

Chapter 2

SURFACE TO AIR RANGE SAFETY

INTRODUCTION

0201. Surface to Air Ranges. The basic difference between a range used for surface to air weapon firings and a range used for other surface based firings is that the Air Danger Area (ADA) has increased significance when assessing the total danger area. For GBAD weapon systems the warhead event is planned to be at altitude. This effectively means that the WDA will to a large extent reflect a Total Energy Area/Zone (TEA/Z).

0202. Aim. The aim of this chapter is to set out the responsibilities of the range operator and the range control organisation when involved in the conduct of surface to air practices and to define the interface between the Range Staff and the Range User.

GENERAL

0203. Range Authorisation. Land ranges may only be used for surface to air firings if authorised for this type of practice. The procedures for authorisation and for the Safety Management System (SMS) are contained in Reference A1. In relation to TERP ranges the term 'Practice' is taken to include trials unless otherwise stated.

0204. Range Inspection. All surface to air ranges must be inspected in accordance with the inspection cycle laid down in Chapter 8 of Reference A1.

0205. Range Incidents and Accidents. In accordance with Reference A1, any incident or accident resulting from a live firing activity, including the use of the target system, must be reported through the Chain of Command in accordance with the appropriate Service or Agency procedures. Both the User and the Range Staff are separately responsible for reporting incidents. The relevant Service Publication should include the reporting of accidents/ incidents.

0206. Environmental Concerns. There will need to be a full environmental impact statement¹ concerning the use of the range danger area, where such topics as noise, pollution, effects of troop activity on flora, fauna and archaeology are addressed, which may in turn limit or prevent certain types of military activity. It should also be noted that the land/sea edge is generally considered to be a fragile area in environmental terms and this may well affect its use as a part of the range area. Further guidance is available in Reference O.

0207. Byelaws. Military byelaws are in place on some ranges but are specific to their defined areas. Advice on byelaws should be sought from Defence Estates. It should be noted that they can be enforced only when the range is being used for Defence purposes as set out in the specific byelaws.

0208. Duty Holders. The MOD as owners and operators of surface to air ranges in the UK and overseas has a responsibility to see that the ranges are operated in accordance with JSP 403. A Duty Holder, as defined in Reference AA, is an MOD person with specific responsibilities for the safety management of the system.

¹ See Reference A1 Chapter 6

Therefore, Range Staff who are responsible for the maintenance of the infra-structure of the range, such as emplacements and radars, as well as the control of access are duty holders. Users of ranges are also duty holders with the responsibility for the safe conduct of firing practices.

0209. Range Authorising HQ. The CO/Head of the Range Administering Unit exercises responsibility for the safety of the range on behalf of the Range Authorising Officer (RAO). The RAO HQ is responsible for ensuring that Range SO are produced and maintained and that monthly and annual inspections of the range and its operations are conducted.

0210. Level of Risk. Guidance on individual risk is given in Reference A1, Chapter 1. The level of risk that is acceptable to the range user will vary as training needs change and experience with the weapon system grows. Against this variable must be weighed the consequences of an accident both to human life and in material terms. The user, in this situation, will be guided both by the Chain of Command and DOSG advice. On TERP ranges the user's risks will also be considered as part of the Trials requirement by the range operator.

0211. Ammunition and Pyrotechnic Storage. The energetic materials used in the weapon systems and in the targetary must be adequately stored whilst on range. Reference H gives the MOD regulations for explosive storage on the range. In addition, JSP 454 gives guidance on the EMC environment.

USE OF THE RANGE

0212. Types of Practice. Within the UK most of the surface to air ranges are on the coast with the bulk of their danger areas out to sea. This lack of land space has lead over the years to the development of fixed firing points and formalised firing practices. Range users, however, have expressed the need for increased realism in training. This has produced four different types of training practice that are used for training weapon system operators in surface to air engagements:

a. **Technical Firings.** These practices are carried out from fixed firing positions with the Safety, Assessment and Monitoring Equipment (SAME) fitted under the direction of the Unit with the appropriate Subject Matter Expert (SME) staff in support. The aim is to gain the maximum benefit for the firer in terms of assessment of the firer's performance and also to collect the maximum data on the performance of the equipment.

b. **Tactical Firings (Static).** Tactical firings exercise the complete firing detachment. These practices are carried out from fixed firing points with the SAME connected but under realistic tactical scenarios. The firing detachment is separated from the mechanics of target presentation, the physical presence of SME and higher Unit Command, the safety net communications and range timings. The SAME is required to be effective but unobtrusive. Safe firing arcs are set by detachment orders and range clear orders translated to the language of unit fire control orders. Individual ranges must have SOP to cover these requirements that take into account the technical level of SAME available. Multiple targets with counter measures, both electronic and by decoy, can be used at unpredictable times under this system.

