SAFETY ASSESSMENT
OF
INDOOR LIVE FIRE RANGE
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U. S. DEPARTMENT OF ENERGY
EG&G MOUND APPLIED TECHNOLOGIES
INDOOR LIVE FIRE RANGE

SAFETY ASSESSMENT REPORT

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SAFETY ASSESSMENT REPORT

I. INTRODUCTION

A. General Description

The following Safety Assessment (SA) pertains to the indoor live fire range (LFR) at EG&G Mound Applied Technology plant. The purpose of the indoor LFR is to conduct training with live ammunition for all designated personnel. The SA examines the risks that are attendant to the operation of an indoor LFR for this purpose.

B. Location

The indoor LFR occupies Building No. GS-1 which is primarily dedicated to training activities. Only those activities that pertain to firearms training are addressed in this SA.

C. Rationale

This SA is according to DOE Order AL 5481.1B, 27 January 1988. It thereby examines the risks to worker health and safety as well as risks to the public environment. The specific requirements for firearms training are pursuant to DOE 5480.16.

The terminology of the Standard Operating Procedures (SOP) and Range Operation Policy (ROP) both dated October 1988 are followed in this report. The SOP and ROP are appended.

II. SUMMARY/CONCLUSION

A. General

The design of the LFR and the operating procedures are according to accepted contemporary standards as far as could be ascertained.

B. Safety Considerations

If the SOP, ROP and other procedures that are now in place are maintained, there is no need for changes or upgrading for safety reasons; however, there may be reasons because of increased training load, and/or new courses (1). [See references at end of SA.]

III. SITE DESCRIPTION AND ASSESSMENT

A. General

The range and its ancillary requirements are in a free standing building dedicated to this function. The ancillary areas are the range office, armory, and a vault for the storage of firearms, and ammunition. These areas along with the range comprise the scope of this SA. A portion of the building also is used for physical fitness training and other activities. That area and those activities are not addressed.

B. Security

The indoor LFR is in an active area near the main entrance of the EG&G Mound plant, and generally accessible to in-plant personnel. Access control was not examined but is assumed to be according to the procedures that apply to all other low risk buildings at the facility. The indoor LFR activities are not classified .

IV. DESCRIPTION OF FACILITY

The indoor LFR and its ancillary activities are housed in a modern building. In general it appears to be suitable for this role and is in good condition. The building was examined closely only from the standpoint of the specialized firearms training requirements. It appears to fulfill these adequately. Comparison to current construction criteria was not considered germane.

V. DESCRIPTION OF OPERATIONS

Standard Operating Procedures (SOP) and Range Operating Policy (ROP) are in force for the firearms training of all designated personnel. These are current, dated October 1988. They appear to follow the currently accepted state-of-the-art for such activities. [Note there is no "official" state-of-the-art because of the wide diversity of training requirements. Instead it is considered to be an eclectic cross section of the teachings found in the police and security trade and professional journals.] It is recommended that the SOP and ROP be reviewed on a regular basis (2).

The operation of the indoor LFR is specifically addressed in the SOP (3). The courses are referred to as "tasks" and are in Appendix 3 of the SOP. None specifically identifies an indoor or an outdoor range. However, the language of their light requirements, calling for day and night courses, indicates that they were originally for outdoor ranges.

The range proper is fully state-of-the-art for conventional recruit and in-service training. The target retrieval equipment shows signs of heavy use and may require replacement or overhaul in the foreseeable future. The design of this facility did not anticipate the requirements for advanced training in the SOP (4), a relatively recent development. Therefore, it appears to be hoped that much of this can be conducted on the outdoor LFR. That is limited as discussed in its SA. By means of improvisation some advanced training can be conducted on the indoor LFR but not efficiently.

VI. ACCIDENT ASSESSMENT

A. General

Order AL 5481.1B, extends the scope beyond accidents in order to address risks to the public, employees and the environment (5). Although the principle focus may have been radiation, it must be applied in this SA to all aspects of firearms training and range management. Therefore, we will consider risks that extend beyond would ordinarily be called accidents.

