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The ineffective way of using gun light to deliver light sign for aircraft with total radio failure or receiver failure

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Abstract. Ineffective use of gun light by Air Traffic Controller on aerodrome control tower unit. As we know based on International Civil Aviation Organisation Annex 2 rules of the air, ATC on TWR unit use gun light to deliver clearance to pilot when the radio is failed. The clearance given by the controller is a light sign. For example, if the controller gives sign steady red light, that sign has two meanings, for the aircraft is in flight completely different from the aircraft still on the ground. Unfortunately, using gun light on a daylight pilot find difficulties locating the signal lamp. The intensity usually not as bright as we need. This case pilot will try to find another thing besides solving the radio problem at the same time they still have to land the aircraft. ATC can't use higher intensity cause that may be dangerous for people to use. Purpose this journal is to prove the ineffective way gun light use.

1. Introduction

Signs are used widely in everyday life as a kind of visual language. It is known that all living organisms communicate nonverbally, one of which is the Homo sapiens species, which can communicate simultaneously or verbally and nonverbally at the same time or alternately [1].

Humans communicate with a verbal or sound usually, we communicate with acoustics sound, or as we speak, a sign is an alternate language beside the one usually we speak or write. The air traffic controller is responsible for guiding and helping the pilot to navigate save, and efficiently, the task of an air traffic controller starts from the moment the aircraft is doing pushback and or starting the engine. Air traffic controllers divided into 3 sectors based on their area of responsibility. For take-off landing activity and also movement on the taxiway, the responsibility is given to the air traffic controller inside the tower control unit. And air traffic controller who guides the pilot after take-off or before landing is an approach control unit. When the pilot already maintains their altitude on the cruising level, the responsibility of control is given to the area control unit.

In aviation, The way the air traffic controller communication with pilots and guides the [1] traffic is via radio communication or verbal communication, there are six languages that can use English, Spain, Arabic, French, Chinese, and Russian but the main language is English [2] Besides those six languages, that they are used to control the traffic or communicate to each pilot in order to accomplish data exchanges or giving them information that helps to maintain an orderly flow of air traffic [3] on two-way directions, air traffic controller use lamp signal from the gun light. This is a special case if the aircraft had a radio communication failure on the transmitter or totally failed. There are three different colors and two different ways to deliver the light sign to the aircraft, which had radio failure, different position of the aircraft also affect the meaning [4].



Unfortunately, the way gunlight delivers the sign is not clear enough to avoid ambiguity. That is why the International Civil Aviation Organization creates an organized form and words to communicate between a pilot and an air traffic controller. It is called phraseology [3].

Light	From Aerodrome Control to:		
	Aircraft in flight	Aircraft on the ground	
Directed towards aircraft concerned (see Figure A1-1).	Steady green	Cleared to land	Cleared for take-off
	Steady red	Give way to other aircraft and continue circling	Stop
	Series of green flashes	Return for landing*	Cleared to taxi
	Series of red flashes	Aerodrome unsafe, do not land	Taxi clear of landing area in use
	Series of white flashes	Land at this aerodrome and proceed to apron*	Return to starting point on the aerodrome
Red pyrotechnic	Notwithstanding any previous instructions, do not land for the time being		
* Clearances to land and to taxi will be given in due course.			

Figure 1. Gunlight signals and meaning.

Besides the gun light, there is another lamp also transmitted light sign but not for giving clearance. Just information like runway lamp, the flashes show the pilot the direction for landing and take-off, or precision approach path indicator shows pilot right path and glideslope to land. And also there are more. But this will not discuss in this research paper because only gunlight could transmit clearances and information to the pilot. Like a landing and take-off clearance or instruction to abort landing process because runway not safe yet to be land.

Not like the other sign-on, he daily uses like © for copyright or for parking lot and 3 different colors on traffic light one color have only one mean, one sign for one meaning does not apply to gunlight. Gunlight have two meaning for each lamp sign. This can lead to a dangerous situation. That will be explained later.

2. Problem

Gunlight is the only one to use when the air traffic controller wants to communicate or give clearances to pilot in the radio failure situation. On daylight, the problem is the light intensity and position the gunlight being shoot at and also the position of the aircraft. See figure 2.

When pilots had the broken radio on the aircraft that can cause additional workload to them, they have to open manual books and try to fix it while they still on the aircraft, and while they do two different things at the same time.

