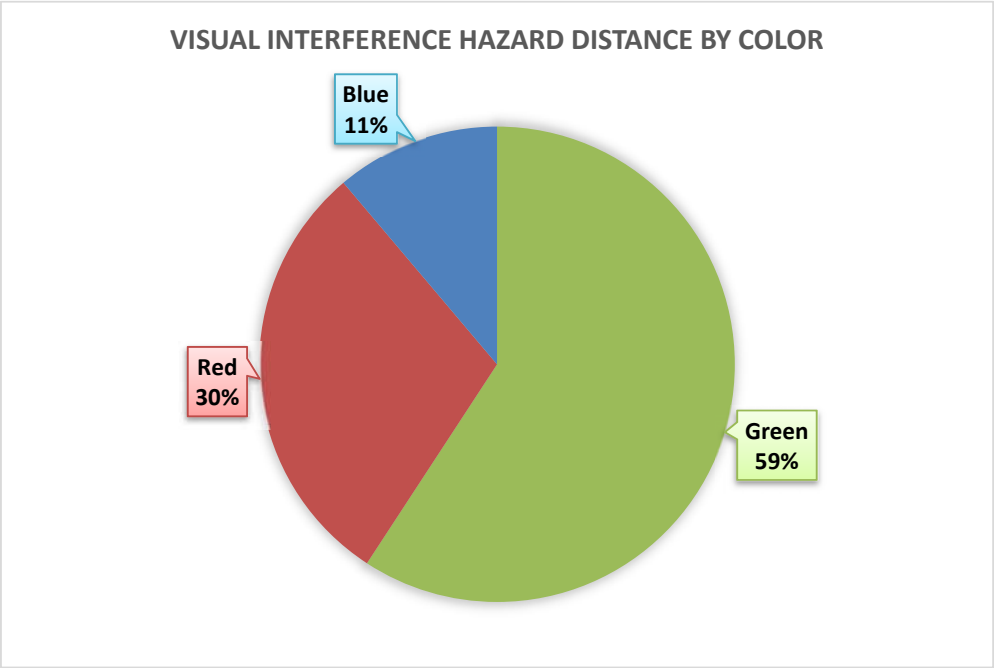


Figure 18: Visual Interference Hazard Distance by Color

The most common colour is the green colour, green has the longest visual interference hazard distance. With the great visual effects on pilot eyes, causing maximum distraction or glare or flash blindness.

3.7 CAA Control Methods:

CAA Shall control the ground bases responsible for laser night shows like clubs and ceremonies:

1- Having prior clearance.

2- Controlling laser beam directions (vertically and horizontally in degrees) to be away from runways centerlines extension.

3- Increasing diversion and output power or pulse energy of the beam to reduce visual hazard.

4- Terminating beams to protect critical airspace.

CHAPTER 4

Applying ICAO protection zones dimensions on airport chart.

4.1 PLOTTING THE LFFZ, LCFZ, AND LSFZ AT ALPHA AIRPORT WITH AUTOCAD.

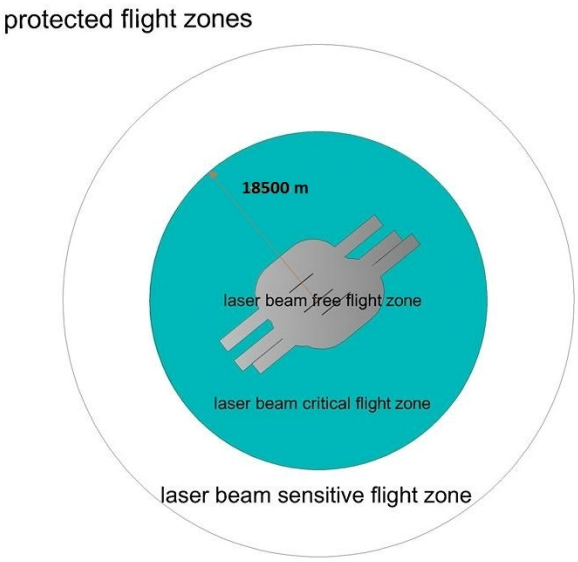
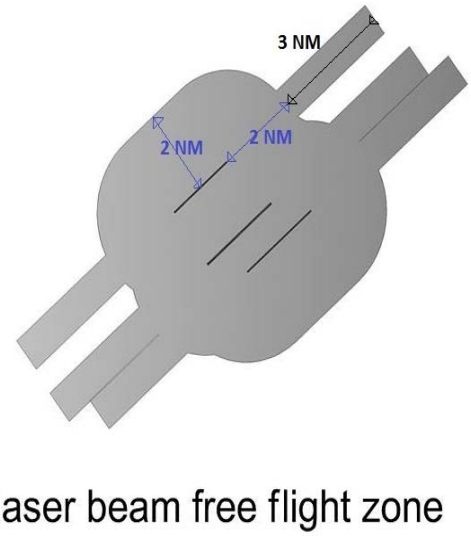