c. **Tactical Firings (Mobile).** These practices primarily involve the movement of the launcher and firing detachment to a variety of actual or

potential firing positions on the range in order to develop into and out of action drills. There are a variety of techniques to maintain the SMS depending on the level of risk that is acceptable to the exercise commander and within the constraints of the range SOP. The purpose is to test the weapon system and firing detachment as fully as possible within the SMS. The intrusion of the SAME system may be reduced in order to increase realism if this is acceptable within the range SMS. Multiple targets with counter measures, both electronic and by decoy, can be used.

d. **Fire and Manoeuvre Engagements.** These practices are dependent on there being sufficient space to both manoeuvre and fire in the Danger Area. Positive safety² may well be applied as connection to a fixed safety system could prove unacceptable in terms of timely support to the Combined Arms Grouping. The intention is to integrate the weapon system with the other Arms and Services within the Combined Arms command structure.

0213. Trials. Land ranges may be used for surface to air firing trials which are conducted at the direction of or on behalf of the MOD³.

0214. Principles. The core principles governing the use of any range for surface to air firings are:

a. **Range Clearance.** Before any firing is carried out the range is to be cleared by the range authorities and that state maintained as long as the range is in operation⁴. In practical terms this may involve a variety of measures such as sentries, wardens, flags, lights, fences and signposts as well as more complex arrangements such as motion detectors, radars of various types, aircraft with trained observers and safety boats.

b. **Range Surveillance.** During operations on the range it is important that the area surrounding the range is also monitored so that there is time to react to a potential incident or incursion. Achieving this may involve a variety of measures such as sentries, range radars, local Air Traffic Control (ATC) radars and Safety Officers with the firing/flying equipment. Duty of care is also part of the operators remit and applies to civilian contractors as well as to MOD personnel. The control of movement within the range boundary is part of the safety management system.

c. **Communications.** All MOD surface to air ranges, when in operation, are required to have a dedicated 'all informed' range safety communications network. This is so that if anyone, either range staff or from the user unit, sees a potential safety incident, they are able to stop the firing and warn others.

d. **Cut Down Systems.** Both surface to air weapon systems and their targets commonly have some form of cut down or bring down system in accordance with Reference P. However, there is a requirement to evaluate when and where to use these systems as, uniquely with UAS, it may well be

² The term Positive Safety refers to the actions of a supervisor at the firing position where he/she is in a position to terminate by a physical action the firing practice. It is a position that requires judgement and a detailed understanding of the weapon system involved.

³ See Reference A1 Chapter 3.

⁴ See Reference A1 Chapter 5.

the safer option at the time to turn the UAS back into the range centre rather than risk recovering it outside the range boundary.

e. **Air Danger Height.** The air danger height above the range must contain the Total Energy Zone (TEZ) of the weapon and its warhead effect. If the warhead uses any form of shaped charge for target attack, the effect must be added to the TEZ.

FIRING POINT PROCEDURES

0215. General. Dedicated surface to air firing ranges have specific Range SO to control the conduct of firing practices. However, other types of ranges may also accommodate surface to air firings and when the user is firing on these he must be sure that he is using the appropriate section of the Range SO. The 'best practice' procedures that have been established on dedicated surface to air ranges are to be carried forward to firings on other types of range. SME located within the individual Services are to be used to provide the depth of experience and advice to ensure this happens. They must be fully consulted at an early stage within the planning process.

0216. Weapon Crews. All weapon crews are to be qualified, current and competent for the type of firing practice in which they are involved. In the case of progressive training firing practices this means that the firer has completed the necessary dry training before attempting to qualify for the next level of training competence. The Range Officer will require confirmation from the user (CO/OC of the unit or equivalent for a civil contractor) that the crews are so qualified. The user is responsible for ensuring that all firers have met the required standards.

0217. Safety Staff Certification. The appropriate single Service training pamphlet will provide the required pre-firing standards that must be achieved by Safety Supervisors. The CO of the user unit is responsible for ensuring that all Safety Supervisors have met these standards and is responsible for certifying that this is so.

0218. Misfire Bearing. Whenever there is a misfire, the gun/weapon system is to be immediately laid in the pre-planned misfire bearing and elevation. This should be the centre of the firing arc with an elevation that will cause any round subsequently fired to land in the middle of the WDA. The misfire procedure and settings are to be known and understood by both the FPSO and the firer.

0219. Restriction of Firing Arcs. The mechanical/electrical 'taboos' and arc restrictions must be correctly set prior to firing. The RCO will require confirmation from the FPSO that the firing arcs are set and have been checked.

