Advisory Circular
[AC/AD – 014]

Human Factors Principles
in
Aerodrome Emergency Planning

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May 2013

CIVIL AVIATION AUTHORITY OF NEPAL

LIST OF EFECTIVE PAGES

RECORD OF AMENDMENTS

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001	May 2013	All	Advisory Circular : Human Factor Principles in Aerodrome Emergency Planning

Table of Contents

Aerodrome Advisory Circulars are published by the Department of Aerodrome Safety and Standards, CAAN for purposes of promulgating supplementary guidance materials to the Standards and Recommended Practices in the Civil Aviation Requirements (CAR – 14, Part 1). The advisory circulars are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the airport certification regulations, civil aviation requirements and specifications of CAR – 14, Part 1. Aerodrome Advisory Circulars may explain certain regulatory requirements by providing interpretive and explanatory material.

Foreword

Nepal as a Contracting State to the Convention on International Civil Aviation has an obligation to the international community to ensure that civil aviation activities under its jurisdiction are carried out in strict compliance with the Standards and Recommended Practices contained in the eighteen Annexes to the Convention on International Civil Aviation in order to maintain the required aviation standards.

As per the standards of the Annex 14 to the Convention, Aerodromes used for International Civil Aviation are required to be certified by the State. In addition as per the Civil Aviation Authority of Nepal (CAAN), Airport Certificate Regulation – 2061 (2004):

(1) The operator of the airport that may be used for public purpose as per the national need must obtain the Aerodrome Certificate.

(2) The Aerodrome Certificate must be obtained to operate international public air transportation service at any airport of Nepal.

Issue of an Aerodrome Certificate by the Director General of Civil Aviation Authority of Nepal to an aerodrome operator seeking such certificate is a requirement as per CAAN Airport Certificate Regulation, 2061 (2004), if the aerodrome operator satisfies the Rules specified in that Regulation. Hence, certification of an aerodrome is a vital role in the regulatory system.

The regulatory Rules to be satisfied by the Aerodrome Operators for the certification of an aerodrome are specified in the CAAN Airport Certificate Regulation (ACR), 2061 (2004).

The Rule 3 of CAAN ACR 2004 states that *"any matter pertaining to the setting standards of the airport as mentioned here in shall be deemed to be remained as the part of the Standards and Recommended Practices as mentioned in Annex 14 of the Convention on International Civil Aviation (as Amended) . These matters shall remain as the parts of the national rules and practices enforced in Nepal and amended from time to time"*.

The requirements for establishment of aerodrome emergency plan by aerodrome operator are stipulated in CAR-14, Part 1/ICAO Annex 14, Volume I, and Chapter 9.1. In 9.1.6 it is stated that "The plan shall observe Human Factors principle to ensure optimum response by all existing agencies participating in emergency operations". Furthermore, in accordance with the specification 9.2 of CAR-14, Part 1/ ICAO Annex 14, Volume I, the aerodrome operator shall establish the rescue and fire fighting services at the airport. In 9.2.39 it is stated that "The rescue and firefighting personnel training programme shall include training in human performance, including team coordination".

This Advisory Circular provides guidance to aerodrome operator(s) to meet the above mentioned minimum standards and recommended practices of CAR-14, Part 1/ICAO Annex 14, Volume I in order to demonstrate aerodrome operators capability to retain the existing/or obtain new aerodrome certificate or renew the existing one under the CAAN ACR 2004.

Users of this Advisory Circular are reminded that the provisions of the ***Civil Aviation Authority Act 1996 (2053), CAAN Airport Certificate Regulations 2004 (2061) and other applicable regulatory documentation***, rather than this Advisory Circular, determine the requirements of, and the obligations imposed by or under, the civil aviation legislation. Users should refer to the applicable provisions when any doubt arises.

It is expected that the applicant of an Aerodrome Certificate will be benefited by this Advisory Circular as it explains the procedures for conducting aeronautical studies. It also explains that aerodrome physical facilities, equipment and aerodrome operating procedures shall meet the SARPs of Manual of Aerodrome Standards, Nepal.

This Authority may, without any prior notice, change the content of this Advisory Circular as appropriate.