Figure 19: AUTOCAD Plotting the LFFZ, LCFZ and LSFZ Chart at Alpha Airport



laser beam free flight zone

Figure 20: LFFZ (Laser Free Flight Zone) Chart at Alpha Airport

4.2 publish new chart in national AIP

CHAPTER 5

COORDINATION

5.1. MANAGEMENT COORDINATION

1- Aerodrome managers.
2- Air traffic managers.
3- Local police organizations.

5.2. LOCAL LASER WORKING GROUP (LLWG)

- Already Done by CAA, and This Study is a Product of Several Meetings during the last three years.
- A guidance material is provided parallel to this study.

Chapter 6

MITIGATION MEASURES:

A) Long term:

TECHNOLOGY:

- Aircraft manufactures should design new aircraft wind shield with new technology, to be reflection curved surface or diffuse reflection.

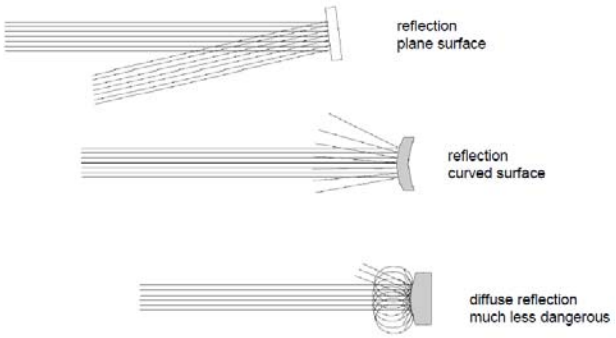


Figure 21: Proposed Reflected Wind Shield Design

PROCEDURES:

- **Curricula in schools** about the seriousness of the laser.
- Trade association: **Laser labeling**: manufacture voluntarily adds aircraft safety labels. , a warning statement or sheet.

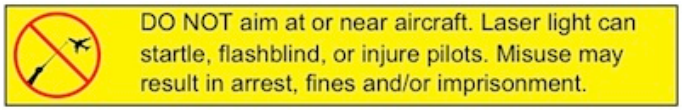


Figure 22: Laser Labeling

- **Stronger laws**, jail, for any one intentionally aiming at aircraft.
- **User education**. Via laser sellers' websites, manuals.
- **License** for outdoor laser activities, SOS…
- **Taxes:** Tax on consumer laser power. Tax laser pointers and handheld lasers at a rate significant enough to discourage casual purchases by the public, without making them unaffordable for persons who might need or want a laser for work or useful personal purposes. It May be applied in future.

Figure 23: User Education Manual

- **Ban sales of Class 4 consumer lasers.**

B) Medium term:

Technology:

- **Emergency phone number** for reporting to local police department.
- Airbus invented a test windscreen anti-laser film for most common type of laser pointer, up to
  2 m watts.

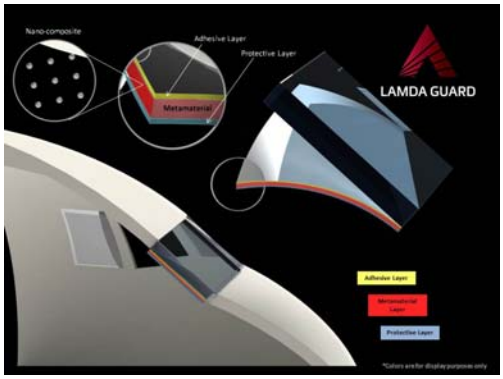


Figure 24: Anti-Laser Film (Nano Technology

Procedures:

- **Laws restricting sale** and/or possession of consumer handheld lasers above a specified power level.

Training:

- **Pilots training.** FAA studies in a 737 simulator have shown that pilots often have trouble during their first exposure to laser light while simulating a tricky "short final" approach. However, success rates improve markedly after the second or third exposure. The pilots now know what to expect, and how to react. ***Pilots are the "last line of defence".***

Figure 25: Simulation Training for Pilots

- **ATC training.**
- Undertake safety promotion activities to increase awareness and reporting.
- Public Awareness campaigns.