B. Types of Risks

1. Ballistical Considerations

Order AL 5481.1B contains examples of Failure Mode and Effect Analysis for IFR Operations (FMEA). Typical tables such as 6-1 and 6-2 from Pinellas approved FSAR are applicable to the indoor LFR.

A problem is presented, however, by FMEA Table 6.3. Categories I, II and III are difficult to distinguish for firearms related accidents. All are usually considered catastrophic in the allegations of the injured. Some events under Category IV may never become record, whereas some others will quickly escalate to a higher category.

It is axiomatic that no firearms training with live ammunition can be "safe" per se. It should be noted that every year there are injuries and occasionally fatalities from the use of blank ammunition. Relative risk derives from the resolve of the trainees and the competence of the instruction guided by the training procedures. Poor equipment and poor ranges can exacerbate safety, but good facilities cannot assure it. Similarly, risk for firearms training cannot be prudently audited on a statistical basis as it can in many fields - even the first shot might be misdirected, and any misdirected bullet might cause an injury or fatality.

This matter is complicated by the fact that ricochets are more hazardous than direct impact of misdirected bullets. Unfortunately, there are no experience data to quantify this apparent paradox. However, few experienced shooters would deny this. Even after repeated ricochets a bullet may retain sufficient energy to inflict a severe

wound, and will almost always injure an eye (6). The reason why the baffle systems in modern ranges utilize the so-called air-space principle is to capture the ricochets and back splatter particles of misdirected high shots. Of course, such ballistic security can never be perfect and eye protection must be obligatory (7).

—No misdirected bullet can escape the range and endanger the public if fired from the firing line in the direction of the butts end of the range. Even if metal piercing handgun ammunition was misfired in such a way to miss the baffles and strike the roof, it would be unlikely to penetrate. If it did, it would be unlikely to reach the street. Again, there are no statistics to confirm this but considerable empirical evidence.

The greatest risk of ballistic injury in this LFR is from ricochets from auxiliary target equipment that may be set up for advanced training (8). There is no practical relief for this. The skill of the instructors in setting up the courses and monitoring them remains the best safeguard.

2. Nonballistical Considerations

This group of risk considerations includes all risks that are not involved with the discharge of weapons, but are peculiar to indoor LFR facilities. Those common to typical employee environments are not in the scope of this SA. The following discussion is in order of importance, albeit that is a subjective consideration.

a. Accidents from Mechanical Target Equipment

Two type of such accidents have occurred on other ranges. The most common accident occurs when one or more target carriers are left out in the range instead of being returned to the firing line. Housekeeping and maintenance personnel engrossed in their work have had head injuries from bumping into them.

The second type of injury has occurred when the target edge or face signal has caused a target holder to strike a person not alerted to this hazard. Effective range discipline will reduce this risk to acceptable levels.

b. Falls

Falls are a particular concern considering that personnel on a range may be carrying loaded and sometimes cocked firearms. Slipping on spent cartridge cases has been a cause of falls. Strict adherence to SOP will minimize this (9).

c. Fires

It is generally accepted that approximately 20% of the propellant in a cartridge is expelled without combustion. No verification can be found but an inspection of any active indoor LFR will reveal unburned powder on the floor and all other surfaces. Although range accidents are usually concealed, it is believed that there have been a number of accidents. Some of these caused only fire damage whereas others probably caused injury. The latter usually involved the housekeeping personnel. It is recommended that the range floor be flushed with water after each day of active use.

No evidence of excessive unburned gun powder was found during the inspection of the indoor LFR for this SA. Recognition of this problem is found in FMEA Table 6-1.

d. Noise Pollution

There are three noise considerations. The most obvious is the noise level to which the trainees and instructors are subjected during active firing. The hearing protection required by the SOP satisfies this requirement (10). Annual hearing tests are required for all members of the security force.