The air traffic controller has a guideline for dealing with an emergency or unusual situation; there several guidelines to use. It depends on the authoritarian state. Usually, it comes with acknowledging the problem let it pilot know that the air traffic controller understands their problem; it helps them to get the assistant related to their situation. After that, the air traffic controller has to manage the traffic around this airplane to give space and remain silent on the frequency in order not to trigger a panic situation to pilot on the aircraft with the problem. The air traffic controller has to give this aircraft time to solve their problem; that is why keep the frequency as silent as possible is important. And for the air traffic controller itself, ask for the assistant to the supervisor or colleagues.

Even though they are not repairing the radio, they still find difficulties in locating the light source that transmitting light signs for them. When the air traffic controller sends them a light sign from a gunlight, they might not see the signal lamp. Some possible causes are the intensity on daylight, the light around them, or the position of the light source or aircraft when the light sign is transmitted.

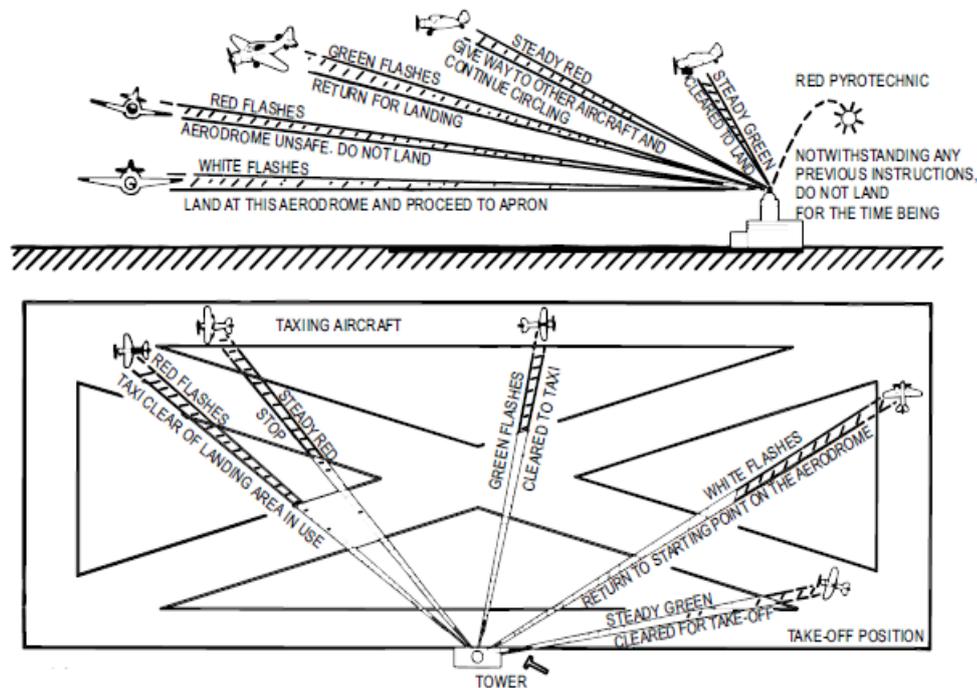


Figure 2. Illustration of the use of gunlight.

Another problem is after the sign transmitted, after they insight and receives the light sign, they have to translate the sign. It takes time to interpret the sign. Meantime the aircraft move with high speed. This can jeopardize the flight when the aircraft on the critical position.

This situation creates a hazard to the hazardous situation. Besides the way using gunlight to deliver light sign not so effective, this is a hazard to the flight. Based on a swiss cheese theory, the hazard will slip away from the existing defenses and cause losses like incidents or accidents [5].

The existing defenses do not guarantee the hazard will not slip away a caused losses as incidents or accidents. It reduces the chance the losses occur at the very least. The way air traffic control use gunlight to deliver light sign is a form defense from radio failure situations, but it also hazards at the same time.

The other problem is, for one sign, it has two meanings, what if two pilots on 2 different aircraft on different positions receive the same sign but execute them with different action cause it literally has two meanings. Imagine there are two aircraft, one on the runway and one another is going to use the same runway. Aircraft A on the taxiway before take-off position preparing for departure and Aircraft B is on final approach preparing to land and they are saw light sign from control tower it delivers green sign flashes, they will be executing different actions at the same time. Just for remember, aircraft move fast enough when it flies or about to fly, so there is no room for error. One aircraft enter the active runway to rolling out for departure and one another lower the altitude for land at the same time while the runway still not clear to execute those activities they are doing. It leads to accidents catastrophically. It is a big loss, and no one wants this to happen.