UK AIRSPACE

0220. General. In the UK, the airspace above the range is not owned by the MOD but is part of the overall UK airspace controlled and regulated by the Civil Aviation Authority (CAA). The CAA is advised by the Directorate of Airspace Policy (DAP) on all military requirements within UK airspace. In practice, the MOD is responsible for safety within a defined and activated Air Danger Area (ADA) during the time that surface to air firing is taking place. The MOD, as the owner of the range, has a duty of care in respect of all activities within the boundary of the range danger zone. Therefore any hazardous activity must have a Safety Management System (SMS) in place to control the risks involved and to show that those risks have been driven down to a level that is ALARP and tolerable.

0221. SMS. On a MOD surface to air range there should be a layered approach to the range SMS, based on four principles:

- a. Notification - where the wider public is kept informed of range activities, including specialist groups such as pilots of aircraft.
- b. Surveillance – of the air, land and sea approaches to the range boundary and the enclosed danger areas.
- c. Positional awareness - in that all users of the range are kept informed of what others are doing.
- d. Duty of care - proactive response to any potential incident with the necessary communications to facilitate this.

0222. Memorandum of Understanding (MOU). Firing practices are largely conducted on surface to air ranges where there is a MOU between the RAU and National Air Traffic Services. The MOU defines the extent of the danger area, the activation times, activation altitude limits, notification procedures and conditions of use. Each Service has a representative on the UK Danger Area Users Group (UKDAUG) which deals through DAP with the CAA.

0223. Notification. In practice, the following apply:

- a. **Notice To Airmen (NOTAM).** The Air Danger Area (ADA)⁵ applicable to the range must have a NOTAM that is current and which specifies the grid references or latitude/longitude of the ADA, as well as the height and the times that it is effective. It is normally the responsibility of the RAU to arrange or activate the NOTAM in accordance with the MOU.
- b. **Airspace Co-ordination Notice (ACN).** It is possible to conduct firing practices in airspace which is not covered by an MOU, or where an existing MOU will not accommodate the WDA for a particular weapon system. A firing practice carried out in these circumstances is defined as Unusual Aerial Activity (UAA)⁶. The RAU wishing to obtain approval for UAA is to apply at least 6 weeks in advance of the start of the UAA, to the Airspace Utilisation Section (AUS) in the Directorate of Airspace Policy. AUS will pass the UAA request to the civilian and military Air Traffic Control (ATC) authorities. ATC may impose conditions and restrictions on the UAA. Once AUS has obtained ATC agreement for the UAA, AUS will produce an ACN. The ACN will include:
 - (1) Description of UAA.
 - (2) Dates and Times.
 - (3) Operating Area.
 - (4) Vertical Limits.
 - (5) Sponsor / Operating Authority.

⁵ See Reference A1 Chapter 6.

⁶ See Reference S, Section 215.

(6) Co-ordination Arrangements.

(7) Aeronautical Publications. Note that AUS will issue the Notice to Airmen (NOTAM) for UAA.

WEAPON DANGER AREA TEMPLATES

0224. Derivation. The WDA for both the weapon system and the target are derived from data provided by the Design Authority (DA) in the first instance and as a result of further work done by DOSG. Initially a 6⁰ of freedom model is developed from the analysis of the hazard log, the Fault Tree (FT) and the Failure Modes Effects and Criticality Analysis (FMECA) that is tested against the prototype firings and refined. From this model probability contours are derived which allows recommendations to be made as to the levels of risk. Advice is consolidated into the Safety Case suite of documents and passed to the Service SME concerned. The Service SME are responsible for producing the appropriate training publication.

0225. Calculation of Risk. Weapon Danger Area (WDA) templates are constructed on the basis that the following factors are valid:

- a. The firer is competent, current and qualified up to the level of training that is being carried out.
- b. The weapon will be fired within the safe firing arc.
- c. The firing practice has been approved by the competent authority (see paragraph 0117.a).
- d. The range is fully prepared for firing.
- e. The firing will be conducted and supervised at the appropriate level.

SAFETY ASSESSMENT AND MONITORING

0226. General. For surface to air weapon systems, it is important to control the firing effects and to gain the maximum benefit from each firing. For gun systems with a predictable trajectory the safety problem may be easier to define, whereas a missile can go rogue at any time in its flight and the outcome is more difficult to predict. Safety of the surface to air range, therefore, is a matter of identifying what can go wrong, assessing the probability and taking precautions to mitigate the identified hazards.

0227. SAME. Due to the high cost of modern munitions it is incumbent on all parties to obtain the maximum benefit from each firing. To achieve this most dedicated surface to air ranges in UK have a built-in SAME. This may be linked to on-board target equipment such as the Miss Distance Indicator (MDI) that helps to provide a complete performance record of both the individual firer and the missile.