The second consideration is the noise level within areas of the building other than the range proper. Although these may be annoyance, it would be difficult to allege that they are a physiological hazard.

The third consideration is the noise that pollutes the environment. In this case it appears to be well below the lowest limit commonly used by municipalities. That is 50 dB at a distance of 50 feet from the facility. This is affirmed by the fact that there have been no complaints of record for this facility.

e. Lead Intoxication

The SOP requires the testing for airborne lead (11). The permissible level for lead particulates in the indoor LFR is defined by OSHA Std. No. 1910.1025 (12). This is affirmed by DOE 5480.16. Lead poisoning is the most publicized concern involving firearms training. In spite of the attention this has received, to our knowledge there has never been a case adjudicated in court in which duty on a range was found responsible for the health deficiencies of anyone. However, there have been out-of-court settlements of allegations of such problems.

There are two possibilities to be considered. The first is most unusual, but theoretically possible. An individual may be hypersensitive to lead. However, in these cases the problem is seldom the range. Such individuals would be expected to have had greater exposure "to other sources of lead such as automotive emissions" and paint than from their firearms training.

The second possibility is more frequently encountered. The possibility of lead intoxication is a real and serious concern for all personnel having continuous exposure to lead. For most personnel this will be unrelated to range duties and often is unrelated to any service activities at all. Therefore, the requirement for twice yearly physiological lead check in DOE Order 5480.16 should be adequate assurance.

Currently some 16 persons receive these tests. They comprise the duty officers, range safety officers, clean-up personnel, armorers and others with high exposure. All tests thus far have been within the established limits.

Paragraph 4.j of the same order requires compliance to OSHA Standard No. 1910.1025. This involves sampling the air for lead content. We understand that this is being done quarterly. Although not privy to the test results, it would be a surprise if they were not satisfactory. This LFR has an exceptionally carefully planned ventilation system. It should provide nearly laminar air flow past the firing line. Some authorities such as the Army Corps of Engineers believe that this is desirable.

C. Physical Injury

The SOP devotes considerable attention to the procedure for emergency medical assistance in case of training accidents (13). There is also an entry on page 3 of the ROP. It is assumed that these requirements are being met by drills, not actual experiences.

VII. SAFETY RELATED DOCUMENTATION

Exceptional documentation that relates to this report is already in place. Among the items are the following:

A. EG&G Mound Documentation

1. Standard Operating Procedures, Protective Force Training, October 1988.
2. Range Operations Policy, October 1988.

B. Other Governmental Publications

1. DOE Order 5480.16, Firearms Safety; 1-12-88.
2. SAND82-1022, DOE/SNL Live-Fire Range SAR; March 1983.
3. WSI/SRP 5484.1, Standard Procedures Manual, 8-15-84.

C. Non-Governmental Publications

1. Instruction manuals for all firearms, pyrotechnics and munitions involved in training.
2. The trade and professional publications for law enforcement and security.

VIII. REFERENCES

The following are the references for the parenthetical numerals in the SA. They are from the SOP except where otherwise noted.

- (1) VI.A.1, page 16
VIII.A-D, pages 31-33
- (2) IV.D.1-6, page 6
- (3) VI.B 1-5, pages 20-23
- (4) V.D.1-8, pages 13-14.
- (5) Order 5481.1B: Chapter 1, parag. 4 (d), 6.
- (6) VI.A.5.E, page 16.
- (7) V.D.1-8, pages 13-14
- (8) II.A.y, page 18
VI.A.9.c, page 20
B.1.j, page 22
- (9) IV.B.3, page 5
V.A.8, page 8
Appendix 1, Task PFTI-9091, D.4, page 21
- (10) VI.A.4, page 16
- (11) IV.C.5, page 6
VIII.A.3.i, page 32
- (12) IV.B.3, page 5
IV.C.4, page 6
IV.F.3, page 7
V.A.9, page 8
VI.E.1-5, pages 25-28.