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Director General
Civil Aviation Authority of Nepal
Babar Mahal, Kathmandu, Nepal May 2013

1 Purpose

1.1 The purpose behind this Advisory Circular (AC) came from the finding made by CAAN Audit Team during its initial audit at Tribhuvan International Airport for the certification purpose, and particularly in the area of Airport Emergency Service in December 2008. The same finding was also made by the ICAO Audit Team as a result of ICAO USOAP audit in May 2009. During the audit, it was observed that although there were evidences of human factors principles that were incorporated into the aerodrome emergency plan and the comprehensive training framework, it seemed that knowledge of human factor principles was not a competency requirement in the training of aerodrome rescue and fire-fighting (ARFF) personnel.

1.2 Following the audit, it also became apparent that the ICAO Human Factors Training Manual (Doc 9683) was neither entirely applicable nor intimately relevant to ARFF services, instead focusing more on human performance and team coordination pertaining to flight operations.

2 Introduction

2.1 The subject of human factors is about people. It is about people in their working and living environments. It is about their relationship with equipment, procedures and the environment. Just as importantly, it is about their relationships with other people. Human Factors involve the overall performance of human beings within the aviation system; it seeks to optimize people's performance through the systematic application of the human sciences, often integrated within the framework of system engineering. Its twin objectives can be seen as safety and efficiency.

2.2 Human Factors is essentially a multidisciplinary field, including but not limited to; psychology; engineering; physiology; sociology; and anthropometry. Indeed, it is this multidisciplinary nature and the overlapping of the constituent disciplines that make a comprehensive definition of Human Factors difficult.

3 The SHEL Model

3.1 The SHEL model provides a conceptual framework to help understand Human Factors. It illustrates the various constituents and the interfaces - or points of interaction - which comprise the subject. Human Factors elements can be divided into four basic conceptual categories:

a) *Software:* plans, procedures, documentation etc.

b) *Hardware:* machine, equipment, etc.

c) *Environment:* internal (e.g. workplace), external (e.g. surroundings) etc.

d) *Liveware:* the human factor

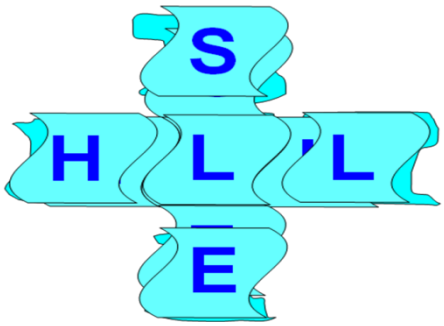
3.2 Interactions between people and the other elements of the SHEL model are at the heart of Human Factors, which involves the interfaces between:

a) People and machines - "Liveware vs. Hardware"

b) People and procedures - "Liveware vs. Software"

c) People and colleagues - "Liveware vs. Liveware"

d) People and workplace - "Liveware vs. Environment"



S = Software (procedures, symbology, etc)
H = Hardware (machine);
E = Environment
L = Liveware (human);

In this model the match or mismatch of the blocks (interface) is just as important as the characteristics of the blocks themselves. A mismatch can be a source of human error.

Figure 1.1 - The SHEL model as modified by Hawkins

4 Human Factors Issues in ARFF Services

4.1 A competent and professional ARFF service must rely on a comprehensive and relevant set of training modules, coupled with an internal audit framework to regularly check the effectiveness and efficacy of these programmes. However, in the process of promulgating the training framework, one must not be overly fixated with the `hard' skills component of the training outcomes. Thought must be given to the `soft' human factor components during the promulgation and execution of the training programmes. Similarly, any assessment of the operational effectiveness of ARFF personnel must take into account human factor principles such as team coordination.

4.2 Human factors principles are not only confined to the development of ARFF training programmes. Consideration must also be given to the formulation of drawer plans such as the aerodrome emergency plan and the unit tactical plans of the ARFF service.

4.3 The application of human factor principles to ARFF services can therefore be classified into two broad pillars as follows:

a) Operational effectiveness and standards; and

b) Safety and well-being of ARFF personnel

5 Operational Effectiveness and Standards

5.1 As the success of any ARFF operations rely very much on teamwork, the importance of building mutual trust and team coordination amongst staff during training cannot be overstressed (Liveware vs. Liveware). Training must therefore be designed to guide ARFF personnel towards achieving these objectives.

5.2 In order for ARFF training to be as realistic as possible, live fire training is crucial in helping ARFF personnel acclimatize to a heat and smoke filled environment (Liveware vs. Environment), so that in the event of an actual emergency, ARFF personnel will be able to execute their tasks more confidently and effectively. Where possible, simulators replicating different facades of ARFF operations (e.g. vehicle driving and operations; command and control etc.) should be made available for ARFF personnel to be trained in a controlled, safe and realistic environment.