C) Short term:

Procedures:

- Newspapers and Media coverage of hazards, prohibitions.
- The extensive presence of police in specific places, for most of the attacks for rapid intervention.
- Laser warning Signs around the airport.
- Protection zones around the airport:

1. *Laser-beam free flight zone (LFFZ).*
2. *Laser-beam critical flight zone (LCFZ).*
3. *Laser-beam sensitive flight zone (LSFZ).*

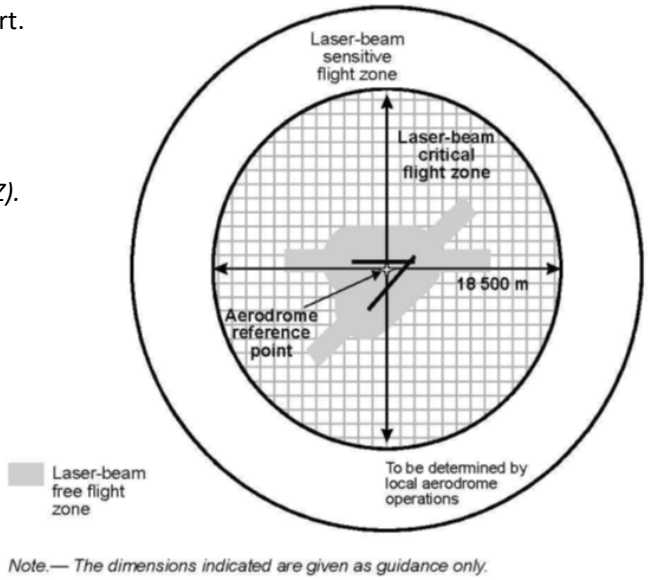


Figure 26: ICAO Protected Flight Zones

1. *Laser-beam free flight zone (LFFZ).*

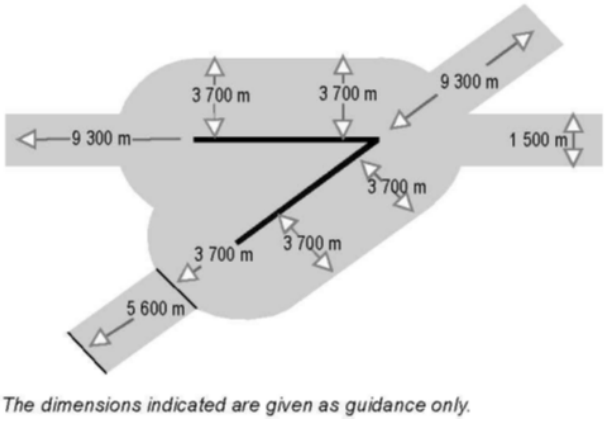


Figure 27: ICAO Laser Free Flight Zone (LFFZ) Dimensions

Technology*:*

- Make website for **pilots' reports** .to register reports at it.
- Send information to the **Civil Aviation Authority** via email to (email).
- Create a **mobile application** for (pilots and public) connected with **CAA** website. Enables them to report an event or request clearances for laser activity (clubs…).
- **Pilot goggles.**
  Red goggles protects from blue and green laser beam. The other one protects from red laser beam.

Figure 28: Pilot Protection Goggles

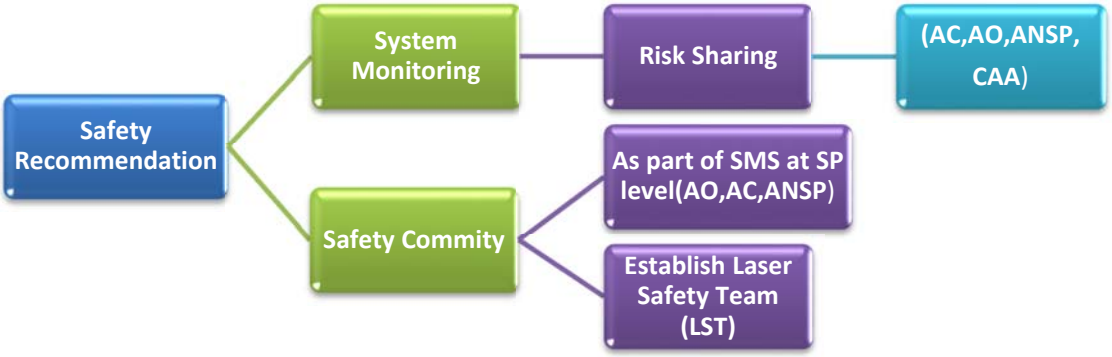
Precautions:

- Training for pilots shall include goggles manual.
- Never use goggles for the wrong laser!