OVERSEAS RANGES

0228. General. The UK has a variety of agreements with other nations so that UK units may use their ranges. As a general principle UK units will operate to normal UK regulations and procedures, but will apply Host Nation requirements wherever

they are the more stringent⁷. UK units will not modify their normal UK practices without obtaining dispensation to do so⁸.

0229. Air Space. Unlike the UK, where all the national airspace is controlled by the CAA, there are many countries that have large volumes of national airspace controlled by the military. When operating overseas units must ascertain exactly who controls the airspace above the range and comply accordingly with Host Nation requirements.

0230. Air Surveillance. Depending on which type of range is being used, there may be a facility that provides air surveillance coverage of the range danger area and the associated ADA. It should be noted that on some overseas ranges, the ADA is owned by the military and they may use a simple NOTAM or ACN procedure. It may be possible to use a FFA without radar coverage provided a risk assessment has been carried out and measures are in place to mitigate against the risk of hitting an intruder. The duty of care may be met with adequate air sentries, communications and restricted target heights. In all cases the requirement is to show that the risk to an intruder is ALARP.

Annexes:

- A. Points of Contact.
- B. Incident Reporting.

⁷ See Reference A1 Chapter 3.

⁸ See Reference A1 Chapter 2

Chapter 2 Annex A

POINTS OF CONTACT

The Secretary
Defence Land Ranges Safety Committee
Ash 2b, MOD Abbey Wood #3212
Bristol BS34 8JH

Tel No: 0117 91 35339
Fax No: 0117 91 35903
e-mail: deswpns-dosg-dlrsc1@mod.uk

RN Subject Matter Expert HQs.

- a. In the case of UAS, the Operating Unit is 792 RNAS on behalf of ACOS(AV) to CinCFleet, who holds the RTS.
- b. For weapon systems and ammunition matters, the CinCFleet SME is SO2 SW & Practices.
- c. For towed target matters, JSATO at RNAS Yeovilton.

Army Subject Matter Expert HQs.

In the case of Army UAS, including aerial targets, HQ DAAVn is the Release to Service Authority. Thus:

- a. For airworthiness matters - HQ DAAVn.
- b. For operational and training matters - HQ DRA.
- c. For engineering matters - ES(Land)

In the case of weapon systems, the appropriate Arms Directorate will act as the Competent Army Authority and provide the SME. Thus:

- a. For infantry weapons to be used in the Surface to Air role - HQ D INF.
- b. For armoured weapons used in the Surface to Air role - HQ DRAC.
- c. For primary Surface to Air weapons - HQ DRA.

Test and Evaluation Ranges

MoD Test & Evaluation Ranges Manager
Trials Evaluation Services and Targets

JSP 403 Volume 3
Edition 1 Change 3

SURFACE TO AIR RANGES

Rm 142 Bldg 456
MoD Boscombe Down
Salisbury
Wilts SP4 0JF

Trials Evaluation Services and Targets
Defence Equipment and Support
Walnut 3, Bay H26
MOD Abbey Wood #1324
Bristol BS34 8JH

Joint GBAD HQ (Air through 3 GROUP)

The operational role of the Jt GBAD HQ is to provide air-minded GBAD advice, expertise and augmentation to relevant HQs during crisis. Its peacetime roles include setting individual and collective operational performance standards (OPS) for all GBAD-related activities, co-ordination of GBAD collective training, Jt 2C(PM) responsibility across all GBAD DLODs, monitoring and reporting on GBAD readiness, standardisation and evaluation (STANEVAL) of GBAD units, and exercising the full range of OPCOM functions for SHORAD elements comprising 16 Regt RA, 106 Regt RA(V)⁹, the RAF Regt GBAD Wg, the Joint Rapier Training Unit (JRTU) and RAP Tp.

Joint Ground Based Air Defence Headquarters

The Bunker
RAF High Wycombe
Naphill
Buckinghamshire
HP14 4UE

⁹ Arrangements to be confirmed pending the outcome of TA FAS.

Chapter 2 Annex B

INCIDENT REPORTING

1. JSP 751 gives the Tri Service Casualty and Compassionate Procedures.
2. The Joint Casualty Compassionate Centre at RAF Innsworth.
3. The Army Accident and Incident Notification Centre (AINC) at Netheravon.
Contact Nos are:

FAX is 94321 8450

Phone 94321 8458

Civil Dialling Code: 01980 670 201 + 8458

4. **Reporting Procedures.** Reporting procedures are to be found as follows:
 - a. **Laser Incident.** - See Annex B to Chapter 2 to Part I of this Volume.
 - b. **UK Danger Area Infringements.** - See Annex C to Chapter 2 to Part 1 of this Volume.
 - c. **Ammunition Incidents.** – See Reference H, Chapter 25.
 - d. **UAS Incidents and Accidents.** – See Reference R Volume I Section 200.

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