5.3 ARFF operations require fire fighting personnel to be proficient in the operation of fire vehicles and other rescue equipment (Liveware vs. Hardware). This is crucial as it would enable the ARFF service to control any aircraft fires swiftly and effectively, in order to facilitate the evacuation and rescue of survivors. The airport fire vehicle is therefore an extremely vital asset that must be designed to take into account the human instinct and intuition of the vehicle operator. Therefore, ARFF services must place sufficient emphasis on the design ergonomics of fire vehicles during the pre-fabrication stage in order to optimise human performance during training and operations.

5.4 The design of fire stations is another important factor that could affect the human performance of ARFF personnel when responding to aircraft accidents or incidents (Liveware vs. Environment). This is especially relevant for large aerodromes which provide a high category of runway fire protection. Fire stations in such aerodromes are typically larger, thus requiring ARFF personnel to travel a longer distance before reaching their fire vehicles. Such considerations must therefore be taken into account during the design phase of a fire station so that the ARFF service is able to meet the stipulated response time in the event of an aircraft emergency.

5.5 Communication is possibly the most important human factor in ARFF operations. Operational readiness and safety standards will be compromised without effective communication amongst ARFF personnel, air traffic control and pilots. Therefore, the type of communications equipment and the transmission of messages must allow critical information to be conveyed, assimilated, processed and executed (Liveware vs. Hardware and Liveware vs. Liveware). Therefore, ARFF training programmes must incorporate

components to ensure the accurate and timely transmission of information to avoid miscommunication which could result in serious consequences.

5.6 It is obvious that any ARFF service will need to be kept up-to-date with the constant development and innovation of more sophisticated rescue equipment and fire vehicles (Liveware vs. Hardware). It is equally important for ARFF personnel to be well acquainted with the different configurations of various aircraft types operating at the particular aerodrome. Boosting the knowledge of ARFF personnel in these areas would indirectly enhance human performance during a response to any aircraft emergency.

5.7 The ARFF industry is a highly specialised one which compels the management and leadership team of ARFF services to promulgate a system of self-audit. Such systems must not only include the ratings and revalidation of individual standards. More importantly, as we recognise the importance of teamwork and team coordination in ARFF operations, ARFF services should place heavy emphasis on the collective performance of an ARFF outfit during such an audit (Liveware vs. Liveware). The audit can then reveal observations and findings about the effects of human behaviour on pre-stipulated procedures. Similarly, such audits can also highlight human reaction to any unforeseen circumstances in the form of injects during a unit proficiency test. Results from the audits can then be used to modify, tweak and improve training programmes in order to enhance human performance during ARFF operations.

6 Safety and Well-Being of ARFF Personnel

6.1 In the aftermath of an aircraft accident, it is often necessary to provide CARE (Caring Action in Response to Emergency) treatment for the survivors. However, aerodrome operators and ARFF services must also not neglect the mental and psychological well-being of emergency responders such as ARFF personnel who may suffer from post traumatic stress disorders. It will therefore be essential to provide CARE treatment for ARFF personnel after a major crisis (Liveware vs. Liveware) both from a welfare perspective and also from a business continuity standpoint. Such treatment and counseling can be provided by other ARFF or airport personnel who had undergone the proper training or more likely to be provided by external medical institutions. Arrangements for the latter should then be formalised in the form of mutual aid agreements or can be incorporated into the aerodrome emergency plan (Liveware vs. Software).

6.2 The job nature of ARFF personnel poses numerous potential hazards (Liveware vs. Environment). The risk of inhalation of carbon or smoke particles when extinguishing a fire, either during an incident or during training, is very high. Therefore, ARFF services must provide all fire fighters with the appropriate personal protective equipment (PPE) such as self-containing breathing apparatus (SCBA), helmets, boots, protective clothing etc. In relation to day-to-day operations, the uniform worn by ARFF personnel should also be of a suitable material depending on the local climate and conditions.

6.3 To ensure that ARFF personnel are able to perform their roles effectively, thought needs to be put into designing an appropriate physical fitness programme to condition them for the physical rigours of the job (Liveware vs. Environment). In the process of designing any physical fitness programmes, due considerations must be given to individual human limitations. ARFF management must also accept that not all personnel can perform at the same level of physical fitness standard. The key is to establish the minimum physical fitness requirements of a fire fighter and design a programme that can best replicate these demands.