Training:

- Public awareness campaign. (This technique can solve many aviation issues related to public (like FOD/Bird strike/Laser), by Appling it in the vicinity or airports at free flight zone only). It will achieve very good results in a very short time, by applying 1 to 2 minutes in every speech every week or month) (CAA should make awareness campaigns to get effective and fast results. and this solution will save more money in future.
- Using checklists to reduce the laser-beam incident severity and probability. For pilots and ATCO'S.

SAFETY RECOMMENDATION



- Start a Combined Training Campaigns for Pilots and Awareness Campaigns for ATCOs.
- Apply ICAO Protective Zones. And publish it in AIP.
- Survey for all aircraft operator to assess their capabilities (Procedures or checklists, Training, Safety reporting culture and Laser incidents record), and to provide further information.
- Assess the capability of the affected ATC facilities.
- Establish Database for system monitoring for national level (airports).
- Enhance the reporting mechanisms/systems at national level.
- Continues determination of contributing factors and root causes, in order to support the development of mitigation measures.
- Arranging coordination as soon as possible between all stakeholders.
- Insert ICAO Protective Zones (as a part of safeguarding) into future airports plans, and to be a part of airport certification. Before building any future airports.
- Issue annual NOTAMS for affected airports includes information about time, location and any available information about laser events.

CONCLUSION

Laser illumination is a safety and security concern. The annual percentage of laser illumination per all year traffic was less than 0.1%. We can reduce probability and severity of laser by different measures. Applying ICAO recommendation by establishing database helped us to identify hazard and to know how to control it. But after deep analysis, Gap analysis indicates that pilots are bias in reporting system. Moreover, I found that the results of risk assessment indicates the true size of the problem, if we managed to mitigate the tolerable incident reports, which were 99% of all incidents, and control the remaining by control measures and system monitoring, then we finally can reach Acceptable Level of Safety ALS. Pilots/ATCOs should have proper training including (visual effects, situational factors, operational factors, the impact on aircrew, and the main sources of laser, causal factors, how to recover and how to use best practices/checklists...).

Deep analysis enabled us to achieve fast results, Laser beam reported incidents were reduced by approximately 70% annually during the study period at Alpha airport. Top of event at Alpha airport happened during January and May at days Monday and Thursday at hours 19:00 Z, and 23:00 Z. The approach flight phase was the most affected phase of flight, it was more than 90%, and my results confirms IATA results in annual safety report 2014. Laser free flight zone (LFFZ) was the most affected zone after plotting incidents inside, which was approximately 50% of total incidents, we should start mitigating the LFFZ first to ensure safety and to get fast results. Green laser has the greatest visual effect, moreover, approximately 45% of reported incidents were green laser beam. The results of Applying laser beam incidents on google earth, were the concentration areas of laser beam attackers, thus, we can place police intervention around these places during top of event times. That is how we act proactively in the future, so that the hazard is recognized and addressed before it could turn into an occurrence.

Finally, the most effective control methods was ATC/Pilot checklists. And eventually, start phase three, to provide guidance materials. Moreover, phase four, to start a training campaign. Furthermore, phase five, audit by CAA. Furthermore, monitor the system, renew database and renew root cause analysis to support and develop new mitigation measures or corrective action plan if required.

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11. http://www.caa.co.uk/
12. http://www.faa.gov/
13. http://www.fbi.gov/
14. http://www.laserist.org/
15. http://www.eurocontrol.int/sites/default/files/field_tabs/content/documents/events/laser-interference-seminar-icao.pdf

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APPENDIX C

CIFT DIP Status

DIP	Description	Output	Deadline	Status	Comments
CIFIT/1	The implementation of BPN Approach procedures to all runways not currently served by precision approach procedures.	1. Identify and prioritize the airports/runways, which require specific PBN approaches. 2. Concerned States, CANSO, IATA and ICAO to establish a Work Force to develop an appropriate detailed action plan for the implementation of PBN approaches at the identified airports/runways. 3. Implementation of PBN approach procedures at the identified airports/runways in accordance with their associated action plans.	Long Term	1.Completed 2.On going 3. On going	**Runway priorities** 1 OMRK 16/34 (Completed) 2.OIMM 13**. procedure design completed (pending Flight Check)** 3.OISS 11 /29. **procedure design completed (pending Flight Check)** 4.HEBA 14 5.ORMM 14/32 6.ORNI 10 (Completed) 7. ORBI (Baghdad Int'l) 15L 33R 8. OIIE (Tehran – Imran Khomeini) 11L & 11 R