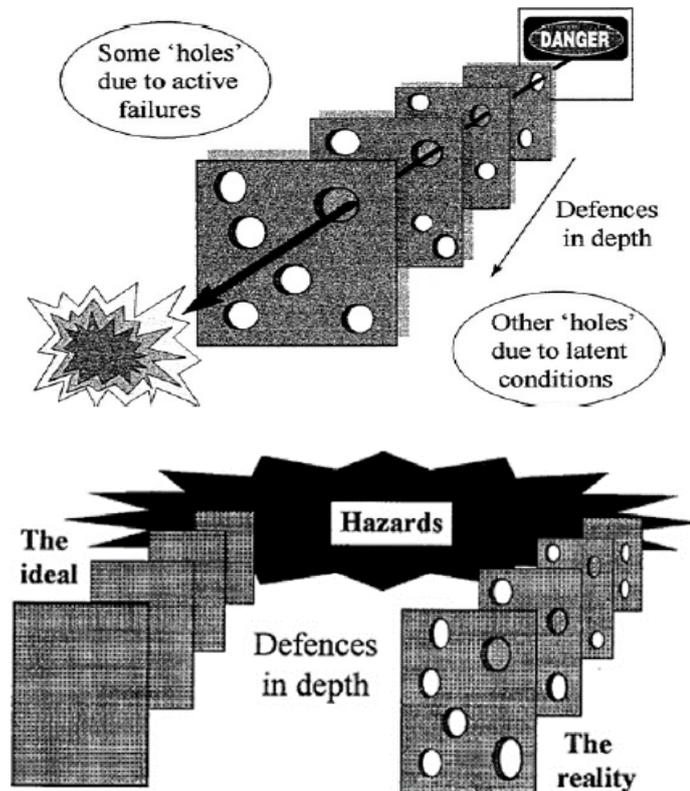


Figure 3. Swiss Cheese Model.

As written above, it is just an example one ambiguous sign on one simulation conditions. There are many scenarios that will appear in any way to find out. One of the causes is the beam from standard gunlight is widespread like other flashlights, and I have to explain how the light spread and how to use the gunlight because it is the source and it contained the sign [6] if this just the only question to us so the answer is we can use laser light, but we cannot do this, cause laser light is dangerous. As dangerous as flying with the ability to communicate with air traffic controllers or the other and the frequency. It will dazzle the pilots and take the ability to see landmarks on the ground or even their instrument on the cockpit. So it does not help any of the questions.

The two meanings will not be the problem if just one particular aircraft on with just one particular position receiving it. It means this cut another possibility or cut the ambiguous cause. It just delivers one particular light sign to one aircraft in one position.

3. Method and materials

In order to satisfy the objectives of the study, this study will employ the qualitative method. The material will be collected in the documentation, questioner, and interview with the pilot who operates near Sultan Hasanuddin International Airport. Questioner and interview used for the purpose of getting a reaction pilot when they received a gunlight signal and how long until they got the meaning. Documentation like daily logbooks will be needed to support this research paper.

4. Finding

Based on popular theory in aviation "swiss cheese theory," the problem in this study is a hazard to a hazardous situation. It may lead the pilot to a dangerous situation or a catastrophic accident. And this particular question not discuss that much on aviation cause it is irregular. It is not a usual problem. This radio failure almost never happens, but it does not mean not to happen.

The use of gunlight to deliver light signs based on the above article is not so effective or even dangerous. It is not simple things to do in a complicated situation. Pilots have searched the light source and then interpret the sign while fly and controlling the aircraft. Pilots need more time to get the meaning of light sign form gunlight. They also can receive the light sign that was transmitted not to their aircraft or even think the light sign is for another aircraft near their position. This means they don't receive the information and clearance transmitted to them.

5. Concluding remarks

When using gunlight, the pilot in the same direction with the target gunlight shot is also able to see the light sign. When they receive the sign, they will execute the clearance immediately. Two aircraft take landing or take-off action at the same time on the same runway that is dangerous lead to accept.

Because the light beam is widespread, so it is possible not only one particular aircraft was able to see, the others in the same direction will. If the light beam is not widely spread, so just one particular aircraft will able to see that close another hole at the "swiss cheese."

A guide lamp when on the ground for the gunlight substitution on the particular position will help as the taxi lamp to guide the pilot until the parking stand if this could be realised, so it is possible to "put the gunlight on the ground" just like taxi light, runway light, and precision approach path indicator.

When it realized, air traffic controller could turn on the lamp on a specific position near the aircraft so only one aircraft will be able to receive the light sign, the pilot will not trying to find the gun light sign from a great distance again.

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