6.4 Noise is an important human factor (Liveware vs. Environment) that is omnipresent in an airport environment and cannot be ignored. Most fire stations are located within close proximity of the runway and aircraft movement areas, thus exposing ARFF personnel to constant loud noises. Besides posing as disruptive interferences during the transmission of messages, long term and regular exposure to noise can have serious implications on one's health (e.g. temporary, partial or permanent hearing loss). To address this issue, ARFF services should issue and mandate the use of suitable hearing protection devices.

In addition, personnel who are subjected to constant exposure to noise should be sent for regular noise induced deafness (NID) hearing tests.

6.5 Fatigue is one important factor that directly affects human performance and is greatly influenced by the shift system of ARFF services (Liveware vs. Software). Besides the need to conform to local labour rules and regulations of individual States, there must be considerations to ensure that ARFF personnel can have sufficient rest despite the need to be on 24-hour operational readiness at most airports.

6.6 A leader is an individual whose ideas and actions influence the thought and behaviour of others (Liveware vs. Liveware). Through the use of motivation and persuasion, and an understanding of the goals and desires of the team, the leader becomes an agent of change and influence. Skilled leadership may be needed to understand and handle various operational, training and administrative situations. For instance, personality clashes within a team complicate the task of a leader and can affect both safety and efficiency.

7 Conclusion

7.1 Human factors specific to ARFF services pervade a wide spectrum of activities, ranging from training and operations to station routine and audits. The study of human factors principles can be described as both an art and a science and must be associated with the entire range of ARFF activities in order to achieve a higher level of professionalism, a higher state of operational effectiveness and a higher standard for safety.

8 References

Airport Certificate Regulations, 2004;
Civil Aviation Requirement (CAR – 14, Part 1);
CAAN SMS Requirements, 2010;
ICAO Annex 14, Volumes I, Attachment A, Section 17;
ICAO Doc 9774 - Manual on Certification of Aerodromes;
ICAO Doc 9859 -- Safety Management Manual
ICAO Doc 9137 - Airport Services Manual, Part 1; and
ICAO Doc 9683 - Human Factors Training Manual

9 Queries

If there are any queries with regard to this Advisory Circular, please address them to:

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10 List of Effective Publications:

AC/AD – 001:	Requirements for Issue/Renewal of Aerodrome Certificate, First Edition, April 2010
AC/AD – 002:	Airside Safety Procedure for Ground Handling Operation at Airports, First Edition, December 2011
AC/AD – 003:	Guidance Materials for Wildlife Hazards Management for Aerodrome Operator, First Edition 1st September 2012.
AC/AD – 004:	Guidance Materials for Obstacle Restriction, Marking, Lighting and Removal, First Edition 1st September 2012.
AC/AD – 005:	Guidance Materials for Coordination with Land Use Authorities for Obstacle Control, First Edition 1st September 2012.
AC/AD – 006:	Guidance Materials for Development of Procedure Manual for Monitoring, Reporting and Analyzing of hazard, accident and incident, First Edition 1st September 2012.
AC/AD – 007:	Policy and Procedures for Management of conflicts Between Safety and Environmental Requirements, First Edition 1st September 2012.
AC/AD – 008:	Guidance Material for Conducting an assessment of Tribhuvan International Airport to identify whether non-aeronautical ground lights or Laser Emitter near the aerodrome which may endanger the aircraft are properly, First Edition March 2013.
AC/AD – 009:	Guidance Material for Ensuring Aerodrome Operators take corrective action with any internal or external agency to shield non-aeronautical ground lights or Laser emitter near the aerodrome which may endanger the safety of aircraft, First Edition March 2013.
AC/AD – 010:	Guidance Material for Aerodrome Operators to Implement Accident and Incident Occurrence Reporting System, Analyze and Maintain Database to Observe Trends and Take Appropriate Action, First Edition March 2013.
AC/AD – 011:	Guidance Material for Surface Movement Guidance and Control System (SMGCS), First Edition March 2013.
AC/AD – 012:	Guidance Material for Procedure for Evaluation of Impact on Safety of the Existing Operation whenever there is Proposal for a Change in the Physical Characteristics, Facilities or Equipment, First Edition March 2013.