TABLE 6-1
FAILURE MODE AND EFFECTS ANALYSIS FOR IFR SYSTEMS

SYSTEM	FAILURE MODE	DETECTION	COMPENSATION	EFFECTS	EFFECTS CATEGORY
Smoke and Heat Detectors	Detector fails mechanically	During weekly inspections	Multiple detectors cover a given area	Fire would be more advanced when detected	IIIf
Smoke and Heat Detectors	Power failure	Switch to emergency power triggers alarms	Detectors have battery backups	No interruption	IVh
Auxiliary Ventilation	Mechanical failure	Sufficient air flow not felt on firing line	No compensation	Range is inoperative until system is repaired	IVe
Auxiliary Ventilation	Electrical	Ventilation system does not engage when switched on	No compensation	Range is inoperative until system is repaired	IVe
Bullet trap	Steel plate becomes improperly aligned	During pre-use range inspection by RSO	No compensation	Range is inoperative until system is repaired	IVe

TABLE 6-2
FAILURE MODE AND EFFECTS ANALYSIS FOR IFR OPERATIONS

OPERATION	FAILURE MODE	COMPENSATION	EFFECTS	EFFECTS CATEGORY
Firing .38 Caliber Handgun	Loaded weapon is dropped while changing firing positions	GOP #07 presents specific Range safety rules; weapon holstered while moving firing positions	Weapon discharges and seriously injures nearby shooter	Ig
Firing .38 Caliber	While reloading weapon, bullet is dropped	Firing line is carpeted	Bullet landing on carpeted surface does not go off	IVg
Firing 9mm Rifle	Hangfire of 9mm round	GOP #07 requires all weapons to be pointed down range while on the firing line	Round does not immediately fire when trigger is pulled; after a few seconds' delay, round fires while weapon is still pointed down range; range and bullet trap contain the bullet	IVg
Firing 7.62mm Automatic Rifle	Cookoff of chambered round	GOP #07 requires all weapons to be pointed down range while on the firing line	While in automatic mode, a chambered round is discharged without trigger being pulled due to excessive heat from automatic firing; range and bullet trap contain the bullet	IVg
Firing .227 Caliber, Automatic Rifle	Fired bullet lodges in barrel	Security Patrol's weapons manual and lesson plans for remedial weapons training instructs shooter to be aware of noticeable differ- ences in firing sound and recoil for this weapon; shooter should stop firing and inspect barrel for lodged bullet	No effects	IVg

TABLE 6-2
FAILURE MODE AND EFFECTS ANALYSIS FOR IFR OPERATIONS
(CONTINUED)

OPERATION	FAILURE MODE	COMPENSATION	EFFECTS	EFFECTS CATEGORY
Firing 12 Gauge Shotgun	Round misfires	<p>GOP #07 and weapon specific lesson plans instruct shooters to wait 20 seconds to ensure that round does not fire before removing shell from chamber.</p>	No effects	IVh

TABLE 6-3

QUALITATIVE ACCIDENT HAZARD SEVERITY

HAZARD CATEGORIES	CONSEQUENCES TO THE PUBLIC, WORKERS, OR ENVIRONMENT
Category I - Catastrophic	May cause deaths, or loss of the facility/operation, or severe impact on the environment.
Category II - Critical	May cause severe injury, or severe occupational illness, or major damage to a facility/operation, or major impact on the environment.
Category III - Marginal	May cause minor injury, or minor occupational illness, or minor impact on the environment.
Category IV - Negligible	Will not result in a significant injury, or occupational illness, or provide a significant impact on the environment.

TABLE 6-4

EFFECTS CATEGORIES

<u>CATEGORIES</u>	<u>CONSEQUENCES</u>
a	Hazardous Materials Released to the Environment
b	Hazardous Materials Released Within the Building
c	Loss of Plant Operational Capability
d	Loss of Plant Security Capability
e	Loss of IFR Operational Capability
f	Loss of System Capability
g	Personnel Exposed to Safety Hazards
h	No Hazard